Narrow Water Bridge Project
ENVIRONMENTAL IMPACT STATEMENT

VOLUME 2 - TEXT

Client
Louth County Council
Roads Section,
County Hall,
Millenium Centre,
Dundalk,
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NARROW WATER BRIDGE PROJECT

ENVIRONMENTAL IMPACT STATEMENT / ENVIRONMENTAL STATEMENT

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Acknowledgements

Detailed reports from specialists are available for review in the offices of Louth County Council, County Hall, Millennium Centre, Dundalk as are the Constraints Study Report, the Route Selection Report, the Bridge Feasibility Report and the Preliminary Design Report which were prepared during the design process.

This Environmental Statement has been prepared by a team consisting of the following members:

Roughan & O'Donovan Consulting Engineers

Environmental Impact Statement Authors, Scheme Design and Team Leaders.

Biosphere Environmental Services

Impacts on Terrestrial Ecology and Ornithology

Archaeological Development Services Ltd

Impact on Architectural, Archaeological and Cultural Heritage

Brady Shipman Martin

Landscape and Visual Impact

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Noise and Vibration Impact

AWN Consulting Ltd

Air Quality

AOS Planning Ltd

Socio-economic impacts

Philip Farrelly and Partners

Agronomy Study

Aquafact International

Hydrodynamic Modelling and Aquatic Ecology

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Part I
Background Information and General Description

1.0 INTRODUCTION

This Environmental Impact Statement/ Environmental Statement (EIS/ES) is for the proposed Narrow Water Bridge Project and has been prepared by Roughan & O'Donovan Consulting Engineers, on the instruction of Louth County Council in association with Newry and Mourne District Council (NMDC).

At present there is no direct link between the Cooley Peninsula in County Louth and the "Kingdom of Mourne" in County Down and no connection between the northern and southern shores of Carlingford Lough. Instead, to gain access around the Lough all vehicular traffic must cross the Newry River in Newry City. This involves a considerable journey away from the Lough and its environs and diverts traffic from the Carlingford area and toward the motorway system connecting Dublin and Belfast.

2.0 BACKGROUND TO THE PROPOSED DEVELOPMENT

Louth County Council, in the Louth County Development Plan 2009 – 2015, identified that linking the Cooley Peninsula and the Mourne District would unlock the tourist and leisure potential of the Carlingford Lough area.

The Development Plan supports the Narrow Water Bridge under Tourism policy TOU 6: "*To co-operate with the authorities in Northern Ireland in the provision of a road bridge between Cooley and south County Down."*

The following further explanation is provided:

"The provision of a road link through the construction of a bridge between the Cooley Peninsula in County Louth and the southern portion of the Mourne Mountains in County Down at Narrow Water would make a valuable contribution to the development of tourism in Louth and the Mournes."

The proposed Narrow Water Bridge aims to create a new cross border connection between the Republic of Ireland and Northern Ireland across the Newry River to the north of Carlingford Lough. It is intended that the proposed bridge will link the R173 Omeath to Newry Road in Co. Louth with the A2 Newry to Warrenpoint Road in Co. Down. The primary objectives of providing the Narrow Water Bridge are:

- Assist the social and economic development of the area;
- Facilitate access to the scenic beauty of Carlingford Lough;
- Enhance the tourist potential of the region;
- Improve the leisure potential of the region;
- Promote interaction between communities north and south of the border;
- Encourage pedestrian and cyclist activity.

3.0 DESCRIPTION OF THE PROPOSED DEVELOPMENT

3.1 Location

The proposed Narrow Water Bridge will cross the Newry River approximately 400m south of the Narrow Water Keep (**see Figure 3.1** in Volume 3). The bridge, which will connect the R173 Omeath Road south of Ferry Hill and the A2 dual carriageway at the existing roundabout, is situated approximately 1km and 2km northwest of Warrenpoint and Omeath, respectively. The bridge will pass close to the beacon near the southern shoreline.

The site is situated between the steep Cooley Mountains to the south and the drumlins of Down to the north. The Newry River flows through this valley before widening to form Carlingford Lough. The shoreline is flanked by roads on both sides and a former rail line occurs along the southern shore. In the immediate vicinity of Narrow Water the countryside pattern is of small fields bounded by hedgerows.

3.2 Proposed Scheme

Overview

The scheme will provide a new single carriageway link between Omeath and Warrenpoint. The proposed 6m wide carriageway will connect the R173 and the A2 dual carriageway across the Newry River at Narrow Water. A new roundabout will be constructed at the junction with the R173 Omeath Road and the existing A2 roundabout will be upgraded to accommodate the required additional arm. The total length of the scheme, including the required bridge crossing, is approximately 660m.

Cable-Stayed Bridge with Opening Span

The proposed structure is illustrated on **Figures 3.4 – 3.10** in Volume 3 and will comprise a cable-stayed bridge with a rolling bascule opening span. The structure is supported by asymmetric back-ward inclined towers, with the higher (86m) tower located on the southern side of the crossing. The lower (33m) twin towers on the northern side operate the rolling bascule opening span. The cable-stayed span is supported by a double plane of cable-stays which are anchored to an inclined vertical tower.

Plate 3.1 Photomontage of Proposed Narrow Water Bridge

The superstructure is primarily constructed from stiffened steel plates whereas the abutments at either end consist of reinforced concrete. The tower will be constructed from structural steel, consisting of an outer and inner steel skin which will be infilled with concrete. The cable-stays are small diameter stays comprised of parallel wires with multiple layers of corrosion protection.

The bridge design was influenced by the requirement to allow continued navigation along the Newry River and the need to minimise the impacts on this sensitive receiving environment. The construction methodology of the cable-stayed bridge allows minimal interference with the in-river environment with slim supporting piers required at only one location and the bridge can completed in component sections from the foreshore embankments (**see Figures 11.2 – 11.7** in Volume 3).

Navigation Beacon

The proposed bridge will interfere with the navigational beacon situated near Ferry Hill and therefore, the operation of the leading lights. Therefore, it is proposed to construct a new navigational beacon on the downstream of the proposed bridge as shown in **Figure 3.15** in Volume 3. The new navigational beacon shall mimic the existing masonry navigational beacons in shape, dimension, colour and surface finish however the requirements of Warrenpoint Harbour authority and Carlingford Loughs Commission will be adhered to in the construction and finishing of the proposed beacon.

Control Building

A control building is required to facilitate the opening of the bridge. It is preferable that the operators in the control building shall have a clear unobstructed view to the bridge and along the river. Therefore, the proposed control building is located at the edge of the river on the north side approximately 200m from the bridge as shown in **Figures 3.16 to 3.20** in Volume 3.

The proposed control building is approximately 9.7m long and 7.4m wide single storey rectangular structure with a pitched roof. The wall nearest the river will be curved and contain a large bay window that will permit the bridge operators a clear unobstructed view of the river.

Pedestrian and Cyclist Facilities

The proposed Narrow Water Bridge includes for the provision of a combined cycle / footway between the proposed Cornamucklagh Roundabout on the R173 and the A2 roundabout. Both the Cooley Peninsula and the Mourne Mountains are popular among hill walkers and cyclists, therefore, it is important that the Narrow Water Bridge should cater for pedestrians and cyclists.

4.0 ALTERNATIVES CONSIDERED

As part of the development of the Narrow Bridge Project the scheme has gone through a number of development stages:

- Identification of Study Area;
- Identification of Constraints;
- Route Selection;
- Hydrodynamic Modelling;
- Bridge Design Options Appraisal and;
- Bridge Preliminary Design Report.

4.1 Identification of Study Area

In the recent past three studies have been carried out to determine whether a bridge or car ferry link between the Cooley Peninsula and the Mourne District was feasible. These studies are:

- 'Omeath to Warrenpoint, Feasibility Study', 1979, Nicolas O'Dwyer and Partners;
- 'Carlingford Lough-Ferry Feasibility Study', 1993, Jonathan Blackwell and Associates; and
- 'Omeath – Warrenpoint Road Link, Feasibility Study', 2001, M C O'Sullivan and Co. Ltd (now RPS Consulting Engineers).

The 1979 and 2001 studies determined that a bridge crossing located within the vicinity of the A2 roundabout was viable. The study area for the current project was subsequently developed based on the environmental, engineering and economic constraints previously identified and incorporating the crossing point already identified by previous studies as being viable.

The study area for the proposed bridge is indicated on **Figure 2.1** in Volume 3.

4.2 Route Selection

Three initial routes (**Figure 4.1** in Volume 3) were developed based on site visits and information recorded in the constraints study. The route options examined were as follows:

- Route Option A: Southern Corridor (connects to A2 roundabout);

- Route Option B: Central Corridor (connects to A2 50m north of Narrow Water Keep);
- Route Option C: Northern Corridor (connects to A2 600m and 1km north of the Narrow Water Keep and the existing A2 roundabout, respectively.

Each of these three route options was assessed on the basis of environmental impacts, engineering requirements and economic grounds. Route Option A was subsequently ranked highest and most favourable of the three options (detailed information available in the Route Selection Report).

4.3 Bridge Design Options

Three design options were considered:

- Design Option 1 – Multi-span Bridge with Bascule Opening Span
- Design Option 2 – Multi-span Bridge with Twin Swing Opening Span
- Design Option 3 – Cable-stayed Bridge with Rolling Bascule Opening Span

Hydrodynamics and Marine Modelling

Early consultations with the Loughs Agency and Warrenpoint Harbour Authority highlighted the importance of minimising the release of sediment during both the construction and operation of the bridge.

As a consequence of these significant concerns, AQUAFACT International Services Ltd. were commissioned to develop a computer model to assess the hydrodynamics of Newry River Estuary and to assess the effects of a proposed bridge on the water circulation patterns of the estuary. This detailed hydrodynamic assessment concluded that cable-stayed option would have minimal impact on water circulation patterns and therefore sediment release.

Bridge Design Option Selection

In addition to undertaking the hydrodynamic modelling exercise, the three feasible bridge design options were evaluated against the various engineering, environmental and economic issues. The Bridge Feasibility Report was completed in November 2008 and reviews each option against all environmental, engineering and economic issues identified. The parameters which were identified as the key environmental factors influencing the design choice were:

- Archaeology and cultural heritage;
- Aquatic Environment;
- Terrestrial Ecology;
- Socio-economic impact; and
- Landscape and visual amenity.

Each parameter was weighted and the bridge designs were subsequently assessed and scored in an assessment matrix. This process identified the preferred bridge option when weighed against the above factors as being Option 3 – the Cable-Stayed Option with Bascule Opening Span. The factors which weighted the decision in favour of Option 3 were the minimal impact this option will have on the aquatic environment and the archaeological and cultural heritage.

5.0 TRAFFIC AND TRANSPORT IMPACTS

The proposed Narrow Water Bridge will significantly improve connectivity between the Cooley peninsula and the Mourne District, thus enhancing the tourist potential of the region. The primary finding of the traffic assessment concludes that the bridge and link road will be able to accommodate the predicted traffic levels. Other highlighted findings include:

- The proposed bypass is forecast to carry a design year traffic flow of between 1,036 and 3,767 AADT in 2033.
- The provision of a link results in an 18 minute journey time saving for traffic travelling between Omeath and Warrenpoint.
- It is expected that the road geometry will discourage HGVs from crossing the Narrow Water Bridge. The HGV traffic, which is likely to use the crossing, will result in a minimal increase of HGV traffic on the A2 dual carriageway.
- A 6.0m wide carriageway is the most suitable road type for the Narrow Water Bridge.
- The opening operation is estimated to take 20 minutes to complete.
- On the south side, queues can be accommodated between the wig wag signals and the Cornamucklagh Roundabout.
- On the north side, queues can be accommodated on the approaches to the A2 roundabout without blocking any accesses with the appropriate traffic management.
- On the north side, queues can be accommodated on the approaches to the A2 roundabout without blocking any accesses with a slight modification to the A2 roundabout southern approach and the appropriate traffic management
- In the unlikely event of a RORO ship arriving when the bridge is opening during the morning peak hour, the bridge shall not be opened until the ship is unloaded or peak hour traffic has dissipated. This procedure should be included in the Environmental Operating Plan.
- The segregated and combined pedestrian and cyclist facilities along the bridge and approaches provide a safe environment pedestrians and cyclists to utilise.
- The Narrow Water Bridge is beneficial as it improves road safety in the vicinity of the crossing;
- The peak truck traffic during the construction period is estimated to amount to 20 truck movements per day during the first 4 months of the construction period, and to then drop to 10 truck movements per day for the following 20 months.
- Construction near or adjacent the navigational channel shall be highlighted to approaching vessels.
- The navigational channel shall be closed during the installation of this opening span.
- An Environmental Operating Plan, which will include a Traffic Management Plan, will be put in place by the contractor during the construction phase of the scheme with regard to the NRA Guidelines for the Creation and Maintenance of an Environmental Operating Plan (2007). This EOP will include a Traffic Management Plan.

Part II
Significant Environmental Effects and Proposed Ameliorative Measures

6.0 SOCIO-ECONOMIC IMPACTS

This section examines the effects of the proposed development on human beings that are adjacent to, and are affected by, the proposed project; in particular focusing on socio-economic issues including land-use, population, economic activity, agriculture, tourism and residential amenity.

It is considered that the bridge will have a positive impact on tourism and economic activity, with the proposed signature structure having the potential to become an attraction and a landmark in its own right. The provision of footpaths and cycle lanes will enhance this experience for bridge users.

The project is also considered as having no negative community impacts. During the construction phase there will be a low level of nuisance and disruption, but due to the bridge design and construction method this will be minimal and temporary. In fact the enhanced community connectivity delivered by the project, through vehicular, bicycle and pedestrian access, will have a significant positive impact and will strengthen local community identity.

7.0 THE NATURAL ENVIRONMENT

7.1 General

The issues that are assessed in this chapter of the Environmental Statement are as follows:

- Terrestrial Ecology;
- Marine Modelling and Aquatic Ecology;
- Noise and Vibration;
- Air Quality and Climate; and
- Soils, Geology and Hydrogeology.

7.2 Terrestrial Ecology

The ecological impact assessment identified that the proposed road and bridge at Narrow Water is in an area of high nature conservation value. The area of foreshore is a candidate Special Area of Conservation in County Louth and an Area of Special Scientific Interest in County Down (refer **Figure 7.1** in EIS Volume 3). Carlingford Lough Special Protection Area, which is designated specifically for birds, also occurs further up the lough. A Natura Impact Statement completed for the project finds that there is no impact on the features or integrity of these designated sites.

A number of detailed surveys were undertaken to record the habitats, bird usage and mammal presence. The primary potential impacts highlighted by the study include minor loss of poor quality saltmarsh habitat on the Omeath foreshore the temporary loss of a high tide waterbird roost site on the Omeath foreshore and the potential for avian collision against the bridge cables.

A comprehensive range of measures to avoid or reduce these potential impacts are proposed. These include measures to protect and re-establish salt-marsh vegetation, creation of a high tide bird roost slightly downstream from the development and up-lighting the bridge at night to prevent bird strike. Mitigation measures are also proposed to minimise any potential impact on badgers and bats which use the area. In addition, a project ecologist will be appointed to manage the implementation of all mitigation measures and there will be ongoing monitoring of bird numbers using the site.

7.3 Aquatic Ecology and Marine Modelling

The issues of concern in terms of aquatic ecology were identified as water quality / aquaculture and fish migration.

Water Quality and Aquaculture

Carlingford Lough is a designated shellfish production site and as such contains licenced shellfish beds. The quality of the water is thus protected by the EC (Quality of Shellfish Waters) Regulations 2006, the essence of which makes it imperative that the construction and operation of the bridge does not result in significant sediment release which could impair water quality.

The chosen cable-stayed bridge requires only one series of slim in-river piers and therefore has minimal impact on water velocity and sediment transport. In addition, the construction methodology allows the bridge to be built in segments from the embankments. This construction methodology and slim in-river piers combine to direct that there is no requirement for specific mitigation measures in this instance.

Fish Migration

The issue in this instance is the requirement to avoid preventing salmonids, eels or lamprey species migrating upstream. The sheet piling which is necessary in coffer dam construction could prevent this migratory movement. These operations will only be undertaken during normal working hours and as such will allow fish movement during at least half of the 24 hour tidal cycle. However in order to minimise any impact on fish movements, the construction and removal of the coffer dam and necessary in-river piling shall be undertaken outside of the main migratory periods. With respect to this, the contractor shall be required to submit their methodology and timing to and receive the agreement of the Loughs Agency.

7.4 Noise and Vibration

The Noise and Vibration Impact assessment identified that two properties in County Louth (location 1 and location 4) and one (currently vacant – location 11) property in County Down would suffer minor increases in noise levels as a result of traffic using the road and bridge.

The use of 'low noise road surface' will reduce the noise impact by between 3 and 5 decibels which in each case brings the noise levels to within the recommended limits.

It is recognised that during construction there is the potential for temporary noise impact. This will be controlled and limited through the adherence to a number of mitigation measures including the use of well maintained and serviced plant; noise monitoring and screening where necessary.

7.5 Air Quality and Climate

Neither the construction nor operation of the scheme will have a significant impact on the existing air quality or climate.

7.6 Soils, Geology and Hydrogeology

The assessment has been completed using a desk study of published information and field investigations of terrestrial and marine environments. Soils encountered are generally at least firm or medium dense with frequent cobbles and boulders along the river. Bedrock consists of sedimentary limestone, siltstone and sandstone which is often fractured. Modest height embankments and cuttings as well as piled foundations and construction methods are proposed. Overall, the road and bridge foundation construction requirements result in minimal impacts on soils, geology and hydrogeology receptors.

8.0 LANDSCAPE AND VISUAL IMPACT

The effects of the proposed development on the receiving landscape and visual environment are assessed and described. In order to do so all relevant planning policy documentation from both jurisdictions has been reviewed.

The assessment highlights that the proposal sits within an area of high scenic quality and within the vicinity of a number of protected and familiar monuments such as Narrow Water Castle.

While it is acknowledged that the issue of bridge design and bridge impact is influenced by highly subjective considerations and personal experiences, it is considered that the proposed development will not adversely or directly alter the inherent quality of the landscape, its significance or value. Indeed it is considered that this unique structure (refer **Figures 8.4 – 8.7** in Volume 3) has the potential to add to the significance of its setting and to present focus and momentum towards realising local landscape and tourist related objectives.

Given the nature of the project, consideration of mitigation has been a significant aspect of the project design and as such the proposal incorporates a number of design elements to minimise the landscape and visual impact of the project. These elements include:

- An alignment that is near perpendicular to the river centerline, which is thereby shorter and a more visually natural bridging
- A tie-in to an existing roundabout on the A2 on the northern side of the river, thereby reducing impact on shore and surrounding area;
- Siting the bridge adjacent to and avoiding impact on the wooded promontory of Ferry Hill. In this way the wooded hill provides a visual foreground/background anchor for the main tower on the southern side of the bridge. This effect is clearly illustrated in the Photomontages;
- Minimising and down-sizing the number of piers and apparent mass of the structural components, thereby decreasing adverse visual impacts on views along the river/lough; and
- Incorporation of a signature bridge design with inclined towers and a unique opening mechanism.

As such cognisance was taken of the significance of the landscape setting and it was considered that the landmark bridge best:

- acknowledges and reflects the recognised scenic and visual qualities of its wider setting;
- provides an iconic structure that will assist in the development and realisation of co-ordinated and focused amenity, landscape and recreation objectives and policies for the significant landscape resource of the Cooley Peninsula and the South Down landscapes;
- marks a location of a clear transition between inland river valley and open coastal inlet;
- defines a boundary to westward extension of visually detracting port, port-related and mixed-use development along the shore towards Narrow Water Castle at Warrenpoint;

9.0 MATERIAL ASSETS

Agriculture

Four agricultural holdings will be affected by the proposed Narrow Water Bridge Project. However, there are no farms on which the agricultural impact will be severe or major. The impacts on the farm holdings are considered moderate to minor. **Figure 9.1, Volume 3** illustrates the land to be acquired for construction of the proposed scheme.

Measures to compensate farmers/landowners due to land acquisition, drainage works and loss of facilities will be agreed by the valuer as the project progresses.

Commercial

Warrenpoint Harbour and Carlingford Lough Commission

Access to Warrenpoint Harbour is provided by a series of buoys and leading lights which are the property of Warrenpoint Harbour Authority (WHA). The link road and southern tower in County Louth will have a significant impact on the operation of this leading light navigation system by interrupting and partly blocking the view of one of a pair of stone navigation beacons (see **Figure 3.2 and 3.15** in Volume 3). To remedy this situation Carlingford Lough Commission and Warrenpoint Harbour Authority have been consulted with respect to the acceptability of replacing this leading light and on the proposed location and design of the new structure. Louth County Council proposes to construct a new structure and leading light to the satisfaction of WHA and CLC prior to the construction of the southern tower. This structure will be constructed immediately east of the bridge and in line with the two existing leading lights. See **Figure 3.2 and 3.15** in Volume 3.

Carneyhaugh Properties Ltd.

Carneyhaugh Properties Ltd control received outline planning permission for a mixed use development on a site adjacent to the bridge on the northern shore. The proposed development as described within the outline application includes for provision of a hotel and restaurant, residential units and office and retail units. The property group have stated their full support of the project and have cooperated in the design of the Control Building and access as the proposed scheme will enhance their development. The design and location of the Control Building and the access has been agreed with Carneyhaugh Properties Ltd. The design and location of the

Control Building and the access has been agreed with Carneyhaugh Properties Ltd. Finishes will be as per **Figure 3.16 to 3.19** in Volume 3 and will be sympathetic to the proposed development.

10.0 CULTURAL HERITAGE

The location of the proposed scheme is in an archaeologically sensitive area with 14 recorded sites within a 1.5km radius. Recorded archaeological features within the area shows activity from the Prehistoric through the Early Christian, Medieval and Post Medieval periods.

Narrow Water is, as its name suggests, the narrowest point on the Newry River which would have been a major route into Ulster from Carlingford. Therefore, the area would have been naturally used as a crossing point throughout history.

Prominent local features include Narrow Water Castle and the associated Keep, the motte to the north of the A2 roundabout and the existing stone tower navigation beacons.

Given the archaeological sensitivity of the environs of the line of the proposed bridge, non-invasive pre-development testing has been carried out in accordance with mitigation measures as stipulated by the Heritage authorities in NI and ROI. This pre-development testing took the form of geophysical, non-invasive surveys within the riverine line of the proposed route and within the terrestrial line of the project. These surveys have been carried out by appropriate specialists who have made further recommendations including archaeological investigation of geo-physical anomalies and pre-construction top soil stripping to allow for the identification and preservation of undiscovered remains and artefacts.

11.0 CONSTRUCTION PHASE

The construction of the proposed road and bridge is estimated as taking 18 to 21 months.

During construction, measures will be put in place to minimise any temporary nuisance that may occur. This will include a dust management plan, traffic management at the tie-ins to the existing road network (the R173 and the A2), maintaining roads clear of mud and where necessary using screening to minimise noise levels.

A number of mitigation measures will be included in the contract to ensure that there is no contamination of the Newry River estuary or related drains or watercourses.

The contractor will be required to prepare a Waste Management Plan and an Environmental Operating Plan prior to construction commencing. In addition the appointed contractor will be required to prevent, as far as is possible dirt being released onto public roads. In the event that site traffic leaves dirt on the road the Contractor will be required to clean the road.

All of the above mitigation measures will be tied into all contract documents and it will be a requirement of the Main Contractor to adhere to all of these mitigation measures and any further measures required as part of the planning conditions.

12.0 INTERRELATIONSHIPS

Chapters 5 – 11 inclusive discuss the impacts of the proposed scheme on the various elements of the environment and highlight the measures necessary to mitigate these impacts. The mitigation measures could potentially impact on other elements of the environment, and the inter-relationships of the various measures proposed to mitigate the impact of the scheme have been assessed. In this instance traffic has been shown to interact with air quality and noise and vibration; and landscape and visual impact has been influenced by aquatic ecology and cultural heritage.

13.0 MITIGATION MEASURES

The principal mitigation measures proposed in the scheme are as follows:

- Pre-construction archaeological investigations and monitoring of topsoil stripping will be undertaken to ensure that any undiscovered archaeological remains are discovered and protected;
- A new high tide bird roost will be constructed;
- The bridge will be lit at night to prevent bird strike;
- All necessary vegetation clearance will be undertaken outside of the bird breeding season;
- Mammal fencing and underpasses shall be provided to avoid unnecessary road casualties;
- A bat fly-over shall be developed to ensure the continuation of bat foraging and commuting routes;
- To minimise any impact on fish movements, the construction and removal of the coffer dam and necessary in-river piling shall be undertaken outside of the main fishery migration periods.
- During construction, stringent restrictions will be imposed on the contractor to prevent pollution of the Newry River estuary;
- The completed scheme will be landscaped, where appropriate, with trees and shrubs to soften the impact of the engineered features;
- All suitable material excavated within the cut sections shall be used to the greatest possible degree as fill material on the development;
- Embankment and cut slopes which are considered at risk from erosion are to be topsoiled and seeded as soon as possible to prevent the deterioration due to weathering effects;
- Low noise road surface will be used to reduce the operational noise impact to within the recommended limits; and
- Boundary treatment / secure fencing shall be provided at the site to protect the public.

14.0 FURTHER INFORMATION

The full Environmental Statement will be on display and available for inspection and purchase for not less than 6 weeks from the date of publication at Louth County Council Offices and in the offices of Newry and Mourne District Council.

Please contact:

The Senior Engineer
Roads Department
Louth County Council
County Hall
Millennium Centre
Dundalk

Phone: 00353 (0)42 9335457

The following additional reports will also be available for inspection upon request:

- Constraints Report
- Route Selection Report
- Bridge Feasibility Report
- Bridge Preliminary Design Report

15.0 WHAT HAPPENS NEXT?

Construction of the scheme is dependent on approval from An Bord Pleanála in the Republic of Ireland and The Planning Service in Northern Ireland. The planning application will be advertised locally and written submissions relating to the environmental effects can then be made to the planning authorities. These advertisements will indicate where the planning application, Environmental Impact Statement and other supporting documents can be viewed. Any written submissions will be considered by the planning authorities in making their decision on whether or not to approve the scheme with or without modifications.

Part I

Background Information
General Description

Chapter 1

Introduction

Chapter 1 Introduction

1.1 General

This Environmental Impact Statement (EIS) / Environmental Statement (ES) is for the proposed Narrow Water Bridge Project and has been prepared by Roughan & O'Donovan Consulting Engineers, on the instruction of Louth County Council (in conjunction with Newry and Mourne District Council). The Statement is a compilation of the inputs provided by the various bodies listed in the acknowledgements on the previous pages.

This document will be submitted as the required Environmental Impact Statement in support of the planning application in the Republic of Ireland and the Environmental Statement in support of the planning application in Northern Ireland.

For presentation purposes, this EIS/ES is set out in three Volumes:

Volume 1 Non Technical Summary

Volume 2 Main Text

Volume 3 Figures

This document, Volume 2 contains the following elements:

Non - Technical Summary

Part I "Background Information and General Description"

There are five chapters to this part of the document.

Chapter 1: Introduction
Chapter 2: Background to the Proposed Development
Chapter 3: Description of the Proposed Development
Chapter 4: Alternatives Considered
Chapter 5: Traffic and Transport Impacts

Part II "Significant Environmental Effects and Proposed Ameliorative Measures"

This part of the document sets out the likely significant environmental effects of the scheme under the headings:

Chapter 6: Human Beings
Chapter 7: The Natural Environment
Chapter 8: Landscape and Visual Impact
Chapter 9: Material Assets
Chapter 10: Cultural Heritage
Chapter 11: Construction Phase
Chapter 12: Interrelationships
Chapter 13: Mitigation Measures

1.2 Context to the Proposed Development

At present there is no direct link between the Cooley Peninsula in County Louth and the "Kingdom of Mourne" in County Down and no connection between the northern and southern shores of Carlingford Lough. Instead, to gain access around the Lough all traffic must cross the Newry River in Newry City. This involves a considerable journey away from the Lough and its environs and diverts traffic from the Carlingford area and toward the motorway system connecting Dublin and Belfast.

The Narrow Water Bridge project arises directly from an identified priority in Chapter 5 'All Island Co-operation' of the Republic of Ireland's National Development Plan 2007 - 2013 to "improved access for tourism and other opportunities along the eastern corridor, including better links between County Louth and County Down in Northern Ireland." The Good Friday Agreement in Northern Ireland supports this stance and has designated tourism as an area for co-operation under the auspices of the North-South Ministerial Council.

Louth County Council, in the Louth County Development Plan 2003 – 2009 (as amended, July 2006) has also identified that linking the Cooley Peninsula and the Mourne District would unlock the tourist and leisure potential of the Carlingford Lough area. At Section 8.8, the Development Plan makes the construction of a bridge at Narrow Water an objective of Louth County Council. The Council have now embraced this policy and are proposing this bridge as the element of tourism infrastructure needed to open up the Carlingford Lough area.

1.3 Legal Requirements

1.3.1 Legislative Requirement for an Environmental Impact Assessment (EIA)

The proposed bridge at Narrow Water crosses an international border, providing a road and pedestrian/cycle link connecting the Republic of Ireland and Northern Ireland across the Newry River. As a consequence, it is essential that the development of this Environmental Impact Assessment adequately addresses the requirements of legislation in both jurisdictions.

Despite the differing legislation used in each jurisdiction, it is in both cases an interpretation of the E.C. Directives – 85/337/EC of 27th June 1985 "The assessment of certain public and private projects on the environment" as amended by Directive 97/11/EC and Directive 03/35/EC).

Republic of Ireland

In the Republic of Ireland, The Roads Act, 1993, together with the Roads (Amendment) Act 1998 and the Roads Regulations, 1994 (S.I. No. 119 of 1994) give effect to the E.C. Directive 85/337/EC as amended. The amendment, E.C. Directive 97/11/EC, was incorporated into amending regulations and published as Section 14 of the European Communities (Environmental Impact Assessment) (Amendment) Regulations 1999 (SI No. 93 of 1999).

Section 50 of the Roads Act, 1993 as amended by, *inter alia,* the European Communities (EIA) (Amendment) Regulations, 1999, the Planning and Development Act, 2000, the Planning and Development (Strategic Infrastructure) Act 2006, the Roads Act 2007 and the Planning and Development Act 2010 sets out provisions for the preparation of an Environmental Impact Statement (EIS) / Environmental Statement (ES) by a Road Authority, such as Louth County Council.

Northern Ireland

In Northern Ireland the application will be made as a planning application under the Planning (Northern Ireland) Order 1991 (SI 1991 No. 1220 (N.I. 110). Planning Service have advised that the application will be treated as an Article 31 application "Special Procedure for Major Planning Applications". The relevant EIA legislation is the Planning (Environmental Impact Assessment) Regulations (Northern Ireland) 1999 (Statutory Rules of Northern Ireland 1999 No. 73).

Schedules 1 – 4 of the Planning (Environmental Impact Assessment) Regulations (Northern Ireland) 1999 identify those projects which will require environmental impact assessment, how this is determined and what must be included in the report.

1.3.2 Determination of the requirement for an EIA

Republic of Ireland

The legal requirements for Environmental Impact Assessment of a road development are defined in the Roads Act (1993) as amended by the Planning and Development Acts (2000 - 2010), the Roads Act (2007), and by Regulations made under the Roads Acts, The European Communities (Environmental Impact Assessment) (Amendment) Regulations 1989 – 2001 and the EC Directives 85/337/EC and 97/11/EC. Section 50 of the Roads Act (1993), as amended by Section 9 of the Roads Act (2007), sets out provisions for the preparation of an Environmental Impact Statement (EIS) by a Road Authority.

Environmental Impact Statement (EIS) Section 50 of the Roads Act, 1993 as amended by Section 9 (1) (d) (i) of the Roads Act 2007 states:

"A road authority or the Authority shall prepare a statement of the likely effects on the environment ('environmental impact statement') of any proposed road development consisting of:

(i.) *the construction of a motorway,*

(ii.) *the construction of a bus way,*

(iii.) *the construction of a service area, or*

(iv.) *any prescribed type of proposed road development consisting of the construction of a proposed public road or the improvement of an existing public road."*

The prescribed type of proposed road development, as defined by paragraph 8 of the Roads Regulations (S.I. No.119 of 1994), for the purpose of subsection (1) (a) (iii) of section 50 of the Act is as follows:

"(a) *the construction of a new road of four or more lanes, or the realignment or widening of an existing road so as to provide four or more lanes, where such new, realigned or widened road would be eight kilometres or more in length in a rural area, or 500 metres or more in length in an urban area;*

(b) ***the construction of a new bridge or tunnel which would be 100m or more in length****."*

Northern Ireland

The Planning (Environmental Impact Assessment) Regulations (Northern Ireland) 1999 and the Planning (Environmental Impact Assessment) (Amendment) Regulations (Northern Ireland) 2008 give effect to the E.C. Directive 85/337/EC of 27th June 1985, as amended by Directive 97/11/EC, "on the assessment of the effects of certain public and private projects on the environment."

Schedule 2 of The Planning (Environmental Impact Assessment) Regulations (Northern Ireland) 1999 states that road projects for which the area of works exceeds one hectare require Environmental Impact Assessment.

Schedule 3 defines the selection criteria for sub threshold development. Section 2 'Location of Development' references the need to consider the environmental sensitivity of the area likely to be affected by the development and specifies areas protected by member states legislation and by the Habitats and the Birds Directives. In Northern Ireland the bridge abutment will be constructed within Carlingford Lough Area of Special Scientific Interest (ASSI).

Louth County Council were therefore obligated to have an Environmental Impact Assessment undertaken, in both jurisdictions, to examine the likely significant effects of the proposed scheme at Narrow Water and to identify, where appropriate, relevant mitigation measures.

1.3.3 Required Contents of the Environmental Impact Statement

Despite the differing legislation used in each jurisdiction, it is in both cases an interpretation of the E.C. Directives – 85/337/EC of 27th June 1985 "The assessment of certain public and private projects on the environment" and the amendment Directives 03/35/EC 97/11/EC and 03/35/EC.

In the Republic of Ireland it is Sections 50(2) and 50(3) of the Road Acts, 1993 (as amended), which define the information to be contained in the Environmental Impact Statement. In Northern Ireland it is Schedule 4 of the Planning (Environmental Impact Assessment) Regulations (Northern Ireland) 1999 (as amended).

For the purposes of this document, the required content of an Environmental Impact Statement / Environmental Statement is considered as:

- "A description of the proposed road development (project) comprising information about the site, design and size of the proposed road development.
- A description of the measures envisaged in order to avoid, reduce and, if possible, remedy significant adverse effects.
- The data required to identify and assess the main effects which the proposed road development is likely to have on the environment.
- An outline of the main alternatives studied and an indication of the main reasons for its choice, taking into account the environmental effects.
- A summary in non-technical language of the above information.

Further explanation and clarification is given in both jurisdictions – by Section 50(3) of the Roads Act in the Republic of Ireland and by reference to Part 1 of Schedule 4 of the Planning (Environmental Impact Assessment) Regulations (Northern Ireland) 1999 (as amended). The following is taken directly from Section 50(3) of the Roads Act, but for the purposes of this EIS it is considered a pertinent interpretation of the relevant elements of Part 1 of Schedule 4.

An environmental impact statement shall, in addition to and by way of explanation or amplification of the specified information referred to (above), contain further information on the following matters: -

(a) (i) a description of the physical characteristics of the whole proposed road development and the land use requirements during the construction and operational phases;

(ii) an estimate, by type and quantity, of expected residues and emissions (including water, air and soil pollution, noise, vibration, light, heat and radiation) resulting from the operation of the proposed road development;

(b) a description of the aspects of the environment likely to be significantly affected by the proposed road development, including in particular: -

- human beings, fauna and flora,
- soil, water, air, climatic factors and the landscape,
- material assets, including the architectural and archaeological heritage, and the cultural heritage,
- the inter-relationship between the above factors;

(c) a description of the likely significant effects (including direct, indirect, secondary, cumulative, short, medium and long term, permanent and temporary, positive and negative) of the proposed road development on the environment resulting from: -

- the existence of the proposed road development,
- the use of natural resources,
- the emission of pollutants, the creation of nuisances and the elimination of waste,
- and a description of the forecasting methods used to assess the effects on the environment."

(d) an indication of any difficulties (technical deficiencies or lack of know-how) encountered by the road authority concerned in compiling the required information;

(e) a summary in non-technical language of the above information.

(As the above is an unqualified interpretation of the legislation in both jurisdictions, the reader is advised to consult the Acts and the Statutory Instruments for the full text).

1.4 Public Consultation

1.4.1 Informal Scoping

Roughan & O'Donovan Consulting Engineers in conjunction with Louth County Council undertook an informal scoping exercise during April and May 2008. This consisted of written consultation with a number of both Statutory and Non-Statutory bodies who were deemed to have an interest in the scheme. As the scheme will provide an international link between the Republic of Ireland and Northern Ireland it was necessary to consult the relevant bodies in both jurisdictions. Tables 1.1 and 1.2 list the Consultees in the Republic of Ireland and Northern Ireland respectively.

The purpose of the Scoping Document was to provide consultees with information on the scheme and on the proposed scope of the Environmental Impact Assessment. This scoping exercise was relatively successful with a significant number of responses received. **Appendix 1.1** provides a summary of all responses received. In general, the responses are in support of the proposed scheme and confirm satisfaction with the studies being undertaken as part of the Environmental Impact Assessment.

Table 1.1 List of Consultees – Republic of Ireland

Ordnance Survey Ireland
Land Registry Dublin
Louth County Council – Planning Department
Louth County Council – Roads and Marine
Eastern Regional Fisheries Board
The Marine Institute
Commissioner of Irish Lights
Department of Communications, Energy and Natural Resources
Department of Environment, Heritage and Local Government
An Taisce
Failte Ireland
The Arts Council
Iarnrod Eireann
National Roads Authority
The Heritage Council
National Parks and Wildlife Service
Department of Agriculture Fisheries and Food – Foreshore Section
Geological Survey Of Ireland
Environmental Protection Agency
Tourism Ireland
County Louth Archaeological and Historical Society
Bord Gais
Eircom

Table 1.2 List of Consultees – Northern Ireland

Ordnance Survey Northern Ireland
Warrenpoint Harbour Authority
Northern Ireland Water
Environment and Heritage Service (now Northern Ireland Environment Agency): - Built Heritage; - Natural Heritage; - Water Management Unit; and - Land and Resource Management
The Crown Estates
Armagh and Down Tourism Partnership
Geological Survey of Northern Ireland
The Planning Service
The Mournes Heritage Trust
The Royal Society for the Protection of Birds

Council for Nature Conservation and the Countryside
Centre for Environmental Data and Recording
Fisheries Conservancy Board
SusTrans
Newry and Mourne District Council
The Woodland Trust
The Wildfowl and Wetlands Trust
Council for Nature Conservation and the Countryside
Warrenpoint Chamber of Commerce
Newry Chamber of Commerce and Trade
Police Service Northern Ireland
Invest NI
Inland Waterways Association
Translink
Department of Agriculture and Rural Development
Department of Culture Arts and Leisure – Inland Waterways and Inland Fisheries
Department of Enterprise Trade and Industry
Foyle Carlingford and Irish Lights Commission
The Rivers Agency
The Loughs Agency
The National Trust
Land Registers of Northern Ireland
Carlingford Lough Yacht Club
Warrenpoint Boating Club

1.4.2 Further Consultations

In addition to the above consultation exercise, a series of ongoing meetings have been held with the key relevant statutory stakeholders.

In Northern Ireland this has been supported through the Pre-Application Discussions process arranged by the Planning Service Northern Ireland. A number of meetings have taken place and representatives of the following bodies have attended:

- Northern Ireland Environment Agency (Built and Natural Heritage Directorates);
- Landscape Architects Branch of Planning Service;
- Newry and Mourne District Council;
- Rivers Agency;
- Roads Service Northern Ireland;
- The Planning Service;
- Warrenpoint Harbour Authority;
- Carlingford Loughs Commission; and
- Loughs Agency.

A number of separate meetings have also been held with following bodies:

- The Centre for Maritime Archaeology;

- The Loughs Agency;
- Newry and Mourne District Council;
- Roads Service Northern Ireland;
- Police Service Northern Ireland and Ambulance Service;
- Warrenpoint Harbour Authority; and
- All affected landowners.

In the Republic of Ireland, meetings and discussions have been held with the National Parks and Wildlife Service, the Archaeology, Architecture and Underwater Archaeology Unit of DoAHG and with the Foreshore Section of the Department of the Environment, Community and Local Government (DoECLG).

1.4.3 Public Consultation Events

Public Consultation No. 1

A first public consultation event was held on 19th May 2008 in Omeath, at the Granvue House Hotel, and on 20th May 2008 in Warrenpoint, at the Warrenpoint Town Hall. A series of posters and leaflets were prepared for both events.

Members from Roughan & O'Donovan's project design team were also on hand to answer queries and comment sheets were made available. The events were advertised locally and both events were very well attended.

The purpose of the first public consultation was to aid in the identification of constraints or issues which members of the public may have. The overwhelming public opinion recorded was one of strong support for the scheme. Statements were made about the need to upgrade the R173 on the County Louth side and the wish to prevent HGVs from using the link.

Public Consultation No. 2

A second public consultation event was held on the 20th and 21st October 2008 again in the Granvue House Hotel in Omeath and Warrenpoint Town Hall. These events were used to present the Preferred Route and the selected bridge design to the communities on both sides of the Newry River and Carlingford Lough.

The two unsuccessful bridge design options and a route selection matrix were also presented to the public on fourteen A1 boards on display at both venues. Both events were exceedingly well attended and the response was overwhelmingly positive and supportive, indicating the level of local public support which exists for the proposed scheme and proposed bridge structure. The events created significant interest within both the local and national media with coverage on both the RTE and UTV evening news.

Plate 1.1 **Public and UTV cameras during a presentation on the Preferred Route and chosen bridge design at PC2**

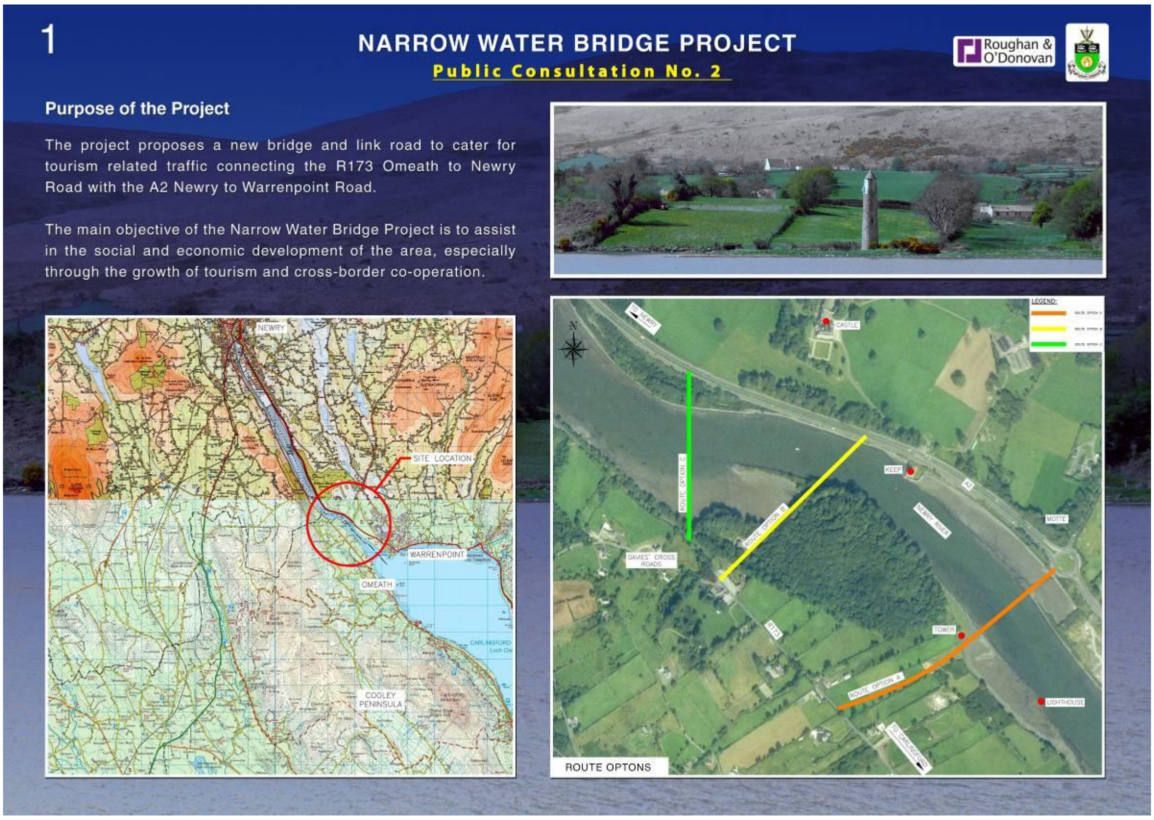

Plate 1.2 **Display Board No. 1 – Route Options at PC2**

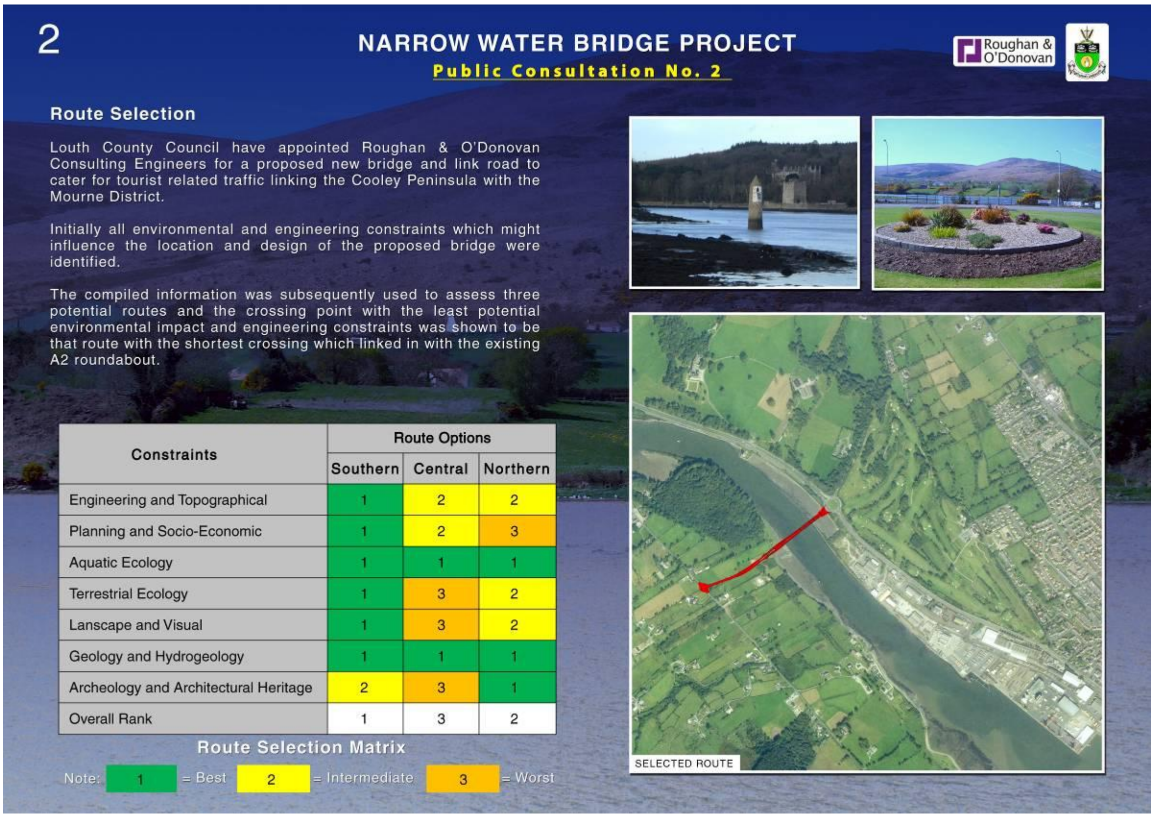

Plate 1.3 Display Board No. 2 – Preferred Route at PC2

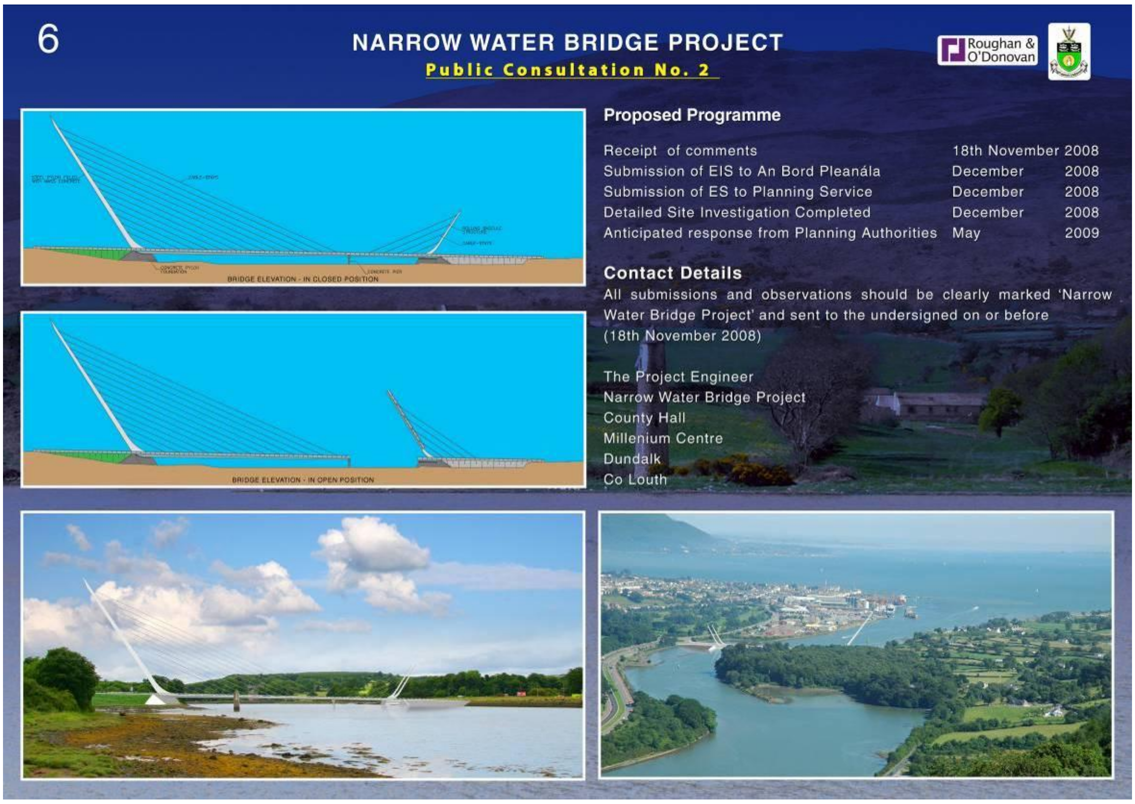

Plate 1.4 Display Board No. 6 – Images of Preferred Bridge Design at PC2

1.4.4 Statutory Consultation Requirement

Republic of Ireland

Section 51 of the Roads Act, 1993, as amended, requires that public notice should be issued stating:

(i) that such application has been made to An Bord Pleanála for approval;

(ii) that an environmental statement has been prepared in respect of the proposed road scheme;

(iii) that copies of the statement be available for inspection for a specified period not less than six weeks;

(iv) that copies are available for sale at a cost not exceeding the reasonable cost of making a copy;

(v) that submissions may be made in writing to An Bord Pleanála in relation to the likely effects on the environment of the proposed road development before a specified date (which shall be not less than two weeks after the end of the period for inspection).

Northern Ireland

Regulations 12 and 13 of the Planning (Environmental Impact Assessment) Regulations (Northern Ireland) 1999, as amended, identify the statutory public consultation requirements when a planning application is lodged with an Environmental Statement.

Regulation 12 requires the Department (The Planning Service) to publish notice of the planning application and the associated environmental statement. This notice must state where the environmental statement can be viewed. Regulation 12 states that at least 4 weeks must be allowed for responses to be made to the application from the date on which the notice was first published. Regulation 12 further requires that any person or group affected, or with a likely interest in the application, who are unlikely to become aware of it through public advertisement, must be directly notified.

Regulation 13 requires the applicant to ensure that sufficient copies are made available at the specified address and that sufficient copies are supplied to the Department.

In addition, in Northern Ireland all planning applications are subject to neighbour notification, whereby the applicant must supply the Department with a list of addresses of immediate neighbours. These neighbours are subsequently given direct notice of the application by the Department.

1.5 Difficulties Encountered

It is considered that the only particular difficulty encountered was in the availability of funding to progress to the planning stage resulting in some delays throughout the development of the project.

Name	Title / Division	Company	Date	Comments	Actions
Terence P Johnston	Geological Survey of Northern Ireland	Department of Enterprise, Trade and Investment	04/05/2008	**Comments:** - Ensure the geological context of the site and surrounding area has been described in appropriate detail.	GSNI is good starting point for geological and hydrogeological research for EA/ES. Large archive.
Orla Jackson	Chief Executive	Newry Chamber of Commerce	07/05/2008	In favour of bridge under following conditions: - bridge allows for navigation into Newry City. - bridge does not allow for access of HGV vehicles and buses. - bridge must be in keeping with surrounds. - feasibility study must take into account recommendations of consultants undertaking feasibility study on the Southern Relief Road.	Would welcome opportunity to discuss in further detail in near future.
Karen Simpson	Chief Executive	Fisheries Conservation Board for Northern Ireland	21/04/2008	Lies within the jurisdiction of the Loughs Agency of Foyle, Carlingford and Irish Lights Commission.	
Nicola O'Neill		BT Northern Ireland	08/05/2008	Copy of BT mark up plan.	
P.A. Hoben	Honary Secretary	The John Donnelly, Newry and Portadown Canal Branch (of Inland Waterways Association of Ireland)	04/05/2008	**Comments:** - Bridge must be a minimum of 100ft at a high spring tide to enable high masted ships.	
J White	Acting Director of Strategic Programmes	Roads Service	01/05/2008	**Suggests:** - Expanding paragraph 3.5 to include: i) Land Use ii) Pedestrians, Cyclists, and Community Effects iii) Vehicle Travellers iv) Plans and Policies and v) Disruption due to Construction (may be in Chapter 11) - Soils and Geology Section - include comments on significance of soils and geology of locality and impact of proposal / mitigation. - Will be forwarding recent traffic surveys.	Suggests traffic assessment is sent in as a Traffic Impact Statement.
Helen Hossack	Senior Conservation Architect	Environment and Heritage Service	30/04/2008	**Suggests:** - using their website or visit their office to gain information (Monuments and Building Record). - any research or impact assessment would need to take into consideration the potential for new remains being uncovered and included and record in proposed programme of works.	

Name	Title / Division	Company	Date	Comments	Actions
Martin Carey	Chief Executive	Mourne Heritage Trust	02/05/2008	**Following points:** - take into account impacts on wider area eg. Kilkeel. - take into account impact of Southern Relief Road. - impact on character of the Mourne area. - design issues and measures to mitigate a diverse visual and biodiversity impact are particularly important. - good impact on tourism. - will compliment European Geopark.	
Fraser McConnell	Brown McConnell, Clark, McKee	(The Crown Estate Agents)	01/05/2008	**Comments:** - Crown Estate's consent would be required for foreshore, riverbed works. - Foreshore currently leased by The Crown Estate to Newry & Mourne District Council. - Only other interest in area is a lease to Carneyhaugh Properties Limited. - They have no record of an outfall to adjoining sewerage works.	
Jonathan McGilly	Enterprise Development Officer	Newry and Mourne District Council	24/04/2008	They have previously supplied us with all relevant information. Happy with EIA approach but stress the need to consult locally with environmental groups and with the council directly.	Strongly recommend consulting with Mr Gareth Coughlin in Scott Wilson in relation to Southern Relief Road.
Hilary Heslip	Divisional Planning Manager	The Planning Service	22/05/2008	Tom Clarke in headquarters will take the lead on this project. Contact him in future.	
Colin Hedderly	Assistant Divisional Engineer	Iarnród Éireann	26/04/2008	Not affected. He has forwarded EIA scoping doc to C.I.E. Group Property Manager.	
E McAuley	Countryside and Coast	Environment and Heritage Service	24/04/2008	Acknowledgment of receipt of EIA.	
J Aaron McCormick	Admin Section	Rivers Agency	23/04/2008	Acknowledgment of receipt of EIA.	
Helen Kirk	Land Use Planning Adviser for NI	The National Trust	22/04/2008	Not affected by proposed development. Still wish to be kept in informed and comment on EIA.	
Claire Ferry	Conservation Officer (Planning)	RSPB Northern Ireland	22/04/2008	**Comments:** - RSPB do not hold any data for the area. Greencastle is a SPA. - Refer to letter and details of contact information for other bodies and Orders.	Contact the British Trust for Ornithology - WEBS count data.

Name	Title / Division	Company	Date	Comments	Actions
Brian Forrest	Land and Resource management	Environment and Heritage Service	26/05/2208	EHS Database identifies three possible sources of contamination - petrol station, railway lands and sewage works. Recommends investigation of information websites - see letter	
Damien Mulligan	Planning Service - Strategic Projects Team	Planning Service	16/05/2008	PADS info	
Patrick Casement		Stautory Advisory Councils (CNCC, HBC, HMC)	19/05/2008	No comment - look forward to reading EIA	
Kevin Scullion	Assistant Direcotr - Environmental Health	Newry and Mourne District Council	21/05/2008	Happy with scope of EIA and supports the methodology for the Air and Noise and Vibration assessments	

Chapter 2

Background to the Proposed Development

Chapter 2 Background to the Proposed Development

2.1 Need for the Scheme

Carlingford Lough and the upper reaches of the Newry River estuary are bounded by Counties Louth, Armagh and Down. In times past, up to the 19th Century, ferry services were provided between Greenore in County Louth and Greencastle in County Down. Similarly, ferry services existed across the Newry River Estuary at Narrow Water Keep.

At present, there is no direct link between the Cooley Peninsula and coastal area of Co. Down. Instead, access is provided by crossing the Newry River in the city of Newry. Since the termination of the ferry services between Greenore and Greencastle, there has been a locally recognised need for a link across Carlingford Lough. At present all traffic travelling along the southern or northern shores of Carlingford Lough is directed away from the Lough through Newry and toward the motorway linking Dublin and Belfast. Consequently the majority of tourist traffic does not continue around the Lough, to the detriment of the tourist economy in both areas.

The need for the scheme is outlined in numerous Planning and Policy documents

- National Development Plan 2007 – 2013;
- National Spatial Strategy 2002 – 2020;
- Regional Development Strategy for Northern Ireland;
- Infrastructure Investment Priorities 2010 – 2016;
- Louth County Development Plan 2009 – 2015;
- Banbridge / Newry and Mourne Area Plan 2015 (Draft Plan).

Strategic Planning Policy

Since the Good Friday Agreement (1998), there has been a transformation in Northern Ireland and in North/South co-operation. In the National Development Plan 2007-2013, the Irish Government sets out proposals for investment in North/South projects and initiatives of mutual benefit. The Narrow Water Bridge project arises from a commitment in the National Development Plan 2007-2013 for "improved access for tourism and other opportunities along the eastern corridor, including better links between Co. Louth and Co. Down in Northern Ireland". The Good Friday Agreement in Northern Ireland supports this stance and has designated tourism as an area for co-operation under the auspices of the North-South Ministerial Council.

National Development Plan 2007 – 2013

The National Development Plan (NDP) 2007 – 2013 entitled 'Transforming Ireland – A Better Quality of Life for All' is an ambitious investment plan designed to link Regional and Local Planning to continued economic investment and expansion.

The Narrow Water Bridge project arises directly from an identified priority in Chapter 5 'All Island Co-operation' of the NDP to "improved access for tourism and other opportunities along the eastern corridor, including better links between County Louth and County Down in Northern Ireland."

National Spatial Strategy 2002 – 2020

The National Spatial Strategy (NSS) is the national planning framework for Ireland whose primary aim is to achieve a better balance of social, economic and physical development across the country. One of the policies of the NSS is to maximise the potential of the tourism sector. Section 5 clearly stresses the need to address 'infrastructural bottlenecks' and to provide coastal infrastructure, commensurate with the needs of the seafood and marine leisure sectors, at strategic locations of particular importance for local economies.

Regional Development Strategy for Northern Ireland

The Regional Development Strategy (RDS) for Northern Ireland 2025, entitled "Shaping our Future" establishes a strategic planning framework for Northern Ireland that will guide physical development within the Region until 2025. The overall aim of the RDS for rural Northern Ireland is to develop an attractive and prosperous rural area. This is to be achieved by action on a series of Strategic Objectives and Supporting Planning Guidelines.

Of significance is the recognition by the RDS of the need to support the growth of tourism as a major economic development theme. In particular is the identification (within policy ECON 8.3) of the need to facilitate the development of infrastructure to meet the needs of visitors.

Infrastructure Investment Priorities 2010-2016 – A Financial Framework

Although stating that spending will shift more towards public transport this document highlights the need to further develop the tourism product.

"Ireland has witnessed a significant drop in the number of overseas visitors coming to our shores. Recent data shows a fall in the number of trips to Ireland by overseas residents. The number of visits to Ireland in 2009 was 17 percent lower than the corresponding period in 2007…….Tourism remains a valuable internationally traded service however and can again deliver significant value added and employment to the economy. Nonetheless, steps must be taken to reinvigorate this sector. While the opening of the National Conference Centre (to be known as Convention Centre Dublin) later this year will provide a major addition to Ireland's tourism infrastructure, further development of the tourism product is required. The Exchequer Capital Programme therefore provides for a high level of investment in this area into the medium term."

Local Planning Policy

Louth County Development Plan 2009-2015, under Section 7.4 Tourism within Chapter 7 'Economic Development, Employment and Tourism' has identified the need for the link as outlined below:

Policy

TOU 6 To co-operate with the authorities in Northern Ireland in the provision of a road bridge between Cooley and south County Down."

The specific requirements, which relate to the Narrow Water Bridge, are outlined in the various policy statements below.

"7.5.4 Narrow Water Bridge

The provision of a road link through the construction of a bridge between the Cooley Peninsula in County Louth and the southern portion of the Mourne Mountains in County Down at Narrow Water would make a valuable contribution to the development of tourism in Louth and the Mournes. Initial funding for the project *has been provided in the National Development Plan 2007-2013 and preliminary design work commenced."*

<u>*Banbridge / Newry and Mourne Area Plan 2015 (Draft Plan)*</u>

The primary objective of the plan for this region of Northern Ireland is to deliver a sustainable pattern of growth in the area. It recognises as one of its goals the need to promote Warrenpoint as a local hub of development and to strengthen its role as both a port and a tourist destination.

2.2 Identification of the Study Area

In the recent past three studies have been carried out to determine whether a bridge or car ferry link between the Cooley Peninsula and the Mourne District was feasible. These studies are:

- 'Omeath to Warrenpoint, Feasibility Study', 1979, Nicholas O'Dwyer and Partners;
- 'Carlingford Lough-Ferry Feasibility Study', 1993, Jonathan Blackwell and Associates; and
- 'Omeath – Warrenpoint Road Link, Feasibility Study', 2001, M C O'Sullivan and Co. Ltd (now RPS Consulting Engineers).

The 'Omeath to Warrenpoint, Feasibility Study' published in 1979 recommended a bridge crossing at the A2 Roundabout west of Warrenpoint. The 'Carlingford Lough-Ferry Feasibility Study' undertaken in 1993 only considered a ferry crossing and did conclude with some uncertainty that the operation of a ferry was economically viable. The 'Omeath – Warrenpoint Road Link, Feasibility Study' completed in 2001 compared bridge and road ferry options. It concluded that a bridge would be preferential to a ferry crossing and that this crossing should be located at the same crossing point identified in the 1979 study.

The 1979 and 2001 studies determined that a bridge crossing located within the vicinity of the A2 roundabout was viable. The study area for the current project was subsequently developed based on the environmental, engineering and economic constraints previously identified and incorporating the crossing point already identified by previous studies as being viable.

The study area for the proposed bridge is indicated on **Figure 2.1** in Volume 3 of this EIS/ES.

2.3 Objectives of the Scheme

The proposed Narrow Water Bridge aims to create a new crossing over the Newry River to the north of Carlingford Lough. It is intended that the proposed bridge will link the R173 Omeath to Newry Road in Co. Louth with the A2 Newry to Warrenpoint Road in Co. Down. The primary objectives of providing the Narrow Water Bridge are:

- Assist the social and economic development of the area;
- Facilitate access to the scenic beauty of Carlingford Lough;
- Enhance the tourist potential of the region;
- Improve the leisure potential of the region;
- Promote interaction between communities north and south of the border; and
- Encourage pedestrian and cyclist activity.

2.4 Development of the Proposed Scheme

In April 2008, Louth County Council engaged the services of Roughan & O'Donovan Consulting Engineers (ROD) to progress the planning, design and environmental assessment of a proposed bridge link in the vicinity of Narrow Water. This process has so far been undertaken in a number of clear stages with input from the public at all stages in the selection of the proposed scheme being developed for the purpose of this assessment (See Section 1.4.3 of this document).

Initially a study area was identified so as to limit the area within which potential constraints would be identified. Within the Study area the identified constraints aided in the identification of a preferred route and the selection of a preferred bridge design (refer to Chapter 4, Sections 4.3 and 4.4). This current stage in the development of the scheme is the preparation of an Environmental Impact Statement / Environmental Statement for the preferred preliminary bridge design, road alignment and associated features.

Chapter 4 of this EIS/ES provides detailed information about the development of the proposed Route Selection Process and scheme design.

Chapter 3

Description of the Proposed Development

Chapter 3 Description of the Proposed Development

3.1 Site Location

The proposed Narrow Water Bridge will cross the Newry River approximately 400m south of the Narrow Water Keep (see **Figure 3.1** in Volume 3). The bridge, which will connect the R173 Omeath Road south of Ferry Hill and the A2 dual carriageway at the existing roundabout, is situated approximately 1km and 2km northwest of Warrenpoint and Omeath, respectively. The bridge will pass close to the stone tower navigational beacon near the southern shoreline.

3.2 Site Description

The site is situated between the steep Cooley Mountains to the south and the drumlins of Down to the north. The Newry River flows through this valley before widening to form Carlingford Lough (see Plate 3.1 below). The shoreline is flanked by roads on both sides and a former rail line occurs along the southern shore. In the immediate vicinity of Narrow Water in the south the countryside pattern is of small fields bounded by hedgerows, whereas to the north the immediate countryside is dominated by Warrenpoint Golf Course and the demesne surrounding Narrow Water House. A site on the northern shoreline, south-east of the A2 roundabout, has been granted planning permission for a mixed use development. It is proposed that the site will accommodate a 60 bed hotel, 40-50 residential units, offices and tourist retail/restaurant/information area. This development was taken into consideration during the design of this development and in particular the siting of the proposed control building.

The Newry River, which is a tidal river leading into Carlingford Lough, can be in excess of 280m wide at high tide. At low tide, the main channel is relatively narrow, approximately 40m wide, exposing mudflats and foreshore on either side.

The site lies within an ecologically sensitive area with deciduous woodland and the foreshore in the south and the inter-tidal mudflats in the north all possessing nature conservation designations. A bird roost has been identified has been identified on the southern foreshore approximately 70m southeast of the navigational beacon near Ferry Hill.

There are a number of important monuments in close proximity to the site including the Narrow Water Castle, which was built in 1837 in a Tudor Revival style, and the associated Keep, which is believed to have been built in 1560. In addition, there is a medieval motte located directly adjacent to the A2 roundabout. This is thought to be the location where King John crossed Carlingford Lough in 1210.

The site is also situated in an area of high landscape quality and high visual amenity, the status of which is confirmed by the protective landscape designations in the Development Plans of both jurisdictions.

3.3 Topography

In the south, the topography is dominated by the steep mountains of the Cooley Peninsula. In proximity of the study area, the land slopes from Anglesey Mountain (422 mOD Malin Head/Belfast) down to the Newry River at sea level. The level of the R173 Omeath Road ranges between 15 mOD and 19 mOD (Malin Head/Belfast).

The highest local point is Ferry Hill (23 mOD Malin Head/Belfast), although it is obscured by the surrounding forest.

The topography on the north side of the study area gradually slopes towards the river as it is located within the foothills of the Mourne Mountains. The A2 dual carriageway roundabout, which is situated directly adjacent the Newry River, is at an approximate level of 3.5 mOD (Malin Head/Belfast).

Plate 3.1 Landscape Quality (view from Flag Staff)

3.4 Narrow Water Bridge Link and Approaches

3.4.1 General Route Alignment

The proposed Narrow Water Bridge will provide a new single carriageway link road, which will connect Omeath and Warrenpoint in counties Louth and Down, respectively (see **Figure 3.1** in Volume 3). It is intended that the proposed link would intersect the existing R173 south of Ferry Hill in the townland of Cornamucklagh. The total length of the scheme is approximately 660m.

A new roundabout will be required, where the link road connects to the R173 Omeath Road. The route, which commences at the proposed Cornamucklagh Roundabout, heads towards the Newry River following the existing field boundaries. The vertical alignment generally reflects the existing terrain, which descends from 19m OD along the R173 Omeath Road to sea level, on the southside, however, some “cut and fill” will be necessary to ensure a smooth flowing alignment.

The route straightens and gently rises as it approaches the river avoiding the stone tower to the north. Upon reaching the river’s navigational channel, the alignment descends to tie into the A2 dual carriageway at the existing roundabout, which is situated directly adjacent the Newry River at 3.5m OD above sea level (Malin and Belfast). The existing A2 roundabout will be modified to accommodate this additional link.

The geometric standards used in the design of the road generally follow the requirements of the National Road Authority's Design Manual for Roads and Bridges (NRA DMRB) and the Highway's Agency Design Manual for Roads and Bridges (UK DMRB). A 60kph Design Speed is deemed appropriate for this road link as it is a short length of carriageway (620m) between two roundabouts. The link roads horizontal and vertical alignments, which are shown in **Figures 3.2 and 3.3** in Volume 3, have been designed in accordance with TD 9 of the National Roads Authority Design Manual for Roads and Bridges (NRA DMRB) and TD 9 of the UK DMRB and comply with the following design criteria as outlined in Table 3.1 below.

Table 3.1 Design Standards for Horizontal and Vertical Alignment

Stopping Sight Distance	**Distance**
Desirable Minimum Stopping Sight Distance	90
One step below Stopping Sight Distance	70
Two steps below Stopping Sight Distance	50
Horizontal Curvature for 60kph Design Speed	**Radius**
Minimum R without elimination of adverse camber and transitions	720
Minimum R with Superelevation of 2.5%	510
Minimum R with Superelevation of 3.5%	360
Desirable Minimum R with Superelevation of 5%	255
Vertical Curvature for 60kph Design Speed	**'K' Value**
Desirable Minimum Crest Curve	17
One step below Desirable Minimum Crest Curve	10
Desirable Minimum Sag Curve	13
One Step below Desirable Minimum Sag Curve	9

3.4.2 Facilities for Pedestrians and Cyclists along the Narrow Water Bridge

The proposed Narrow Water Bridge includes the provision of pedestrian and cyclist facilities between the proposed Cornamucklagh Roundabout on the R173 and the A2 roundabout. Both the Cooley Peninsula and the Mourne Mountains are popular among hill walkers and cyclists, therefore, it is important that the Narrow Water Bridge should cater for pedestrians and cyclists, particularly given that it is being promoted as a tourist bridge.

On the northern approach to the structure a 3.0m combined cycle / footway is provided on either side of the carriageway. This combined cycle / footway will tie into the existing footpath on the A2 roundabout. The cyclists will be able to access this combined cycle / footway via the dished kerbs that are to be provided at crossing points. The 3.0m combined cycle / footway is continued across the opening span. The rolling bascule pylons and cables act to segregate pedestrians and cyclists from traffic. The footway and cycleway diverge around the cable anchors on the main span providing a dedicated 2.0m footway and 1.5m cycle track on each side of the bridge (refer **Figure 3.9** in Volume 3). After approximately 100m the footway and cycleway merge once more to give a 3.0m combined cycle / footway (refer **Figure 3.4** in Volume 3).

On the southern approach, the western combined cycle / footway terminates shortly after leaving the structure while the eastern cycle / footway gradually reduces from 3.0m to 1.75m wide. This 1.75m combined cycle / footway, which is separated from the roadway by 0.75m grass segregation continues up the hill to the proposed Cornamucklagh Roundabout (refer **Figure 3.4** in Volume 3).

Presently, there are no pedestrian or cyclist facilities on the R173 Omeath Road, hence the termination at the proposed Cornamucklagh Roundabout. Furthermore, the population centres are Omeath, Warrenpoint and Newry. Therefore, it is considered appropriate that pedestrian and cyclist facilities should be provided on both sides across the bridge but only on the eastern side on the southern approach to the structure.

Dedicated uncontrolled pedestrian and cyclist crossing points at 60m to 100m intervals are to be provided on the bridge.

3.4.3 Road Cross-section

The following minimum road cross-sections are proposed for the Narrow Water Bridge project (refer **Figures 3.4** and **3.7** in Volume 3**)**:

Bridge Cross-section:

• 2 x 3.00m carriageway	6.00m
• 2 x 0.30m setback	0.60m
• 2 x 0.30m barrier / separator	0.60m
• 2 x 0.30m working width	0.60m
• 2 x 0.90m cable anchor	1.80m
• 2 x 3.00m combined cycle / footway	6.00m
Total width	**15.60m**

Bridge Approach Road Cross-section:

• 2 x 3.00m carriageway	6.00m
• 2 x 0.50m hard strip	1.00m
• 1 x 0.75m segregation	1.50m
• 1 x 1.75m combined cycle / footway	3.50m
• 1 x 0.50m verge	0.50m
• 1 x 3.0m verge	3.00m
Total width	**15.50m**

This is consistent with NRA TD27/00 Annex A, which suggests that the cross-sections for non-national roads should be between 5.5m and 7.5m wide. This is considered to be the narrowest cross-section that could be adopted to accommodate the movement of vehicular traffic and cyclists and pedestrians along the link.

This cross-section is considered to be appropriate given the main objective of the scheme is to assist the social economic development of the area through enhancing the tourist amenity of the area and promoting interaction between the communities on either side of the border. In order to achieve this objective, the Narrow Water Bridge should be attractive to tourists including pedestrians and cyclists. It is desirable that traffic is calmed across the bridge. Research has shown that carriageway width is an important factor in limiting vehicular speeds and therefore, a 6.00m carriageway has been selected.

Furthermore, the Narrow Water Bridge connects the R173 Omeath Road with A2 roundabout, which is situated north of Warrenpoint. Although the A2 is a dual carriageway north of Warrenpoint, the R173 Omeath Road is a narrow single carriageway, which is only 6.00m wide.

The Narrow Water Bridge will act as a tourist link between the Cooley Peninsula and the Mourne District and therefore, must accommodate tourist coaches and buses. A 6.00m wide carriageway can accommodate two coaches passing alongside each other. The maximum width of a coach neglecting wing mirrors is 2.5m.

The road markings delineating the carriageway cross-section shall be in accordance with the Department of Transport Traffic Signs Manual in the Republic of Ireland and the Department of Regional Development (Northern Ireland) Traffic Signs Manual in Northern Ireland. Similarly, the road signage shall be in accordance with the Department of Transport Traffic Signs Manual in the Republic of Ireland and the Department of Regional Development (Northern Ireland) Traffic Signs Manual in Northern Ireland. The movement joint between the fixed cable-stayed span and the rolling bascule opening span shall define the boundary between the different signage and road markings schemes applied in the various jurisdictions. The Department of Transport Traffic Signs Manual shall apply south of this boundary while the Department of Regional Development (Northern Ireland) Traffic Signs Manual shall apply north of this boundary.

3.4.4 Junctions

A new roundabout is proposed where the Narrow Water Bridge link intersects the R173 south of Ferry Hill in Cornamucklagh. Although the primary objective is to allow traffic to safely negotiate the link with the R173, this roundabout has the added benefit of calming traffic locally.

The roundabout design utilises the TD16/07 design standard and has been designed as a ‘Large’ sized roundabout as it is considered safer in road safety terms than a smaller roundabout on the R173 at this location.

The Roundabout geometry is in accordance with TD16/07, with an Inscribed Circle Diameter (ICD) of 50m. Entry widths are 6m minimum, effective flare lengths are 30m approx and an entry radius of 20m and exit radius of 60m minimum has been generally adopted throughout.

Access from the north will be provided from the existing A2 roundabout. The existing 3-arm roundabout will be upgraded to accommodate an additional link. The modifications to the roundabout will be in accordance with the same standard as above.

Pedestrian and cyclist movements have been considered in the design, such that pedestrians and cyclists will be easily guided around these junctions.

The Transport Research Laboratory software programme ARCADY assesses capacities, queues and delays at roundabouts. Both the Cornamucklagh and A2 roundabouts were assessed using the heaviest estimated traffic flows and were shown to operate satisfactorily during the Design Year (2033). A more detailed discussion on the operational capacity of these roundabouts can be found in Chapter 5 Traffic and Transport Impacts.

3.4.5 Queuing Facilities

The bridge is required to open to accommodate marine traffic. It is predicted that the entire opening operation of the bridge will take approximately 20 minutes to complete. This is based on the following assumptions:

• Bridge section to fully open	5 minutes
• Passage of marine vessel through bridge	10 minutes
• Bridge section to close	5 minutes
	20 minutes

While the opening operation is taking place traffic on either side of the Newry River will queue. Therefore, sufficient length of carriageway is required to accommodate these subsequent queues. It is conceivable that queue lengths could extend back to the A2 Roundabout and impact on its operational capacity. Should this occur alternative mitigating measures would need to be provided to ensure the safety of all road users and that the operational capacity of the adjacent junctions remains unaffected. Therefore, traffic management proposals, include road markings, VMS signage and gantries are required to ensure the roundabout continues to flow freely. These proposals are being developed in conjunction with Roads Service in Northern Ireland and Louth County Council and will be finalised at detailed design stage.

In addition, it is proposed that a closed circuit television (CCTV) system be installed on the bridge structure. The CCTV system would be linked with the Louth County Council offices in Dundalk to enable activities on the bridge to be monitored at all times. In conjunction with this, it is proposed that there will be a facility to over-ride the messages on the VMS gantries and signage. Therefore, in the case of an road traffic incident occurring on the bridge, this facility would allow the emergency services to re-direct traffic away from the accident zone if required.

3.4.6 Parking

There is an existing lay-by on the northbound carriageway of the A2 dual carriageway situated between the A2 roundabout and the Narrow Water Keep (see Plate 3.2 below). The lay-by, which has recently refurbished by the Loughs Agency, has been provided to provide parking for visitors to the Narrow Water Park. It is 6m wide and approximately 110m in length excluding entry and exit tapers. The parking layout is informal with the exception of the two mobility impaired parking spaces at either end of the lay-by. It is considered that the lay-by can accommodate 18 vehicles parallel to the kerb including 2 mobility impaired vehicles. Based on visitor information between 21st April 2011 and 31st August 2011, it is estimated that between 3 and 4 vehicles utilise this lay-by at peak times. It is only during exceptional circumstances that the parking provision of the lay-by is exceeded.

It is possible that the parking demand at this location will increase due to the provision of the Narrow Water Bridge. However, it is not anticipated that the increase in the parking will compromise the safe operation of the existing lay-by. In the worst case, it is estimated that an additional 9 vehicles will utilise the lay-by at peak times. Even though this is a two- or three-fold increase in parking demand, the lay-by can easily accommodate these additional vehicles. Therefore, it is not proposed to provide any additional parking spaces as part of the Narrow Water bridge scheme. It is difficult to accurately predict tourist traffic, and therefore, it is recommended that the parking demand at this lay-by monitored by local authorities following completion of the bridge.

Plate 3.2 Existing parking adjacent to Narrow Water Keep

3.5 Proposed Structure

3.5.1 Consultants Brief

Roughan & O'Donovan Consulting Engineers were engaged by Louth County Council to undertake engineering consultancy services for a proposed bridge and associated road works at Narrow Water on the Newry River.

The brief included the delivery of the following objectives:

(i) "The bridge design must reflect its assistance to the social economic development of the area, especially through the growth of tourism and cross-border community co-operation;

(ii) The design must take account of its sensitive location in an environmentally protected area (candidate Special Area of Conservation, Area of Special Scientific Interest and Area of Outstanding Natural Beauty);

(iii) The design will cater for tourist traffic; and

(iv) The bridge is required to open to accommodate marine traffic. This opening must be able to accommodate tall ships and other leisure craft. A separate Navigational Report has been compiled and will be supplied with the planning application."

3.5.2 General Description

Cable-Stayed Bridge with Rolling Bascule Opening Span

The structure is a two span cable stayed bridge with an asymmetric arrangement. The south span is 138.35m and the north span is 56.8m giving a total length of 195m.

All towers are located at the edge of the bridge over the abutment foundation and are leaning back 56 degrees towards the outside of the main crossing. Neither tower has back stays.

The asymmetry of the span is reflected in the tower heights, while the south tower is approximately 84m high and the north tower is only 32m high. Additionally, the south tower is located transversally on the centre line of the bridge while the north tower consists of twin cantilever towers located on each side of the structure.

The deck has a linear variable depth along the south span from 2.0m at the south abutment to 1.5m over the central pier, keeping a constant depth of 1.5m along the north span. The bridge shows no skew at any of its three supports.

The south abutment will be integral, connecting monolithically the abutment, the south tower and the deck. The bridge will have a construction joint at the intermediate pier and at the end of the north abutment, as required to allow the opening of the north span.

Plate 3.2 Photomontage of Proposed Narrow Water Bridge from southern side

Plate 3.3 Photomontage of Proposed Narrow Water Bridge in open position

The deck will be an orthotropic steel deck supported from the steel-concrete composite towers.

This bridge design is illustrated on Figures 3.5 – 3.12 in Volume 3 and on Plates 3.2 and 3.3 above.

3.5.3 Detailed Description of Proposed Scheme

Span Arrangement

The span arrangement is a two span structure over the Newry River, the south span has 138.5m and the north span has 56.8m. The structure shows articulations at both the central pier and the north abutment.

Approaches Including Run on Arrangement

The proposed link road is constructed on embankments of side slope 1 (V) in 2 (H) at the approaches to the bridge. This slope has been adopted to ensure that the toe of the embankments do not impede on to the river tidal zone.

The embankments will be constructed in suitable fill material in accordance with the specification. The backfill to the abutment will consist of well compacted granular material.

Substructures

The end supports consist of reinforced concrete piled abutments.

The north abutment is a hollow structure to accommodate a counter weight which is part of the north span when the bridge opens. The abutment also includes the machinery required to open the bridge and it will have appropriate access for inspection and maintenance.

The piers consist of steel driven piles of small diameter with a concrete cross head where both cable stayed decks will be supported.

The pier location has been chosen so that the piers have a minimum dimension and provide a navigational channel of at least 25m width.

See **Figures 3.6** to **3.8** in Volume 3.

Superstructure

Deck

The cable-stayed deck cross section consists of two strengthened steel orthotropic boxes with orthotropic top slabs to carry the traffic loads. The twin deck boxes will be connected with a transversal rib every 5.0m. Two cantilevers of 3.00m on each side, made of steel orthotropic slabs are provided to accommodate the footpaths and cycleways along the bridge.

The steel deck will have a depth varying linearly along the south span from approximately 2.0m at the south abutment to 1.5m at the central support keeping a constant depth of 1.5m along the north span. The deck will be supported by cables with a 10m longitudinal spacing on both spans.

Towers

The south tower, which is 86m high will have a dimensions of 4.00 x 3.00 metres at the top to 4.50 x 3.50 metres at the bottom (dimensions are given longitudinally and transversally), the tower will be a steel composite structure with an outer steel plate connected to a concrete hollow section that provides both additional counterweight and structural capacity. Additionally, there will be provision for prestressing cables running along the back face of the tower and anchored at different heights and at foundation level. These cables will be accessible on both ends for inspection and maintenance.

The two northern towers, which are 33m high will have a constant dimension of 2.10 x 1.0m and will consist of a steel section filled with non structural concrete. The concrete will act purely as counterweight.

Cable-stays

The cable-stays are small diameter stays, which allows for greater redundancy, improved aesthetics and ease of replacement with minimal effect on service during possible replacement scenarios. The cable-stays will be parallel wires or equivalent with multiple layers of corrosion protection and will be designed in accordance with the latest international recommendations. The cable-stays will be anchored to both the deck and the pylon.

Foundation Type

Due to the heavy loads expected in both abutments and the geotechnical conditions determined by site investigations, all of the foundations will be piled to some extent. Based on the available site investigation information it is expected that all of the piles supporting the structure are to be concrete bored piles of 900mm diameter. Based on the distribution of the rock cores' unconfined strength and point load test results, and the frequency of discontinuities in the rock, it is assessed that on a preliminary basis, the design of the 900mm diameter bored piles with 5m long rock sockets should be adequate to support the structure.

South Abutment

It is expected that the quantity of the piles will be 10 No. with an average length of approximately 15m. A coffer dam is required to facilitate reinforced concrete construction of the pilecap in the dry.

North Abutment

To accommodate the opening mechanism discussed below, the north abutment will be constructed in a secant piled coffer dam extending down through boulders and into the sandstone rock below. Approximately 10m depth is to be constructed, requiring a deep dry coffer dam.

Central Pier

The central pier is to be piled as it is located within the river and as already stated, its dimensions have to be minimized to avoid any affecting the water regime during tidal flows. Based on the preliminary design, the quantity of the piles at each pier location will be 3 No. rotary bored piles with an approximated length of 10m to 15m.

Navigation Beacon

The supports to the navigation beacon are to be piled, with a wider pilecap base to be constructed to allow for temporary works. A dry coffer dam may be required, but alternatives may be possible.

Opening Mechanism

It is a navigational requirement of this crossing to provide a 20m wide navigational channel to water traffic and for this reason the north span will have a rolling bascule configuration.

The rolling bascule and opening mechanism is housed in the hollow northern abutment and the control mechanism shall be manually operated from the associated control building (refer to **Figure 3.13 in Volume 3**). The control building is located to afford good visibility of the navigation channel, the roadway and all pedestrian and cycle lanes.

Proposed Mode of Operation

The span will roll back away from the channel through an angle of approximately 56 degrees. The span will be operated using two hydraulic cylinders pinned to the lower portion of the counterweight pit at their lower end and to the bottom of the counterweight at their upper end. The span shall be balanced and the cylinders so arranged such that the horizontal load will not exceed 10% of the vertical load at the rolling tread interfaces for any position of span opening under all operational wind load cases. The corresponding percentage for any holding wind load case shall not exceed 17%. For design purposes the maximum horizontal operational wind load shall be assumed to be 0.5 kN/m^2 acting upon any vertical projection of the rolling span under any position of opening and the maximum assumed vertical operating wind shall be assumed to be 12 kN/m^2 acting vertically upon the horizontally projected surface of the span in the closed position only. For holding the span in any fixed position of opening the wind shall be assumed to be 1 kN/m^2 acting horizontally upon any vertical projection of the span.

The hydraulic cylinders shall be designed such that under all operating and holding conditions the maximum static design pressure shall not exceed 125 BAR when two cylinders are operating or 250 BAR with only one cylinder operating. The cylinder manufacturer shall verify that the cylinders are rated for service throughout their full range of motion for all operating and holding load cases. The entire hydraulic system shall be rated at 250 BAR minimum. The hydraulic system shall meet the requirements of “The American Association of State and Highway Transportation Officials” (AASHTO) for movable bridges in addition to any local or national codes having jurisdiction over this project. The hydraulic power unit (HPU) pump capacity shall be sized such that the span can be opened or closed in no more than 150 seconds including acceleration and deceleration periods at the beginning and end of travel. The HPU shall normally run using a minimum of two motor and pump units to provide the necessary flow with provisions to run the system from one pump unit only if necessary for maintenance purposes. A reservoir shall be provided with sufficient volume to equal at least twice the total rated pump flow in litters per minute or sufficient volume to store the complete volume of oil contained in the two cylinders whichever is greater.

Span locks shall be required to lock the tip of the span to the adjoining span at the rest pier. The locks shall be designed to resist all applied live loads and to prevent opening of the span inadvertently using the hydraulic cylinders. A minimum of two span locks shall be required consisting of guided lock bars driven into receiver sockets on the adjoining span. The lock bars can be actuated using either electro-mechanical devices or hydraulic cylinders. In either case the actuators themselves shall not resist any live load once the lock bars are engaged and vehicle traffic is allowed on the bridge.

Tail locks may be required to resist live loads on the counterweight for that portion of the counterweight located behind the centre of rotation and exposed to vehicle traffic. If tail locks are required they shall be designed to resist all live load when the span is open to vehicle traffic then swing out of the way to allow the span to open when necessary. Tail locks can be operated using either electro-mechanical or hydraulic actuators. In either case the tail locks if necessary shall be designed such that when engaged they are in firm contact with the mating surface prior to live load being imposed. The actuators themselves shall not resist any live load once the tail locks are engaged and vehicle traffic is allowed on the bridge.

The control system shall be designed to interlock all the various components such that it will not be possible for the operator to open or close the bridge out of proper sequence. The hydraulic cylinders shall have the capability of being controlled using an open or closed loop system with position feedback. This system shall work with either cylinder operating or both. During operation the system shall monitor position and pressure as well as temperature at all times and incorporate sufficient alarms and shut-downs to prevent damage to the hydraulic system in the event of a malfunction.

Location of Operating and Control Mechanisms

The operator house has been designed and so located to offer good visibility of both, the navigation channel and roadway as well as all pedestrian and cyclist lanes. The use of CCTV cameras may be required to allow proper visibility of all these areas for proper safety. The operator consul shall incorporate a simple ergonomic design that allows the operator to pay attention to what is going on at the site while operating the bridge.

Electricity Power Supply and Distribution

The span operating machinery and pumps will be powered by three phase industrial duty electric motors. A substation will be required if ordinary industrial three phase power is not available close to the bridge in order to step the high transmission voltage down to medium and low voltage for use with electric motors. The stepped down industrial voltage power will be used to directly power the hydraulic pump motors and any electro-mechanical devices such as span locks or tail locks through motor starters and/or electronic controllers. The voltage will further be stepped down using additional transformers to provide single phase power used for lighting, control and for other uses.

Communications Systems

Typically the bridge operator will have a normal phone line available for communication as well as an intercom system to communicate between the operator control room and other areas where maintenance personnel may be located such as the electrical control room or the pier area where the hydraulic power unit is located. The regular phone line can be used to communicate with emergency personnel as well as marine personnel who can call in to request a bridge opening. In some cases a loud speaker is provided allowing the operator to give instructions to pedestrians, cyclists, motorists or marine personnel. CCTV cameras are also used on many bridges to allow the operator to see all areas of access to the moveable span. It is intended that the control room may also have direct connection with the Police Service Northern Ireland Control Room in Newry for emergency incidents.

Plant Room

The span operating machinery will be located within the confines of the bascule pier. This machinery will primarily consist of two large hydraulic cylinders piped to a hydraulic power unit (HPU) located nearby. The electric pump motors and valves for the HPU will be controlled from the electrical control room and operated from the operator station. Maintenance provisions must include a method to replace the hydraulic cylinders and HPU valves, motors and pumps without excessive effort or expense. Typically this is done by incorporating hatchways in the bridge deck or walkway areas or large openings in the pier walls. Sometimes electric cranes are included in the plant room for this purpose.

All equipment should be protected from excessive moisture or direct water contact. Sump pumps shall be provided to remove any water that may enter the counterweight pit area. The HPU should preferably be located inside a protected room within or next to the bascule pier. The HPU shall be manufactured using corrosion resistant components and properly protected from corrosion for long life in the anticipated environment. The electrical controls shall be located inside a room protected from the outside environment which includes proper ventilation and heat if necessary.

3.5.4 Aesthetic Consideration

The bridge has a dramatic profile giving a spectacular appearance to the crossing. This fact is enhanced by the opening system of the north abutment where the deck of the north span rolls back with a bascule movement towards the abutment to achieve an opening position where the deck follows a line parallel to the south tower. This effect can be appreciated in the photomontages shown in Plates 3.4 and 3.5 below.

Plate 3.4 View from A2 on Newry side of Narrow Water Castle (Closed Position)

Plate 3.5 View from A2 on Newry side of Narrow Water Castle (Open Position)

The bridge has been designed as a Signature Structure to mark this historic, international link between the Republic of Ireland and Northern Ireland. It was considered that the substantial natural and cultural heritage warranted a 'signature structure' and that the dramatic landscape possessed the ability to accommodate such a structure.

The bridge aesthetics were thus chosen to reflect the unique character and nature of the bridge setting. The southern side at the intersection of the Newry River and Carlingford Lough is dominated by rugged mountains, predominantly, Anglesey Mountain. The northern side is dominated by low lying rolling parkland associated with Hall's Estate and Warrenpoint golf club. On examination of the site at a closer viewpoint, the southern side is dominated by the high trees of Ferry Hill Wood whilst the northern side consists of low-lying urban roads and parks. This examination of the global and local topography revealed an asymmetric nature to the crossing, which led the design team away from the initial thought process that the most suitable bridge structure at this location would be symmetrical in nature. Continuing on the asymmetrical nature of the crossing, when the detailed bathymetric survey of the river was examined, this also revealed that due to the sweeping bend of the river at the location of the bridge, the navigable river channel is also asymmetric with the centre of the river channel being located towards the northern side of the channel.

This overwhelming asymmetry of the bridge site combined with the challenging aspect of trying to ensure that the bridge design in the closed position will be viewed as one continuous structure led to the development of this option, an inclined cable-stayed bridge visually connected to a rolling bascule opening bridge. When viewed from a distance, the tall inclined tower on the southern side reflects the inclined slopes of the mountain in the background and the smaller yet still distinctive rolling bascule tower counterweights reflect the more low-lying topography on the northern side. The continuous nature of the flowing steel structure flowing from the tip to the bottom of the inclined tower and continuing in the deck across the river and returning to a modest height at the tip of the tower, results in the entrance to Newry River from Carlingford Lough being framed like a distinctive cradle, yet almost surprisingly, when the bridge opens, this physical and visually horizontal dominant element is broken to reveal a welcoming and most interesting nature to the entrance to the Newry River.

A further important consideration of this bridge design option, was to ensure that whilst the a structure with significant vertical elements could be accommodated in the topography, they could not interfere with views up and down the river towards Narrow Water Castle and Carlingford Mountain in the distance. As such the ability of the proposed bridge to frame and thus maintain these existing views was considered of significant aesthetic relevance.

These effects are clearly illustrated on the photomontages and are discussed in more depth in Chapter 8.

3.5.5 Proposed Lighting

At night, the bridge will be illuminated with an architectural lighting scheme. The lighting is considered important from a number of standpoints:

- To enhance the architectural significance of the structure;
- As a signature structure enhancing the importance of the setting;
- To provide a recognisable distance feature; and
- To allow birds in flight at night to avoid the structure and cable-stays.

The main concept of the lighting design is to ensure that the towers and cable stays are the strongest visual features at night.

Narrow beam luminaries mounted on the deck and anchorage abutments will be directed up at the cables and towers, picking out the structure and cable stays in coloured lighting. As the beams converge they will have the effect of strongly highlighting and framing the bridge structure. Light emitting fibre optics may be used to enhance this vision and define the cable stays.

The lighting scheme will reinforce the high quality aesthetic nature of the bridge. The narrow luminaries will wash the towers and cable stays in pale light, providing immediate recognition of the bridge's setting.

The directed nature of the luminaries and the low level of luminescence provided will ensure that the neighbouring residents will not suffer from any glare, that there will be no impact on the fish movements within the Newry River and will ensure that any birds moving at night can see and avoid the bridge structure.

3.5.6 Navigation Beacon

The proposed bridge will interfere with the navigational beacon situated near Ferry Hill and therefore, the operation of the leading lights. Therefore, it is proposed to construct a new navigational beacon on the downstream of the proposed bridge. The new navigational beacon shall be installed in a reinforced concrete tower as shown in **Figure 3.15** in Volume 3. The new navigational beacon shall mimic the existing masonry navigational beacons in shape, dimension, colour and surface finish however the requirements of Warrenpoint Harbour authority and Carlingford Loughs Commission will be adhered to in the construction and finishing of the proposed beacon.

3.5.7 Control Building

A control building is required to facilitate the opening of the bridge. It is preferable that the operators in the control building shall have a clear unobstructed view to the bridge and along the river. Therefore, the proposed control building is located at the edge of the river on the north side approximately 200m from the bridge as shown in **Figures 3.16 to 3.20** in Volume 3.

The proposed control building is approximately 9.7m long and 7.4m wide single storey rectangular structure with a pitched roof. The wall nearest the river will be curved and contain a large bay window that will permit the bridge operators a clear unobstructed view of the river. The floor levels within the control building will be set 0.50m above the 1 in 100 year flood event.

The proposed control building, which is located a short distance upstream from Warrenpoint Harbour, is situated at edge of a derelict industrial site that contains dilapidated buildings, masonry rubble and other rubbish including furniture. However, as mentioned previously, planning permission has been granted on the site for a 60 bed hotel and 40-50 residential units. Therefore, the external appearance of the control building has been chosen to integrate into a residential environment rather than an industrial zone. Therefore, the external walls shall have a grey rendered finish while the roof tiles will be slate giving the control building the appearance of a residential dwelling.

A vehicular access is to be provided off the A2 approximately 100mm south of the A2 roundabout. It is anticipated that the access road is only lightly trafficked as it is only to be utilised when the bridge is to be opened. Therefore, the access will be a permeable gravel access roadway of similar construction to NRA Road Construction Detail RCD/700/6. It is proposed that the access road is partially constructed prior to commencing the construction of the control building. Therefore, it can be used as a haul road for the transportation of materials during construction of the control building.

A mains water connection is proposed. It is proposed to pump foul effluent to a stand-off manhole near the northern boundary and discharge by gravity to the existing sewer at the edge of the A2. The control building roof is proposed to drain to a soakaway.

It is proposed that the standby generator situated within the control building shall be powered by natural gas via a connection of the gas main located along the A2.

3.6 Earthworks

On the south side, the ground conditions along the mainline typically consist of dense sands / gravels and stiff clay overlying 5-10m rock. On the north side, the soil consists of made ground, gravels, alluvial mud and shingle on fractured rock. The river consists of alluvial mud, clays, gravels and boulders over fractured rock.

In the preliminary design, both cuttings and embankments are assessed at side slopes of 2 horizontal to 1 vertical. Local steepening of slopes may be required to maximum 1.7 horizontal to 1 vertical due to site constraints. Geosynthetic reinforcement or selected frictional fill may be required to achieve this.

Due to topography and alignment, cuttings of up to 4m depth through overburden soils and fill embankments up to 4m height will be required on the south side of the bridge, resulting in a net earthworks balance on that side of the bridge. Extraction of soils is likely to be carried out by mechanical methods such as digging with average plant and machinery. Based on the frequency of gravels and stiff clay soils observed during ground investigation, it is considered that the percentage reuse will be high, in the range of 80-90%. Part of the quantity will be topsoil suitable for spreading on landscape areas. Minor quantities of imported materials will be required to make up the difference.

On the north side it is mainly fill up to a height of 4m that will be required. In carrying out these works on-site, an earthworks volume deficit of approximately 8,250 cubic metres (assumed to be equivalent to 20,000 tonnes) will need to be imported to site as shown in Table 3.2 below. The soft ground present will need to be excavated and replaced with granular fill and possibly rock armour. Depths affected range up to 1.3m. Class 6A will be used if it is to be placed under water. This volume may alter slightly when allowance is made for pavement materials and proposed landscaping.

Table 3.2 Earthworks Quantities

Quantities	Area	**Cut**	**Fill**	**Soft**	**Balance**
		m^3	**m^3**	**m^3**	**m^3**
	South of Bridge	8,700	8,700	-	-
	North of Bridge	-	8,250	-	-8,250
	Totals	8,700	16,950	-	-8,250

Unacceptable material may be transported for disposal to a licensed facility. Any such exported earthworks material that requires to be disposed of off site will be subject to the Waste Management Acts, 1996 to 2008, the NRA *Guidelines for the Management of Waste from National Road Construction Projects* (2008) and all other relevant legislation as well as any conditions imposed by the Planning Authority.

3.7 Drainage System

The proposed road will be constructed within the catchment of the Newry River. The drainage system serving the new road discharges to the Newry River and other local watercourses. The section of catchment traversed by the proposed road is predominantly rural and is characterised by steep gradients falling towards the Newry River. The proposed drainage system for the Narrow Water Bridge is indicated on **Figure 3.13** in **Volume 3**.

3.7.1 Mainline Road Drainage

The proposed mainline road drainage system shall be designed in accordance with the NRA DMRB and the current best practice guidance for drainage i.e. “Sustainable Urban Drainage Systems” or SUDS.

Drainage of the mainline will generally consist of over the edge drainage into ditches or swales. The typical details of the mainline drainage will be similar to those shown in Plate 3.6 below. These drainage channels will seed naturally thereby fitting into the surrounding landscape. They will also operate as attenuation and treatment in the proposed drainage system by slowing the velocity of the runoff thereby facilitating settlement.

Appropriate planting along the proposed swales will be carried out to improve the effectiveness in retaining suspended solids. If required, baffles will be used to further attenuate the flows in order to facilitate treatment of the road runoff pollutants.

A kerb and gully drainage system will be provided at the proposed Cornamucklagh Roundabout and A2 Roundabout. In addition, a petrol interceptor shall be provided at the A2 Roundabout prior to connecting with the existing system. On the south side, the gullies will connect into the swales and interceptor ditches while on the north side the drainage system will be connected via a carrier drain into the existing drainage system.

Plate 3.6 Typical Detail of Drain at Toe of Embankment

In accordance with HD 33/06 of the DMRB, the road drainage will be designed to accommodate a 1 in 1 year rainfall event without surcharge and a 1 in 5 year rainfall event, with surcharge levels below finished road level. This approach will enable the road drainage system to accommodate higher rainfall intensities for short storms. Rainfall intensities will be increased by 20% in order to take into account the future possible effects of climate change.

The proposed drainage system will be effective in the removal of suspended solids and associated heavy metals through the physical processes of settlement, filtration and adsorption. The swales and ditches will be planted with appropriate vegetation such as reeds, pond weeds and grasses however the final details of the wetlands will be confirmed at detailed design stage of this project and will be accordance with the 'HA 103/06 Vegetated Drainage Systems for Highway Runoff'. These pollution control measures will ensure that all runoff undergoes a high level of treatment prior to discharge to the sensitive receiving waters of the Newry River.

The control building roof is proposed to drain to a soakaway. It is proposed to pump foul effluent to a stand-off manhole near the northern boundary and discharge by gravity to the existing sewer at the edge of the A2.

3.7.2 Bridge Drainage

It is proposed to collect the surface water off the bridge deck using kerb drains which will outfall to the mainline road drainage system. Deck and carriageway falls are provided to ensure that no ponding on or beneath the deck surfacing occurs, this has led to a requirement for a minimum 0.5% fall in the vertical alignment. As described above attenuation, pollution control and spillage containment will be provided in the interceptor ditches to the prior to outfall. On the north side, mainline road drainage will connect into the existing drainage system via a petrol interceptor.

Runoff which collects in the base of the northern abutment will be conveyed into the mainline road drainage system on the north side via a pumped system.

3.8 Utilities

Enquires were sent to all known service providers identified within the Study Area, requesting details of both existing and planned installations within or adjacent to the study area. A Utilities Services Plans can be seen, as shown in **Figure 3.14** in Volume 3, outlining all services found at the site.

3.8.1 Electricity

On the southside, the Electricity Supply Board (ESB) has identified that the local distribution network consists of low to medium voltage overhead lines. There are no underground cables located within the constraints study area.

On the northside, the information Northern Ireland Electricity (NIE) provided indicates that there are no overhead lines or underground cables located within the area of interest. There are road lighting columns surrounding the A2 roundabout, which the Department of the Environment in Northern Ireland maintain.

There are no known high voltage lines or cables within the constraints study area.

A three-phase electrical supply will be required to power the mechanical and electrical equipment used in the opening of the bridge. A connection is required to the electricity supply network in Northern Ireland.

In addition, the control building will require electricity and therefore, shall be connected into the electricity network in Northern Ireland. It is proposed that the connection be provided along the access road to facilitate ease of construction and maintenance.

3.8.2 Telecommunications

Eircom is the only communication service provider with equipment within the constraints study area on the south side. The Eircom overhead cables typically follow the R173 Omeath Road and the surrounding local roads.

Similarly, British Telecom (BT) is the only communications provider on the north side of the Newry River. The BT underground cables follow the existing road infrastructure with cables on both sides of the A2 dual carriageway.

3.8.3 Gas

Firmus Energy have confirmed that a medium pressure (4 bar) distribution gas pipeline was laid along the A2 in 2010. This 180mm diameter PE100 pipeline passes beneath the north eastern portion of the A2 Roundabout. Although considerable care must be exercised at all time and particularly, when working near a gas main, it is not anticipated that this gas main conflicts directly with the works associated with the proposed Narrow Water Bridge Project.

The exact position of this underground service must be determined and verified on site in advance of undertaking any works in the vicinity of the gas main. Consultations shall be held and the appropriate mitigation measures shall be agreed with Firmus Energy, should a conflict between the works associated with the bridge and the gas main become apparent. Any works near gas plant should be undertaken in accordance with the Health & Safety Executive guidance HSG47 – Avoiding Danger from Underground Services and no mechanical excavators or power tools should be used within 500mm of any gas apparatus.

3.8.4 Water and Drainage Services

There are no known watermains or foul sewers located within the constraints study area on the southside of the Newry River.

On the northside, there is a watermain and foul sewer, which pass through the A2 roundabout, between the Burren Road and the A2 heading into Warrenpoint.

The provision of welfare facilities in the control building demands potable water. It is proposed, therefore, to connect into the existing waterman on the A2.

The Rivers Agency has also confirmed that there are two 1500mm diameter culverts under the A2 roundabout.

Chapter 4

Alternatives Considered

Chapter 4 Alternatives Considered

This chapter describes the route selection process which was undertaken and the bridge design options that were considered. The main reasons for selecting the preferred route and bridge design are subsequently outlined.

4.1 Legislative Requirement

The Statutory Environmental Impact Assessment Regulations in both the Republic of Ireland and Northern Ireland directly interpret the EIA Directive in requiring that the Environmental Impact Statement (EIS) / Environmental Statement (ES) contain the following information:

"an outline of the main alternatives studied by the road authority concerned and an indication of the main reasons for its choice, taking into account the environmental effects;"

4.2 Identification of Study Area

In the recent past three studies have been carried out to determine whether a bridge or car ferry link between the Cooley Peninsula and the Mourne District was feasible. These studies are:

- 'Omeath to Warrenpoint, Feasibility Study', 1979, Nicolas O'Dwyer and Partners;
- 'Carlingford Lough-Ferry Feasibility Study', 1993, Jonathan Blackwell and Associates; and
- 'Omeath – Warrenpoint Road Link, Feasibility Study', 2001, M C O'Sullivan and Co. Ltd (now RPS Consulting Engineers).

The 'Omeath to Warrenpoint, Feasibility Study' published in 1979 recommended a bridge crossing at the A2 Roundabout west of Warrenpoint. The 'Carlingford Lough-Ferry Feasibility Study' undertaken in 1993 only considered a ferry crossing and did conclude with some uncertainty that the operation of a ferry was economically viable. The 'Omeath – Warrenpoint Road Link, Feasibility Study' completed in 2001 compared bridge and road ferry options. It concluded that a bridge would be preferential to a ferry crossing and that this crossing should be located at the same crossing point identified in the 1979 study.

The 1979 and 2001 studies determined that a bridge crossing located within the vicinity of the A2 roundabout was viable. The study area for the current project was subsequently developed based on the environmental, engineering and economic constraints previously identified and incorporating the crossing point already identified by previous studies as being viable.

The study area for the proposed bridge is indicated on **Figure 2.1** in Volume 3 of this EIS/ES.

4.3 Identification of Potential Constraints

A data collection exercise was undertaken which focussed on determining the physical, environmental and engineering constraints which exist and which could affect the location and design of the scheme within the proposed study area. The Constraints Report identified the sensitivity of the natural and cultural environment and examined the existing topography, geology, road network and land-use in the immediate locality (Refer to Roughan and O'Donovan (2008) '*Narrow Water Bridge Constraints Study Report*'). This study gathered considerable information which was subsequently used to inform the route selection report.

4.3.1 Constraints Identified

The Constraints Study was carried out at an early stage of the project with the objective of gathering as much background information relating to the study area as possible. This data collection exercise focused on determining the physical, environmental and engineering constraints which exist and which could affect the location, design and progress of the scheme. The main constraints arising from the 'Narrow Water Bridge Constraints Study Report' by Roughan & O'Donovan dated June 2008 are listed below:

(i) The southern shoreline of Carlingford Lough is designated as Carlingford Shore candidate SAC and proposed Natural Heritage Area. As a consequence of its cSAC status it is imperative that there is no impact on the Annex 1 habitats for which the site is selected (refer to Natura Impact Statement, Appendix 7.2.3);

(ii) Carlingford Lough also contains two Special Protection Area designations, one in Northern Ireland and one in the Republic of Ireland. These are opposite each other, occur significantly to the east of the proposed development (from the harbour at Carlingford to Greenore Point on the southern shore; and from Killowen Point to Soldier's Point on the northern shore) and cover the intertidal areas therein. As a consequence of these designations it is important that there is no impact on the bird populations which form the Special Conservation Interests of these sites (refer Natura Impact Statement);

(iii) Carlingford Lough Area of Special Scientific Interest extends from the inner part of the Newry River to Cranfield Point - the entire northern shore of Carlingford Lough. This is a site of national nature conservation interest which is designated under the Environment (NI) Order 2002 (refer to Chapter 7, Section 7.2).

(iv) The water quality in Carlingford Lough is strictly monitored and controlled as it is a designated shellfish production site (S.I. 268 of 2006 (EC (Quality of Shellfish Waters) Regulations 2006)

(v) The tidal zone in the vicinity of Narrow Water is also regularly dredged for mussel seed and therefore, access to these grounds by fishing vessels must be maintained;

(vi) The study area lies within an area of high archaeological sensitivity. A number of listed monuments, including Narrow Water Keep and a motte, located just to the north of the A2 roundabout, occur in the immediate vicinity and the area possesses significant cultural history. It is crucial that the development does not physically impact or visually detract from these monuments. In addition, the archaeological studies indicate that the possibility of archaeological remains being discovered along the selected route is relatively high;

(vii) The landscape quality and visual amenity in the study area is very high. Planning policy, in both jurisdictions, protects the landscape quality and visual amenity from adverse development. The Narrow Water Castle is of particular importance in Northern Ireland as it's setting is specifically protected;

(viii) A previous flood study, commissioned by the Northern Ireland Rivers Agency, has shown that the 1:200 year flood event is 4.05m OD (Malin Head) (4.02 OD Belfast). Under these circumstances the A2 roundabout and approach roads, which are on the northern side, would flood.

4.4 Route Selection

Following the compilation of the Constraints Report, a Route Selection Study (refer Roughan & O'Donovan 2008 '*Narrow Water Bridge Route Selection Report*') was undertaken based on the above study area. This study consists of an assessment of the various potential route options on environmental, engineering and economic grounds such that a complete investigation and thorough analysis of the most feasible route corridors is undertaken.

4.4.1 Route Options

A number of initial routes were developed based on site visits and information recorded in the Constraints Study. The route options examined were as follows:

- Route Option A: Southern Corridor;
- Route Option B: Central Corridor;
- Route Option C: Northern Corridor;

These Route Options are illustrated on **Figure 4.1** in Volume 3.

Route Option A: Southern Corridor

This corridor commences south of Ferry Hill in the townland of Cornamucklagh. It departs from the R173 following the field boundaries as it heads towards the Newry River. It crosses the river south of the stone tower and connects with the A2 dual carriageway at the existing roundabout.

Route Option B: Central Corridor

The central corridor begins at Davies' Crossroads. It continues through the forest to the north of Ferry Hill and crosses over the dismantled railway line. The corridor follows the alignment of the existing road, traversing the Newry River 30m north of the slipway before connecting with the A2 dual carriageway 150m north of Narrow Water Keep.

Route Option C: Northern Corridor

This is the northernmost option. Its beginning is located between Davies' Crossroads and the County Bridge. The corridor heads north crossing a wide section of the Newry River. It ties into the A2 dual carriageway 600m and 1km north of the Narrow Water Keep and the existing A2 roundabout, respectively.

4.4.2 Assessment of Route Options

A Route Selection Exercise, and associated report, was completed in November 2008. The study consisted of an assessment of the various options on environmental, engineering and economic grounds.

Each of the three route options was specifically scored against:

- Engineering and Topographical Impacts;
- Planning and Socio-Economic Impacts;
- Aquatic Ecology an Sedimentation;
- Terrestrial Ecology;
- Landscape and Visual Impact;
- Geology and Hydrogeology; and

- Impacts on the Archaeological and Cultural Heritage.

These are detailed below and the findings are summarized in Table 4.1

Engineering and Topography

In the south, the topography is dominated by the steep mountains of the Cooley Peninsula, while on the north side the ground gradually slopes towards the river as it is located within the foothills of the Mourne Mountains. The main topographical constraint, which impacts on all route options, is the proximity of the A2 dual carriageway to the northern bank of the Newry River as this limits the vertical alignment over the navigational channel.

All three route options connect the R173 (B79) Omeath Road and A2 dual carriageway and therefore, would satisfy the traffic demand between the Cooley Peninsula and the Mourne District. However, Davies' Crossroads would appear to be particularly hazardous junction and therefore, it is preferable to avoid locating the bridge crossing nearby. Furthermore, the Roads Service Northern Ireland (RSNI) has indicated its preference for the Narrow Water Bridge to tie into the existing A2 roundabout as a second roundabout is undesirable to road users travelling along the A2 dual carriageway to Newry. On this basis, Route Option A has the least impact on the existing road network and is the preferred route option.

Existing utilities and services were identified within the Constraints Study. All three route options impact on electricity and communication cables, which can be easily diverted. The Rivers Agency (Northern Ireland) have confirmed the existence of two 1500mm diameter culverts, which impact on Route Option A, under the A2 roundabout. These culverts can be diverted and this is not considered a significant constraint.

Planning and Socio-economics

The proposed bridge will link Omeath and Warrenpoint. Omeath possesses a small population with commercial activity being based upon summer tourism and fishing and agriculture. Warrenpoint, on the other hand, is the second largest town in the Newry and Mourne district after Newry with a population of 7000. Warrenpoint's status as a service centre for the surrounding area is secured by the presence of its modern port and associated industrial area. However, similar to Omeath, Warrenpoint also has a strong history of tourism and continues to attract tourists for beach and specialist activity holidays.

In terms of the receiving environment the Constraints Study Report has shown that from both a social and economic viewpoint the existence of a bridge at any one of the route options would have a beneficial impact. However, in terms of physical usage of the bridge Route Option A provides the closest link to both Warrenpoint and Omeath and as such provides the better facility for cyclists and pedestrians.

Aquatic Environment

In terms of aquatic ecology the potential impacts of the three route options are very similar. In relation to the marine environment the Constraints Study Report identifies the most significant issues as being the release of sediments and contaminants into the water body. This issue is more likely to vary in respect of bridge design, than in respect of the suite of route options, and as such is addressed under Section 4.5 Bridge Design Options.

Terrestrial Ecology

The Constraints Study Report highlights that the area is of high nature conservation value and is covered by a number of nature conservation designations (refer to Section 7.2 for detail).

Each of the Route Options will have a similar impact on the mudflats of Carlingford Lough Area of Special Scientific Interest (ASSI) on the northern shore.

Route Option A will have a direct impact on a high tide roost used by the ASSI bird features mentioned. This roost is the Habitats Directive Annex 1 Habitat – salt marsh, although this is not a selection feature of Carlingford Shore candidate Special Area of Conservation (cSAC), which covers the southern shoreline. Route Option B will directly impact the mature deciduous woodland which forms an integral part of the candidate SAC. Route Option C will be a significantly larger span than the other two options and will result in direct impact on mudflats on both sides of the proposal and an area of woodland on the northern shore.

It is not possible to prevent the loss of deciduous woodland as per Route Option B. This is thus the least appropriate site in ecology terms – a decision which is supported by the fact that the woodland is included within the candidate SAC.

It is likely that Route Option A will result in the high tide roost being abandoned during the construction phase. However it is proposed to construct an additional and alternative high tide roost a short distance downstream and this is considered as likely to result in a negligible impact.

Route Option C will impact mudflats on both sides of the Newry River. These mudflats are potentially used as feeding grounds by some of the bird species. This option will also result in the loss of some un-designated woodland on the northern side.

On the basis of this information Route Option A was identified as having the least impact on habitats and species and from an ecological view point is the preferred option.

Landscape and Visual

The study area falls entirely within an area defined by both Louth County Council and Newry and Mourne District Council as being of very high landscape quality. Accordingly the development plans for both areas contain restrictive planning policies which are intended to prevent deterioration of either the natural or cultural landscapes in the area.

In order to assess the potential impact of any one of the route options they must be assessed in terms of their visual impact. The visual impact depends upon the critical views of the bridge which are available and thus is directly dependant on bridge design.

Route Option B, due to its proximity to Narrow Water Keep will have a very significant impact on the cultural landscape. In addition, one of the most significant short range critical views is on the approach to Narrow Water from Newry along the A2. On that basis, Route Option C, being located in front of Narrow Water as it is approached, will have a high visual impact. Similarly, an important long range critical view occurs from Flag Staff view point looking down the Newry River valley towards Narrow Water and Warrenpoint. Route Option C would directly interrupt this view whereas the views towards Route Option A, depending on bridge design, could be alleviated and mitigated by harnessing the presence of the cranes of the industrial area beyond.

Geology and Hydrogeology

The assessment of geological and geotechnical constraints for the three route options was carried out in advance of any specific ground investigation and is based on desk study information only.

The bedrock underlying all three routes is the same sedimentary greywacke turbiditic sandstone. It is known to be metamorphosed to hard hornfels adjacent to major intrusions such as the Slieve Gullion Complex, which all three options are relatively close to. The northern route option is the closest but is not necessarily any more likely to have been altered in this way. Hornfels is more dense than sandstone and much harder to excavate but less likely to have stability concerns. None of the proposed routes are situated on any fault-lines indicated on geological mapping.

The slope stability of excavations in rock is affected by the orientation of the alignment to the dip direction of the discontinuities in the rock when the dip angle is high, as it is in this case. Both the central and southern route options run almost orthogonal to the dip direction indicated on geological mapping. This means that plane failure would be the most likely mechanism for kinematic instability of rock masses daylighting in excavations. The northern route option runs at approximately 46° to the other two options, so wedge failure mechanisms are much more likely to be prevailing. The likelihood and severity of either failure mechanism is unknown without detailed information on discontinuities and groundwater conditions.

The topsoil types indicated on the southern riverbank show that the central route option is based predominantly on lithosols (soil derived from rock and typically very shallow) while the other two route options are indicated to be on a mixture of organic peaty podsolic clays and lithosols, also assumed to be relatively shallow. Any subsoils present are indicated to be tills derived from granite. Bedrock is indicated to be close to surface at all three options on the southern riverbank.

The alluvial soils at and adjacent to the river are generally soft to very soft. It would be preferable to minimise the length of soft alluvium over which the bridge alignment crosses. In particular it would be preferable to minimise the depth of alluvium encountered during construction. The central route option crosses a shorter distance of alluvium and river channel compared to the northern and southern route options. The depth of alluvium present at each location is currently not known.

The superficial groundwater aquifer on the northern riverbank does not extend to include the northern route option however it does cover the other two. None of the three route options propose to extend for any considerable distance into the northern riverbank.

There is no appreciable difference in the route selection based on geological, geotechnical or hydrogeological constraints.

Archaeology and Cultural Heritage

The Constraints Study highlights that the study area is located within a very archaeologically sensitive area. The sites shown include state monuments, such as Narrow Water Castle and its associated buildings, historic buildings and industrial heritage sites. Despite the fact that none of the options will directly impact physically upon any of these sites, there is a requirement within planning policy to minimise the visual impact and to protect the settings of these sites.

Route Option B will directly impact a slipway on the southern side and comes within 150m of Narrow Water Keep on the northern side. The impact on the setting of the Keep, forming as it does the entrance to Warrenpoint and the Lough, is too great for this option to be considered further.

Route Option A comes across at the existing roundabout on the A2. When compared against Option B, this will have a significantly reduced visual impact on the setting of Narrow Water. However it will still have some impact on the motte to the north of the roundabout and to the immediate setting of the tower and lighthouse.

Route Option C ties into the A2 600 metres north of the Narrow Water Keep and would appear to have the least direct impact. However, it should be noted that another potential constraint are as yet undetected archaeological sites and in that respect it is interesting that the Built Heritage Directorate of Northern Ireland Environment Agency identified, during the Pre-Application Discussion Process with Northern Ireland Planning Service, that Route Option A is their preferred route as they believe upstream to be the potentially richer archaeological zone.

Preferred Route

Table 4.1 summarises the above information. In order to determine the preferred route option all the routes were ranked against the various aspects considered in this route selection. The preferred route selected is the route that was considered most favourable overall.

Table 4.1: Summary of Route Options Assessment

Constraints	Route Options		
	Southern	Central	Northern
Engineering and Topographical	1	2	2
Planning and Socio-Economic	1	2	3
Aquatic Ecology	1	1	1
Terrestrial Ecology	1	3	2
Landscape and Visual	1	3	2
Geology and Hydrogeology	1	1	1
Archaeology and Architectural Heritage	2	3	1
Overall Rank	**1**	**3**	**2**

This process came out strongly in favour of the Southern Option (Route Option A – **Figure 4.1** in Volume 3).

In summary, this route option was identified as the preferred option for the following reasons:

(i) It is the shortest crossing and has the least impact on the foreshore and on terrestrial habitats;

(ii) Minimises the visual impact from Flag Staff (protected view) by harnessing the presence of the cranes of the industrial area beyond and being partly obscured by Ferry Hill;

(iii) Minimises the impact on the existing road network by utilising the existing A2 roundabout; and

(iv) Most advantageous for cyclists and pedestrians due to its proximity to Warrenpoint and Omeath.

4.5 Bridge Design Options

4.5.1 Moveable Bridge Design Options

Generally speaking there are three basic types of movable bridges in common operation; bascule, swing and vertical lifts. Each of these options, along with variations of each, was evaluated for suitability to this project. Each is described briefly below:

Bascule bridges rotate vertically about a horizontal axis called a trunnion. Bascule spans are generally counterweighted so that the power required to open or close the span is limited to that which is required to overcome inertia, wind and unbalanced forces and not actually to lift the full dead weight of the span. Electric motor and gear drives are commonly used to pivot the span about the trunnion although hydraulically actuated cylinders may also be used to provide the force required to move the span.

Swing bridges rotate horizontally about a vertical axis called the centre pivot. The swing bridge spans may either be symmetric about the pivot, or may have unequal length spans with the shorter span counterweighted, with the latter form referred to as a bobtail swing. Again, electric motor and gear drives are most commonly used to rotate the span about the centre pivot. Hydraulically actuated cylinders may also be used to provide the force required to move the span.

In the most conventional configuration, a vertical lift bridge has a simple span which raises and lowers guided by a tower on each end. One end of a set of wire ropes is fixed to the lift span, the other to a counterweight with a pulley, or sheave, between them. The sum of the counterweights roughly equals the weight of the span, thus providing a balanced system. Movement can be accommodated either by mechanizing the span, the sheave, or the counterweights.

Bascule and swing bridges were considered for the moveable span as described below.

4.5.2 Design Options Considered

Design Option 1 – Multi-span Bridge with Bascule Opening Span

This bridge option is illustrated on **Figure 4.2** in Volume 3 and consists of a northern approach embankment (57m), a northern fixed span (60m), a moveable span & substructure (61m), two southern fixed spans (60m & 48m) and a southern embankment (66m) resulting in a total bridge length of 238m. As a result of the multi-span nature of the bridge three significant (13m x 13m) piled substructures will be required in the Newry River.

Design Option 2 – Multi-span Bridge with Twin Swing Opening Span

This approach was developed around focusing on the bridge opening span as a gateway from Carlingford Lough to the Newry River. This bridge option is illustrated on **Figure 4.3** in Volume 3 and consists of a northern approach embankment (36m), two northern fixed spans (2 x 37m), a moveable span & substructure (49m), three southern fixed spans (2 x 37m) and a southern embankment (92m) resulting in a total bridge length of 234m. In this instance 5 piled substructures are required within the Newry River, with the two needed to support the opening span being significant structures (20m x 8m).

Design Option 3 – Cable-stayed Bridge with Rolling Bascule Opening Span

Option 3 has been chosen as a Signature Bridge Option to mark a unique and historic bridge crossing between the Republic of Ireland and Northern Ireland.

This bridge option is illustrated on **Figure 4.4** in Volume 3 and at the time of bridge options consisted of a northern approach embankment (42m), a northern fixed span (60m), a moveable span & substructure (49m), a cable-stayed suspended span (148m), a southern approach span (25m) and a southern embankment (35m) resulting in a total bridge length of 283m. The cable-stayed span is supported by a double plane of cable-stays which are anchored to an inclined vertical tower. The cable stayed nature of the bridge requires only one small piled leaf pier substructure to be located in the Newry River.

4.5.3 Hydrodynamics and Marine Modelling

Early consultations with the Loughs Agency and Warrenpoint Harbour Authority highlighted the importance of minimising the release of sediment during both the construction and operation of the bridge.

The presence of commercially licensed aquaculture beds (mussels and oysters) within Carlingford Lough directed the Loughs Agency to advise of the requirement to ensure that these commercial interests were not impacted by the release of either sediment or contaminants into the water body.

Warrenpoint Harbour Authority made it clear that any release of sediment could impact their dredging contract which is required to maintain the deep water channel and turning circle serving the harbour.

As a consequence of the above substantial constraints AQUAFACT International Services Ltd. were commissioned to develop a computer model to assess the hydrodynamics of Newry River Estuary and to assess the effects of a proposed bridge on the water circulation patterns of the estuary. With respect to developing the hydrodynamic model, Bridge Options 1 and 2 are considered as one within the model due to the requirement in both designs to have substantial bridge pier foundations in the central river channel. The cable stayed option was considered separately.

Hydrodynamic Modelling

A hydrodynamic model was used to calculate current speeds and directions within the estuary. For this study two models were developed, one to examine the existing circulation patterns in the estuary and the other to examine the circulation patterns in the estuary due to the presence of the proposed bridge (for which two different construction options were examined). The first model was calibrated against field measurements of water surface elevations and current magnitude and direction. The second was then executed using these same parameters to determine the relative effects due to the proposed bridges.

The bathymetry defining existing conditions in the estuary is presented in Plate 4.1. A more localised bathymetry plot outlining the area of interest adjacent to the proposed bridge site is presented in Plate 4.2.

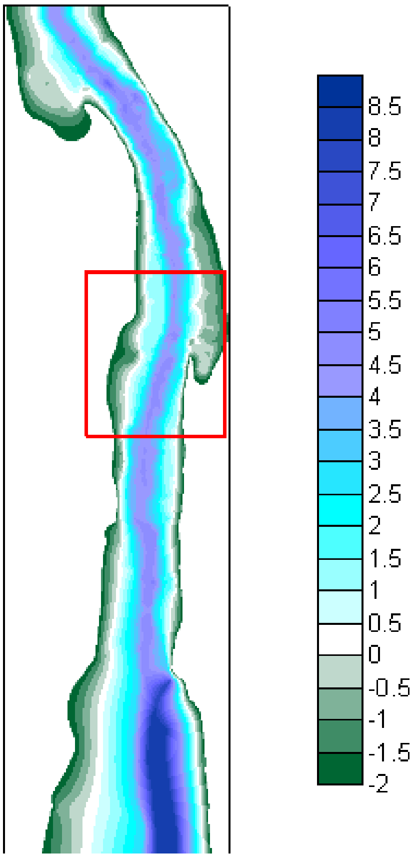

Plate 4.1: Bathymetry plot of Newry River Estuary with the area of interest outlined

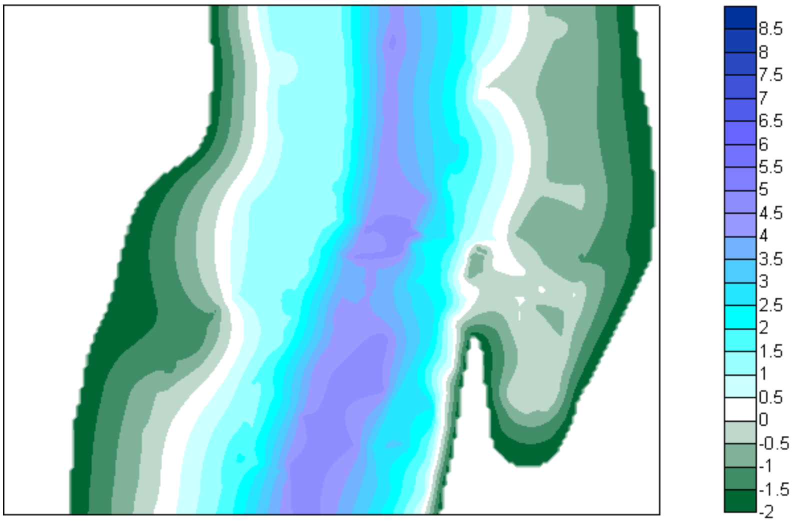

Plate 4.2: Bathymetry plot of the area of interest in the vicinity of the proposed bridge site

Model Description

The type of model used in this study, DIVAST (Depth Integrated Velocity and Solute Transport) is a two-dimensional, finite difference model. It is amongst the best tools available for the modelling of hydrodynamic conditions within a coastal environment. The mathematical formulation of the model is based on the Navier-Stokes equations that describe variations in current speeds and directions. DIVAST uses an implicit finite difference scheme to solve the Navier-Stokes equations for unsteady flow conditions. The finite difference technique is the most common method employed to solve these equations and is ideally suited for total water quality management of a water body as well as evaluating individual problems.

The computer model DIVAST was used to carry out a study of the Newry River Estuary to examine the hydrodynamic patterns in the area and to assess the possibility of alterations in these patterns due to the construction of a bridge. The model is widely used in Ireland and the U.K. for many different types of hydro-environmental studies in coastal waters such as sewage effluent discharges, oil spill modelling, aquaculture assessment and water quality management planning. The model has been used to date on more than 200 such studies and has proven to be a reliable tool for such analysis. DIVAST is an industry standard package for water quality studies.

Model Development

This hydrodynamic model study was carried out by developing a model to simulate water circulation for a full spring to neap tidal cycle. This was performed, as typical in all such model studies, in three interactive stages.

- The first stage consisted of developing a water circulation model of Newry River to compute the hydrodynamic patterns and tidal elevations within the estuary for prescribed environmental conditions.
- The second stage in the study was the calibration of this hydrodynamic model against field data.
- The third stage of the study consisted of the development of a hydrodynamic model to assess the circulation pattern with the two different bridge options present.

The finite difference model of Newry River Estuary was developed by overlaying a grid on top of the relevant Admiralty Chart. The data obtained from the Admiralty Chart was then interpolated and a finite difference grid was produced using the commercially available software SURFER. The grid had equal spacing of 2m x 2m in two orthogonal directions. A total of 479,226 grid points were used to define the model. At each grid point the water depth at that location is identified to the model using the bathymetric data. A two-dimensional surface plot of the bathymetry of the bay is shown in Plate 4.1.

The topography of the area is defined by specifying land boundaries, which delineate the extent of the water body. At the northern and southern limits of the model water elevation boundaries are specified. These boundary conditions are the main forcing functions that induce circulation in the water body.

The water currents that are observed in coastal waters are induced by many different forces. In the model employed for this study the following significant forcing functions were incorporated into all simulation runs of the hydrodynamic model:

- Tide elevations
- Coriolis effect

The Coriolis force induces water currents due to the fact that the water body is on the surface of a rotating globe. The force is a function of the latitude of the water body and the rotational velocity of the earth, in this case considered to be 54.15° and 400 m/s respectively.

Model Calibration

Before a model can be employed with any degree of credibility as a water quality simulation tool, its hydrodynamic predictions must first be shown to give good agreement with actual field measurements. Therefore, the hydrodynamic calibration process is an integral part of the water circulation modelling process. Details of the calibration exercise for the Newry Estuary model used in this study are presented in this section.

A field survey was carried out by Aqua-Fact International Services Ltd. in February 2008 to provide information about the tidal regime in the vicinity of the proposed development in Newry River. The field survey included both water surface elevation measurements and current speed and direction measurements over a full tidal cycle. These hydrodynamic data sets were used to calibrate the hydrodynamic model.

For the calibration analyses, the environmental conditions, which were recorded during the field survey were used as input for the model simulations. The tidal elevations as measured on the day when the hydrographic survey was carried out were specified to the model. Wind blowing over the surface of a large body of water will transmit some of its energy to the water, thereby inducing currents. The induced water circulation is a function of the wind speed, direction and transfer coefficient. Therefore, during the simulation the prevailing wind conditions were also defined in the hydrodynamic model.

A number of runs of the hydrodynamic model were necessary before sufficiently accurate correlations were obtained between the predicted and measured current velocities, directions and water surface elevations. The bed roughness length was adjusted until adequate agreement was obtained. A number of fine adjustments were applied to other empirical coefficients. The hydrodynamic model was calibrated by comparing current velocities and water surface elevations as calculated by the model against their field-measured counterparts.

Hydrodynamic Calibration

The hydrodynamic model was calibrated by comparing model predictions against field measurements of current speeds and water surface elevations for given environmental conditions. When running the model, tidal elevations were specified at the northern and southern open sea boundaries for spring and neap tides. These elevations corresponded with measured tidal dynamics. In the current study, the model was calibrated from physically measured field data, using an Acoustic Wave and Current (AWAC) meter.

Hydrodynamic Modelling Results

Plates 4.3 – 4.10 present snapshots of water velocity during various tidal conditions at the study site in the Newry River while Plates 4.11 – 4.18 present the snapshots with the introduction of the bridge structure (two design options) to the river.

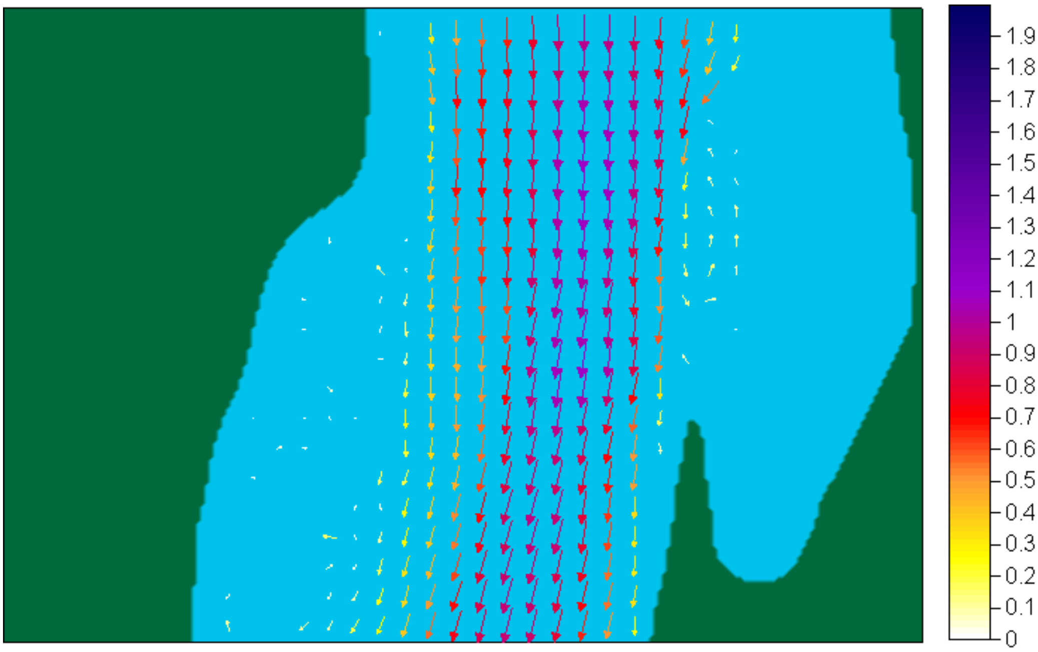

Plate 4.3: Snapshot of current velocity vectors within Newry River Estuary at mid-ebb during a spring tidal cycle

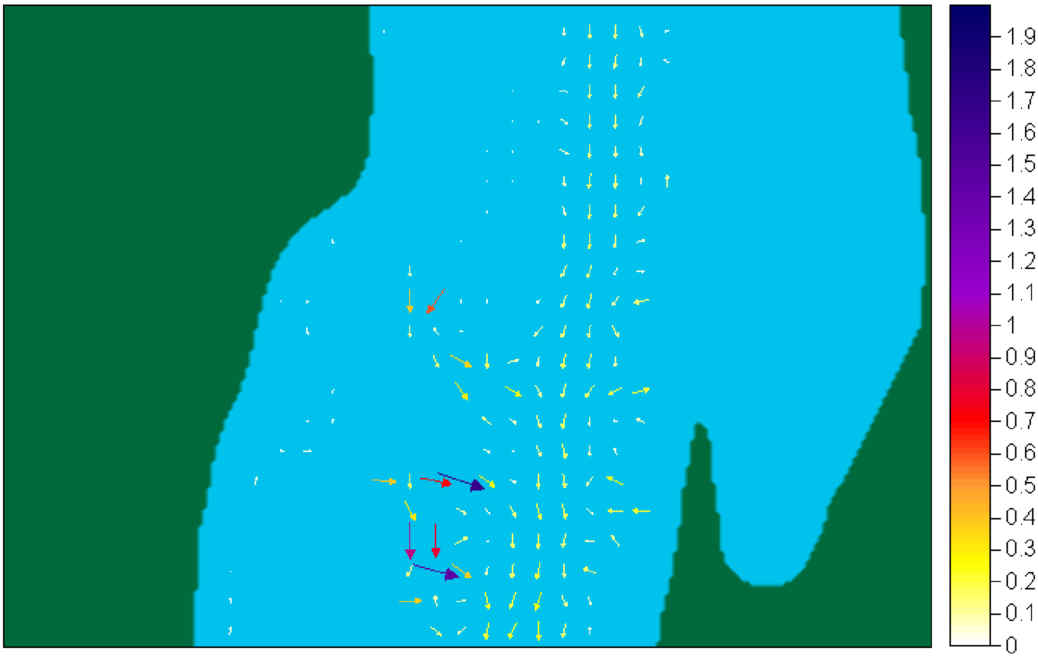

Plate 4.4.: Snapshot of current velocity vectors within Newry River Estuary at low water during a spring tidal cycle

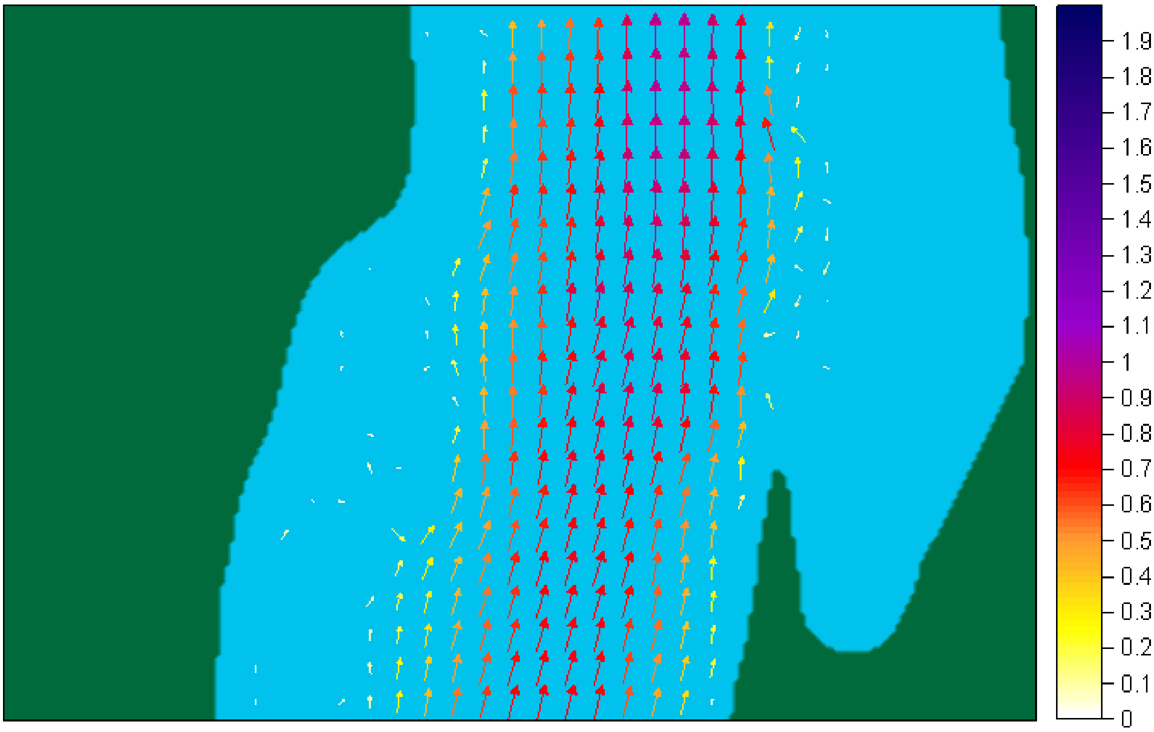

Plate 4.5.: **Snapshot of current velocity vectors within Newry River Estuary at mid-flood during a spring tidal cycle**

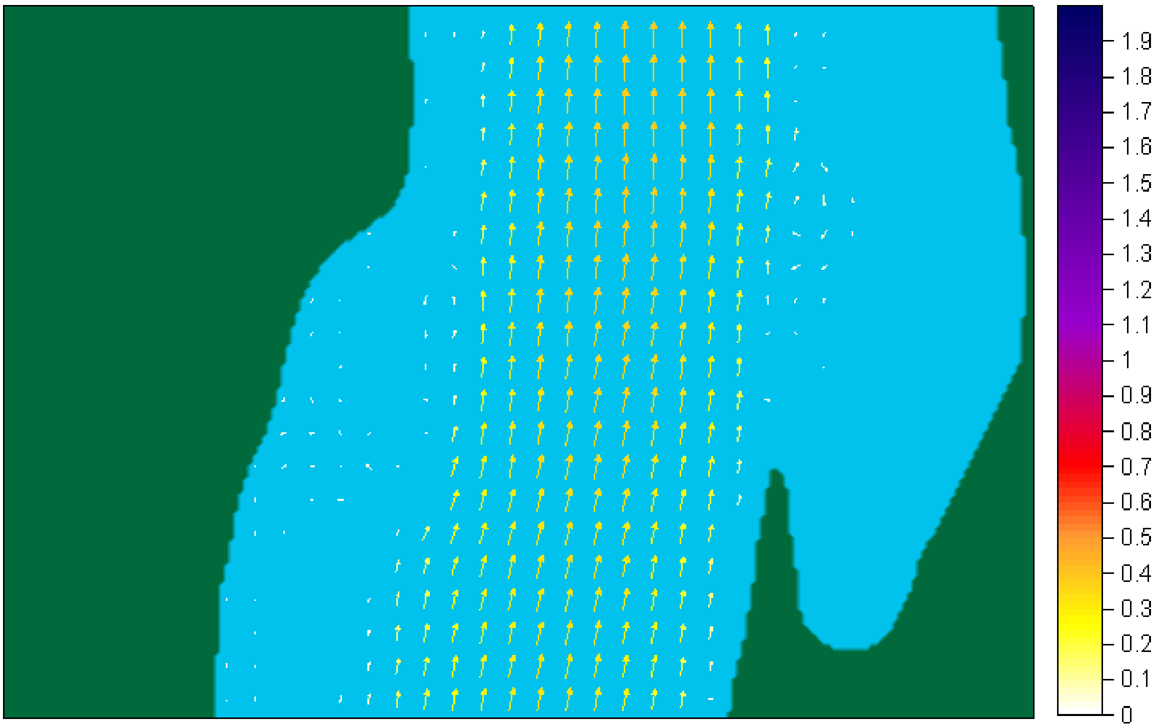

Plate 4.6: **Snapshot of current velocity vectors within Newry River Estuary at high water during a spring tidal cycle**

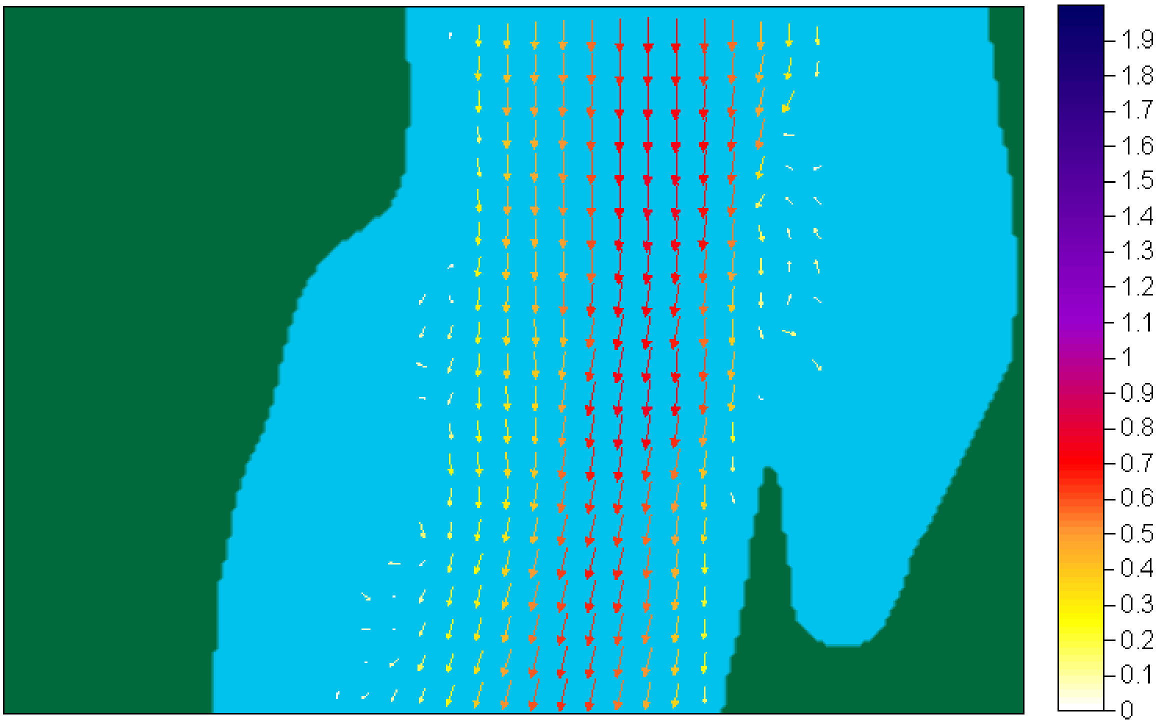

Plate 4.7: Snapshot of current velocity vectors within Newry River Estuary at mid-ebb during a neap tidal cycle

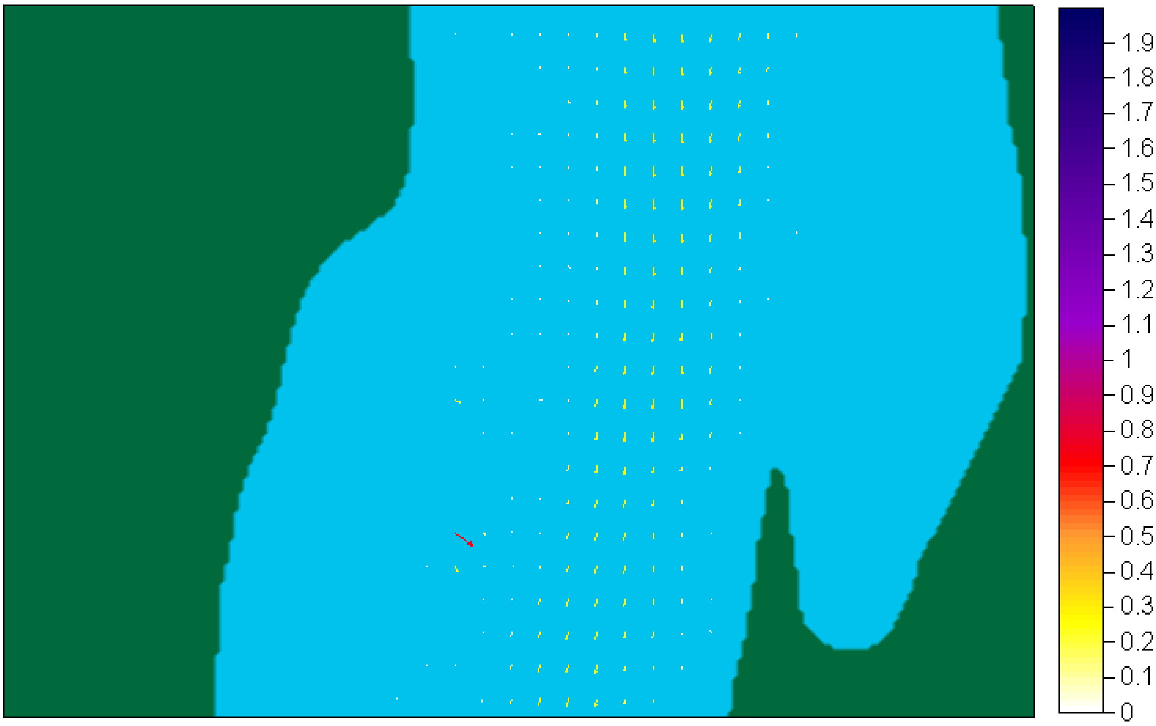

Plate 4.8: Snapshot of current velocity vectors within Newry River Estuary at low water during a neap tidal cycle

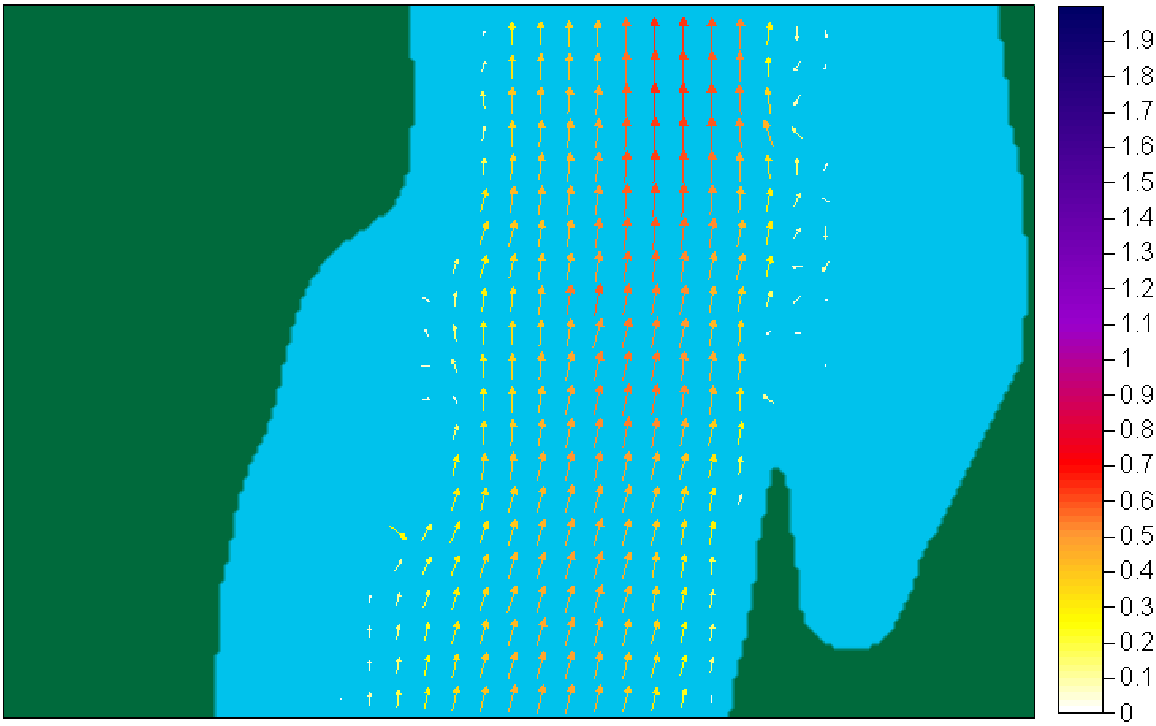

Plate 4.9: Snapshot of current velocity vectors within Newry River Estuary at mid-flood during a neap tidal cycle

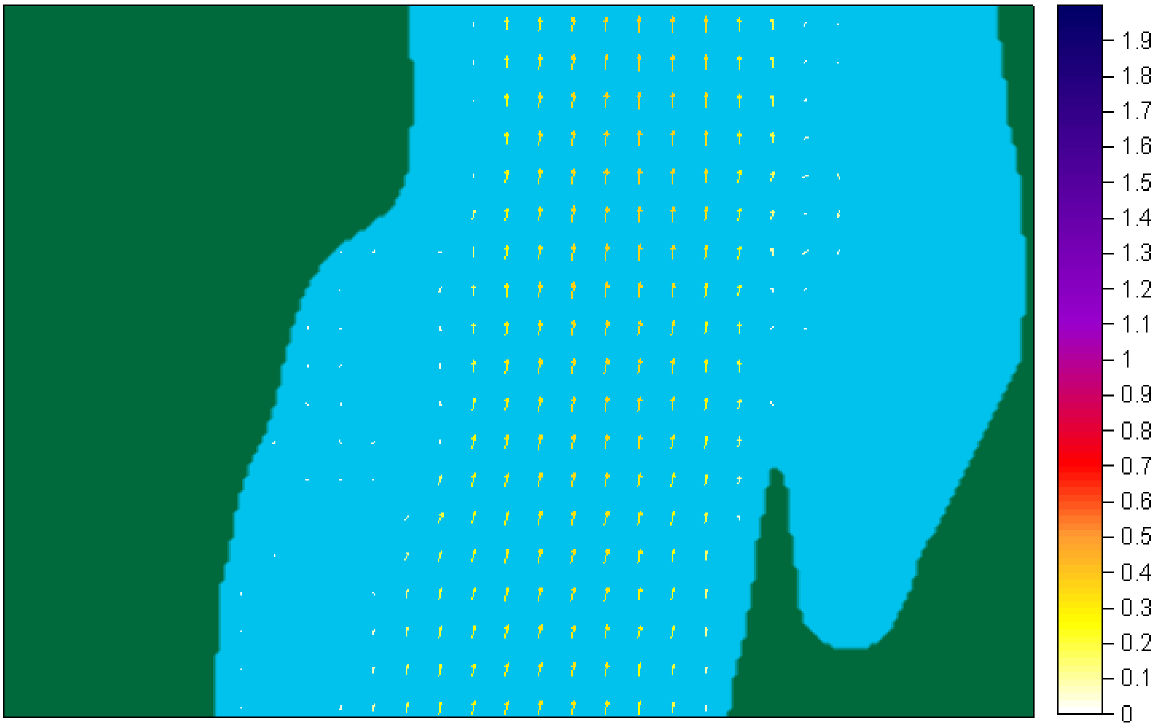

Plate 4.10: Snapshot of current velocity vectors within Newry River Estuary at high water during a neap tidal cycle

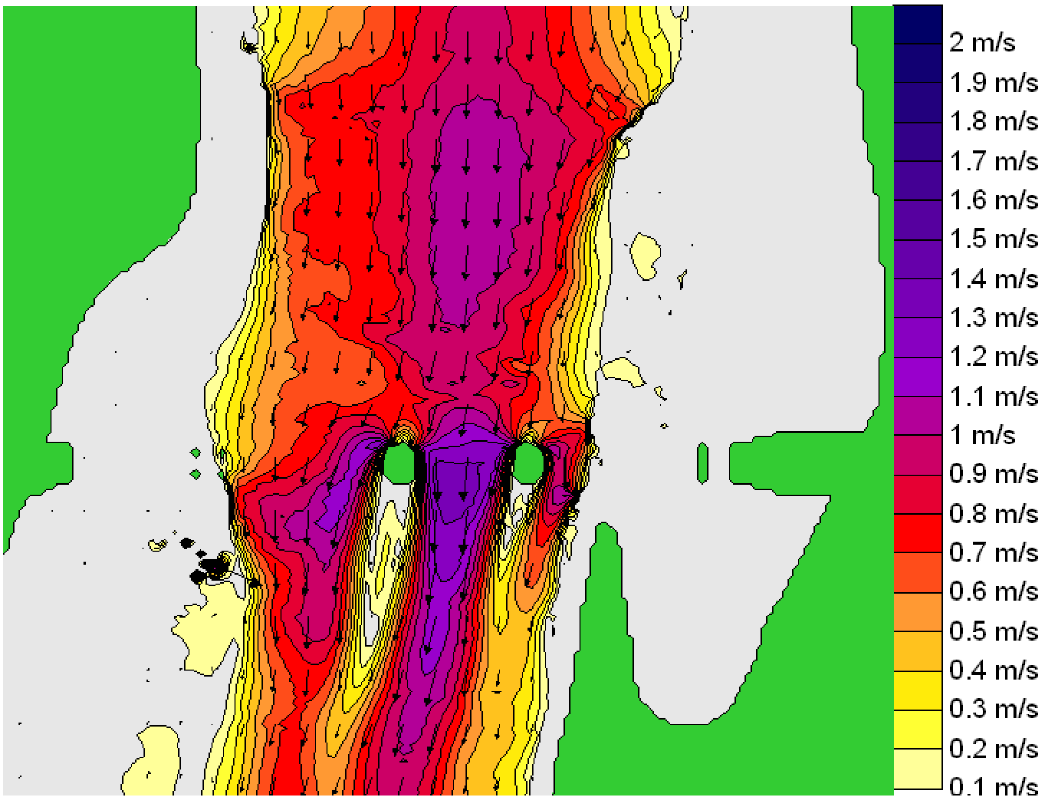

Plate 4.11: Snapshot of current velocity vectors within Newry River Estuary at mid-ebb during a spring tidal cycle with the proposed Design Option 1 structure present

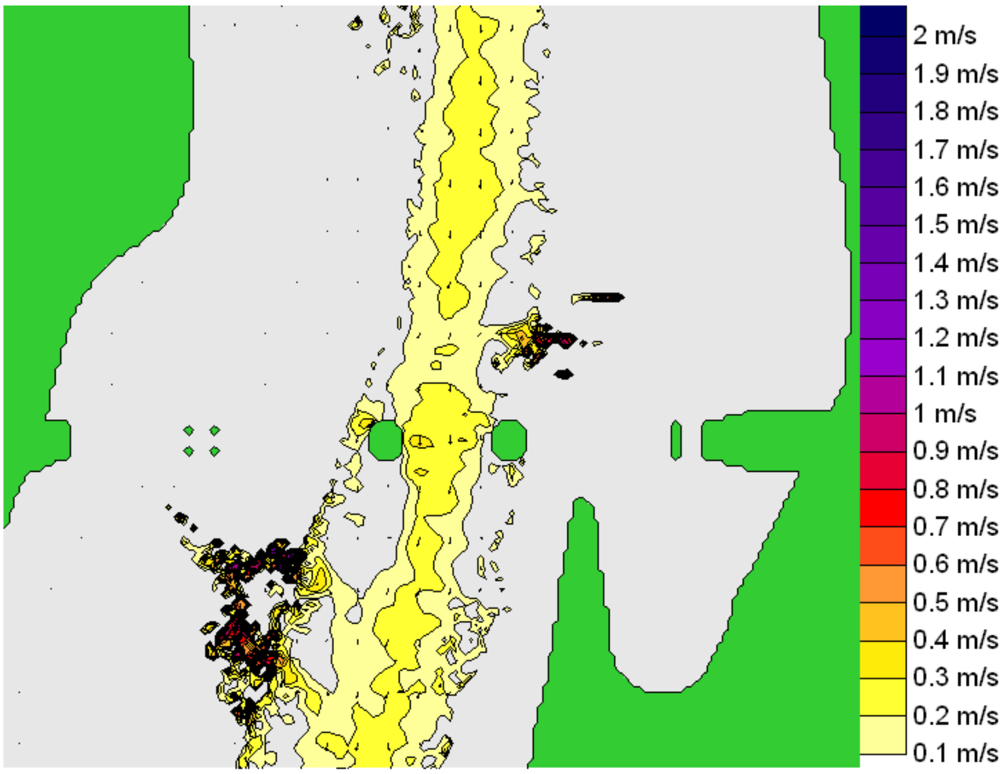

Plate 4.12: Snapshot of current velocity vectors within Newry River Estuary at low water during a spring tidal cycle with the proposed Design Option 1 structure present

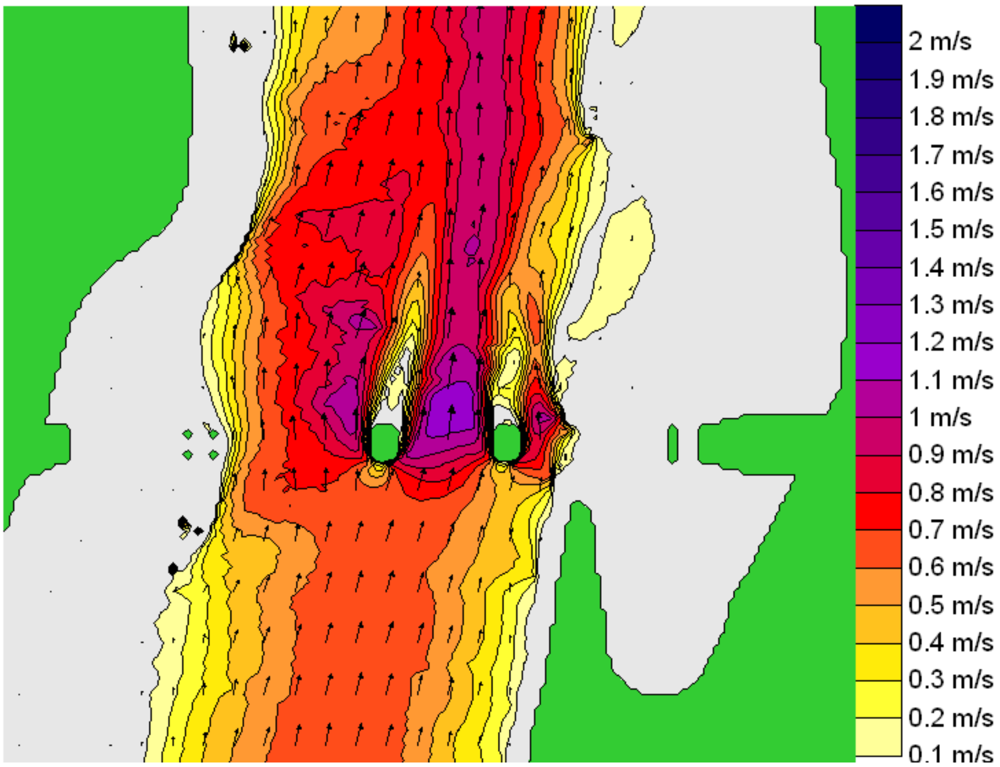

Plate 4.13: Snapshot of current velocity vectors within Newry River Estuary at mid flood during a spring tidal cycle with the proposed Design Option1 structure present

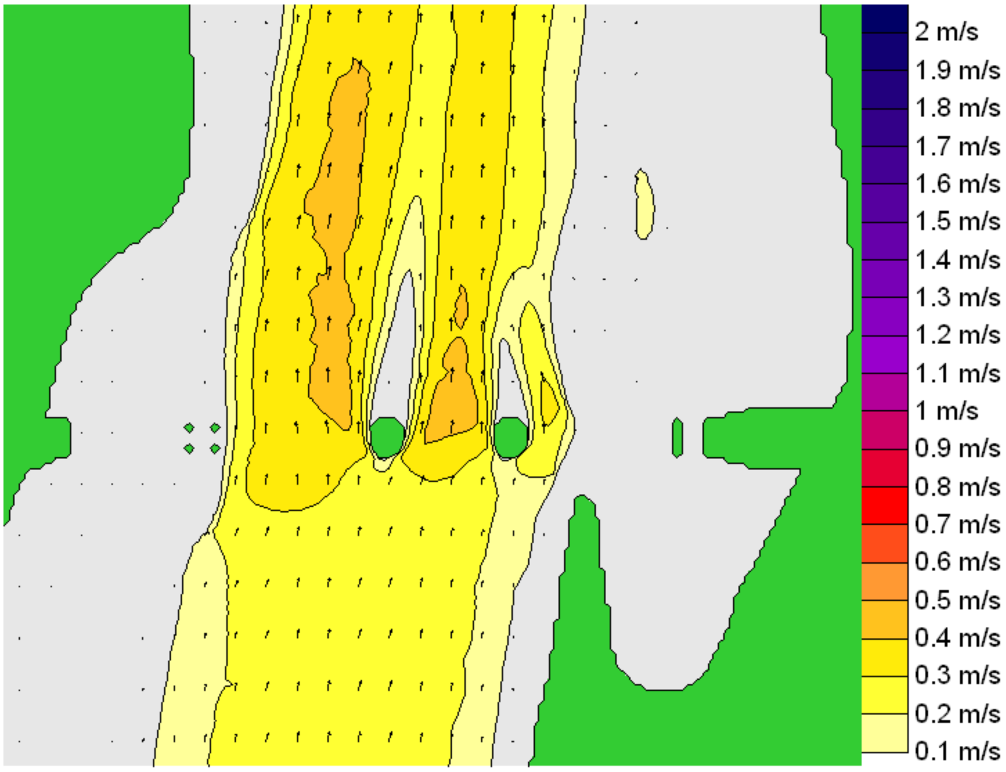

Plate 4.14: Snapshot of current velocity vectors within Newry River Estuary at high water during a spring tidal cycle with the proposed Design Option1 structure present

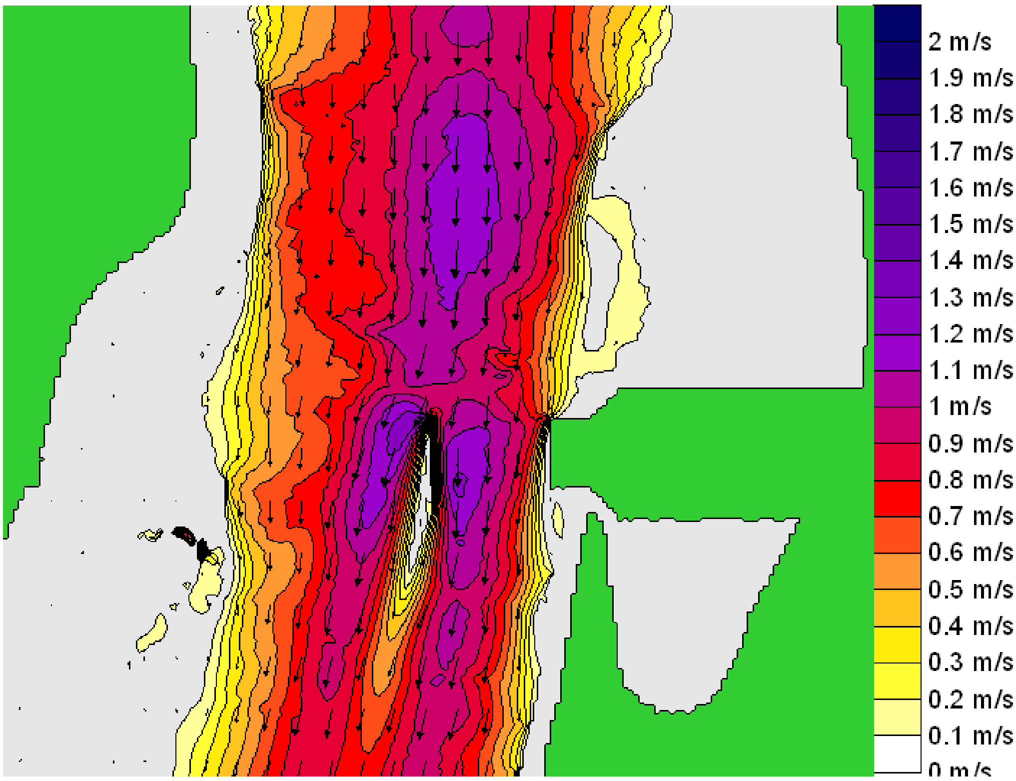

Plate 4.15: **Snapshot of current velocity vectors within Newry River Estuary at mid-ebb during a spring tidal cycle with proposed Cable-stayed structure present.**

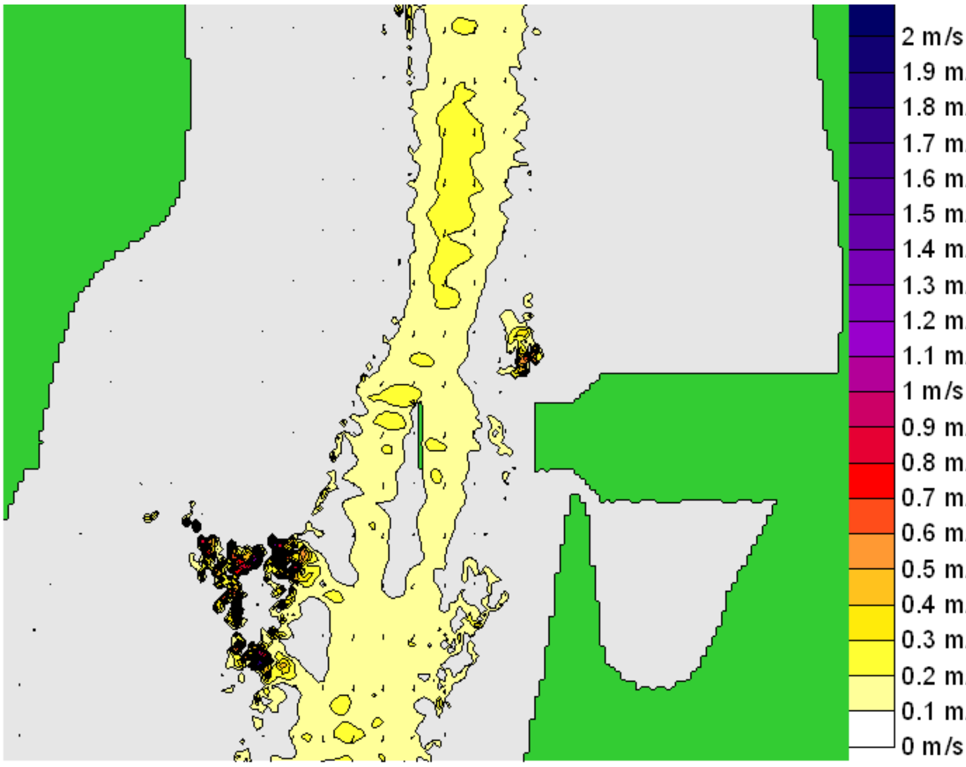

Plate 4.16: **Snapshot of current velocity vectors within Newry River Estuary at low-water during a spring tidal cycle with proposed Cable-stayed structure present.**

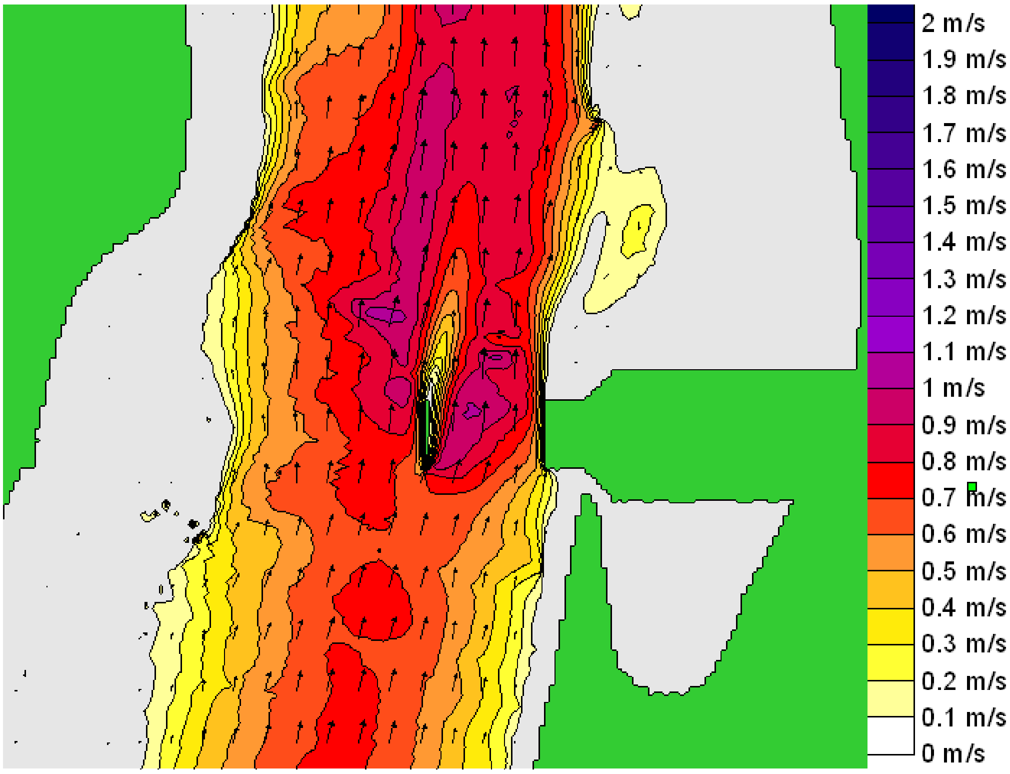

Plate 4.17: Snapshot of current velocity vectors within Newry River Estuary at mid-flood during a spring tidal cycle with proposed Cable-stayed structure present.

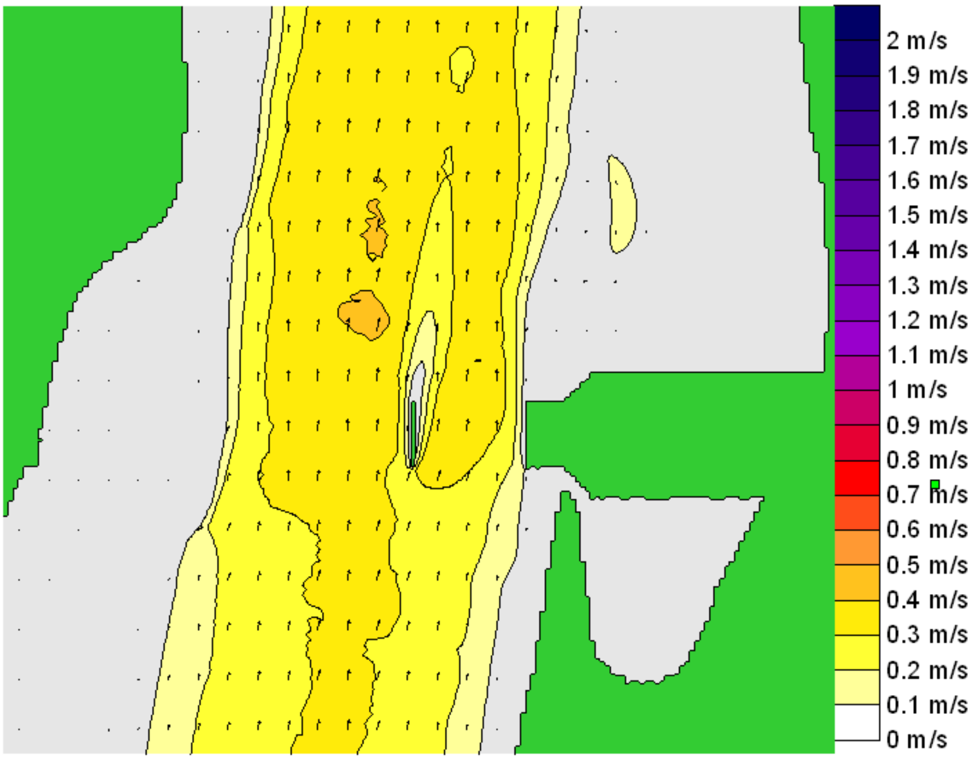

Plate 4.18: Snapshot of current velocity vectors within Newry River Estuary at high-water during a spring tidal cycle with proposed Cable-stayed structure present.

Interpretation of Results

The model predicts that the velocity of the water current and the natural hydrodynamic regime in the river channel at the location of the proposed crossing was altered as a result of the proposed structures.

The existing velocities were predicted to be approximately 0.85 m/s in the centre of the channel during flooding tides, rising to approximately 1.24 m/s during ebb tides during spring tide conditions.

With the proposed Design Option 1 structure in place, the model predicted the water currents to be approximately 1.18 m/s during flood tides and 1.15 m/s during ebb tides on a spring tide. The regions of high velocity are located on the outside of the bridge piers and between the piers. This represents an increase of 39% in water current velocities on a flood tide and a decrease of 8% on an ebbing tide.

With the proposed Cable-stayed structure in place, the model predicted the water currents to be approximately 0.81 m/s during flood tides and 1.11m/s during ebb tides on a spring tide. The regions of high velocity are located either side of the central pier. This represents no change in water current velocities on a flood tide and a decrease of 10% on an ebbing tide.

In the immediate vicinity of the piers, the predicted changes in current velocity for both options indicate that there will be scouring effects around their bases, which will lead to mobilisation of sediments upstream and downstream of the structures.

The scouring effects occur at the north face of the piers during an ebbing tide with regions of slack water occurring in the wake region to the south of the structure. The inverse occurs during flooding tides when the scouring effects is in evidence on the south face of the piers with regions of slack water occurring in the wake region of the piers to the north of the proposed structures.

It is unlikely that the scoured material would be deposited in the wake region on the opposite side of the piers given the magnitude of the current velocities as the water passes around the bridge piers and the associated transport distance of the entrained sediments. It is more likely that the sediments on the ebb tide will be exported eastwards into the main body of Carlingford Lough and deposit when velocities fall to ca 0.1m/s. The opposite pattern will occur on the flood tide *i.e.* re-suspended sediments will be transported up stream.

Conclusion

Plates 4.11 to 4.18 clearly identify that the chosen bridge design will have the least impact on the existing marine hydrodynamics, on sediment transport and on the ecological functioning of the estuary.

Given the very low effect of the chosen design on current velocity and therefore sediment mobilisation, this design is considered to have negligible impact on the ecological functioning of the estuary.

Further Design Review

Since the completion of the hydrodynamic modelling further design reviews of the proposed cable stayed option have been completed. This has resulted in the bridge abutment on the County Down foreshore being further limited in size such that it no longer extends into the river channel (refer to Plates 4.15 to 4.18). The outcome of this design amendment is to further reduce the impact on the existing hydrodynamic situation.

4.5.4 Bridge Options Assessment and Design Choice

Assessment Criteria

In addition to undertaking the hydrodynamic modelling exercise, the three feasible bridge design options were evaluated against the various engineering, environmental and economic issues. The Bridge Feasibility Report was completed in November 2008 and reviews each option against all environmental, engineering and economic issues identified. The parameters which were identified as the key environmental factors influencing the design choice were:

- Archaeology and cultural heritage;
- Aquatic Environment;
- Terrestrial Ecology;
- Socio-economic impact; and
- Landscape and visual amenity.

Archaeology and Cultural Heritage

The Constraints Report highlighted that the proposed site lies within an area of very high archaeological sensitivity. There is a concentration of known sites around the vicinity of Narrow Water, dating from Early Christian to Post Medieval. Narrow Water is considered to be a strategic location, an idea that is borne out by the presence of the motte to the side of the A2 roundabout and by Narrow Water Castle itself.

During the consultation process both DoEHLG and NIEA identified the requirement for extensive archaeological surveys along the entire route of the scheme. Geophysical surveys, dive surveys and ground truthing were requested in order to identify the presence of any remains or artefacts. This is considered an essential requirement as the area around Narrow Water is believed to have been a significant crossing point, thus making the presence of remains or artefacts a significant possibility.

In archaeological terms, the three bridge options all have the potential to impact Archaeology and Cultural Heritage through direct impact on buried or unrecorded remains. However, during the series of consultations held with both of the statutory bodies, it was made clear that the least impact on the Newry River channel and the inter-tidal area would be preferable as it is believed that if any significant remains or artefacts exist they are likely to be located within this environment. Therefore, Option 3 was the preferred option.

Aquatic Environment

As highlighted during the Hydrodynamic Modelling exercise, the issue, which has been strongly identified during the consultation meetings with The Loughs Agency, is that any significant level of additional sediment release as a consequence of the construction and operational phases of the bridge could result in compensation claims (the Loughs Agency have stated that the aquaculture industry is currently worth €3.5 million annually) from aquaculture licence holders. The perception being that the release of sediment could smother or cause disease of the cultured shellfish.

In addition to potential for compensation claims to be made by the aquaculture industry, the possibility of Warrenpoint Harbour Authority requesting a contribution to its dredging fund should sediment release be significant must also be borne in mind.

The Hydrodynamic modelling of the water flows within the Newry River and the associated potential sediment release have clearly shown that Bridge Options 1 and 2 will result in significant sediment release as a consequence of the large central piers required to allow for the bridge opening mechanism. The cable stayed nature of Option 3 allows this design to span from one shore to the other with only minimal impact on sediment release due to the requirement for only a small singular central pier.

The Loughs Agency has indicated that, as with archaeology, the preferred option would have the least impact on the aquatic environment in terms of sediment release and also in terms of the Habitats Directive Annex IV species – Eel and Brook and Sea Lamprey. The Loughs Agency also expressed concern regarding the presence of significant substructures in the Newry River and therefore would not be in favour of Options 1 and 2. Therefore, Option 3 would be the preferential option.

Terrestrial Ecology

The proposed route is within an area of high nature conservation value. On the southern side the shoreline falls within Carlingford Shore cSAC, although no SAC feature habitat occurs at the site. On the northern side the foreshore is within Carlingford Lough ASSI. Mudflat and wintering waterbirds are important elements of this ASSI.

Each of the three bridge options will have a similar impact on the habitats present. Further, these habitats in themselves are not considered of sufficient quality for the impact on them to be considered significant.

However, the potential impact on the wetland birds, which use the area, is a concern. The Warrenpoint to Newry section of the Newry River estuary supports a significant proportion of Carlingford Loughs' population of Shelduck, Teal, Black-tailed Godwit and Redshank, all of which are named as feature species of the neighbouring Carlingford Lough SPA. In addition, the ASSI is specifically selected for a number of the wetland species which occur in the Narrow Water area (Shelduck, Oystercatcher, Dunlin and Redshank).

Field surveys have indicated that small scale movements of these species do occur up and down the Newry River estuary. The risk that the bridge could pose to these movements is a concern. Options 1 being a low lying structure should not pose any significant barrier to this movement. However, the cable stayed nature of Option 2 and 3 may create a significant barrier and may prevent the movement of these birds to upstream feeding sites. This will need to be examined further by monitoring the exact flight paths as for Options 2 and 3 only parts of the structure would provide a restriction to movements.

In addition, the possibility of birds striking the cables could be significant, especially for the larger species such as Shelduck. The presence of a heronry in the adjacent woodland should also be noted as juvenile herons are not agile fliers.

Therefore, in terms of terrestrial ecology, Option 1 was identifies as the preferred option.

Socio-economic Impact

The bridge is proposed in the Louth County Development Plan as a piece of essential tourism infrastructure. The intention is to provide access across Carlingford Lough, linking Omeath and Warrenpoint, enhancing the tourism potential of both areas. It is believed that the bridge will increase tourist numbers through connecting these exceptionally scenic areas.

All three bridges can be considered equally beneficial in so much as they provide the required road and pedestrian link. However, in terms of providing a landmark structure with the potential to add to the amenity of the area, which is itself a tourist feature, than Option 3, with its slim deck, impressive towers, portal like entrance to the Newry River and its unique opening mechanism, must be considered as the front runner in terms of positive economic impact.

Landscape and Visual Amenity

The proposed bridge is located within an area of high landscape quality and high visual amenity. This is recognised by the landscape designations contained within the Development Plans of both jurisdictions. Planning policy attached to these designations is designed to ensure that any development does not detract from the existing landscape quality and visual amenity. In addition, the setting of Narrow Water Castle is protected, in Northern Ireland, by Planning Policy Statement 6 ‘Planning, Archaeology and the Built Heritage’.

Furthermore, it should be noted that the Planning Policy Statement (PPS) 6 states in ‘Conservation and Economic Prosperity’ that “Just as there is continuity between past and present, so also there is between present and future. We have a duty to care for what we ourselves have inherited not simply for our own benefit but also with a view to passing it on, as a living legacy, to those who come after us. We can add to our historic legacy by creating examples of high quality architecture and townscape and landscape design which can fittingly represent our own age in the decades and centuries to come”.

The potential landscape and visual impact of each option is, hence, of significant importance in determining which Bridge Option performs best in this setting at the entrance to Carlingford Lough.

The second Pre-Application Discussion meeting with The Planning Service in Northern Ireland was attended by Landscape Architects Branch personnel of Planning Service. The three bridge options and photomontages were discussed.

Option 1 was agreed to possess a simple floating elegance of the substructure which blended well into the surrounding environment and had minimal visual intrusion. However, the chunky central piers appear starkly incongruous to this elegance.

The central arrangement of Option 2 was considered to detract from views down the river and leaves the observer with the impression that the bridge is the focus of this environment rather than the landscape or cultural heritage. It was suggested that this bridge would work in an urban regeneration situation.

Option 3 has been driven by the unique nature of the landscape. The contrasting tower heights mirroring the landscape, rising tall adjacent to the mountains of the Cooley Peninsula and retaining modesty to match the drumlin landscape to the north. The slim deck and narrow cables allow the bridge to blend into this environment, while simultaneously framing the important significant landscape and cultural features.

In terms of Planning Policy Statement (PPS) 6 it is important to note that, in terms of protecting the setting of Narrow Water, the Planning Service considers the critical views of and from Narrow Water to be of paramount importance. Option 1 is subtle enough not to detract from these views, while Option 3 in essence frames and directs these views towards the monument and downstream.

The three bridge options were presented to Louth County Council in terms of aesthetics in June 2008. Roughan & O'Donovan Consulting Engineers have also received opinions on the relevant aesthetic merits of the three options from Brady Shipman Martin (the Landscape and Visual Specialist Sub-Consultant for the Environmental Impact Assessment) and other independent architectural and aesthetic advisors.

Consideration of visual aesthetics and responses to such structures is recognised as being highly subjective. However, the general response has been overwhelming favourable in terms of the uniqueness of Design Option 3, which will be a fitting legacy of the design representing our own age in future years.

Ranking and Design Selection

Each constraint does not have the same significance as the others and certain constraints should therefore be more influential than others. Therefore, an importance rating has been assigned to each constraint. For example, the Narrow Water Bridge is located in an Area of Outstanding Natural Beauty (AONB) and therefore, a high level of importance has been allocated to the landscape and visual amenity parameter, while a low importance has been allotted to existing utilities and services since this impact can be readily and easily considered at the detailed design and construction stage.

Once the importance of the constraint is decided, each bridge option is assessed as to whether it has a negative, neutral or positive impact. That option is then assigned a score for that constraint in accordance with **Table 4.2** below. The preferred bridge option selected is the option that scores the highest since this option represents the most favourable option overall. The colours are included in the table as a visual aid to clarify this selection process.

Table 4.2 Scoring System

Impact		Negative			Positive	
		Significant	Slight	Neutral	Minor	Major
Importance	Low	-2	-1	0	1	2
	Medium	-4	-2	0	2	4
	High	-8	-4	0	4	8

Table 4.3 Bridge Option Assessment Matrix

Constraints	Importance	Bridge Options		
		1	2	3
Traffic & Road Design	Low	-1	0	1
Geotechnical Design	Low	0	0	0
Maintenance & Durability: Superstructure Fixed	Medium	2	2	-2
Maintenance & Durability: Superstructure Moveable Span	Medium	-4	-4	-2
Maintenance & Durability; Substructure	Medium	0	0	0
Navigational Requirements	Low	1	1	0
Operational Issues	Low	1	0	0
Existing Utilities & Services	Low	0	0	0
Agricultural Impacts	Low	0	0	0
Archaeology & Cultural Heritage	High	-8	-8	-4
Aquatic Environment	High	-8	-8	0
Terrestrial Ecology	Medium	0	-2	-4
Socio-Economic / Material Assets	High	4	4	8
Air Quality	Low	0	0	0
Noise & Vibration	Low	-1	-1	0
Landscape & Visual Impact	High	0	-8	8
Construction Impact	Medium	-2	-2	2
Capital & Whole Life Costs[1]	High	0	-8	-8
Overall Score		**-16**	**-34**	**1**
Overall Rank		**2**	**3**	**1**

This process identified the preferred bridge option when weighted against the above factors as being Option 3 – the Cable-Stayed Option. The factors which weighted the decision in favour of Option 3 were the minimal impact this option will have on the aquatic environment and on the archaeological and cultural heritage.

This bridge design option was presented to the public in October 2008 as discussed in Section 1.4.3 of this document.

4.5.5 Bridge Design Review and Amendment

Since the chosen bridge design was selected the Narrow Water Bridge Project has engaged with the statutory authorities within both jurisdictions in order to allow the design team to address all possible concerns.

This process was assisted significantly by the invitation from the Planning Service (Northern Ireland) to engage with the Pre Application Discussion process. Through this process the design team were able to routinely engage with all the Northern Ireland statutory consultees round one table. This has allowed many of the concerns of the consultees, such as the requirement for terrestrial and aquatic geophysical archaeological surveys, to be addressed and completed.

During consultations with the Landscape Architects Branch of Planning Services concerns with respect to the impact of the tall southern tower were raised and, while the reasoning behind the bridge design selection was accepted, it was agreed that the bridge design engineers would explore the potential to reduce the height and bulk of the southern tower.
These investigations revealed that a cable could be omitted from the main span by relocating the southern tower 4.5m further north on to the foreshore. The reduction from 13 cables to 12 cables enabled the height of the tower to be reduced by around 7m without compromising the structural integrity of the bridge or intruding into the river channel, which is a fundamental requirement of the Loughs Agency.

A different alignment across the bridge compared to that shown previously has the additional benefit of lowering the southern tower by almost 2m. Together these two modifications have had the overall combined effect of reducing the highest point of the structure by approximately 10m and the width by 1m, from 5m to 4m.

These modifications have also had the additional benefit of reducing the length of the northern abutment such that it does not intrude into the river channel (refer Section 4.5.3). This further reduces the hydrodynamic impact of the bridge structure.

4.5.6 Siting of Control Building

A control building is required to facilitate the opening of the bridge. The main requirements of the location of the control building are to have a clear unobstructed view to the bridge and along the river and to be sufficiently close to the proposed bridge for opening and closing.

It is clear theat the most suitable location is on the northern bank as cloe to the bridge s possible with an unrestricted view up and downstream. Therefore, the proposed control building is located at the edge of the river on the north side approximately 200m from the bridge as shown in Figures 3.16. The owners of the lands which have planning permission for development have been consulted and have cooperated in ensuring a design and access to the control building which matches with their proposals.

Chapter 5

Traffic & Transport Impacts

Chapter 5 Traffic and Transport Impacts

5.1 Introduction

5.1.1 General

This chapter provides an overview of the traffic and transport impact assessment undertaken for the Narrow Water Bridge project. This includes the following activities:

- Examine the existing traffic conditions and transport facilities;
- Estimate future traffic growth;
- Appraise the proposed development;
- Assess the traffic and transport impacts of the scheme during operation and construction;
- Determine any mitigation measures required.

The transport assessment indicates that the proposed Narrow Water Bridge will significantly improve connectivity between the Cooley peninsula and the Mourne District, which will enhance the tourist potential of the region. In addition, the analysis illustrates that using traffic management it is possible to accommodate all the queues, which form when the bridge opens, safely without compromising the operation of the A2 roundabout. Furthermore, the study indicates that the construction traffic will have a negligible impact on the local road network.

5.1.2 Background

A comprehensive traffic study was undertaken as part of the 'Omeath – Warrenpoint Road Link, Feasibility Study' published by RPS Consulting Engineers in 2001.

This traffic model was developed using data collected from manual traffic counts and roadside interviews. This model was based on the principal assumption that "the local traffic using the R173 and A2 via Newry for journeys between County Down and the Cooley Peninsula will transfer to a new 'crossing route' if there is a time saving to be gained". This traffic model found that a bridge crossing "would account for a travel time benefit of 40 minutes for each return trip" and therefore, the study predicted that between 883 and 1116 AADT would utilise the new bridge crossing in the base year (2000).

A similar model has been developed for this traffic study. The latest model utilises the same roadside interview data collated in the previous study to determine the likely trip distribution, however, the traffic flows, which are based on more recent traffic counts conducted by Scott Wilson, are representative of existing traffic conditions.

5.2 Existing Conditions

5.2.1 Local Road Network

The local road network is distinctly different on each side of the Newry River, as shown in **Figure 5.1** in Volume 3.

On the south side, the R173 (B79) is the primary route serving the Cooley Peninsula. The R173 starts north of Dundalk where the N52 Dundalk Eastern Bypass meets the M1 Motorway. It continues along the peninsula edge before turning around the

Cooley Mountains and passing through Carlingford and Omeath. It terminates in Newry at Bridge Street.

The R173 carriageway cross-section is typically wide, although at certain locations, such as in the vicinity of Narrow Water, the cross-section is no greater than a reduced single carriageway. These discrepancies in carriageway cross-section cause road users to speed where it is not appropriate to do so.

The R173 primarily serves local and tourist traffic, although it does accommodate some Heavy Goods Vehicle (HGV) traffic, which the road is not particularly well suited, generated by Greenore. Traffic originating and terminating outside the Cooley Peninsula is not attracted onto the R173 as the M1 Motorway offers a reliable, fast and direct route between Newry and Dundalk.

The remaining road network on the Cooley Peninsula with exception to the R174, which connects the M1 Motorway and the R173 through Ravensdale, and the R175, which connects Greenore to the R173, consists of narrow winding local roads that are not suitable for distributing large volumes of traffic.

On the north side, the A2 dual carriageway, which has few junctions, connects Newry to Warrenpoint. Beyond Warrenpoint, the A2 route continues as a single carriageway road and it terminates at Clough providing access to Ballynahinch, Downpatrick and ultimately Belfast. The A2 dual carriageway is currently operating well within capacity.

The existing Warrenpoint Roundabout is a 3-arm roundabout situated at the end of the A2 dual carriageway at a junction between the A2 route and a local road. This local road leads to the B7 route, which connects Warrenpoint to Rathfriland.

Any vehicles travelling between the Cooley Peninsula and the Mourne District are required to travel through Newry. Bridge Street and William Street, which cross the Newry River, join the R173 (B79) Omeath Road with the A2 dual carriageway.

5.2.2 Accessibility for Cyclists and Pedestrians

Any trips between the Cooley Peninsula and the Mourne District pass through Newry, which is a distance of 20km. The length of the journey ensures that there are negligible pedestrian movements and few cyclist journeys between Omeath and Warrenpoint.

On the north side, there is an existing footway around the A2 roundabout and cycle tracks along the A2 dual carriageway. On the south side, however, no pedestrian or cyclist facilities exist. A number of accidents have occurred on the R173, which involved pedestrians.

5.2.3 Existing Traffic

Scott Wilson conducted data collection surveys commissioned by Roads Service Northern Ireland in the Newry Area during April and May 2007. The data collection surveys consisted of the following:

- Manual classified traffic counts (MCC) at 14 junctions on Tuesday, 17th April 2007, or Thursday, 3rd May 2007;
- Automatic traffic counts (ATC) at separate locations between Monday, 16th April 2007 and Sunday, 6th May 2007;

- Journey time surveys along two routes on Tuesday, 17th April 2007, and Wednesday, 18th April 2007;
- Vehicle registration number surveys at 6 locations on Thursday, 19th April 2007;
- Roadside interview surveys at 2 locations on Thursday, 3rd May 2007.

These surveys also examined the data from a permanent automatic traffic counter (ATC421), which is located on the A2 Warrenpoint Road, Newry.

Roughan & O'Donovan conducted an additional manual traffic count during the morning peak hour at the A2 roundabout on Tuesday, 21st October 2008. This survey was conducted to assess the typical peak hour turning movements at the A2 roundabout.

The Annual Average Daily Traffic (AADT) is the total volume of vehicle traffic in both directions of a road for a year divided by 365 days. AADT is a useful and simple measurement of how busy the road is. The AADT flows on the A2 dual carriageway were estimated using the permanent automatic traffic counter (ATC421) as the near continuous collection of traffic data ensures a high degree of accuracy. Examination of the estimated AADT flows from the permanent automatic traffic counter, ATC421, indicates that there has been negligible growth on the A2 dual carriageway over the past number of years as shown in the table below.

There is no permanent automatic traffic counter on the R173 (B79). Instead, the AADT flows on this link were calculated from the traffic data collected over 3 weeks. The daily traffic counts were factored using 'RT 201 - Expansion Factors for Short Period Traffic Counts' by J Devlin to generate the AADT flows. However, it would appear a substantial increase traffic has occurred on the R173 (B79) when the existing traffic flows are compared with base year flows (2000) provided in the 'Omeath – Warrenpoint Road Link Feasibility Study, 2001'. This discrepancy in traffic growth between the A2 and the R173 (B79) is attributed to the economic growth experienced in southern Ireland.

Table 5.1 Traffic Growth on A2 and R173 (B79) between 2000 and 2007

Link	2000	2001	2002	2003	2004	2005	2006	2007	Growth
A2 Dual-carriageway	11,955[1]	13,564[2]	13,643[2]	14,344[2]	13,734[2]	13,283[2]	14,035[2]	14,351[3]	20%
R173 (B79)	2,612[1]	-	-	-	-	-	-	4,421[3]	69%

[1] The mean AADT flows taken from the 'Omeath – Warrenpoint Road Link Feasibility Study, 2001'
[2] The estimated AADT flows from the ATC421 permanent automatic traffic counter
[3] The mean AADT flows derived using 'RT 201 - Expansion Factors for Short Period Traffic Counts' by J Devlin

Table 5.2 Base Year (2007) Traffic Flows

Location	Base Year Traffic (AADT)		
	Lower	Mean	Upper
R173 Omeath Road	4,254	4,421	4,588
A2 Dual-carriageway	13,017	14,351	15,686
A2 Warrenpoint Harbour	12,821	14,136	15,450
Burren Road	196	216	236

Although traffic flows have increased in the intervening years, the traffic distribution identified within the 'Omeath – Warrenpoint Road Link Feasibility Study, 2001' has remained largely unchanged particularly since the dominant link is the A2 dual carriageway and any vehicles travelling between the Cooley Peninsula and the Mourne District must pass through Newry. The existing traffic flows are shown in Table 5.2 above.

Warrenpoint Harbour

Warrenpoint Harbour is a busy commercial port situated near the A2 roundabout at the edge of the town of Warrenpoint. The port generates a significant volume of traffic (~500 AADT), which a large proportion consists of HGVs. It should be noted the port traffic is taken into account by the traffic surveys used to determine the base year traffic flows.

The port facilitates both scheduled and unscheduled services. The scheduled services consist of a Roll On Roll Off (RORO) service to Heysham and a container line service to Cardiff. The unscheduled services consists of a broad range of ships of varying size that can be accommodated at the harbours 7 berths.

The RORO service operates 3 times daily or 28 sailings a week. It is considered to be responsible for much of the traffic generated by the port. The ships operating this service can accommodate 12 accompanied units or 120 unaccompanied units. In the worst case, it is assumed that the RORO service will generate vehicle 120 trips in an hour. The RORO service arrival and departure times are given in Table 3.3 below:

Table 5.3 Warrenpoint Harbour RORO Service Schedule

	Arrive	Depart	Arrive	Depart	Arrive	Depart
Monday	05:00					20:00
Tuesday	05:00	09:00	10:00	13:00	16:30	20:30
Wednesday	05:00	09:00	10:00	13:00	16:30	20:30
Thursday	05:00	09:00	10:00	13:00	16:30	20:30
Friday	05:00	09:00			16:30	20:30
Saturday	05:00					19:00
Sunday	05:00					19:00

It should be noted that the RORO service schedule is arranged to minimise the impact on the existing road network. It is apparent from the table above that the RORO service typically arrives or departs during off peak hours with the exception of the 09:00 departure and the 16:30 arrival. However, in both exceptional cases, the port traffic passing through Newry travels in the opposite direction to the primary peak hour flows and therefore, its impact on the existing road network is minimal.

5.2.4 Road Accidents

A total of 12 road traffic accidents (1 serious, 10 minor & 1 material damage) have been recorded in the vicinity of the proposed Narrow Water Bridge and the locations of these accidents are shown in **Figure 5.2** in Volume 3.

According to Louth County Council's accident database, between 1990 and 2006, 6 road traffic accidents have occurred on the R173 Omeath Road in the vicinity of the crossing. Fortunately, 5 accidents resulted in only minor injuries and 1 accident in material damage although it should be noted that a single vehicle fatal collision did occur nearby. A total of 5 accidents, including an accident involving a pedestrian, have occurred in close proximity to Davies' Crossroads and therefore it would appear to be particularly hazardous junction.

Based on accident data received from the Roads Service Northern Ireland (RSNI), in the past 5 years it would appear that 6 road traffic accidents have occurred on the A2 dual carriageway near the crossing location. However, only one accident causing serious injury has occurred as the remaining accidents consisted of minor injuries or material damage. There is no clear hazard on the north side as the accidents occurred at numerous locations for a variety of reasons.

5.3 Proposed Development

5.3.1 Description

The primary objective of the Narrow Water Bridge is to assist in the social economic development of the Cooley Peninsula and the Mourne District, through enhancing the tourist potential of the region and through cross-border community co-operation. The proposed development seeks to achieve this by providing a new single carriageway link between Omeath and Warrenpoint in counties Louth and Down, respectively.

It is intended that the proposed 6.0m wide carriageway will intersect the R173 Omeath Road south of Ferry Hill in the townland of Cornamucklagh and the A2 dual carriageway at the exsiting roundabout north of Warrenpoint. A roundabout is proposed at the junction with the R173 Omeath Road and the existing A2 roundabout is to be upgraded to accommodate an additional arm. The total length of the scheme is approximately 620m.

The proposed Narrow Water Bridge will be a cable-stayed bridge with a rolling bascule opening section. The carriageway alignment will split around the pylon for the main cable-stayed span. The rolling bascule opening section is required to permit marine vessels including pleasure craft, dredgers and tall ships access to the Victoria Lock and Newry. The opening procedure will be managed from a control building situated on the north side of the River Newry.

5.3.2 Pedestrian and Cyclist Facilities

The proposed Narrow Water Bridge includes the provision of pedestrian and cyclist facilities between the proposed Cornamucklagh Roundabout on the R173 and the A2 roundabout. Both the Cooley Peninsula and the Mourne Mountains are popular among hill walkers and cyclists. Therefore, it is important that the Narrow Water Bridge should cater for pedestrians and cyclists, particularly given that it is being promoted as a tourist bridge.

On the northern approach to the structure, a 3.0m combined cycle / footway will be provided on either side of the carriageway. This combined cycle / footway will tie into the existing footpath on the A2 roundabout. The cyclists will be able to access this combined cycle / footway via that dished kerbs that are to be provided at crossing points.

The 3.0m combined cycle / footway is continued across the opening span. The rolling bascule pylons and cables act to segregate pedestrians and cyclists from traffic.

The footway and cycleway diverge around the cable anchors on the main span providing a dedicated 2.0m footway and 1.5m cycle track on each side of the bridge. After approximately 100m the footway and cycleway merge once to give a 3.0m combined cycle / footway.

On the southern approach, the western combined cycle / footway terminates shortly after leaving the structure while the eastern cycle / footway gradually reduces from 3.0m to 1.75m wide. This 1.75m combined cycle / footway, which is separated from the roadway by a 0.75m grass segregation continues up the hill to the proposed Cornamucklagh Roundabout.

Presently, there are no pedestrian or cyclist facilities on the R173 Omeath Road, hence the termination at the proposed Cornamucklagh Roundabout. Furthermore, the population centres are Omeath, Warrenpoint and Newry. Therefore, it is considered appropriate that pedestrian and cyclist facilities should be provided on both sides across the bridge but only on the eastern side on the southern approach to the structure.

Dedicated uncontrolled pedestrian and cyclist crossing points at 60m to 100m intervals are to be provided on the bridge.

5.3.3 Traffic Management during Bridge Opening

Louth County Council will open the Narrow Water Bridge for marine vessels that cannot pass underneath Narrow Water Bridge. This includes opening the bridge for leisure craft heading for the Albert Basin and fishing vessels heading upstream of Narrow Water. Traffic management is necessary before, during and after the bridge opens and queuing facilities will need to be provided for traffic wishing to cross the bridge.

Traffic management measures including wig wag warning lights, barriers, advance warning and variable message signs will be required to control traffic and pedestrians when the bridge is open.

The following traffic management procedures have been assumed in the preliminary design. These procedures will be confirmed and agreed at Detailed Design stage with Louth County Council and Newry and Mourne District Council.

Proposed Advance Procedure

Step 1:

Vessels seeking to pass through Narrow Water Bridge will be required to contact Louth County Council or Newry and Mourne District Council 48 hours in advance of arrival giving details of vessel and estimated time of arrival.

Step 2:

Louth County Council to send a minimum of 3 no. operatives to Narrow Water on the day of arrival.

Step 3:

The vessel requiring the bridge to be opened shall contact the Narrow Water Bridge control building upon arrival in Carlingford Lough giving details of the updated time of arrival.

Step 4:

The operatives in the control building shall contact Warrenpoint Harbour to confirm that the passage of the marine vessel past the harbour is permitted. If the passage is not permissible, the vessel will be requested to make anchorage. Once Warrenpoint Harbour confirms the passage is clear, the marine vessel will be instructed to proceed beyond Warrenpoint Harbour and wait for further instruction.

Step 5:

Once the vessel is proceeding past Warrenpoint Harbour, the VMS signs in north and south, respectively, will display “BRIDGE OPENING QUEUES LIKELY” or “BRIDGE OPENING EXPECT QUEUES” informing road users that the bridge will open soon.

Step 6:

An operative shall leave the control building and walk along the Narrow Water Bridge informing pedestrians and cyclists to retreat from the structure as it is soon to open.

It should be noted that a similar procedure is required for vessels heading from Newry. In this circumstance, the control building should be initially contacted from the Victoria Lock.

Proposed Opening Procedure

Step 1:

Once the operative in the control building has verbal and visual confirmation that the vessel has passed Warrenpoint Harbour (or arrived at Narrow Water Keep for vessels approaching from Newry), the operative shall illuminate the wig wag signs and raise the vehicle barriers.

Step 2:

An operative on each side of the bridge (i.e. fixed and opening bridges) will ensure that all cyclists and pedestrians have disembarked from the bridge and place pedestrian barriers restricting access on to the bridge. The operatives will inform the control building once both sides of the bridge is clear.

Step 3:

Once the bridge is clear, the operative in the control building will begin opening the bridge. Initially, the locking pins at the central pier and northern abutment will retract permitting the opening span to roll. Once the locking pins have disengaged, the liftin jacks will lower the opening span counterbalance causing the opening span to roll open.

Step 4:

Once the bridge is fully open, the operative on the control building instructs the vessel to proceed through the opening bridge. It is anticipated that the opening procedure will take 5 minutes to complete.

It should be noted that vessels entering Carlingford Lough are expected to contact Warrenpoint Harbour before proceeding into the lough.

Proposed Closing Procedure

Step 1:

Once the operative in the control building receives verbal and visual confirmation the vessel has successfully passed through the bridge, the opening span is lowered.

Step 2:

Once the opening span is fully closed, the operative in the control building informs the operatives on the bridge.

Step 3:

The operatives on each side of the bridge remove pedestrian barriers, which permits pedestrians and cyclists to cross the bridge.

Step 4:

The vehicle barriers are lowered and the wig wag signs are turned off, which allows traffic to proceed across the bridge.

Step 5:

Once the queuing on the approaches to the bridge has cleared, the operative in the control building will stop displaying the warning message on the VMS signs. It is estimated that the bridge will be open to traffic 5 minutes after commencing the closing sequence.

5.4 Traffic Forecasts

5.4.1 Traffic Assessment Methodology

Traffic forecasts for the Narrow Water Bridge are based on a simple reassignment of traffic based on the results of origin-destination surveys and junction turning counts.

It should be noted that the crossing is beneficial for HGV traffic departing from the port of Greenore destined for Northern Ireland as it enables access to the A2 dual carriageway and improves access to the Newry and beyond. However, it is not anticipated that Greenore traffic heading south towards Dublin will divert across the bridge as this would not result in a travel time saving. Furthermore, it is considered that commercial vehicles originating from or destined for Warrenpoint Harbour will not utilise the crossing as the A2 dual carriageway is a higher quality link to Newry than the R173 Omeath Road. An allowance has been made in the analysis for Greenore traffic that may utilise the crossing while, at the same time, no allowance has been made for Warrenpoint Harbour traffic.

5.4.2 Future Traffic Growth Forecasts

The base year, 2007, has been chosen for the traffic analysis as this is the year the traffic counts and surveys were undertaken. The opening and design years for the bridge have been assumed to be 2013 and 2033, respectively. The same growth rates have been applied to the traffic on both sides of the Newry River, although in recent years a significant difference in traffic growth has been observed. The growth rates, shown below, have been derived using NRA Circular Letter 01/2004 “Future Traffic Forecasts 2002 to 2040”.

Table 5.4 Traffic Growth Rates

Year	Cars & LGVS	HGVs
Base Year (2007)	1.00	1.00
Opening Year (2013)	1.09	1.08
Design Year (2033)	1.26	1.31

5.4.3 Induced Traffic

It is recognised that a new link can generate additional traffic that cannot be identified from roadside interviews. This induced traffic can arise from developments that the new link would stimulate. In this case, the bridge, which increases mobility between the Cooley Peninsula and the Mourne District, enhances the tourist amenity of Carlingford Lough and this is likely to induce traffic in the region. The exact quantity of induced traffic is difficult to determine but in order to ensure a robust traffic assessment, the traffic flows have been increased by 25% to account for induced.

5.4.4 Trip Distribution

Specific Roadside Interviews were undertaken as part of the 'Omeath – Warrenpoint Road Link Feasibility Study, 2001' in order to assess the likely trip distribution.

The traffic study area, which included the Republic of Ireland and Northern Ireland, was divided up into thirteen zones. The interzonal flows, which were obtained from these surveys, were used to predict the traffic distribution with the new crossing in place. Trips were distributed assuming that local traffic using the R173 and A2 via Newry for journeys between County Down and the Cooley Peninsula will transfer across the bridge if there is a time saving.

In this report, the traffic distribution was based on the same interzonal flows. As in the previous study, any traffic travelling between the Cooley Peninsula and south Co. Down is predicted use the Narrow Water Bridge. In addition, it is anticipated that some traffic between the Cooley Peninsula and Newry might utilise the new link. The lower bound assumes that no Newry traffic will use the link while the upper bound assumes all traffic from central, east and north Newry will use the bridge. The Origin-Destination Surveys are summarised in the Table 5.6 below. For further details on the inter-zonal flows and traffic distribution refer **Appendix 5.1** at the end of this chapter.

Table 5.6 Origin – Destination Surveys

Origin	**Destination**							
Omeath	Cooley	Mourne	Newry East & North	Newry South & West	Rathfriland & Newcastle	Downpatrick	Northern Ireland	Republic of Ireland
	8%	14%	40%	14%	3%	1%	20%	1%
Destination	**Origin**							
Omeath	Cooley	Mourne	Newry East & North	Newry South & West	Rathfriland & Newcastle	Downpatrick	Northern Ireland	Republic of Ireland
	6%	13%	40%	12%	3%	0%	22%	3%

5.4.5 Traffic Assignment

Roughan O'Donovan have prepared a traffic model using the above parameters (i.e. existing traffic, traffic distribution, traffic and induced growth) was developed to predict the future traffic flows.
The predicted traffic flows in the Opening Year (2013) are given in Table 5.7 below.

Table 5.7 Opening Year (2013) Traffic Forecast

Location	Opening Year Traffic (AADT)		
	Lower	Mean	Upper
Narrow Water Bridge	1,037	2,227	3,503
R173 Omeath Road North	3,815	3,056	2,229
R173 Omeath Road South	4,813	5,198	5,599
A2 Dual-carriageway	13,568	15,266	16,989
A2 Warrenpoint Harbour	14,131	15,569	17,005
Burren Road	247	269	297

The traffic forecasted in the Design Year (2033) is illustrated in Table 5.8 below.

Table 5.8 Design Year (2033) Traffic Forecast

Location	Design Year Traffic (AADT)		
	Lower	Mean	Upper
Narrow Water Bridge	1,036	2,309	3,767
R173 Omeath Road North	4,549	3,722	2,728
R173 Omeath Road South	5,584	6,031	6,495
A2 Dual-carriageway	15,768	16,959	18,944
A2 Warrenpoint Harbour	16,423	18,100	19,777
Burren Road	286	299	323

It is the predicted design year traffic would be low across the Narrow Water Bridge and therefore, in light of its location would constitute a rural low-flow road.

5.5 Traffic and Transport Impacts

5.5.1 Narrow Water Bridge Mainline

The future traffic forecasts indicate low traffic flows (3,500 AADT or less) in the design year, which are significantly below the capacity of a reduced single in accordance with Table 4 of design standard TD9 of the NRA DMRB. Therefore, a 6.0m wide carriageway has been provided, which is more appropriate for a rural road carrying low volumes of traffic. This is consistent with NRA TD27/00 Annex A, which suggests that the cross-sections for non-national roads within national road schemes should be between 5.5m and 7.5m wide.

The peak hour traffic flows in the Base (2007), Opening (2013) and Design (2033) years are given in **Figures 5.3**, **5.4** and **5.5** in Volume 3

5.5.2 Proposed Cornamucklagh Roundabout

A new roundabout is proposed at the junction between the Narrow Water Bridge and the R173 Omeath Road. The layout of the proposed Cornamucklagh Roundabout is shown in **Figure 3.2** in Volume 3. The new roundabout was assessed using the Transport Research laboratory (TRL) ARCADY software for roundabout junctions. The junction assessments were carried out for the opening year (2013) and design year (2033) during the morning and evening peak hours. The results of this analysis are tabulated below in Table 5.9 below.

Table 5.9 Proposed Cornamucklagh Roundabout ARCADY Analysis

Time	Arm	Max. Degree of Saturation (RFC)			Queue Length (veh)			Average Delay (min/veh)		
		Base	Opening	Design	Base	Opening	Design	Base	Opening	Design
AM	R173 North	-	0.151	0.191	-	0.2	0.2	-	0.07	0.07
	Narrow Water Bridge	-	0.098	0.105	-	0.1	0.1	-	0.06	0.06
	R173 South	-	0.226	0.266	-	0.3	0.4	-	0.07	0.07
PM	R173 North	-	0.151	0.191	-	0.2	0.2	-	0.07	0.07
	Narrow Water Bridge	-	0.098	0.105	-	0.1	0.1	-	0.06	0.06
	R173 South	-	0.226	0.266	-	0.3	0.4	-	0.07	0.07

A roundabout is considered to operate within capacity if the Ratio of Flow to Capacity (RFC) is less than 0.85. It is clear that the proposed Cornamucklagh Roundabout operates satisfactorily without any queuing or delay. The RFC on all arms is so low (<25%) that a smaller roundabout may seem more appropriate, however, the proposed roundabout has an ICD of 36m and reducing the roundabout to a mini-roundabout would remove much of the traffic calming benefits of the roundabout given its rural location. The proposed roundabout is also suited to the significant amount of HGV utilising this road.

5.5.3 Existing A2 Roundabout

The existing A2 roundabout is to be upgraded to accommodate an additional arm. The revised layout of the A2 roundabout is shown in **Figure 3.2** in Volume 3. Therefore, the junction was analysed using the Transport Research laboratory (TRL) ARCADY software for roundabout junctions. The junction assessments were carried out for the base year (2007), opening year (2013) and design year (2033) during the morning and evening peak hours. The results of this analysis are tabulated below in Table 5.10 below.

Table 5.10 Proposed Cornamucklagh Roundabout ARCADY Analysis

Time	Arm	Max. Degree of Saturation (RFC)			Queue Length (veh)			Average Delay (min/veh)		
		Base	Opening	Design	Base	Opening	Design	Base	Opening	Design
AM	A2 North	0.229	0.198	0.222	0.3	0.2	0.3	0.04	0.03	0.03
	Burren Road	0.015	0.038	0.044	0.0	0.0	0.0	0.09	0.09	0.10
	A2 South	0.456	0.555	0.656	0.8	1.2	1.9	0.05	0.07	0.09
	Narrow Water Bridge	-	0.157	0.187	-	0.2	0.2	-	0.11	0.13
PM	A2 North	0.341	0.377	0.423	0.5	0.6	0.7	0.03	0.03	0.04
	Burren Road	0.014	0.035	0.045	0.0	0.0	0.0	0.12	0.13	0.14
	A2 South	0.228	0.276	0.328	0.3	0.4	0.5	0.04	0.05	0.05
	Narrow Water Bridge	-	0.118	0.129	-	0.1	0.1	-	0.08	0.08

As stated above, a roundabout is considered to operate within capacity if the Ratio of Flow to Capacity (RFC) is less than 0.85. It is clear in Table 5.10 that the proposed Cornamucklagh Roundabout operates satisfactorily without any queuing or delay.

5.5.4 Queuing Facilities during Bridge Opening

The bridge is required to open to accommodate marine traffic. While the opening operation is taking place traffic on either side of the Newry River will queue. These queues are to be accommodated in a safe manner that does not compromise the operation capacity of the Cornamucklagh or A2 roundabouts. The maximum queue lengths have been calculated using the following assumptions:

- The bridge opening occurs during the morning or evening peak hours;
- Two-way peak hour traffic is equivalent to 10% of AADT;
- Traffic arrives at a constant rate;
- Traffic will divert if the travel time saving is less than waiting time.

As previously stated, the travel time saving for vehicles travelling between Omeath and Warrenpoint is 18 minutes. In addition, it is predicted that the entire opening operation of the bridge will take approximately 20 minutes to complete. This is based on the following assumptions:

Bridge section to fully open	5 minutes
Passage of marine vessel through bridge	10 minutes
Bridge section to close	5 minutes
	20 minutes

Therefore, the maximum queue lengths have been calculated based on an 18 minute time to maximum queuing. The predicted queue lengths on either side of the bridge are given in Table 5.11 above.

It is clear from Table 5.11 that the queues can be accommodated in the 310m length of carriageway between the wig wag warning signals and the Cornamucklagh roundabout. Therefore, a sufficient length of carriageway has been provided to accommodate any queuing that may occur in the design year.

On the north side, however, the queuing length provided between the wig wag signals and the A2 roundabout is insufficient to accommodate the predicted queues. The queues will extend beyond the A2 roundabout and these queues will impact the operational capacity of the roundabout unless alternatives measures such as those outlined in **Figure 5.6** and **Figure 5.7** are adopted to mitigate this.

These alternative measures include providing advance fixed and variable message signage to inform drivers of the opening bridge ahead and the queuing that is likely to occur. In addition, yellow hatch road markings will be provided on the A2 roundabout to indicate where queuing is permitted, which will ensure the queuing does not adversely affect the operational capacity of the roundabout. Furthermore, signage will be provided on the Burren Road to prohibit vehicles queuing on this arm. These traffic management proposals are currently being developed in consultation with Roads Service Northern Ireland (RSNI) and Louth County Council. These proposals will be fully developed, finalised and agreed with the relevant authorities at Detailed Design stage. The adoption of these measures will enable vehicles to queue safely on the approaches to the A2 roundabout without impeding the operation of the roundabout.

Table 5.11 Predicted Queue Lengths

Arm			Opening Year (2013) Peak Hour					Design Year (2033) Peak Hour				
Description	Length		Demand		Queue Length		Capacity	Demand		Queue Length		Capacity
	m	pcu	per hour	per period	pcu	m	%	per hour	per period	pcu	m	%total
Lower bound												
Narrow Water Bridge South	366	63	52	16	16	121	26%	52	16	16	121	26%
Narrow Water Bridge North	60	10	52	16	10	58	100%	52	16	10	58	100%
A2 North	200	43	2	1	0	0	0%	3	1	0	0	0%
A2 South	100	17	41	12	12	71	73%	41	12	12	70	72%
Burren Road	6	1	8	3	0	0	0%	8	2	0	0	0%
Mean												
Narrow Water Bridge South	366	63	111	33	33	192	52%	115	35	35	199	57%
Narrow Water Bridge North	60	10	111	33	10	58	100%	115	35	10	58	100%
A2 North	200	43	60	18	9	52	27%	63	19	10	56	30%
A2 South	100	17	43	13	13	74	76%	44	13	13	76	78%
Burren Road	6	1	8	3	2	9	154%	9	3	2	9	161%
Upper bound												
Narrow Water Bridge South	366	63	175	53	53	307	83%	188	56	56	325	88%
Narrow Water Bridge North	60	10	175	53	10	58	100%	188	56	10	58	100%
A2 North	200	43	121	36	27	157	83%	130	39	30	173	91%
A2 South	100	17	43	13	13	76	76%	47	14	14	76	78%
Burren Road	6	1	10	3	2	11	200%	11	3	2	11	220%

It should be noted that the queues will not extend far enough to obstruct any accesses on to the A2 including the Warrenpoint Harbour access or Narrow Water Castle entrance. However, the existence of these queues in the nearside and offside lanes of the south and north approaches to the A2 Roundabout, respectively, will reduce the operational capacity of the junction. Therefore, a further assessment of the A2 Roundabout was undertaken using the Transport Research Laboratory (TRL) ARCADY software considering the queuing on the approaches.

Table 5.12: A2 Roundabout during Bridge Opening ARCADY Analysis

Time	Arm	Max. Degree of Saturation (RFC)			Queue Length (veh)			Average Delay (min/veh)		
		Base	Opening	Design	Base	Opening	Design	Base	Opening	Design
AM	A2 North	-	0.372	0.413	-	0.6	0.7	-	0.07	0.09
	Burren Road	-	0.024	0.029	-	0.0	0.0	-	0.09	0.09
	A2 South	-	0.720	0.837	-	2.5	4.7	-	0.14	0.22
	Narrow Water Bridge	-	0.000	0.000	-	0.0	0.0	-	0.00	0.00
PM	A2 North	-	0.743	0.824	-	2.8	4.6	-	0.16	0.25
	Burren Road	-	0.018	0.022	-	0.0	0.0	-	0.12	0.13
	A2 South	-	0.359	0.417	-	0.6	0.7	-	0.07	0.07
	Narrow Water Bridge	-	0.000	0.000	-	0.0	0.0	-	0.00	0.00

The assessment considers the unlikely event of a RORO ship arriving in Warrenpoint Harbour when the bridge is opening during the morning and evening peak hours. The analysis revealed that the northern approach to the A2 roundabout and the Burren could accommodate the future traffic flows even when the queuing was considered. However, the southern approach required a small modification to facilitate the predicted queues and future traffic volumes, which involves widening the approach to accommodate a third entry lane.

It is clear from Table 5.12 above that the existing A2 Roundabout with a minor alteration to the southern approach operates satisfactorily without any queuing or delay when the bridge is opening.

A further assessment has been undertaken to investigate the unlikely event of a RORO ship arriving in Warrenpoint Harbour when the bridge is opening during the morning and evening peak hours.

Table 5.13: A2 Roundabout during Bridge Opening and RORO Arrival Analysis

Time	Arm	Max. Degree of Saturation (RFC)			Queue Length (veh)			Average Delay (min/veh)		
		Base	Opening	Design	Base	Opening	Design	Base	Opening	Design
AM	A2 North	-	0.372	0.413	-	0.6	0.7	-	0.07	0.09
	Burren Road	-	0.024	0.029	-	0.0	0.0	-	0.09	0.09
	A2 South	-	0.804	0.921	-	3.8	8.7	-	0.19	0.35
	Narrow Water Bridge	-	0.000	0.000	-	0.0	0.0	-	0.00	0.00
PM	A2 North	-	0.743	0.824	-	2.8	4.6	-	0.16	0.25
	Burren Road	-	0.018	0.022	-	0.0	0.0	-	0.12	0.13
	A2 South	-	0.443	0.501	-	0.8	1.0	-	0.08	0.08
	Narrow Water Bridge	-	0.000	0.000	-	0.0	0.0	-	0.00	0.00

It is apparent from Table 5.13 above that A2 roundabout operates within capacity with minor queuing and delays when the bridge is opening and a large shipment of containers arrives during peak hours with the exception of the morning peak hour in the design year. In the design year, the roundabout will operate marginally over capacity with moderate queuing and delay if a large shipment arrives in Warrenpoint at the same time as the bridge opening.

It is highly unlikely that this event will occur. Based on the following assumptions it is predicted that the probability of this event occurring is in excess 1 in 10 years:

- The Narrow Water Bridge is opened 90 times a year within an hour of high tide;
- High or near high tides (within 1 hour) and the morning peak hour coincide for 10 days of every 60 days;
- The RORO service scheduled to arrive at 05:00 is between 3 and 4 hours late once every 100 sailings.

Although it is unlikely that a ship will be unloading while the bridge is open during the peak, it may occur on occasion and therefore, procedures should be in place to prevent queues developing at the A2 roundabout. To mitigate this it is proposed that the opening of the bridge be delayed until the ship in Warrenpoint Harbour is fully unloaded or peak hour traffic flows on the A2 roundabout have dissipated.

5.5.5 Parking

As described in Section 3.4.6, there is an existing recently refurbished lay-by on the northbound carriageway of the A2 dual carriageway situated between the A2 roundabout and the Narrow Water Keep. It is considered that the lay-by can accommodate 18 vehicles parallel to the kerb including 2 mobility impaired vehicles. Based on visitor information between 21st April 2011 and 31st August 2011, it is estimated that between 3 and 4 vehicles utilise this lay-by at peak times. It is only during exceptional circumstances that the parking provision of the lay-by is exceeded.

It is possible that the parking demand at this location will increase due to the provision of the Narrow Water Bridge. However, it is not anticipated that the increase in the parking will compromise the safe operation of the existing lay-by. In the worst case, it is estimated that an additional 9 vehicles will utilise the lay-by at peak times. Even though this is a two- or three-fold increase in parking demand, the lay-by can easily accommodate these additional vehicles. Therefore, it is not proposed to provide any additional parking spaces as part of the Narrow Water bridge scheme. It is difficult to accurately predict tourist traffic, and therefore, it is recommended that the parking demand at this lay-by is monitored by local authorities following completion of the bridge.

5.5.6 Improvement of Journey Times

Journey time surveys were undertaken on Wednesday, 11th November 2009 between Omeath and Warrenpoint via Newry during the AM peak and interpeak periods, with the data collected on a link by link basis. This survey indicated that the provision of the Narrow Water Bridge would result in an 18 minute journey time saving for traffic travelling between Omeath and Warrenpoint.

5.5.7 Safety Benefits of the Narrow Water Bridge

The provision of link between the R173 Omeath Road and the A2 Dual-carriageway has the benefit of reducing journey times and distances for road users travelling between Omeath and Warrenpoint. The likelihood of accidents occurring in the vicinity of the crossing should decrease due to the reduction in journey times and distances.

In addition, traffic heading from Omeath to Newry is also likely to divert across the bridge to the high standard road in the north. The A2 dual-carriageway is designed to accommodate significant volumes of traffic and it would provide a safer for traffic travelling between Omeath and Newry.

The Narrow Water Bridge will reduce the traffic volumes passing through Davies' Crossroads where a significant number of accidents have occurred in recent years. In addition, the proposed Cornamucklagh Roundabout will calm traffic on the R173 Omeath Road. In particular, it should reduce traffic speeds on the approach to Davies' Crossroads and subsequently, improving safety at the junction.

Furthermore, the proposed carriageway is only 6.0m wide. A major reason for selecting such a narrow carriageway is to calm traffic and create a safer road environment. Research has shown that carriageway width is an important factor in limiting vehicular speeds

Finally, the proposed Narrow Water Bridge includes the provision of segregated and combined pedestrian and cyclist facilities. These facilities provide safe environment pedestrians and cyclists to utilise away for the full length of the proposed link.

In summary, the Narrow Water Bridge has the benefit of improving road safety in the vicinity of the crossing.

5.6 Construction Stage

5.6.1 Construction Traffic Estimates

Chapter 3 of this report outlines the details of the existing ground conditions and proposals for earthworks design based on data obtained from the preliminary site investigations.

5.6.2 Earthworks Traffic

The scheme involves the excavation and transportation of large volumes of material excavated both within and from the site.

The estimated earthworks quantities for the scheme sees an earthworks balance south of the River and a deficit of 8,300 cubic metres north of the River. Additional, a total amount of unsuitable material of 1,700 south of the River and 3,500 North of the river will need to be disposed of within the working area, being used in other uses on site such as landscaping and noise bunds.

In the worst case scenario if it is necessary to export the residual surplus volume of earthworks of up to 9,000 cubic metres of cut material this would involve 820 truck loads (assuming 20 Tonnes or 11 cubic metres per truck load). This would represent an average of 13 loads per day if the bulk earthworks are spread over a period of 3 months.

5.6.3 Pavement Materials

The main materials that will be hauled to site in bulk are: granular sub-base material, and bituminous pavement materials, amounting to a volume of 1720 cubic metres. It is likely that surplus cut material will be processed on site for use as sub-base material, which would reduce the volume of pavement materials to be transported to site. In the worst case scenario of 800 cubic metres of material to be imported to site, this represents some 75 truck loads assuming 11 cubic metres per truck load, which would represent an average of 12 loads per day if the pavement works are spread over a period of 1.5 months.

The haulage of pavement and construction materials is not likely to coincide with the earthworks operations and therefore the haulage of materials will peak during the earlier earthworks phase.

5.6.4 Concrete Works

The scheme includes the construction of the Narrow Water Bridge and a number of culverts. These structures are likely to contain both pre-cast reinforced concrete units and in situ concrete. Assuming an in-situ concrete will be used in the construction of Narrow Water Bridge, it is estimated that the construction of these structures will involve some 2,900 cubic metres of concrete, which could involve up to 485 truckloads of concrete inbound to the site (6 cubic metres per truck) over a 12 month period, which would represent an average of 3 truck movements per day.

5.6.5 Prefabricated Steel Sections

The bridge deck and towers are steel orthotropic and steel composite sections respectively. This will require the assembly on site of large sections of steel elements previously fabricated elsewhere and transported to site. The south bridge will have a total tonnage of approximately 1600 tons of steel. Assuming an average section of 25 tons this will require a total of 65 loads, considering a construction period of 18 months; this will require an average of 4 movements per month.

5.6.6 Overall Volume of Construction Truck Traffic

The peak truck traffic during the construction period is estimated to amount to 20 truck movements per day during the first 4 months of the construction period, and to then drop to 10 truck movements per day for the following 20 months.

5.6.7 Construction Site Access

It is anticipated that the main site compound would be located on the south side and the access to the southern site and the site compound would be from the R173 Omeath Road. Access to the northern site will be provided off the A2 roundabout.

5.6.8 Construction Traffic Routing

The haulage of materials to and from the site could create a significant temporary impact to both road users and to residents living along haul roads. To minimise these impacts it is important that only authorised roads are to be used by construction vehicles.

5.6.9 Traffic Management

The scheme construction also impacts on the existing roads at the following locations:

- R173 Omeath Road in Cornamucklagh;
- A2 Roundabout north of Warrenpoint.

It is likely that significant temporary works and traffic management will be required to facilitate the passage of traffic on the existing R173 and A2 at these locations during construction.

In addition, the Narrow Water Bridge crosses the Newry River, which is navigable via the Newry Canal as far as Newry. Although the proposed bridge clearly has implications for marine traffic when operational, it also has an impact on marine vessels during construction.

In particular, a single leaf pier, which is located in the centre of the river, will be constructed adjacent the navigational channel prior to the construction of the main cable-stayed span. Vessels could collide with this pier, unless this pier is highlighted to approaching vessels. A similar problem occurs when the main cable-stayed span extends over the navigational channel unless adequately highlighted.

Finally, the opening section extends over the navigational channel. The channel will need to be closed during the installation of this span.

An Environmental Operating Plan will be put in place by the contractor during the construction phase of the scheme with regard to the NRA Guidelines for the Creation and Maintenance of an Environmental Operating Plan (2007). This EOP will include a Traffic Management Plan.

Further detail of the construction phase impacts and mitigations measures are included in Chapter 13.

5.7 Conclusions

5.7.1 Traffic and Transport Impact

The proposed Narrow Water Bridge will significantly improve connectivity between the Cooley peninsula and the Mourne District, which will enhance the tourist potential of the region.

(a) The proposed bypass is forecast to carry a design year traffic flow of between 1,036 and 3,767 AADT in 2033.

(b) The provision of a link results in an 18 minute journey time saving for traffic travelling between Omeath and Warrenpoint.

(c) It is expected that the road geometry will discourage HGVs from crossing the Narrow Water Bridge. The HGV traffic, which is likely to use the crossing, will result in a minimal increase of HGV traffic on the A2 dual carriageway.

(d) A 6.0m wide carriageway is the most suitable road type for the Narrow Water Bridge.

(e) The opening operation is estimated to take 20 minutes to complete.

(f) On the south side, queues can be accommodated between the wig wag signals and the Cornamucklagh Roundabout.

(g) On the north side, queues can be accommodated on the approaches to the A2 roundabout without blocking any accesses with the appropriate traffic management.

(h) On the north side, queues can be accommodated on the approaches to the A2 roundabout without blocking any accesses with a slight modification to the A2 roundabout southern approach and the appropriate traffic management

(i) In the unlikely event of a RORO ship arriving when the bridge is opening during the morning peak hour, the bridge shall not be opened until the ship is unloaded or peak hour traffic has dissipated. This procedure should be included in the Environmental Operating Plan.

(j) The existing lay-by on the northbound carriageway of the A2 dual-carriageway is capable of accommodating any additional parking demand arising from the provision of the bridge;

(k) The segregated and combined pedestrian and cyclist facilities along the bridge and approaches provide a safe environment pedestrians and cyclists to utilise.

(l) The Narrow Water Bridge is beneficial as it improves road safety in the vicinity of the crossing;

(m) The peak truck traffic during the construction period is estimated to amount to 20 truck movements per day during the first 4 months of the construction period, and to then drop to 10 truck movements per day for the following 20 months.

(n) Construction near or adjacent the navigational channel shall be highlighted to approaching vessels.

(o) The navigational channel shall be closed during the installation of this opening span.

(p) An Environmental Operating Plan, which will include a Traffic Management Plan, will be put in place by the contractor during the construction phase of the scheme with regard to the NRA Guidelines for the Creation and Maintenance of an Environmental Operating Plan (2007). This EOP will include a Traffic Management Plan.

The noise and air quality impacts associated with traffic are detailed in Chapter 7. In addition, further detail of the construction phase impacts are included in Chapter 11.

5.7.2 Mitigation Measures

The following measures are proposed to mitigate any adverse impacts addressed above:

(a) A traffic management plan will be finalised at detailed design stage with the relevant authorities to ensure that A2 Roundabout flows freely during the opening of the bridge.

(b) An Environmental Operating Plan, which will include a Traffic Management Plan, will be put in place by the contractor during the construction phase of the scheme with regard to the NRA Guidelines for the Creation and Maintenance of an Environmental Operating Plan (2007). This EOP will include a Traffic Management Plan;

(c) The parking at the lay-by on the northbound carriageway of the A2 dual-carriageway should be monitored by local authorities following completion of the bridge.

The measures to mitigate the noise and air quality impacts are detailed in Chapter 7 while the construction phase mitigation measures are discussed in Chapter 11.

5.8 References

‘Omeath – Warrenpoint Road Link, Feasibility Study’ by M. C. O’Sullivan & Co. Ltd. (now RPS Consulting Engineers), 2001.

‘Newry Southern Relief Road, Traffic Survey and Data Report’ by Scott Wilson, Draft Issue, May 2008.

‘Narrow Water Bridge, Constraints Study Report’ by Roughan & O’Donovan Consulting Engineers, Final Issue, November 2008.

'Narrow Water Bridge, Route Selection Report' by Roughan & O'Donovan Consulting Engineers, Final Issue, November 2008.

'Narrow Water Bridge, Bridge Feasibility Study' by Roughan & O'Donovan Consulting Engineers, Final Issue, November 2008.

'Narrow Water Bridge, Preliminary Design Report, Volume 1A' by Roughan & O'Donovan Consulting Engineers, Issued for Client Approval, November 2010.

Appendix 5.1 - Trip Distribution

From Omeath										To Omeath									
Origin		**Destination**		**Trip**						**Origin**		Destination		Trip					
Zone	Name	Zone	Name	Non Leisure	Leisure	Petrol	All	%	Trip Factor	Zone	Name	Zone	Name	Non Leisure	Leisure	Petrol	All	%	Trip Factor
1	Cooley Mountains	1	Cooley Mountains	24	12	7	43	7.49%	0.00	1	Cooley Mountains	1	Cooley Mountains	14	18	12	44	6.04%	0.00
										1	Cooley Mountains	7	Centre County Louth	2	1	0	3	0.41%	0.00
										1	Cooley Mountains	12	West Ireland	1	0	0	1	0.14%	0.00
										1	Cooley Mountains	13	East Ireland	1	1	0	2	0.27%	0.00
1	Cooley Mountains	2	Mourne Mountains	45	17	15	77	13.41%	1.00	2	Mourne Mountains	1	Cooley Mountains	34	33	26	93	12.76%	1.00
										2	Mourne Mountains	13	East Ireland	1	1	0	2	0.27%	0.00
1	Cooley Mountains	3	Rathfirland & Newcastle	17	1	1	19	3.31%	1.00	3	Rathfirland & Newcastle	1	Cooley Mountains	4	13	7	24	3.29%	1.00
1	Cooley Mountains	4	Banbridge	11	1	10	22	3.83%	0.00	4	Banbridge	1	Cooley Mountains	5	10	10	25	3.43%	0.00
1	Cooley Mountains	5	Bessbrook, Tandridge and	4	0	1	5	0.87%	0.00	5	Bessbrook, Tandridge and	1	Cooley Mountains	1	7	4	12	1.65%	0.00
1	Cooley Mountains	6	South County Armagh	2	1	1	4	0.70%	0.00	6	South County Armagh	1	Cooley Mountains	4	2	0	6	0.82%	0.00
1	Cooley Mountains	7	Centre`County Louth	8	4	0	12	2.09%	0.00	7	Centre`County Louth	1	Cooley Mountains	9	10	0	19	2.61%	0.00
1	Cooley Mountains	81	Central Newry	98	34	1	133	23.17%	0.50	81	Central Newry	1	Cooley Mountains	118	50	3	171	23.46%	0.50
1	Cooley Mountains	82	East Newry	11	0	6	17	2.96%	0.50	82	East Newry	1	Cooley Mountains	7	12	7	26	3.57%	0.50
1	Cooley Mountains	83	North Newry	44	0	32	76	13.24%	0.50	83	North Newry	1	Cooley Mountains	13	42	33	88	12.07%	0.50
1	Cooley Mountains	84	West Newry	15	1	11	27	4.70%	0.00	84	West Newry	1	Cooley Mountains	4	21	12	37	5.08%	0.00
1	Cooley Mountains	85	South Newry	22	1	30	53	9.23%	0.00	85	South Newry	1	Cooley Mountains	11	22	19	52	7.13%	0.00
1	Cooley Mountains	9	Downpatrick	8	0	0	8	1.39%	1.00	9	Downpatrick	1	Cooley Mountains	1	0	2	3	0.41%	1.00

Appendix 5.1 - Trip Distribution

From Omeath										**To Omeath**									
Origin		**Destination**		**Trip**						**Origin**		Destination		Trip					
Zone	Name	Zone	Name	Non Leisure	Leisure	Petrol	All	%	Trip Factor	Zone	Name	Zone	Name	Non Leisure	Leisure	Petrol	All	%	Trip Factor
1	Cooley Mountains	10	Belfast and County Antrim	38	11	4	53	9.23%	0.00	10	Belfast and County Antrim	1	Cooley Mountains	34	40	8	82	11.25%	0.00
										10	Belfast and County Antrim	7	Centre County Louth	1	1	0	2		
										10	Belfast and County Antrim	13	East Ireland	0	1	0	1		
1	Cooley Mountains	11	North Armagh and Donegal	17	1	0	18	3.14%	0.00	11	North Armagh and Donegal	1	Cooley Mountains	8	22	5	35	4.80%	0.00
										11	North Armagh and Donegal	7	Centre County Louth	1	0	0	1		
1	Cooley Mountains	12	West Ireland	1	1	0	2	0.35%	0.00	12	West Ireland	1	Cooley Mountains	1	1	0	2	0.27%	0.00
1	Cooley Mountains	13	East Ireland	1	0	0	1	0.17%	0.00	13	East Ireland	1	Cooley Mountains	1	1	0	2	0.27%	0.00
7	Centre County Louth	1	Cooley Mountains	1	1	0	2	0.35%	0.00										
7	Centre County Louth	2	Mourne Mountains	0	2	0	2	0.35%	1.00										
7	Centre County Louth	4	Banbridge	1	0	0	1												
7	Centre County Louth	7	Centre County Louth	1	1	0	2												
7	Centre County Louth	81	Central Newry	1	2	0	3			81	Central Newry	7	Centre County Louth	1	1	0	2		
7	Centre County Louth	83	North Newry	1	0	0	1												
13	East Ireland	11	North Armagh and Donegal	2	1	0	3												
13	East Ireland	81	Central Newry	1	0	0	1			81	Central Newry	13	East Ireland	0	1	0	1		
										83	North Newry	7	Centre County Louth	1	1	0	2		
Total Outbound Trips				374	92	119	585	100%		Total Inbound Trips				278	312	148	738	100%	

Appendix 5.1 - Trip Distribution

From Omeath									
Origin		**Destination**		**Trip**					
Zone	Name	Zone	Name	Non Leisure	Leisure	Petrol	All	%	Trip Factor
Bridge Trips Lowerbound				70	20	16	106	18%	
Bridge Trips Mean				147	37	36	219	37%	
Bridge Trips Upperbound				223	54	55	332	57%	
Total Omeath Road Trips				367	88	119	574	98%	

To Omeath									
Origin		Destination		Trip					
Zone	Name	Zone	Name	Non Leisure	Leisure	Petrol	All	%	Trip Factor
Bridge Trips Lowerbound				39	46	35	120	16%	
Bridge Trips Mean				108	98	57	263	36%	
Bridge Trips Upperbound				177	150	78	405	55%	
Total Omeath Road Trips				274	307	148	729	99%	

Notes:

1. Trip distribution to and from Omeath was derived from the information gathered during Roadside Interview Surveys undertaken on Wednesday, 23rd August 2000, for the 'Omeath - Warrenpoint Road Link Feasability Study, June 2001'.