Chapter 4

Description of the Proposed Scheme

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4 DESCRIPTION OF THE PROPOSED SCHEME

4.1 Introduction

This chapter of the Environmental Impact Assessment (EIAR) is supported by **Volume 3 – Technical Drawings** which contains design and technical drawings to illustrate the location of key features described in the chapter.

The N2 national primary route, through its connection with the M2 at Ashbourne, connects Dublin city to the border with Northern Ireland, passing through counties Dublin, Meath, Louth and Monaghan. At the border the route becomes the A5 to Derry, passing through counties Tyrone and Derry, with links at Strabane to the N14 and N15 National Primary routes in Donegal. The N2 route forms an integral part of this important long-distance transport corridor, as well as carrying significant volumes of local traffic. The N2 runs north-south passing through Slane village.

The N2 connects with the N51 National Secondary route in Slane village. The N51 runs east-west and connects Drogheda to Navan and on to Mullingar and the midlands, via the N52 National secondary route at Delvin. The location of the N2 Slane Bypass and Public Realm Enhancement Scheme (the 'Proposed Scheme') in a regional context and the Constraints Study Area is shown in **Figure 4.1** with a detailed layout shown in **Volume 3**, Technical Drawing **MDT0806-RPS-01-N2-DR-Z-LP0001** (Location Plan).

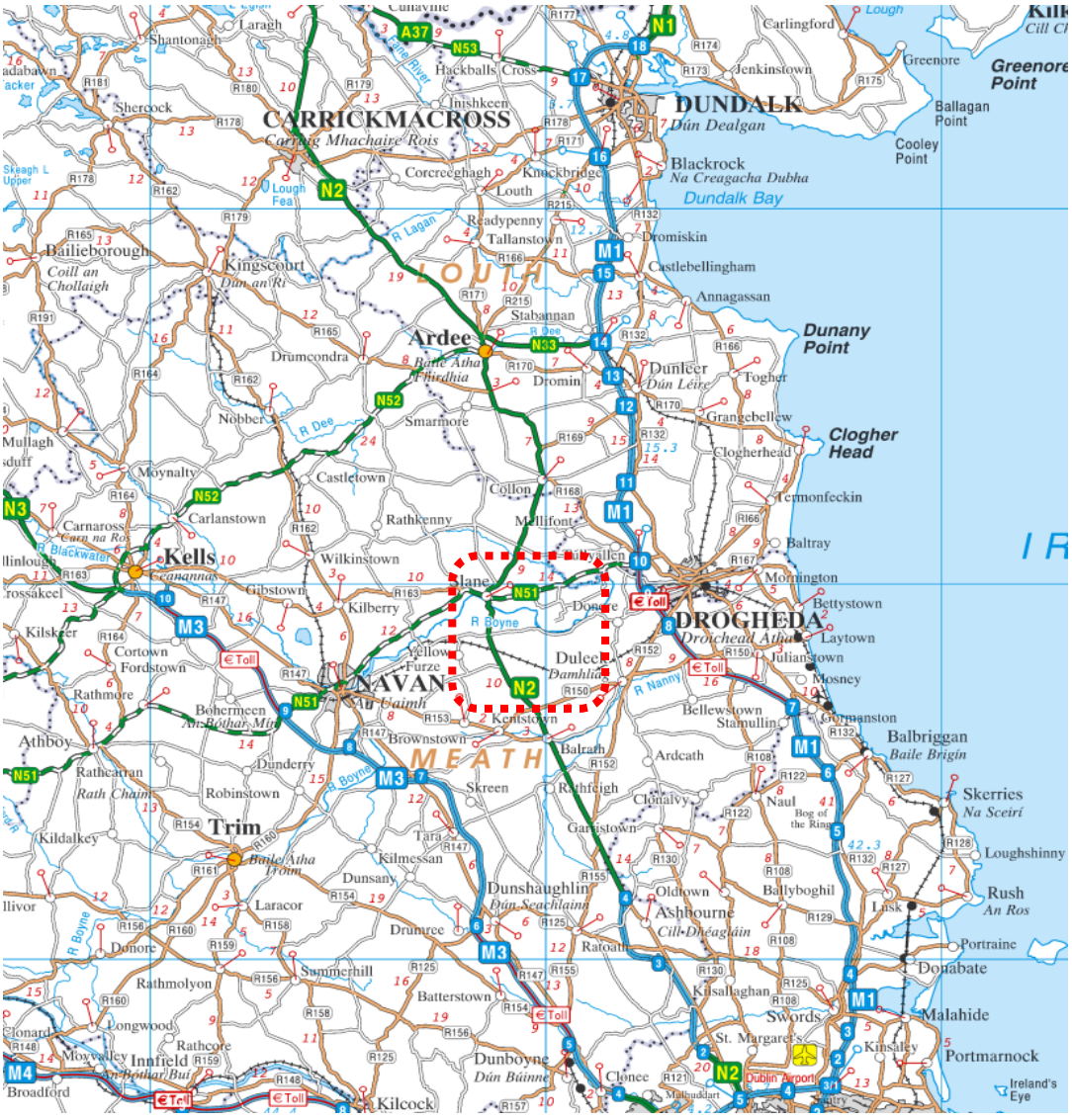


Figure 4.1: Proposed Scheme Location in a Regional Context and Constraints Study Area

The N2 route at Slane is severely deficient, causing environmental nuisance to local residents, and visitors with a long history of traffic accidents, including fatalities. These arise from the sub-standard alignment particularly in the vicinity of Slane Bridge, the steep approach gradients on the N2 in Slane village and approaches to Slane Bridge, and the high percentage of heavy goods vehicles (HGVs) through the village.

The Proposed Scheme is located withing an environmentally sensitive environment. Environmental constraints of particular significance are:

- Archaeological and Cultural Heritage (e.g. UNESCO World Heritage Property of Brú na Bóinne, Hill of Slane National Monument, and other recorded monuments and protected features);
- Architectural (i.e. Architectural Conservation Areas (ACAs) – Slanecastle Demesne ACA, Slane Village ACA, Slane Mill ACA and Stackallen ACA) and other protected features;
- Landscape (i.e. Protected Views, Landscape Character Areas (LCAs) – Rathkenny Hills, North Navan Lowlands, Boyne Valley, and Central Lowlands); and
- Ecological and natural heritage (i.e. European Sites comprising Special Area of Conservation (SAC) – River Boyne and River Blackwater SAC, Special Protection Areas (SPA) – River Boyne and River Blackwater SPA, Proposed Natural Heritage Areas (pNHA) – Boyne Woods pNHA, Natural and semi-natural habitats, salmonid river (River Boyne), Nutrient Sensitive River (River Boyne), Annex I bird species (kingfisher) along River Boyne).

4.2 Overview of the Proposed Scheme

Volume 3 – Technical Drawings MDT0806-RPS-01-N2-DR-C-GA0000 – GA0003 (General Arrangement) and **MDT0806-RPS-01-N2-DR-C-GA2201** (General Arrangement - N51 West) illustrate the layout of the bypass and improvements proposed on the N51. **Volume 3 – Technical Drawings MDT0806-RPS-01-PR-DR-C-GA9000 – GA9008** (Public Realm General Arrangement) along with **MDT0806-RPS-01-PR-DR-C-GA9101** (Public Realm Enhancement Area - Overview), **GA9201** (Public Realm Enhancement Area General Arrangement - Car Park Layout) and **MDT0806-RPS-01-PR-DR-C-GA9202** (Public Realm Enhancement Area General Arrangement - Car Park Pavement Details) illustrate the proposals included in the public realm improvements in Slane village.

The proposed N2 Slane Bypass will consist of the construction, operation and maintenance of 3.5 kilometres (km) of dual carriageway, located to the east of Slane village. The bypass includes for existing road connectivity at the N2 south of Slane, the N51 east of Slane and the N2 north of Slane. A major river crossing of the River Boyne is required to traverse the Boyne valley including the Boyne navigation canal and its associated tow-path. This river crossing consists of a four-span major bridge structure, approximately 258 m long. The Proposed Scheme provides for improvement to the N51 either side of the proposed bypass, to improve alignment deficiencies on the east side and to provide appropriate improvement to the N51 link as far as the village on the west side.

The project includes for traffic management and public realm improvements within Slane village, including new junction design, traffic calming measures, improved sustainable transport measures within the village and a new off-street car park (refer to **Section 4.4.13** for further details).

The proposed bypass commences on the existing N2 at a location approximately 1.6 km south of the existing Boyne crossing, approximately 0.4 km north of McGruder's Cross and completes at a tie-in to the existing N2 at a location approximately 0.6 km north of the existing 50km speed limit gateway to Slane village. An overview of the Proposed Scheme is shown on **Figure 4.2** and **Figure 4.3** comprising:

- Approximately 3.5 km of mainline N2 bypass Type 2 dual carriageway;
- Approximately 1.4 km of realigned N51 National Road;
- Reconfiguration of The Square junction in Slane, including removal of traffic light control;
- Public Realm improvement and traffic management measures in Slane village;
- Approximately 2.7 km of accommodation works and maintenance access tracks;
- 3 at-grade roundabouts at N2 South, N51 and N2 North;
- 1 major bridge crossing of River Boyne;

- 1 new road overbridge to allow the proposed N2 to pass under Rossnaree Road;
- 2 farm accommodation overbridges;
- 3 No. new culverts on the Mattock (Mooretown) Stream[1] and removal of existing culvert under existing N2;
- Provision of shared footway/cycleway facilities, including a pedestrian/cyclist bridge to the existing Boyne Canal towpath;
- Utility diversions;
- Drainage system, including attenuated outfalls; and
- Landscaping and environmental mitigation measures.

Also included in the Proposed Scheme are substantial temporary works associated with the construction of the River Boyne bridge. The Proposed Scheme includes for both the construction and decommissioning of these temporary works.

Other temporary works such as at overbridge construction locations will also be necessary as will the establishment of site compounds and other temporary areas e.g. stockpiling. The Proposed Scheme includes for both the construction and decommissioning of all these temporary works.

[1] An upper tributary of the EPA delineated Mattock River_030. Referred throughout EIAR as Mattock (Mooretown) Stream.

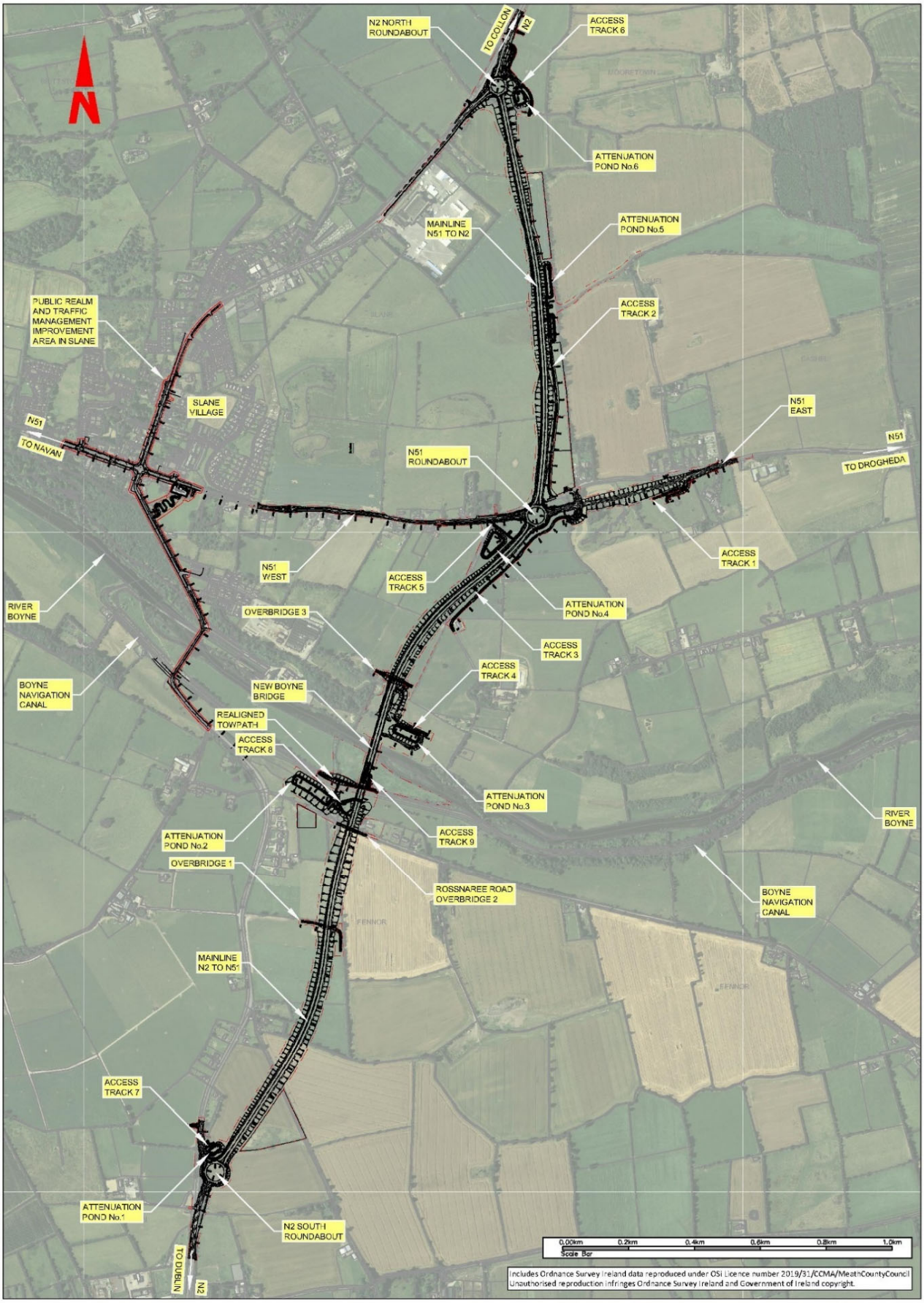


Figure 4.2: Outline of the Proposed N2 Slane Bypass and Public Realm Enhancement Scheme

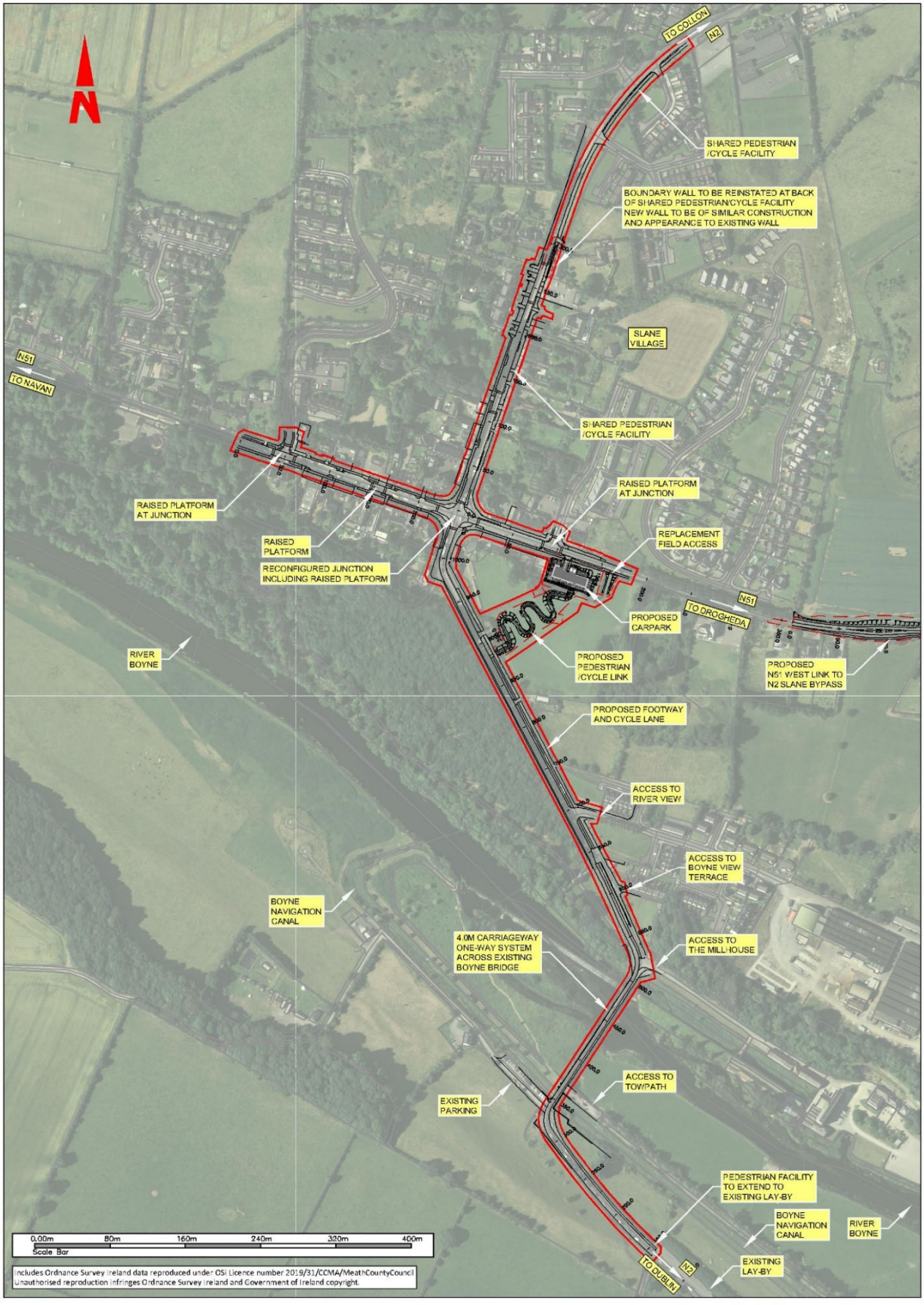


Figure 4.3: Outline of proposed Public Realm Improvement Proposals in Slane Village

The proposed N2 bypass route corridor runs to the east of Slane Village and is approximately 3.5 km in length. The proposed route diverts from the existing N2, in a north-easterly direction, from a location approximately 400 m north of McGruder's crossroads in the townland of Johnstown. It continues in a north-north easterly direction, through Fennor and Crewbane townlands in a 6 m to 7 m deep cutting. The route passes under the existing Rosnaree Road, crossing the River Boyne approximately 630 m east of the existing Slane Bridge. After crossing the river, the route runs in a north-easterly direction in a typically 6m deep cutting until it reaches the N51. It crosses the at-grade N51 roundabout, approximately 1,300 m east of the N2/N51 junction in the centre of Slane Village. The route then proceeds northwards, passing east of Ledwidge Cottage, through the townlands of Cashel and Mooretown, before turning north-west to tie in with the existing N2, approximately 500 m north of the entrance to the Grassland Agro plant. The section from the N51 to the northern tie-in to the N2 is a combination of cut and fill.

At-grade roundabouts are proposed at each tie in with the existing N2 and at the interface with the N51.

The Proposed Scheme includes for a realignment of the N51 between the proposed bypass and the edge of the village. The purpose of the realignment is to provide consistency of cross-section, easing of existing bends, extension of the existing footway and to provide public lighting. The design of the N51 takes cognisance of TII Standard DN-GEO-03084 - The Treatment of Transition Zones to Towns and Villages on National Roads and DN-GEO-03030 - Design Phase Procedure for Road Safety Improvement Schemes, Urban Renewal Schemes and Local Improvement Schemes.

This section of road is in the rural fringe of the village. The design includes measures which emphasise the change from standard (higher speed) rural road to rural fringe and gateway treatment on the approach to the urban development in Slane village.

The improvements to the N51 between Slane village and the proposed bypass include the following:

- Realigning the N51 route west of the N2 Bypass over approximately 820 m adopting a design speed of 60 km/h to improve the standard of the horizontal alignment. This will improve some localised sharp bends, improving visibility along the route. A carriageway cross-section comprising two 3.25 m lanes is provided. A grass verge of approximately 2.0 m width is proposed on the northern side of the route and an approximately 2.0 m wide pedestrian footway is provided on the south side. Road lighting is extended along the N51 route to the N2 bypass.
- On the east side of the bypass, the N51 is realigned for approximately 600 m to remove a significantly sub-standard section of the existing route, which has horizontal alignment and visibility deficiencies.
- The proposed traffic management measures and public realm improvements within Slane Village include the following:
  - Removal of traffic signals and left turn slips at the existing junction;
  - Provision of necessary signage and road markings so that the junction becomes a priority junction with the east-west N51 forming the major arms and the northern and southern approaches giving way;
  - Implementation of a HGV ban on the existing N2 on both the north and south sides of the existing N2/N51 junction;
  - Realignment of kerblines to narrow the carriageway widths on approach to the junction and allow widening of the road verge and footway;
  - Provision of verge areas for suitable on-street planting;
  - Provision of raised pedestrian/ cyclist crossing ramps on each arm of the junction with signalised crossings on the N51 arms and zebra crossings on the N2 arms;
  - Enhanced pedestrian/ cyclist accessibility from the centre of Slane to the Existing River Boyne bridge and river amenity area;
  - Removal of existing gantries on the southbound approach to the existing Boyne bridge; and
  - New off-street parking area.

With the increasing popularity of recreational cycling generally in Ireland, it is proposed that the bypass will facilitate local cycling loops to and from the village. The route of a local cycling loop could include the existing N2 route through the village and linking with the cycling facilities along the proposed bypass. A further route for a cycling route may be feasible using the proposed link to the existing canal

towpath and linking back to the existing N2. The cycling strategy for the scheme is outlined in **Section 4.4.4** below. **Section 4.4.13** describes the provisions to be incorporated in the Proposed Scheme to improve facilities for cycling within Slane village.

The concept of walking loops between the village and the bypass offers an opportunity to enhance the amenity value of the project to the local community and visitors to Slane. This concept is considered in the Proposed Scheme design and is described further in **Section 4.4.3** below. The Proposed Scheme includes for the provision of enhanced footway access along the existing N51 between the village and the bypass. Taking this into consideration, the provision of shared use cycle/ pedestrian facilities along the proposed bypass, linking to the existing canal towpath, presents the opportunity for an appealing pedestrian route. **Section 4.4.13** describes the provisions to be incorporated in the Proposed Scheme to improve facilities for walking within Slane village.

4.3 Design Standards

The Proposed Scheme has been designed, in accordance with the following standards:

Transport Infrastructure Ireland (TII) Publications:

The Proposed Scheme is designed to comply with TII design standards for National Roads. Relevant standards include:

- DN-GEO-03031. Road Link Design;
- DN-GEO-03036. Cross-Sections and Headroom;
- DN-GEO-03030 Design Phase Procedure for Road Safety Improvement Schemes, Urban Renewal Schemes and Local Improvement Schemes Design;
- DN-GEO-03084 The Treatment of Transition Zones to Towns and Villages on National Roads;
- DN-GEO-03044 The Geometric Layout of Signal-Controlled Junctions and Signalised Roundabouts;
- DN-GEO-03060 Geometric Design of Junctions (priority junctions, direct accesses, roundabouts, grade separated and compact grade separated junctions);
- DN-DNG-03061 Design of Outlets for Surface Water Channels (including Amendment No. 1 dated June 2015);
- DN-DNG-03062 Edge of Pavement Details (including Amendment No. 1 dated June 2015);
- DN-DNG-03063 Vegetated Drainage Systems for Road Runoff (including Amendment No. 1 dated June 2015);
- DN-DNG-03064 Drainage of Runoff from Natural Catchments (including Amendment No. 1 dated June 2015);
- DN-DNG-03065 Road Drainage and the Water Environment (including Amendment No. 1 dated June 2015);
- DN-DNG-03066 Design of Earthworks Drainage, Network Drainage, Attenuation & Pollution Control;
- DN-DNG-03071 Design of Outfall and Culvert Details (including Amendment No. 1 dated June 2015;
- DN-DNG-03073 Grassed Surface Water Channels for Road Runoff (including Amendment No. 1 dated June 2015);
- DN-ERW-03083 Managing Geotechnical Risk;
- DN-PAV-03021 Pavement & Foundation Design;
- DN-PAV-03026 Footway Design;
- DN-REQ-03034 The Design of Road Restraint Systems (Vehicle and Pedestrian) for Roads and Bridges;
- DN-STR-03001 Technical Acceptance of Road Structures on Motorways and Other National Roads;

- DN-STR-03002 Weathering Steel for Highway Structures;
- DN-STR-03004 Bridge Bearings. Use of BS 5400: Part 9: 1983;
- DN-STR-03005 Design Criteria for Footbridges; and
- DN-STR-03006 Expansion Joints for Use in Highway Bridge Decks.

Department of Transport:

- Traffic Signs Manual, 2019;
- Design Manual for Urban Roads and Streets (DMURS), 2019; and
- DMURS Advice Note 1 – Transition Zones and Gateways.

4.4 Proposed Scheme Description

This section is supported by **Volume 3 – Technical Drawings**, with specific drawing series referred to throughout the section to illustrate key features described below.

4.4.1 Mainline

Figure 4.2 above illustrates the alignment of the N2 Slane Bypass. The speed limit of the existing N2 in the vicinity of the proposed bypass is 100 km/h. While design speed is not directly related to the mandatory speed limit, in order to maintain consistency between the various sections of the N2, a design speed of 100 km/h has been adopted for the Proposed Scheme.

The recommendations of an assessment on the proposed bypass concluded that there is economic and safety benefit justification for a Type 2 Dual Carriageway cross section to be used for the mainline of N2 Slane Bypass. Refer to **Section 3.3.6** of **Chapter 3**.

The results of traffic modelling for the design year of 2041, indicates that the Average Annual Daily Traffic (AADT) flow forecast along the proposed bypass route is 13,610 vehicles per day on the southern section from the southern tie-in to the N2 to the proposed N51 junction which includes the new bridge over the River Boyne, and 11,800 AADT on the northern section from the N51 junction to the N2 northern tie-in. Table 6.1 of TII DN-GEO-03031 indicates that a Type 2 Dual Carriageway has the capacity to provide a level of service D for an AADT of 20,000.

The Type 2 Dual Carriageway cross section consists of two 3.5 m carriageway lanes in both directions with 0.5 m wide hard strips and divided by an approximately 1.5 m wide central reserve. Alongside the southbound carriageway, it is proposed to provide an approximately 3m wide grassed verge. Alongside the northbound carriageway, it is proposed to provide a verge with a total width of approximately 5.5 m (not including hard strip), which includes:

- A 2.0 m wide shared cycle / pedestrian facility (one step below desirable minimum width for low volume shared use two-way cycle facility with pedestrians as per Table 4.5 of DN-GEO-03036). This standard is considered appropriate for low volume facilities, which are those considered to attract less than 1500 users a day. Volumes of users in excess of 1500 per day are not expected on the bypass.
- An approximately 2.5 m wide grassed verge between shared cycle / pedestrian facility which, in addition to 0.5 m wide hard strip, provides a total separation distance of approximately 3.0 m between shared facility and edge of running carriageway (one step below desirable minimum separation distance for Type 2 and Type 3 Dual Carriageways as per Table 4.5 of DN-GEO-03036).
- An approximately 1 m wide grassed verge between back of shared cycle/ pedestrian facility and adjacent earthworks.

Volume 3 – Technical Drawing MDT0806-RPS-01-N2-DR-C-CS1001 (Mainline Cross-Section - Ch.480 & 490) illustrates the proposed cross-section of the mainline.

The horizontal alignment of the bypass comprises a curvilinear combination of curves, transitions and straights, all in compliance with the adopted design speed of 100 km/h. Horizontal curve radii range from 650 m to 2,040 m.

The vertical alignment of the bypass takes account of the need for the bypass to be sympathetic to the landscape and visual sensitivity of the area, which is noted for its protected views, e.g. from the Hill of

Slane and also views from the UNESCO World Heritage Property of Brú na Bóinne and the view from the monument at Knowth in particular. Therefore, the alignment has been designed to be generally in cutting and with a profile which minimises its elevation across the River Boyne valley. This is achieved through a series of crest and sag curves between straight gradients, including up to 6% gradient on both approaches to the Boyne valley. Gradients of 6% for a Type 2 dual carriageway require a departure from TII standards (maximum permitted gradient is 5% without a departure), which has been sought and granted.

This section is supported by **Volume 3 – Technical Drawings MDT0806-RPS-01-N2-DR-C-GA0000 –GA0003** (General Arrangement) and **MDT0806-RPS-01-N2-DR-C-GE1000 – GE1005** (Geometrics – Mainline).

4.4.2 Cycling Strategy

Traffic counts undertaken for the proposed project show that there is currently very little demand for cycling on the N2 corridor. The existing N2 route is heavily trafficked, containing a significant proportion of HGVs, making the environment hostile for both cyclists and pedestrians.

Similarly, cycling within Slane village is not common, likely to be due to the extremely poor quality of service provided in the existing infrastructure and high traffic volumes. Limited pedestrian movements do take place within the village but demand for walking is not considered to be very high at present.

However, in the future year scenario, with the proposed bypass and public realm improvements in place, it is anticipated that local demand for both walking and cycling will increase with the reduction in traffic and improved non-motorised user facilities in Slane village.

Additionally, recreational cycling can be expected to increase in the future. This cohort of cyclists are likely to consider Slane village as a particularly interesting place to visit. North-South recreational cycling will be facilitated by the N2 corridor and the old N2 within the village. The existing N51 is not considered to be a suitable route for cyclists due to its relatively high traffic volumes, including HGVs, its narrow width and poor horizontal alignment. East-West recreational cycling demand will be catered for by the proposed River Boyne Greenway. Increased cycling into Slane village is predicted to occur in the future year scenario.

Taking account of the above, the cycling strategy for the Proposed Scheme considers the following:

- **Long distance cycling along the N2:** The steep gradient along the existing N2 through Slane village is not conducive to cycling. Therefore, the proposed bypass is considered as a more suitable route for long distance cyclists and appropriate cycling facilities are to be provided alongside the Proposed Scheme's mainline. However, the demand for this type of cycle trip is not predicted to be significant, as noted above.
- **Local cycling:** With the increasing popularity of recreational cycling generally in Ireland, provision for local cycling loops incorporating the proposed bypass is also considered. The route of a local cycling loop could include the existing N2 route through the village and linking with the cycling facilities along the proposed bypass. The Proposed Scheme could allow the creation of a further cycling route using the proposed link from the bypass to the existing canal towpath/ potential future greenway and linking back to the existing N2.
- **Proposed River Boyne Greenway:** Meath County Council are advancing a greenway project along the River Boyne from Navan to Drogheda. Should this project receive planning, it is expected that this greenway may incorporate the existing towpath alongside the canal to the south of the River Boyne. The Proposed Scheme includes for a link to be provided from the bypass cycling facility to the canal towpath, which requires a crossing of the existing canal. This would enhance Slane as a cycling destination.

Accounting for the considerations discussed above, **Figure 4.4** illustrates the proposed cycle strategy to be adopted for the Proposed Scheme.

Further provisions for cycling within Slane village are included in the scope of works described in **Section 4.4.13** below.

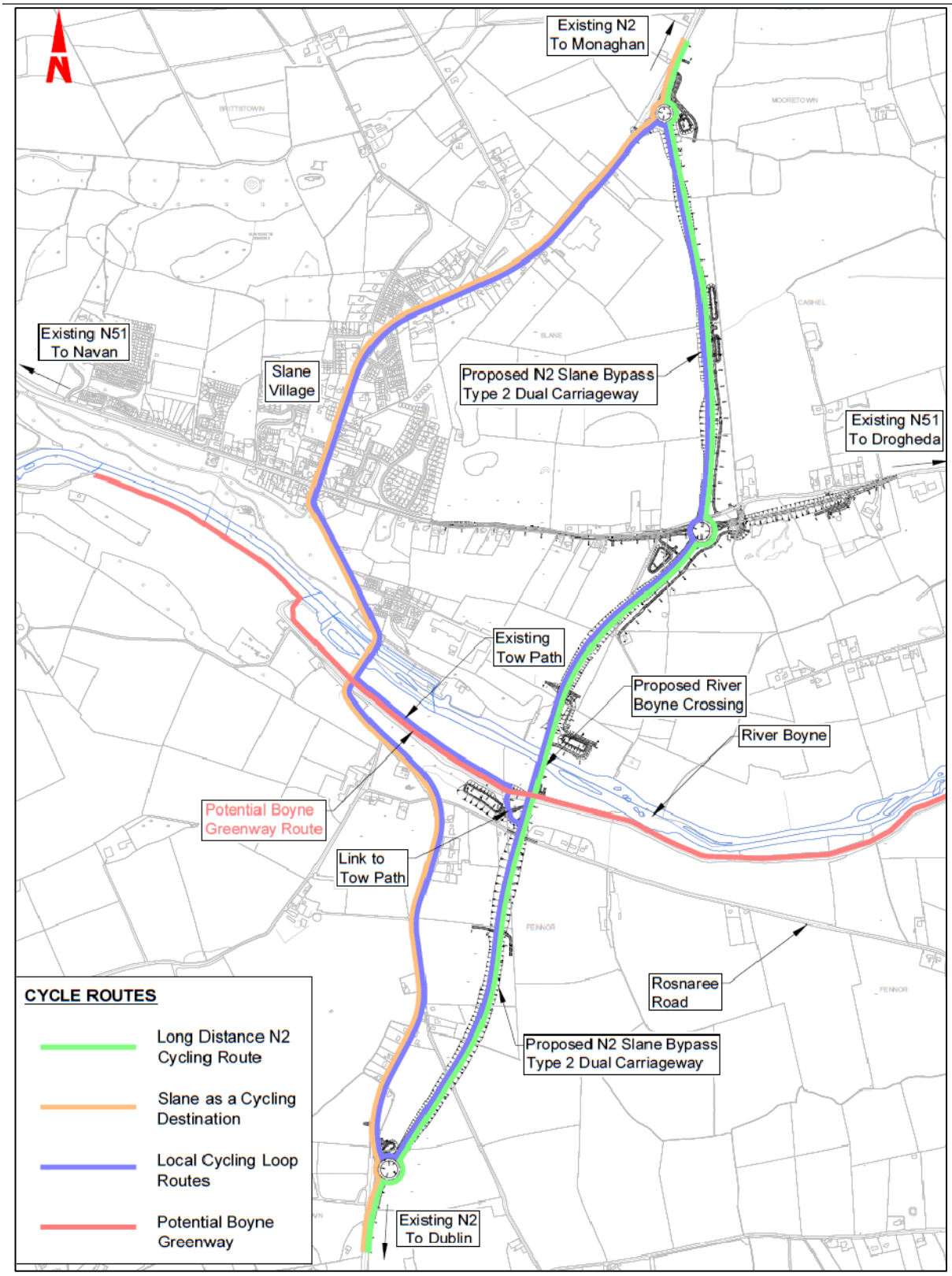


Figure 4.4: N2 Slane Bypass Cycle Strategy

4.4.3 Pedestrian Strategy

Recreational walking is growing in popularity and the provision of walking loops, particularly to areas of scenic or other amenity value, has been considered. In this regard, the scenic nature of the countryside around the River Boyne and environs is particularly relevant. The concept of walking loops from the village, using the bypass offers an opportunity to enhance the amenity value of the project to the local community and visitors alike. The Proposed Scheme includes for the provision of enhanced

footway access along the existing N51 between the village and the bypass. It is also proposed to provide a footway from the northern end of the Scheme along the southbound side of the existing N2 extending as far as the entrance to Grassland Agro where the existing footway terminates. The provision of these footways, along with shared use cycle / pedestrian facilities along the proposed bypass and link to the existing canal towpath, presents the opportunity for appealing pedestrian routes. **Figure 4.5** illustrates the proposed walking strategy to be adopted for the Proposed Scheme.

The Public Realm proposals within Slane village provide for enhanced pedestrian facilities by the reallocation of existing road space to more sustainable modes. This enhances active travel locally within the village and provides better environment for both residents and visitors alike. Further provisions for walking within Slane village are included in the scope of works described in **Section 4.4.13** below.

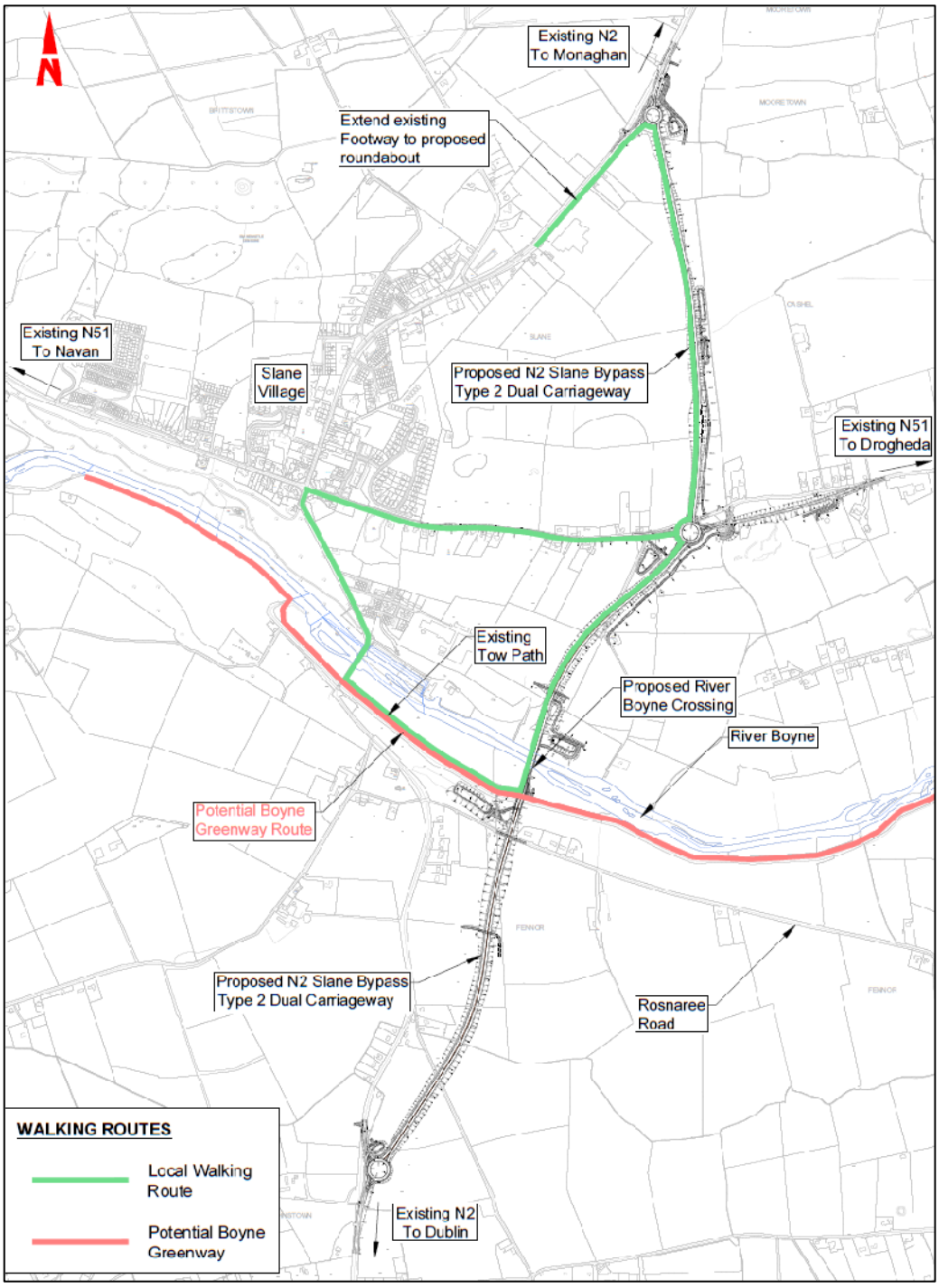


Figure 4.5: N2 Slane Bypass Pedestrian Strategy

4.4.4 Proposed Cycling / Pedestrian Facility along Bypass

In accordance with TII Standard, DN-GEO-03036 Cross Sections and Headroom, cycle/ pedestrian facilities shall be provided as part of all Type 2 dual carriageway national road schemes. Considering the scheme's proposed bridge structure across the River Boyne, a cyclist / pedestrian facility along the maintenance strip is less feasible than a facility located in the proposed verge. Therefore, it is proposed to provide a shared use two-way cycle/ pedestrian facility located in the northbound verge.

Given that the use of this shared cycle/ pedestrian facility is predicted to be low volume, it is considered appropriate to provide a 2.0 m wide shared two-way facility with approximately 3.0 m separation distance to the bypass carriageway. In accordance with TII Standard DN-GEO-03036. low volume pedestrian/cyclist facilities are those considered to attract less than 1500 users a day.

To assess the future demand for cycling and walking along the bypass, the following is considered.:

- It is not anticipated there will be growth in long distance cycling generally along the N2 corridor, which would be expected to use the proposed bypass and not visit the village. The significant demand for pedestrian and cyclist movements along the bypass is predicted to come from both residents and visitors to Slane.
- According to the 2022 census, the population of the Slane Electoral Division is 1,925 persons. The census also notes only 10.1% of the population of Slane currently travel to work, college and school by foot or by bicycle (only 0.3% is by bicycle).
- Taking a conservative approach in terms of future growth, it is assumed the population of Slane will increase by 20% by 2040 and there will be around 2,300 people living in the village in 2040.

As noted above, the key demand for walking and cycling along the bypass will likely come from residents and visitors to the village. The following is a conservative assessment of potential increased future year demand for cycling and walking:

- On any given day, no more than circa 200 residents are predicted to utilise the local cycling and walking loops provided from the village to the proposed bypass.
- A reasonable assumption on the average number of visitors to Slane would be of the order of say, 500 on any given day including visitors using the proposed River Boyne Greenway. Only a proportion of these visitors will also choose to utilise the local walking/cycling loops provided within the scheme. A conservative assumption would be that circa 200 visitors would utilise the proposed facilities on any given day.

Considering the above, it can be concluded that a conservative assessment of walking and cycling demand to utilise the proposed bypass might be of the order of a maximum of 420 trips in a day (allowing for a small cohort of long-distance cycle trips). This assessment of demand is considerably lower than the indicative capacity of the proposed facility of 1,500 users per day.

Lighting of the cycling/pedestrian facility is not proposed. Passively safe reflective vertical features shall be positioned within the grassed verge width between the cycle/ pedestrian facility and the road. **Figure 4.6** illustrates the indicative cross-section for the proposed two-way facility adjacent to the road.

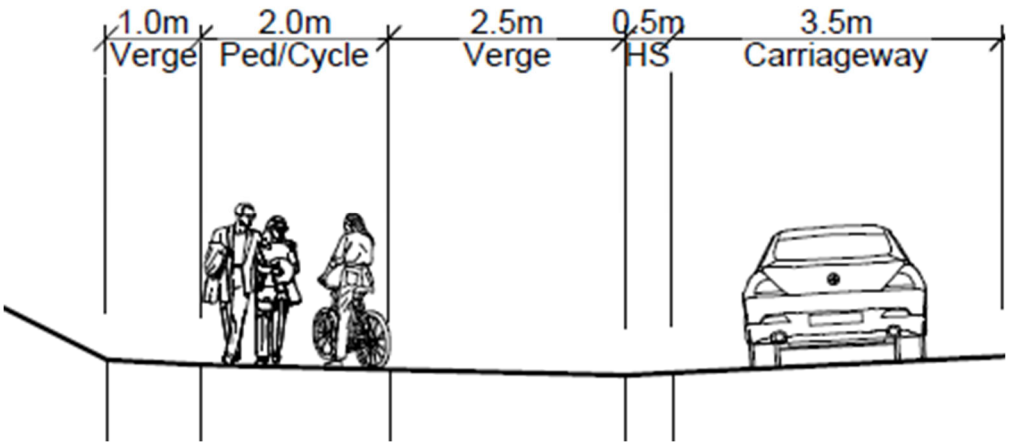


Figure 4.6: Indicative Cross-Section showing Two-Way Cycle / Pedestrian Facility

Crossing facilities for non-Motorised users (NMUs) at the roundabout junctions are designed in accordance with TII Standard DN-GEO-03060 as illustrated in **Figure 4.7** below.

This section is supported by **Volume 3 – Technical Drawings MDT0806-RPS-01-N2-DR-C-GA0000 –GA0003** (General Arrangement).

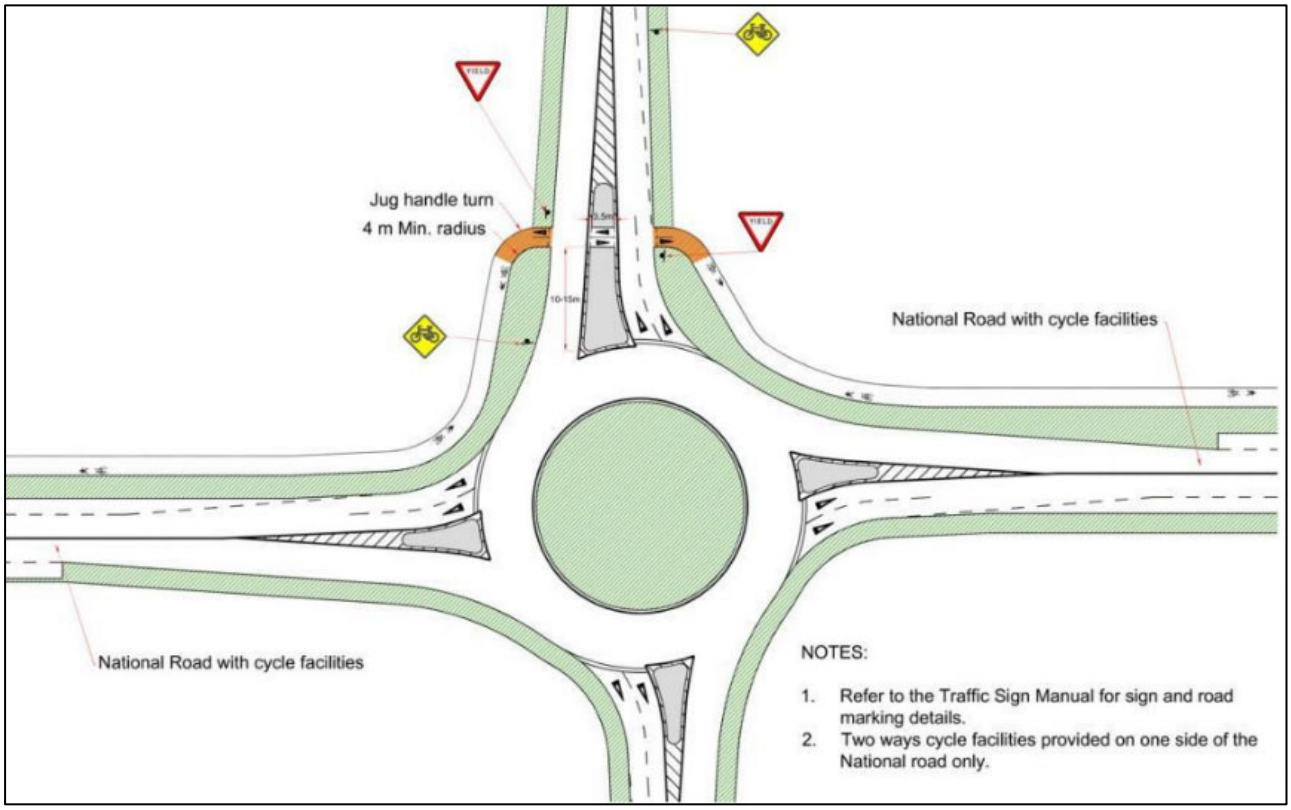


Figure 4.7: Recommended Arrangement for NMU Crossings at Roundabout Junctions

4.4.5 N51 West

With the proposed N2 Slane bypass in place to the east of the village, there is expected to be a significant future year traffic demand on the N51 West from the bypass to the centre of the village. With proposed bans on HGVs imposed on the existing Boyne bridge and on the N2 north of Slane junction, HGVs to / from Navan and the N2 north and south of Slane will also have to use this link. This proposal eliminates HGV right and left turning movements at the junction in Slane and caters for these movements as straight through movements instead. This will provide for the most efficient way for this traffic to negotiate their journeys through the village.

In order to safely cater for the predicted additional traffic on the N51 West from the bypass to the village, it is proposed that a significant upgrade of this link be provided. The proposed upgrades will include for:

- Improvement of the horizontal alignment;
- Standardisation of the road cross-section;
- Road design measures to emphasise the change from standard (higher speed) rural road to rural fringe zone and gateway treatment on the approach to the urban development in Slane village;
- Application of the 60 km/h urban speed limit on this link;
- Provision of footway extension from the village to the bypass; and
- Extension of public lighting from the village as far as the bypass.

This section of the N51 extends for approximately 820 m from the edge of Slane village to the proposed N2 Slane bypass. This section of the N51 is considered to be the rural fringe on the approach to Slane village.

This section is supported by **Volume 3 – Technical Drawings MDT0806-RPS-01-N2-DR-C-GA2201** (General Arrangement – N51 West) and **MDT0806-RPS-01-N2-DR-C-GE2201 – 2202** (Geometrics – Side Roads Plan and Profile – N51).

4.4.5.1 Design Speed

As noted above, it is proposed that the mandatory speed limit along the N51 from the existing 50 km/h zone in Slane to the proposed N2 bypass junction will be 60 km/h. Therefore, a design speed of 60 km/h has been considered in the design of the proposed upgrade of the N51 West.

4.4.5.2 Design Standards

In addition to the usual TII standards relating to geometric design, the design of the N51 West takes particular cognisance of TII Standard DN-GEO-03084 – 'The Treatment of Transition Zones to Towns and Villages on National Roads' and DN-GEO-03030 – 'Design Phase Procedure for Road Safety Improvement Schemes, Urban Renewal Schemes and Local Improvement Schemes'.

As noted above, the link is considered to be the rural fringe on the approach to Slane village. The overarching objective of the design is to present a sense to drivers that this section of road is not a normal rural national road but is a transition towards an urban centre. Roadside treatments such as provision of the footway, public lighting, road markings, signage, landscape treatments and existing roadside development, as well as the mandatory speed limit reinforce the message to drivers to slow down within this zone.

4.4.5.3 Cross Section

To minimise the impact on lands adjacent to the route while allowing for the provision of a suitably wide footpath, it is considered that the most appropriate road cross-section to be provided is a consistent 6.5 m wide carriageway. This is the standard carriageway width quoted in TII Standard DN-GEO-03084 where the proportion of HGVs is above 10%.

It is proposed to provide an approximately 2.0 m wide footpath on the southern side of the proposed route, which is the minimum width recommended in TII Standard DN-GEO-03084 and as per Table 2.3 of DN-PAV-03026. Where feasible, the footway is to be provided at a set-back from the proposed road edge to create a landscaped verge area between the road traffic and pedestrians.

TII DN-GEO-03036 requires that approximately 3 m wide verges are provided. However, due to the significant site constraints, primarily associated with the extent of existing houses and curtilage along the route, it is proposed that this be reduced to 2m minimum on the north side of the road.

This section is supported by **Volume 3 – Technical Drawing MDT0806-RPS-01-N2-DR-C-GA2201** (General Arrangement - N51 West).

4.4.5.4 Horizontal Alignment

The N51 West is proposed to be realigned over approximately 820m adopting a design speed of 60km/h to improve the standard of the horizontal alignment where possible. The key improvements are the removal of tight bends in the alignment on the approach to the Gateway into Slane, on the approach to the cluster of roadside dwellings from Ch 400 to Ch. 550 and straightening of the alignment on approach to the proposed roundabout junction with the N2 Slane bypass.

These improvements generally improve forward visibility along the route, ensuring that road signage, including the proposed Gateway into Slane are clearly visible to drivers at the appropriate distance.

This section is supported by **Volume 3 – Technical Drawings MDT0806-RPS-01-N2-DR-C-GE2201 – 2202** (Side Roads N51 - Plan & Profile).

4.4.5.5 Vertical Alignment

The existing vertical alignment of this section of the N51 is not considered to be deficient in terms of the design standards. To avoid issues with the tie in of the adjacent vehicle accesses to the proposed road realignment and to minimise the volume of earthworks required, it is proposed that the vertical geometry of the proposed route will generally match existing levels.

This section is supported by **Volume 3 – Technical Drawings MDT0806-RPS-01-N2-DR-C-GE2201 – 2202** (Side Roads N51 - Plan & Profile).

4.4.5.6 Visibility at Vehicle Accesses

Vehicle accesses including field accesses located along the route have been checked against the visibility requirements defined in TII DN-GEO-03060 Section 5.6.3 and in DMURS. The visibility checks for each access, have been carried out assuming a setback distance of 2.4 m from the carriageway edge as per Table 5.4 of DN-GEO-03060 (relaxation from standard). The required visibility distance, as per Table 5.5 of DN-GEO-03060, is 90m for a design speed of 60 km/h.

DMURS measures visibility splay to the left slightly differently to the TII standard, in that visibility distance to the left is measured to centreline on non-overtaking sections of road. For 60 km/h design speed, the DMURS minimum standard visibility splay distance is 59m.

The visibility checks indicate that the visibility distances achieved meet the requirements discussed above or the realignment of the N51 improves the existing visibility splays with the exception of two accesses at Ch 428 and 470, respectively on the eastbound side where effectively there is no change to the road edge at the access and the existing visibility splay deficiencies are not improved. The proposed changes to the road alignment and cross-section do not reduce the available visibility distances at theses accesses.

4.4.5.7 Rural Fringe Design

TII Standard DN-GEO-03084 'The Treatment of Transition Zones to Towns and Villages on National Roads' supplements the information provided in the Department of Transport, Tourism and Sport (DTTAS) Design Manual for Urban Roads and Streets (DMURS) and provides additional guidance for the treatment of the Rural Fringe and Transition Zones on National Roads entering towns and villages. Successful treatments of roads leading to/from urban zones will balance the functional needs of different road users and manage speed in a manner that does not rely extensively on lining and signing but more so on place based psychological measures.

This section of the N51 between the proposed Slane bypass and the village is considered to be a combination of rural fringe and transition zone on the approach to the urban village of Slane. The proposed scheme includes the following design elements within the design of the N51 between the bypass and Slane village to reduce speed:

- Prohibition of overtaking within the rural fringe, using more formal landscaping, signs, continuous centre line road markings leading to the Gateway treatment;
- Extension of urban 60 km/h speed limit from the village to the bypass;
- Elimination of the hard strip;
- Narrowing of the carriageway;
- Use of signs including Driver Speed Feedback signs and landscaping with a vertical emphasis;
- Retention of existing tourist signage;
- Use of appropriate soft landscape elements such as small girth trees or shrubs which change in composition and degree of formality along the rural fringe to the Gateway/Transition Zone;
- Provide roadside mown verges, particularly as the Gateway is approached;
- Provision of pedestrian facilities; and
- Provision of road lighting, designed in accordance with DN-LHT-03038 Design of Road Lighting for the National Road Network.

This section is supported by **Volume 3 – Technical Drawing MDT0806-RPS-01-N2-DR-C-GA2201** (General Arrangement - N51 West).

4.4.5.8 Proposed Transition Zone/Rural Fringe Landscape Design

Studies have demonstrated that the presence of trees and planting areas can aid traffic calming in a number of ways. Trees can help road users to recognise the spatial geometry of carriageway edges.

Tree-lined streets also create a 'parallax effect' which helps motorists to better gauge their speed. It has been observed that trees, when located to both sides of the street, create a sense of enclosure that also discourages drivers from speeding.

Transition zone/rural fringe will be treated according to the landscape character of the area. The following are incorporated into the proposed design of the N51 West:

- Existing landscape features are retained insofar as possible;
- Native plant hedgerows are proposed along the edges of the verges in combination with existing hedgerows, where these are retained;
- Linear trees are proposed in the landscape areas between the roadside and the proposed footway where feasible on the south side of the road;
- Linear trees are also proposed on the northside of the road; and
- It is envisaged tree density will increase as the Gateway to Slane is approached.

This section is supported by **Volume 3 – Technical Drawing MDT0806-RPS-01-N2-DR-C-GA2201** (General Arrangement - N51 West).

4.4.5.9 Gateway

The gateway defines the change in the character of the surrounding area from rural to urban. The design proposes to enhance the existing gateway feature at the location of the existing 50 km/h speed limit towards Slane. The proposed realignment of the N51 will enhance visibility to the gateway feature. The gateway will be designed in accordance with the guidance provided in TII's DN-GEO-03084. A gateway with a central island, similar to the design as illustrated in TII Standard Construction Detail, CC-SCD-05005-01, 'Gateway: Type B Design' is envisaged. This is illustrated in **Figure 4.8** below.

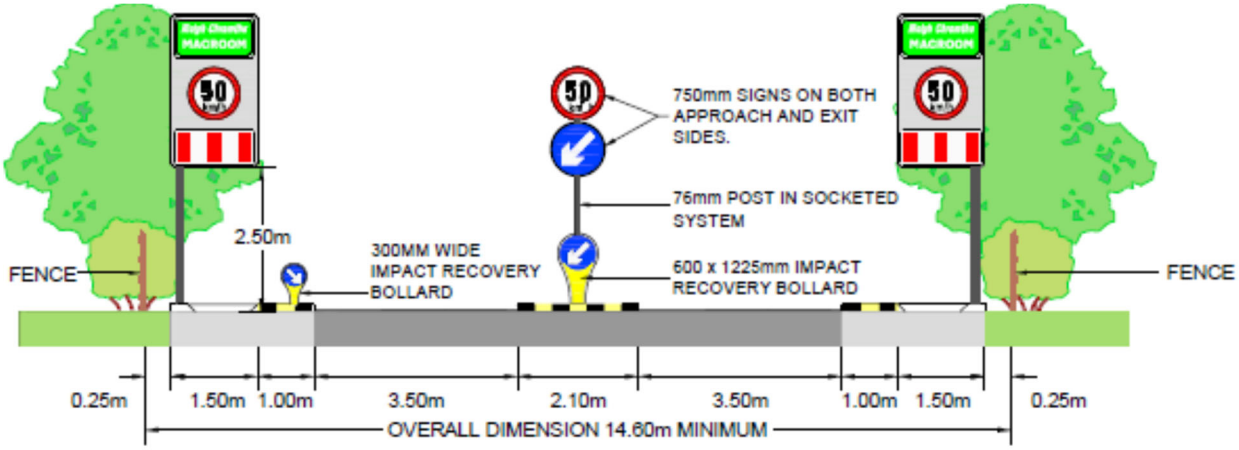


Figure 4.8: Illustration of Type B Gateway

4.4.6 Junctions

As an overarching principle TII supports a junction strategy which seeks to prevent a proliferation of side road junctions along national roads with speed limits of greater than 60 km/h. The application of this strategy will maintain the capacity, efficiency and safety of the national road network.

Notwithstanding the broad policy, there is need for new national roads to be accessible and their interface with the existing road network must be considered in the development of a scheme. The junction selection for this Proposed Scheme is based on the Transport Infrastructure Ireland (TII) design standard DN-GEO-03060. The objectives of the proposed junction strategy are:

- To provide road connectivity and access to Slane village to the required standard;
- To enhance the economic benefits and ensure the safety of the Proposed Scheme by providing access where there is sufficient traffic demand to warrant it;
- To ensure safety by applying modern design standards (particularly with regard to consistency, visibility and gradients);

- To improve safety by adopting where possible 'self-explaining', consistent and predictable junction layouts that are readily comprehensible to road users unfamiliar with the area; and
- To reduce environmental impact, including community severance where viable.

The junction strategy for the proposed N2 Slane Bypass considers the following:

a. Designation as a national road;

b. Existing junctions and accessibility;

c. Minimise proliferation of junctions;

d. Design standards;

e. Location of population and employment centres; and

f. Pedestrian and Cyclist Strategy.

Three roundabout junctions are proposed as part of this Proposed Scheme. These roundabout junctions are summarised in **Table 4-1** below. This section is supported by **Volume 3 – Technical Drawings MDT0806-RPS-01-N2-DR-C-GE2101** (Side Roads South Roundabout - Plan & Profile), **GE2203** (Side Roads N51 - Plan & Profile) and **GE2301** (Side Roads North Roundabout - Plan & Profile).

Table 4-1: Summary of Roundabout Junctions

Junction Reference	Drawing	Mainline Chainage	AADT (2041 Design Year)		Inscribed Circle Diameter Approx. (m)	Circulatory Carriageway Width Approx. (m)
			Link	Flow		
South Roundabout	GE2101	Ch. 0	N2 South	14,430	72.0	9.0
			Existing N2 North	820		
			N2 Bypass	13,610		
N51 Roundabout	GE2203	Ch. 2220	N51 West	9,610	70.0	9.5
			N51 East	8,240		
			N2 Bypass (South)	13,610		
			N2 Bypass (North)	11,800		
North Roundabout	GE2301	Ch. 3495	Existing N2 South	3,400	60.0	9.0
			N2 North	11,830		
			N2 Bypass	11,800		

4.4.7 Side Roads

The proposed N2 Slane Bypass interfaces with existing roads as follows:

- Tie-in to N2 South: Roundabout junction at Ch. 0;
- L16002 Rosnaree Road: bypass crosses under the L16002 at Ch.1100;
- N51 Slane to Drogheda: Roundabout Junction at Ch. 2220; and
- Tie-in to N2 North: Roundabout Junction at Ch. 3495.

The side road links included in the Proposed Scheme are summarised as:

- Local tie-in links associated with the N2 South Roundabout;
- Realignment of the Rosnaree Road over the proposed bypass;
- N51 West as described above and N51 East realignments at the N51 roundabout; and
- Local tie-in links associated with the N2 North Roundabout.

The alignment of each side road link is summarised in **Table 4-2** below. This section is supported by **Volume 3 – Technical Drawings MDT0806-RPS-01-N2-DR-C-GE2000 – GE2401** (Side Roads - Plan & Profile).

Table 4-2: Horizontal Alignment of Side Roads

Side Road Reference	Start Chainage	End Chainage	Length Approx. (m)	Alignment Type	Radius Approx. (m)
South Roundabout – Existing N2 South Link	0.0	3.5	3.5	Straight	–
	3.5	117.5	114	Transition	–
	117.5	240.5	123	Right Hand Curve	510
South Roundabout – Existing N2 North Link	0.0	133.2	133.2	Right Hand Curve	255
N51 West	*Refer to Section 4.4.5 above*				
N51 East	0.0	54.2	54.2	Right Hand Curve	720
	54.2	115.1	60.9	Transition	–
	115.1	500.8	385.7	Left Hand Curve	2040
	500.8	555.6	54.8	Transition	–
	555.6	598.7	43.1	Right Hand Curve	800
North Roundabout – Existing N2 South Link	0.0	68.0	68.0	Right hand Curve	360
	68	110.8	42.8	Transition	–
	110.8	143	32.2	Straight	–
North Roundabout – Existing N2 North Link	0.0	194.3	194.3	Right Hand Curve	650
	194.3	16.6	210.9	Transition	–
L16002 Rosnaree Road	0.0	5.6	5.6	Transition	–
	5.6	89.2	83.6	Left Hand Curve	851.02
	89.2	99.9	10.7	Straight	–

4.4.8 Pavements

The preliminary pavement design is based on a 40 year design life. Design traffic loading was estimated, as per TII PE-SMG-02002 Traffic Assessment, for the following routes:

- N2 Mainline;
- N51 West; and
- N51 East.

Traffic flow data for the opening year (2026) was obtained from the latest traffic model for the Proposed Scheme. Growth factors for design traffic estimation were obtained from TII PE-PAG-02017 Project Appraisal Guidelines for National Roads Unit 5.3 – Travel Demand Projections. **Table 4-3** below summarises design traffic loading for each route.

Table 4-3: Design Traffic Loading

Route	Opening Year Traffic Flows				% of Traffic in Heaviest Loaded Lane	Design Traffic (msa)
	AADT	% HGV	PSV + OGV1 AADF	OGV2 AADT		
N2 Mainline	11,680	16.9	296	691	96%	63.5
N51 West	6,650	17.1	171	398	100%	36.6
N51 East	6,550	7.1	70	163	100%	15.0

For the purposes of the preliminary pavement design, it has been assumed that the Proposed Scheme will utilise fully flexible pavement construction. It has been assumed that pavement layers will consist of:

- Base and binder layer constructed with asphalt concrete utilising 40/60 pen bitumen; and
- Surface course constructed with stone mastic asphalt (SMA).[2]

Required thickness of fully flexible pavement was determined for design traffic load as per TII DN-PAV-03021 Pavement and Foundation Design. Suitable pavement options were selected from TII CC-SPW-00900 Specification for Road Works Series 900 - Road Pavements - Bituminous Materials.

The following sections summarise the preliminary pavement design proposals for each route. It should be noted that the preliminary pavement design is indicative only and may be subject to change at detailed design stage.

4.4.8.1 N2 (Mainline)

Table 4-4 below describes a suitable pavement construction for the N2 Mainline which provides the required thickness of combined asphalt layers.

Table 4-4: Suitable Pavement Construction – N2 Mainline

Pavement Layer	Clause	Material	Thickness Approx. (mm)	Notes
Surface Course	5.1.1	Stone Mastic Asphalt SMA 10 surf PMB 65/105-60 des	40	–
Binder Course	3.1.4	Asphalt Concrete AC 20 dense bin 40/60 des	60	–
Base Course	3.1.1	Asphalt Concrete AC 32 dense bin 40/60 des	240	Laid in two layers (each 120mm thick)
Total Pavement Thickness (excluding Sub-base)			**340**	

4.4.8.2 N51 West

Table 4-5 below describes a suitable pavement construction for the N51 West which provides the required thickness of combined asphalt layers.

Table 4-5: Suitable Pavement Construction – N51 West

Pavement Layer	Clause	Material	Thickness Approx. (mm)	Notes
Surface Course	5.1.1	Stone Mastic Asphalt SMA 10 surf PMB 65/105-60 des	40	–
Binder Course	3.1.4	Asphalt Concrete AC 20 dense bin 40/60 des	60	–
Base Course	3.1.1	Asphalt Concrete AC 32 dense bin 40/60 des	210	Laid in two layers (each 105mm thick)
Total Pavement Thickness (excluding Sub-base)			**310**	

[2] Note: SMA has been proposed for the surface course as it generates less tyre/road interface noise compared to hot rolled asphalt (HRA) surfacing.

4.4.8.3 N51 East

Table 4-6 below describes a suitable pavement construction for the N51 East which provides the required thickness of combined asphalt layers.

Table 4-6: Suitable Pavement Construction – N51 East

Pavement Layer	Clause	Material	Thickness Approx. (mm)	Notes
Surface Course	5.1.1	Stone Mastic Asphalt SMA 10 surf PMB 65/105-60 des	40	
Binder Course	3.1.4	Asphalt Concrete AC 20 dense bin 40/60 des	60	
Base Course	3.1.1	Asphalt Concrete AC 32 dense bin 40/60 des	170	Laid in two layers (each 85mm thick)
Total Pavement Thickness (excluding Sub-base)			**270**	

4.4.8.4 Side Roads

The preliminary pavement design for the Proposed Scheme's side roads can be summarised as follows:

- **South Roundabout – Existing N2 South Link:** a pavement thickness of approximately 330 mm.
- **South Roundabout – Existing N2 North Link:** a pavement thickness of approximately 200mm.
- **Rosnaree Road:** Assumed that design traffic loading will be less than 1 msa, requiring a pavement thickness of approximately 200mm.
- **North Roundabout – Existing N2 South Link:** a pavement thickness of approximately 220 mm.
- **North Roundabout – Existing N2 North Link:** a pavement thickness of approximately 320 mm.

4.4.9 River Boyne Bridge Crossing

4.4.9.1 Site location

This section is supported by **Volume 3 – Technical Drawings MDT0806-RPS-ST01-N2-DR-D-BR0210-01 – BR0210-03** (Plan Layouts, Long Sections and Cross-Sections).

The site of the proposed River Boyne bridge is on the eastern side of Slane village, Co. Meath at the location where the proposed N2 Slane Bypass crosses the River Boyne; see **Figure 4.9**. The proposed bridge is approximately 630 m to the east of the existing Slane Bridge. The detailed construction strategy for the Proposed Scheme, including the proposed River Boyne bridge crossing, is set out in **Chapter 5 – Description of the Construction Phase**.

Figure 4.9: Site location for the Proposed River Boyne Crossing

4.4.9.2 Function of the Structure and Obstacles Crossed

The primary function of the River Boyne Crossing bridge is to carry the proposed N2 Slane Bypass over the River Boyne. The River Boyne provides a significant physical constraint due to the width of the watercourse. At the proposed location of the crossing the river channel is approximately 50 m wide and the flood channel is approximately 120 m wide. Setback exclusion zones of minimum 10 m width are also required from the top of both the northern and southern banks of the river to avoid hydraulic effects on river flows, as well as any disturbance to the bed of this important fisheries habitat. The minimum 10 m setbacks ensure that construction works for the piers and foundations will have no adverse impact on the river, including the risk of pollution from construction materials.

On the southern side of the river, the proposed bridge will span over the Boyne Canal and towpath which forms part of the Boyne Navigation. The Inland Waterways Association of Ireland (IWAI) – Boyne Navigation Branch have as a primary objective the restoration of the canal. A minimum vertical clearance for canal navigation is generally required to be a minimum of 3.6 m, a minimum vertical clearance of 5.1 m to the canal towpath is also required for maintenance of the canal.

4.4.9.3 Cross Sectional Dimensions

The River Boyne Crossing bridge has the cross-sectional dimensions as per **Table 4-7**.

Table 4-7: Proposed N2 Cross-sectional Dimensions at River Boyne Crossing

Overbridge Cross Section	Width Approx. (m)
Parapet Upstand	0.500
Hard Strip	0.500
Cycleway/Footway	2.500 (comprising 2.0m pedestrian/cyclist facility plus 0.5m clearance from the bridge parapet)
Safety Barrier Upstand	0.450
Hard Strip	1.100
Carriageway	7.000
Central Reserve	1.500
Carriageway	7.000
Hard Strip	0.500
Raised Verge	2.000
Parapet Upstand	0.500
Total Bridge Width (minimum)	**23.550**

4.4.9.4 Hydrology Summary

The proposed bridge will introduce a negligible hydraulic constraint into the River Boyne channel as it achieves significant clearance of approximately 12 m to the river with no footprint within the river channel while also maintaining the additional 10 m setback to the river channel on both banks. The bridge will require the northern end of the Boyne Valley to be filled in over a distance of approximately 15m, the increase in flooding risk due to this fill is negligible.

The lowest soffit level proposed for the bridge is approximately 18.7 mAOD and is approximately 3.75 m above the predicted 0.1% AEP predicted flood level. It is also approximately 2.2 m above the predicted 0.1% AEP predicted flood level for the high-end climate change scenario. OPW recommends a minimum 300 mm freeboard above the 100 year (1% AEP) level to the soffit of any new structure. Hence the proposed bridge has more than adequate freeboard and will not contribute to surcharging during extreme flood events.

4.4.9.5 General description of recommended structure

The proposed new structure comprises a four-span steel plate girder bridge made composite with a reinforced concrete deck slab. The span arrangements are approximately 53 m, 75 m, 77 m and 53 m and give a total bridge length of approximately 258 m. The depth of the steel plate girders varies from 4 m at the intermediate supports to 2.15 m at mid span and the abutments. The substructure consists of cast in-situ reinforced concrete bearing shelves and columns supported by bored pile capped foundations at the piers. The abutments consist of cast in-situ reinforced concrete walls supported by bored pile foundations.

The particular constraints of the site, the River Boyne, Boyne Navigation channel and towpath, SAC/SPA designation of the site and the sensitivity of the area to visual intrusion, together with structural and aesthetic considerations have determined the optimal form for the bridge structure. The result is a structure with well-balanced structural form in terms of span/depth proportions, minimal footprint within the SAC/SPA and at an elevation which minimises adverse impact on the landscape and visual intrusion.

4.4.9.6 Aesthetic considerations

Several different structural forms for the bridge crossing were considered in the development of the proposed bridge as described in Chapter 3 Alternatives Considered, taking account of project constraints including the very sensitive environment in the vicinity of Slane, the River Boyne valley and the Brú na Bóinne UNESCO World Heritage Property.

The proposed bridge structure has an uncomplicated slender form and is visually pleasing due to the relatively symmetric arrangement of its spans and span to depth ratios. Structural efficiency is also achieved due to the ratio of side spans to main span achieving a value of approximately 0.69 and 0.71 for the north and south segments of the structure respectively. The varying depth girders have a curved bottom flange which form an appealing arched elevation on both the main spans and side spans. The varying depth also allows the depth of the beams to be reduced at midspan to 2.15m which contributes to the open aspect nature of the structure.

Transverse deck cantilevers will overhang and shadow the main structural members, disguising the structural depth of the bridge, giving a slimmer, less intrusive appearance. The plate girders fabricated from weathering steel provide a rustic appearance and contribute additionally to the architectural value of the structure by having the load carrying members fully on display. Weathering steel initially starts out with a grey colour; the surface progressively oxidises over time on exposure to weather conditions which takes about six months, after which the steel takes on a stable patina with rust-like appearance. This darkens further over time, turning to a darkened brown shade at about ten years post-production. Use of weathering steel eliminates the need to repaint the bridge structure as part of maintenance requirements and is more sympathetic to the surrounding landscape.

With regards to the visual impact on the local landscape the new bridge will be visible from Slane Bridge, Mill House, Rossnaree Road as well as from the canal towpath and fields local to the bridge. A visualisation model and photomontages have indicated that only a small portion of the southern part of the proposed bridge will be visible from Knowth

4.4.9.7 Proposals for recommended structure or family of structures

4.4.9.7.1 Proposed Category

The bridge is a Category 3 structure as per DN-STR-03001.

4.4.9.7.2 Span Arrangements

The steel plate girder bridge is a four-span structure with the span arrangement of approximately 53 m, 75 m, 77 m and 53 m. The total length of the structure is approximately 258 m. **Figure 4.10** illustrates the proposed span arrangement of the River Boyne bridge. Refer also to the detailed drawing in **Volume 3**, **Technical Drawing MDT0806-RPS-ST01-N2-DR-D-BR0210-01** (Plan Layouts and Long Section).

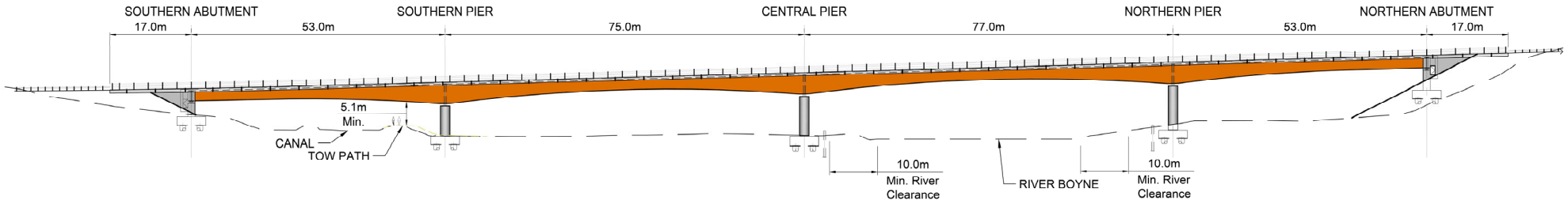


Figure 4.10: Proposed Span Arrangement of the River Boyne Bridge

4.4.9.7.3 Minimum Headroom Provided

There are requirements for minimum vertical clearance for the bridge structure. On the southern side of the river, the proposed bridge will span over the Boyne Canal and towpath which forms part of the Boyne Navigation. The Inland Waterways Association of Ireland (IWAI) – Boyne Navigation Branch have as a primary objective the restoration of the navigation from Drogheda to Navan. A minimum vertical clearance for canal navigation is generally required to be a minimum of 3.6 m, a minimum vertical clearance of 5.1 m to the canal towpath is also required for maintenance of the canal. The proposed structure will provide for 5.1m clearance over the tow-path and a clearance well in excess of the minimum required for canal navigation.

Navigable clearance over the river Boyne is easily achieved due to the proposed vertical alignment.

4.4.9.7.4 Foundation Type

The structure will have reinforced concrete bored pile foundations. Each pier and abutment reinforced concrete pile cap will be founded on two rows of approximately 1.2 m diameter bored piles, with 14 piles required for each abutment. The depth of the pile toe level will vary for each abutment and pier. The governing design criteria for the pile being that a 3 m rock socket is formed in suitably identified rock.

This form of foundation is not sensitive to underlying ground conditions above bedrock. Bedrock profiles and levels have been confirmed by the geophysical investigation. The choice of pier and abutment locations avoids known faults in the rock formation.

4.4.9.7.5 Substructure

The three intermediate piers consist of cast in-situ reinforced concrete bearing shelf crosshead beams on three reinforced concrete columns, each approximately 1.5 m diameter. The bridge abutments will take the form of reinforced concrete bankseats consisting of reinforced concrete walls and inspection galleries. The substructure at the piers and abutments will be supported by the bored pile foundations.

Hydraulic modelling for the river in the bridge crossing reach included estimation of out-of-bank flow velocities, and a bridge scour assessment was completed in accordance with DMRB BD97/12 (Highways Agency, 2012). Each of the piers were subject to scour assessment using conservative values for input parameters (i.e. 1 in 1,000 year event, 50 mm diameter bed material). The result of the assessments gave the bridge a risk rating of 5 which is the lowest risk rating; no action is required other than routine inspections in accordance with DMRB CS 450 *[formerly BD63]* (Highways England, 2021).

4.4.9.7.6 Superstructure

The superstructure comprises steel plate girders made composite with a reinforced concrete deck slab. The girder depth varies from 4 m at the intermediate supports to 2.15 m at midspan and the abutments. The steel plate girders are braced together at the abutments and piers using a combination of cross and horizontal bracing. Intermediate cross bracing is provided at discrete locations along the structure between paired girders. Plan cross bracing is provided to the bottom flanges of the plate girders to improve the overall torsional stiffness of the bridge.

4.4.9.7.7 Articulation Arrangements, Joints and Bearings

Bridge bearings and movement joints will be required at each of the supports. Each support will have 6 bearings giving a total of 30 bearings overall. The bearings at the central pier are fixed pot bearings and will allow horizontal forces to be transmitted along any direction to the bridge substructure. The bearings at the intermediate piers consist of guided sliding pot bearings that will allow horizontal forces to be transmitted perpendicular to the line of guidance i.e. the horizontal forces are transmitted transversely to the bridge substructure. The bearings at the abutments consist of guided sliding pot bearings and one free sliding pot bearing. The free sliding pot bearing does not transmit any horizontal forces to the bridge substructure. The movement joints at the position of the abutments will be the Type 6 elastomeric in metal runners. The movement joints at the central and intermediate piers will be the Type 5 reinforced elastomeric.

4.4.9.7.8 Vehicle Restraint System

With reference to **Volume 3 – Technical Drawing MDT0806-RPS-ST01-N2-DR-D-BR0210-02** (Plan Layouts, Long Sections and Cross-Sections), a 1.25 m high H2 steel or aluminium parapet with mesh infill is proposed at the eastern edge of the structure. An approximately 1.4 m high H2 steel or aluminium parapet with mesh infill is proposed on the west side of the structure located between the carriageway and the shared cycleway/footway. An approximately 1.4 m high steel or aluminium guardrail is proposed on the western edge side of the structure. Parapets will extend a minimum of 6 m or one bay beyond the top of the earthworks slope.

H2 safety barriers will transition from the bridge parapets to protect from the hazard posed by end-on impact and will be provided for a minimum of 30 m on approach to, and 30 m on departure from, the parapet ends.

Parapets, safety barriers, transitions and terminals will comply with TII standards.

4.4.9.7.9 Drainage

A combined kerb and drainage unit is proposed at each side of the carriageway to drain surface and subsurface water from the deck which will discharge to the road drainage system. Sufficient falls to the bridge will prevent ponding on the surface and subsurface level of the bridge. A linear drainage channel is proposed on one side of the cycleway to drain surface and subsurface water from the deck which will discharge to the road drainage system.

A drainage layer will be provided to the back of the abutments, water will be collected by an approximately 150 mm diameter perforated pipe located at the base of the abutment stem which will outfall to a soakaway.

4.4.9.7.10 Durability

The design life of the structure shall be 120 years. Bridge deck waterproofing systems will be spray applied and will be capable of being non-destructively tested. The following surfaces will be protected with a bridge deck waterproofing system:

- The deck slab between parapet upstands;
- The parapet upstands to a height of 100 mm minimum above the adjacent deck slab level; and
- The back of the abutment from bridge deck level to a level 200 mm below the construction joint between superstructure and substructure.

All buried concrete surfaces apart from those coated with bridge deck waterproofing will be protected with two coats of epoxy resin waterproofing. All exposed concrete in the bridge superstructure and substructure will be impregnated with a hydrophobic pore liner in accordance with the TII Specification for Road Works.

The steel plate girders will be fabricated from weathering steel meaning a sacrificial thickness for corrosion is included in the cross-section of the steel members. This improves the durability of the structure while keeping whole life maintenance costs to a minimum compared to painted carbon steel which would require full repainting every 25 to 30 years. Corrosion allowances for the weathering steel shall be in accordance with TII DN-STR-03002.

All structural reinforced concrete shall 50% Ground Granulated Blast-furnace Slag (GGBS) cement replacement and have minimum grade in accordance with IS EN 206 and TII DN-STR-03012.

Stainless steel reinforcement Type 1.4301 to IS EN 10088 Ribbed bars Grade 500 to BS 6744:2016 shall be used for all reinforcement within parapet edge beams and below movement joints on bearing shelves and in bearing plinths. All other reinforcement shall be Grade B500B or B500C; Ribbed bars to BS 4449:2005.

4.4.9.7.11 Sustainability

The steel plate girders will be fabricated from weathering steel which will mean that maintenance painting will not be required over the lifetime of the structure. The concrete elements of the structure will generally comprise of 50% GGBS cement. Concrete consisting of a portion of GGBS cement is considered to have a lower carbon footprint than concrete consisting solely of Ordinary Portland Cement. The proposed structure is structurally efficient thus employing a minimum of materials. At the end of its lifespan, the structure could be readily demolished, and all materials can be recycled.

The use of weathering steel for the plate girders improves the sustainability of the structure by removing the need for any painting or repainting.

4.4.10 Other Structures

4.4.10.1 Site Location

Figure 4.11 shows the location map of the three proposed overbridges along with the proposed River Boyne bridge crossing and the proposed shared pedestrian/cycleway bridge crossing.

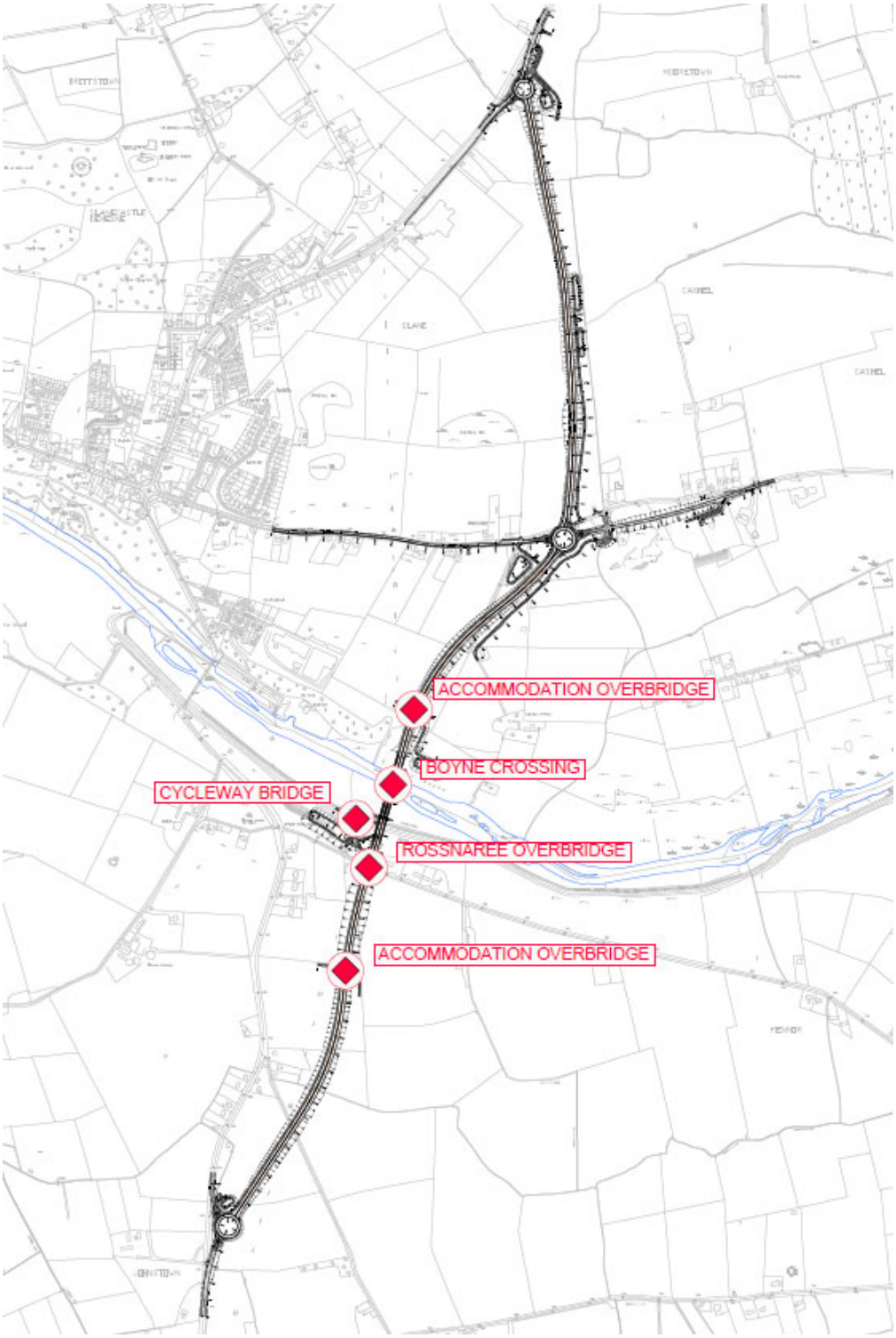


Figure 4.11: Bridge Site Location Map

4.4.10.2 Overbridges

This section is supported by **Volume 3 – Technical Drawings MDT0806-RPS-00-N2-DR-D-BR0102-01** – **102-04** (Structure Locations), **MDT0806-RPS-ST03-N2-DR-D-BR0103-01 – BR0103-02** (Accommodation Overbridge), **MDT0806-RPS-ST04-N2-DR-D-BR0103-01 – BR0103-02** (Rossnaree Overbridge) and **MDT0806-RPS-ST05-N2-DR-D-BR0103-01 – BR0103-02** (Accommodation Overbridge)**.**

The three overbridges on the Proposed Scheme are required to carry two farm accommodation tracks and Local Road L16002 (Rossnaree Road) over the proposed N2 Slane Bypass.

Each of the structures are three span integral bridges. The bridge decks are formed from precast prestressed concrete W-beams acting compositely with a cast in-situ reinforced concrete deck slab.

The end supports will take the form of reinforced concrete bank-seats founded on reinforced concrete spread footings. The intermediate pier supports will take the form of reinforced concrete bearing shelves supported by two circular columns founded on reinforced concrete spread foundations.

The farm accommodation overbridges (ST03 and ST05) have a total width of approximately 6.2 m including a 4 m wide carriageway. The Rossnaree Road Overbridge (ST04) has a total width of approximately 9.64 m including 2.5 m wide carriageways in each direction.

Slurry pits will be provided at the downhill ends of each farm accommodation overbridge to collect any contaminated run-off from the bridges. These slurry tanks will be compliant with the Nitrates Directive and will be maintained by the landowner.

A typical arrangement of the overbridges proposed for the project is illustrated in **Figure 4.12** below.

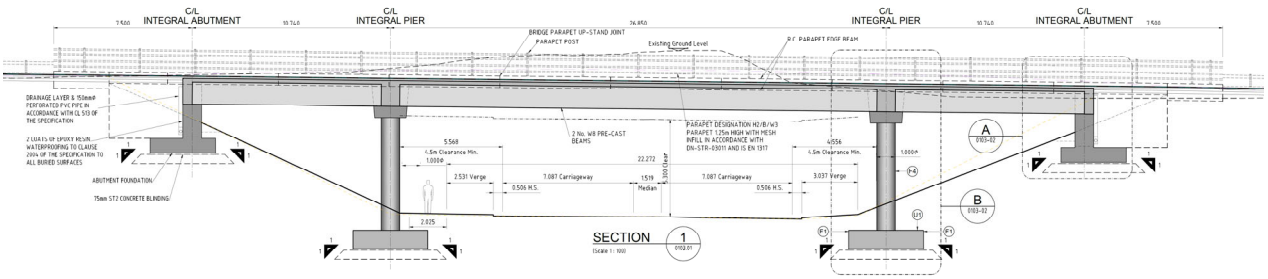


Figure 4.12: Typical Arrangement of the Overbridges

4.4.10.3 Shared Use Cycle & Pedestrian Bridge

This section is supported by **Volume 3 – Technical Drawings MDT0806-RPS-ST02-N2-DR-D-BR0103-01** and **MDT0806-RPS-ST02-N2-DR-D-BR0103-02 – BR103-03** (Plan Layouts and Sections).

The Shared Use Cycle & Pedestrian Bridge (ST02) is required to link the existing Boyne Canal towpath to the Shared Use Cycle & Pedestrian facility of the proposed N2 Slane Bypass. The bridge will span over the Boyne Canal, which forms part of the Boyne Navigation, and tie into the towpath.

The proposed new structure is a single span low profile steel arch with the deck supported directly from the arch via struts. The structure has an overall span of approximately 30.64 m and a width of approximately 3 m. and provides for the minimum navigation headroom requirement of 3.6 m. The abutments consist of cast in-situ reinforced concrete springing blocks for the main arch members and a reinforced concrete retaining wall both supported by bored pile foundations. The deck consists of a steel plate that is braced in the longitudinal and transverse directions and supported by rectangular hollow sections. The steel arch represents a structurally efficient option and is aesthetically pleasing giving a light appearance and open aspect.

The steel bridge will be fully assembled off site, transported to site and positioned into place by mobile crane following construction of the reinforced concrete sub-structure.

Figure 4.13 illustrates the proposed span arrangement of the Shared Use Cycle & Pedestrian bridge.

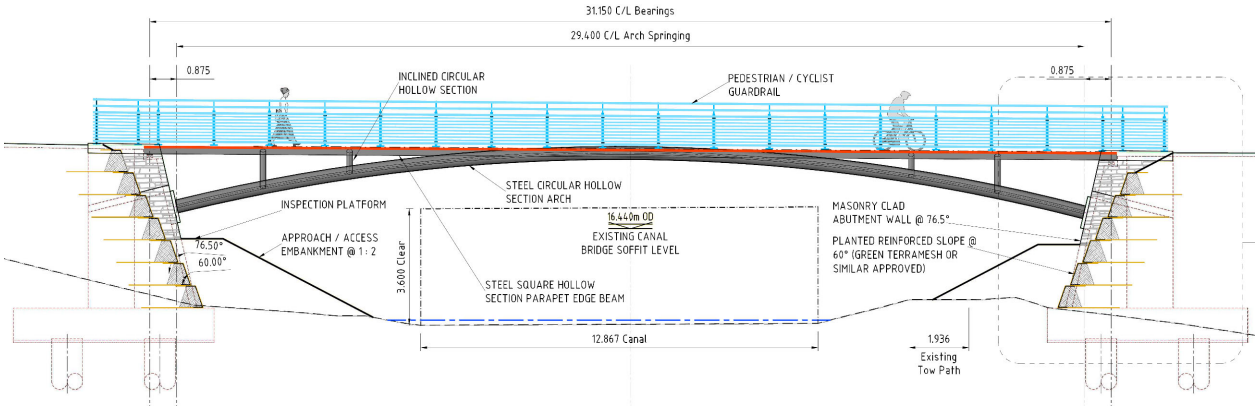


Figure 4.13: Proposed Span Arrangement of the Shared Use Cycle and Pedestrian Bridge

4.4.10.4 Culverts

The proposed alignment crosses a number of existing watercourses and agricultural drains. Hydrological assessments were carried out to determine the design flow for each culvert. A factored Institute of Hydrology (IH) IH 124 method was adopted to calculate the 1% AEP including a 20% allowance for climate change, with an allowance for a 100-year return period growth factor of 1.96. All culvert flows were established, and suitable pipe diameters were selected. In accordance with the requirements and stipulations set out in Section 50 of the Arterial Drainage Maintenance Act 1945 – The Office of Public Works specify the minimum size culvert for any watercourse shall be (minimum) 900 mm diameter. This has been applied as a minimum for all culverts located on watercourses. There are several culverts located on interceptor ditches and diverted drainage ditches which have not been sized as they will need further detail and agreement with landowners at detailed design stage. All watercourse culverts are designed to accommodate the 1% AEP design flow including Climate Change and Growth factor; hence the culverts will not impede on the hydraulic conveyance of the existing watercourse when culverted.

There are approximately thirteen culverts required to accommodate existing watercourses traversed by the Proposed Scheme such as streams and land drains. Where culverts are not proposed for other watercourses, such as minor land drains, these shall be intercepted by the interceptor ditches and conveyed to the nearest downstream outfall and/or culvert. **Table 4-8**, below, summarises the nature and extent of the culverts proposed for this Proposed Scheme. Note the Proposed Scheme also includes for the removal of the existing culvert under the existing N2 at Mooretown.

This section is supported by **Volume 3 – Technical Drawing MDT0806-RPS-01-N2-DR-C-DR2001 – DR2002** (Culverts 6A, 6B and 6C Layout Plan).

Table 4-8: Schedule of Culverts

Culvert No.	Description	Location	Design Flow Q100 (m^3/s)	Approx. Dimensions (mm)	Approx. Length (m)	Culvert Type
1	Drainage Ditch and Interceptor Ditch	Ch 210	0.20	600	30	Pipe
2A	Interceptor Ditch	Ch 790	TBC	*To Be Sized*	14	Pipe
2B	Interceptor Ditch	Ch 800	TBC	*To Be Sized*	12	Pipe
2C	Interceptor Ditch	Ch 1100	TBC	*To Be Sized*	250	Pipe
2D	Interceptor Ditch	Ch 1075	TBC	*To Be Sized*	470	Pipe
3A	Interceptor Ditch	Ch 2100	TBC	*To Be Sized*	25	Pipe
3B	Interceptor Ditch	Ch 1570	TBC	*To Be Sized*	20	Pipe
4A	Interceptor Ditch	Ch 2250	TBC	*To Be Sized*	162	Pipe
4B	Interceptor Ditch	Ch 1560	TBC	*To Be Sized*	25	Pipe
5	Drainage Ditch	Ch 2850	TBC	*To Be Sized*	60	Pipe
6A	Mattock (Mooretown) Stream	Ch 3460	1.36	2400 x 2400	33	Box Culvert

Culvert No.	Description	Location	Design Flow Q100 (m^3/s)	Approx. Dimensions (mm)	Approx. Length (m)	Culvert Type
6B	Mattock (Mooretown) Stream	Ch 3450	1.41	1800 x 1800	56	Box Culvert
6C	Mattock (Mooretown) Stream	Ch 3440	1.42	1800 x 1800	10	Box Culvert

4.4.11 Drainage

4.4.11.1 Drainage Overview

This section is supported by **Volume 3 – Technical Drawings MDT0806-RPS-01-N2-DR-C-DR0000 – DR0008** (Drainage Layouts), **MDT0806-RPS-01-N2-DR-C-DR1001** (Drainage – Typical Mainline Cross-Section) and **MDT0806-RPS-01-N2-DR-C-DR1003 – DR1004** (Outfall Details) and **MDT0806-RPS-01-PR-DR-C-DR9000 – DR9012** (Public Realm Drainage).

Adequate provision must be made for the surface water drainage of the Proposed Scheme for it to provide satisfactory performance throughout its design life. There are three major objectives in the drainage of national roads, and they are:

- The speedy removal of surface water to provide safety for road users;
- The provision of effective sub-surface drainage to maximise longevity of the pavement and its associated earthworks; and
- The minimisation of the impact of the runoff on the receiving environment.

It is also necessary to provide for drainage of earthworks and structures associated with the road. Drainage designs shall ensure that:

a. All drainage systems are accessible for inspection and maintenance;

b. All impermeable and semi-impermeable surfaces are adequately drained;

c. Drainage systems do not have negative effects on existing ecology, surface-water hydrology or groundwater hydrogeology;

d. In the interest of pollution control and containment, the road drainage shall, wherever possible, be kept separate from another catchment drainage; and

e. The road drainage causes no disruption in water supply to landowners/occupiers who obtain their water from wells, boreholes and the like.

The road drainage system will ensure that surface water drains quickly from the carriageway and is collected and conveyed to the nearest outfall in order to avoid flooding or ponding on the road surface. The outfalls from the road drainage system must be designed so as to not increase pollution or flood risk. The drainage system must also ensure that groundwater is not permitted to infiltrate the sub-grade and pavement layers to the extent where it could cause a build-up of excess pore water pressure capable of undermining or weakening the road foundation. The water table must also be maintained at an adequate level below the pavement at all times of the year. The drainage system must also ensure that flooding of the road by water from adjoining properties is prevented by intercepting it with suitable drains and conveying it to a suitable outfall.

The proposed road drainage system will incorporate a carriageway drainage system, together with a system of bridges and culverts to accommodate watercourses that intersect the Proposed Scheme.

Objective INF OBJ 14 in particular of the Meath County Development Plan 2021-2027 also requires the use of sustainable urban drainage systems (SuDS): "*To require the use of SuDS within Local Authority Developments and other infrastructural projects in accordance with the Greater Dublin Regional Code of Practice for Drainage Works*."

The drainage design of the project complies with TII design standards and implement the concepts of SuDS, which requires the drainage to be carefully integrated into the Proposed Scheme while taking account of the original greenfield drainage patterns. It includes provisions to control volume and rate of runoff from the road

as well as provisions to remove pollutant from the runoff. These issues are discussed further in the following sections.

4.4.11.2 Drainage Design Considerations and Options

4.4.11.2.1 Effect of Road Geometry

The geometry of a road can impact on:

- The ability of sections of road to be drained e.g. a sag in a cutting may be impossible to outfall;
- Surface and sub-surface outfall levels; and
- Areas of flat longitudinal gradient and rollovers may result in 'flat spots'.

The geometric design of the Proposed Scheme takes account of these potential problems.

4.4.11.2.2 Edge Drainage Systems

The TII design Standard DN-DNG-03022, Drainage Systems for National Roads (including Amendment No. 1 dated June 2015), sets out the commonly available edge surface water collection systems. Options include kerb and gully, filter drains, surface water channels, drainage channel blocks, combined kerb and drainage blocks, over the edge and grassed channels. The proposed drainage system for the Proposed Scheme utilises options from this list.

4.4.11.2.3 Sub-Surface Drainage

Sub-surface drainage of road pavements is provided to control levels of groundwater and drain the road foundation. Options include filter drains, fin drains, narrow filter drains and extended capping layer. The design provisions included are shown on drawings, **MDT0806-RPS-01-N2-DR-C-DR0000 – DR0008** (Drainage Layouts) and **MDT0806-RPS-01-N2-DR-C-DR1001** (Drainage – Typical Mainline Cross-Section).

4.4.11.2.4 Earthworks Drainage

It is essential that existing land drainage and runoff from external catchments be taken into account in the design of road drainage. Where surface water and sub-surface water from adjoining land will flow towards the road, it will generally be necessary to construct intercepting drains at the tops of cuttings and the toes of embankments. In rural areas these may be ditches rather than filter drains because of their greater capacity and comparative low cost.

All run off from the existing land drainage system will be kept entirely separate from the carriageway drainage systems where practicable. Surface water from the external catchment will not be connected to the road drainage system to avoid oversized attenuation and treatment system provisions.

Watercourses and ditches crossed by a major road are generally bridged or culverted.

4.4.11.2.5 Control of Pollution and Flooding

Road drainage systems have been designed to minimise the potential for pollution and flooding. TII Standards, DN-DNG-03022, Drainage Systems for National Roads (including Amendment No. 1 dated June 2015) and DN-DNG-03065, Road Drainage and the Water Environment (including Amendment No. 1 dated June 2015) provide details of the methodologies to be applied and of the measures to be implemented to ensure that pollution and flood risk is minimised. Four aspects in particular were considered, namely:

- Management of flood risk;
- Management of outfall pollution risk;
- Management of groundwater pollution risk; and
- Management of spillage risk.

4.4.11.3 Management of Flood Risk

A desktop study was conducted to ascertain any sources of potential flood risk to the Proposed Scheme. The desktop study involved assessing the available records, flood risk management maps, Local Authority flooding information and proposed mainline and catchment drainage measures.

4.4.11.3.1 CFRAM Maps

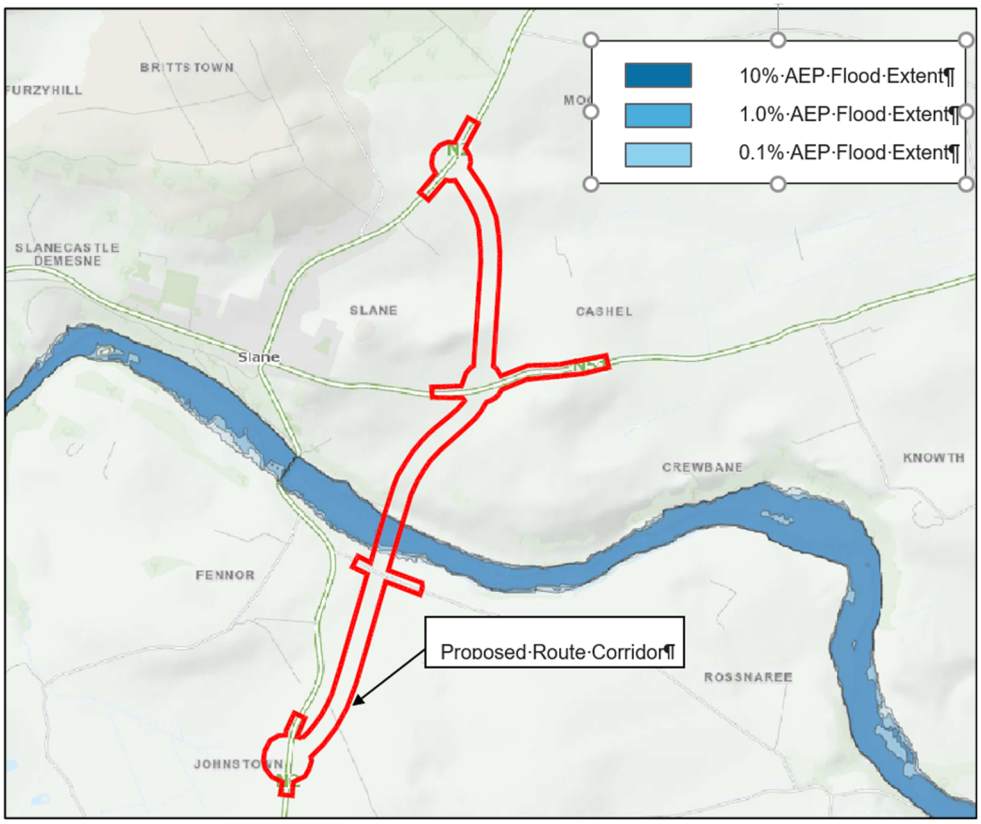
The Catchment Flood Risk Assessment and Management Studies (CFRAMS) programme aims to assess flood risk through the identification of flood hazard areas and the associated impacts of flooding. The flood hazard areas have been identified as being potentially at risk from significant flooding, including areas that have experienced significant flooding in the past. The flood zones are determined under the following zones:

- **Flood Zone A:** where the probability of flooding from rivers and the sea is highest (greater than 1% or 1 in 100 for river flooding or 0.5% or 1 in 200 for coastal flooding);
- **Flood Zone B:** where the probability of flooding from rivers and the sea is moderate (between 0.1% or 1 in 1000 and 1% or 1 in 100 for river flooding and between 0.1% or 1 in 1000 year and 0.5% or 1 in 200 for coastal flooding); and
- **Flood Zone C:** where the probability of flooding from rivers and the sea is low (less than 0.1% or 1 in 1000 for both river and coastal flooding). Flood Zone C covers all areas of the plan which are not in zones A or B.

The CFRAM maps were evaluated as part of this assessment (See **Figure 4.14** and **Figure 4.15**). The maps show the River Boyne which flows through Slane (flow direction: west to east) and is crossed by the existing N2 at the existing Slane Bridge. From this assessment, it can be seen that the CFRAM study indicates that the River Boyne is predicted to experience out of bank fluvial flooding in the immediate vicinity of the proposed works, see **Figure 4.14**. The CFRAM maps also indicate that the River Boyne is subject to out of bank flood effects due to tidal impacts, with these tidal impacts noted to continue west past Slane.

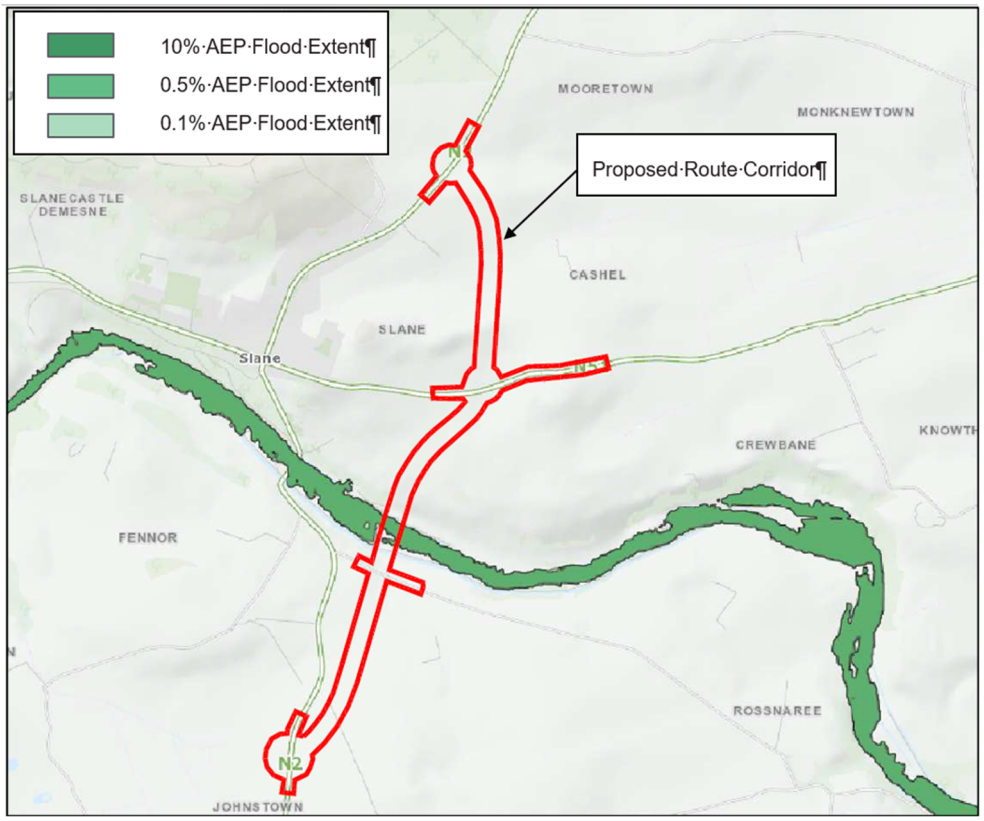
The Eastern CFRAM Study Flood Risk Review notes that Slane was originally included as a possible area for further assessment (AFA) due to potential flood risk to the N2. The principal flood risk at Slane is to the existing Slane bridge and the old mill downstream of the bridge which is now being used as apartments. It was noted that the Local Authority considered the potential disruption from the road being flooded to be easily manageable given the close proximity of the M1, N51 and M3. It was therefore recommended that Slane Bridge should not be considered an AFA, and accordingly no detailed CFRAM study was undertaken for Slane.

Other sources of flooding such as surface water ponding (rainfall/ pluvial) were investigated. There is no evidence of pluvial flooding in the subject works area and no other sources are shown.



Source: *OPW, https://www.floodinfo.ie/map/floodmaps/*

Figure 4.14: CFRAM Map – Fluvial Flooding to River Boyne at Slane



Source: *OPW, https://www.floodinfo.ie/map/floodmaps/*

Figure 4.15: CFRAM Map – Coastal Flooding to River Boyne at Slane

4.4.11.3.2 Flooding Arising from Mainline Drainage

The proposed mainline drainage system incorporates positive drainage networks drained to attenuation ponds, where the surface water runoff volume can be stored and released to the receiving water course at run-off rates equivalent to the pre-development greenfield run off rates for the chosen return period. This approach results in no increase to the existing flow rates in the watercourses currently draining the surrounding lands. The design rationale utilised the TII design standard DN-DNG-03066 Design of Earthworks Drainage, Network Drainage, Attenuation & Pollution Control approach to limit all surface water run off to the equivalent rate of greenfield run-off. The greenfield run-off rate has been calculated using the Institute of Hydrology Report 124 (IH 124).

Sections 4.4.11.8 and **4.4.11.10** below describe the mainline drainage design and the design of the attenuation measures in greater detail.

The procedure adopted to size the attenuation systems used the Source Control Application within the MicroDrainage hydraulic design software. Impermeable catchment areas were established for each attenuation system and these were modelled for the 1% AEP, including for a 20% allowance for climate change. The attenuation ponds have been modelled to accommodate the design return period and parameters.

4.4.11.3.3 National Flood Hazard Mapping

An assessment of the National Flood Hazard Mapping website www.floodmaps.ie was undertaken. The website indicates one location where two historic flooding events were noted to have reoccurred on two separate occasions as recorded by the OPW in close proximity to the proposed alignment of the road, with this location being the existing Slane bridge. The flood source was noted as river. A summary of the flood event for this location was recorded as follows:

- **Slane Bridge** – Boyne overflowed its banks in February 1990 and November 2002 after heavy rain. Property was also affected. (Flood occurrence is noted within vicinity of existing N2 bridge crossing. The location is upstream of the proposed River Boyne crossing, and it will not affect the new alignment).

4.4.11.3.4 Conclusion

The sources of information used to conduct this assessment of flood risk indicate that:

- **Pluvial sources** of flooding e.g. rainfall on the impermeable road pavement would be accommodated by the proposed mainline drainage strategy. This system includes attenuation systems to ensure adequate retention (to greenfield rates) of the surface water runoff generated from the road will not increase the flows in the existing watercourses.
- **Fluvial sources** of flooding e.g. flooding arising from river/ watercourse. The CFRAMS flood extents maps were assessed as part of this study to establish any fluvial sources of flood risk. The CFRAM flood maps do not extend to the location of the proposed bypass, but the information is available online in GIS format. The maps did indicate out of bank flooding along the River Boyne, however the existing N2 is shown not to experience flooding. A separate Stage 1 Flood Risk Assessment has been carried out (RPS, 2021) which examines the flood risk associated with the proposed River Boyne bridge in more detail. With this information, coupled with the proposed watercourse culvert sizing calculations, it is concluded that the culverts to be installed as part of the Proposed Scheme are designed in accordance with the OPW requirements and hence, shall not restrict the hydraulic conveyance of the watercourses.
- **Tidal sources** of flooding e.g. flooding arising from tidal/coastal influences. The Preliminary Flood Risk Assessment (PFRA) and CFRAMS flood extents maps were both assessed as part of this study to establish any fluvial sources of flood risk. The CFRAM flood maps did not extend to the proposed location of the proposed bypass. The PFRA maps would suggest that the River Boyne in the Slane area is subject to coastal influences and indicates out of bank flooding along the River Boyne, however the existing N2 was shown not to experience flooding.
- **Local flooding information** – The National Flood Hazard Mapping website www.floodmaps.ie was reviewed. There was one location (the existing Slane Bridge) identified and reported to flood during heavy rainfall events from the Boyne River. However, the proposed alignment of the bypass crosses the Boyne with a proposed four-span bridge, with a single span over the main river channel, at a higher

elevation, which results in a negligible likelihood of flood risk compared to the existing multi-arch bridge with a much lower soffit level.

Based on this assessment, it is concluded that the Proposed Scheme is at a low risk of flooding from fluvial, pluvial and tidal sources.

4.4.11.4 Management of Outfall Pollution Risk

The European Community (Salmonid Water) Regulations 1988 (S.I. No. 293 of 1988) stipulates that the suspended sediment concentration in the River Boyne should not exceed 25 mg/l.[3] As a result, it is necessary to implement measures as part of the drainage design to ensure that road runoff is treated, and any sediment is captured and retained before final discharge to a watercourse.

The CIRIA SuDs Manual (C753) gives an indication of measured pollutant concentrations for a main highway based on previous studies in the UK. The total concentrations for the 25%ile, the mean and the 75%ile events are given in **Table 4-9**.

Table 4-9: CIRIA C753 Measured Highway Pollutant Concentrations

Land Use	Total Suspended Solids Concentration		
	25%ile (mg/l)	Mean (mg/l)	75%ile (mg/l)
Main Highway	62.2	156.9	396.3

Table 4-9 shows that the measured Total Suspended Solids (TSS) concentrations in untreated road run-off is significantly higher than the allowable background river concentration of 25 mg/l. The drainage methodologies included in the design of the proposed Scheme were selected with the reduction in TSS as a main concern. The methods used and their typical removal efficiencies are shown in **Table 4-10** from TII Drainage Systems for National Roads, DN-DNG-03022.

Table 4-10: Treatment System Indicative Removal Efficiency (TII DN-DNG-03022)

Site/Treatment Devices	% Reduction: Inlet to Outlet			
	Initial Form of Treatment	Second Form of Treatment	Third Form of Treatment	Total System Treatment
Swales and Grassed Channel / Vortex grit separators / Wet retention pond	80%	40%	60%	95.2%

The proposed scheme provides for a treatment train incorporating grassed channels, vortex grit separators, petrol/oil interceptors and retention ponds to ensure that the maximum possible removal efficiency can be achieved without implementing overly complex drainage treatment technologies. The grassed channels act as the initial form of treatment, helping to reduce the runoff velocity and encourage the settlement of TSS. The vortex grit separators trap large volumes of suspended sediment before the runoff enters the petrol/oil interceptors and the forebay and permanent retention pond. The permanent water in the ponds, along with the selected vegetation ensure further settlement of any remaining TSS.

Comparing these indicative removal efficiencies to the typical TSS concentrations in highway run-off shows that the post-treatment TSS concentrations in the discharge will be less than the limit of 25mg/l. This is shown in **Table 4-11** below.

[3] The First Schedule to the regulations states: *The standard is expressed as an average concentration over a period of 12 months and does not apply to suspended solids with harmful chemical properties.*

Table 4-11: Reduction of Sediment Concentrations at Outfall

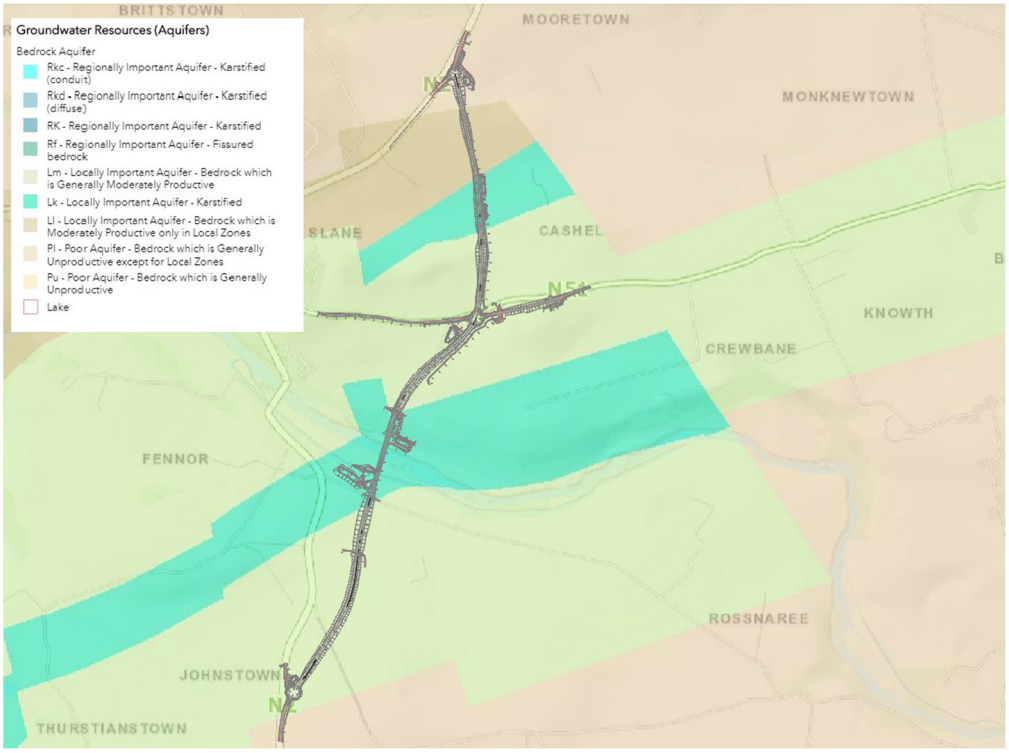
Land Use	Total Suspended Solids Concentration		
	25%ile (mg/l)	Mean (mg/l)	75%ile (mg/l)
Main Highway Pre-Treatment Sediment Levels	62.2	156.9	396.3
Main Highway Post-Treatment Sediment Levels	3.0	7.5	19.0

4.4.11.5 Groundwater Assessment

The potential for groundwater pollution has been assessed using HAWRAT (Highways Agency Water Risk Assessment Tool v. 1.0)[4] Method C – Groundwater Protection Response (GPR) for the use of permeable drain systems on Road Schemes as set out in the TII Standard DN-DNG-03065 Road Drainage and the Water Environment (including Amendment No. 1 dated June 2015). The updated version of the HEWRAT (Highways England Water Risk Assessment Tool v. 2.0.4) has also been applied for completeness; no changes to the results were found.

As indicated in **Figure 4.16**, the Proposed Scheme is located over areas where the underlying aquifer has the following classifications:

- LM – Locally Important Aquifer, Bedrock which is Moderately Productive;
- Lk – Locally Important Aquifer, Karstified;
- Ll – Locally Important Aquifer, Bedrock which is Moderately Productive only in Local Zones; and
- Pl – Poor Aquifer, Bedrock which is Generally Unproductive except for Local Zones.



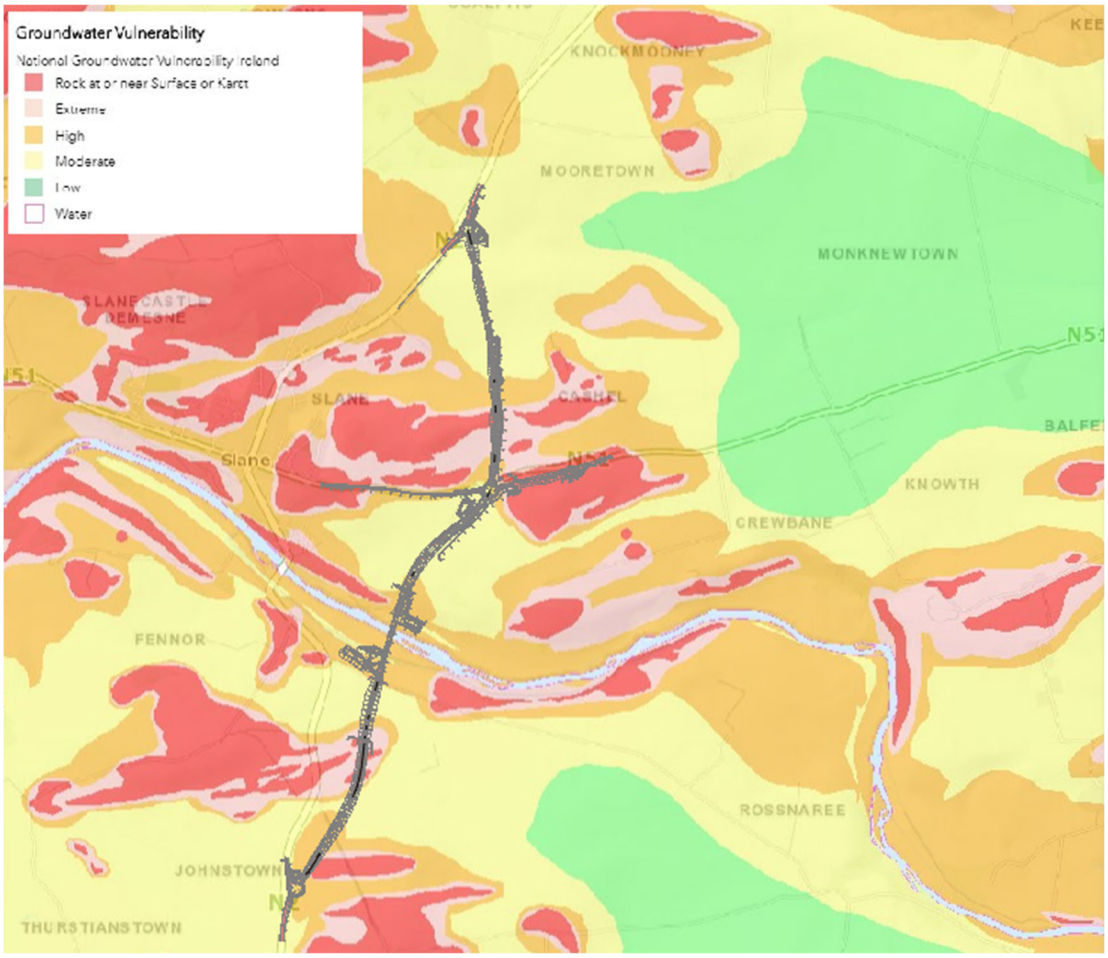
Source: *GSI, https://www.gsi.ie/en-ie/data-and-maps/Pages/default.aspx*

Figure 4.16: Bedrock Aquifer Map

[4] Known as HAWRAT in DN-DNG-03065 - Road Drainage and the Water Environment (including Amendment No. 1) (TII, 2015). Note, this tool is now known by its new acronym, HEWRAT (Highways England Water Risk Assessment Tool) which reflects the UK agency name change from Highways Agency to Highways England.

Figure 4.17 illustrates the proposed alignment for the Proposed scheme is located over areas where the underlying groundwater is noted to have the following vulnerabilities:

- Moderate;
- High;
- Extreme; or
- Rock at or near surface or karst.



Source: *GSI, https://www.gsi.ie/en-ie/data-and-maps/Pages/default.aspx*

Figure 4.17: Groundwater / Aquifer Vulnerability Map

From the GPR matrix as outlined in Table A.4 (Appendix A of DN-DNG-03065), the N2 Slane Bypass route falls into R1, R3(1), R2(1) and R2(2) classifications along the route. The majority of the route is classified as R2(1) and R(2), i.e. permeable drainage is only acceptable along these sections subject to certain conditions set out in **Table 4-12**.

Table 4-12: Relevant Extracts from TII Notes on Permeable Drainage Systems

R1	Acceptable subject to minimum design standards in the NRA DMRB and Notes 1 and 2
R2 (1)	Acceptable subject to minimum design standards in the NRA DMRB and to meeting the following requirements: • There is a consistent minimum thickness of 1 m unsaturated subsoil, or 2 m in areas of karstified rock (Rkc & Lk), beneath the invert level of the drainage system (Note 1). • During all stages of design particular attention must be paid to the presence of karst features and additional assessments undertaken if required. If karst features are identified response R2 (3) must be applied as a minimum.

	• During all stages of design particular attention must be paid to receptors (such as public wells, group schemes, industrial water supply sources and springs) and additional assessments undertaken if required.
R2 (2)	Acceptable subject to minimum design standards in the NRA DMRB, meeting requirements 1, 2 and 3 of above and the following additional requirements: • Where the subsoil is classed using BS5930 as; SAND, GRAVEL or SILT (in circumstances where the clay content is <10%) AND/OR is underlain by limestone bedrock, there is a consistent minimum thickness of 2m unsaturated subsoil beneath the invert level of the drainage system. OR • There is a minimum consistent unsaturated thickness 1m of "appropriate material" (Note 3 in Appendix A of DN-DNG-03065) either natural or man-made beneath the invert level of the point of discharge. • Where a gravel aquifer is present, a consistent minimum thickness of 3m unsaturated subsoil beneath the invert level of the drainage system must be present.
R3 (1)	Not generally acceptable, unless requirements 1, 2, 3 and 4 and the following additional requirements are met: • If discharge to surface water is not possible then additional assessments by an appropriately qualified groundwater specialist are required to determine the risk to groundwater resources (the aquifer).

In consideration of the above standards, a summary of the groundwater assessment is presented in **Table 4-13** below.

Table 4-13: Groundwater Assessment

Chainage	Calculated Vulnerability Rating	Aquifer Type	Matrix Response Category	Suitable for use of a Permeable Drainage System
N2 Bypass				
0-70	High (H)	Locally Important, Moderately Productive - LM	R2 (2)	Not Acceptable (See Table 4-12) – Cutting in Rock
70-175	Rock (X)	Locally Important, Moderately Productive - LM	R3 (1)	Not Acceptable (See Table 4-12) – Cutting in Rock
175-400	High (H)	Locally Important, Moderately Productive - LM	R2 (2)	Not Acceptable (See Table 4-12) – Cutting in Rock
400-535	Moderate (M)	Locally Important, Moderately Productive - LM	R2 (1)	Not Acceptable (See Table 4-12) – Cutting in Rock
535-565	High (H)	Locally Important, Moderately Productive - LM	R2 (2)	Not Acceptable (See Table 4-12) – Cutting in Rock
565-600	Extreme (E)	Locally Important, Moderately Productive - LM	R2 (2)	Not Acceptable (See Table 4-12) – Cutting in Rock
600-650	Rock (X)	Locally Important, Moderately Productive - LM	R3 (1)	Not Acceptable (See Table 4-12) – Cutting in Rock
650-685	Extreme (E)	Locally Important, Moderately Productive - LM	R2 (2)	Not Acceptable (See Table 4-12) – Cutting in Rock
685-750	Rock (X)	Locally Important, Moderately Productive - LM	R3 (1)	Not Acceptable (See Table 4-12) – Cutting in Rock
750-775	Extreme (E)	Locally Important, Moderately Productive - LM	R2 (2)	Not Acceptable (See Table 4-12) – Cutting in Rock
775-815	Rock (X)	Locally Important, Moderately Productive - LM	R3 (1)	Not Acceptable (See Table 4-12) – Cutting in Rock
815-865	Extreme (E)	Locally Important, Moderately Productive - LM	R2 (2)	Not Acceptable (See Table 4-12) – Cutting in Rock
865-920	High (H)	Locally Important, Karstified – LK	R2 (2)	Not Acceptable (See Table 4-12) – Cutting in Rock, Karstified
920-1050	Moderate (M)	Locally Important, Moderately Productive - LM	R2 (1)	Not Acceptable (See Table 4-12) – Cutting in Rock

Chainage	Calculated Vulnerability Rating	Aquifer Type	Matrix Response Category	Suitable for use of a Permeable Drainage System
1050-1650	High (H)	Locally Important, Karstified – LK	R2 (2)	Not Acceptable (See Table 4-12) – Cutting in Rock, Karstified
1650-2230	Moderate (M)	Locally Important, Moderately Productive - LM	R2 (1)	Not Acceptable (See Table 4-12) – Cutting in Rock for most part, sealed drainage system at roundabout.
2230-2385	High (H)	Locally Important, Moderately Productive - LM	R2 (2)	Not Acceptable (See Table 4-12) – Cutting in Rock
2385-2550	Extreme (E)	Locally Important, Moderately Productive - LM	R2 (2)	Not Acceptable (See Table 4-12) – Cutting in Rock
2550-2600	Rock (X)	Locally Important, Moderately Productive - LM	R3 (1)	Not Acceptable (See Table 4-12) – Cutting in Rock
2600-2630	Extreme (E)	Locally Important, Moderately Productive - LM	R2 (2)	Not Acceptable (See Table 4-12) – <2m between invert of drainage and rock level.
2630-2760	High (H)	Locally Important, Karstified – LK	R2 (2)	Not Acceptable (See Table 4-12) – Road Embankment
2760-2950	Moderate (M)	Locally Important, Karstified – LK	R2 (1)	Not Acceptable (See Table 4-12) – Road Embankment
2950-3350	Moderate (M)	Locally Important, Moderately Productive - LI	R2 (1)	Not Acceptable (See Table 4-12) – Road Partially in Embankment
3350-3525	Moderate (M)	Poor Aquifer, Generally Unproductive – PI	R1	Not Acceptable (See Table 4-12) – Road Embankment
N51 West				
0-240	Rock (X)	Locally Important, Moderately Productive - LM	R3 (1)	Acceptable. Note: no significant change to existing road.
240-260	Extreme (E)	Locally Important, Moderately Productive - LM	R2 (2)	Acceptable. Note: no significant change to existing road.
260-700	High (H)	Locally Important, Moderately Productive - LM	R2 (2)	Acceptable. Note: no significant change to existing road.
700-800	Moderate (M)	Locally Important, Moderately Productive - LM	R2 (1)	Acceptable. Note significant change to existing road.
N51 East				
0-25	High (H)	Locally Important, Moderately Productive - LM	R2 (2)	Not Acceptable (See Table 4-12) – Cutting in Rock
50-75	Extreme (E)	Locally Important, Moderately Productive - LM	R2 (2)	Not Acceptable (See Table 4-12) – Cutting in Rock
75-600	Rock (X)	Locally Important, Moderately Productive - LM	R3 (1)	Not Acceptable (See Table 4-12) – Cutting in Rock

4.4.11.6 Effects of Routine Run-off on Surface Waters

TII standard DN-DNG-03065, Road Drainage and the Water Environment (including Amendment No.1 dated June 2015) deals with the assessment of the impact new roads may have on the receiving water environment.

A broad range of potential pollutants is associated with routine runoff from operational roads. These are combustion products of hydrocarbons, fuel and fuel additives, catalytic converter materials, metal from friction and corrosion of vehicle parts, lubricants, and materials spread during gritting and de-icing. Particulate contaminants originating from vehicles and vehicle-related activities include carbon, rubber, plastics, grit, rust and metal filings.

The standard outlines research carried out in the UK and the development of an assessment tool, called HAWRAT.[4] HAWRAT adopts a tiered consequential approach to assessment and can report the results at three different stages depending upon the level of assessment required for any given site. These are:

a. Step 1, the run-off quality (prior to any pre-treatment and discharge into a water body);

b. Step 2, in river impacts including downstream protected sites (after dilution and dispersion); and

c. Step 3, in river impacts post-mitigation.

A summary of the required inputs and outputs for each stage of the HAWRAT assessment are included in **Table 4-14** below.

Table 4-14: Stages of Assessment in HAWRAT

Stage of Assessment	Inputs	Outputs
Step 1 Run-off Quality	• Traffic volume • Geographic location • 10 years of rainfall data, ~1000 rainfall events (embedded in HAWRAT)	• Runoff concentrations of soluble pollutants and sediment-bound pollutants for each event • Pass/Fail standards
Step 2 In River Impacts	• Outputs from Step 1 • Area draining to outfall • Characteristics of receiving watercourse	• Concentration of soluble pollutants after dilution • Stream velocity at low flow • Deposition index (extent of sediment coverage) • Pass/Fail standards • Percentage settlement required to comply with deposition index • Annual average concentrations of soluble pollutants
Step 3 After Mitigation	• Outputs from Steps 1 and 2 • Existing and proposed mitigation measures • Treatment of soluble pollutants or flow attenuation • Settlement of sediments	• Concentration of soluble pollutants after treatment • Concentration of soluble pollutants after further dilution • Pass/Fail standards • Annual average concentrations of soluble pollutants after mitigation

A HAWRAT 'Method A' Assessment of Runoff Quality, as per Step 1, for the Proposed Scheme was carried out for each of the proposed drainage outfall locations. Application of the HAWRAT methodology indicates that the outfalls along the bypass route all pass at Step 2, except for the outfalls at Ponds 5A and 5B which require inclusion of the proposed mitigation measures (i.e. attenuation ponds) within the assessment to then pass at Step 3. This is due to the limited flow in the stream to which the proposed outfall discharges. The comparison with Environmental Quality Standards (EQS's) also passes and as indicated by Table 5.2 in TII DN-DNG-03065, no further detailed assessment is required. The conclusion from the assessment is that the predicted drainage run-off pollution levels from the Proposed Scheme does not require further mitigation, outside of what is already being proposed.

In accordance with industry best practice, the Proposed Scheme will incorporate a number of measures which will significantly treat and enhance the quality of the runoff out-falling to the receiving environment. These measures include the provision of petrol/oil interceptors, vortex grit separators, sediment traps, attenuation ponds with treatment forebays, grassed channels and filter drains where appropriate.

4.4.11.7 Pollution Impact from Spillages

Spillages caused by accident or other causes can occur anywhere on the road network. Although the effect of many road improvement projects will be to reduce the overall risks of collisions, it is important to assess the risks of an acute pollution impact.

Spillage risks can conveniently be expressed as annual probabilities of such an event occurring. This allows objective decisions to be made as to their acceptability, or whether measures are needed to reduce the risk. The risks to each receiving water body will be assessed. Where more than one outfall discharges to the same water body, the combined risk from all such outfalls will be assessed. This is especially important if several outfalls discharge to the same reach of a river.

As a guide, water bodies will be protected so that the risk of a serious pollution incident has an annual probability of less than 1%. TII Standard DN-DNG-03065 sets out Method D - Assessment of Pollution Impacts from Spillages requirements, which provides an indication of the risk of a spillage causing a pollution impact on receiving waterbodies.

As with Method A, an analysis was carried out for each of the four outfalls. **Table 4-15** to **Table 4-18** below show the results of the analysis and highlight that no further prevention measures are required to reduce risk of serious spillage as the risks are assessed to be less than 1% annual probability of occurrence.

Spillage Risk Assessment Calculation Parameters

The parameters adopted for the Pollution Spillage Risk Assessment are as follows:

- **Water body type:** Surface watercourse (i.e. River Boyne, Mattock (Mooretown) Stream and field drain leading to (EPA named) Slane Stream which is a tributary of the Mattock River);
- **AADT for two-way flow:** Average AADT for length of road; and
- **HGV:** 22%.
- **From Table A.5 Spillage rates, SS:**
  - For main carriageway: 0.29;
  - For side roads: 0.93; and
  - For roundabouts: 3.09.

Table 4-15: Spillage Prevention Assessment Summary – Outfall 1 (Ponds 1 and 2)

N2 Section	Road Length (km)	AADT for two-way flow (vehicles/day)	HGV %	Spillage Rate	P_{SPL}	P_{POL}	P_{INC} (%)	Further spillage prevention measures required?
Mainline	1.49	13,610	22	0.29	0.0005	0.6	0.03	No
Mainline within 100m of Junction	0.2	13,610	22	0.93	0.0002	0.6	0.01	No
Side Roads	0.13	820	22	0.93	0.0000	0.6	0.00	No
Roundabout	0.20	13,610	22	3.09	0.0007	0.6	0.04	No
Total					**0.0013**	**0.6**	**0.08**	**No**

Table 4-16: Spillage Prevention Assessment Summary – Outfall 2 (Ponds 3 and 4)

N2 Section	Road Length (km)	AADT for two-way flow (vehicles/day)	HGV %	Spillage Rate	P_{SPL}	P_{POL}	P_{INC} (%)	Further spillage prevention measures required?
Mainline	2.11	13,610	22	0.29	0.0007	0.6	0.04	No
Mainline within 100m of Junction	0.40	13,610	22	0.93	0.0004	0.6	0.02	No
Roundabout	0.20	13,610	22	3.09	0.0007	0.6	0.04	No
Total					**0.0017**	**0.6**	**0.10**	**No**

Table 4-17: Spillage Prevention Assessment Summary – Outfall 3 (Ponds 5A and 5B)

N2 Section	Road Length (km)	AADT for two-way flow (vehicles/day)	HGV %	Spillage Rate	P_{SPL}	P_{POL}	P_{INC} (%)	Further spillage prevention measures required?
Mainline	0.76	13,610	22	0.29	0.0002	0.6	0.01	No
Mainline within 100m of Junction	0.10	13,610	22	0.93	0.0001	0.6	0.01	No
Total					**0.0003**	**0.6**	**0.02**	**No**

Table 4-18: Spillage Prevention Assessment Summary – Outfall 4 (Pond 6)

N2 Section	Road Length (km)	AADT for two-way flow (vehicles/day)	HGV %	Spillage Rate	P_{SPL}	P_{POL}	P_{INC} (%)	Further spillage prevention measures required?
Mainline	0.11	11,800	22	0.29	0.0000	0.6	0.00	No
Mainline within 100m of Junction	0.10	11,800	22	0.93	0.0001	0.6	0.00	No
Side Roads	0.14	3,400	22	0.93	0.0000	0.6	0.00	No
Roundabout	0.20	11,800	22	3.09	0.0005	0.6	0.03	No
Total					**0.0007**	**0.6**	**0.04**	**No**

4.4.11.8 Summary of Carriageway Drainage Proposals

Where the proposed carriageway is not on an embankment, it is envisaged that surface water run-off from the proposed carriageway, verges and cut slopes on the mainline will be collected by a network of grassed channels. Grassed surface water channels are a vegetated drainage system and are considered to be a SuDS, in that they use minimal non replenishable materials such as quarried stone or oil-based products and they can offer further environmental benefits when compared to more traditional road drainage systems. This section is supported by **Volume 3 – Technical Drawings MDT0806-RPS-01-N2-DR-C-DR0000 – DR0008** (Drainage Layouts).

These grassed channels will collect stormwater runoff from the mainline including the road, footpath and cycle path, as well as the runoff from the cut-slopes where necessary. The channels will discharge to a sealed pipe network at regular intervals to prevent water building up in the channels. The proposal includes a grassed channel on either side of the road carriageway, with another in the verge at the base of the cutting slope. The channel at the base of the slope and the roadside channel will drain into the same sealed carrier pipe network, located beneath the roadside grassed channel.

The grassed channels will help to promote the settlement of sediment as the water velocity is reduced and the vegetation itself helps to capture suspended particles and heavy metals. This reduced velocity also helps to attenuate the surface water flow in the channel, thereby increasing the time of concentration and reducing the peak discharge flow from the network.

TII Standards do not permit the use of grassed surface water channels when the carriageway is on an embankment greater than 1.5 m in height. In locations where the proposed carriageway is on an embankment greater than 1.5 m, the provision of ‘over the edge’ drainage is not feasible due to the inclusion of a new footpath along the carriageway edge. Therefore, it is envisaged that surface water run-off from the proposed carriageway will be collected by a system of carrier drains with concrete surface water channels.

Site investigations and the groundwater assessment indicate that groundwater vulnerability must be addressed for the majority of the length of the Proposed Scheme. To cater for this, the proposed design includes an impermeable liner under the grassed channels. The grassed channels discharge to a separate sealed carrier drain system for conveyance to proposed outfalls. This aims to prevent contaminants from the road runoff entering the groundwater.

Where required to control groundwater levels at an acceptable level, a separate filter drain system is to be installed under the grass verge, to collect and convey groundwater to the nearest suitable discharge point, i.e. a watercourse or drainage ditch. This filter drain will have access chambers located within the grass verge at required intervals; refer to Volume 3, drawing refer to drawing **MDT0806-RPS-01-N2-DR-C-DR1001**. The location of all groundwater filter rains is outlined in **Table 4-19** below. The locations of all design aspects are shown on the design drawings in **Volume 3**, drawings **MDT0806-RPS-01-N2-DR-C-DR0000 – DR0008**.

Table 4-19: Groundwater Filter Drain Locations

Groundwater Filter Drain Locations	
N2 Bypass	**N51 East**
Ch. 35 – Ch. 1,125	Ch. 20 – Ch. 300
Ch. 1,490 – Ch. 2,150	–
Ch. 2,260 – Ch. 2,630	–
Ch. 3,065 – Ch. 3,340	–

Due to space constraints, it will be necessary to use filter drains as part of the surface water drainage on the northern side of the N51 West alignment, between Ch. 5 and Ch. 665. Filter drains are trenches filled with permeable material into which runoff is collected from the edge of paved areas, then stored and conveyed. A slotted pipe is incorporated in the base of the trench to collect and convey filtered water. Filter drains are able to perform moderate to good in pollutant removal.

Standard open ditches will act to intercept water from adjoining lands both at the top of cut slopes and at the toe of embankments. It is envisaged that ditches will be trapezoidal in shape, 1 m wide at the base with 1:1 side slopes. Where the interceptor drains are in a fill scenario, they can be unlined but should be lined where the proposed road is in cut. This may vary in some locations depending on ground conditions.

The road drainage design is based on the Modified Rational Method and designed in accordance with TII requirements. **Table 4-20** below outlines the principal design parameters used for the preliminary design of this drainage system.

Table 4-20: Drainage Design Parameters

Parameters	Value
Impermeability Factor for Paved Areas	0.95
Impermeability Factor for Cuttings and Embankments	0.4
Impermeability Factor for Grass Verges	0.10
Minimum Diameter Pipe to be used in Road Drainage System	225 mm
Pipe Roughness Co-Efficient (k_s)	0.6
Minimum Permissible Velocity	1.0 m/s
Time of Entry	5 mins
Minimum cover to carrier pipes	1.2 m
Minimum Rainfall Intensity (I)	50 mm/hr
Standard Average Annual Rainfall (SAAR) Value	947 mm
M5 - 60	15.3 mm
Ratio R	0.273
Climate Change Factor	20%
Return Period for Carriageway Drainage (without pipe surcharge)	1 year
Return Period for Carriageway Drainage (without chamber surcharge)	5 years
Return Period for Culvert Design	100 years
Return Period for Bridge Design	100 years
Return Period for Attenuation Storage	100 years
Mean Annual Flood Flow from a rural catchment (Q_{BAR})	Q_{BAR} (IH124)

The road drainage catchments have been divided into sections based on road gradients and outfalls. The various catchments of the Proposed Scheme are as described in **Table 4-21** below.

Table 4-21: Catchment Summary

Road Drainage Catchment Section (Pond Designation)	Location/Chainage	Discharge Point
1	Southern Roundabout, Approach Roads and CH 0 to 20	Into the proposed storm network at Ch. 50 draining to Pond 2
2	CH 20 to 1450	River Boyne (via the Boyne Navigation Canal)
3	CH 1450 to 2150	River Boyne at Ch. 1350
4	N51 East Upgrade, N51 West Upgrade and CH 2150 to 2640	Into the proposed storm network at CH 2040 draining to Pond 3
5A	CH 2640 to 2950	Watercourse at Ch. 2850
5B	CH 2950 to 3495	Watercourse at Ch. 2850
6	Northern Roundabout, Approach Roads and Proposed Footpath on Existing N2	Mattock (Mooretown) Stream at Ch. 3450

4.4.11.9 Culverts

This section is supported by **Volume 3 – Technical Drawings MDT0806-RPS-01-N2-DR-C-DR2001 – DR2002** (Culverts 6A, 6B and 6C Layout Plan) and **MDT0806-RPS-01-N2-DR-C-DR2003** (Culvert 6A Detail Plan).

The proposed alignment crosses a number of existing watercourses, agricultural drains and the River Boyne. Hydrological assessments were carried out to determine the design flow for each watercourse culvert. A factored IH 124 method was adopted to calculate the 1% AEP including a 20% allowance for climate change, with an allowance for a 100-year return period growth factor of 1.96 and hence the culverts will not impede on the hydraulic conveyance of the existing watercourse. In accordance with the requirements and stipulations set out in Section 50 of the Arterial Drainage Maintenance Act 1945 – The Office of Public Works specify the minimum size culvert for any watercourse shall be (minimum) 900 mm diameter. This has been applied as a minimum for all culverts located on watercourses. OPW Section 50 approvals to the above proposals was granted in October 2021.

Local watercourses crossed by the proposed scheme are proposed to be accommodated in culverts. The following provisions are proposed:

- Mattock (Mooretown) Stream at North Roundabout: 2.4 m x 2.4 m Box Culvert,
- Mattock (Mooretown) Stream mainline crossing, Ch. 3450: 1.8 m x 1.5 m Box Culvert,
- Mattock (Mooretown) Stream Access Road 6 Crossing: 1.8 m x 1.5 m Box Culvert.

The proposed design also includes for the removal of the existing culvert on the Mattock (Mooretown) Stream under the existing N2 at the northern end of the project.

4.4.11.10 Summary of any Other Drainage Proposals

4.4.11.10.1 Attenuation and Retention Storage

The attenuation storage required for the proposed road alignment was designed in accordance with the provisions of the TII design standard DN-DNG-03022, Drainage Systems for National Roads (including Amendment No.1 dated June 2015) and the requirements outlined in the Greater Dublin Strategic Drainage Study (GDSDS). This section is supported by **Volume 3 – Technical Drawings MDT0806-RPS-01-N2-DR-C-DR0000 – DR0008** (Drainage Layouts) and **MDT0806-RPS-01-N2-DR-C-DR1002** (Pond – Typical Detail).

It is well established that stormwater runoff rates from impervious surfaces, such as roadways, are considerably greater than those from an equivalent greenfield area. Best practice SUDS management

measures are now introduced throughout Ireland to attenuate runoff from new developments to replicate existing or greenfield conditions.

By using SuDS techniques, water can be infiltrated at source, collected and attenuated in swales or channels, or conveyed downstream via filter or carrier drains or surface water channels to attenuation ponds, prior to discharge to watercourses. This more closely replicates natural catchment behaviour where rainfall either infiltrates through the soil or runs off slowly over the ground surface to the nearest ditch or watercourse. Runoff is frequently delayed in natural ponds or hollows. In addition to delaying the rate of runoff, there is more likelihood in the natural situation that pollutants will be filtered through soils or broken down by bacteria. SuDS attempts to mimic this natural behaviour and results in attenuation of stormwater runoff and improved environmental performance.

The allowable discharge from the Proposed Scheme has been calculated in accordance with the requirements of the TII standard DN-DNG-03066 Design of Earthworks Drainage, Network Drainage, Attenuation & Pollution Control. Section 5.11 of this document states that "*In order to try to replicate the natural response of an undeveloped catchment, runoff rates from the site are restricted to closely match those of the pre-developed site. In doing so, attenuation storage is required to store the volumes of water occurring during storm events. The principle is that runoff for events of equivalent frequency of occurrence to the same peak rate of runoff that would have occurred pre-development. This is generally the greenfield rate (or other agreed rate in the case of brownfield sites). This slows down the response time to storm events and reduces the peak runoff rate. It does not greatly reduce the increase in runoff volume caused by developments. Infiltration systems can work well in achieving runoff volume reduction."* The pre-developed condition of the site contains a combination of greenfield and hardstanding areas. The allowable flow rate (Q_{BAR}) has been estimated using the Institute of Hydrology Report 124 (IH 124) to calculate the pre-development run-off from greenfield areas.

In the event of an accident spillage within the carriageway, each pond outfall shall be fitted with an emergency shut-off to prevent contaminants entering the downstream watercourse.

A breakdown of catchment areas in each section of the Proposed Scheme is outlined in **Table 4-22**. The post-development discharge from the scheme and the estimated retention and attenuation storage volume are outlined in **Table 4-23**.

Initial sizing of the proposed ponds resulted in an excessively large plan area being required for Pond 2 in order to provide the required retention and attenuation storage volume. In order to minimise land acquisition and the visibility of such a large pond, a decision to reduce the size required was made. This reduction in size also minimises the extent of proposed works within the SAC. The outfall from Pond 2 which discharges to the Boyne Navigation Canal, which is hydraulically connected to the River Boyne. Pond 2 can therefore be considered to ultimately discharge to the River Boyne – as is the case with Pond 3 which discharges directly to the River Boyne. As a result of this, it was considered feasible to adjust the flows from Ponds 3 and 4 to allow for a reduction in the size of Pond 2, while still maintaining the overall allowable outflow to the River Boyne. This has been achieved by reducing the outflow from Pond 4 to 10 l/s, from a calculated allowable of 21.8 l/s, thereby increasing the volume of attenuation storage to 1,500 m^3. The reduced outflow from Pond 4 flows back into the network and cascades into Pond 3. The allowable outflow from Pond 3 is the sum of the calculated allowable outflow from Pond 3 plus Pond 4 (14.7 l/s + 10 l/s = 24.7 l/s). The remaining allowable outflow from Pond 4 (11.8 l/s) is then added to the allowable outflow from Pond 2 to reduce the storage volume required.

It is proposed that Pond 1 outfalls to the drainage network and discharges into Pond 2, from where it ultimately discharges to the River Boyne via the Boyne Navigation Canal. The total allowable outflow from Pond 2 has been assessed as the sum of the allowable outflows from Pond 1 (6.7 l/s) plus Pond 2 (32.9 l/s), along with the allowance taken from Pond 4 (11.8 l/s) totalling 51.4 l/s. This gives a required volume of 1,650 m^3 in Pond 2. While the discharge rate from Pond 2 is increased, the rate from Pond 3 is decreased, meaning the overall allowable outflow entering the River Boyne is still equal to the allowable greenfield runoff for the 1-in-100 year design event.

While attenuation aims to reduce the rate of runoff from a development, the level of treatment provided is limited due to the shorter retention time in the ponds. In order to provide further water quality treatment, a permanent water retention pond is provided below the attenuation outlet level. The water level in the retention ponds is maintained by utilising an impermeable liner and the volume being sized to equal 15mm of rainfall on the hardstanding areas of the catchment. These retention ponds are designed in accordance with TII design standard DN-DNG-03022, Drainage Systems for National Roads (including Amendment No.1 dated June 2015) (formally NRA HD33/15) and TII design standard DN-DNG-03066, Design of Earthworks Drainage, Network Drainage, Attenuation & Pollution Control.

The inclusion of the permanent retention pond effectively provides a hybrid wetland/pond system as described in TII design standard DN-DNG-03063, Vegetated Drainage Systems for Road Runoff, where it is indicated that these hybrid systems are considered to be more effective than pond or wetland systems alone. To maximise potential runoff treatment and ecological benefits, the permanent retention pond shall be planted with species suitable for moderate to deep standing water. The remaining extents of the attenuation pond shall be planted with species tolerant of fluctuating water levels and duration.

A treatment forebay shall be provided at the inlet of the attenuation system by constructing a permeable bund across the pond. This forebay will allow any sediment entering the attenuation system to be trapped near the inlet and prevented from entering the downstream portion of the pond, therefore simplifying the required maintenance operations.

Table 4-22: Catchment Areas and Greenfield Run-off

Pond	Total Catchment Area (ha)	Hardstanding Area (ha)	Grass/Verge Area (ha)	Cutting Area (ha)	Greenfield Run-off (QBAR) (1 in 100 Year Return Period) (l/s)
1	1.361	0.665	0.608	0.082	6.71
2	6.668	2.845	0.740	3.083	32.88
3	2.971	1.427	0.470	0.984	14.65
4	4.413	1.950	1.097	1.360	21.76
5A	0.774	0.570	0.204	0.000	3.82
5B	1.729	1.024	0.359	0.344	8.52
6	1.372	0.944	0.408	0.020	6.77
Total	**19.288**	**9.424**	**3.886**	**5.873**	**95.2**

Table 4-23: Discharge, Retention and Attenuation Storage – Post Development

Section No.	Adjusted Discharge Rate (l/s)	Retention Volume Provided (m^3)	Attenuation Volume Provided (1 in 100 Year Return Period) (m^3)
1	6.7 (to pond 2)	99.72	290
2	**51.4***	426.79	1,650
3	**24.7***	213.98	790
4	10.0 (to Pond 3)	292.50	1,500
5A	**3.8***	85.43	260
5B	**8.5***	153.60	520
6	**6.8***	141.60	430
Total	**95.2**	**1,413.6**	**5,440**

As can be seen in the above tables, the total post-development discharge of 95.2 l/s during a 1:100 year storm event limits the discharge from the Proposed Scheme and mimics, or improves upon, the pre-development run-off methodology. This is in accordance with the TII and GDSDS requirements outlined previously in this section. A total of 5,440 m^3 of attenuation storage has been provided in the scheme.

4.4.11.10.2 Oil/Petrol Interceptors

In order to prevent petrochemicals or other substances, arising from accidental spillages from motor vehicles on the proposed scheme, discharging into the receiving watercourses, it is proposed to install Class 1 oil/petrol bypass interceptors upstream of where the drainage collection system discharges into the retention/attenuation ponds.

In total, there are seven no. oil/petrol interceptors proposed for the scheme. These will be Class 1 bypass interceptors, designed to provide for full treatment to 10% of the design maximum runoff, as this recognises that the greatest pollution load is carried by the 'first flush' of a rainfall event. The bypass interceptors will

comply with the requirements of the TII standard DN-DNG-03066 Design of Earthwork Drainage, Network Drainage, Attenuation and Pollution Control.

The oil/petrol bypass interceptors will have a capacity to retain silt and other deposits which may be included in the road run-off. Details of locations of the oil/petrol interceptors proposed for this scheme are outlined in **Table 4-24** below.

Table 4-24: Oil/Petrol Interceptor Schedule

Reference	Outfall	Pond/Section	Hardstanding Catchment Area (m^2)	Selected Unit
PI – 01	OF1	1	6,648	NSBE015
PI – 02	OF1	2	28,450	NSBE075
PI – 03	OF2	3	14,265	NSBE030
PI – 04	OF2	4	19,500	NSBE040
PI – 05A	OF3	5A	5,695	NSBE015
PI – 05B	OF3	5B	10,240	NSBE020
PI – 06	OF4	6	6,359	NSBE015

4.4.11.10.3 Hydrodynamic Vortex Grit Separators

Hydrodynamic vortex grit separators, referred to as vortex separators, are proprietary products designed to remove sediment and floatable debris from road surface runoff. It is proposed to provide a vortex separator upstream of each oil/petrol interceptors and attenuation pond, further reducing the potential sediment load in flows discharging from the road drainage system.

Appropriate proprietary units shall be provided for each vortex separator ensuring adequate sediment removal and flow capacity for each drainage network's catchment area and design flows. Each unit shall be suitably located to facilitate safe access for maintenance operations.

4.4.11.11 Drainage Proposals in Slane Village

4.4.11.11.1 Existing Drainage

The existing drainage network in Slane Village consists of surface water carrier drains and combined sewers. The road pavement on the existing N2 and N51 drain to road gullies which discharge to the surface water/ combined sewer network. At some locations, where the existing footpath falls away from the road, linear drainage channels have been provided to collect run-off.

There are two existing outfalls to the River Boyne which convey surface water run-off from the village. One of these outfalls discharges to the Boyne from the existing N2 near the northern end of the existing Slane Bridge. Utility survey records indicate that this outfall conveys surface water run-off only to the river. The other outfall is located from the existing N51 to the west of the Proposed Scheme. Utility survey records indicate that this outfall conveys combined foul and surface water flows to the river.

4.4.11.11.2 Proposed Drainage

The drainage design for Slane Public Realm Enhancement includes the following proposals:

- Existing drainage network to be retained wherever possible;
- Drainage chamber covers to be adjusted as required to suit proposed ground levels;
- Sections of drainage network to be diverted where required to allow for Public Realm design proposals e.g. tree planting;
- Redundant road gullies to be removed where appropriate and new road gullies to be provided along proposed kerb lines;
- Linear drainage channels to be provided at back of footways / cycleways at locations where crossfall towards the road cannot be maintained; and

- Bypass oil / fuel separator to be provided at existing surface water drainage outfall to River Boyne. This will improve water quality of flows discharging to the watercourse.

This section is supported by **Volume 3 – Technical Drawings MDT0806-RPS-01-PR-DR-C-DR9000 – DR9012** (Public Realm Drainage).

4.4.11.12 Environmental Emergency Procedures

As set out above, the design for the Proposed Scheme has been developed in order to ensure there will not be any uncontrolled run-off or spillage to the River Boyne or its tributaries, or the SAC and SPA. However, in the unlikely event that some accidental spillage occurs, it will be critical that an emergency procedure is in place.

Therefore, prior to opening of the bypass, the appointed operator shall prepare an Environmental Emergency Response Plan, which fully incorporates the mitigation requirements outlined in **Chapter 15 – Biodiversity: Terrestrial Ecology**, **Chapter 16 – Biodiversity: Aquatic Ecology**, **Chapter 17 – Water**, and the NIS (available under separate cover).

4.4.12 Utilities

4.4.12.1 Introduction

Utility Providers were contacted and requested to provide information regarding the location and nature of any existing plant each service provider may have within the area traversed by the Proposed N2 Slane Bypass and Public Realm Enhancement Scheme. Responses received indicated that Eir, ESB and Irish Water all have utilities in the area. The majority of the other utility companies responded confirming that they do not currently own any plant within the study area and have no plans to construct any new plant within the study area in the foreseeable future.

Section 4.4.12.2 below provides an overview of existing services affected by the Proposed bypass and summarises correspondence with each utility provider. **Section 4.4.12.3** below provides a summary of the proposed measures for utility conflicts encountered on the Proposed Scheme. **Section 4.4.12.3** below provides a description of the existing and proposed measures for utilities with Slane village.

This section is supported by **Volume 3 – Technical Drawings MDT0806-RPS-01-N2-DR-C-UT0000 – UT0007** (Mainline and Side Roads - Utilities), **MDT0806-RPS-01-PR-DR-C-UT8000 – UT8010** (Public Realm - Existing Utilities) and **MDT0806-RPS-01-PR-DR-C-UT9000 – UT9010** (Public Realm - Proposed Utilities).

4.4.12.2 Overview of Existing Services - Bypass

4.4.12.2.1 Gas

Gas Networks Ireland (GNI) confirmed as of February 2020 that they have no services in the area.

4.4.12.2.2 Electricity

ESB overhead lines are encountered on the Proposed Scheme at multiple locations, including:

N2 Mainline:

- Medium Voltage (MV) overhead line crosses the Proposed Scheme between Ch. 150 to 350;
- MV overhead line runs adjacent to the Proposed Scheme between Ch. 885 to 1500;
- MV overhead line crosses the Proposed Scheme at approximately Ch. 950;
- MV overhead line crosses Attenuation Pond 2 at approximately Ch. 1200;
- MV overhead line crosses raised towpath at approximately Ch. 1250;
- MV overhead lines crosses access track (Overbridge 3) at approximately Ch. 1575; and
- MV overhead line crosses the Proposed Scheme at approximately Ch. 1650.

N51 West:

- MV overhead line crosses the Proposed Scheme at approximately Ch. 350; and
- Low Voltage (LV) overhead lines crosses the Proposed Scheme at approximately Ch. 400.

N51 East:

- MV overhead line runs between adjacent to the Proposed Scheme between Ch. 115 to 390;
- MV overhead line crosses the Proposed Scheme at approximately Ch. 375; and
- High Voltage (HV) overhead line crosses the Proposed Scheme near tie-in to existing N51.

Works affecting electricity services must be carried out strictly in accordance with the ESB Code of Practice. Where construction equipment passes under lines, goalpost barriers will be established either side of the line, ensuring that high vehicles will not come into contact with overhead lines during construction. A No-tip zone will also be established within 10 m of power lines. All proposed poles will be placed at a sufficient distance from proposed earthworks.

For LV, 10 kV, 20 kV, and 38 kV lines, an Exclusion Zone shall be established within a 3 m radius of the overhead lines and a Hazard Zone will be established within a lateral distance of 6 m either side the lines. For 220 kV lines, an Exclusion Zone shall be established within a 6 m radius of the overhead lines and a Hazard Zone will be established within a lateral distance of 10 m either side the lines. Contractors are to be made aware there is a possibility that lines may sag and move as a result of weather conditions.

A description of the utilities relating to the Public Realm Enhancement proposals in Slane village are included in **Section 4.4.12.4**.

4.4.12.2.3 Water

Water mains are encountered on the Proposed bypass at several locations, including:

- Along existing N2 at the southern end of the Proposed Scheme;
- Along existing Rossnaree Road;
- Along existing N51; and
- Along existing N2 at the northern end of the Proposed Scheme.

4.4.12.2.4 Sewer

Irish Water records indicate that sewer lines should not be encountered on the proposed bypass.

4.4.12.2.5 Telecoms

Eir underground and overhead services are encountered on the proposed bypass at several locations, including:

- Underground cables and overhead lines along existing N2 at southern end of the Proposed Scheme;
- Overhead lines along existing Rossnaree road;
- Underground cables and overhead lines along existing N51; and
- Underground cables and overhead lines along existing N2 at northern end of the Proposed Scheme.

4.4.12.2.6 Unknown Utilities

Slit trench ST303 and GPR utility survey, carried out on the existing N51, discovered two utility lines in the verge along the westbound side of the road, near the location of the proposed N51 Roundabout. These utility lines are described in the slit trench records as follows:

- **Diameter:** 30 mm
- **Colour:** Grey

- **Material:** Metal
- **Utility:** ESB

Although the slit trench records indicate that these utility lines belong to the ESB, they are not indicated on any of the records received from ESB Networks or any other service provider.

No specific measures are currently recommended for these unknown utilities; however, they will be considered further during the Proposed Scheme's detailed design as a diversion may be required.

4.4.12.3 Summary of Utility Conflicts

Table 4-25 below provides a summary of the utility conflicts expected to be encountered on this Proposed Scheme and the recommended measures for each conflict.

Table 4-25: Summary of Utility Conflicts

Location	Description of Service	Conflict	Recommended Measures
N2 Mainline Ch 150 to 350	ESB 10kv - 20kv OH	ESB powerlines cross the proposed road alignment diagonally. Existing poles clash with proposed road alignment.	Relocate lines to cross the route perpendicularly at Ch 75
N2 Mainline Ch 885 to 1500	ESB 10kv - 20kv OH	ESB powerlines run parallel to west side of proposed alignment close to the top edge of earthworks	Relocate lines further west to ensure poles do not clash with Proposed Scheme works
N2 Mainline Ch 950	ESB 10kv - 20kv OH	ESB powerlines cross the proposed alignment with a pole located at the top of the earthworks on west side of proposed alignment	Relocate line to ensure pole does not clash with Proposed Scheme works. Ensure appropriate measures are taken for construction under power lines.
N2 Mainline Ch 1100 to Ch. 1550	ESB 10kv - 20kv OH	ESB powerlines, located west of mainline alignment, cross pedestrian / cyclist link, raised towpath and Pond 2. Poles clash with attenuation pond's earthworks and temporary working platform required to construct the River Boyne Bridge. Overhead line also within swing / fall radii of crane's that will be operating during bridge construction.	Relocate line to ensure poles do not clash with Proposed Scheme works and line's hazard zone is outside swing / fall radii of cranes. Relocated line to be provided at sufficient height to provide necessary clearance. Ensure appropriate measures are taken for construction under power lines.
N2 Mainline Ch 1575	ESB 10kv - 20kv OH	ESB Powerlines cross proposed access track	Ensure appropriate measures are taken for construction under power lines
N2 Mainline Ch 1650	ESB 10kv - 20kv OH	ESB powerlines cross the proposed road alignment. Existing poles clash with proposed road alignment.	Relocate lines with perpendicular crossing of road alignment ensuring poles do not clash with Proposed Scheme works
N51 West Ch 350	ESB 10kv - 20kv OH	ESB powerline crosses the proposed road alignment.	Ensure appropriate measures are taken for construction under power lines
N51 West Ch 400	ESB LV OH	ESB powerline crosses the proposed road alignment.	Ensure appropriate measures are taken for construction under power lines
N51 East Ch 375	ESB 10kv - 20kv OH	ESB powerline crosses the proposed road alignment.	Ensure appropriate measures are taken for construction under power lines
N51 East Ch 390 to 550	ESB LV OH	ESB powerlines clash with proposed road alignment.	Relocate line to ensure pole does not clash with Proposed Scheme works. Ensure appropriate measures are taken for construction under power lines.
N51 East Ch 575	ESBI 220kV OH	ESB powerlines cross proposed road alignment near tie-in with existing N51	Ensure appropriate measures are taken for construction under power lines
North Roundabout – N2 South Link	ESB LV OH	ESB powerlines cross proposed footpath link to Slane at several locations.	Ensure appropriate measures are taken for construction under power lines

Location	Description of Service	Conflict	Recommended Measures
(N2 Mainline Ch 3495)			
South Roundabout (N2 Mainline Ch 0)	Eir Underground Cable	Eir cable runs underneath proposed roundabout junction and associated links to existing N2	Eir ducting to be protected in place during construction. Access covers on chambers to be raised / lowered as required.
Rossnaree Road (N2 Mainline Ch 1100)	Eir Overhead Line	Eir line runs along existing Rossnaree road which is to be replaced with overbridge.	Overhead line to be diverted underground through ducts which will cross overbridge along raised verge.
N51 West Ch 0 to 420	Eir Underground Cable	Eir cable runs underneath realigned carriageway and verge.	Eir ducting to be protected in place during construction. Access covers on chambers to be raised / lowered as required. Chamber access covers in realigned carriageway to be replaced with suitable D400 grade covers if not already in place.
N51 West Ch 420 to 710	Eir Underground Cable	Eir cable runs underneath existing verge adjacent to realigned road.	Eir ducting to be protected in place during construction.
N51 West Ch 710 to 815 / N2 Mainline Ch 2250	Eir Underground Cable	Eir cable runs underneath verge along redundant section of existing N51, crossing under proposed N2 Mainline. Proposed road alignment is in shallow cutting at this location and it is likely that there will be insufficient remaining cover depth to keep existing ducting in place.	Eir cable to be diverted in new ducting installed in proposed road verge along realigned N51 with perpendicular crossing of N2 Mainline.
N51 East Ch 525 to 600	Eir Underground Cable	Eir cable runs underneath realigned carriageway and verge.	Eir ducting to be protected in place during construction.
North Roundabout – N2 South and N2 North Links	Eir Underground Cable	Eir cable runs underneath proposed links to existing N2	Eir ducting to be protected in place during construction. Access covers on chambers to be raised / lowered as required.
South Roundabout (N2 Mainline Ch 0)	Water Main	2 no. water mains proposed roundabout junction and associated links to existing N2	Water mains and associated apparatus to be protected in place during construction.
Rossnaree Road (N2 Mainline Ch 1100)	Water Main	Water main runs along existing Rossnaree road which is to be replaced with overbridge.	Water main to be diverted through duct which will cross overbridge along raised verge.
N51 West Ch 0 to 420	Water Main	Water main runs underneath realigned carriageway and verge.	Water mains and associated apparatus to be protected in place during construction.
N51 West Ch 420 to 710	Water Main	Water main runs underneath existing verge adjacent to realigned road.	Water mains and associated apparatus to be protected in place during construction.
N51 West Ch 710 to 815 / N2 Mainline Ch 2250	Water Main	Water main runs underneath verge along redundant section of existing N51, crossing under proposed N2 Mainline. Proposed road alignment is in shallow cutting at this location and it is likely that there will be insufficient remaining cover depth to keep existing water main in place.	Water mains and associated apparatus to be protected in place during construction. Additional protection measures may be required due to reduction in cover depth.
N51 East Ch 500 to 600	Water Main	Water main runs underneath realigned carriageway and verge.	Water main to be diverted to proposed road verge along realigned N51 with perpendicular crossing of N2 Mainline

Location	Description of Service	Conflict	Recommended Measures
North Roundabout – N2 South and N2 North Links	Water Main	Water main runs underneath proposed links to existing N2	Water main to be protected in place during construction.

4.4.12.4 Utilities Within Slane Village

The utilities identified within the Proposed Scheme in Slane village include:

- **ESB Electricity Network:** ESB ducting is present on all road within the public realm enhancement area, with frequent overhead powerlines also crossing the carriageway in all areas. Overhead ESB cables and poles are present along the eastern verge of the N2 Chapel Street, and also along the southern verge of the N51 Main Street East;
- **Water Mains:** Irish Water watermains run under all roads within the village, both under the carriageway and under the footpaths;
- **Foul & Storm Water Drainage:** Foul sewers, combined sewers and surface water drains run under the carriageway/ footpaths on all roads in the village; and
- **Eir:** Eir underground network runs under the footpath on all roads in the village. Eir fibre optic cables are present under the southern footpath along the N51 Main Street West and under the northern footpath along the N51 Main Street East. Overhead Eir cables frequently cross the carriageway on all roads within the village.

This section is supported by **Volume 3 – Technical Drawings MDT0806-RPS-01-PR-DR-C-UT8000 – UT8010** (Public Realm - Existing Utilities) and **MDT0806-RPS-01-PR-DR-C-UT9000 – UT9010** (Public Realm - Proposed Utilities).

4.4.12.4.1 Proposed Utility Works

Existing public utilities affected by the Proposed public realm improvements may need to be diverted to a suitable location to accommodate the works or be protected in place. Any diversion of public utilities will ensure that future access to the utilities is convenient. The new location of the services will ensure that future performance of the service is not affected and will enable safe construction of the development.

One of the objectives of the strategy for the Slane public realm enhancement is to "*enhance the character of the village by under-grounding services*". To this end, existing overhead services will be relocated underground and poles removed throughout the area within the Slane Village Architectural Conservation Area (ACA) where reasonably practicable. Consultations with utility providers have not identified the need for additional supplies or other proposals to upgrade or provide new services. This consultation will be revisited during detailed design stage of this project. Any additional service needs identified will be catered for at that stage.

The following sections detail the potential changes and interventions to the existing services encountered that are required as a result of the proposed works within the village. All other utilities and services are to be retained and protected in place. Chamber access covers will be raised/ lowered as required to suit proposed ground levels. New access covers will be provided, where necessary.

4.4.12.4.2 ESB

- Ch. 17 N51 Main Street West, road crossing – Existing 10/20kV cable to be diverted underground;
- Ch. 165 N51 Main Street West, southern verge – Exact location of ESB underground services to be confirmed on site to avoid clash with proposed planting;
- Ch. 100 to Ch. 172 N51 Main Street East, southern verge – Existing 10/20kV cable to be diverted underground;

- Ch. 20 to Ch. 325 N2 Chapel Street, eastern verge / carriageway – Existing 10/20kV cable to be diverted underground;
- Ch. 67 N2 Chapel Street, road crossing – Existing 10/20kV cable to be diverted underground;
- Ch. 110 N2 Chapel Street, road crossing – Existing 10/20kV cable to be diverted underground;
- Ch. 155 N2 Chapel Street, road crossing – Existing 10/20kV cable to be diverted underground;
- Ch. 202 N2 Chapel Street, road crossing – Existing 10/20kV cable to be diverted underground;
- Ch. 264 N2 Chapel Street, road crossing – Existing 10/20kV cable to be diverted underground; and
- Ch. 312 N2 Chapel Street, road crossing – Existing 10/20kV cable to be diverted underground.

4.4.12.4.3 Eir

- Ch. 65 N51 Main Street West, road crossing – Existing Eir overhead service to be diverted underground;
- Ch. 216 N51 Main Street West, road crossing – Existing Eir overhead service to be diverted underground;
- Ch. 15 N51 Main Street East, road crossing – Existing Eir overhead service to be diverted underground;
- Ch. 1021 N2 South, road crossing – Existing Eir overhead service to be diverted underground;
- Ch. 536 to Ch. 640 N2 South, eastern verge – Existing Eir overhead service to be diverted underground;
- Ch. 640 N2 South, road crossing – Existing Eir overhead service to be diverted underground; and
- Ch. 94 N2 Chapel Street, road crossing – Existing Eir overhead service to be diverted underground.

4.4.12.4.4 Irish Water Watermain

- Ch. 29 N51 Main Street West, northern verge – Existing Watermain to be slewed to avoid tree pit;
- Ch. 60 N51 Main Street West, southern verge – Existing Watermain to be slewed to avoid tree pit;
- Ch. 150 to Ch. 180 N51 Main Street West, southern verge – Existing Watermain to be slewed to avoid tree pit;
- Ch. 1010 to Ch. 1030 N2 South, western verge – Exact location of Watermain to be confirmed on site to avoid clash with proposed planting; and
- Ch. 83 to Ch. 100 N51 Main Street East, northern verge – Exact location of Watermain to be confirmed on site to avoid clash with proposed planting.

4.4.13 Public Realm and Traffic Management in Slane

As part of the development of the Public Realm Plan for Slane Village, prepared by MCC and published in August 2022[5], enhancement proposals for the scenario of when a bypass would be in place have been included as part of the overall Proposed Scheme. This encompasses the traffic management/calming proposals developed as part of the Proposed Scheme. The enhancement proposals also include for significant change of character and improved public realm for the village centre, in particular on the north-south route. Improvements can still be made east-west which improve the setting and provide for improved management of the residual traffic (predominantly east-west traffic) by reducing traffic speeds and facilitating ease of movement on the east and west route through the village. The introduction of planting will help

[5] MCC (August 2022) Public realm Plan for Slane Village. Available at: https://www.meath.ie/council/council-services/planning-and-building/development-plans/public-realm-plans/slane-public-realm-plan-august-2022

improve the pedestrian experience and can help reduce air pollution. The significant reduction of traffic over the existing old bridge will allow this area to be redefined as a destination with potential links along the river.

This element of the Proposed Scheme aims to deliver an improved public realm for the village of Slane following opening of the proposed N2 Bypass, as well as providing measures to best manage the residual traffic travelling through the village. The proposals include the reorganisation of the N2 and the N51 passing through the village and the redesign of the N2/N51 junction (the 'Square'), creating a new village centre. It is also proposed to provide a new off-streetcar park, accessed off the N51 with pedestrian connectivity to the existing N2, and a new shared pedestrian/cyclist facility extending from the village centre to St Patrick's National School. The proposed extent of the Slane Public Realm Enhancement Scheme is indicated in **Figure 4.18**.

The broad proposals anticipated for inclusion in the public realm enhancement within Slane village include:

a. New junction design including reorganised traffic lanes, pedestrian crossings, resurfacing and planted verges to create a village square as a new focus to the village centre and to improve continuity and quality of footways to increase pedestrian comfort;

b. Raised tables/ramps with pedestrian crossings to create safe and regular pedestrian crossing points along the N-S and E-W roads and tightening of the carriageway as traffic calming measures;

c. Enhance the general character of the area by implementing a greening strategy with new tree planting to enhance the character of the streetscape and reduce air pollution, taking care not to obscure valuable facades and significant views within Slane Village ACA;

d. Improved sustainable transport measures within the village. Enhancement of active travel by improved accessibility for pedestrians and cyclists, including bike parking and public transport facilities such as improved bus stops, and pedestrian/cyclist crossings;

e. Rationalise and unify street furniture including lighting and remove street clutter such as the existing traffic gantries;

f. Narrowed carriageway where possible with pockets of parallel parking;

g. Improve continuity and quality of footways to increase pedestrian comfort;

h. Reorganised carriageway on the existing N2 to the existing Boyne bridge: Width reduced to 6.4m with 2 lanes of traffic (1+1); planted verges to create a pedestrian friendly environment and reduce air pollution; improved pedestrian footpaths and cycle facilities; and new tree planting to enhance the character of the N2 in the vicinity of the existing lay-by south of the bridge;

i. Off-streetcar park accessed from N51 with pedestrian/cyclist link to the existing N2;

j. Enhance the character of the village by undergrounding all services in the ACA; and

k. Defined footway on the existing bridge with physical separation from traffic for a safer pedestrian experience.

This section is supported by: **Volume 3 – Technical Drawings MDT0806-RPS-01-PR-DR-C-GA9000 – GA9008** (General Arrangement); **MDT0806-RPS-01-PR-DR-C-GA9201** (General Arrangement – Car Park Layout); **MDT0806-RPS-01-PR-DR-C-GE9000 – GE9011** (Public Realm Geometrics); **MDT0806-RPS-01-N2-DR-C-CS9000 – CS9002** (Cross Sections); **MDT0806-RPS-01-PR-DR-C-KP9000 – KP9008** (Public Realm Kerbs and Pavement); and **MDT0806-RPS-01-PR-DR-C-RM9000 –RM9006** (Public Realm Road Markings & Signals). The following sections describe the proposed measures in more detail.

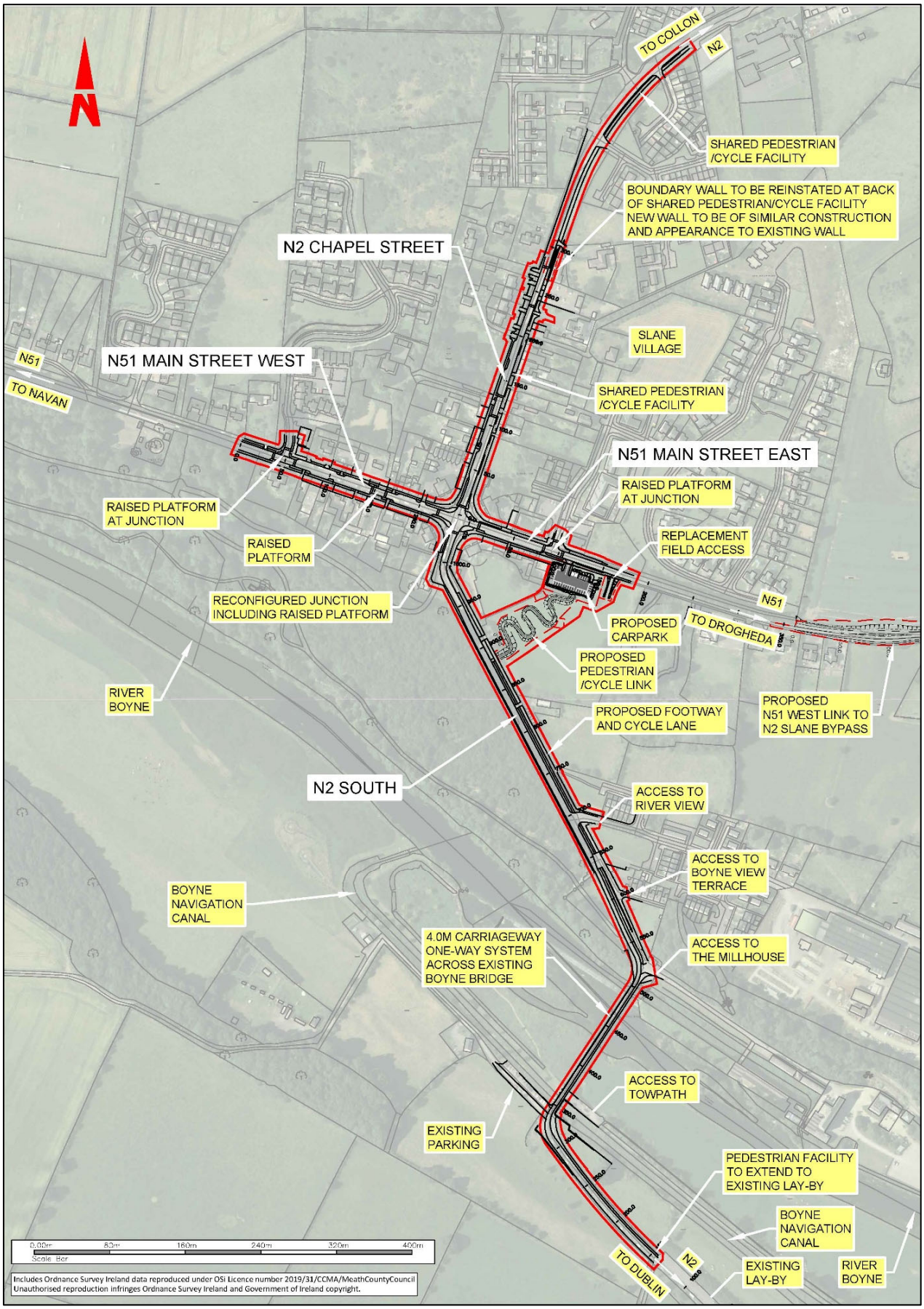


Figure 4.18: Proposed Extent of Slane Public Realm Enhancement

4.4.13.1 N2 Chapel Street

Proposals include footpath enhancements on both sides of the street with natural stone paving and granite kerbs. It is proposed to provide a consistent carriageway width of approximately 6.4 m along the street from Ch. 0 to Ch. 300. The ghost island and turning lanes approaching the N2/N51 junction will be removed with a single southbound lane to be provided on the approach to the proposed priority junction.

It is proposed to provide a shared pedestrian/cycle facility on the southbound/eastern side of the road extending north as far as St. Patrick's National School. Between Ch. 0 to Ch. 300, the width of the shared facility varies but is generally no less than 3.8 m from carriageway edge to the back of the path. Occasional pinch points will occur such as at steps to building entrances. The footway along this section is to be increased in width to accommodate this facility from 2.7 m to 4.0 m in width. Low level planting (kept to a minimum width to maximise space) will be provided between the shared facility and the road at suitable locations.

On-street car parking on the northbound/western side of the street will be retained and demarcated. On-street parking is to be provided along the northbound/western side of the road only; spaces will be provided between Ch. 80 to Ch. 195, with spaces omitted as required to allow for vehicular accesses and proposed kerb build outs (tree planting will be provided on this side of the road where appropriate). The width of the northbound/western footpath will be reduced slightly in places to accommodate this parking, but will maintain a minimum footway width of 2.0 m. To accommodate existing and future bus services, in-line bus stops are to be demarcated on the southbound and northbound sides of the road at approximately Ch. 35 and Ch. 55 respectively.

Two new raised platforms with ramped access on two sides will be provided along the street to reduce traffic speed and provide safe pedestrian crossing points. One of the raised platforms is located at a key space in front of St Patrick's Church and the Health Centre. These raised platforms will be surfaced in natural stone paving to enhance local character and reinforce pedestrian use. New controlled and uncontrolled pedestrian crossings will be provided with tactile flags and flush kerbs to further enhance crossing safety.

A cast-iron water pump/hydrant (NIAH Reg No: 14315051) located on the northbound/western side of Chapel Street will be temporarily relocated to avoid clashing with the realigned kerbing. It will be taken up and protected until it can be reinstated at a suitable position within the vicinity of its current location. The streetscape will be greened where possible through provision of new street trees and mixed shrub/ hardy perennial planting in strips at the roadside to soften the street's appearance. Overhead services will be undergrounded to enhance the visual quality. **Figure 4.19** and **Figure 4.20** illustrate the proposed measures. A typical proposed cross section for the N2 Chapel Street is illustrated in **Figure 4.21**.

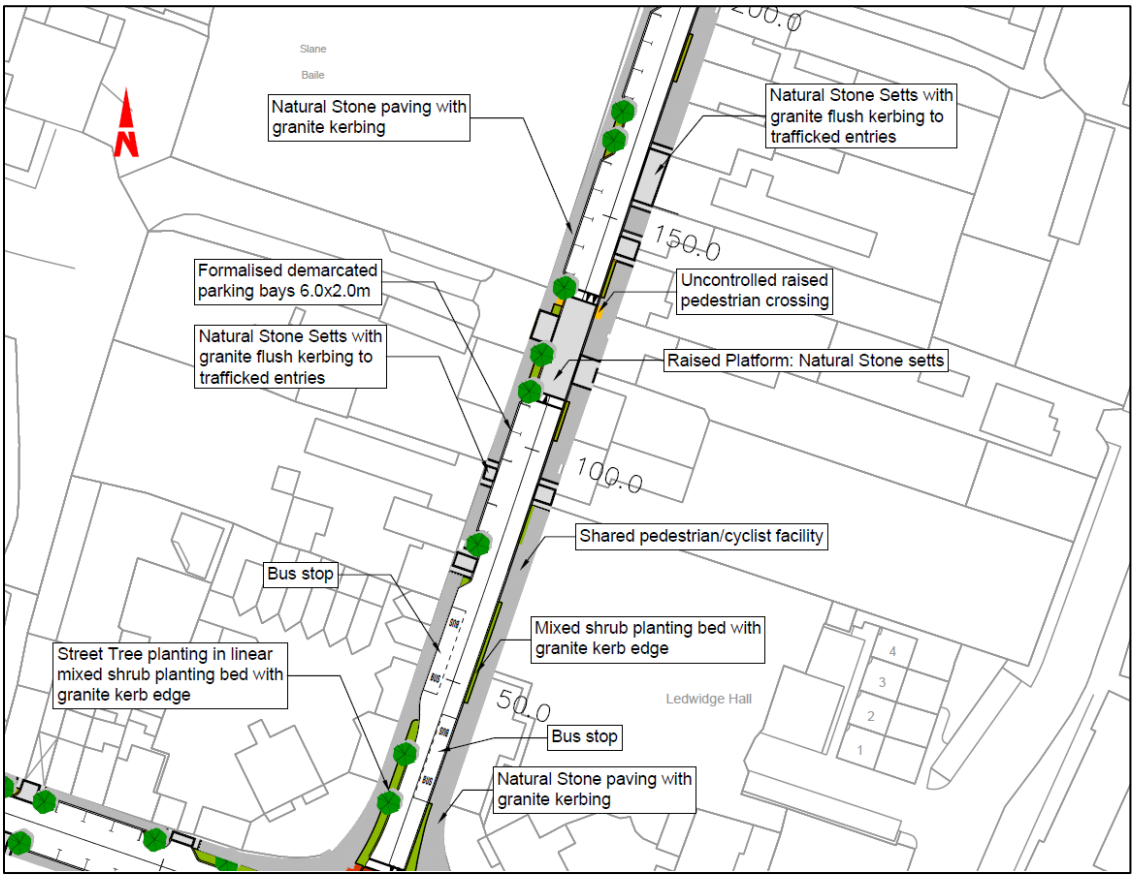


Figure 4.19: Public Realm Proposals for Existing N2 Chapel Street North of the Square

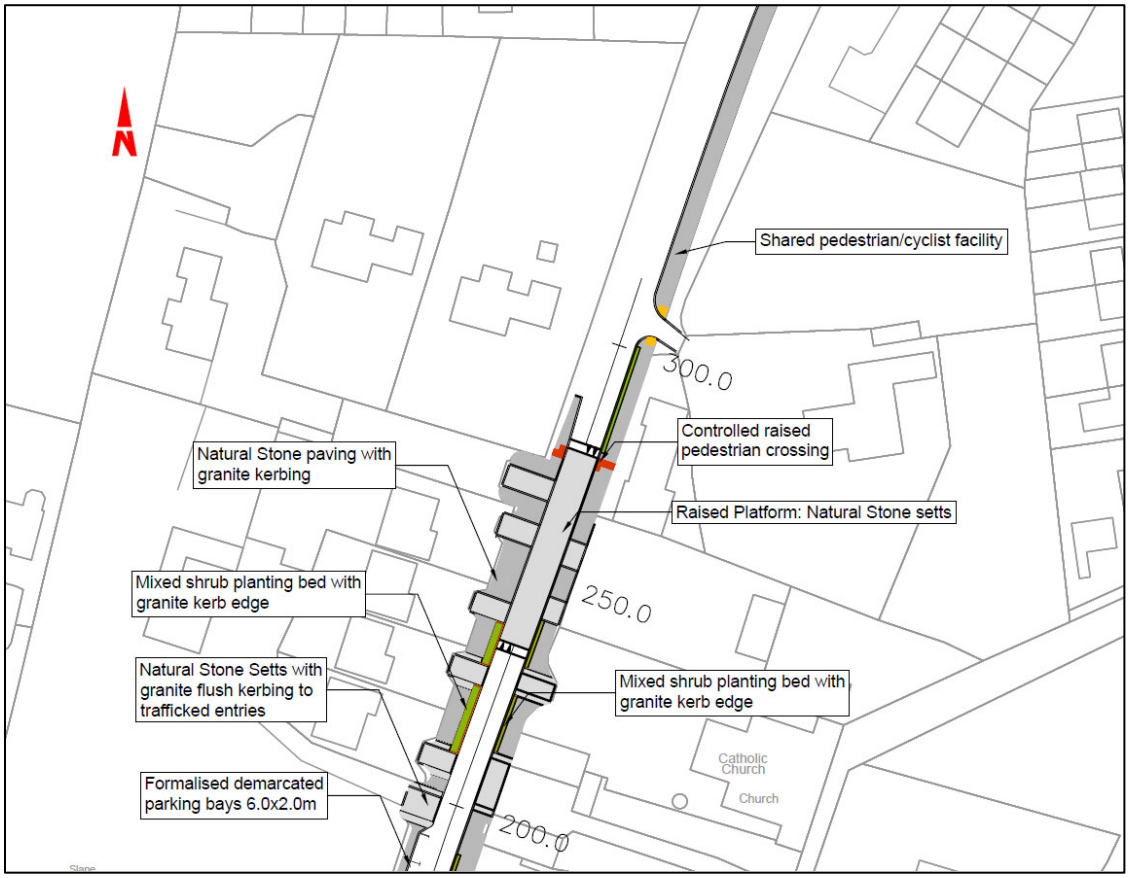
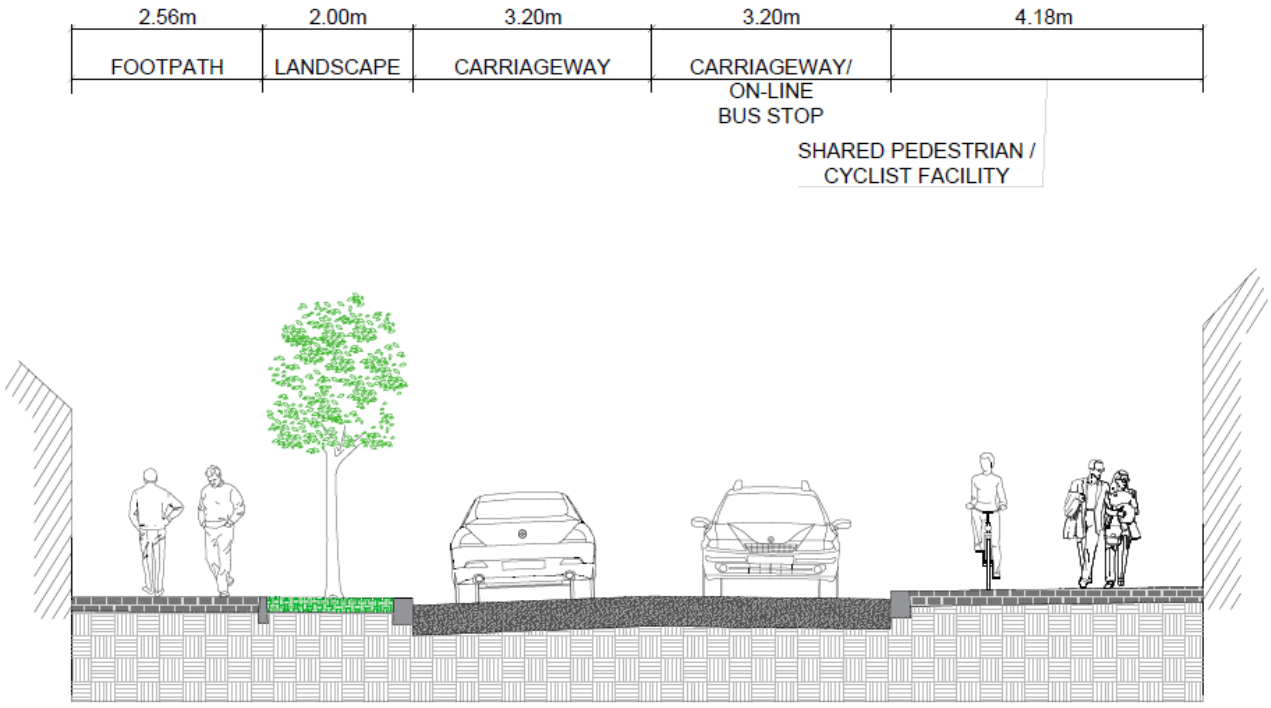


Figure 4.20: Public Realm Proposals for Chapel Street from St Patrick's Church to Stanley Heights



Note: Public lighting or street furniture is not displayed on the cross section

Figure 4.21: Typical Proposed Cross Section – Existing N2 Chapel Street (Section at Ch. 35)

4.4.13.2 N2 South

As the large majority of HGVs will be removed from this route following the opening of the N2 Slane Bypass, it is proposed to remove the extra lane for segregating heavy vehicles from light vehicles. A consistent carriageway width of approximately 6.4 m will be provided between Ch. 655 to Ch. 1040, with some lane widening being required around the tight bend at Ch. 990. A traffic light controlled one-way system, with a 4.0 m wide carriageway, is proposed from Ch. 330 to Ch. 655 which includes the crossing of the existing Slane Bridge. It is not proposed to provide any on-street parking along this road.

A soft landscape area is proposed between the footpath and the road with tree planting at appropriate intervals. A link, providing access for pedestrians to the proposed car park at the N51, is to join the footpath along the existing N2 South at approximately Ch. 880, requiring an approximately 5.0 m wide new opening in the existing stone wall. A one-way cycle track is proposed beside the footpath on the eastern side of the road extending from the existing bridge to the car park's pedestrian/cyclist link. This cycle track is to be used by northbound cyclists who will be travelling uphill.

From Ch. 560 to Ch. 640, it is proposed to provide the footpath and cycle track on the road side of the retaining wall at the access to Boyne View Terrace. This avoids the need for pedestrians or cyclists to use the excessively steep existing footpath which rises up behind the retaining wall. It is proposed to realign the road at Ch. 990 to remove the pinch point and allow the footpath to be significantly widened around the tight bend. Pedestrians will be able to cross the bridge on an approximately 2.0 m wide footway which shall be provided at existing road level. Physical separation shall be provided between this footway and the carriageway.

Footpaths will be enhanced throughout with natural stone paving and granite kerbs. Smaller units of natural stone setts will define accesses and side roads including the existing access to the Millhouse. Strategically located fingerposts will be provided to orientate pedestrians/ cyclists and to enhance the visitor experience. Overhead gantries will be removed from the existing N2 further improving the visual quality of this area.

Figure 4.22 and **Figure 4.23** illustrate the proposed measures. A typical proposed cross section for the N2 South is illustrated in **Figure 4.24**.

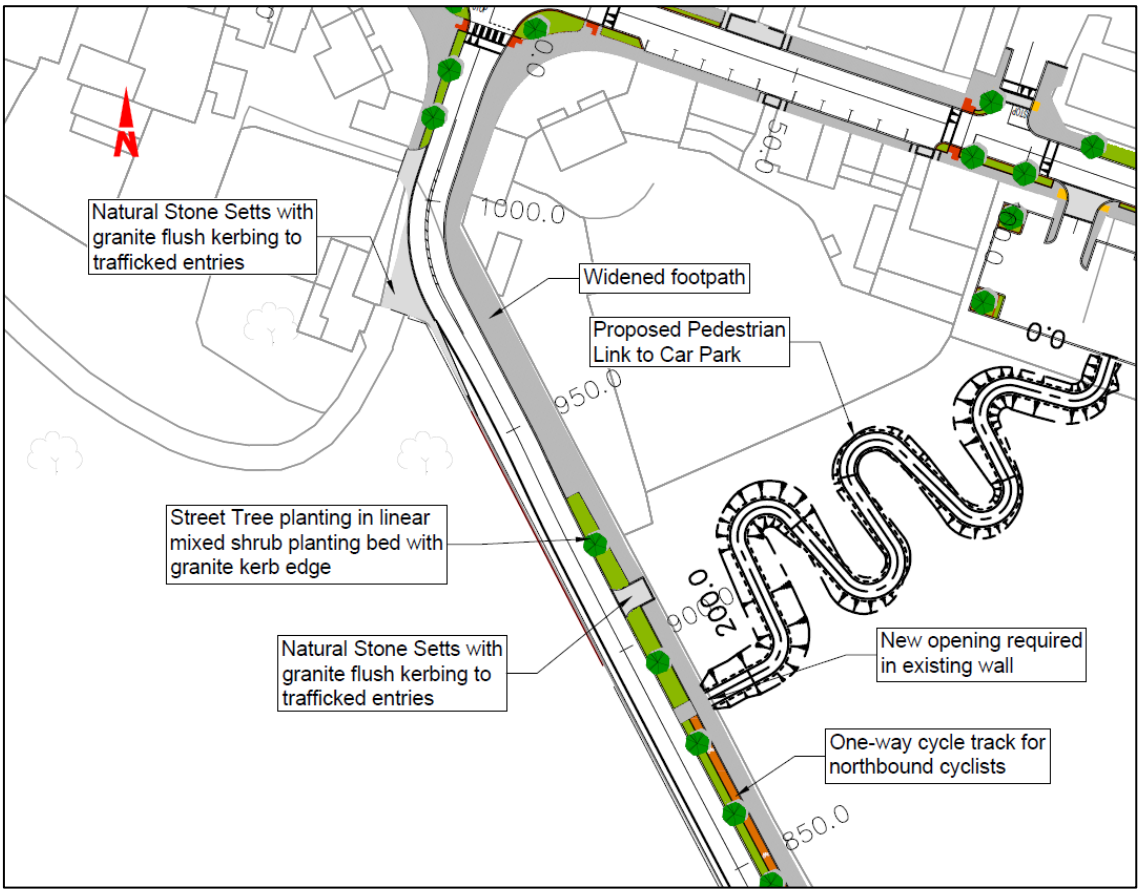


Figure 4.22: Public Realm Proposals for Existing N2 South from the Square

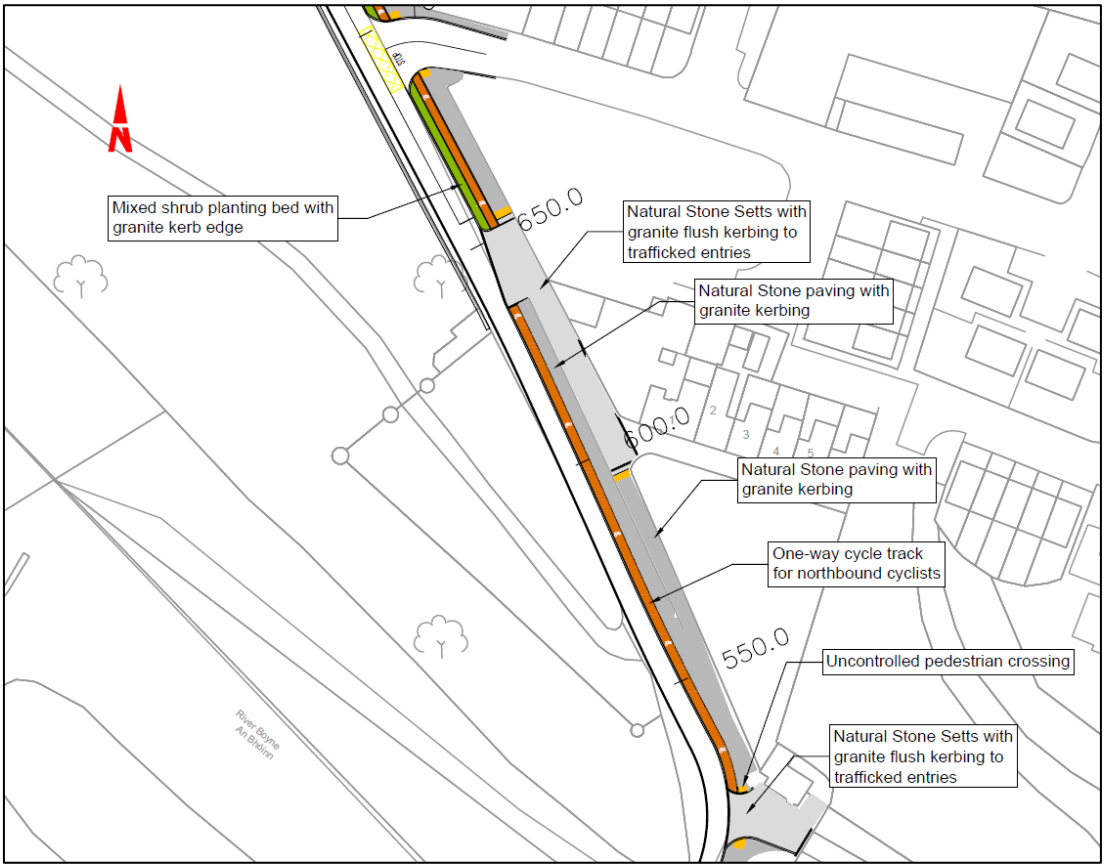
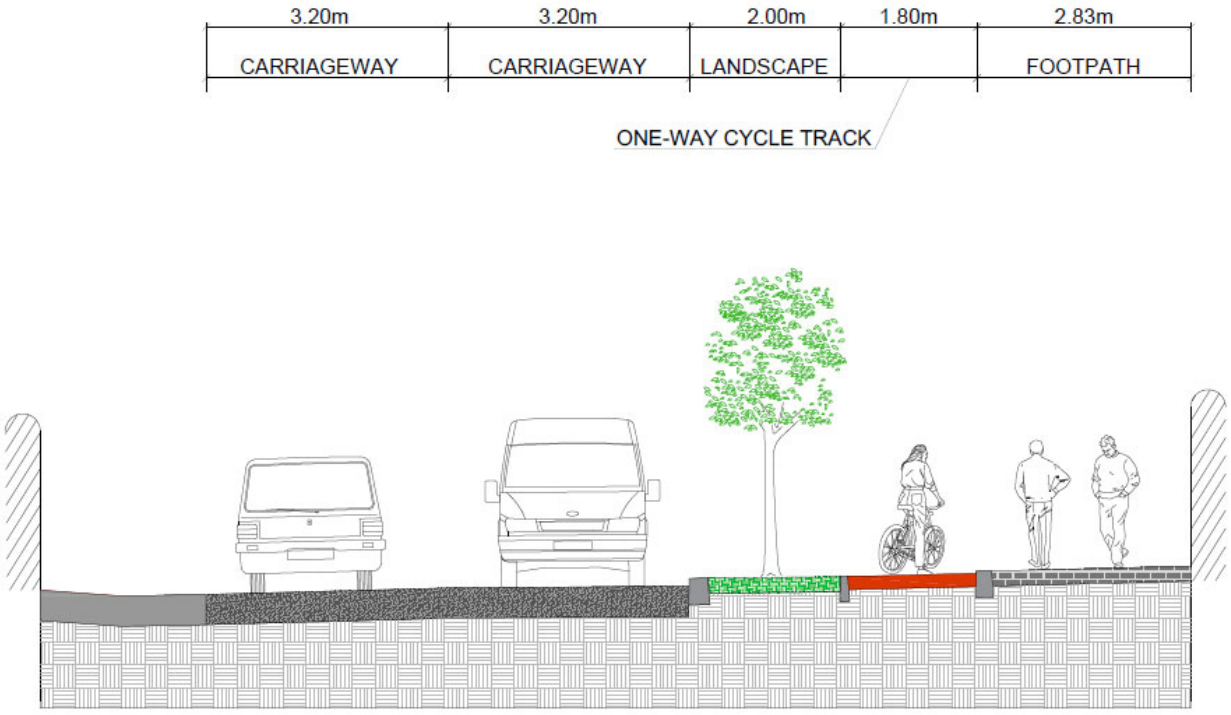


Figure 4.23: Public Realm Proposals for Lower Existing N2 South approaching River Boyne



Note: Public lighting or street furniture is not displayed on the cross section

Figure 4.24: Typical Proposed Cross Section – Existing N2 South (Section at Ch. 850)

4.4.13.3 N51 Main Street West

The design proposals include strategic tree planting and a raised platform at the western approach to the village centre located at the junction with the access to Churchlands at Ch 50. This platform will be surfaced in asphalt which may be colour contrasted and will have ramped access on three sides. Pedestrian safety will be improved at this junction through the reduction of traffic speeds due to the raised platform, and provision of a controlled and an uncontrolled crossing point with appropriately coloured tactile flags.

A second similar raised platform with ramped access on two sides with be provided in front of the Conyngham Arms Hotel at Ch 150. This platform is strategically located in front of a key building and also in front of the Village Garden, with the inclusion of a controlled pedestrian crossing to improve pedestrian safety.

Footpath enhancements throughout will include natural stone paving and granite kerbs. Smaller units of natural stone setts will define access to entries and alleyways. Footways along this section of Main Street are broadly the same width as existing and are a minimum of 2.0m in width. It is proposed to provide a consistent carriageway width of approximately 7.0m along this street from Ch.50 to Ch.230, which is considered appropriate given the volume of HGVs expected to use this route. On-street parking is proposed on each side of the road where vehicle accesses, loading bays, bus stops, or kerb build outs are not located. It is proposed that bus stops will be provided on each side of the road at the same locations as the existing scenario (approximately Ch.120). Loading bays are to be provided on the westbound side of the road.

The streetscape will be greened where possible through provision of new street trees and with mixed shrub and hardy perennial planting in strips at the roadside at the western gateway and in front of St Patrick's Church. These soft landscaping areas are proposed on the eastbound side of the road between Ch. 0 to Ch. 65 and between Ch. 195 to Ch. 230, and on the westbound side of the road between Ch. 55 to Ch. 80 and between Ch. 215 to Ch. 230. Existing lime trees along the street will be retained where possible and complemented by new tree planting at appropriate locations within these soft landscaping areas or kerb build outs on each side of the road.

Figure 4.25 illustrates the proposed measures. A typical proposed cross section for the N51 Main Street West is illustrated in **Figure 4.26** below.

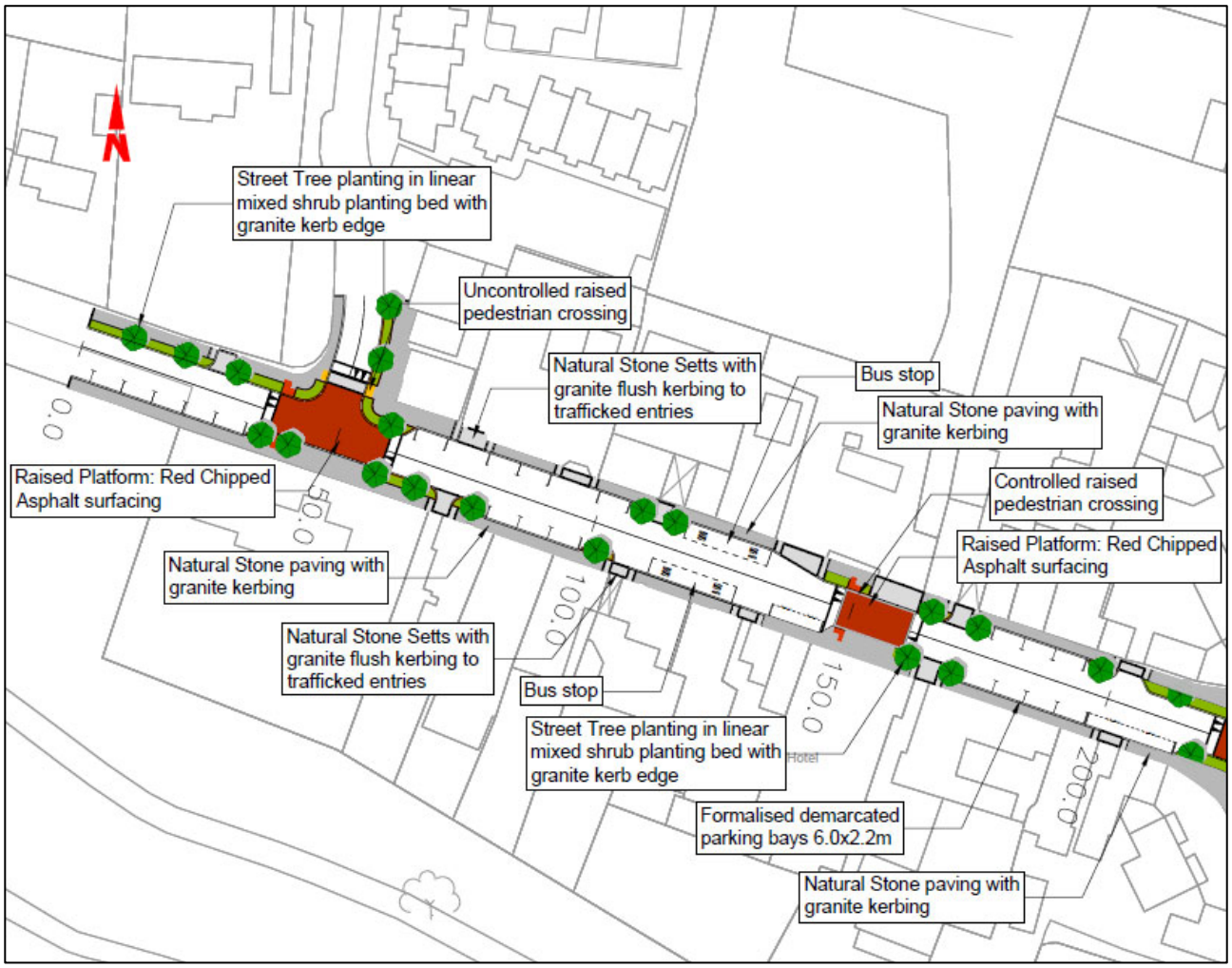
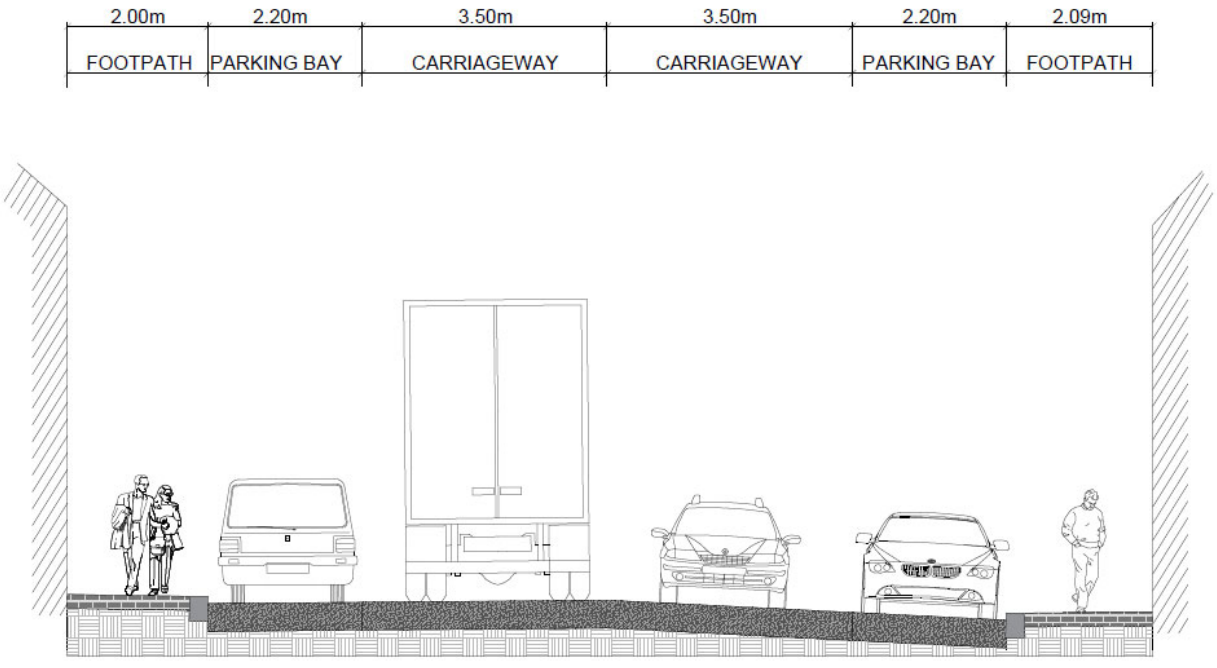


Figure 4.25: Public Realm Proposals for N51 Main Street West



Note: Public lighting or street furniture is not displayed on the cross section

Figure 4.26: Typical Proposed Cross Section – N51 Main Street West (Section at Ch. 180)

4.4.13.4 N51 Main Street East

The design proposals on N51 Main Street West include footpath enhancements on both sides of the street with natural stone paving and granite kerbs. Smaller units of natural stone setts will define access to entries and alleyways. The southern footway along this section is broadly the same width as existing measuring at approximately 2.2 m. The northern footway along this alignment will be significantly increased from approximately 1.8 m to approximately 3.2 m with the removal of on-street parking enhancing pedestrian circulation.

It is proposed to provide a consistent carriageway width of approximately 7.0 m along the N51 Main Street East from Ch.0 to Ch.110. This carriageway width is considered appropriate given the volume of HGVs expected to use this route.

On-street car parking bays will be demarcated on the southern side of the road. A new car park is proposed on the south side of the road with the vehicle access located at approximately Ch. 110. An uncontrolled crossing will be provided at the new car park access to maintain pedestrian movements along the southern side of the street. Given constraints on available width, it is not proposed to provide parking on the eastbound side of the road with the loss of on-street parking being compensated by the proposed car park.

A new raised platform with ramped access on three sides with be provided at the junction with Ledwidge Hall at Ch 90. This platform will be surfaced in asphalt and may be colour contrasted. Pedestrian safety will be improved at this junction through the reduction of traffic speeds due to the raised platform, and provision of a controlled and an uncontrolled crossing point with appropriately coloured tactile flags.

Soft landscaping areas are proposed on the eastbound side of the road between Ch. 0 to Ch. 35. It is proposed that the existing footpath, on the eastbound side of the road between Ch. 110 to Ch. 145 will be replaced with planting. Soft landscaping areas will be provided on the westbound side of the road between Ch. 0 to Ch. 20 and between Ch. 85 to Ch. 150. Tree planting shall be provided at appropriate locations within these soft landscaping areas on each side of the road. Existing street furniture will be rationalised throughout to reduce clutter and provide a co-ordinated and unified approach to new street furniture.

Figure 4.27 illustrates the proposed measures. A typical proposed cross section for the N51 Main Street East is illustrated in **Figure 4.28** below.

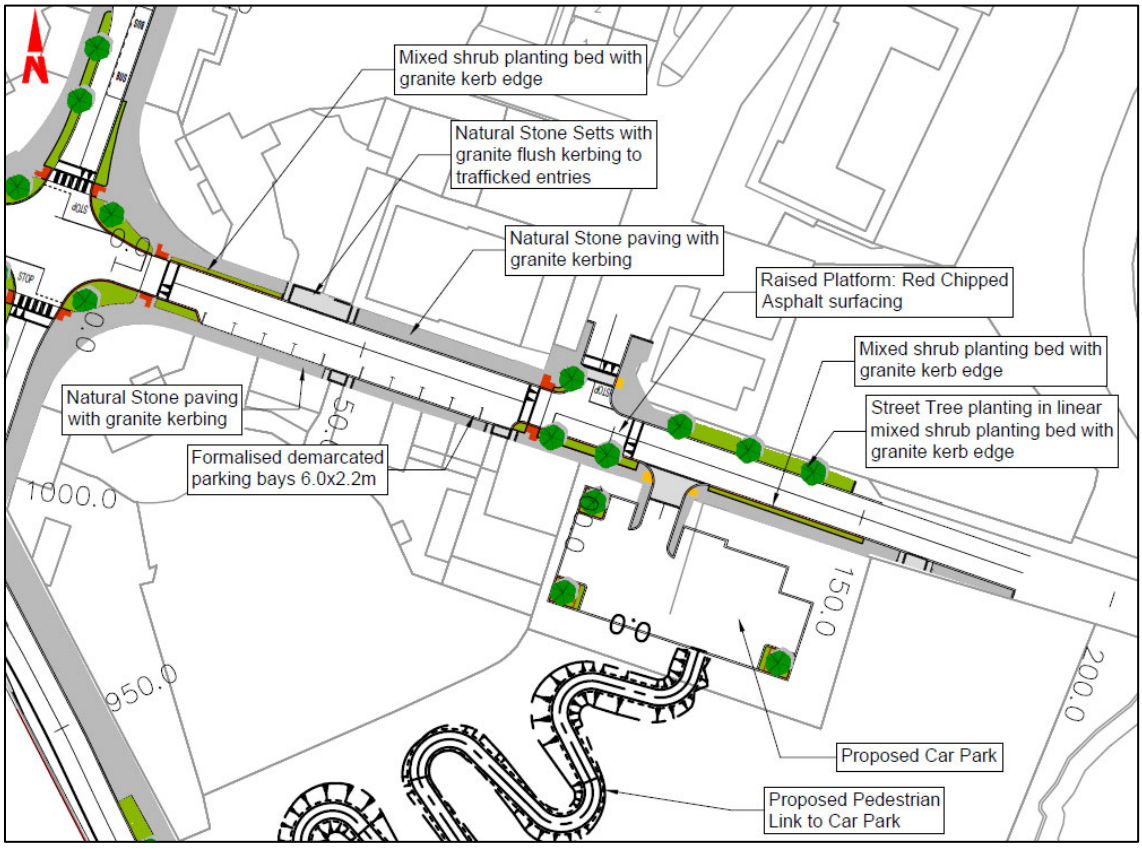
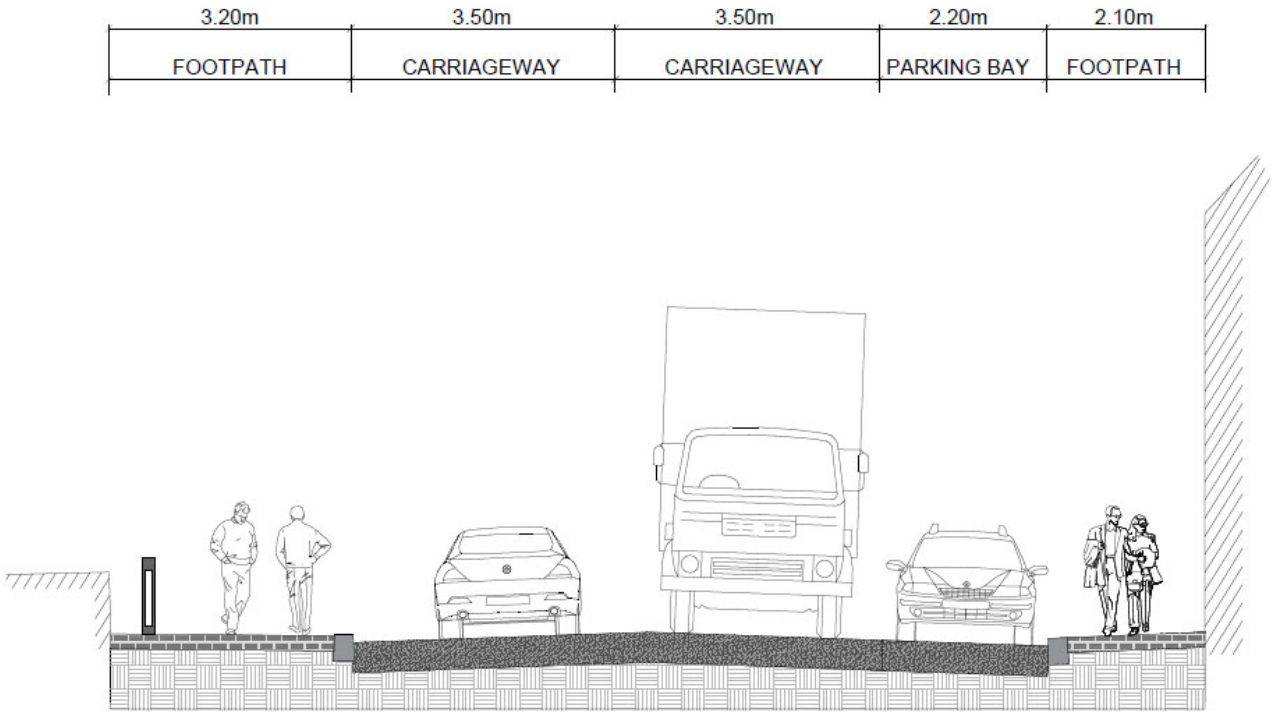


Figure 4.27: Public Realm Proposals for N51 Main Street East



Note: Public lighting or street furniture is not displayed on the cross section

Figure 4.28: Typical Proposed Cross Section – N51 Main Street East (Section at Ch. 70)

4.4.13.5 Village Square

At the heart of the village, the Square will be redesigned with a new ramp-accessed raised platform provided with pedestrian crossings. It will be constructed using asphalt which will be colour contrasted to differentiate this area from the standard road carriageway as a location where pedestrian activity is anticipated.

Pedestrian crossings around the Square will be enhanced with zebra crossings provided on the north and south side of the junction and a signal-controlled pedestrian and cyclist crossing provided on the eastern side. New directional signage on fingerposts will be provided to local amenities and points of interest. Footway widths will be significantly widened at the Square, junctions, and crossing points to improve pedestrian circulation. The wider footpaths created at the junction will also allow for provision of new green spaces to soften the current arrangement and provides spaces to sit and meet.

Street trees will be strategically located to accentuate vistas along Chapel Street and Main Street with plant beds and low-lying shrubs and hardy perennial plants creating interest and colour. The area will be paved with natural stone paving with granite kerbs defining the road edge. New functional lighting will be used to provide sufficient lighting to the streetscape whilst making the spaces more inviting and safer.

Figure 4.29 illustrates the proposed measures at the Square.

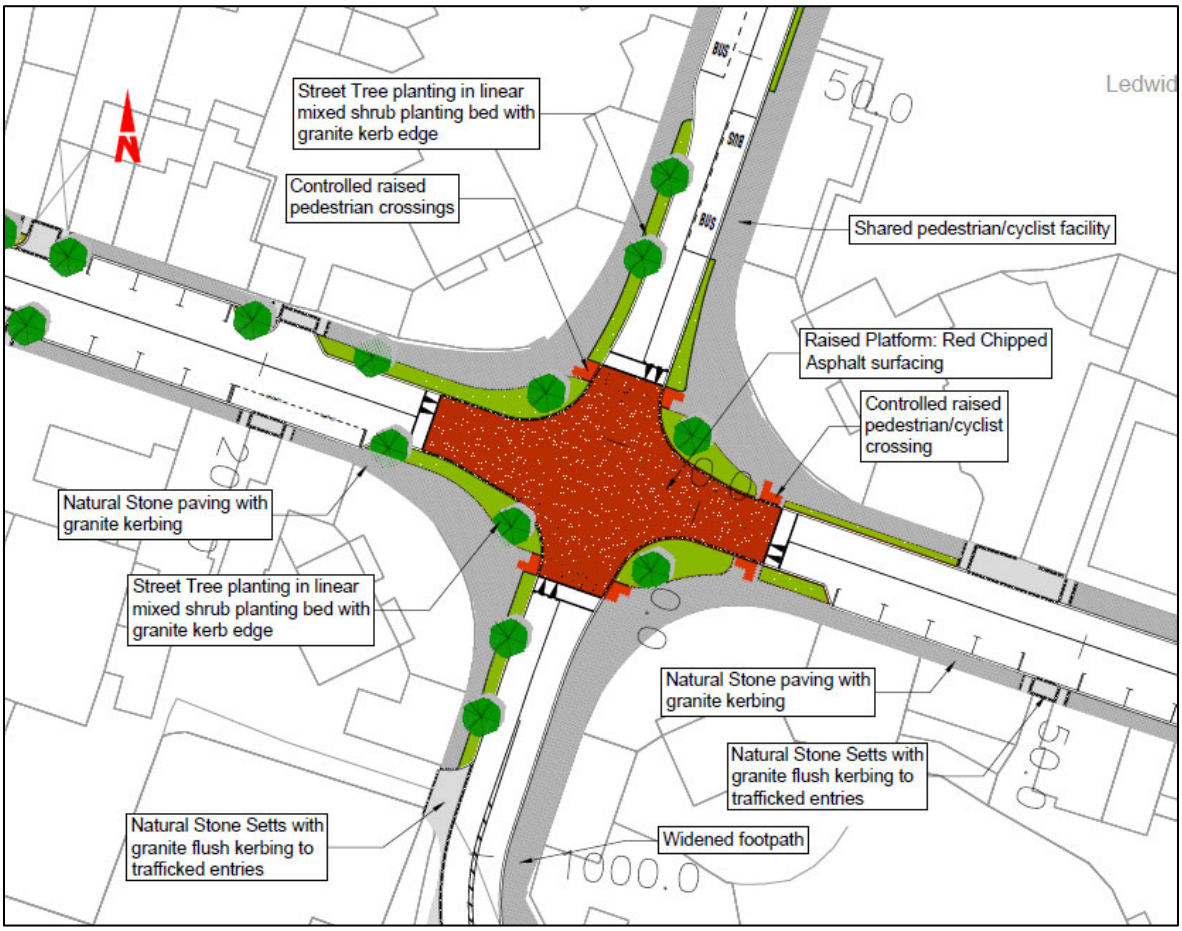


Figure 4.29: Public Realm Proposals for The Square

4.4.13.6 Parking

On-street parking is currently provided along the existing N2 and N51 within Slane. The Public Realm proposals will require amendments to the on-street parking arrangements. **Table 4-26** outlines the existing and proposed on-street parking spaces within the extents of this Proposed Scheme. There is a reduction of 24 no. on-street parking spaces when comparing the proposed scenario to the existing scenario.

Table 4-26: On-street Parking

Location	Number of On-Street Parking Spaces		
	Existing Scenario	Proposed Scenario	Difference
N51 Main Street West	35	25	-10
N51 Main Street East	19	8	-11
N2 Chapel Street	13	10	-3
N2 South	0	0	0
Total	**67**	**43**	**-24**

Note: For estimating the number of spaces provided in the existing scenario, a minimum required length of 6.0m has been assumed for each car where spaces are not individually delineated.

To compensate for this and to cater to visitors, a new off-street car park is proposed, located to the south of the N51 approximately 140 m east of the crossroads in Slane. Immediately inside the existing entrance, a portion of the lands is surrounded by an old stone wall and the car park is to be contained within this walled area. The ground within the proposed site generally falls in a west-south-west direction at a relatively steep gradient. There a number of trees located within the site with the largest being located near the southern boundary. These trees are protected under the Meath CDP 2021-2027, as is the existing wall along the N51, and it is proposed to retain mature trees within the site where possible with provision of 3 no. new trees within the car park.

It is proposed to relocate the site entrance by approximately 11 m to the west of the existing gate. This will require a new opening in the existing wall with an approximately 10 m long section of the wall to be removed, including 2 no. buttresses supporting the structure. Due to the significant longitudinal gradient along the existing N51, the road level at the entrance location is approximately 0.8 m lower than at the existing location. This allows the car park to be provided at a lower level, reducing the height of fill earthworks required and allows for the provision of 31 no. parking spaces within the confines of the site.

A link for pedestrians is to be provided on the southern side of the car park between the car park and the footpath along the existing N2 South. A replacement landowner's field access is to be provided on the westbound side of the N51 to the east of the proposed car park, requiring an approximately 8.0 m wide new opening in the existing wall.

The car park design is illustrated in **Figure 4.30**. Parking provisions will be provided in line with the relevant applicable guidance, as illustrated in **Figure 4.31**. This section is supported by **Volume 3 – Technical Drawing MDT0806-RPS-01-PR-DR-C-GA9201** (General Arrangement - Car Park Layout).

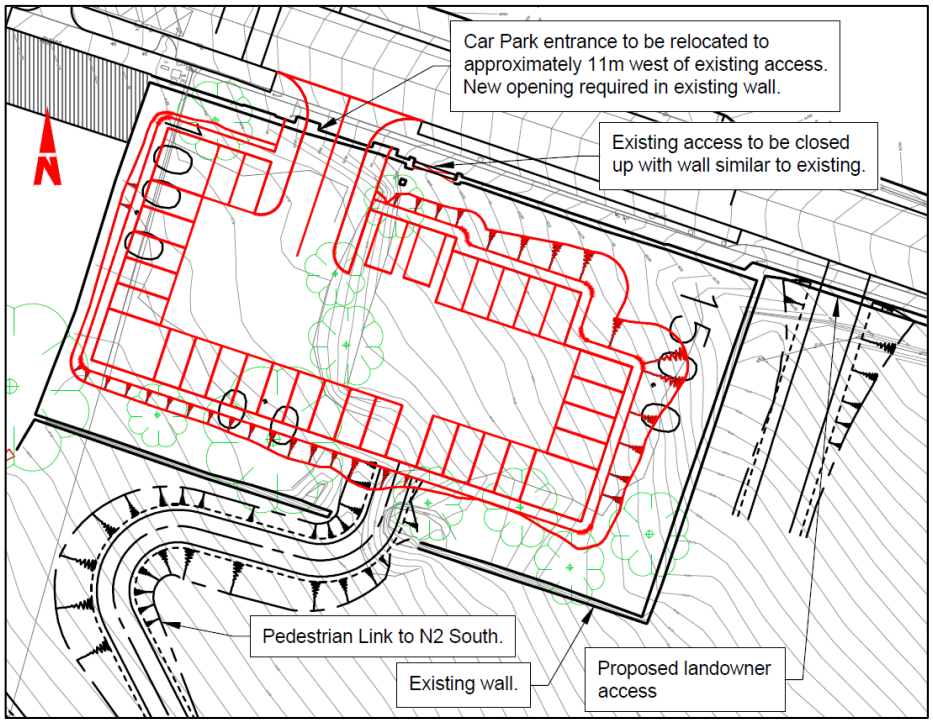


Figure 4.30: Proposed New Off-street Car Park Design

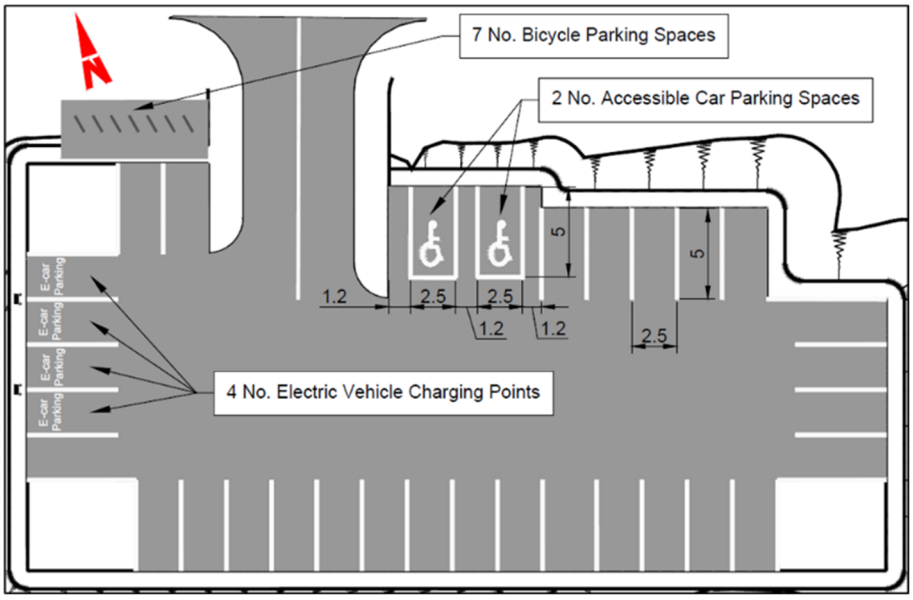


Figure 4.31: New Off-street Car Park Proposed Parking Provisions

The car park requires the construction of new hardstanding and provision of a sustainable drainage solution for surface water run-off. All surfacing within the car park will be permeable with appropriate surfacing solutions for the parking bays, car park entrance and circulation area. To minimise asphalt pavement works, parking will be provided with a gravel surfacing with a permeable paving reinforcement system within the bays. The accessible parking bays will be provided on bituminous pavement with slip-resistant surfacing.

An impermeable membrane is proposed to be installed to prevent infiltration to the subgrade. Consequently, the water is retained within the aggregate beneath the pavement layers with an outlet pipe discharging the flows from the system at a controlled rate. These discharged flows will be conveyed to the existing drainage network along the existing N2 South prior to reaching the existing surface water drainage outfall at the River Boyne. The pipework necessary for conveyance of these flows will be constructed along the proposed pedestrian/cyclist link between the car park and the existing N2. A bypass oil/ fuel separator will be provided at the existing surface water drainage outfall at the River Boyne to allow further treatment of the surface water runoff from the car park prior to discharging to the river.

Ducting will be required to allow connection to the ESB network for the supply of power to the 4 no. proposed electric vehicle charging points. Provision of ducting to accommodate future power connections is required for a minimum of an additional 3 no. charging points. The car park shall be suitably lit for the safety of users and designed to achieve Class P3 while minimising the environmental impact.

4.4.13.7 Paving Strategy

The predominant paving material selected to tie-in with the historic character of Slane will be limestone. Large and medium unit sizes will be used on the main footpath and pedestrian use areas. Small setts will used at shared sections of the pavements such as alleyways. The kerbs and drainage channels will consist of silver-grey granite.

4.4.13.8 Planting Strategy

The locations of new trees have been considered to avoid conflict with residents, shop owners and pedestrians. Tree planting will also be in line with local character e.g. lime trees (and/or native tree species), which have historically been planted around Slane. The final tree type will be determined at detailed design stage through consultation with the necessary departments in Meath County Council (MCC), particularly the maintenance department. Resin bound gravel or tree grilles using integrated paving will be used at the base of trees as it limits weed growth; is porous and provides a suitable surface for wheelchairs and prams. A maintenance regime for all trees will be established in consultation with MCC.

As kerb lines will be redefined to allow for greater footpath space, the existing trees and planting throughout the town will become obstructive to the clear throughway of footpaths which will require some existing trees to be removed. These will be replaced with new trees located at a suitable offset from kerb lines to allow for a clear throughway of footpaths.

A combination of shrub and hardy perennial planting is proposed in clearly defined and suitably located plant beds at the roadside. The planting and soil will be designed to encourage pollinators. The design approach will use multi-layered planting. It is proposed to create small areas of flower-rich landscape ideal for pollinators. The soil in plant beds will be selected for low fertility and be free-draining to decrease unwanted weed growth and to be suitable for drought-tolerant species.

4.4.13.9 Street Furniture

An overarching guiding principle for street furniture is that it will only be located and used where there is a clear public benefit; items will be common to all streets and provided at suitable locations. The proposal is that all street furniture elements will be coordinated to avoid visual clutter and establish a ‘sense of place’ for Slane and preferred materials to reflect the character of Slane are coated steel and timber with neutral colours. Street furniture will be designed with sockets were possible to allow for ease of maintenance and replacement by MCC if required. A variety of seating options are to be incorporated, including benches with armrests and backs, benches as seating platforms, ledges, and steps. Bins will be located at key junctions and spaced at regular intervals along the streets.

4.4.13.10 Traffic Control and Road Markings

As discussed previously, the junction between the existing N2 and N51 in the centre of Slane is proposed to change from a signalised controlled junction to a priority junction which will require the removal of the traffic signals from the junction along with any associated ducting and service chambers. Suitable road markings and signage will be provided for the proposed priority junction.

The existing N2 South will be reconfigured following the opening of the proposed N2 Slane Bypass. With the considerable reduction in traffic, particularly HGVs (HGV ban on the existing bridge and on the north side of the junction – refer to **Section 4.4.13.11** below), it is proposed to remove the traffic control system on the southbound existing N2 which separates HGVs from light vehicles prior crossing Slane bridge, which includes overhead gantries with signage and traffic signals.

Pedestrian crossings are to be provided on the proposed raised tables as described previously. Additional uncontrolled crossings are to be provided across some side roads and vehicle accesses. An uncontrolled crossing is also proposed across the existing N2 on the southern side of Slane Bridge. Appropriate tactile paving will be provided at all pedestrian crossings.

It is proposed that a one-way traffic system, managed with traffic lights, will be maintained across the existing Slane Bridge given the limited available width on the structure. The proposed one-way system extends along the existing N2 South alignment for a length of approximately 330 m with the stop line at the northern end located at approximately Ch. 655 and the stop line at the southern end located at approximately Ch. 325. Additional traffic signal control is required for traffic entering the one-way system from Boyne View terrace and the Millhouse.

This section is supported by **Volume 3 – Technical Drawings MDT0806-RPS-01-PR-DR-C-RM9003 – RM9004** (Public Realm Road Markings & Signals).

4.4.13.11 HGV Bans

Whilst the provision of an N2 bypass will in itself, result in the reassignment of a significant proportion of HGV traffic from the existing N2 in Slane, not all would divert to the bypass. In the context of the preferred eastern bypass route, the main cohort of residual HGV traffic that could/would continue to pass through the village is the traffic travelling to and from the west (to/from Navan, for example). Without intervention, north-west and south-west HGV traffic would continue to make turning movements at the junction in Slane.

This is a highly undesirable outcome, as not only is the junction in Slane restricted in terms of available space, making some manoeuvres quite difficult for larger vehicles but there would still remain a notably high proportion of HGV traffic on the existing N2 in this scenario.

The proposed solution is that HGV bans would be applied to the existing N2 in Slane with the bypass in place, which would require north-west and south-west traffic to utilise the bypass and travel through the village as straight-ahead movements through the junction. With traffic speed measures, this was assessed to be the most efficient and safe way to cater for the residual traffic in Slane with a bypass in place.

HGV traffic management has been achieved by many Local Authorities in Ireland through the implementation of HGV axle bans. An axle ban can't sensibly be applied to two axle vehicles, this would technically include for most motorised traffic. Therefore, the HGV axle ban with the widest effect would be a three-axle ban.

An axle ban may be put in place by a Local Authority (Roads Authority) under the powers provided in Article 4 of the Road Traffic (Control of Traffic) Regulations 2006, more specifically S.I. No. 638 of 2006. This is an executive function of the Roads Authority. Under this legislation, access by prohibited vehicles within the restricted area is allowed where a permit has been issued by a local authority under regulations made under section 35 of the Road Traffic Act 1994.

To implement a HGV ban, the area where the restriction applies will be designated using Traffic Sign RUS 046, supplemented with advance notice signage to warn drivers of the upcoming restriction. An outline plan of a potential layout of traffic signs implementing a 3-axle HGV ban in Slane is shown in **Figure 4.32** below. The restriction on HGVs is shown applying to the existing N2 within Slane village, with the provision of advance notification signage on the various approaches to the village.

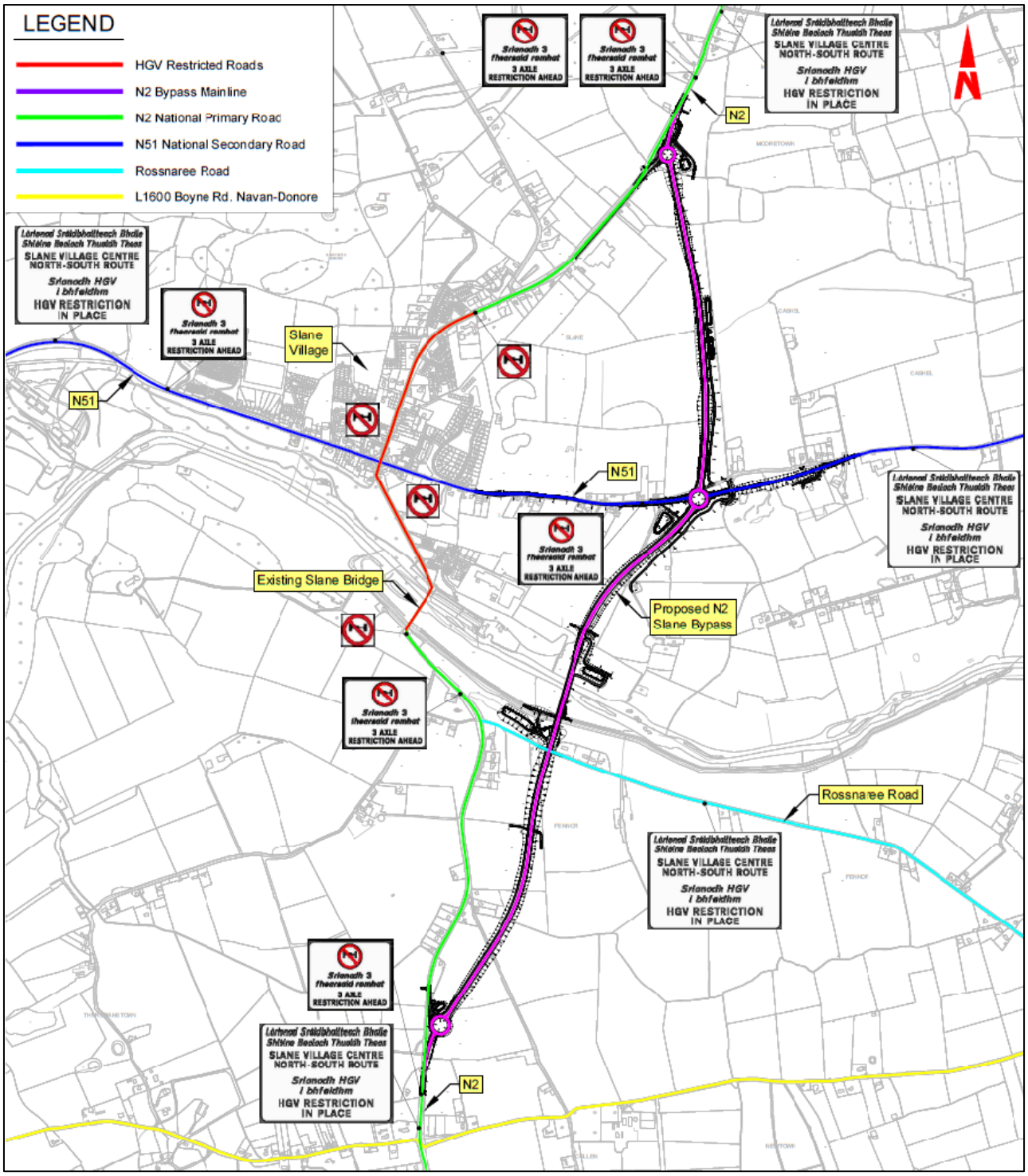


Figure 4.32: Illustrative Layout of implementation of a Proposed HGV Ban in Slane Village

4.4.13.12 Geometry

Given the constraints of an urban environment, it is not feasible to make significant changes to the vertical alignment of the associated roads and streets. Therefore, the main objective of the geometric design is to provide proposed cross-sections with a consistent kerb height of 100 mm while ensuring the roads and footpaths drain towards the edge of the road wherever possible.

At some locations it will be necessary to raise the back of footpaths to ensure the path's surface falls towards the road. However, this is not feasible in all circumstances e.g. where raising the back of the path will impact existing doorways etc. In some locations, it is feasible to lower the road pavement levels to allow crossfall on

the footpaths to fall towards the carriageway. Where the required depth of this pavement lowering is assessed to be excessive, the remaining alternative is for the crossfall on footpaths to fall away from the road, with drainage channels provided at the back of the path where necessary.

This section is supported by **Volume 3 – Technical Drawing Series MDT0806-RPS-01-PR-DR-C-GE9000 – GE9011** (Public Realm Plan & Sections).

4.4.13.13 Pavement

It is proposed to resurface the road pavement along the N2 and N51 within the extent of the Public Realm Enhancement Scheme. The majority of the resurfacing will be carried out by pavement inlay works by removing the existing pavements via cold milling prior to replacing the surface course. The inlay will consist of approximately 40 mm thick SMA 10 wearing course, with regulating course as required.

At locations where lowering of road levels is required, pavement inlay of greater depth or full pavement construction will be required. The exact proposals for the road pavement works at these locations will be dependent on the depth and condition of the existing pavement and will be confirmed at detailed design stage. The current preliminary design indicates that the lowering of road levels is required at a number of locations along the N51 Main Street West, N51 Main Street East, and N2 Chapel Street.

Raised tables along the N51 will be surfaced with SMA 10 wearing course, with a coloured aggregate. A regulating course will be used to construct the raised tables at the required height.

This section is supported by **Volume 3 – Technical Drawing Series MDT0806-RPS-01-PR-DR-C-KP9000 – KP9008.**

4.4.14 Other Scheme Design Aspects

4.4.14.1 Signage

4.4.14.1.1 General

Traffic signs, road markings and road studs will be provided in accordance with the Traffic Signs Manual (TSM), August 2019 (The Department of Transport, Tourism and Sport) and any subsequent amendment of this document.

4.4.14.1.2 Regulatory and Warning Signage

All warning and regulatory signage for the Proposed Scheme will be as standard and comply with the TSM. Consideration will be given to the provision of regulatory and warning signage including speed limit signs, roundabout ahead signs, end of dual carriageway signs and two-way traffic signs.

New signage will also be implemented within Slane to implement the proposed HGV ban, one way system across the existing Slane bridge and any other signage required for implementation of speed limits and traffic signals installation.

Particular consideration will be given to the provision of regulatory signage associated with the transition zone and rural fringe along the realigned N51 West alignment between Slane village and the N51 roundabout.

This section is supported by **Volume 3 – Technical Drawing MDT0806-RPS-01-N2-DR-C-GA2201** (General Arrangement - N51 West).

4.4.14.1.3 Directional Signage

A strategy for directional signage will be developed in conjunction with the roads authority and TII. Direction signs will be required at the Proposed Scheme's three roundabout junctions in accordance with the TSM. Advance direction signs and route confirmatory signs will be required on the N2 and N51 routes, approaching and departing each junction. **Table 4-27** below sets out the advance direction and route confirmatory signage considered necessary for the Proposed Scheme.

Table 4-27: Proposed Advance Direction and Route Confirmatory Signage

Junction	Alignment	Approx. Chainage	Side of Alignment	Sign Type	Notes
South Roundabout	South Roundabout – N2 South Link	Ch. 100	Northbound	Advance Direction	Assumed that South Roundabout – existing N2 North Link will be reclassified as local road with 60 km/h speed limit, therefore not requiring advance direction or route confirmatory signage.
		Ch. 140	Southbound	Route Confirmatory	
	N2 Mainline	Ch. 100	Northbound	Route Confirmatory	
		Ch. 150	Southbound	Advance Direction	
		Ch. 500	Southbound	Advance Direction	
N51 Roundabout	N2 Mainline	Ch. 1700	Northbound	Advance Direction	*N/A*
		Ch. 2050	Northbound	Advance Direction	
		Ch. 2100	Southbound	Route Confirmatory	
	N51 West	Ch. 700	Westbound	Advance Direction	
		Ch. 660	Eastbound	Route Confirmatory	
	N51 East	Ch. 120	Eastbound	Route Confirmatory	
		Ch. 150	Westbound	Advance Direction	
	N2 Mainline	Ch. 2340	Northbound	Route Confirmatory	
		Ch. 2390	Southbound	Advance Direction	
		Ch. 2740	Southbound	Advance Direction	
North Roundabout	N2 Mainline	Ch. 2995	Northbound	Advance Direction	Assumed that North Roundabout – existing N2 South Link will be reclassified as local road with 60 km/h speed limit, therefore not requiring advance direction or route confirmatory signage.
		Ch. 3355	Northbound	Advance Direction	
		Ch. 3390	Southbound	Route Confirmatory	
	North Roundabout – N2 North Link	Ch. 100	Northbound	Route Confirmatory	
		Ch. 140	Southbound	Advance Direction	

4.4.14.2 Fencing and Boundary Treatment

This section is supported by **Volume 3 – Technical Drawings MDT0806-RPS-01-N2-DR-C-FE0000 – FE0007** (Fencing and Boundary Treatments) for fencing and boundary treatment proposals.

4.4.14.2.1 Mainline Boundary Fencing

Timber post and rail Boundary fences are considered hazards within the clear zone under TII DN-GEO-03036 (Cross Sections and Headroom). Therefore, timber post and tension mesh fencing, complying with TII CC-SCD-00320 as per **Figure 4.33** below, shall be provided along the boundary of this Proposed Scheme to avoid introducing a hazard.

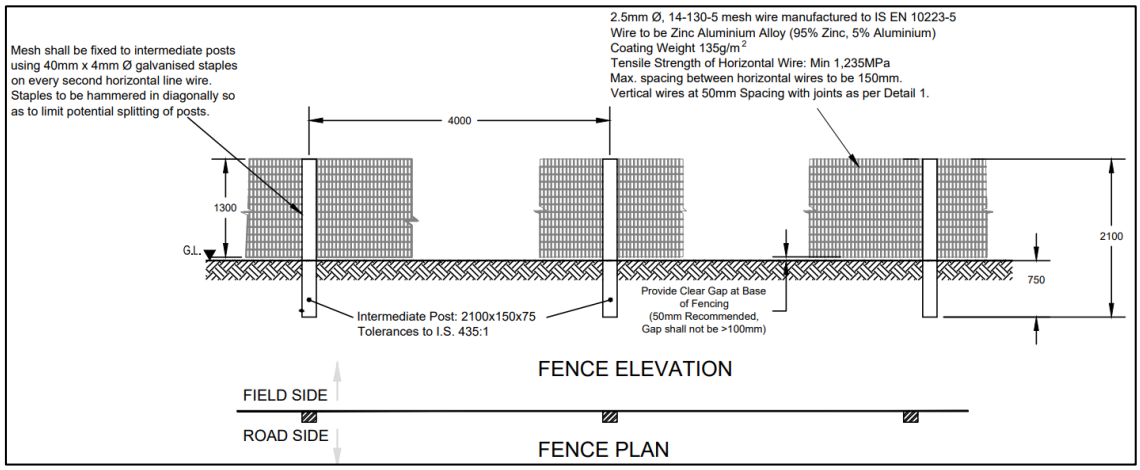


Figure 4.33: Timber Post and Tension Mesh Fence (Taken From TII CC-SCD-00320)

4.4.14.2.2 Security Fencing at Attenuation Ponds

Security fencing, e.g. palisade or paladin fencing, is not proposed for the Proposed Scheme's attenuation ponds as it would be considered to have an undesirable visual and ecological impact, particularly for the ponds located adjacent to the River Boyne. Therefore, to benefit the integration of the Proposed Scheme into the existing landscape, it is proposed that each pond is surrounded with standard boundary fencing and suitable landscaping treatment. Appropriate planting shall be provided along the fence line to discourage public access to the pond while still allowing emergency access for rescue if required.

4.4.14.3 Forgiving Roadsides

The methodology adopted for this design includes the concept of forgiving roadsides to minimise the consequences of driving errors rather than preventing them i.e. remove the need for safety barriers where feasible, at an acceptable cost.

The design of the bypass was optimised to minimise the consequences of driver error which could lead to serious injury or death. The approach of hazard removal, modification or protection was applied to the design to maintain clear zones where possible. It is considered that a Vehicle Restraint System (VRS) will only be incorporated into the design where a roadside hazard cannot be removed or modified.

4.4.14.3.1 The Clear Zone

The clear zone is the total of width of traversable land, available for use by errant vehicles, which is to be kept clear of unprotected hazards. The clear zone width is measured from the edge of the running carriageway and has been assessed for the project.

4.4.14.3.2 Roadside Hazards

Generally roadside hazards are categorised into:

- Single Fixed Hazards;
- Continuous Hazards; and
- Dynamic Hazards.

The above are discussed in the following sections in relation to the adopted design principles.

Single Fixed Hazards

All drainage headwalls will be located outside the clear zone of the bypass unless a VRS (i.e. safety barrier) is provided to protect the hazard.

Lighting columns and traffic signposts will be required within the clear zone of the bypass. These columns/posts must be designed as passively safe to minimise damage on impact along with energy absorbing benefits.

Trees with a diameter exceeding 100 mm or a girth exceeding 314 mm (mature size of tree measured at 0.3m above the ground), shall not be provided within the clear zone of the bypass. Also, trees with diameters ≤ 100mm and/or girths ≤ 314mm must not be grouped within the clear zone with a spacing of less than 1,500 mm given the potential for the cumulative impact of grouped trees to constitute a hazard for an errant vehicle.

Three overbridges are included in the Proposed Scheme as follows:

- ST03 – Accommodation Works Overbridge (approx. Ch.800);
- ST04 – Rossnaree Road Overbridge (approx. Ch.1100); and
- ST05 – Accommodation Works Overbridge (approx. Ch.1575).

These overbridges are 3 span structures with 1.0 m diameter reinforced concrete piers located within the clear zone on either side of the bypass. Therefore, VRS will be required along both sides of the bypass mainline to protect the bridge pier hazards at the 3 no. overbridges. To prevent direct impact between a vehicle and the end of a bridge parapet safety barriers will be required at the end of bridge parapets at the following locations:

- ST01 – Boyne Crossing (approx. Ch. 1300): Safety barrier required along both sides of bypass mainline at each end of bridge parapets; and
- ST04 – Rossnaree Road Overbridge (approx. Ch. 1100): Safety barrier is required along both sides of Rossnaree Road at each end of bridge parapets. It is noted however, that existing accesses to adjacent residential property will need to be retained and this may reduce the extent of barrier provided.

The majority of the proposed attenuation ponds are outside the clear zone of the bypass mainline and are therefore not considered a hazard. An exception to this occurs at approx. Ch. 2900 where the invert of Pond 5A encroaches the clear zone. The water near the edge of this pond could rise to a depth of up to 600 mm during extreme storm events and therefore would be considered a hazard. It is considered appropriate to protect this water hazard with a VRS (i.e. a safety barrier).

Continuous Hazards

The earthworks slopes along the Proposed Scheme are potential continuous hazards. Cut slopes, which are along the majority of the bypass mainline, are no steeper than 1:2 and therefore are not considered a hazard as per DN-GEO-03036.

The majority of embankment slopes on the scheme are less than 6m high and no steeper than 1:3. Therefore, these embankment slopes are not considered a hazard as per DN-GEO-03036. An exception to this occurs between approximately Ch. 2730 to 2830 east side, where the embankments slopes are higher than 0.5 m and steeper than 1:3. Therefore, the embankment slope at this location would be considered a hazard and must be protected by a VRS.

As discussed in **Section 4.4.4** above, it is proposed to provide reflective vertical features in the grassed verge width between the cycle/ pedestrian facility and the road. These features must be passively safe and therefore would not be considered a roadside hazard.

Dynamic Hazards

Dynamic roadside hazards relate to moving objects and may include cyclist and pedestrians using nearby shared facility. DN-REQ-03034 recommends that, in general, VRS should not be provided solely to protect pedestrians or cyclists. However, where VRS is required to protect other roadside hazards beyond a cycle/ pedestrian facility, it should be located between the road and shared facility.

4.4.14.4 Lighting

4.4.14.4.1 General

Road lighting will be provided at the locations identified in **Section 4.4.14.4.2** in accordance with TII Publication DN-LHT-03038 Design of Road Lighting the National Road Network. MCC has been consulted with as the competent authority in terms of the lighting proposals for the Proposed Scheme.

The lighting will be provided by energy efficient light emitting diode lanterns (LED) providing a neutral white output with each mounted on galvanised steel lighting columns/passively safe lighting columns (as appropriate to the location) up to a maximum of 12 m high above finished road level. All lanterns will be fully cut-off type to minimise light spill and ensure that light is concentrated on the road surface. The lighting will be designed to the appropriate Lighting Class in compliance with BS 5489-1: Code of Practice for the Design of Road Lighting. All cables for the lighting installation will be ducted underground.

It is noted that there is a Dark Sky monitoring station situated at Newgrange within the Brú na Bóinne World Heritage Property. Dark Sky issues have been taken into consideration via the use of minimal lighting at the proposed bypass roundabout junctions with the existing N2 and N51 and on the N51 West.

4.4.14.4.2 Locations for Road Lighting

Road lighting for the Proposed Scheme shall be provided at the following locations:

- **N2 South Roundabout:** Lighting to be provided on all approaches to the N2 South roundabout within an extent of 60m from the junction;
- **N51 Roundabout:** Lighting to be provided on all approaches to the N51 roundabout within an extent of 60m from the junction. Additional lighting also to be provided along the N51 West into Slane village with existing lighting columns to be retained where possible;

- **N2 North Roundabout:** Lighting to be provided on all approaches to the N2 North roundabout within an extent of 60m from the junction**.** Additional lighting also to be provided along the existing N2, South from the roundabout towards Slane extending to the existing lighting columns on the approach to the village; and
- **Slane Village:** It is proposed that existing lighting columns within the Public Realm extent will be removed and replaced with new columns. The proposed columns and luminaires will have a neutral style sympathetic to the character of the existing surroundings and will be carefully positioned to integrate into the environment ensuring they do not impede pedestrian movements or interfere with key views.

4.4.15 Land and Property Requirements – Permanent

4.4.15.1 Landtake

It is estimated that approximately 43.4 ha of permanent land acquisition (including roadbed) will be required for the construction of this scheme. Additionally, it is estimated that approximately 7.0 ha of temporary land acquisition will be required to facilitate construction.

The construction of the Proposed Scheme will require the acquisition of the following buildings:

- **CPO 113:** Occupied private dwelling at Rossnaree Road – acquisition of plot without demolition of the dwelling;
- **CPO 118:** Derelict gatehouse at N51 West, approx. Ch. 700 – acquire and demolish;
- **CPO 119:** Occupied private dwelling at N2, approx. Ch. 1825 – acquire and demolish;
- **CPO 121:** Occupied private dwelling at N51 East, approx. Ch. 75 – acquire and demolish; and
- **CPO 148:** Agricultural buildings and uninhabited dwelling at North Roundabout – acquire and demolish.

4.4.15.2 Works to facilitate landowners affected by the Scheme and CPO

Measures will be provided to facilitate landowners that will be affected by the Proposed Scheme. These measures are provided to achieve the following:

- Re-instatement of access to properties/land holdings severed by the Proposed Scheme.
- Re-instatement of boundary walls and boundary fencing at properties affected by the Proposed Scheme.
- Provision of ducting to allow landowners to maintain service connections.

Works to be provided as part of the Proposed Scheme to facilitate adjoining landowners are summarised in the sections below.

This section is supported by **Volume 3 – Technical Drawings MDT0806-RPS-01-N2-DR-C-LO0000 – LO0003** (Landowner Access and Service Works), **MDT0806-RPS-01-PR-DR-C-LO9200 – LO9203** (Landowner Access and Service Works - Public Realm) and **MDT0806-RPS-01-N2-DR-C-LH0000 – LH0002** (Land Holdings).

4.4.15.2.1 Access Arrangements

Access to lands impacted by the Proposed Scheme shall be maintained through the following measures where required:

- New direct accesses/field accesses may be provided where existing access is to be removed or where land is severed from existing access;
- Access tracks may be provided where access is required through neighbouring lands; and
- 2 no. overbridges are to be provided across the N2 mainline to maintain access to severed agricultural lands.

Access tracks will be constructed as per TII CC-SCD-00706 and will generally have a pavement width of approximately 4.0 m with approximately 1.0 m wide grassed verges.

Existing direct accesses to private properties shall be maintained wherever feasible. Where modification/ removal of a direct access is required, a new access shall be provided to a similar standard as the existing access. Access will be provided to all retained lands/premises whose road frontage is being acquired both during construction and operation and services will be similarly maintained.

Table 4-28 below summarises the access measures proposed for properties/ land holdings impacted by the Proposed Scheme.

Table 4-28 Works to facilitate Landowners affected by the Scheme and CPO – Access Measures

Access Reference	Description
Access 101.1 **Access 102.1**	Existing accesses to be retained, connecting to proposed South Roundabout – N2 South Link via existing N2 (section of existing road pavement retained for local access only).
Access 103.1	Proposed field access connecting to proposed South Roundabout – N2 North Link. Approximately 29m long access track required to provide acceptable gradient between the field and road.
Access 108.1	Access to severed lands via Overbridge 1 (ST03).
Access 111.1	Existing direct access to be retained, connecting to Rossnaree Road.
Access 112.1	Existing field access to be retained, connecting to Rossnaree Road.
Access 113.1	Existing direct access to be retained, connecting to Rossnaree Road.
Access 115.1	Existing field access to be retained, connecting to Rossnaree Road.
Access 118.1	Proposed direct access connecting to proposed N51 East route via Access Track 3.
Access 118.2	Existing field access to be retained, connecting to proposed N51 West route. Access crosses proposed footpath.
Access 118.3	Access to severed lands via Overbridge 3 (ST05)
Access 120.1 **Access 120.2**	Existing direct access and adjacent field access to be replaced with combined domestic and field access, connecting to proposed N51 West route. Replacement walls and gates to be of similar standard to existing Combined access crosses proposed footpath.
Access 121.1	Proposed direct access connecting to proposed N51 East route via Access Track 3A.
Access 122.1	Proposed field access connecting to proposed N51 East route via Access Track 1.
Access 122.2	Existing field access to be retained, connecting to proposed N51 East route via existing N51 (section of existing road pavement retained for local access only).
Access 123.1	Existing direct access to be replaced with new access, connecting to proposed N51 East route. Replacement walls and gate to be of similar standard to existing.
Access 123.2	Proposed field access connecting to proposed N51 East route via Access Track 1A.
Access 124.1 **Access 125.1**	Existing direct accesses to be retained, connecting to proposed N51 East route.
Access 126.1 **Access 127.1**	Existing direct accesses to be retained, connecting to proposed N51 East route via existing N51 (section of existing road pavement retained for local access only).
Access 129.1	Existing direct access to be retained, connecting to proposed N51 West route. Note: access is adjacent to proposed footpath and coach parking area.
Access 129.2 **Access 129.3**	Existing direct accesses to be retained, connecting to proposed N51 West route. Note: accesses cross proposed footpath and coach parking area.
Access 130.1 **Access 131.1** **Access 132.1** **Access 133.1** **Access 134.1** **Access 135.1** **Access 135.2**	Existing direct accesses to be retained, connecting to proposed N51 West route.

Access Reference	Description
Access 136.1	Existing direct access to be retained with amended boundary walls, connecting to proposed N51 West route. Replacement walls to be of similar standards to existing. Access crosses proposed footpath.
Access 136.2	Existing direct access to be retained, connecting to proposed N51 West route. Access crosses proposed footpath.
Access 137.1	Existing direct access to be retained with amended boundary walls, connecting to proposed N51 West route. Replacement walls to be of similar standards to existing. Access crosses proposed footpath.
Access 138.1 **Access 138.2**	Existing field accesses to be retained, connecting to proposed N51 West route. Accesses cross proposed footpath.
Access 139.1 **Access 140.1** **Access 141.1** **Access 142.1** **Access 143.1** **Access 144.1**	Existing direct accesses to be retained, connecting to proposed N51 West route. Accesses cross proposed footpath.
Access 146.1	Proposed field access connecting to proposed N51 West route.
Access 146.2	Existing field access to be retained, connecting to proposed N51 West route.
Access 146.3	Proposed field access connecting to proposed N51 West route.
Access 146.4	Proposed field access connecting to proposed N51 East route via existing N51 (section of existing road pavement retained for local access only).
Access 146.5	Existing direct access to be retained, connecting to existing N2. Access crosses proposed footpath.
Access 147.1	Existing field access to be retained, connecting to existing N2. Access crosses proposed footpath.
Access 147.2	Proposed field access connecting to proposed North Roundabout – N2 North Link via Access Track 6.
Access 149.1	Existing direct access to be retained, connecting to existing N2. Access crosses proposed footpath.
Access 150.1	Existing direct access to be retained, connecting to existing N2.
Access 151.1	Existing field access to be retained, connecting to proposed North Roundabout – N2 South Link.
Access 151.2 **Access 151.3**	Existing field access to be retained, connecting to proposed North Roundabout – N2 North Link.
Access 152.1	Existing direct access to be retained, connecting to proposed N51 East route via existing N51 (section of existing road pavement retained for local access only).
Access 154.1	Existing direct access to be retained, connecting to proposed South Roundabout – N2 South Link.
Access 156.1 **Access 157.1** **Access 158.1** **Access 159.1** **Access 160.1** **Access 161.1** **Access 162.1**	Existing direct accesses to be retained, connecting to proposed N51 East route via existing N51 (section of existing road pavement retained for local access only).

4.4.15.2.2 Boundary Treatments

Suitable boundary treatment shall be provided where required for properties / landholdings impacted by the scheme. As per **Section 4.4.14.2.2** above, the Proposed Scheme boundary will generally be fenced with timber post and tension mesh fence as per TII CC-SCD-00321. Where existing boundary walls or gates at

private properties are impacted, replacement walls and gates shall be provided to a similar standard as the existing situation.

Figure 4.27 summarises the boundary treatment proposals for properties/ landholdings impacted by the scheme.

Table 4-29: Works to facilitate Landowners affected by the Scheme and CPO – Boundary Treatment

Landowner Reference	Description of Boundary Treatment Works
102/103	Timber post and tension mesh fence (CC-SCD-00321) to be provided along scheme boundary Steel single field gate (CC-SCD-00309) to be provided at Access 103.1
104	Timber post and tension mesh fence (CC-SCD-00321) to be provided along scheme boundary.
105	Timber post and tension mesh fence (CC-SCD-00321) to be provided along scheme boundary.
106	Timber post and tension mesh fence (CC-SCD-00321) to be provided along scheme boundary.
107/108	Timber post and tension mesh fence (CC-SCD-00321) to be provided along scheme boundary. Steel single field gate (CC-SCD-00309) to be provided at both ends of Overbridge 1.
109	Timber post and tension mesh fence (CC-SCD-00321) to be provided along scheme boundary.
110	Timber post and tension mesh fence (CC-SCD-00321) to be provided along scheme boundary.
111	Timber post and tension mesh fence (CC-SCD-00321) to be provided along scheme boundary.
112	Timber post and tension mesh fence (CC-SCD-00321) to be provided along scheme boundary.
113	Timber post and rail fence (CC-SCD-00301) to be provided along scheme boundary.
114	Timber post and tension mesh fence (CC-SCD-00321) to be provided along scheme boundary.
115	Timber post and tension mesh fence (CC-SCD-00321) to be provided along scheme boundary.
117	Timber post and tension mesh fence (CC-SCD-00321) to be provided along scheme boundary.
118/119	Timber post and tension mesh fence (CC-SCD-00321) to be provided along scheme boundary. Steel single field gate (CC-SCD-00309) to be provided at both ends of Overbridge 3.
120	Agricultural lands: Timber post and tension mesh fence (CC-SCD-00321) to be provided between proposed road alignment and adjacent lands. Steel single field gate (CC-SCD-00309) to be provided at Access 120.1. Curtilage of private dwelling: Boundary wall to be replaced to similar standard as existing. Gates at Access 120.2 and pedestrian access to be relocated / new gates to be provided.
121	Timber post and tension mesh fence (CC-SCD-00321) to be provided between Access Track 3 and adjacent lands. Steel single field gate (CC-SCD-00309) to be provided at both ends of Access Track 3A (Access 121.1).
122	Timber post and tension mesh fence (CC-SCD-00321) to be provided along scheme boundary. Steel single field gate (CC-SCD-00309) to be provided at both ends of Access Track 1 (Access 122.1).
123	Timber post and tension mesh fence (CC-SCD-00321) to be provided between proposed road alignment and adjacent lands. Timber post and rail fence (CC-SCD-00301 to be provided between Access Track 1A and adjacent lands. Boundary wall at Access 123.1 to be replaced to similar standards as existing. Gate at Access 123.2 to be relocated / new gate to be provided. Steel single field gate (CC-SCD-00309) to be provided at both ends of Access Track 1A (Access 123.2).
136	Boundary wall to be replaced to similar standard as existing.
137	Boundary wall to be replaced to similar standard as existing.
146/147	Timber post and tension mesh fence (CC-SCD-00321) to be provided along scheme boundary. Steel single field gate (CC-SCD-00309) to be provided at Access 146.1, Access 146.4 and both ends of Access Track 6 (Access 147.2). Steel double field gate (CC-SCD-00310) to be provided at Access 146.3.
148	Timber post and tension mesh fence (CC-SCD-00321) to be provided along scheme boundary. Steel single field gate (CC-SCD-00309) to be provided at Access 148.1.

Landowner Reference	Description of Boundary Treatment Works
201	Timber post and tension mesh fence (CC-SCD-00321) to be provided along pedestrian/cyclist link. Steel single field gates (CC-SCD-00309) to be provided at replacement field access and for access across the pedestrian/cyclist link.
202	Existing stone-faced stepped wall to be removed. Replacement boundary wall of similar construction to be provided at back of proposed shared pedestrian/cyclist facility. Gates to be provided at pedestrian accesses.
203	Existing stone-faced stepped wall to be removed. Replacement boundary wall of similar construction to be provided at back of proposed shared pedestrian/cyclist facility.

4.4.15.2.3 Accommodation Works to facilitate landowners affected by CPO/Scheme in Slane Village

The following accommodation works are proposed for landowners impacted by the Slane Public Realm Enhancement Scheme:

- **Landowner 201:**
  - Replacement field access to be provided which will require new opening in existing boundary wall.
  - Access to be maintained across proposed pedestrian/cyclist link, by provision of a gate in the proposed fencing to be erected along the pedestrian/cyclist link.
- **Landowner 202 / Landowner 203:**
  - Replacement boundary wall to be provided at back of proposed shared pedestrian/cyclist facility.

This section is supported by **Volume 3 – Technical Drawings MDT0806-RPS-01-PR-DR-C-LO9200 – LO9203** (Public Realm - Landowner Access and Service Works).

4.4.15.2.4 Service Ducts

Where agricultural lands are severed from other retained lands of the landowner by the Proposed Scheme, ducts will be provided crossing the road alignment and associated earthworks, to allow the landowners to maintain connection of services to the severed lands. **Table 4-30** below summarises the service duct proposed for land holdings impacted by the Proposed Scheme.

Table 4-30: Works to facilitate Landowners affected by the Scheme and CPO – Service Ducts

Service Ducts Reference	Description of Service Ducts
Ducts 107.1	2 no. 100 mm diameter service ducts crossing N2 mainline road alignment at approximately Ch. 300.
Ducts 108.1	2 no. 100 mm diameter service ducts crossing Overbridge 1 (approximately Ch. 800).
Ducts 118.1	2 no. 100 mm diameter service ducts crossing Overbridge 3 (approximately Ch. 1575).
Ducts 118.2	2 no. 100 mm diameter service ducts crossing N2 mainline road alignment at approximately Ch. 1770.
Ducts 122.1	2 no. 100 mm diameter service ducts crossing N51 East road alignment at approximately Ch. 200.
Ducts 146.1	2 no. 100 mm diameter service ducts crossing N2 mainline road alignment at approximately Ch. 2350.
Ducts 146.2	2 no. 100 mm diameter service ducts crossing N2 mainline road alignment at approximately Ch. 3350.

4.4.15.2.4.1 Utility Connections

Where it is necessary to sever any utility connections to properties, e.g. power, water, telecoms etc., the existing connection shall be maintained until an alternative connection has been provided.

This is particularly relevant for Landowner 119, where telecom and water connections run along existing access lane from the N51 and therefore will be severed by proposed N2 Mainline construction. Alternative utility connections will be provided for this landowner, e.g. along proposed Access Track 3, before any existing connections are severed.

4.4.15.3 Planning Permission Modifications / Extinguishment

No planning permission modifications or extinguishments are required.

4.4.15.4 Rights of Way and Easements

There are rights of way and easements which will be acquired/ extinguished as part of the Proposed Scheme. These are set out in **Volume 3**, drawings **MDT0806-RPS-01-N2-DR-C-DM1000 – DM1003** (Engineering Drawings).

4.4.16 Design Measures to Offset Impact

Throughout the option selection and design processes, a number of measures were employed to help offset the impact of the Proposed Scheme; these included:

- Location of the river crossing to reduce visibility in the landscape and to avoid Annex I Habitat and Architectural Conservation Areas.
- Design of the bridge crossing to reduce visibility in the landscape – low level rather than statement bridge.
- Inclusion of a 10m setback distance from either side of the banks of the River Boyne to help preserve otter movements and eliminate any direct negative impact on the river during construction.
- Discussions with significantly impacted landowners and agricultural enterprises, and alignment adjustments where feasible and provision of suitable accommodation/ scheme works.
- Design and location to minimise visibility from World Heritage Property at Bru na Bóinne and from the monument at Knowth, in particular.
- Drainage design in accordance with the principles of SUDs to fully mitigate potential for pollution and increased flood risk.
- Design of the supporting bridge piers to have the least amount of impact in terms of footprint and in terms of visual impact.
- Design and inclusion of sympathetic Public Realm Enhancement (having regard to the overall Public Realm plan) to the Proposed Scheme to reflect and connect heritage, and to enhance the village amenity for the local and wider community.
- Design of the bridge crossing to avoid piers in the river and reduce disturbance of riverine environment.
- Acquisition of the wet field under and either side of the proposed River Boyne bridge crossing as part of biodiversity enhancement to include planting of native wet meadow species mix.

4.5 Operation and Maintenance

4.5.1 Maintenance Regime

4.5.1.1 Permanent Maintenance Facilities

4.5.1.1.1 Inspection and Maintenance of the River Boyne Crossing

The use of weathering steel for the fabrication of the steel plate girders will ensure that maintenance painting will not be required over the lifetime of the structure. The deck surfacing will need maintenance and replacement after 20 years. Bridge bearing and movement joints will need to be inspected and maintained regularly and replaced after 50 and 20 years respectively.

The configuration of the structure has been undertaken to afford good access for inspection and maintenance. Inspection of the bridge superstructure can be undertaken safely from the bridge itself, from the ground below the bridge and from the river using boat access when required. Sufficient space and headroom clearance are provided under the bridge deck at each abutment to facilitate future inspections. Shallow side slopes no steeper than 1V:2H are provided at the structure meaning access steps to the abutments are not required. Inspection galleries at the abutments allow for access, maintenance and replacement of the bridge bearings.

Permanent access tracks will be required to allow vehicular access to the intermediate piers to facilitate scaffold erection for bearing inspection, maintenance and replacement. To minimise environmental impact in the permanent condition these tracks would not need to be surfaced and would instead be grassed over hardstanding. It is proposed that access to the bridge will be along the existing Boyne Canal towpath, accessed from the existing gate adjacent to the existing River Boyne bridge. An access track to the bridge supports will be provided from the towpath.

The structure will be inspected every six years or as required by the TII Eirspan Bridge Management System (2017).

4.5.1.1.2 Inspection and Maintenance of Overbridges

Due to the integral nature of the overbridge structures, maintenance requirements are minimised for the design life of the structures. The configuration of the structures has been undertaken to afford good access for inspection and maintenance. Inspection of all components of the structures can be done visually from proposed ground level.

Sufficient space and headroom clearance are provided under the bridge deck at each abutment to facilitate future inspections. Shallow side slopes no steeper than 1V:2H are provided at each of the structures meaning access steps to the abutments are not required. Access for inspections and maintenance will be from the mainline, with temporary traffic management arrangements in place as necessary or from the bridge deck as required.

The structures will be inspected every six years or as required by the TII Eirspan Bridge Management System.

4.5.1.1.3 Inspection and Maintenance of the Canal Pedestrian/Cyclist Bridge

The steel elements of the structure will be painted and require nominal maintenance over the first 20 years after which maintenance painting of the steel work will be required. It is expected that full repainting will be required after 25-30 years.

The deck surfacing will consist of an epoxy resin based, tar derived resin slurry and will need maintenance and replacement after 20 years. The movement joints and bearings will need maintenance and replacing after 35-40 years.

The configuration of the structure has been undertaken to afford good access for inspection and maintenance. Inspection of all components of the structure can be done visually from proposed ground level. Sufficient space and headroom clearance are provided under the bridge deck at each abutment to facilitate future inspections.

Shallow side slopes no steeper than 1V:2H are provided at the structure meaning access steps to the abutments are not required. Access for maintenance will be provided via the proposed pedestrian/cyclist route from the mainline or from the canal towpath.

4.5.1.1.4 Inspection and Maintenance Drainage

4.5.1.1.4.1 Grassed Surface Water Channels

Grassed channels will be maintained as described in Section 12 of TII DN-DNG-03073-02 *'Grassed Surface Water Channels for Road Runoff (including Amendment No.1)'* (TII, 2015).

To ensure optimum hydraulic performance, the mowing schedule will be developed to ensure that the grass blades are no longer than 75 mm.

The grassed surface water channel will be capable of being mowed using the same equipment that is used to maintain the verge.

The maintenance regime will also include the removal of litter and other debris, as well as weed control and the repair of any damage to the channels caused by vehicles.

Access to the grassed channels will be provided from the mainline and will include traffic management as may be necessary to carry out maintenance works.

4.5.1.1.4.2 Filter Drains

Maintenance requirements for filter drains will include monthly inspections, monthly weed control, annual sediment removal and replacement of clogged filter material as required (typically 10 years or more).

4.5.1.1.4.3 Attenuation and Retention Ponds

Ponds shall be maintained as described in Section 6 of TII DN-DNG-03063-02 '*Vegetated Drainage Systems for Road Runoff*'.

The ponds will need regular inspection as the growth of vegetation will need to be inspected and controlled to ensure the system continues to operate as designed. A maximum six-month inspection interval will be implemented, scheduled for the start and end of the growing season.

Additional inspections will be carried out after any significant storm events (greater than a 1-in-1 year event) to check for signs of erosion or flooding, which would indicate whether the system has been affected by the storm.

The maintenance regime will ensure that the hydraulic and treatment performance of the ponds is operating as designed.

Any sediment which is not collected upstream of the ponds is likely to settle in the base of the retention pond. This sediment, along with any plant waste, will be removed with care to avoid damage to the pond liner (if part of the pond design) and any vegetation. Information will be provided to operatives on the presence and depth of liners and on the existence of any depth markers. Consideration will be given to the impact that disturbance of the sediment will have on the short-term migration of fines and contaminants from the system and maintenance operations planned accordingly.

Sediment removal will take place at least every ten-years, but this will vary by location and shall be determined by inspection during operation. The removal may need to be phased to protect the existing vegetation.

As the ponds are designed to collect and treat contaminants associated with run-off, the area in and around the pond will be considered contaminated and the maintenance regime will take account of this during the disposal of any sediment or plant waste from the ponds, as well as the de-contamination of the pond when it has reached the end of its useful life.

A management plan for the ponds will be prepared to ensure they continue to operate as intended. This may need to be adjusted during the operation of the ponds due to changes in the vegetation, ecology etc.

The maintenance plan will incorporate the measures contained in Table 6.1 of TII DN-DNG-03063-02 '*Vegetated Drainage Systems for Road Runoff'.*

Access to the attenuation ponds provided under this Proposed Scheme will be as described in **Table 4-31** below and are illustrated in Volume 3, drawing series **MDT0806-RPS-01-N2-DR-C-GE3000-GE3007** (Access Tracks).

Table 4-31: Attenuation Ponds – Access Arrangements

Pond No.	Description of Access
1	Dedicated access track provided from the old N2, north of the proposed southern roundabout
2	Access provided via the proposed pedestrian/cyclist link from the proposed bypass on the south side of the proposed River Boyne crossing.
3	Access track provided from the southbound carriageway of the proposed N2 dual carriageway bypass, located on the north side of the proposed River Boyne crossing.
4	Dedicated access track provided from the realigned N51 on the west side of the proposed bypass.
5A and 5B	Access track provided from the old section of the N51 located on the east side of the proposed bypass.
6	Access track provided from the N2 located on the north side of the proposed northern roundabout.

4.5.1.1.4.4 Vortex Grit Removal Chambers

The vortex grit removal chambers are standalone units and their maintenance will be carried out in accordance with the manufacturer's recommendations. This will normally include inspection of the unit regularly after installation, and every six months after the first year of installation. This ensures that the system is operating as intended and helps to highlight any issues.

Sediment and oil removal will be carried out at least once per year and following any accidental spill in the area draining to the unit. This will vary depending on the nature and size of the catchment in question.

Vortex grit removal structures are provided at each outfall to the attenuation ponds. Therefore, access to each vortex grit removal chamber is provided as per **Table 4-31** above.

4.5.1.1.4.5 Petrol/Oil Interceptors

The petrol/oil interceptor's maintenance will be carried out in accordance with the manufacturer's recommendations and BS EN 858-2:2003 Separator systems for light liquids (e.g. oil and petrol) – Part 2.

It is normally recommended that cleaning of the interceptor takes place every three to six months, but this may vary depending on location and catchment area. Additional cleaning and maintenance will be undertaken after any major events that may have caused additional debris to collect in the system.

The regular maintenance schedule will include, but not be limited to:

- Check the integrity of the interceptor and all its mechanical parts;
- Inspect the filters and repair or replace, where required;
- Assess the volume of contaminants collected in the tank;
- Service all electrical systems, interceptor management systems and alarms etc.;
- Have all silt and contaminants removed and disposed in accordance with environmental regulations;
- Keep logs of any inspections, maintenance, incidents, services and contaminant removal activities; and
- Ensure any contaminants are removed and transported in accordance with relevant legislation.

Petrol/oil interceptors are provided at each outfall to the attenuation ponds. Therefore, access to each petrol/oil interceptor is provided as per **Table 4-31** above.

4.5.1.1.5 Pavement

The mainline pavement will require ongoing inspection, testing and maintenance. This will be carried out in accordance with TII pavement management requirements. Temporary traffic management will be provided where required to facilitate inspection, testing and maintenance.

It is expected that the pavement surface course will require to be replaced every 8 to 10 years.

4.5.1.1.6 Public Realm

Resin-bound gravel or tree grilles using integrated paving will be used at the base of trees as it limits weed growth. A maintenance regime for all trees will be undertaken by MCC.

Street furniture will be designed with sockets were possible to allow for ease of maintenance and replacement by MCC if required.

Tree planting within the public realm will be monitored to ensure that the tress have established. The maintenance regime will need to be tailored at the detailed design stage, as the specific materials used will define certain maintenance parameters.

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