Flood Risk Assessment Report 1

Assessment Parameters and Preliminary Flood Risk Assessment

A5 Western Transport Corridor

October 2015

Produced for

transportni

DRD Transport NI (TNI) Western Division

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Document Control Sheet

Project Title A5 Western Transport Corridor

Report Title Flood Risk Assessment Report 1

Revision 3

Status DRAFT

Control Date October 2015

Record of Issue

Issue	Status	Author	Date	Check	Date	Authorised	Date
V1	DRAFT	LG	APR 11	SMcG	APR 11	AH	APR 11
V2	ISSUE	LG	NOV 12	OC	NOV 12	AMcC	NOV 12
V3	DRAFT	LG	AUG 15	OC	OCT 15	AH	OCT 15

Distribution

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This report is presented to DRD Transport NI (TNI) in respect of the A5 Western Transport Corridor Flood Risk Assessment and may not be used or relied on by any other person or by the client in relation to any other matters not covered specifically by the scope of this report.

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Executive Summary

Introduction

Proposals to upgrade the A5 between Londonderry/Derry and Aughnacloy have featured prominently in previous strategy documents produced by the Department for Regional Development (DRD). In October of 2007 Mouchel was appointed to develop the A5 Western Transport Corridor (WTC) scheme on behalf of DRD.

The key objectives of the proposed A5 WTC 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 A5WTC,
- To provide improved overtaking opportunities for motorists along the A5 WTC,
- To develop the final proposals in the light of environmental, engineering, economic and traffic considerations.

The overall length of the proposed scheme is approximately 88km and the scheme has been split into three sections: Section 1 begins at New Buildings ending south of Strabane; Section 2 begins south of Strabane and ends south of Omagh and Section 3 begins south of Omagh and terminates at Aughnacloy.

An overview of the scheme and detail in relation to route development is available in the following reports: *Preliminary Options Report (September 2008)* and *Preferred Options Report (June 2009)*.

A5 WTC Project History

The A5 WTC has progressed through a number of stages which are summarised below:

- 2007 – Initial route development for Sections 1, 2 and 3
- 2009 – Preferred Route announced
- 2011 – Proposed Scheme presented at Public Inquiry
- 2012 – Positive outcome from Public inquiry, scheme progressed to Proposed Scheme and portions of Section 1 and 3 progress to Detail

- 2013 – Judicial review quashed Orders for Section 1 and 3
- 2014 – Scheme returns to Proposed Scheme for Sections 1, 2 and 3

The Flood Risk Assessment

The Proposed Scheme is subject to a Flood Risk Assessment (FRA) in accordance with guidelines contained within the Design Manual for Roads and Bridges (DMRB) and Department of the Environment Revised Planning Policy Statement 15 (PPS 15) 'Planning and Flood Risk'.

The purpose of the flood risk assessment is to identify areas of existing flood risk, and where development within floodplains is permitted; to ensure that the development is not at risk from flooding nor does it materially increase flood risk elsewhere.

The FRA report will comprise of three documents:

1) Flood Risk Assessment Report 1 - *Assessment Parameters and Preliminary Flood Risk Assessment.*
2) Flood Risk Assessment Report 2 – *Hydraulic Model Build Report*
3) Flood Risk Assessment Report 3 – *Impact and Mitigation Assessment Report*

Flood Risk Assessment Consultation History

Due to the complex project history, a summary of the previous versions of this Flood Risk Assessment (FRA) Report can be seen below:

- April 2011 Version 1 – Prior to Public Inquiry (May 2011), a draft FRA Report compiled.
- November 2012 Version 2 – Following the Public Inquiry and decision to progress portions of Sections 1 and 3, the detailed design FRA Report completed.
- July 2015 Version 3 – the A5 WTC has returned to the Proposed Scheme for the full Scheme (Sections 1, 2 and 3). Therefore this version of the report will be an updated draft FRA as was submitted with Version 1.

Flood Risk Assessment Guidelines

Guidance documents reviewed to inform this flood risk assessment include; Planning Policy Statement 15 (PPS 15) – *Planning and Flood Risk* (June 2006),

Revised Planning Policy Statement 15 – *Planning and Flood Risk* (September 2014), Strategic Planning Policy Statement for Northern Ireland (SPPS) (September 2015), Design Manual for Roads and Bridges (DMRB); specifically Volume 11, Section 3, Part 10 HD45/09 *Road Drainage and the Water Environment*, Construction Industry Research and Information Association (CIRIA) C624 – *Development and Flood Risk – Guidance for the Construction Industry* and Rivers Agency Guidelines.

Preliminary Flood Risk Identification

An assessment of potential flood impact is required to facilitate an appraisal and comparison of the various route options. DMRB (HD 45/09) procedures for assessing flood impacts identify the potential effects of alignments on pre-defined attributes. Outline assessments for identifying potential flood risk are determined by two key aspects; the importance attached to the attribute; i.e. floodplain and the likely magnitude of the impact. These elements can then be assessed together to provide an estimate of the significance of potential effects.

It was considered to be impractical and inefficient to undertake detailed hydraulic modelling for all watercourses/floodplains within the A5 WTC study area/preferred corridor. The initial assessment of magnitude of impact was devised on the basis of available data: Rivers Agency Northern Ireland Strategic Flood Maps, historical flooding records, alluvium mapping from drift geology and additional sources of information such as desktop studies and site surveys.

The preliminary flood risk assessment methodology examines the magnitude of impact and is based on potential disruption to floodplain connectivity and/or the length of road within floodplain. This assessment was based on the floodplain data gathered, providing a consistent and measurable assessment of the extent of potential impacts across the study area.

Detailed Assessment Rationale

The DMRB identifies that where it is essential to locate infrastructure within floodplains, a detailed assessment of flood risk is required. To complete this assessment it is necessary to understand the extents of the floodplain/floodwater levels, the impact arising from the proposed road and the development of appropriate mitigation measures.

The DMRB also provides guidance on some of the impacts that can arise from development within floodplains; these include afflux, loss of floodplain storage, impediment of water flows and potential increase in flood risk.

Guidance within DMRB (HD 45/09) advises that the development of hydraulic models is generally required to complete detailed assessments, including review of impacts and mitigation measures.

Further guidance on model data input, calibration / validation and sensitivity testing is contained within Flood Risk Assessment Report 2 - *Hydraulic Model Build Report*.

Mitigation Measures

Where development is required within a floodplain, additional works may be required to mitigate flood risk changes caused by the project. The DMRB 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.

Flood Risk Assessment Report 3 - *Impact and Mitigation Assessment Report* outlines assessments pertaining to the development of flood mitigation options including a review of residual impacts, composite mitigation options and detailed analysis.

Implications of Changes to the DMRB

In July 2009 Transport Minister Conor Murphy announced the Preferred Route for the A5 WTC scheme. Following this announcement, DMRB Volume 11 Section 3 Part 10 HA 216/06 was superseded by the DMRB, Volume 11 (Environmental Assessment), Section 3 (Environmental Assessment Techniques), Part 10 HA45/09 (Road Drainage and the Water Environment) in November 2009. Thus, the initial assessment of route options was completed before the release of the updated DMRB. Although the ethos of the guidance has not changed, there are additional mandatory requirements; most notably, the addition of a mandatory requirement contained within paragraph 2.37. This states 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.'

Where this guidance cannot be applied, a departure from standard will be required; submitting formal documentation to TNI as specified in *DMRB Volume 0, Section 1, Part 2 GD 01/08 Para. 1.17*

Implications of Changes to Planning Policy Statement 15

In September 2014 the Department of the Environment issued Revised Planning Policy Statement 15 'Planning and Flood Risk' superseding the previous PPS 15 published in June 2006. Thus, the initial assessment of route options was completed before the release of the updated planning policy document. Further to this in September 2015 the Department of Environment issued Strategic Planning Policy Statement for Northern Ireland (SPPS); SPPS identifies a transitionary period during which time the provisions of PPS 15 Revised apply; it is considered that at the time of writing the A5 WTC FRA the transitionary period applies.

Generally, the ethos of all the guidance remains unchanged with the primary aim of the documents being '*to prevent future development that may be at risk from flooding or that may increase the risk of flooding elsewhere'.* The definition of a flood plain for planning purposes remains unchanged, this being:

- River (Fluvial) Flood Plain – the extent of a flood event with a 1 in 100 year probability of exceeding peak floodwater level,
- Coastal (Tidal) Flood Plain – the extent of a flood event with a 1 in 200 year probability of exceeding peak floodwater level.

It is identified that amendments have been made in relation to individual policies contained within the documents. Policy FLD1 of PPS 15 Revised defines the 'Exception Test' where development within floodplains may be permitted, including for transport infrastructure. The policy also extends the Overriding Regional Importance criteria to include *'overriding regional or sub regional economic importance'*. Policy FLD2 includes Drainage Infrastructure as well as flood defences. Policy FLD3 relates to surface water / pluvial flooding; the policy provides clear guidance in relation to thresholds for undertaking Drainage Assessments. Policy FLD4 addresses culverting and Policy FLD5 Development in Proximity to Reservoirs.

Climate Change

Climate change is expected to increase both the severity and the frequency of flooding and has implications for the assessment of flood risk and scheme design.

Guidance Documents

To facilitate an understanding of the potential consequences of climate change, particularly in relation to flood risk, the following document were reviewed as part of this study: *United Kingdom Climate Impacts Programme 2009* (UKCIP09), SNIFFER (Scotland and Northern Ireland Forum for Environmental Research) – *Preparing for a Changing Climate in Northern Ireland* (January 2007), DoE Planning Service, Planning Policy Statement 15 (PPS 15) and Revised Planning

Policy Statement 15 - *Planning and Flood Risk* (2006 / 2014), The Climate Change Risk Assessment (CCRA) for Northern Ireland (2012), the Northern Ireland Climate Change Adaption Programme (2014), Design Manual for Roads and Bridges, Volume 11, Section 3, Part 10, HD45/09 *Road Drainage and the Water Environment* and Rivers Agency *Guidance for Road Schemes* were reviewed.

Implications for the A5 WTC

In relation to the A5 WTC, climate change is taken into account with regards to both fluvial and tidal flood events.

With regards to fluvial climate change considerations, the following has been taken into account during design assessments:

- Roads should be designed to be above 100 year flood levels plus a minimum 600mm freeboard (RA guidance, PPS15 and DMRB). This freeboard includes an allowance for climate change.
- All culverts will incorporate appropriate levels of freeboard according to size, function and location as outlined within the DMRB; these design parameters, including suitable allowances for climate change and modelling uncertainty have also been agreed with Rivers Agency.
- Sensitivity analysis will include 100 year + climate change (20% uplift on flows)

In the context of possible sea level rise scenarios resulting from climate change (particularly when considering a design horizon to 2140), the standard 600mm freeboard is considered to be inadequate for coastal / tidal areas. When taking into account predicted sea level rises and the uncertainty surrounding these long term predictions, it is considered that an appropriate uplift should be applied to tidal design levels that explicitly takes account of the climate change guidance in relation to sea levels in addition to the standard 600mm freeboard. Adopting a precautionary approach (based on UKCIP09) is recommended for A5 WTC design levels on the Foyle.

Data Collection

Data relating to hydrology, drainage and flooding issues associated with areas within the A5 WTC corridor was collated to aid in design assessments.

Statutory Consultations

Through meetings with the GIS Unit, Planning Advisory Unit and Hydrometrics Unit of Rivers Agency, data/information relevant to the A5 WTC was provided to Mouchel. Additional information was received from Donegal County Council,

Department of Environment Planning Service, Department of Regional Development Transport NI (formally Roads Service), Londonderry/Derry Port and Harbour Commissioners and the Metrological Office.

Tidal Data

The northerly A5 WTC study area includes the River Foyle north of Strabane. The River Foyle then flows into Lough Foyle north of Londonderry/Derry. Lough Foyle is tidal and exerts a tidal influence up the River Foyle beyond the Rivers Mourne and Finn at Strabane. Consequently, consideration needs to be given to this tidal influence as part of the flooding assessment accordingly.

Information in relation to Admiralty tidal statistics, recorded tidal data, extreme tides and Mouchel tidal monitoring was gathered as part of the assessment.

Other Sources of Information

Other sources of information were collected for the study area; these included historical flooding records from newspapers and libraries, river alluvium drift geology, topographical information in the form of digital terrain mapping, hydrological catchments and site / watercourse inspections from desk studies and fieldwork.

A5 WTC Study Area

The general centreline of the study area was largely dictated by the overriding requirement that the route should generally follow the existing established transport corridor which provides strategic links between the urban centres of Londonderry/Derry, Strabane, Omagh, and Aughnacloy; in addition to providing crucial links from both Dublin and Northern Ireland to urban centres in County Donegal.

Extensive consultation and investigation was required to ensure that all pertinent environmental and engineering constraints were considered. For this reason it was necessary to identify a study area that covers a sufficiently large geographical area at the outset of the assessment process.

The initial study area boundary was refined during the study area assessment period to reflect a greater knowledge of particular locations and associated constraints.

Hydrological information was collected for watercourses crossing the existing A5. Further information in relation to the existing conditions associated with the A5 is detailed in *Preliminary Options Report Scheme Assessment Report 1 (SAR 1) – Constraints Report.*

Route Development

A preferred corridor and subsequently preferred route were developed on the basis of information collated in relation to the study area.

Development of Preferred Corridor

Three principal improvement strategies were identified for the preferred corridor; west of the existing A5, utilising the existing A5 and east of the existing A5.

These three strategies developed into a large number of potential corridors that could improve the link between Londonderry/Derry, Strabane, Omagh, and Aughnacloy, whilst at the same time developing the links between Co. Monaghan and Co. Donegal.

The criteria that were assessed included: cost, engineering, environment, traffic and economics.

The evaluation of the preliminary corridor options involved a two step approach:

- Step 1 - Preliminary corridors
- Step 2 - Draft Preferred corridor

The draft was further developed in consultation with key representatives from Road Service to produce the Preferred Corridor.

More detailed information is contained within *Preliminary Options Report, Scheme Assessment Report 1 – Constraints Report*

Development of Preferred Route

Once the preferred corridor had been determined, it was necessary to evaluate different route options within this corridor. The assessment of the varying route options ultimately led to the selection of a preferred route. A more detailed assessment of the lands within the corridor was undertaken with the intention of identifying possible route options which were assessed against the key criteria of: safety, economics, environment, integration and accessibility.

As part of the initial route options assessment process, the route options for each section - Brown, Pink, Green and Blue, were presented at Public Consultation events. The routes were then appraised in consideration of comments received from the Public and key stakeholders against the four criteria of engineering, environment, economics and traffic to assist in the development of routes.

As a result of the first stage appraisal a number of recommendations were made which assisted the creation or augmentation of the initial routes, to form full length sectional routes. The routes were developed to form four route options for

the sections. Each route option was recognisable by colour and these are as follows:

- Section 1 Route Options: Black, Pink, Green and Purple
- Section 2 Route Options: Yellow, Black, Red and Purple
- Section 3 Route Options: Green, Pink, Purple and Red

Each of the revised/new routes was once again assessed, based on the four key criteria and constraints were highlighted by environment and engineering disciplines.

Preliminary Flood Risk Assessment

The assessment of flood risk for the key route options provides information on the locations of potential floodplain, the level of significance attached to each floodplain and the estimated significance of impacts arising from the A5 WTC. This was completed as per the preliminary flood risk identification methodology in relation to Section 1, 2 and 3 route options.

Information in relation to floodplains was made available to design teams and was given due consideration when developing the Preferred Corridor and subsequently, the routes within that corridor.

Flood Impacts Summary

A comparison of potential flood impacts for the proposed routes in each of the sections was completed in relation to the total length of each route located within floodplains, along with total number of instances along a route corresponding to varying degrees of impact significance.

Although information to fully quantify the impact of the various option proposals on predicted water levels was not available at the time of the preliminary assessment; it was recognised that extensive construction within the floodplain could materially influence flood risk.

Preliminary consideration of floodplain constraints informed the development of options. Where development of an option within the floodplain was deemed necessary; alignments have been restricted to the periphery of the floodplain, wherever possible.

Emerging Preferred Route

The preliminary flood risk assessments were given due consideration at the Preferred Options Workshop held with Mouchel Engineering and Environment Discipline Leaders, the Project Management team and Transport NI

representatives. The *Preferred Options Report - Scheme Assessment Report 2* provides full details in relation to the route development; resulting in the Preferred Route. The preferred route for each of the sections is as follows:

- Section 1: Purple and Black Routes
- Section 2: Black Route
- Section 3: Combination of Red and Pink Routes

Emerging Preferred Route Description

The A5 WTC begins in Section 1 as a single carriageway bypass to the west of New Buildings; the dual carriageway section starts south of New Buildings. The route then passes west of Magheramason, east of Bready, between Drumgauty and Magherareagh, west of Cloghcor and Ballymagorry and skirts the western edge of Strabane town, before heading south-east towards Glebe and Sion Mills.

Section 2 of the A5 WTC commences between Sion Mills and Glebe. The route then passes to the west of Seein and west of both Newtownstewart and Harry Avery's Castle. It traverses the lower slopes of Bessy Bell before passing to the west of Mountjoy, roughly following the path of the disused railway line. The final part of Section 2 follows a line close to the western outskirts of Omagh.

The beginning of Section 3 is to the south-east of Omagh at Doogary. The route then passes west of Moylagh, east of Newtownsaville, west of Ballygawley, west of Tullyvar and north of Aughnacloy before bypassing the town to the east. The final part of Section 3 ties in to the existing A5 north of the border at Moy Bridge with a single carriageway link between the A28 and the existing A5.

Hydraulic Modelling Requirements

Preliminary flood risk assessments identified a number of floodplains within the study area of the A5 WTC and along the alignment of the Preferred Route.

Hydraulic modelling requirements were identified using historical flood maps, alluvium mapping, Rivers Agency Strategic Flood Maps and other sources which included data in relation to desk top studies and survey information.

Information pertaining to the development of the hydraulic models and subsequent assessment of impacts and mitigation is provided in Flood Risk Assessment Report 2 – *Hydraulic Model Build Report* and Flood Risk Assessment Report 3 – *Impact and Mitigation Assessment Report.*

Summary

This flood risk assessment is part one of three reports. It outlines the assessment parameters in relation to the preliminary flood risk assessment and assess the various route options proposed for the A5 WTC in relation to preliminary flood risk; these assessments contributed to the overall consideration of constraints associated with various route options.

The outcome of the assessment in relation to various engineering and environmental constraints was the emergence of a Preferred Route within each section. Residual areas of flood risk remain at locations identified in these flood risk assessment reports.

Hydraulic models were developed in order to further assess the potential impacts of the A5 WTC. Information pertaining to further assessment can be found Flood Risk Assessment Report 2 – *Hydraulic Model Build Report* and Flood Risk Assessment Report 3 – *Impact and Mitigation Assessment Report*.

1 Introduction

1.1 The A5 Western Transport Corridor (A5 WTC)

Proposals to upgrade the A5 between Londonderry/Derry and Aughnacloy have featured prominently in previous strategy documents produced by the Department for Regional Development such as:

- *'Shaping Our Future: the Regional Development Strategy for Northern Ireland 2025'* - a document containing a Regional Development Strategy (RDS) which offers a strategic and long-term perspective on the future development of Northern Ireland up to the year 2025.

- *'Regional Transportation Strategy for Northern Ireland 2002-2012'* (RTS) – a document that identifies strategic transportation investment priorities and considers potential funding sources and affordability of planned initiatives over the strategy period. It is identified that the A5 Western Transport Corridor (A5 WTC) is one of five key strategic corridors in Northern Ireland as defined in the RTS.

The Northern Ireland Executive have also agreed in principle to taking A5 WTC project forward and it was included in the Investment Delivery Plan (IDP) for Roads which was published in April 2008.

The key objectives of the proposed A5 WTC 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 WTC,

- To develop the final proposals in the light of environmental, engineering, economic and traffic considerations.

In October of 2007 Mouchel was appointed by the Department of Regional Development (DRD) Transport NI (formally Roads Service) to develop the scheme.

1.2 A5 WTC Project History

During 2007 to 2009, the A5 WTC progressed through the initial stages of route development; selection of the Study Area, the Preferred Corridor and then

assessing route options within the Preferred Corridor to produce the Preferred Route. In July 2009 the A5 WTC Preferred Route was announced to the public.

The Preferred Route was then further developed and amended to become the Proposed Scheme which was presented at Public Inquiry in May 2011. The Proposed Scheme was developed further by incorporating the commitments from the Public Inquiry into the design which then formed part of the Contract documents and it was intended that the Proposed Scheme would be further development during detailed design.

On 14th February 2012 an announcement was made by the Northern Ireland Government, following a review of the funding arrangements for the A5WTC, to proceed with construction of elements of the A5WTC; subject to a positive outcome from the Inspector Report from the Public Inquiry. This announcement identified that portions of Section 1 and Section 3 were to be progressed to construction; it further identified that no portions of Section 2 were being progressed at that time.

On 31st July 2012 the Northern Ireland Government confirmed that 15km of the A5 WTC in Section 1 and 23km of the A5 WTC in Section 3 (referred to as the Phase 1 Works) would be progressing to detailed design and construction. It was further confirmed that the progression of the remaining 47km of the scheme was dependent on the availability of future funding.

However, on 10th September 2012 the DRD TNI received a legal challenge which was the subject of a number of court hearings. The Judge ruled against the Department on the need for an Appropriate Assessment on Rivers Foyle and Finn Special Areas of Conservation. On 12th March 2013, the Judge advised that he was minded to quash the Orders which were made in September 2012. The quashing of the Orders became operative on 15th April 2013.

Following the Judge's ruling, the Department decided to remedy the omission by revisiting the Habitats Regulations Assessment and also decided to republish the Environmental Statement and draft orders. This has required updated data and changes to the scheme design to take account of new design standards and policy. The scheme has, therefore, returned to the Proposed Scheme stage which includes all three sections of carriageway with a total length of approximately 88km.

1.3 Route Development Summary

The overall length of the Proposed Scheme is approximately 88km and the scheme has been split into three sections:

- Section 1: New Buildings to south of Strabane
- Section 2: South of Strabane to South of Omagh

- Section 3: South of Omagh to Aughnacloy.

At the outset of the project a number of milestones were defined. These being:

- Identification of the study area
- Determination of the Preferred Corridor extents
- Assessment of varying route options to confirm a Preferred Route
- Progression of the Preferred Route towards Proposed Scheme

An overview of the scheme and details in relation to route development is available in the following reports: *Preliminary Options Report Scheme Assessment Report 1 (September 2008) – Constraints Report* and *Preferred Options Report Stage 2 Scheme Assessment Report (June 2009).*

1.4 The Flood Risk Assessment

The proposed scheme is subject to a Flood Risk Assessment (FRA) in accordance with guidelines contained within the Design Manual for Roads and Bridges (DMRB), Volume 11 Environmental Assessment, Section 3 Environmental Assessment Techniques, Part 10 HD45/09 Road Drainage and the Water Environment; and Department of the Environment (DoE) Planning Service, Revised Planning Policy Statement 15 (PPS 15) – Planning and Flood Risk: Annex D: Assessing Flood Risk and Drainage Impact.

The purpose of the FRA is to identify areas of existing flood risk, and where development within floodplains is permitted; to ensure that the proposed development is not at risk from flooding nor does it materially increase flood risk elsewhere.

In accordance with Flood Risk Assessment requirements outlined within the DMRB and Revised PPS 15 – Planning and Flood Risk, Annex D: Assessing Flood Risk and Drainage Impact; when the proposed development is within the fluvial / coastal floodplain, this assessment will include as a minimum:

- Location plan to a suitable scale illustrating geographical features and identifies the catchment, watercourses in the vicinity and the built development;
- A site plan....showing re-development and post development levels related to Ordnance Datum;
- Details of any existing or proposed flood alleviation measures or flood defence structures that may influence the site…;
- The identification of all potential sources of flooding pre and post development;

- An assessment of hydraulic capacity and structural integrity of all drains and sewers within or bounding the site…;
- Data on historical flooding events…;
- A plan of the site showing the extent of the Q100 floodplain…and inclusion of information such as …. access road and car park levels, estimated flood water levels, flood depths and velocities and associated probability of flooding;
- A plan and description of features which may influence local hydraulics. For example bridges, pipes or ducts crossing watercourses, culverts, embankments and walls;
- An assessment of the likely speed of potential flooding, the sequence in which various parts of the site may flood, the likely duration of a flood event, the potential consequences of a flood event, the depth and velocity of flood water;

Where the proposed development site is located within the fluvial / coastal floodplain, the flood risk assessment will also be required to provide details of flood control and mitigation measures as well as safety procedures that will address the flood risks identified.

Information pertaining to a number of the above requirements is detailed in *Preferred Options Report Stage 2 Scheme Assessment Report* and *Stage 3 Scheme Assessment Report*.

Additional information relating to flood risk will also be contained within subsequent Flood Risk Assessment Reports.

1.5 Flood Risk Assessment Consultation History

As noted in Section 1.2 the A5 WTC project has been through a number of stages. A summary of the previous versions of this Flood Risk Assessment (FRA) Report can be seen below:

- April 2011 Version 1 – Prior to Public Inquiry (May 2011), a draft FRA Report was sent to Rivers Agency in April 2011 for their review. This was based on the Proposed Scheme for the full scheme (Sections 1, 2 and 3). The FRA approach was subsequently accepted by Rivers Agency.
- November 2012 Version 2 – Following the Public Inquiry and decision to progress portions of Sections 1 and 3, the Contractors developed the A5 WTC Detailed Design. The FRA Report was re-drafted with information pertaining to the detailed design and the detailed design FRA Report was submitted to Rivers Agency in November 2012. The FRA approach was subsequently accepted by Rivers Agency.

- October 2015 Version 3 – the A5 WTC is currently back to Proposed Scheme for the full Scheme (Sections 1, 2 and 3). Therefore this version of the report will be an updated draft FRA as was submitted with Version 1. During a meeting with Rivers Agency on 12th January 2015 it was agreed that the Version 1 report content was acceptable and that the detail would be updated as applicable and re-submitted to Rivers Agency for their review.

As mentioned above, this version of the report is draft as it is based on the Proposed Scheme, not the detailed design. At this stage floodplains extents and elevations have been assessed in accordance with PPS 15. Further information in relation to a drainage impact assessment and likely speed / sequence / duration of potential flooding will be included within the FRA Report associated with the Detailed Design.

1.6 Flood Risk Assessment Report Format

The FRA report will comprise of three documents. A summary of the information contained within the FRA is outlined below.

1) Flood Risk Assessment Report 1 - *Assessment Parameters and Preliminary Flood Risk Assessment.*

   This report includes assessments pertaining to the selection of the preferred route of the scheme and contains details in relation to:

   - FRA Guidelines,
   - Climate Change Assessments,
   - A5 WTC Study Area,
   - Data Collection,
   - Route Development,
   - Preliminary Floodplain Identification,
   - Identification of Hydraulic Modelling Requirements.

2) Flood Risk Assessment Report 2 – *Hydraulic Model Build Report*

   This report contains technical information on the assessment of the preferred route and contains details in relation to:

- Route Development,
- Model Study Areas & Extents,
- Model Data Collection,
- Catchment Analysis & Design Flow Estimation,
- Hydraulic Modelling
    - Model Results – Flood Mapping,
- Model Calibration / Sensitivity Analysis.

3) Flood Risk Assessment Report 3 – *Impact and Mitigation Assessment Report*

   This report provides details of the assessment of the final published A5 WTC route and contains details in relation to:

   - Proposed Scheme Summary,
   - Engineering Features Identification
   - Impacts and Mitigation Options Assessment,
   - Mitigation Modelling,
   - Discussion of Mitigation Results.

2 Flood Risk Assessment Guidelines

This section provides a summary of the key guidance documents that have informed this flood risk assessment. It provides background information in relation to flood risk assessment practices, impact reviews and development of mitigation solutions.

2.1 Planning Policy Statement 15 (PPS 15) – 'Planning and Flood Risk'

During the initial flood risk assessment for the A5WTC, relevant planning information was contained within the PPS 15, June 2006. This has been superseded by the Revised Planning Policy Statement 15, September 2014.

The initial assessment of route options was completed before the release of the updated planning policy document. Generally, the ethos of the guidance remains unchanged with the primary aim of the document being '*to prevent future development that may be at risk from flooding or that may increase the risk of flooding elsewhere'.*

2.1.1 Revised PPS 15 (September 2014)

Similar to the June 2006, the Department of Environment Northern Ireland, Planning Service's policy and guidance in relation to flood risk states that:

The purpose of Revised PPS 15 is to *'set out the Department's draft planning policies to minimise and manage flood risk to people, property and the environment. It embodies the Government's commitment to sustainable development and the conservation of biodiversity. It adopts a precautionary approach to development and the use of land that takes account of climate change and emerging information relating to flood risk through the implementation of the EU Floods Directive in Northern Ireland and the implementation of the sustainable drainage systems. The revised PS* (policy statement) *is supportive to the safety and wellbeing of people'*.

The aim of the Revised PPS 15 remains the same; to prevent development within floodplains that may place people at risk from flooding or that may increase the risk of flooding elsewhere:

'The susceptibility of all land to flooding is a material consideration in determining planning applications. New development may be directly at risk from flooding from a number of sources and/or may increase the risk elsewhere.'

In consideration of the above, the updated Policy FLD 1, Development in Fluvial (River) and Coastal Floodplains, states that;

'Development will not be permitted within the 1 in 100 year fluvial flood plain (AEP of 1%) or the 1 in 200 year coastal flood plain (AEP of 0.5%) unless the

applicant can demonstrate that the proposal constitutes an exception to the policy.'

In furtherance of this Policy FLD1 includes the introduction of an 'Exception Test' incorporating an exception for undefended coastal flood plains whereby land raising to acceptable levels may be permitted. The policy also extends the Overriding Regional Importance criteria to include *'overriding regional or sub regional economic importance'*.

'A development proposal within the floodplain that does not constitute an exception to the policy may be permitted where it is deemed to be of overriding regional or sub regional economic importance and meets both of the following criteria:

- *Demonstration of exceptional benefit to the regional or sub-regional economy;*
- *Demonstration that the proposal requires a location within the floodplain and justification of why possible alternative sites outside the floodplain are unsuitable.*

Where the principle of development is established through meeting the above criteria, the planning authority will steer the development to those sites at lowest flood risk. The applicant is required to submit a Flood Risk Assessment for all proposals'.

The policy further recognises that for *'planning purposes, taking into account climate change predictions based on available scientific evidence, the design limits of floodplains are currently defined as follows:* (Paragraph 6.2)

- *'Rivers (fluvial) Flood Plain – the extent of a flood risk event with a 1 in 100 year probability (or 1% annual probability) of exceeding peak floodwater level.*
- *Coastal (Tidal) Flood Plain – the extent of a flood risk event with a 1 in 200 year probability (or 0.5% annual probability) of exceeding peak floodwater level'*

It is identified that the A5 WTC study area incorporates both fluvial and tidal systems; therefore, this assessment considers those areas at risk of flooding during a 1 in 100 return period event (Q_{100}) for rivers, and during a 1 in 200 return period event for tidal extents. Should the Preferred Route impact upon floodplains the scheme may be considered to fall under the *'overriding regional or sub regional economic importance'* of FLD1. This is supported by the RTS, in which the A5 WTC is identified as one of five key strategic corridors for Northern Ireland (NI).

Other notable revisions to the policy document include the extension of Policy FLD2 to include Drainage Infrastructure as well as flood defences, this infrastructure primarily relating to culverted watercourses. As per the previous document Policy FLD3 relates to surface water / pluvial flooding, the revised policy provides clearer guidance in relation to thresholds for undertaking Drainage Assessments. Policy FLD4 is largely unchanged. Finally, Revised PPS 15 includes one new policy, Policy FLD5 – Development in Proximity to Reservoirs'.

Revised PPS 15 advises that *'Where the risk of flooding is a material consideration good practice dictates that applicants should identify potential flood risk and/or run-off issues as early in the development process as possible.'* It is in line with this guidance and the requirements of Policy FLD1 that this flood risk assessment for the A5 WTC has been developed.

As part of the flood risk assessment, Revised PPS 15 identifies in Paragraph 6.27 that *'Where, by exception or overriding need, built development is acceptable in principle in the floodplain, then a Flood Risk Assessment (FRA) is required. This must demonstrate measures that shall be taken to manage and mitigate the identified risks. These measures will be proportionate to the flood risk and generally will be more rigorous in undefended areas than in defended areas where the flood risk (residual) is lesser.*' It is the aim of this study to ensure that where location of the A5 WTC is within floodplain, suitable mitigation measures are adopted to minimise changes in flood risk. These assessments are detailed in A5 WTC Flood Risk Assessment Report 3 – *Impact and Mitigation Assessment Report.*

Revised PPS 15 maintains a precautionary approach to flood risk assessment (Paragraph D13) and the policy acknowledges that climate change will have impacts on the severity and frequency of flooding. Further information pertaining to climate change is provided in Section 3 of this report.

2.2 Strategic Planning Policy Statement for Northern Ireland (SPPS) – Planning for Sustainable Development

In September 2015 the Department of Environment Northern Ireland published in final form the Strategic Planning Policy Statement for Northern Ireland (SPPS) – Planning for Sustainable Development. The document sets out the Department's regional planning policies for securing orderly and consistent development of land in Northern Ireland under the reformed two tier planning system; the provisions of the SPPS apply to the whole of Northern Ireland.

It is identified within the document that a transitional period will operate until such times as a Plan Strategy for the whole of the council area has been adopted. It is considered that at the time of writing the A5 WTC Flood Risk Assessment the transitional period applies. The policy statement further details that during the transitional period planning authorities will apply existing policy as outlined within

SPSS. Section 1.13 of SPSS states that policy provisions contained within PPS 15 Revised: Planning and Flood Risk shall be retained during the transitional period.

Generally, the ethos of the guidance remains similar to that of PPS 15 Revised with Sections 6.99 – 6.132 of SPSS outlining that, in relation to flood risk, it is the aim of the SPPS to prevent future development that may be at risk from flooding or that may increase the risk of flooding elsewhere.

Section 6.106 and 6.107 identifies that *development within floodplains should be avoided where possible, not only because of the high flood risk and the increased risk of flooding elsewhere, but also because piecemeal reduction of the floodplain will gradually undermine their functionality. Accordingly, built development must not be permitted within the floodplains of rivers or seas unless the following circumstances apply:*

- *The development proposals constitutes a valid exception to the general presumption against development in floodplains*
- *The Development proposal is of over-riding regional or sub-regional economic importance; and*
- *The development proposal is considered as minor development in the context of flood risk.*

SPSS identifies floodplains as *generally flat areas adjacent to a watercourse or the sea where water flows in a flood, or would flow, but for the presence of flood defences. The limits of the floodplain area defined by the peak water level of an appropriate return period (currently defined as 1 in 100 year or 1 % AEP for the river or fluvial floodplain and 1 in 200 year or AEP of 0.5% for the coastal floodplain).*

The SPSS highlights that where the principal of development within the floodplain is accepted a Flood Risk Assessment is required.

2.3 Planning Policy Statement 25 (PPS 25)

Planning Policy Statement (PPS) 25 relates to development and flood risk in England; referenced in the Design Manual for Roads and Bridges (DMRB). However, PPS 25 does not apply in Northern Ireland and its provisions are not adopted by the DRD Transport NI.

2.4 Design Manual for Roads and Bridges (DMRB)

The Design Manual for Roads and Bridges (DMRB) '*provides a comprehensive manual system which accommodates….current Standards, Advice Notes and other published documents relating to Trunk Road Works.'* (DMRB Volume 0, Section 1, Part 2 GD 01/08)

Utilisation of this set of manuals is mandatory when undertaking design work for Trunk Road Schemes:

'Compliance with the Standards in force is mandatory for all Trunk Road Works, except where the Overseeing Organisation has either:

(a) approved a Departure from Standard….or

(b) agreed that a new or revised Standard should not be implemented on an individual scheme…'

(DMRB Volume 0, Section 1, Part 2 GD 01/08 Para. 1.17)

During initial Flood Risk Assessments for the A5WTC, relevant information has contained within Volume 11 (Environmental Assessment), Section 3 (Environmental Assessment Techniques), Part 10 HA216/06 (Road Drainage and the Water Environment). This has then been superseded by Volume 11 (Environmental Assessment), Section 3 (Environmental Assessment Techniques), Part 10 HD45/09 (Road Drainage and the Water Environment) in November 2009. This volume provides guidance on the assessment and management of the impacts that roads projects may have on the water environment; including floodplains.

Within the DMRB it is noted that government guidance on flood risk and development is provided, for Northern Ireland, within PPS 15. Other related policies include PPS 25 in England and SPP in Scotland. A general theme in all the policies identifies that development within floodplains should be restricted to essential transport and utilities infrastructure. DMRB HD 45/09 Para. 2.37 further adds that such infrastructure should be designed and constructed so as to remain operational even at times of flood, to result in no net loss of floodplain storage, not to impede flood flows and not to increase flood risk elsewhere.

Advice contained within Chapter 3 of the DMRB HD 45/09 states that *'roads should only be located within functional floodplains…if there is no acceptable alternative…'* Where this is not possible, it is recommended that the road should traverse the floodplain in the shortest practical crossing, and that extensive construction within a floodplain should be avoided. It is recognised that this may be unavoidable, and therefore the level of the road should be above the level of a predicted flooding event 1% annual probability (1 in 100) for fluvial floodplains and 0.5% annual probability (1 in 200) for tidal floodplains.

Within Chapter 6 DMRB HD 45/09 it is identified that there are varying levels of flood risk assessment specific to different stages of design; scoping, simple assessment and detailed assessment, as outlined in Figure 6.1, Chapter 6, HD 45/09:

<table>
<tr><td colspan="2"></td><td colspan="3">Stage of Project</td></tr>
<tr><td colspan="2"></td><td>Establishing Feasibility

Considering Options</td><td>Evaluating Options</td><td>Evaluation of Preferred Option</td></tr>
<tr><td rowspan="3">Level of Assessment</td><td>Scoping</td><td>Essential</td><td>Essential if project enters this stage</td><td>Essential if project enters at this stage</td></tr>
<tr><td>Simple Assessment</td><td rowspan="2">Greater level of detail for higher potential impact ↓</td><td colspan="2" rowspan="2">→ Assessments reviewed as more data becomes available</td></tr>
<tr><td>Detailed Assessment</td></tr>
</table>

Figure 2.4-1 – Level of Assessment Needed at Various Stages of Project Development

This report, Flood Risk Assessment Report 1 - *Assessment Parameters and Preliminary Flood Risk Assessment,* concentrates on the scoping aspects and elements of simple assessment as appropriate. The following sections provide detailed information in relation to methodologies and assessment conclusions for preliminary flood risk reviews.

Outline information regarding requirements for detailed flood risk assessments are also provided in the following sections. Information in relation to specific floodplains is contained with Flood Risk Assessment Report 2 – *Hydraulic Model Build Report* and Flood Risk Assessment Report 3 - *Impact and Mitigation Assessment Report.*

2.4.1 Preliminary Flood Risk Identification

An assessment of potential flood impact is required to facilitate an appraisal and comparison of the various route options. DMRB (HD 45/09) procedures for assessing flood impacts identify the potential effects of alignments on pre-defined attributes. Outline assessments for identifying potential flood risk are determined by two key aspects:

- The importance attached to the attribute; i.e. floodplain (Table A4.3 – *Estimating the Importance of Water Environment Attributes*, Annex IV HD 45/09).
- The likely magnitude of the impact (Table A4.4 – *Estimating the Magnitude of an Impact on an Attribute,* Annex IV HD 45/09).

The above elements can then be assessed together to provide an estimate of the significance of potential effects (Table A4.5 – *Estimating the Significance of Potential Effects*, Annex IV HD 45/09). This assessment is aimed at providing a consistent and objective flood risk appraisal across various options.

It is noted that at the time of initial options assessment, detailed data pertaining to predicted flood water levels for watercourses within the A5 WTC study area was limited and existing information was only available for specific floodplain areas in the vicinity of Newtownstewart (Section 2) and Strabane (Section 1). Where existing hydraulic models did exist these were not sufficiently up to date or detailed for the purposes of predicting changes in water levels as a result of A5 WTC proposals.

It was considered inappropriate to undertake detailed hydraulic modelling for all watercourses/floodplains within the A5 WTC study area/preferred corridor. Therefore practical measures for the assessment of magnitude of impact were devised on the basis of currently available data:

- ***Flood Maps - Rivers Agency Northern Ireland Strategic Flood Maps***

  NI Strategic Flood Maps were utilised for the study area floodplain assessment. These maps identify the areas throughout Northern Ireland that have flooded from rivers and sea in the past, and those predicted to flood in the future (including climate change). The maps also give an indication of existing flood defences.

  For preliminary flood risk assessments, the strategic flood maps were used in conjunction with other resources, such as desktop studies and surveys completed by Mouchel. This has been supplemented by discussion with Rivers Agency in relation to known flooding issues and the potential for flood risk within the study area, the preferred corridor and along identified route options. It is observed that the flood maps are designed to give an overview of flood prone areas but should not be used to determine the flood risk to specific point locations. Catchment areas less than 3km^2 are not represented on Rivers Agency Strategic Flood Mapping. Therefore, other means of assessment were required for smaller potential floodplains such as utilising alluvium mapping from drift geology.

- ***Historical Flooding Records***

  Rivers Agency provided information in relation to historical flooding along sections of the existing A5. This information has been largely digitised from aerial photographs of extensive flooding that occurred in October 1987. Rivers Agency has highlighted however that this dataset is incomplete, in particular between Newtownstewart and Strabane.

Furthermore, the return periods for this historical flooding vary with each drainage catchment.

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 floodplains (defended and undefended) in the vicinity of development limits for areas covered by the plan. It is highlighted that the 100 Year (Q100) floodplains displayed are extracts provided for the local area plan prior to 2009 and do not represent the full extent of floodplains within the study engineering area.

- ***Alluvium Mapping from Drift Geology***

  A5 WTC assessments have identified that in many instances there is a good correlation between alluvium extents and floodplains. For this reason it is assumed that where alluvium is present, there is potentially floodplain at this location. Therefore, the alluvium mapping has been used in conjunction with flood maps and historical flooding records for the preliminary flood risk assessment.

Additional detail regarding sources of information is outlined in Section 4 of this report.

The flood risk assessment methodology utilised on the A5 WTC examines the magnitude of impact and is based on the disruption to floodplain connectivity and/or the length of road within floodplain. This assessment was based on the floodplain data gathered, providing a practical, consistent and measurable preliminary assessment of the extent of flood impacts across the study area.

Table 2.3.1-1 below illustrates the method adopted for estimating the magnitude of impact on flood risk for the A5 WTC.

Table 2.4.1-1: Flood Risk Magnitude Criteria

Magnitude	Criteria	DMRB Typical Example (*Table A4.4* HD 45/09)	A5 WTC Adopted Differentiator for Estimating Magnitude of Impact
Major Adverse	Results in loss of attribute and / or quality and integrity of attribute	Increase in peak flood level (1% annual probability) >100mm	Major disruption to floodplain connectivity and / or length of road within floodplain >500m
Moderate Adverse	Results in effect on integrity of attribute, or loss of part of attribute	Increase in peak flood level (1% annual probability) >50mm	Moderate disruption to floodplain connectivity and / or length of road within floodplain between 100m – 500m

Table 2.4.1-1: Flood Risk Magnitude Criteria

Magnitude	Criteria	DMRB Typical Example (*Table A4.4* HD 45/09)	A5 WTC Adopted Differentiator for Estimating Magnitude of Impact
Minor Adverse	Results in some measurable change in attributes quality and vulnerability	Increase in peak flood level (1% annual probability) >10mm	Minor disruption to floodplain connectivity and / or length of road within floodplain between 50m – 100m
Negligible	Results in effect on attribute but of insufficient magnitude to affect the use or integrity	Negligible effect in peak flood level (1% annual probability) +/- 10mm	Length of road within floodplain <50m

The importance of the attributes of the water feature must also be assessed. This is in accordance with the DMRB and is categorised as follows:

Table 2.4.1-2: Flood Risk Importance Criteria

Importance	Criteria	DMRB Typical Example (*Table A4.3* HD 45/09)
Very High	Attribute has a high quality and rarity on a regional or national scale	Floodplain or defence protecting more than 100 residential properties from flooding
High	Attribute has a high quality and rarity on a local scale	Floodplain or defence protecting between 1 and 100 residential properties or industrial premises from flooding
Medium	Attribute has a medium quality and rarity on local scale	Floodplain or defence protecting 10 or fewer industrial properties from flooding
Low	Attribute has a low quality and rarity on local scale	Floodplain with limited constraints and a low probability of flooding of residential and industrial properties

Once both the importance and magnitude of impact have been considered, the significance of potential impacts can then be estimated. This assessment corresponds to *Table A4.5 – Estimating the Significance of Potential Effects*, (Annex IV HD 45/09). The table can also be seen below:

Table 2.4.1-3: Flood Risk Significance

IMPORTANCE OF ATTRIBUTE					
	Very High	Neutral	Moderate/Large	Large/Very Large	Large
	High	Neutral	Slight/Moderate	Moderate/Large	Large/Very Large
	Medium	Neutral	Slight	Moderate	Large
	Low	Neutral	Neutral	Slight	Slight/Moderate
		Negligible	**Minor**	**Moderate**	**Major**
		MAGNITUDE OF IMPACT			

2.4.2 Detailed Assessment Rationale

It is identified within the DMRB that where it is essential to locate infrastructure within floodplains, a detailed assessment of flood risk is required. To complete this assessment it is necessary to fully understand the extents of the floodplain/floodwater levels, the impact arising from the development and assessment/implementation of appropriate mitigation measures.

The DMRB also provides guidance on some of the impacts that can arise from development within floodplains, these can include:

- ***Afflux*** – Afflux is the increase in upstream water level caused by a restriction in flow; *'Construction in floodplains can affect the nature and extent of the flood envelope in the area of construction and for some distance upstream and downstream….Bridges and embankments, in particular can obstruct or change the path of floodwaters, thereby changing the shape and/or extent of the flood envelop. A change in upstream flood levels, resulting from such an obstruction, is known as afflux.' (*Para. 3.28 HD 45/09)

- ***Loss of Floodplain Storage*** - In relation to the location of a road within a floodplain, Paragraph 5.46 (HD 45/09) explains that *'Any construction within a river or estuarial floodplain will occupy areas which were previously available for flood storage or flows.'*

- ***Impediment of Water Flows*** - Guidance within Paragraph 3.36 (HD 45/09) states that *'The construction of a new road forms a barrier that may cross existing drainage routes, causing potential blockage and altering local catchment areas and boundaries. It is usual practice to keep the existing land drainage separate from the road drainage where possible, using ditches and culverts beneath the road embankment.'*

- ***Potential Increase in Flood Risk*** – it is identified that there is a potential to impact flood water levels, thus increasing flood risk both within the vicinity of the development and elsewhere in the catchment, *'A road built across a major floodplain can have a significant effect on flood levels, whereas one built alongside will be less'* (Paragraph 3.29 HD 45/09).

Guidance within Annex I *Assessment Methods* (HD 45/09) advises that the development of hydraulic models is generally required to complete detailed assessments including review of impacts and mitigation measures.

It is identified that hydraulic models may be one, two or three dimensional with steady or unsteady flows and built using software packages such as HEC-RAS, ISIS, MIKE or InfoWorks. It is recognised that flooding mechanisms and impacts are specific to each individual floodplain location and thus the application of different hydraulic modelling techniques may be required. Flood Risk Assessment Report 2 - *Hydraulic Model Build Report* provides information pertaining to the development of individual hydraulic models including software used and the nature of the model (e.g. 1D or 2D).

Further guidance on model data input, calibration/validation and sensitivity testing, is contained within Annex 1, *Method F – Hydraulic Assessment* (HD 45/09) and within Flood Risk Assessment Report 2 - *Hydraulic Model Build Report*.

2.4.3 Mitigation Measures

Where development is required within a floodplain, additional works may be required to mitigate flood risk changes caused by the project. The DMRB 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.

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).

Guidance is further provided in Paragraph 5.46 (HD 45/09) on the application of storage compensation, *'Any construction within a river or estuarial floodplain will occupy areas which were previously available for flood storage or flows. Therefore, flood storage compensation should be provided. For example, if an embankment is built within a floodplain….request that material is removed in areas as close as possible to the proposed road crossing, so that the compensation works relate hydraulically to loss of floodplain.'*

The DMRB identifies the provision of flood mitigation (including storage compensation), and highlights the importance of assessing mitigation options as part of the flood risk assessment. It is stressed that mitigation options in themselves can generate impacts; *'...can have environmental impacts with regard to habitats. These impacts should be compared with the alternative impact of higher flood water levels in the catchment'* (Para. 5.48 HD 45/09).

In assessing the provision of compensatory storage for the Proposed Scheme detailed consultation was undertaken with Rivers Agency regarding the approach and development of proposals.

Flood Risk Assessment Report 3 - *Impact and Mitigation Assessment Report*, details assessments pertaining to the development of flood mitigation options including a review of residual impacts and alternative mitigation options.

2.4.4 Implications of Changes to the DMRB

In July 2009 Transport Minister Conor Murphy announced the Preferred Route for the A5 WTC scheme. Following this announcement, DMRB Volume 11 Section 3 Part 10 HA 216/06 was superseded by the DMRB, Volume 11 (Environmental Assessment), Section 3 (Environmental Assessment Techniques), Part 10 HA45/09 (Road Drainage and the Water Environment) in November 2009. Thus, the assessment of Route Options was completed before the release of the updated DMRB.

Although the ethos of the guidance has not changed, there are additional mandatory requirements; most notably, the addition of a mandatory requirement contained within paragraph 2.37. This states 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.'

As noted in Section 2.3, where this guidance cannot be applied, a departure from standard will be required; submitting formal documentation to TNI as specified in *DMRB Volume 0, Section 1, Part 2 GD 01/08 Para. 1.17*

2.5 Construction Industry Research and Information Association (CIRIA) C624 – Development and Flood Risk – Guidance for the Construction Industry

This document describes technical information in relation to the mechanisms and the impacts of flooding. The book *'provides guidance to developers and the construction industry on the implementation of good practice in the assessment*

and managements of flood risk….and…promote development that is sustainable in terms of flood risk.'

This guidance mentions the importance of the relevant planning authorities, the flood risk assessment process, technical guidance and mitigation measures for flood risk management.

2.6 Rivers Agency

Rivers Agency has provided guidelines in relation to Road Schemes.

General comments related to floodplains are as follows:

- *'Floodplain: effects of road development elsewhere: The raising of ground levels, in a floodplain, in association with development works can remove flood storage capacity and interfere with the conveyance of floodwater which can create or increase the risk of flooding elsewhere. Pick a route least likely to involve infilling of the floodplain identified in the FRA. If encroachment on floodplain cannot be avoided, it is the applicant's responsibility to demonstrate to planning service that the proposals are of overriding regional importance and therefore an exception under FLD 1 of Planning Policy Statement 15 (Planning and Flood Risk). Mitigatory measures such as spanning over the floodplain and/or providing level for level compensatory works to maintain storage and thereby offset the effects of the proposed infilling elsewhere should then be introduced.'*

- *'Floodplain: impact of flooding on the road itself: For development (including infilling) outside and particularly adjacent the floodplain, the Agency recommends that a minimum freeboard (safety factor) of 600mm should be added to the 100 year flood levels contained in the FRA (subject to consent) for design purposes.'*

Further information on flood risk is available from Rivers Agency, entitled *'Guidance on Flood Risk Assessments'.* This document provides information with regards to reporting requirements and flood assessment methodology, including the following key points:

- *'In order to determine design water levels the appropriate application of hydraulic modelling will be required'*

- *'Appropriate sensitivity analysis should be carried out to determine the sensitivity of design flood levels to key model parameters such as the effects of climate change'*

Guidance for hydraulic modelling is also included within this document.

Where appropriate, and in consultation with Rivers Agency; information from this guidance has been utilised in the current assessment.

3 Climate Change

Flooding is a natural process along river and coastal systems, and results from the accumulation of heavy rainfall, coastal surges and raised ground water. In some locations, the A5 WTC is at potential risk of flooding from both fluvial and coastal sources and in particular, parts of the scheme fall within an intermediate flooding zone at the tidal / fluvial interface along the Foyle system. Climate change is expected to increase both the severity and the frequency of flooding and has important implications for the assessment of flood risk and scheme design.

3.1 Guidance Documents

To assist with the determination of potential climate change impacts and proposed design criteria (for example freeboard requirements) for the A5 WTC, the following documents have been reviewed:

- United Kingdom Climate Impacts Programme 2009 (UKCIP09)
- SNIFFER (Scotland and Northern Ireland Forum for Environmental Research) – Preparing for a Changing Climate in Northern Ireland, January 2007
- DoE Planning Service, Planning Policy Statement 15 (PPS 15), Planning and Flood Risk, June 2006 and Revised Planning Policy Statement 15 (PPS 15), Planning and Flood Risk, September 2014
- Design Manual for Roads and Bridges, Volume 11 Environmental Assessment, Section 3, Part 10, HD45/09 Road Drainage and the Water Environment
- Rivers Agency Guidance for Road Schemes
- The Climate Change Risk Assessment (CCRA) for Northern Ireland (January 2012) and Northern Ireland Climate Change Adaptation Programme (January 2014)

It should be highlighted that climate change predictions and associated guidance are under continual review and updated periodically.

3.1.1 United Kingdom Climate Impacts Programme 2009 (UKCIP09)

UKCIP09 predicts that for Northern Ireland there will be a mean average increase in temperature of 2.8 C and 3.2 C for winter and summer respectively. A

mean average increase in winter precipitation of 11%, with a mean average decrease of summer precipitation by 15% is also predicted.

The previous UKCIP02 report predicted that increases in winter rainfall could potentially result in an increase in river flows across the UK by 20% over the next 100 years. There is currently no firm update on this prediction however, work by the Centre for Ecology and Hydrology (CEH) is in progress to determine a national assessment of the consequences of the various UKCP09 climate change predictions on river flows.

The UKCP09 report also provides a range of predicted sea level increases for Northern Ireland, the medium of these indicates an approximate increase of 14.5 cm by 2050's and 25.3cm by 2080's.

3.1.2 SNIFFER (Scotland and Northern Ireland Forum for Environmental Research) – Preparing for a Changing Climate in Northern Ireland, January 2007

Climate Change predictions utilised within the SNIFFER document are based on the UKCIP02 scenarios and indicate that mean temperatures may increase by 1.0 C – 2.5 C in summer and 0.5 C – 1.5 C in winter. Rainfall predictions indicate a decrease in summer precipitation by 10 – 30% and an increase in winter precipitation by 15 % (2050's) and 25% (2080's). The report indicates that Northern Ireland may experience more intense rainfall in winter and spring and more intense summer storms. It is predicted that the likelihood of winter flooding will increase.

The SNIFFER report further advises of a global sea level raise of 9 – 69 cm by 2080's. Storm surge heights are not predicted to significantly increase for Northern Ireland above the relative mean sea level.

3.1.3 DoE Planning Service, Planning Policy Statement 15 (PPS 15), Planning and Flood Risk, June 2006

Advice provided within PPS 15 are based on climate change predictions within the UKCIP02 report and SNIFFER Report 'Implications of Climate Change: Informing Development Strategy' and are similar to those indicated above.

The document highlights the importance of taking into account climate change and its associated impacts on flood risk within the planning process and advises a precautionary approach to design.

The document defines the extent of a floodplain as being that of a 1% annual probability of exceeding peak flood water level (1 in 100 year event). The document does not specifically define climate allowances to be adopted, although notes that potential climate change impacts should be considered.

3.1.4 DoE Planning Service, Revised Planning Policy Statement 15 (PPS 15), Planning and Flood Risk, September 2014

Within the revised PPS 15, the key message in relation to the implication of climate change is *'Climate change is one of Northern Ireland's foremost environmental, social and economic challenges. It is vitally important to ensure that our new and existing infrastructure is as resilient as possible to all potential impacts. This includes being able to adapt to both gradual climate change as well as the increased risk of extreme weather events such as flooding.'*

The revised PPS 15 references a number of reports and their key findings including; *UKCP09*, the cross departmental *Northern Ireland Climate Change Adaption Programme* (published January 2014) and the *Climate Change Risk Assessment (CCRA)* for Northern Ireland (published January 2012).

All of the documents highlight the importance of taking into account climate change and its associated impacts on flood risk. However, the documents do not specifically define climate allowances to be adopted, but note that potential climate change impacts should be considered.

Within the PPS 15 document there is only one reference to a quantitative allowance for the consideration of climate change. Note 10 of Paragraph 6.8 references freeboard requirements associated with flood defences and states that *'this is normally between 300mm – 600mm above the design flood level to accommodate factors such as wave action, storm surge and climate change.'*

3.1.5 Design Manual for Roads and Bridges, Volume 11 Environmental Assessment, Section 3, Part 10, HD45/09 Road Drainage and the Water Environment

As with PPS 15 the DMRB references climate change predictions provided within UKCIP studies and identifies the key legislation within Northern Ireland as being PPS 15. The DMRB advises of the importance of climate change in completing assessments and that consideration should be given to the extent of potential future flooding. The DMRB specifies the 1% Annual Event Probability (EPA) floodplain. When constructing flood protection measures, DMRB 11.3.10 HD 45/09 Paragraph 8.13 advises that a minimum of 500mm freeboard is commonly added to 1 in 100 year design levels.

3.1.6 Rivers Agency Guidance for Road Schemes

The Rivers Agency guidance on flood risk assessments recommends that best estimates, based on the most up-to date findings should be made of climate change impacts on probabilities, flood depths and extents. Previous discussions have outlined that in relation to hydraulic assessments and modelling, a standard

20% uplift on fluvial flows should be utilised to account for climate change and this scenario will be utilised during sensitivity checks.

Furthermore, Rivers Agency recommends that design levels should be greater than the 1 in 100 year flood levels, and that a further 600mm freeboard is added to account for climate change impacts and modelling uncertainties.

3.2 Implications for A5 WTC

3.2.1 Climate Change Considerations (Fluvial)

For fluvial flooding, roads should be designed to be above 100 year flood levels plus a minimum 600mm freeboard (RA guidance, PPS15 and DMRB). At crossings of watercourses this will generally be the design level for culvert/bridge soffits so road levels will be at higher elevations (accounting for road makeup). 100 year + climate change (20% uplift on flows) checks will be assessed as part of the model sensitivity analysis. The following has been taken into account during design assessments:

- Based on Rivers Agency Guidance, a standard 600mm minimum freeboard is intended to include for climate change and modelling uncertainty.
- All culverts will incorporate appropriate levels of freeboard according to size, function and location as outlined within the DMRB; these design parameters, including suitable allowances for climate change and modelling uncertainty have also been agreed with Rivers Agency. In summary:
  - In relation to culverts and freeboard - the DMRB Volume 4 Section 2 Part 7 HA 107/04 Chapter 4 (Para. 6.13 & 6.14) advises that large culverts should have a 600mm freeboard and smaller culverts have a 300mm freeboard. During some negotiation with Rivers Agency, it was agreed that smaller pipe culverts of 1.5m diameter or less with 300mm freeboard would be accepted by Rivers Agency; agreed through correspondence between Mouchel and Rivers Agency dated 2nd March 2010.
  - Where culverts are provided on floodplains (floodplain connectivity culverts), are distant from main channel and the culvert does not provide significant conveyance (i.e. the chances of blockage are low due to relatively low velocities), no additional 600mm freeboard will be applied.
- Sensitivity analysis will include 100 year + climate change (20% uplift on flows).

3.2.2 Climate Change Considerations (Tidal)

The UKCIP09 Report predicts changes to sea levels until 2080. Since the design life of the A5 WTC is 120 years, the road will still be functioning during 2080 and beyond (until year 2140).

For coastal waters it is the 200 year flood level plus freeboard which is the appropriate design standard. For the tidally influenced areas of the Foyle, joint probability methods have been used to derive the appropriate tidal/fluvial co-incidences which yield an equivalent 100 year fluvial dominant event / 200 year tidal dominant flood event.

As global temperatures rise, global-average sea level may rise around UK and Ireland due to the thermal expansion of sea water and to the addition of water from the polar mass. Based on information from UKCIP09 (Climate Change Scenarios for the United Kingdom, 2009), the relative sea level change by 2100 in the Lough Foyle area close to Londonderry/Derry may be between 8.3cm and 76.9cm depending on the emission scenario chosen (low, medium or high) and the probability associated with that scenario (5% (very likely), 50% (central estimate) or 95% (very unlikely)). To assess potential sea level rises impacting on the A5 WTC scheme in the vicinity of the Foyle, the 50% probability and medium emission scenario has been selected and extrapolated to 2140 (Figure 3.2.2-1), yielding a value for predicted relative sea level rise of 0.533m.

Sea levels associated with storm surge are not anticipated to increase much beyond mean relative sea level rises for UK and Irish waters by 2080. From data contained in UKCIP09, a predicted increase in surge of 0.014m by 2140 was estimated.

In the context of possible sea level rise scenarios resulting from climate change (particularly when considering a design horizon to 2140), the standard 600mm freeboard is considered to be inadequate for coastal / tidal areas. Considering the predicted sea level rises and the uncertainty surrounding these long term predictions, it is considered that an appropriate uplift should be applied to tidal design levels that explicitly takes account of the climate change guidance in relation to sea levels in addition to the standard 600mm freeboard. Adopting a precautionary approach (based on UKCIP109) is recommended for A5 WTC design levels on the Foyle.

In determining design levels a total uplift of 1.147m is to be applied to 200 year tidal levels within the coastal / tidal zone. This uplift represents a predicted sea level increase of 0.547m (UKCIP09 predicted relative sea level rise for a medium emissions scenario at 50th percentile probability extrapolated to year 2140) plus surge of 0.014m and 600mm freeboard allowance.

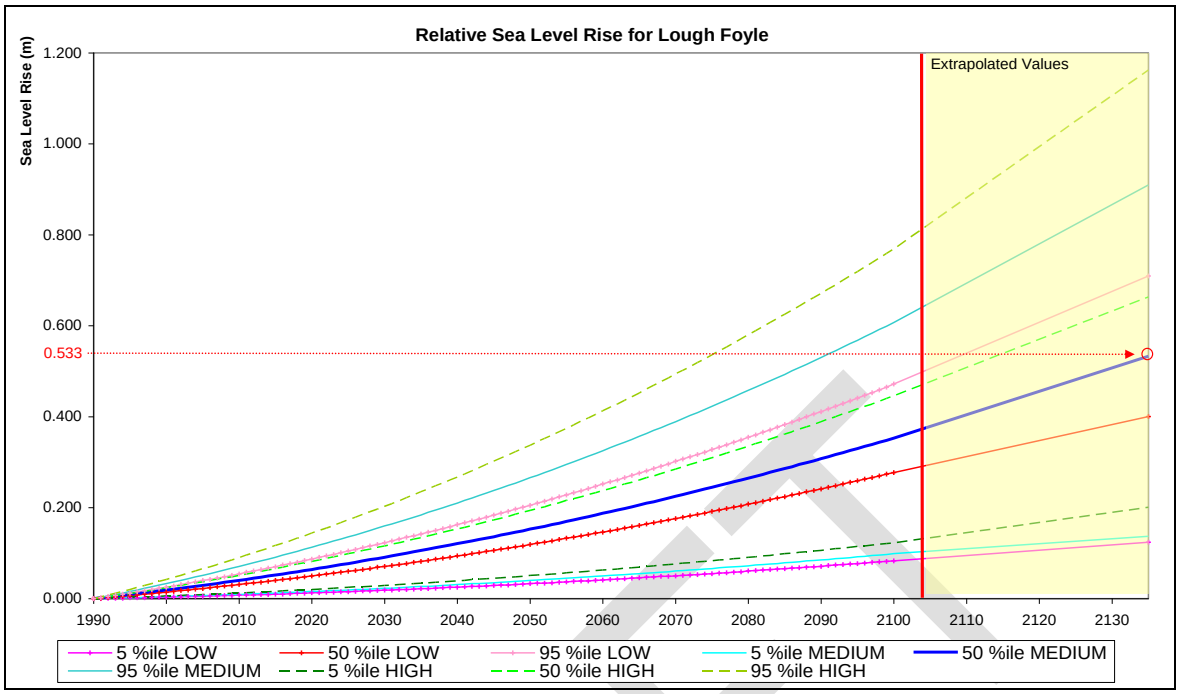

Figure 3.2-1 – Predicted UKCIP09 Relative Sea Level Rise in the Lough Foyle

4 Data Collection

The purpose of this section of the report is to detail the data that has been collated relating to hydrology, drainage and flooding issues.

4.1 Statutory Consultations

4.1.1 Rivers Agency (IT / GIS)

An initial meeting was held with Rivers Agency GIS Unit on 8th February 2008.

The following data was provided for the A5 WTC Study area by Rivers Agency GIS Unit:

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

  It is noted that the GIS data provided depicts historical flooding for various events throughout the study area; no classification of return period has been provided for historical flooding events. It was observed that the dataset was partially complete between Newtownstewart and Strabane. Due to the varying return periods, it should not be assumed that this depicts the full extent of floodplains within the study area.

  It is further 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 flood defences were constructed. These concrete defences were completed in 1991.

- Rivers Agency Flood Defences

  Mouchel undertook site investigations to confirm the category of existing flood defences (hard or soft). It is highlighted that the principal hard defences are through Omagh, Strabane and more recently, Ballygalwey. All other defences are considered soft defences, which are categorised as flood defences with no internal impermeable core.

- Rivers Agency Hydraulic Models
- Rivers Agency LiDAR Coverage Data

  Detailed LiDAR data for Strabane, Newtownstewart and Omagh was provided.

Subsequent to the receipt of the above data, updated historical flood maps were provided in January 2009. Additional river centre line data, designated watercourses and Rivers Agency flood defences were also provided in January 2009 for a small section of study area (Section 2) which had been extended beyond the original study limits provided to Rivers Agency.

4.1.2 Rivers Agency Planning Advisory Unit

Consultations have been ongoing with Rivers Agency Planning Advisory Unit (PAU) with regard to the A5 WTC proposals.

Rivers Agency Planning Advisory Unit has provided the following guidance / guideline information:

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

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

In November 2008 Rivers Agency launched their online strategic flood maps which provide information to the public in relation to historical flooding and predicted floodplains; including the impacts of climate change.

In subsequent discussions the use of geo-referenced flood mapping was agreed as an effective method of cross referencing other information provided by Rivers Agency in conjunction with that collated by Mouchel. It is recognised that the Strategic Flood Maps are not sufficiently accurate to determine flood risk to individual properties nor do they provide an exhaustive reference source for floodplain definition.

HEC-RAS hydraulic models for the following watercourses were provided by Rivers Agency PAU. These models were of varying extent and quality. It is noted that the models received were largely non geo-referenced due to being a number of years old. Some models have subsequently been manually geo-referenced by Mouchel to better assess these existing models.

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

4.1.3 Rivers Agency (Hydrometrics)

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 A5 WTC). The gauging stations cover the largest designated watercourses in the area (refer to Figure 4.1.3-1). Records start from the 1970's – 1990's depending on the gauging station and all of the stations are still in use. The gauging information is utilised when deriving design flows for the major rivers; detailed information can be seen in Flood Risk Assessment Report 2 – Hydraulic Model Build Report.

Figure 4.1-1 – Rivers Agency River Gauging Stations

4.1.4 Donegal County Council

The following relevant information has been received from Donegal County Council:

- River Finn Flood Study (N14/N15 Junction) - Mott MacDonald (Report and ISIS Model)

4.1.5 DoE Planning Service

DoE Planning Service provided copies of the East Tyrone Area Plan.

Copies of flood risk assessment report for the proposed Harcourt Development at Strabane have also been obtained from DoE Planning Service.

4.1.6 DRD Transport NI (formally Roads Service)

Consultations have been held with Transport NI (TNI) Section Engineers to collate data relating to the existing A5.

It was identified, through discussions with TNI Section Offices and River Agency that sections of the existing A5 have been prone to flooding, and these include:

- Burndennet Bridge – The road previously flooded here to a depth of 4 – 6 ft. Rivers Agency have now provided flood defences (clay embankment) in this area,
- Junction Victoria Road – Localised flooding. Watercourse culvert was enlarged to mitigate against future occurrences,
- A5 at the Fairy Water – Localised flooding,
- A5 north of Mountjoy – Water flowing across the road from embankments in periods of very heavy rain.
- Urney Roundabout, Strabane – Flood encroaches onto the road.

Reports relating to other roads projects previously undertaken within the study area have also been provided by Transport NI, these include:

- Newtownstewart Bypass Report (inc. Flood Risk Assessment Report)
- Omagh Throughpass Reports
- Strabane Phase 3 Reports

4.1.7 Londonderry/Derry Port and Harbour Commissioners

Londonderry/Derry Port and Harbour Commissioners were consulted in relation to tidal records for the Foyle (Londonderry/Derry Port and Harbour Commissioners manage and operate a tidal gauge at Lisahally docks).

4.1.8 Metrological Office

The MET office has been consulted in relation to spatial rainfall data for the River Foyle hydrological catchment.

4.2 DoE Planning Service – East Tyrone Area Plan

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 (Q_{100}) floodplains (defended and undefended) in the vicinity of town development limits for areas covered by the plan.

Towns included within the study area are:

- Ballymagorry
- Strabane
- Clady
- Sion Mills
- Victoria Bridge
- Ardstraw
- Newtownstewart
- Omagh
- Beragh
- Sixmilecross
- Fintona

It is noted that the Q_{100} floodplains displayed are extracts provided for the local area plan and do not represent the full extent of floodplains within the study area.

4.3 Tidal Data

The northerly A5 WTC study area includes the River Foyle north of Strabane. The River Foyle then flows into Lough Foyle north of Londonderry/Derry. Lough Foyle is tidal and exerts a tidal influence up the River Foyle as far inland as the Rivers Mourne and Finn at Strabane. Consequently, consideration needs to be given to this tidal influence as part of any flood assessment for rivers around Strabane and to the north of Strabane.

4.3.1 Admiralty Tidal Statistics

Admiralty tidal statistics for Londonderry/Derry Port and Lisahally Port are shown below, together with a port location plan.

Londonderry/Derry Port

- Londonderry/Derry is a secondary harmonic port
- Tide type is Semi-Diurnal
- Latitude 55° 00' N Longitude 07° 19'W
- Datum of statistics = Chart Datum
- Chart Datum = 1.61m below ordnance datum (Belfast)
- Highest Astronomical Tide (HAT) : 3.10 metres (1.49m AOD)
- Mean High Water Spring (MHWS): 2.70 metres (1.09m AOD)
- Mean High Water Neap (MHWN): 2.10 metres (0.49m AOD)
- Mean Sea Level : 1.64 metres (0.03m AOD)
- Mean Low Water Neap (MLWN): 1.20 metres (-0.41m AOD)
- Mean Low Water Spring (MLWS): 0.60 metres (-1.01m AOD)

River Foyle (Lisahally)

- River Foyle (Lisahally) is a Standard harmonic port
- Tide type is Semi-Diurnal
- Latitude 55° 03' N Longitude 07° 16'W
- Datum of statistics = Chart Datum
- Chart Datum = 1.37m below ordnance datum (Belfast)
- Highest Astronomical Tide (HAT) : 3.10 metres (1.73m AOD)
- Mean High Water Spring (MHWS): 2.60 metres (1.23m AOD)
- Mean High Water Neap (MHWN): 1.90 metres (0.53m AOD)
- Mean Sea Level : 1.42 metres (0.05m AOD)
- Mean Low Water Neap (MLWN): 0.90 metres (-0.47m AOD)
- Mean Low Water Spring (MLWS): 0.40 metres (-0.97m AOD)

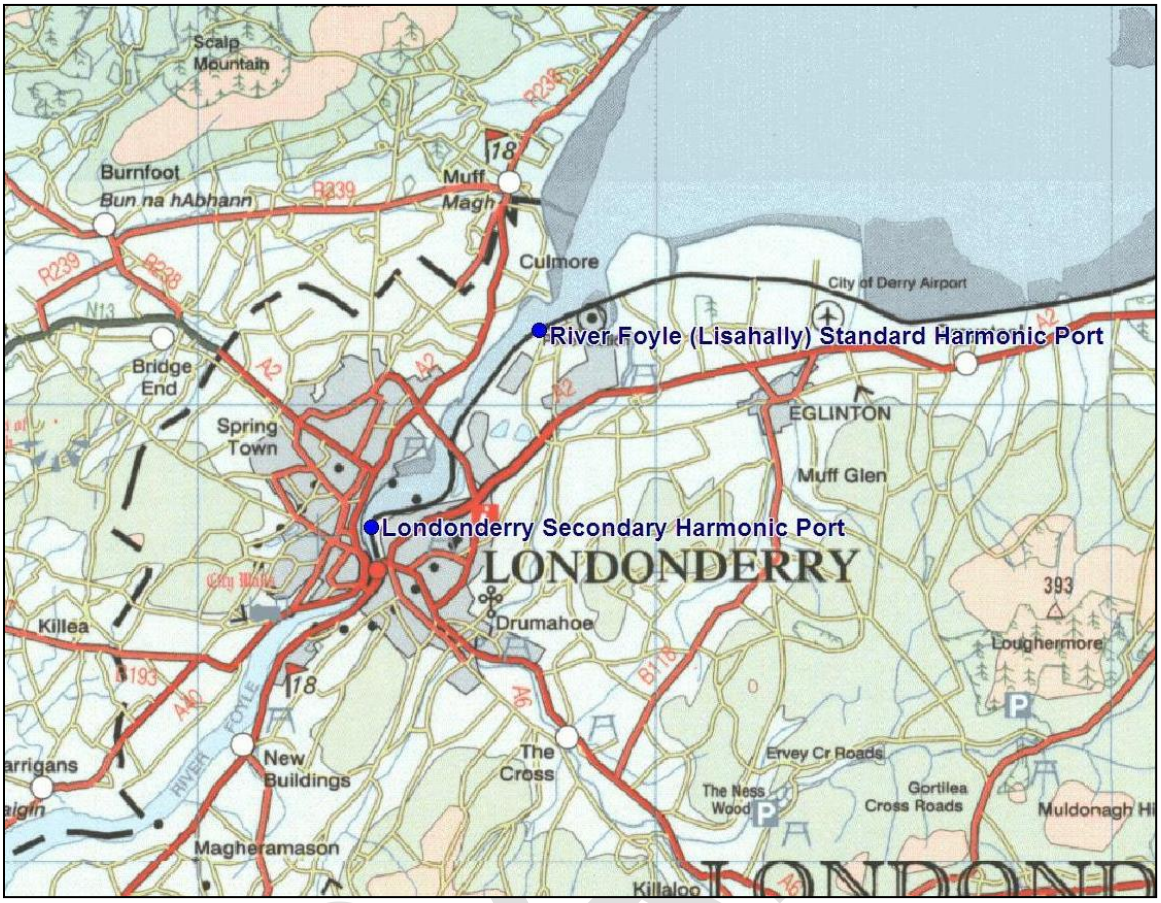

Figure 4.3-1 – Londonderry/Derry Port Location Plan

Chart Datum at all ports in the British Isles is set approximately at the level of the lowest astronomical tide (LAT).

Lough Foyle is subject to two 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.

4.3.2 Recorded Tidal Data

Rivers Agency (Hydrometrics Unit) and Londonderry/Derry Port and Harbour Commissioners were consulted in relation to actual tidal records for the Foyle. Both Rivers Agency and Londonderry/Derry Port and Harbour Commissioners manage and operate tidal gauges at Lisahally docks, north of Londonderry/Derry. Rivers Agency data were recorded at 15 minute time intervals, whereas the time interval for the Port Authority varies across the records (5 minutes for the 1996-2000 period and 50 seconds since 2000). Existing records were supplied for the periods:

- January 2007 - 2008 (Rivers Agency Gauge – Lisahally)
- 1996 – 2008 (Harbour Commissioners Gauge – Lisahally). It should be noted that some long gaps have been found in these data.

Recorded tidal levels include meteorological factors (tidal surge) and are used in the analyses to estimate extreme tides associated with a range of return periods (joint probability method).

4.3.4 Extreme Tides

Rivers Agency (PAU) supplied extreme 200 year tidal levels for the entire province. The 200 year tide level (including storm surge) for Milligan Point was given as 2.58m AOD. There were no 200 year levels available specifically for Lough Foyle.

4.3.5 Mouchel Tidal Monitoring

To facilitate an understanding of the tidal effects on the Foyle River, Mouchel undertook temporary tidal gauging at two locations along the Foyle system. From 28/08/08 to 04/09/08 tidal gauges were installed at Johnstown (near Dunnalong) and Strabane (near Drumenny). The purpose of these gauges, in conjunction with the permanent tidal gauge at Lisahally was to check if there was any significant deformation in water levels as the tides propagated up the River Foyle. The gauges were set to record over a typical series of spring tides.

4.4 Historical Flooding (Newspapers and Libraries)

Historical flood data for Londonderry/Derry, Strabane, Omagh and surrounding areas was gathered from newspaper archives and microfiche held in Londonderry/Derry, Strabane and Omagh public libraries. Internet research was also undertaken.

The information gathered for Strabane primarily refers to flooding in 1987, for Londonderry/Derry the articles refer to floods in 1985 and 1990 and Omagh 1987, 1990 and 2011. The newspaper pieces provide an overview, in written and pictorial form, of the extent of the flooding. Some of the articles contain water level estimates in feet, although there is no exact flood water level or rainfall data amongst the information. In many of the articles, particular streets or areas are mentioned and this information was cross referenced with Rivers Agency's historical flood mapping.

4.5 Geology

Mouchel Geotechnical team provided details of River Alluvium Drift Geology for the study area. Along river corridors this data depicts the extent of floodplains arising from long-term historical flooding.

It is noted that this data relates to historical events and will not depict flooding associated with more recent hydraulic controls such as culverts, bridges or any other man made structures.

4.6 Topography

The topography within the A5 WTC study area is extremely variable. Hydrological assessments require detailed topographical information in order to properly define drainage catchments.

4.6.1 Digital Terrain Mapping

Topographical information was obtained for the A5 WTC study area in a number of formats. The current topographical data sets are:

- Ordnance Survey - 1:50,000 contoured mapping
- DTM Data (Standard) - 10m grid,
  - general vertical accuracy +/- 1000mm
- DTM Data (Enhanced) - variable grid
  - soft ground vertical accuracy +/- 500mm
  - hard ground vertical accuracy +/- 300mm
- Strabane LiDAR data - vertical accuracy +/- 100mm
- Newtownstewart LiDAR data - vertical accuracy +/- 100mm
- Omagh LiDAR Data - vertical accuracy +/- 100mm
- Flood Estimation Handbook (FEH) drainage area software

4.7 Hydrological Catchments

Hydrological catchments were identified with the use of OS contour mapping, DTM data and Flood Estimation Handbook (FEH) software. FEH software has digital catchment descriptors (including topography) of over 4 million UK catchments which drain an area of 0.5 km^2 or greater.

Preliminary hydrological assessments were made in order to ascertain the principal rivers and associated drainage basins within the A5 WTC study area. The main drainage basins are shown in Figure 4.7-1. These main drainage basins ultimately feed into the Foyle via the main artery of the Strule / Mourne River, except the River Blackwater catchment which drains in a southerly direction away from the Strule / Mourne / Foyle system.

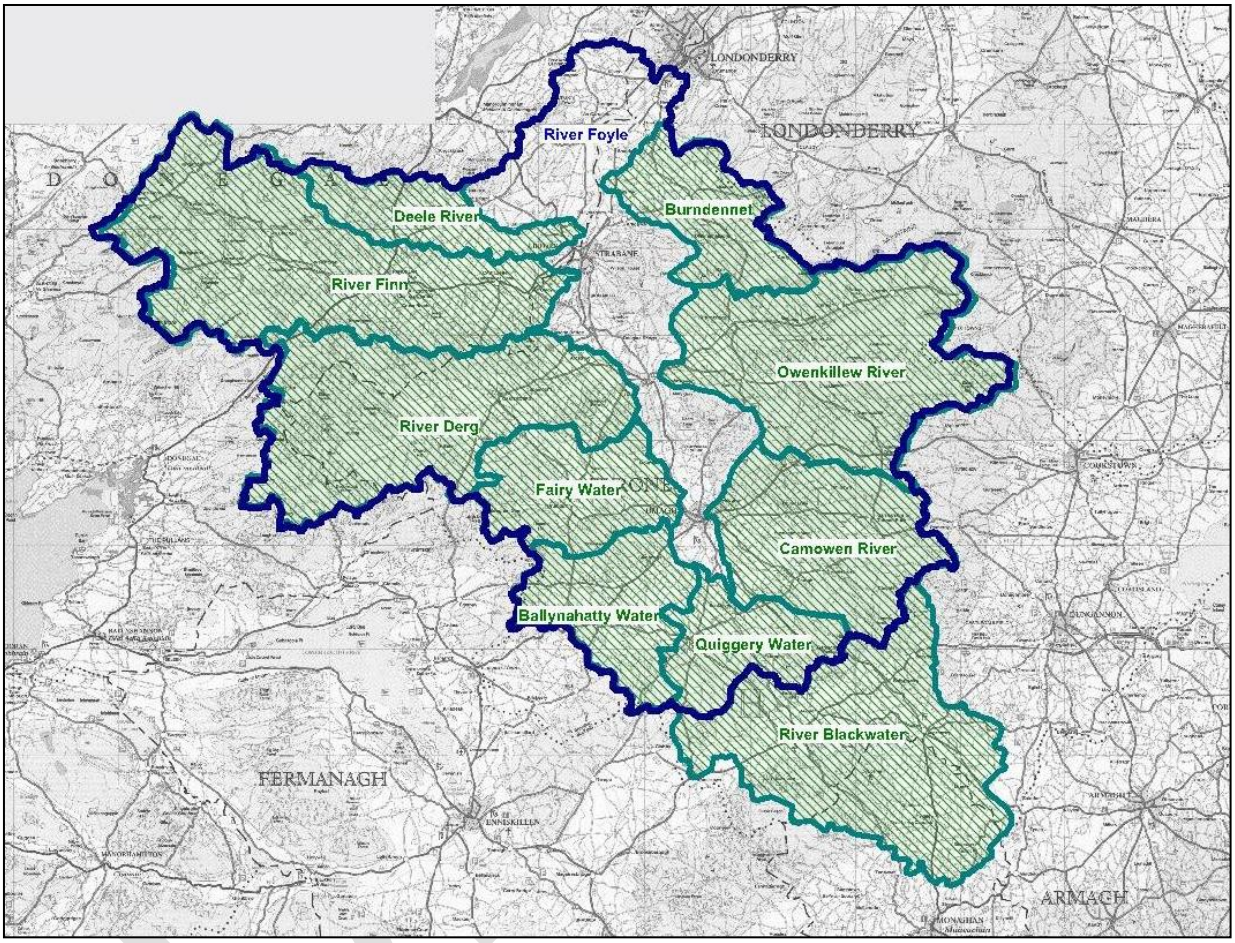

Figure 4.7-1 – Principal A5 WTC Drainage Basins

4.8 Site / Watercourse Inspections

4.8.1 Desk Study

Watercourses in the A5 WTC were identified from Rivers Agency data. This data comprised of digitised and colour coded designated and non-designated watercourse centrelines.

Initially, the route of the existing A5 was studied and existing culvert (or bridge) crossings were identified and marked for site survey. In addition, surveyors were instructed to identify any additional crossings found along the existing A5 route.

The Rivers Agency data was cross referenced in GIS with the FEH database and ordnance survey mapping.

Secondly, a number of potential route corridors had been provisionally identified. These routes were digitised and a further number of locations were identified for survey.

Thirdly, as route corridor options were identified, survey programmes were developed in relation to these options. These surveys were completed from December 2008 to February 2009; information pertaining to watercourse shape and size was collected.

All points were surveyed following the same procedure, outlined below.

4.8.2 Fieldwork

On site each location was surveyed as follows:

- The culvert / watercourse was measured using either a tape measure or surveying staff
- Photos of the watercourse / bridge or culvert and looking up and downstream of the associated watercourse were taken
- A brief description of the watercourse
- Connections for road drainage were also noted where evident

The output survey information from the fieldwork was recorded in an Excel spreadsheet and the photos organised into a suitable folder structure.

5 A5 WTC Study Area

This section of the report outlines the study area associated with the A5 WTC, which was determined by reference to mapping, undertaking site visits and taking into account areas of settlement, very high and steep ground, major watercourses and the border. This boundary was an initial assessment and was refined during the assessment period to reflect a greater knowledge of particular locations.

The general centreline of the study area was largely dictated by the overriding requirement that the route should generally follow the existing established transport corridor, and in so doing link the main centres of population along the route (i.e. Aughnacloy, Omagh, Strabane and Londonderry/Derry). In view of this fact, it was considered necessary to collect hydrological information associated with existing A5 to enable assessment of the study area in relation to drainage and flooding.

5.1 Existing Situation

Hydrological information was collected for watercourses crossing the existing A5. The A5 is located in the west of the province and presently provides strategic links between the urban centres of Londonderry/Derry, Strabane, Omagh, and Aughnacloy. The existing corridor, in addition, provides crucial links from both Dublin and Northern Ireland to urban centres in County Donegal.

The current A5 route is shown in Figure 5.1-1. Further information in relation to the existing conditions associated with the A5 is detailed in *Preliminary Options Report Scheme Assessment Report 1– Constraints Report.*

Figure 5.1-1 – Map of Northern Ireland Highlighting the Location of the Existing A5

5.2 The Study Area

In order to identify a route for the A5 WTC, extensive consultation and investigation was required to ensure that all pertinent environmental and engineering constraints were considered and for this reason it was necessary to identify a study area that covers a sufficiently large geographical area at the outset of the assessment process.

As mentioned previously, the study area was largely dictated by the overriding requirement that the route could link the main centres of population and there was also a requirement for the A5 WTC to link in with the A4 (recently upgraded to dual carriageway standard) close to the village of Ballygawley and in so doing open up an improved East–West Link to Belfast.

The initial study area boundary was refined during the study area assessment period to reflect a greater knowledge of particular locations and associated constraints. Further information in relation to the constraints associated with the A5 is detailed in *Preliminary Options Report Scheme Assessment Report 1 – Constraints Report.*

The study area crosses the border to allow the identification and assessment of trans-boundary effects in accordance with environmental legislation.

The plan below indicates the study area associated with the A5 WTC; it is within this area that constraints, including flood risk, have been identified to facilitate the development of a Preferred Route Corridor.

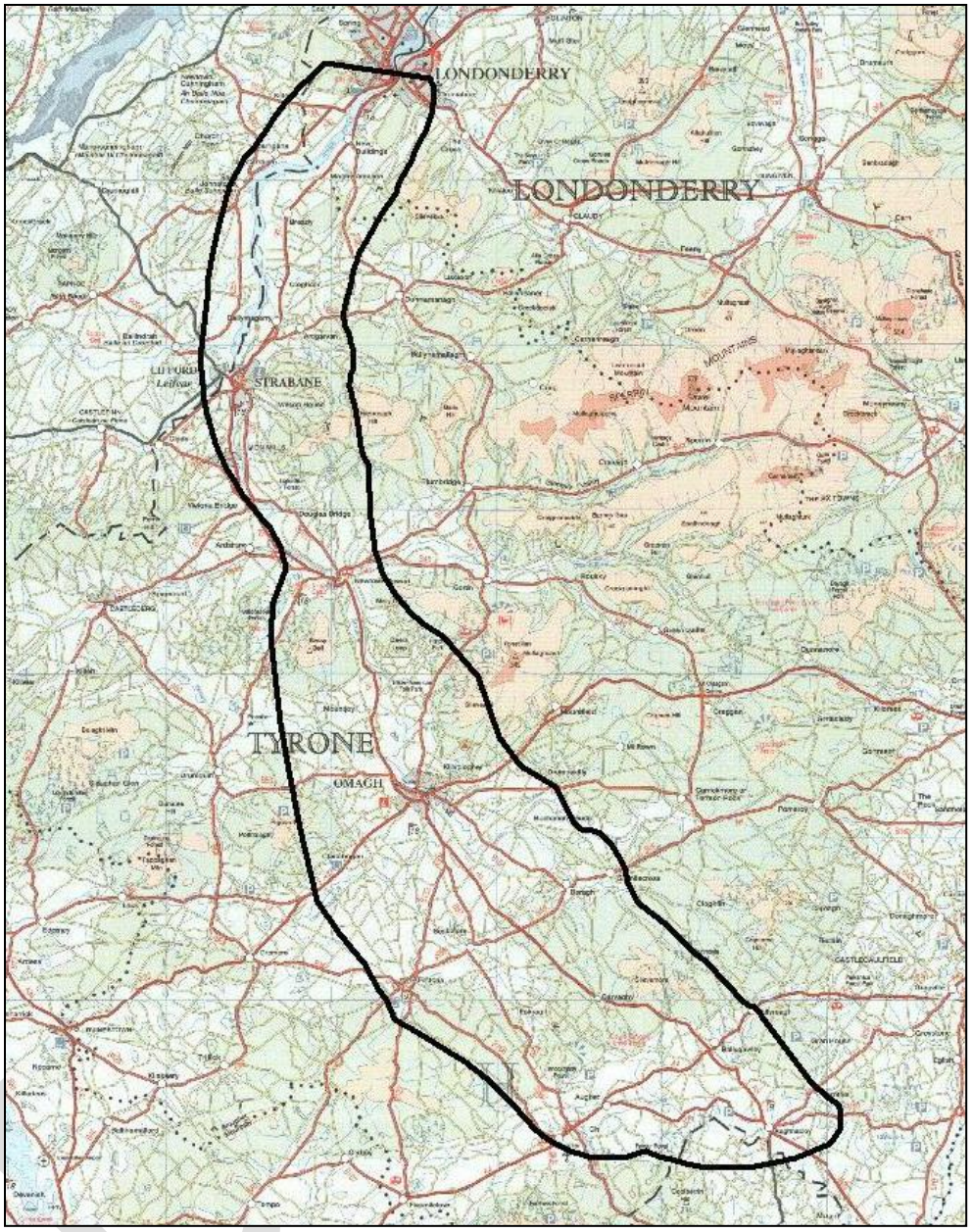

Figure 5.2-1 – Map illustrating the A5 WTC Study Area

6 Route Development

This section summarises the key steps involved in determining an A5 WTC Preferred Route from an initial Study Area which was described in the previous section.

6.1 Development of Preferred Corridor

The Design Manual for Roads and Bridges (DMRB) requires the Stage 1 Assessment of road improvements to identify and consider broadly defined improvement strategies referencing major features as appropriate. Three principal improvement strategies were identified, namely:

- West of the existing A5
- Utilising the existing A5
- East of the existing A5

These three strategies developed into a large number of potential corridors that could improve the link between Londonderry/Derry, Strabane, Omagh, and Aughnacloy, whilst at the same time developing the links between Co. Monaghan and Co. Donegal.

The criteria that were assessed included: cost, engineering, environment, traffic and economics. The Engineering elements assessed were Geotechnical, Flooding & Drainage, Alignment Feasibility & Buildability, Structures and Utilities.

The evaluation of the preliminary corridor options involved a two step approach:

Step 1: Preliminary corridors - exclusion of options where major and/or cumulative constraints precluded further consideration.

Step 2: Draft Preferred corridor - detailed evaluation whereby all planning and engineering design criteria were assessed and reviewed against those options that emerged from step 1.

The draft proposed corridor was further developed in consultation with key representatives from Transport NI to produce the Preferred Corridor.

More detailed information is contained within Preliminary Options Report, *Scheme Assessment Report 1 – Constraints Report.*

6.2 Development of Preferred Route

Following announcement of the Preferred Corridor, the development of the Route Options was carried out in four principal steps:

1) Develop Route Options within the Preferred Corridor avoiding, where possible, significant constraints,

2) Present these Route Options to the public at a series of public consultation events and obtain comment,

3) Carry out initial assessments of the Route Options. Eliminate areas where Routes cannot easily be developed,

4) Develop Routes within the retained lengths of Route Options and undertake full length scheme assessments.

As introduced in Section 1.4, the scheme is divided into three sections to enable the detailed assessment of the area to be undertaken more efficiently. The sections are as follows:

- Section 1: New buildings to south of Strabane

This section can be seen in Figure 6.2-1:

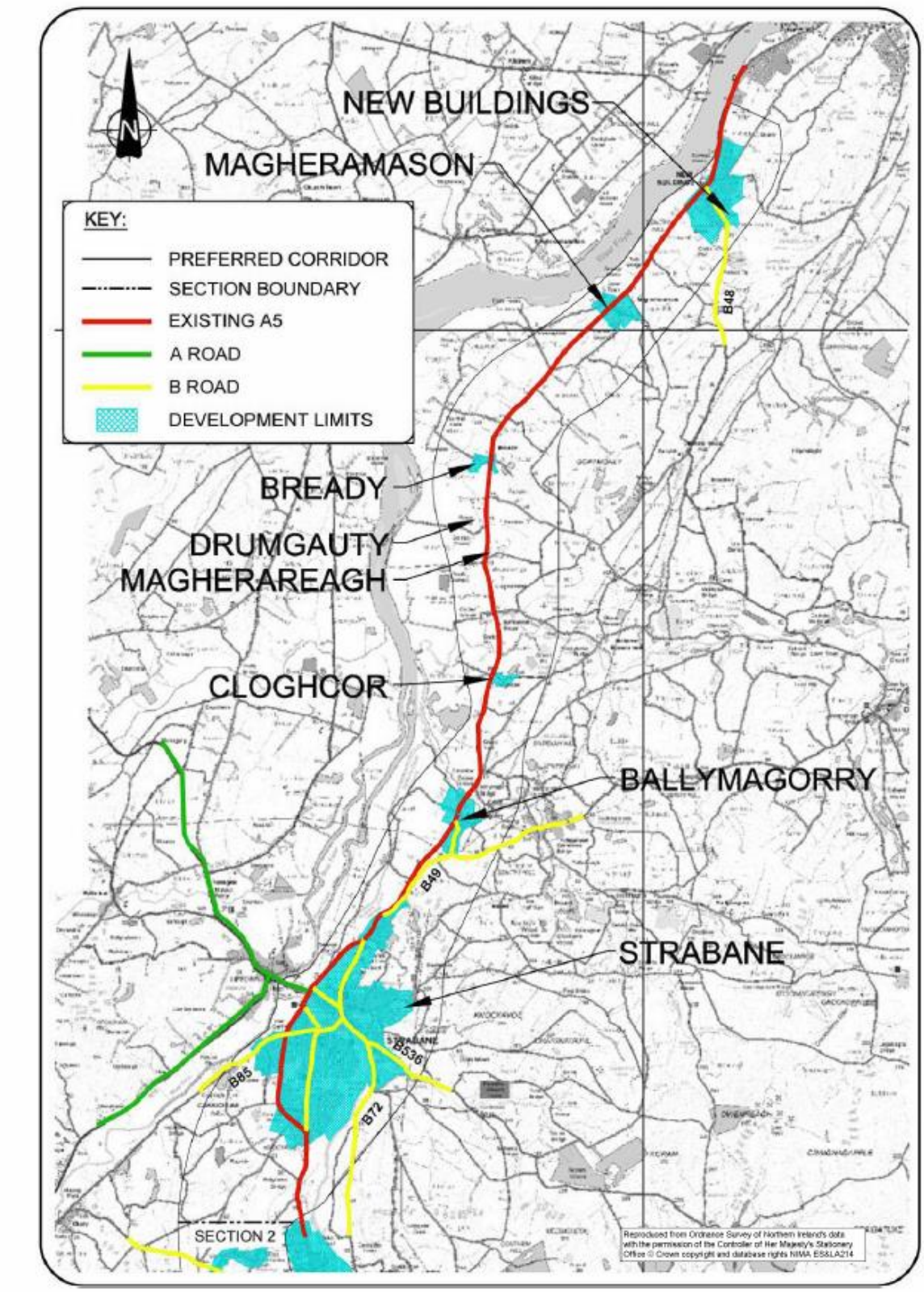

Figure 6.2-1 – Map Illustrating Section 1 of the A5 WTC

- Section 2: South of Strabane to south of Omagh

This section can be seen in Figure 6.2-2:

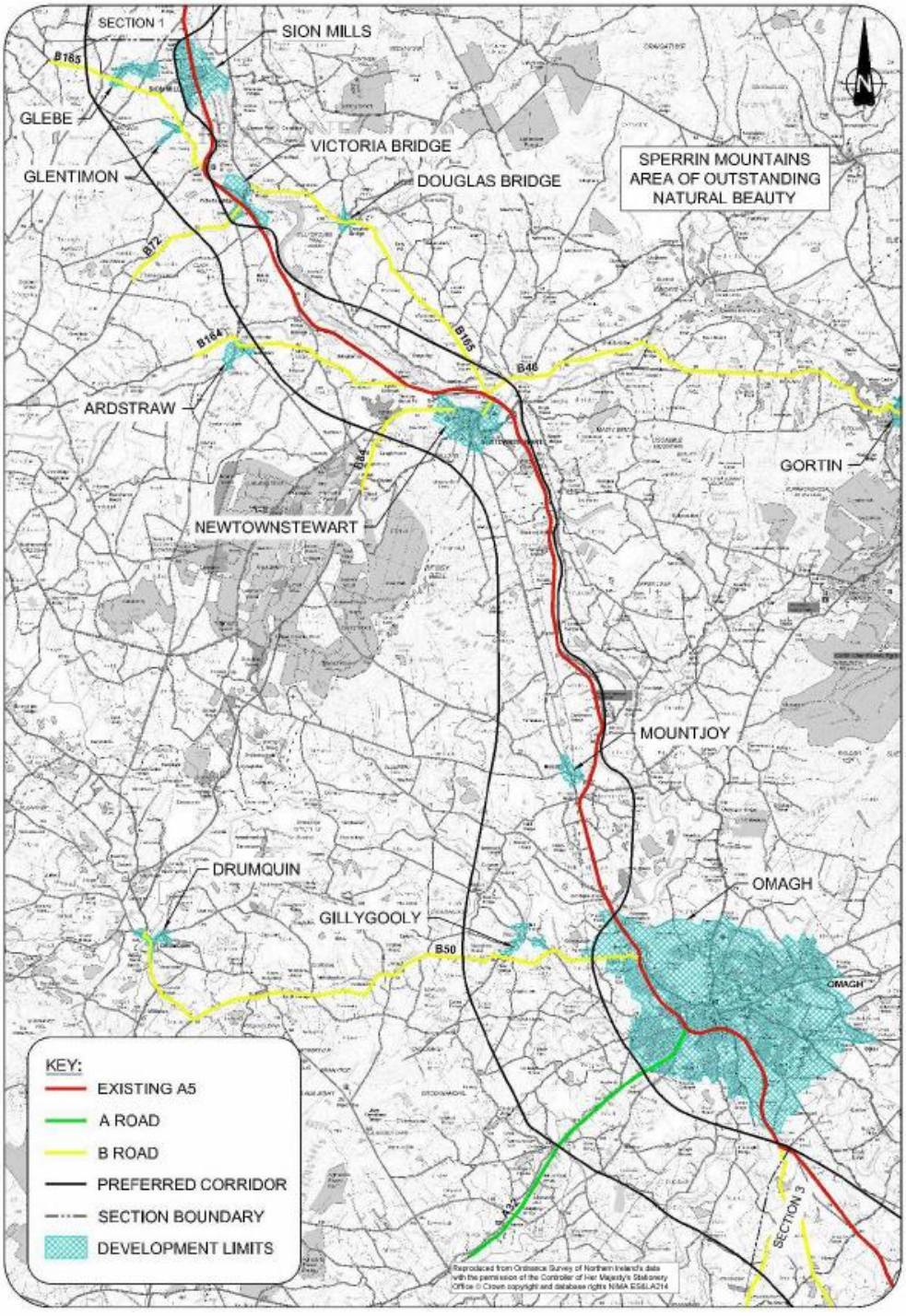

Figure 6.2-2 – Map Illustrating Section 2 of the A5 WTC

- Section 3: South of Omagh to Aughnacloy

This section can be seen in Figure 6.2-3:

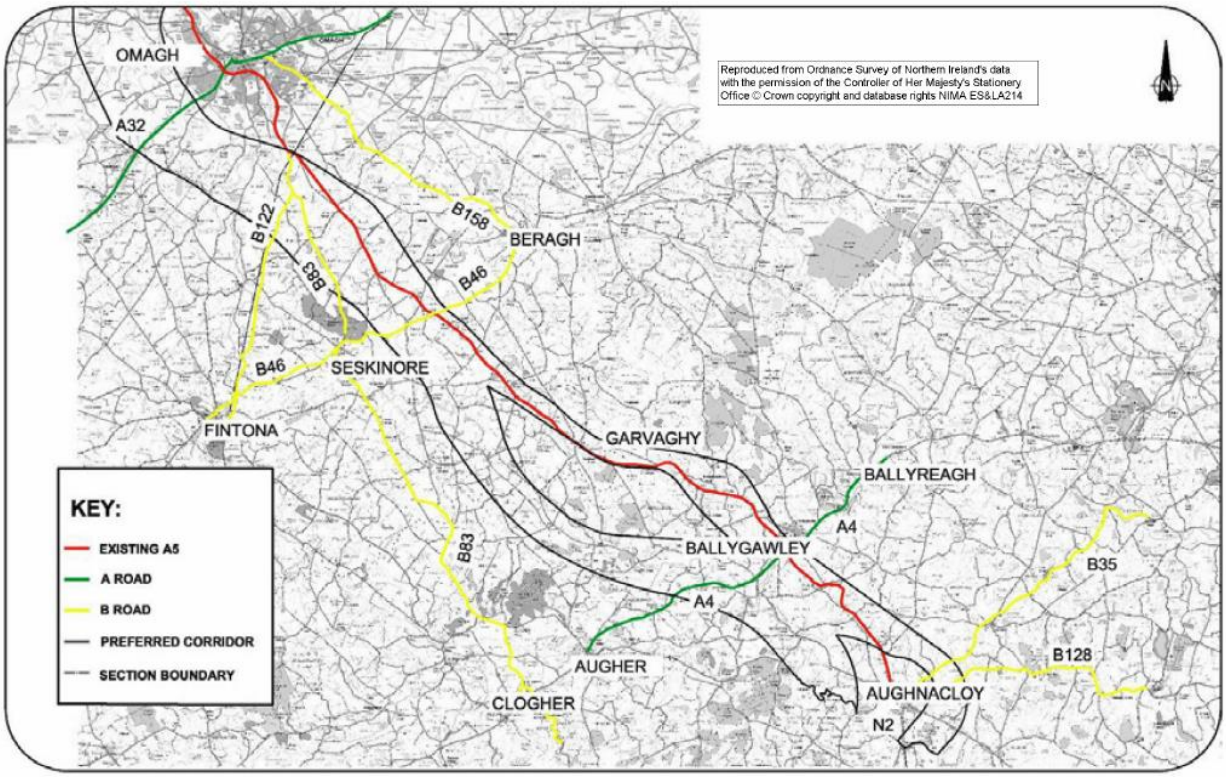

Figure 6.2-3 – Map Illustrating Section 3 of the A5 WTC

Route options were developed using The Design Manual for Roads and Bridges (DMRB) design standards in conjunction with other aims and constraints; details of which are provided within *Preferred Options Report, Section 3.0 Evolution and Description of the Routes.*

As part of the initial route options assessment process, the route options for each section were allocated a colour; Brown, Pink, Green and Blue. These sections were presented at Public Consultation Events. The routes were then appraised in consideration of comments received from the public and key stakeholders, and against the four criteria of engineering, environment, economics and traffic to assist in the development of routes to be taken forward for Stage 2 Assessment. Details of the initial routes can be found in *Preferred Options Report Stage 2 Scheme Assessment Report, Section 3.0 Evolution and Description of the Routes, Section 3.2 Description of Route Options.*

As a result of the first stage appraisal a number recommendations were made which assisted the creation or augmentation of the initial routes to form full length sectional routes. The routes were developed to form four different route options for the sections. Each route option was recognisable by colour and these are as follows:

- Section 1 Route Options: Black, Pink, Green and Purple
- Section 2 Route Options: Yellow, Black, Red and Purple
- Section 3 Route Options: Green, Pink, Purple and Red

The route options for each section can be seen in Drawings 718736-0500-D-00100 to 718736-0500-D-00109 in Appendix B and a description of each route can be found in the *Preferred Options Report, Section 3.4 Routes for Assessment.*

Each of the revised/new routes was once again assessed, based on the four key criteria. Additionally, consideration was given to scheme wide connectivity of the route options. The flooding aspects of this assessment can be seen in Section 7 and were one of the many constraints that were considered during the assessment.

The outcome of the development route options assessment was the emergence of a Preferred Route within each section. The Emerging Preferred Route is discussed in Section 7.4.

7 Preliminary Flood Risk Assessment

This section details the assessment of flood risk for the key route options and provides information on the locations of potential floodplain, the level of significance attached to each floodplain and the estimated significance of impacts arising from the A5 WTC. This was completed as per the preliminary flood risk identification outlined in Section 2.3.1; whereby each option was assessed for potential flooding along the various routes discussed in Section 6.2.

Information in relation to these floodplains was made available to design teams and was given due consideration when developing the Preferred Corridor and then the routes within that corridor.

7.1 Section 1 Floodplains

Drawings 718736-0500-D-00110 to 718736-0500-D-00121 in Appendix B are provided in support of the assessments below.

7.1.1 Green Option

Table 7.1.1-1: Flood Impacts - Green

Approximate Chainage (m)	Watercourse	Feature	Importance of Feature	Magnitude of Impact	Estimated Significance of Potential Impacts
6250	Gortin Hall Drain	Floodplain – Identified from RA Strategic Flood Maps	Low	Approximately 220m of embankment obliquely crossing watercourse and floodplain - Moderate Adverse	Slight
13500	Burndennet	Floodplain – Identified from RA Strategic Flood Maps & Historic Flood Maps	High	Approximately 200m of embankment perpendicularly crossing floodplain - Moderate Adverse	Moderate / Large
24000	Mourne - Strule (Extension)	Floodplain – Identified from RA Strategic Flood Maps & Alluvium Drift Geology	Medium	Approximately 990m of embankment obliquely crossing floodplain - Major Adverse	Large

Table 7.1.1-1: Flood Impacts - Green

Approximate Chainage (m)	Watercourse	Feature	Importance of Feature	Magnitude of Impact	Estimated Significance of Potential Impacts
(N14 Link)	River Finn	Floodplain – Identified from RA Strategic Flood Maps & Alluvium Drift Geology	High	Approximately 180m of embankment perpendicularly crossing floodplain (NI portion only) - Moderate Adverse	Moderate / Large

7.1.2 Pink Option

Table 7.1.2-1: Flood Impacts - Pink

Approximate Chainage (m)	Watercourse	Feature	Importance of Feature	Magnitude of Impact	Estimated Significance of Potential Impacts
7300	Blackstone Burn	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 27m of embankment perpendicularly crossing floodplain - Negligible	Neutral
8000	Undesignated / Blackstone Burn	Floodplain – Identified from RA Strategic Flood Maps	High	Approximately 195m of embankment impacting periphery of floodplain - Moderate Adverse	Moderate / Large
11500	Bready Stream	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 400m of embankment obliquely crossing floodplain – Moderate Adverse	Slight
14500	Burndennet	Floodplain – Identified from RA Strategic Flood Maps & Historical Flooding Records	High	Approximately 220m of embankment perpendicularly crossing floodplain – Moderate Adverse	Moderate / Large

Table 7.1.2-1: Flood Impacts - Pink

Approximate Chainage (m)	Watercourse	Feature	Importance of Feature	Magnitude of Impact	Estimated Significance of Potential Impacts
15000 - 22250	River Foyle	Floodplain – Identified from RA Strategic Flood Maps & Historical Flooding Records	Very High	Approximately 7,000m of embankment impacting the periphery of floodplains and perpendicularly crossing watercourse - Major Adverse	Very Large
(N14 Link)	River Finn	Floodplain – Identified from RA Strategic Flood Maps & Alluvium Drift Geology	High	Approximately 180m of embankment perpendicularly crossing floodplain (NI portion only) - Moderate Adverse	Moderate / Large

7.1.3 Purple Option

Table 7.1.3-1: Flood Impacts - Purple

Approximate Chainage (m)	Watercourse	Feature	Importance of Feature	Magnitude of Impact	Estimated Significance of Potential Impacts
7250	Blackstone Burn	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 27m of embankment perpendicularly crossing floodplain - Negligible	Neutral
8000	Undesignated / Blackstone Burn	Floodplain – Identified from RA Strategic Flood Maps	High	Approximately 195m of embankment impacting periphery of floodplain - Moderate Adverse	Moderate / Large

Table 7.1.3-1: Flood Impacts - Purple

Approximate Chainage (m)	Watercourse	Feature	Importance of Feature	Magnitude of Impact	Estimated Significance of Potential Impacts
10250	Undesignated	Floodplain – Identified from RA Strategic Flood Maps & Alluvium Drift Geology	High	Approximately 400m of embankment perpendicularly crossing floodplain – Moderate Adverse	Moderate / Large
11500 - 13000	Bready Stream / River Foyle	Floodplain – Identified from RA Strategic Flood Maps & Historical Flooding Records	Low	Approximately 1,300m of embankment impacting the periphery of floodplain - Major Adverse	Slight / Moderate
14000 - 19000	Burndennet / River Foyle	Floodplain – Identified from RA Strategic Flood Maps & Historical Flooding Records	High	Approximately 4,500m of embankment obliquely impacting floodplain - Major Adverse	Large / Very Large
24500	Mourne - Strule (Extension)	Floodplain – Identified from RA Strategic Flood Maps & Alluvium Drift Geology	Medium	Approximately 990m of embankment obliquely crossing floodplain - Major Adverse	Large
(N14 Link)	River Finn	Floodplain – Identified from RA Strategic Flood Maps & Alluvium Drift Geology	High	Approximately 180m of embankment perpendicularly crossing floodplain (NI portion only) - Moderate Adverse	Moderate / Large

7.1.4 Black Option

Table 7.1.4-1: Flood Impacts - Black

Approximate Chainage (m)	Watercourse	Feature	Importance of Feature	Magnitude of Impact	Estimated Significance of Potential Impacts
7300	Blackstone Burn	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 27m of embankment perpendicularly crossing floodplain - Negligible	Neutral
8000	Undesignated / Blackstone Burn	Floodplain – Identified from RA Strategic Flood Maps	High	Approximately 195m of embankment impacting periphery of floodplain - Moderate Adverse	Moderate / Large
11500	Bready Stream	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 400m of embankment obliquely crossing floodplain – Moderate Adverse	Slight
14500	Burndennet	Floodplain – Identified from RA Strategic Flood Maps & Historical Flooding Records	High	Approximately 220m of embankment perpendicularly crossing floodplain – Moderate Adverse	Moderate / Large
15000 - 23400	River Foyle / River Finn / River Mourne	Floodplain – Identified from RA Strategic Flood Maps & Historical Flooding Records	Very High	Approximately 8,000m of embankment impacting the periphery of floodplains and perpendicularly crossing watercourse - Major Adverse	Very Large

Table 7.1.4-1: Flood Impacts - Black

Approximate Chainage (m)	Watercourse	Feature	Importance of Feature	Magnitude of Impact	Estimated Significance of Potential Impacts
(N14 Link)	River Finn	Floodplain – Identified from RA Strategic Flood Maps & Alluvium Drift Geology	High	Approximately 180m of embankment perpendicularly crossing floodplain (NI portion only) - Moderate Adverse	Moderate / Large

7.1.5 Section 1 Flood Impacts Summary

A comparison of potential flood impacts for the proposed routes in Section 1 is provided in Table 7.1.5-1 below. This provides a comparison of the total length of each route located within floodplains, along with total number of instances along a route corresponding to the varying degrees of impact significance.

Table 7.1.5-1: Section 1 Flooding Summary

Impact Significance	Route Options			
	Green	Pink	Purple	Black
Total Length of Route Located within Floodplains (m)	1,590	8,022	7,592	9,022
No. Neutral Impacts	-	1	1	1
No. Slight Impacts	1	1	-	1
No. Slight / Moderate Impacts	-	-	1	-
No. Moderate Impacts	-	-	-	-
No. Moderate / Large Impacts	2	3	3	3
No. Large Impacts	1	-	1	-
No. Large / Very Large Impacts	-	-	1	-
No. Very Large Impacts	-	1	-	1

It is identified from the above table that the Pink, Purple and Black options all involve extensive lengths of carriageway within floodplain areas. The extent of carriageway within floodplains for these options ranges from 7.5 km – 9 km.

It is noted that within Section 1 there is a floodplain area with a Very High level of importance attributed to it, whereby the attribute has a high quality and rarity on a regional or national scale (i.e. floodplain or defence protecting more than 100 residential properties). This assessment is based on information obtained from Rivers Agency, historical sources etc as outlined in Section 4 of this report and considers the floodplain as a whole. The River Foyle floodplain, including its upstream tributaries of the Mourne-Strule Extension and the River Finn, are classified as Very High. Furthermore there are significant existing flood defences through Strabane providing protection to the town from flooding. The Pink and the Black options both have the potential to have a major adverse impact on the floodplain attribute.

As outlined above, the floodplain in the vicinity of Strabane is deemed to be of Very High importance. In this location, both the Pink and the Black options propose extensive lengths of carriageway within the floodplain zone. It is further identified that the Purple option also has a significant length of carriageway within the potential floodplain.

The town of Strabane sits at the confluence of the Mourne-Strule River and the River Finn, which combine to form the River Foyle. Flood defences have been provided to Strabane town and these defences protect a significant number of properties within the town centre and along the existing A5.

Although information was not available at the time of the preliminary assessment to fully quantify the impact of the various option proposals on predicted water levels, it is recognised that extensive construction within the floodplain could materially impact flood risk.

It is acknowledged that preliminary consideration of floodplain constraints along the River Foyle did inform the development of options. Where development of an option within the floodplain was deemed necessary; alignments have been restricted to the periphery of the floodplain, wherever possible. Preliminary assessments also identified potential mitigation strategies such as the provision of connectivity that could be adopted in order to minimise changes in flood risk.

7.2 Section 2 Floodplains

Drawings 718736-0500-D-00122 to 718736-0500-D-00138 in Appendix B are provided in support of the assessments below.

7.2.1 Black Option

Table 7.2.1-1: Flood Impact - Black

Approximate Chainage (m)	Watercourse	Feature	Importance of Feature	Magnitude of Impact	Estimated Significance of Potential Impacts
30000	Undesignated	Floodplain – Identified from RA Strategic Flood Maps	Low	Approximately 110m of embankment infilling floodplain - Moderate Adverse	Slight
34500	River Derg	Floodplain – Identified from RA Strategic Flood Maps & Alluvium Drift Geology	Low	Approximately 80m of embankment perpendicularly crossing floodplain - Minor Adverse	Neutral
36500	Undesignated	Floodplain – Identified from RA Strategic Flood Maps & Alluvium Drift Geology	Medium	Approximately 127m of embankment perpendicularly crossing floodplain - Moderate Adverse	Moderate
49500 - 51500	Fairy Water (inc. Aghnamoyle Drain, Coneywarren Drain, Tully Drain & Rash Drain)	Floodplain – Identified from RA Strategic Flood Maps & Historical Flooding Records	High	Approximately 1,350m of embankment obliquely crossing floodplain – Major Adverse	Large / Very Large
57000	Drumragh River	Floodplain – Identified from RA Strategic Flood Maps & Historical Flooding Records	Low	Approximately 88m of embankment perpendicularly crossing floodplain - Minor Adverse	Neutral

7.2.2 Red Option

Table 7.2.2-1: Flood Impact - Red

Approximate Chainage (m)	Watercourse	Feature	Importance of Feature	Magnitude of Impact	Estimated Significance of Potential Impacts
30000	Undesignated	Floodplain – Identified from RA Strategic Flood Maps	Low	Approximately 110m of embankment infilling floodplain - Moderate Adverse	Slight
34500	River Derg	Floodplain – Identified from RA Strategic Flood Maps & Alluvium Drift Geology	Low	Approximately 60m of embankment perpendicularly crossing floodplain - Minor Adverse	Neutral
38250 - 40000	Mourne - Strule	Floodplain – Identified from RA Strategic Flood Maps & Alluvium Drift Geology	High	Approximately 730m of embankment obliquely crossing floodplain – Major Adverse	Large / Very Large
50500 - 52500	Fairy Water (inc. Aghnamoyle Drain, Coneywarren Drain, Tully Drain & Rash Drain)	Floodplain – Identified from RA Strategic Flood Maps & Historical Flooding Records	High	Approximately 1,350m of embankment obliquely crossing floodplain – Major Adverse	Large / Very Large
58000	Drumragh River	Floodplain – Identified from RA Strategic Flood Maps & Historical Flooding Records	Low	Approximately 88m of embankment perpendicularly crossing floodplain - Minor Adverse	Neutral

7.2.3 Purple Option

Table 7.2.3-1: Flood Impact - Purple

Approximate Chainage (m)	Watercourse	Feature	Importance of Feature	Magnitude of Impact	Estimated Significance of Potential Impacts
34250	River Derg	Floodplain – Identified from RA Strategic Flood Maps & Alluvium Drift Geology	Low	Approximately 130m of embankment perpendicularly crossing floodplain - Moderate Adverse	Slight
37500 - 39500	Mourne - Strule	Floodplain – Identified from RA Strategic Flood Maps & Alluvium Drift Geology	High	Approximately 730m of embankment obliquely crossing floodplain – Major Adverse	Large / Very Large
49750 - 51750	Fairy Water (inc. Aghnamoyle Drain, Coneywarren Drain, Tully Drain & Rash Drain)	Floodplain – Identified from RA Strategic Flood Maps & Historical Flooding Records	High	Approximately 1,350m of embankment obliquely crossing floodplain – Major Adverse	Large / Very Large
57250	Drumragh River	Floodplain – Identified from RA Strategic Flood Maps & Historical Flooding Records	Low	Approximately 88m of embankment perpendicularly crossing floodplain - Minor Adverse	Neutral

7.2.4 Yellow Option

Table 7.2.4-1: Flood Impact - Yellow

Approximate Chainage (m)	Watercourse	Feature	Importance of Feature	Magnitude of Impact	Estimated Significance of Potential Impacts
30000	Undesignated	Floodplain – Identified from RA Strategic Flood Maps	Low	Approximately 110m of embankment infilling floodplain - Moderate Adverse	Slight
34500	River Derg	Floodplain – Identified from RA Strategic Flood Maps & Alluvium Drift Geology	Low	Approximately 80m of embankment perpendicularly crossing floodplain - Minor Adverse	Neutral
36500	Undesignated	Floodplain – Identified from RA Strategic Flood Maps & Alluvium Drift Geology	Medium	Approximately 127m of embankment perpendicularly crossing floodplain - Moderate Adverse	Moderate
47000	Undesignated	Floodplain – Identified from RA Strategic Flood Maps	Low	Approximately 235m of embankment perpendicularly crossing floodplain - Moderate Adverse	Slight
48250 - 49500	Fairy Water (inc.Calkill Drain & Gillygooly watercourse)	Floodplain – Identified from RA Strategic Flood Maps & Historical Flooding Records	Low	Approximately 690m of embankment impacting peripheral extents of floodplain - Major Adverse	Slight / Moderate
57000	Drumragh River	Floodplain – Identified from RA Strategic Flood Maps & Historical Flooding Records	Low	Approximately 250m of embankment impacting peripheral extents of floodplain - Moderate Adverse	Slight

7.2.5 Section 2 Flood Impacts Summary

A comparison of potential flood impacts for the proposed routes in Section 2 is provided in Table 7.2.5-1 below. This provides a comparison of the total length of each route located within floodplains, along with the total number of instances along a route corresponding to the varying degrees of impact significance.

Table 7.2.5-1: Section 2 Flooding Summary

Impact Significance	Route Options			
	Black	Red	Purple	Yellow
Total Length of Route Located within Floodplains (m)	1,755	2,338	2,298	1,492
No. Neutral Impacts	2	2	1	1
No. Slight Impacts	1	1	1	3
No. Slight / Moderate Impacts	-	-	-	1
No. Moderate Impacts	1	-	-	1
No. Moderate / Large Impacts	-	-	-	-
No. Large Impacts	-	-	-	-
No. Large / Very Large Impacts	1	2	2	-
No. Very Large Impacts	-	-	-	-

The Yellow option exhibits the shortest length of highway located within floodplains, with the scale of the impact not exceeding moderate. The Red and the Purple options involve the greatest lengths of carriageway to be located within floodplains.

There are two areas that have a high level of importance attributed to them, whereby the existence of floodplain or flood defence affects between 1 – 100 residential properties or industrial premises. The areas are the floodplain associated with the Mourne-Strule Extension in the vicinity of Newtownstewart and that associated with the Fairy Water in the vicinity of Omagh.

The floodplain in the vicinity of Newtownstewart is deemed to be of high importance; in this location both the Red and the Purple options propose utilisation of the existing Newtownstewart Bypass.

The proposed alignment along the Red and Purple options around Newtownstewart could involve the requirement to increase the embankment located within the floodplain over a distance of approximately 730m. It is

considered that an overall loss of floodplain storage could increase flood risk, with mitigation subsequently being required. It is anticipated that implementation of these measures may disrupt the existing embankment/road structure.

The floodplain area to the north-west of Omagh, along the Fairy Water and its associated tributaries, is deemed to be of high importance. At this location the Red, Purple and Black options obliquely cross the floodplain for a distance of approximately 1.3km.

Although no information was available at the time of the preliminary assessment to fully estimate the volume of floodplain storage lost as a result of the Red, Purple and Black options or quantify the scale of the impact, it is identified that extensive construction within the floodplain could materially impact flood risk and that mitigation would be required.

7.3 Section 3 Floodplains

Drawings 718736-0500-D-00139 to 718736-0500-D-00153 in Appendix B are provided in support of the below assessments.

7.3.1 Red Option

Table 7.3.1-1: Flood Impact - Red

Approximate Chainage (m)	Watercourse	Feature	Importance of Feature	Magnitude of Impact	Estimated Significance of Potential Impacts
64500	Ranelly Creamery Drain	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 121m of embankment perpendicularly crossing floodplain - Moderate Adverse	Slight / Moderate
65500	Ranelly Drain	Floodplain – Identified from RA Strategic Flood Maps	Low	Approximately 55m of embankment perpendicularly crossing floodplain - Minor Adverse	Neutral
69000	Letfern	Floodplain – Identified from Alluvium Drift Geology Mapping	High	Approximately 108m of embankment perpendicularly crossing floodplain - Moderate Adverse	Moderate / Large

Table 7.3.1-1: Flood Impact - Red

Approximate Chainage (m)	Watercourse	Feature	Importance of Feature	Magnitude of Impact	Estimated Significance of Potential Impacts
70250	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 150m of embankment perpendicularly crossing floodplain – Moderate Adverse	Slight
70500	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 60m of embankment perpendicularly crossing floodplain - Minor Adverse	Neutral
72000	Routing Burn Extension	Floodplain – Identified from RA Strategic Flood Maps	Low	Approximately 40m of embankment perpendicularly crossing floodplain - Negligible	Neutral
73000	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 140m of embankment perpendicularly crossing floodplain - Moderate Adverse	Slight
79000	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 140m of embankment perpendicularly crossing floodplain - Moderate Adverse	Slight
82000	Roughan	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 335m of embankment obliquely crossing floodplain – Moderate Adverse	Slight

Table 7.3.1-1: Flood Impact - Red

Approximate Chainage (m)	Watercourse	Feature	Importance of Feature	Magnitude of Impact	Estimated Significance of Potential Impacts
82500	Annaghilla	Floodplain – Identified from Alluvium Drift Geology Mapping	Medium	Approximately 127m of embankment obliquely crossing floodplain – Moderate Adverse	Moderate
83500	Annaghilla	Floodplain – Identified from RA Strategic Flood Maps & Alluvium Drift Geology	Low	Approximately 310m of embankment obliquely crossing floodplain – Moderate Adverse	Slight
84750	Ballygawley Water	Floodplain – Identified from RA Strategic Flood Maps & Alluvium Drift Geology	High	Approximately 1,000m of embankment and junctions obliquely crossing floodplain – Major Adverse	Large / Very Large
87500	Undesignated	Floodplain – Identified from RA Strategic Flood Maps	Low	Approximately 56m of embankment infilling floodplain – Minor Adverse	Neutral
88500	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 620m of embankment obliquely crossing floodplain – Major Adverse	Slight / Moderate
89700	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 45m of embankment infilling floodplain – Negligible	Neutral
90250	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 250m of embankment perpendicularly crossing floodplain - Moderate Adverse	Slight

Table 7.3.1-1: Flood Impact - Red

Approximate Chainage (m)	Watercourse	Feature	Importance of Feature	Magnitude of Impact	Estimated Significance of Potential Impacts
91000	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 200m of embankment obliquely crossing floodplain - Moderate Adverse	Slight
92000	Lisadavil / Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	Medium	Approximately 45m of embankment periphery of floodplain - Negligible	Neutral
92500	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 100m of embankment perpendicularly crossing floodplain – Minor Adverse	Neutral
93250 / 94000	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	High	Approximately 625m of embankment perpendicularly crossing floodplain – Major Adverse	Large / Very Large
95000	River Blackwater	Floodplain – Historic Flood Maps & Alluvium Drift Geology	Low	Approximately 100m of embankment perpendicularly crossing floodplain – Minor Adverse	Neutral

7.3.2 Pink Option

Table 7.3.2-1: Flood Impact - Pink

Approximate Chainage (m)	Watercourse	Feature	Importance of Feature	Magnitude of Impact	Estimated Significance of Potential Impacts
63500	Ranelly Drain	Floodplain – Identified from RA Strategic Flood Maps	Low	Approximately 40m of embankment perpendicularly crossing floodplain - Negligible	Neutral
66750	Raw Drain Branch	Floodplain – Identified from RA Strategic Flood Maps & Alluvium Drift Geology	Low	Approximately 90m of embankment perpendicularly crossing floodplain - Minor Adverse	Neutral
69000	Letfern	Floodplain – Identified from RA Strategic Flood Maps & Alluvium Drift Geology	High	Approximately 427m of embankment and possible junctions obliquely crossing floodplain – Moderate Adverse	Moderate / Large
72750	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	Medium	Approximately 60m of embankment perpendicularly crossing floodplain – Minor Adverse	Slight
76250	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	Medium	Approximately 120m of embankment perpendicularly crossing floodplain - Moderate Adverse	Moderate
79800	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	High	Approximately 38m of embankment perpendicularly crossing floodplain - Negligible	Neutral

Table 7.3.2-1: Flood Impact - Pink

Approximate Chainage (m)	Watercourse	Feature	Importance of Feature	Magnitude of Impact	Estimated Significance of Potential Impacts
80000	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	High	Approximately 95m of embankment perpendicularly crossing floodplain – Minor Adverse	Slight / Moderate
80750	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	High	Approximately 159m of embankment obliquely crossing floodplain – Moderate Adverse	Moderate / Large
82000	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 240m of embankment obliquely crossing floodplain – Moderate Adverse	Slight
83000	Feddan	Floodplain – Identified from Alluvium Drift Geology Mapping	High	Approximately 250m of embankment perpendicularly crossing floodplain – Moderate Adverse	Moderate / Large
83500	Ballygawley Water	Floodplain – Identified from RA Strategic Flood Maps & Alluvium Drift Geology	High	Approximately 1,060m of embankment and junctions obliquely crossing floodplain – Major Adverse	Large / Very Large
86000	Tullyvar	Floodplain – Identified from RA Strategic Flood Maps & Alluvium Drift Geology	Low	Approximately 485m of embankment obliquely crossing floodplain – Moderate Adverse	Slight

Table 7.3.2-1: Flood Impact - Pink

Approximate Chainage (m)	Watercourse	Feature	Importance of Feature	Magnitude of Impact	Estimated Significance of Potential Impacts
86900	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 135m of embankment perpendicularly crossing floodplain – Moderate Adverse	Slight
89150	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 150m of embankment perpendicularly crossing floodplain – Moderate Adverse	Slight
90150	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 80m of embankment impacting periphery of floodplain – Minor Adverse	Neutral
91250	Lisadavil	Floodplain – Identified from RA Strategic Flood Maps & Alluvium Drift Geology	Medium	Approximately 245m of embankment obliquely crossing floodplain – Moderate Adverse	Moderate
92000	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 370m of embankment perpendicularly crossing floodplain – Moderate Adverse	Slight
93000	River Blackwater	Floodplain – Historic Flood Maps & Alluvium Drift Geology	Low	Approximately 100m of embankment perpendicularly crossing floodplain – Minor Adverse	Neutral

7.3.3 Green Option

Table 7.3.3-1: Flood Impact - Green

Approximate Chainage (m)	Watercourse	Feature	Importance of Feature	Magnitude of Impact	Estimated Significance of Potential Impacts
63000	Freughmore Drain	Floodplain – Identified from RA Strategic Flood Maps	Low	Approximately 95m of embankment perpendicularly crossing floodplain – Minor Adverse	Neutral
68000	Letfern	Floodplain – Identified from Alluvium Drift Geology Mapping	High	Approximately 370m of embankment and junctions perpendicularly crossing floodplain – Moderate Adverse	Moderate / Large
69000	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 141m of embankment perpendicularly crossing floodplain – Moderate Adverse	Slight
69500	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 60m of embankment perpendicularly crossing floodplain – Minor Adverse	Neutral
71000	Routing Burn Extension	Floodplain – Identified from RA Strategic Flood Maps	Low	Approximately 40m of embankment perpendicularly crossing floodplain - Negligible	Neutral
71750	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 140m of embankment perpendicularly crossing floodplain - Moderate Adverse	Slight

Table 7.3.3-1: Flood Impact - Green

Approximate Chainage (m)	Watercourse	Feature	Importance of Feature	Magnitude of Impact	Estimated Significance of Potential Impacts
77750	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 140m of embankment perpendicularly crossing floodplain - Moderate Adverse	Slight
80750	Roughan	Floodplain – Identified from Alluvium Drift Geology Mapping	High	Approximately 205m of embankment perpendicularly crossing floodplain - Moderate Adverse	Moderate / Large
83250	Ballygawley Water	Floodplain – Identified from Alluvium Drift Geology Mapping	High	Approximately 1,500m of embankment and junctions obliquely crossing floodplain – Major Adverse	Large / Very Large
84250	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 60m of embankment (side road) perpendicularly crossing floodplain - Minor Adverse	Neutral
84750	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 150m of embankment perpendicularly crossing floodplain - Moderate Adverse	Slight
85500	Tullyvar / Tullyvar Branch	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 565m of embankment perpendicularly crossing floodplain - Major Adverse	Slight / Moderate

Table 7.3.3-1: Flood Impact - Green

Approximate Chainage (m)	Watercourse	Feature	Importance of Feature	Magnitude of Impact	Estimated Significance of Potential Impacts
86500	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 180m of embankment perpendicularly crossing floodplain - Moderate Adverse	Slight
86750	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 90m of embankment perpendicularly crossing floodplain - Minor Adverse	Neutral
87400	Ravella	Floodplain – Identified from RA Strategic Flood Maps	Low	Approximately 40m of embankment perpendicularly crossing floodplain - Negligible	Neutral
88000	Ravella / Undesignated	Floodplain – Historic Flood Maps & Alluvium Drift Geology	High	Approximately 930m of embankment and junctions obliquely crossing floodplain – Major Adverse	Large / Very Large
89000 / 89500	Ravella / Aughnacloy River	Floodplain – Historic Flood Maps & Alluvium Drift Geology	High	Approximately 960m of embankment and junctions obliquely crossing floodplain – Major Adverse	Large / Very Large
90000	River Blackwater	Floodplain – Historic Flood Maps & Alluvium Drift Geology	Low	Approximately 400m of embankment running parallel to floodplain - Moderate Adverse	Slight

7.3.4 Purple Option

Table 7.3.4-1: Flood Impact - Purple

Approximate Chainage (m)	Watercourse	Feature	Importance of Feature	Magnitude of Impact	Estimated Significance of Potential Impacts
63000	Freughmore Drain	Floodplain – Identified from RA Strategic Flood Maps	Low	Approximately 95m of embankment perpendicularly crossing floodplain – Minor Adverse	Neutral
65000	Ranelly Drain	Floodplain – Identified from RA Strategic Flood Maps	Low	Approximately 45m of embankment perpendicularly crossing floodplain – Negligible	Neutral
68500	Letfern	Floodplain – Identified from RA Strategic Flood Maps & Alluvium Drift Geology	High	Approximately 427m of embankment and possible junctions obliquely crossing floodplain – Moderate Adverse	Moderate / Large
72250	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	Medium	Approximately 60m of embankment perpendicularly crossing floodplain – Minor Adverse	Slight
75750	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	Medium	Approximately 120m of embankment perpendicularly crossing floodplain - Moderate Adverse	Moderate
79300	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	High	Approximately 38m of embankment perpendicularly crossing floodplain - Negligible	Neutral

Table 7.3.4-1: Flood Impact - Purple

Approximate Chainage (m)	Watercourse	Feature	Importance of Feature	Magnitude of Impact	Estimated Significance of Potential Impacts
79500	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	High	Approximately 95m of embankment perpendicularly crossing floodplain – Minor Adverse	Slight / Moderate
80250	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	High	Approximately 159m of embankment obliquely crossing floodplain – Moderate Adverse	Moderate / Large
81500	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 240m of embankment obliquely crossing floodplain – Moderate Adverse	Slight
82500	Feddan	Floodplain – Identified from Alluvium Drift Geology Mapping	High	Approximately 250m of embankment perpendicularly crossing floodplain – Moderate Adverse	Moderate / Large
83000	Ballygawley Water	Floodplain – Identified from RA Strategic Flood Maps & Alluvium Drift Geology	High	Approximately 1,060m of embankment and junctions obliquely crossing floodplain – Major Adverse	Large / Very Large
86000	Undesignated	Floodplain – Identified from RA Strategic Flood Maps	Low	Approximately 56m of embankment infilling floodplain – Minor Adverse	Neutral

Table 7.3.4-1: Flood Impact - Purple

Approximate Chainage (m)	Watercourse	Feature	Importance of Feature	Magnitude of Impact	Estimated Significance of Potential Impacts
88750	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 150m of embankment perpendicularly crossing floodplain – Moderate Adverse	Slight
89750	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 80m of embankment impacting periphery of floodplain – Minor Adverse	Neutral
90750	Lisadavil	Floodplain – Identified from RA Strategic Flood Maps & Alluvium Drift Geology	Medium	Approximately 245m of embankment obliquely crossing floodplain – Moderate Adverse	Moderate
91500	Undesignated	Floodplain – Identified from Alluvium Drift Geology Mapping	Low	Approximately 370m of embankment perpendicularly crossing floodplain – Moderate Adverse	Slight
92750	River Blackwater	Floodplain – Historic Flood Maps & Alluvium Drift Geology	Low	Approximately 100m of embankment perpendicularly crossing floodplain – Minor Adverse	Neutral

7.3.5 Section 3 Flood Impacts Summary

A comparison of potential flood impacts for the proposed routes in Section 3 is provided in Table 7.3.5-1. This provides a comparison of the total length of each route located within floodplains, along with total number of instances along a route corresponding to the varying degrees of impact significance.

Table 7.3.5-1: Section 3 Flooding Summary

Impact Significance	Route Options			
	Red	Pink	Green	Purple
Total Length of Route Located within Floodplains (m)	4,627	4,144	6,066	3,590
No. Neutral Impacts	8	5	6	6
No. Slight Impacts	7	6	6	4
No. Slight / Moderate Impacts	2	1	1	1
No. Moderate Impacts	1	2	-	2
No. Moderate / Large Impacts	1	3	2	3
No. Large Impacts	-	-	-	-
No. Large / Very Large Impacts	2	1	3	1
No. Very Large Impacts	-	-	-	-

The Purple option exhibits the shortest length of carriageway located within floodplains. The Green option involves the greatest length of carriageway to be located within floodplains, with 3 No. impacts identified as Large/Very Large.

It is identified that there are three areas where there is the potential for Large/Very Large level of impact if flood risk is not appropriately mitigated. The areas are the floodplain associated with the Ballygawley Water in the vicinity of Ballygawley, the floodplain area associated with the confluence of the Ravella and Aughnacloy Rivers to the River Blackwater (south-west of Aughnacloy) and potential floodplain areas associated with Lisadavil to the south/south-east of Aughnacloy.

It is observed from Table 7.3.5-1 above that all options have the potential to impact floodplains associated with the Ballygawley Water.

It was also identified that the Green option had the potential to have a Large / Very Large impact on the floodplain area associated with the Ravella River / Aughnacloy River and the River Blackwater.

Although insufficient information was available at the time of the preliminary assessment to fully estimate the volume of floodplain storage lost as a result of the Red, Purple and Black options or quantify the scale of the impact, it is identified that extensive construction within the floodplain could materially impact flood risk and that mitigation would be required.

It was identified that the Red, Purple and Pink options have the potential to impact on the potential floodplain area associated with undesignated watercourses to the south /south-east of Aughnacloy. It is noted that only the Red option impacts this area in a Large/Very Large way due to the extended length of carriageway within the floodplain area.

It is highlighted that this area has been identified from alluvium mapping and is not indicated on other flood mapping sources; historical flood records or Rivers Agency Strategic Flood Maps.

7.4 Emerging Preferred Route

The above assessments were all given due consideration at the Preferred Options Workshop held with Discipline Leaders, the Project Management team and Transport NI representatives between 5th and 7th May 2009, when developing the Preferred Route in conjunction with all other identified constraints. The *Preferred Options Report - Scheme Assessment Report 2* provides full details in relation to the route development; resulting in the Preferred Route. Drawings 718736-0500-D-00154 to 718736-0500-D-00163 in Appendix B illustrate the Preferred Route as published in July 2009. A summary of the Preferred Route selected for each section is provided below:

7.4.1 Section 1 Preferred Route

Following due consideration of the assessments undertaken, the Purple Route is preferred from the commencement of the scheme south of New Buildings. It continues south before adopting the Black Route, at approximately Chainage 8000, for the remainder of Section 1. Refinements to this route were made and can be seen in the *Preferred Options Report - Scheme Assessment Report 2.*

7.4.2 Section 2 Preferred Route

Following due consideration of the assessments undertaken, it was recommended that the Black Route option should be taken forward as the Preferred Route for Section 2 subject to examination of a number of alternatives in specified areas; details of which can be seen in the *Preferred Options Report - Scheme Assessment Report 2.*

7.4.3 Section 3 Preferred Route

Following due consideration of the assessments undertaken it is recommended that the Preferred Route for Section 3 initially follows the alignment of the Red Route as far as the A4 before adopting the Pink Route for the remainder of Section 3. Refinements to this route were made and can be seen in the *Preferred Options Report - Scheme Assessment Report 2.*

7.4.4 Overall Preferred Route Description and Main Affected Watercourses

The northern terminal point of the proposed A5 WTC is located to the northwest of Newbuildings, close to Woodside road. It begins here to allow for future development of the proposed A6 link. Here the proposed route must cross its first minor watercourse, Newbuildings stream.

The road continues south west, located between the River Foyle and the existing A5. After 2.5km the proposed road passes over another watercourse, Gortin Hall Drain. The road travels south west, travelling to the north west of the village of Magheramason. At this location it crosses another watercourse, Blackstone Burn.

The Proposed A5 WTC continues its way south intersecting the existing A5 at the east side of the Cloghboy road, taking the road away from the River Foyle's flood bank. From here the route travels for a further 2.7km to the east of the existing A5, bypassing the village of Bready to the west. It crosses the existing A5 650m south of the Donagheady road, and continues to the west of the existing A5. At 10.5km from the start of the Proposed Route, the road bridges its first major watercourse the Burndennet. The road travels to the west of the existing A5 for a further 2.2km when it goes across another major watercourse, the Glenmornan River.

The route maintains its course between the Foyle and A5 passing to the west of Ballymagorry, and then onwards past the west of Strabane, crossing the Mourne River approximately 100m downstream from the existing A5 bridge.

The road resumes to the south west travelling between the River Finn and Urney Road, 240m to the South West of Glenfinn Park a junction will be installed with the intention of future development with the N14/N15 Letterkenny link. From here the proposed road changes direction and travels due South, passing behind Sion Mills keeping to the west of the existing A5, passing over minor watercourses.

Progressing into Section 2, the route continues south, keeping to the west of the existing A5, crossing minor watercourses. It bridges the river Derg 420m upstream from the existing A5 Bridge. A further 2.1km south, the route crosses Coolaghy Burn. Continuing towards Omagh, the preferred route passes to the south of Newtownstewart. The route then makes its way back towards the existing A5; from here it follows its path south, crossing more watercourses including Tully Drain.

As the proposed road approaches Omagh, it must traverse the Fairy Water River, 327m upstream from the existing A5 bridge, and to the west of the Omagh Rugby Club grounds.

From here the proposed A5 WTC passes around Omagh keeping to the west of the town, crossing over three more watercourses Aghnamoyle drain, Fireagh

Lough Drain and Loughmuck. 300m from Loughmuck the proposed route passes over another major river, the Drumragh. The crossing is located 190m to the south east of the Ballynahatty road and 580m south of the Shanley road.

Section 3 of the proposed road then makes its way back towards the existing A5, then follows its path south east, keeping west of the road.

After Drumconnelly road, the distance between the existing A5 gradually increases, crossing the watercourse Ranelly Drain and Tullyrush Road. From here, the road travels south east crossing the Moylagh road and Augherpoint Road, 200m to the south west of where these roads meet; the route also passes over Letfern watercourse.

The Preferred Route continues south east for another 3km where it must pass another main watercourse, Routing Burn, located 445m to the south of Greenmount Road and 320m to the east of Killadroy Road. A further 2km south, the route passes the Springhill Road at the point where a watercourse is already bridged.

The proposed road proceeds south east for a further 3.6km going over minor watercourses, here it changes direction and begins to head east. 4km on and the preferred route must traverse the Roughan River. After a further 2km it approaches the existing A4 and it is proposed that there will be a junction at this location.

350m to the south east of this junction the proposed road will pass over the Ballygawley Water. After a further 4.7km in a south eastern direction, the proposed road changes direction in order to circle around Aughnacloy; from north to south, clockwise. When the proposed road is to the east of Aughnacloy, it crosses another main watercourse, Lisadavil, and the road then travels south towards the Blackwater River.

A junction will be put in place where the proposed road crosses the Caledon Road; afterwards it ends where it meets the Monaghan Road with the potential of future development onwards towards Dublin.

8 Hydraulic Modelling Requirements

Preliminary flood risk assessments identified a number of floodplains within the study area of the A5 WTC and along the alignment of the Preferred Route. Tables 8-1, 8-2 and 8-3 below identify where there is considered to be potential floodplains along the Preferred Route of the A5 WTC and the data sources utilised to indicate these potential floodplains. Drawings 718736-0500-D-00164 - 718736-0500-D-00183, Appendix B, illustrate potential floodplains identified along the Preferred Route.

It was identified that no detailed information relating to design criteria floodplain extents and estimated flood levels was available for the floodplains identified along the Preferred Route; therefore hydraulic models were developed for the locations detailed in Tables 8-1 - 8-3.

It can be seen in the following tables that the requirement for hydraulic models were identified using historical flood maps, alluvium mapping, Rivers Agency Strategic Flood Maps and other sources; which included data in relation to desk top studies and survey information.

Table 8-1: Section 1 (New Building –Sion Mills) Preliminary Floodplain Identification

Mouchel Model Reference	Watercourse	Floodplain Location Summary	Floodplain Identifier			
			Historical Flooding Indicated	Alluvium Floodplain Indicated	Rivers Agency Strategic Flood Maps	Other Sources
M.A	Gortin Hall Drain	Between Magheramason and Rossnagalliagh at Tully Bridge	-	-	**X**	X
M.B	Blackstone Burn	Magheramason	-	X	X	X

Table 8-1: Section 1 (New Building –Sion Mills) Preliminary Floodplain Identification

Mouchel Model Reference	Watercourse	Floodplain Location Summary	Floodplain Identifier			
			Historical Flooding Indicated	Alluvium Floodplain Indicated	Rivers Agency Strategic Flood Maps	Other Sources
M.1, M.2 and M.3	River Foyle, River Finn, Mourne River, Deele River, Swilly Burn, Glenmornan & Burndennet Rivers	From Carrick Lee (Rr Finn), Milltown Bridge (Mourne Rr), Ballynabreen (Deele Rr), Swilly Bridge (Swilly Burn), Burndennet Bridge (Burndennet) and Ballymagorry Bridge (Glenmornan) to Lough Foyle at Londonderry/Derry City	**X**	**X**	**X**	**X**

Table 8-2: Section 2 (New Building –Drumragh River) Preliminary Floodplain Identification

Mouchel Model Reference	Watercourse	Floodplain Location Summary	Floodplain Identifier			
			Historical Flooding Indicated	Alluvium Floodplain Indicated	Rivers Agency Strategic Flood Maps	Other Sources
M.D	Undesignated	Upstream Seein Bridge	-	-	**X**	X
M.5	River Derg	Between Mourne – Strule Extension at New Bridge and Ardstraw	-	X	X	X

Table 8-2: Section 2 (New Building –Drumragh River) Preliminary Floodplain Identification

Mouchel Model Reference	Watercourse	Floodplain Location Summary	Floodplain Identifier			
			Historical Flooding Indicated	Alluvium Floodplain Indicated	Rivers Agency Strategic Flood Maps	Other Sources
M.E	Coolaghy Burn (Undesignated)	Between New Bridge (Coolaghy) and Woodbrook	-	X	X	X
M.F	Back Burn	South-West of Newtownstewart	-	-	-	X
M.G	Undesignated	North-West Mountjoy	-	-	-	X
M.H	Tully Drain	South-West Mountjoy	-	-	X	X
M.4	Fairy Water, Strule, Coneywarren Drain, Aghnamoyle and Tully Drain Rivers	West Omagh (Lislimnaghan – Mullaghmenagh)	X	-	X	X
M.I	Fireagh Lough Drain	South-West Omagh in vicinity of A32	-	-	-	X
M.6	Drumragh River	From Drumshanly to Crevenagh, Omagh	X	X	X	X

Table 8-3: Section 3 (Drumragh River - Aughnacloy) Preliminary Floodplain Identification

Mouchel Model Reference	Watercourse	Floodplain Location Summary	Floodplain Identifier			
			Historical Flooding Indicated	Alluvium Floodplain Indicated	Rivers Agency Strategic Flood Maps	Other Sources
M.J	Ranelly Drain	In vicinity of Lislea House at Tattykeel	-	-	X	X
M.K	Ranelly Creamery Drain	In vicinity of Tattykeel.	-	X	-	X
M.L	Ranelly Drain	In vicinity of Doogary Rd	-	-	X	X
M.M	Letfern	In vicinity of Moylagh	-	X	-	X
M.N	Undesignated	In vicinity of Killadroy	-	X	-	X
M.O	Undesignated	In vicinity of Killadroy	-	X	-	X
M.P/M.Q	Routing Burn & Routing Burn Ext.	North of Newtownsaville	-	X	X	X
M.R	Undesignated	South-East Newtownsaville	-	-	X	X
M.S	Undesignated	In vicinity of Kilgreen	-	X	-	X
M.T	Roughan	In vicinity of Ballynasaggart	-	X	-	X
M.U	Ballygawley Water	Tullybryan, South-West of Ballygawley	X	X	X	X
M.V	Tullyvar	In vicinity Lisginny Rd	-	X	X	X

Table 8-3: Section 3 (Drumragh River - Aughnacloy) Preliminary Floodplain Identification

Mouchel Model Reference	Watercourse	Floodplain Location Summary	Floodplain Identifier			
			Historical Flooding Indicated	Alluvium Floodplain Indicated	Rivers Agency Strategic Flood Maps	Other Sources
M.W	Ravella	In vicinity Derrycreevy	-	-	X	X
M.X	Undesignated	In vicinity Glack	-	-	X	X
M.Y	Lisadavil	South-East Aughnacloy	-	X	X	X

Information pertaining to the development of the hydraulic models and subsequent assessment of impacts and mitigation is provided in Flood Risk Assessment Report 2 – *Hydraulic Model Build Report* and Flood Risk Assessment Report 3 – *Impact and Mitigation Assessment Report.*

9 Summary

This flood risk assessment is part one of three reports. It outlines the assessment parameters in relation to the preliminary flood risk assessment by reviewing relevant FRA guidelines.

The A5 WTC has progressed through a number of stages from initial route development for Sections 1, 2 and 3 to the presentation of Proposed Scheme presented at Public Inquiry to then moving forward with portions of Section 1 and 3 progress to Detailed Design stage. Following this, a Judicial Review quashed Orders, returning the scheme to the Proposed Scheme for Sections 1, 2 and 3 and the scheme is currently at this stage.

During the various stages of the project, consultations have been held with Rivers Agency throughout. This report has been issued to Rivers Agency in two previous versions and the content of this version (version 3) was agreed with Rivers Agency.

This report assesses the various route options proposed for the A5 WTC in relation to preliminary flood risk, describing the assessment methods and detailing the preliminary assessments of potential flood impacts. These assessments then contributed to the overall consideration of the various Route Options.

Each of the Route Options were assessed based on the four key criteria; engineering, environment, traffic and economics. Additionally, consideration was given to scheme wide connectivity of the Route Options. The preliminary flood risk assessments held within this report were taken into account during selection of the Preferred Route. Flood risk was one of several constraints that were considered during assessment of the Route Options.

Further detail in relation to the assessment of the Route Options can be found in *Preliminary Options Report (September 2008),* and *Preferred Options Report (June 2009)*.

The outcome of the assessment in relation to the constraints submitted by various engineering disciplines was the emergence of a Preferred Route within each section. A brief description of this route has been provided in this report. It must be noted that this route is subject to change following further assessments.

Furthermore, this report contains information in relation to the locations of the hydraulic models to be developed, arising from the Emerging Preferred Route.

Residual areas of flood risk potentially remain at the areas identified in the previous chapter. It is the conclusion of this report that these areas require more detailed assessment. Information pertaining to further assessment can be found

Flood Risk Assessment Report 2 – *Hydraulic Model Build Report* and Flood Risk Assessment Report 3 – *Impact and Mitigation Assessment Report*.