A5 Western Transport Corridor

Stage 3 Scheme Assessment Report

Part 2 (SAR3) - Volume 1

August 2016

Produced for

Prepared by

Project Office:
Mouchel
Shorefield House
30 Kinnegar Drive
Holywood
County Down
Northern Ireland
BT18 9JQ

T 028 9042 4117
F 028 9042 7039
E @mouchel.com

Preface

The Department for Infrastructure (*the Department*), is proposing an upgrade of the A5 corridor by building a new dual carriageway between New Buildings and Aughnalcoy – the A5 Western Transport Corridor (A5WTC).

The scheme is promoted for the Department by TransportNI, which prior to 2015 embraced the Roads Service brand and this document may refer to either.

TD37/93 (Scheme Assessment Reporting) requires that the Stage 3 Scheme Assessment Report is divided into two parts: the Environmental Statement (refer to document 718736-3000-R-021) and this document, referred to as the SAR3, which covers all other aspects of the Proposed Scheme that are not covered in the Environmental Statement.

The SAR3 is a "live" document and this version takes into account the recommendations from the 2011 Public Inquiries, recent consultations with stakeholders, revised standards or guidance and updated design related information which includes but is not limited to the various surveys and traffic data.

This SAR3 document comprises 3 Volumes:

Volume 1 – Stage 3 Scheme Assessment Report _Part 2

Volume 2 – Drawings

Volume 3 – Appendices

Electronic copies (CD) of the SAR3 are available free of charge, on written request, from: Manny Gault, TransportNI, Western Division, County Hall, Drumragh Avenue, Omagh, BT79 7AF, or can be downloaded in PDF format from the A5 Western Transport Corridor project website www.a5wtc.com

Document Control Sheet

Project Title	A5 Western Transport Corridor
Report Title	Stage 3 Scheme Assessment Report – Part 2 (SAR3) – Volume 1
Revision	718736-0000-R-010 REV 2
Status	DRAFT
Control Date	August 2016

Record of Issue

Issue	Status	Author	Date	Check	Date	Authorised	Date
1	Draft	V Kangley	30.03.11	D. Parody	30.03.11	P. Edwards	30.03.11
2	Draft	M Henderson J Cassidy	08.08.16	D. Parody	08.08.16	P. Edwards	08.08.16

Distribution

Organisation	Contact	Copies
Department for Infrastructure, TransportNI	Seamus Keenan	1 (e)

Contents

Volume 2 – Drawings

Volume 3 - Appendices

Abbreviations

A5WTC	A5 Western Transport Corridor
AADT	Annual Average Daily Traffic
AAWT	Annual Average Weekly Traffic flows
AEP	Annual Exceedance Probability
ANPR	Automatic Number Plate Recognition
AOD	Above Ordnance Datum
ASSI	Area of Specific Scientific Interest
ATC	Automatic Traffic Counts
BS	British Standard
BT	British Telecom
CEMP	Construction Environment Management Plan
CGSJ	Compact Grade Separated Junction
Ch	Chainage
CMS	Central Management System
DARD	Department of Agricultural and Rural Development
DCAL	Department of Culture, Arts and Leisure
DfT	Department for Transport
DM	Do – Minimum
DMRB	Design Manual for Roads & Bridges
DoE	Department of the Environment
DRD	Department for Regional Development
DS	Do – Something
DTM	Digital Terrain Model
ECI	Early Contractor Involvement
EcIA	Ecological Impact Assessment
EIA	Environmental Impact Assessment
ES	Environmental Statement
EU	European Union
FCSA	Flood Compensation Storage Area
FEH	Flood Estimate Handbook
FRA	Flood Risk Assessment
FOSD	Full Overtaking Sight Distance
GIS	Geographical Information System
GI	Geotechnical Investigation
GSJ	Grade Separated Junction
HGVs	Heavy Goods Vehicles
HDVs	Heavy Duty Vehicles
HRA	Habitats Regulations Assessment
IAN	Interim Advice Note

ICD	Inscribed Circle Diameter
IDP	Investment Delivery Plan
IDT	Integrated Delivery Team
ISNI	Investment Strategy for Northern Ireland
LA	Loughs Agency
LDP	Local Development Plans
LED	Light Emitting Diode
LGV	Light Goods Vehicle
LNS	Low Noise Surfacing
MCC	Manual Classified Counts
NCR	National Cycle Route
NI	Northern Ireland
NIE	Northern Ireland Electricity
NIEA	Northern Ireland Environment Agency
NIMDO	Notice of Intension to Make Direction Order
NIMVO	Notice of Intension to Make Vesting Order
NIW	Northern Ireland Water
NMU	Non-Motorised Users
OS	Ordnance Survey
OSNI	Ordnance Survey Northern Ireland
PCU	Passenger Car Unit
PED	Pre Earthworks Drainage
PIA	Personal Injury Accident
PPS	Planning Policy Statements
RA	Rivers Agency
RDS	Regional Development Strategy
RFC	Reference Flow / Capacity
ROI	Republic of Ireland
RRS	Road Restraint System
RSI	Road Side Interview
RSPPG	The Department's (Roads Service) Policy and Procedure Guidelines
RSTN	Regional Strategic Transport Network
RSTN – TP	Regional Strategic Transport Network – Transport Plan
RTS	Regional Transport Strategy
SAC	Special Area of conservation
SAR2	Stage 2 Scheme Assessment Report
SAR3	Stage 3 Scheme Assessment Report
SSD	Stopping Sight Distance
SRI	Strategic Road Improvements
SATURN	Simulation and Assignment of Traffic to Urban Road Networks
SUPA	Stopping Up of Private Access Order
SWMP	Site Waste Management Plan

TNI	Transport Northern Ireland
TSCS	Thin Surface Course System
TRRL	Transport and Road Research Laboratory
VO	Vesting Order
vpd	vehicles per day
vph	vehicles per hour

1 INTRODUCTION

1.1 Policy and Funding Background

1.1.1 In September 2001, the Department for Regional Development (DRD) formulated "Shaping Our Future: the Regional Development Strategy (RDS) for Northern Ireland 2025". This strategy was intended to guide the future development of the region up to 2025 and provided guidance on a range of social, economic and environmental matters which are implemented through the plans and strategies of Government Departments.

1.1.2 An integral feature of the RDS 2025 was the requirement to develop a Regional Transportation Strategy having a vision of *"a modern, integrated and sustainable transportation system which benefits society, the economy and the environment and which actively contributes to social inclusion and everyone's quality of life"*. In July 2002, the Assembly approved the strategic direction and underlying principles of the 'Regional Transportation Strategy for Northern Ireland 2002-2012' (RTS). The RTS identified strategic transportation investment priorities and considered potential funding sources over a 10 year period as well as setting down guidance as to how funding would be split between areas and transport modes.

1.1.3 The Regional Development Minister launched a revised RDS 2035 on 15th March 2012. In recognition of the changing challenges facing the region, the Executive agreed that the RDS 2025 published in 2001 (and amended in 2008) needed to be reviewed. Whilst many of the objectives of the previous strategy are still valid, this new document now replaces it. The RDS 2035 provides an overarching strategic planning framework to facilitate and guide the public and private sectors.

1.1.4 "Ensuring a Sustainable Transport Future: A New Approach to Regional Transportation" (later referred to as the "New Approach") was published on 28th March 2012. Unlike the 2002 Strategy, the New Approach does not include details of schemes or projects. Rather, the Department has set three high level aims for transportation along with twelve supporting strategic objectives, covering the economy, society and the environment. The new approach to regional transportation complements the RDS 2035 and aims to achieve the transportation vision. The document recognises the need to complete the work identified in the current Regional Strategic Transport Network Transport Plan and Strategic Road Improvement Programme, while new programmes of work are developed for the main roads and railways.

1.1.5 The Regional Strategic Transport Network - Transport Plan 2015 (RSTN TP), published in March 2005 is one of 3 multi modal transport plans which facilitated the delivery of the RTS. This Plan will be reviewed in light of the New Approach.

1.1.6 The Regional Strategic Transport Network (RSTN) of Northern Ireland comprises the rail network, 5 Key Transport Corridors, 4 Link Corridors, the Belfast Metropolitan Transport

Plan and the remainder of the trunk road network. A number of priority schemes to improve the RSTN were ongoing and appraisal work (based on the Government's five key criteria of environment, safety, economy, accessibility and integration) was undertaken to identify further Strategic Roads Improvements (SRI) schemes for inclusion in the RSTN TP. The RSTN TP followed the funding levels envisaged in the RTS, although they were extrapolated to match the longer period of the RSTN TP (2005 – 2015).

1.1.7 Delivery of the RDS received a boost in 2005 with the announcement of the Investment Strategy for Northern Ireland (ISNI). In July 2006, Roads Service published the consultation document 'Expanding the Strategic Road Improvement Programme 2015' which included schemes to the value of the ISNI programme as well as a list of schemes that performed well in assessment but were not affordable within anticipated ISNI funding for the period 2005 - 2015.

1.1.8 In 2008, the Northern Ireland Executive agreed its first Budget and endorsed a revised 10 year Investment Strategy, covering the period 2008 – 2018. This strategy included a contribution of £400 million from the Irish Government for investment in the A5 and A8 dualling projects. A further budget covering the period 2011-2015 was subsequently agreed by the Executive. It included in the region of £1.2 billion of capital road improvements which embraced the continuing commitment from the Irish Government to an investment of £400 million towards the A5 and A8 dualling projects.

1.1.9 As a consequence of the downturn in the world economy, the Irish Government deferred its £400 million contribution in November 2011, but committed £25 million per annum towards the project in 2015 and 2016. Following a review of spending priorities the Executive announced a revised budget on 14 February 2012, in which £500 million would be invested in road infrastructure over the subsequent four year period. The £330 million investment in the A5 would allow two sections to progress: a section from Londonderry to the north of Strabane and a section from south of Omagh to Ballygawley.

1.1.10 Under the 'Fresh Start Agreement' in November 2015 the Irish Government reaffirmed its existing commitment to providing funding of £50 million for the project and committed an additional £25m to ensure that Phase 1 of the project can commence as soon as the necessary planning issues have been resolved by the Northern Ireland authorities. In accordance with the revised project timeline, the Irish Government funding will be provided in three tranches of £25m in the years 2017, 2018 and 2019 respectively.

1.1.11 The RSTN TP has 8 primary objectives including the need "to examine access to regional gateways and cross border links with an emphasis on improving connections from the 5 key transport and 4 link corridors". This is also reflected in Strategic Objective 1 of the New Approach, i.e. to improve connectivity within the region.

1.1.12 One such corridor identified in the RSTN TP is the A5 Western Transport Corridor (A5WTC), which runs from Londonderry to Aughnacloy. This corridor is also an important 'all Island' route as it forms part of the main route from Dublin to the North West. The scheme was one of the projects that was included in the Investment Delivery Plan (IDP) for roads which was published in April 2008.

Proposed A5WTC Network

1.1.13 The A5WTC starts in the North West of the province at New Buildings and runs for a distance of 85km south to the border, close to the village of Aughnacloy. The A5WTC feeds into the N2 in the Republic of Ireland (ROI) at the Moy Bridge border crossing and together the A5 and N2 provide a strategic link between Dublin and the North West. Within the extent of the scheme itself, there are strategic links between the urban centres of Londonderry, Strabane, Omagh, and Aughnacloy. The existing corridor, in addition, will improve links between the urban centres in the west of the province and provide a strategic link with international gateways.

1.1.14 The route is intersected by 4 key routes, including the A4 Key Transport Corridor (Belfast - Enniskillen – Sligo), the A32 Trunk Road (Enniskillen – Omagh), the A505 Trunk Road (Omagh - Cookstown) and the A38/N14, Lifford/Strabane cross border link road. At the northern end of the A5 it also links to the A6 Key Transport Corridor (Londonderry - Belfast) and the A2 Key Transport Corridor (Londonderry – Limavady).

1.1.15 Since the opening of the A4 Dualling Scheme between Dungannon and Ballygawley in 2010, the only scheme in the immediate vicinity of the A5WTC is the A38/N14 Lifford/Strabane cross border link road. This scheme provides a multi-span crossing of the River Finn and floodplain and connects the existing N15 south of Lifford with the proposed A5WTC at a roundabout junction. It is being promoted by Donegal County Council on behalf of both Governments, has been the subject of separate Statutory Procedures and is programmed to be constructed concurrently with Phase 2 of the A5WTC.

Figure 1-1 Map of Northern Ireland Highlighting the Location of the Existing A5

1.1.16 The existing A5 comprises a variety of differing width single carriageway roads with intermittent stretches of climbing lanes and overtaking opportunities. This lack of consistency in road standard leads to the use of inappropriate high speeds through the higher standard lengths of the road resulting in a lack of appreciation for the poorer sections of the road ahead. In excess of 200 side road junctions currently connect with the A5 with over 420 domestic/commercial accesses, excluding those in the various urban settlements, adjacent to the route.

1.2 History of the Proposed Scheme

Appointment of Consultants and Construction Contractors

1.2.1 In November 2007, The Department appointed consultants, Mouchel, from its framework contract to take forward the A5WTC dualling project. Mouchel was supported by cost consultants, Chandler KBS, as well as procurement experts, Rowsell Wright. The initial appointment was to assist in the development of the scheme through to the Preferred Route Announcement. Key early actions included:-

- Carrying out a market research survey of the construction industry to assess the capabilities of the supply chain and major contractors to deliver the scheme within the timeframe. The outcome of this survey resulted in the scheme being split into 3 sections for the assessment stages; and

- Developing the procurement strategy for construction from which it was decided that an Integrated Delivery Team should be established. This team included the contractors who would build the scheme using an 'Early Contractor Involvement' approach with contractors appointed earlier in the process than typically would be the case. This brought the contractor procurement phase of the project ahead of the statutory procedures process thus removing about 9 months from the overall project delivery timeframe. It also allowed the contractors to provide valuable input to the design and to provide advice and costs on construction-related issues.

1.2.2 In November 2009, three contracting consortia were appointed to the project. The Section boundaries and appointed consortia are shown in Figure 1-2 and are listed as follows:-

- Section 1: New Buildings – Sion Mills (Balfour Beatty/BAM/FP McCann Joint Venture).
- Section 2: Sion Mills – South of Omagh (Roadbridge/Sisk/PT McWilliams Joint Venture).
- Section 3: South of Omagh - Aughnacloy (Graham/Farrans Joint Venture).

1.3 Key Objectives of the Scheme

1.3.1 The key objectives of the proposed A5WTC scheme are:

- To improve road safety;
- To improve the road network in the west of the Province and north/south links;
- To reduce journey travel times along the A5 Western Transport Corridor;
- To provide improved overtaking opportunities for motorists along the A5 Western Transport Corridor; and,
- To develop the final proposals in light of safety, economic, environmental, integration and accessibility considerations

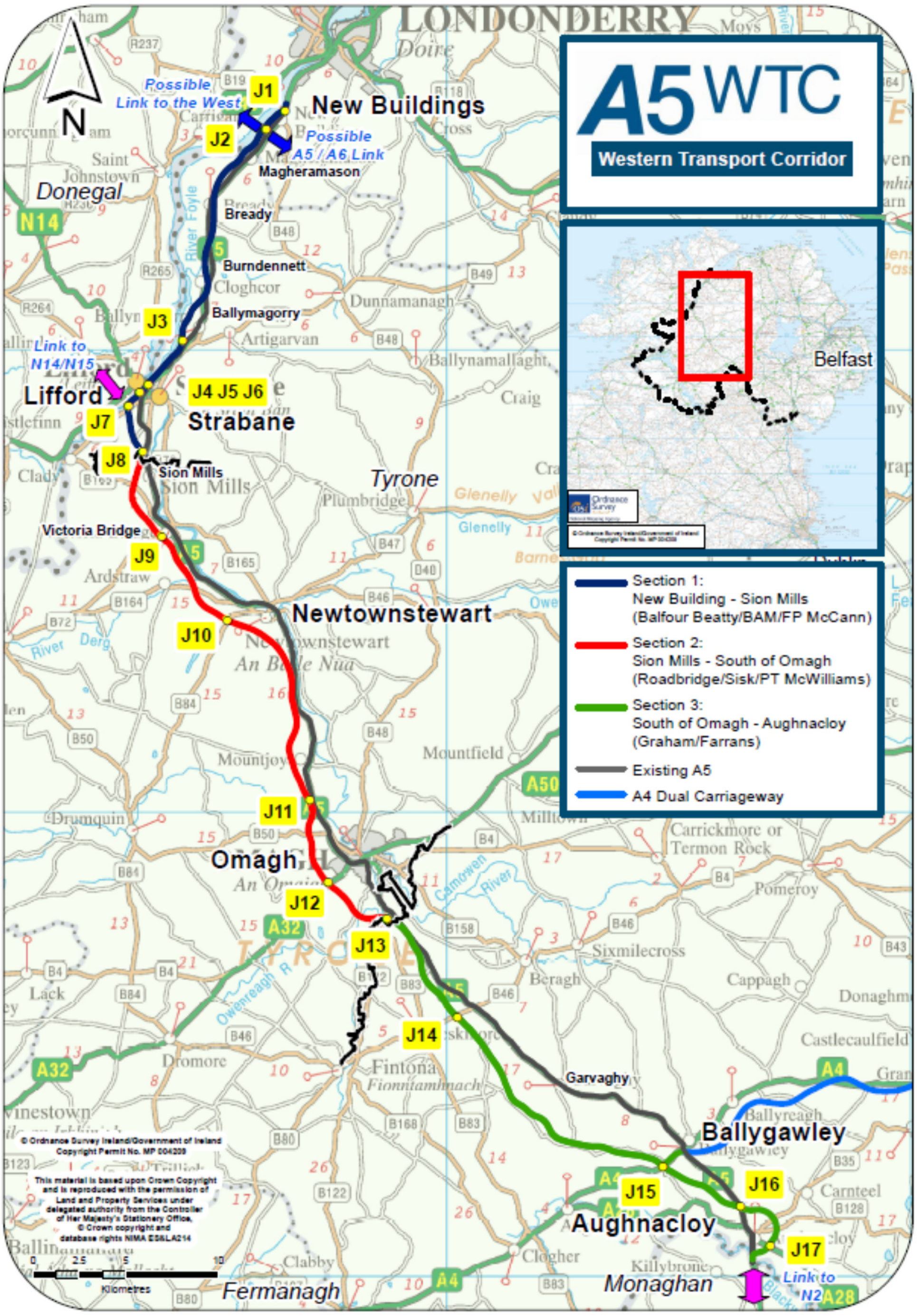


Figure 1-2: Plan Showing the Section and Construction Consortia

Stakeholder Liaison

1.3.2 There has been an extensive process of consultation which has informed the planning, design and assessment of the Proposed Scheme. This has included:

- A series of public exhibitions;

- Liaison with statutory consultees and other organisations to gather information; and
- Discussions with affected parties and landowners.

1.3.3 The Department has also established a dedicated project website (www.a5wtc.com) with links to the Department for Infrastructure (DFI) website. The websites have served to support the overall consultation strategy for the project, providing an additional means by which statutory, public and private stakeholders have been given access to scheme updates and announcements.

1.3.4 A 0845 telephone information line has been operated as a facility for receipt of public enquiries. A facility catering for international calls has also been operated to ensure that potential cross-border enquiries from the community in the ROI can be similarly addressed

Scheme Assessment Reports (2008-2009)

1.3.5 In 2008, a series of Public Awareness days were held during April/May 2008 (28th /29th April and 8th /9th May). They involved one-day events in Ballygawley, Omagh, Strabane and Londonderry. The purpose was to:

- advise the public that the Department was promoting the scheme;
- explain the objectives of the scheme;
- introduce the key transport, engineering, economic and environmental criteria that would inform the planning, design and assessment process;
- outline the statutory process that would be followed;
- introduce the public to the extent of the initial study areas being considered; and
- seek initial information and responses from attendees.

1.3.6 The first major deliverable of this process, the Stage 1 Scheme Assessment Report (SAR1), ''Preliminary Options Report'', was published in October 2008 and is available electronically from the A5WTC website, www.a5wtc.com, Ref: 796036/0000/R/006 V3.

1.3.7 A further series of Public Consultation days were then held in February 2009 for the exhibition of the Preferred Corridor and potential Route Options. The Preferred Corridor and the Route Options had emerged following preliminary consideration of key constraints. Comments were sought relating to the preliminary Route Options and the public were encouraged to provide information relating to the corridors. This information assisted with the refinement and, where relevant, modification of the Route Options prior to their subsequent evaluation and selection of a Preferred Route.

1.3.8 In July of 2009, the Minister for Regional Development announced the Preferred Route for the A5WTC and the publication of the Preferred Options Report. The Stage 2 Scheme Assessment Report (SAR2), ''The Preferred Options Report'' summarised the work carried out and detailed the Preferred Route and the rationale for its choice. This report is also available from the A5WTC website, Ref: 796036/0000/R/011 V2.

1.3.9 Public Exhibitions were held over four consecutive days in Omagh, Strabane, Londonderry and Ballygawley to present the Department's Preferred Route to the public. Visitors to the exhibitions were invited to comment on the Preferred Route and individual landowners, who would be potentially affected, were offered the opportunity for individual discussions with members of the Project Team.

1.3.10 The ''Preferred Options Report'' (July 2009), came to several conclusions and made recommendations on the basis of those conclusions. These are summarised below;

Conclusions

- The assessment concluded that the Preferred Route is an amalgam of sections from a number of options. This reflects the assessment process which placed emphasis on the constraints and impacts when considering the options. The Preferred Route also takes into consideration the importance of the European (Designated) Sites[1] and Appropriate Assessments in accordance with the Habitats Regulations[2] where necessary to demonstrate the level of impact on the sites.
- The traffic predictions for the Preferred Route indicate significant journey time savings and consistency of journey time compared with the current journey on the existing A5 whilst accident rates are predicted to fall.
- An economic appraisal of the Preferred Route shows that it provides a robust scheme, offering value for money and wider economic benefits through greater opportunities for growth within the region.
- A plan of the Preferred Route is contained on drawing numbers 718736-S1-0800-D-00401-00408, 718736-S2-0800-00409-00418 and 718736-S3-0800-D-00419-00429 in Volume 2.

Recommendations

- On the basis of the Stage 2 assessment described in the Preferred Options Report, it was recommended that the Preferred Route be taken forward and progressed through a Stage 3 Assessment (in accordance with TD 37/93) culminating in the preparation and publication of the Statutory Orders, including Notice of Intention to Make Vesting Order (NIMVO), Notice of Intention to Make Direction Order (NIMDO), Stopping Up of Private Access Order (SUPA) and the Environmental Statement (ES).
- It is also recommended that an Economic Appraisal Report for the project be prepared in accordance with DMRB TD37/93 and that, in accordance with the Habitats Regulations Assessment, the Appropriate Assessment procedure is completed for all

[1] European (Designated) sites are defined as Special Areas of Conservation (SACs), Special Protection Areas (SPAs) or Ramsar Sites designated under the Habitats Directive or Directive 2009/147/EC on the conservation of wild birds (the codified version of Council Directive 79/409/EEC as amended) ('the Birds Directive'). These are also known, collectively, as Natura 2000 sites.

[2] Provisions of the Habitats Directive have been implemented into UK legislation through The Conservation (Natural Habitats, &c.) Regulations 1994 (as amended), and The Conservation (Natural Habitats, &c.) Regulations (Northern Ireland) 1995 (as amended). These Regulations are hereafter collectively referred to as the Habitats Regulations.

locations where the Preferred Route crosses the River Foyle and Tributaries Special Area of Conservation (SAC).

- Continued liaison with Irish Government officials has ensured that adequate provision has been made for connectivity with the road network in the ROI. It is recommended that cooperative working with Irish Government officials continues with a view to maximising the benefits of the A5 project through delivery of cross border linkages.

Development of Alternatives to the Preferred Route (2009-2010)

1.3.11 Following the Preferred Route Announcement in July 2009, data collection and assessment has continued along the Preferred Route. These studies focused mainly on, but were not limited to, environmental surveys, drainage surveys and ground investigations. Meetings with landowners and other statutory consultees and interested parties also continued to allow relevant information to be fed into the design development of the Preferred Route.

1.3.12 Between August and October 2009, Introduction Meetings were held with the landowners to:

- introduce specific landowners to the reasoning behind the selection of the Preferred Route;
- confirm the lines of communication between each landowner and the Project Team;
- gather data from landowners to further inform local design development and identify potential mitigation needs;
- explain the process through to the preparation of Orders; and
- outline expected programme of subsequent meetings

1.3.13 Various flood, traffic and environmental models have also been developed. As new data became available and following comments from the landowner meetings, alterations to the alignment of the Preferred Route along discrete lengths were considered.

1.3.14 This resulted in thirty-one alternatives to sections of the Preferred Route being considered. The following reports are also available at www.a5wtc.com:-

- Alternatives Discussion Paper, Mouchel (2010) (718736/0000/R/013).
- Report on the Choice of Route for the A5WTC at Ballymagorry, Mouchel 2010 (718736/0800/R/029)

1.3.15 In total, eleven of the considered alternatives were adopted as variants to the Preferred Route. These are described further in Chapter 3 and in the Alternatives Discussion Paper.

1.3.16 The culmination of the development of the Preferred Route since it was announced in July 2009, was defined in November 2010 as the Proposed Scheme.

Environmental Statement 2010 (ES 2010)

1.3.17 Part V of The Roads (Northern Ireland) Order 1993, as substituted by the Roads (Environmental Impact Assessment) Regulation (Northern Ireland) 1999 and amended by The Roads (Environmental Impact Assessment) Regulations (Northern Ireland) 2007, sets out the statutory requirements for assessment of environmental impacts of road schemes and requires the Department to determine using the Annexes to EC Council Directive 85/337/EEC on the assessment of the effects of certain public and private projects on the environment, as amended by EC Council Directive 97/11/EC and Directive No. 2003/35/EC of the European Parliament and Council, whether or not a relevant project should be made subject to an Environmental Impact Assessment, and to publish this determination. The Department determined that the Project fell within Annex I of the Directive and that an Environmental Statement should be prepared.

1.3.18 Between April and October 2010, Mitigation Meetings were held with the various parties to:

- update landowners on progress and any emerging information such as development of side roads, junctions and alignments;
- review impacts specific to each landowner including potential landtake in light of the further development of the design proposals; and
- discuss and seek agreement to proposed mitigation measures and outline accommodation works.

1.3.19 In October/ November 2010, Pre-vesting meetings were held to:

- confirm the extent of landtake proposed and other impacts specific to each landowner/stakeholder;
- confirm the proposed design and mitigation measures specific to each landowner/stakeholder; and
- reprise the statutory context and rights relative to landowners and potential sources of advice.

1.3.20 The Environmental Impact Assessment continued and an Environmental Statement (hereinafter described as the 'ES 2010') prepared. Notice of the ES 2010 was published during week commencing 15 November 2010 with the statutory consultation period extending to 21 January 2011. Subsequent addenda to the ES 2010 were issued during the consultation period but because the changes were very minor in nature, it was considered that there was no need to extend the consultation period.

1.3.21 A further addendum was published on 22 March 2011 to highlight changes to the noise and air quality sections of the ES 2010 as a result of updating the traffic model. While this identified a number of local changes to conditions, in overall regional terms the changes were not significant.

1.3.22 The ES 2010 presented the findings of the environmental assessment of the scheme and described the measures proposed to mitigate impact on the natural and built environment. The ES 2010 is available to view on the project website (www.a5wtc.com).

Habitats Regulations Assessment (HRA)

1.3.23 Throughout the scheme development and in preparing the ES 2010, the project team identified seven European Designated Sites and one Ramsar Site which could be impacted on by the proposed scheme. These included four Special Areas of Conservation (SACs) and three Special Protection Areas (SPAs) as well as the Ramsar site. Four screening reports were prepared for the likelihood of significant effects upon the identified sites in accordance with the Design Manual for Roads and Bridges (DMRB) Volume 11 Section 4 Part 1 and Article 6 of the EC Habitats Directive. In accordance with the specific guidance on the assessment of plans or projects affecting Natura 2000 sites published by the European Commission in 2001, the outputs of these reports would be the preliminary assessments of the likelihood of significant effects on the integrity of the sites. These were summarised in the form of screening matrices using the DMRB format. These reports are available on the project website (www.a5wtc.com)

Statutory Orders (2010)

1.3.24 In November 2010, the Pre-Orders Public Exhibitions were held over four consecutive days in Omagh, Strabane, Londonderry and Ballygawley. This involved presentation of the Department's Proposed Scheme to the public. The aims and objectives of this event were to:

- demonstrate the assessments carried out to date and explain how the Proposed Scheme was developed including the approach to alternatives;
- highlight the key factors which influenced the choice of the Proposed Scheme;
- present the Junction layouts;
- explain the direct or indirect effects that the Proposed Scheme would have on property, the community and the environment;
- detail the next steps in the process;
- inform the public of the statutory procedures and anticipated programme to the opening of the road;
- increase public awareness of the project; and
- engage with a range of stakeholders.

Notice of Intention to Make a Direction Order (December 2010)

1.3.25 As the A5 is a trunk route, a Direction Order is required in accordance with The Roads (Northern Ireland) 1993 Order for new sections of the route. For this purpose, a draft Order was prepared and published (hereinafter described as the "Direction Order 2010") and was the subject of consideration at the Public Inquiries.

1.3.26 The Direction Order 2010 set out in detail, the designation of the new route as a Trunk Road and the stopping-up of roads. In accordance with Schedule 8 of The Roads (Northern Ireland) 1993 Order, signs were posted on the roads named in the Notice where stopping-up was proposed, to inform local residents.

1.3.27 The Direction Order 2010 is available to view on the project website (www.a5wtc.com).

Notice of Intention to Make a Vesting Order (December 2010)

1.3.28 The Notice of Intention to Make a Vesting Order (hereinafter described as the "Vesting Order 2010") included provision for acquisition of those lands and interests considered by the Department to be necessary for construction of the scheme to:

- Construct the new route and alterations to side roads;
- allow for alterations to water courses;
- accommodate drainage requirements;
- allow for the deposition of matter obtained in the course of constructing the new road;
- allow for space to construct associated bridges and culverts;
- allow for space to construct environmental mitigation measures, and
- provide access to severed land and property.

1.3.29 The Vesting Order 2010 is available to view on the project website (www.a5wtc.com)

Notice of Intention to Make a Stopping-up Order (Private Accesses) (December 2010)

1.3.30 Where it is considered necessary to stop-up private accesses, a Stopping-up Order is required under Article 69 of The Roads (Northern Ireland) Order 1993. In relation to the A5WTC, the draft Stopping up Order sets out in detail the stopping up to road traffic of five private accesses where it was considered necessary, for safety reasons, to relocate these particular accesses. The Stopping Up Order is available on the project website (www.a5wtc.com).

Public Inquiry (2011)

1.3.31 In 2011, between May and July, the Department held a series of Public Inquiries. A total of 2579 letters/signatories were received during the statutory objection/comment period associated with the publication of the draft Orders and the ES 2010.

1.3.32 Comments and recommendations following the Public Inquiries were published in the Inspector's Report in February 2012 (available to view on the project website, www.a5wtc.com). The recommendations and comments were reviewed and, where accepted, recorded in the Departmental Statement and incorporated into the Proposed Scheme design. The DRD Minister made the decision to proceed with the A5WTC project on 31st July 2012.

1.3.33 The Notice of Making the Supplementary Vesting Order included provision for acquisition of those lands and interests considered by the Department to be necessary to implement some of the recommendations made by the Inspector at the Public Inquiries and the proposed changes agreed with landowners, also at the Public Inquiries. This land was necessary to facilitate;

- alterations to side roads; and
- better access to severed land and property

1.3.34 During the period between the public inquiries being held and the Inspectors Report being published the Irish Government deferred on a large proportion of the funding commitment for the A5 scheme. Following this announcement a decision was taken by the Northern Ireland (NI) Executive to deliver the A5WTC in a manner reflective of the funding available. This approach led to a proposal to construct two stretches; Newbuildings (Jct 1) to north of Strabane (Jct 3), and south of Omagh (Jct 13) to Ballygawley(Jct 15). This proposal was referred to as Phase 1 of the project.

1.3.35 In line with a recommendation from the Inspector's Report following the 2011 Public Inquiry, the Department accepted that the section between Ballygawley and Aughnacloy should be deferred pending details of the link with the N2 at the border with the ROI being clearly identified. This section, along with the section of dual carriageway between Junctions 8 to 11, was referred to as Phase 3.

1.3.36 Phase 2 referred to the remaining stretches from north of Strabane (Jct 3) to south of Strabane (Jct 8) and north of Omagh (Jct 11) to south of Omagh (Jct13). These were considered respectively as the Strabane and Omagh bypasses.

1.3.37 A presumption was made that the following phased approach would be adopted. In summary, the 3 phases identified for the whole project delivery are shown in Figure 1-3 and are as follows:

- Phase 1: Junctions 1 to 3 (Newbuildings to North of Strabane) and Junctions 13 to 15 (South of Omagh to Ballygawley).
- Phase 2: Junctions 3 to 8 and Junctions 11 to 13 (North of Strabane to South of Strabane and North of Omagh to South of Omagh).
- Phase 3: Junctions 8 to 11 (Strabane South to Omagh North) and Junction 15 to the Border (Ballygawley to the Border at Aughnacloy).

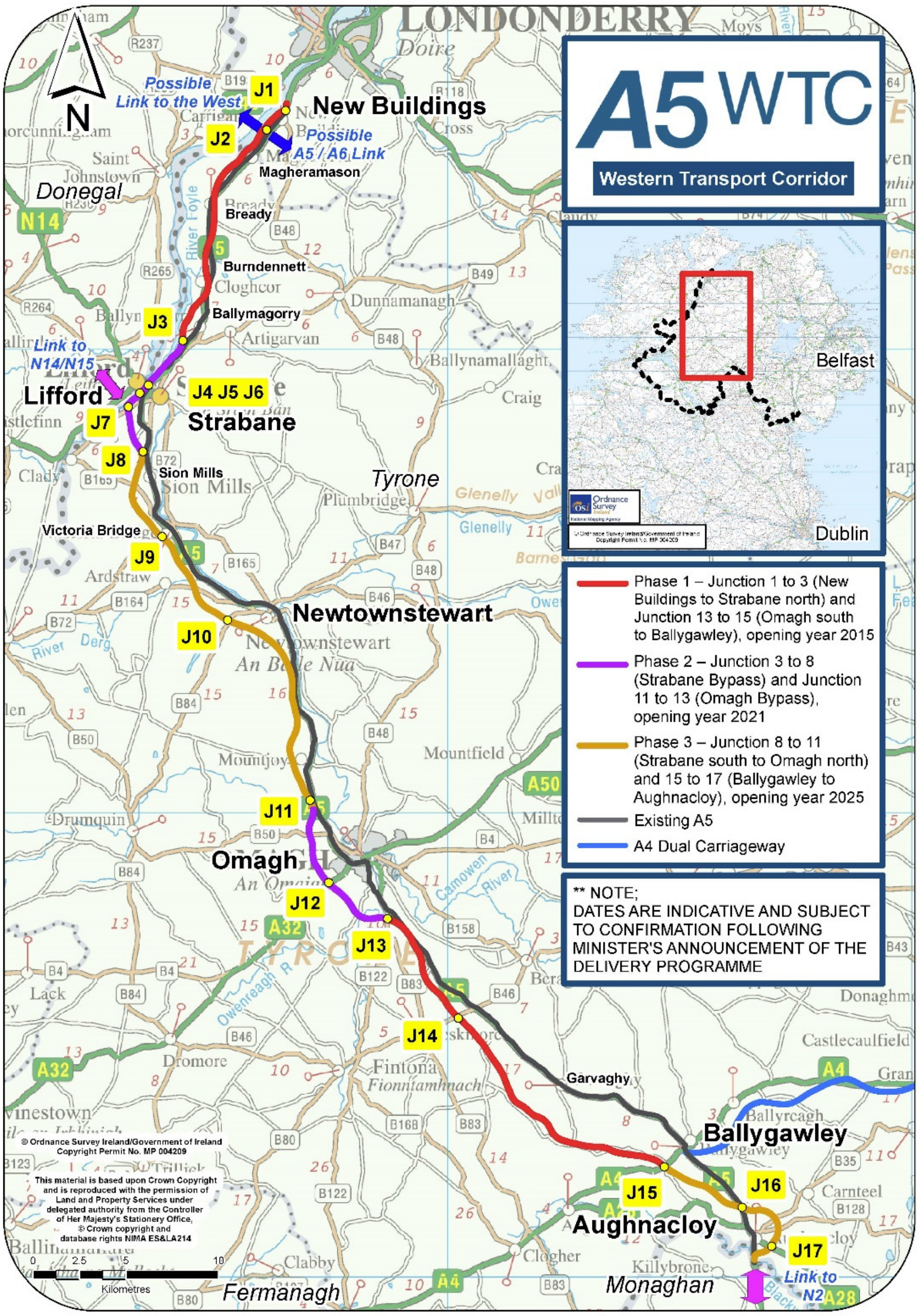


Figure 1-3: Plan shows the anticipated Construction Phasing of Proposed Scheme in 2012

1.3.38 The following Orders became operative on the dates given below:

- Notice of Making the Vesting Order, for Phase 1 of the scheme, – 11th September 2012

- Notice of Making the Supplementary Vesting Order , for Phase 1 of the scheme, – 11th September 2012
- Notice of Making the Direction Order, from Junction 1 to Junction 15 of the scheme, – 9th October 2012
- Notice of Making the Stopping Up Order, for Phase 1 of the scheme, – 9th October 2012

1.3.39 One outcome of the Public Inquiries was the Department's agreement to the number of changes to the land requirements proposed by landowners. To formalise such an agreement a Notice of Intentions to Make a Supplementary Vesting Order to change the lands required was published In April 2012. As no objections were received during the consultation period, no Public Inquiry was required and the changes to the vested lands were incorporated into the Orders.

1.3.40 A second commitment of the Department was to minimise the area of the vested lands in the Made Order. Following the development of the detailed design by the design consultant working on behalf of the Contractor's Joint Venture, the 'land take' was reduced throughout the scheme.

Legal Challenge (2012)

1.3.41 On 10th September 2012 the Department received a legal challenge to the making of the Orders. This was the subject of a number of court hearings.

1.3.42 Although the Judge ruled for the Department on 11 of the 12 issues that were raised in the legal challenge, he ruled against the Department on the need for an Appropriate Assessment on Rivers Foyle and Finn Special Areas of Conservation under Article 6 (3) of the Habitats' Directive 92/43/EEC

1.3.43 On 12th March 2013, the Judge advised that he was minded to quash the Orders and the quashing of the Orders became operative on 15th April 2013.

1.3.44 The Department accepted the ruling of the Court and decided not to appeal, issuing the following statement by the Minister;

''*The Judge took the view that a fuller assessment of the impact of the A5 proposals on the rivers Foyle and Finn Special Areas of Conservation (SAC) should have been carried out. I now intend to have a more comprehensive assessment conducted. When this is completed I will consider the matter further.*''

Scheme Re-Assessment (2013-2016)

1.3.45 Following the statement by the Department in 2013, reports containing Information to Inform an Appropriate Assessment were prepared for Natura 2000 sites and Ramsar sites. It was concluded that the Proposed Scheme is either likely to have a significant effect on the sites in the context of the Habitats Directive, or that sufficient uncertainty remains following screening, such that likely significant effects cannot be ruled out. These reports are available on the www.a5wtc.com website.

1.3.46 Meetings and site visits with affected landowners to describe changes to the scheme design, required to comply with current engineering and environmental standards, were also conducted during this period. In addition to meetings, there were a series of written communications to landowners to keep them appraised of developments on the scheme.

1.4 Stage 3-Scheme Assessment Report 2016

1.4.1 The Stage 3 Scheme Assessment Report is another key document in the delivery programme as described by the Department's Policy and Procedure Guidelines (RSPPG) E030 Major Road Improvement Schemes – Inception to Construction and the Design Manual for Roads and Bridges (DMRB) TD 37/93 Scheme Assessment Reporting. The primary focus of this report is to describe the engineering aspects of the Proposed Scheme (2016) that inform the Draft Vesting Order, Direction Order, SUPA and ES.

1.4.2 The Stage 3 Scheme Assessment Report is divided into two parts; Part 1: Environmental Statement (ES) and Part 2: All other Aspects of Assessment. This report forms Part 2 of the Stage 3 Report and is referred to as the SAR3.

Environmental Assessment (2016)

1.4.3 As environmental and traffic surveys and data have a limited shelf life, the baseline environmental and traffic surveys and data has been updated since the original ES was published in 2010 and a new 2016 Environmental Statement, hereafter ES (2016) published that considers updated information and any scheme developments since 2010.

1.4.4 The Environmental Assessment was undertaken in accordance with the guidance detailed in Volume 11 of the DMRB and reported in accordance with TD 37/93. The environmental reporting is contained within the ES (2016).

1.4.5 In addition to the publication of the ES (2016), the following draft Orders have been published:

- Notice of Intention to Make a Vesting Order Phase 1a
- Notice of Intention to make a Vesting Order Phase 1b
- Notice of Intention to Make a Vesting Order Phase 2
- Notice of Intention to Make a Direction Order – Newbuildings to Ballygawley
- Notice of Intention to Make a Stopping-up Order (Private Accesses) – Newbuildings to Ballygawley

1.4.6 Public Exhibitions were held following the publication of the new draft Orders and the ES (2016). Information relating to these events is available on the project website (www.a5wtc.com).

Stage 3 Scheme Assessment Report – Part 2 (SAR3) Draft

1.4.7 For the purposes of the assessments contained in the SAR3, a presumption has been made that the following phased approach will be adopted. In summary, the 4 phases identified for whole project delivery are shown in Figure 1-4 and are as follows:

- Phase 1a: Junctions 1 to 3 (Newbuildings to North of Strabane), and
- Phase 1b: Junctions 13 to 15 (South of Omagh to Ballygawley).
- Phase 2: Junctions 3 to 13 (North of Strabane to South of Omagh).
- Phase 3: Junction 15 to the Border (Ballygawley to the Border at Aughnacloy).

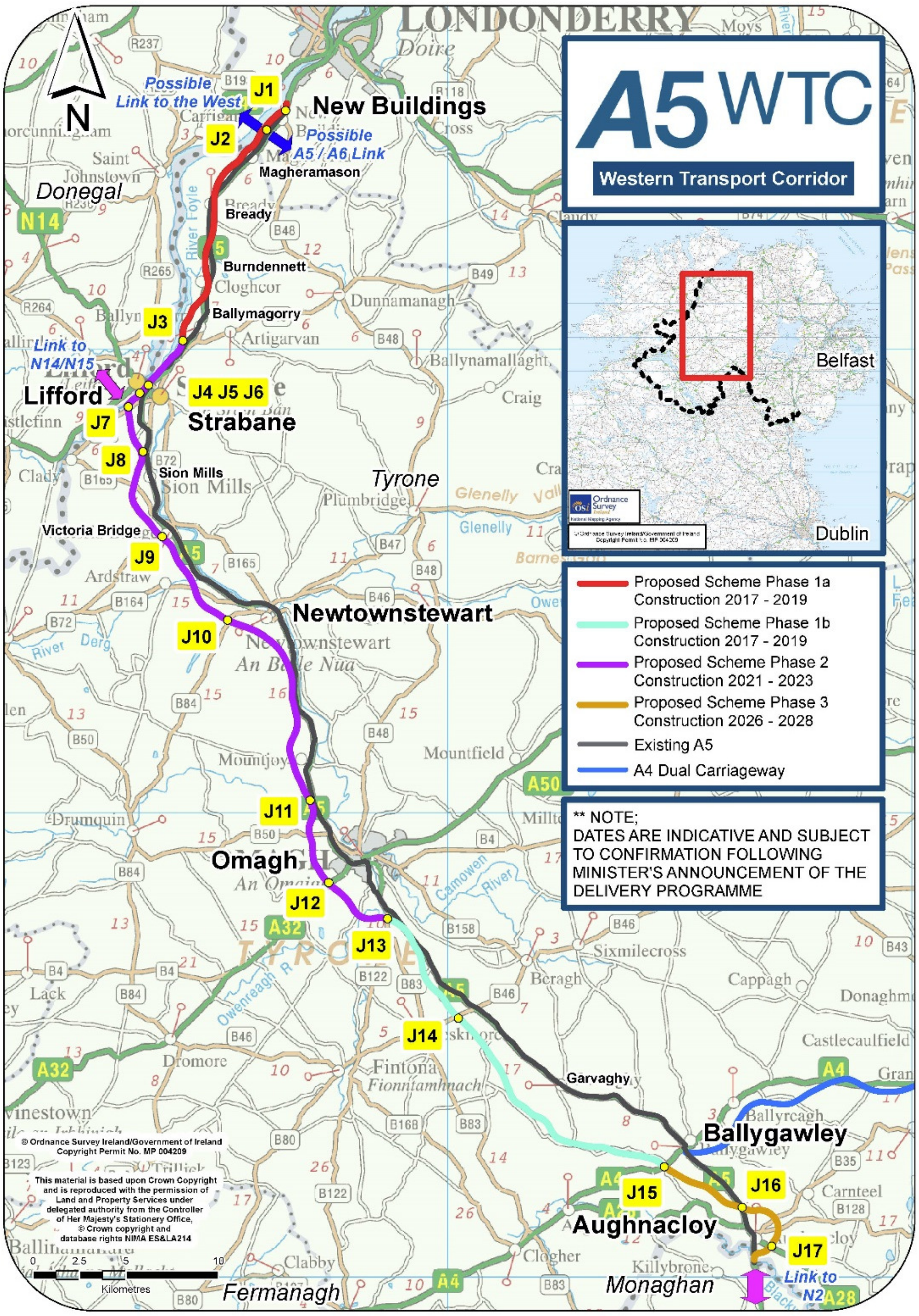


Figure 1-4: Plan shows the Construction Phasing of Proposed Scheme

1.4.8 The sections below expand on the key elements of the assessment.

Format of Report

1.4.9 The description and assessment of the Proposed Scheme is divided into 3 Sections as follows:-

Section	Extents
Section 1	New Buildings to South of Strabane
Section 2	South of Strabane to South of Omagh
Section 3	South of Omagh to Aughnacloy

Table 1-1 Section Titles

1.4.10 Following this Introduction chapter are the following chapters:

- Chapter 2 presents the Existing Conditions pertaining to the existing highway network;
- Chapter 3 provides a Description of the Proposed Scheme;
- Chapter 4 details the Engineering Principles employed in the Proposed Scheme;
- Chapter 5 details the Section 1 Engineering Information;
- Chapter 6 details the Section 2 Engineering Information;
- Chapter 7 details the Section 3 Engineering Information; and
- Chapter 8 presents the Traffic and Economic Assessment.

1.4.11 Although several towns and town lands within the Preferred Corridor have local variations in spelling, for the purposes of this report the spellings recorded by Ordnance Survey Northern Ireland (OSNI) are used in the text and on the drawings.

1.4.12 Both parts are prepared in accordance with the Department's Policy and Procedure Guide (RSPPG) _E030 Major Road Improvement Schemes - Inception to Construction and TD 37/93 Scheme Assessment Reporting of the DMRB Volume 5 – Section 1 and Volume 11 of the DMRB, in particular for the ES.

Engineering Assessment Process

1.4.13 The Engineering Assessment has been undertaken in accordance with the guidance detailed in the DMRB and RSPPG_E030. The assessment has been reported in accordance with TD37/93.

1.4.14 Using the Proposed Scheme as identified in the Preferred Options Report, the design was developed by refining the engineering principles applied to the route and examining the route in further detail from all engineering and environmental aspects. Since the announcement of the Preferred Route, further environmental, engineering and geotechnical surveys and assessments have been carried out. The additional information received from these surveys, along with feedback from Stakeholders, and recommendations and comments from the Inspector following the 2011 Public Inquiry, have aided in the refinement and optimisation of the Proposed Scheme. Since 2013 the scheme design has been further developed to take into account changes in legislation and design standards. This process is described in more detail in Chapters 2 to 4 of this report.

1.4.15 The resulting alignment, junction strategy and side road strategy is described in detail in chapters 5 to 7, on a Section by Section basis, under the following headings:

- Cross Section
- Mainline Horizontal and Vertical Alignment
- Side Roads
- Junctions
- Existing Roads' Realignments/Upgrades
- Road Closures
- Departures from Standards - Mainline
- Departures from Standards - Side Roads
- Public Utilities
- Geotechnical Constraints and Proposed Solutions
- Earthworks
- Mainline Drainage
- Side Road Drainage
- Watercourse Crossings
- Watercourse Diversions
- Flood Mitigation Strategy
- Hydraulic Models
- Connectivity Culverts
- Deposition Areas
- Road Signage
- Road Side Features
- Structures

Economic Appraisal Process

1.4.16 The Economic Appraisal of the scheme will be prepared in accordance with the latest WebTAG guidance issued by the Department for Transport (DfT). WebTAG guidance is based on HMT's Green Book [HMT, 2007], that sets out the framework for appraisal and evaluation for all policies, programmes and projects.

1.4.17 Mouchel continued to take the scheme through the statutory procedures with draft Orders and an Environmental Statement published in November 2010 followed by public inquiries in the summer of 2011. Following receipt of the Public Inquiries Inspector's Report, the Orders for the scheme were made in summer 2012. These made Orders were the subject of a successful High Court challenge in April 2013. The Department accepted the judgement and commissioned Mouchel to carry out further work to remedy the situation. This further work included updating existing data where necessary, updating the design to new standards and repeating the statutory procedures which has culminated in the publishing of new draft Orders and a new Environmental Statement.

1.5 Scheme Delivery

1.5.1 In assessing timeframes for the phased delivery, a presumption has been made that there will be a continuing commitment from the NI Executive and ROI Government to progress the whole of the A5WTC and account has been taken of anticipated future budgetary periods. As such, the following timeframes have been identified as working presumptions for use in the assessment process:

- Phase 1a – NI Executive period 2016 to 2020; construction period 2017 to 2019; opening year 2019;
- Phase 1b – NI Executive period 2016 to 2020; construction period 2017 to 2019; opening year 2019;
- Phase 2 – NI Executive period 2020 to 2024; construction period 2021 to 2023; opening year 2023;
- Phase 3 – NI Executive period 2024 to 2028; construction period 2026 to 2028; opening year 2028;
- Whole Scheme – design year 2041[3].

[3] Whilst the design year is 15 years on from opening year for the complete scheme (2028 + 15 = 2043), the forecasting factors are only available until 2041. As such the traffic forecasting has used 2041 as the design year.

2 Existing Conditions

2.1 Sources of Information

2.1.1 This section provides a description of the existing highway network and conditions pertinent to the Preferred Route and the subsequent development of the Proposed Scheme. Depending on the subject being described, this may be local in nature or of a broader context which reflects the scale of impact that the Proposed Scheme may have on engineering issues. This chapter is divided into four main sections.-

- Section 2.1 discusses the sources of information for data used within the report;
- Section 2.2 describes the existing conditions as they relate to Section 1 – New Building to South of Strabane;
- Section 2.3 describes the existing conditions as they relate to Section 2 – South of Strabane to South of Omagh;
- Section 2.4 describes the existing conditions as they relate to Section 3 – South of Omagh to Aughnacloy.

Drainage and Hydrology

2.1.2 The information used to compile this section and the associated drawings referenced within Volume 2 was sourced from the following:

- Consultations with key statutory bodies including Rivers Agency, TransportNI and Londonderry Port and Harbour Commissionaires;
- Field work surveys and assessments of watercourses, floodplains and drainage catchments;
- Collation of historical flooding data;
- Fluvial design flow estimations based on Flood Estimation Handbook (FEH) Software;
- Existing Flood Risk Assessments and consultations with Rivers Agency and its consultants;
- Hydraulic models.

2.1.3 The potential flood extents adjacent to river corridors were further delineated using available geological information. Alluvium drift geology mapping indicates the possible extent of floodplains arising from long-term historical flooding. This data does not represent localised flooding associated with hydraulic restrictions such as culverts, bridges and retaining walls.

2.1.4 The NI Water infrastructure includes drainage outfalls at numerous locations along the length of the Preferred Corridor. Existing discharge to watercourses from existing NI Water infrastructure is not considered in this section.

2.1.5 In considering the existing drainage and hydrological conditions along the Proposed Scheme, a desk based assessment has been supplemented with site visits and watercourse inspections. The desk based assessment utilised the information sources outlined previously, with specific inputs outlined below.

Primary Rivers Agency Data

2.1.6 There are a number of discrete departmental Units within Rivers Agency, each providing specific information that has been utilised.

2.1.7 Rivers Agency GIS Unit has provided:

- River Centre Line Data
- Designated Watercourses
- Areas of Historical Flooding

2.1.8 In relation to the provision of historical flood maps, these depict historical flooding events of varying return periods along the Proposed Scheme. The dataset is incomplete between Newtownstewart and Strabane. Due to the varying return periods, it should not be assumed that this depicts the full extent of flood plains within the study area.

2.1.9 It is also noted that the historical flooding depicted within Strabane town centre resulted from breaching of the masonry flood defences and not overtopping. Following this event the current concrete flood defences were constructed in 1991.

Rivers Agency Flood Defences

2.1.10 Mouchel undertook site investigation to confirm the category of defence; hard or soft. The principal hard defences are through Omagh and Strabane. All other defences are considered soft defences with no internal impermeable core.

Location of Rivers Agency HEC-RAS Models

2.1.11 The models received from Rivers Agency were not geo-referenced and some models have been geo-referenced by Mouchel.

Rivers Agency LiDAR Coverage Data

2.1.12 Detailed LiDAR data for Strabane, Newtownstewart and Omagh was received from Rivers Agency.

Department of Agriculture and Rural Development (DARD) Flood Maps

2.1.13 Rivers Agency publish strategic flood maps which provide information to the public in relation to historical flooding and predicted 1 in 100 year floodplains; including the impacts of climate change, for rivers and 1 in 200 year tidal floodplains including the 20% impacts for climate change. The latest versions (2013) of these maps have been used to assess the impacts of the Proposed Scheme and are viewable on http://www.dardni.gov.uk/flood-maps-ni

2.1.14 In addition, the Planning Advisory Unit (PAU) has provided the following assessment guidelines:

- Guidelines for Road Schemes
- Guidelines on Completion of Flood Risk Assessments
- Guidance on Flood Plain Storage Compensation

2.1.15 These guidelines had been developed by Rivers Agency for the assessment of road schemes, including flood risk assessments.

2.1.16 HEC-RAS Hydraulic models for the following watercourses were also provided by Rivers Agency PAU:

- Ballygawley Water
- Burn Dennet
- River Derg
- Fairy Water
- River Finn
- River Mourne
- Quiggery Water
- River Strule

2.1.17 Rivers Agency Hydrometrics Unit provided annual maximum series flood data per Water Year (year start 1st October and ends the following year on 30th September) for 11 river catchments (10 relevant to the A5WTC). The gauging stations cover the largest designated watercourses in the area, (refer to Figure 2-1 below). Records start from the 1970's – 1990's depending on the gauging station and all of the stations are still in use. This gauging information was used later in the studies when deriving design flows for the major rivers.

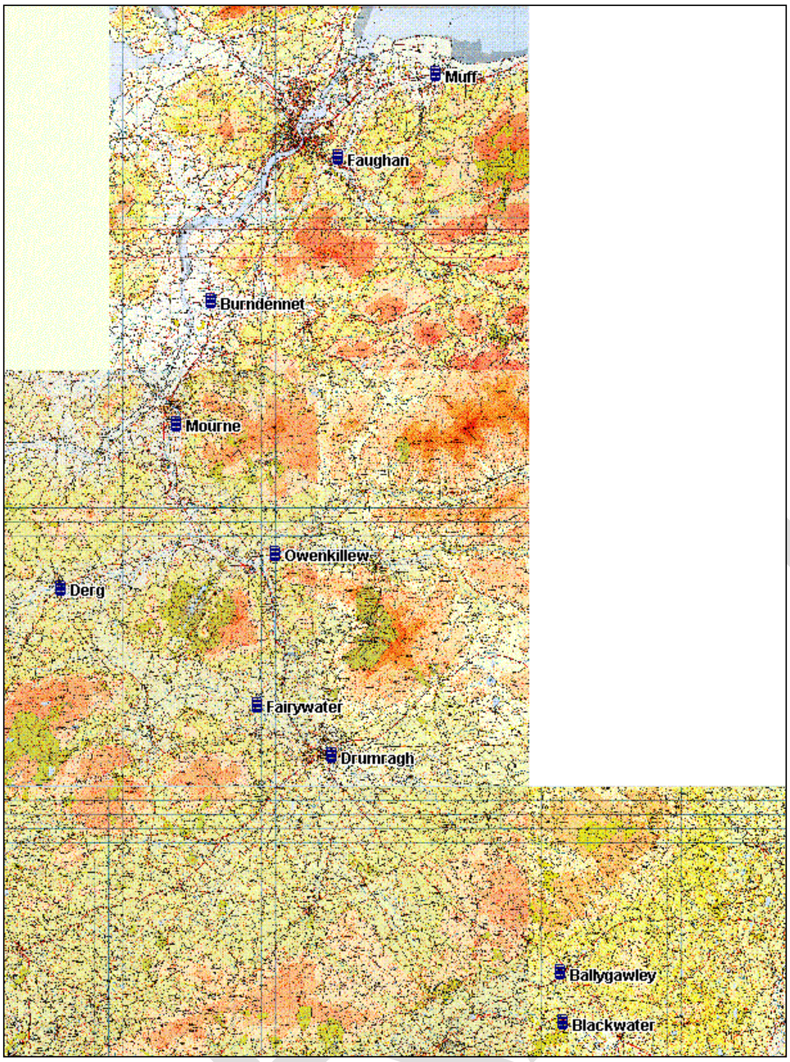


Figure 2-1: Rivers Agency Gauging Station Locations

2.1.18 Historical flood data for Londonderry, Strabane, Omagh and surrounding areas was also gathered from newspaper archives and microfiche held in Londonderry, Strabane and Omagh public libraries. Internet research was also undertaken which included utilising the DARD flood maps.

Flood Risk Assessment & Previous Flooding Incidences

2.1.19 Previous studies that have been reviewed include the River Finn Flood Study (N14/N15 Junction) - Mott MacDonald (Report and ISIS Model),Three Rivers Development (Strabane) flood risk assessment report, available through the DoE Planning Service and Newtownstewart by-pass flood risk assessment report.

2.1.20 Consultations have been held with various TransportNI departments to collate data relating to the existing A5 and local road network flooding. As part of consultations undertaken by DoE Planning Service for the East Tyrone Area Plan, Rivers Agency provided maps depicting the extent of 100 Year (Q100) floodplains (defended and undefended) in the vicinity of town development limits for areas covered by the plan.

2.1.21 The Q100 flood plains displayed are extracts provided for the local area plan and do not represent the full extent of flood plains within the study area.

Tidal Data

2.1.22 The northern extents of the Proposed Scheme include the River Foyle north of Strabane which flows into Lough Foyle. Lough Foyle is tidal and exerts a tidal influence on the River Foyle as far inland as the Rivers Mourne and Finn. Consequently, consideration of the tidal influence on these rivers adjacent to Strabane has been undertaken as part of the flood modelling. Londonderry Port and Harbour Commissionaires were consulted in relation to tidal records for Lough Foyle.

2.1.23 The Admiralty tidal statistics for Derry Port and Lisahally Port were reviewed, together with a port location plan (refer to Figure 2-2). Rivers Agency (Hydrometrics Unit) and Londonderry Port and Harbour Commissionaires were also consulted in relation to actual tidal records for the Foyle. Rivers Agency (PAU) supplied extreme 200 year tidal levels for the entire province. In addition the DARD flood mapping was also reviewed.

Figure 2-2: Derry Port Location Plan

2.1.24 To facilitate an understanding of the tidal effects on the Foyle River, tidal gauging was undertaken at 2 locations along the Foyle system between 28/08/08 and 05/09/08. The purpose of these gauges, in conjunction with the permanent tidal gauge at Derry (sited over a spring tide) was to gain an appreciation of the deformity of the tide as it progressed up the fluvial system.

Site/Watercourse Inspections

2.1.25 The watercourses along the route of the existing A5 were identified, marked in GIS and mapped for site survey. Rivers Agency data was cross referenced with the FEH database and ordnance survey mapping. 594 watercourse surveys have also been undertaken within the A5WTC Preferred Corridor, collating information pertaining to watercourse shape, size and gradient. All watercourses crossed by the Preferred Corridor have been mapped.

2.1.26 A program of survey works was undertaken to provide detailed topographic surveys for 26 hydraulic flood models. An additional program of surveys at approximately 342 outfall locations/watercourse crossings have also been undertaken along the Proposed Scheme to collate information pertaining to watercourse shape, size and gradient. A number of nearby structures, such as culverts or bridges, likely to affect the watercourses at the specified locations were also surveyed. The results of the surveys were developed with accompanying drawings, sketches, field notes and photographs to provide additional information on each location and watercourse surveyed.

Existing Drainage

2.1.27 The existing A5 highway drainage will continue to be maintained by TransportNI regardless of the alignment of the new road.

2.1.28 Through discussions with TransportNI Maintenance Section Offices and Rivers Agency, it is known that sections of the existing A5 have been prone to historical flooding. These areas are described in the relevant section paragraphs below.

Hydrology & Flooding Overview

2.1.29 Preliminary hydrological reviews have ascertained the principal rivers and associated drainage basins within the Preferred Corridor. The main drainage basins are shown on drawing 796036-0500-D-00038. The principal watercourses are outlined in drawings 796036-0500-D 00011, 00014, 00017, 00020, 00023, 00026, 00029, 00032, 00035 in the Preliminary Options Report at www.a5wtc.com. The watercourses to the north of Ballygawley feed into the main Foyle Basin which comprises the Strule River, Mourne River and River Foyle. The River Blackwater catchment to the south does not form part of the Foyle basin.

Flood Modelling

2.1.30 1D and 2D flood models have been developed to analyse the effects of the Proposed Scheme on the major flood regimes within the Preferred Corridor. The results of these flood models allowed analysis of the impacts of the Proposed Scheme and the consideration of alternatives with potential reduced impacts. They also fed into the design of the flood mitigation strategy and flood attenuation measures.

2.1.31 Flood Risk Assessments were undertaken to identify areas of existing flood risk, and where development within floodplains was essential, to ensure that the proposed road was not at risk from flooding nor would it materially increase flood risk elsewhere.

2.1.32 In accordance with Flood Risk Assessment requirements outlined within the DMRB and PPS 15 these assessments included as a minimum:

- Location plans illustrating geographical features, built development, identifying all watercourses, water bodies, drainage infrastructure and drainage outfalls,
- Plans of the proposed road layout illustrating existing and post development levels,
- Details of any existing flood alleviation measures or flood defence works which may influence the site,
- Identification of potential sources of flooding,
- Plans illustrating the extent and depth of flood predictions or flood events, and
- Proposals for the mitigation of any increases in flood risk that may arise as a result of the proposed road.

Structures

2.1.33 Data on the structures on the existing A5 and road network was gathered by desk study and on-site inspections. This process comprised:

- A study of available TransportNI data, including inspection and maintenance records, the original construction records and “as built” drawings. It should be noted that all of this data was not available for every existing structure.
- A “walk through” survey which identified and reviewed all the known bridges and located all the retaining walls and minor structures (less than 1.8m span) on the route.
- Detailed condition inspections of the major structures, using the HA BE/11 forms as well as the Highways Agency’s (HA) “Performance Measurement of Highway Structures” (PMHS) system of inspection.

Public Utilities

2.1.34 The information used to compile this section and the associated drawings referenced within Volume 2 was derived from data provided by Statutory Undertakers as well as from supplementary sources, as set out below:

- NIE – provided complete MapInfo data sets of all existing plant and apparatus.
- BT – provided scanned images of hand drawn record maps.
- NIW – Transport NI (formerly Roads Service) provided complete digital drawings of all existing plant and apparatus.
- Virgin Media – provided complete digital drawings of all existing plant and apparatus.
- Eir – provided complete digital drawings of all existing plant and apparatus.
- Vodafone (formerly Cable and Wireless) - provided complete digital drawings of all existing plant and apparatus.
- Firmus Gas - provided complete digital drawings of all existing plant and apparatus.

- O2 – provided co-ordinates of mobile phone masts.
- EE (Orange, T-Mobile) and Vodafone – information gathered from the 'Site Finder' website.

2.1.35 Future utility proposals and additional background information was gathered during discussions and meetings with each of the statutory undertakers.

Geotechnics

2.1.36 The existing geotechnical conditions were established using desk study and ground investigation data. The desk study involved the examination of published data including geological maps, hydrogeological maps, aerial photography, 3-D terrain models and previous ground investigation records. The desk study also included assessments of the current status of the various known gravel pits, quarries and landfill sites identified throughout the study area. A preliminary visual survey of the peat bogs identified throughout the study area was undertaken to confirm the type & extent of peat bog i.e. blanket (upland) Peat, inter-drumlin (fen) accumulations or raised (lowland) bog. The desk study also included a preliminary ground investigation, (which was carried out in 2009 on publicly accessible ground) to obtain outline geotechnical data within the preferred corridor. This was used in conjunction with the other field surveys and desk top searches to allow a comparison between the route options and to assist in the decision making process of selecting the Proposed Scheme.

2.1.37 The desk study phase was carried out between February 2008 and June 2009.

2.1.38 The Geological Society of Northern Ireland (GSNI) consultation was revisited in October 2014 to establish whether there were any material changes to the information gathered previously. This confirmed that no significant change had occurred. A walkover survey of the proposed route between New Buildings and Ballymagorry was also undertaken in June 2012 and between Omagh and Ballygawley in August 2012 and this again confirmed no significant changes.

2.1.39 The following information sources were used as part of the desk study:

Information Source	Data gathered	Application of information
Ordnance Survey	Current OS mapping	Topography, water supplies, peat, Man-made obstructions/voids/sources of contamination
	Historical Ordnance Survey of Northern Ireland Maps	Man-made obstructions/voids/sources, of contamination, water supplies, peat,
	Historical mapping	Digital historical mapping for 1830's, 1860's & 1900's Former/present mining/quarrying and land-filling - Identification of geo-hazards water supplies, peat,
	Ortho Aerial photography (2006)	Land use, water supplies, peat, Former/present mining/quarrying and land-filling - Identification of geo-hazards

Information Source	Data gathered	Application of information
	Aerial photographs held by the Public Records Office	Former/present mining/quarrying and land-filling – Identification of geo-hazards
	Soil Maps	Determine soil types & other properties, geomorphology & physical geography, vegetation & land use
	Topography Maps	Representation of the relief with contours
	Digital Terrain Mapping	Digital representation of the relief
Geological Survey of Northern Ireland	1:250 000 Geological Map of Northern Ireland (Solid Edition)	Bedrock (Solid) geology along route corridor
	1:250 000 Geological Map of Northern Ireland (Quaternary Edition)	Superficial (Quaternary) deposits along route corridor
	1:250 000 Groundwater Vulnerability Map of Northern Ireland	Identification of the vulnerability of groundwater to contamination - Aquifer recognition & groundwater conditions
	1:250 000 Hydrogeological Map of Northern Ireland	Hydrogeological risk assessment – Aquifer recognition & groundwater conditions
	1:50 000 Solid Edition – Sheets 11, 33, 34, 45, 46.	Underlying Geology – Bedrock (Solid) geology along route corridor
	1:50 000 Drift Edition – Sheets 11, 33, 34, 45, 46	Underlying Geology – Superficial (Drift) deposits along route corridor
	6” Scale Field Maps	Detailed Geological map
	Geological field slips	Identification of likely ground conditions
	Mineral Extraction Records	Former/present mining/quarrying and land-filling - Identification of mineral extraction hazards
	Borehole Records	Historical information on geotechnical & groundwater conditions
	Abandoned Mines Records	Former mining location of shafts adits & abandonment plans - Identification of mining hazards
	Oil/Gas Extraction	Former or present oil/gas extraction locations
	Website - Mineral Licensing	Minerals & petroleum exploration & development in Northern Ireland
	Website - Petroleum Licensing	Petroleum Licensing: September 2004, map indicating licenses applied by for by exploration companies

Information Source	Data gathered	Application of information
Northern Ireland Environment Agency	Contaminated Land Database	Present/previous landfills & potentially contaminating sites
	Water Quality Management Unit	Sensitivity of ground/surface water for drainage design, pollution incidents, consented industrial discharges, sewage discharges, designated groundwater extraction points.
	Industrial Pollution Unit	Identification of industrial operations, COMAH sites – Enforcements, prohibitions, prosecutions
	Water Quality	Includes GQA chemical & biological classification results for river
	Landscape Character Areas	Landscape. Geological and biodiversity summaries
	Waste Licensing Unit	Register of licensed & exempt sites
	Habitas Website	Earth Science Conservation Review Sites
Londonderry, Strabane, Omagh and Dungannon District Councils	Building Control	No significant data
	Environmental Health	Records of potential contaminating sites/landfills/fuel installations
	Planning Department	Planning Applications, geotechnical & contaminated found conditions
The Department of Finance and Personnel, Central Procurement Directive	Historical Ground Investigation Reports	Historical information on geotechnical and groundwater conditions
Geological Survey of Ireland	Co. Monaghan Drift maps	Drift geology for Northern / Republic of Ireland border area
	Quarry and mineral database	Identification of mineral extraction hazards for Northern / Republic of Ireland border area
	Land Slides in Ireland	
Mouchel Internal Records	A4/A5 Ballygawley Intersection	PSSR & GI Records
	A5 Newtownstewart Bypass	Geotechnical design details
	A5WTC	796036-0000-R-006 Preliminary Options Report
		Geotechnical Walkover Survey Methodology
		Geotechnical Initial Key Constraints 796036-0500-R-003A
		Geotechnical Statement of Intent 796036-0500-R-00001

Information Source	Data gathered	Application of information
Public Records Office	Current & Historical Ordnance Survey of Northern Ireland Maps	Man-made obstructions/voids/sources of contamination
	Aerial photographs (usually dating back to 1946) held by the Public Records Office	Former/present mining/quarrying and land-filling
Department of Environment (Planning Services)	Planning Service	May provide reference to data submitted with planning applications & also mineral planning details
British Geological Survey	GeoIndex	Various Information including, SI's, Shafts & Adits, Mineral occurrence, topography, geology
Department for Regional Development: TransportNI - Section Engineers	Section Engineers: Londonderry Strabane Omagh Dungannon	Local Information on ground conditions; Subsidence; Earthwork Records; Previous Investigations
Agriculture & Rural Development: Rivers Agency	Rivers Agency	Culverted watercourses, low flow water course and any pollution incidents to watercourses
Department of Culture Arts & Leisure	Website - Mosaic 4 Utilities	Information on utilities from DRD Water Service, Rivers Agency, DRD Roads Service, NTL, Phoenix Gas, & NIE.

Table 2-1: Sources of Information for Geological Desk Study

2.1.40 The results of the desk study, including the interpretation of the preliminary ground investigation, are presented in Mouchel Preliminary Sources Study Reports ref. 796036/0600/R/005 (Section 1), 796036/0600/R/006 (Section 2) and 796036/0600/R/007 (Section 3) and are available on the project website (www.a5wtc.com)

2.1.41 Phases 1 to 4 of the main ground investigation commenced in September 2009 were completed in November 2010.

2.1.42 The main ground investigation comprised:

- cable percussion boring;
- rotary coring;
- window sampling;
- dynamic probing;
- trial pitting;
- mackintosh probing;

- cone penetration testing.

2.1.43 Stand pipes and stand pipe piezometers were installed in selected exploratory holes to monitor water levels. The water monitoring exercise continued throughout 2010 and 2011.

2.1.44 During June to December 2012, additional (Phase 5) ground investigation was carried out by the contractor advisors to TransportNI to provide specific information on selected earthworks and proposed structures in the sections between New Buildings & Ballymagorry (Section 1) and between Omagh & Ballygawley (Section 3). The same drilling techniques were used as for the previous phases, although in Section 3, "Geobor-S" core drilling was used in selected holes to obtain high quality undisturbed samples of glacial soils to ascertain effective strength parameters.

2.1.45 The results of the preliminary ground investigation are presented in the Soil Mechanics Factual Report ref Y9901, dated April 2009.

2.1.46 The results of the main ground investigation are presented in the Mouchel Ground Investigation Reports 718736-0600-R-006 (Section 1), 718736-0600-R-007 (Section 2) and 718736-0600-R-008 (Section 3) and are available on the project website (www.a5wtc.com).

Pavements

2.1.47 To assess the structural condition of the pavement, various technical assessments were carried out along the existing A5. The sources of data for these assessments included historical Deflectograph and SCRIM records, Ground Penetrating Radar (GPR) survey and a visual assessment using a Digital Video (DV) survey. In summary, the visual and machine based surveys showed that the existing route is variable in its condition. There are some sections that have been improved and upgraded to current standards and are in good condition with a high residual value. Some older sections have more general deterioration with some defects requiring maintenance.

Deflectograph

2.1.48 Deflectograph survey data dated 2002, 2004, 2005, 2007 and 2010 was provided by the Department. The data provided was then used to calculate the remaining life of the existing A5 pavement. The remaining life of the pavement was divided into 3 categories:

- Less than 5 years,
- Between 5 and 20 years,
- Greater or equal to 20 years.

Visual Assessment using Digital Video Survey

2.1.49 A Traffic Speed Digital Video (DV) survey was carried out between 10 and 14 March 2008. A desk based visual assessment of the carriageway was then undertaken using data obtained from the DV survey by analysing the video and abstracting the visual signs of physical deterioration. The extents of any defects were identified from their start chainage to end chainage and then rated according to the proportion of the lane width they covered; the severity of the defects has not been assessed. Figure 2-3 below shows a snap shot of the digital video survey.

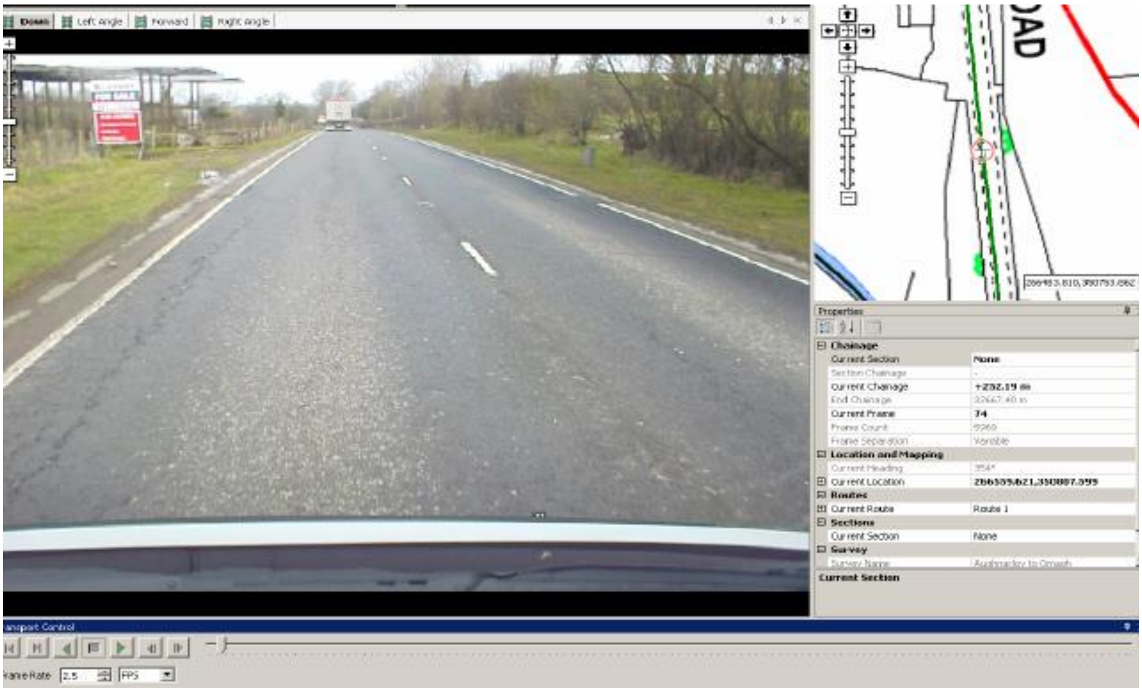


Figure 2-3: Visual Assessment using Digital Video Survey

2.1.50 Carriageway condition surveys have been carried out since 2010 along the 48 stretches of the A5 (totalling to 85 km). These surveys are carried out by the Department on a 3 year rolling programme.

2.1.51 A number of resurfacing schemes have been carried out since 2009 and will be listed in the corresponding Sections.

Traffic and Economics

2.1.52 Sections 2.2, 2.3 and 2.4 of this report, describe the existing conditions relating to traffic and accidents along, and local to, the existing A5 in the vicinity of the Preferred Corridor. The Proposed Scheme has been divided into 3 sections for highway design purposes, and for consistency the existing traffic conditions are reported separately for each of these 3 sections, together with overall corridor summaries.

Existing Traffic Conditions

2.1.53 Traffic data has been taken from the traffic surveys commissioned specifically for the A5WTC scheme and carried out in Spring 2008, and again in Autumn 2013 and finally Spring 2014. These included Roadside Interviews, Manual Classified Counts, (MCC's) Automatic Traffic Counts (ATC's) and Automatic Number Plate Recognition (ANPR) surveys as well as use of existing survey information supplied by the Department.

2.1.54 Traffic surveys should generally be undertaken in neutral months in order to minimise the variability of traffic flows. For this scheme, the majority of data was collected in the neutral months of May 2008, October/November 2013 and April/June 2014. October 2013 has been chosen as the base for the traffic model. It should be noted that when school holidays fell during these periods, data was either not collected or not used for analysis, so the different characteristics of traffic at such times were therefore excluded.

2.1.55 Data from the surveys commissioned for the A5WTC scheme have been used in assessing the existing traffic conditions in the corridor and have been presented below in terms of traffic flows, turning movements, vehicle proportions, daily flow profiles, vehicle speeds and summaries of origins and destinations of traffic.

2.1.56 In addition to the surveys commissioned for the A5WTC scheme itself, longer term ATC data at NIRS sites monitored by the Department were also used to assess seasonal variation of traffic flows.

Existing Accident Conditions

2.1.57 The assessment of accidents forms part of the overall scheme appraisal. Historically, the UK Department of Transport (DfT) COBA program was used to compare the costs of providing road schemes with the benefits derived by road users (in terms of time, vehicle operating costs and accidents) and presented the results in terms of a monetary valuation. COBA was applicable to the appraisal of trunk road schemes in England, Wales and Northern Ireland and included a set of national average accident rates expressed in terms of the number of Personal Injury Accidents (PIA) per million vehicle kilometres.

2.1.58 For the appraisal of accidents, COBA has recently been replaced with a new tool known as COBALT. This uses the same methodology to produce accident benefits for a highway scheme. These benefits can then be merged with the time and vehicle operating benefits calculated by the DfT appraisal software TUBA, which is widely used for assessing benefits from highway schemes.

2.1.59 When preparing inputs for COBALT there are two options: to attribute all accidents to links along the road (“combined” accidents) or to attribute them separately to links and junctions.

2.1.60 For appraisal purposes, PIAs are categorised as fatal, serious or slight depending on the severity of the worst casualty in each accident. The three casualty severity levels are defined in Table 2- 2.

Severity	Definition
Fatal	Death within 30 days as a result of the accident
Serous	Fracture; severe cuts; burns; concussion; detention in hospital as in-patient
Slight	Strains; whiplash; bruises; slight cuts; slight shock

Table 2-2: Definition of casualty severity levels

2.1.61 COBALT allows accident rates to be derived using observed accident data or, as a default, relies on national average PIA rates and severity proportions. These change over time and are determined for various road types using the definitions set out in Table 2- 3.

Analysis Type	Definition	Determinants	units
Combined Link and Junction	Rates attribute all accidents to the links. As a result, 'Combined Link and Junction' rates are greater than those for 'Link Only'.	1) Road Type 2) Speed over or under 40mph	Personal Injury Accidents per million vehicle kilometres (PIA/mvkm)
Link Only	Rates exclude accidents occurring within 20 metres of modelled junctions. Link lengths adjusted to suit.	1) Road Type 2) Speed over or under 40mph	Personal Injury Accidents per million vehicle kilometres (PIA/mvkm)
Junction	Rates establish number of accidents occurring at or within 20 metres of modelled junctions.	1) Junction Type 2) Number of arms 3) Flow on major/minor links 4) Speed limit (Threshold at 40mph)	Number of Personal Injury Accidents per year

Table 2-3: Explanation of Classes of accident type which may be used in COBALT

2.1.62 For the appraisal of the A5 project using COBALT, it is considered that the ‘combined link and junction’ approach is appropriate. Accidents occurring at modelled intersections will be allocated to the appropriate link which enters the node.

2.2 Existing Conditions – Section 1 New Buildings to South of Strabane

2.2.1 This section provides a description of the existing highway network, particularly the existing A5, and conditions pertinent to the Preferred Route and the subsequent development of the Proposed Scheme.

Description of the Current Network

2.2.2 This section should be read in conjunction with drawings 718736-0800-D-00001 to 718736-0800-D-00019 included in Volume 2 for reference.

2.2.3 These drawings show the Preferred Route and local road network on aerial photography and Ordnance Survey (OS) mapping tiles prior to the development of the Proposed Scheme.

2.2.4 The existing A5 within Section 1 runs for approximately 23km south from New Buildings towards Strabane, initially travelling adjacent to the River Foyle. It passes through Magheramason before continuing in a south-westerly direction round the base of Gortmonly Hill toward the bridge over the Burn Dennet River. After the river crossing, the A5 continues to traverse between sparsely located residential and commercial properties, while passing through villages and hamlets (Cloghcor and Ballymagorry). The A5 then enters Strabane utilising an at-grade roundabout junction with connections to Lifford Road (A38) and Railway Street (B72), before crossing the River Mourne. After the river crossing, the A5 enters a roundabout with Bradley Way, before heading onto the Strabane through-pass around the western edge of the town. The A5 then joins Melmount Road at another roundabout at the end of the through-pass, before heading south to Sion Mills.

2.2.5 A local side road network serves the developments and farming communities on either side of the existing A5 with numerous priority junctions with the main road. A number of side roads to the west of the A5 are cul-de-sacs which access the low lying area of the Foyle floodplain. The side road network around Strabane serves to link the wider farming and smaller developments with the town in a radial nature around the town. The key arteries to the town are the B85 from the south-west, the B72 from the south, the B536 from the south-east and the B49 from the north.

2.2.6 There are natural and man-made constraints along the environs of the existing A5 which influenced the Proposed Scheme. The man made constraints include:

- St. Mary's Oratory and Primary School in New Buildings,
- A textile factory south of New Buildings,
- Magheramason Presbyterian Church,
- Bready Reformed Presbyterian Church,
- St John's Church in Bready,
- Strabane Canal,
- Fox Lodge Cricket Club,

- Burn Dennet Bridge,
- Spruce Road Bridge,
- Ballymagorry Bridge,
- River Mourne Bridge.

2.2.7 There are also a number of settlements with commercial properties such as shops, filling stations, public houses and housing throughout the environs of the Proposed Scheme from New Buildings to Strabane.

2.2.8 The settlements in Section 1 fall within either The Derry Area Plan 2011 or the Strabane Area Plan 1986-2001. As in most developments, housing, industry, commerce, community facilities and recreation/open space are situated at convenient locations in the community. Various cultural, landscape and environmental features are also present in the surrounding areas along the Proposed Scheme, such as The Three Rivers Project to the west (and associated floodplain), Knockavoe Hill and the West Sperrin Mountains to the east (including the Sperrins Area of Outstanding Natural Beauty). Major planning applications in this region in the last 8 years include restoration of the Strabane Canal between the River Foyle and Glenmornan River, which is now complete, and a strategic Three Rivers Project mixed use development to the west of Strabane (employment park, a leisure complex and hotel) along the River Foyle immediately west of the existing A5 (approved in 2010, with further approvals in 2014, but construction is yet to commence at the date of this report).

2.2.9 The main economic activity in the region is agriculture. There are expansive areas of Best and Most Versatile lands; private and Department of Agriculture and Rural Development (DARD) Woodlands, and agri-environmental schemes. The whole of the River Foyle and its tributaries are well known in Northern Ireland for game and coarse fishing, supporting a diverse mixture of fish and river dynamics. Major tributaries known to be used extensively by anglers consist of the Burn Dennet (originating in the West Sperrins and running west towards Cloghcor) and the River Mourne (running north from Newtownstewart to Strabane).

2.2.10 Public transport is run by Translink Bus services in this area and are fairly limited. The only rail connection from west to east is the Belfast-Coleraine-Londonderry line. The bus routes in this corridor consist of the Ulsterbus services 102 between Strabane and New Buildings; service 101 between Sion Mills and Strabane; service 98 between Strabane, Ballymagorry and New Buildings; Strabane town services 398A-D and Goldline Express service 273. The services run infrequently, providing hourly services at best. Smaller settlements such as Magheramason, Bready and Cloghcor do not have access to mainstream public transport. However, there are private bus companies which offer, among other services, door to door minibus services aimed at elderly and less mobile customers all over the country.

2.2.11 Sustrans are responsible for the National Cycle Network, which in this region, can be found going out of New Buildings along the B48, and through Strabane, exiting the town on the B72.

2.2.12 A number of A and B Class routes join the existing A5 within the extent of Section 1. The routes are identified in Table 2-4, along with the local settlement with which they connect. The remainder of the network consists of C class and unclassified roads.

Route	Connecting town
B48	New Buildings
B49	Ballymagorry/Strabane
B72	Strabane
A38	Strabane/Lifford
B85	Strabane

Table 2-4: Section 1 A and B Class routes join the existing A5

2.2.13 An overview of Section 1 showing the existing A5, the Proposed Scheme, Development Limits and intersecting route/links are shown in Figure 2-4 below.

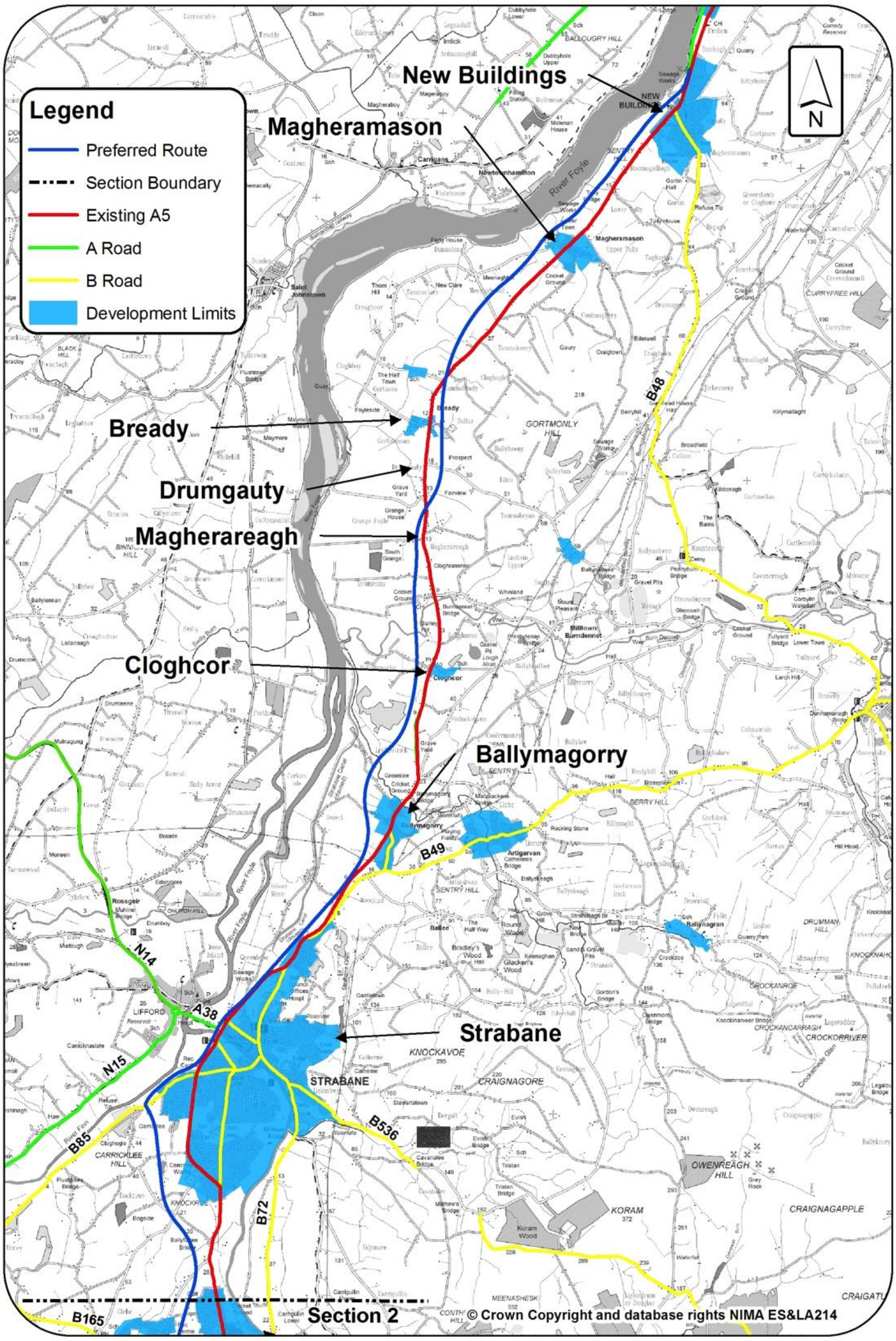


Figure 2-4: Overview of Section 1: The Existing A5, the Preferred Route, Development Limits and Intersecting Routes/Links

Existing Highway Conditions

2.2.14 The majority of the existing A5 from New Buildings to the south of Strabane is derestricted, and is therefore subject to the national speed limit of 60mph. However, there is a section near Brookvale when the speed limit is reduced to 40mph. In accordance with the Design Manual for Roads and Bridges (DMRB) TD9/93, this equates to a design speed of 100kph. A geometric assessment of the stopping sight distance, and the horizontal and vertical alignments has been carried out. The Full Overtaking Sight Distance (FOSD) assessment has also been carried out for the existing carriageway. The FOSD gives a safe distance for overtaking on single carriageways, and is generally only realistically achieved in areas of relatively flat terrain. A geometric assessment of the existing A5 was carried out using the existing speed limits. In this assessment, cognisance was given to variances in speed limit. The results of this analysis showed that there are 51 areas that are sub-standard to such an extent that they would require departures from the current standard TD9/93 (DMRB 6.1.1).

2.2.15 Within the 23km of Section 1 there are over 300 residential, farm and commercial accesses directly onto the road. The A5 is classified as having a high density access constraint, which has an impact on both traffic speed and safety. The A5 is generally undulating and lies at the foot of several hills: the highest point is 37m Above Ordnance Datum (AOD) between Meenagh Road and Ballybeeny Road (south of Magheramason) and the lowest point of the road is 3.5m AOD between A5 Barnhill Road and Park Road (Strabane). Footways and kerbing are generally provided all through the settlements.

2.2.16 The cross-section widths of the carriageway vary throughout, between 6.3m and 14.7m, and on occasion, do not meet the current standards' requirements either in terms of road or verge widths, or by the absence of a hard strips along the edge of the carriageway. These non-compliances with standards generally occur between population settlements. The northbound carriageway through Bready also contains a 115m-stretch which does not comply with Stopping Sight Distance (SSD) standards.

2.2.17 The road is generally undulating on the approach to Magheramason, and passes through the town, widening from 7.5m into a 10m-wide, 775m-long southbound climbing lane (Figure 2-5). It then narrows back down to 6.5m wide and continues in a south-westerly direction round the base of Gortmonly Hill, towards the bridge over the Burn Dennet river. The minor roads joining this section of the trunk road primarily weave between farms with road widths and alignments limiting vehicle speeds. These generally have no road markings except at their intersections with the A5 and their average cross-section width is under 3m.

Figure 2-5: Transition to climbing lane, Magheramason

2.2.18 Mason Road and Dunnalong Road with 30mph speed limits within the village limits, are wider at 6m with kerbs, footways and vehicle lay-bys, and run through residential/commercial areas. Approximately 500m south of the Burn Dennet river crossing, the level of the road drops to 4.1m AOD; furthermore, the A5 narrows to 6.3m-wide to a point immediately north of Cloghcor, where it is widens to 7.6m, rising to 10.7m AOD, and continues to traverse between sparsely located residential and commercial properties. Victoria Road (A5) widens to 13.4m between Cloghcor and Leckpatrick to accommodate a 750m-long northbound climbing lane. South of Leckpatrick Victoria Road (A5) continues southwards as it passes through a number of smaller communities and over the Glenmornan River.

2.2.19 South of the Glenmornan Rover Victoria Road (A5) widens to 8.4m to include a dedicated right-turning lane for northbound traffic into Woodend Road in Ballymagorry and onto several more villages. The road is generally undulating in this section, reducing to a width of 7.3m which is maintained as Victoria Road enters Strabane. Most of the minor roads along this stretch are predominantly urban with kerbs, footways, vehicle lay-bys and a speed limit ranging between 30mph and 60mph.

2.2.20 The Proposed Scheme runs to the west of Victoria Road, south of the Glenmornan River, heading into Strabane, crossing Park Road, Spruce Road and then crossing back over Park Road again within the limits of Strabane town.

Figure 2-6: Signalised pedestrian crossing at River Mourne crossing

2.2.21 The A5 enters Strabane as Derry Road to a point 650m south of Woodend Road in Roundhill (north Strabane), where the road widens from 7.3m to approximately 9.6m to facilitate provision a right-hand turn lane. Immediately prior to the widening, Derry Road (A5) becomes Barnhill Road (A5). The road level is approximately 3.5m AOD with little vertical deviation. South of this point Barnhill Road (A5) joins a roundabout with Lifford Road (A38). The Lifford Road, approximately 9.6m wide, exits the roundabout to the west crossing the River Finn near the confluence of the River Mourne and River Finn. At the roundabout to the east of the river crossing is a pedestrian crossing (Figure 2-6). The A5 then widens to 3 lanes with a dedicated left turn onto Railway Street.

Figure 2-7: Combined footway and cycleway on either side of the A5 at Strabane Bypass

2.2.22 South of the bridge over the River Mourne, Bradley Way joins a roundabout and branches off (as one arm) whilst the A5 continues as the Great Northern Link. This section is 9.3m wide, inclusive of 1m hard strips. An approximately 3m-wide combined footway and cycleway (Figure 2-7) can be found on either side of the road, south of the intersection with the B85 Urney Road. The B85 is approximately 4.7m wide as it heads south out of Strabane town through a residential area parallel to the River Finn. The Great Northern Link then heads onto the Strabane bypass round the western edge of the town, joins Melmount Road (A5) at another roundabout at the southern end of the bypass where it narrows down to 6.4m wide, and then heads south towards Sion Mills. The road level rises steadily from 7m AOD south of the river crossing, to 33m AOD prior to joining this roundabout. Most of the minor roads in Strabane pass through residential and commercial areas while some run through farmlands. The speed limit of the minor roads range between 30mph and 60mph and the average cross-section width is around 3.5m. There are road markings, kerbs, footways and vehicle lay-bys along the length of some of these roads.

2.2.23 As the Proposed Scheme exits Strabane in a south-easterly direction, it crosses Strahans Road to the south of the disused quarry before heading towards Sion Mills.

Public Utilities

2.2.24 Apparatus for the supply of electricity and potable water, the removal of waste water, and the provision of telecommunications all exist in Section 1. These apparatus are concentrated in and around settlement areas and are generally located in or above the existing highway network. Between settlements, the existing A5 provides an important utility corridor for water and telecommunications supply. Apparatus for the supply of electricity and trunk water mains also traverse this section away from the existing highway network, Details of the major undertaker’s apparatus can be found in drawings 718736-0100-D-10016/10017 in Volume 2.

Electricity

2.2.25 Northern Ireland Electricity (NIE) operate an extensive network of overhead and underground transmission and distribution apparatus which provides electricity to domestic and commercial premises. Within this section, Ballymagorry substation to the north of Strabane and immediately east of the existing A5 is the main electricity installation.

2.2.26 Between New Buildings and Sion Mills, 110kV electricity transmission lines extend to the north, south and west of Ballymagorry substation. Only one of these 110kV transmission lines crosses the existing A5, immediately west of Ballymagorry. This conductor is carried on portal poles and pylons.

2.2.27 A 33kV distribution line carried on single wooden poles extends north of Ballymagorry substation, running broadly parallel to the existing A5 and crossing it three times. A further two 33kV distribution lines extend south from Ballymagorry substation broadly parallel and west of the existing A5, crossing the Mourne River to the east of the existing Bradley Way bridge. From this point, one 33kV line turns east and crosses the A5 Great Northern Link Road, to supply South Strabane and the other continues to run broadly parallel and west of the existing A5 to Sion Mills.

2.2.28 A more extensive network of overhead 11kV lines is connected to the 33kV lines and provides electricity supply to dwellings and properties in the rural areas between settlements. This network is generally remote from the existing highway network, which it crosses occasionally, instead crossing green fields. Within settlements and towns, underground MV conductors, laid within the existing highway boundaries supply power to properties.

Water mains and Sewers

2.2.29 The majority of the water supply network in Section 1 consists of small to medium diameter (80-200mm) gravity distribution mains laid in the existing minor road network. More extensive water supply networks are located and in and around New Buildings and Strabane.

2.2.30 A 12" cast iron trunk water main originating at Prospect Reservoir, to the west of Sion Mills, runs cross country northwards to the A5 Great Northern Link Road. This feeds a 250mm trunk water main that reduces in diameter at the existing A5 Mourne River crossing, from where it continues to New Buildings as an 8-9" ductile iron pipe laid in the existing A5 and Woodend Road.

2.2.31 Waste water apparatus within this section is confined to small self-contained networks, with sewers of 300mm diameter and smaller, serving the settlements of Magheramason, Bready and Ballymagorry. There are more extensive networks of sewers in New Buildings and Strabane. Domestic and commercial premises located in rural areas are generally served by private septic tanks.

2.2.32 In New Buildings, there is a sewage pumping station located immediately to the west of the existing A5 opposite the New Buildings Petrol filling station which is fed by two 525mm concrete combined gravity sewers laid in the existing A5 Victoria Road. This station pumps waste water from New Buildings in a 250mm ductile iron pipe laid in the existing A5 to a treatment facility to the north of Londonderry. There is also a 1050mm concrete surface outfall in the vicinity of Woodside Road in New Buildings, which crosses the existing A5 and flows west to outfall into the Foyle River. On the southern fringe of New Buildings, there is a 600mm foul overflow from the disused Desmonds textile factory, which also outfalls to the Foyle River.

2.2.33 Small waste water treatment package plants located to the west of the existing A5 treat dirty water from the small settlements between Strabane and New Buildings such as Magheramason, Bready and Ballymagorry.

2.2.34 Waste water from Strabane generally flows west towards the Foyle River and is collected and carried to Strabane Waste Water Treatment works in a 1050mm concrete combined gravity sewer that crosses the existing A5 Barnhill Road at its junction with Park Road.

2.2.35 Rural dwellings not serviced by sewage treatment plants would generally have a septic tank located on the property.

Telecommunications

2.2.36 BT has a network of overhead and underground apparatus located alongside and below the existing highway network. Between New Buildings and Sion Mills underground trunk fibre optic and copper cables are located in ducts in the existing A5. There is also an extensive network of ducts in New Buildings and Strabane, with spurs in Woodend Road, Lifford Road and Urney Road, as well as ducts in 8 other minor roads between New Buildings and Strabane.

2.2.37 Furthermore, there is an extensive network of overhead copper BT apparatus which has been placed on wooden poles in the verge of most of the minor roads.

2.2.38 Virgin Media, Eir and Atlas Communications (NI) have trunk fibre optic apparatus laid inside a shared 4-way duct that extends south of New Buildings to Magheramason in the existing A5 Victoria Road from where it follows the rural minor road network east of the A5 to the Woodend Road at Ballymagorry. This 4 way duct joins the existing A5 Derry Road north of Strabane at the Wooden Road junction. This 4-way duct is laid through the centre of Strabane before re-joining the A5 Melmount Road at Ballycolman where it continues in a southerly direction along the existing A5 to Sion Mills.

2.2.39 EE (formerly T-Mobile and Orange), Vodafone and O2 have mobile phone base stations/masts which are predominately located on higher ground to the east of the existing A5 and within Strabane town centre. Three mobile phone masts are located to the west of the existing A5 on the Foyle flood plain.

Miscellaneous

2.2.40 There is a small network of Firmus natural gas pipes that has been recently laid to serve New Buildings. The main distribution pipe has been laid from Londonderry to New Buildings in the Woodside Road. This pipe runs along the existing A5 Victoria Road between Duncastle Road and Ballymore Road in the southern part of New Buildings.

2.2.41 There are future plans to bring natural gas supplies to Strabane, in a transmission pipeline that extends from the existing north-west pipeline, close to Derry City Airport, south and west to a point near Woodend Road, to the north east of Strabane. Proposals for a distribution network served by this transmission pipeline have not yet been published.

Geotechnical

2.2.42 The ground conditions in Section 1 of the scheme break easily into 2 zones which are defined by the underlying geology, with the high and steep ground of the Sperrin Mountain Foothills in the east and the soft ground of the Foyle, Mourne, Finn, Burn Dennet and Glenmornan Floodplains in the west.

2.2.43 Reference should be made to the Ground Investigation Reports identified in Section 2.1 of this Chapter for a detailed discussion of the results of the investigation.

Topography

2.2.44 The topography of Section 1 is split into two different regimes – the foothills of the Sperrins and the floodplain of the River Foyle and its tributaries. The Proposed Scheme crosses both of these types of terrain in different areas which are described from north to south in the following paragraphs

2.2.45 In the north, between New Buildings and Bready, the hills of Clondermont and Gortmonly slope steeply down towards the villages, then the gradient slackens towards the banks of the River Foyle. The existing A5 road follows the boundary between the steep upper and shallower lower slopes. The Proposed Scheme generally crosses the gentler lower slopes closer to the river. The exception is at Bready village where the Proposed Scheme crosses the existing road east of the village and cuts through the side of Gortmonly Hill in a deep cutting.

2.2.46 South of Bready, the Proposed Scheme crosses the Burn Dennet and descends on to the River Foyle floodplain between there and Strabane. Between the Burn Dennet & Glenmornan River crossings (which discharge into the River Foyle) the Proposed Scheme skirts to the east of McKeans Moss and just off the floodplain by stepping on to the edge of the terrace of fluvio-glacial gravels which form the eastern margin of the Foyle Valley.

2.2.47 Between the Glenmornan River and the Mourne River in Strabane, the route crosses the low lying and flat broad Foyle floodplain, though in the Ballymagorry area, it rises over shallow ridges of sands and gravels which protrude above the floodplain.

2.2.48 South of the confluence of the Mourne, Finn and Foyle Rivers in Strabane, the route follows the east (Tyrone) bank of the River Finn. The floodplain on this bank narrows significantly and is largely absent, with the ground sloping moderately steeply from the edge of Strabane town to the banks of the Finn.

2.2.49 At the southern edge of Strabane, the route swings southwards, away from the river and over the low hills of Carrickalee Hill and Orchard Hill, to the southern edge of the section, near Sion Mills. There is a large, disused and flooded quarry on Orchard Hill, near the intersection of the Proposed Scheme and Strahans Road, south of Strabane.

Superficial (Drift) Geology from Published Records

2.2.50 Drift is largely absent or thin on the high ground in the north of the section and around Bready. Elsewhere, the superficial geology of the Foyle Valley area is complex, reflecting a number of changes in sea level in post glacial times.

2.2.51 There are two main categories of superficial deposits present in the Foyle Valley area:- deposits relating to the last glacial stage and post glacial estuarine / alluvial deposits. The Foyle and the principal side valleys were deep, steep sided glacial valleys that have been infilled with glacial and post-glacial deposits.

Glacial Deposits

2.2.52 During the last glacial period, much of the region was covered by a thick ice sheet. At the base of this ice sheet, a layer of lodgement glacial till was deposited by the glaciers onto the underlying bedrock. Like many glacial tills in Ireland, this deposit is predominantly a sandy gravelly silt, with a minor clayey fraction. Lenses of sand and gravel are often present within the lodgement till. As the ice decayed, a layer of ablation till would have been deposited onto of the lodgement till layer; however, across much of the Proposed Scheme corridor in Section 1, the upper part of the sequence of glacial deposits is dominated by ice contact materials (see below).

2.2.53 Most of the glacial deposits present beneath the Proposed Scheme corridor in the Mourne and Foyle Valley area in Sections 1 and 2 relate to the deglaciation stage, when a substantial fan of outwash deposits were laid down between the coast and the Sperrin Mountains to the south east. Much of the outwash material is of an 'ice contact' character, relating to the late advance and decay of ice lobes flowing down the valleys of the Rivers Mourne, Finn, Burn Dennet and River Glenmornan at a late stage in the last glacial stage. The deposits of this last glacial phase have reworked the earlier stages, and the landscape left in the side valleys as the ice lobe finally decayed and has only been slightly modified by post glacial alluvial deposits.

2.2.54 The lower parts of the Mourne, Burn Dennet and River Glenmornan valleys are dominated by the hummocky and irregular terrain left as the ice decayed. Significant moraine ridges are present in the Burn Dennet / Glenmornan Valleys and immediately south of Newtownstewart. The ice contact fluvio-glacial material generally comprises dense poorly graded sands and gravels, but with a variable fines content of between 5 and 25%. In places lenses of well graded sands occur reflecting ephemeral deltas where sub glacial meltwater stream exited the ice onto the outwash zone. Also present within the ice contact material are sporadic loose zones. Some of these may reflect the decay of isolated masses of ice and are incipient kettle holes; others reflect the rapidly changing and chaotic depositional environment associated with the final decay of the Sperrin Mountains glacier.

2.2.55 In some areas, there are occasional closed depressions (kettle holes) formed by detached masses of ice that became partly buried by the outwash material, and then melted. These depressions have become partly infilled with alluvial and colluvial material, often with a layer of peat at the base reflecting initial lacustrine conditions.

Post Glacial deposits

2.2.56 In the valley of the River Foyle (which in Section 1 means the section north of Urney Road in Strabane), the glacial soils are concealed beneath a significant and complex thickness of more recent post glacial deposits, reflecting fluctuations of the sea levels.

a. A late glacial low-stand sequence

2.2.57 Immediately after the retreat of ice from the area (18,000 – 20,000 yrs. BP (Before Present), sea levels were some 20-30m higher than present, but due to rapid post glacial isostatic uplift, sea levels fell to about 30m below present by 10,000 – 12,000 yrs. BP (the Early Holocene low-stand). In the Foyle Valley south of Londonderry, alluvial (river) conditions would have prevailed in the valley bottom, reworking the earlier glacial deposits.

2.2.58 Alluvial deposits comprise silts, sands and some gravels, largely derived from the underlying and surrounding glacial deposits, which were deposited prior to the Early Holocene rise in sea level, which later transformed the alluvial valley bottom into an estuary. These deposits can be distinguished from the overlying Estuarine deposits by the absence of organic material.

2.2.59 However, there are also old river channels within this deposit that are infilled with old peaty soils.

b. An Early Holocene transgressive sequence

2.2.60 After the late glacial low-stand, sea levels rose steadily during early Holocene times as the Eustatic sea level rise from the melting continental ice sheets outpaced the isostatic rise of the land. During this period, the Foyle Valley south of Londonderry became an estuary, as the sea flooded the valley bottom. Initially during this phase, there was a period of peat formation across the valley bottom, but this was rapidly replaced by estuarine conditions.

2.2.61 Early – Mid Holocene Estuarine deposits in the River Foyle valley bottom, lapped onto the landscape left by the retreating glaciers, and were deposited over a much larger area than the present Foyle Estuary. The Estuarine deposits were largely deposited in a quiet saltmarsh environment and are soft and organic silt and clay. However, adjacent to the influx of the Burn Dennet and River Glenmornan watercourses, lenses of more clastic sandy and gravely alluvial deposits are present, which in places inter finger with the saltmarsh estuarine deposits.

c. A Late Holocene regressive sequence

2.2.62 By mid Holocene times (6,000 years BP), eustatic sea level rise was largely complete, but isostatic uplift continued, resulting in a fall in sea level by about 6-8m, since 6,000 years BP. This uplift would have shrunk the Foyle Estuary to its present configuration, with local peat formation succeeding the salt marsh estuarine deposits in places. Two areas of lowland raised peat bog are locally present on the floodplain west of Leckpatrick and Cloghcor (McKeans Moss).

2.2.63 Continued alluvial deposition by the Foyle and its tributaries (fluvial alluvium) to the present day has deposited a layer of alluvium on top of the earlier deposits (flood plain deposit). The Fluvial alluvium is also slightly incised into the earlier deposits beneath the present day channel. These deposits are described as sandy silts, gravelly clays and sandy silt/clay. Abandoned meanders of the rivers are infilled with clay and locally peaty deposits.

2.2.64 Along the sides of the Foyle valley, a degraded cliff line is present in places within the glacial soils, at about 6m OD, reflecting the former sea level.

2.2.65 Colluvium has been found in localised areas, generally in hollows or mantling the lower slopes of hillsides. Colluvium formed generally by intensive rainfall runoff erosion from the slopes above (hillwash).

Bedrock (Solid) Geology from Published Records

2.2.66 Section 1 of the Proposed Scheme is underlain by Precambrian Strata (Dalradian in age) which form a large fold known as the Sperrin Nappe. The northwest limb of the Sperrin Nappe, pertaining to this area, consists of the main stratigraphic units; Ballykelly, Claudy and Dungiven Formations which are separated from the extreme northwest, by the Pettigoe Fault, which takes the approximate line of the Foyle Valley.

2.2.67 In the north of Section 1, the rocks are generally a mix of old hard shale[1], schist[2] (pelite[3]) and sandstone (Psammite[4]). In the vicinity of New Buildings, the strata in the underlying solid strata have been identified to be the Ballykelly Formation, made up of a coarse grained meta-arenite with psammites and pelites. This formation is likely to be close to the surface around Clondermont Hill.

2.2.68 The remainder of the Section is predominantly underlain by the Claudy Formation, also of the Southern Highland Group and made up of mixed psammite and semi-pelites interbedded with bluish grey medium to coarse grained meta-limestone. These are exposed in a small disused quarry near Bready and the weathered surface appears to be friable schist. The Pettigoe Fault on the line of the Foyle Valley again defines the edge of this region.

2.2.69 A mosaic of drift free summits associated with the Sperrin range is shown to have bedrock at or close to the surface in the vicinity of Bready. Local Pre-Caledonian unnamed igneous intrusions consisting of Metamorphosed Basaltic Rock appear to underlay the drift around Magheramason.

2.2.70 The area just south of Artigarvan is underlain by the lithologically diverse Dungiven Formation of the Argyll Group. This encompasses pelite, semi-pelites, psammite and quartzite with limestone as the major constituent.

[1] Shale = metamorphosed mudstone with a defined parting

[2] Schist = fine grained metamorphic rock with strongly defined, though often irregular parting

[3] Pelite = metamorphosed and hardened mudstone

[4] Psammite / Arenite = metamorphosed & hardened sandstone/gritstone

2.2.71 In the areas immediately east and south of Strabane, the older Dungiven Formation is exposed, which contains a higher proportion of metamorphosed limestone than further north, also with local Pre-Caledonian un-named igneous intrusions consisting of Basaltic Rock around Flushtown.

Depth to Bedrock

2.2.72 Between New Buildings and Bready, rockhead varies between just over 3m depth to just less than 10m depth. Rock was at very shallow depth in the area of Bready Cutting, increasing to a maximum depth of around 3.5m between Bready and north of the Burn Dennet, though generally at just less than 2m.

2.2.73 Between the Burn Dennet and west of Strabane, it was not possible to prove rockhead, which was blanketed by thick alluvial soils associated with the River Foyle floodplain.

2.2.74 Between Urney Rd (southwest of Strabane) and north of Sion Mills, rock head was generally between 1.5m depth (west of the flooded quarry) and 8.5m depth.

2.2.75 The bedrock encountered in the ground investigation was generally described as interbedded grey psammite, pelite and phyllite. Around Strahans Road metamorphosed limestone and quartzite was also encountered

Potentially Contaminated Sites and Land

2.2.76 Potentially contaminated sites located within or immediately adjacent to the areas required for construction of the Proposed Scheme are detailed in Table 2-5 below with the relative potential hazard rating. A summary of the results of the ground investigation is given below, however reference should be made to the Ground Investigation Report for a detailed discussion.

Type	Location	Potential Risk
Petrol Filling Station	New Buildings	High
Disused Quarry	Sollus Hill	High
Corn and Flax Mills/Kilns	New Buildings	Low
Infilled Mill Pond	Grange Road	Low
Infilled Brickfield	New Buildings	High
Two Petrol Stations	North Strabane	High
Infilled Brick Field	Route to Leckpatrick	High
Railway Line and Sidings	North Strabane	Medium
Two Infilled Refuse Tips	East of Park Road, Strabane,,	High
Infilled Canal and Tow Path	North Strabane	Low
Railway Station	South of Park Road, Strabane	Medium
Landfill site	Adjacent Urney Road	High
Infilled Slate Quarry	South Strabane	High
Flooded Limestone Quarry	East of Carricklee Hill	Medium

Type	Location	Potential Risk
Petrol Station	Lifford Road	High
Several Areas of Fly Tipping	Strabane	High

Table 2-5: Potentially Contaminated Sites Under or Immediately Adjacent to the Proposed Scheme – New Buildings to Strabane

2.2.77 Where crossed by the Proposed Scheme, samples from these sites were analysed in the ground investigation to determine chemical conditions. Random samples of Greenfield sites were also tested to determine the background chemical concentrations.

2.2.78 The background sampling established the unexpected sporadic presence of metals and Polychlorinated Biphenyl (PCBs) at levels above expected background concentrations within natural ground at several locations, between New Buildings to Clogchor and around Strabane. They occurred at depths significantly below the surface indicating they cannot be attributed to aerial deposition. They are, however, at levels that are not considered to be a risk to human health and part of the natural statistical variability of the ground.

2.2.79 Samples primarily related to areas of overlying peat were found to be naturally highly acidic. Samples taken south of Strabane also contained phytotoxic concentrations of boron.

2.2.80 Levels of ammonia and ammonium within soils sampled throughout the corridor were found to be consistent with an agriculture supported by management regimes with moderate to high fertilizer inputs.

2.2.81 Although enriched chemical concentrations were largely not found in these areas, a number of elevated concentrations of determinands were identified from the ground investigation within the suspected brownfield land. Major items are discussed below:

2.2.82 In the infilled brickfield along the unmade road 180m to the north-west of Ballyheather Road, south of Cloghcor, there was an elevated concentration of sulphate.

2.2.83 One of the main areas that could potentially have a high risk of contamination is the former refuse tip adjacent to the existing A5 and Park Road in Strabane. The material from the former refuse tip comprised waste materials such as glass bottles, fabric, metal, wood, rubber, burnt waste and had a hydrocarbon odour. Elevated concentrations with respect to long and short term human health of Polycyclic Aromatic Hydrocarbons (PAHs), Total Petroleum Hydrocarbon (TPHs), pH, carbazole, zinc and sulphate were recorded. With respect to the risk to the aquatic environment elevated concentrations of PAHs, pH, ammonium and ammonia were recorded. With respect to phytotoxicity-elevated concentrations of cadmium, copper, lead, molybdenum, zinc and acidic pH were recorded.

2.2.84 Made ground was also present on the opposite side of the road to the Park Road refuse tip. With respect to human health, elevated concentrations of TPHs were recorded. With respect to the aquatic environment, elevated concentrations of ammonia and ammonium were recorded. With respect to phytotoxicity elevated concentrations of molybdenum, nickel and pH were recorded.

2.2.85 Fly tipping was noted in the Strabane area, in particular the area adjacent to Urney Road, located next to the Clady Road former landfill. With respect to human health, elevated concentrations of TPH were recorded. With respect to the aquatic environment, elevated concentrations of ammonia and ammonium were recorded.

2.2.86 The Proposed Scheme, by design, does not cross the area of the landfill at Clady Road/Urney Road south of Strabane. As it is not beneath the road and outside the proposed vested land, the landfill itself was not investigated. Responsibility for the landfill remains with Strabane District Council and the NIEA.

2.2.87 In the area of the old station at Strabane, only one sample had an elevated pH value with respect to human health. Ammonia, ammonium and pH were elevated with respect to the aquatic environment.

2.2.88 Several other areas of made ground were encountered in this section relating to areas such as infilled brickfields, an infilled canal, backfilled quarries and a backfilled millpond. With respect to human health, one elevated concentration of arsenic was recorded within the infilled quarry, located 560m to the west of Orchard Industrial Estate, and two acidic pHs were recorded in the infilled canal. Samples from the infilled canal also recorded elevated concentrations of sulphates. With respect to risk to the aquatic environment, elevated concentrations of ammonia were recorded in most of the samples, with an additional exceedance of PAHs in the backfilled quarry to the east of Knockroe Road, and ammonium in the infilled canal.

2.2.89 As discussed above, the proposed scheme passes close to but not across the former landfill at Urney Road south of Strabane. In consequence, that site was outside the powers of TransportNI to carry out any investigation and responsibility remains with the license holder.

Mineral and Mining Resources

2.2.90 Quarrying was widespread in the region although many quarries have now been backfilled or are disused.

2.2.91 The key quarrying locations are a disused slate quarry adjacent to the proposed Bready cutting and a disused flooded quarry located adjacent to the route to the south west of Strabane at Strahans Road.

2.2.92 Sites with active sand and gravel extraction are present east of the route around Milltown Burn Dennet area and there are a number of backfilled small sand or gravel pits in the vicinity of the route.

2.2.93 More detail is given in Ground Investigation Report with further information on more minor quarry and sand and gravel pit locations discussed.

2.2.94 The GSNI has confirmed that there is no oil and gas exploration within the area. No mineral (coal or metal) workings are present along the route.

Drainage and Hydrology

2.2.95 The existing drainage and hydrological features for Section 1 within the Preferred Corridor are described in this section. Specific engineering constraints are outlined in conjunction with information relating to flooding considerations.

2.2.96 Preliminary hydrological assessments have been made in order to ascertain the principal rivers and associated drainage basins along the Proposed Scheme. The principal drainage basins are shown in Figure 2-8.

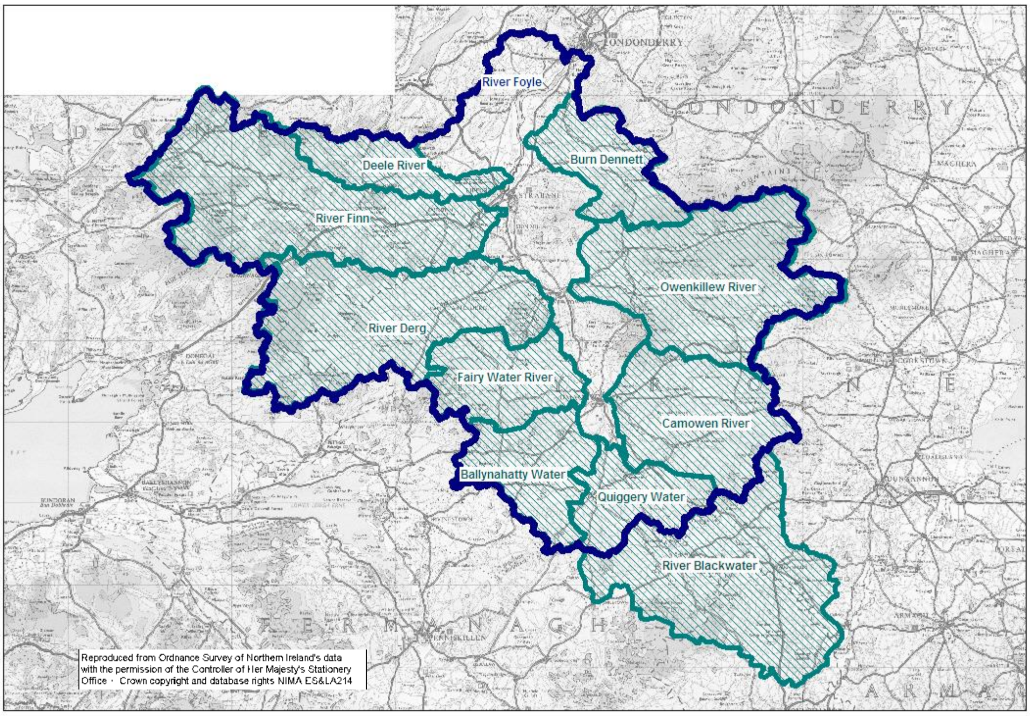


Figure 2-8: Principal Drainage Basins

2.2.97 There are a number of watercourses crossed by or flowing adjacent to Section 1 of the Proposed Scheme. In general, the principal watercourses flow from the south to the north, discharging to the River Foyle, which flows approximately parallel to the west of the existing A5, into Lough Foyle north of Londonderry. The main Foyle basin comprises the Mourne River and River Foyle. Lough Foyle is tidal and exerts a tidal influence up the River Foyle as far inland as the Mourne and Finn Rivers at Strabane.

2.2.98 Lough Foyle is subject to 2 high tides per lunar day and around 705 tides per year. It should be noted that published predicted tide levels do not take into account any meteorological effects. Such effects (wind and pressure) can significantly alter the observed tide, causing it to deviate considerably from the predicted values.

2.2.99 Rivers Agency (Hydrometrics Unit) and Londonderry Port and Harbour Commissionaires were consulted in relation to actual tidal records for the Foyle. Rivers Agency (PAU) supplied extreme 200 year tidal levels. The 200 year tide level (including storm surge) for Magilligan Point was 2.58m AOD. There were no 200 year levels available for Lough Foyle.

2.2.100 The principal tributaries to the River Foyle along the Proposed Scheme include the Rivers Finn and Mourne, which converge to the western side of Strabane town to form the River Foyle. The Glenmornan at Ballymagorry and the Burn Dennet also join the River Foyle system.

2.2.101 The Burn Dennet catchment is predominantly rural but does include the small urban catchment of Dunnamanagh, the river incorporates a number of principal tributaries, including the Cullion Burn, Mountcastle Drain and the Altinaghree Burn. In general, the river flows in an east to west direction from the highland areas of Mullaghclogher (635m AOD) and Slievekirk (370m AOD) to where it discharges to the River Foyle. The river is approximately 27km, from source to discharge, and flows perpendicular to and is crossed by the Proposed Scheme close to its convergence with the River Foyle.

2.2.102 The Glenmornan watercourse is approximately 12km in length and flows from its source, in the Owenreagh Hill area to its point of discharge into the River Foyle at Cloghcor. The Glenmornan receives flow from numerous smaller streams and flows perpendicular to the Proposed Scheme. The catchment area of the watercourse is predominately rural but it does include the small urban catchments of Artigarvan and Ballymagorry.

2.2.103 Through discussions with TransportNI Maintenance Section Offices and Rivers Agency, it is known that sections of the existing A5 within Section 1 have been prone to historical flooding.

- South of Burn Dennet Bridge, north of the junction with Lough Neas Avenue – The road previously flooded in this region to a depth of 1.2-1.8m. Consequently Rivers Agency has installed flood defences (clay embankment) in this area.
- Urney Road Roundabout, Strabane – flooding encroaches onto the road.

2.2.104 Alluvium drift geology mapping and Rivers Agency Strategic Floodplain Maps indicates potential floodplains at the following watercourses; the Blackstone Burn, the Bready Stream, the Gortmessan Drain, the Ballymagorry Burn and the Backfence Drain.

2.2.105 At the Burn Dennet Floodplain at Burn Dennet Bridge on the existing A5, the road previously flooded to a depth of 1.2-1.8m. Rivers Agency subsequently provided flood defences (clay embankment) in this area. Historic flooding records and alluvium mapping indicate that the existing floodplain is around 200m wide at the existing A5 crossing.

2.2.106 The Glenmornan River Floodplain at Ballymagorry is potentially over 400m wide west of the existing A5. Flood defences, in the form of earthen embankments are sited along the route of the watercourse through Ballymagorry Town.

2.2.107 The floodplain at Strabane, where the Mourne and Finn Rivers converge with the River Foyle is potentially sensitive to flooding occurrences. Rivers Agency historic records indicate significant flooding in the area in 1987, albeit the flooding in Strabane Town Centre was as a result of the breaching of masonry defences and not overtopping. Subsequent to this event, new concrete flood defences were constructed in 1991. The existing A5 partially crosses some 3km of floodplain around the town.

2.2.108 There are no existing flood defences on the Mourne River/Mourne-Strule Extension between Strabane and Sion Mills. Alluvium mapping and Rivers Agency Strategic Flood Maps indicate that there are some extensive floodplain areas parallel to the Mourne River/Mourne Strule Extension between Strabane and Sion Mills, with a maximum width of approximately 900m. There are no other significant watercourses or floodplains identified to the south of Strabane.

Existing Structures Conditions

2.2.109 This section of the document deals with the assessment of the condition of the existing structures, recommendations on any remedial works required and comments on the options for widening each structure in Section 1. For those sections of the existing route where there are significant constraints to widening the route, such observations are made.

Summary of Route

2.2.110 There are 8 significant structures in Section 1, although only one of them (Mourne Bridge) is considered to be a major crossing, having a cumulative span of 68m.

2.2.111 The majority of the bridges carry the existing A5 over watercourses with only 1 road over road bridge at Woodend (Spruce Road). This is typical of routes in such landscapes where most junctions are at grade. Generally, the structures are not very large with a median span of 10.2m but with a maximum span of 68.0m.

Function	Number
Footbridge Over Road	-
Road Over Accommodation	1
Road Over Pedestrian Subway	-
Road Over Road	1
Road Over Watercourse	6
Grand Total	**8**

Table 2-6: Bridges by Function in Section 1

2.2.112 As indicated in Table 2-6, there are a total of 8 significant bridges (i.e. > 1.8m span) on the route. There are no retaining walls over 1m high which either support the road or retain landscape and/or structures adjacent to the road.

Structure Types

2.2.113 Of the significant bridges, there are a wide variety of construction types, with some of mixed construction where the structure has been widened.

Structure Type	Number
Composite Concrete & Steel	-
Concrete Arch/Masonry Arch	1
Concrete Box Culvert	1
Corrugated Steel Pipe	1
Half Joints	-
Masonry Arch	2
Masonry Arch/RC Slab	-
Prestressed Concrete Beams	2
RC Pipe	1
RC Slab	-
RC Slab/RC Pipe	-
Steel Truss/Steel Plate	-
Grand Total	**8**

Table 2-7: Significant Structures by Road Section

2.2.114 In addition, there are a number of small culverts (less than 1.8m) whose construction was often unclear as they were submerged or otherwise hidden.

2.2.115 No retaining walls (>1m high) were identified along the route where failure may impact on the carriageway.

2.2.116 Very few construction details were available for inspection for any of the major structures and none for the minor structures. An assessment of the basic construction type is included in the national database and this has been used as a basis for this study. For the minor structures and retaining walls, no attempt has been made to classify the construction type.

2.2.117 The following tables indicate the size, type and general condition of the structures. As can be seen, they are of mixed size and construction type but are generally in good condition throughout. Some relatively minor defects are present and the key information about each structure is presented below.

NIRS StructureNo	Structure Name	Structure Type	No of Spans	Span (m)	Width (m)
30011	Tully	Masonry Arch	1	1.87	9.85
60880	Magheramason Bridge	Twin RC Pipes	2	2.7	17
62410	Magheramason Cattle Creep	Concrete Box Culvert	1	4	18
60736	Burn Dennet Bridge	Corrugated Steel Pipe	3	23	25.1
61210	Ballymagorry	Concrete Arch/Masonry Arch	4	23.14	16.9
61448	Woodend Bridge Spruce Road	Prestressed Concrete Beams	1	16.43	7.65
60887	Mourne Bridge	Prestressed Concrete Beams	3	68	14
60875	Unnamed	Masonry Arch	1	3.3	14

Table 2- 8: Section 1 Structures - Construction Type and Size

NIRS Structure No	Structure Name	Average Condition Rating	Critical Condition Rating
30011	Tully	Fair	Very Good
60880	Magheramason Bridge	Very Good	Very Good
62410	Magheramason Cattle Creep	Fair	Very Poor
60736	Burn Dennet Bridge	Very Good	Very Good
61210	Ballymagorry	Very Good	Very Good
61448	Woodend Bridge (spruce Road)	Fair	Very Poor
60887	Mourne Bridge	Fair	Very Poor
60875	Unnamed	Fair	Very Good

Table 2-8: Section 1 Structures – Condition Ratings [Scores are based on draft Highways Agency standard performance measurement of highway structures (PMHS)]

2.2.118 The vast majority of these structures are in fair to very good condition. There are also a number of smaller structures (less than 1.8m span) along the route although these were not thoroughly inspected and no condition ratings were assigned.

Retaining Walls

2.2.119 There are no retaining walls in Section 1.

Widening Issues

2.2.120 Approximately half of the structures in Section 1 would be difficult to widen on line. Typically, the structure itself could be widened but there are existing constraints adjacent to it.

2.2.121 About one third of the structures could readily be widened on line, if required, although this would be considered further as the detailed design is developed.

2.2.122 Of the remaining structures, it is considered that it would be more economical to completely replace 1 no., should it be required to accommodate a widened A5. This structure is considered to be at high risk of needing major repairs in the short to medium term.

Structural Capacity

2.2.123 The assessed capacity of the structures is reported in the NIRS database although the records were not complete at the time of inspection.

2.2.124 Of the 8 bridges, 6 have been assessed as having 40 Tonne HA loading capacity and are rated at 45 units of HB loading (with 2 bridges having no HB entries).

Existing Pavement Conditions

2.2.125 In 2010 a detailed pavement survey was carried out which analysed the condition of the existing A5 pavement condition under the following headings:

- Deflectograph

- Visual Survey

2.2.126 The findings of this survey were reported in the Preferred Options Report. Since that date several maintenance and local realignments works have been carried out along the length of the existing A5.

2.2.127 Since 2009 the following carriageway structural maintenance works have been undertaken:

- Melmount Road between Strabane and Sion Mills, 0.5km
- Victoria Road at Beady, 0.5km
- Victoria Road from Woodend Road to 220m past Spruce Road overbridge, 1.0km
- Victoria Road at Cloghcor (Coach Inn), 1.0km

Existing Traffic Conditions for Section 1

Traffic Flows

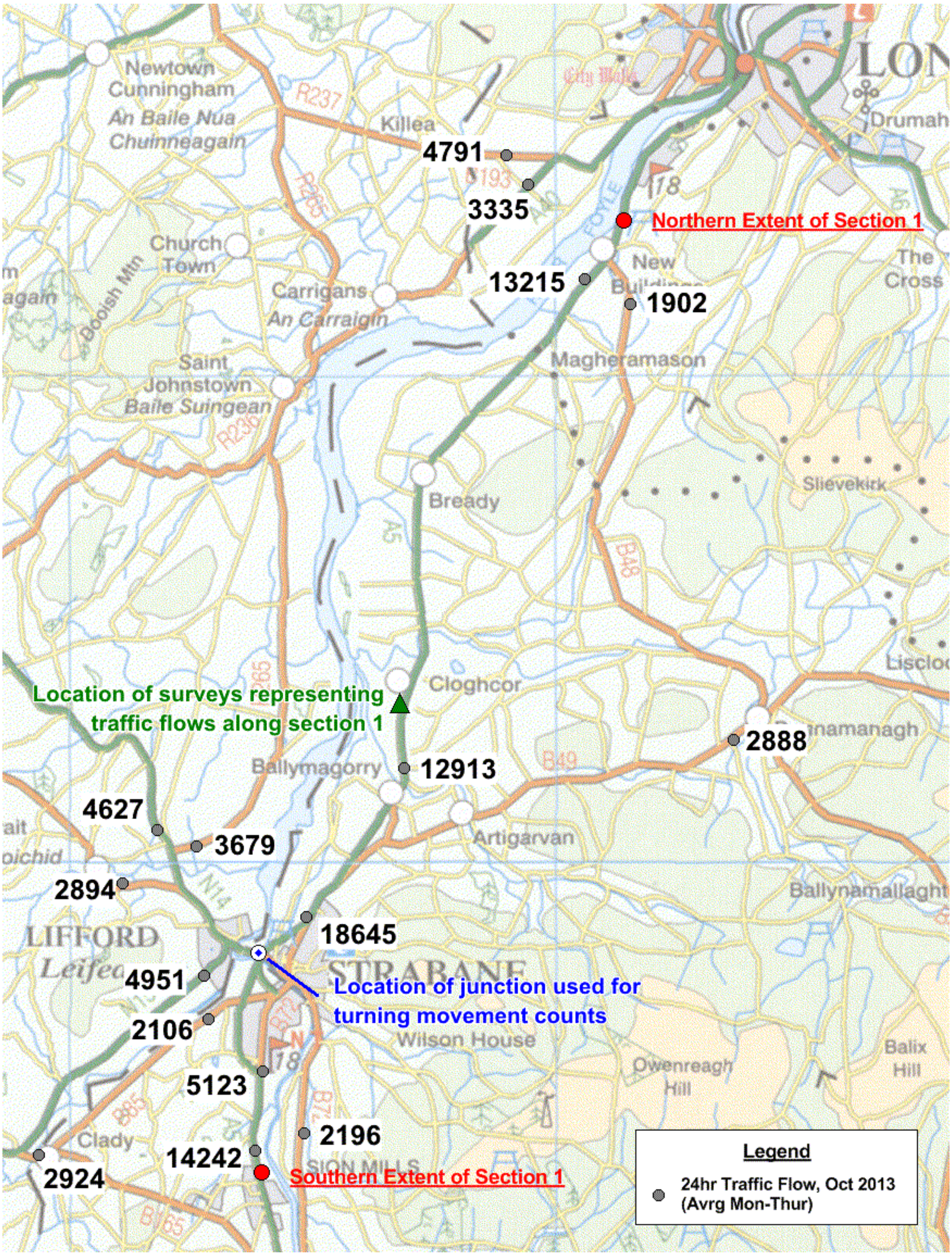


Figure 2-9: 24 hour traffic flows in the vicinity of Section 1 (Avg. Mondays to Thursdays, October 2013

2.2.128 Figure 2- 9 shows traffic flows along roads in Section 1. These values are average 24 hour October weekday (Monday to Thursday) vehicle flows for 2013 which were derived using all Mon-Thurs flows other than the week leading into half term.

2.2.129 Traffic analyses have been prepared for the location shown by the green triangle in Figure 2-9. This location is on the existing A5 between New Buildings and Strabane and is a TransportNI long term ATC site (Site 663). The analyses for the seasonal and daily flows are presented in Figure 2-10 and Figure 2-11 respectively.

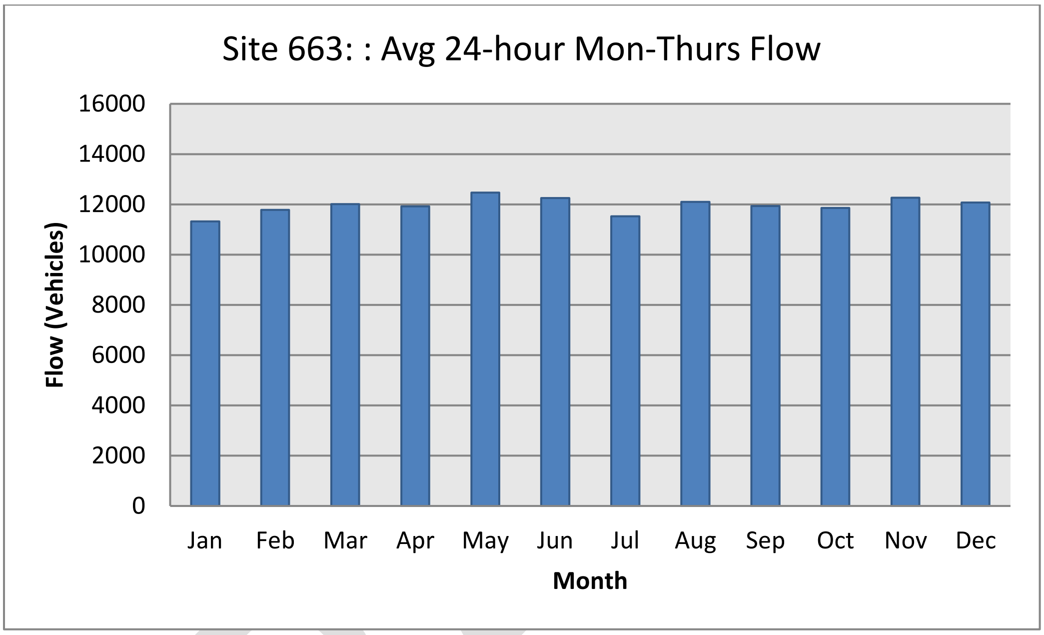


Figure 2-10: Seasonal variation of traffic flows on the A5 during 2013 in Section 1 (Avg Mon – Thurs)

2.2.130 Figure 2-10 shows the moderate seasonal variation at this location. It is considered that the traffic flow for October 2013 are close to the annual average and therefore considered to be representative of flows throughout the whole of 2013.

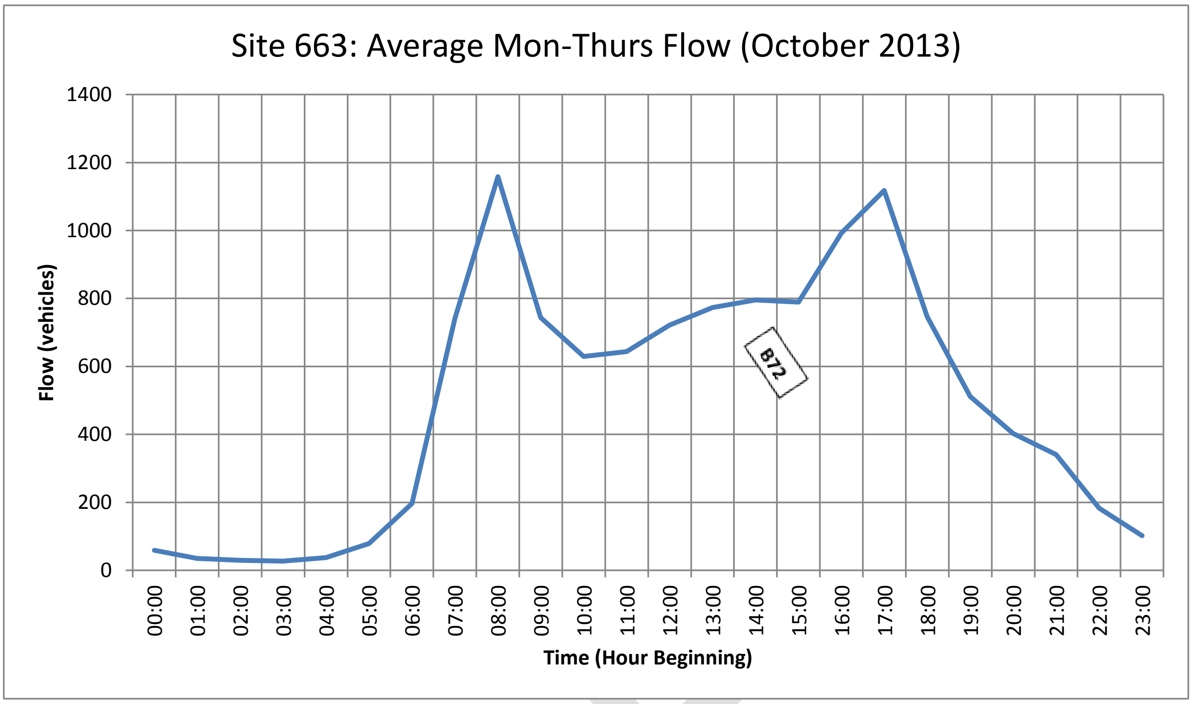


Figure 2-11: Daily flow profile on the A5, north of Strabane (Avg. Mon – Thurs, October 2013)

2.2.131 Figure 2- 11 illustrates the average daily variation of flow during October 2013 at this location (A5 North of Strabane). This shows that the peak flow in the PM peak is marginally lower than in the morning.

2.2.132 The turning movements of traffic at the junction of the A5 with the A38 (Lifford Road) and the B72 (Railway Street) are shown in Figure 2- 13. A plan of the junction is presented in Figure 2-12. These data are from a turning movement count (MCC5) carried out in October 2013.

Figure 2-12: Junction of the A5 with the A38 at Strabane

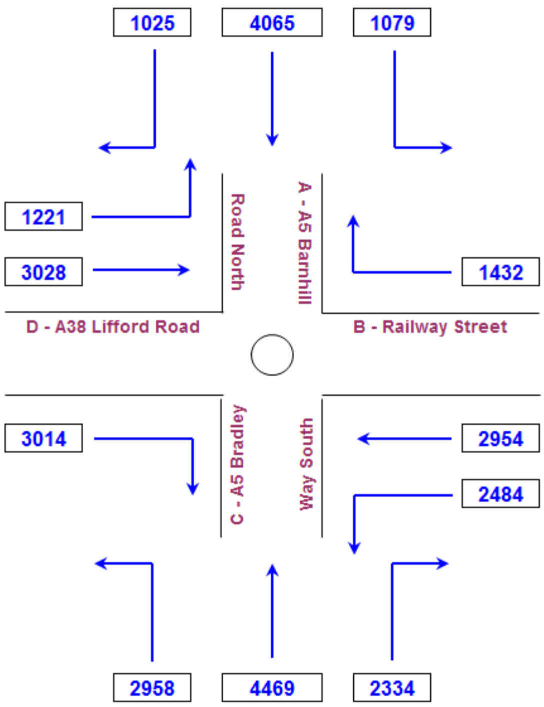


Figure 2-13: 12 hour vehicle flows at junction of the A5 with the A38 in Strabane (Tuesday 15th October 2013)

2.2.133 Figure 2-13 shows the principal movements at this junction. It should be noted that there is a fifth access to the roundabout between the A38 Lifford Road and A5 Barnhill Road. This is sometimes mapped as Branch Road and shown as leading to Greenbrae Park. The access has a barrier and presently leads to a facility for the travelling community. Its usage is very limited and it is therefore omitted from this figure.

2.2.134 The busiest movement is straight ahead on the A5 between north and south, followed in magnitude by the movements between the A38 Lifford Road and both B72 Railway Street and the A5 Bradley Way to the south. There is also a large movement between B72 Railway Street and the A5 Bradley Way. The flows between the A38/B72 and the A5 to the north are less significant.

2.2.135 The proportions of vehicle types at this location are shown below in Figure 2- 14.

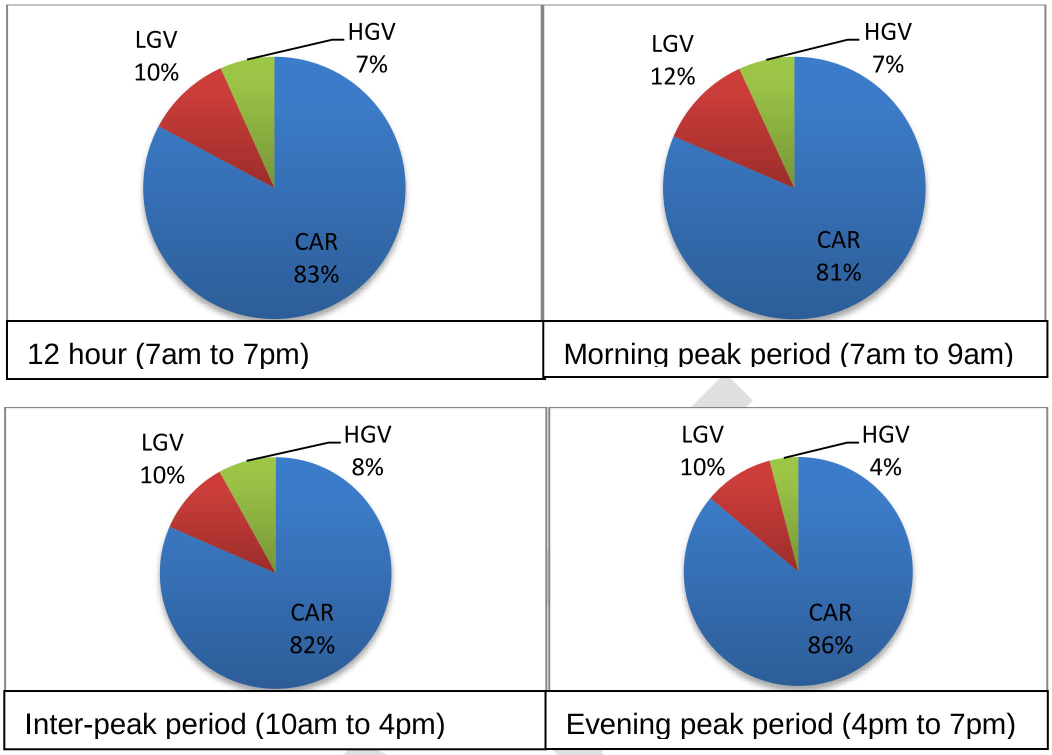


Figure 2-14: Vehicle proportions at the junction of the A5 with the A38 (Lifford Bridge) (Tuesday 15th October 2013)

2.2.136 This shows that the proportion of car journeys passing through this junction is greatest during the evening peak period (86%). The LGV proportion stays fairly constant at around 10% throughout the day as does the HGV, except in the afternoon peak where it drops by about half by comparison with the rest of the day. This reflects the absence of an evening peak for HGVs.

Major Traffic Movements

2.2.137 Roadside interview surveys to establish origin destination patterns were carried out in April 2014 at Prehen, north of New Buildings, and Burn Dennet Bridge, between New Buildings and Ballymagorry. The findings of these surveys are reported more fully in the Data Analysis Report (718736-2700-R-008).

2.2.138 The key feature of the traffic pattern at Prehen, which was surveyed in the northbound direction, was that over 80% of the trips were bound for Londonderry or its immediate surroundings. Of these, one third originated in the eastern part of the Strabane local government district and a further quarter elsewhere in the Derry City local government district.

2.2.139 The site at Burn Dennet Bridge was surveyed southbound. At this site, 45% of observed trips were going from the Derry City district to Strabane and its surroundings and another 13% from Derry City district to the Omagh area.

Journey Time Observations

2.2.140 Journey times were surveyed in April 2014 for both the AM and PM peaks and the inter-peak along the entire length of the A5 corridor. This was divided into ten sections, giving 20 one way “routes”. This provided sufficient detail for an assessment of travel times along the corridor.

2.2.141 For convenience, the key factors relating to the entire survey are described here, with commentary specific to study Sections 2 and 3 given later.

2.2.142 The start and finish points and route lengths for each journey time section are given in Table 2- 9 below, while Figure 2-15 plots the extent of each route. Odd numbered routes are southbound and the even numbered routes are northbound.

2.2.143 Table 2- 9 also shows which routes fall in each section of the scheme, with Section 1 containing routes 1 to 4 plus part of 5 and 6. For the purposes of this report all of Sections 1 to 6 may be considered as falling in Section 1.

2.2.144 The use of short one way routes meant that the journey time runs on each route could be well distributed through each time period. Particularly when dealing with peak hours, specifying longer routes brings a risk that the extremes of the route are only surveyed at the beginning or end of the period. Meanwhile the observations towards the centre of the route are concentrated around the middle of the peak. These risks were eliminated as a result of the approach adopted.

2.2.145 The collection methodology used GPS loggers to provide a facility to disaggregate the data to include additional timing points if required.

Route	Direction	Distance (Km)	Urban/Rural	Route Details
Section 1				
1	SB	16.1	Rural	Londonderry - Strabane
2	NB	16.1	Rural	Strabane - Londonderry
3	SB	5	Urban	Through Strabane
4	NB	5	Urban	Through Strabane
Section 1/2				
5	SB	11.1	Rural	Strabane - Newtownstewart
6	NB	11.1	Rural	Newtownstewart - Strabane
Section 2				
7	SB	3.3	Urban	Through Newtownstewart
8	NB	3.3	Urban	Through Newtownstewart
9	SB	11.6	Rural	Newtownstewart - Omagh
10	NB	11.6	Rural	Omagh - Newtownstewart
11	SB	5.5	Urban	Through Omagh

Route	Direction	Distance (Km)	Urban/Rural	Route Details
12	NB	5.5	Urban	Through Omagh
Section 3				
13	SB	7.7	Rural	Omagh - A5 Junction with B46
14	NB	7.7	Rural	A5 Junction with B46 - Omagh
15	SB	11.7	Rural	A5 Junction with B46 - Garvaghy
16	NB	11.7	Rural	Garvaghy - A5 Junction with B46
17	SB	9.3	Rural	Near Garvaghy - Aughnacloy
18	NB	9.3	Rural	Aughnacloy - Near Garvaghy
19	SB	1.1	Urban	Urban through Aughnacloy
20	NB	1.1	Urban	Urban through Aughnacloy

Table 2-9: Journey time survey routes (April 2014)

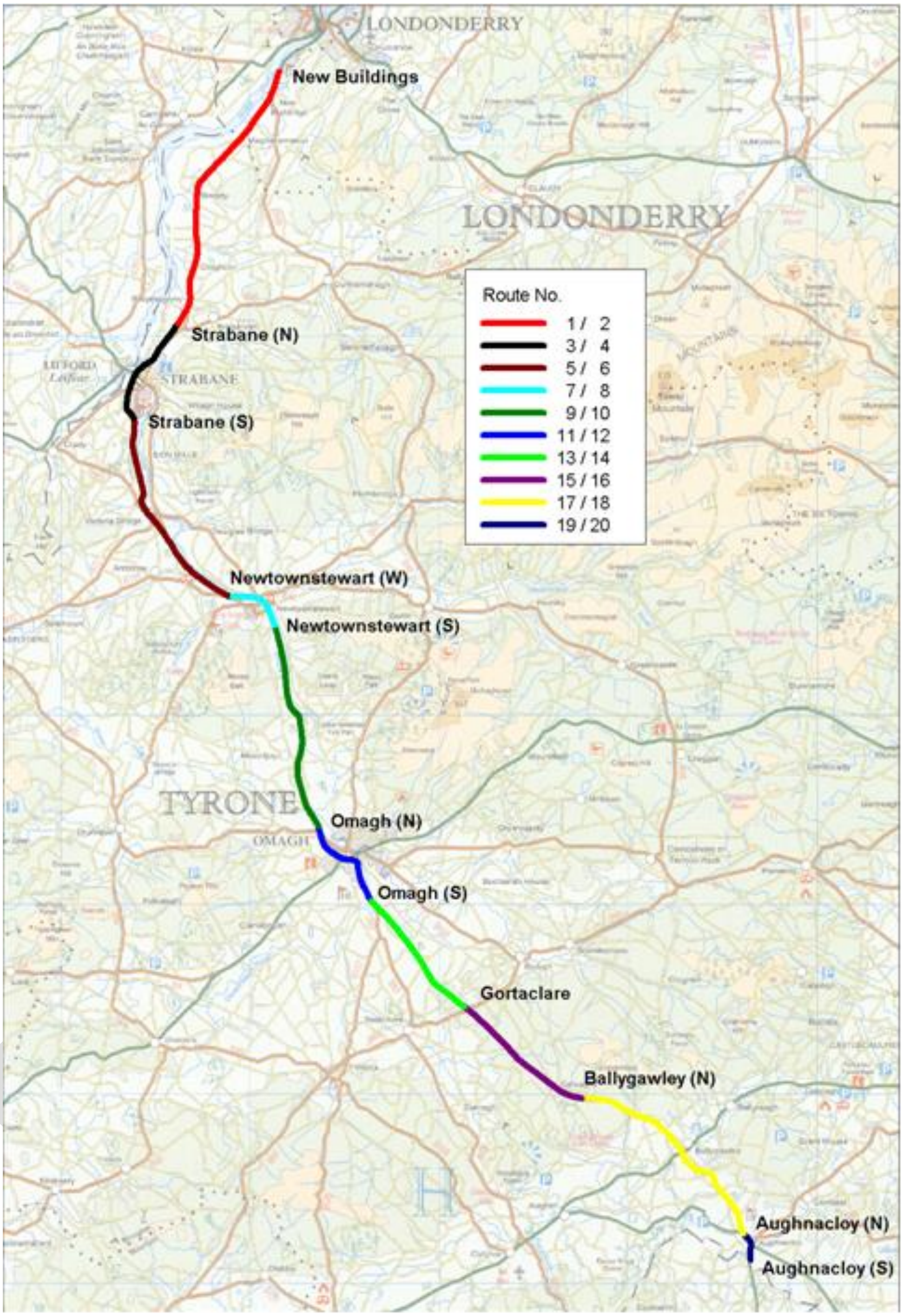


Figure 2-15: Journey Time Routes (April 2014)

2.2.146 The number of timing runs in each time period on each route varied between 13 and 47 as summarised in Table 2-10.

Route	AM	IP	PM	TOTAL	Falls in
1	16	16	15	**47**	**Section 1**
2	15	13	15	**43**	
3	14	20	19	**53**	
4	14	24	19	**57**	
5	15	17	15	**47**	
6	15	16	16	**47**	
7	16	23	16	**55**	**Section 2**
8	16	13	16	**45**	
9	15	22	15	**52**	
10	15	17	15	**47**	
11	21	20	21	**62**	
12	24	24	21	**69**	
13	18	16	19	**53**	**Section 3**
14	19	16	20	**55**	
15	25	22	22	**69**	
16	25	24	22	**71**	
17	16	25	19	**60**	
18	16	22	16	**54**	
19	33	41	33	**107**	
20	32	47	32	**111**	
TOTAL	**380**	**438**	**386**	**1204**	

Table 2-10: Total number of runs carried out for each Journey time route

2.2.147 The individual trip records were processed to provide average times by time period and the results are summarised in Table 2- 11 and Figure 2-16.

Route	AM	IP	PM	All Periods Average
1	00:15:23	00:15:38	00:15:14	00:15:25
2	00:15:50	00:16:13	00:15:55	00:15:59
3	00:06:42	00:06:56	00:07:57	00:07:14
4	00:06:41	00:06:52	00:06:53	00:06:50
5	00:09:36	00:09:53	00:09:51	00:09:49
6	00:09:43	00:10:25	00:09:54	00:10:01
7	00:04:04	00:03:14	00:03:53	00:03:40
8	00:02:53	00:03:08	00:03:10	00:03:03
9	00:08:20	00:08:27	00:08:14	00:08:45
10	00:07:58	00:10:03	00:08:22	00:08:51
11	00:05:39	00:05:49	00:06:03	00:05:50
12	00:05:14	00:05:36	00:07:07	00:05:56
13	00:06:04	00:06:29	00:06:04	00:06:27
14	00:06:00	00:06:35	00:05:50	00:06:06
15	00:05:20	00:05:03	00:04:54	00:05:06
16	00:05:17	00:04:49	00:04:51	00:05:00
17	00:09:59	00:10:39	00:10:26	00:10:31
18	00:10:01	00:10:19	00:10:19	00:10:13
19	00:02:40	00:02:51	00:02:52	00:02:48
20	00:02:48	00:03:09	00:03:13	00:03:04

Table 2-11: Journey Time Averages by time period

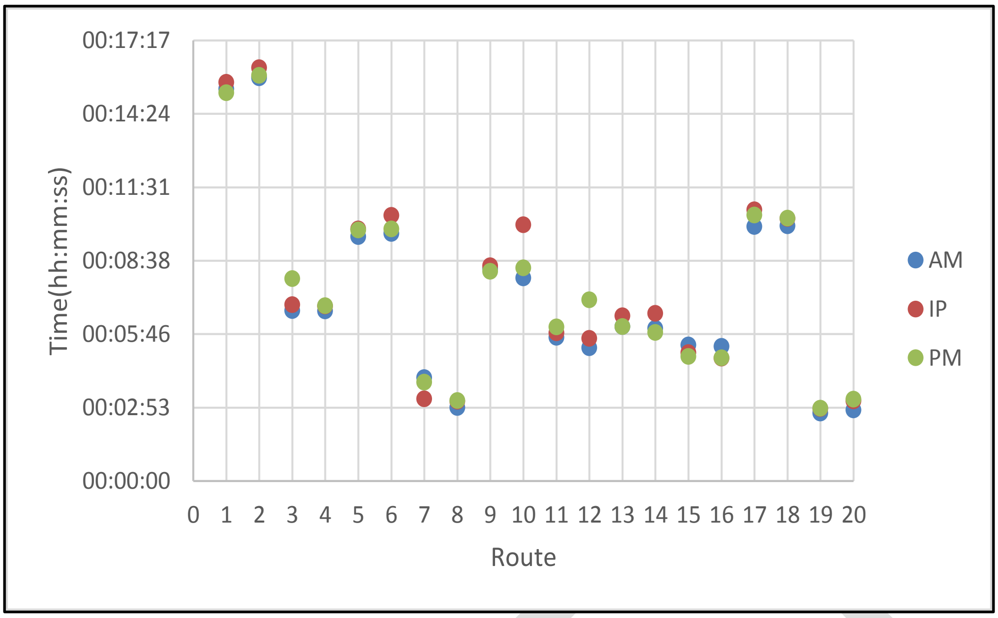


Figure 2-16: Observed Average Journey Times by Time Period

2.2.148 These results show a high degree of consistency through the day for the routes in Section 1. For Routes 3 and 4, which include the Strabane bypass the evening peak in the southbound direction is slower than the other periods, while the northbound direction shows minimal variation across all time periods.

Accident History

2.2.149 The ‘combined link and junction’ accident statistics for the A5 in Section 1 are shown in Table 2-12.

2.2.150 Along the A5 between Londonderry and Sion Mills, a length of approximately 28km, a total of 114 PIAs were recorded for the period 2008 to 2012. This included two fatal accidents, one of which occurred between Londonderry and New Buildings, and the other between New Buildings and Strabane.

Section 1	LINK DETAILS								
Combined Link and Junction Accident Statistics	Road Type	AADT	Length (km)	Total Observed PIA	Slight	Serious	Fatal	Observed Accident Rate (PIA/million vkm)	Observed Fatal and Serious to PIA ratio
A5, Main Line Links									
Londonderry to New Buildings	A-road	14023	4.6	23	22	0	1	0.20	0.25
New Buildings to Strabane	A-road	12288	17.1	48	39	8	1	0.13	0.25
Strabane (Urban)	A-road	16195	2.9	9	9	0	0	0.10	0.14
Strabane (Urban) to Sion Mills	A-road	16522	3	34	25	9	0	0.38	0.14

Table 2-12: Accident statistics for Section 1 of the A5WTC (links and junctions combined) for the period 2008 to 2012

2.3 Existing Conditions – Section 2 South of Strabane to South of Omagh

2.3.1 The text in this section should be read in conjunction with drawings 718736-0800-D-00019 to 718736-0800-D-00039 included in Volume 2 for reference. These drawings show the Preferred Route and local road network on aerial photography and OS mapping tiles prior to the development of the Proposed Scheme.

Description of Current Network

2.3.2 This section provides a description of the existing highway network, especially the existing A5, and conditions pertinent to the Preferred Route and the subsequent development of the Proposed Scheme.

2.3.3 In Section 2, the existing A5 is approximately 31km in length and links the settlements of Sion Mills, Victoria Bridge, Newtownstewart, Mountjoy and Omagh. Figure 2-17 , page 51, shows a plan of the area of interest along with the Proposed Scheme, which was confirmed during the Summer of 2009.

2.3.4 The existing A5 runs through Sion Mills along the west of the Mourne River. The road follows the bend of the Mourne River, where it passes through the settlement of Seein Bridge and intersects with the B165. The A5 then runs through Victoria Bridge, crossing the B72 near the centre of the village. Between Victoria Bridge and Newtownstewart, the existing A5 runs in close proximity to the western banks of the Mourne and Strule Rivers, crossing the River Derg to the east of Ardstraw. North of Newtownstewart the B164 (Deerpark Road) joins the A5 at Lower Deerpark from the west, before the A5 by-passes the town. The Newtownstewart bypass, which is part of the existing A5 and opened in 2002, follows a route to the north-east of the town where it is intersected by the B46.The road crosses the Strule River twice before tying back in to the original A5 to the east of the town. South of Newtownstewart, the road continues to run in close proximity to the western banks of the River Strule steadily rising to the site of the Ulster American Folk Park. From here, the level of the existing A5 generally falls, continuing south past Mountjoy Bridge and Poe Bridge (Fairy Water) before entering the outskirts of Omagh. Following planning approval of the Wastewater Treatment Works in 2005 Rash Road (South) was improved and its junction with the A5 moved further south. The A5 continues through Omagh in a south-easterly direction. The A5 intersects a number of side roads as it passes through the town, including the B50 and the A32. Towards the southern extents of Omagh, the A5 crosses the Drumragh River before continuing south along the Omagh Through pass.

2.3.5 Man-made constraints along the environs of the existing A5 which influenced the route of the Proposed Scheme are:

- Quarries located between Victoria Bridge and Newtownstewart
- Pubble Graveyard north of Newtownstewart bypass
- The Mellon Country Inn
- Garage and Restaurant at Mountjoy Bridge

- Approximately 200 residential, farm and commercial accesses and associated properties

2.3.6 Natural constraints close to the existing A5 include:

- Grange Wood ASSI south of Newtownstewart,
- Strule River (part of the Foyle River and Tributaries SAC)
- Tully Bog SAC, north-west of Omagh.
- Fairy Water
- Bessy Bell

2.3.7 Major planning applications in the region in the last 8 years include the Omagh Opportunity, which is a mixed use development and construction is yet to commence at the date of this report, and the Lisanelly Campus which is due to open in 2019.

2.3.8 The main economic activity in the area is agriculture. There are expansive areas of Best and Most Versatile lands; private and Department of Agriculture and Rural Development (DARD) Woodlands, and agri-environmental schemes. The whole of the Strule River, Mourne, Finn and Foyle and their tributaries are well known in Northern Ireland for game and coarse fishing, supporting a diverse mixture of fish and river dynamics.

2.3.9 Within Section 2, the existing A5 is utilised by several bus services. Goldline Express services 273 and 274 use the full length of existing A5, running up to ten times daily, and Ulsterbus service 97 utilises the existing A5 between Newtownstewart and Omagh running up to six times daily. The existing A5 also crosses the National Cycle Network Route 92 around Newtownstewart.

2.3.10 A number of A and B Class routes join the existing A5 within the extent of Section 2. The routes are identified in Table 2-13, along with the town/ village with which they connect.

Route	Connecting Town
• B165	• Clady
• B72/ B165	• Castlederg, Douglas Bridge
• B164	• Ardstraw
• B84	• Drumquin
• B46	• Plumbridge, Gortin
• B50	• Drumquin, Omagh
• A32	• Dromore, Irvinestown, Enniskillen

Table 2-13: A & B class routes joining the existing A5 within Section 2

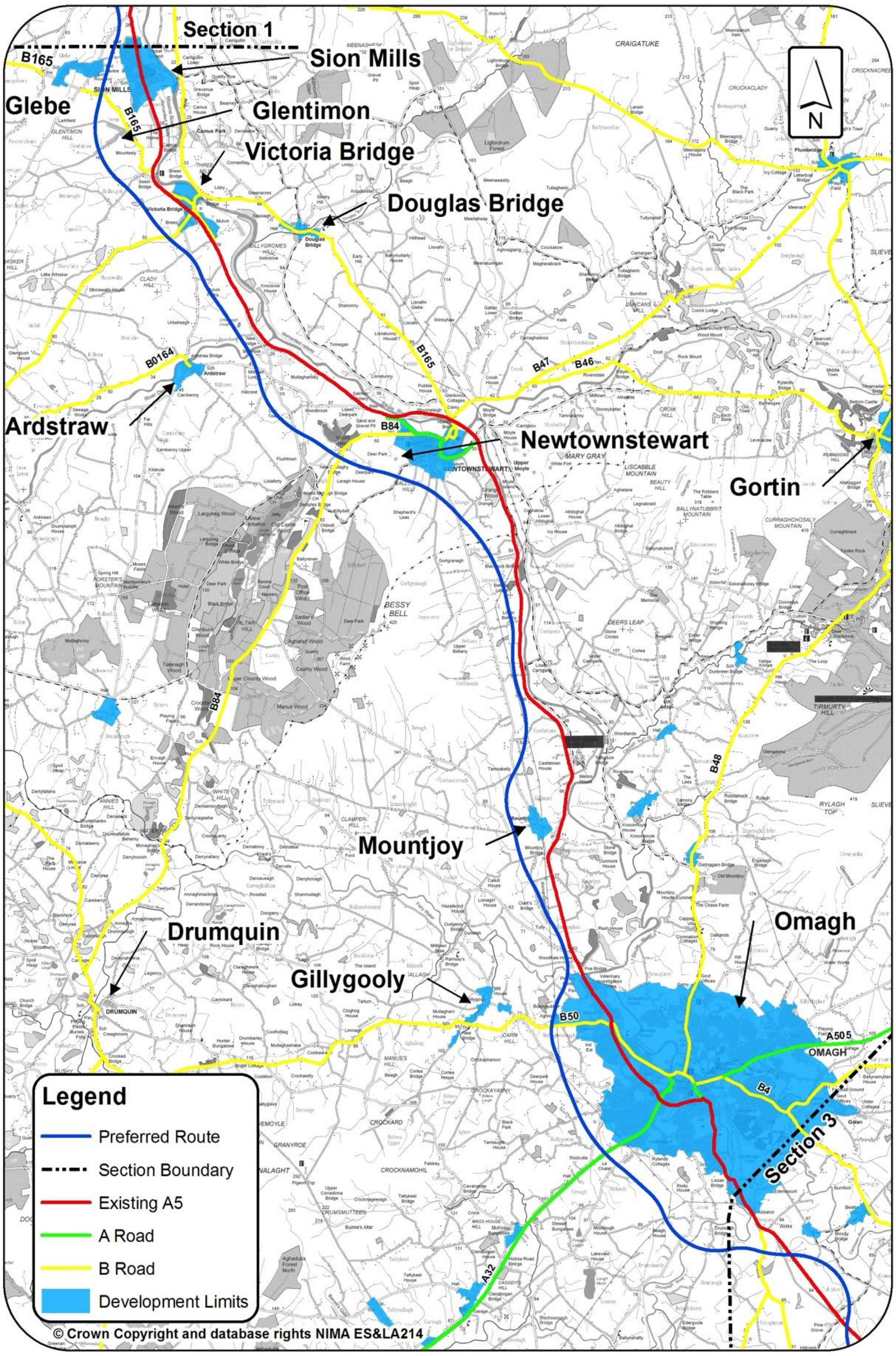


Figure 2-17: Overview of Section 2: Preferred Route, the Existing A5, Development Limits and Intersecting Routes/Links

Existing Highway Conditions

2.3.11 The majority of the existing A5 from the South of Strabane to the South of Omagh is derestricted, and is therefore subject to the national speed limit of 60mph. In accordance with the Design Manual for Roads and Bridges (DMRB 6.1.1) TD9/93, this equates to a design speed of 100kph. A geometric assessment of the Stopping Sight Distance (SSD) and the horizontal and vertical alignments has been carried out. The Full Overtaking Sight Distance (FOSD) assessment has also been carried out for the existing carriageway. This gives a safe distance for overtaking on single carriageways and is generally only realistically achieved in areas of relatively flat terrain. A geometric assessment of the existing A5 was carried out using the existing speed limits. The results of this analysis showed that there are 22 areas that are sub-standard to such an extent that they would require departures from the current standard TD9/93 (DMRB 6.1.1).

2.3.12 Section 2 of the A5 is approximately 31km in length and runs south from Strabane to south of Omagh with the Proposed Scheme to the west throughout.

2.3.13 With nearly 200 residential, farm and commercial accesses directly onto the road, the A5 is classified as a high density access constraint, which has an impact on both traffic speed and safety. The A5 is generally undulating and lies at the foot of several hills: the highest point is 82m AOD at the site of the Ulster-American Folk Park and the lowest point of the road is 21m AOD and lies between Sion Mills and Victoria Bridge.

2.3.14 The cross-section width of the A5 carriageway is approximately 7.3m throughout, with the hard strip width varying between 0.3m and 1.0m. The 0.3m wide hard strips generally occur on the older sections of the A5, with the hard strip along the Newtownstewart Bypass being to the 1.0m wide standard.

Figure 2-18:Existing A5 North of Newtownstewart

2.3.15 South of Victoria Bridge, the road is generally undulating and climbing on the approach to Newtownstewart, running approximately parallel to the River Mourne in a south-easterly direction along the lower slopes of Clady Hill and Bessy Bell. The minor roads joining this section of the A5 generally have national speed limits in force, and do not generally have road markings except at their junctions with the A5. There are 2 right turn lanes situated along this length, increasing the overall carriageway width from approximately 7.3m to 9.5m over short and isolated lengths.

Figure 2-19: River Strule Northern Crossing, Newtownstewart Bypass

2.3.16 The Newtownstewart Bypass was constructed in 2002 to divert the A5 around the town. The bypass starts to the north of Newtownstewart, approximately 0.7km before the first crossing of the River Strule. The carriageway width along the bypass is 7.3m with 1m wide hard strips along the edge of the carriageway. Along the length of the bypass, there are three areas where the carriageway width increases to approximately 11.0m to facilitate right turn lanes. The minor roads joining this section of the trunk road generally have national speed limits in force. The bypass ties back in to the original A5 to the east of the town, approximately 1.2km south of the second crossing of the River Strule.

Figure 2-20: Existing A5 with Central Hatching, Mountjoy

2.3.17 From the Newtownstewart bypass southwards, the carriageway width remains at 7.3m with 0.3m wide hard strips until it reaches Poe Bridge at the northern extents of Omagh. Within this Section, there are 3 areas where the carriageway width has been widened to approximately 9.0m to include a right turn lane. There are also several lengths where the north and southbound running lanes have been segregated by the provision of hatched areas. The road is generally undulating in this section, and reaches a high point around the Ulster American Folk Park, reducing in level by approximately 20m before reaching Poe Bridge. The minor roads joining this section of the trunk road generally have national speed limits in force.

2.3.18 The Proposed Scheme interacts with a complex local road network comprising 2 A class roads, 5 B class roads and 38 unclassified roads. In the main, these are rural routes connecting small communities with the existing A5 via a priority junction or a local settlement adjacent to the Proposed Scheme. Key connector routes along the path of the Proposed Scheme would be:

- Primrose Park which connects the local town of Sion Mills with the village of Glebe,
- Bells Park Road (B165) linking Clady to the existing A5 from the west and Newtownstewart to Douglas Bridge and then onto the existing A5 from the east.
- The B72 from Castlederg which crosses the Proposed Scheme before connecting to the existing A5 within the limits of Victoria Bridge.
- In connecting the B72 to Ardstraw and onto the existing A5 the B165 crosses the Proposed Scheme between Ardstraw and the existing A5.
- The B84 extends from the town of Newtownstewart to Drumquin passing under the path of the Proposed Scheme as it heads west.
- Further south, the B50 also from Drumquin connects with the Existing A5 at the northern extents of Omagh.
- The Proposed Scheme also crosses the A32 as it approached Omagh from the west. All other roads crossing the Proposed Scheme are unclassified

Public Utilities

2.3.19 Apparatus for the supply of electricity and potable water, the removal of waste water, and the provision of telecommunications all exist in Section 2. These apparatus are concentrated in and around settlement areas and are generally located in or above the existing highway network. Between settlements, the existing A5 provides an important utility corridor for water and telecommunications supply. Apparatus for the supply of electricity and trunk water mains also traverse this section away from the existing highway network, Details of the major undertaker's apparatus can be found in drawings 718736-0100-D-20016 to 20018 within Volume 2.

Electricity

2.3.20 NIE operate an extensive network of overhead and underground transmission and distribution apparatus which provides electricity to domestic and commercial premises. Within this section, Doogary substation, to the south of Omagh, alongside the existing A5 is the main electricity installation.

2.3.21 Within this section and between Sion Mills and south of Omagh, there are three important 110kV electricity transmission lines.

2.3.22 One 110kV line extends between Ballymagorry substation and Doogary substation south of Omagh. This line runs cross country broadly parallel to the existing A5. From Sion Mills it is located to the east of the Mourne River until it crosses the Strule River and the existing A5 Beltany Road approximately 3km south of Newtownstewart. It then continues cross country broadly parallel and to the west of the existing A5 and Omagh, to Doogary substation. The conductors are mainly supported on twin portal poles, interspersed with tower pylons at changes of direction.

2.3.23 The second 110kV line extends cross country from Doogary substation to the west and then south west, crossing the existing A5 at Doogary. This line is carried on pylons.

2.3.24 The third 110kV line also extends west from Doogary substation. This line supplies electricity from the Magherakeel wind farm and crosses the existing A5 at Doogary. It is carried on wooden poles and was constructed in 2011.

2.3.25 In Section 2, 33kV distribution lines are located to the east and west of the residential areas around Sion Mills. These lines extend to the south as far as Ardstraw, where one turns to the south west and the other continues in a south easterly direction to a point south of Newtownstewart. This line then runs south parallel to the Castletown Road as far as Mountjoy where it turns east and continues to Doogary substation.

2.3.26 A further three 33kV distribution lines extend cross country to the west and south of Doogary substation into Section 3.

2.3.27 A more extensive network of overhead 11kV lines is connected to the 33kV lines and provides electricity supply to dwellings and properties in the rural areas between settlements. This network is generally remote from the existing highway network, which it crosses occasionally, instead crossing green fields. Within settlements and towns, underground MV conductors, laid within the existing highway boundaries supply power to properties.

Water Mains and Sewers

2.3.28 The majority of the water supply network serving the rural areas between Sion Mills and South of Omagh are small diameter (80-150mm) gravity distribution mains laid in the existing minor road network.

2.3.29 Between Sion Mills and south of Omagh, a 80-200mm diameter distribution mains have been laid in the existing A5 at a number of locations to connect settlements located in the vicinity of the A5 to potable water storage facilities.

2.3.30 Four larger diameter trunk gravity mains are located in the following locations; cross country in the vicinity of Stone Road (300mm Ductile Iron pumped), in Drumlegagh Road North (250mm HPPE), Lisnagirr Road (8” Ductile Iron) and in Drumlegagh Road South (250mm HPPE).

2.3.31 The largest diameter apparatus are a 15” ductile iron trunk gravity distribution water main located north of Fyfin Road to the west of Victoria Bridge, and a 400mm Ductile Iron trunk gravity main located in Gillygooley Road to the west of Omagh.

2.3.32 There is a proposal for laying a new 500mm abstraction pipe along Derg Road from the Strule River to the north west of Newtownstewart.

2.3.33 The waste water network within this section generally consists of sewers of 300mm diameter and smaller, which are limited in extent to the settlements of Sion Mills, Victoria Bridge, and Newtownstewart. There is a more extensive network of sewers in Omagh town. Domestic and commercial premises located in rural areas are generally served by private septic tanks.

2.3.34 There are two combined gravity sewers which are located in Primrose Park and Bells Park Road, which have diameters of 225mm and 150mm respectively. Both sewers bring effluent into Sion Mills waste water treatment works from settlements to the west.

2.3.35 A 500mm diameter pumped sewer runs alongside the existing A5 between the A5 Fairy Water Bridge to a point 1km further north. This pipe carries waste water to the Omagh waste water treatment works

Telecommunications

2.3.36 BT has a network of overhead and underground apparatus located alongside and below the existing highway network. Between Sion Mills and South of Omagh, underground trunk fibre optic and copper cables are located in ducts in the existing A5. There is also an extensive network in Omagh, with spurs in the B165 Bells Park Road, B72 Fyfin Road, B84 Baronscourt Road, B50 Gillygooley Road, and the A32 Clanabogan Road, as well as in 4 other minor roads.

2.3.37 Furthermore, there is an extensive network of overhead copper BT apparatus which has been placed on wooden poles in the verge of most of the minor roads.

2.3.38 Virgin Media, Eir and Atlas Communications (NI) have trunk fibre optic apparatus laid inside a shared 4-way duct that extends from Sion Mills to south of Omagh. This duct is generally laid in the existing A5, except where it diverts into Newtownstewart and Omagh town centre.

2.3.39 EE (formerly T-Mobile and Orange), Vodafone and O2 have a number of mobile phone masts located between Sion Mills and south of Omagh. The location of these is shown in more detail on the utility drawings.

Miscellaneous

2.3.40 Current utility information indicates that there are no gas apparatus or gas pipelines located within Section 2.

Geotechnical

2.3.41 The topography along the Proposed Scheme for Section 2 is extremely variable and ranges from flat land along the floodplains of the river courses to the moderately sloping foothills of the Sperrin Mountains and Bessy Bell.

2.3.42 From the northern section boundary to the confluence of the River Derg and the Mourne/Strule River, the topography generally slopes down towards the River Mourne to the east of the route. The highest ground is at approximately 120m AOD in the west and slopes down to 40m AOD in the east at gradients of between 1:10 and 1:5.

2.3.43 From the confluence of the River Derg and Mourne/Strule Rivers, southwards to Newtownstewart, the route is the south side of the Strule River. The area is generally fairly flat, although in the Deer Park area the topography is more undulating, with several glacial eskers, and maximum elevations of up to 100m AOD.

2.3.44 Immediately south of Newtownstewart is a substantial ridge of glacial material running of the slopes of Bessy Bell. The area to the south of Newtownstewart slopes down to the north east from Bessy Bell, which is at a height of 120m AOD, to the town at approximately 50m AOD, with slopes of between 1:10 to 1:5 gradients.

2.3.45 From the south of Newtownstewart to the Ulster-American Folk Park, the route is constrained to the west by Bessy Bell and to the east by the Strule River. The topography of the area slopes down from the west at 220m AOD to 50m AOD in the east, at gradients of between 1:10 and 1:3. This section follows the west side of the U-shaped Strule Valley, which is flat bottomed, with steep side slopes. There is a narrow “shelf” half way up the western valley side, which is occupied by a minor road (Castletown Road). The existing A5 is benched on to the lower valley side slope, approximately on the line of the former railway.

2.3.46 From the Mountjoy area southwards to the Fairy Water, the topography of the land is generally gently undulating, with infrequent drumlins. The land is generally 50m to 70m AOD in this area, with the drumlins being between 10m and 20m above the surrounding area.

2.3.47 From Gillygooley to the southern Section 2 boundary, the landscape is dominated by tightly packed drumlins and undulating land, with side slopes of between 1:10 and 1:5 and ranging in heights of between 150m AOD to 60m AOD.

Superficial (Drift) Geology from Published Records

2.3.48 The underlying geology will be first described in terms of published geological records and then in terms of what was actually encountered along the route. The published geology is still considered appropriate as it sets the route into the wider geological context.

2.3.49 Reference should be made to the Ground Investigation Report (718736-0600-R-007) for a detailed discussion of the results.

Glacial Deposits

2.3.50 As described in Section 1, during the last glacial period, much of region was covered by a thick ice sheet. At the base of this ice sheet, a layer of lodgement glacial till was deposited by the glaciers onto the underlying bedrock. Like many glacial tills in Ireland, this deposit is predominantly a sandy gravelly silt, with a minor clayey fraction. Lenses of sand and gravel are often present within the lodgement till. As the ice decayed, a layer of ablation till would have been deposited onto of the lodgement till layer. These deposits are widespread south of Mountjoy and form tightly packed drumlin mounts of stony clay. However, across much of the northern part of the A5WTC corridor in Section 2 (North of Newtownstewart), the upper part of the sequence of glacial deposits is dominated by ice contact materials.

2.3.51 Most of the glacial deposits present beneath the A5WTC corridor in the, Mourne and Foyle Valley area in Section 1 and the northern part of Section 2 relate to the deglaciation stage, when a substantial fan of outwash deposits were laid down. Much of the outwash material is of an 'ice contact' character, relating to the late advance and decay of ice lobes flowing down the valleys of the Rivers Mourne, and Owenkillew a late stage in the last glacial stage. The deposits of this last glacial phase have reworked the earlier stages, and the landscape left in the valleys as the ice lobe finally decayed has only been slightly modified by post glacial alluvial deposits.

2.3.52 The lower parts of the Mourne valley system are dominated by the hummocky and irregular terrain left as the ice decayed. (Described on some geological maps as "undifferentiated hummocky glacial moraine") Significant moraine ridges are present in the area immediately south of Newtownstewart. Conversely, there are large outwash sheets of sand and gravel in the Ardstraw and Deerpark areas. Esker type features (ridges of outwash sand and gravel) are also present in the Deerpark area. The ice contact fluvioglacial material generally comprises dense poorly graded sands and gravels, but with a variable fines content of between 5 and 25%. In places lenses of well graded sands occur reflecting ephemeral deltas where sub glacial meltwater stream exited the ice onto the outwash zone. Also present within the ice contact material are sporadic loose zones. Some of these may reflect the decay of isolated masses of ice and are incipient kettle holes; others reflect the rapidly changing and chaotic depositional environment associated with the final decay of the Sperrin Mountains glacier.

2.3.53 Small areas of similar sand and gravel are also recorded under the line of the route in the vicinity of Mountjoy and Fairy Water.

2.3.54 To the south of Newtownstewart the glacial deposits are shown to be thin or even absent under the line of the route, on the west side of the steep sided valley of the Strule, to Castletown, near the Ulster-American Folk Park.

2.3.55 From south of Mountjoy to the southern limits of Section 2, the older lodgement and ablation till deposits are not significantly modified by widespread and form a series of stony clay drumlin mounds.

Post-Glacial Deposits

Peat Deposits

2.3.56 Low-lying areas of raised peat bogs have been recorded in the valley of the Fairy Water, close to its confluence with the Strule. Most notable of these is the Tully Bog Special Area of Conservation (SAC), which is to the west of the route.

2.3.57 Other smaller accumulations of peat have been recorded in the northern part of the route, one being approximately 1km to the south east of Victoria Bridge and the other close to the confluence of the Rivers Derg and Mourne/Strule.

2.3.58 From Mountjoy, to the Section 2 southern boundary, are several pockets of soft ground dominated by fen-type peat accumulations in the low-lying, poorly drained inter-drumlin areas. These are numerous, though small in area are not largely interconnected. There was a single outlier in the north, near Sion Mills.

2.3.59 South of Newtownstewart and west of the Ulster American Folk Park, thin peat deposits were occasionally encountered in low-lying pockets overlying the glacial tills and sands and gravels.

2.3.60 A linear area of inter-drumlin fen peat was mapped north and south of Tamlaght Road. However, the investigation proved that, with the exception of a 200m length south of the road, glacial till was in fact present.

2.3.61 The main ground investigation identified larger quantities of peat deposits than was anticipated in the PSSR. The thickness of the peat and associated soft clays encountered during the main ground investigation ranged from 0.1m to more than 10m, though largely less than 4m.

Alluvial Soils

2.3.62 The alluvial soils crossed by the Proposed Scheme in Section 2, comprise river alluvium and post glacial lacustrine deposits.

2.3.63 River alluvium deposits are recorded along the banks of the major river courses located in the vicinity of the route. These include the River Derg, Strule River, Coolaghy Burn, the Fairy Water and the Drumragh River. These deposits are typically between 30m and 1km wide, with the most extensive deposits being located in the Newtownstewart area. There is borehole evidence that these can be as much as 25m deep and largely consist of sand/gravel, though also with pockets of soft peat and clay, especially in the upper 5m, though the most extreme of these are largely not crossed by the Proposed Scheme.

2.3.64 Lake alluvium, which is expected to be very soft to firm grey blue sandy silts and clays, with some organic content, is generally found in discrete areas of low-lying land, close to water courses. Two of these areas are recorded in the northern part of the Section 2, within 0.5km of Seein Bridge. Another area is noted around Mountjoy.

Topsoil

2.3.65 Topsoil was recorded throughout the Proposed Scheme, while there is very little presence of Made Ground. Topsoil was found to be up to 0.9m in thickness, while made ground, where it was encountered, was found with thicknesses of between 0.1m and 3.5m. The Made Ground in Section 2 is mainly associated with the former railway line and isolated areas, possibly unofficial former landfill sites.

Bedrock (Solid) Geology

2.3.66 The underlying solid geology is structurally complex, but falls into 2 distinct provinces: Pre-Cambrian strata to the north of the Omagh Thrust Fault and Devonian and Carboniferous strata to the south of the fault.

2.3.67 The Omagh Thrust Fault is a sub-horizontal thrust fault that is crossed by the Proposed Scheme immediately to the south of Omagh near Clanabogan Road/Loughmuck Road, south west of Omagh. The Precambrian strata from the north have been thrust southwards and over younger rocks beneath, in the form of a large overturned fold, known as the Sperrins Nappe.

2.3.68 North of the thrust, in the area to the west of Newtownstewart, the Sperrins Nappe takes the form of an asymmetric anticline, the axis of which trend from the south west to north east. Newtownstewart Formation, described as thickly bedded quartzose psammite with thin pelite interbeds, is the stratum at the centre of the nappe. Due to the deformation that the folded nappe has been subjected to, the strata differ between the north west and the south east limb. The strata on the north west limb have moderate dips towards the north west and comprise Dungiven Formation and Claudy Formation. The strata on the south east limb of the fold dip steeply to the south east and comprise the Dungiven Formation and the Mullaghcarn Formation. The Dungiven Formation is essentially limestone, with psammite, pelite and semipelite. Both the Claudy Formation and the Mullaghcarn Formation are described as mixed psammite, semipelite and pelite strata. These Pre Cambrian units form the Sperrin Mountains and Bessy Bell, which are located east and west of the route respectively.

2.3.69 The strata encountered to the south of the Omagh Thrust Fault are predominately younger Upper Devonian Shanallagh Formation, which comprises sandstone and mudstone. A small wedge of Carboniferous Slievebane Group strata is also noted along the fault boundary.

2.3.70 Between Victoria Bridge and Omagh, local faulting has left two outliers of younger Carboniferous age sandstone resting uncomfortably upon the older (Dalradian) Sperrins strata described above;

- The Omagh sandstone & Claragh sandstone around Omagh,
- The Owenkillew sandstone between Victoria Bridge & Newtownstewart

Potentially Contaminated Sites and Land

2.3.71 Potentially contaminated sites located within or immediately adjacent to the areas required for construction of the Proposed Scheme are shown within the Environmental Statement and on Table 2-14 along with their relative hazard rating. A summary of the results of the ground investigation is given below, however reference should be made to the Ground Investigation Report for a detailed discussion.

Type	Location	Potential Risk
Backfilled Quarry	West of Sion Mills	Medium
Active Quarries	Urbalreagh	Medium
Active Quarries	Deer Park	Medium
Former Route of Great Northern Railway	South of Rash Road 1.5 KM to Todds Road	Medium
Disused Nestle Factory	Poe Bridge	Medium

Table 2-14: Potentially Contaminated Sites under, or Immediately Adjacent to Proposed Scheme – Strabane to Omagh

2.3.72 These areas were subjected to chemical testing to determine the actual level of any contamination. Selected samples of Greenfield soils were also tested, to determine the natural background chemical concentrations.

2.3.73 Testing of greenfield sites indicated above background levels of ammonium, ammonia and also arsenic in one instance. There was also evidence of local high pH levels, a potential constraint on plant species that would be suited to such conditions.

2.3.74 An isolated relatively elevated concentration of arsenic was identified in samples taken during the site investigations, just south of Milltown Road. However, there is no information available regarding expected background levels of arsenic in Northern Ireland. Therefore it has not been possible to establish if the identified level is due to background conditions as there is no apparent man-made likely source of this chemical in the vicinity. Notwithstanding that, this part of Northern Ireland is in an area where there are mineralised veins within the ancient (Dalradian) rocks. Local enrichment of heavy metals such as silver, lead, zinc and arsenic are to be expected associated with those veins.

2.3.75 Samples primarily related to areas of overlying peat were found to be highly acidic. Samples taken in Section 2 also contained occasional phytotoxic concentrations of boron.

2.3.76 Levels of ammonia and ammonium within soils sampled throughout the corridor were was found to be consistent with agricultural management regimes with moderate to high fertilizer inputs.

2.3.77 In the brownfield areas elevated concentrations of PAHs were identified in samples obtained from the railway embankment area. A single total cyanide leachate exceedance was identified adjacent to an infilled quarry to the west of Sion Mills. The origin of this material is unexplained.

Mineral and Mining Resources

2.3.78 There are a number of active, backfilled and disused quarries within the vicinity of the Proposed Scheme. The majority of these are sand and gravel extraction sites.

2.3.79 Along Bells Park Road, there is a small backfilled quarry approximately 80m west of the Proposed Scheme. There is also a backfilled quarry along Urbalreagh Road, approximately 90m west from the Proposed Scheme.

2.3.80 Along the Old Bridge Road, there are 2 active quarries both to the east of the Proposed Scheme and one to the west, accessed off the Derg Road. The quarry to the west (Tony Harley & Son Ltd (Urbalreagh) is located adjacent to the Proposed Scheme, while the two quarries to the east are 50m and 150m from the Proposed Scheme. It is likely that the extent of these gravel workings will change significantly before the scheme is constructed and the design will need to be able to accommodate several different scenarios of excavated or backfilled land in that area.

2.3.81 There is a large scale active quarry approximately 150m to 300m east of the Proposed Scheme, both to the north and south of Baronscourt Road. Adjacent to the active quarry and to the south, there is a quarry that has been backfilled. This is approximately 150m east of the alignment.

2.3.82 In close proximity to Lisnagirr Road approximately 150m to the west of the Proposed Scheme is another small backfilled quarry. Between Tamlaght Road and Loughmuck Road both to the east and west of the Proposed Scheme are a number of small backfilled quarries, between 50m and 150m from the route.

Drainage and Hydrology

2.3.83 The existing drainage and hydrological features along Section 2 of the Proposed Scheme are described in this section. Specific engineering constraints are outlined in conjunction with information relating to flooding considerations.

2.3.84 Preliminary hydrological assessments have been made in order to ascertain the principal rivers and associated drainage basins along the Proposed Scheme. The principal drainage basins are shown in Figure 2-21.

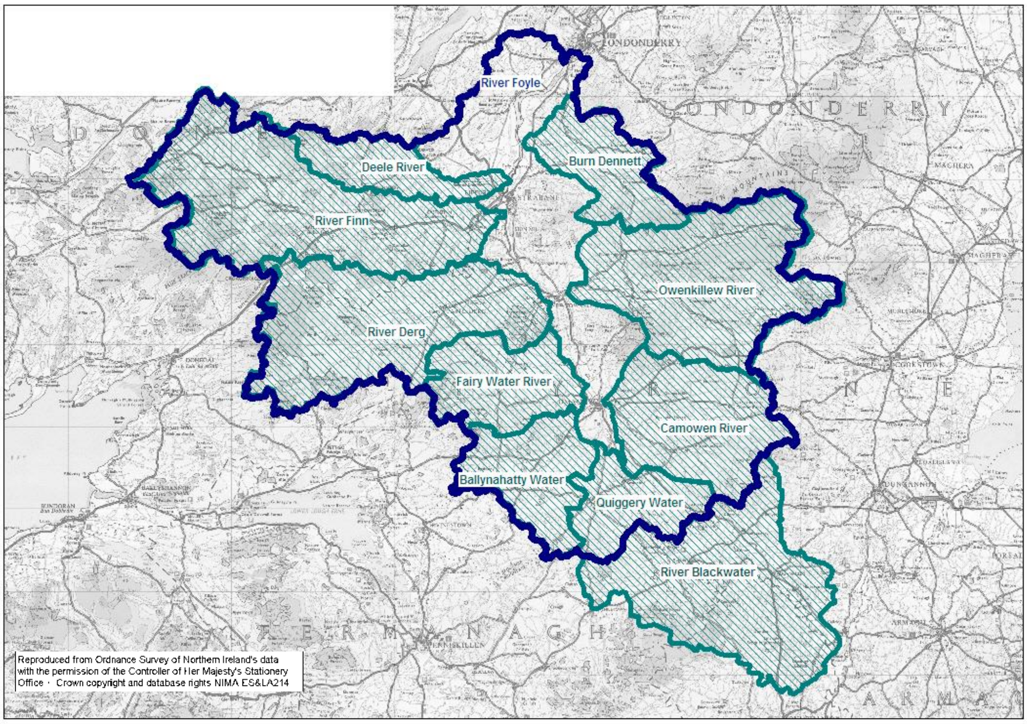


Figure 2-21: Principal A5WTC Drainage Basins

2.3.85 The principal watercourse in Section 2 is the Mourne/Strule River which flows in a south to north direction from Omagh to Strabane via Newtownstewart, Victoria Bridge and Sion Mills.

2.3.86 The Strule River is formed when the Camowen and Drumragh Rivers converge at Drumragh Bridge in Omagh. The Strule River then flows for approximately 26km in a northerly direction towards Strabane until it converges with the River Derg at Bunderg to form the Mourne River (4km north-west of Newtownstewart). The Mourne River then flows 14km towards Strabane, where it converges with the Finn River to form the River Foyle.

2.3.87 The Strule River incorporates a number of designated watercourses as well as numerous undesignated watercourses as it flows towards Strabane. Its principal tributaries include the Fairy Water, which discharges into the river at the Beltany Road in Omagh and collects water from the largely rural catchment area to the west of Omagh, and the Owenkillew River at Newtownstewart, which collects water from a predominantly rural upland catchment area to the east of Newtownstewart. The Owenkillew River catchment also incorporates the small urban catchments of Plumbridge and Gortin.

2.3.88 Through discussions with TransportNI Maintenance Section Offices and Rivers Agency, it is known that sections of the existing A5 within Section 2 have been prone to historical flooding or effected by flood debris.

- A5 at the Fairy Water – is liable to flooding.
- A section of the A5 north of Mountjoy experiences localised flooding with the free passage of surface water across the road surface as it discharges from the adjacent slope during exceptional rainfall.
- Junction at Victoria Bridge has exhibited localised flooding. The existing watercourse culvert has been enlarged to mitigate against future occurrences.

2.3.89 It was observed that there is a narrow floodplain, approximately 150m wide, along the length of the Mourne – Strule Extension. At the confluence with key tributaries, these floodplains are more extensive.

2.3.90 Where the River Derg converges with the Mourne-Strule Extension, the floodplain is approximately 500m wide. The River Derg Floodplain is crossed perpendicularly at Ardstraw. There is also an extensive floodplain in the local of Newtownstewart associated with the convergence of the Owenkillew River and the Mourne – Strule Extension. The floodplain adjacent to Newtownstewart varies in width to a maximum of approximately 800m wide.

2.3.91 Along the Proposed Scheme to the west and north-west of Omagh, there is an extensive floodplain associated with the confluence of the Fairy Water, including the Fairy Water tributaries of Tully Drain, Rush Drain, Gillygooley and Coneywarren Drain. It is identified that the floodplain associated with this network of watercourses is approximately 1.2 km in width. It has also been identified that a significant recurrent area of flooding is located at the existing A5 crossing with the Fairy Water at the Beltany Road in Omagh.

2.3.92 Immediately south of Omagh, the Drumragh River floodplain runs parallel to the watercourse and is approximately 200m wide.

Existing Structures Conditions

2.3.93 This section deals with the assessment of the condition of the existing structures, recommendations on any remedial works required and comments on the options for widening each structure in Section 2. For those sections of the existing route where there are significant constraints to widening the route, such observations are made. The structures described in this section are those that remain within the Preferred Corridor.

Summary of Route

2.3.94 There are 14 significant bridges in Section 2 and 3 of them are considered to be major crossings with cumulative spans of over 40m.

2.3.95 The majority of the bridges on the route carry the A5 over watercourses with only 1 road over road bridge. This is typical of routes in such landscapes where most junctions are at grade. Generally the structures are not very large with a median span of 4.1m but with a maximum span of 118.9m.

Function	Number
Footbridge Over Road	-
Road Over Accommodation	-
Road Over Pedestrian Subway	1
Road Over Road	1
Road Over Watercourse	12
Grand Total	**14**

Table 2-15: Bridges by Function and Section

2.3.96 As indicated in Table 2-15, there are a total of 14 significant bridges (i.e. > 1.8m span) on the route. Additionally, there are 4 retaining walls over 1m high which either support the road or retain landscape and/or structures adjacent to the road. The vast majority of these structures are in fair to very good condition and, when considered in isolation, most could be modified for use in a scenario where the existing A5 was widened to dual carriageway, if required. There are also a number of smaller structures (less than 1.8m span) along the route although these were not thoroughly inspected and no condition ratings were assigned.

2.3.97 The assessed capacity of the structures is reported in the NIRS database although the records were not complete at the time of inspection.

Structure Types

2.3.98 Of the significant bridges, there are a wide variety of construction types, with some of mixed construction where the structure has been widened.

Structure Type	Number
Composite Concrete & Steel	2
Concrete Arch/Masonry Arch	-
Concrete Box Culvert	2
Corrugated Steel Pipe	-
Half Joints	-
Masonry Arch	3
Masonry Arch/RC Slab	1
Prestressed Concrete Beams	1
RC Pipe	1
RC Slab	2
RC Slab/RC Pipe	2
Steel Truss/Steel Plate	-
Grand Total	**14**

Table 2-16: Significant Structures by Road Section

2.3.99 In addition, there are a number of small culverts (less than 1.8m) whose construction was often unclear as they were submerged or otherwise hidden.

2.3.100 Four retaining walls (>1m high) were identified along the existing A5, where failure may impact on the carriageway. There does not appear to be a register of retaining walls for the existing A5 and therefore, not all of the walls which were recorded in the survey may be in public ownership. However, they are included as they will need to be considered as part of any proposed A5 widening scheme. For convenience, these walls have been split into four arbitrary height bands:

- Small – less than 3m;
- Medium – 3 to 5m;
- Large – 5 to 9m;
- Very Large – Over 9m.

2.3.101 Very few construction details were available for inspection for any of the major structures and none for the minor structures or the retaining walls. An assessment of the basic construction type is included in the national database and this has been used as a basis for this study. For the minor structures and retaining walls, no attempt has been made to classify the construction type.

2.3.102 The following tables indicate the size, type and general condition of the structures. As can be seen, the structures are of mixed size and construction type but are generally in good condition throughout. Some relatively minor defects are present and the key information about each structure is presented below.

NIRS Structure No	Structure Name	Structure Type	No of Spans	Span (m)	Width (m)
60662	Unnamed	RC Slab/RC Pipe	1	2.45	34.80
60661	Unnamed	RC Slab	1	4.9	34.80
61433	Derg River Bridge	Half Joints	3	44.8	17.05
62406	Pubble Bridge	Composite Concrete & Steel	3	118.9	13.60
62409	Newtownstewart Bypass Pedestrian Underpass	Concrete Box Culvert	1	4	23.36
62407	Croshballinree Bridge	Composite Concrete & Steel	3	92.35	13.20
62408	Grange Bridge	Concrete Box Culvert	1	9.7	27.00
60660	Unnamed	RC Slab	1	2.17	24.50
61208	Beltany Bridge	Masonry Arch/RC Slab	1	3.62	16.20
61211	Unnamed	RC Pipe	1	1.2	17.00
61819	Unnamed	Masonry Arch/RC Slab	1	1.85	18.00
61209	Unnamed	Masonry Arch/RC Slab	1	2.3	18.00
60878	Unnamed	Masonry Arch	1	1.94	13.10
61143	Poe Bridge	Masonry Arch	2	20.76	13.20

Table 2-17: Section 2 Structures along existing A5 – Construction Types and Size

NIRS Structure No	Structure Name	Overall Assessment (Average)	Overall Assessment (Critical)
60662	Unnamed	Good	Very Good
60661	Unnamed	Good	Very Good
61433	Derg River Bridge	Fair	Very Poor
62406	Pubble Bridge	Very Good	Very Good
62409	Newtownstewart Pedestrian Underpass	Very Good	Very Good
62407	Croshballinree Bridge	Very Good	Very Good
62408	Grange Bridge	Very Good	Poor
60660	Unnamed	Fair	Very Good
61208	Beltany Bridge	Good	Very Good
61211	Unnamed	Fair	Not fully inspected
61819	Unnamed	Very Good	Very Good
61209	Unnamed	Good	Very Good
60878	Unnamed	Fair	Fair
61143	Poe Bridge	Fair	Very Good

Table 2-18: Section 2 Structures – Condition Ratings [Scores are based on draft Highways Agency standard performance measurement of highway structures (PMHS)]

Retaining Walls

Mouchel Structure No	Wall Length (m)	Wall Height (m)	Function	Overall Assessment
S16	47	1.15	Supports an Embankment	Very Good
S17	59	1.4	Supports Residential land	Poor
S21	35	4	Supports Strabane Road	Very Good
OM2A	24	3	Supports the A5	Very Good

Table 2-19: Section 2 Retaining Walls – Size, Function and Condition [Scores are based on draft Highways Agency standard performance measurement of highway structures (PMHS)]

Widening Issues

2.3.103 Approximately a quarter of the structures in Section 2 would be difficult to widen on line. Typically, the structure itself could be widened but there are existing constraints adjacent to it.

2.3.104 About half of the structures could readily be widened on line.

2.3.105 Of the remaining structures, it is considered that it would be more economical to completely replace 2 no, should they be required to accommodate a widened A5. These structures are considered to be at high risk of needing major repairs in the short to medium term.

2.3.106 It is considered that the 2 relatively new bridges on the Newtownstewart bypass would require the construction of new bridges parallel to the existing rather than widening of the existing structures.

Structural Capacity

2.3.107 The assessed capacity of the structures is reported in the NIRS database although the records were not complete at the time of inspection.

2.3.108 Eight bridges have been assessed as having 40 Tonne HA loading capacity and are rated at 45 units of HB loading. The remaining 6 structures have no HB rating.

Existing Pavement Conditions

2.3.109 In 2010 a detailed pavement survey was carried out which analysed the condition of the existing A5 pavement condition under the following headings:

- Deflectograph
- Visual Survey

2.3.110 The findings of this survey were reported in the Preferred Options Report. Since that date several maintenance and local realignments works have been carried out along the length of the existing A5.

2.3.111 Since 2009 the following carriageway structural maintenance works have been undertaken-

- Beltany Road (Lisimnaghan), 1.4km
- Beltany Road, Omagh (Killynure), 1.2km
- Mulvin Road at Urbalreagh, 1.4km
- Mulvin Road at Breen (Victoria Bridge), 0.9km
- Beltany Road, Beltany Grove to Drumlegagh Road South, 0.9km
- Beltany Road, Newtownstewart, 0.54km
- Melmount Road, south of Sion Mills, 0.64km
- Great Northern Road, 0.3km

Existing Traffic Conditions

2.3.112 It should be noted that for a considerable part of Section 2, the existing A5 is at some distance from the proposed route of the A5WTC. Notwithstanding this, traffic conditions on the existing road network are likely to change considerably with an improved A5WTC and are therefore described in this section.

Traffic Flows

2.3.113 Figure 2-22 shows traffic flows along roads in Section 2 of the A5WTC scheme. These values are average 24 hour October weekday (Monday to Thursday) vehicle flows for 2013, which were derived using all Mon-Thurs flows other than the week leading into half term.

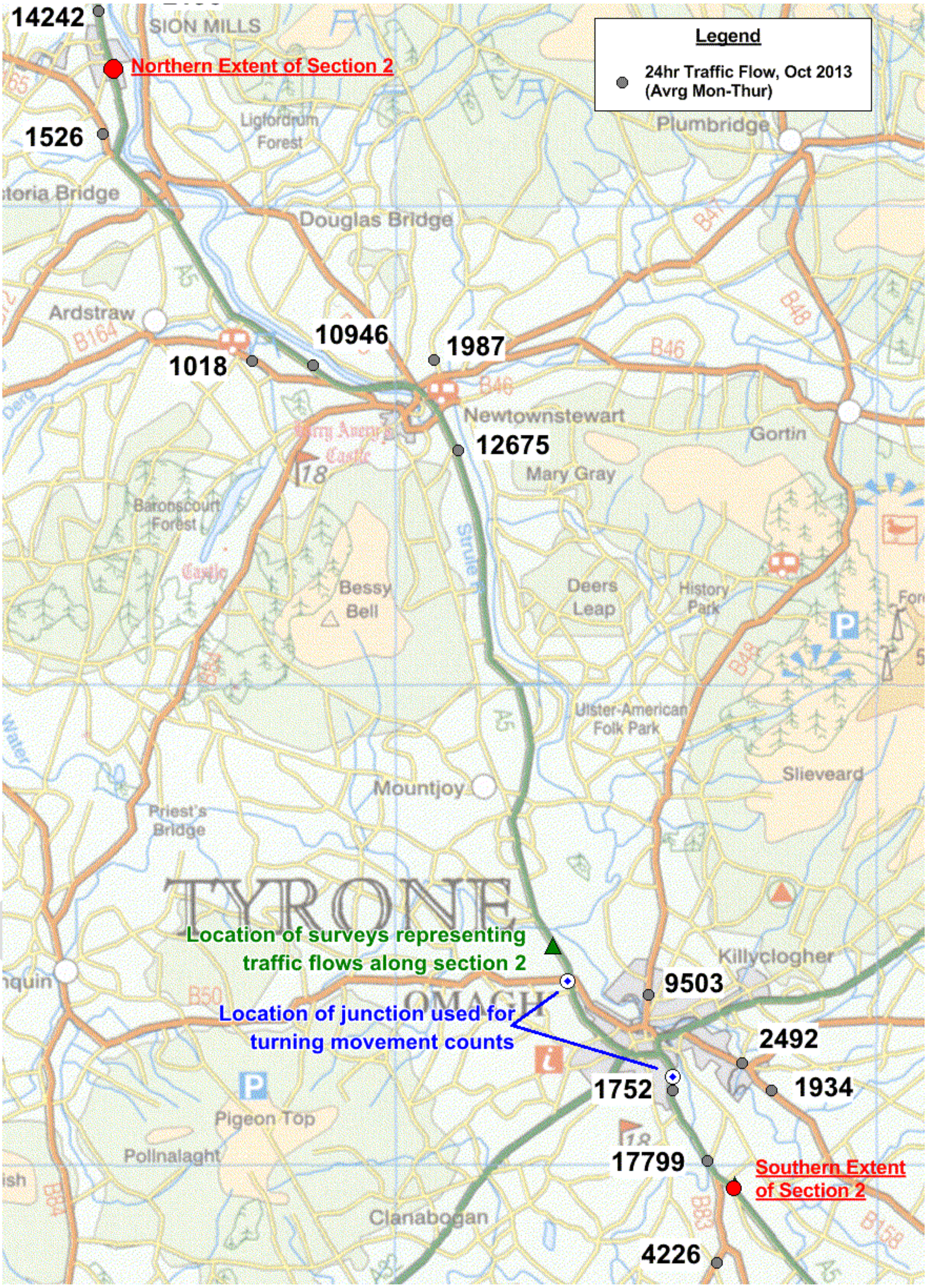


Figure 2-22: 24 hour traffic flows in the vicinity of Section 2 (Avg. mons- Thurs, October 13)

2.3.114 Detailed traffic analyses have been undertaken for the location shown by the green triangle in Figure 2-22. This location is the TransportNI long term ATC site (Site 626) on the A5 immediately to the north of Derry Road roundabout and just north of Omagh. This analysis is summarised in Figure 2-23 and Figure 2-24 for the monthly and daily flows respectively.

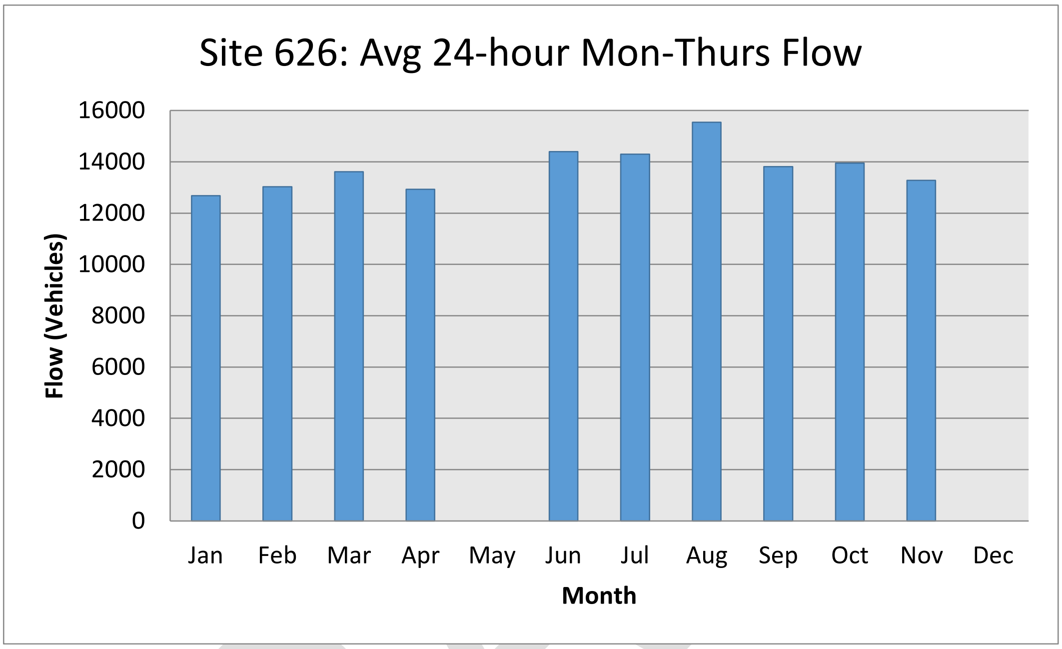


Figure 2-23: Monthly variation of traffic flows along the A5 during 2013 in Section 2 (Site 626)

2.3.115 It can be seen that Figure 2-23 omits values for May and December 2013. This reflects prolonged periods of missing data during these months. There is considerable variation across the other months, with the highest flow in the holiday month of August. The flow for October 2013 appears to be close to the mean for the months reported and it is therefore consider that traffic in this month is reasonably representative of the year as a whole.

2.3.116 The daily profile in October 2013 at this location is shown in Figure 2-24. This shows that the peak flow in the AM and PM peak observes similar volume of traffic

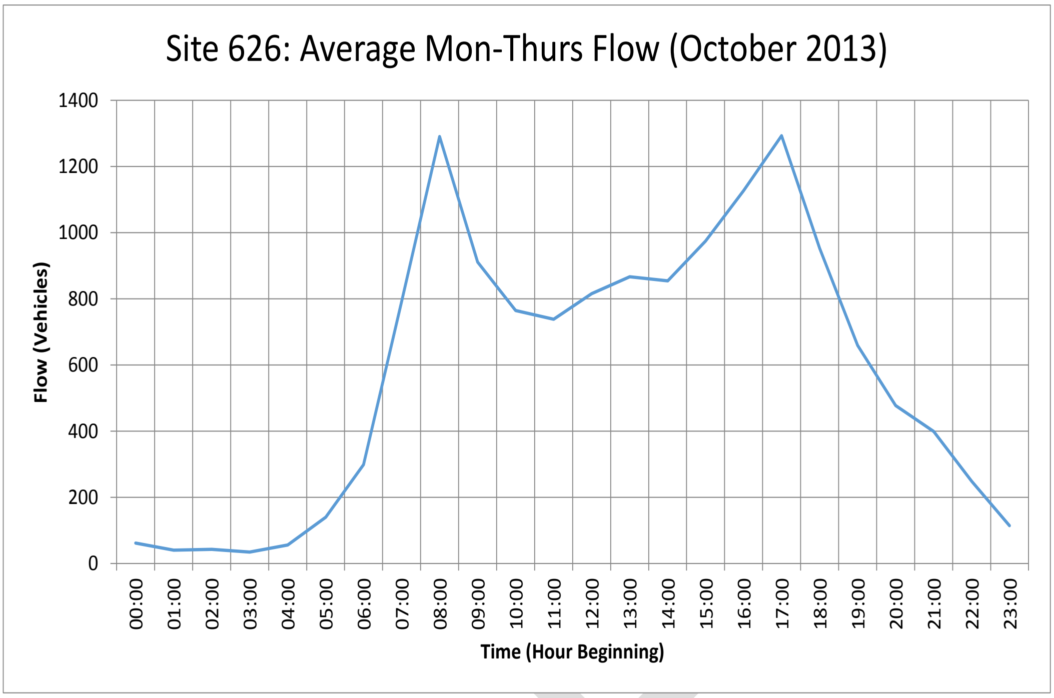


Figure 2-24: Daily flow profile on the A5 north of Omagh (Avg. Mon- Thurs, October 2013)

2.3.117 The layout of the Derry Road roundabout junction of the A5 with the B48 (Derry Road) and the B50 (Gillygooley Road) is shown in Figure 2-25. A turning movement count was carried out at this site (Site MCC14) in October 2013. The results of this count are shown in Figure 2-26.

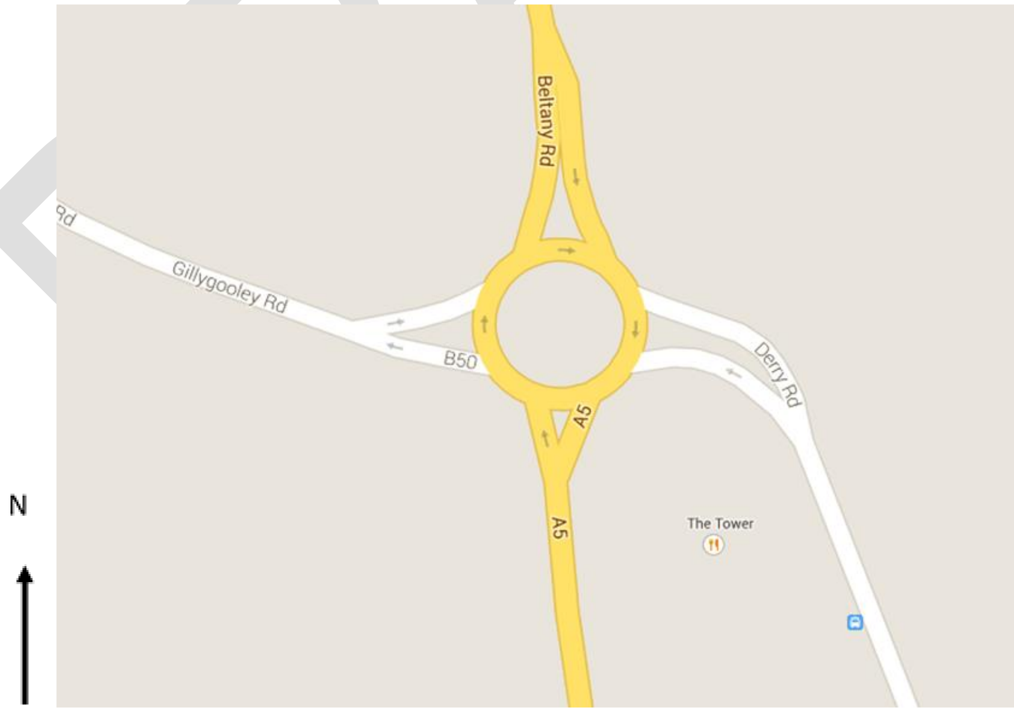


Figure 2-25: Junction of the A5 with the B48 and the B50 to the north of Omagh

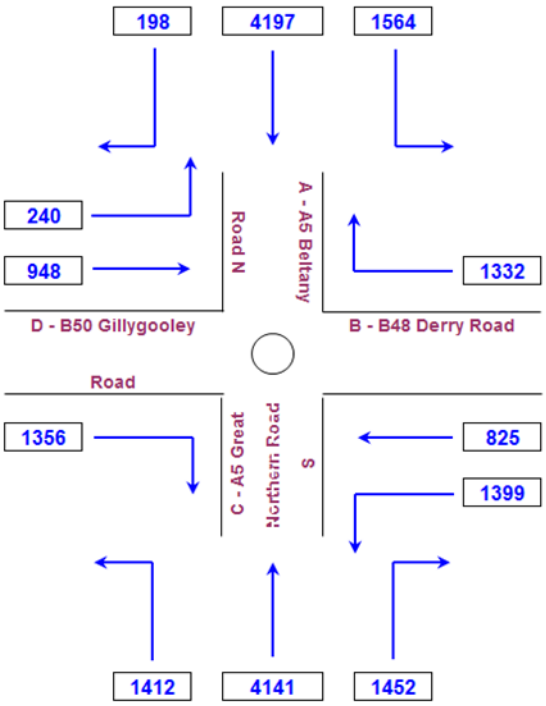


Figure 2-26: 12 hour vehicle flows at junction of the A5 with the B48 and the B50 to the north of Omagh (Tuesday 15th October 2013)

2.3.118 Figure 2-26 shows that the main movement of traffic at this junction is between the two arms of the A5. There are substantial volumes of traffic turning between the B48 and both the A5 arms, and also between the B50 and the southern arm of the A5, though not between the B50 and the A5 to the north.

2.3.119 Similarly, a turning movement count was carried out on at the junction between the A5 and the A505 (Crevenagh Road as realigned) to the south of Omagh. The layout of this junction is shown in Figure 2-27. The results of this October 2013 count (site MCC22) are shown in Figure 2-28.

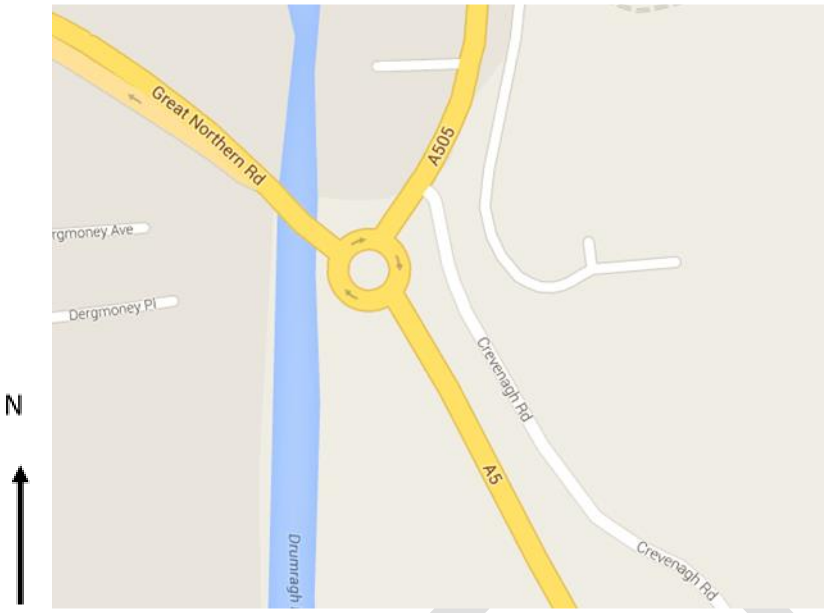


Figure 2-27: Junction of the A5 with the A505 to the south of Omagh

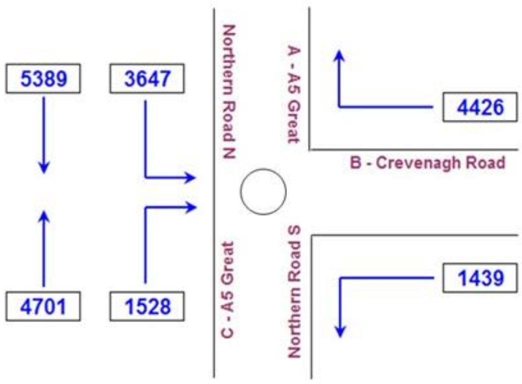


Figure 2-28: 12 hour vehicle flows at junction of the A5 with the A505 to the south of Omagh (Tuesday 15th October 2013)

2.3.120 Although this junction is to the south of the town, the volume of traffic between the A505 and the A5 south is much lower than that joining the A5 north. This suggests that the latter movement includes cross town traffic avoiding the centre, which may include movements which are internal to Omagh at one end or both.

2.3.121 The proportions of vehicle types at this location are shown below in Figure 2-29.

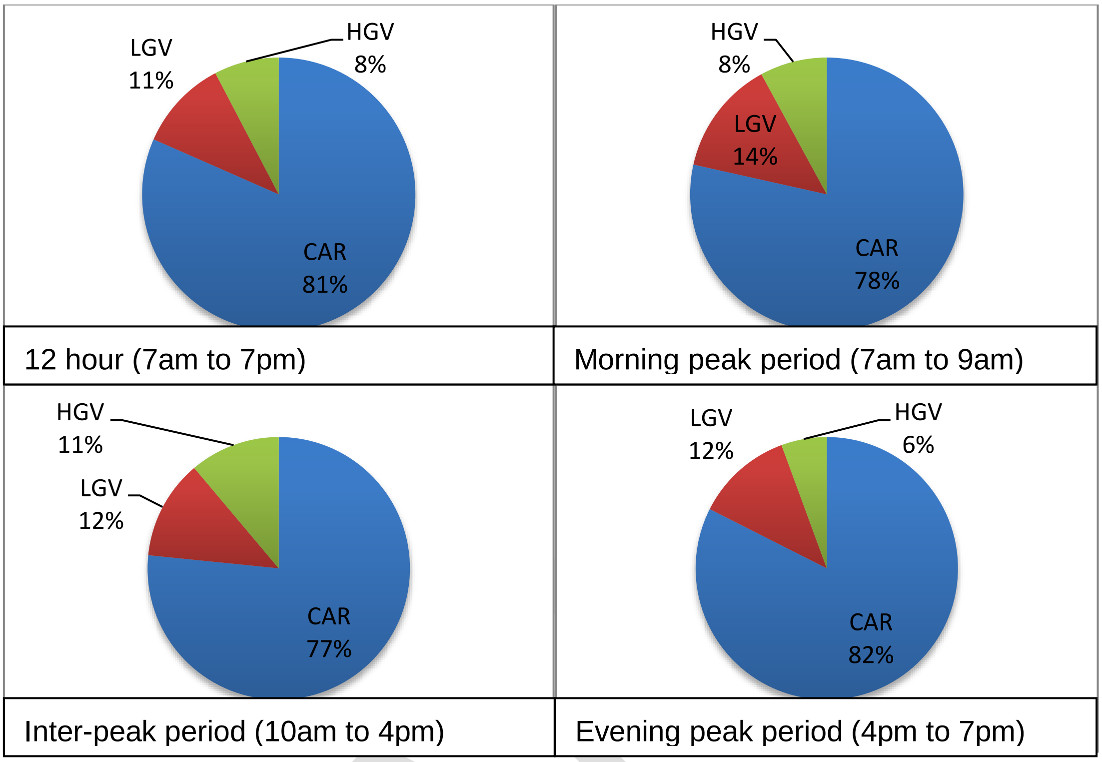


Figure 2-29: Vehicle proportions at the junction of the A5 with the A505 to the south of Omagh (Tuesday 15th October 2013)

2.3.122 The majority of journeys observed at these junctions were by car. LGV proportions are fairly constant throughout the day. The HGV and LGV proportions are approximately equal to one another during the inter-peak period, but the LGV proportion is significantly higher than the HGV proportion during the morning and evening peaks.

Major Traffic Movements

2.3.123 Roadside interview (RSI) surveys to establish origin destination patterns were carried out in April 2014 between Newtownstewart and Castletown and on the A32 at Fireagh to the west of Omagh. An RSI was also undertaken June 2014 to the south of Victoria Bridge. The findings of these surveys are reported in further detail in the Data Analysis Report.

2.3.124 The site south of Victoria Bridge was surveyed in the northbound direction. Observed trip patterns were widely distributed, with about one fifth travelling from the Omagh area to the Strabane area, 13% local to the Strabane local government district and around one tenth each from Omagh to Londonderry and to Co Donegal from other parts of the RoI.

2.3.125 The site near Castletown was surveyed in the southbound direction. Nearly one third of observed trips were from the Strabane area to the Omagh area, about one sixth from Londonderry to Omagh and one fifth from Donegal to the north eastern sector of the RoI, including Dublin.

2.3.126 The Fireagh site was surveyed in the direction towards Omagh. Over two thirds of trips originated in Fermanagh and the west of Tyrone, while three quarters of all trips had destinations in and around Omagh.

Journey Time Analyses

2.3.127 A journey time analysis was undertaken as described previously in this report and illustrated in Figure 2-15.

2.3.128 Section 2 is covered by journey time routes 7/8, 9/10 and 11/12. These sections have a combined length of approximately 21 km and run from north of Newtownstewart to south of Omagh.

2.3.129 The results of the journey time analysis are shown in Table 2-11 and Figure 2-16. It is noteworthy that the inter-peak times on the section between the Newtownstewart bypass and the Omagh through pass are greater than in either peak period. The reason to this is currently being investigated further. The other sections are reasonably consistent over the day, although the northbound Omagh through-pass is slower in the evening peak than at other times.

Accident History

2.3.130 The 'combined link and junction' accident statistics for the A5 in Section 2 are shown in Table 2-20.

Section 2	LINK DETAILS								
Combined Link and Junction Accident Statistics	Road Type	AADT	Length (km)	Total Observed PIA	Slight	Serious	Fatal	Observed Accident Rate (PIA/million vkm)	Observed Fatal and Serious to PIA ratio
A5, Main Line Links									
Sion Mills to Newtownstewart	A-road	10379	12.2	24	17	6	1	0.10	0.25
Newtownstewart to Omagh	A-road	11143	12.8	22	17	3	2	0.08	0.25
Omagh (Urban)	A-road	20757	1.8	34	29	5	0	0.50	0.13

Table 2-20: Accident statistics for Section 2 of the A5WTC (link and junctions combined) for the period 2008 to 2012

2.3.131 Along the A5 between Sion Mills and the south side of Omagh, a length of approximately 27km, a total of 80 PIAs were recorded for the period 2008 to 2012. This included three fatal accidents, one of which occurred north of Newtownstewart and the other two on the length between Newtownstewart and the edge of Omagh.

2.4 Existing Conditions – Section 3 South of Omagh to Aughnacloy

2.4.1 This section provides a description of the existing highway network, especially the existing A5, and conditions pertinent to the Proposed Scheme and the subsequent development of the Preferred Route.

Description of Current Network

2.4.2 The text in this section should be read in conjunction with drawings 718736-0800-D-00039 to 718736-0800-D-00058 included in Volume 2. These drawings show the Preferred Route and local road network on aerial photography and OS mapping tiles prior to the development of the Proposed Scheme.

2.4.3 The existing A5 for Section 3 initially runs from Doogary, south of Omagh, to Ballygawley. At Ballygawley the existing A5 (Omagh Road) joins the Annaghilla Road (A4) at the Ballygawley roundabout before continuing south to Aughnacloy along the Tullyvar Road (A5). It continues to Aughnacloy before joining Moore Street (A28) through Aughnacloy on Lettice Street prior to joining the existing N2 in the Republic of Ireland.

2.4.4 The A4 Belfast to Enniskillen road is crossed by both the existing A5 and the Proposed Scheme close to and west of Ballygawley. The B83 is west of the existing A5 and the Proposed Scheme and runs north – south between Doogary and Clogher and on to the border. The B46 crosses both the existing A5 and the Proposed Scheme at Moylagh as it runs between Beragh and Seskinore. The B35 (from Dungannon to Aughnacloy) and B128 (from Benburb to Aughnacloy) both cross the Proposed Scheme and connect with the existing A5 in Aughnacloy. The remainder of the area crossed by the Proposed Scheme is criss-crossed by a network of local (C class and unclassified) roads which serve the local communities and businesses.

2.4.5 There are natural and man-made constraints along the environs of the existing A5 and the line of the Preferred Route. The man-made constraints include

- Primary school, St Matthew’s church and filling station in Garvaghy hamlet
- Glencull Parochial House & Primary School
- A number of settlements comprising commercial properties such as shops, filling stations, pubs and housing throughout the stretch of the existing A5 and environs of the Proposed Scheme from Omagh to the ROI border south of Aughnacloy.
- Tyrone GAA Centre of Excellence
- Former quarry/landfill at Tullyvar.
- Tycanny Hill fort
- Errigal Kerrogue
- Aughnacloy Golf Club
- The Thistle
- Favour Royal

- Wind Farm at Slievemore Hill

2.4.6 The settlements in Section 3 fall within either Omagh Area Plan 1987 - 2002 or the Dungannon & South Tyrone Area Plan 2010. Like any developments, housing, industry, commerce, community facilities and recreation/open space are situated at convenient locations within the community.

2.4.7 The main economic activity in the region is agriculture. There are expansive areas of private and Department of Agriculture Environment and Rural Affairs (DAERA) Woodlands, and agri-environmental schemes. Major watercourses within Section 3 known to be used extensively by anglers consist of the Blackwater (passing to the south of Aughnacloy) and the Owenreagh, Quiggery, Cloghfin and Camowen Rivers. One Public Angling Estate (White Lough) is located approximately 3km east of Aughnacloy and is designated as a rainbow trout fishery.

2.4.8 Public transport is run by Translink. Bus services in this area are fairly limited. The bus routes in this corridor consist of the Ulsterbus services and serve the main settlements of Omagh, Ballygawley and Aughnacloy. The only rail connection is the Belfast-Coleraine-Londonderry line. Due to the predominance of agriculture in this region; most people use their own vehicles for transportation..

2.4.9 Sustrans are responsible for the National Cycle Network. The cycle route for this region is designated as Route 92 Enniskillen to Derry, and travels through Omagh and Fintona.

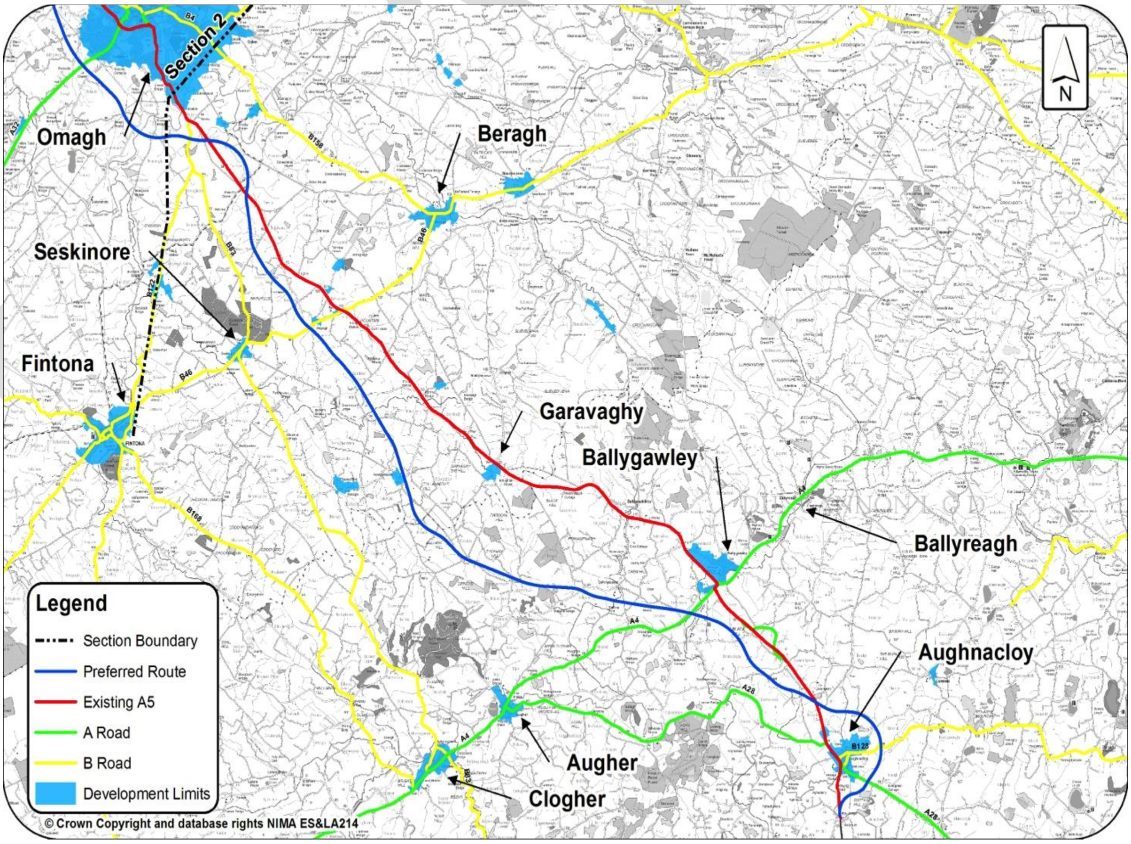


Figure 2-30: Overview of Section 3: Preferred Route, the existing A5, Development Limits and Intersecting Routes/Links within Section 3

Existing Highway Conditions - Section 3

2.4.10 Section 3 of the A5 is approximately 32km in length and runs from Doogary (south of Omagh) towards Tullyheeran (Augher Point Road).

2.4.11 The majority of the existing A5 from South of Omagh-Doogary to the border with the Republic of Ireland is derestricted, and is therefore subject to the national speed limit of 60mph. In accordance with the Design Manual for Roads and Bridges (DMRB) TD9/93, this equates to a design speed of 100kph. However, some sections of the road are not of a suitable geometric standard to achieve this design speed and have imposed speed limits of 50mph and 40mph, and a 30mph limit through the town of Aughnacloy. Most sections of road along the A5 in Section 3 are considered to be high density access constraint, which has an impact on both traffic speed and safety.

2.4.12 A geometric assessment of the existing A5 was carried out using the existing speed limits. The results of this assessment showed that there are 45 areas that are sub-standard to such an extent that they would require departures from the current standard TD9/93 (DMRB 6.1.1).

2.4.13 In the first 1.3km of this stretch of the A5, the road rises from a level of approximately 73.00m AOD to a level of approximately 92.00m AOD. At the junction of the Tullyrush Road and the Doogary Road the level of the road is approximately 102.00m AOD.

2.4.14 There are 24 private accesses and 13 public accesses and approximately 63% of the road can be classified as below standard with regards to horizontal and vertical geometry and would require departures from standard based on current design standards. In addition to this, 20% and 26% of the Stopping Sight Distances northbound and southbound respectively do not achieve current design standards

Figure 2-31: Junction with Greenmount Road

2.4.15 The road then passes between Tullyheeran and Gortaclare where there are 9 public accesses and 10 private accesses. Approximately 80% of this section of the road can be classified as below standard with regards to horizontal and vertical geometry and would require departures from standard if current design standards were applied.

2.4.16 In addition to this, 24% and 37% of the Stopping Sight Distances northbound and southbound respectively do not achieve current design standards.

2.4.17 The existing A5 alignment for this section rises from approximately 110.00m AOD to a high of 124.00m AOD back down to 110.00m AOD at Gortaclare.

Figure 2-32: Two+One Southbound from Seskilgreen

2.4.18 From here, the A5 runs south from Gortaclare to Garvaghy with 18 public accesses and 38 private accesses along this 6.75km stretch of road. Approximately 45% of this section of road can be classified as below standard with regards to horizontal and vertical geometry and would require departures from standard.

2.4.19 In addition to this, 7% and 17% of the Stopping Sight Distances northbound and southbound respectively do not achieve current design standards.

2.4.20 The road is undulating in this section, rising steeply initially from approximately 122.50m AOD to 140.00m AOD then reducing back to 127.00m AOD before rising steeply again to 141.00m and 167.00m AOD near Garvaghy.

2.4.21 The road continues south between Garvaghy and Seskilgreen with 7 public accesses and 29 private accesses along this 4.55km stretch of the A5. Approximately 64% of the road can be classified as below standard with regards to horizontal and vertical geometry and would require departures from standard. In addition to this, 27% and 20% of the Stopping Sight Distances northbound and southbound respectively do not achieve current design standards.

Figure 2-33: Northbound Climbing Lane north of Ballygawley Roundabout

2.4.22 Once again this section of the road rises and falls sharply ranging between 167.00m AOD and 105.00m AOD at the Ballynasaggart Road outside of Seskilgreen.

2.4.23 The road continues south between Seskilgreen and Ballygawley Roundabout (Grange) with 14 public accesses and 8 private accesses along this 3.0km stretch of the A5. Approximately 48% of the road can be classified as below standard with regards to horizontal and vertical geometry and would require departures from standard. In addition to this, 27% and 13% of the stopping sight distances northbound and southbound respectively do not achieve current design standards.

Figure 2-34: Pedestrian crossing in Aughnacloy – Moore Street

2.4.24 The A5 between Ballygawley Roundabout (Grange) and Aughnacloy, has 14 public accesses and 32 private accesses along this stretch. Approximately 86% of the road can be classified as below standard with regards to horizontal and vertical geometry and would require departures from standard. In addition to this, 29% and 41% of the Stopping Sight Distances Northbound and Southbound respectively, do not achieve current design standards.

2.4.25 The A5 has a level of approximately 69.00m AOD gradually rising to approximately 95.00m AOD as it moves south.

2.4.26 Part of the constructed A4 and A5 Corridor Improvements scheme, included the realignment of 2.7km of the A5 between Ballygawley and Aughnacloy known as the Tullyvar scheme. The scheme followed the existing A5 and then moved off-line as it approached Tullywinny Road to avoid sharp bends in the existing road. The scheme then tied back onto the existing A5 south of the existing crossroads with Lisginny Road and Aghaloo Road. Climbing lanes have been provided in both directions on Tullyvar hill which has a rising gradient up to 120.00m AOD.

2.4.27 The A5 continues in a south-easterly direction to Aughnacloy before joining the existing N2 at Moy Bridge.

Public Utilities

2.4.28 Apparatus for the supply of electricity and potable water, the removal of waste water, and the provision of telecommunications all exist in Section 3. These apparatus are concentrated in and around settlement areas and are generally located in or above the existing highway network. Between settlements, the existing A5 provides an important utility corridor for water and telecommunications supply. Apparatus for the supply of electricity and trunk water mains also traverse this section away from the existing highway network, Details of the major undertaker's apparatus can be found in drawings 718736-0100-D-30016 to 30018 in Volume 2.

Electricity

2.4.29 NIE operate an extensive network of overhead and underground transmission and distribution apparatus within Section 3 that provides electricity to domestic and commercial premises.

2.4.30 Within this section, between Doogary and Aughnacloy there are currently no overhead 110kV transmission lines. A new 110kV line is proposed which will extend east and then southeast from Doogary to the 275kV substation at Tamnamore to the east of Dungannon. This proposed line runs east and broadly parallel to the existing A5. It is expected that this line will be completed in 2016.

2.4.31 Between Doogary and Ballygawley there is a 33kV line which runs from Doogary substation, south of Omagh, broadly parallel but remote from the existing A5, crossing it to the south east of Garvaghy. Further to the south, 33kV lines run south east from Ballygawley to Aughnacloy and south west from Ballygawley towards Augher. More 33kV lines exist in the vicinity of Aughnacloy, running broadly parallel to the existing A5, the A28 Caledon Road and the B35 Carnteel Road. All of the above mentioned 33kV lines are laid across green fields.

2.4.32 A new underground 33kV distribution line was laid in Seskinore Road at Doogary early in 2010. This conductor connects Screggagh windfarm to Doogary substation.

2.4.33 A more extensive network of overhead 11kV lines is connected to the 33kV lines and provides electricity supply to dwellings and properties in the rural areas between settlements. This network is generally remote from the existing highway network, which it crosses occasionally, instead crossing green fields. Within settlements and towns, underground MV conductors, laid within the existing highway boundaries supply power to properties.

Water Mains and Sewers

2.4.34 The majority of the water supply network serving the rural areas between Doogary and Aughnacloy are small diameter (80-150mm) gravity distribution mains laid in the existing minor road network.

2.4.35 Between Doogary and Aughnacloy a 80-150mm diameter distribution mains have been laid in the existing A5 at a number of locations to connect settlements located in the vicinity of the A5 to potable water storage facilities.

2.4.36 Three larger diameter trunk gravity distribution mains are laid in the following locations; close to Seskinore Road (300mm ductile iron), in Ballysaggart Road (225mm PVC) and in the A4 Annaghilla Road (180mm HPPE).

2.4.37 The largest diameter apparatus in Section 3 is a 450mm ductile iron trunk water main which is located in Glenhoy Road, to the west of Ballygawley. This main links Tattinbar service reservoir with Glenchuil service reservoir.

2.4.38 The public waste water network within this section generally consists of sewers smaller than 300mm diameter which are limited in extent mainly to the settlements of Ballygawley and Aughnacloy. Most domestic and commercial premises located in rural areas are served by private septic tanks.

Telecommunications

2.4.39 BT has a network of overhead and underground apparatus located alongside and below the existing road network. Between Doogary and Aughnacloy underground trunk fibre optic and copper cables are located in ducts below the existing A5 which is a primary corridor, as well as below the B83 Seskinore Road, A4 Annaghilla Road, Loughans Road, B35 Carnteel Road and A28 Caledon Road.

2.4.40 Furthermore, there is an extensive network of overhead copper BT apparatus which has been placed on wooden poles in the verge of most of the minor roads.

2.4.41 Virgin Media, Eir and Atlas Communications (NI) have trunk fibre optic apparatus laid inside a shared 4-way duct in the existing A5 that extends south of Omagh to Ballygawley, where it then runs east along the existing A4 carriageway. Cable and Wireless have services located to the south of Aughnacloy, which is laid in the existing A5 Monaghan Road and the A28 Caledon Road.

2.4.42 EE (formerly T-Mobile and Orange), Vodafone and O2 have a number of mobile phone masts located in Section 3. In particular, these are located in Ballygawley and Aughnacloy, on Black Hill to the South East of Garvaghy and adjacent to the existing A5 at Tullyheeran.

Miscellaneous

2.4.43 Current utility information indicates that there are no gas apparatus or gas pipelines located within Section 3.

2.4.44 There are future plans to bring a natural gas transmission line from Portadown to Enniskillen. This line may cross the existing A5 to the south of Omagh in the vicinity of Seskinore Road. Proposals for a distribution network served by this transmission pipeline have not yet been published.

Geotechnical

2.4.45 The ground conditions in Section 3 of the scheme break easily into 3 zones which are defined by the underlying geology and in particular two prominent southwest-northeast trending geological faults.

- Omagh – Gortaclare/Seskinore – Poorly developed Drumlin Topography)
- Seskinore/Gortaclare – Ballygawley (the Slievemore Ridge)
- Clogher Valley & Aughnacloy – (Pronounced Drumlin Topography)

2.4.46 The northern and southern blocks are relatively low lying (drumlin landscapes) with the Brougher/Slievemore Ridge forming a block of high ground between them.

2.4.47 Reference should be made to the Ground Investigation Report (718736-0600-R-008) for a detailed discussion of the ground investigation results.

Topography

2.4.48 The northern section (north of Seskinore/Gortaclare) is relatively low lying, with a number of poorly developed drumlins scattered across the landscape. Drumlins vary between 4m and 10m high, are irregular in extent and typically have 1:10 to 1:5 side slopes. There are a number of areas of flat ground occupied by peat bogs between Omagh and Moylagh.

2.4.49 Continuing southeast, between Gortaclare and Ballygawley, this section consists of an east north east – west south west trending ridge of relatively high ground, dominated by the summit of Slievemore (313m AOD) and Tycanny Hill. The north-west facing slopes of this ridge fall at a shallow gradient towards Omagh and are cut by broad, shallow valleys of the Routing Burn and its tributaries.

2.4.50 Conversely, the steep south-east facing slope, which is fault controlled, is typically a 1:5 gradient, though locally as steep as 1:3. The ridge is crossed by a number of valleys which have been adopted by the current A5 alignment north-west of Ballygawley and by other minor roads. These valleys are narrow, sinuous, and steep sided. The Proposed Scheme follows one of the steep sided valleys beneath the western slopes of Tycanny Hill.

2.4.51 Land is also constrained by development around the settlement areas of Eskragh and Newtownsaville.

2.4.52 In the Clogher Valley, the terrain comprises very closely packed drumlins. The drumlins here are better developed and higher than around Omagh, with heights up to 20m and side slopes of 1:8 – 1:5. Deep inter-drumlin areas are often infilled with soft soils. The valley is crossed by the Ballygawley Water and Blackwater River, both of which have locally broad, flat flood plains which are 50m to 300m wide.

2.4.53 To the east of Aughnacloy & Ballygawley, the ground rises to form the rocky high ground of Big Hill, Burnt Hill & Branny Hill (120m AOD) which have localised steep west facing slopes.

Superficial (Drift) Geology

Topsoil

2.4.54 Topsoil can be observed along the route up to 1m in thickness although it is generally around 0.3m thick. There is very little presence of Made Ground, but, where it was encountered thicknesses varied between 0.4m and 2.8m. Made Ground is encountered in isolated small areas, possibly as a result of unofficial landfilling/raising or associated with road construction.

2.4.55 South of Moylagh, as far south as Errigal, superficial soils are often thin or locally absent, especially on the high ground of Brougher/Slievemore Ridge and Tycanny Hill and the underlying rock is indicated to be close to surface. The high ground to the east of Aughnacloy is also largely devoid of any superficial cover, with bedrock at or close to surface.

Peat

2.4.56 Extensive peat bogs are present in the north of this section around the Tattyreagh – Seskinore Forest area with a large bog present south of Doogary. While the Proposed Scheme avoids most of these bog areas, those at Doogary and Seskinore Road impact upon the scheme and the peat in those areas varied from 3 to 7m thick.

2.4.57 Extensive blanket peat bog covers the very high ground (not affected by the scheme), but there are also pockets of peat in local hollows, such as can be found to the south of Newtownsaville at the Beltany Bog near Cormore Road which is up to 8m deep.

2.4.58 In the Clogher valley area in the south of the section, as far south as the border, many of the inter-drumlin hollows are infilled with a mix of peat and soft clay / silt of a fen-type origin. Typically these are between 1 and 3m deep, but locally as much as 5m deep. The proportion of peat and clay varies greatly between these deposits, but largely meets the classification of very organic clay.

Alluvium & Lacustrine Deposits

2.4.59 According to published geology, alluvium occurs in areas associated with existing designated watercourses or historic watercourses, predominantly in the area of Rannelly Drain, Letfern, Routing Burn, Roughan Burn, Ballygawley Water, Tullyvar and Lisadavil Burns. Ballygawley Water and particularly the Blackwater River have wide, but very variable flood plains of soft and variable clay/sand alluvial soils.

2.4.60 Alluvium was encountered during the main ground investigation within these areas and ranged in thickness from less than a metre, up to 4-5m, though with a single extreme maximum of 16.75m at the point where the proposed scheme crosses the Ballygawley Water.

2.4.61 Published geology indicates lacustrine deposits (also known as lake alluvium), along the route at Tullyrush Road. Lacustrine deposits are considered to have been formed in post-glacial lake environments.

Glacial Deposits

2.4.62 South of Omagh is an area of poorly developed drumlins and locally thick layers of glacial till. Both these tend to be firm red brown very stony clay. Between the drumlins, the hollows have become infilled with soft weathered clay, silt and sometimes peat.

2.4.63 The glacial Ballygawley delta complex of outwash sands and gravels which extended north-west from the ridge has left some widespread deposits of sand and gravel, the closest being at Eskragh, west of the Proposed Scheme.

2.4.64 Superficial deposits are thickest in the Clogher Valley, where extensive glacial till surmounted with drumlins is present. Like those near Omagh, the drumlins consist of stony firm clay, but the hollows between drumlins are infilled with soft clay, alluvial soils and sometimes peat. These can locally be of substantial thickness.

Bedrock (Solid) Geology from Published Records

2.4.65 Section 3 is underlain by Devonian and Carboniferous age rocks that are dominated by sandstone, but with some mudstone and (in the south) limestone. As described above, the strata are divided into 3 distinct fault blocks defined by 2 major east-north-east – west-south-west trending faults:

- The Killadeas – Seskinore Fault and Tempo – Sixmilecross Fault in the north.
- The Clogher Valley Fault complex in the south.

2.4.66 The former two faults coalesce close to Moylagh and the eroded fault zone is reflected in the terrain forming the low lying ground in the centre of the village.

2.4.67 South of Omagh, the strata in the Fintona block are formed of the Shanmullagh Formation, of Devonian age. The Shanmullagh Formation is a brown, coarse, pebbly sandstone, with inter-bedded bands of purple sandstone and mudstone. Outside the peat bogs and between drumlins, this sandstone is indicated to be quite close to the ground surface.

2.4.68 The major faults are clearly visible in the terrain mapping between Gortaclare and Ballygawley, and the up-thrust central block forms the Brougher/Slievemore Ridge, which comprises coarse conglomerates (and minor volcanic lavas) of the Gortfinbar Conglomerate Formation, again of similar Devonian Age. The conglomerate contains mainly volcanic cobbles, with some quartzite and sandstone. Throughout this area of high ground, the conglomerate and sandstone will be very close to surface.

2.4.69 The Clogher Valley Fault consists of a complex of several interlinked faults and some of these have dropped down blocks of the younger Ballyness (sandstone) and Clogher Valley (mudstone) Formations. The Clogher Valley Fault complex defines the steep south eastern face of the Brougher/Slievemore Ridge.

2.4.70 The Clogher Valley is underlain by Carboniferous age rocks of the Clogher Valley and Maydown Limestone Formations. The Clogher Valley Formation is a fossiliferous mudstone, with bands of sandstone and limestone, while the Maydown Formation is a fossil rich limestone. This forms the high ground east of Aughnacloy and is one of the few strata in the district that may be a significant groundwater resource. Karstification of the limestone is however not known to be an issue in this area.

Superficial (Drift) Geology Encountered in the Ground Investigation

Glacial Till

2.4.71 Glacial till deposits along the route are the most abundant of all the superficial deposits. They are described in the published geology and from historical borehole records as soft to firm sandy gravelly clay and silt with cobbles and boulders, with bands of medium dense to dense clayey silty sand and gravel. General thicknesses of these deposits range between 1m to greater than 35m, where large drumlins are present.

2.4.72 Information obtained from the ground investigation confirmed what was anticipated from the published geology and the historical borehole records. However, there are significant bands of cobbles and moderate to large boulders present within the clay.

Glacio-fluvial Sand and Gravel

2.4.73 The published geology indicates glacio-fluvial sand and gravel to be present along the route in small pockets at a few locations; Drumconnelly Road, north west of Newtownsaville, Rarogan Road, south west of Ballygawley, and east of Aughnacloy. These deposits are located in the vicinity of current and historic watercourses, although deposition is associated with glacial origins from outwash fans.

2.4.74 The main ground investigation confirmed that glacio-fluvial sand and gravel deposits corresponded with that anticipated from published geology. The thickness of the deposits, as observed by the main ground investigation, ranged from 1.8m to 3.8m.

Bedrock (Solid) Geology Encountered in the Ground Investigation

2.4.75 South of Omagh to Seskinore the bedrock comprises sandstone of the Shanmullagh Formation and was found typically at 4m depth in the interdrumlin areas, becoming shallower with progression towards Seskinore, where rock is close to the surface at less than 1m depth.

2.4.76 Between Seskinore and Moylagh, the drift deposits overlie red sandstone bedrock of the Raveagh Formation at depths of up to 7m depth. Further south, between Moylagh and Ballygawley, the ground comprises thin deposits of glacial till overlying bedrock, which comprises purple conglomerate of the Gortfinbar Conglomerate Formation with rockhead typically between 0.5m and 4m depth. Rock cuttings in the hills around Tycanny Hill and Errigal will be formed of this stratum

2.4.77 South of Ballygawley to Aughnacloy bedrock comprises black mudstone of the Clogher Valley Formation or grey argillaceous limestone of the Maydown Limestone Formation. Bedrock is typically found at between 4m and 6m depth in interdrumlin areas.

Potentially Contaminated Sites and Land

2.4.78 Potentially contaminated sites located within or immediately adjacent to the areas required for construction are given in Table 2-21 along with their relative hazard level. A summary of the results of the ground investigation is given below, however reference should be made to the Ground Investigation Report for a detailed discussion.

Type	Location	Risk
Back Filled Gravel Pit	Moylagh Road Junction	Medium
Back Filled Gravel Pit and Brick Kiln	Greenmount Road	Medium
Made Ground	South of Newtownsaville	High
Back filled Quarries and Gravel Pits	Clogher Valley and Augnacloy	Medium
Tullyvar Landfill	Clogher Valley and Augnacloy	High
Reclaimed Landfill	Aughnacloy	High
Back filled Quarries	West of Old Chapel Road	Medium

Table 2-21: Potentially Contaminated Sites under or Immediately Adjacent to Proposed Scheme – Omagh to Aughnacloy

2.4.79 With the exception of Tullyvar landfill (not affected by the Proposed Scheme), these sites were sampled and chemically tested where they are intersected by the route. In addition, selected samples of “Greenfield” soils were also tested to determine the natural background concentrations.

2.4.80 Background concentrations of ammonium and ammonia were found to be higher than expected, though commensurate with agricultural land use involving moderate to high fertiliser use. There was also local evidence of high (alkaline) pH levels.

2.4.81 Samples primarily relating to areas of overlying peat were found to be highly acidic. Samples taken between Omagh and Aughnacloy also contained phytotoxic concentrations of boron.

2.4.82 Random elevated local concentrations of copper, zinc, sulphate and lead were locally recorded which may be a potential risk to the aquatic environment.

2.4.83 In the brownfield areas, copper, zinc and sulphate were elevated in the area of fly tipping at Newtownsaville bog. These levels may prove a risk to the aquatic environment.

2.4.84 With respect to the ground conditions of the route near the active and backfilled landfills in the Clogher Valley, and near Aughnacloy, concentrations of boron were recorded which exceeded phytotoxicity levels. Local exceedances for copper and zinc were recorded at the disused limestone quarry south of Tullywinny Road which may prove a risk to the aquatic environment.

Mineral and Mining Resources

2.4.85 A limited number of small backfilled quarries and gravel pits are located under the route footprint. The main locations are at Moylagh Junction, west of Old Chapel Road and east of Old Chapel Road. There is no active mineral extraction in the immediate vicinity of the scheme, the nearest being gravel workings at Eskragh.

2.4.86 GSNI have indicated that there is no current or proposed metal, oil or coal extraction in the area.

Drainage and Hydrology

2.4.87 The existing drainage and hydrological features along Section 3 of the Proposed Scheme are described in this section. Specific engineering constraints are outlined in conjunction with information relating to flooding considerations.

2.4.88 Preliminary hydrological assessments have been made in order to ascertain the principal rivers and associated drainage basins along the path of the Proposed Scheme. The main drainage basins are shown in Figure 2-35. The River Blackwater catchment does not form part of the Foyle basin and drains away to the south.

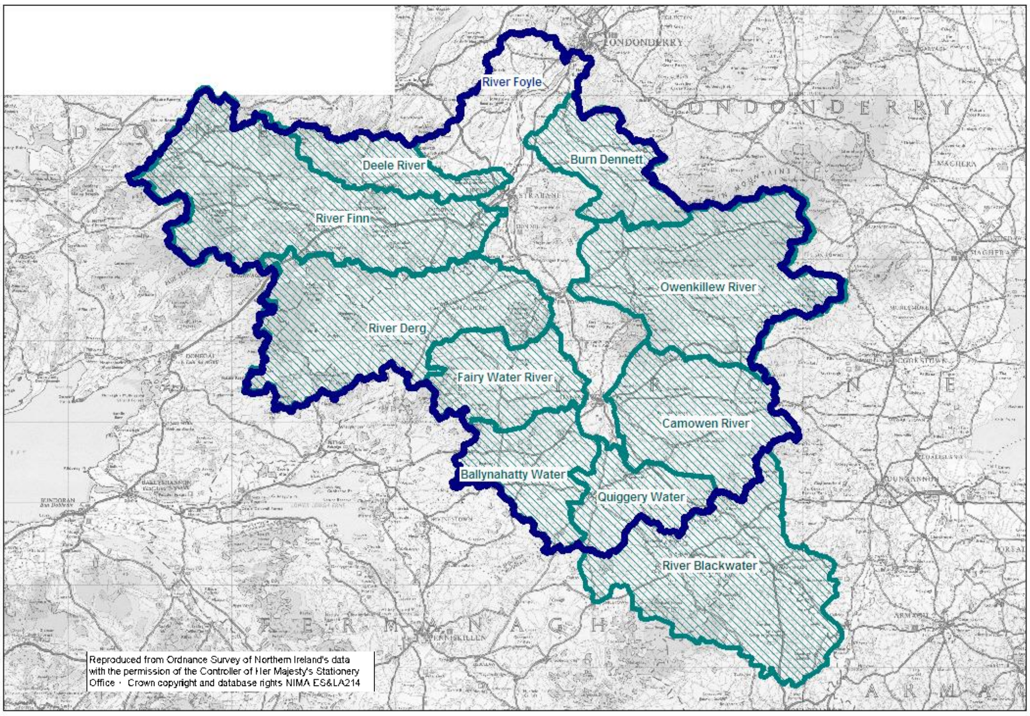


Figure 2-35: A5WTC Drainage Basins

2.4.89 This section incorporates 3 main hydrological catchment areas. The Camowen basin and the Quiggery Water basin feed into the main River Foyle catchment basin and flow north towards Lough Foyle. The River Backwater catchment in the southern region of the study area supplies the Blackwater and conveys flows towards Lough Neagh.

2.4.90 The Camowen watercourse is approximately 30km in length and flows from its source in the Cappagh Mountain area to the east of Omagh to its point of discharge into the River Strule at Drumragh Bridge in Omagh. Major tributaries of the watercourse include the Cloghfin River, the Owenbrack River, the Altanagh River and the Sluggan River. The catchment area of the watercourse is predominately rural but it does incorporate the small urban catchments of Sixmilecross and Beragh.

2.4.91 The Owenreagh River (Dromore) and Quiggery Water River converge at Relaghdooey approximately 4km south-west of Omagh to form the Drumragh River, which then flows for 8km in a northern direction until its confluence with the Camowen River to form the Strule River. The Quiggery Water is formed when the Seskinore and Fintona Rivers converge in Tattyreagh, between Omagh and Fintona. Upstream tributaries of the Seskinore River include the Routing Burn and the Eskragh River which converge approximately 2.5km south east of Seskinore. In general, these watercourses flow from a south-east to north-west direction and in doing so feed into the major river systems.

2.4.92 The principal watercourse in the River Blackwater hydrological catchment basin is the Ballygawley River, which crosses at the south end of the Preferred Corridor. The Ravella and the Aughnacloy River minor watercourses also cross at Aughnacloy.

2.4.93 The Proposed Scheme affects the Camowen basin between Doogary and Moylagh; the Quiggery basin between Moylagh and Tycanny Hill and the River Blackwater catchment between Tycanny Hill and the border.

2.4.94 Through discussions with TransportNI Maintenance Section Offices and Rivers Agency, it is known that sections of the existing A5 within Section 3 have been prone to historical flooding.

- The area to the west of Ballygawley roundabout is liable to flooding.
- Low-lying ground around the River Blackwater near Aughnacloy is liable to flooding.
- Fields at the side of the Tattyreagh Road are liable to flooding.

2.4.95 There are narrow floodplains running parallel to a number of watercourses within this section. These include the Cloghfin River, the Drumragh River, the Quiggery Water, the Owenreagh River (Dromore), the Fintona Water and the Seskinore. In general, these floodplains vary in width from approximately 100m to 400m.

2.4.96 The Ballygawley River Floodplain varies from 100m to 500m wide near Ballygawley. The Ravella and Aughnacloy River floodplains approach 1km wide to the west of Aughnacloy. The Lisadavil River Floodplain to the east of Aughnacloy is approximately 200m wide.

2.4.97 The potential for minor floodplain areas have also been identified for the following watercourses: the Roughan River, Annaghilla River, Ballynanny River, and the Tullyvar River.

Existing Structures Conditions

2.4.98 This section deals with the assessment of the condition of the existing structures, recommendations on any remedial works required and comments on the options for widening each structure in Section 3. For those sections of the existing route where there are significant constraints to widening the route, such observations are made.

Summary of Route

2.4.99 There are 11 significant structures in Section 3 greater than 1.8m in span. During the recent upgrading of the existing A5 south of Ballygawley, a number of new structures were constructed. However, as these structures were all under 1.8m in span they do not feature in the lists below.

2.4.100 There are two structures which are not on the existing A5 but would be affected by the Proposed Scheme. The first carried the Tullybryan road over the Ballygawley Water. This is a two span Reinforced Concrete (RC) structure with two clear spans of 7.5m and, from the information currently available, is in fair-poor condition. The second carries the A4 over the Ballygawley Water. This is a single span RC structure with a clear span 15m and, from the information currently available, is in good-fair condition. The structure has undergone minor upgrading work to parapets and barriers as part of the recent A4 and A5 Improvements Project.

2.4.101 All of the bridges carry the existing A5 over watercourses with no road over road bridges. This is typical of routes in such landscapes where most junctions are at grade. Generally, the structures are not very large with a median span of 4.3m but with a maximum span of 15.00m.

Function	Number
Footbridge Over Road	-
Road Over Accommodation	-
Road Over Pedestrian Subway	-
Road Over Road	-
Road Over Watercourse	11
Grand Total	**11**

Table 2-22: Bridges by Function in Section 3

2.4.102 As indicated in Table 2-22 above, there are a total of 11 significant bridges (i.e. > 1.8m span) on the route. Additionally, there are 3 retaining walls over 1m high which either support the road or retain landscape and/or structures adjacent to the A5. The vast majority of these structures are in fair to very good condition and, when considered in isolation, most could be modified for use in a scenario where the existing A5 was widened to dual carriageway. There are also a number of smaller structures (less than 1.8m span) along the A5 although these were not thoroughly inspected and no condition ratings were assigned.

Structure Types

2.4.103 Of the significant bridges, there are a wide variety of construction types, with some of mixed construction where the structure has already been widened.

Structure Type	Number
Composite Concrete & Steel	
Concrete Arch/Masonry Arch	
Concrete Box Culvert	2
Corrugated Steel Pipe	2
Half Joints	
Masonry Arch	1
Masonry Arch/RC Slab	1
Prestressed Concrete Beams	1
RC Pipe	
RC Slab	4
RC Slab/RC Pipe	
Steel Truss/Steel Plate	
Grand Total	**11**

Table 2-23: Significant Structures by Road Section

2.4.104 In addition, there are a number of small culverts (less than 1.8m) whose construction was often unclear as they were submerged or otherwise hidden.

2.4.105 Three retaining walls (>1m high) were identified along the route where failure may impact on the carriageway. There does not appear to be a register of retaining walls for this route and therefore not all of the walls which were recorded in the survey may be in public ownership. However, they are included as they will need to be considered as part of any proposed A5 widening scheme. For convenience, these walls have been split into four arbitrary height bands:

- Small – less than 3m;
- Medium – 3 to 5m;
- Large – 5 to 9m;
- Very Large – Over 9m.

Section	Height Band				
	Small	Medium	Large	Very Large	Grand Total
3	2	1			3

Table 2-24: Significant Retaining Wall by Size and Road Section

2.4.106 Very few construction details were available for inspection for any of the major structures and none for the minor structures or the retaining walls. An assessment of the basic construction type is included in the national database and this has been used as a basis for this study. For the minor structures and retaining walls, no attempt has been made to classify the construction type.

2.4.107 The following tables indicate the size, type and general condition of the structures. As can be seen, the structures are of mixed size and construction type but are generally in fair to good condition throughout although there are a few structures which are in a poor condition. Some relatively minor defects are present and the key information about each structure is presented below.

NIRS Structure No	Structure Name	Structure Type	No of Spans	Span (m)	Width (m)
62139	Unnamed	Concrete Box Culvert	1	3.1	13.50
61587	Crawford's Bridge	Corrugated Steel Pipe	1	4.05	45.00
62208	Monteith's Culvert	Corrugated Steel Pipe	1	2.1	30.00
60733	Barony Bridge	RC Slab	1	5.8	15.90
62213	Unnamed	Concrete Box Culvert	1	2.5	27.30
60316	Clarkes Cattle Creep	RC Slab	1	6.2	17.00
60289	Glenchuil Big Bridge	Masonry Arch/RC Slab	1	4.3	22.50
60742	Unnamed	Prestressed Concrete Beams	1	9.05	16.80
61010	Unnamed	Masonry Arch	1	1.8	12.05
**	Tullybryan Road over Ballygawley Water	RC Slab	2	≈15	≈8
**	A4 over Ballygawley Water	RC Slab	1	≈15	≈17

Table 2-25: Section 3 Structures – Construction Types and Size

*** Detailed information not available*

NIRS Structure No	Structure Name	Overall Assessment (Average)	Overall Assessment (Critical)
62139	Unnamed	Fair	Very Poor
61587	Crawford's Bridge	Fair	Fair
62208	Monteith's Culvert	Good	Very Good
60733	Barony Bridge	Fair	Fair
62213	Unnamed	Poor	Very Poor
60316	Clarkes Cattle Creep	Poor	Very Poor
60289	Glenchuil Big Bridge	Fair	Fair
60742	Unnamed	Fair	Very Poor
61010	Unnamed	Fair	Very Good
**	Tullybryan Road over Ballygawley Water	N/A	N/A
**	A4 over Ballygawley Water	N/A	N/A

Table 2-26: Section 3 Structures – Condition Ratings [Scores are based on draft Highways Agency standard performance measurement of highway structures (PMHS)]

*** Detailed information not available*

Retaining Walls

Mouchel Structure No	Wall Length (m)	Wall Height (m)	Function	Overall Assessment
DUN7	80	3	Supports the A5	Very Good
DUN8	80.2	2.75	Supports the A5	Very Good
DUN20	35	2	Supports Farmland	Very Good

Table 2-27: Section 3 Retaining Walls – Size, Function and Condition [Scores are based on draft Highways Agency standard performance measurement of highway structures (PMHS)]

Widening Issues

2.4.108 Approximately one third of the structures in Section 3 would be difficult to widen on line. Typically, the structure itself could be widened but there are existing constraints adjacent to it.

2.4.109 Another one third of the structures could readily be widened on line, if required.

2.4.110 The remaining structures would best be replaced, either because they are in poor condition, present vertical alignment difficulties or are considered to be at high risk of needing major repairs in the short to medium term.

Structural Capacity

2.4.111 The assessed capacity of the structures is reported in the Department's database although the records were not complete at the time of inspection.

2.4.112 Of the 11 bridges, 9 have been assessed as having 40 Tonne HA loading capacity. 5 bridges are rated at 45 units HB, 2 at 37.5 units HB and 1 at 30 units HB. The remaining structure has no HB rating. Information on the remaining 2 structures was not available.

Existing Pavement Conditions

2.4.113 In 2010 a detailed pavement survey was carried out which analysed the condition of the existing A5 pavement condition under the following headings:

- Deflectograph
- Visual Survey

2.4.114 The findings of this survey were reported in the Preferred Options Report. Since that date several maintenance and local realignments works have been carried out along the length of the existing A5.

2.4.115 Since 2009, the following carriageway structural maintenance works have been undertaken-

- Omagh Road, Ballymackilroy from Ballynasaggart towards Omagh, 1.3km
- Omagh Road, Ballymackilroy to Black Hill, 1.6km
- Curr Road from 880m north of Church Road, Dervaghroy towards Augher point road, 0.6km

- Monaghan Road, Aghnacloy at Old Customs House, 0.2km
- Doogary Road, including the junctions at the Camowen, Tattykeel and Drumconnelly Roads, 0.21km
- Curr Road, Omagh from Church Road to Crannoge Road, 1.1km
- Omagh Road, Ballygawley between the junctions of Cavey Road and Ballynasaggart Road, 1.45km
- Curr Road from 100m before Newtownsaville Road to past John Deere tractors, 1.26km
- Tullyvar Road from Moore Street to 300m past Hill Crest toward Ballygawley, 1.13km

Existing Traffic Conditions

Traffic Flows

2.4.116 Figure 2-36 below shows typical flows along roads in Section 3 of the A5WTC scheme. These values are 24 hour October weekday (Monday to Thursday) vehicle flows in 2013 derived using all Mon-Thurs flows other than the week leading into half term.

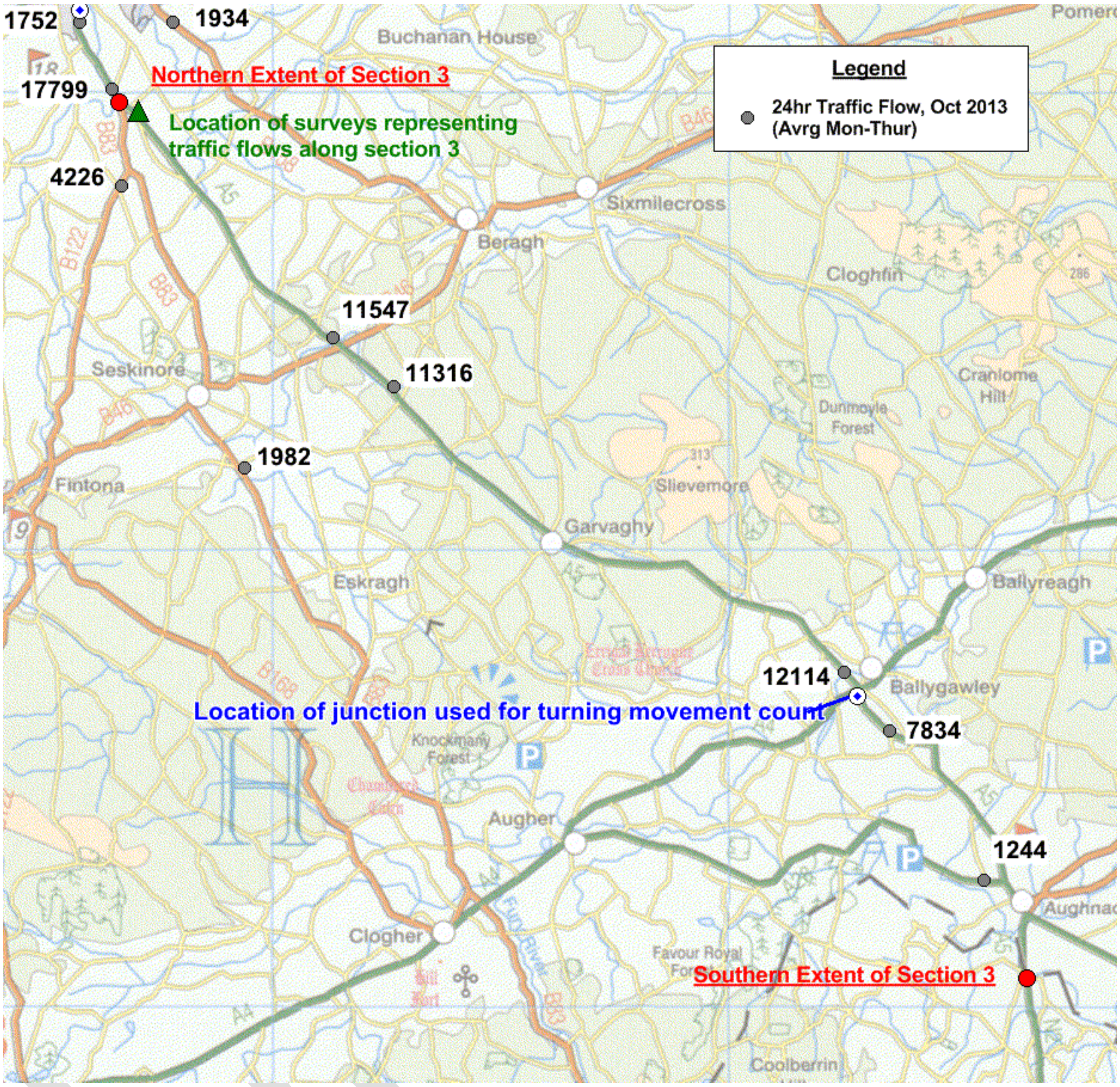


Figure 2-36: 24 hour traffic flows in vicinity of Section 3 (Avg Mon- Thurs, October 2013)

2.4.117 Traffic analyses have been prepared for the location shown by the green triangle on Figure 2-36. This is located on the A5 south of Omagh and is a TransportNI long term ATC site (Site 610). The monthly flow and daily flow analyses are presented in Figure 2-37 and Figure 2-38 respectively.

2.4.118 Figure 2-37 shows there to be moderate seasonal variation at this location. It is considered that the traffic flows for October 2013 are close to the annual average and are therefore reasonably representative of flows throughout the whole of 2013.

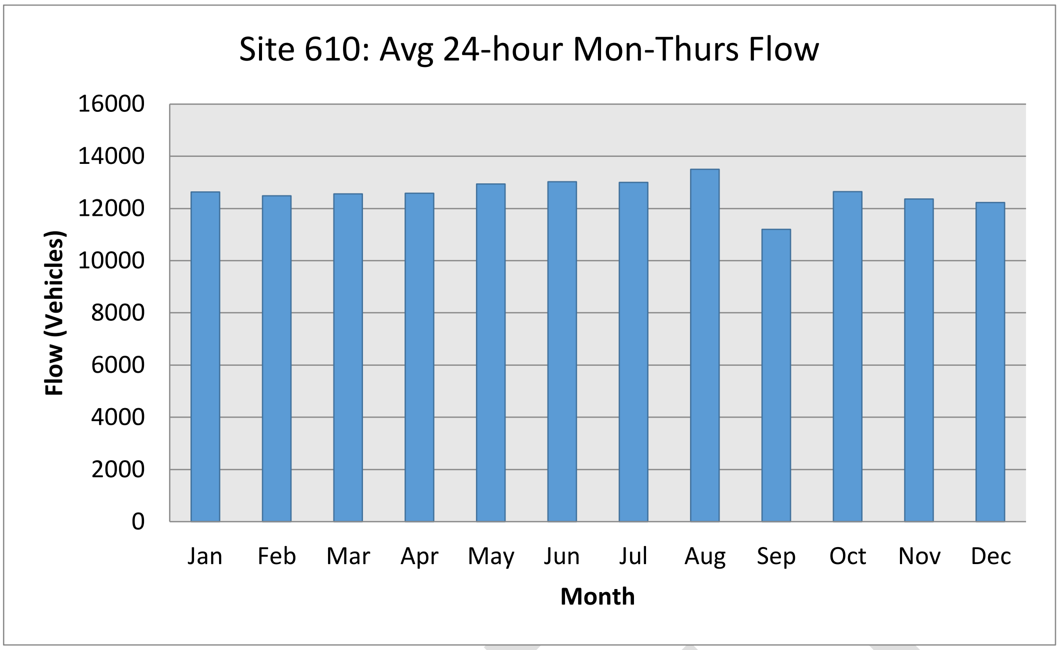


Figure 2-37: Seasonal variation of traffic flows on the A5 during 2013 in Section 3 (Avg. Mon- Thurs)

2.4.119 Figure 2-38 illustrates the average daily variation of flow during October 2013. This shows that the PM peak flow is marginally higher than the AM peak flow.

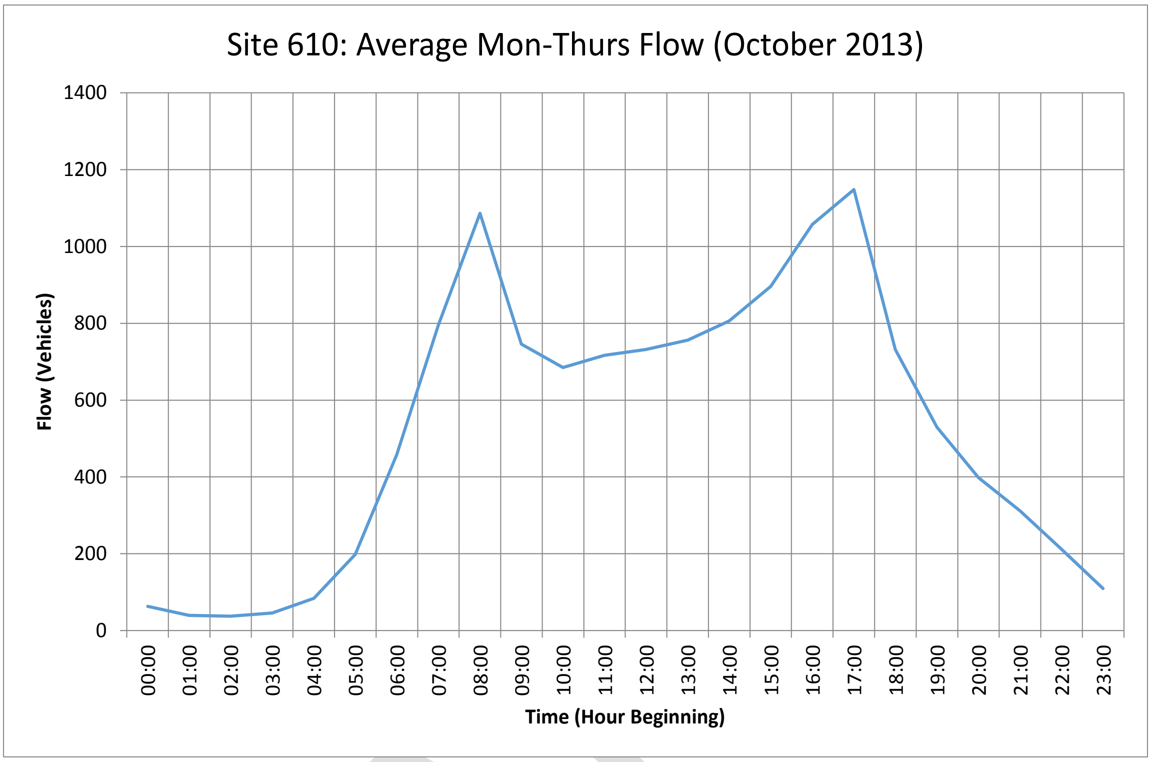


Figure 2-38: Daily flow profile on the A5 to the south of Omagh (Avg. Mon- Thurs, October 2013)

2.4.120 The layout of the junction of the A5 with the new A4 (Annaghilla Road) is shown in Figure 2-39. Turning movements at this junction are shown in Figure 2-40. These data are from a turning movement count (MCC 27) carried out in 2013.

Figure 2-39: Junction on the A5 with the A4 to the south of Ballygawley

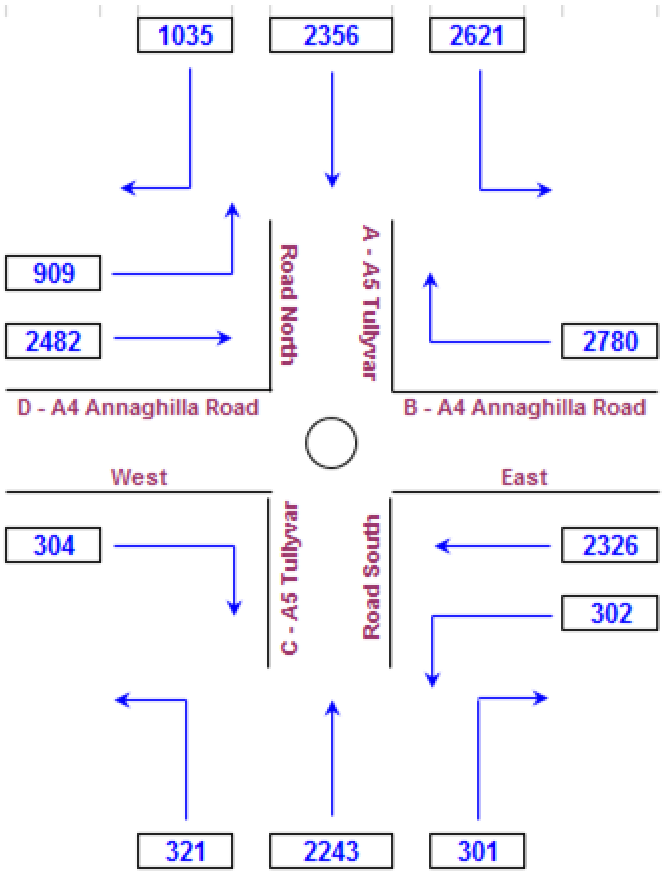


Figure 2-40: 12 hour vehicle flows at junction on the A5 with the A4 to the south of Ballygawley (Tuesday 15th October 2013)

2.4.121 The major movement at this site is between the A4 east and the A5 north. The movement between the A5 south and the A5 north is also strong, although A4 east to A4 west is marginally stronger. The movements between A5 south and the A4 in both directions are very much weaker.

2.4.122 The proportions of vehicles by type at this location are shown in Figure 2-41 below.

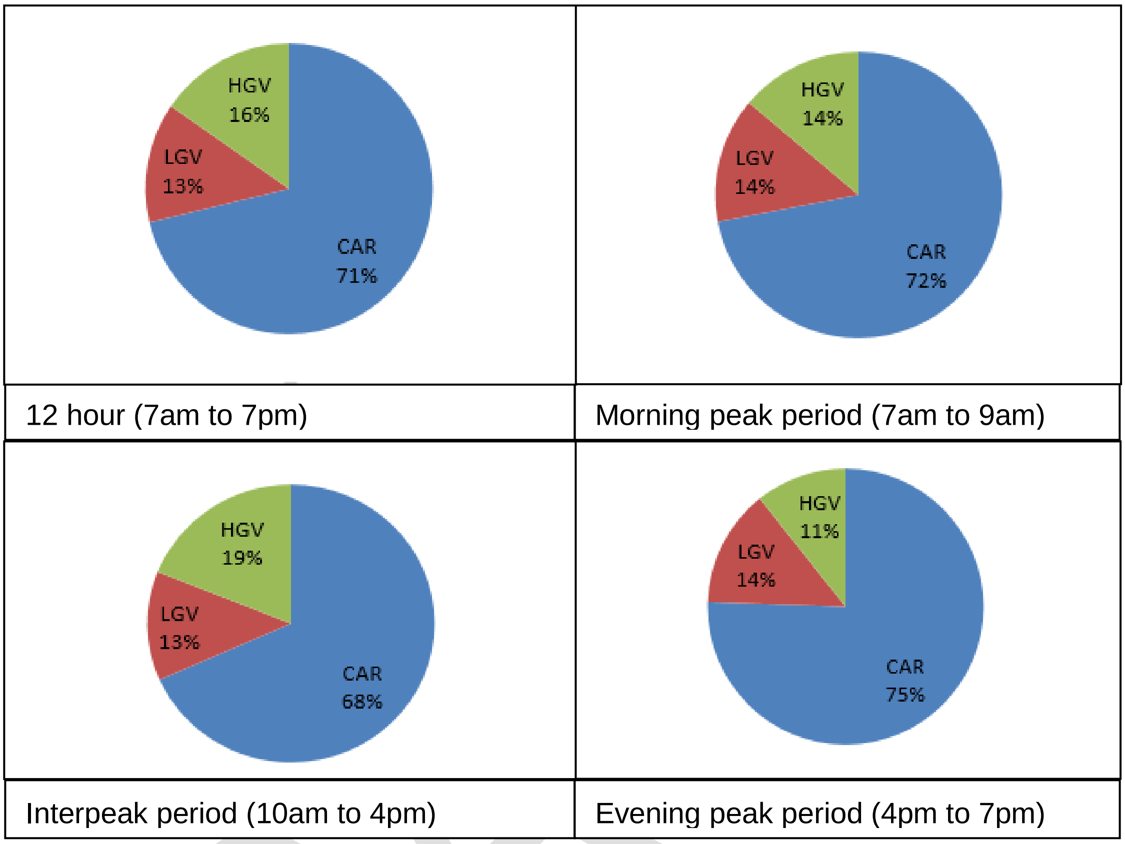


Figure 2- 41 Vehicle proportions at the junction on the A5 with the A4 to the south of Ballygawley (Tuesday 15th October 2013)

2.4.123 Figure 2-41 indicates that there is a lower proportion of cars at this location in all time periods by comparison with the other sections along the A5. As a result there are larger proportions of goods vehicles and in particular HGVs during all periods.

2.4.124 As this location is close to the intersection of the A4 and A5, which are both major strategic corridors, and relatively far from any substantial settlement, it is likely that the vehicle proportions reflect the dependence of Northern Ireland on road transport for freight, combined with a lower level of local journeys for commuting and other private purposes.

Major Traffic Movements

2.4.125 Roadside interview surveys to establish origin destination patterns were carried out in April 2014 just north of Aughnacloy. A survey was also undertaken in June 2014 at Tattykeel to the south of Omagh. The findings of these surveys are reported more fully in the Data Analysis Report.

2.4.126 The site at Aughnacloy was surveyed in the southbound direction. Half of the observed trips had destinations in the ROI, of which over one third had originated in Co Donegal. A further fifth of the total movement was local traffic in the area around Aughnacloy.

2.4.127 The site at Tattykeel was surveyed northbound. 60% of trips here had destinations in Omagh and its surroundings. One third of these originated in the southeast of the province, including Belfast, and are likely to have used the A4. Almost 15% of total trips were heading for Co Donegal, but less than 5% for the area around Londonderry.

Journey Time Analyses

2.4.128 A journey time analysis was undertaken as described commencing in earlier paragraphs of this report with the routes illustrated in Figure 2-15.

2.4.129 Section 3 is approximately 30 km long and comprises routes 13/14, 15/16, 17/18 and 19/20, running from south of Omagh to the land border south of Aughnacloy.

2.4.130 It can be seen from the results shown in Table 2-11 and Figure 2-16 that journey times over these sections are fairly consistent over the three periods of the day, although the first section south from Omagh is slightly slower in the inter-peak than in either peak period. The reason to this is currently being investigated further.

Section Three Accident Data Analysis

2.4.131 The ‘combined link and junction’ accident statistics for the A5 in Section 3 are shown in Table 2-28.

Section 3	LINK DETAILS								
Combined Link and Junction Accident Statistics	Road Type	AADT	Length (km)	Total Observed PIA	Slight	Serious	Fatal	Observed Accident Rate (PIA/million vkm)	Observed Fatal and Serious to PIA ratio
A5, Main Line Links									
Omagh to A4	A-road	11455	26.1	53	43	8	2	0.10	0.25
A4 to Aughnacloy	A-road	7121	6.1	16	13	2	1	0.20	0.25
Aughnacloy (Urban)	A-road	7056	1.8	3	2	1	0	0.13	0.13

Table 2-28: Accident statistics for Section 2 of the A5 WTC (links and junctions combined) for the period 2008 to 2012

2.4.132 Along the A5 between the south of Omagh and the land border at Aughnacloy, a length of approximately 34km, a total of 72 PIAs were recorded for the period 2008 to 2012. This included three fatal accidents, two of which occurred between Omagh and the A4 at Ballygawley and one between the A4 and Aughnacloy.

3 SCHEME DESCRIPTION

3.1 Introduction

3.1.1 This Section describes the key components associated with the construction of the Proposed Scheme (2016), hereafter referred to the Proposed Scheme.

3.1.2 The key design aspects of the scheme comprise the carriageway and associated earthworks, junctions, side roads, structures, drainage, lighting, landscape proposals, flood mitigation and compensation, land take, deposition areas and environmental mitigation measures. This section also considers the incorporation of alternatives into the Proposed Scheme.

3.1.3 The assessment of impacts, the proposed mitigation and the potential residual environmental effects of the Proposed Scheme are contained in the 2016 Environmental Statement (ES) (718736-3000-R-008).

3.1.4 Detailed design for part of the 2010 scheme, Phase 1, commenced following a positive outcome of the statutory processes for the scheme including the Public Inquiries that were held from 23rd May 2011 to the 1st July 2011.

3.1.5 The recommendations as set out in the A5 Western Transport Corridor Public Inquiry Report dated February 2012 have, where appropriate, been incorporated into the Proposed Scheme.

3.1.6 The Proposed Scheme has also taken cognisance of the changes to the current engineering and environmental standards. Coupled with elements from the previous processes the changes in standards have been included in the development of the specimen design of the 2016 scheme.

3.1.7 Any further modifications would be subject to approval by the Department who, as promoters of the Proposed Scheme, would ensure that those responsible for the detailed design would demonstrate that such modifications would not detrimentally change the significance of the impacts described in the 2016 ES.

3.2 Incorporation of Alternatives into the Proposed Scheme

3.2.1 Prior to the finalisation of the 2010 Proposed Scheme, consideration was given to 31 alternatives in certain discrete areas arising from the updating of baseline information and stakeholder consultations.

3.2.2 All the alternatives were considered against the process indicated in the flowchart in Appendix 3A. This determined that a number of the alternatives justified full consideration and assessment prior to consideration for incorporation into the Proposed Scheme.

3.2.3 Online widening of the existing A5 was also reconsidered as an alternative in certain discrete areas following stakeholder feedback. However, this reassessment provided the same results as previously reported in the Preferred Options Report and these were discounted from further consideration

3.2.4 In total, eleven of the considered alternatives were adopted as variants to the Preferred Route and incorporated into the Proposed Scheme. These are described in paragraphs 3.2.6 – 3.2.19.

3.2.5 Further detail on each of the Alternatives can be found in Appendix 3A, the Alternatives Discussion Paper (718736-0000-R-013) and the Report on the Choice of Route for the A5WTC at Ballymagorry (718736-0800-R-029) available to review on the project website www.a5wtc.com

Section 1

Alternative 1 – New Buildings

3.2.6 Following a series of landowner meetings, an alternative was considered to move the mainline closer to the River Foyle (whilst remaining outside the Q100 floodplain) near New Buildings in order to reduce severance and maximise the size of landholdings to the east of the mainline. Although there would be greater impact to the setting of the river and increased risk of a pollution event, the alternative was found to be preferable to the Preferred Route as these potential impacts could be readily mitigated and there would also be a reduction of visual, air quality and noise impacts to residential dwellings to the south west of New Buildings.

Alternative 2 - Bready

3.2.7 The Preferred Route crossed over the existing A5 at a high skew angle north of the Magherareagh community, swinging from the east to the west. During the development of the Proposed Scheme the initial assumptions were reviewed leading to constraints around Magherareagh being re-defined. The result of this was that a second crossing point of the existing A5 became viable resulting in the development of an alternative alignment which was also suggested by a number of local residents during landowner meetings.

3.2.8 The alternative would reduce the volume of earthworks and the length of side road diversions required, providing an overall saving in construction costs and consequent increase in the economic benefits. There would be significant landscape and visual impacts to residential properties for both options although the alternative had greater potential for mitigation. The alternative would have a lower impact on wintering birds on Grange Foyle and would sever fewer landowners. The summation of these factors led to the adoption of the alternative.

Alternative 3 – McKean's Moss

3.2.9 The Preferred Route skirted the edge of McKean's Moss Area of Specific Scientific Interest (ASSI), which could have resulted in direct impacts on the ASSI. Ground investigation results also revealed that this section of the Preferred Route running along the edge of McKean's Moss would have resulted in a complex, expensive and challenging engineering solution. An alternative design was developed which substantially avoided the poor ground that bordered McKean's Moss but required acquisition and demolition of three properties. The alternative is located on relatively competent ground which would allow for a less complex engineering solution. Despite the cost of the property acquisition, the alternative remained favourable in terms of engineering and cost. The alternative route minimised possible impacts on the ASSI and minimised the need for complicated drainage works. From an engineering, cost and environmental perspective (including human impacts) the alternative was considered preferable.

Alternative 4 - Ballymagorry

3.2.10 An alternative route was developed west of the Preferred Route at Ballymagorry due to a review of the flood modelling data and following consultation with local landowners. The results of detailed traffic modelling also showed that connectivity to Woodend Road was required and that a junction at this location would provide greater scheme economic benefits. The alternative would improve traffic connectivity and was further away from the highest density of residential dwellings, although overall, the number of affected landowners increased. The alternative would also reduce the amount of displaced flood water compared to the Preferred Route. Overall the alternative was considered preferable due to the economic and connectivity benefits and the reduction in impact on the flood regime. Further information regarding this alternative is provided in the Report on Choice of Route for the A5WTC at Ballymagorry Report.

Alternative 5 - Strabane

3.2.11 An alternative route at the Mourne River crossing was developed which reduced the complexity of the structure and improved the geometry of the junctions. Altering the alignment and reducing the complexity of the bridge in turn reduced the associated costs of the structure, although there would be additional landtake as a result. The alternative was also further away from residential properties to the south of the Mourne River. The alternative was considered preferable to the Preferred Route primarily due to improved geometry of the junctions, reduced complexity of the structure and reduced impacts on residential areas.

Section 2

Alternative 6 – Newtownstewart

3.2.12 Following consultations with the Northern Ireland Environment Agency (NIEA), concerns were expressed about potential impacts at Harry Avery's Castle. An alternative to the Preferred Route which aligned the route further south of Harry Avery's Castle was developed to reduce the potential heritage impacts and visual intrusion. The alternative route would also have cost and environmental benefits due to reduced earthworks and eliminated the need to divert the Back Burn. The combination of benefits provided by the alternative led to its adoption at this location.

Alternative 7 - Omagh

3.2.13 The ground investigation revealed that the poor ground below the woodland area close to Gillygooley Road would require complex and expensive engineering solutions due to the depths and extents of the soft ground. An alternative route was developed which avoided the deeper areas of soft ground. The alternative would sit lower in the valley, reducing the landscape and visual impact and by avoiding the woodland, minimise the ecological impact. The alternative was considered preferable to the Preferred Route due to reduced construction cost and reduced environmental impact.

Section 3

Alternative 8 - Doogary

3.2.14 During the Preferred Route exhibitions in July 2009 there was some objection to the alignment at Doogary, which crossed the existing A5 twice and passed through agricultural land in order to avoid an adjacent bog. The Preferred Route alignment was developed giving consideration to a need to maintain connectivity to the existing A5 south of Omagh and avoid the raised bog which desk top studies had identified as being potentially of national importance.

3.2.15 Further assessment of the status of the raised bog indicated that it was of local importance only. An alternative was developed which passed through the bog, reducing the amount of land take and the number of bridges required. Avoiding the need to cross the existing A5 also improved safety and buildability by simplifying temporary traffic management needs. Although more complex ground engineering would be required to construct the alternative across the bog, the reduced number of bridges and shortened length of the alternative would result in increased economic benefits of the scheme. The alternative was considered preferable to the Preferred Route, primarily on the basis of increased economic benefits.

Alternative 9 - Newtownsaville

3.2.16 During the Preferred Route exhibitions and subsequent landowner meetings, there was objection to the route at Newtownsaville. The objections were on the basis that the route crossed the existing Newtownsaville Road twice and passed through agricultural land and near dwellings in order to avoid an area of perceived poorer ground including a bog located to the east of the existing Newtownsaville Road. An alternative was developed to address these issues. The result of the assessment determined that the cost of the alternative would be lower than the Preferred Route as it would be shorter in length and have fewer crossings of existing side roads. The alternative would also have lesser landscape and visual impacts and there would be improved integration due to reduced community severance with less impact on existing side roads. Therefore, the alternative was considered preferable to the Preferred Route.

Alternative 10 - Ballygawley

3.2.17 A number of objections to the Preferred Route at Ballygawley and the location of the proposed junction with the A4 were made by members of the public and landowners at the Preferred Route exhibitions and subsequent meetings. Objections were due mainly to the potential impact on properties and land close to the A4. The combination of the development of the junction strategy following the Preferred Route Announcement at this location and landowner objections led to alternatives being considered. An alternative mainline alignment was developed further west, away from Ballygawley, which resulted in lower costs due to reduced earthworks and shortening of the route. By crossing the Ballygawley Water further south, the alternative route also reduced the impact to the flood regime in the area. The alternative was therefore adopted.

Alternative 11 - Aughnacloy

3.2.18 Following approaches by Aughnacloy representatives and businesses, a decision was made to incorporate a limited access junction north of Aughnacloy. The junction, at the crossing between the proposed A5WTC and existing A5, would provide access to and from Aughnacloy through north facing slip roads only.

3.2.19 The Preferred Route approaching from Ballygawley impacted on a number of drumlins requiring significant earthworks. The addition of the junction also presented issues in terms of impacts with properties and achieving design standards at side roads due to the need to include a junction with the existing A5. An alternative was developed which provided sufficient room for the junction to be constructed offline with the existing A5 thus improving on buildability and reducing the need for significant traffic management. The alternative also provided a better and safer realignment of Loughans Road and reduced the earthworks on the approach to the junction. This resulted in lower costs due to the reduced earthworks and reduced land take. Landscape and visual impacts would also be reduced as the drumlins would be avoided. The alternative was preferable to the Preferred Route due to reduced costs, improved safety of the realigned Loughans Road and lesser environmental impact.

3.3 Principal Design Components

3.3.1 Throughout the length of the scheme a number of cuttings and embankments would be required to ensure the road gradients meet the required standards. The size and number of cuttings and embankments is largely dependent on the existing topography and ground conditions, as well as the need to minimise the surplus or deficit of material, i.e. balance the earthworks. The need to retain the local road network has also determined road levels and the size of the cuttings and embankments along the route.

3.3.2 The Proposed Scheme would be 85km in length and has been sub-divided into 3 Sections. Each Section has an independent chainage (Ch.) referencing system, which allowed for variations in length as the Section designs developed, as shown below:

- Section 1: Ch. 0 to 22.8km.

- Section 2: Ch. 22.8km to 57.5km
- Section 3: Ch. 61.6km to 93.1km

3.3.3 Connectivity between the A5WTC and the existing road network has been provided through the junction strategy described in Section 3.7.

3.3.4 The Proposed Scheme would affect approximately 100 side roads. Twenty side roads would be stopped-up with the remainder being substantially unaltered or diverted to alternative routes via the local road network. In such a situation it is recognised that there would be additional short lengths of existing side roads that would also be stopped up. Full details are available in the Direction Order. The Proposed Scheme would also include a number of structures to provide continued access to severed land and to bridge watercourses and take account of drainage and flooding considerations. Further details on each of the above can be found in Chapters 5, 6 and 7.

3.3.5 Lighting would be provided at all junctions described in Chapter 4. There would be no provision for lighting for the rest of the dual carriageway.

3.3.6 All three Sections of the Proposed Scheme would be constructed to the extents set out below and as shown in Figure 3-1:

- Phase 1a: Junctions 1 to 3 (New Buildings to North of Strabane) and
- Phase 1b: Junctions 13 to 15 (South of Omagh to Ballygawley)
- Phase 2: Junctions 3 to 13 (North of Strabane to South of Omagh)
- Phase 3: Junction 15 to the Border (Ballygawley to the Border at Aughnacloy)

3.3.7 The key activities, phasing and other construction related details are described in Chapter 6 of the ES

3.4 Design Standards

3.4.1 The Proposed Scheme would be constructed mostly as a Category 6 Dual Carriageway in accordance with the Design Manual for Roads and Bridges (DMRB) Volume 6, Section 1, Part 1 TD 9/93 Highway Link Design standards and as detailed in Table 3-1. A typical mainline cross section is shown on Figure 3-1.

Element	Carriageway Cross Section Width
Carriageways	2 x 7.3m
Hard Strips	4 x 1m
Central Reserve	2.5m (minimum)
Earthworks	Varies
Verges	2 x 2.5m (minimum)
Total Width	**26.1m (minimum)**

Table 3-1 Standard Dual Carriageway Dimensions

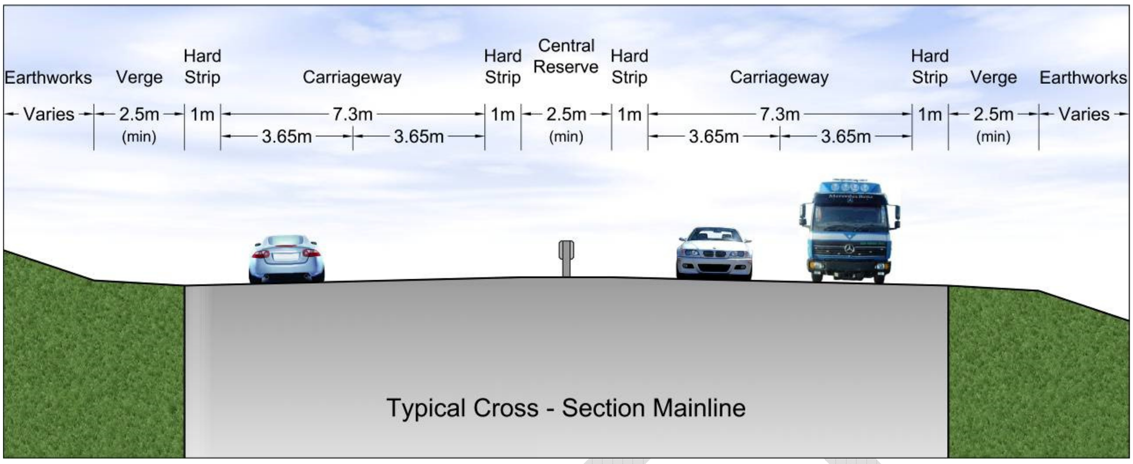


Figure 3-1 Indicative Mainline Cross Section for the Dual Carriageway Section of the A5WTC

3.5 Road Alignment

The following paragraphs provide an overview of the Proposed Scheme. More detailed descriptions of the engineering aspects of the scheme are described in Chapters 5, 6 and 7.

Section 1 – Phase 1a

New Buildings to Bready

3.5.1 The route would commence at New Buildings where a roundabout junction positioned adjacent to the existing A5 would provide connectivity between the Proposed Scheme and the existing A5. Upon exiting the junction, the route would continue as a single carriageway, 2+1 design, with overtaking opportunities provided in the southbound direction, west of the existing A5, for a distance of approximately 1km. The route would then approach another proposed roundabout junction south of New Buildings, which would be the commencement of the proposed dual carriageway.

3.5.2 The route would continue in a southerly direction adjacent to and within the edges of the River Foyle floodplain within a Greenbelt area passing to the west of Magheramason, and crossing Dunnalong Road as it does so. Further south, it would pass through Meenagh Hill, crossing Meenagh Road. The route would then curve south crossing the existing A5 just north of Bready, where Cloghboy Road joins the existing A5.

Bready to North of Strabane

3.5.3 The route would continue in a southerly direction, east of the existing A5, skirting around Bready and Gortmessan and crossing Donagheady Road in Drumgauty and continuing on to cross Willow Road. It would then cross back to the west of the existing A5 at Grange Foyle bypassing Magherareagh at the proposed realignment of Willow Road. Prior to crossing the Burn Dennet at Ballydonaghy, the route would cross Ash Avenue and then through Drumenny over Drumenny Road.

3.5.4 Upon crossing the Burn Dennet the route would continue south heading towards Strabane passing over Ballydonaghy Road and Moss Road to the west of the existing A5. The route would continue to run parallel to the existing A5 before crossing over the Glenmornan River. Immediately south of the river, it would cross Greenlaw Road and Park Road. Further south it would run between Ballymagorry and Desert.

3.5.5 Another junction would be provided at Woodend to link the Proposed Scheme with the B49 Woodend Road and the existing A5 before crossing Spruce Road.

Section 1 – Phase 2

North of Strabane to South of Strabane -

3.5.6 As the Proposed Scheme enters Strabane, it would continue along the edge of and within the floodplain of the River Foyle close to a backfilled gravel pit. Immediately north of the disused Strabane Canal, the route would run parallel to the existing A5 (Barnhill Road) and continue adjacent to it for a distance of 0.7km. Continuing southwards the route would cross Park Road for the second time where a junction would incorporate the existing A38 roundabout providing connectivity to Park Road, Strabane town centre and to Lifford in the Republic of Ireland (ROI) for southbound traffic and access to the Proposed Scheme for northbound traffic.

3.5.7 To the south of this junction, the Proposed Scheme would cross the North West Trail Cycle Route and the Mourne River, west of Strabane. Thereafter, it would briefly run parallel to the existing A5 (The Great Northern Link). South of the River Mourne, to the west of the existing A5, a further junction would be included to complement the junction north of the River Mourne providing access to the Proposed Scheme for southbound traffic and access to Strabane for northbound traffic. As the route continues south it would lie adjacent to or within the floodplain of the River Finn for some 1.4km.

3.5.8 The Proposed Scheme would bypass Strabane to the southwest towards the B85 (Urney Road). There would be another roundabout junction at this location which would provide connectivity to the proposed N14/N15 link road in Donegal via a proposed river crossing which would be constructed under a separate contract. It is intended that both schemes will have a coincident opening date. At this junction, the route would change direction towards the south, crossing Strahans Road and running adjacent to the western edge of a currently disused and flooded quarry.

3.5.9 The route would continue south passing close to the concrete works and Orchard Road Industrial Estate. It would cross Bog Lane Road, Knockroe Road and Orchard Road, and run across a former landfill site. A junction is proposed south of Strabane close to the golf centre at Sion Mills, between Peacock Road and the existing A5 which would provide a link to Sion Mills, Glebe and Strabane South.

Section 2 – Phase 2

South of Strabane to South of Newtownstewart

3.5.10 The Proposed Scheme would continue between Sion Mills and Glebe, travelling in a south-westerly direction. To the south of Glebe, the route would cross Primrose Park, the B165 Bells Park Road and High Road, skirting to the west side of Seein as it crosses Seein Road. After passing Seein, the route would head in a south-easterly direction, passing west of Victoria Bridge, crossing Concess Road and the B72 Fyfin Road. Where the Proposed Scheme crosses the B72, another junction would be provided, facilitating access to the existing A5/Victoria Bridge to the east and Castlederg to the west.

3.5.11 To the south of Victoria Bridge, the Proposed Scheme would continue in a south-easterly direction crossing Stone Road and Urbalreagh Road to the north of the River Derg. After crossing Derg Road, the route would then continue south-east, crossing the River Derg, the B164 Deerpark Road and Milltown Road before continuing to Wood Hills.

3.5.12 The route would cross Magheracoltan Road, to the west side of Wood Hills, before reaching another junction to the west of Newtownstewart incorporating Drumlegagh Road North and the B84 Baronscourt Road. The route would continue to the south of Harry Avery's Castle crossing Oldcastle Road and on to Gallows Hill in a south-easterly direction.

South of Newtownstewart to North of Omagh

3.5.13 South of Newtownstewart, the Proposed Scheme would cross Honeyford Lane, Glen Road, Gortgranagh Road, Castletown Road and Grange Road. The route would then run roughly parallel to the existing A5 crossing West Road and Joe's Lane. It would pass to the west of the Mellon Country Hotel crossing Gordon's Lane before deviating away and crossing Killynure Road.

3.5.14 The Proposed Scheme would cross Castletown Road and McFarlands Road and then pass to the west of Mountjoy crossing Dunteige Road and Lisnagirr Road. It would then cross Tully Road (roughly following the line of the disused railway), Rash Road and then Tully Road again. North of Omagh there would be a junction with the existing A5 approximately 700m north of Poe Bridge. After this junction, the Proposed Scheme would cross Drumlegagh Road and pass to the east of Tully Bog (Special Area of Conservation) and then cross Todds Road, the Fairy Water and Mellon Park Drive.

North of Omagh to South of Omagh

3.5.15 The route would run south-westerly, close to Omagh, crossing Gillygooley Road, Aghnamoyle Road, Botera Road, Tamlaght Road and Brookmount Road before reaching the A32 Clanabogan Road where there would be another junction connecting the Proposed Scheme with Omagh, Dromore and Enniskillen.

3.5.16 South of the A32, the route would pass through steep sided drumlin terrain with crossings of Loughmuck Road, Beagh Road and Ballynahatty Road. There would be a clear span structure over the Drumragh River, after which the route would curve to the east before crossing Blackfort Road and Drumragh Road approximately 1km west of Doogary.

Section 3 – Phase 1b

South of Omagh to Routing Burn

3.5.17 The route would continue, crossing the B83 Seskinore Road, where a full grade separated junction would be provided. From this junction the route would change from an easterly to a southerly direction, running adjacent to the existing A5 before crossing the Tattykeel Road (twice in this vicinity), Drumconnelly Road and Tullyrush Road. The route would then turn in a south-easterly direction, crossing Rarone Road to pass to the west of Gortaclare. The route would then cross Drumconnelly Road, the B46 Moylagh Road and Augher Point Road where another junction would be provided. From the B46 the route would continue in a south-easterly direction to cross Killadroy Road and Greenmount Road on the approach to the Routingburn Road.

Routing Burn to Ballygawley Water

3.5.18 The Proposed Scheme would continue south-easterly from the Routing Burn, crossing the road of the same name, before turning in a southerly direction crossing Springhill Road.

3.5.19 The route would then curve to the east crossing Cormore Road and Tullanafoile Road, passing between Beltany Hill to the west and Tycanny Hill to the east. It would then curve eastwards crossing Tullycorker Road, Tycanny Road and Rarogan Road.

3.5.20 The route would continue in a south-easterly direction crossing Glenhoy Road to the west side of Errigal. It would then cross Ballynasaggart Road and Crew Road heading in a south-easterly direction as it approaches the A4 Annaghilla Road.

3.5.21 A new roundabout junction would be provided where the route crosses the A4, approximately 1.4km from Ballygawley. The Proposed Scheme at this location would also include the existing A4/A5 roundabout (opened in 2010), as recommended in the Public Inquiries Inspector's Report (February 2012). The A4 Annaghilla Road would be upgraded to dual carriageway between these roundabouts, utilising the existing single carriageway for the proposed eastbound carriageway, while the proposed westbound carriageway would be constructed offline.

Section 3 – Phase 3

Ballygawley Water to the River Blackwater

3.5.22 From the A4 junction the route would continue south-eastwards crossing the Ballynanny Road, Tullywinny Road and Lisginny Road.

3.5.23 The route would then curve to the east, crossing Old Chapel Road and the A5 Tullyvar Road where a partial (north facing slip roads) grade separated junction would be located. The route would then cross Loughans Road, followed by the B35 Carnteel Road and the B128 Rehaghy Road on a constant curve to the east of Aughnacloy.

3.5.24 The route would continue southwards where the dual carriageway section ends with a roundabout junction on the A28 Caledon Road. A single carriageway would then continue in a south-westerly direction crossing Douglas Road before tying into the existing A5 north of Moy Bridge at the border with ROI.

3.6 Proposed Road Levels

Section 1

New Buildings to Bready

3.6.1 As the Proposed Scheme exits New Buildings it would undulate slightly until it reaches Bready. Between New Buildings and Magheramason the existing ground levels vary between approximately 9m and 16m above ordnance datum (AOD) and for the most part this section of the Proposed Scheme would follow the existing ground level with the exception of where the alignment would drop through a local area of high ground immediately north of Magheramason. From here the route would rise steadily from 9m AOD to approximately 34m AOD just north of Bready.

Bready to North of Strabane

3.6.2 From Bready, the Proposed Scheme would continue to fall to approximately 16m AOD at a point just east of Grange Road and then rise again to 21m AOD to facilitate the underbridge over the existing A5 before dropping to 10m AOD between Ash Avenue and Drumenny Road. The route would then undulate slightly, varying in height from approximately 13m AOD to 6m AOD into Strabane.

North of Strabane to South of Strabane

3.6.3 As the Proposed Scheme enters Strabane from the north it would rise slightly to a height of 16m AOD at the proposed Mourne River crossing and then would gently descend again to a low of 8m AOD as it passes Strabane to the west. Running parallel to the River Finn the route rises to 14m AOD to facilitate the N14/N15 link. Turning southwards it falls slightly to 12m AOD south of Urney Road before rising to a high point of 23m AOD as it passes under Strahans Road.

Section 2

South of Strabane to South of Newtownstewart

3.6.4 South of Strahans Road the Proposed Scheme would fall to 17m AOD and then undulate between levels of 20m AOD and 18m AOD to the proposed junction immediately north of Peacock Road. From here it would rise from 32m AOD, north of Sion Mills, to 103m AOD to the west of Newtownstewart.

South of Newtownstewart to North of Omagh

3.6.5 Between Newtownstewart and Omagh the Proposed Scheme would drop from a peak of 126m AOD near Castletown Road (North) to 73m AOD south of the Mellon Country Hotel before rising to 106m AOD west of the Ulster American Folk Park and then reducing to 66m AOD on the approach to the Fairy Water.

North of Omagh to South of Omagh

3.6.6 Around Omagh the proposed road levels would vary between 65m AOD and 100m AOD.

Section 3

South of Omagh to Routing Burn

3.6.7 South of Omagh, the Proposed Scheme would rise from a level of 80m AOD to a high point of 119m AOD before falling to 110m AOD near Routing Burn.

Routing Burn to Ballygawley Water

3.6.8 This section of the Proposed Scheme would rise to a high point of 163m AOD near Newtownsaville before descending to a level of 66m AOD at the junction with the A4 Annaghilla Road.

Ballygawley Water to the River Blackwater

3.6.9 Over this section the proposed road level would reach a high point of 81m AOD before descending to 47m AOD at the River Blackwater.

3.7 Junction Strategy

3.7.1 A key element of achieving the scheme objectives is the segregation of strategic traffic (using the new A5WTC) from local traffic (users of the existing road network). However connectivity between the new road and the existing network is critical to maximising the opportunities for road users to join and leave the new road in a safe and efficient manner.

3.7.2 In relation to Major Junctions, Table 4 TD9/93, Highway Link Design, of the DMRB states that for a Category 6 dual carriageway junctions should consist of:-

At-grade roundabouts at lower end of range. Otherwise full grade separation.

3.7.3 Further clarification is provided in Paragraph 8.6 of TD9/93:

'In Category 6, major intersection types, which may include roundabouts, will be determined by site conditions, traffic demand, and economic/environmental effect.'

3.7.4 The locations of the junctions reflects the nature and category of the existing road network, following the hierarchy below:-

- key transport corridors
- trunk roads
- A class roads
- B class roads of local importance

3.7.5 In line with TD9/93, for a Category 6 dual carriageway, 3 types of junction have been considered at each junction location:- at-grade roundabout (TD 16/07); compact grade separated junction (TD 40/94) and full grade separated junction (TD 22/06).

The design standards provide advice on the suitability of junction type depending on the levels of traffic predicted for the design year for each of the junctions. In summary these are:-At-grade Roundabout: Suitable for junctions where traffic flows are at the lower end of the range for a Category 6 dual carriageway.

Compact Grade Separated Junction: Suitable where the side road and turning traffic flows are less than 10% of the through flow. *[ref TD 40/94: Flow levels: para 5.3: Compact grade separated junctions appear to be suitable for use where mainline flows are between approximately 12,500 AADT and 30,000 AADT and are normally associated with very low flows (generally below 10% of mainline flow) on the minor road.]*

Full Grade Separated Junction: Suitable for high flows and high turning flows.

3.7.6 In addition, TD9/93 requires consideration to be given to the environmental effects and economics of the various junction types in deciding the junction type to be adopted. The design standards also recommend that where possible there is consistency in the choice of junction and this should also be taken into account in determining the choice of junction.

3.7.7 Below are indicative figures relating junction type to traffic delays and economics:-

- Provision of an at-grade roundabout on the dual carriageway typically causes up to a 1 minute delay to through traffic as vehicles slow down, manoeuvre around the roundabout and accelerate to driving speed.
- The lowest level of junction provision would be at-grade roundabouts at every location, however the journey time delays and likely loss of economic benefits (approximately £120m for the Proposed Scheme) do not accord with the standard of a high quality dual carriageway. On the Proposed Scheme, provision of at-grade roundabouts is therefore limited to certain locations.

3.7.8 When the above factors are were taken into consideration and the junction assessment undertaken, the following junction types were incorporated into the Proposed Scheme:

- the two at-grade roundabouts at New Buildings would allow safe termination of the dual carriageway (northbound) and also allow for future development of the road network around Londonderry;
- the terminal roundabout on the A28 at Aughnacloy would be an at-grade roundabout to allow safe termination of the dual carriageway (southbound) and also allow for future up-grading when the N2 improvement in Co Monaghan is approved and a new cross border link finalised;

- the cross border junction to the N14/N15 just west of Lifford would be an at-grade junction to allow safe termination of the dual carriageway before crossing the River Finn into County Donegal;
- A4/A5 junction would be an at-grade roundabout – traffic volumes justify full grade separation but a roundabout solution was adopted based on balance of flows as well as environmental and cost grounds (significant earthworks and associated impacts on the community for a grade separated interchange);
- the junction with the existing A5 south of Strabane would be compact grade separated – traffic volumes justify full grade separation but a compact grade separated option was adopted on environmental and cost grounds;
- the junction with the existing A5 north of Aughnacloy would be a partial grade separated junction with north facing slip roads only;
- all other A class road junctions are full grade separated; and
- junctions with B class roads are compact grade separated.

3.7.9 There would be junctions at 15 locations along the mainline of the Proposed Scheme. The “3 part” junction at Strabane West, forms one combined junction with each part numbered separately, hence the junctions are numbered 1 to 17 in Table 3-2 below.

<table>
<tr><th colspan="2">Proposed Junction</th><th>Description, Location and Chainage</th></tr>
<tr><td colspan="3">Section 1</td></tr>
<tr><td colspan="2">J1 - New Buildings North</td><td>At grade roundabout linking to the existing A5 Victoria Road
At the northern end of the 2+1 carriageway New Buildings Bypass at Ch. 450</td></tr>
<tr><td colspan="2">J2 - New Buildings South</td><td>At grade roundabout linking to the existing A5 Victoria Road
At the south end of the 2+1 carriageway New Buildings Bypass at Ch. 1750 and commencement of the dual carriageway</td></tr>
<tr><td colspan="2">J3 - Ballymagorry</td><td>Full grade separated junction linking to the existing A5 Victoria Road and B49 Woodend Road
North of Strabane and south west of Ballymagorry at Ch. 14700</td></tr>
<tr><td rowspan="2">Junctions 4, 5 and 6 combine to form the fully grade separated Strabane West Junction</td><td>J4 – Strabane Lifford Road</td><td>Two roundabout junctions accommodating the A38 Lifford Road, Junction 5 and Park Road and the northbound entry slip road to the Proposed Scheme.
A38 Lifford Road west of Strabane town and north of the Mourne River at Ch. 17900</td></tr>
<tr><td>J5 - Strabane Railway Street</td><td>At grade roundabout accommodating the southbound exit slip road from the Proposed Scheme, the existing A5, Railway Street and Junction 4.
West of Strabane town, immediately north of the Mourne River at Ch. 17900</td></tr>
</table>

Proposed Junction		Description, Location and Chainage
	J6 - Strabane Bradley Way	At grade roundabout accommodating the south facing slip roads (northbound exit and southbound entry) of the Proposed Scheme, the existing A5 and Bradley Way West of Strabane town, immediately south of the Mourne River at Ch. 18030
J7 - Strabane N14/N15		At grade roundabout to accommodate the proposed N14/N15 Cross Border Link across the River Finn. South west of Strabane at Ch. 19500
J8 - Strabane South		Compact grade separated junction linking to the existing A5 Melmount Road South of Strabane and north-west of Sion Mills at Ch. 22100
Section 2		
J9 - Victoria Bridge		Compact grade separated junction connecting to the B72 Fyfin Road Adjacent to Victoria Bridge at Ch. 31400
J10 - Newtownstewart		Compact grade separated junction linking to the B84 Baronscourt Road and Drumlegagh Road North West of Newtownstewart at Ch. 37300
J11 - Omagh North		Full grade separated junction linking with the A5 Beltany Road and Drumlegagh Road South North-west of Omagh at Ch. 49230
J12 - Omagh West		Full grade separated junction with the A32 Clanabogan Road South-west of Omagh at Ch. 54030
Section 3		
J13 - Omagh South		Full grade separated junction linking to the B83 Seskinore Road and the existing A5 South of Omagh at Ch. 62060
J14 - Moylagh		Compact grade separated junction linking to the B46 Moylagh Road and Augher Point Road South-west of Moylagh at Ch. 68770
J15 - Ballygawley Roundabout		At grade roundabout junction with the A4 Annaghilla Road and Tullybryan Road. South-west of Ballygawley at Ch. 83400
J16 - Aughnacloy North		Partial grade separated junction with north facing slips only linking to the A5 Tullyvar Road and Loughans Road North of Aughnacloy at Ch. 88400
J17- Aughnacloy East		At grade roundabout junction with the A28 Caledon Road South-east of Aughnacloy at Ch. 91900

Table 3-2 Proposed Junctions along the A5WTC

3.8 Side Roads

3.8.1 The Proposed Scheme would affect approximately 100 roads on the network. Side Roads are discussed in more detail in Chapters 5, 6 and 7.

3.8.2 The major side roads affected are:

Section 1

- the existing A5 with crossings/junctions at Ch. 1770, 6400, 9100 and 14700 in addition to the northern terminal point;
- the B49 Woodend Road at Ch. 14750 that would link into the proposed junction 3 between Strabane and Ballymagorry;
- the A38 Lifford Road at Ch. 17800 that would pass under the Proposed Scheme and connect into Junction 4/5; and
- the B85 Urney Road at Ch. 19500 that would pass under the Proposed Scheme.
- the existing A5 with a junction at Ch. 22050;

Section 2

- the B165 Bells Park Road at Ch. 27995 that would pass over the Proposed Scheme;
- the B72 Fyfin Road at Ch. 31445 that would pass under the Proposed Scheme;
- the B164 Deer Park Road at Ch. 34725 that would pass over the Proposed Scheme;
- the B84 Baronscourt Road at Ch. 37290 that would pass over the Proposed Scheme;
- the B50 Gillygooley Road at Ch. 51255 that would pass over the Proposed Scheme; and
- the A32 Clanabogan Road at Ch. 54045 that would pass under the Proposed Scheme.

Section 3

- the B83 Seskinore Road at Ch. 62065 that would pass over the Proposed Scheme;
- the B46 Moylagh Road at Ch. 68700 that would pass under the Proposed Scheme;
- the A4 Annaghilla Road at Ch. 83500 that would be crossed at grade via a new roundabout;
- the existing A5 with a junction at Ch. 88400 in addition to the southern terminal point;
- the B35 Carnteel Road at Ch. 90300 that would pass over the Proposed Scheme;
- the B128 Rehaghy Road at Ch. 90800 that would pass under the Proposed Scheme; and

- the A28 Caledon Road at Ch. 91900 that would be crossed at grade via a new roundabout.

3.8.3 Thirty-two side roads (7 No in Section 1; 10 No in Section 2 and 15 No in Section 3) would be stopped-up with the remainder being substantially unaltered or diverted to alternative routes via the local road network. In such a situation it is recognised that there would be additional short lengths of existing side roads that would be stopped up. These are described further in Chapters 5, 6 and 7 and full details are available in the Direction Order.

3.9 Significant Sections of Cutting and Embankment

3.9.1 Cuttings and embankments would be required at locations along the route to maintain road vertical alignment design standards, maintain the existing side road network and achieve an optimum earthworks balance.

3.9.2 Significant cuttings and embankments have been defined as either short, deep cuttings or high embankments which are over 10m deep/high, or sustained embankments or cuttings which are over 1km in length.

3.9.3 The locations of these significant cuttings and embankments are identified in Chapter 6 of the ES.

3.10 Structures

Overbridges

3.10.1 Along the Proposed Scheme there would be 39 overbridges carrying the local road network. The majority of the overbridges would be either 2 span structures, with a central reserve support, or single span structures.

Underbridges

3.10.2 There would be 24 underbridges carrying the Proposed Scheme over the local road network and watercourses. The structures would generally be single span.

3.10.3 All Structures, including overbridges, under bridges and culverts, along the length of the Proposed Scheme are discussed in more detail in Chapters 4, 5, 6 and 7.

Culverts, River Crossings and Flood Relief Structures

3.10.4 Watercourses would generally be crossed with culverts with the size and shape determined by watercourse characteristics. Culvert locations are given in Chapter 5, 6 and 7.

3.10.5 Where the watercourse is an existing land drainage feature, a pipe culvert would be used to intercept the watercourse or the watercourse would be intercepted by pre-earthworks drainage.

3.10.6 Installation of some of the culverts would require realignment or diversion of existing watercourses. Proposed diversions are discussed in more detail in Chapters 5, 6 and 7.

3.10.7 In addition to the many small watercourses there would be several larger water crossings requiring more complex bridge structures. These are as follows:

Burn Dennet (Ch. 10500), River Glenmornan (Ch. 12700) and River Mourne (Ch. 17800)

3.10.8 Structures would be required to cross the Burn Dennet, River Glenmornan and River Mourne. All three bridges would provide a clear span of the river channels under normal flow conditions. The Burn Dennet Bridge would be a three span structure approximately 75m in length; the River Glenmornan Bridge would also be a three span structure approximately 64m in length. The River Mourne Bridge would be a four span structure with a total length of approximately 271m. The main river span of the River Mourne Bridge would be approximately 85m and the remaining side spans would be arranged to accommodate the highway infrastructure beneath.

Flood Relief Structures to the North of the River Mourne

3.10.9 On the approaches to the River Mourne crossing the Proposed Scheme would run through a floodplain area and flood relief structures would be required to minimise the impact of the scheme over this length. A combination of open span structures would be required at chainages 13500 (Park Road), 14800 and 14900.

River Derg crossing at Ch. 34330

3.10.10 A structure would be required to cross the River Derg and the associated floodplains. The structure would be a two span structure approximately 92m long, with one span providing a clear crossing of the river under normal flow conditions.

Coolgahy Burn at Ch. 36500

3.10.11 A structure would be required to cross the Coolgahy Burn. The structure would comprise a relatively short 15m (approximately) span bridge with two adjacent connectivity culverts.

Fairy Water at Ch. 50050

3.10.12 A structure would be required to cross the Fairy Water and the associated floodplain. The structure would be a 47m (approximately) single span bridge with associated connectivity culverts. The culverts would run through the embankment to both the north and south of the bridge.

Drumragh River crossing at Ch. 56590

3.10.13 A structure would be required to cross the Drumragh River and the associated floodplain. The structure would be a 34m (approximately) single span bridge with three associated connectivity culverts located to the south of the bridge.

Routing Burn crossing at Ch. 71700

3.10.14 A structure would be required to cross the Routing Burn. The structure would be a single span structure with a span of 31m (approximately) to span the Burn and two accommodation access tracks.

Ballygawley Water crossings at Ch. 83800

3.10.15 There would be two structures crossing Ballygawley Water. The first would be a 51m (approximately) long three span structure carrying the proposed A5 across Ballygawley Water, with a main river span of 25m (approximately) and the remaining side spans set to accommodate two access tracks. The other structure would be a single span structure located off the main line, carrying the new westbound carriageway of the A4 dualling section.

3.11 Land Use Requirements

3.11.1 Some 1150 hectares of land would be required for the construction of the Proposed Scheme. Approximately 250 of these 1150 hectares would only be required temporarily during the construction phase.

3.11.2 No work would take place outside of the Vesting Order (VO) boundary other than where the contractor has sought and received approval from the Department, the landowner and other relevant statutory authorities.

Buildings

3.11.3 Construction of the Proposed Scheme would result in a number of buildings being demolished as the land on which they are situated would be required for construction of the scheme. They are as follows:

3.11.4 Residential:

Section 1

- Farmhouse at Ch. 3300.
- 3 dwellings and a double garage/office at Ch. 11600.
- Castletown House (flats) at Ch. 19000.

Section 2

- 1 dwelling at Ch. 37300.
- 1 dwelling on Baronscourt Road at Ch. 37400.

Section 3

- None

3.11.5 Other buildings:

Section 1

- 4 farm buildings Ch. 3300.
- 1 Barn at Ch. 7000.
- 1 Barn at Ch. 16400.
- 1 Commercial Property (Garage) at Ch. 17000.

Section 2

- 2 farm buildings at Ch. 29100.

Section 3

- Chicken Shed at Ch. 76600.
- Farm Building at Ch. 78700.
- Farm Buildings at Ch. 91800.

3.12 Construction Environmental Management

3.12.1 A draft Construction Environmental Management Plan (CEMP) – Principles and Guidance, included in the ES, provides a summary of the generic principles that the contractors would be required to comply with. It sets out how the environmental impacts of the construction activities would be managed and minimised through the implementation of best practice.

3.12.2 The contractors would be required to produce and maintain a detailed CEMP as part of the contract for the proposed works. The measures included would address management of construction related traffic, management of the local road traffic, noise and dust suppression, working margins and working methods related to historic features, sensitive habitats, species and watercourses.

3.13 Materials Requirements and Earthworks Balance

3.13.1 The Proposed Scheme would include significant sections of cutting and embankment which have been designed to minimise the impact on the surrounding topography whilst achieving the required design standards for the proposed road. Where practicable, excavated material would be deposited along the route in areas of proposed fill and within the deposition areas. Usage of construction materials would be managed on site through a Site Waste Management Plan (SWMP).

3.13.2 Assessments indicate that the cuttings would generate approximately 16 million m^3 of material, of which approximately 12 million m^3 is likely to be suitable for re-use. Within these figures, cognisance has been given to standard engineering practices of processing marginal material to render it acceptable thereby maximising the volume of material suitable for re-use in the works. An initial assessment also indicates there would be a requirement to import approximately 1 million m^3 of material.

3.13.3 The works would generate around 4 million m^3 of surplus material which it is intended would be deposited wherever possible within deposition areas specifically vested for the deposition of material. Schedules of the proposed deposition areas for the scheme are provided in Chapters 5, 6 and 7.

3.13.4 Wherever possible, site derived materials for re-use would be directly transferred from areas of cut to areas of fill. Should there be a requirement for temporary stockpiling of materials, the material would be stored away from sensitive locations such as marshy areas, watercourses, flood areas, or close to property, where dust during dry periods could be a nuisance to residents.

3.13.5 Where off site movement of materials is required, haul routes would be subject to agreement under a required Traffic Management Plan. Specific consideration would be given to minimising the impact on communities located along potential haul routes.

Contamination

3.13.6 The Geotechnical Investigation (GI) has identified 26 areas of potentially contaminated ground distributed throughout the Proposed Scheme corridor. It is considered unlikely that other areas of contaminated ground, not identified during the GI, would be encountered during site clearance and excavation. However, any potentially contaminated material would be separated from other excavated material and tested. If assessed as hazardous the material would be disposed of to an appropriately licensed location.

4 ENGINEERING PRINCIPLES

4.1 Mainline Highway Alignment

4.1.1 The geometric design of the alignment of the Proposed Scheme can be seen on Plan and Profile drawings within Volume 2. These drawings display the horizontal and vertical geometry including radii, and proposed levels.

Horizontal Geometry

4.1.2 The horizontal geometry of the Proposed Scheme was designed in accordance with DMRB Volume 6 TD 9/93 Highway Link Design. The geometry was predominantly dictated by the need to avoid constraints, such as existing properties and environmentally sensitive sites, while providing accessibility to and connectivity between key locations along the Preferred Corridor. It incorporates Alternative Options as set out in the Preferred Options Report, (796036-0000-R-011). As well as the recommendations set out in the A5 Western Transport Public Inquiry Report dated February 2012.

4.1.3 The horizontal alignment was also affected by the requirements of the vertical geometry to minimise impact on existing properties and/or environmental constraints as well as a desire to minimise the land take as far as practicable.

4.1.4 Details of reasoning and decision making behind the development of the horizontal alignment of the Preferred Route can be found in the Preferred Options Report (796036-0000-R-011).

Vertical Geometry

4.1.5 Within the scope of consideration of all the factors within 4.1.6, the rate of ascent and descent of the alignment was maintained within the allowable gradients dictated by TD 9/93. This standard also determined the allowable vertical curvature on sag and crest curves in the alignment. Details of the vertical geometry can be found on the Plan and Profile drawings within Volume 2.

4.1.6 There were a large number of issues that influenced the vertical alignment of the mainline along the length of the Proposed Scheme. Amongst these were the following;

- Optimising the bulk earthworks quantities

- Creating low points in the alignment at suitable drainage outfall locations
- Crossing over or under side roads at an appropriate level to minimise earthworks and diversion works
- Crossing watercourses at an appropriate level to minimise earthworks and diversion works, while maintaining appropriate freeboard and taking account of climate change
- Utilising the local topography to fit into the local landscape
- Maintaining appropriate height above potential flood levels
- Incorporating an appropriate junction strategy

4.2 Side Roads' Alignment

4.2.1 The alignment for the Proposed Scheme would cross over approximately 100 side roads. For the majority of these, provisions have been made within the overall scheme design to preserve the continuity of the existing side roads via a process of realignment and crossing the mainline as either an overbridge (taken over the mainline) or underbridge (passing through a bridge carrying the mainline).

4.2.2 The following documents from the DMRB were used to determine design standards for the side road realignments:

- TD9/93 – Highway Link Design
- TD27/05 – Cross-Sections and Headrooms
- TD41/95 – Vehicular Accesses to All-Purpose Trunk Roads
- TD42/95 – Geometric Design of Major/Minor Priority Junctions
- TD 16/07 – Geometric Designs of Roundabouts
- TD 22/06 – Layout of Grade Separated Junctions
- TD 40/94 – Layout of Compact Grade Separated Junctions

4.2.3 Across the scheme there is a high degree of variability regarding existing side roads conformance to current design standards. The proposed side road re-alignments have been developed by designing realignments in accordance with current design standards, whilst recognising existing alignments, road characteristics, and constraints especially at tie-ins, and the usage of the side road.

4.2.4 Formal discussions were held with the Department to ensure acceptance of the proposed alignment, where the design being promoted departed from the standards.

Development of Design

4.2.5 Guidance for the proposed cross section width for side roads has been taken from TD27, for roads with traffic flows less than 5000 vehicles per day. A departure from standard, omitting the need for hard strips running adjacent to either side of the carriageway has been accepted by the Department. Such hard strips are therefore generally not present on the side roads and this is also in-keeping with the existing road network.

4.2.6 Prior to the commencement of design work on the side roads, the design speed for each was determined. This design speed assessment was carried out using one of three possible methods, depending on the situation:

- Method A – If the side road currently operates at a speed limit below the National Speed Limit, this 'preset' design speed would be used for any related realignment.
- Method B – For existing side roads which currently operate at the National Speed Limit, the design speed would be assessed according to TD 9/93, Annex A – Harmonic Mean Visibility. This involves assessing such constraints as the 'bendiness' of the road and the number of accesses onto the road per kilometre.
- Method C – For existing side roads that have a length less than the minimum 2km needed to facilitate Harmonic Mean Visibility analysis as set out in Method B, a departure from standard was applied and picked up as Method C.

4.2.7 Tables describing the results of the above assessment can be found in Appendices 5, 6 and 7.

4.3 Ground Conditions, Geology and Geomorphology

4.3.1 In developing the Proposed Scheme, outline geotechnical designs were developed for use throughout. The outline designs for various geotechnical scenarios are described below.

Cutting stability

Soil Slopes

4.3.2 The stability of slopes has been assessed for both long and short term conditions.

4.3.3 A surcharge loading of 20kN/m^2 has been modelled on the footprint of the road carriageway with a surcharge of 10kN/m^2 on verges and above the slopes to model agricultural traffic and maintenance vehicles.

4.3.4 For cuttings, the high groundwater table encountered was modelled in the design and in accordance with the recommendations of EuroCode 7, the long term performance of toe drainage was not relied upon. Modelling has been carried out to determine a safe angle of side slopes using the partial factor method within EuroCode 7, which requires an overall over-design ratio of 1.0 or greater. The analysis was limited to significant slip circles of thickness greater than 0.75m, which would result in a slip mass of 10T or greater. Smaller superficial slips were not considered significant.

4.3.5 In Section 1 and the northern part of Section 2, where soils are more freely draining, this analysis determined that generally slopes up to a maximum height of 10m would be stable with a slope angle of 1 vertical (v): 2.5 horizontal (h), providing that the groundwater is at least 1m below ground surface. In Section 3 and the southern part of Section 2, where soils are more cohesive, the assessed stable side slope is 1v:3h. Particularly in the southern part of Section 3, some of the higher slopes have a very high groundwater level and / or weaker soils. For some of these, a granular drainage blanket will be required to maintain this slope gradient. At specific pinch points, some slope reconstruction with granular fills may be required to maintain this gradient.

4.3.6 Slopes greater than 10m high would require a berm at mid height of at least 3m wide to maintain stability.

Rock Slopes

4.3.7 The stability of rock slopes in which the rocks are moderately weak or weaker are largely controlled by a combination of the rock strength and the orientation and shear strength properties of the discontinuities. In higher strength rocks the stability of the slope is mostly controlled by discontinuities within the rock.

4.3.8 In Section 1 on the A5WTC, at Bready Cutting, the propensity of the Dalradian shale and schist rocks to decay to a scree slope means that slopes steeper than 1v:2h have not been adopted. However, the cutting between Strahans Rd and Urney Rd is in mixed schist and limestone, which is expected to be stable at 1v:1h. The opportunity may be taken to win additional limestone aggregate from that cutting.

4.3.9 In Section 3, rock cuttings may be encountered at Tycanny cutting. In order to maintain a topsoil covering, it would be necessary to design the slope to not steeper than 1v:2h. However, if an exposed rock face is permitted, then a steeper slope of 3v:1h is feasible. If that option is permitted, then the opportunity may be taken to win additional aggregate from this cutting and replace it with Class 4 landscape fills in the lower slopes.

Embankment Stability

Slopes

4.3.10 The stability of embankment slopes has been assessed in a similar manner to cutting slopes. A surcharge loading of 20 kN/m^2 has been modelled on the carriageways with a 10 kN/m^2 surcharge on the verges.

4.3.11 The majority of soils encountered on the scheme are of glacial origin and contain a significant proportion of fine material. In light of the high rainfall in the region and high groundwater table encountered, a pore water pressure coefficient (r_u) of 0.15 was adopted for embankments. This yields a safe angle of slope of 1v:2.2h in Section 1 and the northern end of Section 2. In Section 3 and the southern part of Section 2 where the soils are more cohesive and less free draining, this yields a safe side slope of 1v:2.5h

4.3.12 If the shoulders of embankments are constructed with free-draining, high friction, granular fills, then it would be feasible to steepen the side slopes to 1v:2h.

4.3.13 Where the substrate is very soft or where embankments cross a transverse slope, then 1v:3h slopes have been used because of the risk of edge failures and the impact of high water tables.

4.3.14 The design philosophy for embankments over poor ground conditions is described below.

Embankment Construction

Materials

4.3.15 In areas of soft cohesive sub-grade, or where the groundwater level is within 1m of the ground surface, embankments would be constructed with a granular starter layer, such as Class 6C (Rock) or 6A (selected well graded granular material), to relieve excess pore water pressure in the underlying material, hence increasing stability and accelerating consolidation. The starter layers would typically be 0.6 m thick.

4.3.16 The majority of earthworks will be constructed with materials won from within the scheme, which in the majority will consist of Class 2C (stony cohesive fills). In Section 1 and parts of Section 2, more granular material will be available, which may meet the classification for Class 1A (well graded granular) fills. Where these are available, then the option may be taken to construct the embankments (or their shoulders) using free draining Class 1A fills and achieve 1v:2h side slopes.

4.3.17 In addition, where a drainage blanket is required for stability of cutting slopes, Class 6C free draining fill will be required.

Embankments over Poor Ground Conditions

4.3.18 The Proposed Scheme would cross a number of areas of peat and soft alluvial clay. These comprise smaller scale inter drumlin "fen" infilling areas, and larger raised peat bogs. In Section 1, the scheme crosses part of the flood plain of the River Foyle.

4.3.19 Where the peat / soft ground is less than 4-6 m deep, excavation and replacement is the proposed solution. In this scenario the soft material is excavated out and a buried "false" embankment constructed below ground level to the original ground level using granular fills with the new embankment constructed over it. This technique would also apply to at grade sections over soft ground. A typical section is shown in Figure 4-1

.

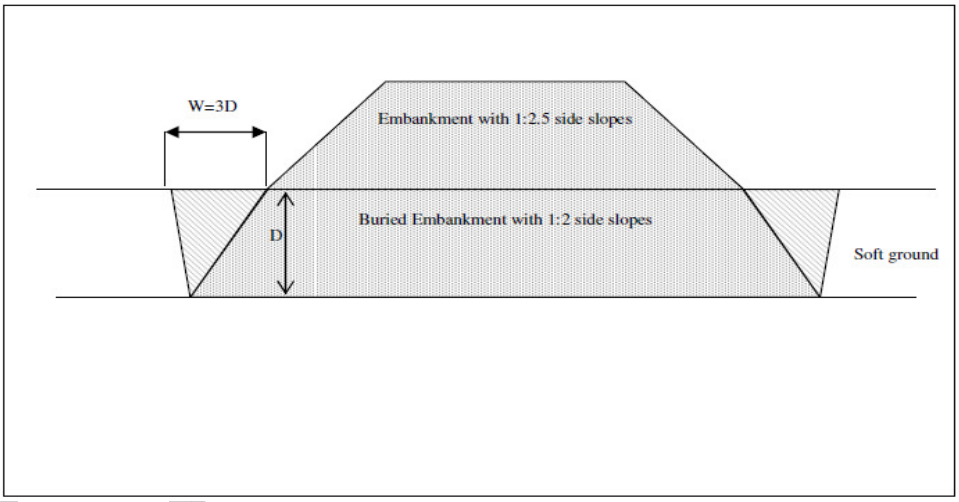


Figure 4-1Typical Section for Excavate and Replace Sites

4.3.20 Embankments or at grade sections over deeper areas of peat or soft ground may be treated in a number of ways, such as;

- Using piled supports to the embankments;
- Surcharging (including use of band drains);
- Using lightweight fills;

Flood Protection for Embankments

4.3.21 In areas prone to flooding, the embankments would be protected from scour to a height of at least 0.5 m above maximum predicted flood levels. In the majority of cases however, the flood flow velocities are sufficiently low for a grassed sward to provide sufficient protection. The impact of flood inundation on embankment stability has also been considered in the design of embankment side slopes.

Ground Treatment

Soft Spots

4.3.22 In at grade sections, where soft spots are encountered (CBR<2.5% or undrained shear strength <50 kPa), these would be excavated and replaced with suitable material. If the excavation of the soft material is below water table level, the replacement material would be Class 6A.

Watercourses

4.3.23 The abandoned channels of diverted watercourses would be treated as per the soft spots, with the channel and any associated soft material excavated and replaced.

Contaminated Land

4.3.24 The surveys and ground investigations have revealed that the majority of the scheme is on previously undeveloped land. Considerable effort has been taken in the development of the scheme to avoid known areas of contamination such as is associated with former industrial or landfill use. Such land is mostly confined to the urban areas around Strabane.

4.3.25 While chemicals are naturally present in the ground in background concentrations, the ground investigations have identified that the land beneath the proposed route is not enriched in these to a degree that would constitute an unacceptable risk to the environment, or to the users / maintenance staff of the road, when assessed in accordance with the methods recommended by the NIEA.

4.3.26 It is known that ammonia and nitrate compounds are widely enriched across the scheme and this is typical of a situation where fertiliser and slurry spreading on grazing land is practiced. However, the concentrations are not such as to constitute an unacceptable risk. Where there are high levels of acidity or of ammonium in soils, then the proposed planting mixes would be modified. Any soils that have been identified as having a high risk to the aquatic environment would not be re-used adjacent to watercourses.

4.3.27 The ground investigation and walk over surveys have identified use of “hardcore” to create field accesses, along with historic infilled sand and gravel pits and occasional pockets of fly tipping. There are also random, but unexplained isolated occurrences of hydrocarbons, heavy metals and in one case Polychlorinated Biphenyl (PCB) revealed in the natural soils. Natural variation in the soil chemistry and aerial "fall-out" account for such occurrences. In all of these settings, the scale is very small and further investigations and sampling would be undertaken to delineate these in advance of construction commencing. This would enable the lateral extent of these materials to be determined. Method statements would be prepared detailing handling, removal and disposal measures to ensure that site staff and the public are not exposed to risk. Where this involves excavation of materials the resultant material would be removed to a suitably licensed facility. On-site treatment such as bio-remediation may be practicable, though the quantities involved are likely to render that option unviable.

4.4 Drainage

4.4.1 This section describes the hydrological constraints and associated drainage design of the Proposed Scheme.

4.4.2 A number of design objectives were established, ensuring all the components of the drainage design were met and the evolution of the design was homogeneous throughout the whole scheme. The design objectives were as follows:

- Prevention of flooding of the proposed carriageway and ponding on the surface.
- Provision of sub-surface drainage to protect the integrity of the road pavement and subgrade material.
- Prevention of erosion of cutting and embankment slopes.
- Interception of boundary drains and overland flow.
- Minimisation of impacts on existing floodplains
- Control of water borne pollutants associated with carriageway run-off and accidental spillage to protect receiving watercourses and ground water from potential contamination.

4.4.3 The design methodology for the drainage aspect of the Proposed Scheme is discussed in the following sections.

Road Drainage Design

4.4.4 The purpose of the road drainage design is to provide infrastructure for discharge of road related runoff to existing watercourses at particular locations. Along the Proposed Scheme, there are a number of mainline and side road outfalls, details of which can be found in Chapters 5, 6 and 7.

4.4.5 Surface water channels would be utilised, in line with DMRB HD33/06, for the majority of mainline drainage networks. The surface water channels discharge to carrier drains, which in turn discharge to suitable watercourses.

4.4.6 The drainage system design would include an additional 20% allowance within rainfall intensity calculations to account for climate change.

4.4.7 Environmental mitigation measures would be included to reduce the impact that road drainage outfalls would have on the receiving watercourses and the wider environment.

4.4.8 Throughout the mainline drainage network, appropriate treatment facilities involving Sustainable Urban Drainage Systems (SuDS) would be provided for each network/outfall. The principal processes behind these mitigation measures are absorption, where pollutants bind to soil particles, and uptake by plants. These measures would reduce the volume of soluble pollutants within road runoff.

4.4.9 At various locations, these SuDS measures are also utilised to attenuate flow; throttling flows from road runoff to the receiving watercourse in order to reduce the potential of downstream flooding.

4.4.10 An additional 300mm of freeboard would be incorporated at each pond to allow for climate change.

4.4.11 Erosion protection would be used where high velocity discharge may result in scour. These would take the form of erosion protection aprons, stone rip-raps or geotextiles.

4.4.12 All side roads would discharge to adjacent watercourses or existing side road drainage where acceptable.

4.4.13 Pre earthworks drainage (PED) would be provided as a network of open channel ditches discharging into existing watercourses along the length of the scheme. PED ditches would also pick up existing field drains in various locations. These would have sufficient capacity to transfer flows from the surrounding topography and proposed slopes to suitable watercourses/drains, assessed for the 75 year return period storm in accordance with HA 106/04. PED would be required:

- in areas of cutting to intercept flows from the surrounding natural topography and adjacent lands to prevent discharge into the Works;
- in areas of embankment to intercept flows from proposed embankment slopes and surrounding natural topography to prevent discharge from the Works onto adjacent lands and vice-versa.

- to intercept flows from existing land drainage; including field drains, boundary drainage and private drains.
- in areas where there is the potential for water to collect and pond.

4.4.14 Sub-surface drainage would be provided to protect the integrity of the road pavement and sub grade material.

Watercourse Crossings

4.4.15 The Proposed Scheme would include 147 crossings of watercourses varying in size from known small open field drains to major rivers.

4.4.16 The hydraulic design of culverts has been completed in accordance with the methodology outlined in CIRIA C689 Culvert Design and Operation Guide – Initial Design, and as per DMRB, Volume 4, Section 2, Part 7 HA 107/04 Design of Outfall and Culvert Details.

4.4.17 All culverts have been designed to accommodate a Q100 flow in agreement with Rivers Agency. Flow rates for the individual watercourses have been calculated using either Poots & Cochrane or Flood Estimation Handbook (FEH) methods.

4.4.18 An allowance for climate change would be included within the freeboard of each culvert.

4.4.19 Small culverts (1500mm diameter or less) would include a minimum of 300mm freeboard allowance above the Q100 level within the culvert, as per DMRB HA107/04 guidance (Paragraphs 6.13 and 6.14) and Rivers Agency guidance.

4.4.20 Large culverts and bridges (> 1500mm diameter) would include a minimum of 600mm freeboard allowance above the Q100 level within the watercourse/culvert, as per DMRB HA107/04 guidance (Paragraphs 6.13 and 6.14) and Rivers Agency guidance.

4.4.21 The structures required for watercourse crossings can have an effect on the ecological and hydrological systems which occur naturally within a watercourse. These systems could be impacted in the following way:

- Forming a barrier to the movement of fish and other wildlife.
- Disruption of sediment and debris transport.
- Increased erosion of river bed and banks.
- Prevention of lateral migration of rivers
- Impacting on flooding and floodplain connectivity.

4.4.22 These impacts can be mitigated by applying appropriate ecological and hydrological design principles and by following 'best practice' during construction and operation, details of which are outlined in the Environmental Statement.

Watercourse diversions

4.4.23 The Proposed Scheme would include 104 permanent diversions, on watercourses varying in size from known small open field drains to large streams.

4.4.24 Watercourses are natural dynamic systems which constantly change through the movement of water, sediment and debris. These changes can result in the movement or migration of the channel. Therefore, the positioning of the diversion should aim to minimise the impact on the natural processes.

4.4.25 The proposed diversions would be routed away from identified sensitive locations, wherever possible and the level of required mitigation applied to each watercourse would consider the sensitivity, size and length of the watercourse being diverted.

4.4.26 Wherever possible, proposed diversions would be located on straight, stable reaches away from areas of deposition thus avoiding increased sedimentation and erosion.

4.4.27 The hydraulic design of the proposed permanent diversions has been designed to match the current hydraulics of the existing channel as close as possible. Consideration was given to the size and shape, flow characteristics, cross sectional area and gradient. Diversion dimensions have been designed on a like for like basis whenever possible. By doing so the risk of localised flooding has not intensified.

4.4.28 Where possible, bank habitats would be maintained with the appropriate vegetation replaced.

4.5 Flooding

The Flood Risk Assessment

4.5.1 The Proposed Scheme has been subject to a Flood Risk Assessment (FRA) in accordance with guidelines contained within the DMRB, Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 10 HD 45/09 Road Drainage and the Water Environment; and Department of Environment (DoE) Planning Service, Planning Policy Statement 15 (PPS 15) – Planning and Flood Risk. Construction Industry Research and Information Association (CIRIA) C624 – Development and Flood Risk – Guidance for the Construction

Industry and Rivers Agency Guidelines have also been referred to in developing the flooding assessment.

4.5.2 The purpose of the FRA has been to identify areas of existing flood risk, and where development within floodplains is essential, to ensure that the proposed road would not be at risk from flooding nor would it materially increase flood risk elsewhere.

4.5.3 Refer to Draft 2016 FRA Reports 1, 2 and 3 for further information.

Hydraulic Modelling Requirements

4.5.4 DMRB HD45/09 states that when an infrastructure is located within a floodplain, a detailed assessment of flood risk is required. To complete this assessment it was necessary to understand the extents of the floodplain/floodwater levels, the impact arising from the proposed road and the development of appropriate mitigation measures.

4.5.5 To assess the extents, mitigation, impacts and flood risk, DMRB HD45/09, Annex 1, Method F recommends that a hydraulic assessment should be undertaken. A preliminary FRA identified specific areas along the Proposed Scheme, where detailed consideration using hydraulic models was required. Chapters 5, 6 and 7, provide further information on the potential floodplains along the Proposed Scheme.

Data Collection

4.5.6 Site inspections of all the proposed modelling locations were undertaken to confirm the location and nature of the various watercourses, gain an appreciation of catchment characteristics (steepness, land use, etc), confirm model extents and determine the appropriate channel and floodplain roughness (Manning's n) coefficients to be applied to the hydraulic model.

4.5.7 A specification for the topographical survey was developed after the site visits, detailing model cross sections and any hydraulic control structures to be surveyed (bridges, culverts, etc).

4.5.8 Cross-sections and structures for flood modelling were surveyed primarily using a combination of GPS and Total Station survey techniques, with control being provided by GPS. Manual measurements using tapes and staffs were also made to record dimensions of structures. A reflectorless total station was used to survey large existing structures or in locations where access was difficult.

4.5.9 Deep river channels were surveyed using a small boat with onboard GPS and depths recorded using a staff. Depths were recorded on deeper stretches of water using an Acoustic Doppler Current Profiler combined with onboard GPS.

4.5.10 Digital Terrain Model (DTM) data supplemented surveyed data in floodplain areas and was used for 3D flood mapping purposes. It was also used where floodplains were modelled in 2D as the key component of any 2D model is a detailed ground model.

4.5.11 In addition to the DTM data acquired for the A5WTC scheme, a more detailed LiDAR data set was commissioned covering the extent of the Proposed Scheme.

Catchment Analysis and Design Flow

4.5.12 Assessments were undertaken based primarily on FEH techniques, OS mapping, and DTM data. The appropriate hydrological catchments were also identified.

4.5.13 DMRB HD45/09, Annex 1, Method E – Hydrological Assessment of Design Floods recommends the FEH for assessing hydrology. Two approaches have been utilised for the A5WTC; the statistical analysis of peak flows, and the rainfall-runoff method.

4.5.14 Statistical analysis is generally the first choice method where there are long records of gauged floods at or near the site of interest. The statistical approach is more suited to larger gauged catchments as the concept of a catchment wide design storm becomes less realistic the larger the catchment. Where catchments sizes are smaller and/or no gauged data exists, the Rainfall Runoff Method is typically the most appropriate method. However, in some instances both approaches were used for comparative purposes.

4.5.15 For the purposes of design flow estimation, no reliance was placed upon any restrictions caused by upstream structures. This is considered a robust and conservative approach as it is possible that during extreme storm events any upstream structures which may currently serve to restrict flows could be overtopped and bypassed.

Hydraulic Models

4.5.16 The hydraulic models were used to determine the extent of a flood event, typically 1% Annual Exceedance Probability (1% AEP), on the specific watercourses listed in Chapters 5, 6 and 7. From the models, the effect that the Proposed Scheme could have on the existing floodplains was deduced. This information was the basis for creating flood mitigation measures and ensuring the design complies with the recommendations set out in the DMRB.

4.5.17 The river reach was modelled using a series of cross-sections obtained from site, which captured the associated structures. The Manning's roughness values were based on site visits and photographs. Once the model was built, the flows were run through the watercourse simulating different flood events.

4.5.18 These site specific parameters were input to either 1D or 2D hydraulic modelling software packages as appropriate depending on the characteristics of the watercourse/existing floodplain.

4.5.19 Model calibration/sensitivity testing is necessary for the validation of the results and thus, the inferred mitigation strategies. The models were calibrated by obtaining water levels for a recorded flood event of known peak flow, and adjusting the model coefficients until a matching result was obtained.

4.5.20 This calibration method was used where peak flow recorded information existed for a particular model. However, in some cases the model could not be calibrated as there was no existing peak flow data. In these instances, the model was subjected to sensitivity testing.

4.5.21 Once the calibration of each of the models was completed, a series of sensitivity tests were carried out in order to determine the models' sensitivity to the coefficients and parameters used.

Mitigation Measures

4.5.22 The DMRB (Para. 2.37 HD 45/09) stipulates that with regards to management of flood risk, the mandatory requirements state that transport infrastructure must:

i) remain operational and safe for users in times of flood;

ii) result in no net loss of floodplain storage;

iii) not impede water flows; and

iv) not increase flood risk elsewhere.'

4.5.23 Where development is required within a floodplain, additional works may be required to mitigate flood risk changes caused by the project. The DMRB HD45/09 identifies some of the potential mitigation options available in relation to road schemes; these include design of road geometry, flood relief culverts, storage compensation and modifications to river channels and river structures.

4.5.24 The purpose of mitigation measures within a floodplain is to manage floodwater levels in a way that reduces the potential impact of flooding on the scheme itself and also elsewhere in the catchment.

4.5.25 Various iterations with regards to the mitigation measures have been undertaken to find the optimum mitigation solution, within practical / feasible bounds. These iterations have run alongside the multidisciplinary evolution of the scheme and have been discussed with Rivers Agency.

4.5.26 Hydraulic models were utilised to inform the route development and to assist in the avoidance and/or reduction of impacts arising from the road alignment as far as reasonably practicable. The models facilitated the testing of various crossing structure sizes and floodplain impacts. Generally, flood impacts would be mitigated using measures which include some, or all, of the following:

- Avoidance of floodplains as far as reasonably practicable and whilst considering multi-discipline engineering and non-engineering factors,
- Minimisation of road footprint as far as reasonably practicable and whilst considering multi-discipline engineering and non-engineering factors,
- Appropriately sized culverts
- Large span structures where feasible,
- Provision of floodplain connectivity structures to maintain floodplain conveyance where floodplains are bisected by the road alignment, and
- Provision of compensatory storage where volumetric floodplain encroachment remains.

4.5.27 In addition to the above, an allowance for climate change would be provided by setting the finished road level with a minimum of 600mm freeboard above the 'design' (1% annual exceedance probability (AEP) for river floodplains and 0.5% AEP for tidal floodplains) flood level where the Proposed Scheme is within floodplain.

4.5.28 Specifically with regards to compensatory storage, the DMRB identifies that *'Providing compensatory flood storage can significantly mitigate the effect of the project on the maximum flood level….storage is required for all developments regardless of their anticipated effect, so as to result in no net change in catchment hydrology, and to the capacity of the floodplain.'* (Para. 3.29 HD 45/09).

4.5.29 To create the required volume for flood compensatory storage, the Flood Compensatory Storage Areas (FCSAs) would be excavated and re-contoured with a series of terraces or steps.

4.5.30 The lowest contour would be the existing watercourse top of bank level; the highest would be the predicted 1 % AEP event level. The level of the outer perimeter of the FCSA would therefore correspond to the predicted flood level for the 1 % AEP event. The land would typically be lowered in terraces of approximately 200mm in height, with gentle slopes from one terrace to the next.

4.5.31 The ground within each step would be sloped gently towards the watercourse such that after any flood event, the flood waters would recede. The stepped nature of the contouring would also mean that during more frequent flood events, the steps would help define the limits of the extent of the flood waters by forming an effective barrier to the inundation extending over the whole of the FCSA.

4.5.32 The topsoil within the FCSA would be stripped and set aside for re-use on the re-contoured area. If a temporary leasing arrangement is agreed with the landowner, the land would be reinstated to a standard suitable for agricultural use before being returned to the landowner.

Flood Risk Identification

4.5.33 Within the FRA, the limits of floodplains assessed are:

- Rivers – the extent of a flood risk event with a 1% annual exceedance probability [1 in 100] of exceeding the peak floodwater level.
- Coastal – the extent of a flood risk event with a 0.5% annual probability [1 in 200] of exceeding the peak floodwater level.

4.5.34 Various mitigation measures were tested within the model and impacts were assessed for the above floodplain extents.

4.5.35 Flood risk has been assessed using the specified 'design' flood event (1% annual exceedance probability (AEP) for river floodplains and 0.5% AEP for tidal floodplains). To assist in the determination of residual, post scheme flood risk associated with assessment, methodologies identified within appendices of the DMRB were used, whereby the importance of the floodplain, the magnitude of the impact and the significance of the potential effects have been defined as per the guidance tables A4.3, A4.4 and A4.5 of HD 45/09. Finally, the qualifying conditions for the overall assessment score for residual, post mitigation flood risk from Table A4.6 HD 45/09 have been applied.

4.6 Deposition Areas

4.6.1 Along the length of the Proposed Scheme it is estimated that approximately 16M m^3 of material would be excavated. The intention is that as much as possible of this will be used in the construction of the scheme.

4.6.2 However, some excavated material can be very organic or wet and therefore difficult to use, In which case, traditionally, this is disposed of off-site at a licensed facility. However, this can result in transporting material considerable distances to sites that can a) accept the classification of the material and b) accommodate the required volumes. Furthermore, the haulage and the process of filling otherwise valuable landfill space with inert material is not considered sustainable and has a significant carbon impact.

4.6.3 The Proposed Scheme would generate some 4M m^3 of such material. As such, a philosophy for the creation of deposition areas for this material has been developed in discussion with the NIEA.

4.6.4 Under the Roads (Northern Ireland) Order 1993 land may be vested which complies with the following article 110: (2) (a) *land adjacent to a road which is being constructed or improved by the Department if the land is required for the depositing of matter obtained in the course of constructing or improving the road.*

4.6.5 The Department has taken the decision to utilise the Order to provide greater economic certainty to the Proposed Scheme and help reduce the environmental impacts of the construction by minimising lorry trips to off-site tips.

4.6.6 Sites were examined for potential suitability against a number of factors. These include;

- The need to be adjacent to the Proposed Scheme
- Proximity to areas where material was being generated
- Proximity to likely haulage routes during the construction of the scheme
- Opportunities to fill in hollows, whether natural or created as a result of the Proposed Scheme e.g. embankment near the bottom of a valley.
- Making use of severed or 'land locked' parcels of land
- The deposition areas must be contiguous with the proposed scheme works (that is a requirement of the Northern Ireland Environment Agency, NIEA)
- The Department must have control over the land, either through the vesting process or by a temporary access agreement with the landowner (a Planning Service requirement)
- That they are poor quality land that would benefit from improvement
- Contaminated material not meeting the definition of inert waste would not be deposited in these areas

- Hedgerows would be replanted in agreement with the farmers, to restore the natural landscape (an NIEA requirement)

4.6.7 Following the selection of initial sites, an assessment was carried out to determine any engineering issues that could arise and the extent of any environmental impact. Following completion of this assessment, some initial sites were deemed unsuitable. Those that were deemed suitable have been included within the draft Vesting Order. Further details of this assessment can be found in Chapters 5, 6 and 7.

4.6.8 Each Deposition Area would have a landform shaping and landscaping design that would be in-keeping with the characteristics of the surrounding landscape whilst retaining the option of returning the area to agricultural use that would similarly be in-keeping with the adjacent land usage.

4.6.9 The reinstatement specification for the Deposition Areas would comprise the following minimum requirements:

- The maximum slope within the Deposition Area would not generally exceed 1: 4 (Vertical : Horizontal)

- The minimum combined depth of topsoil and subsoil depth would not be less than 750mm.

- The minimum depth of topsoil would not be less that 150mm or greater than 300mm.

- The subsoil would be loose tip and lightly trafficked to avoid excessive compaction. The top 150mm of sub-soil would be thoroughly broken up after the initial laying to a depth of 150mm and cleared of all stones and debris with any dimension greater than 75mm.

- The topsoil would confirm to BS3882:2007 fertile agricultural soils with stones not exceeding 50mm in any dimension.

- The area would be drained by appropriate contouring to naturally occurring or engineered drainage paths along the perimeter of the area. These drainage paths would become functional prior to the commencement of any fill operation to ensure the appropriate containment of any run off from the works.

- The final contoured area would be seeded with a grass mix appropriate for the surrounding landscape and for retaining the option of returning the area to agricultural use that would be in-keeping with the adjacent land usage.

4.6.10 The confirmed deposition areas are identified on Plan and Profile Drawings within Volume 2.

4.7 Pavement Design

4.7.1 Fully flexible pavements (layers consisting of bituminous materials) and flexible composite pavements (bituminous layers overlaying a hydraulically bound layer) would be considered appropriate for the Proposed Scheme.

4.7.2 The design of the pavement layer thickness would be in accordance with the relevant current standards (e.g. BS594987:2010, BSEN13108, etc.) and the Design Manual for Roads and Bridges (DMRB) HD 26/06. The pavement foundations would be designed to Interim Advice Note (IAN) 73/06 rev1 (Draft HD25).

4.7.3 The pavement design traffic msa (million standard axles) would be based on HD24/06 using traffic figures obtained from the A5WTC Traffic Model.

4.7.4 Thin Surface Course Systems (TSCS) would be used along the length of the scheme to meet the requirements of a low-noise surface layer. The skid resistance of the surface course will be in accordance with IAN 156/12.

4.8 Road Lighting

4.8.1 The Road Lighting design for the proposed Scheme was undertaken in accordance with BS5489-1:2003 - Code of Practice for the design of road lighting. This design has been updated to take into consideration the recent update to the Standards, BS 5489-1:2013. Additional guidance was sought from the Department's Policy & Procedure Guidance documents relating to street lighting including, RSPPG E011: Street Lighting General Principles and RSPPG E014: Street Lighting Design. Consideration was also given to all relevant design standards and industry practices including DMRB TD 34/07, TA49/07, BS12767, Well Lit Highways: Code of Practice for Highway Lighting Management and International Commission on Illumination (or Commission Internationale de l'Eclairage) CIE 115. Cognisance in the design was also given to safety in installation and maintenance, environmental consciousness and energy conservation. Full details of the design considerations and parameters are detailed in the Lighting Project Appraisal Report (PAR) (718736-0100-R-002) which is available to view on the project website www.a5wtc.com. An Addendum (718736-0100-R-009) which is available to view on the project website www.a5wtc.com) has been added to the report to reflect the changes to BS 5489 introduced in 2013 plus the significant developments in available lighting technologies.

4.8.2 The PAR was prepared in accordance with TA49/07 and the Benefit /Cost Ratio for economic viability of accident savings to installation cost of road lighting for the proposed A5WTC route was established. This analysis determined that the provision of lighting was not required on the A5WTC. However, in-line with Section 2.3.3 of The Department's document RSPPG E011, the junctions were deemed to require to be lit. These junctions are considered as Conflict Areas (i.e. areas where significant streams of motorised traffic intersect with each other and other road users) and as such warrant the provision of lighting. The extent of the lighting was determined from CIE 115 and in-line with the Department's requirements, where the lighting would extend for 5 seconds at the road design speed from the turning point of the conflict area along the Major route.

4.8.3 Calculations were carried out to determine the most appropriate method of providing the lighting levels to BS5489: 2013. To ensure that the design not only achieved the required lighting levels but considered the whole life costing and environmental affects the lighting would have on the area, criteria such as capital and revenue cost, energy efficiency, sustainability, carbon emissions in both direct energy usage and production energy usage for materials and reduction in energy wastage through light pollution / intrusion were also factored in.

4.8.4 These calculations established that the lighting would consist of lighting columns with a 15m mounting height incorporating LED luminaires with a wattage up to and including 150W with a light output not exceeding 24klm on the mainline. Whilst the conflict areas would be lit utilising lighting columns with a 12m mounting height incorporating LED luminaires with a wattage up to and including 110W with a light output not exceeding 17klm. LED luminaires are energy efficient and can have a lamp and driver life expectancy of up to 25 years requiring no maintenance, other than cleaning and statutory electrical testing throughout their lifespan. The use of a Central Management System (CMS) to remote monitor, switch and vary lighting levels, as required can also assist in prolonging the life expectancy of the road lighting system. The design principles applied are reflected in the Proposed Scheme Preliminary Lighting Strategy layouts detailed on drawings 718736-1400-S1-0001 to 0004, 718736-1400-S2-0001 to 0004 and 718736-1400-S3-0001 to 0005.

4.9 Road Signage

4.9.1 The Proposed Scheme would require standard signage and road markings in accordance with RSPPG E017 Traffic Sign and Road Markings. This would include advanced direction signs, route confirmatory signs and standard dual carriageway direction signs and

2+1 signs between Junctions 1 and 2 and along the temporary link south of Junction 17.

4.9.2 A preliminary signage strategy has been developed, indicating the locations and approximate size of key large signs to ascertain any additional landtake that may need to be included within the draft Vesting Order. Drawings illustrating the locations of signage are included on the Plan and Profile drawings within Volume 2.

4.9.3 Local Transport Note 1/94, The Design and use of Directional Informatory Signs, was used to determine the siting of the signage along the length of the Proposed Scheme and on the approach to junctions.

4.10 Road Restraint Systems

4.10.1 Road Restraint Systems (RRS) would be provided at all locations that are identified during the process of assessment as required in the DMRB Volume 2, TD19/06 – Requirements for Road Restraint Systems.

4.10.2 Typical locations for the installation of RRS are on the central reservations, verges, where there are significant embankments, where bodies of water or other hazards are in close proximity to the road and on the approach to and passing of structures, large road signs and street lighting columns.

4.10.3 A preliminary assessment of the locations where the use of RRS would be appropriate has been carried out to provide indicative RRS locations. This assessment took into account design criteria such as the requirement for RRS to be suitably placed in areas of verge widening and central reserve widening so as to avoid reduction in Stopping Sight Distance. The Plan and Profile drawings within Volume 2 show the indicative RRS locations for the Proposed Scheme.

4.11 Road Side Features

4.11.1 In accordance with the Department's requirements, lay-bys would be provided at a maximum interval of 7.5km. It was recognised that junctions provide opportunity for the road users to leave the dual carriageway and this was taken into account when determining the need for and location of the lay-bys.

4.11.2 For this scheme, Type A lay-bys with merge tapers would be provided.

4.11.3 The locations of the lay-bys that would be provided are indicated in Chapters 5, 6 and 7.

4.12 Structures

4.12.1 Dependant on the ground conditions at each location, structures would either be founded on pad foundation or on piles with load transferred to more competent underlying material. Measures would be required to prevent arisings from piling operations impacting on water quality.

'Family of Structures' Descriptions

Overbridges

4.12.2 The overbridges would be the most dominant structures within the Proposed Scheme, being viewed constantly by the road users on the proposed mainline. The Proposed Scheme would have a 'family of structures' to give a consistent look and feel to the A5WTC users. Two options were considered suitable; open aspect bridges and closed aspect bridges.

Open Aspect Overbridges

4.12.3 Open aspect overbridges are designed such that the side slopes at the bridge locations are not interrupted by large areas of concrete. This often results in two span structures, with supports located in the central reserve and small bankseats positioned to typically give 1.5m of exposed front face of the bankseat support, (Figure 4-2). The area of exposed concrete wing wall is consequently limited in size.

Figure 4-2 Typical Two Span Open Aspect Structure

4.12.4 Depending on the gradient of the side road over the mainline this could produce an asymmetrical arrangement of spans.

4.12.5 Structures would generally be of integral construction, using concrete pre-stressed beams decks, to avoid maintenance issues relating to bearings and joints. Where skews are above 30 degrees or the spans are in excess of 60m, non-integral structures would be used.

4.12.6 General arrangements for the proposed standard open aspect overbridges are shown on drawing 718736-1700-D-0505 within Volume 2.

Closed Aspect Overbridges

4.12.7 For the standard two lane dual carriageway cross-section of the Proposed Scheme, single span closed aspect structures would also be a practical and economic solution.

4.12.8 The structures would generally be of integral construction with concrete pre-stressed beam decks supported on full height abutments. The abutments would either be reinforced concrete or reinforced earth with a feature finish.

4.12.9 Where widening would be required on the mainline to accommodate sight lines and where there would be a significant skew to the structure it may be necessary to provide an intermediate pier. This would detract from the open feel of the structure. Figures 4-3 and 4-4 show examples of closed aspect structures.

Figure 4-3 Single Span Closed Aspect Overbridge Structure

Figure 4-4 Two Span Closed Aspect Overbridge Structure

4.12.10 General arrangements for the proposed standard closed aspect overbridges are shown on drawing 718736-1700-D-0506 within Volume 2.

Underbridges

4.12.11 Underbridges carrying the main line generally have a short span relative to their width (the opposite of the over bridges)

4.12.12 The proportions of the structure (effectively a box) as shown in figure 4-5, create sizeable areas of concrete which would be finished using some type of grooved vertical feature set within the concrete.

Figure 4-5 Closed Aspect Underbridge

4.12.13 The structures' wing walls would be constructed either from reinforced concrete, which would have a similar feature groove to the main walls or from hard faced reinforced earth walls. The latter consist of pre-cast concrete panels or block facing units retaining the earth using metal or polyester fibre straps buried in the granular backfill.

4.12.14 As they are not viewed by significant numbers of members of the public, accommodation underbridges, in isolated locations, would not require any form of feature groove or coping detail to the walls.

4.12.15 Structures would generally be of integral construction to avoid maintenance issues relating to bearings and joints.

4.12.16 Structural forms that would be considered suitable for the Proposed Scheme include reinforced concrete box type structures, integral precast beam structures supported on reinforced concrete or reinforced earth abutments, or precast opti-cadre structures.

4.12.17 General arrangements for the proposed standard underbridges are shown on drawing 718736-1700-D-0500 within Volume 2.

Subways

4.12.18 There would not be any pedestrian subways on the Proposed Scheme.

Footbridges

4.12.19 There would not be any pedestrian footbridges on the Proposed Scheme.

Retaining Structures

4.12.20 Retaining structures would be required at isolated locations on the Proposed Scheme. There is a wide variety of different forms of earth retaining structures. Typical earth retaining structures are shown on drawing 718736-1700-D-0504 within Volume 2.

4.13 Non-Motorised User (NMU) Audit

4.13.1 Non-Motorised User Audits are required as part of the assessment of trunk road schemes as outlined in the Design Manual for Roads and Bridges (DMRB), Volume 5 – Assessment and Preparation of Road Schemes, Section 2 – Preparation and Implementation, Part 5 HD 42/05 and Part 4 TA 91/05 Provision for Non-Motorised Users.

4.13.2 The objectives of the NMU are to:

- Encourage the Design Team to take all reasonable opportunities to improve the service offered to NMUs;
- Prevent conditions for NMUs being worsened by the introduction of Highway Schemes;
- Document design decisions that affect NMUs.

5 SECTION 1 – ENGINEERING INFORMATION

5.1 Cross Section

5.1.1 Between Junction 1 (New Buildings North) and Junction 2 (New Buildings South), over a length of approximately 1.2km, the Proposed Scheme has been designed as a Wide Single 2+1 Carriageway (WS 2+1) to a design speed of 100 kph.

5.1.2 From Junction 2 to south of Junction 8 – Strabane South at Ch. 22800m (the tie-in point between Section 1 & 2), over a length of approximately 21.5km, the Proposed Scheme has been designed as a Dual 2 Lane All Purpose (D2AP) Carriageway to a design speed of 120kph.

5.1.3 The dual carriageway would commence at a point south of New Buildings to facilitate a potential A5/A6 link, the feasibility of which was considered as part of the wider review of the strategic traffic in and around the Londonderry area. Traffic modelling and forecasting determined that a bypass of New Buildings beyond this point would provide additional economic benefits. The carriageway standard for this length would be WS 2+1, with the southbound direction being 2 lanes wide and the northbound single lane.

Carriageway Type	Dual Carriageway (D2AP)	Wide Single Carriageway (WS 2 + 1)
Element	**Width (m)**	**Width (m)**
Carriageway	2 x 7.3	3 x 3.5
Hard Strips	4 x 1.0	2 x 1.0
Central Reserve	2.5 (min)	N/A
Verges	2 x 2.5 (min)	2 x 2.5 (min)
Earthworks	Varies	Varies
Total Width	**26.1 (min)**	**18.5 (min)**

Table 5-1 Mainline Cross Section Dimensions

5.2 Mainline Horizontal and Vertical Alignment

5.2.1 Details of the Proposed Scheme's mainline horizontal and vertical alignments are shown on the Plan and Profile drawings 718736-S1-0800-660 to 676 in Volume 2. Details of departures from standard and relaxations associated with the mainline are given in paragraph 5.7 below and in Appendix 5A.

5.3 Side Roads

5.3.1 A tabular summary of the side road proposals is included in Appendix 5B. Further details of the side roads are shown on drawings 718736-S1-0800-680 to 718736-S1-0800-692, 718736-S1-0800-720 to 718736-S1-0800-723 and 718736-S1-0800-725 within Volume 2.

5.3.2 A design speed assessment was carried out on each of the side roads in accordance with the methods described in Chapter 4. Following this assessment, a review was undertaken on each side road to establish where departures or relaxations would exist in the design. The outcome of the design speed assessment process is reported in Appendix 5C.

5.4 Junctions

5.4.1 There would be a total of eight junctions, at six locations, within Section 1. Details of the junction provision and arrangement are provided below and in Table 5-2. Drawings 718736-S1-0800-724 and 718736-S1-0800-759 to 718736-S1-0800-765 show details of the mainline junction layouts are contained within Volume 2 and further details are given in Appendix 5D.

Junction 1 – New Buildings North

5.4.2 The Proposed Scheme would commence at New Buildings at the junction with the existing A5 at Ch. 450m. The commencement of the Proposed Scheme at New Buildings is influenced by the wider strategy for Londonderry including on-going studies regarding the A5/A6 link. The Proposed Scheme would extend southwards from Junction 1 as a WS 2+1 carriageway with overtaking opportunities provided for vehicles in the southbound direction.

5.4.3 Analysis of traffic data has confirmed that most movements on the A5WTC are heading towards Londonderry in the AM peak. However, traffic from New Buildings also needs to travel towards Londonderry and also access the A5WTC southbound carriageway. As a result, a roundabout junction is the preferred solution at this location and it has been designed in accordance with TD16/07. The junction would consist of a three arm roundabout to the west of the existing A5 with an Inscribed Circle Diameter (ICD) of 70m. This has been tested using the traffic modelling forecasts which confirm that such a roundabout would operate satisfactorily in both the AM and PM peaks. To the north, the single carriageway approach to the roundabout would deviate westwards from the existing A5 local to the existing petrol filling station. To the south-east, the single carriageway approach would connect to the existing A5 local to the Woodside Road. The new A5 would run to the south-west. All current local accesses would be retained.

5.4.4 Key considerations in determining the location and layout of the junction included;

- Tying into the wider traffic strategy for Londonderry;
- The topography of the existing ground which rises from the River Foyle and locally from north to south;
- The relationship between the geometry of the existing roads and the Proposed Scheme, including the proposed roundabout;
- Avoiding residential and commercial properties;
- Avoiding utilities and in particular the sewerage pumping station;
- Remaining outside the River Foyle Floodplain;
- Retaining access to residential and commercial premises on connecting roads; and,
- Traffic requirements dictating the size for the roundabout thus restricting its potential location.

5.4.5 Drawing 718736-S1-0800-760 provides further technical information pertaining to Junction 1 and is contained within Volume 2.

Junction 2 – New Buildings South

5.4.6 The junction at New Buildings South would be located at Ch. 1750m local to the existing A5, south of New Buildings and to the north of Magheramason.

5.4.7 The roundabout would be built west of the existing A5 and outside the floodplain. The junction would consist of a 3 arm roundabout with an ICD of 75m. This would constitute the WS 2+1 to the north, D2AP to the south and a link to the existing A5 to the east The possible future A5/A6 link was a key consideration in determining the location of this roundabout.

5.4.8 The link from the dual carriageway to the existing A5 would connect via a 45m ICD roundabout to minimise delays in the transition from the strategic dual carriageway to the local road network.

5.4.9 The WS 2+1 road would include a northbound differential acceleration lane from the exit of the roundabout.

5.4.10 Key considerations in determining the layout and location for this junction included:

- The commencement point of the dual carriageway;
- Providing connectivity between the existing A5, the proposed A5WTC and a possible future A5/A6 link whilst minimising abortive works;
- Remaining outside the River Foyle floodplain;

- Minimising the impact on properties; and,
- Maximising the area of usable agricultural land to the west of the A5 and minimising the severed land to the west, adjacent to the River Foyle while ensuring the floodplain is not adversely affected.

5.4.11 Drawing 718736-S1-0800-761 provides further technical information pertaining to Junction 2 and is contained within Volume 2.

Junction 3 – Ballymagorry

5.4.12 The Junction at Ballymagorry would be located at Ch. 14700m immediately north of the Woodend Bridge at Spruce Road and to the south-west of Ballymagorry.

5.4.13 Traffic modelling and forecasting has confirmed that Ballymagorry (and beyond to Artigarvan and Dunnamanagh) is an important generator and attractor of traffic, particularly to and from the B49 Woodend Road, with this road facilitating a connection to the A6. A Full Grade Separated Junction (FGSJ), in accordance with TD22/06 was determined as the most appropriate form of junction to meet the needs of the local and strategic traffic movements. The junction would provide a free-flow mainline whilst retaining access to the existing A5 and providing a new link onto Woodend Road.

5.4.14 The Proposed Scheme would pass adjacent to and through the River Foyle floodplain at Ballymagorry. The mainline would be positioned to lie on ridges of existing high ground to the west, predominantly outside of the floodplain, to minimise the impact on the floodplain. The junction would consist of a dumbbell arrangement with a 50m ICD roundabout to the west of the mainline situated on high ground, that would serve to link the local road network (Park Road) as well as the northbound slips. A link over the mainline would connect this roundabout to a 50m ICD roundabout located to the east of the mainline. From this roundabout, a high level road over the flood plain would connect to another new 80m ICD roundabout on the existing A5 to the east on the fringe of the Foyle floodplain. This would be a 5 arm roundabout serving the southbound on-slip, the existing A5 to the south and Woodend Road. The southbound off-slip would connect to the eastern roundabout of the dumbbell arrangement.

5.4.15 The mainline would cut into the landform where possible to minimise the height of the link road. This in turn would facilitate the flood connectivity structures that would be required to maintain the existing flood channel. To the east, the level difference between the existing A5 and Woodend Road would be such that a short direct link between the roundabout and Woodend Road would not be feasible without reducing the geometric road standards or causing greater intrusion on the floodplain. A section of Spruce Road would be stopped up with local traffic movements diverted through the junction. The existing bridge over the existing A5 would remain for local access.

5.4.16 Ground improvement works would be anticipated where roadworks are within the floodplain. Outside of the structures required for flood connectivity, all roads would be on embankments to stay above maximum flood levels.

5.4.17 Key considerations in determining the layout and location for this junction included:

- Traffic patterns;
- The topography (use of higher ground) within the River Foyle floodplain
- The level difference between the B49 Woodend Road and the existing A5;
- Avoiding residential properties;
- Providing connectivity between the existing A5, the proposed A5 and the B49 Woodend Road ;
- Minimising the footprint of the Proposed Scheme in the River Foyle floodplain;
- Retaining the flood channel via flood connectivity structures within the River Foyle floodplain; and,
- Minimising impact on existing overhead high voltage power lines

5.4.18 Drawings 718736-S1-0800-762 and 763 provide further technical information pertaining to Junction 3 and are contained within Volume 2.

Junction 4 – Strabane Lifford Road, Junction 5 – Strabane Railway Street and Junction 6 – Strabane Bradley Way combine to form the fully grade separated Strabane West Junction

5.4.19 An assessment of traffic movements has demonstrated that Strabane needs one or more junctions with the A5WTC to cater for strategic access to Strabane, local network connections and cross-border provision. A grade separated junction was determined to best satisfy the connectivity requirements at this location.

5.4.20 The junction at Strabane West would be located at Ch. 17900m in close proximity to the existing A5 and the A38 roads. However, existing constraints dictated that the junction would have to be split north and south of the Mourne River and utilise the existing road network to facilitate all movements.

5.4.21 The mainline would be constructed at a higher level to provide a minimum 5.3m clearance to the local road network and would be approximately 7m higher than the existing Mourne River Bridge road level.

5.4.22 At Junction 4 (Ch. 17700m), Lifford Road would be centred on the existing A38 Lifford Road under the back span of the proposed new Mourne River Bridge. The 65m ICD roundabout, which would be predominantly at existing road level, would connect the two arms of Lifford Road to a new single carriageway link which would serve the northbound on-slip and a connection to the existing Park Road network. This connection would be achieved by a smaller 50m ICD roundabout located approximately 300m north of Lifford Road. All new links would be constructed on embankment at a height of approximately 3m above the existing ground level.

5.4.23 At Junction 5 (Ch. 17700m), Railway Street would be centred on the existing Railway Street Roundabout. It would be connected to Junction 4 via the existing A38 Lifford Road and to Junction 6 via Bradley Way. The southbound off-slip would connect to the roundabout utilising the existing connection point at Greenbrae Park, which would be stopped up. The ICD of the existing roundabout would be increased to 70m to allow for the additional A5WTC slip road entry onto the roundabout.

5.4.24 At Junction 6 (Ch. 18000m), Bradley Way would be centred on the existing Bradley Way Roundabout, south of the Mourne River. The junction would consist of two grade separated slip roads connecting to the existing Bradley Way Roundabout. The proposed arrangement would increase the existing roundabout from a 3 arm roundabout to a 4 arm roundabout. The ICD and level of the roundabout would remain the same and construction works at the roundabout would be limited to the slip roads' tie-ins only.

5.4.25 Key considerations in determining the layout and location for this junction included:

- Providing connectivity between the existing A5, the proposed A5 and the A38 Lifford Road;
- Minimising the footprint of the Proposed Scheme in the vicinity of the Mourne River and urban centre of Strabane;
- Tying into and utilising the existing highway infrastructure where possible;
- Optimising span arrangements for the new bridge crossing the Mourne River;
- Providing connectivity with the Park Road network to the north;
- Maintaining cross border movements;
- Retaining the "Let The Dance Begin" sculpture in-situ;
- Minimising impacts on the multi-use development site north of Lifford Road; and,
- Minimum levels determined by modelled floodplain.

5.4.26 Drawing 718736-S1-0800-764 provides further technical information pertaining to Junctions 4, 5 and 6 and is contained within Volume 2.

Junction 7 – Strabane N14/N15

5.4.27 The Junction at Strabane (N14/N15) would be located at Ch. 19450m to the south-west of Strabane, local to the B85 Urney Road and adjacent to the River Finn and the Republic of Ireland (ROI) border.

5.4.28 On the Proposed Scheme, there are two locations that would provide connectivity between Northern Ireland and the ROI. The location of this junction has been deemed as suitable to provide a potential future link over the River Finn connecting with the proposed N14/N15 works in the ROI. Due to the limited space and the proximity of the floodplain and the River Finn, the junction would take the form of a roundabout and would be a strategic junction only, i.e. there would be no links to the local road network from this junction.

5.4.29 The junction would be a roundabout with an ICD of 70m that would accommodate the three connecting dual carriageway approaches. The connection from the northwest would be from the ROI via a new structure crossing the River Finn that would link into the existing N15. The standard of this carriageway would be based on ROI highway geometric standards and would be a dual carriageway (and is beyond the scope of this report). The proposed river crossing would be constructed under a separate contract and it is intended that both schemes would have a concurrent opening date.

5.4.30 The level for the roundabout would be set at approximately 14m AOD to facilitate the crossing of the River Finn and to provide an underbridge for Urney Road which would be diverted at its current level to pass beneath the proposed roundabout. Ground conditions are variable in the area of the junction and consist of soft spots and made ground which would require localised ground improvements.

5.4.31 Key considerations in determining the layout and location for this junction included:

- Providing strategic connectivity between the proposed A5 and the Republic of Ireland;
- Minimising the footprint of the Proposed Scheme in the floodplain;
- Minimum levels determined by modelled floodplain;
- Maintaining the Urney Road link between Clady and south west Strabane; and,
- Reducing impact on the listed buildings and access to properties to the south of Urney Road.

5.4.32 Drawing 718736-S1-0800-724 provides further technical information pertaining to Junction 7 and is contained within Volume 2.

Junction 8 – Strabane South

5.4.33 The junction at Strabane South would be located at Ch. 22050m north of Sion Mills, south of Strabane and immediately north of Peacock Road.

5.4.34 This junction is located to enable traffic from Strabane to travel south via the Proposed Scheme and to maximise the relief to the existing A5 south of Strabane. Traffic flows and movements would be accommodated by a Compact Grade Separated Junction (CGSJ). The junction would maintain a free-flow mainline while providing connectivity to the existing A5.

5.4.35 Compact horizontal and vertical links would be provided in accordance with TD40/94 providing two-way movements on and off the mainline. The link from the northbound side of the mainline would continue to run over the mainline and connect to the existing A5 via a proposed new roundabout.

5.4.36 The junction link would rise up and over the mainline at a level of approximately 25m AOD to tie in with the existing A5. A 50m ICD roundabout, located on the existing A5, would be positioned to minimise disruption to local business. The links on and off the mainline would have acceleration/deceleration tapers to assist with maintaining a free flow on the mainline. Peacock Road would be stopped up as a consequence of this layout with traffic being diverted via Primrose Park.

5.4.37 Key considerations in determining the layout and location for this junction included:

- Traffic patterns;
- Providing connectivity between the existing A5 and the proposed A5;
- Maintaining the desire line for movements in to the south of Strabane and to Sion Mills;
- Minimising the impact on and clearance to the existing watercourse;
- Minimising the footprint of the Proposed Scheme junction;
- Minimising the visual intrusion of the junction in the landscape; and,
- Minimising impact on dwellings

5.4.38 Drawing 718736-S1-0800-765 provides further technical information pertaining to Junction 8 and is contained within Volume 2.

Summary of Section 1 Junctions

Junction	Connecting road(s)	Connecting town(s) or village(s)	Junction type	Relevant DMRB standard	Restrictions
Junction 1 – New Buildings North	Existing A5	New Buildings	At-Grade Roundabout	TD16	All movements catered for
Junction 2 – New Buildings South	Existing A5	New Buildings Magheramason	At-Grade Roundabout	TD16	All movements catered for
Junction 3 - Ballymagorry	Existing A5 B49 Woodend Road	Ballymagorry Dunnamanagh Artigarvan Strabane North	Full Grade-Separated	TD22	All movements catered for
Junction 4 – Strabane Lifford Road	Existing A5 A38 Lifford Road	Strabane Lifford, ROI	At-Grade Roundabout – Forms part of a Full	TD16, TD22	All movements catered for

Junction	Connecting road(s)	Connecting town(s) or village(s)	Junction type	Relevant DMRB standard	Restrictions
			Grade Separated Junction		
Junction 5 – Strabane Railway Street	Existing A5 A38 Lifford Road	Strabane, Lifford, ROI	At-Grade Roundabout – Forms part of a Full Grade Separated Junction	TD16, TD22	All movements catered for
Junction 6 – Strabane Bradley Way	Existing A5	Strabane Lifford, ROI	At-Grade Roundabout – Forms part of a Full Grade Separated Junction	TD16, TD22	All movements catered for
Junction 7 – Strabane N14/N15	Proposed A5 Future N14/N15 Link	ROI	At-Grade Roundabout	TD16	All movements catered for
Junction 8 – Strabane South	Existing A5	Sion Mills Strabane South	Compact Grade-Separated	TD40, including TD42 for major/ minor junctions	All movements catered for

Table 5-2 Description of Junctions along Section 1 of the A5WTC

5.5 Existing Roads' Realignments/Upgrades

5.5.1 Within the Proposed Scheme, there would be no upgrade or realignment of any of the existing local road network outside of tie-in works associated with either the provision of junctions or in the provision of over/under bridges to maintain the existing side road connectivity.

5.6 Road Closures

5.6.1 In Section 1, the following side roads would be stopped up:

- Meenagh Road;
- Bog Lane Road;
- Peacock Road; and,
- Spruce Road.

5.6.2 The following side roads would be diverted to an adjacent side road that would be kept open:

- Ash Avenue;
- Ballydonaghy Road;
- Greenlaw Road; and,
- Tamnabrady Road.

5.6.3 All other side roads would be catered for by a connection to an existing side road via an overbridge or underbridge passing over or under the Proposed Scheme mainline. Spruce Road would be accommodated through Junction 3 with the remaining section of it being stopped up. Where roads would be stopped up or where realignments of existing roads have led to cul-de-sacs to maintain access to existing properties, provision would be made for turning heads at the end of these access roads to allow vehicles including emergency and farm vehicles (dependent on the current usage of the road) to turn safely. The proposed side road layouts are shown in drawings 718736-S1-0800-680 to 692, 720 to 723 and 725 contained within Volume 2.

5.7 Departures from Standards – Mainline

5.7.1 There are no mainline departures from standard in the design of the Proposed Scheme in Section 1.

5.7.2 There are 14 relaxations to desirable minimum standard that have been incorporated into the design of the mainline of the Proposed Scheme. A tabular summary is included in Appendix 5A.

5.8 Departures from Standards – Side Roads

5.8.1 A number of departures from standard have been introduced into the design of the side roads within the Proposed Scheme as a result of the existing alignments, cross sections and constraints of the local road network.

5.8.2 A tabular summary of the departures from standard and relaxations that have been incorporated within the side roads is included in Appendix 5C.

5.9 Public Utilities

5.9.1 Apparatus for the supply of electricity, potable water and telecommunications exist in the vicinity of the Proposed Scheme. These apparatus are mainly concentrated in and around settlement areas, as well as traversing across rural areas, and are also installed within the existing A5 corridor. Details of the Statutory Undertakers' major apparatus can be found in drawings 718736-S1-0100-001 and 002 in Volume 2.

Electricity

5.9.2 One 110kV electricity transmission line, originating in Ballymagorry sub-station and extending west across the border, would cross the Proposed Scheme to the north of Strabane. This line is supported on a mixture of portal poles and pylons. No diversionary works would be required to this line. A further four 110kV lines extend to the north and south of Ballymagorry sub-station but these would not be affected by the Proposed Scheme.

5.9.3 In Section 1, the Proposed Scheme would cross existing 33kV overhead distribution conductors 15 times. The mainline would cross these conductors at; Cloghboy Road, Willow Road, twice in the vicinity of Cloghcor, twice to the west of Ballymagorry, six times to the south and west of Strabane and once north of Sion Mills. 33kV conductors would be crossed a further two times by tie-in/accommodation works to the south-west of New Buildings.

5.9.4 There are also extensive networks of 11kV overhead and LV underground distribution apparatus which provide electricity supply to domestic and commercial premises along the length of the Proposed Scheme.

5.9.5 Approximately 40 diversions would be required to Northern Ireland Electricity (NIE) distribution apparatus. These diversions would generally involve raising existing conductors to provide the necessary statutory ground clearances above the Proposed Scheme carriageway. In some locations there would also be a requirement for limited horizontal realignment of conductors, and where embankments are very high, under-grounding of apparatus.

5.9.6 A single NIE 11kV overhead diversion was carried out as part of previous advance works.

Water Mains and Sewers

5.9.7 The majority of the water supply network in Section 1 consists of small to medium diameter (80-200mm) gravity distribution mains buried in the existing minor road network. Approximately 17 such mains exist in Section 1. More extensive water supply networks are located in and around New Buildings and Strabane. Where the mainline of the Proposed Scheme would cross these water mains on embankment, they would need to be re-laid under the new carriageway within protective sleeves. If the mainline is in cutting, severed mains would be re-laid along the new carriageway across adjacent new side road structures.

5.9.8 There is a 12" cast iron trunk water main that brings water from Prospect Reservoir, to the west of Sion Mills, into Strabane. This pipe reduces in diameter at the existing A5

Mourne River crossing, from where it continues to New Buildings as an 8-9” ductile iron pipe along the existing A5 and Woodend Road. This main would be protected or lowered at locations where it is crossed by the Proposed Scheme.

5.9.9 Public sewerage within Section 1 is confined to small self-contained networks, with sewers of 300mm diameter and smaller, serving the settlements of Magheramason, Bready and Ballymagorry. There are more extensive networks of sewers in New Buildings and Strabane. Domestic and commercial premises located in the rural areas which would be adjacent to the Proposed Scheme are generally served by private septic tanks.

5.9.10 The Proposed Scheme in Section 1 would cross two 525mm concrete combined gravity sewers in New Buildings and a 1050mm concrete combined gravity sewer in Strabane at Park Road. In New Buildings, the Proposed Scheme would also cross a 1050mm concrete surface water outfall in the vicinity of Woodside Road and a 600mm foul overflow from the disused Desmonds textile factory. In most cases these large diameter sewers would remain in their existing locations with appropriate measures taken to protect them. It is likely that the combined sewer located in Park Road, Strabane, will need to be re-laid to accommodate proposed drainage ponds.

Telecommunications

5.9.11 BT has a network of overhead and underground apparatus located alongside and below the existing road network. Within Section 1, underground trunk fibre optic and copper cables are located in ducts below the existing A5 between New Buildings and Sion Mills. There is also an extensive network of ducts in New Buildings and Strabane, with spurs in Woodend Road, Lifford Road and Urney Road, as well as ducts in 8 other minor roads between New Buildings and Strabane. Where the Proposed Scheme would cross these networks of ducts they would be lowered and/or protected as appropriate.

5.9.12 Furthermore, there is an extensive network of overhead copper BT apparatus which would be crossed 21 times by the Proposed Scheme in Section 1. In general these overhead cables would be diverted into new ducts in the realigned side road network and new structures. Where no new structures are proposed, BT apparatus would cross the Proposed Scheme in either existing ducts or new steel ducts.

5.9.13 Virgin Media, Eir and Atlas Communications (NI) have trunk fibre optic apparatus located generally to the east of Section 1. This apparatus is laid inside a 4-way duct that extends south of New Buildings to Magheramason where if follows the rural minor road network to the A5 Victoria Road north of Strabane. This 4-way duct is laid through the centre of Strabane before re-joining the A5 Melmount Road where it continues in a southerly direction to Sion Mills. Although the mainline of the Proposed Scheme does not cross this duct it is affected in 7 locations by tie-in works to the existing highway network. It is likely that diversionary works would be limited to local protection and lowering of ducts at the tie-in locations.

5.9.14 EE (formerly T-Mobile and Orange), Vodafone and O2 have mobile phone base stations/masts which are predominately located on higher ground to the east of Section 1. Only one of these masts, operated by EE, would be in close proximity to the Proposed

Scheme at Park Road to the west of Strabane. This mast may need to be temporarily re-located in order facilitate the construction works.

Miscellaneous

5.9.15 There is a proposal for a new gas transmission pipeline that may reach Strabane in the vicinity of Woodend Road. The design of this pipeline is at an early stage and its alignment will be required to accommodate the Proposed Scheme.

5.10 Geotechnical Constraints and Proposed Solutions

5.10.1 Within Section 1, areas with ground conditions and associated geotechnical risks requiring particular engineering solutions or ground treatment are listed in Table 5-3.

Approx. Mainline Ch. (m)	Problematic Ground Conditions	Geotech. Risk	Proposed Treatment	Comments
1285	Alluvium to ~1m bgl	Bearing capacity failure, adverse settlement	Excavate and replace soft alluvium	Localised alluvial areas associated with small watercourse
2545	Alluvium to ~1m bgl	Bearing capacity failure, Instability of side slopes	Excavate and replace soft alluvium	Localised alluvial area associated with small watercourse
3050	Alluvium up to 2.2m bgl, generally less than 1m thick	Bearing capacity failure	Excavate and replace soft alluvium	Localised alluvial area associated with small watercourses
3880	Alluvium to ~3m bgl	Bearing capacity failure, Instability of side slopes	Excavate and replace soft alluvium	Localised alluvial area associated with small watercourse
5300	Alluvium to 2.50m bgl, generally less than 1m bgl	Bearing capacity failure, adverse settlement	Excavate and replace soft alluvium	Localised alluvial area associated with small watercourse
6580 - 7280	Rock Cutting in fractured shales/pelites/ phylites and schist	Excavated rock breaking down into finer material. Slope instability - bedding dip out of face/low angle of friction of shale /pelite/phylite/schist Weathered bedrock - susceptibility to erosion/weathering/ scree slopes	Safe angle of slope required for local features subject to degradation or weathering	Bready Rock Cutting

Approx. Mainline Ch. (m)	Problematic Ground Conditions	Geotech. Risk	Proposed Treatment	Comments
7300 - 7850	Thin layer of Alluvium (occasionally peat)	Bearing capacity failure, adverse settlement	Excavate and replace soft alluvium	Associated with watercourse South of Bready Cutting
10460 – 10660	Cohesive Alluvium to ~ 3-5m bgl	Bearing capacity failure, adverse settlement, instability	Piled embankment	Burn Dennett River
10950 – 11400	Cohesive Organic Alluvium to ~7m bgl	Bearing capacity failure, adverse settlement, instability	Staged construction*	Cloghcor
12300 – 13100	Cohesive Organic Alluvium to ~10-17m bgl	Bearing capacity failure, adverse settlement, instability, lateral movements	Staged construction* with possible piled embankment or load transfer platform nr bridge interface	Glenmornan River
13350 - 13650	Cohesive Organic Alluvium to ~6.1- 7.6m bgl	Bearing capacity failure, adverse settlement, instability, lateral movements	Staged construction* with flood structure foundation piled	Flood alleviation structures to be piled
13850 – 14150	Cohesive Organic Alluvium to ~1.9 - 8.0m bgl	Bearing capacity failure, adverse settlement, instability, lateral movements	Staged construction*	Foyle floodplain
14500 – 14750	Anticipated Soft Alluvium - beneath slip roads between new and existing A5.	Adverse settlement, bearing capacity failure, instability, lateral movements	Staged construction* with flood structure foundation piled	Flood alleviation structures to be piled
14800 – 16750	Alluvium to ~5-6m bgl	Bearing capacity failure, adverse settlement, instability, lateral movements	Staged construction*	Foyle floodplain
16750 – 17150	Alluvium to ~3m bgl	Bearing capacity failure, adverse settlement, instability	Excavate and replace soft alluvium	Foyle floodplain
17150 – 17780	Made ground and Alluvium to 7-12m bgl	Bearing capacity failure, adverse settlement, instability, lateral movements	Piled embankment (main line) with some staged construction (slip roads)	Foyle floodplain

Approx. Mainline Ch. (m)	Problematic Ground Conditions	Geotech. Risk	Proposed Treatment	Comments
17780 -	Past issues with piling in the silty Alluvium for the existing bridge - High horizontal pile loads	Failure of piles	Detailed design of piles to take into account lateral loads on piles in soft ground	Mourne River Crossing. 4 span structure with piled foundations
18000 – 18500	4 - 5m of loose ground underlain by inter-bedded medium dense sand and gravel	Bearing capacity failure, adverse settlement, instability, lateral movements	Staged construction* with bridge foundation piled.	Mourne River approach embankments
18500 – 19375	1 - 2m of granular made ground underlain by organic silt/clay with occasional peat to 3-4m bgl.	Bearing capacity failure, adverse settlement, instability	Excavate and replace soft ground	Adjacent to River Finn.
19375 – 19550	Made Ground to 2 - 4mbgl underlain by soft grey organic silt with pockets of peat and clay to 8 - 10mbgl.	Bearing capacity failure, adverse settlement, instability, lateral movements	Staged Construction*	
19550 – 20880	Rock Cutting excavation into weathered bedrock.	Cutting drainage affecting general groundwater levels in the area Bedding dip out of face. Low angle of friction. Slope instability - susceptibility to erosion/weathering/ scree slopes.	Safe angle of slope required for local features subject to degradation or weathering	Significant cutting, partly into rock
20450 – 20650	Practicalities with geometry of Cutting adjacent to quarry	Cutting drainage affecting groundwater levels at the quarry.	Oversized Drain in cutting likely to be required.	Rock cutting adjacent to abandoned flooded Strahans Road Quarry

Approx. Mainline Ch. (m)	Problematic Ground Conditions	Geotech. Risk	Proposed Treatment	Comments
20900 – 21040	Soft grey silt/clay (Lake Alluvium) to 7 - 9m bgl.	Bearing capacity failure, adverse settlement, instability, lateral movements	Staged Construction*	
21040 – 21270	Pockets of soft clay up to 1.5m bgl (Lake Alluvium)	Bearing capacity failure, adverse settlement,	Excavate and replace soft ground	
22000	Soft organic clay to 1.5m bgl	Bearing capacity failure, adverse settlement, instability	Excavate and replace soft ground	Localised alluvial area associated with small watercourse

Table 5-3 Section 1 Geotechnical Constraints and Proposed Solutions

*Staged construction, involves the placing of preload fill in stages of limited thickness (typically 2m), with time allowed, between stages, for the foundation soils to consolidate and strengthen before the next increment in load is added.

Volumes of Earthworks Material

5.10.2 The estimated volumes of earthworks material for Section 1 are detailed in Table 5-4.

Activity	Approx. Volumes (Million m^3)
Excavation of Topsoil	0.5
Excavation of Suitable Material	3.0
Excavation of Marginal Material	0.4
Imported Material	0.4
Total Excavated & Imported Volume	**4.3**
Deposition of Topsoil	0.5
Deposition of Suitable Material	3.0
Deposition of Imported Material	0.4
Deposition of Material in Deposition Areas	0.4
Disposal of Unsuitable Material off Site	0.0*
Total Deposited & Exported Volume	**4.3**

Table 5-4 Section 1 Earthworks Volumes

* Relatively small quantities of unacceptable materials Classes U1B & U2 will be disposed off-site to licensed tips.

5.11 Drainage and Flooding

5.11.1 This section provides information on the proposed drainage design for Section 1. For details of the methodology of the drainage engineering assessments and design refer to Chapter 4.

Mainline Drainage

5.11.2 The purpose of the road drainage is to provide a strategy for discharge of road related run-off to existing watercourses at particular locations. Within Section 1, there would be 32 mainline outfalls, details of which are given in Table 5-5.

Outfall ID	Chainage (m)	Receiving Watercourse ID	Proposed Mitigation at Outfall
S1 OF: 1.1	300	River Foyle	Retention Pond
S1 OF: 2.1 A	700	River Foyle	Retention Pond
S1 OF: 2.1 B	1000	River Foyle	Retention Pond
S1 OF: 25	1570	River Foyle	Retention Pond
S1 OF: 40	2500	Gortin Hall Drain	Retention Pond
S1 OF: 26	3300	Blackstone Burn	Retention Pond
S1 OF: 5.1	3980	UD_04	Grassed Channels and Retention Pond
S1 OF: 7.1	6000	UD_05	Retention Pond
S1 OF: 10.1	8150	UD_07	Retention Pond
S1 OF: 08	8270	UD_07	Retention Pond
S1 OF: 11	9950	Burn Dennet	Retention Pond
S1 OF: 12	10400	Burn Dennet	Retention Pond
S1 OF: 13	10600	Burn Dennet	Retention Pond
S1 OF: 42	11850	FD_02	Grassed Channels and Retention Pond
S1 OF: 15	12750	Ballymagorry	Retention Pond

Outfall ID	Chainage (m)	Receiving Watercourse ID	Proposed Mitigation at Outfall
S1 OF: 16	12750	Ballymagorry	Retention Pond
S1 OF: 17	13840	Ballymagorry Burn	Retention Pond
S1 OF: 27	14600	Ballymagorry Burn	Retention Pond
S1 OF: 27A	14750	Ballymagorry Burn	Retention Pond
S1 OF: 29.1	15050	Ballymagorry Burn	Retention Pond
S1 OF: 39	15500	Strabane Glen Stream	Retention Pond
S1 OF: 31	15700	Roundhill Drain 0.01	Retention Pond
S1 OF: 32	16210	FD_13.b	Retention Pond
S1 OF: 33	17200	Nancy Burn	Grassed Channels and Retention Pond
S1 OF: 34	17200	Nancy Burn	Retention Pond & Attenuation Pond
S1 OF: 36	18660	River Finn	Retention Pond
S1 OF: 37	18800	River Finn	Grassed Channels
S1 OF: 41	19200	River Finn	Grassed Channels
S1 OF: 22.2	19300	River Finn	Retention Pond
S1 OF: 23.1	20900	Flushtown	Pollution Control Unit, Vortex Separator and Retention Pond,
S1 OF: 38	20900	Flushtown	Grassed Channels and Retention Pond
S1 OF: 24.1	22000	UD_12	Retention Pond

Table 5-5 Section 1 Mainline Outfalls

Side Road Drainage

5.11.3 Within Section 1, there would be a total of 26 side road outfalls which would discharge into suitable receiving watercourses or existing road drainage networks. Details are given in Table 5-6.

Outfall ID	Chainage (m)	Receiving Watercourse ID
S1 OFS: Victoria Road 1.1	530	New Buildings Stream
S1 OFS: Victoria Road 2A	1700 (130 W)	River Foyle
S1 OFS: Dunnalong Road .1	3925 (80 W)	UD_04
S1 OFS: Dunnalong Road 2	4000	UD_04
S1 OFS: Meenagh Road 1	5300 (580 W)	UD_105
S1 OFS: Meenagh Road 2	4000	UD_04
S1 OFS: Tamnabrady Road	5800	UD_05
S1 OFS: Cloughboy Road	5900 (265 W)	UD_05.1
S1 OFS: Bready Cut Accommodation Road	7300	Bready Stream
S1 OFS: Donagheady Road 2	7900	Bready Stream
S1 OFS: Drumenny Road	10100 (185 E)	Burn Dennet
S1 OFS: Victoria Road 3.2	11050	Ballydonaghy Drain
S1 OFS: Greenlaw Road 1	12850	FD_101
S1 OFS: Greenlaw Road 2	13300	Greenlaw Rd 2
S1 OFS: Spruce Road 1	14600 (235 W)	FD_18
S1 OFS: Park Road 1	17300	Park Road Drain
S1 OFS: Park Road 2	17300	Park Road Drain
S1 OFS: Lifford Road	17900	Mourne
S1 OFS: Great Northern Link	18000	Mourne

Outfall ID	Chainage (m)	Receiving Watercourse ID
S1 OFS: Urney Road 2	19230	UD_10
S1 OFS: Strahans Road 1.1	19450	River Finn
S1 OFS: Knockroe Road .1	20900	Flushtown
S1 OFS: Orchard Road .1	20900	Flushtown
S1 OFS: Melmount Road 2.1	21950 (420 E)	UD_12
S1 OFS: Melmount Road 3	21950 (315 E)	UD_12
S1 OFS: Melmount Road 4	22000	UD_12

Table 5-6 Section 1 Side Road Outfalls

Watercourse Crossings

5.11.4 A total of 34 watercourse crossings would be required for the Proposed Scheme in Section 1. Three of the crossings would be bridges and the remainder would consist of 31 culverts. Details of the crossings are given in Table 5-7.

Crossing Reference	Watercourse ID	Chainage (m)	Type	Indicative Size of Opening (m) H x W
S1-B06	Burn Dennet	10500	Bridge	Approx. span = 22m+33m+22m
S1-B08	Glenmornan	12750	Bridge	Approx. span = 14m+23m+14m
S1-B14	Mourne	17900	Bridge	Approx. span = 50m+64m+85m+64m
S1-PC-01	New Buildings Stream	540	Box	1.8 x 2.7
S1-PC-02	UD_01	1330	Box	2.1 x 2.1
S1-PC-03	Gortin Hall Drain	2485	Box	1.8 x 4.5
S1-PC-04	UD_02	3050	Pipe	1.5m Ø
S1-PC-32	UD_02	3125	Pipe	1.5m Ø
S1-PC-05	Blackstone Burn	3375	Box	2.1 x 3.9

Crossing Reference	Watercourse ID	Chainage (m)	Type	Indicative Size of Opening (m) H x W
S1-PC-37	UD_04	3900	Box	1.8 x 1.8
S1-PC-06	UD_04	3980	Box	1.8 x 1.8
S1-PC-29	UD_04	3950	Box	1.8 x 1.8
S1-PC-07	UD_05	5800	Box	1.5 x 1.5
S1-PC-41	UD_05	5825	Box	1.5 x 1.5
S1-PC-08	UD_07	8240	Box	2.1 x 3.0
S1-PC-38	UD_07	8250	Box	2.1 x 3.0
S1-PC-09	Ballydonaghy Drain	10990	Pipe	1.8m Ø
S1-PC-40	Ballydonaghy Drain	10990	Pipe	1.8m Ø
S1-PC-10	FD_04	12600	Pipe	1.5m Ø
S1-PC-16	Strabane Glen Stream	15470	Box	2.7 x 3.0
S1-PC-17	Roundhill Drain	15680	Box	1.8 x 2.4
S1-PC-18	FD_13.b	16210	Pipe	1.8m Ø
S1-PC-19	Backfence Drain	16650	Pipe	2.4m Ø
S1-PC-20 (A)	Nancy Burn	17090	Pipes	0.6m Ø
S1-PC-20 (B)				1.2m Ø
S1-PC-20 (C)				0.6m Ø
S1-PC-33	Nancy Burn	17130	Box	2.4 x 3.9
S1-PC-42	Nancy Burn	17200	Box	2.4 x 3.9
S1-PC-22	Park Road Drain	17380	Pipe	1.5m Ø

Crossing Reference	Watercourse ID	Chainage (m)	Type	Indicative Size of Opening (m) H x W
S1-PC-23	UD_08	18180	Pipe	1.8m Ø
S1-PC-24	Urney Road Drain	18720	Box	2.4 x 2.4
S1-PC-25	UD_10	19240	Pipe	1.8m Ø
S1-PC-27	Flushtown	20900	Box	2.1 x 3.6
S1-PC-28	UD_12	21990	Box	2.1 x 2.1

Table 5-7 Section 1 Watercourse Crossings

Watercourse Diversions

5.11.5 There would be 12 proposed watercourse diversions within Section 1. These are detailed in Table 5-8. The size of watercourse being diverted ranges from small, open field drains to large streams. In some instances, it is proposed that land and field drainage would be incorporated into the proposed pre-earthworks drainage (PED) design and at these locations, no watercourse diversion would be proposed.

Diversion Reference	Watercourse ID	Chainage (m)	Approximate Length (m)
S1-WD-17	New Buildings Stream	540	100
S1-WD-01	UD 01	1330	119
S1-WD-16	Gortin Hall Drain	2485	93
S1-WD-02	UD 02	3050	130
S1-WD-03	Blackstone Burn	3375	182
S1-WD-05	UD 04	3950	367
S1-WD-06	UD 05	5800	125
S1-WD-07	UD 07	8240	252
S1-WD-08	Ballydonaghy Drain	10990	200
S1-WD-18	UD 08	18180	243
S1-WD-14	Urney Road Drain	18720	107
S1-WD-19	UD 12	21990	252

Table 5-8 Section 1 Watercourse Diversions

Flood Mitigation

5.11.6 This section provides information on the flood mitigation that would be required for the Proposed Scheme through Section 1. For the methodology of the flood risk assessments and processes, refer to Chapter 4 and the A5 WTC Flood Risk Assessment.

Hydraulic Models

5.11.7 A number of hydraulic models were developed for Section 1. The purpose of the hydraulic models was to ascertain the extent of floodplains and associated depths/elevations of water for particular watercourses over defined flood events. The details of each hydraulic model within Section 1 are given below.

Model A Gortin Hall Drain

5.11.8 The Gortin Hall Drain is located between the towns of New Buildings and Magheramason. (Refer to drawing 718736-S1-0500-0108 for the 1% Annual Exceedance Probability (AEP) design return period flood outline).

5.11.9 Hydraulic modelling indicates that based on the existing 100 year fluvial levels within the Gortin Hall Drain (with a corresponding annual tidal level in the River Foyle) the proposals result in the displacement of approximately 55m^3 of fluvially dominant floodwater. The floodplain is primarily restricted to the downstream side of the Proposed Scheme within an inter-tidal zone and impacts arising from displacement are considered minimal and no compensatory storage has been provided. The overall impact from the Proposed Scheme is Slight Adverse.

Model B Blackstone Burn

5.11.10 The Blackstone Burn is located in the vicinity of Magheramason. (Refer to drawing 718736-S1-0500-0109 for the 1% AEP (design return period) flood outline).

5.11.11 Hydraulic modelling indicates that based on the existing 100 year fluvial levels within the Blackstone Burn (with a corresponding annual tidal level in the River Foyle) the proposals result in the displacement of approximately 135m^3 of fluvially dominant floodwater. River engineering proposals together with the inter-tidal downstream extent retain design fluvial flows within channel such that potential impacts from water displacement are minimal. Accordingly, no compensatory storage is provided. The overall impact from the Proposed Scheme is Slight Adverse.

Model M.1, M.2 and M.3 – Foyle River System (including River Foyle, River Mourne, River Finn, Ballymagorry, Burn Dennet, Deele River, Swilly Burn)

5.11.12 The River Foyle and the lower reaches of the River Mourne and River Finn are located within Section 1 of the Proposed Scheme. The River Foyle starts at the confluence of the River Mourne and the River Finn. The Deele River, Swilly Burn, Burn Dennet, Glenmornan River and a number of other small tributaries discharge to the River Foyle. The extent of the River Foyle System floodplain is from Lough Foyle to Strabane / Lifford and Clady. (Refer to drawings 718736-S1-0500-101 to 0107 and 718736-S1-0500-0113 for the 1% AEP (design return period) flood outline).

5.11.13 Hydraulic modelling indicates that based on existing 100 year fluvial levels within the Foyle system the proposals result in the displacement of approximately 685,945m3 of floodwater.

5.11.14 Although volumetric compensation storage for displaced floodplains is generally accounted for within DMRB and Rivers Agency guidance, alternative measures were agreed with Rivers Agency for displaced flood volumes on the Foyle/Finn.

- The Foyle system (including the Finn, Mourne, Burndennet, Glenmornan, Deele and Swilly tributaries) has been replicated using a dynamic unsteady model with the lower boundary limits extending beyond Londonderry / Derry City to Lough Foyle and consequentially the likelihood of unquantified downstream impacts arising from floodplain degradation has been reduced.

- The most effective and practical mitigation options tested to maintain floodplain extents, levels and temporal nature were to reduce floodplain encroachment, reduce road footprint, provide floodplain connectivity and large structures (on main channels and some key floodplain conveyance locations). These options have been explored in detail and form the major impact mitigation strategy that has been proposed for the scheme following discussions with TransportNI and Rivers Agency.

5.11.15 In order to maintain conveyance across the floodplain, connectivity culverts would be incorporated into the Proposed Scheme through structures S1-CC-01 to S1-CC-08 inclusive (see Table 5-9). (For further details refer to mitigation drawing 718736-S1-0500-0101 to 0107 and 718736-S1-0500-0110 to 0113). The overall impact from the Proposed Scheme is Slight Adverse.

Connectivity Culverts

5.11.16 Along Section 1 there would be 6 connectivity culverts. Table 5-9 below lists the proposed connectivity culverts within Section 1.

Connectivity Culvert Reference	Chainage (m)	Hydraulic Clear Opening Requirement	
		Height (m)	Width (m)
S1-CC-01	11000	1.8 Ø	
S1-CC-02	13000	1.8 Ø	
S1-CC-03	15570	3.3	4.0
S1-CC-04	15775	3.0	4.0
S1-CC-05	16360	2.1	4.0
S1-CC-08	18375	5.1	4.0*

Table 5-9 Section 1 Connectivity Culverts

5.11.17 A number of bridge structures would also be included to provide flood connectivity in areas where there are significant flow paths or inundation channels. These structures are detailed in section 5.15 below.

5.12 Deposition Areas

5.12.1 A number of possible areas for the deposition of material have been identified adjoining the Proposed Scheme. These were assessed under various engineering and environmental headings and the most appropriate chosen. The schedule below sets out the location and size of the chosen Deposition Areas

Reference	Approx. Mainline Chainage (m)	Location	Fill Volume (m³)
S1-DEP-001	6000 - 6275	East of mainline, west of Victoria Road	89,000
S1-DEP-002	7350 - 7830	North of Donagheady Road, east of mainline	303,000
S1-DEP-003	7325 - 7800	North of Donagheady Road, west of mainline	70,000
S1-DEP-004	9200 - 9375	East of mainline, south of Victoria Road	53,000

Table 5-10 Deposition Areas in Section 1

5.13 Road Signage

5.13.1 As discussed in Chapter 4, a road signage strategy design was carried out to identify areas of land that needed to be included in the draft Vesting Order.

5.14 Road Side Features

5.14.1 Within Section 1, two lay-bys would be constructed in accordance with Volume 6 TD69/07 Type A. One northbound and one southbound lay-by would be provided at Ch. 8060m and Ch. 7460m respectively.

5.15 Structures

5.15.1 The tables below summarises the nature and type of structure that would be required in Section 1. The locations of the structures are shown on drawings 718736-S1-0800-660 to 676 within Volume 2.

Structure Reference	Structure Name	Type	Chainage (m)
AC-01	Accommodation	Overbridge	2840
S1-B01	Dunnalong Road	Overbridge	3930
AC-03	Accommodation	Overbridge	4935
S1-AC-04	Accommodation	Overbridge	5405
S1-AC-05	Accommodation	Overbridge	5730

Structure Reference	Structure Name	Type	Chainage (m)
S1-B02	Victoria Road	Underbridge	6410
S1-B03	Donagheady Road	Overbridge	7875
S1-B04	Victoria Road (A5)	Underbridge	9110
S1-B05.1	Drummeny Road	Underbridge	10025
S1-B06	River Burn Dennet	River Structure	10510
S1-B07	Moss Road/ Ballydonaghy Road	Underbridge	11060
S1-AC-06	Accommodation	Overbridge	11660
S1-B08	River Glenmornan	River Structure	12730
S1-B09	Park Road & Flood Relief	Flood Relief Structure	13475
S1-AC-07	Accommodation	Underpass	14075
S1-B010	Ballymagorry Junction	Overbridge	14690
S1-B10.1	Ballymagorry Junction	Flood Relief Structure	14760
S1-B10.2A	Ballymagorry Junction	Flood Relief Structure	14950
S1-AC-08	Accommodation	Underpass	15210
S1-AC-09	Accommodation	Underpass	15775
S1-AC-10	Accommodation	Underpass	16365
S1-B13	Now Part of River Mourne Structure (S1-B14)		
S1-B14	River Mourne	River Structure	17925
S1-B15	Now Part of River Mourne Structure (S1-B14)		
S1-AC-11	Accommodation	Underpass	18375

Structure Reference	Structure Name	Type	Chainage (m)
S1-B15.1	Urney Road	Underbridge	19525
S1-B16	Strahans Road	Overbridge	20390
S1-B17	Orchard Road	Overbridge	21420
S1-B18	Peacock Junction	Overbridge	22065

Table 5-11 Section 1 Public Structures

5.15.2 These structures can generally be classified within the 'family of structures' described in Chapter 4.

5.15.3 The following section describes the more significant structures that would be required.

Burn Dennet (Ch. 10506m)

5.15.4 This structure would carry the A5WTC over the Burn Dennet River to the North of Strabane. The bridge would require a clear span of 33m to cross the channel and river banks. The land owners on both sides of the river also require accommodation access under the structure. The bridge would be a 3 span symmetrical structure that spans approximately 77m between centreline of bearings at each end.

5.15.5 The above span arrangement would allow the use of either composite precast beams or composite steel plate girders superstructures. Drawing 718736-1700-D-0507 in Volume 2 shows the general arrangement of the proposed structure.

Glenmornan River (Ch. 12720m)

5.15.6 This structure would carry the A5WTC over the River Glenmornan to the North of Strabane. The bridge would require a clear span of 23m to cross the channel and river banks. The land owners on both sides of the river also require accommodation access under the structure. The bridge would be a 3 span symmetrical structure that spans approximately 51m between centreline of supports at each end.

5.15.7 The above span arrangement would allow the use of either composite precast beams or composite steel plate girders superstructures. Drawing 718736-1700-D-0508 in Volume 2 shows the general arrangement of the proposed structure.

Ballymagorry Flood Connectivity Structures (Ch. 13500m, 14600m & 14800m)

5.15.8 These structures would carry the A5WTC over Park Road, Junction 3 slip roads and link road and are required to provide connectivity during flood events in the vicinity of Ballymagorry. The structures would be of varying lengths, 120m, 142m and 135m; and would be made up of a series of symmetric spans. The arrangement for these structures would comprise of a series of spans with approximate lengths of 17m, 27m and 28m, each consisting of composite precast beam superstructures.

Mourne River (Ch. 17920m)

5.15.9 The new Mourne River Bridge, which would carry the Proposed Scheme over the Mourne River in Strabane, would be the largest and most prominent structure in the scheme. The proposed bridge would be a 4 span asymmetrical structure with spans, from north to south, of approximately 50m, 64m, 85m and 64m giving a total length for the structure of 263m between the centreline of bearings at each end. The bridge would span the Lifford Road Roundabout (spans 1 & 2), the River Mourne (span 3) and the proposed A5WTC north slip roads (span 4).

5.15.10 The proposed spans arrangement are governed by the following factors;

- providing a clear span over the River Mourne, in normal flow conditions, with no intermediate supports located in the river;
- accommodating the highway network beneath the north and south spans;
- having appropriate span proportions both structurally and aesthetically.

5.15.11 The proposed superstructure would have a curved soffit for the three main spans. This is considered to be the most aesthetically appropriate for a relatively low level river crossing. The approximately 50m end span to the north of the river would be of constant depth throughout its length.

5.15.12 The structural form of the superstructure of the bridge would be either a post-tensioned concrete box girder or a composite steel plate girder. Drawing 718736-1700-D-0509 in Volume 2 shows the general arrangement of the proposed structure.

6 SECTION 2 – ENGINEERING INFORMATION

6.1 Cross Section

6.1.1 From Sion Mills to a point approximately 500m west of the Seskinore Road junction, south of Omagh, the Proposed Scheme mainline has been designed as a Dual 2 Lane All Purpose (D2AP) Carriageway to a design speed of 120kph.

Carriageway Type	Dual Carriageway (D2AP)
Element	**Width (m)**
Carriageway	2 x 7.3
Hard Strips	4 x 1.0
Central Reserve	2.5 (min)
Verges	2 x 2.5 (min)
Earthworks	Varies
Total Width	**26.1 (min)**

Table 6-1 Mainline Cross Section Dimensions

6.2 Mainline Horizontal and Vertical Alignment

6.2.1 Details of the Proposed Scheme's mainline horizontal and vertical alignments are shown on Plan and Profile drawings 718736-S2-0800-560 to 581 in Volume 2. Details of departures from standard and relaxations associated with the mainline are given in paragraph 6.7 below and in Appendix 6A.

6.3 Side Roads

6.3.1 A tabular summary of the side road proposals is included in Appendix 6B. Further details of the side roads are shown on drawings 718736-S2-0800-590 to 630 and 672 to 675 within Volume 2.

6.3.2 A design speed assessment was carried out on each of the side roads in accordance with the methods described in Chapter 4. Following this assessment, a review was undertaken on each side road to establish where departures or relaxations would exist in the design. The outcome of the design speed assessment process is reported in Appendix 6C.

6.4 Junctions

6.4.1 There would be four junctions within Section 2, at Victoria Bridge, Newtownstewart, Omagh (North) and Omagh (West). Details of the junction provision and arrangements are provided below and in Table 6-2. Drawings 718736-S2-0800-753 to 757 showing details of the junction layouts are contained within Volume 2 and further details are given in Appendix 6D.

Junction 9 – Victoria Bridge

6.4.2 Junction 9 is a compact grade separated junction located near Victoria Bridge at Ch. 31550m. The Proposed Scheme would cross the B72 Fyfin Road and the adjacent Liscreevaghan Burn on an embankment varying in height from 8m to 15m. The roads connecting the northbound and southbound carriageways to the B72 would be realigned to minimise impact on property and avoid the steeper areas of the landscape. The vertical alignment of the southbound connector road would have a maximum gradient of 9% which is a relaxation from standards (TD40 para 6.15).

6.4.3 Ground conditions in the valley south of Fyfin Road are such that improvement works would be required beneath the high embankment. Verge widening would be required to the northern side of Fyfin Road in the vicinity of the junction with the southbound connector road to provide the desirable stopping sight distance.

6.4.4 Considerations that influenced the layout of this junction included:

- Minimising impact on the nearby farmhouse and associated buildings/ access;
- Minimising culverting works to Liscreevaghan Burn;
- Minimising roadworks within the area of soft ground between Fyfin Road and the Burn.

6.4.5 Drawing 718736-S2-0800-753 provides further technical information pertaining to Junction 9 and is contained within Volume 2.

Junction 10 – Newtownstewart

6.4.6 The junction at Newtownstewart would be located where three side roads, Drumlegagh Road North, Golf Course Road and Baronscourt Road, would be crossed by the Proposed Scheme near Ch. 37300m.

6.4.7 The main factors influencing the design of the layout of this compact grade separated junction were;

- Improving the alignment and visibility on the B84 Baronscourt Road;
- Rationalising the side road crossings of the dual carriageway and minimising bridge construction works, whilst maintaining local access

6.4.8 The B84 Baronscort Road would be realigned approximately 50m to the west with the introduction of two 45m ICD roundabouts positioned to either side of the mainline. These would then connect to the compact grade separated junction to the mainline.

6.4.9 The junction between the connector road and the northbound carriageway would be located some 200m north-west of the proposed bridge to allow connectivity with Drumlegagh Road North. Golf Course Road, which predominantly provides field access, would be stopped up. The connector road for the southbound carriageway would terminate at a small roundabout on Baronscourt Road to help reduce approach speeds, as visibility near the tie-in is constrained by property frontages.

6.4.10 Drawing 718736-S2-0800-754 provides further technical information pertaining to Junction 10 and is contained within Volume 2.

Junction 11 – Omagh (North)

6.4.11 Omagh is a major generator and attractor of traffic and flows to and from the north are best accommodated by a full grade separated junction at this location, with a link towards the town centre via the existing A5. The Proposed Scheme would pass through the floodplain associated with Tully Drain and over the watercourse itself, and consequently would maintain an embankment height of up to 4m. Due to the height of the mainline embankment at this location, the link road overbridge which would form part of the dumb-bell arrangement consisting of 45m ICD roundabouts, would be approximately 11m above existing ground level to ensure that the required headroom of 5.3m is maintained through the structure.

6.4.12 Key considerations in determining the design of the layout and location of this junction included:

- Minimising Departures on the road linking the junction with the existing A5;
- Providing connectivity to Drumlegagh Road South, whilst reducing movements at the junction with the existing A5 where sub-standard visibility currently exists;
- Minimising widening / additional structures over Fairy Water either for junction approach visibility or for the slip roads themselves;
- Minimising demolition of dwellings;
- The proximity of the slip roads and mainline to Tully Bog SAC.

6.4.13 As the more dominant flow from the dual carriageway would be in to and out of Omagh, the existing A5 to the north would form a priority junction with the new link. Ground conditions from Tully Drain to where the Proposed Scheme would cross Drumlegagh Road South are poor and ground improvement works would be required throughout the junction.

6.4.14 Drawing 718736-S2-0800-755 provides further technical information pertaining to Junction 11 and is contained within Volume 2.

Junction 12 – Omagh (West)

6.4.15 Similarly to Omagh (North), flows to and from the west would be such that a full grade separated junction would be required that also minimises delays to traffic remaining on the A32. A single large elongated roundabout with a 60m ICD would best achieve this objective. From just north of Brookmount Road to the drumlins between the A32 and Loughmuck Road, the dual carriageway would be on embankment up to 11m in height. This vertical alignment lends itself to the construction of two underbridges either side of the A32 to accommodate the circulatory carriageway of the proposed roundabout. This arrangement would minimise disruption to users of the A32.

6.4.16 Other engineering considerations that influenced the proposed design of the layout of this junction included:

- Topography south of the A32;
- Minimising the length of the south-facing slip roads, whilst not departing from vertical gradient standards;
- Minimising landtake as far as practicable.

6.4.17 Drawing 718736-S2-0800-756 provides further technical information pertaining to Junction 12 and is contained within Volume 2.

Summary of Section 2 Junctions

Junction	Connecting road(s)	Connecting town(s) or village(s)	Junction type	Relevant DMRB standard	Restrictions
Junction 9 – Victoria Bridge	B72	Victoria Bridge, Castlederg	Compact Grade-Separated	TD40, including TD42 for major/ minor junctions	All movements catered for
Junction 10 - Newtownstewart	B84, Drumlegagh Road North	Newtownstewart, Dumquin	Compact Grade-Separated	TD40, including TD42 for major/ minor junctions	All movements catered for
Junction 11 – Omagh (North)	A5, Drumlegagh Road South	Omagh	Full Grade-Separated	TD22	All movements catered for

Junction	Connecting road(s)	Connecting town(s) or village(s)	Junction type	Relevant DMRB standard	Restrictions
Junction 12 – Omagh (West)	A32	Omagh, Dromore, Enniskillen	Full Grade-Separated	TD22	All movements catered for

Table 6-2 Section 2 Junction Descriptions

6.5 Existing Roads' Realignments/Upgrades

6.5.1 As Peacock Road would be closed it would be expected that a greater volume of traffic would use Primrose Park to access the existing A5. It is therefore proposed to carry out improvement works on the junction of Peacock Road and Primrose Park to improve safety for the additional traffic.

6.5.2 In order to provide connectivity to the Proposed Scheme from the existing A5 through Victoria Bridge for northbound traffic, improvement works would be required at the junction of Fyfin Road (B72) and Mulvin Road within the limits of the village itself.

6.5.3 Improvement works would also be required at the south-west corner of the junction of Coolaghy Road and Milltown Road to improve visibility.

6.5.4 Within the Proposed Scheme there would be no other upgrade or realignment of any of the existing local road network outside of tie-in works associated with either the provision of junctions or the provision of over / under bridges to maintain the existing side road connectivity.

6.6 Road Closures

6.6.1 In Section 2, the following side roads would be stopped up:

- High Road;
- Milltown Road;
- Golf Course Road;
- Honeyford Lane;
- Tully Road (at mainline Ch. 48450m)
- Todds Road.
- Mellon Park Drive

6.6.2 The following side roads would be diverted to an adjacent side road that would be kept open:

- Garden Road
- Urbalreagh Road;
- Drumlegagh Road North;

- Glen Road;
- Grange Road;
- McFarlands Road
- Tully Road (at Ch 48100m);
- Drumlegagh Road South;
- Mellon Park Drive
- Botera Road;
- Drumragh Road.

6.6.3 All other side roads would remain substantially unaltered and would be catered for by a connection to an existing side road via an overbridge or underbridge passing over or under the Proposed Scheme mainline. Except at Golf Course Road, where roads would be stopped up or where realignments of existing roads have led to cul-de-sacs to maintain access to properties, provision would be made for turning heads at the end of these roads to allow emergency and farm vehicles (dependent on the current usage of the road) to turn safely . The proposed side road layouts are shown on drawings 718736-S2-800-590 to 630 and 672 to 675 contained within Volume 2.

6.7 Departures from Standards – Mainline

6.7.1 There are 2 mainline departures from standard in the design of the Proposed Scheme in Section 2.

6.7.2 There are 18 relaxations to desirable minimum standard that have been incorporated into the design of the mainline of the Proposed Scheme. A tabular summary is included in Appendix 6A.

6.7.3 The first departure is located on the mainline between Ch. 43545m and Ch. 43090m at maintenance access northbound affecting Lane 2. The required SSD is 295m but only a SSD of 230m can be achieved. This is a 1 step relaxation in standards that becomes a departure because of its proximity to a junction.

6.7.4 The second departure is located on the mainline between Ch. 43710m and Ch. 43390m at maintenance access northbound affecting Lane 2. The required SSD is 295m but only a SSD of 233m can be achieved. This is a 1 step relaxation in standards that becomes a departure because of its proximity to a junction.

6.8 Departures from Standards – Side Roads

6.8.1 A number of departures from standard have been introduced into the design of the side roads within the Proposed Scheme as a result of the existing alignments, cross sections and constraints of the local road network.

6.8.2 A tabular summary of the departures from standard and relaxations that have been incorporated within the side roads is included in Appendix 6C.

6.9 Public Utilities

6.9.1 Apparatus for the supply of electricity, potable water, and telecommunications exist in the vicinity of the Proposed Scheme. These apparatus are mainly concentrated in and around, settlement areas, as well as traversing across rural areas, and are also installed within the existing A5 corridor. Details of the Statutory Undertakers' major apparatus can be found in drawings 718736-S2-0100-001 to 003 within Volume 2.

Electricity

6.9.2 Three 110kV electricity transmission lines that terminate in the Doogary sub-station to the south-east of Omagh would cross the Proposed Scheme in Section 2. The first line extends west of Doogary sub-station. This would cross the Proposed Scheme in the vicinity of Beagh Road where it is supported on pylons. It is anticipated that no diversionary works would be required to this line.

6.9.3 The second 110kV line runs from Doogary sub-station north to Ballymagorry sub-station north-east of Strabane. This line would cross the Proposed Scheme five times; to the south of West Road, at Killynure Road, to the south of Dunteige Road, at Gillygooley Road and south of Botera Road. This line is generally supported on portal poles with pylons used where the line changes direction. In most instances where the Proposed Scheme would cross the transmission line, diversionary works would be limited to line raising. In the vicinity of Killynure Road the Proposed Scheme would run parallel and in close proximity to the transmission line for a distance of over 2km and more extensive realignment and line raising works may be required.

6.9.4 The third 110kV line crosses the Proposed Scheme north of Beagh Road in the southern part of Section 2. This line has been constructed so that no future diversions would be required as a result of the Proposed Scheme.

6.9.5 The Proposed Scheme would cross existing 33kV overhead distribution conductors 15 times in Section 2. The mainline would cross these conductors twice to the west of Sion Mills, four times to the west and south of Newtownstewart, twice between Newtownstewart and Mountjoy and four times south of Omagh. 33kV conductors would be crossed a further three times by side road diversions in Section 2.

6.9.6 There are also extensive networks of 11kV overhead and LV underground distribution apparatus which provide electricity supply to domestic and commercial premises along the length of the Proposed Scheme.

6.9.7 Approximately 50 diversions would be required to Northern Ireland Electricity (NIE) distribution apparatus. These diversions would generally involve raising existing conductors to provide the necessary statutory ground clearances above the Proposed Scheme carriageway. In some locations, there would also be a requirement for limited horizontal realignment of conductors, and where embankments are very high, under-grounding of apparatus.

Water Mains and Sewers

6.9.8 The majority of the water supply network in Section 2 consists of small diameter (80-150mm) gravity trunk mains buried in the existing minor road network. 41 such mains exist in Section 2 that would be intersected by the Proposed Scheme. Where the mainline of the Proposed Scheme crosses these water mains on embankment they would need to be re-laid under the new carriageway embankments and will be within protective sleeves. If the mainline is in cutting, severed mains would be re-laid above the new carriageway across adjacent new side road structures.

6.9.9 Four larger diameter trunk mains exist in Section 2 and these are located; in the vicinity of Stone Road (300mm ductile iron pumped), in Drumlegagh Road North (250mm HPPE), in Lisnagirr Road (8" ductile iron) and in Drumlegagh Road South (250mm HPPE). In each location these mains would need to be re-laid within the new side roads and their associated structures.

6.9.10 The larger diameter water mains in Section 2 are a 380mm ductile iron trunk gravity distribution water main located north of Fyfin Road to the west of Victoria Bridge, and 400mm ductile iron trunk gravity main located in Gillygooley Road to the west of Omagh. Both mains would need to be re-laid below the mainline of the Proposed Scheme.

6.9.11 The public sewerage network within Section 2 generally consists of sewers of 300mm diameter and smaller, which are limited in extent to the settlements of Sion Mills, Victoria Bridge, and Newtownstewart. There is a more extensive network of sewers in Omagh but this would not be affected by the Proposed Scheme. Domestic and commercial premises located in the rural areas adjacent to the Proposed Scheme are generally served by private septic tanks.

6.9.12 The Proposed Scheme in Section 2 would cross two combined gravity sewers which are located in Primrose Park and Bells Park Road. These have diameters of 225mm and 150mm respectively. Both sewers bring effluent into Sion Mills Waste Water Treatment Works from settlements to the west. It is likely that the gravity sewer in Primrose Park would need to be re-laid below the main line of the Proposed Scheme, whilst the Bells Park Road sewer would need to be accommodated in the verge of the new side road structure.

6.9.13 There is a proposal for the construction of a new 500mm diameter abstraction pipe along Derg Road to the north-west of Newtownstewart. The design of this new pipeline would ensure that the Proposed Scheme would affect it as little as possible.

Telecommunications

6.9.14 BT has a network of overhead and underground apparatus located alongside and below the existing road network. Within Section 2, underground trunk fibre optic and copper cables are located in ducts; below the existing A5 between Sion Mills and Omagh, Bells Park Road, Fyfin Road, Baronscourt Road, Gillygooley Road, and Clanabogan Road, as well as in 4 other minor roads. Where the Proposed Scheme crosses these networks of ducts, they would be lowered and/or protected as appropriate.

6.9.15 Furthermore, there is an extensive network of overhead copper BT apparatus which would be crossed 39 times by the Proposed Scheme in Section 2. In general these overhead cables would be diverted into new ducts in the realigned side road network and new structures. Where no new structures are proposed, BT apparatus would cross the Proposed Scheme in steel ducts.

6.9.16 Virgin Media, Eir and Atlas Communications (NI) have trunk fibre optic apparatus located in the existing A5 between Omagh and Strabane. It is contained within a 4-way duct laid in a common trench. This apparatus would be affected by the tie-ins to the existing A5 at the Proposed Scheme junction to the north of Omagh. This would require a full diversion to be carried out. The apparatus would also be affected by access road tie-ins and drainage works to the existing A5, however, it is likely that only minor protection works in these locations would be required.

6.9.17 EE (formerly T-Mobile and Orange), Vodafone and O2 have mobile phone base stations/masts located in the Section 2. Only one of these masts, operated by Vodafone, would be in close proximity to the Proposed Scheme at Killynure Road. No diversionary works are likely to be required to this mast.

Miscellaneous

6.9.18 Current utility information indicates that there are no gas pipes located or proposed within Section 2.

6.10 Geotechnical Constraints and Proposed Solutions

6.10.1 Within Section 2, areas with ground conditions and associated geotechnical risks requiring particular engineering solutions or ground treatment are listed in Table 6.3.

Approx. Mainline Ch.(m)	Problematic Ground Conditions	Geotech. Risk	Proposed Treatment	Comments
27480-27580	Space Restriction	Over-steepened slopes	Possible 1.5m high retaining wall.	Possible shallow rock
29600-29900	Lake Alluvium	Instability of embankment slopes	1:3 side slopes	Lake Alluvium associated with dip in topography
30460-30600	Peat to 2.2m bgl	Adverse settlement, instability of embankment slopes	Excavate and replace	
31450-31630	Peat to 2.8m bgl	Adverse settlement, instability of embankment slopes	Excavate and replace 1:3 side slopes	Liscreevaghan Burn

Approx. Mainline Ch.(m)	Problematic Ground Conditions	Geotech. Risk	Proposed Treatment	Comments
38430-38580	Space Restriction	Over-steepened slopes	Steepen side slopes to 1v:2h	Harry Avery's Castle
42000-44500	Side long ground Strule Valley	Potential stability issues due to high ground water	1:3 side slopes	
43520-43580	Space restriction	Over-steepened slopes	Possible retaining wall of varying height	Minimise land take
45290-45335	Space restriction	Over-steepened slopes	Possible retaining wall of 2m height	
45600-45700	Peat to 3.3m bgl	Adverse settlement, instability of embankment slopes	Excavate and replace	Castletown Road South
46370-46520	Peat >10m bgl	Adverse settlement, instability of embankment slopes,	Piled Embankment	Inter-drumlin peat
47000-47500	Peat to 3.5m bgl	Adverse settlement, instability of earthwork slopes	Excavate and replace	South of Dunteige Road
48100-48400	Peat to 3.5m bgl	Instability of side slopes	Excavate and replace	Rash Road
49275-49725	Peat to 4.5m bgl	Adverse settlement, instability of embankment slopes,	Excavate and replace	Omagh North Junction
49970-50090	Soft Ground and Alluvium to 5.5m	Bearing capacity failure, Adverse settlement, instability of embankment slopes.	Excavate and replace	Fairy Water
50420-50600	Peat to 1.5m bgl	Adverse settlement, instability of embankment slopes	Excavate and replace	South of the Fairy Water

Approx. Mainline Ch.(m)	Problematic Ground Conditions	Geotech. Risk	Proposed Treatment	Comments
50900-51040	Peat to 1.5m bgl	Adverse settlement, instability of embankment slopes	Excavate and replace	North of Gillygooley Road
51350-51940	Peat to 3.7m bgl	Adverse settlement, instability of embankment slopes	Excavate and replace	South of Gillygooley Road
52800-53250	Peat to 4m bgl	Adverse settlement, instability of embankment slopes	Excavate and replace	
53000-53150	Peat to 4m bgl	Instability of embankment slopes	1:3 side slopes	Tamlaght Road
54640-54740	Space restriction	Over-steepened slopes	Possible retaining wall of 3m height	
55000-55100	Peat to 4.5m bgl	Adverse settlement, instability of embankment slopes	Excavate and replace or piled embankment	
55100-55600	Peat to 4m bgl	Adverse settlement, instability of embankment slopes	Excavate and replace	

Table 6-3 Section 1 Geotechnical Constraints and Proposed Solutions

Volumes of Earthworks Material

6.10.2 The volumes of earthworks material for Section 2 are detailed in Table 6.4.

Activity	Approx. Volumes (Million m^3)
Excavation of Topsoil	0.8
Excavation of Suitable Material	4.0
Excavation of Marginal Material	1.3
Imported Material	0.3
Total Excavated & Imported Volume	**6.4**
Deposition of Topsoil	0.8
Deposition of Suitable Material	4.0
Deposition of Imported Material	0.3
Deposition of Material in Deposition Areas	0.8
Disposal of Unsuitable Material off Site	0.5
Total Deposited & Exported Volume	**6.4**

Table 6-4 Section 2 Earthworks Volumes

6.11 Drainage & Flooding

6.11.1 This section provides information on the proposed drainage design for Section 2. For the methodology of the drainage engineering assessments and processes, refer to Chapter 4.

Mainline Drainage

6.11.2 The purpose of the road drainage is to provide a strategy for discharge of road related run-off to existing watercourses at particular locations. Within Section 2, there would be 30 mainline outfalls, details of which are given in Table 6-5.

Crossing ID	Chainage (m)	Receiving Watercourse ID	Proposed Mitigation at Outfall
S2 OF: 01	28000	UD_13.3	Retention Pond
S2 OF: 02	29900	UD_15	Retention Pond
S2 OF: 03	30800	UD_17.1	Grassed Channels and Retention Pond
S2 OF: 04	31450	UD_19	Retention Pond

Crossing ID	Chainage (m)	Receiving Watercourse ID	Proposed Mitigation at Outfall
S2 OF: 05	34300	River Derg	Retention Pond
S2 OF: 06	34350	River Derg	Retention Pond
S2 OF: 08	36400	UD_20/ Coolaghy Burn	Retention Pond
S2 OF: 09	37500	Scotts Mill Layde	Grassed Channels and Retention Pond
S2 OF: 10	39100	UD_22	Retention Pond
S2 OF: 33	40600	UD_23	Retention Pond
S2 OF: 34	41250	UD_24.1	Retention Pond
S2 OF: 11	41800	UD_26.1	Retention Pond
S2 OF: 13	43800	UD_33	Retention Pond
S2 OF: 35	43950	UD_34	Retention Pond
S2 OF: 39	44250	UD_35.1	Retention Pond
S2 OF: 18	46280	UD_37.1	Retention Pond
S2 OF: 19	47300	UD_41	Retention Pond
S2 OF: 21	49120	Tully Drain	Retention Pond
S2 OF: 22	49300	Tully drain	Retention Pond
S2 OF: 23	50000	Fairy Water	Retention Pond
S2 OF: 41	50000	Fairy Water	Retention Pond
S2 OF: 24	51100	Aghnamoyle Drain	Retention Pond
S2 OF: 25	51100	Aghnamoyle Drain	Retention Pond

Crossing ID	Chainage (m)	Receiving Watercourse ID	Proposed Mitigation at Outfall
S2 OF: 27	53750	Fireagh Lough Drain	Retention Pond
S2 OF: 29	53900	Fireagh Lough Drain	Retention Pond
S2 OF: 37	55250	UD_56.1	Retention Pond
S2 OF: 38	55950	Loughmuck	Retention Pond
S2 OF: 30	56600	Drumragh (Extension)	Retention Pond
S2 OF: 31	56600	Drumragh (Extension)	Retention Pond
S2 OF: 32	57400	Freughmore Drain	Retention Pond

Table 6-5 Section 2 Mainline Outfalls

Side Road Drainage

6.11.3 Within Section 2, there would be a total of 61 side road outfalls which would discharge to suitable receiving watercourses or existing road drainage networks. Details are given in Table 6-6.

Crossing ID	Chainage (m)	Receiving Watercourse ID
S2 OFS: Primrose Park 2	27200	Connects into existing drainage infrastructure
S2 OFS: Primrose Park 1	22000	UD_12
S2 OFS: Bells Park Road 3	22000	UD_12
S2 OFS: Bells Park Road 1.1	28130 (230 E)	UD_13.1
S2 OFS: Bells Park Road 2.1	28250 (310 E)	UD_14.1 (Connects into existing manhole)
S2 OFS: Garden Road	27650 (450 E)	Connects into existing drainage infrastructure

Crossing ID	Chainage (m)	Receiving Watercourse ID
S2 OFS: Seein Road 1	29660	UD_15.4
S2 OFS: Seein Road 2	29900	UD_15 WC Diversion
S2 OFS: Concess Road	30130	UD_16
S2 OFS: Fyfin Road	31200 (370 E)	Connects into existing drainage infrastructure
S2 OFS: Stone Road 1	31500	UD_19
S2 OFS: Stone Road 2	31500	UD_19
S2 OFS: Urbalreagh Road 1	31230 (480 E)	UD_19.3
S2 OFS: Derg Road 1	34190 (240 W)	River Derg 0.2
S2 OFS: Derg Road 2	33900 (330 E)	Connects into existing drainage infrastructure
S2 OFS: Deerpark Road 1	34450 (140 W)	River Derg 0.1
S2 OFS: Deerpark Road 2	34550 (270 E)	River Derg 0.3
S2 OFS: Maghercolton Road	36470	UD_20/ Coolaghy Burn
S2 OFS: Drumlegagh Road 1	36850 (345 S)	UD_20.02
S2 OFS: Drumlegagh Road 2	36450	UD_20/ Coolaghy Burn
S2 OFS: Baronscourt Road 1	37150 (350 S)	UD_20.01
S2 OFS: Baronscourt Road 2	37450 (120 N)	Scott Mill Layde 0.1
S2 OFS: Oldcastle Road 1	38250	UD_21
S2 OFS: Oldcastle Road 2	38250	UD_21
S2 OFS: Glen Road 1	39280 (50 S)	UD_22

Crossing ID	Chainage (m)	Receiving Watercourse ID
S2 OFS: Glen Road 2	39280 (90 S)	UD_22
S2 OFS: Glen Road 3	39280	UD_22
S2 OFS: Castletown Road 1	39110 (105 N)	UD_22
S2 OFS: Castletown Road 2	40330 (170 W)	UD_23.2
S2 OFS: Grange Road	40600	UD_23
S2 OFS: West Road	41220 (90 E)	UD_24.1
S2 OFS: Joes Lane 1	42600	UD_27
S2 OFS: Joes Lane 2	42540 (135 E)	Connects into existing drainage infrastructure
S2 OFS: Gordons Lane	43630 (170 E)	Connects into existing drainage infrastructure
S2 OFS: Killinure Road 1	44530	UD_36.1
S2 OFS: Killinure Road 2	44430	UD_36.1
S2 OFS: Castletown Road 1A	46270 (80 E)	UD_37.1
S2 OFS: Dunteige Road 1	47310 (60 W)	UD_41
S2 OFS: Dunteige Road 2	47250	UD_40A
S2 OFS: Rash Road 1	48230 (255 W)	UD_44.3
S2 OFS: Rash Road 2	48960	UD_45
S2 OFS: Rash Road 3	48960	UD_45
S2 OFS: Drumlegagh Road	49260	Tully Drain
S2 OFS: Beltany Road 1	49270 (90 E)	Tully Drain

Crossing ID	Chainage (m)	Receiving Watercourse ID
S2 OFS: Beltany Road 2	49380 (80 E)	Tully Drain 0.1
S2 OFS :Gillygooley Road 1	51170 (330 W)	Aghnamoyle Drain 0.3
S2 OFS :Gillygooley Road 2	51130 (425 E)	Connects into existing infrastructure
S2 OFS: Aghnamoyle Road	51650 (80 W)	UD_49.b
S2 OFS: Tamlaght Road 1	53200	UD_52
S2 OFS: Tamlaght Road 2	53030 (190 E)	Connects into existing drainage infrastructure
S2 OFS; Brookmount Road	53650 (160 E)	Fireagh Lough Drain 0.3
S2 OFS: Clanabogan Road 1	54040 (90 W)	Fireagh Lough Drain 0.4
S2 OFS: Clanabogan Road 2	53900 (80 E)	Fireagh Lough Drain
S2 OFS: Loughmuck Road	54300	UD_55
S2 OFS: Beagh Road 1	55960 (90 W)	Loughmuck
S2 OFS: Beagh Road 2	56030	Loughmuck
S2 OFS: Ballynahatty Road 1	56490 (130 S)	Drumragh (Extension)
S2 OFS: Ballynahatty Road 2	56330 (140 E)	Loughmuck 0.2
S2 OFS: Blackfort Road 1	56800 (270 S)	UD_57.01
S2 OFS: Blackfort Road 2	57300	Freughmore Drain 0.1
S2 OFS: Drumragh Road	57300	Freughmore Drain 0.1

Table 6-6 Section 2 Side Road Outfalls

Watercourse Crossings

6.11.4 A total of 47 watercourse crossings would be required for the Proposed Scheme in Section 2. Four of the crossings would be bridges and 43 culverts. Details of the crossings are given in Table 6-7.

Crossing Reference	Watercourse ID	Chainage (m)	Type	Indicative Size of Opening (m) H x W
S2/BO7	Derg	34400	Bridge	Approx. span 31m+61m
S2/B09	Coolaghy Burn	36500	Bridge	Approx. span = 12m
S2/B19	Fairy Water	50020	Bridge	Approx. span = 46m
S2/B28	Drumragh	56580	Bridge	Approx. span = 34m
S2-PC-54	UD_13.1	28100	Pipe	0.6m Ø
S2-PC-01	UD_15	29900	Box	2.4 x 5.4
S2-PC-55	UD_16	30150	Pipe	1.2m Ø
S2-PC-48	UD_16	30150	Pipe	1.2m Ø
S2-PC-56	UD_16	30150	Pipe	1.2m Ø
S2-PC-58	UD_16	30150	Pipe	1.2m Ø
S2-PC-02	UD_17	30820	Box	1.8 x 2.7
S2-PC-03	UD_19	31500	Box	2.1 x 3.3
S2-PC-49	UD_19	31500	Box	2.4 x 3.6
S2-PC-07	Scotts Mill Layde	37500	Pipe	1.5m Ø
S2-PC-08	UD_21	38250	Box	1.2 x 2.1
S2-PC-09	UD_22	39250	Box	1.8 x 1.8
S2-PC-60	UD_22	39250	Box	1.8 x 1.8

Crossing Reference	Watercourse ID	Chainage (m)	Type	Indicative Size of Opening (m) H x W
S2-PC-10	UD_23	40600	Box	1.8 x 1.8
S2-PC-11	UD_24	41250	Pipe	1.8m Ø
S2-PC-12	UD_26	41850	Box	1.8 x 3.3
S2-PC-13	UD_28	42600	Box	1.2 x 1.2
S2-PC-14	UD_29	42850	Box	1.2 x 1.5
S2-PC-16	UD_31	43150	Box	1.5 x 1.5
S2-PC-17	UD_32	43370	Box	1.8 x 2.4
S2-PC-18	UD_33	43780	Box	1.5 x 1.5
S2-PC-19	UD_34	43950	Pipe	1.2m Ø
S2-PC-50	UD_35a	44200	Box	1.2 x 1.2
S2-PC-20	UD_36	44500	Box	1.5 x 1.8
S2-PC-21	UD_37	46200	Box	2.1 x 3.0
S2-PC-22	UD_39	46440	Box	1.8 x 3.0
S2-PC-47	UD_40	47350	Box	2.1 x 2.1
S2-PC-59	UD_43.1	47700	Box	2.1 x 2.1
S2-PC-26	UD_45	48950	Box	1.5 x 1.5
S2-PC-27	Tully Drain	49180	Box	3.9 x 5.1
S2-PC-53	Tully Drain	49250	Box	3.9 x 5.1
S2-PC-28	Tully Drain	49290	Box	3.9 x 5.1
S2-PC-29	Aghnamoyle Drain	51025	Box	4.5 x 5.1

Crossing Reference	Watercourse ID	Chainage (m)	Type	Indicative Size of Opening (m) H x W
S2-PC-32	UD_52	53200	Box	1.2 x 1.2
S2-PC-34	UD_54	53700	Box	1.5 x 1.5
S2-PC-51	UD_54	53700	Box	1.5 x 1.5
S2-PC-57	Fireagh Lough Drain	53900	Box	2.1 x 3.0
S2-PC-36	Fireagh Lough Drain	53970	Box	2.1 x 3.0
S2-PC-38	UD_55	54320	Pipe	1.5m Ø
S2-PC-39	UD_56	55250	Box	1.5 x 1.5
S2-PC-43	Loughmuck 0.1	56300	Box	1.8 x 1.8
S2-PC-44	Loughmuck 0.2	56450	Box	1.8 x 2.4
S2-PC-45	Freughmore Drain	57300	Box	2.4 x 2.4

Table 6-7 Section 2 Watercourse Crossings

Watercourse Diversions

6.11.5 There would be 32 proposed watercourse diversions within Section 2. These are detailed in Table 6-8. The size of watercourse being diverted ranges from small field drains to large streams. In some instances the picking up of existing drainage would be incorporated into the proposed pre-earthworks drainage (PED) design and at these locations no watercourse diversion would be proposed.

Crossing ID	Drainage Watercourse ID	Chainage (m)	Approximate length (m)
S2-WD-43	UD_15.2	29800	85
S2-WD-01	UD_15	29900	198
S2-WD-33	UD_19	31500	262
S2-WD-05	Scotts Mill Layde	37500	129

Crossing ID	Drainage Watercourse ID	Chainage (m)	Approximate length (m)
S2-WD-34	UD_21	38250	173
S2-WD-08	UD_23	40600	136
S2-WD-35	UD_25	41700	275
S2-WD-09	UD_26	41850	99
S2-WD-10	UD_28	42600	155
S2-WD-36	UD_29	42850	98
S2-WD-41	UD_31	43150	107
S2-WD-42	UD_32	43370	98
S2-WD-37	UD_33	43770	200
S2-WD-38	UD_34	43980	132
S2-WD-11	UD_35.1	44200	95
S2-WD-13	UD_36	44500	262
S2-WD-14	UD_37	46200	174
S2-WD-15	UD_38	46400	174
S2-WD-16	UD_40	47300	165
S2-WD-18	UD_42	47500	210
S2-WD-19	UD_45	48950	241
S2-WD-39	Tully Drain	49200	453
S2-WD-20	Tully Drain 0.1	49500	301
S2-WD-21	Fairy Water 0.1	50135	83

Crossing ID	Drainage Watercourse ID	Chainage (m)	Approximate length (m)
S2-WD-25	UD_50	52700	313
S2-WD-40	UD_52	53200	90
S2-WD-26	UD_54	53700	135
S2-WD-27	Fireagh Lough Drain	53950	271
S2-WD-28	UD_55	54300	123
S2-WD-29	UD_56	55250	123
S2-WD-30	Loughmuck 0.1	56050	532
S2-WD-31	Freughmore Drain	57300	211

Table 6-8 Section 2 Watercourse Diversions

Flood Mitigation

6.11.6 This section provides information on the flood mitigation that would be required for the Proposed Scheme through Section 2. For the methodology of the flood risk assessments and processes refer to Chapter 4 and the A5 WTC Flood Risk Assessment (FRA) Report.

Hydraulic Models

6.11.7 A number of hydraulic models were developed for Section 2. The purpose of the hydraulic models was to obtain the extent of floodplains and associated depths/elevations of water for particular watercourses over defined flood events. The details of each hydraulic model within Section 2 are given below.

Model D Undesignated Watercourse

6.11.8 This undesignated watercourse is located approximately 0.5 km upstream of Seein Bridge. (Refer to drawing 718736-S2-0500-0101 for the 1% Annual Exceedance Probability AEP (design return period) flood outline).

6.11.9 Hydraulic modelling indicates that for the design event there would be approximately 185m^3 of water displaced by the Proposed Scheme. Flood compensatory storage would be provided through S2-CS-01 (see Table 6-10). The inundation mechanisms of the floodplain would not be significantly affected by the Proposed Scheme. (For further details refer to mitigation drawing 718736-S2-0500-0101).The overall impact from the Proposed Scheme is Slight Adverse.

Model 5 River Derg

6.11.10 The River Derg is a tributary of the Strule River. The Proposed Scheme would cross approximately 0.4km to the south-west of the Derg Bridge on the existing A5. (Refer to drawing 718736-S2-0500-0102 for the 1% AEP (design return period) flood outline).

6.11.11 Hydraulic modelling indicates that for the design event there would be approximately 375m^3 of water displaced by the Proposed Scheme. Flood compensatory storage would be provided through S2-CS-02 (see Table 6-10). The inundation mechanism of the floodplain would not be significantly affected by the Proposed Scheme. The overall impact from the Proposed Scheme is Neutral (For further details refer to mitigation drawing 718736-S2-0500-0102). The overall impact from the Proposed Scheme is Neutral.

Model E Coolaghy Burn

6.11.12 The Coolaghy Burn is a tributary of the River Derg. The Proposed Scheme would cross this watercourse approximately 2.5km upstream of its confluence with the River Derg. The crossing would be located approximately 0.7km to the north of the junction of the Drumlegagh Road North and the Magheracolton Road. (Refer to drawing 718736-S2-0500-0103 for the 1% AEP (design return period) flood outline).

6.11.13 Hydraulic modelling indicates that for the design event there would be approximately 1,735m^3 of water displaced as a result of the Proposed Scheme. Flood compensatory storage would be provided through S2-CS-03 (see Table 6-10). In order to maintain equilibrium across the existing floodplain, connectivity would be incorporated into the design through structures S2-CC-01 and S2-CC-02 (see Table 6-9). (For further details refer to mitigation drawing 718736-S2-0500-0103). The overall impact from the Proposed Scheme is Slight Adverse.

Model F Back Burn

6.11.14 This undesignated watercourse is located south of Newtownstewart. The Proposed Scheme would cross the watercourse approximately 0.8 km upstream of the town. (Refer to drawing 718736-S2-0500-0112 for the 1% AEP (design return period) flood outline).

6.11.15 Hydraulic modelling indicates that for the design event there would be no water displaced as a result of the Proposed Scheme. The overall impact from the Proposed Scheme is Neutral.

Model G Undesignated Watercourse

6.11.16 The Model G watercourse is a tributary of the River Strule and is located in the vicinity of the village of Mountjoy. The Proposed Scheme would cross approximately 0.5km to the north of the junction of Dunteige Road and the Cashty Road. (Refer to drawing 718736-S2-0500-0104 for the 1% AEP (design return period) flood outline).

6.11.17 Hydraulic modelling indicates that for the design event there would be approximately 2,070m^3 of water displaced as a result of the Proposed Scheme. Flood compensatory storage would be provided through S2-CS-04 (see Table 6-10), however, it is considered that the river engineering proposals fully mitigate the impacts arising from the Proposed Scheme. (For further details please refer to mitigation drawing 718716-S2-0500-0104). The overall impact from the Proposed Scheme is Slight Beneficial

Model H Tully Drain

6.11.18 The Model H watercourse is located upstream of Tully Drain between the Dunteige and Lisnagirr Roads. Tully Drain is a tributary of the Mourne-Strule (Extension) located to the north of Omagh. (Refer to drawing 718736-S2-0500-0105 for the 1% AEP (design return period) flood outline).

6.11.19 Hydraulic modelling indicates that for the design event there would be approximately 200m^3 of water displaced as a result of the Proposed Scheme. Flood compensatory storage would be provided through S2-CS-05 (see Table 6-10). The inundation mechanism of the floodplain would not be significantly affected by the Proposed Scheme. (For further details refer to mitigation drawing 718736-S2-0500-0105). The overall impact from the Proposed Scheme is Slight Adverse.

Model 4 Omagh (including Fairy Water, Aghnamoyle Drain, Coneywarren Drain, Tully Drain and Strule River)

6.11.20 The route of the Proposed Scheme would cross the Tully Drain, Fairy Water and Aghnamoyle Drain as it bypasses Omagh. As the Proposed Scheme progresses south towards Omagh it would cross the Tully Drain to the north-west of the junction of Drumlegagh Road South and the Beltany Road. Further south, it would bridge the Fairy Water 400m upstream of Beltany Road. To the west of Omagh, the Proposed Scheme would cross the Aghnamoyle Drain approximately 170m to the north-west of the junction between Gillygooley Road and Mullaghmena Road. (Refer to drawing 718736-S2-0500-0106 to 0110 for the 1% AEP (design return period) flood outline).

6.11.21 Hydraulic modelling indicates that for the design event there would be approximately 149,725m3 of water displaced as a result of the Proposed Scheme. Flood compensatory storage would be provided through S2-CS-06 to S2-CS-12, S2-CS-14 and S2-CS-15 inclusive (see Table 6-10). In order to maintain equilibrium across the existing floodplain, connectivity would be incorporated into the design through structures S2-CC-16 and S2-CC-03 to S2-CC-12 inclusive (see Table 6-9). (For further details refer to mitigation drawing718736-S2-0500-0106 to 0110). The worst case impact from the Proposed Scheme is Slight Adverse, however, benefits in relation to water levels are also realised across large areas of the flood plain.

Model I Fireagh Lough Drain

6.11.22 Fireagh Lough Drain is located west of Omagh between the A32 Clanabogan Road and the Brookmount Road. (Refer to drawing 718736-S2-0500-0113 for the 1% AEP (design return period) flood outline)

6.11.23 Hydraulic modelling indicates that for the design event there would be no water displaced as a result of the Proposed Scheme, however, flow characteristics are slightly changed as a consequence of river engineering (For further details refer to mitigation drawing

718736-S2-0500-0113). The overall impact from the Proposed Scheme is Slight Adverse.

Model 6 Drumragh River

6.11.24 The Drumragh River is located approximately 2.5 km south-west of Omagh. The Proposed Scheme would cross the river between Drumragh Bridge and Drumshanly. (Refer to drawing 718736-S2-0500-0111 for the 1% AEP (design return period) flood outline)

6.11.25 Hydraulic modelling indicates that for the design event there would be approximately 2,765m3 of water displaced as a result of the Proposed Scheme. Flood compensatory storage would be provided through S2-CS-13 (see Table 6-10). In order to maintain equilibrium across the existing floodplain, connectivity would be incorporated into the design through structures S2-CC-13 to S2-CC-15 inclusive (see Table 6-9). (For further details refer to mitigation drawing 718736-S2-0500-0111). The overall impact from the Proposed Scheme is Slight Adverse.

Connectivity Culverts

6.11.26 Along Section 2 there would be 16 connectivity culverts. Table 6.9 lists the proposed connectivity culverts within Section 2.

Connectivity Culvert Reference	Chainage (m)	Hydraulic Clear Opening Requirement	
		Height (m)	Width (m)
S2-CC-01	36410	1.5	6.0
S2-CC-02	36440	1.5	6.0
S2-CC-16	49570	2.1	5.0
S2-CC-03	49610	2.1	5.0
S2-CC-04	50000	3.6	5.0
S2-CC-05	50105	4.2	5.0
S2-CC-06	50205	3.9	5.0
S2-CC-07	50245	3.6	5.0
S2-CC-08	50370	3.0	5.0
S2-CC-09	50470	2.7	5.0

Connectivity Culvert Reference	Chainage (m)	Hydraulic Clear Opening Requirement	
		Height (m)	Width (m)
S2-CC-10	50620	2.7	5.0
S2-CC-11	50980	2.1	5.0
S2-CC-12	51090	1.5	5.0
S2-CC-13	56600	1.8	6.0
S2-CC-14	56620	1.8	6.0
S2-CC-15	56640	1.8	6.0

Table 6-9 Section 2 Connectivity Culverts

6.11.27 A number of bridge structures would also be included to provide flood connectivity in areas where there are significant flow paths or inundation channels. These structures are detailed in paragraph 6.15.

Flood Compensation

6.11.28 Where the Proposed Scheme would cross floodplains, and it is appropriate to do so, land would be vested to create compensatory flood storage areas. Table 6-10 below lists the flood compensatory storage areas for Section 2.

Compensatory Storage Area Reference	Chainage (m)	Watercourse ID	Total Excavation Required (m^3)
S2-CS-01	29850	UD_15	1660
S2-CS-01	29850	UD_15	1,660
S2-CS-02	34400	Derg	1,355
S2-CS-03	36400	Coolaghy Burn/UD_20	9,660

Compensatory Storage Area Reference	Chainage (m)	Watercourse ID	Total Excavation Required (m^3)
S2-CS-04	46400	UD_39	3,660
S2-CS-05	47500	UD_42	414
S2-CS-06	49000	Tully Drain	127,955 (Combined volume with S20CS-14)
S2-CS-14	48850	Tully Drain	127,955 (Combined volume with S20CS-06)
S2-CS-07	49050	Tully Drain	5,710
S2-CS-08	49400	Tully Drain	21,780 (Combined volume with S20CS-15)
S2-CS-15	49600	Tully Drain	21,780 (Combined volume with S20CS-08)
S2-CS-09	49900	Fairy Water	11,390
S2-CS-10	50600	Fairy Water	125,305
S2-CS-11	51100 (W)	Aghnamoyle	10,720
S2-CS-12	51100 (E)	Aghnamoyle	20,845
S2-CS-13	56650	Drumragh River	7,015

Table 6-10: Section 2 Flood Compensatory Areas

6.12 Deposition Areas

6.12.1 A number of possible areas for the deposition of material have been identified adjoining the Proposed Scheme. These were assessed under various engineering and environmental headings and the most appropriate chosen for incorporation into the Proposed Scheme. Table 6-11 sets out the location and size of the chosen Deposition Areas.

Ref:	Approx. Mainline Chainage (m)	Location	Fill Volume (m³)
S2-DEP-003	45700 – 46000	East side of mainline, north of Castletown Road	58,000
S2-DEP-004	45750 – 46050	West side of mainline, south of Castletown Road	69,000
S2-DEP-005	46700 – 46950	East side of mainline, north of Dunteige Road	131,000
S2-DEP-009	48050 – 48150	East side of mainline, south of Rash Road	31,000
S2-DEP-010	51600 – 51950	West side of mainline, north of Aghnamoyle Road	114,000
S2-DEP-011	52500 – 52700	West side of mainline, between Aghnamoyle Road and Tamlaght Road	57,000
S2-DEP-012A	55200 – 55450	East side of mainline	19,000
S2-DEP-013	54900 – 55400	East side of mainline	67,000
S2-DEP-014	54950 – 55400	West side of mainline	293,000
S2-DEP-015	55250- 55450	West side of mainline	40,000

Table 6-11: Deposition Areas in Section 2

6.13 Road Signage

6.13.1 As discussed in Chapter 4, a preliminary road signage design was carried out to identify areas of land that needed to be included in the draft Vesting Order.

6.14 Road Side Features

6.14.1 Within Section 2, one southbound and one northbound lay-by would be provided at Ch. 42000m and Ch. 44200m respectively.

6.15 Structures

6.15.1 The table below summarises the nature and number of structures that would be required in Section 2. The locations of the structures are shown on drawings 718736-S2-0800-561 to 581 in Volume 2.

Structure Reference	Structure Name	Type	Chainage (m)
B01.1	Primrose Park	Overbridge	27215
B01	Bells park Road	Overbridge	27995
B02	Seein Road	Overbridge	29165
B03	Concess Road	Underbridge	30140
AC01	Accommodation	Underpass	30400
AC02	Accommodation	Underpass	30945
B04	Fyfin Road	Underbridge	31445
B05	Stone Road	Overbridge	31910
AC11	Accommodation	Underpass	32920
B06	Derg Road	Overbridge	33995
B07	River Derg	River Structure	34330
B08	Deerpark Road	Overbridge	34725
B09	Maghercoltan Road	Underbridge	36285
B09.1	Coolaghy Burn	River Structure	36500
B10	Baronscourt Road	Overbridge	37290
AC03.1	Accommodation	Underpass	37810
B11	Old Castle Road	Overbridge	38625
B11.1	Glen Road	Overbridge	39305
B12	Castletown Road	Overbridge	40060
B13	West Road	Underbridge	41180
AC04	Accommodation	Underpass	41490

Structure Reference	Structure Name	Type	Chainage (m)
B13.1	Joes Lane	Overbridge	42610
AC05	Accommodation	Underpass	43590
B14	Killynure Road	Overbridge	44980
B15	Castletown Road	Underbridge	45688
B16	Dunteige Road	Overbridge	46970
B17	Lisnagirr Road	Underbridge	48305
B17.1	Rash Road	Overbridge	48100
B18	New Link Road Junction	Overbridge	49250
B19	Fairywater Bridge	River Structure	50050
B20	Mellon Park Drive	Overbridge	50750
B21	Gillygooley Road	Overbridge	51255
B22	Aghnamoyle Road	Overbridge	51300
B23	Tamlaght Road	Overbridge	53205
B23.1	Brookmount Road	Underbridge	53750
B24A	A32 Clanobogan Road - North	Underbridge	54100
B24B	A32 Clanobogan Road - South	Underbridge	54100
B25	Loughmuck Road	Underbridge	54350
AC08	Accommodation	Underpass	54970
B26	Beagh Road	Overbridge	55980
B27	Ballynahatty	Overbridge	56530

Structure Reference	Structure Name	Type	Chainage (m)
B28	River Drumragh	River Structure	56590
B29	Blackfort Road	Overbridge	57130

Table 6-12 Section 2 Public Structures Summary

6.15.2 These structures can generally be classified within the 'family of structures' described in Chapter 4. The following section describes the more significant structures that would be required.

River Derg (Ch. 34330m)

6.15.3 This structure would carry the A5 over the River Derg. The bridge would require a clear span of 60m to cross the channel and river banks. The bridge would be a 2 span asymmetrical structure with spans of approximately 31m and 61m giving a total length of 92m between centreline of bearings at each end. The 31m span is required to maintain the required connectivity across the floodplain in which the structure would be located.

6.15.4 The above span arrangement would require the use of composite steel plate girders to form the superstructure. Drawing 719736 -1700-D-0510 in Volume 2 shows the general arrangement of the proposed structure.

Fairy Water (Ch. 50050m)

6.15.5 This structure would carry the A5 over the Fairy Water. The bridge would be a single span structure with a clear span of 46m to cross the channel and river banks.

6.15.6 The above span arrangement would require the use of composite steel plate girders to form the superstructure. Drawing 719736-1700-D-0511 in Volume 2 shows the general arrangement of the proposed structure.

6.15.7 To prevent excessive afflux in a flood event, a series of connectivity culverts would be required adjacent to the structure.

River Drumragh (Ch. 56590m)

6.15.8 This structure would carry the A5 over the River Drumragh. The bridge would be a single span structure with a clear span of 34m to cross the channel and river banks.

6.15.9 The above span arrangement would allow the use of either composite precast beams or composite steel plate girders superstructures. Drawing 718736-1700-D-0512 in Volume 2 shows the general arrangement of the proposed structure.

7 SECTION 3 – ENGINEERING INFORMATION

7.1 Cross Section

7.1.1 From the tie-in with Section 2 immediately west of Junction 13 - Omagh South to Junction 17 – Aughnacloy East, the Proposed Scheme has been designed as a Dual 2 Lane All Purpose (D2AP) Carriageway to a design speed of 120kph.

7.1.2 From the proposed Aughnacloy East roundabout to the tie-in point with the existing A5 just north of Moy Bridge, the Proposed Scheme has been designed as a single carriageway (S2) to a design speed of 100 kph over its length of approximately 1.6km.

7.1.3 Table 7-1 shows the typical cross section dimensions for both carriageway types.

Carriageway Type	Dual Carriageway (D2AP)	Single Carriageway (S2)
Element	**Width (m)**	**Width (m)**
Carriageway	2 x 7.3	2 x 3.65
Hard Strips	4 x 1.0	2 x 1.0
Central Reserve	2.5 (min)	N/A
Verges	2 x 2.5 (min)	2 x 2.5 (min)
Earthworks	Varies	Varies
Total Width	**26.1 (min)**	**14.3 (min)**

Table 7-1 Mainline Cross Section Dimensions

7.2 Mainline Horizontal and Vertical Alignment

7.2.1 Details of the Proposed Scheme's mainline horizontal and vertical alignments are shown on Plan and Profile drawings 718736-S3-0800-660 to 681 within Volume 2. Details of Departures from Standard and Relaxations associated with the mainline are included in section 7.7 below and in Appendix 7A.

7.3 Side Roads

7.3.1 A tabular summary of the side road proposals is included in Appendix 7B. Further details of the side roads are shown on drawings 718736-S3-0800-690 to 706, 709 to 711, 714 to 720, 745 to 749 and 756 to 758 within Volume 2.

7.3.2 A design speed assessment was carried out on each of the side roads in accordance with the methods described in Chapter 4. Following this assessment, a review was undertaken on each side road to establish where departures or relaxations would exist in the design. The outcome of the design speed assessment process is reported in Appendix 7C

7.4 Junctions

7.4.1 There would be five junctions within Section 3; Junction 13 - Omagh South, Junction 14 - Moylagh, Junction 15 - Ballygawley, Junction 16 - Aughnacloy North and Junction 17 - Aughnacloy East. Details of the junction provision and arrangements are provided below and in Table 7-2. Drawings 718736-S3-0800-750 to 755 showing details of the junction layouts are contained within Volume 2 and further details are given in Appendix 7D.

Junction 13 - Omagh South

7.4.2 The junction at Omagh South would be located at Ch. 62050m where the B83 Seskinore Road would cross the Proposed Scheme south-west of the existing B83 / A5 junction.

7.4.3 Analysis of traffic data has confirmed that a junction located in this area would serve the needs of the local and strategic traffic movements around Omagh. A grade separated junction (GSJ) in accordance with TD22/06 would cater for the flows on both the mainline and the B83 Seskinore Road. The junction would provide a free-flow mainline while retaining access to the existing A5 for traffic travelling between Fintona/Seskinore and Omagh South on the B83.

7.4.4 The realigned B83 would pass over the mainline. Links to/from the proposed dual carriageway and the B83 would be provided via a dumb-bell type junction arrangement using 50m Inscribed Circle Diameter (ICD) roundabouts on the B83.

7.4.5 A roundabout with an ICD of 50m would be provided at the junction of the B83 and the existing A5 to cater for the flows between these two roads and traffic travelling to and from the dual carriageway.

7.4.6 The Proposed Scheme mainline would pass through part of Doogary Bog immediately east of the existing B83. The side road would be realigned from its current position to avoid the overbridge structure carrying the B83 impacting on the bog and to allow the structure to be built offline.

7.4.7 Ground improvement works would be required beneath the B83 link roads and the mainline east of the existing B83. An embankment height of approximately 4m would be maintained on the mainline that crosses the bog in the vicinity of the junction.

7.4.8 Key considerations in determining the location and layout of this junction included:

- Providing connectivity between Fintona, Seskinore and Omagh South, whilst improving the standard of the junction with the existing A5;
- Minimising the footprint of the Proposed Scheme that impacts on poor ground and the bog to the east of the existing B83;

- Minimising impact on dwellings;

7.4.9 Drawing 718736-S3-0800-751 provides further technical information pertaining to Junction 13 and is contained within Volume 2**.**

Junction 14 - Moylagh

7.4.10 The junction is required to provide connectivity with the local communities and the existing A5. The crossing of the B46 Moylagh Road which serves Fintona and Beragh provides an appropriate location for this junction.

7.4.11 This junction would be located at Ch. 68700m where two side roads – the B46 Moylagh Road and the Augher Point Road would cross the Proposed Scheme within a distance of approximately 80m. A compact grade separated junction (CGSJ) in accordance with TD40/94 would be constructed at this location that would allow the mainline traffic to continue unhindered by the traffic flows associated with the side roads.

7.4.12 The mainline would cross an area of high ground on either side of the B46 that would involve significant cuttings. The need to balance the impacts of the cuttings through the high ground and the mainline levels near Moylagh result in embankments in the region of 3.5m in height at the location where the mainline would cross over the existing Moylagh Road.

7.4.13 The B46 Moylagh and C657 Augher Point roads would be realigned to link via a roundabout to the south of the mainline and would pass under the mainline with a structure approximately 60m south of the existing B46 Moylagh Road.

7.4.14 Ground improvement works would be required to the north of the structure and to either side of the existing B46 Moylagh Road.

7.4.15 Key considerations in determining the layout and location for this junction included:

- Access for the local communities including the town of Fintona which is located to the west of the Proposed Scheme.
- Rationalising the side road crossings of the dual carriageway and minimising bridge construction works, whilst maintaining local access.
- Recognising and taking cognisance of the potential impacts on the occupiers of the residential properties on both the Augher Point and Moylagh roads during construction and operation of the dual carriageway / junction.
- Considering the existing topography in the area including the large hills that exist on either side of Moylagh and the B46 Moylagh Road.
- Avoiding poor ground and in particular a geotechnical fault line located just south of the existing B46 Moylagh Road.

7.4.16 Drawing 718736-S3-0800-752 provides further technical information pertaining to Junction 14 and is contained within Volume 2.

Junction 15 - Ballygawley

7.4.17 The junction at Ballygawley would be located at Ch. 83450m where the A4 Annaghilla Road would cross the Proposed Scheme approximately 1.3km west of the existing A4 / A5 Ballygawley roundabout.

7.4.18 A roundabout junction in accordance with TD16/07 would fulfil the requirements to cater for the relatively balanced flows between these two roads.

7.4.19 The new A4/A5WTC junction would consist of a 5 arm roundabout with an ICD of 90m and would provide a link between the A4 (one dual carriageway link and one single carriageway link), the A5WTC (two dual carriageway links) and Feddan Road (single carriageway link).

7.4.20 The roundabout would be built online with the existing A4. The existing topography would result in cuttings being generated along the mainline ranging from 4m to 13m deep due to the need to be at grade with the existing A4, while considering the impact on properties in the area.

7.4.21 The existing A4/A5 Ballygawley Roundabout, constructed as part of the A4 dualling works, would be retained, as recommended in the Public Inquiry Report (February 2012). The existing A4 would be upgraded to dual carriageway from the current termination point of the A4 dual carriageway to the new A4/A5WTC junction, using the existing single carriageway for the proposed eastbound carriageway, while the proposed westbound carriageway would be constructed offline.

7.4.22 Key considerations in determining the layout and location for this junction included:

- Providing direct connectivity between the A5WTC and A4 Annaghilla Road.
- Extending the A4 link to the A5 to dual carriageway and improving traffic transfer.
- Considering the existing topography and minimising earthworks whilst allowing for the need to be at grade at the existing A4
- Minimising demolition of dwellings and overall impact on properties in the area.
- Minimising impact on the floodplain at Ballygawley Water in terms of the mainline and link roads into Ballygawley.
- Considering existing environmental constraints, enclosures, raths and other environmental effects.

7.4.23 Drawing 718736-S3-0800-753 provides further technical information pertaining to Junction 15 and is contained in Volume 2.

Junction 16 - Aughnacloy North

7.4.24 The junction at Aughnacloy North would be located at Ch. 88400m where the Proposed Scheme would cross the existing A5.

7.4.25 The junction north of Aughnacloy, serving the Proposed Scheme and the existing A5, would allow access to and from the town for traffic wishing to use the A5WTC.

7.4.26 A combination of the traffic flows, topography and properties in the vicinity of the existing A5 at the proposed junction location has indicated that a grade separated junction with limited movements, i.e. north facing slip roads would be the most appropriate solution.

7.4.27 The Proposed Scheme would cross the existing A5 in a cutting ranging from 2m to 10m deep on side-long ground resulting in larger cuts on the north side of the alignment. The existing A5 would pass over the proposed mainline, with links to/from the mainline and the existing A5 being provided via a dumb-bell type arrangement. A 3 arm 40m ICD roundabout is proposed on the south side of the mainline and would serve links to the existing A5 southwards to/from Aughnacloy, the northbound entry slip road and a link across the mainline to the larger 4 arm roundabout. This 60m ICD roundabout would serve the southbound exit slip road, the existing A5 northwards, Loughans Road and the link across the mainline.

7.4.28 The existing A5 would be realigned to the east of its current position to reduce the skew of the structure, allow adequate deflection at the dumb-bell roundabouts and minimise departures on the approach roads. Locating the structure for the junction offline would also ensure that the existing A5 can remain open during construction.

7.4.29 Ground conditions in the vicinity of the existing A5 at the junction location are poor and ground improvement works would be required beneath the mainline either side of the existing A5.

7.4.30 Key considerations in determining the layout and location for this junction included:

- Providing connectivity between Aughnacloy, the existing A5 and the Proposed Scheme.
- Minimising the footprint of the Proposed Scheme in the vicinity of the drumlins and side long ground.
- Minimising the number of departures on the approach roads to the junction.
- Minimising impacts on dwellings.
- Providing options to keep the existing A5 open during construction by building the structure offline.

7.4.31 Drawing 718736-S3-0800-754 provides further technical information pertaining to Junction 16 and is contained within Volume 2.

Junction 17 - Aughnacloy East

7.4.32 The junction at Aughnacloy East would be located at Ch. 91950m on the A28 Caledon Road and provide access into Aughnacloy for traffic from the south as this will be the last junction before the Republic of Ireland (RoI) border at Moy Bridge.

7.4.33 The dual carriageway section of the Proposed Scheme within Section 3 would terminate at the A28 Caledon Road and a single carriageway link would be provided from the Caledon Road to the Proposed Scheme termination point on the existing A5 north of Moy Bridge.

7.4.34 The termination point of the dual carriageway at the A28 Caledon Road is considered to be a suitable location to provide connectivity with the future upgrade of the N2 in the ROI

7.4.35 A roundabout junction in accordance with TD16/07 would cater for the relatively balanced flows between the Proposed Scheme and the A28 Caledon Road. The junction would consist of a 4 arm roundabout with an ICD of 70m serving the A28 Caledon Road and the Proposed Scheme in both directions.

7.4.36 The roundabout would be built online with the A28 and a cutting of up to 12m would be generated on the northern side of the roundabout due to the need for it to be at grade with the existing A28. Allowance has been made when sizing the roundabout for the possible future upgrade of the southern link from single to dual carriageway.

7.4.37 Key considerations in determining the layout and location for this junction included:

- Providing an option for a future dual carriageway tie in from the southern arm.
- Considering existing topography and minimising earthworks allowing for the need to be at grade at the existing A28.
- Minimising demolition of dwellings and overall impact on properties in the area.

7.4.38 Drawing 718736-S3-0800-755 provides further technical information pertaining to Junction 17 and is contained within Volume 2.

Summary of Section 3 Junctions

Junction	Connecting road(s)	Connecting town(s) or village(s)	Junction type	Relevant DMRB standard	Restrictions
Junction 13 – Omagh South	B83 Seskinore Road	Omagh, Fintona and Seskinore	Full Grade-Separated	TD22	All movements catered for
Junction 14 - Moylagh	B46, Moylagh Road and Augher Point Road	Fintona, Moylagh Beragh and Eskra	Compact Grade-Separated	TD40, including TD42 for major/ minor junctions	All movements catered for

Junction	Connecting road(s)	Connecting town(s) or village(s)	Junction type	Relevant DMRB standard	Restrictions
Junction 15 – Ballygawley Roundabout	A4 Annaghilla Road and Feddan Road	Ballygawley, Enniskillen, Dungannon and Aughnacloy.	At-Grade Roundabout	TD16	All movements catered for
Junction 16 – Aughnacloy North	Existing A5 (Tullyvar Road) and Loughans Road	Aughnacloy, Ballygawley	Partial Grade-Separated (with northern slips only)	TD22	All movements catered for
Junction 17 - Aughnacloy East	A28 Caledon Road	Aughnacloy, Caledon	At-Grade Roundabout	TD16	All movements catered for

Table 7-2 Section 3 Junction Descriptions

7.5 Existing Roads' Realignments/Upgrades

7.5.1 Within the Proposed Scheme there would be no upgrade or realignment of any of the existing local road network outside of tie-in works associated with either the provision of junctions or in the provision of over/under bridges to maintain the existing side road connectivity.

7.6 Road Closures

7.6.1 In Section 3, the following side roads would be stopped up:

- Seskinore Road, incorporated into Junction 13
- Tattykeel Road (at Ch. 63900m);
- Drumconnolly Road (at Ch. 67930m);
- Routingburn Road;
- Cormore Road;
- Crew Road;
- Tullybryan Road would be stopped-up in part at the tie-in with the A4 Annaghilla Road;
- Feddan Road would be stopped in part at the tie-in with the A4 Annaghilla Road;
- Ballynanny Road;
- Tullywinny Road would be stopped in part at the tie-in with the A4 Annaghilla Road; and
- Monaghan Road (stopped-up at Ch. 93000m, at tie in to the scheme).

- Douglas Road

7.6.2 The following side roads would be diverted to an adjacent side road that would be kept open:

- Moylagh Road
- Augher Point Road
- Greenmount Road
- Tycanny Road
- Feddan Road
- Killadroy Road

7.6.3 All other side roads would remain substantially unaltered and would be catered for by a connection to an existing side road via an overbridge or underbridge passing over or under the Proposed Scheme mainline. Where roads would be stopped up or where realignments of existing roads have led to cul-de-sacs to maintain access to properties, in most cases, provision would be made for turning heads at the end of these to allow emergency and farm vehicles (dependent on the current usage of the road) to turn safely. The proposed side road layouts are shown in drawings 718736-S3-0800-690 to 706, 709 to 711, 714 to 720, 745 to749 and 756 to 758 contained within Volume 2.

7.7 Departures from Standards – Mainline

7.7.1 Six departures from standards, and five relaxations would be incorporated into the Proposed Scheme mainline design.

7.7.2 The first departure is located on the mainline dual carriageway as it passes through Junction 13 between Ch. 62000m and Ch. 62075m. Due to this short straight section being located between consecutive right handed curves, the associated adverse camber has been applied to link the curves.

7.7.3 The second of the mainline departures is a combination of vertical and stopping sight distance (SSD) relaxations located on the mainline single carriageway between Ch. 92450m and Ch. 92780m. Both the vertical crest curve and SSD are 1 step below the desirable minimum at this location. The single carriageway section is considered a temporary link until such time as the N2 upgrade is complete. The adoption of this combination of relaxations reduces the depth of cutting by 3-4m.

7.7.4 The third departure would also be located on the mainline single carriageway section between Ch. 92780m and Ch. 93060m. This is a combination of horizontal, vertical and SSD relaxations including a 3 step relaxation in horizontal curvature, a 1 step relaxation in vertical crest curve and a 1 step relaxation in SSD. As with the previous departure, the single carriageway section is considered a temporary link until such time as the N2 upgrade is complete. The adoption of this proposed highway alignment would offer benefits in terms of providing a cost effective solution whilst avoiding impact on the Old Customs House development.

7.7.5 The fourth departure is again located on the mainline single carriageway section and is linked to the first and second departures described above. The “Y” distance applied to the Douglas Road north side road at Ch. 92500m has been reduced by 1 step from 215m to 160m.

7.7.6 The fifth of the departures is also located on the mainline single carriageway section and is linked to the first and second departures described above. The “Y” distance applied to the Douglas Road south side road at Ch. 92600m has been reduced by 1 step from 215m to 160m.

7.7.7 The sixth departure is again located on the mainline single carriageway section and is linked to the first and second departures described above. The “Y” distance applied to the Monaghan Road access at Ch. 93105m has been reduced by 2 steps from 215m to 120m, when not allowing the visibility splay to cross the centre line.

7.7.8 In addition, there are also 5 Relaxations to the design standards.

7.7.9 A tabular summary of the departures from standard and relaxations within the mainline of the Proposed Scheme is included in Appendix 7A.

7.8 Departures from Standards – Side Roads

7.8.1 A number of departures from standard have been introduced into the design of the side roads within the Proposed Scheme as a result of the existing alignments, cross sections and constraints of the local road network.

7.8.2 A tabular summary of the departures from standards and relaxations that have been incorporated within the side roads is included in Appendix 7C.

7.9 Public Utilities

7.9.1 Apparatus for the supply of electricity, potable water and telecommunications exist in the vicinity of the Proposed Scheme. These apparatus are mainly concentrated in and around settlement areas, as well as traversing across rural areas, and are also installed within the existing A5 corridor. Details of the Statutory Undertakers’ major apparatus can be found in drawings 718736-S3-0100-001 to 003 in Volume 2.

Electricity

7.9.2 In Section 3, the Proposed Scheme would cross existing overhead 33kV distribution conductors six times. The mainline would cross these conductors four times in the vicinity of Aughnacloy, and would be crossed a further two times to the southwest of Ballygawley roundabout.

7.9.3 The proposed scheme crosses a 33kV underground distribution cable in the B83 Seskinore Road at the northern end of Section 3. This cable connects the Screggagh windfarm to the Omagh sub-station at Doogary Road. It is likely that this would have to be re-laid through the new grade separated junction that is proposed for Seskinore Road.

7.9.4 There is also an extensive network of 11kV overhead and LV underground distribution apparatus which provide electricity supply to domestic and commercial premises along the length of the Proposed Scheme.

7.9.5 Approximately 26 diversions would be required to Northern Ireland Electricity (NIE) distribution apparatus. These diversions would generally involve raising existing conductors to provide the necessary statutory ground clearances above the Proposed Scheme carriageway. In some locations, there would also be a requirement for limited horizontal realignment of conductors, and where embankments are very high, under-grounding of apparatus.

7.9.6 No overhead 110kV electricity transmission apparatus are located in the vicinity of the Proposed Scheme within Section 3. A new 110kV line is however proposed. This will extend east and then southeast from Doogary to the 275kV substation at Tamnamore to the east of Dungannon. This proposed line would be unaffected by the Proposed Scheme.

7.9.7 10 advance works diversions were made to NIE overhead plant in the past and these diversions remain valid for the current Proposed Scheme.

Water Mains and Sewers

7.9.8 The majority of the water supply network in Section 3 consists of small diameter (80-150mm) gravity distribution mains, which are buried in the existing minor road network. Approximately 42 such mains exist in this section. Where the mainline of the Proposed Scheme would cross these water mains on embankment, they would need to be re-laid under the new carriageway. If the mainline is in cutting, these mains would be re-laid along the new carriageway within the verge of new side road structures.

7.9.9 Three larger diameter trunk gravity distribution mains exist in Section 3, and are located; close to Seskinore Road (300mm ductile iron), in Ballynasaggart Road (225mm PVC) and in the A4 Annaghilla Road (180mm HPPE). It is likely that all 3 of these mains would need to be re-laid below the mainline carriageway of the Proposed Scheme.

7.9.10 The largest diameter apparatus in Section 3 is a 450mm ductile iron trunk water main located in Glenhoy Road, to the west of Ballygawley. This main links Tattinbar service reservoir with Glenchuil service reservoir.

7.9.11 The public sewerage network within Section 3 generally consists of sewers smaller than 300mm diameter which are limited in extent mainly to the settlements of Ballygawley and Aughnacloy. Most domestic and commercial premises located in the rural areas adjacent to the Proposed Scheme are served by private septic tanks.

Telecommunications

7.9.12 BT has a network of overhead and underground apparatus located alongside and below the existing road network. Within Section 3, underground trunk fibre optic and copper cables are located in ducts below B83 Seskinore Road, Tattykeel Road, A5 Doogary Road, A4 Annaghilla Road, A5 Tullyvar Road, Loughans Road, B35 Carnteel Road and A28 Caledon Road. Where the Proposed Scheme crosses these networks, the ducts would be lowered and/or protected.

7.9.13 Furthermore, there is an extensive network of overhead copper BT apparatus which would be crossed 31 times by the Proposed Scheme in Section 3. In general, these overhead cables would be diverted into new ducts in the realigned side road network and new structures. Where no new structures are proposed, BT apparatus would cross the Proposed Scheme in steel ducts.

7.9.14 Virgin Media, Eir and Atlas Communications (NI) have trunk fibre optic apparatus which are located in the existing A5 between Ballygawley and Omagh. They are contained within a 4-way duct laid in a common trench. This apparatus would be affected by the B83 Seskinore Road tie-in works with the existing A5. It is likely diversionary works would be limited to local protection and lowering of ducts at the tie-in locations.

7.9.15 Vodafone (formerly Cable and Wireless) also has fibre optic apparatus in a 2-way duct located in the A28 Caledon Road and the A5 Monaghan Road to the south of Aughnacloy. This apparatus would need to be re-laid in both locations.

7.9.16 EE (formerly T-Mobile and Orange), Vodafone and O2 have mobile phone base stations/masts located in the area but the Proposed Scheme does not impact on them.

Miscellaneous

7.9.17 A windfarm consisting of 12 turbines, with a further 8 proposed, is located at Slieve Divena to the east of Garvaghy. This is remote from the Proposed Scheme and is unaffected by it.

7.9.18 Current utility information indicates that there are no gas pipelines located within Section 3.

7.9.19 There is a proposal for a new gas transmission pipeline that may cross the Proposed Scheme to the south of Omagh in the vicinity of Seskinore Road. The design of this pipeline is at an early stage and will be required to accommodate the Proposed Scheme.

7.10 Geotechnical Constraints and Proposed Solutions

7.10.1 Within Section 3, areas with ground conditions and associated geotechnical risks requiring particular engineering solutions or ground treatment are listed in Table 7-3.

Approx. Mainline Ch. (m)	Problematic Ground Conditions	Geotech. Risk	Proposed Treatment	Comments
62060-62060 (Seskinore Side Road)	Soft ground: soft peat to 1.5m bgl	Adverse settlement, instability of embankment slopes	1.5m excavate & replace peat	Seskinore Side Road
62100-62800	Soft ground: very soft peat to 4m bgl over soft to stiff clay to 8.5m bgl	Adverse settlement, instability of embankment slopes	Either excavate & replace peat, to 4m then surcharge clay or use piled embankment	Seskinore Junction to Tattykeel Road

Approx. Mainline Ch. (m)	Problematic Ground Conditions	Geotech. Risk	Proposed Treatment	Comments
63200-63850	Soft ground – raised peat bog – peat to 8.5m bgl	Adverse settlement, instability of embankment slopes	A piled embankment structure	Doogary Bog CH 63150 – 64000
63850-64400	Soft ground: pockets of very soft peat to 2.5m bgl	Adverse settlement, instability of embankment slopes	2.5m excavate & replace peat	South of Doogary Bog
68700-68800	Soft ground: soft to stiff clay between 3-6m bgl	Adverse settlement, instability of embankment slopes	3-6m excavate & replace or surcharge clay	Moylagh Junction
69730-70250	Two pockets of soft ground: soft to firm clay / silt to 2m bgl over gravel / clay to 5m bgl	Adverse settlement, instability of embankment slopes	2m excavate & replace clay	West of Legacurry Road
72280-72540	Soft ground: soft - firm clay to 0.8m,sand to 1.8m gravel to >2.4m	Adverse settlement, instability of embankment slopes	1m excavate & replace clay	South of Routing Burn Road
74200-74500	Side long ground: soft clay 2m bgl, stiff clay 3m bgl over dense sand & gravel	Potential stability issues due to high ground water	Potential instability managed by installing pre-earthworks drainage	East of Newtownsaville Road, North of Newtownsaville Bog
75000-75350	Soft ground: very soft peat to 3m bgl, loose silty sand / soft to firm silt to 4.5m over firm to stiff clay	Adverse settlement, instability of embankment slopes	4.5m excavate & replace peat / alluvium	Newtownsaville Bog
76750-76930	Soft ground: soft silty clay to 2.5m bgl, firm clay to 4m bgl	Adverse settlement, instability of embankment slopes,	2.5m excavate & replace peat & clay	Tycanny Road
77520-77720	Side long ground: silt up to 0.5m bgl, clay up to 2.3m bgl,	Potential stability issues due to high ground water	Potential instability managed by installing pre-earthworks drainage	South of Tycanny Road

Approx. Mainline Ch. (m)	Problematic Ground Conditions	Geotech. Risk	Proposed Treatment	Comments
78160-78250	Soft ground: soft clay to 0.7m bgl gravel to 2m bgl	Adverse settlement, instability of embankment slopes	0.7m excavate & replace clay	Tycanny Road Crossing
78200-78400	Side long ground medium dense gravel & stiff clay.	Potential stability issues due to high ground water	Potential instability managed by installing pre-earthworks drainage	North of Rarogan Road
78380-78500	Soft ground: very soft peat to 2.8m bgl, medium dense gravel to 6.3m bgl	Adverse settlement, instability of embankment slopes	2.8m excavate & replace peat	Rarogan Road
78700-79340	Side long ground in stiff clay	Potential stability issues due to high ground water	Potential instability managed by installing pre-earthworks drainage	Adjacent to Newtownsaville Rd.
80300-80570	Side long ground: firm to very stiff clay	Potential stability issues due to high ground water	Potential instability managed by installing pre-earthworks drainage	Glenhoy Road
81000-81150	Soft ground: very soft peat to 1.5m bgl, very stiff clay to 2.5m bgl, gravel to 4m bgl over very strong limestone	Adverse settlement, instability of embankment slopes	1.5m excavate & replace peat	South of Glenhoy Road
81200-81400	Soft ground: soft clay / peat to 1.0m bgl, stiff clay to 2.7m bgl, medium dense sand to gravel to 8.0m bgl.	Adverse settlement, instability of embankment slopes	1m excavate & replace clay / peat	South of Glenhoy Road, at Access Track
82750-83050	Soft ground: firm clay to 3.1m bgl overlying soft clay to 5.1m bgl.	Adverse settlement, instability of embankment slopes	replace or surcharge clay	South of Feddan Road
83370-83700	Soft ground: soft clay to 2.8m bgl, firm clay to 10.0m bgl.	Adverse settlement, instability of embankment slopes	2.8m excavate and replace clay or surcharge	Ballygawley Junction (Roundabout Junction)

Approx. Mainline Ch. (m)	Problematic Ground Conditions	Geotech. Risk	Proposed Treatment	Comments
83450-83450 (Annaghilla side Rd)	Soft ground: soft clay to 2.8m bgl. Firm to stiff clay / sands and gravel to 8.2m bgl over limestone.	Adverse settlement, instability of embankment slopes	2.8m excavate and replace or surcharge	A4 / A5 Link Roads from Ballygawley Roundabout Junction
83700-83910	Soft ground: peat and silt to 8.2m bgl, firm to stiff clay to 9.0m, medium dense sand to 10.0m over medium strong sandstone	Adverse settlement, instability of embankment slopes	Potential surcharge or piled embankment at bridge approach	Ballygawley Water and Ballynanny Road
83910-84120	Side long ground: soft to 5.5m bgl.	Potential stability issues due to high ground water	Potential instability managed by installing pre-earthworks drainage	South of Ballygawley Water
85180-85320	Soft ground: soft clay to 4.0m, bgl.	Adverse settlement, instability of embankment slopes	4m excavate & replace clay	South of Tullywinny Road
85850-86380	Soft ground: very soft peat to 2m bgl, soft silt to 3m bgl sand to 4m bgl.	Adverse settlement, instability of embankment slopes	3m excavate & replace peat & silt	North of Lisginny Road
86850-87400	Soft ground: soft clay to 4.8m bgl	Adverse settlement, potential instability of embankment slopes	4.8m excavate & replace clay or surcharge	North of Old Chapel Road
88350-88530	Soft ground: soft clay to 2.0m bgl	Adverse settlement	2m excavate & replace clay or surcharge	Tullyvar Road Junction
88470-88600	Side long ground: firm clay to 2m bgl, stiff clay top 3m bgl	Potential stability issues due to high ground water	Potential instability managed by installing pre-earthworks drainage	South of Loughans Road
88650-88800	Soft ground: soft clay to 1.2m bgl. Firm to stiff clay to 4m bgl.	Adverse settlement	1.2m excavate & replace clay	South of Tullyvar Road

Approx. Mainline Ch. (m)	Problematic Ground Conditions	Geotech. Risk	Proposed Treatment	Comments
88780-89000	Side long ground: soft to firm clay to 3.4m bgl	Potential stability issues due to high ground water	Potential instability managed by installing pre-earthworks drainage	South of Loughans Rd
89150-89350	Soft ground: soft organic clay to 1.2m bgl, stiff clay to 4.3m bgl	Adverse settlement, instability of embankment slopes	1.5m excavate & replace clay	South of Tullyvar Road
90270-90340	Soft ground: soft to firm clay to 1.9m bgl	Adverse settlement, instability of embankment slopes	1.9m excavate & replace clay	Carnteel Road Side Road
91270-91450	Soft ground: soft clay to 8.0m bgl, very dense sand to 10.10m bgl	Adverse settlement, instability of embankment slopes	8.0m surcharge clay	South of Rehaghy Road, North of Caledon Road.
91450-91500	Soft ground: clay to 2m bgl over very strong limestone	Adverse settlement, instability of embankment slopes	2m excavate & replace clay	Lisadavil
91870-92000	Soft ground: very soft peat to 1m bgl, soft clay to 2m bgl, very dense sand and gravel to >5.3m bgl	Adverse settlement, subgrade failure, cutting slope failures	2m excavate & replace peat & clay	Caledon Road

Table 7-3 Section 3 Geotechnical Constraints and Proposed Solutions

Volumes of Earthworks Material

7.10.2 The estimated volumes of earthworks material for Section 3 are given in Table 7-4.

Activity	Approx. Volumes (Million m^3)
Excavation of Topsoil	0.7
Excavation of Suitable Material	2.7
Excavation of Marginal Material	2.5
Imported Material	0.3
Total Excavated & Imported Volume	**6.2**
Deposition of Topsoil	0.7
Deposition of Suitable Material	2.7
Deposition of Imported Material	0.3
Deposition of Material in Deposition Areas	1.9
Disposal of Unsuitable Material off Site	0.6
Total Deposited & Exported Volume	**6.2**

Table 7-4 Section 3 Earthworks Volumes

7.11 Drainage and Flooding

7.11.1 This section provides information on the proposed drainage design for Section 3. For the methodology of the drainage engineering assessments and processes refer to Chapter 4.

Mainline Drainage

7.11.2 The purpose of the road drainage is to provide a strategy for discharge of road related run-off to existing watercourses at particular locations. Within Section 3, there would be 29 mainline outfalls, details of which are given in Table 7-5.

Outfall ID	Chainage (m)	Receiving Watercourse ID	Proposed Mitigation at Outfall
S3 OF 21	62650	UD_58	Pollution Control Unit, Vortex Separator and Retention Pond
S3 OF 2	64380	Ranelly Drain 0.5	Pollution Control Unit, Vortex Separator and Detention Pond
S3 OF 22	64950	Ranelly Drain 1.1	Retention Pond
S3 OF 3	66200	Ranelly Drain 3.1	Retention Pond

Outfall ID	Chainage (m)	Receiving Watercourse ID	Proposed Mitigation at Outfall
S3 OF 4	66850	UD_60.1	Pollution Control Unit, Vortex Separator and Retention Pond
S3 OF 5	68750	Letfern 0.1	Retention Pond
S3 OF 6	70200	UD_65.1	Grassed Channels and Retention Pond
S3 OF 23	71380	UD_67	Retention Pond
S3 OF 7	71690	Routing Burn Ext 0.2	Retention Pond
S3 OF 24	72300	UD_69.1	Retention Pond
S3 OF 8	73760	UD_71.1	Retention Pond
S3 OF 9	74890	UD_110.3	Retention Pond
S3 OF 10	75800	UD_110	Retention Pond
S3 OF 11	78210	UD_78.4	Retention Pond
S3 OF 12	80900	Roughan 0.2	Retention Pond
S3 OF 13	82700	UD_81.2	Grassed Channels and Retention Pond
S3 OF 14	83860	Ballygawley River	Retention Pond
S3 OF 33	83860	Ballygawley River	Retention Pond
S3 OF 28	84090 (640N)	Ballygawley River	Retention Pond
S3 OF 29	84300 (1000N)	Ballygawley River	Grassed Channels
S3 OF 25	85200	UD_117	Retention Pond
S3 OF 15	86070	Tullyvar 0.1	Retention Pond
S3 OF 16	88000	UD_89.2	Grassed Channels and Retention Pond
S3 OF 31	90560	UD_91.1	Retention Pond

Outfall ID	Chainage (m)	Receiving Watercourse ID	Proposed Mitigation at Outfall
S3 OF 27	90800	UD_92.1	Retention Pond
S3 OF 32	91200	UD_93.D	Retention Pond
S3 OF 18	91600	Lisadavil	Retention Pond
S3 OF 19	91750	Lisadavil 0.3	Retention Pond
S3 OF 20	93100	Blackwater	Retention Pond

Table 7-5 Section 3 Mainline Outfalls

Side Road Drainage

7.11.3 Within Section 3, there would be a total of 58 side road outfalls which would discharge to suitable receiving watercourses or existing road drainage networks. Details are given in Table 7-6.

Outfall ID	Chainage (m)	Receiving Watercourse ID
S3 OFS: Seskinore Road 1	61880 (690 N)	Drumragh River
S3 OFS: Seskinore Road 2	62000 (225 S)	UD_57.2
S3 OFS: Doogary Road 1	62630	UD_58
S3 OFS: Doogary Road 2	62780 (170: S)	UD_108
S3 OFS: Drumconnelly Road 1	64520 (160W)	Ranelly Drain 0.5
S3 OFS: Drumconnelly Road 2	64390	Ranelly Drain 0.5
S3 OFS: Drumconnelly Road 3	64390 (300E)	Discharges to existing road drainage
S3 OFS: Tullyrush Road Lane 1	65580	Ranelly Drain 2.2
S3 OFS: Tullyrush Road Lane 2	65900	Ranelly drain 2.3
S3 OFS: Rarone Road 1	66850	UD_60.2

Outfall ID	Chainage (m)	Receiving Watercourse ID
S3 OFS: Rarone Road 2	66790 (143 S)	UD_60.1
S3 OFS: Rarone Road 3	67000 (200 N)	UD_60.2
S3 OFS: Rarone Road 4	66850	UD_60
S3 OFS: Drumconnelly Road 4	67750	UD_61
S3 OFS: Moylagh Road 1	68700 (100S)	Letfern 0.1
S3 OFS: Greenmount Road Lane	71240	UD_67.2
S3 OFS: Greenmount Road	71160 (275 W)	UD_67.1
S3 OFS Routingburn Road Lane 1	71690	Routing Burn extension 0.1
S3 OFS Routingburn Road Lane 2	71690	Routing Burn extension
S3 OFS: Springhill Road	73750	UD_71.1
S3 OFS Tullanafoile Road 1	75850	UD_110
S3 OFS: Tullanafoile Road 2	74980	UD_110.3
S3 OFS: Tycanny Road 2	76800 (60W)	UD_111.2
S3 OFS: Tycanny Road 1	78180	UD_78.3
S3 OFS: Tycanny Road 3	76950	UD_75.3
S3 OFS: Rarogan Road	78210 (90S)	UD_78.1
S3 OFS: Newtownsaville Road Lane 1	78840	UD_79.1
S3 OFS: Glenhoy Road 2	80380 (100 N)	UD_80.1
S3 OFS: Glenhoy Road 3	80400 (60 S)	UD_80.2
S3 OFS: Bloomhill Lane	80860	UD
S3 OFS: Sess Road Lane 1	81400	Roughan

Outfall ID	Chainage (m)	Receiving Watercourse ID
S3 OFS: Sess Road Lane 2	80890 (225S)	Roughan 0.2
S3 OFS Ballynasaggart Road 1	81640 (90 N)	UD_118
S3 OFS: Ballynasaggart Road 2	81700 (115 N)	UD_118
S3 OFS: Sess Road	82410	UD_81.2
S3 OFS: Feddan Road	83110	UD_115
S3 OFS: Annaghilla Road 5	84510 (1200N)	Ballygawley Water
S3 OFS: Ballynanny Road 4	83700 (190N)	Existing Road Drainage
S3 OFS: Ballynanny Road 3	83850	Ballygawley Water
S3 OFS: Ballynanny Road 2	83310 (590S)	UD
S3 OFS: Ballynanny Road 1	82750 (620S)	UD
S3 OFS: Tullywinny Road	83800 (220 S)	UD_83.3
S3 OFS Lisginny Road Lane	85890	UD_85.1
S3 OFS: Lisginny Road 1	86050	Tullyvar 0.1
S3 OFS: Lisginny Road 2	86240	Tullyvar
S3 OFS: Old Chapel Road 1	87800	UD_87.2
S3 OFS: Old Chapel Road 2	87880 (240S)	UD_89.6
S3 OFS: Old Chapel Road 3	87600	UD_86.2
S3 OFS: Tullyvar Road	88290 (90N)	UD_88.1
S3 OFS: Tullyvar Road 2	88450 (300 S)	UD_114.1
S3 OFS: Loughans Road Lane	88710	UD_89.5
S3 OFS: Carnteel Road Lane 1	89950 (50 N)	UD_91.2
S3 OFS: Carnteel Road 2	90480 (377 W)	UD_91.3

Outfall ID	Chainage (m)	Receiving Watercourse ID
S3 OFS: Carnteel Road 1	90260 (120 E)	UD_91
S3 OFS: Carnteel Road 3	90180 (126E)	UD_91
S3 OFS Rehaghy Road	90890	UD_92.1
S3 OFS Rehaghy Road 2	90800	UD_92.1
S3 OFS Lettice Street Lane	92350	UD_95
S3 OFS: Monaghan Road	93010	Blackwater

Table 7-6 Section 3 Side Road Outfalls

Watercourse Crossings

7.11.4 A total of 68 watercourse crossings would be required for the Proposed Scheme in Section 3. Three of the crossings would be bridges and 65 culverts. Details of the crossings are given in Table 7-7.

Crossing Reference	Watercourse ID	Chainage (m)	Type	Indicative Size of Opening (m) H x W
S3/B08.1	Routing Burn	71680	Bridge	Approx. span = 31m
S3/B17.3	Ballygawley Water	83800	Bridge	Approx. spans 13m+25m+13m
S3/B17.4	Ballygawley Water	83800 (1030 N)	Bridge	Approx. span = 12m
S3-PC-84	UD_57	61850	Box	1.8 x 1.8
S3-PC-56	UD_57.2	62100	Box	1.8 x 1.8
S3-PC-51	UD_58	62550	Box	1.5 x 3.0
S3-PC-52	UD_109	64080	Box	2.1 x 2.1
S3-PC-53	Ranelly Drain_0.5	64400	Box	2.7 x 3.3
S3-PC-74	Ranelly Drain_0.5	64390	Box	2.7 x 3.3

Crossing Reference	Watercourse ID	Chainage (m)	Type	Indicative Size of Opening (m) H x W
S3-PC-82	Ranelly Drain_0.5	64500	Box	2.7 x 4.2
S3-PC-06	Ranelly Drain 1	64980	Box	2.7 x 3.0
S3-PC-07	Ranelly Drain 2	65580	Box	2.4 x 2.7
S3-PC-08	Ranelly Drain 2.1	65890	Box	2.1 x 5.1
S3-PC-10	Ranelly Drain 3	66050	Box	2.1 x 2.7
S3-PC-11	UD_60	66870	Box	1.8 x 1.8
S3-PC-12	UD_61	67630	Pipe	1.5m Ø
S3-PC-14	Letfern	68750	Box	2.1 x 3.6
S3-PC-58	Letfern	68780	Box	2.1 x 3.6
S3-PC-15	UD_61.2	68700	Pipe	1.5 x 1.5
S3-PC-66	UD_61.2	68700	Pipe	0.6m Ø
S3-PC-16	UD_62	69710	Pipe	2.4m Ø
S3-PC-17	UD_63.A	69890	Box	1.8 x 1.8
S3-PC-18	UD_64	70200	Box	1.5 x 2.7
S3-PC-83	UD_67.B	71100	Box	1.8 x 1.8
S3-PC-50	UD_67.A	71150	Box	1.8 x 1.8
S3-PC-19	UD_67	71350	Box	1.8 x 1.8
S3-PC-21	UD_68	72090	Box	1.8 x 1.8
S3-PC-22	UD_69	72380	Box	1.8 x 1.8
S3-PC-23	UD_71	73770	Box	2.1 x 2.7
S3-PC-64	UD_72.2	74100	Box	2.4 x 3.0
S3-PC-65	UD_72.1	74210	Box	2.4 x 3.0

Crossing Reference	Watercourse ID	Chainage (m)	Type	Indicative Size of Opening (m) H x W
S3-PC-72	UD_110.2	74900	Box	3.3 x 3.3
S3-PC-54	UD_110	75910	Box	2.1 x 2.4
S3-PC-60	UD_110	75900	Box	2.1 x 2.4
S3-PC-55	UD_75.3	77000	Box	1.8 x 1.8
S3-PC-29	UD_76	77900	Box	2.1 x 2.1
S3-PC-85	UD_77	78130	Box	1.8 x 2.8
S3-PC-30	UD_78.3	78150	Box	2.1 x 2.1
S3-PC-31	UD_78	78190	Box	2.1 x 3.6
S3-PC-32	UD_79	78830	Pipe	1.2m Ø
S3-PC-86	UD_79	78830	Pipe	1.2m Ø
S3-PC-59	UD_80.1	80300	Pipe	1.8m Ø
S3-PC-33	UD_80	80420	Pipe	1.8m Ø
S3-PC-87	CS04	80980	Pipe	1.5m Ø
S3-PC-34	Roughan	81380	Box	2.4 x 5.7
S3-PC-68	UD_118	81680	Box	2.1 x 2.1
S3-PC-73	UD_82	84000 (613 N)	Pipe	1.5m Ø
S3-PC-79	UD_83.2	84700 (1375 N)	Pipe	1.8m Ø
S3-PC-69	UD_83.3	83880	Box	1.8 x 3.0
S3-PC-70	UD_116	84600	Pipe	1.5m Ø
S3-PC-71	UD_117	85220	Pipe	1.8m Ø
S3-PC-39	UD_85.1	85890	Pipe	1.5m Ø
S3-PC-40	Tullyvar	86070	Box	2.4 x 3.9

Crossing Reference	Watercourse ID	Chainage (m)	Type	Indicative Size of Opening (m) H x W
S3-PC-41	UD_86	86990	Box	1.8 x 2.1
S3-PC-57	UD_86	87590	Box	1.8 x 2.1
S3-PC-42	UD_87.2	87800	Box	1.8 x 2.4
S3-PC-75	UD_87.2	87800	Box	1.8 x 3.0
S3-PC-43	UD_89	88220	Pipe	1.5m Ø
S3-PC-61	UD_89	88300	Pipe	1.5m Ø
S3-PC-44	UD_90	89200	Box	2.1 x 3.9
S3-PC-45	UD_91	90300	Box	1.8 x 2.1
S3-PC-88	UD_91	90330	Box	1.8 x 2.1
S3-PC-46	UD_92	90650	Box	1.8 x 2.4
S3-PC-62	UD_92.1	90800	Box	1.5 x 2.7
S3-PC-47	UD_92.1	90850	Box	2.4 x 2.7
S3-PC-48	Lisadavil	91400	Box	2.7 x 3.9
S3-PC-77	UD_94	91820	Pipe	1.5m Ø
S3-PC-49	UD_95	92350	Pipe	2.1m Ø

Table 7-7 Section 3 Watercourse Crossings

Watercourse Diversions

7.11.5 There would be 60 proposed watercourse diversions within Section 3. These are detailed in Table 7-8. The size of watercourse being diverted ranges from known, small, open field drains to large streams. It is proposed that land and field drainage will be incorporated into the proposed pre-earthworks drainage (PED) design and at these locations no watercourse diversions are proposed.

Crossing ID	Drainage Watercourse ID	Chainage (m)	Length (m)
S3-WD-32	UD_57	61850	200
S3-WD-66	UD_57.2	62000	122
S3-WD-43	UD_58.3	62500	118
S3-WD-44	UD_108	62650	182
S3-WD-70	UD_108	62800	156
S3-WD-45	UD_109	64100	108
S3-WD-46	Ranelly Drain 0.5	64450	310
S3-WD-04	UD_119	65000	61
S3-WD-05	Ranelly Drain 1	65050	158
S3-WD-06	Ranelly Drain 2	65650	173
S3-WD-07	Ranelly Drain 2.1	65800	125
S3-WD-08	Ranelly Drain 2.3	65900	125
S3-WD-09	Ranelly Drain 3	66050	220
S3-WD-10	Ranelly Drain 3.1	66200	52
S3-WD-75	UD_60.2	66800	81
S3-WD-11	UD_61.0	67650	144
S3-WD-47	UD_61.2	68650	35
S3-WD-12	Letfern	68750	51
S3-WD-48	Letfern 0.1	68750	51
S3-WD-13	UD_62	69700	186
S3-WD-14	UD_63	69900	218
S3-WD-16	UD_65	70200	87

Crossing ID	Drainage Watercourse ID	Chainage (m)	Length (m)
S3-WD-17	UD_66	70450	326
S3-WD-18	UD_67.A	71270	117
S3-WD-19	UD_67	71300	188
S3-WD-20	UD_68	72100	98
S3-WD-21	UD_69	72400	223
S3-WD-22	UD_70	73000	204
S3-WD-49	UD_71	73800	184
S3-WD-51	UD_110.2	75300	478
S3-WD-50	UD_110	75900	348
S3-WD-53	UD_111.3	76950	183
S3-WD-54	UD_75.3	77000	138
S3-WD-27	UD_78	78200	39
S3-WD-28	UD_78	78200	151
S3-WD-55	UD_79	78820	107
S3-WD-64	UD_80.1	80300	83
S3-WD-65	UD_80	80450	118
S3-WD-90	Roughan	81350	78
S3-WD-68	UD_115	83000	320
S3-WD-77	UD_82.1	84000 (615 N)	6
S3-WD-59	UD_83.1	84600 (1250 N)	4
S3-WD-71	UD_116	84600	4
S3-WD-72	UD_117	85200	4

Crossing ID	Drainage Watercourse ID	Chainage (m)	Length (m)
S3-WD-73	UD_85.1	85900	155
S3-WD-33	UD_101	86200	35
S3-WD-34	Tullyvar	86200	284
S3-WD-62	UD_86.2	87500	259
S3-WD-63	UD_87.2	87800	3
S3-WD-35	UD_89	88200	285
S3-WD-67	UD_89	88200	97
S3-WD-36	UD_90	89200	150
S3-WD-69	UD_120	89300	136
S3-WD-37	UD_91	90300	255
S3-WD-38	UD_92	90600	167
S3-WD-60	UD_92	90700	91
S3-WD-61	UD_92.1	90800	210
S3-WD-40	Lisadavil	91450	168
S3-WD-39	UD_93	91400	27
S3-WD-41	UD_95	92350	104

Table 7-8 Section 3 Watercourse Diversions

Flood Mitigation

7.11.6 This section provides information on the flood mitigation that would be required for the Proposed Scheme through Section 3. For the methodology of the flood risk assessments and processes refer to Chapter 4 and the A5 WTC Flood Risk Assessment (FRA) Report.

Hydraulic Models

7.11.7 A number of hydraulic models were developed for Section 3. The purpose of the hydraulic models was to obtain the extent of floodplains and associated depths/elevations of water for particular watercourses over defined flood events. The details of each hydraulic model within Section 3 are given below.

Model L Ranelly Drain

7.11.8 The Proposed Scheme would cross the upstream extents of the Ranelly Drain in the vicinity of the Doogary / Tullyrush Roads, south-east of Omagh and to the west of the existing A5. (Refer to drawing 718736-S3-0500-0101 and 0102, 718736-S3-0500-0112 and 0113 for the 1% Annual Exceedance Probability AEP (design return period) flood outline).

7.11.9 Hydraulic modelling indicates that for the design event there would be approximately 2.390m^3 of water displaced by the Proposed Scheme. River engineering including floodable berms and flood compensatory storage would be provided through S3-FB-01, S3-FB-02, S3-CS-01 to S3-CS-03 and S3-CS-20 (see Table 7-10). The inundation of the floodplain would not be significantly affected by the Proposed Scheme. (For further details refer to mitigation drawings 718736-S3-0500-0101 and 0102, 718736-S3-0500-0112 and 0113).

Model M Letfern

7.11.10 The Letfern watercourse is located approximately 2 km east of the village of Seskinore, in the locality of the junction of Augher Point Road and B46 Moylagh Road. (Refer to drawing 718736-S3-0500-0103 for the 1% AEP (design return period) flood outline).

7.11.11 Hydraulic modelling indicates that for the design event there would be approximately 10m^3 of water displaced by the Proposed Scheme. Flood compensatory storage would be provided through S3-CS-05 (see Table 7-10). The inundation of the floodplain would not be significantly affected by the Proposed Scheme. (For further details refer to mitigation drawing 718736-S3-0500-0103). The overall impact from the Proposed Scheme is Neutral.

Model N Undesignated

7.11.12 This undesignated watercourse is an upstream tributary of the Letfern Burn and is located between the B46 Moylagh Road and Greenmount Road, approximately 2.8 km south-east of the village of Seskinore. (Refer to drawing 718736-S3-0500-0118 for the 1% AEP (design return period) flood outline).

7.11.13 Hydraulic modelling indicates that for the design event there would be no water displaced by the Proposed Scheme. The overall impact from the Proposed Scheme is Neutral.

Model O Undesignated

7.11.14 Watercourse O flows in a south-westerly direction and is made up of two tributaries whose confluence is approximately 300m downstream of the crossings with the Proposed Scheme. It is located approximately 3.1km to the south-east of Seskinore.

(Refer to drawing 718736-S3-0500-0119 for the 1% AEP (design return period) flood outline).

7.11.15 Hydraulic modelling indicates that for the design event there would be no water displaced by the Proposed Scheme, however, flow characteristics are slightly changed as a consequence of river engineering. (For further details refer to mitigation drawing 718736-S3-0500-0119). The overall impact from the Proposed Scheme is Slight Adverse.

Model P/Q Routing Burn

7.11.16 The Routing Burn watercourse including an undesignated tributary are located in the vicinity of the Greenmount, Killadroy and Routingburn Roads approximately 2 km north-west of the village of Newtownsaville. (Refer to drawing 718736-S3-0500-0124, 0104 and 0120 for the 1% AEP (design return period) flood outline).

7.11.17 Hydraulic modelling indicates that for the design event, at the most northerly watercourse crossing there would be no impact on the floodplain, however further south, on the tributary of the Routing Burn there would be 595m^3 of water displaced by the Proposed Scheme. Additional storage would be provided within channel of associated diversion S3-WD-21 (see Table 7-8). The inundation of the floodplain would not be significantly affected by the Proposed Scheme. (For further details refer to mitigation drawing 718736-S3-0500-0124, 0104 and 0120). The overall impact from the Proposed Scheme is Slight Adverse, however, benefits in relation to water levels are also realised.

Model R Undesignated

7.11.18 This undesignated watercourse is located immediately east of Newtownsaville in the vicinity of the Springhill Road and Newtownsaville Road. (Refer to drawing 718736-S3-0500-0105, 0115, 0116 and 0117 for the 1% AEP (design return period) flood outline).

7.11.19 Hydraulic modelling indicates that for the design event there would be approximately 70m^3 of water displaced by the Proposed Scheme. Flood compensatory storage would be provided through S3-CS-08 (see Table 7-9). The inundation of the floodplain would not be significantly affected by the Proposed Scheme. (For further details refer to mitigation drawing 718736-S3-0500-0105, 0115, 0116 and 0117). The overall impact from the Proposed Scheme is Slight Adverse.

Model S Undesignated

7.11.20 Model S is an undesignated watercourse that is situated to the south of the junction of the Newtownsaville Road and Tullanafoile Road. (Refer to drawing 718736-S3-0500-0127, 0121, and 0122 for the 1% AEP (design return period) flood outline).

7.11.21 Hydraulic modelling indicates that for the design event there would be approximately 25m^3 of water displaced by the Proposed Scheme. Additional storage would be provided within channel of associated diversion S3-WD-28 (see Table 7-8). The overall impact from the Proposed Scheme is Slight Adverse.

Model T Roughan River

7.11.22 The Roughan River is located between the village of Ballynasaggart and Rattling Ford. (Refer to drawing 718736-S3-0500-0106 for the 1% AEP (design return period) flood outline).

7.11.23 Hydraulic modelling indicates that for the design event there would be approximately 4,985m^3 of water displaced by the Proposed Scheme. Flood compensatory storage would be provided through S3-CS-09 (see Table 7-10). In order to maintain equilibrium across the existing floodplain, connectivity would be incorporated into the Proposed Scheme through structures S3-CC-01 and S3-CC-02 (see Table 7-9). (For further details refer to mitigation drawing 718736-S3-0500-0106). The overall impact from the Proposed Scheme is Neutral.

Model U Ballygawley Water

7.11.24 The section of Ballygawley Water in the vicinity of the Proposed Scheme is located between the village of Ballygawley and Lisdoart Bridge. (Refer to drawing 718736-S3-0500-0107, 0108 and 0114 for the 1% AEP (design return period) flood outline).

7.11.25 Hydraulic modelling indicates that for the design event there would be approximately 5,820m^3 of water displaced by the Proposed Scheme. Flood compensatory storage would be provided through S3-CS-10 (see Table 7-10). In order to maintain equilibrium across the existing floodplain, connectivity would be incorporated into the Proposed Scheme through structure S3-CC-03 (see Table 7-9) (For further details refer to mitigation drawings 718736-S3-0500-0107, 0108 and 0114).

Model V Tullyvar Drain

7.11.26 The Tullyvar Drain is a designated watercourse located 1km to the west of the junction of the A5 Tullyvar Road and the Lisginny Road. (Refer to drawing 718736-S3-0500-0109 for the 1% AEP (design return period) flood outline).

7.11.27 Hydraulic modelling indicates that for the design event there would be approximately 3,825m^3 of water displaced by the Proposed Scheme. Flood compensatory storage would be provided through S3-CS-11 and S3-CS-12 (see Table 7-9). In order to maintain equilibrium across the existing floodplain, connectivity would be incorporated into the Proposed Scheme through structures S3-CC-04 and S3-CS-05 (see Table 7-10). (For further details refer to mitigation drawing 718736-S3-0500-0109), The overall impact from the Proposed Scheme is Neutral.

Model W Ravella Drain

7.11.28 The Ravella Drain is a designated watercourse located near Lissenderry between the A5 Tullyvar Road and the A28 Favour Royal Road. Hydraulic modelling identifies that there is no flood plain associated with the watercourse reach, however, it is observed that flooding within the vicinity of the scheme is indicated within Rivers Agency Flood Maps. Rivers Agency maps indicate that these predictions are based on strategic modelling of river reaches and it is therefore considered that these do not have the same level of confidence as applied to those modelled in detail.

7.11.29 River engineering proposals mitigate flood risk impacts associated with the Proposed Scheme. However, as floodplain is indicated on the Rivers Agency Strategic Flood Maps an area of land is identified for compensatory storage; S3-CS-13 (see Table 7-10). (For further details refer to mitigation drawing 718736-S3-0500-0110). The overall impact from the Proposed Scheme is Neutral.

Model X Undesignated

7.11.30 Model X is an undesignated watercourse located approximately 1.5km to the north of the town of Aughnacloy. (Refer to drawing 718736-S3-0500-0123 for the 1% AEP (design return period) flood outline).

7.11.31 Hydraulic modelling indicates that for the design event there would be no flood water displaced by the Proposed Scheme, however, flow characteristics are slightly changed as a consequence of river engineering. (For further details refer to mitigation drawing 718736-S3-0500-0123). The overall impact from the Proposed Scheme is Slight Adverse.

Model Y Lisadavil

7.11.32 The Lisadavil River is located east and south of the town of Aughnacloy. (Refer to drawing 718736-S3-0500-0111, 0125 and 0126 for the 1% AEP (design return period) flood outline).

7.11.33 Hydraulic modelling indicates that for the design event there would be approximately 3,020m^3 of water displaced by the Proposed Scheme. Flood compensatory storage would be provided through S3-CS-14 and S3-CS 15 (see Table 7-10). In order to maintain equilibrium across the existing floodplain, connectivity would be incorporated into the Proposed Scheme through structures S3-CC-06 and S3-CS-07 (see Table 7-9). (For further details refer to mitigation drawing 718736-S3-0500-0111, 0125 and 0126). The overall impact of the Proposed Scheme is Slight Adverse.

Connectivity Culverts

7.11.34 Along Section 3 there would be 7 connectivity culverts. Table 7-9 lists the proposed connectivity culverts within Section 3.

Connectivity Culvert Reference	Chainage (m)	Hydraulic Clear Opening Requirement	
		Height (m)	Width (m)
S3-CC-01	81220	1.2	1.2
S3-CC-02	81305	1.2	1.2
S3-CC-03	83835	1.5	4.0
S3-CC-04	86130	1.5	1.5

Connectivity Culvert Reference	Chainage (m)	Hydraulic Clear Opening Requirement	
		Height (m)	Width (m)
S3-CC-05	86200	1.2	1.5
S3-CC-06	91320	1.5	1.5
S3-CC-07	91375	1.2	1.5

Table 7-9 Section 3 Connectivity Culverts

Flood Compensation

7.11.35 Where the Proposed Scheme would cross floodplains, and it is appropriate to do so, land would be vested to create compensatory flood storage areas. Table 7-10 below lists the flood compensatory storage areas for Section 3

Compensation Storage Area Reference	Chainage (m)	Watercourse ID	Total area required (m^2)
S3-CS-20	64300	Ranelly	6960
S3-CS-01	65100	Ranelly	4090
S3-CS-02	65600	Ranelly	5572
S3-CS-03	65800	Ranelly	23903
S3-CS-05	68750	Letfern	2860
S3-CS-08	75851	UD_110	6307
S3-CS-09	81250	Roughan	24485
S3-CS-10	83800	Ballygawley	52753
S3-CS-11	86100	Tullyvar	5296
S3-CS-12	86300	Tullyvar	28097
S3-CS-13	87100	UD_86	28552

Compensation Storage Area Reference	Chainage (m)	Watercourse ID	Total area required (m^2)
S3-CS-14	90900	UD_92	3355
S3-CS-15	91300	Lisadavil	26561

Table 7-10 *Section 3 Flood Compensatory Storage Areas*

7.12 Deposition Areas

7.12.1 A number of possible areas for the deposition of material were identified adjoining the Proposed Scheme. These were assessed under various engineering and environmental headings and the most appropriate chosen for inclusion within the Proposed Scheme. The schedule below sets out the location and size of the chosen Deposition Areas

Ref:	Approx. Mainline Chainage (m)	Location	Fill Volume (m^3)
S3-DEP-001	62400 – 62900	North of Tattykeel Road, west of mainline	157,000
S3-DEP-002	64300 – 64650	North and south of proposed Drumconnelly Road, east of mainline	167,000
S3-DEP-003	64600 – 64950	South of Drumconnelly Road, west of mainline	93,000
S3-DEP-004	66910 – 67100	South of Rarone Road, east of mainline	13,000
S3-DEP-008	70000 – 70400	Between Moylagh junction and Greenmount Road, east of mainline	66,000
S3-DEP-009	70600 – 70850	North of Greenmount Road, east of mainline	17,000
S3-DEP-010	71700 – 72000	South of Greenmount Road, east of mainline	78,000
S3-DEP-012	74550 – 74800	North of Cormore Road, east of mainline	42,000
S3-DEP-014	76500 – 76600	West of mainline	83,000
S3-DEP-022	80650 – 81000	Between Glenhoy Road and Ballynasaggart Road, east of mainline	119,000
S3-DEP-023	81550 – 81650	West of Ballynasaggart Road, south of mainline	82,000
S3-DEP-024	81750 – 81850	East of Ballynasaggart Road, south of mainline	50,000

Ref:	Approx. Mainline Chainage (m)	Location	Fill Volume (m³)
S3-DEP-025	81700 – 81900	East of Ballynasaggart Road, north of mainline	99,000
S3-DEP-026	82300 – 83200	Between Feddan Road and mainline	488,000
S3-DEP-034	89600 – 90000	North of Carnteel Road, south of mainline	217,000
S3-DEP-038	91900 – 92200	South of Caledon Road, east of mainline	113,000

Table 7-11: Deposition Areas in Section 3

7.13 Road Signage

7.13.1 As discussed in Chapter 4, a road signage strategy design was carried out to identify areas of land that needed to be included in the draft Vesting Order.

7.14 Road Side Features

7.14.1 Within Section 3, three northbound and two southbound lay-bys would be provided at Ch. 73200m, Ch. 79500m and Ch. 85200m northbound and Ch. 72600m and Ch. 78100m southbound.

7.15 Structures

7.15.1 Table 7-12 below summarises the nature and number of structures that would be required in Section 3. The locations of the structures are shown on drawings 718736-S3-0800-660 to 681 in Volume 2

Structure Reference	Structure Name	Type	Chainage (m)
B01	Seskinore Road	Overbridge	62065
B03	Tattykeel Road	Overbridge	62850
AC0.1	Accommodation	Underpass	64000
B04.1	Drumconnelly Road	Overbridge	64400
AC01	Accommodation	Overbridge	65450
B05	Tullyrush Road	Underbridge	66000
B06	Rarone Road	Overbridge	66900
AC03	Accommodation	Overbridge	97550
B07	Moylagh Road	Underbridge	68760

Structure Reference	Structure Name	Type	Chainage (m)
AC04	Accommodation	Overbridge	69300
B08	Greenmount Road	Underbridge	71150
B08.1	Routing Burn River	River Structure	71670
B10	Springhill Road	Underbridge	73800
B14.1	Tullanafoile Road	Underbridge	75900
B14.2	Tullycorker Road	Overbridge	76650
AC05.1	Accommodation	Underpass	78170
B15	Rarogan Road	Underbridge	78450
AC06	Accommodation	Underpass	78930
B16	Glenhoy Road	Overbridge	80200
AC06.1	Accommodation	Underpass	80760
AC07	Accommodation	Overbridge	81120
B16.1	Ballynasaggart Road	Overbridge	81700
AC08	Accommodation	Overbridge	82000
AC09.1	Accommodation	Overbridge	83450
B17.3	Ballygawley Water	River Structure	83850
B17.4	Ballygawley Water	River Structure	83850
B18	Tullywinny Road	Underbridge	84400
AC9.2	Accommodation	Underbridge	84490
AC9.3	Accommodation	Underbridge	84610
AC10	Accommodation	Overbridge	85050
AC11	Accommodation	Underbridge	85860
B20	Lisginny Road	Overbridge	86500
B21	Old Chapel Road	Overbridge	87750
B22	Tullyvar Road	Overbridge	88400
AC12	Accommodation	Overbridge	88620
B23	Carnteel Road	Overbridge	90300
B24	Rehaghy Road (B128)	Underbridge	90800
AC12.1	Ulster Way	Structure Removed	
AC13	Accommodation	Structure Removed	

Table 7-12 Section 3 Public Structures Summary

7.15.2 These structures can generally be classified within the 'family of structures' described in Chapter 4. The following section describes the more significant structures that would be required.

Routing Burn (Ch. 71680m)

7.15.3 This structure would carry the A5 over the Routing Burn. The bridge would be a single span structure with a span, of approximate 31m between the centreline of bearings at each end. The single span would allow accommodation access under the A5 for the landowners on both sides of the river.

7.15.4 The above span arrangement would allow the use of either composite precast beams or composite steel plate girder superstructures. Drawing 718736-1700-D-515 in Volume 2 shows the general arrangement of the proposed structure.

Ballygawley Water (Ch. 83800m)

7.15.5 This structure would carry the A5 over the Ballygawley Water. The bridge would require a span of 25m to cross the channel and river banks. The bridge would be a 3 span asymmetrical structure with spans, of approximate 13m, 25m and 13m giving a total length of 51m. The two end spans would allow accommodation access under the A5 for the landowners on both sides of the river.

7.15.6 The above span arrangement would allow the use of either composite precast beams or composite steel plate girders superstructures. Drawing 718736-1700-D-514 in Volume 2 shows the general arrangement of the proposed structure.

7.15.7 The structures taking the A4 over the Ballygawley Water would utilise the existing Annaghilla Road bridge for the eastbound carriageway. The westbound carriageway would require a new bridge with a clear span of approximately 12m of reinforced concrete or precast beams with a composite reinforced concrete deck slab. Drawing 718736-1700-D-520 in Volume 2 shows the general arrangement of the proposed structure.

8 TRAFFIC AND ECONOMIC ASSESSMENT

8.1 Introduction

8.1.1 This chapter describes the development of the strategic traffic model for the A5 Western Transport Corridor (A5WTC). This covers traffic data collection and processing, trip matrix and network development, calibration, validation and junction capacity assessment.

8.1.2 Base year and future year forecasts are presented for key links along the A5WTC. Operational capacity assessments for all proposed junctions along the A5WTC are also presented based on design year forecasts.

8.1.3 A traffic model for the A5WTC using 2008 base year flows was previously developed from which forecasts were produced in 2010. This latest work represents an update to the traffic model using new data sources to bring the model up to a 2013 base year.

8.2 Background to Model Update

8.2.1 The original 2008 base year traffic model incorporated trip data from (Road Side Interview) RSI surveys undertaken in 2008 and additionally trip data from earlier studies. These data sources were combined to produce a 2008 base year trip matrix.

8.2.2 The development of the original base year model for the A5WTC is described in the report 'A5 Western Transport Corridor, Local Model Validation Report' (718736-2700-R-003), dated 1st April 2011.

8.2.3 Following the decision to update the ES, it was recognised that updated traffic forecasts would be required.

8.2.4 A programme of surveys was undertaken in autumn 2013 and spring 2014, comprising RSIs, volumetric counts, routeings using Automatic Number Plate Recognition (ANPR) through main towns, and journey times.

8.2.5 For the 2013 A5WTC model update the SATURN (Simulation and Assignment of Traffic to Urban Road Networks) suite of modelling software has been used.

8.2.6 SATURN is a widely used industry standard modelling software package. It enables a detailed representation of the highway network, both links and junctions, to be specified and provides a comprehensive range of analytical tools. Model outputs may be easily transferred using GIS formats to provide inputs for subsequent environmental appraisal.

8.3 Model Scope

Study Area

8.3.1 The A5WTC model study area extends between New Buildings in the north and Aughnacloy in the south. The area has a number of key cross border links with the Republic of Ireland (ROI), and includes 3 major urban areas (Londonderry, Strabane and Omagh) along the route of the existing A5. The extent of the study area is shown in Figure 8-1.

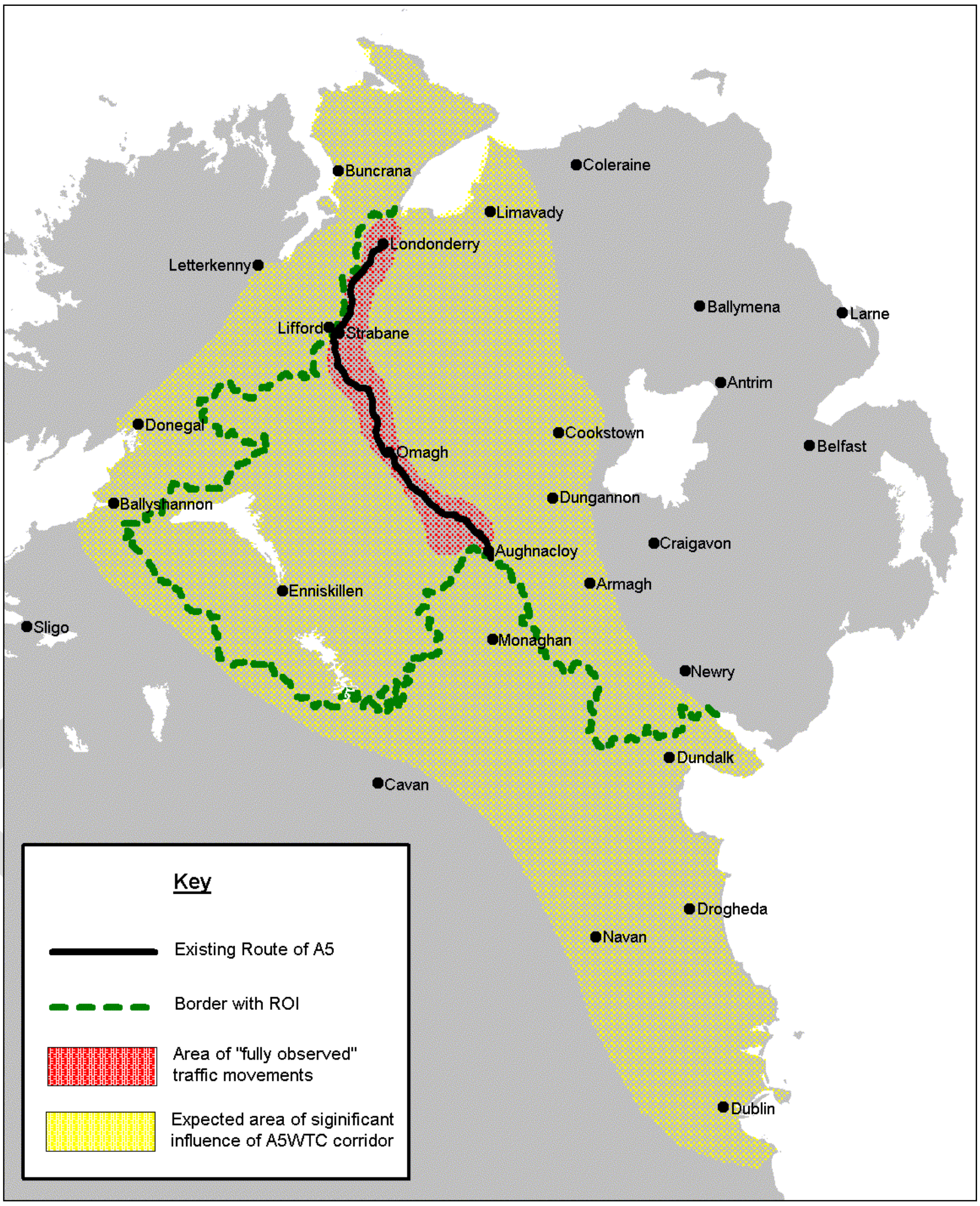


Figure 8-1 Study Area

Zoning System

8.3.2 Traffic models conventionally represent the model area using zones, consistent with administrative boundaries and physical features. Zones within the study area are fairly detailed and coarser further away. In this way all trip movements within the study area may be represented. Each zone is connected to the model network to provide a loading point for assigning current and future 'zone to zone' trip movements.

8.3.3 Northern Ireland has been covered by 481 zones and the ROI by 44 zones, giving a total for the whole model of 525 zones.

8.3.4 Detailed zone systems were specified within the main population centres along the route of the existing A5, particularly Londonderry, Strabane and Omagh. For the inter-urban sections of the existing A5, the zones were also relatively detailed in order to represent the smaller conurbations. Zones were then drawn progressively larger and less detailed further away from the route of the existing A5.

8.3.5 The zone system within Northern Ireland was defined to be consistent with local government (District) boundaries and Parliamentary Constituency boundaries. In the vicinity of the existing A5 (defined by the Districts of Londonderry, Omagh, Strabane and Dungannon), the zones were consistent with ward boundaries.

8.3.6 The zone system is illustrated in Figure 8-2.

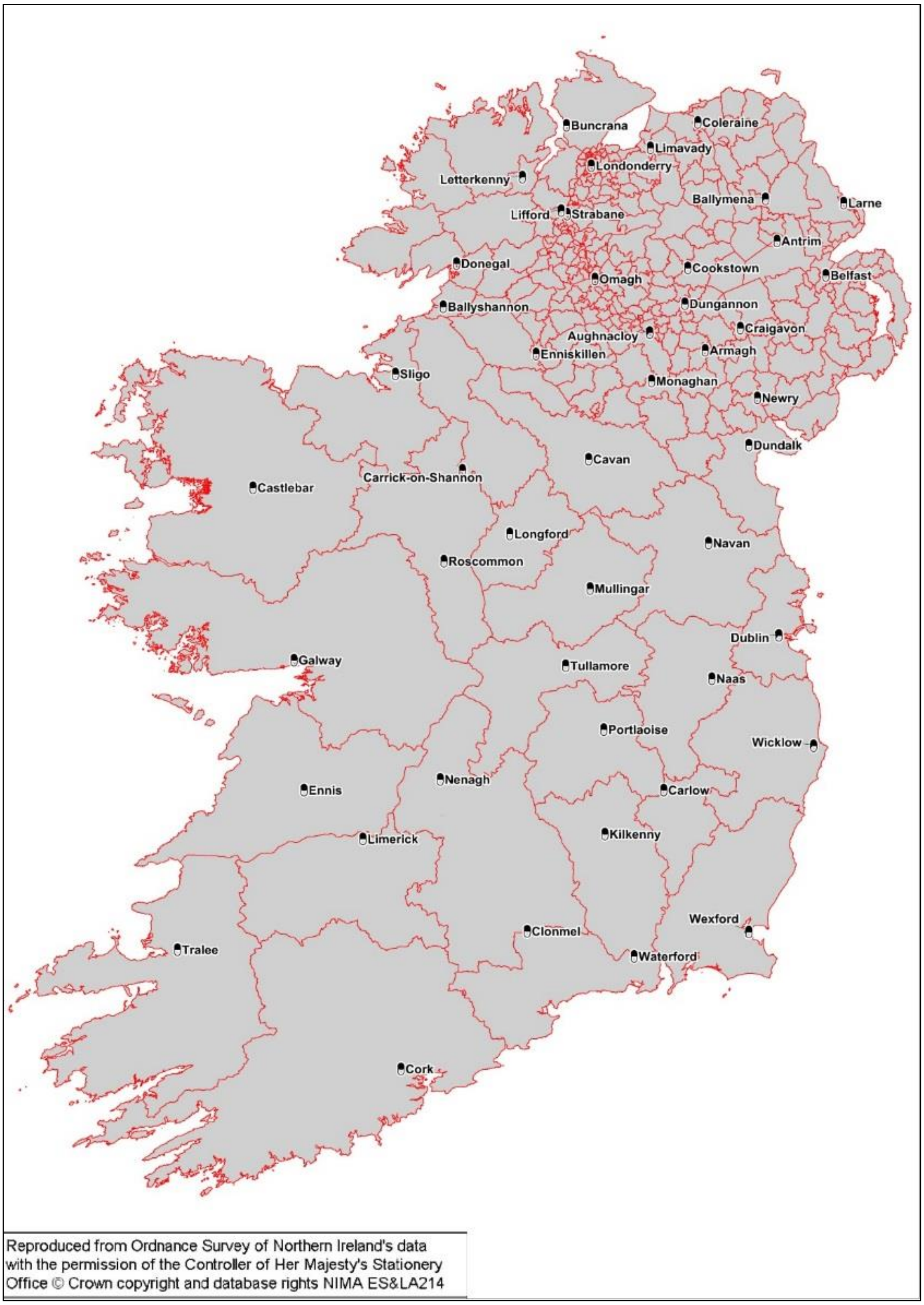


Figure 8-2 A5WTC Model Zone System

Model Time Periods

8.3.7 The A5WTC traffic model includes three separate time periods. These are:

i. AM period from 7:30am to 9:30am;
ii. Inter-peak (IP) period from 9:30am to 4:00pm;
iii. PM period from 4:00pm to 6:00pm.

8.3.8 These periods have been determined with reference to the daily traffic flow profile on the existing A5.

8.3.9 The daily flow profile for each section indicated that both the morning and afternoon peaks extended over predominantly a single hour period. However, given the requirement to model long distance traffic, a 2 hour model period was adopted to ensure that all trips would be represented. The model represents an average hour within the AM, PM and IP hour period in each case.

Vehicle Classes & Trip Purposes

8.3.10 The traffic model defines several user classes to represent vehicle type and trip purpose. These facilitate individual user classes to be modelled separately. Trip matrices have been developed for each vehicle type and trip purpose. The combination of vehicle types and trip purposes are defined as follows:

- Car – Journey between home and work (“Commute”)
- Car – Employers Business
- Car – Other trip purposes
- Light Goods Vehicle (all purposes)
- Heavy Goods Vehicle (including Medium Goods Vehicles) (all purposes)

Modelled Network

8.3.11 The model network is a representation of the highway network within the study area. The network comprises a system of nodes connected by links. The nodes mostly represent junctions and the links represent homogenous stretches of road between junctions.

8.3.12 The A5WTC model has been constructed using the SATURN suite of transport modelling software. The model network has been developed with the aid of the Mapinfo GIS (Geographical Information System) program.

8.3.13 The network has been modelled at two levels of detail, referred to as a simulation area and a buffer area. Within the study area junctions are simulated in order to model delays. The surrounding area is represented as a buffer network with fixed link speeds representing both links and junctions combined.

8.3.14 Details for the 2013 base year network were obtained from the following sources:

- Signal timings - based on street observations taken in 2013 and 2014 plus details obtained from Transport NI.
- Lane arrangements and stop line widths – measured from recent aerial photos and site visits.
- Link types and speed flow curves - allocated using TAG Unit M3.1 Appendix D which specifies the speed/flow relationships used in COBA (the DfT's link-based Cost Benefit Analysis software)

8.3.15 In order to verify that the modelled network correctly represented the current base year a number of checks were undertaken, as follows:

- Correct loading of centroids.
- Link length checks
- Routeing through the network
- Network hierarchy and speed flow definition

8.3.16 The modelling of traffic routeings through the road network was also checked. These were assessed using the 'select path' facility available in SATURN, which displays the computer generated routes graphically on a map based background. This was used to confirm that routeings through the network were as expected and hence that the network data was robust.

8.3.17 Further checks were conducted to ensure that modelled link types were consistent with the actual characteristics of each location, (e.g. rural link types outside of towns and urban link types within towns). This ensured that the appropriate speed flow relationships (based on TAG Unit M3.1) were used on each link in the model network.

8.4 Data Collection and Processing

Survey Programme

8.4.1 A programme of surveys was undertaken in autumn 2013 and spring 2014, comprising RSI's, ANPR's, volumetric counts and journey times. This data was used to update the previous 2008 base year model to a 2013 base year.

8.4.2 The data collection programme comprised:

- 7 Roadside Interviews (RSIs); 6 on the existing A5 between Londonderry and Aughnacloy and one on the A32 west of Omagh.

- 7 Automatic Number Plate Recognition (ANPR) at RSI sites- used to derive the return time of trips in the non-observed direction

- 24 ANPR Sites (forming 2-way cordons around the urban areas of Londonderry, Strabane, Omagh and Aughnacloy

- 91 Automatic Traffic Counts (ATCs)

- 45 Manual Classified Counts (MCCs)

- 20 Journey time Surveys routes

8.4.3 The daily variation of traffic has been analysed at three long term ATC sites (one for each section of the A5WTC scheme):

- Site 663 on the existing A5 between New Buildings and Strabane (Section 1)

- Site 626 on the existing A5 immediately to the north of Derry Road roundabout and just to the north of Omagh (Section 2)

- Site 610 on the existing A5 south of Omagh (Section 3)

The selection of RSI time periods in relation to the two way average hourly total vehicle flow for these sites are shown in Figure 8-3.

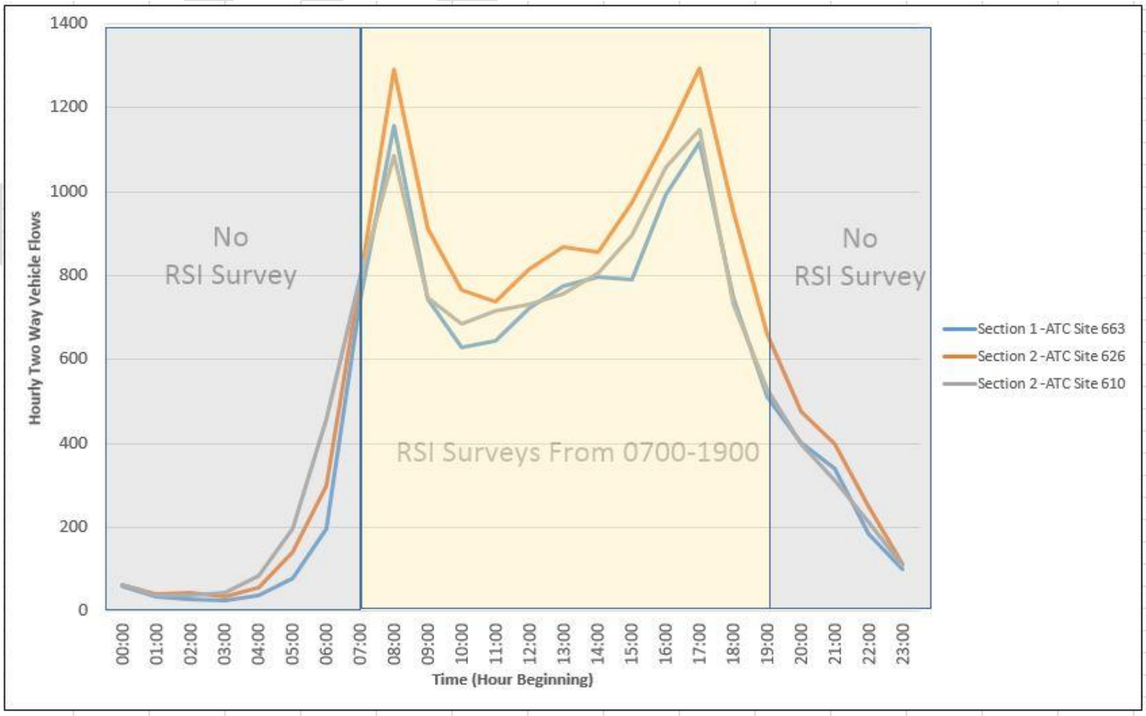


Figure 8-3 Daily flow profile on the existing A5 from Long Term ATC sites (Avg. Mon-Thurs in Oct 2013)

8.4.4 The locations of the RSI and ANPR surveys undertaken in 2014 together with the previous RSI locations are shown in Figure 8-4.

8.4.5 The RSI's were conducted in accordance with DMRB TA 11/09 – Traffic Surveys by Roadside Interview. At each RSI, ATCs were undertaken over 3-weeks and MCCs for 5 days in order to establish average traffic flows. Further details of the surveys is provided in the Traffic Data Collection Report (Report Ref. 718736-2700-R-007).

Data processing

8.4.6 A number of checks were undertaken on the trip record data from the RSI surveys to ensure accuracy and consistency.

8.4.7 These checks comprised:

- Logic Check - confirming that responses for various data fields fell within expected ranges.
- Trip End Check - both trip ends (origin and destination) for each record were converted from addresses / postcodes to Ordnance Survey Grid Reference (OSGRs). These were then plotted using GIS to confirm that each trip would logically pass through the survey location and in the correct direction.

Trip records which did not satisfy these checks were adjusted or eliminated from the expansion processes described below.

Expansion Process

8.4.8 Interview records were expanded to provide total trips and adjusted to represent an October 2013 base.

8.4.9 Expansion factors were derived for each interview based on the total count of traffic (for each vehicle type) through the site compared with the number interviewed. In order to expand each record accurately, trips were grouped based on vehicle type and the time of the journey.

8.4.10 Vehicle types used were:

- Cars and Taxis;
- Light Goods Vehicles (LGV);
- Other Goods Vehicles 1 (OGV-1) eg. Lorry 2 axles;
- Other Goods Vehicles (OGV-2) eg. Lorry 3+ axles.

8.4.11 The model time periods used for expansion were:

- AM period from 7:30am to 9:30am;
- Interpeak (IP) period from 9:30am to 4:00pm;
- PM period from 4:00pm to 6:00pm.

8.4.12 Interviews were undertaken in one direction. At each site ANPR software was used to match vehicles passing in the interview direction with their return journey in the non-interview direction. This provided a typical return time distribution in order to synthesise trips in the non-interview direction.

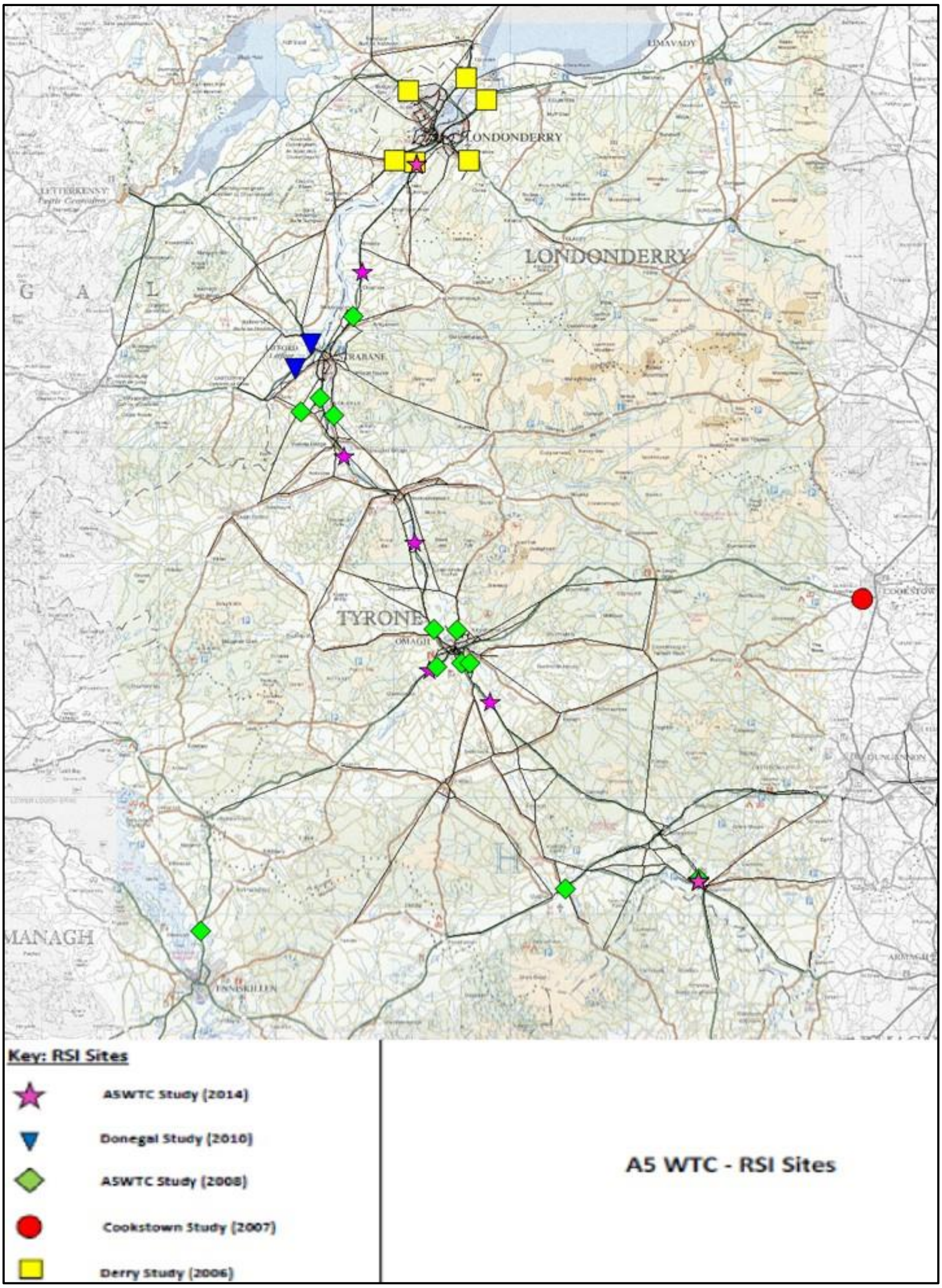


Figure 8-4 Location of RSI Surveys Used to Build Trip Matrices for A5WTC Traffic Model

8.5 Trip Matrix Development

8.5.1 As noted in Section 8.2 the original traffic model was developed from RSI data collected in 2008, together with data from other studies, collected prior to 2008. This included Origin and Destination (O/D) data at cordons located around Londonderry and Omagh.

8.5.2 An analysis of traffic count data for the period between 2008 and 2012/2013 was undertaken and this concluded that there had been little change in volumetric flows in the period. Further details of the analysis is provided in the Traffic Data Analysis Report (718736-2700-R-008). Based on this analysis, it was considered that the earlier 2008 base year trip data was valid and that the model recalibration should focus on updating movements on the strategic routes utilising the 2014 RSI data.

8.5.3 The 2014 RSI data from each site was combined taking account of multiple observations, i.e. through two or more RSIs. Where trips were observed in an interview and non-interview direction at different RSI sites, greater weight was placed on the data collected in the interview direction in order to maximise the confidence of observed data.

8.5.4 The 2014 RSI data set was augmented with the trip data from the 2008 base year model. Wherever observed trip data for 2014 was available this was used in preference to the 2008 data. Importantly, non-calibrated (prior) trip matrix data was used from 2008 i.e. before any matrix calibration using matrix estimation techniques had been applied. This ensured that the integrity of the previously observed trip data was retained.

8.5.5 This process resulted in a 2013 October base year prior matrix which was refined through a matrix calibration process.

8.6 Model Calibration

Calibration Process

8.6.1 Model calibration is the iterative process of reviewing and adjusting the model's network and/or trip matrices so that modelled traffic flows, speeds, junction delays and routeings through the network provide a reliable match to observed data.

8.6.2 Emphasis was placed on the development of the prior matrix and link and junction network representation. A standard process was applied referred to as matrix estimation which adjusts the prior matrix to produce final trip matrices for the base year assignments. The base year matrices formed the basis for producing future year forecast matrices.

8.7 Model Validation

Purpose of Validation

8.7.1 The test of a model's 'fitness for purpose' is carried out by examining the extent to which the model reproduces observed conditions. Validation of the A5WTC model was based on a comparison of observed and modelled traffic flow and journey times.

8.7.2 The traffic count data covering the study area provided a baseline against which to assess the model's performance.

8.7.3 The validation criteria and acceptability guideline for link flows and turning movements are defined in section 3.2.8 of TAG Unit M3.1 and is reproduced in Table 8-1 below:

Criteria	Acceptability Guideline
Assigned Hourly Flows	
Individual flows within 100vph (flows<700vph)	85% of all cases
Individual flows within 15% (flows 700-2700vph)	85% of all cases
Individual flows within 400vph (flows>2700vph)	85% of all cases
GEH statistic: individual flows GEH<5	85% of all cases

Table 8-1 Link and Turning Flow Validation Criteria Summary (TAG Unit M3.1)

8.7.4 The validation criteria and acceptability guideline at screenline level are defined in section 3.2.5 of TAG Unit M3.1 and is reproduced in Table 8-2 below:

Criteria	Acceptability Guideline
Differences between modelled flows and counts should be less than 5% of the counts	All or nearly all screenlines

Table 8-2 Screenline Level Flow Validation Criteria Summary (TAG Unit M3.1)

8.7.5 The validation criteria and acceptability guideline for journey time validation are defined in section 3.2.10 of TAG Unit M3.1 and is reproduced in Table 8-3 below:

Criteria	Acceptability Guideline
Modelled times along routes should be within 15% of surveyed times (or 1 minute, if higher than 15%)	> 85% of routes

Table 8-3 WebTAG Journey Time Validation Criteria Summary (TAG Unit M3.1)

Link Flow Comparison

8.7.6 Assigned model flows were compared with observed traffic counts and assessed against the WebTAG criteria.

8.7.7 The link flow comparison results are shown in Table 8-4.

Measure	Time Period		
	AM Peak	Interpeak	PM Peak
GEH < 5	90%	93%	88%
DMRB flow criteria	95%	97%	94%

Table 8-4 Validation Flow Comparison Summary

8.7.8 The results indicate a good comparison between observed and modelled flows.

Screenline Comparison

8.7.9 Screenlines typically comprise 5 or more links capturing traffic along a particular axis. For the A5WTC model 6 screenlines were defined on an east to west axis and were intended to capture traffic travelling in the north-south direction, which would potentially use the proposed A5 WTC, as shown in Figure 8-5. The percentage differences between modelled and observed flows across each of the screenlines is presented in Table 8-5.

Measure	Time Period		
	AM Peak	Interpeak	PM Peak
EW1NB	-5%	0%	-4%
EW1SB	1%	0%	-1%
EW2NB	1%	4%	-1%
EW2SB	4%	2%	-1%
EW3NB	-5%	3%	0%
EW3SB	-3%	2%	5%
EW4NB	-4%	6%	-3%
EW4SB	1%	3%	1%
EW5NB	-8%	-7%	-9%
EW5SB	2%	-4%	1%
EW6NB	-4%	-8%	-8%
EW6SB	-4%	-5%	-2%

Table 8-5 Screenline Comparison Summary

8.7.10 Overall, these show an acceptable comparison of model and observed flows across the screenlines. In general, the differences between modelled flows and counts are less than 5%. Instances where screenline differences exceed 5% are not considered critical since these screenlines have relatively low traffic flows.

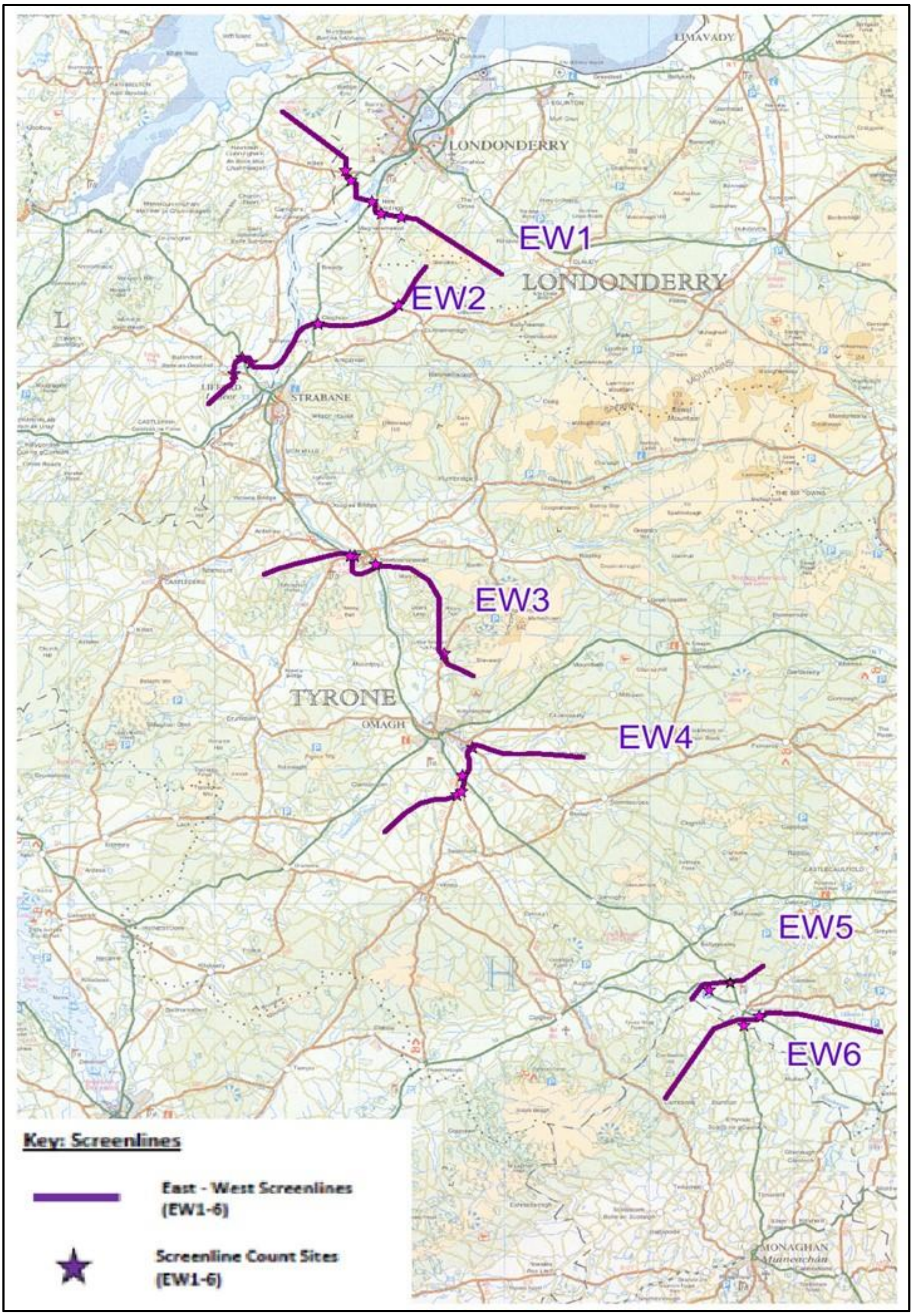


Figure 8-5 Location of East-West Screenlines

Journey Time Validation

8.7.11 Validation of journey times was carried out to determine how well model journey times compared to observed times.

8.7.12 The observed data was collected from journey time surveys undertaken during April 2014 using the moving observer method. The surveys utilised a number of survey vehicles to undertake a series of journeys along each journey time section in both directions during all model time periods.

8.7.13 The use of Global Positioning System (GPS) loggers provided a facility to interrogate this data. These were conducted in accordance with the advice given in DMRB to ensure adequate sampling.

8.7.14 The existing A5 within the model area was split into 10 sections and surveyed in both directions providing 20 separate but consecutive journey time routes. The journey time routes are shown in Figure 8-6, and are identical to those surveyed in 2008.

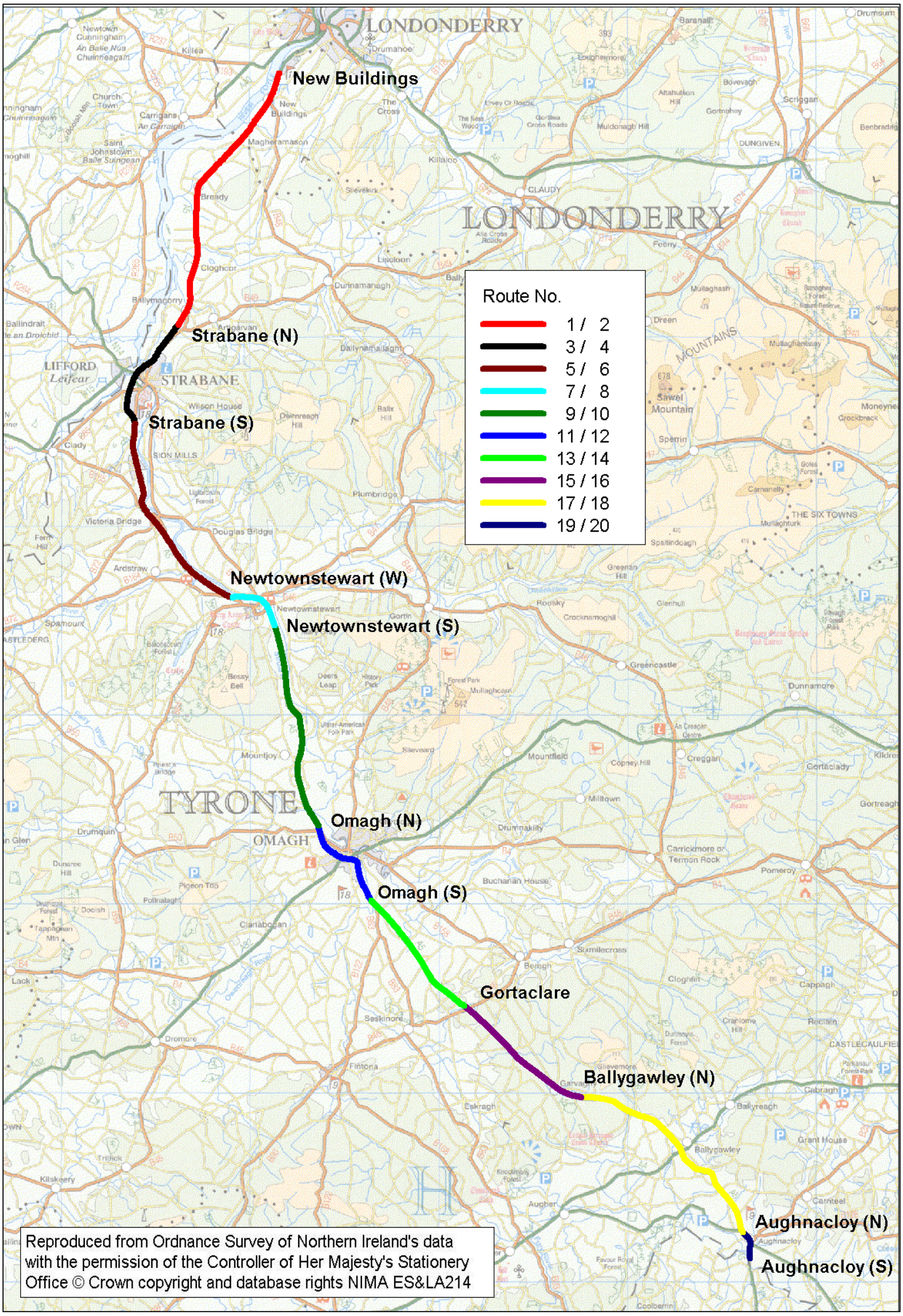


Figure 8-6 Journey Time Routes Used for A5WTC Traffic Model Validation

8.7.15 Table 8-6 shows the results of the validation of the modelled journey times for the morning peak hour, interpeak and evening peak hours.

Journey Time Validation	% of routes within 15% or 1 min
AM	**100%**
IP	**90%**
PM	**90%**

Table 8-6 A5 WTC Journey Time Validation

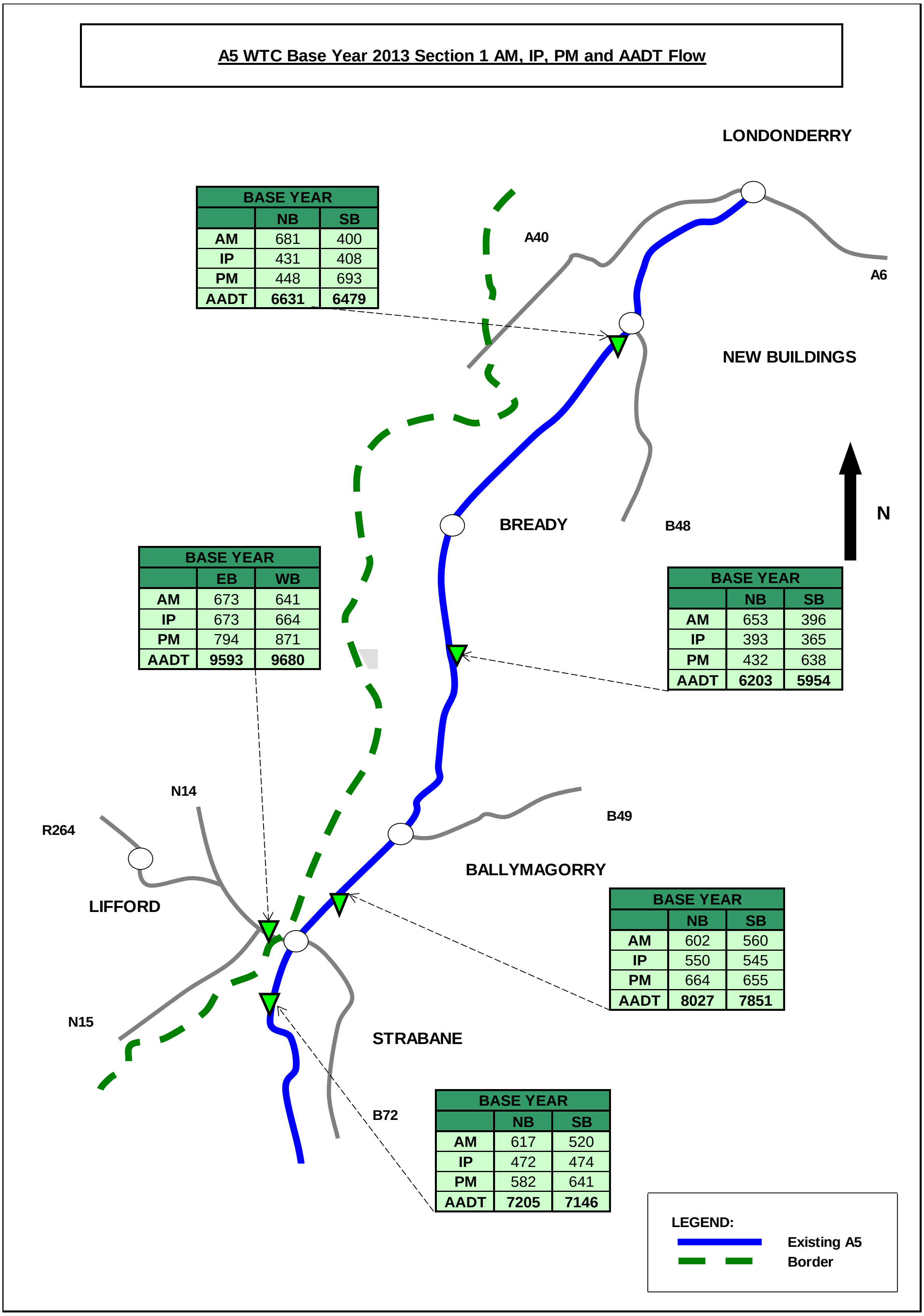
8.7.16 It can be seen that across all time periods, the number of modelled journey time routes that are within 15% of the observed average value (or 1 minute if greater than 15%) exceeds 85% and therefore meets the WebTAG criteria.

8.8 Base Year Flows

8.8.1 Base year traffic flows are presented in Figure 8-7 to Figure8-9 for Section 1, 2, and 3 of the A5 corridor respectively.

8.8.2 Average hour 2-way flows are shown for the AM, Inter, and PM peak periods as vehicles per average hour (vph). Average Annual Daily Traffic (AADT) is shown as vehicles per day (vpd).

8.8.3 As a general observation, hourly traffic flows are highest during the PM peak period. The highest daily flows (AADT) occur along urban sections of the existing A5 within the vicinity of Omagh (20,700 vpd) and Strabane (15,900 vpd). The lowest daily flows occur at the southern end of the study area just north of Aughnacloy (7,120 vpd).



BASE YEAR	NB	SB
AM	681	400
IP	431	408
PM	448	693
AADT	6631	6479

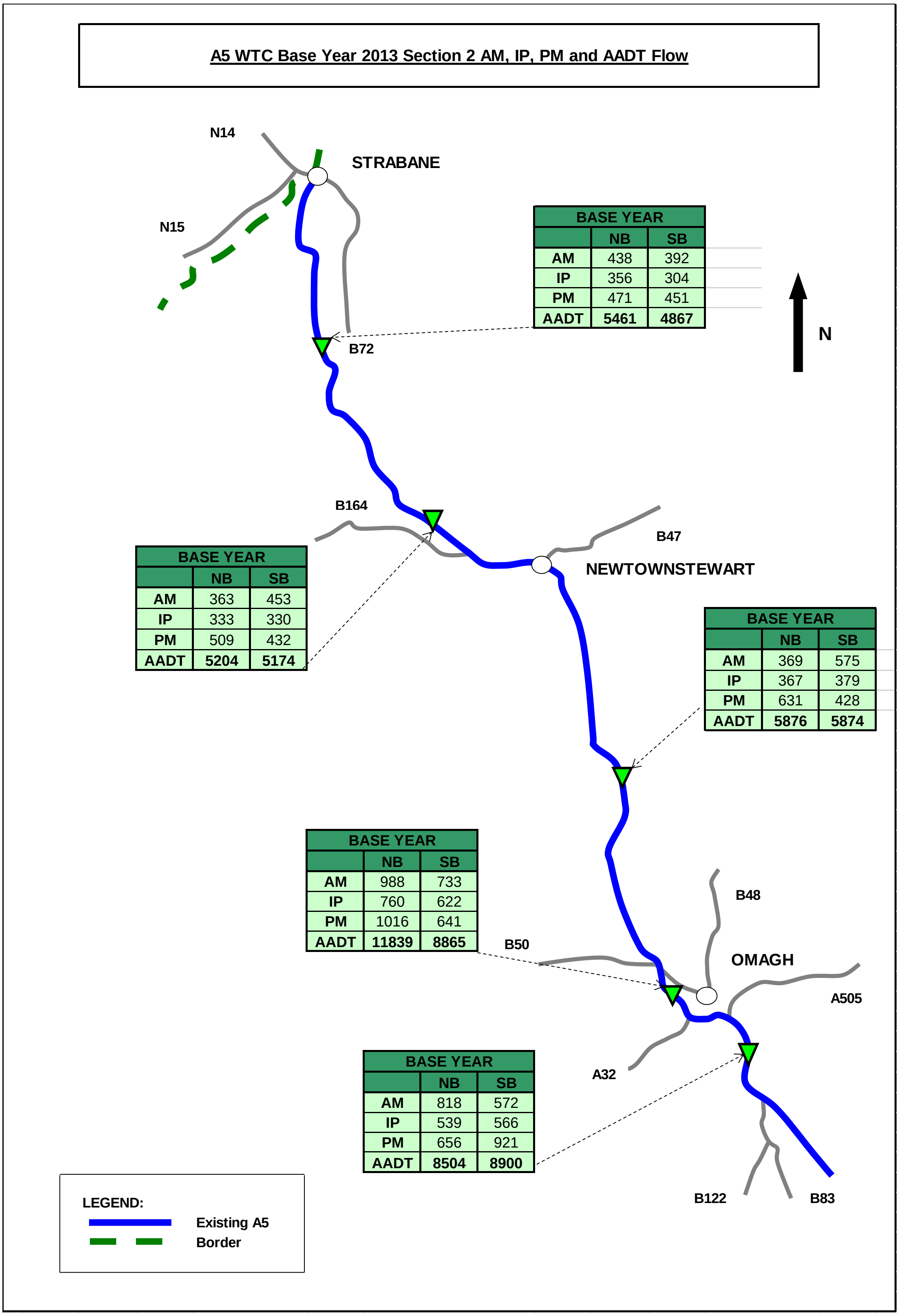
BASE YEAR	EB	WB
AM	673	641
IP	673	664
PM	794	871
AADT	9593	9680

BASE YEAR	NB	SB
AM	653	396
IP	393	365
PM	432	638
AADT	6203	5954

BASE YEAR	NB	SB
AM	602	560
IP	550	545
PM	664	655
AADT	8027	7851

BASE YEAR	NB	SB
AM	617	520
IP	472	474
PM	582	641
AADT	7205	7146

Figure 8-7 Base Year (2013) Modelled Traffic Flows (Vehicles) - Section 1



BASE YEAR	NB	SB
AM	438	392
IP	356	304
PM	471	451
AADT	5461	4867

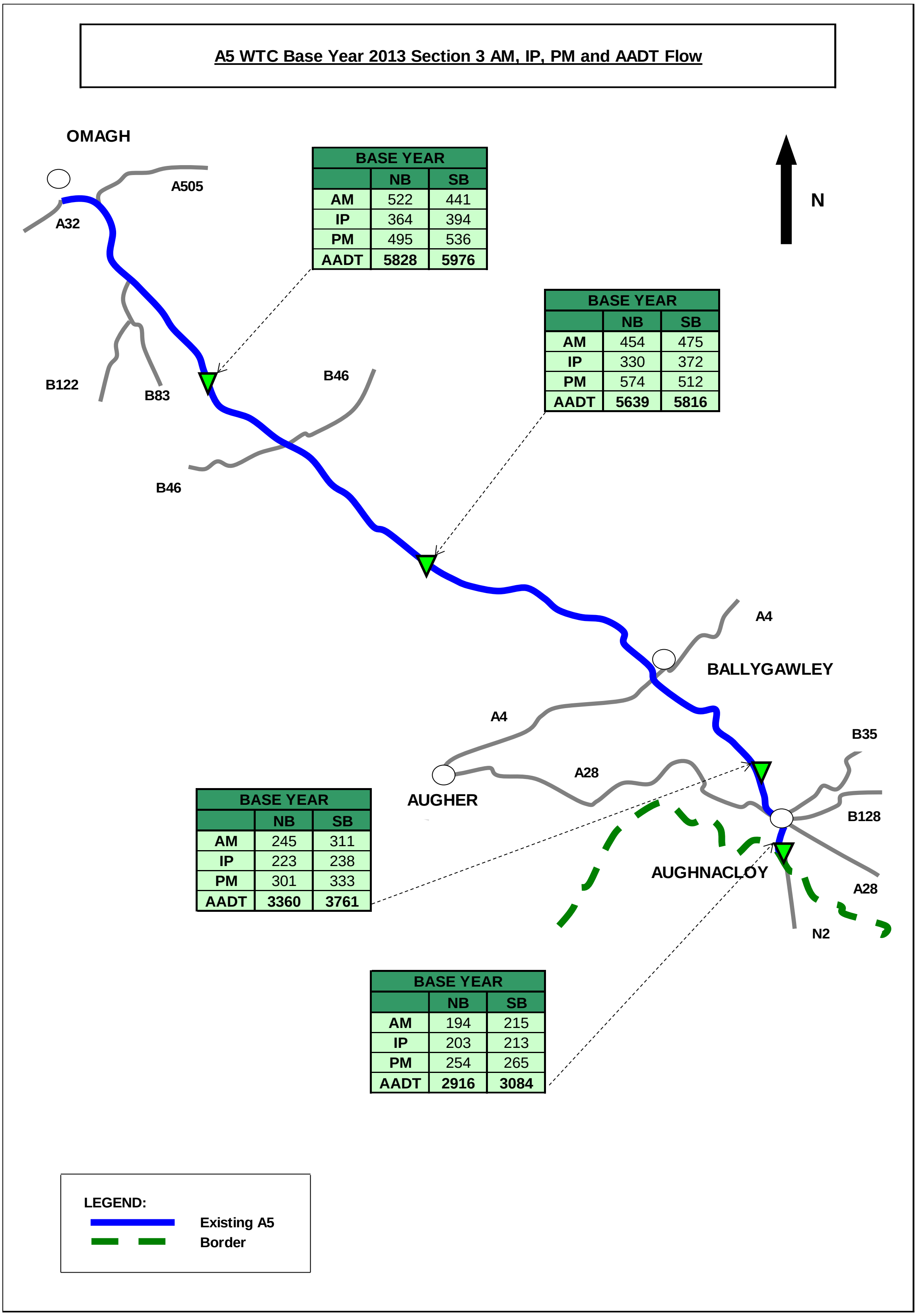
BASE YEAR	NB	SB
AM	363	453
IP	333	330
PM	509	432
AADT	5204	5174

BASE YEAR	NB	SB
AM	369	575
IP	367	379
PM	631	428
AADT	5876	5874

BASE YEAR	NB	SB
AM	988	733
IP	760	622
PM	1016	641
AADT	11839	8865

BASE YEAR	NB	SB
AM	818	572
IP	539	566
PM	656	921
AADT	8504	8900

Figure 8-8 Base Year (2013) Modelled Traffic Flows (Vehicles) - Section 2



BASE YEAR	NB	SB
AM	522	441
IP	364	394
PM	495	536
AADT	5828	5976

BASE YEAR	NB	SB
AM	454	475
IP	330	372
PM	574	512
AADT	5639	5816

BASE YEAR	NB	SB
AM	245	311
IP	223	238
PM	301	333
AADT	3360	3761

BASE YEAR	NB	SB
AM	194	215
IP	203	213
PM	254	265
AADT	2916	3084

Figure 8-9 Base Year (2013) Modelled Traffic Flows (Vehicles) - Section 3

8.9 Traffic Forecasts

Introduction

8.9.1 Traffic forecasts are required for economic, environmental and operational appraisal of the Proposed Scheme. Forecasts were produced for the whole scheme programmed opening year (2028) and the design year (2041). This section sets out the methodology for determining forecast growth factors and then presents the results of the forecast traffic assignments.

Methodology for Determining Growth Forecasts

8.9.2 The forecasts were produced by applying the methodology adopted by the Department for Transport (DfT) for scheme appraisal in Great Britain. This process uses the TEMPRO computer model, developed by the DfT for predicting the growth in travel demand.

8.9.3 Since TEMPRO does not cover Northern Ireland, a bespoke version of TEMPRO for Northern Ireland was developed to provide traffic growth forecasts for the A5WTC project. This tool is referred to as TEMPRO-NI.

8.9.4 The methodology used for developing TEMPRO-NI was similar to that used for the GB version of TEMPRO which is based on the current version of NTEM 6.2 (National Trip End Model). The process requires demographic inputs such as potential growth in housing, population and employment from the present time (model base date) to the forecast years. These factors are used to define future car ownership and usage and hence the potential growth in traffic between model zones.

8.9.5 Trip-ends from TEMPRO-NI have been produced and can be used for determining growth factors with respect to any year for forecasting purposes.

8.9.6 Growth factors for private vehicle trips were derived for each zone by time period (AM, Inter and PM average peak hours), and purpose (Commute, Employers Business & Other) using the TEMPRO zone trip-end totals.

8.9.7 Interpolation of trip ends was done for the relevant intermediate years up to 2031, which is the maximum forecast year within the bespoke TEMPRO NI version. Growth factors between 2031 and 2041 have been applied from TEMPRO GB.

8.9.8 An adjustment was applied to take account of the expected future changes in fuel price and income, both which are considered to have an overall impact on future highway demand flows.

8.9.9 Forecasts for LGV and HGV were derived in accordance with DfT WebTAG guidance (TAG Unit M4). This TAG unit applies to forecasts for Great Britain and to adjust them to Northern Ireland conditions the following adjustment factor has been used:

$$\frac{\text{TEMPRO NI car driver trip-end growth}}{\text{TEMPRO GB car driver trip-ends growth}}$$

8.9.10 The trip-end growth forecasts provided by TEMPRO-NI were used to factor the base year trip matrices using growth factors for each time period, trip purpose, and vehicle type. An iterative *furness* process was applied to alternately factor row and column totals to match the target trip end totals. An adjustment factor was applied to make the target row and column totals equal to ensure the *furness* process would converge.

8.9.11 Table 8-7 presents matrix totals from the A5WTC model. It shows the total number of trips, passenger car units, (PCUs) broken down by purpose, mode, time period and year.

Year	Trips (PCU)					
	Commute	Business	Others	LGV	HGV	Total
2013 AM	12343	3505	7300	3470	2043	28661
2028 AM	14804	4317	9388	4957	2246	35712
2041 AM	16566	4843	10526	6183	2507	40624
2013 IP	2715	3963	14931	3078	2592	27279
2028 IP	3636	4947	19511	4467	2851	35412
2041 IP	4029	5550	22006	5554	3182	40321
2013 PM	10863	4534	13992	3792	2621	35800
2028 PM	13052	5639	17863	5472	2889	44915
2041 PM	14553	6326	20072	6813	3225	50989

Table 8-7 Matrix totals for base and forecast years

8.9.12 Table 8-8 presents the growth in trips in terms of the percentage increases for matrix trip totals between the model base year, 2013, and the future years 2028 and 2041 for the three time periods, AM, IP and PM. It presents the growth both as a total increase from the base year, and then as an annual compound growth rate.

Period During Day	2013-2028	2013-2041
AM trips % increase	24.6%	41.7%
IP trips % increase	29.8%	47.8%
PM trips % increase	25.5%	42.4%
AM trips avg. annual % growth	1.5%	1.3%
IP trips avg. annual % growth	1.8%	1.4%
PM trips avg. annual % growth	1.5%	1.3%

Table 8-8 Growth in trips (% increase)

8.9.13 Table 8-8 shows that the AM and PM trip growth is higher in the early period between 2013 and 2028 at about 1.5% per annum, than over the period 2013 to 2041 when it is lower at about 1.3% per annum. The growth in the IP is slightly higher than predicted growth for the AM and PM peak periods.

8.10 Forecast Traffic Flows

Do-Minimum

8.10.1 The following committed schemes (from 2013 onwards) were included in both the 2028 and 2041 Do-Minimum forecast networks:

- Strathroy Link - New junctions along B48 and Strathroy Rd and new link between these junctions
- A31 Magherafelt Bypass - Additional junctions and links to southeast of Magherafelt
- Three Rivers Development at Strabane - New roundabout junction along the A38 and link connecting this junction with the development zone.

8.10.2 The Three Rivers Development is an outline planning application for a major mixed use development with associated car parking and landscaping on land which is currently vacant off Lifford Road, Strabane.

Do-Something Network

8.10.3 The Do-Something network includes the schemes listed above for the Do-Minimum, together with the N14/N15 to A5 WTC Link (south of Strabane).

Do-Minimum Traffic Flows

8.10.4 Traffic flows for both the Do Minimum and Do Something scenarios are shown in Figure 8-10 to Figure 8-12.

8.10.5 In the Do Minimum, the highest AADT flow is predicted to occur along urban sections of the existing A5 in the vicinity of Omagh. This is predicted as 30,350 vpd in 2028 and 33,360 vpd in 2041 on the existing A5 Through-pass just north of the junction with the A32.

8.10.6 Just north of Strabane, the highest flows are 22,100 vpd in 2028 and 23,950 vpd in 2041.

8.10.7 These locations match the locations of highest flows in the 2013 base year of 20,700 vpd at Omagh and 15,900 vpd at Strabane.

8.10.8 Figure 8-10 also shows that the existing A38 Lifford Bridge will carry flows of 25,950 vpd in 2028 and 28,550 in 2030.

8.10.9 The traffic increases in Omagh represent an increase of 47% between 2013 and 2028 and 61% between 2013 and 2041. The traffic increases at Strabane represent an increase of 42% for between 2013 and 2028 and 46% between 2013 and 2041.

8.10.10 Lowest AADT flows are predicted at the southern end of Section 3 just north of Aughnacloy (Figure 8-12), comprising 9,160 vpd and 10,600 vpd for 2028 and 2041 respectively. These represent increases of 29% and 49% from 2013 to 2028 and 2013 to 2041 respectively.

Do-Something Traffic Flows

8.10.11 The highest AADT flows are predicted to occur on the Proposed Scheme south of Strabane, with 25,500 vpd in 2028 increasing by 20% to 30,500 vpd in 2041.

8.10.12 The lowest AADT flows are predicted to occur on the Proposed Scheme just north of Aughnacloy with 6,700 vpd in 2028 increasing by 16% to 7,800 vpd in 2041.

Traffic Relief

8.10.13 The traffic forecasts show that the Proposed Scheme will substantially relieve traffic flows on the existing network.

8.10.14 Table 8-9 summarises the predicted traffic relief along the existing A5 in 2041 as a consequence of constructing the Proposed Scheme. The relief is quoted at a number of locations for the three sections of the existing A5 to show the changes in traffic at key locations.

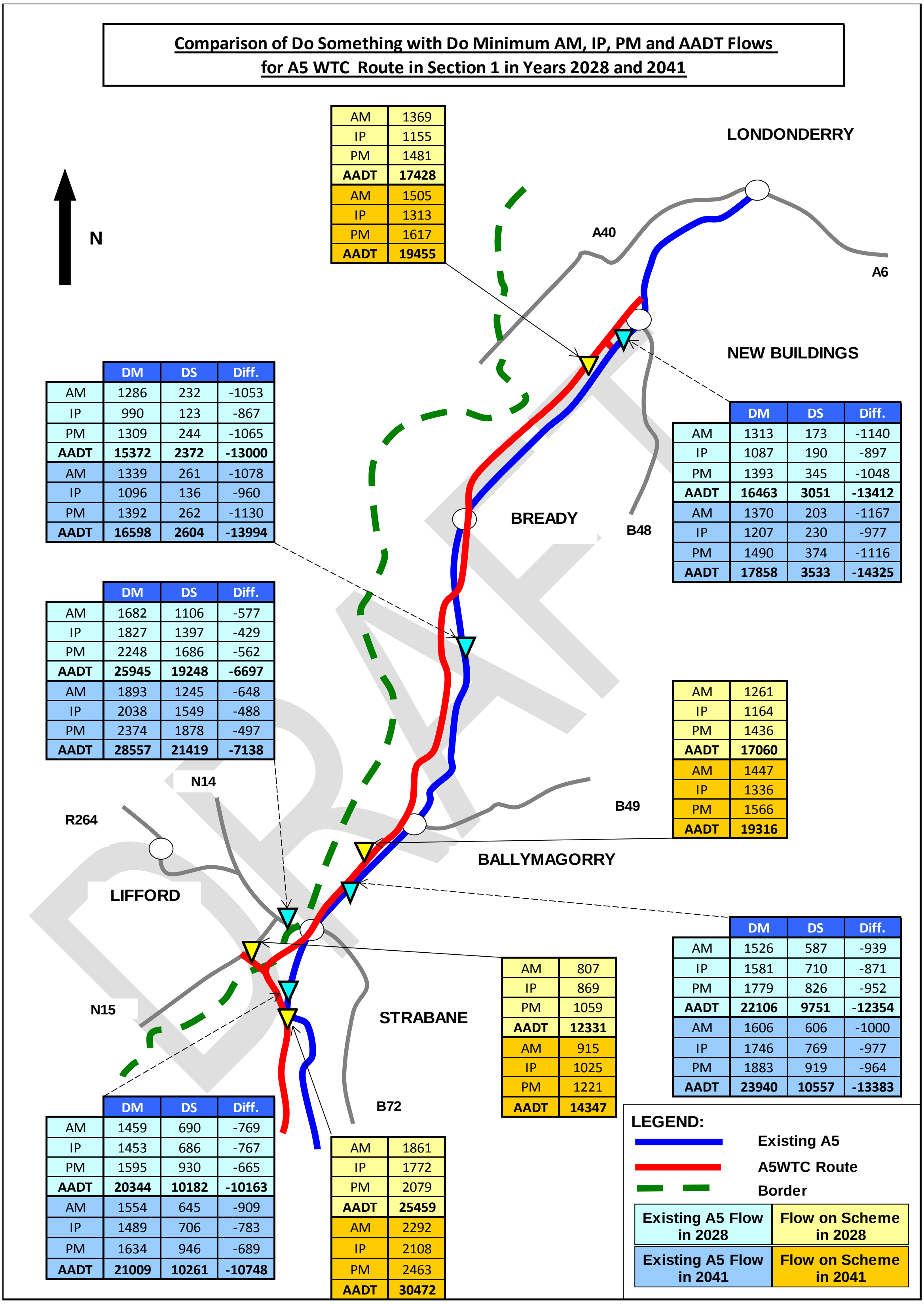
8.10.15 The extent of relief varies between approximately 20% and 90%. The proportional relief is highest for inter-urban sections between the major centres. There would also be some relief to other parallel roads. Overall there is significant traffic relief along all sections of the existing A5.

A5 Section	Description		Predicted Relief
Section 1	1	Just south of New Buildings	80%
	2	Between Bready and Ballymagorry	84%
	3	Between Ballymagorry and Strabane	56%
	4	Strabane Bypass, South of Urney Road Jct.	51%
Section 2	5	Between Strabane and Sion Mills	78%
	6	Between Victoria Bridge and Newtownstewart	78%
	7	Between Newtownstewart and Omagh	62%
	8	Omagh, between B50 and A32	19%
	9	Omagh, south of town boundary	38%

A5 Section	Description		Predicted Relief
Section 3	1	Between Omagh and B46	74%
	1	Between B46 and the A4	87%
	1	Aughnacloy north of A28 (west)	29%
	1	Between Aughnacloy and Moy Bridge*	99%

Table 8-9 Scheme Relief Comments by Section

* This section of road provides local access and is relieved by the proposed A5.



AM	1369
IP	1155
PM	1481
AADT	**17428**
AM	1505
IP	1313
PM	1617
AADT	**19455**

	DM	DS	Diff.
AM	1313	173	-1140
IP	1087	190	-897
PM	1393	345	-1048
AADT	**16463**	**3051**	**-13412**
AM	1370	203	-1167
IP	1207	230	-977
PM	1490	374	-1116
AADT	**17858**	**3533**	**-14325**

	DM	DS	Diff.
AM	1286	232	-1053
IP	990	123	-867
PM	1309	244	-1065
AADT	**15372**	**2372**	**-13000**
AM	1339	261	-1078
IP	1096	136	-960
PM	1392	262	-1130
AADT	**16598**	**2604**	**-13994**

	DM	DS	Diff.
AM	1682	1106	-577
IP	1827	1397	-429
PM	2248	1686	-562
AADT	**25945**	**19248**	**-6697**
AM	1893	1245	-648
IP	2038	1549	-488
PM	2374	1878	-497
AADT	**28557**	**21419**	**-7138**

AM	1261
IP	1164
PM	1436
AADT	**17060**
AM	1447
IP	1336
PM	1566
AADT	**19316**

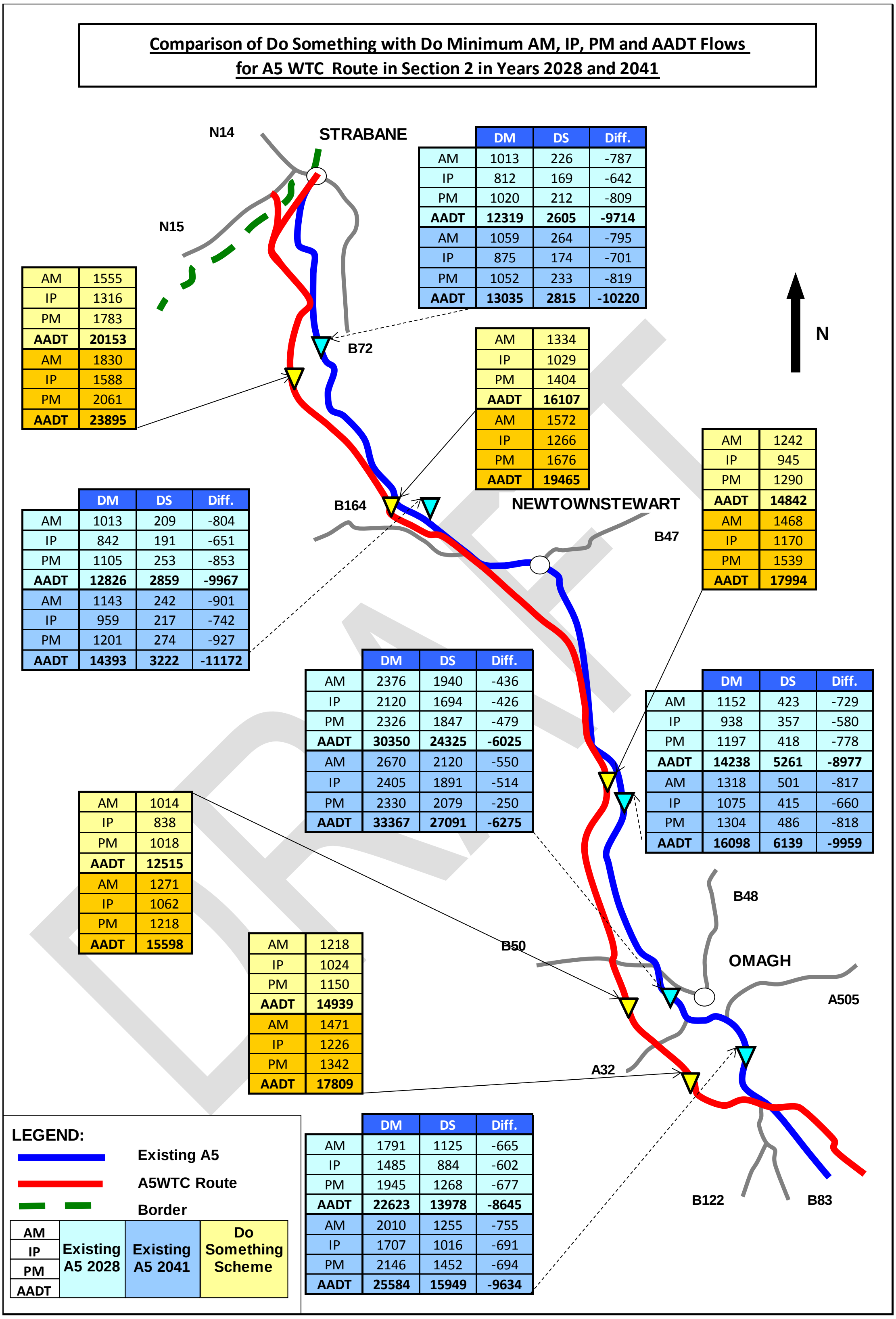
	DM	DS	Diff.
AM	1526	587	-939
IP	1581	710	-871
PM	1779	826	-952
AADT	**22106**	**9751**	**-12354**
AM	1606	606	-1000
IP	1746	769	-977
PM	1883	919	-964
AADT	**23940**	**10557**	**-13383**

AM	807
IP	869
PM	1059
AADT	**12331**
AM	915
IP	1025
PM	1221
AADT	**14347**

	DM	DS	Diff.
AM	1459	690	-769
IP	1453	686	-767
PM	1595	930	-665
AADT	**20344**	**10182**	**-10163**
AM	1554	645	-909
IP	1489	706	-783
PM	1634	946	-689
AADT	**21009**	**10261**	**-10748**

AM	1861
IP	1772
PM	2079
AADT	**25459**
AM	2292
IP	2108
PM	2463
AADT	**30472**

Figure 8-10 Forecast Year Modelled Traffic Flows (Vehicles) - Section 1



	DM	DS	Diff.
AM	1013	226	-787
IP	812	169	-642
PM	1020	212	-809
AADT	12319	2605	-9714
AM	1059	264	-795
IP	875	174	-701
PM	1052	233	-819
AADT	13035	2815	-10220

AM	1555
IP	1316
PM	1783
AADT	20153
AM	1830
IP	1588
PM	2061
AADT	23895

AM	1334
IP	1029
PM	1404
AADT	16107
AM	1572
IP	1266
PM	1676
AADT	19465

AM	1242
IP	945
PM	1290
AADT	14842
AM	1468
IP	1170
PM	1539
AADT	17994

	DM	DS	Diff.
AM	1013	209	-804
IP	842	191	-651
PM	1105	253	-853
AADT	12826	2859	-9967
AM	1143	242	-901
IP	959	217	-742
PM	1201	274	-927
AADT	14393	3222	-11172

	DM	DS	Diff.
AM	2376	1940	-436
IP	2120	1694	-426
PM	2326	1847	-479
AADT	30350	24325	-6025
AM	2670	2120	-550
IP	2405	1891	-514
PM	2330	2079	-250
AADT	33367	27091	-6275

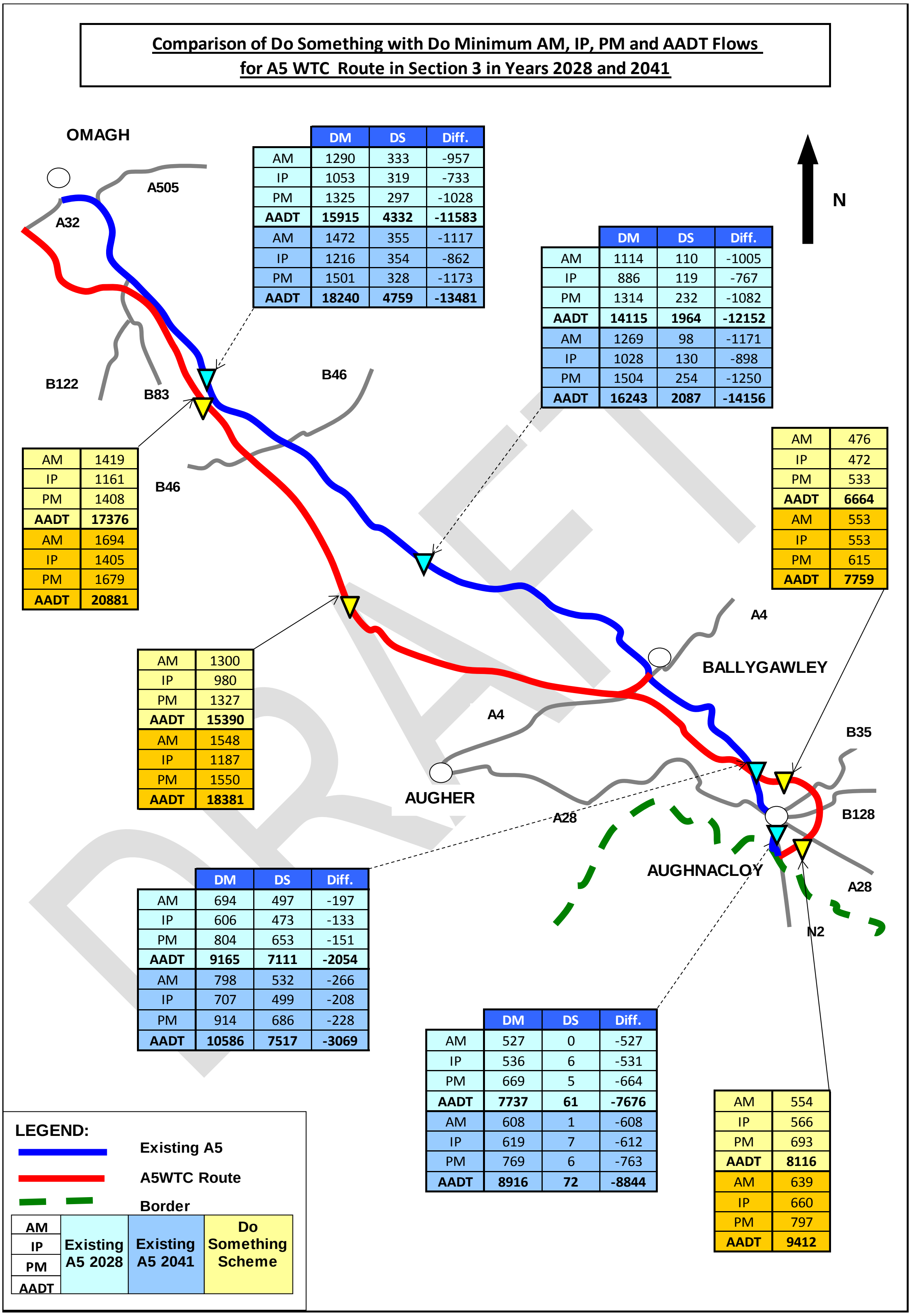
	DM	DS	Diff.
AM	1152	423	-729
IP	938	357	-580
PM	1197	418	-778
AADT	14238	5261	-8977
AM	1318	501	-817
IP	1075	415	-660
PM	1304	486	-818
AADT	16098	6139	-9959

AM	1014
IP	838
PM	1018
AADT	12515
AM	1271
IP	1062
PM	1218
AADT	15598

AM	1218
IP	1024
PM	1150
AADT	14939
AM	1471
IP	1226
PM	1342
AADT	17809

	DM	DS	Diff.
AM	1791	1125	-665
IP	1485	884	-602
PM	1945	1268	-677
AADT	22623	13978	-8645
AM	2010	1255	-755
IP	1707	1016	-691
PM	2146	1452	-694
AADT	25584	15949	-9634

Figure 8-11 Forecast Year Modelled Traffic Flows (Vehicles) - Section 2



	DM	DS	Diff.
AM	1290	333	-957
IP	1053	319	-733
PM	1325	297	-1028
AADT	15915	4332	-11583
AM	1472	355	-1117
IP	1216	354	-862
PM	1501	328	-1173
AADT	18240	4759	-13481

	DM	DS	Diff.
AM	1114	110	-1005
IP	886	119	-767
PM	1314	232	-1082
AADT	14115	1964	-12152
AM	1269	98	-1171
IP	1028	130	-898
PM	1504	254	-1250
AADT	16243	2087	-14156

AM	1419
IP	1161
PM	1408
AADT	17376
AM	1694
IP	1405
PM	1679
AADT	20881

AM	476
IP	472
PM	533
AADT	6664
AM	553
IP	553
PM	615
AADT	7759

AM	1300
IP	980
PM	1327
AADT	15390
AM	1548
IP	1187
PM	1550
AADT	18381

	DM	DS	Diff.
AM	694	497	-197
IP	606	473	-133
PM	804	653	-151
AADT	9165	7111	-2054
AM	798	532	-266
IP	707	499	-208
PM	914	686	-228
AADT	10586	7517	-3069

	DM	DS	Diff.
AM	527	0	-527
IP	536	6	-531
PM	669	5	-664
AADT	7737	61	-7676
AM	608	1	-608
IP	619	7	-612
PM	769	6	-763
AADT	8916	72	-8844

AM	554
IP	566
PM	693
AADT	8116
AM	639
IP	660
PM	797
AADT	9412

AM IP PM AADT	Existing A5 2028	Existing A5 2041	Do Something Scheme

Figure 8-12 Forecast Year Modelled Traffic Flows (Vehicles) - Section 3

Journey Times

8.10.16 Average end to end journey times were extracted for the base year (2013) and for the Do-Minimum and Do-Something scenarios in 2028 and 2041. Table 8-10 shows the average 2-way model journey times for the whole length of the Proposed Scheme (from New Buildings to south of Aughnacloy) for each scenario.

Time Period	Modelled Journey Time (minutes)				
	Base Year	Do Minimum		Do Something	
	2013	2028	2041	2028	2041
AM	70.6	74.4	76.8	51.6	51.7
IP	69.0	72.2	74.2	51.5	51.6
PM	71.8	76.8	80.4	51.7	51.9

Table 8-10 Model Journey Times for the Proposed Scheme (Average 2-way)

8.10.17 Table 8-11 shows the modelled differences in journey time between New Buildings and south of Aughnacloy for the Do Minimum (using existing A5) and Do Something (comparing existing with the new route).

Time Period	Modelled Journey Time Differences (minutes)			
	Do-Minimum - Base Year		Do-Something - Do-Minimum	
	2013 to 2028	2013 to 2041	2013 to 2028	2013 to 2041
AM	+3.8	+6.2	-22.8	-25.1
IP	+3.2	+5.2	-20.7	-22.6
PM	+5.0	+8.6	-25.1	-28.5

Table 8-11 Model Journey Time Difference for the Proposed Scheme (Average 2-way)

+ = increase in journey time; - = saving in journey time.

8.10.18 Table 8-11 shows that without any intervention, (other than the committed schemes included in the Do-Minimum scenario), journey times would continue to worsen in the future. The model predicts that for the AM and PM peak periods, this increase would be in the order of 3 to 5 minutes from 2013 to 2028, and 5 to 8 minutes from 2013 to 2041.

8.10.19 With the proposed A5WTC scheme, journey time would reduce significantly compared to the Do-Minimum scenario. Over the entire length of the scheme journey time saving compared with the Do-minimum are predicted to be in the order of 20 to 25 minutes at 2028 and 22 to 29 minutes at 2041.

8.11 Junction Capacity Assessments

8.11.1 This section presents the results of the capacity assessments for the 17 proposed junctions along the A5 WTC Scheme. The locations of the junctions are shown on Figures 8-12, 8-13 and 8-14.

- Figure 8-13 shows the 8 junctions along Section 1 of the A5WTC from New Buildings to South of Strabane.
- Figure 8-14 shows the 4 junctions along Section 2 of the A5WTC from South of Strabane to South of Omagh.
- Figure 8-15 shows the 5 junctions along Section 3 of the A5WTC from South of Omagh to Aughnacloy.

8.11.2 The capacity assessments are based on forecast traffic flows extracted from the traffic model for the AM and PM peak hours for the design year.

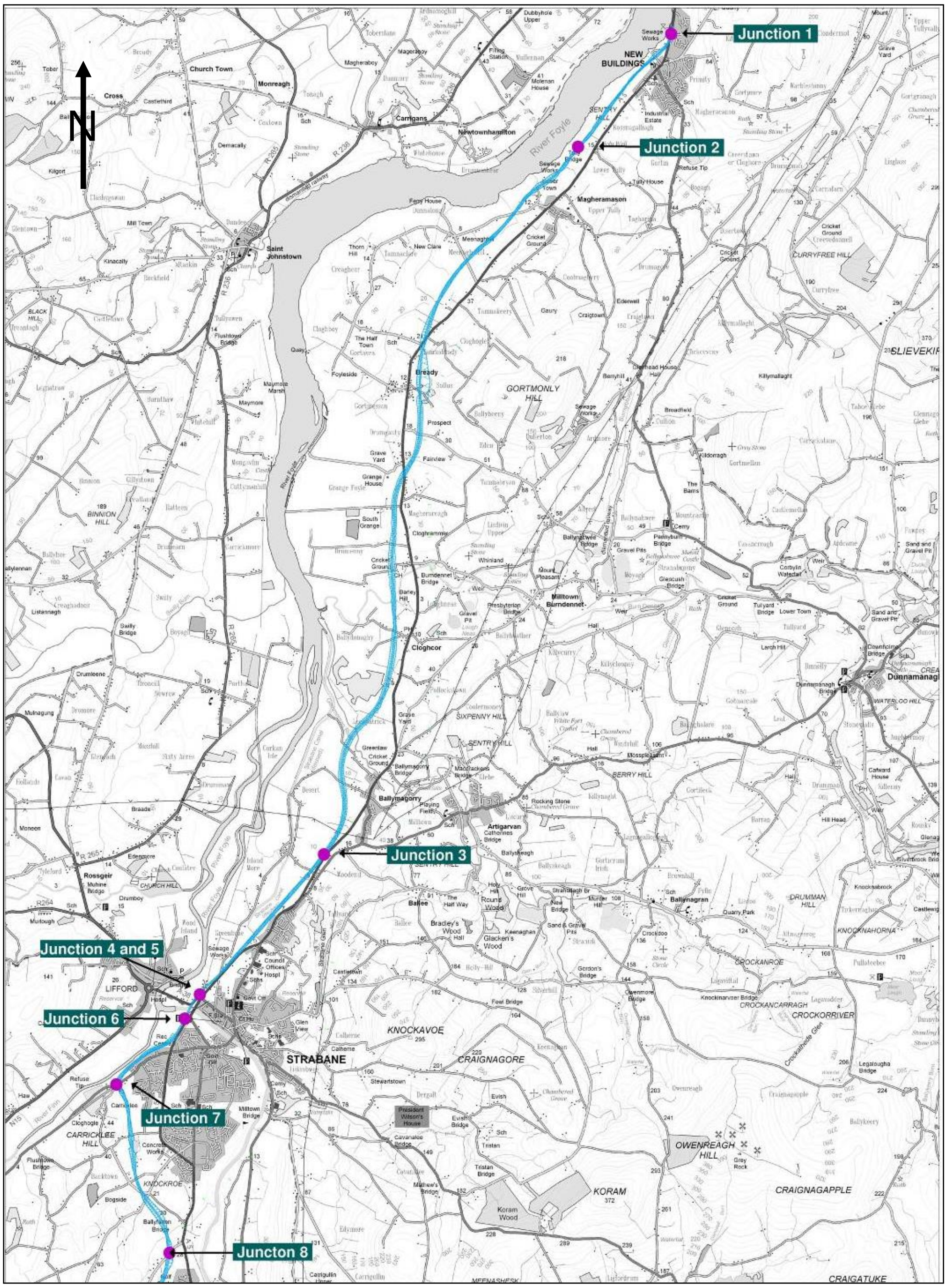


Figure 8-13 Section 1 - Junctions 1 to 8

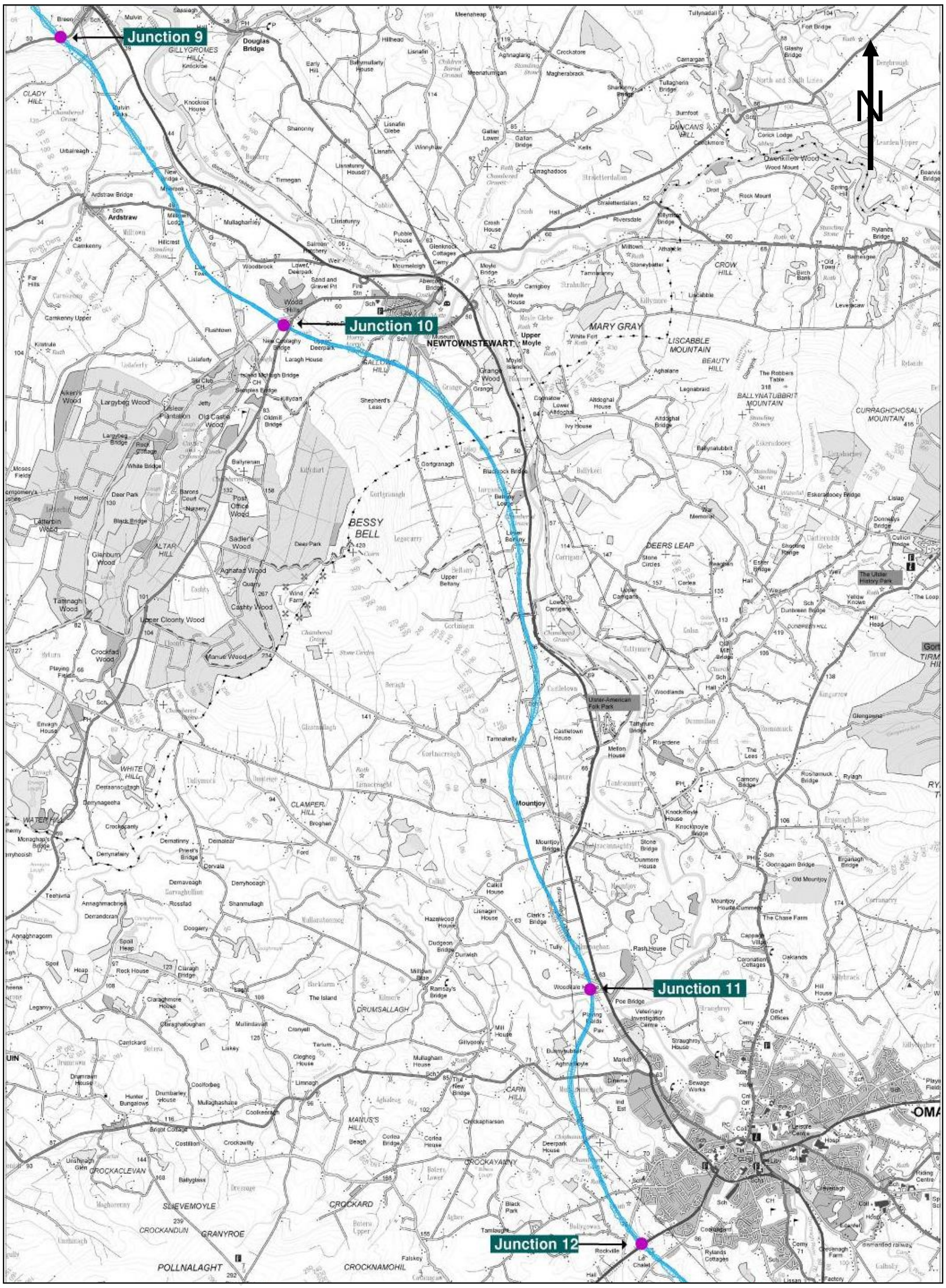


Figure 8-14 Section 2 - Junctions 9 to 12

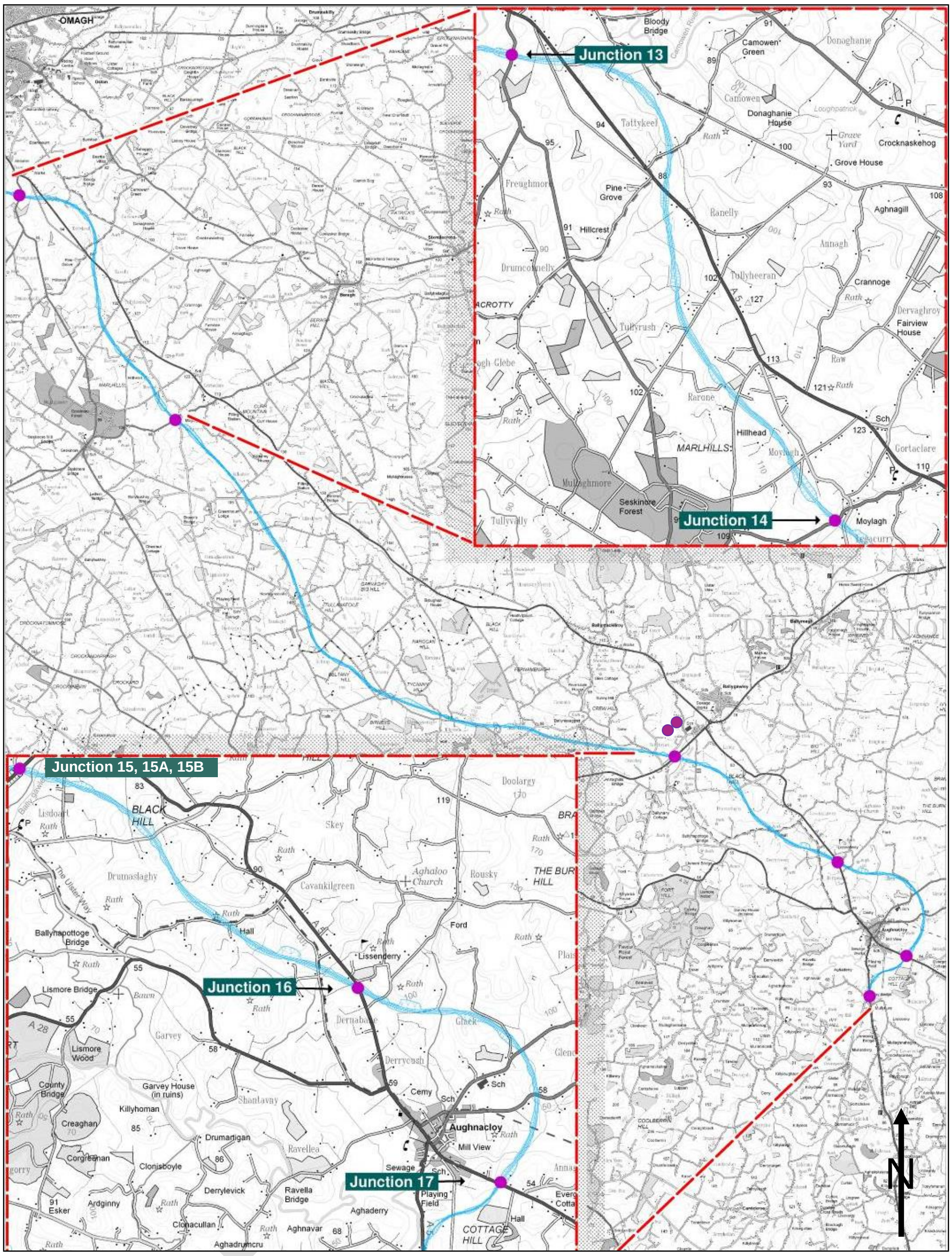


Figure 8-15 Section 3 - Junctions 13 to 17

Method for Assessing Junction Capacity

8.11.3 The junction capacity assessments are based on forecast traffic flows and proposed junction layouts.

8.11.4 The performance of each junction was assessed by determining the ratio of demand flow to capacity for each junction approach arm. Junction capacities were determined using standard formulae developed by 'Transport and Road Research Laboratory' (TRRL) and set out in the DMRB. Industry standard software was used to carry out these calculations, ARCADY for roundabouts and PICADY for major/minor junctions.

8.11.5 The ARCADY and PICADY programs provide as output, a Reference Flow/Capacity ratio (RFC) for the approach arms. The overall junction capacity is governed by the highest RFC for the approach arms. For design purposes, DMRB advises a threshold ratio of 85%, although a higher ratio may be acceptable where there are cost or environmental implications in providing higher capacity, for instance in urban areas.

8.11.6 For priority 'T junctions', DMRB also states that an appraisal for design should be based on ratios of flow to capacity of 85% in urban cases, however, in rural areas a ratio of 75% should be considered.

8.11.7 With an RFC of 85% there will be only nominal queueing at the junction, with an RFC of 75% there would be virtually no right turn queues and delays on the minor road, which is what would be expected in a rural environment. However the practical reserve capacity for both roundabouts and 'T junctions' would still be 85%.

8.11.8 The RFC is not the sole criterion when deciding on a junction layout. Other relevant factors must also be considered. The following sections describe the assessments in more detail.

Design Year and Traffic Flows

8.11.9 Traffic turning movements at each junction have been extracted from the traffic model assignment runs for the design year. Flows have been extracted from the SATURN model for the AM and PM average 2-hour periods. All flows were extracted as passenger car units (PCUs) per hour which can then be used within ARCADY and PICADY. In inputting the flows as PCUs it is t not necessary to specify the proportion of heavy goods vehicles for each junction.

8.11.10 A factor was used to adjust the model average hour flow to provide the AM and PM peak hour flow. The peak profile within the 1 hour period was determined using ARCADY/PICADY default profile factors.

8.11.11 Table 8.12 below shows the results of the highest predicted RFC for the AM and PM peak hours for each junction. Further details for each junction are included in Appendix 8

			Junction Modelling - Highest RFC in the Design Year			
Junction Ref	Junction Type	Junction	AM		PM	
			RFC	Arm with Highest RFC	RFC	Arm with Highest RFC
1	**Roundabout**	A5 WTC / A5 Victoria Road	69.9%	A5 WTC	84.8%	A5 N
2.1	**Roundabout**	A5 WTC	45.2%	DA5 S	13.5%	Link Road
2.2	**Roundabout**	A5 Victoria Road	19.9%	A5 S	22.6%	A5 N
3.1	**Roundabout**	A5 WTC Northbound slip roads	33.8%	Link to Dumbell RB	19.3%	Link to Dumbell RB
3.2	**Roundabout**	A5 Victoria Road	33.7%	A5 Victoria Rd S	47.9%	A5 Victoria Rd S
3.3	**Roundabout**	Southbound off-slip/Link Road	29.2%	Link to Eastern RB	19.6%	Link to Eastern RB
4	**Roundabout**	A38 Lifford Road	76.7%	Underpass	100.0%	A38 to Lifford
5	**Roundabout**	A38 Lifford Road / A5 Barnhill Road / B72 Railway Street / A5 Bradley Way	81.9%	A5 S	84.7%	B72
6	**Roundabout**	A5 Bradley Way /Bradley Way / A5 Great Northern Link/ A5 WTC	61.1%	Connector Road to DA5 slips	84.8%	A5 N
7	**Roundabout**	A5 WTC / Link to ROI	83.3%	DA5 S	80.4%	DA5 N
8.1	**Slip Road**	A5 WTC - West				
8.2	**Slip Road**	A5 WTC – East				
8.3	**Priority T Junction**	A5 WTC Link Road / A5 WTC East Connector Road	62.6%	A5 (S) - A5 WTC Link (E)	75.4%	A5 (S) - A5 WTC Link (E)
8.4	**Roundabout**	A5 Melmount Road	46.1%	New Link across A5	38.9%	Existing A5 S
9.1	**Slip Road**	A5 WTC (Northbound)				
9.2	**Slip Road**	A5 WTC (Southbound)				
9.3	**Priority T Junction**	B72 Fyfin Road (West)	45.9%	Fyfin Road (W)	38.7%	Fyfin Road (W)
9.4	**Priority T Junction**	B72 Fyfin Road (East)	23.2%	A5 (S) - Fyfin Rd (E)	14.1%	A5 (S) - Fyfin Rd (W)
10.1	**Roundabout**	B84 / A5 WTC Connector Road (East)	4.7%	A5 WTC Slip	11.9%	A5 WTC Slip
10.2	**Roundabout**	B84 / A5 WTC Connector Road (West)	7.6%	B84 Baronscourt Rd	10.3%	Link to North RB
10.3	**Slip Road**	A5 slip North				
10.4	**Slip Road**	A5 slip South				
11.1	**Roundabout**	West Dumbell Roundabout	18.1%	New Road	16.7%	New Road
11.2	**Roundabout**	East Dumbell Roundabout	34.9%	Existing A5 (S)	29.9%	Existing A5 (s)
11.3	**Priority T Junction**	A5 Beltany Road (North)	72.6%	Current A5 north - Current A5 south	84.9%	Current A5 south

12	**Roundabout**	Grade Separated Roundabout A32 Clanabogan Road	50.8%	A32 S	60.5%	A32 S
13.1	**Roundabout**	Dumbbell Southern roundabout	35.1%	Link to B83	48.3%	Link to Dumbell RB
13.2	**Roundabout**	Dumbbell Northern roundabout	45.9%	Link to Dumbell RB	56.9%	Link to North RB
13.3	**Roundabout**	Existing Roundabout	59.0%	B83 Link Road	70.5%	Doogary Road W
14.1	**Priority T Junction**	A5 Victoria Road	25.2%	A5 Victoria Rd S	14.4%	A5 Victoria Rd S
14.2	**Roundabout**	B46 Moylagh Rd and Augher Point Road	11.1%	B46 E	5.3%	B46 E
14.3	**Priority T Junction**	B46 Moylagh Road	5.3%	A5 Slip - Link to B46 Moylagh Rd	6.5%	A5 Slip - Link to B46 Moylagh Rd
14.4	**Slip Road**	A5 WTC /Northbound offslip and on-slip connector				
14.5	**Slip Road**	A5 WTC /southbound offslip and on-slip connector				
15	**Roundabout**	A5 WTC / A4 Annaghilla Rd	69.3%	A4 S	81.6%	A4 S
15A	**Roundabout**	A4 Annaghilla Rd / A5 TullyVar Rd	51.6%	A5 Tullyvar Rd North	64.8%	A5 Tullyvar Rd North
15B	**Roundabout**	A5 Omagh Rd / Tullyvar Rd / B34 Dungannon Rd	24.0%	B34 Dungannon Rd	31.4%	B34 Dungannon Rd
16.1	**Roundabout**	Northern Dumbbell Roundabout	17.5%	Existing A5 N	23.7%	Loughans Road
16.2	**Roundabout**	Southern Dumbbell Roundabout	25.6%	Dumbell Link	33.2%	Dumbell Link
17	**Roundabout**	A28 Caledon Road / A5 WTC	23.0%	A5 WTC S	31.2%	A5 WTC S

Table 8-12 Summary of Highest RFCs for Junctions 1-17

Junction Capacity Assessment

8.11.12 The results of the junction capacity assessments, based on the forecast flows for the design year show that in nearly all cases the junctions operate within their practical reserve capacity, i.e. at a predicted RFC ratio not exceeding 85%. The only junction which exceeds this threshold in either of the peak periods is Junction 4.

8.11.13 Junction 4 which is a roundabout, is forecast to operate at capacity in the design year in the PM peak with an RFC of 100%. The development traffic from the proposed Three Rivers Development (planning reference J_2011_433) has been taken into account within the flows used for the junction modelling. This proposed development is predicted to generate a high level of trips. In the design year AM peak, this junction operates with a maximum RFC on the worst arm of 76.7%.

8.11.14 Junction 11.3 which is a priority 'T junction' is on the edge of the urban area of Omagh and would be used by traffic heading to and from Omagh. It would be appropriate to consider the design of this junction in respect of a practical reserve capacity with an RFC of 85%. This junction is therefore anticipated to operate within its practical reserve capacity in its design year.

8.11.15 Junctions 8.3 which is a priority 'T junction' is forecast in the design year to operate with an RFC marginally greater than 75% in the PM peak (75.4%). This is only just over the DMRB appraisal consideration criteria for 'T-junctions' in rural areas. However the flows are relatively low and the junction is indicated to have minimal queueing. Therefore it is not envisaged that this junction would have capacity issues in the design year.

8.11.16 In relation to the proposed on-slip junctions 8.1, 8.2, 9.1, 9.2, 10.3, 10.4, 14.4 and 14.5, it is not appropriate to model these using PICADY, as PICADY applies to priority 'T junctions' and is unable to accurately model on-slips. Notwithstanding, the flows on the on-slip and the A5WTC mainline have been modelled as a 'T junction' within PICADY, with the flow on the on-slip giving way (this provides an extremely robust assessment).

8.11.17 The modelling results for the on-slip tests show that only junction 8.1 would be forecast to be over capacity in the design year if it were to operate as a priority junction instead of an on-slip. However, the flows for this junction are low in design terms for an on-slip and is not envisaged to have capacity issues in the design year.

8.12 Economic Information

8.12.1 The appraisal process completed in 2012 followed the prescribed methodology set out in WebTAG and is a robust approach. Based on a cost estimate of £454.5m (price base of Q4 quarter 2010 discounted to 2002) the Proposed Scheme has a BCR of 1.68.

8.12.2 Information relating to the methodology and outcome of the economic assessment for 2017 will be contained in an Economic Assessment Report which will be published at a later date.