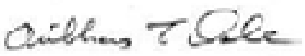
A32 Shannaragh Realignment Stage 3 Scheme Assessment Report

Prepared by: 

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A32 Shannaragh Realignment - Stage 3 Scheme Assessment Report

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Executive Summary

This report presents the findings of the Stage 3 Scheme Assessment in accordance with TD 37/93 the Design Manual for Roads and Bridges (DMRB) Scheme Assessment Reporting.

The A32 forms part of the trunk road network of Northern Ireland and provides a link between the towns of Omagh and Enniskillen. The A32 Shannaragh Realignment Scheme is part of the overall strategy for the A32 and will be required to be consistent with and complement the other improvement schemes on the A32. The section of the A32 under consideration extends from its junction with the B4 Drumlish Road to the outskirts of Dromore village in the townland of Shannaragh.

The A32 presently carries in the region of 5,300 vehicles per day in the locality of the proposed improvements.

The Preferred Option consists of a predominantly off-line improvement commencing at the junction of the A32 with Shannaragh Road travelling in a north easterly direction. The realignment veers to the east of the existing A32 via an embankment constructed within the flood plain. A new bridge is required to span the Owenreagh River before the alignment crosses the existing A32 in advance of a proposed staggered junction with Cavan & Capehill Roads. At this location the route is in cut through a drumlin to the west of the current road layout. The existing direct access for the Derrynaseer Road onto the A32 is diverted to join the Capehill Road, which then joins the A32 at the staggered junction.

The route again crosses the existing A32 and veers to the west of the existing road through a peat bog area, located within the flood plain. The alignment of the route necessitates the re-alignment of the Mullaghbane Drain within this section.

The route crosses the existing road 200m to the southwest of the B4 tie-in location, where it veers to the west of the existing A32 before tying-in to the recently constructed Mullaghbane improvement scheme.

AECOM (previously Faber Maunsell), were commissioned in July 2008 to assist Roads Service in the completion of the Statutory Procedures to improve the A32 Trunk Road at Shannaragh.

A ‘Stage 1 Scheme Assessment Report’ dated June 2009 produced by AECOM, included the consideration of existing conditions, alternative scheme options, buildability, engineering and environmental assessment as well as appraisal against the five key Government Objectives of Environment, Accessibility, Safety, Economy and Integration. The conclusion of the Stage 1 assessment was to progress the standard single carriageway strategy within a defined and constrained corridor. This received Gateway 0 approval in June 2009.

Subsequently a ‘Stage 2 Scheme Assessment Report’ dated December 2009, prepared by AECOM, considered three alternative options. The three options were assessed in accordance with DMRB requirements and appraised against the Government’s five key Objectives. The Stage 2 assessment concluded that the most favourable option for onward progression was the Pink Option. This received Gateway 1 approval in December 2009, allowing the progression of the assessment process to Stage 3.

Since receipt of Gateway 1 Approval, the design development of the scheme has progressed to a level to allow confidence in the proposed vested land boundary.

The environmental impact assessment concluded that there is potential for moderate adverse impacts on cultural heritage sites as the study area has seen little systematic archaeological investigation in the past. Proposed mitigation measures, in agreement with NIEA, include an evaluation excavation adjacent to the possible Rath prior to any construction activities. There are several aspects of the proposed scheme which may have slight adverse impacts prior to mitigation measures being implemented. These include; land use, geology and soils, water quality and drainage, ecology and nature conservation, landscape, air quality and disruption due to construction. An assessment of the impact of noise and vibration indicates an overall reduction in noise and vibration levels due to the source being generally moved further away from residential properties. Communities & NMU’s may experience slight beneficial impacts, while vehicle travellers may experience moderate beneficial impacts.

The Programme Scheme cost estimate for the Preferred Option is £6,977,513 (including fees and risk), which provides a Benefit to Cost Ratio (BCR) of 1.513.

It is therefore concluded that the Pink Option is the preferred improvement for the A32 at Shannaragh.

1 Introduction

1.1 Background to the Scheme

The A32 forms part of the Trunk Road Network of Northern Ireland and links the towns of Omagh and Enniskillen in the west of the province (Figure 1.1).

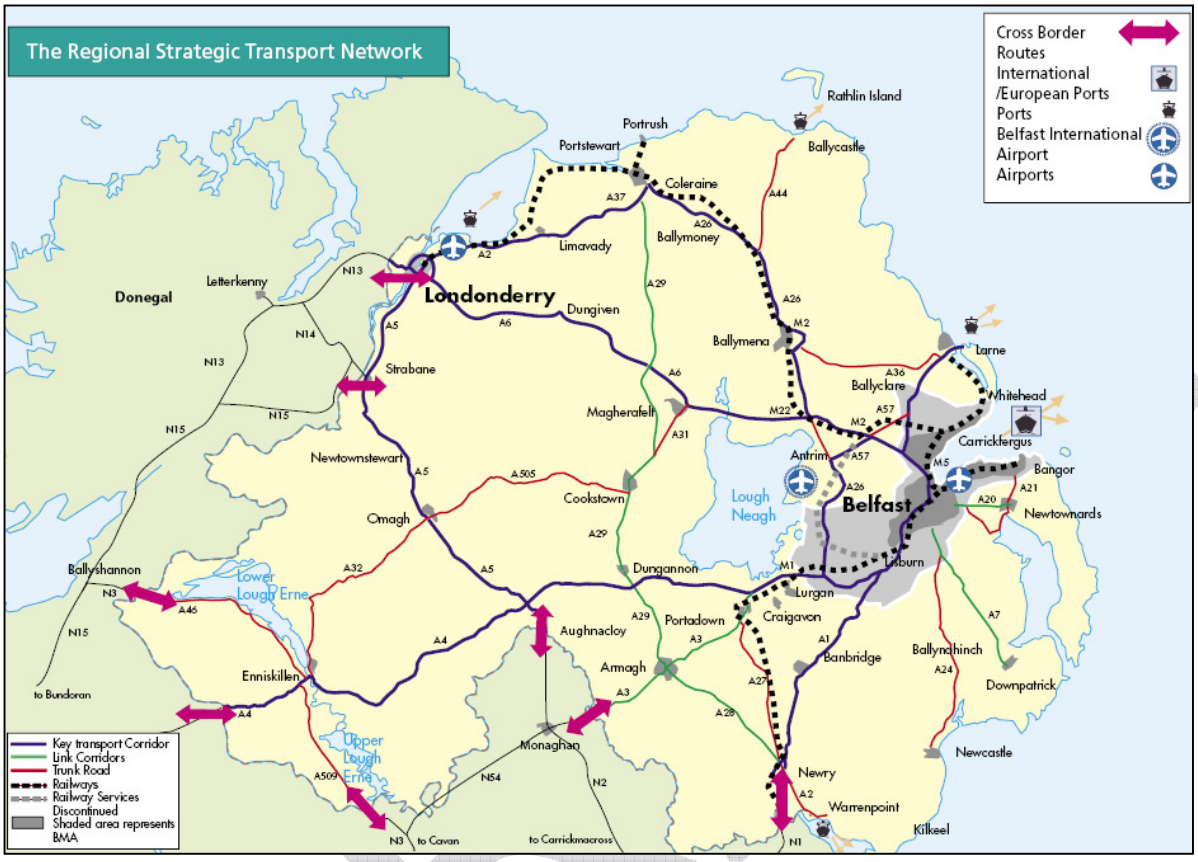

Figure 1.1 - The Regional Strategic Transport Network

The section of the A32 under consideration extends from its junction with the B4 Drumlish Road to the outskirts of Dromore village (Figure 1.2) in the townland of Shannaragh.

Improvements to the A32 at this location were proposed in the consultation document “Expanding the Strategic Road Improvement (SRI) programme 2015”, published in July 2006. The proposed improvements at Shannaragh form part of the overall A32 improvement strategy.

The strategy for improving the A32 was developed by Roads Service in the document “A32 Omagh-Enniskillen Improvement Strategy” (the A32 Improvement Strategy), which considered alternative route options to enhance the transport links between Omagh and Enniskillen. This study concluded that a series of on-line and off-line improvement schemes along the A32 provided the optimal solution in terms of satisfying the five key Government objectives of safety, economy, environment, accessibility and integration.

Capabilities on project:
Transportation

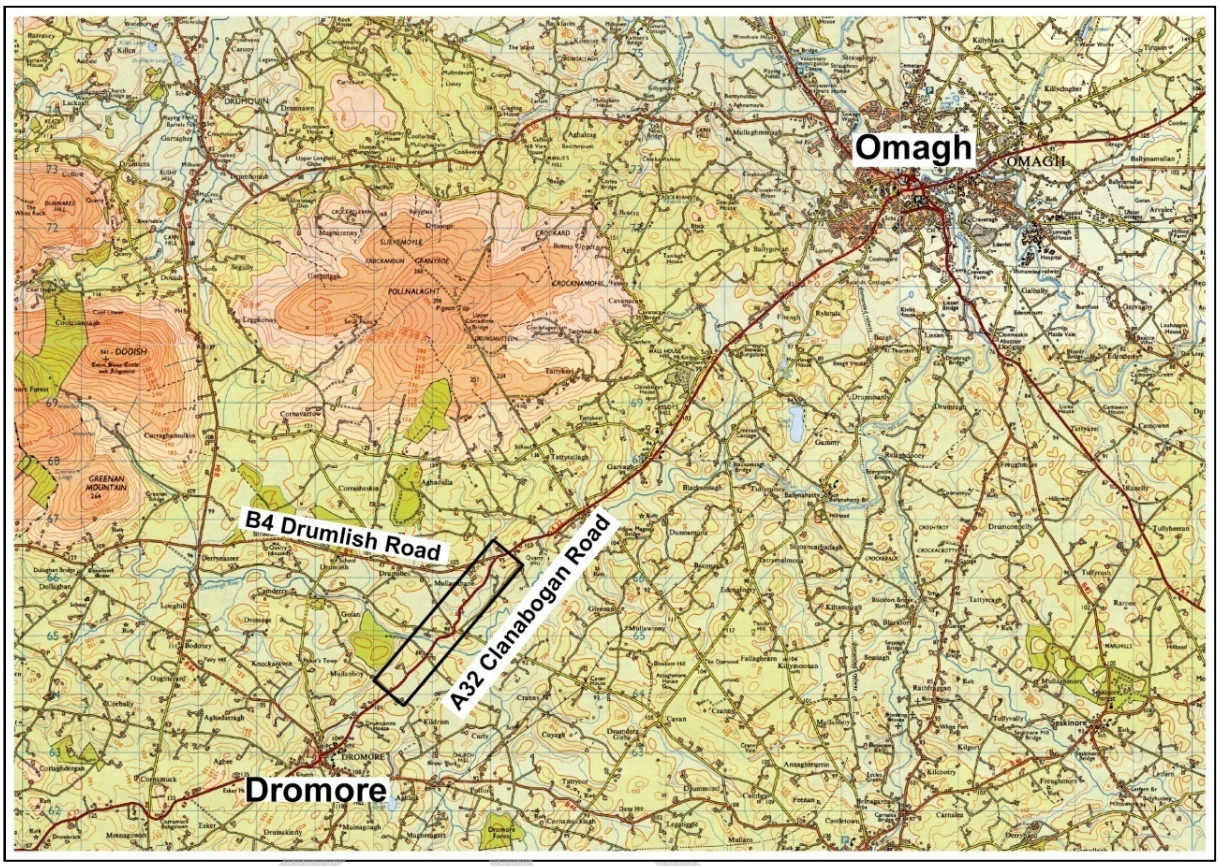

Figure 1.2 - Location Plan

The Investment Delivery Plan for Roads, published in May 2008, identifies Roads Service capital investment priorities over the next ten years, given the funding levels envisaged through the Northern Ireland Investment Strategy 2008-2018 (ISNI). The A32 between Dromore – Irvinestown – Enniskillen is one of the improvements listed within the Strategic Road Improvements with a requirement, as stated in the IDP, "to improve access to the new hospital at Enniskillen." Benefits include improving access to the new Erne hospital by reducing journey times, improving comfort and increased reliability along the A32 between Omagh and Enniskillen.

Locations for improvements between Omagh and Enniskillen were identified within the 'A32 Improvement Strategy', published by Roads Service Western Division, which concluded that a series of on-line and off-line improvement schemes along the A32 will provide the optimal solution in terms of satisfying the five key Government objectives of safety, economy, environment, accessibility and integration.

The A32 Shannaragh Realignment Scheme is part of the overall strategy for the A32 and will be required to be consistent with and complement the other improvement schemes on the A32.

AECOM (previously Faber Maunsell), were commissioned in July 2008 to assist Roads Service in the completion of the Statutory Procedures to improve the A32 Trunk Road at Shannaragh. A 'Stage 1 Scheme Assessment Report' dated June 2009 was submitted and received Gateway 0 approval in June 2009. Subsequently a 'Stage 2 Scheme Assessment Report' dated

December 2009 received Gateway 1 approval in December 2009, allowing the progression of the assessment process to Stage 3, the development of which is the subject of this report.

1.2 Stage 1 Strategies

As part of the overall Stage 1 Assessment, separate assessments were undertaken in relation to the engineering and environmental conditions at Shannaragh. These assessments, although establishing the need for further study, did not indicate any issues which could be detrimental to the scheme. The most significant finding of these assessments was the location of a possible Rath site in close proximity to the existing alignment.

Three potential road improvement strategies were developed and assessed within the defined route corridor in terms of road geometry, buildability, safety, cost, and value for money. These were:

- Normal single carriageway (S2);
- Wide single carriageway (WS2);
- Wide single 2+1 carriageway (WS 2+1).

A number of indicative alignments were produced for each strategy to allow an assessment to be made of their compliance with both DMRB and scheme specific (i.e. junction strategy) design criteria. The outcome of this assessment found that the WS 2+1 strategy was not feasible within the study extents and was discounted from further assessment.

Of the remaining strategies, S2 provided the most economically advantageous results and was compliant in all other aspects with the study objectives.

It was therefore recommended that the S2 strategy be taken forward to Stage 2, with a view to assessing detailed single carriageway design options.

1.3 Stage 2 Options

Three options (Blue, Yellow and Pink) were put forward for Stage 2 assessment, which covered the extremities of the defined corridor and provided the best way forward in determining the preferred option, given the constraints within the corridor. The main engineering issues were related to fitting a new or improved road around a series of man-made and natural constraints within a rural landscape.

The Pink Option (with potential junction modifications to achieve greater overtaking provision in both directions) was recommended to be put forward to Stage 3. It had the lowest estimated cost and a positive net present value; no impact on residential property and less severance of land plots than the Blue or Yellow Options.

1.4 Public Consultation

Public consultation was undertaken at two key stages of scheme development. The first consultation exercise in May 2009 was carried out to ascertain initial public opinion on a preferred route. The three proposed route options were presented at the exhibition, one generally to the northern side of the existing A32 (Blue Option), one generally to the southern side (Pink Option) and one in between (Yellow Option).

The exhibition achieved its objective of obtaining the benefit of local knowledge to assist in the development of the scheme. Although the number of attendees was low, this was expected given the relatively small scale and low impact of the scheme beyond those directly affected by the proposals.

Due to the low written response rate, it was not possible to draw a conclusion on the option preferred by the general public, with each of the options having a greater or lesser degree of impact on those directly affected by the scheme, thereby influencing their individual choice of option.

The main conclusion of the initial public consultation exercise was that the closure of the Capehill Road would not be accepted by the public. This led to a re-design of the junction configuration at the A32/Capehill/Cavan/Derrynaseer Roads.

The second consultation exercise in February 2010 was carried out to present the results of the Stage 2 assessment and to announce the Preferred Option. Although again, there was a relatively low turn-out, the exercise was useful in keeping those people directly affected by the scheme informed of progress on the project and what steps would come next.

To date, no opposition has been voiced.

1.5 Conclusion – The Preferred Option

The conclusion at the end of Stage 2 to develop the Pink Option was confirmed through the Gateway approval process and the on-going design development and refinement of the Pink Option is discussed in detail as the subject of this report.

2 Existing Conditions

2.1 Introduction

This section of the report provides an overview of the existing conditions covering the relevant significant conditions and pertinent issues relating to the A32 at Shannaragh where the realignment works are proposed.

Rural landscape dominates the majority of the road boundaries along the existing A32 route, with a number of direct accesses on to the A32 from residential properties, commercial (farming-related) developments and agricultural land. Within the study area there is a mixture of residential properties, farms and agricultural outbuildings set into the rural landscape.

The existing route crosses the Owenreagh River via a twin arch masonry bridge, within the townland of Shannaragh north east of the junction between the A32 and Shannaragh Road.

2.2 The Highway Network

The existing A32 is designated as a Trunk Road within the Regional Strategic Transport Network and connects the towns of Omagh and Enniskillen via Dromore and Irvinestown. The route is approximately 27 miles in length. The length of the Preferred Option is approximately 2.2km in length and runs between Shannaragh Road to the south and the B4 Drumlish Road to the north.

The existing cross-section of the A32 at Shannaragh is inconsistent with the remaining length of the A32 between Omagh and Dromore. Between Omagh and Lisgarty Road the carriageway is a wide single alignment, 10m wide with hard shoulder. At Lisgarty Road the alignment then changes to a normal carriageway (S2) and remains that way until it reaches Dromore.

The national speed limit (60mph) applies to the section of the A32 at Shannaragh within the study area, however, this section of the route does not currently allow for traffic to travel at the speed limit. Average speeds on the route have been recorded at 34mph.

The section of the A32 within the study area at Shannaragh is inconsistent with the majority of the rest of the A32 between Omagh and Dromore. Travelling between Omagh and Lisgarty Road, the journey ambience is good with no severe bends or undulations and the WS2 alignment provides overtaking opportunities. In comparison, further along the route at Shannaragh the alignment has poor journey ambience, with severe bends and undulations and no opportunity for overtaking.

2.3 Traffic and Collision Information

2.3.1 Existing Traffic Flows

From survey data obtained in 2008, the equivalent annual average 24-hour 7-day daily flows (AADTs) on the A32, recorded in three separate locations, range from 5,339 to 8,146 vehicles. The proportion of HGVs is typically around 14-15%. Journey speeds measured along the existing A32 within the study area range between 34mph and 54.4mph. Historic information indicates an overall increase in traffic volumes of 16.0% between 2001 and 2008, with volumes generally increasing year on year.

In March 2009 acute medical services were removed from Tyrone County Hospital in Omagh. This has necessitated alternative acute journeys for patients to/from the Erne Hospital in Enniskillen. In addition, planning permission has recently been granted for a new acute medical services hospital in Enniskillen to replace the existing Erne Hospital. It is envisaged that this new hospital will serve both the Enniskillen and Omagh districts and be in operation by 2012/2013.

As a result of the acute medical services closure and the new hospital in Enniskillen it is anticipated that, there will be additional trips made between Omagh and Enniskillen for both acute and non acute patients.

The surveys undertaken in early 2008 would not have recorded this ‘transferring’ traffic that now travels the A32 between Omagh and Enniskillen as a result of the closure of acute services.

It is difficult to determine the exact number of additional trips that will materialise on the A32 due to the hospital changes however; initial estimates suggest that in the region of 300 additional trips per day could be made on the A32 at Shannaragh.

2.3.2 Collision Information

Detailed collision information was provided by Roads Service for the study area at Shannaragh for the period 2005 – 2009. There were a total of 12 collisions within the study area in the period 2005 – 2009. No fatal collisions were recorded in this period. The majority of injuries are listed as minor with some serious injuries also recorded. From an analysis of the recorded causes of collisions, it can be concluded that, in approximately one in four cases, the existing road conditions were a contributory factor.

Two of the collisions recorded were head-on collisions as a result of vehicles failing to complete overtaking movements of slower vehicles. One of these collisions occurred between the Shannaragh Road and Kildrum Road junctions, with the other occurring in the area where the A32 currently crosses the Owenreagh River. Injuries from these two collisions included seven minor casualties and five serious casualties. The lack of clear overtaking opportunities within the study area is likely to have been a contributing factor in these collisions

The area of road around Shannaragh Bridge, where the A32 crosses the Owenreagh River is prone to flooding. Safety signs have been erected at this location to warn drivers of the hazard.

2.3.3 Existing Junctions

Currently there are several junctions and accesses located along the A32 within the scheme extents, from the outskirts of Dromore to the junction between the A32 and the B4 Drumlish Road.

Junctions with minor roads which are located within the scheme extents are as follows:

- Junction between the A32/ Shannaragh Road;
- Interchange where Capehill Road, Derrynaseer Road and Cavan Road access the A32.

Also within this length of the A32 there are nine accesses, five of which serve farms with the remaining four serving individual dwellings.

All of the existing junctions and accesses take the form of simple priority junctions. This therefore provides a consistent junction strategy within the existing alignment at Shannaragh.

2.3.4 Public Transport Services

There are a number of public transport services that operate between Omagh and Dromore on the A32 at Shannaragh however only service nos. 94 and 83 stop at this location en route between Omagh and Enniskillen/Irvinestown. The services are relatively infrequent, concentrated primarily in the am and pm peak.

There are also dedicated school services which operate during term time along the A32, serving Drumlish, Tattysallagh, Clanabogan and Omagh. These dedicated services pick up specifically named individuals on the bus driver's list.

Whilst shelters are provided at some of the bus stops, buses stop 'in lane' to pick up/drop off passengers.

2.4 Environment

2.4.1 Manmade Constraints

The area surrounding the proposed improvement scheme at Shannaragh is predominately agricultural land and therefore there are few developments. Where manmade constraints exist they are mostly confined to private dwellings and farm buildings apart from the existing Shannaragh Bridge which carries the A32 over the Owenreagh River. Refer to Drawing 60050885/030/C(94)L366 in Appendix B for an illustration of scheme constraints. Man-made constraints include:

- No. 215 Clanabogan Road;
- No. 222 Clanabogan Road;
- No. 2 Derrynaseer Road;
- No. 6 Capehill Road;
- Shannaragh Bridge;
- Capehill Culvert;
- Mullaghbane Bridge and Culvert;
- Mullaghbane Realignment Scheme.

2.4.1.1 Existing Shannaragh Bridge

The existing A32 crosses the Owenreagh River by means of a masonry twin arch bridge (Photograph 2.1), with a cumulative span of 12.87m. The proposed option will require construction of a new bridge at the Owenreagh River crossing, further details of which are provided in Section 4.3 of this report.

Photograph 2.1 – Existing Shannaragh Bridge

2.4.2 Mullaghbane Realignment Scheme

There are numerous improvement schemes planned for the A32 between Omagh and Enniskillen, a full outline of which is detailed in the A32 Improvement Strategy. Realignment works have recently been completed at Mullaghbane located to the north east of the Shannaragh scheme. The Mullaghbane scheme included the realignment of approximately 700m of the A32 to S2 carriageway and terminates at the A32/B4 junction. The realignment works at Shannaragh will be required to tie into the Mullaghbane scheme at the A32/B4 junction.

2.4.3 Other Constraints

In addition to the above mentioned manmade constraints, several natural constraints also exist which will require consideration. Refer to 60050885/030/C(94)L366 in Appendix B for an illustration of scheme constraints. Natural constraints identified include:

- The possible Rath site;
- Owenreagh River;
- Mullaghbane Drain;
- Capehill Drain;
- Peat Bog;
- Flood Plain.

2.4.3.1 Possible Rath

Within the extents of the proposed scheme there is a possible Rath site. The site holds a prominent position with panoramic views atop a drumlin at the south western end of the valley. The possible Rath consists of a scarp platform, highest to the north where it is 1m high. The interior is slightly domed. It is otherwise featureless. A low perimeter bank measuring 1.5m wide, 0.5m high internally and 1.0m high externally surrounds the site. The possible Rath is shown below in Photograph 2.2.

The site is encircled by a ring of beech trees which further enhances the prominence of the feature within the local landscape. The tree circle at the possible Rath site is listed as an enclosed tree ring in the Northern Ireland Sites and Monuments Record, but is not listed as a scheduled monument.

Photograph 2.2 – Possible Rath

2.4.3.2 Owenreagh River

The Owenreagh River, which is part of the larger Drumragh River system, dissects the existing A32 in the townland of Shannaragh. The river which winds north west to south east through the study area is a designated salmonid river under the EC Freshwater Fish Directive and these rivers are particularly susceptible to adverse impacts during construction. Further discussion of the construction impact on the Owenreagh River will be given in Section 6.2.11 of this report.

Historical flood maps obtained from Rivers Agency show that the Owenreagh River is prone to flooding. Rivers Agency has produced a strategic flood map for the area to give an indication of the likely future flooding patterns as a result of climate change. It is predicted that the Owenreagh River will flood during a 1 in 100 year event.

2.4.3.3 Mullaghbane Drain

The Mullaghbane Drain (Photograph 2.3) is a tributary of the Owenreagh River and crosses the existing A32 in the north of the study area. Similar to the Owenreagh River the Mullaghbane Drain has historically flooded and is predicted to flood during a 1 in 100 year event.

Photograph 2.3 – Mullaghbane Drain

2.4.3.4 Capehill Drain

The Capehill Drain is a tributary of the Mullaghbane drain and the confluence between both watercourses occurs within the study area. Similar to the Mullaghbane Drain the Capehill Drain has historically flooded and is predicted to flood during a 1 in 100 year event.

2.4.3.5 Peat Bog

Peat deposits have been identified in several locations throughout the study area. This is discussed in greater detail In Section 4.6 of this report.

2.4.3.6 Flood Plain

The area around Shannaragh is prone to flooding. Rivers Agency have produced a strategic flood map for the area to give an indication of the likely future flooding patterns as a result of climate change**.** Refer to Drawing 60050885/030/C(94)L366 in Appendix B. Photograph 2.4 shown below, illustrates flooding observed adjacent to the A32 in Shannaragh in October 2008.

Hydraulic models have been constructed for the Owenreagh River, Capehill Drain and Mullaghbane Drain to allow assessment of the effects of the proposed realignment scheme on these watercourses and to assist with the Flood Risk Assessment for the site.

Photograph 2.4 – Flooding Observed in Shannaragh October 2008

2.5 Geology and Soils

A detailed description of drift geology, solid geology, foundations, import and export of materials, contaminated land, drainage, hydrology and hydrogeology can be found in Section 4.6 of this report.

2.6 Public Utilities

Early investigations indicated that only three utility companies stand to be affected by the proposed realignment works at Shannaragh. Consultations have taken place with each of the three affected utility providers, British Telecom (BT), Northern Ireland Electricity (NIE) and NI Water, to determine the likely extent of works which will be required in altering services to facilitate the proposed works.

BT has both underground and overhead services located within the Shannaragh study area. Overhead services supply local individual dwellings and BT has indicated that altering these services should be relatively straightforward. BT also has underground cables running along both verges of the A32 at Shannaragh which will require alteration. The alterations are discussed in detail in Section 4.5 of this report.

NIE services located in the Shannaragh study area are all overhead local services supplying electricity feeds to individual dwellings and farms. A 33Kv supply running parallel to the east of the existing A32 is outside the extents of the scheme. The alterations are discussed in detail in Section 4.5 of this report.

There are a number of NI Water mains which will be affected by the proposed realignment works. A water main runs along Derrynaseer Road, crosses the A32 and continues along Cavan Road. Where this main crosses the A32 an additional main spurs off and continues along the A32 to service No's 215 and 222 Clanabogan Road. This main terminates outside no 215 Clanabogan Road. The proposed realignment will cross this water main in several locations. The alterations are discussed in detail in Section 4.5 of this report.

3 Description of the Scheme

3.1 Key Elements of the Preferred Option

3.1.1 Linear Description of the Scheme

The Preferred Option consists of a predominantly off-line improvement commencing at the junction of the A32 with Shannaragh Road travelling in a north easterly direction. The realignment veers to the east of the existing A32 via an embankment constructed within the flood plain. A new bridge is required to span the Owenreagh River before the alignment crosses the existing A32 in advance of a proposed staggered junction with Cavan & Capehill Roads. At this location the route is in cut through a drumlin to the west of the current road layout. The existing direct access for the Derrynaseer Road onto the A32 is diverted to join the Capehill Road, which then joins the A32 at the staggered junction.

The route again crosses the existing A32 and veers to the west of the existing road through a peat bog area, located within the flood plain. The alignment of the route necessitates the re-alignment of the Mullaghbane Drain within this section.

The route crosses the existing road 200m to the southwest of the B4 tie-in location, where it veers to the west of the existing A32 before tying-in to the recently completed Mullaghbane improvement scheme.

3.1.2 Scheme Development following Stage 2

Following on from the preliminary design presented at Stage 2, the following design development changes have been made (refer to Drawings 60050885/030/C(94)L300 to L305 in Appendix B, for details of proposed horizontal and vertical alignment of the main and side road alignments):

Junction configuration at Capehill Road

The junction strategy at Stage 2 incorporated the closure of the Capehill Road/A32 junction, with the perceived justification being that turning movements onto and off the A32 (based on traffic counts) are very low; few properties are located on the Capehill Road; and, a short diversion via the existing B4 Drumlish Road was a feasible alternative. This junction strategy was presented to the public at the first public consultation exercise. Those attending the exhibition were unanimously opposed to the closure of the Capehill Road junction, due to the location of farmlands owned by the same landowner accessed off the Capehill and Cavan Roads necessitating multiple crossing movements, as well as residents on the Capehill Road being opposed to losing direct access to the A32. It was decided that an alternative strategy be considered.

The background to the decision to close the Capehill Road junction was to rationalise the multitude of lightly trafficked minor roads converging at the same locus on the A32. Within the Pink Option, the opportunity existed to provide a link road between the Capehill and Derrynaseer Roads, allowing only one direct access onto the A32 to form a staggered junction with the A32 and Cavan Road. This opportunity was not possible within the Blue and Yellow Stage 2 Options due to their proximity to the possible Rath.

The decision to link Derrynaseer to Capehill rather than the other way round was based on the requirement to site the proposed junction at a location that would maximise overtaking opportunities in both directions, a key scheme requirement. This arrangement and the length of overtaking sections available, is a significant improvement upon the original Stage 2 Pink Option.

Connection of the Cavan Road to the A32

Within each of the Stage 2 Options, the junction arrangement of the Cavan Road and the existing A32 remnant remained unaltered. This resulted in undesirable priorities between the Cavan Road and the remnant of the existing A32. The existing A32 remnant was to be realigned to form a new junction with the realigned A32. During scheme development it was decided that, due to the undesirable priorities and difficulty in realigning the existing A32 to form a new junction with the realigned carriageway, an alternative junction strategy would be investigated for the Cavan Road and remnants of the existing A32. It was decided to incorporate a realignment of the Cavan Road to meet the A32 directly, with the existing A32 remnants aligned to meet the Cavan Road to provide access to property and agricultural land (Figure 4.1). This is an improvement to the junction

layout of the side roads to the east of the A32. The realigned Cavan Road could have been incorporated into any of the original Stage 2 options.

Drainage design incorporating SuDS

Design development of the drainage regime resulted in the incorporation of SuDS ponds into the scheme footprint to allow for storm water attenuation. It should be noted that the detention ponds have been incorporated solely to attenuate storm water flow and are not a requirement for water quality improvement. The inclusion of SuDs ponds does however add a water quality benefit to the scheme. Again, these amendments would have been equally applicable to each of the Stage 2 Options.

Other design development issues are discussed in detail in Chapter 4.

3.1.3 Public Transport Facilities

A review of bus stop provision was undertaken as a result of the proposed works. The proposed junction arrangements will necessitate the relocation of existing bus stops as well as ensuring adequate footway provision.

Bus lay-bys have been included adjacent to the staggered junction of the A32/Cavan Road/Capehill Road, with footways provided to link the mouth of the junctions to the bus stops. A new footway connection has been incorporated to link the realigned A32 to a remnant of the existing A32, which will remain open to provide access to residential property (Figure 3.1). A further bus lay-by has been incorporated at the southern end of the scheme to relocate an existing bus stop.

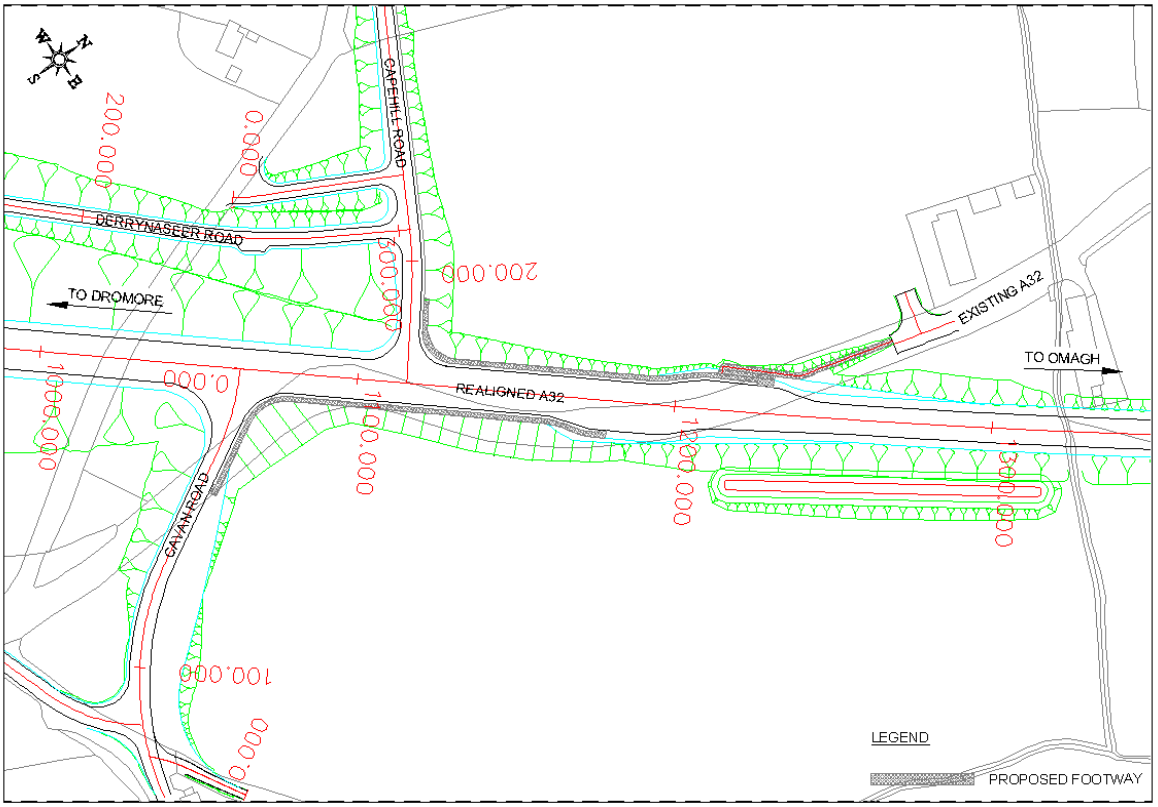

Figure 3.1 – Footway provision

3.1.4 Cost Estimate

Methodology

The development of scheme costs has been a continual process during the three stages of the scheme design process. At Stage 1, initial estimates were undertaken for the three route corridors proposed.

At Stage 2, estimated costs were prepared for all three options under consideration. The level of detail of the cost estimates was commensurate with the broad development of the options at that time. The construction costs for each of the three options were calculated largely using rates provided by Roads Service from recently tendered projects of a similar nature and value. It is believed that these rates reflected construction costs relevant at that time. Land, property and compensation costs were based on rates provided by Land and Property Services (LPS).

At Stage 2, the design of the pink option was developed to a level to permit the calculation of broad quantities for the main bulk items.

For the Stage 3 scheme assessment, the design was developed and further information gathered (e.g. additional detailed site investigation). The design was developed to the point where significant measurement of most aspects of the scheme content could be taken with reasonable confidence.

At Stage 2 a risk allowance was calculated using HARM, the Highways Agency model for risk quantification. This resulted in a risk value being calculated, enabling the scheme designers to have an understanding of the level of risk associated with the scheme.

In addition, it is a well known phenomenon that there is often a systematic tendency to under-estimate scheme costs in capital projects. This is referred to as Optimism Bias (OB), and can often lead to an under-estimate of eventual scheme costs. To counter this possibility, an additional amount of capital is added on to the scheme cost, based on a proportion of original cost estimate. This proportion of OB (typically 44% of the cost estimate at the earliest stages) then reduces as the scheme progresses through the various stages of design as the project team gains a greater understanding of the likely costs of the scheme.

Risk and OB are discussed in more detail in later sections. The Stage 3 Base Cost Estimate is presented in **Table 3.1**, excluding Risk and OB.

Stage 3 Base Cost Estimate

ELEMENT	COST
Preliminaries (£)	358,924
Site Clearance (£)	35,254
Fencing (£)	165,237
Safety Fencing (£)	64,832
Drainage (£)	254,102
Earthworks (£)	1,601,245
Pavements (£)	927,415
Kerbs, Footways, Paved Areas (£)	45,036
Traffic Signs & Road Markings (£)	13,946
Structures (£)	814,752
Landscaping & Ecology (£)	135,748
Statutory Utility Alterations (NIE, NI Water & BT) (£)	327,410
Construction Sub-total (£)	4,743,901
*Land and Property (£)**	340,894
Construction, Land and Property Sub-Total (£)	5,084,795
Fees: Preparation (£)	508,480
Fees: Supervision (£)	254,240

ELEMENT	COST
Fees Sub-Total (£)	762,719
Scheme Base Estimate (SBE) Construction, Consultant Fees and Land Costs Sub-Total (£)	**5,847,514**

Table 3.1 Base Cost Estimate Breakdown

Earthworks were measured from preliminary design drawings or calculated using MX computer software using strip depths, gradients and reusability factors as advised by AECOM geotechnical advisors.

The costs associated with new structures and culverts are based on figures from SPONS (Civil Engineering & Highways Works Price Book, 2009).

The accommodation works for landowners affected by the works are minimal and include for new field gates, fencing and stoned access paths for agricultural accesses.

Land, property and compensation costs were based on rates provided by Land and Property Services (LPS).

Service Utility diversion costs have been refined since Stage 2, with the receipt of C3 estimates from the affected service providers. The costs are broken down as follows:

British Telecom £254,670

NI Electricity £30,188

NI Water £39,350

Quantified Risk Assessment

To adjust the base estimate a quantified risk allowance is added to cover the probability that many things could and will go wrong, be under-measured, or unforeseen etc. These could include unforeseen ground conditions, archaeology risk, under estimation of service diversion costs amongst others.

The value of such risks can be gained from a Quantified Risk Assessment (QRA). This takes account of the likely cost impact of each identified risk but that cost is reduced according to the probability of the risk occurring. The purpose of this is to recognise that it is unlikely for all risks to have certainty of occurring, and it would not be appropriate to allow for full certainty in the scheme cost estimate.

A risk workshop was held during Stage 2 to identify and quantify the key risks to the successful completion of the project. Risks were ranked and possible costs assigned within broad bands. The assigned costs and probabilities were used to carry out a risk analysis Monte Carlo simulation using the HARM software. This exercise was up-dated at Stage 3 to take account of knowledge gained in the intervening period. The mean value of these costs was found to be £545,247.

The base-adjusted estimate plus the risk allowance is therefore £6,392,761. This is referred to as the risk-adjusted base cost estimate.

Optimism Bias

HM Treasury's Green Book recognises that *"there is a demonstrated, systematic, tendency for project appraisers to be overly optimistic. This is a worldwide phenomenon that affects both the private and public sectors. Many project parameters are affected by optimism – appraisers tend to overstate benefits, and understate timings and costs, both capital and operational."*

It further states *"adjusting for optimism should provide a better estimate, earlier on, of key project parameters. Enforcing these adjustments for optimism bias is designed to complement and encourage, rather than replace, existing good practice in terms of calculating project specific risk adjustments. They are also designed to encourage more accurate costing. Accordingly adjustments for optimism may be reduced as more reliable estimates of relevant costs are built up, and project specific risk work is undertaken. Both cost estimates and adjustments for optimism should be independently reviewed before decisions are taken."*

To determine the extent to which the initial 44% OB can be reduced by for the A32 scheme, an exercise was undertaken to quantify the contribution of the various factors to the overall OB, followed by a determination of the mitigation possible for each factor. The results of this exercise are presented within **Table 3.2**.

Contributory factors	Percentage contribution to Optimism bias	Mitigation Factor	Percentage reduction in OB
Late Contractor Involvement in design	3	0.75	2.25
Dispute and Claims	21	0.70	14.7
Environmental Impact	22	0.85	18.7
Inadequacy of the Business case	10	0.85	8.5
Poor Project intelligence	7	0.85	5.95
Public Relations	9	0.75	6.75
Site Characteristics (earthworks)	3	0.50	1.5
Economic	7	0.50	3.5
Other (project specific) 1. Utilities costs escalate	9	0.85	7.65
Other (project specific) 2. Flooding/Drainage issues	9	0.85	7.65
TOTAL	100		**77.15**
Revised OB = Percentage reduction in OB (100-77.15)% multiplied by 44.	**10.05**		

Table 3.2 Adjustment of Optimism Bias (Programme Scheme Estimate)

The calculations in **Table 3.2** result in a revised OB of 10%. Applying this OB to the Base Cost Estimate as presented within **Table 3.3** gives a Programme Scheme Estimate of £6,977,513.

ELEMENT	COST
Base Cost Estimate (£)	5,847,514
HARM Risk Allowance (£)	545,247
OB (£) (10% of Base Cost Estimate)	584,751
Total Cost Estimate (£)	**6,977,513**

Table 3.3 Total Cost Estimate

4 Engineering Assessment

4.1 Detailed Engineering Description

The current proposed scheme incorporates the following key elements:

- Mainline 2.2km realignment of single carriageway extending from the junction of the A32 with Shannaragh Road to the junction of the A32 with the B4 Drumlish Road;
- 240m realignment of the Capehill Road;
- 300m realignment of the Derrynaseer Road;
- 160m realignment of the Cavan Road;
- 21.2m span bridge crossing over the Owenreagh River and multiple culverts.
- Several minor access roads and tie-ins.

Details of the proposed scheme are described in the following paragraphs:

Mainline

The A32 mainline realignment commences at its junction with the Shannaragh Road and veers to the east of the existing A32 via an embankment constructed within the flood plain. A new bridge is required to span the Owenreagh River before the alignment crosses the existing A32 in advance of the current junction arrangement at Capehill/Derrynaseer/Cavan Roads. At this location the route is in cut through a drumlin to the west of the current road layout. The existing direct access for the Derrynaseer Road onto the A32 is diverted along the top of the western cut and joins the Capehill Road. At this point a staggered junction arrangement between Capehill Road and Cavan Road is provided to meet the new alignment (Figure 4.1).

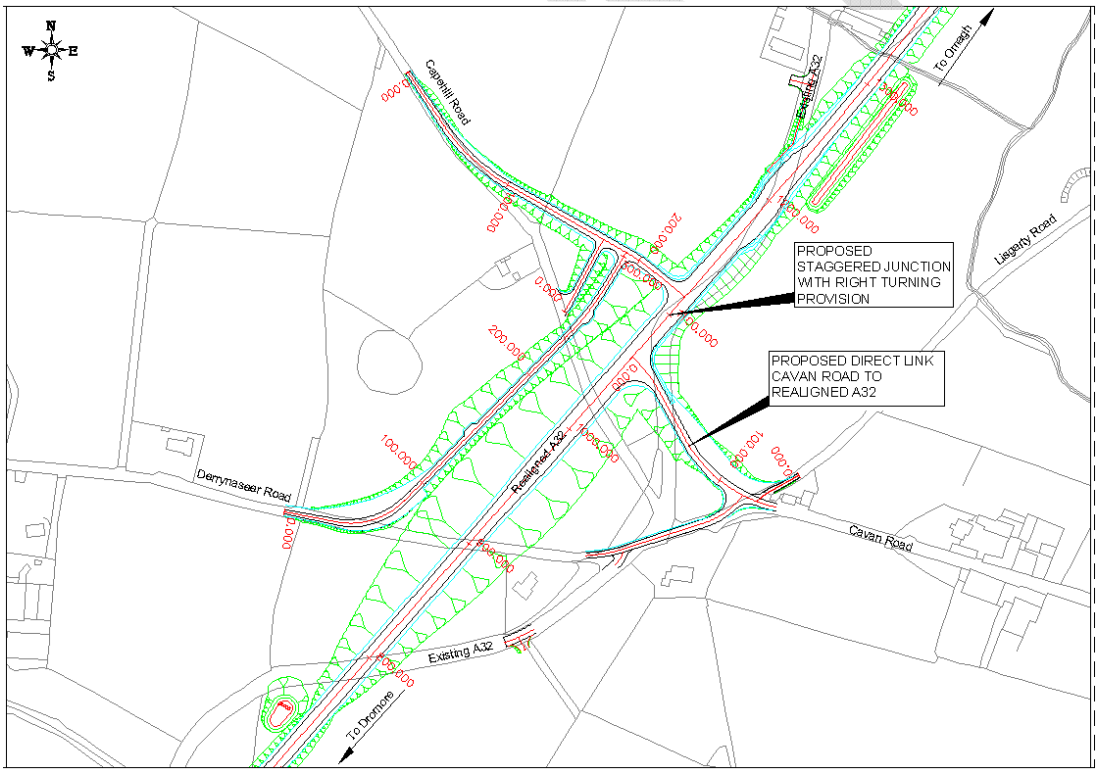

Figure 4.1 – Direct Link Cavan Road to realigned A32

Junction arrangement

The route again crosses the existing A32 and veers to the east of the existing road through a peat bog area, located within the flood plain. The alignment of the route necessitates the re-alignment of the Mullaghbane Drain within this section.

The route crosses the existing road 190m to the southwest of the B4 tie-in location, where it veers to the west of the existing A32 before tying-in to the recently constructed Mullaghbane Realignment Scheme.

The carriageway cross-section incorporates a standard 7.3m wide carriageway (S2) with 1.0m wide hard strips and 2.5m wide verges. Verges are widened in places to facilitate forward visibility requirements. The design speed for the A32 mainline is 100A.

Travelling in the north-south direction, there are two overtaking sections, with a total length of 1347m. In the opposite direction, one section of overtaking is provided at a length of 463m.

The edge of carriageway detail for the majority of the mainline length incorporates combined filter drains and verge and carriageway drainage over embankment slope (discussed in greater detail in section 4.4 Drainage). A kerbed road edge with footways is provided from the junction of the A32 and both the Capehill and Cavan Roads to link these junctions to the bus lay-bys on each side of the road. On the western side of the road, a footway link is provided from the bus lay-by to the A32 road remnant to allow pedestrian access between the bus lay-by and the properties located on the remaining A32 section.

Link Roads

The existing layout incorporates a multiple junction configuration of the A32 with the Capehill, Derrynaseer and Cavan Roads around the middle of the scheme. The junction strategy employed minimises the number of direct junctions onto the A32. The Derrynaseer Road is realigned running parallel to the mainline, forming a junction with the realigned Capehill Road. The Capehill Road is realigned to optimise the junction location for the provision of FOSD on the mainline.

The Cavan Road is realigned to meet the mainline alignment to form a staggered junction with the Capehill Road. A Ghost island layout has been provided to the staggered junction.

The Capehill Road and Derrynaseer Road have a 70A design speed, whereas the Cavan Road has a design speed of 85A. These are based on a combination of the calculated design speed and measured speeds. Where measured speeds have been used, a departure from standard is required, as detailed further below.

Two further minor junctions with the realigned A32 are formed where remnants of the A32 are required to connect with the new alignment to provide access to multiple residential and agricultural entrances.

Private accesses and associated junctions

There are two residential premises that will continue to have direct access onto the realigned A32; these are located at the southern tie-in. It has been necessary to continue to permit direct access for agricultural entrances. The cost of provision of parallel lanes was prohibitive, with no alternative side road access available.

Due to the realigned mainline carriageway, removal of the Derrynaseer Road direct access, as well as retention of remnants of the existing A32 to maintain existing accesses, the overall number of direct accesses and junctions on the realigned A32 has been reduced from 35 to 20.

4.2 Assessment of Compliance with Engineering Standards

Departures from Standard

The Design Manual for Roads and Bridges (DMRB) define 'desirable minimum' standards for Trunk Road schemes. The requirements of the DMRB produce a high standard of road safety. There are instances, however, where it may be necessary to reduce these standards, but at the same time ensuring that levels of safety are not compromised. An application must be made to Roads Service Headquarters for approval of a departure from standard. The table below highlights the departures from standard applied for and their justification.

LOCATION	DEPARTURE	JUSTIFICATION
A32 mainline	TD 41/95: Direct access located in the overtaking section of single carriageway road at Ch. 2127.	Significant cost and environmental benefits achieved by retaining accesses in their existing location.
A32 mainline	TD 41/95: Direct access located in the overtaking section of single carriageway road at Ch. 1840.	Significant cost and environmental benefits achieved by retaining accesses in their existing location.
A32 mainline	TD 41/95: Direct access located in the overtaking section of single carriageway road at Ch. 1570.	Significant cost and environmental benefits achieved by retaining accesses in their existing location.
A32 mainline	TD 41/95: Direct access located in the overtaking section of single carriageway road at Ch. 600.	Significant cost and environmental benefits achieved by retaining accesses in their existing location.
A32 mainline	TD 41/95: Direct access located in the overtaking section of single carriageway road at Ch. 382.	Significant cost and environmental benefits achieved by retaining accesses in their existing location.
A32 mainline	TD 41/95: Direct access located in the overtaking section of single carriageway road at Ch. 384.	Significant cost and environmental benefits achieved by retaining accesses in their existing location.
A32 mainline	TD 41/95: Direct access located in the overtaking section of single carriageway road at Ch. 425.	Significant cost and environmental benefits achieved by retaining accesses in their existing location.
A32 mainline	TD 41/95: Direct access located in the overtaking section of single carriageway road at Ch. 465.	Significant cost and environmental benefits achieved by retaining accesses in their existing location.

LOCATION	DEPARTURE	JUSTIFICATION
A32 mainline	TD 19/06: To omit permanent deformable or rigid safety barrier between chainage 2275 and chainage 2307.	Necessary to facilitate a direct access for a farmer to a field adjacent to the carriageway. Approach and departure terminals have been provided at either end of the VRS break.
A32 mainline	TD 19/06: To omit permanent deformable or rigid safety barrier between chainage 597.5 and chainage 611.	Necessary to facilitate a direct access for a farmer to a field adjacent to the carriageway. Approach and departure terminals have been provided at either end of the VRS break.
A32 mainline	TD 41/95: To provide a direct access at chainage 2120 with a dwell area of 5m and an uphill approach gradient of 4.5%.	Relatively short length of proposed access road serving 1 no. domestic dwelling and 2 no. farm accesses, constrained by tie-in levels at both ends.
Derrynaseer Road	TD 9/93: Horizontal a radius of 70m.	Alignment constraints of avoiding the possible Rath and development site at No. 6 Capehill Road and the earthworks of the proposed A32 realignment. This is a very low flow link road realignment; the traffic volume in the design year (2028) is not forecast to exceed 135 AADT and the proposed alignment is in keeping with the character of the existing road, which is significantly below standard horizontally, vertically and in cross section. The realigned road has a 4.0m wide carriageway with 1.0m wide verges and two number inter-visible passing-bays have been provided. Signage strategy highlighting substandard 70m radius bend has been employed in accordance with Traffic Signs Manual Chapter 4 and Traffic Signs Regulations (Northern Ireland) 1997.
Derrynaseer Road	TD 9/93: Reduction in design speed to 70A.	The Design Speed calculated in accordance with TD 9/93 is 85B. However the layout constraint calculations in TD 9/93 do not take account of the severely restricted layout of the existing Derrynaseer Road which has a width of 2.8m, no verge and vertical visibility restrictions. As a result, it is not considered that the method for calculating the Design Speed prescribed in TD 9/93 is appropriate. The measured speed was calculated as 30mph, therefore justifying a design speed of 70A.
Derrynaseer Road	TD 9/93: Sag K value of 9 and a crest K value of 17.	Alignment constraints of avoiding the possible Rath and the development site at No. 6 Capehill Road and the earthworks of the proposed A32 realignment. This is a very low flow link road realignment; the traffic volume in the design year (2028) is not forecast to exceed 135 AADT and the proposed alignment is in keeping with the character of the existing road, which is significantly below standard horizontally, vertically and in cross section. The existing Derrynaseer Road has a severely undulating vertical alignment with Crest K values of 6.73, Sag K values of 9.86 and gradients of up to 8.31%. The proposed Derrynaseer Road realignment improves the existing vertical alignment parameters and provides a more consistent ride quality
Derrynaseer Road	TD 9/93: 8.56% gradient.	Alignment constraints of avoiding the possible Rath, the development site at No. 6 Capehill Road and the earthworks associated with the proposed realigned A32 Clanabogan Road. The proposed realigned Derrynaseer Road is also constrained by

LOCATION	DEPARTURE	JUSTIFICATION
		the tie-in levels at both ends. This is a very low flow link road realignment; the traffic volume in the design year (2028) is not forecast to exceed 135 AADT and the proposed alignment is in keeping with the character of the existing road, which is significantly below standard horizontally, vertically and in cross section. It connects the existing 2.8m wide verge-less carriageway to the proposed junction with the realigned Capehill Road. The realigned road has a 4.0m wide carriageway with 1.0m wide verges and inter-visible passing-bays.
Derrynaseer Road	TD 9/93: Stopping Sight Distance of 70m	Alignment constraints of avoiding the possible Rath and the development site at No. 6 Capehill Road and the earthworks of the proposed A32 realignment. This is a very low flow link road realignment; the traffic volume in the design year (2028) is not forecast to exceed 135 AADT and the proposed alignment is in keeping with the character of the existing road, which is significantly below standard horizontally, vertically and in cross section. The realigned road has a 4.0m wide carriageway with 1.0m wide verges and inter-visible passing-bays.
Derrynaseer Road	TD 27/05: Carriageway width of 4.0m without provision of hard strips and a verge width of 1.0m.	The proposed Derrynaseer Road realignment is constrained by the requirement to avoid encroachment onto the adjacent possible Rath and the proposed development site at No. 6 Capehill Road. This is a very low flow link road realignment; the traffic volume in the design year (2028) is not forecast to exceed 135 AADT and the proposed alignment is in keeping with the character of the existing road, which is significantly below standard horizontally, vertically and in cross section.
Cavan Road	TD 9/93: Horizontal radius of 90m.	Required due to the alignment constraints of providing the minimum required junction stagger distance of 50m with the proposed new Capehill Road Junction and the desire to minimise the impact on surrounding lands and properties, in particular the property located at the Cavan Road / Lisgarty Road Junction. To the north of the proposed 90m radius bend the existing topography falls away quickly; providing a larger radius bend would require significant earthworks which would have an adverse impact on the surrounding lands and properties. Additionally, the alignment is restricted by the requirement to tie in with the existing Lisgarty Road and the retained section of the existing Cavan Road.
Cavan Road	TD 9/93: Sag K value of 17 and a Crest K value of 9.	Required due to the alignment constraints of the tie-in levels at both ends of the relatively short proposed realignment (approx 142m long) and the desire to minimise the impact on surrounding lands and properties, particularly the existing property located at the Cavan Road / Lisgarty Road junction. Additionally, the alignment is restricted by the requirement to tie in with the existing Lisgarty Road and a retained section of the existing Cavan Road. This is a very low flow link road realignment; the traffic volume in the design year (2028) is not forecast to exceed 643 AADT and the proposed alignment is in keeping with the character of the existing road, which is significantly below standard horizontally, vertically and in cross section.
Cavan Road	TD 27/05: Carriageway width of 6.0m tapering to 4.7m at the tie-	The proposed realignment is constrained by the requirement to avoid the existing property located at the Lisgarty Road / Cavan Road junction. This is a very low flow

LOCATION	DEPARTURE	JUSTIFICATION
	in point with minimum 1.0m wide verges and without hardstrips.	link road realignment; the traffic volume in the design year (2028) is not forecast to exceed 643 AADT and the proposed alignment is in keeping with the character of the existing road, which is significantly below standard horizontally, vertically and in cross section
Cavan Road	TD 9/93: Stopping Sight Distance of 120m.	Required due to the alignment constraint of providing the minimum required 50m right-left stagger with the proposed new Capehill Road junction and the desire to minimise the impact of the surrounding lands and properties, in particular the property at the Cavan Road / Lisgarty Road junction. This is a very low flow link road realignment; the traffic volume in the Design year (2028) is not forecast to exceed 643 AADT and the proposed alignment is in keeping with the character of the existing road, which is significantly below standard horizontally, vertically and in cross section.
Cavan Road	TD 42/95: Junction stagger distance of 12m between the existing Lisgarty Road and the retained section of the existing Cavan Road.	Required due to the alignment constraint of tying in to the existing road network and the desire to minimise the impact on surrounding lands and properties, in particular the property at the Cavan Road / Lisgarty Road junction. The 110m long (approx) retained section of the existing Cavan Road serves only 2 no. dwellings and 2 no. farm accesses, with use in the design year (2028) not forecast to exceed 40 AADT. Lisgarty Road serves very few properties and is significantly below standard horizontally, vertically and in cross section, with the carriageway approximately 3.0m wide. The actual traffic figures for Lisgarty Road are not available, however given the poor standard; it is not an attractive alternative to through traffic and therefore only serves local traffic.
Cavan Road	TD42/95: Siting a bus lay-by on the A32 Mainline within the Cavan Road junction visibility splays.	4.5m x 215m visibility splays have been provided for the minor road junction. The bus lay-by is sited within the visibility splays approximately 100m before the approach to the junction. The location of both the bus lay-by and the junction is restricted by the A32 Mainline earthworks. Bus movements along the route are relatively infrequent (approximately 10 movements per day), with a low number of passengers using the service.
Capehill Road	TD 9/93: Reduction in design speed to 70A.	The Design Speed calculated in accordance with TD 9/93 is 85B. However the layout constraint calculations in TD 9/93 do not take account of the severely restricted layout of the existing Capehill Road which has a width of 2.9m, no verge and vertical visibility restrictions. As a result, it is not considered that the method for calculating the Design Speed prescribed in TD 9/93 is appropriate. The measured speed was calculated as 40mph, therefore justifying a design speed of 70A.
Capehill Road	TD 9/93: Horizontal radius of 127m with 5% superelevation.	Alignment constraints of providing the minimum required 50m right-left stagger with the proposed new Cavan Road junction and the desire to minimise the length of realignment and impact on surrounding lands and properties, in particular the proposed development site at No. 6 Capehill Road. To the north of the proposed 127m radius bend the existing topography falls away quickly; providing a larger radius bend would require significant earthworks which would have an adverse impact on the surrounding lands and properties This is a very low flow link road realignment; the traffic volume in the design year

LOCATION	DEPARTURE	JUSTIFICATION
		(2028) is not forecast to exceed 209 AADT and the proposed alignment is in keeping with the character of the existing road, which is significantly below standard horizontally, vertically and in cross section.
Capehill Road	TD 9/93: Sag K value of 9 and Crest K value of 12.	Required due to the tie in level constraints at both ends of the proposed realignment, which are necessary as a result of providing the minimum required 50m right-left stagger with the proposed new Cavan Road junction and the desire to minimise the length of realignment and subsequent impact on surrounding lands and properties, in particular the development site at No. 6 Capehill Road. This is a very low flow link road realignment; the traffic volume in the design year (2028) is not forecast to exceed 209 AADT and the proposed alignment is in keeping with the character of the existing road, which is significantly below standard horizontally, vertically and in cross section.
Capehill Road	TD 9/93: Stopping Sight Distance of 70m.	Alignment constraint of providing the minimum required 50m right-left stagger with the proposed new Cavan Road junction and the requirement to tie in to the severely sub-standard existing Capehill Road. Additional alignment constraint considerations include the desire to minimise the length of realignment and impact on surrounding lands and properties, in particular the development site at No. 6 Capehill Road. This is a very low flow link road realignment; the traffic volume in the design year (2028) is not forecast to exceed 209 AADT and the proposed alignment is in keeping with the character of the existing road, which is significantly below standard horizontally, vertically and in cross section.
Capehill Road	TD 27/05: Omission of curve widening on the realigned Capehill Road	Required due to the proximity of the bend to the tie-in point with the existing Capehill Road which is only 2.8m in width at this location. As a concern for the safety of road users it is not considered appropriate to provide a full standard alignment at this location due to the requirement to tie in to the severely substandard existing Capehill Road. This is a very low flow link road realignment; the traffic volume in the design year (2028) is not forecast to exceed 209 AADT and the proposed alignment is in keeping with the character of the existing road, which is significantly below standard horizontally, vertically and in cross section.
Capehill Road	TD 42/95: Sighting a bus lay-by on the A32 Mainline within the Capehill Road junction visibility splays.	Departure from standard required to sight a bus lay-by on the realigned A32 Clanabogan Road within the Capehill Road junction visibility splay. 4.5m x 215m visibility splays have been provided for the minor road junction. The bus lay-by is sighted approximately 100m beyond the junction and visibility from the junction of oncoming traffic is not obstructed. Bus movements along the route are relatively infrequent with a low number of passengers using the service. There are approximately 10 movements per day Monday to Friday and 4 movements per day at weekends.
Capehill Road	TD 9/93: Horizontal radius of 180m without	Required due to the alignment constraints of avoiding the possible Rath, the proposed development site at No. 6 Capehill Road and the earthworks associated with the

LOCATION	DEPARTURE	JUSTIFICATION
	superelevation.	proposed realigned A32 Clanabogan Road. The existing topography rises quickly to the north of the proposed alignment towards the possible Rath and falls away quite quickly to the south and east of the proposed alignment. Provision of a larger radius bend would require significant earthworks and would adversely impact the access to the proposed development site at No. 6 Capehill Road. Repositioning of the access to the proposed development site would necessitate steeper gradients (in the region of 17%) due to the local topography.
Capehill Road	TD 9/93: Below standard Minimum overtaking values, in the south – north direction of travel.	The minimum overtaking values were not achieved primarily due to the use of a 2880m (Band B) radius at the northern end of the proposed realignment between Ch. 1195 and Ch. 2120. When travelling in a south – north direction this bend is a left hand bend and in accordance with TD9/93 overtaking is not permitted on a left hand bend with a radius less than 8160m. When travelling in a north-south direction, this curve is a right hand curve and therefore overtaking sections are attainable in this direction with associated verge widening.
Capehill Road	TD 27/05: Carriageway width of 6.0m tapering to 2.8m at the tie-in point with minimum 1.0m wide verges and without hardstrips.	Departure required as it is not considered appropriate to provide an alignment to full design standards at this location, due to the requirement to tie in to the severely sub-standard existing Capehill road (which is 2.8m in width at the tie in point). In addition to this, the alignment is restricted by the requirement to minimise the impact on surrounding lands and properties, in particular the development site at No. 6 Capehill Road and the existing topography, which quickly falls away from the proposed alignment. This is a very low flow link road realignment; the traffic volume in the design year (2028) is not forecast to exceed 209 AADT and the proposed alignment is in keeping with the character of the existing road, which is significantly below standard horizontally, vertically and in cross section.

Table 4.1 - Departures Required

Relaxations from Standard

An application must be submitted to the Divisional Roads Manager for approval of a relaxation from standard, where a particular element of the proposed scheme does not comply with the desirable standard but is nevertheless considered to be within an acceptable range. The table below highlights the relaxations applied for and their justification.

LOCATION	RELAXATION	JUSTIFICATION
A32 Mainline	TD 9/93: Horizontal radius of 360m radius with 5% super-elevation	Constraints of providing a tie-in to the recently constructed on-line improvement at Mullaghbane. Significant cost and environmental benefits achieved in retaining the recently constructed works.
A32 Mainline	TD 42/95: 3.4m wide ghost island turning lane	Constraints of providing a tie-in to the recently constructed on-line improvement at Mullaghbane. Significant cost and environmental benefits achieved in retaining the

		recently constructed works.
Cavan Road	TD 42/95: Use of a junction visibility 'x' distance of 4.5m	Required due to the location of the junction within a large cutting and the desire to minimise impact on surrounding lands and properties. Additionally, this is a very low flow link road realignment (Design year (2028) 24 hour 7-day flow of 643 - Do-Something).

Table 4.2 - Relaxations Required

TD 19/03 Road Safety Audit (RSA)

In accordance with the requirements of TD 19/03, a road safety audit of the proposed scheme was carried out by a team from another AECOM office, who are independent of the design team. The findings of the initial audit and the design team's response are presented in the audit report 'Stage 2 Road Safety Audit – Designer's response' dated 31st August 2010.

The majority of the recommendations identified in the audit have been incorporated into the design. However, some of the recommendations were rejected on the basis that the recommendation falls outside of the terms of reference, i.e. current Roads Service policy dictates (e.g. street lighting provision) or where it has been agreed with the Roads Service Project Manager that the recommended solution is not suitable given environmental or economic constraints.

Further design development necessitated an addendum to the RSA, which was carried out by the same audit team who carried out the initial Stage 2 Road Safety Audit. The addendum incorporated the realigned Cavan Road and associated tie-ins; removal of the slip lanes at the Cavan Road and B4 junction; updated barrier design; updated signing and lining; and, additional departures from standard.

The findings of the audit and the design team's response are presented in the audit report 'Stage 2 Road Safety Audit – Designers Response' dated 15th September 2010.

4.3 Structures

4.3.1 Introduction

The following is a summary of the Stage 3 Structures Assessment. It presents initial designs for the proposed structures along with cost estimates. A more detailed summary of the Stage 3 Structures Assessment is presented in Technical Note 021, 'SAR 3 Structures Assessment' in Appendix E. This technical note also includes environmental mitigation measures to be adopted and a discussion on options for making the appearance of the proposed Shannaragh Bridge sympathetic to its surroundings.

4.3.2 Owenreagh River Underbridge (approx chainage 660)

A bridge structure is required to carry the realigned A32 over the Owenreagh River. The new bridge will be constructed approximately 30m downstream of the existing structure.

The existing structure is a twin arch masonry bridge with a cumulative span of 12.9m. The abutments and central pier are situated in the river; however the new structure will have a larger span so that construction works are not required in the water. Once the new road is open to traffic, the existing bridge will be demolished and so the aesthetic appearance of this structure will not be considered during the design of the new structure.

The Owenreagh River has a Salmonid River designation and so the impact of construction on the river must be minimised, particularly with regard to the ingress of mud and construction materials. It also means that a single-span structure is preferable as this will minimise interference with the watercourse and allow for a natural river bed to be maintained below the structure.

The removal of the existing structure will cause disturbance to the watercourse in the short term during the construction phase, although the removal of the constraints to the watercourse will have significant long-term benefits for the watercourse.

The Owenreagh River is prone to flooding and the proposed portal structure has been designed so that it will not increase afflux upstream of the bridge.

The ground investigation indicates that, in the vicinity of the structure, around 1.75m of soft silty material overlies a dense moderately weathered mudstone. It is proposed that the silt will be excavated down to the mudstone and replaced with imported stone fill to formation level of the foundations. This avoids the need for piling under the foundations of the structure.

The options considered for this structure include precast arches, with and without wingwalls, as well as a precast concrete infill deck with full height in-situ abutments. Precast construction has been considered in all cases as this provides the maximum protection for construction operatives working over the stream as well as minimising the likelihood of construction materials being deposited into the watercourse. A 1.0m wide riparian buffer strip either side of the watercourse has been maintained, which will aid buildability as well as decreasing the adverse environmental impact of the structure. This gives a clear span of 21.2m for the Owenreagh River bridge crossing. The proposed bridge will be integral in accordance with guidance given in DMRB BD 57/01, reducing the long-term maintenance requirements for the structure.

The precast arch options were not feasible as there was not sufficient headroom under the new carriageway alignment for a large enough rise for this span.

The structure type for which costs have been provided is a single span bridge with full-height abutments. An infill type deck with Y beams placed adjacent to each other has been assumed as this construction method is cost effective as well as providing safety and environmental advantages. The cost for the replacement Owenreagh River Bridge is estimated at £465,750.

This estimate is exclusive of preliminaries and ancillaries and is based on SPON'S Civil Engineering and Highway Works Price Book (with a Regional Adjustment factor of 0.90 applied). Refer to Drawing 60050885/ST/PS01/P/001 Rev. A in Appendix E for details of the proposed Owenreagh River Bridge.

4.3.3 Capehill Culvert (approx chainage 1325)

An existing culvert passes under the current A32 at this location. The structure is a precast concrete pipe. This structure will remain in place as this section of the existing road will be retained to provide access to lands and properties.

There will be a new culvert under the realigned A32. The proposed structure is a reinforced concrete box culvert, which may be either precast or insitu depending on the preferences of the contractor. The base of the culvert is to comprise randomly pitched stones in concrete screed, to encourage the bed to naturalise as quickly as possible. The box structure has a clear span of 3.2m and an internal height of 2.75m.

It is proposed that the wingwalls for this structure will be used as headwalls for highways drainage outfalls into the drain.

The cost for the proposed Capehill Culvert is estimated at £101,250. This estimate is exclusive of preliminaries and ancillaries and is based on SPON'S Civil Engineering and Highway Works Price Book (with a Regional Adjustment factor of 0.90 applied). Refer to Drawing 60050885/ST/C1/P/001 Rev. A in Appendix E for details of the proposed Capehill Culvert.

4.3.4 Mullaghbane Culvert (approx chainage 2240)

There is an existing culvert crossing the A32 alignment at this location. The existing structure is a corrugated steel arch with a 3m span and a 1.5m rise, which is showing some signs of rusting, but is generally in a good condition.

While the Mullaghbane Drain does not have an environmental designation, it is a tributary of the Owenreagh River, which is a designated Salmonid River. This means that construction work undertaken over the Mullaghbane Drain must avoid adversely affecting the water quality of the Owenreagh River where possible.

The existing structure is not suitable for reuse and so will be replaced. The watercourse will be realigned at this location meaning that a shorter length of the drain will be culverted. Realigning the watercourse also means that only one diversion will be required as the drain can continue along its existing line until the new channel is finished.

The proposed structure at this location is a reinforced concrete box culvert. The base of the culvert is to comprise randomly pitched stones in concrete screed, to encourage the bed to naturalise as quickly as possible, therefore the new culvert will not degrade the ecological quality of the environment in the long term. The structure may be either precast or insitu depending on the preferences of the contractor.

It is proposed that the wingwalls for this structure will be used as headwalls for highways drainage outfalls into the drain.

The cost for the proposed Mullaghbane Drain Culvert is estimated at £135,000. This estimate is exclusive of preliminaries and ancillaries and is based on SPON'S Civil Engineering and Highway Works Price Book (with a Regional Adjustment factor of 0.90 applied). Refer to Drawing 60050885/ST/C2/P/001 Rev. A in Appendix E for details of the proposed Mullaghbane Culvert.

4.4 Drainage

General

The existing road lies in an upland area with related river valley and associated floodplain. It features a series of rounded hills (drumlins), with low lying boggy areas between the hills. The superficial deposits in the area comprise mostly of glacial till which can be described as hummocky terrain (drumlins). The main watercourses have associated fluvial plains where deposits would be expected. More recent alluvium in the form of peat is present in low lying, waterlogged areas.

Within the study area, the A32 is currently drained by a combination of gullies & associated carrier pipe networks and by over the edge drainage/ gripes to open drains. The Mullaghbane scheme recently constructed immediately north of the proposed A32 Shannaragh Realignment scheme employs a conventional gully and carrier pipe system.

At kerbed areas around junctions and at footways leading to bus stops, a conventional gulley & carrier pipe system will be employed.

The alignment has been designed to include long sections of full overtaking provision. The need for overtaking provision, coupled with other constraints relating to existing property and junction tie-ins, has resulted in an overall relatively flat alignment. There are numerous receiving watercourses in which to discharge the storm run-off. Generally, the proposed alignment will be constructed on embankments in low-lying areas & in deep cuttings in Drumlins. The typical drainage strategy for embankments and cuttings is discussed below:

Embankments

The cohesive site won material currently proposed for use in the formation of embankments is moisture susceptible and would therefore not be considered suitable for an over the edge drainage approach. Reinforcing the cohesive embankments with granular material or geotextiles, or building up a protective outer embankment was investigated. However these methods were ruled out as they were not deemed practicable, too expensive and in most cases the additional footprint would be within the areas identified as flood plain.

It was previously proposed to employ continuous concrete channels in conjunction with narrow filter drains at the edge of the pavement, generally in all embankment areas. However this proved to be too expensive and alternative strategies were investigated.

The current proposal is to provide a combined filter drain at the carriageway edge. This would provide protection to permit the establishment of grass on the embankment slope which would help control soil erosion, eventually enabling the filter drain to be grassed over, thus permitting over the edge drainage to swales at the embankment toe. Although the provision of filter drains

in embankments is not generally considered best practice, it is believed that their use for this establishment period would be acceptable.

The final drainage strategy adopted in embankment areas will employ a combination of the strategies that best suit the many scenarios that occur.

Cuttings

It was previously proposed to employ continuous concrete channels in conjunction with narrow filter drains at the edge of the pavement, generally in all cutting areas. However this proved to be too expensive and alternative strategies were investigated.

The current proposal is to employ combined filter and slope stability drains at the back of the verge (toe of the slope) in conjunction with narrow filter drains at the edge of the pavement. Flows from the cutting slopes will be intercepted by counterforte drains, draining to the combined filter drains located at the toe of the slope. The decision to position the combined filter drain at the back of the verge will help mitigate stone scatter associated with conventional filter drains.

Drainage of Runoff from Natural Catchments

To intercept the runoff from the exterior (natural) catchments (lands draining towards the cuttings and embankments), it is proposed to provide cut-off drains at the tops of cuttings and at the toes of embankments where water from the adjoining land may flow towards the road, as recommended in DMRB HD 33/06.

Sustainable Urban Drainage Systems (SUDS)

Our principal strategy for SUDS involves the use of detention basins in accordance with the latest SUDS design manual CIRIA C697 (2007). As noted in Section 3.1.2, the detention ponds have been incorporated solely to attenuate storm water flow and are not a requirement to address water quality issues. The SUDS basins will be located in isolated pockets, generally outside the areas identified as flood plain, where possible, where levels and availability of a suitable discharge point allow.

Detention basins are to be designed to retain a 1 in 100 year event with 500mm freeboard, while discharging at the equivalent greenfield run-off rate. Pond side slopes will generally be limited to 1:4 for maintenance and safety reasons and the maximum depth of water in the basin will be limited to 1.0m.

4.5 Public Utilities

Information has been received from the following utility providers:

- Northern Ireland Electricity (NIE);
- British Telecom (BT);
- NI Water;
- Virgin Media;
- Firmus Energy;
- Phoenix natural gas;
- Cable & Wireless;
- Eircom.

There are three utility service providers affected by the proposed works; BT, NIE and NI Water. The other providers confirmed that they have no plant in the area and no plans in the near future to provide any services.

It was confirmed by each affected service provider at Stage 2 that the impact on their services would be broadly similar for each of the options under consideration, therefore choice of the Preferred Option was not affected by utility diversion costs.

British Telecom (BT)

BT currently have ducts on both sides of the existing A32. On the western side, the ducts carry copper CJ cables, which BT have advised are more than likely redundant at present and can be taken out during the construction works. On the eastern side, there are fibre-optic cables that will need to be dealt with as part of the works with the A32. There are copper cables in use at the Cavan, Derrynaseer and Capehill Road junctions, which will need to be accommodated during the works.

Proposed alterations include the laying of four-way ducts along the entire length of the new alignment on one side of the road. Once in place, new fibre optic cables will be laid in the ducts and connected into the nearest suitable joint. Fibre optic joints are spaced approximately 2km apart. BT has indicated that there is an existing joint located at the A32 / B4 Drumlish Road junction which will serve as the tie in for BT at the northern end of the scheme. A joint box located at Shannaragh Road will serve as the tie in point for BT at the southern end of the scheme.

The fibre-optic cables must remain operational at all times during the works; the new ducts will have to be laid, tested and approved by BT in advance of any changeover of cables. The changeover itself necessitates a 16-week consultation period with customers to agree the changeover date.

Local adjustments to overhead services can be incorporated into underground ducts. Alterations to copper cable services are less onerous than those associated with the fibre-optic cables.

The maintenance of BT services during construction is likely to present some difficulties at locations where the proposed alignment crosses the existing A32, particularly in areas of deep cuttings. The methodology for this will be the responsibility of the main contractor, however, the basic principle of maintaining service throughout construction has been discussed with BT and there are available feasible options i.e. in deep cutting the ducts may be slung from scaffolding, and in other areas, may be carefully set aside from the main works area and protected.

Northern Ireland Electricity (NIE)

The scheme will traverse overhead MV lines at four separate locations. NIE have provided details of their proposed alteration works to local overhead supplies. C3 estimates and proposals have been received from NIE and NIE would not anticipate any problems in altering supplies to facilitate the scheme. The only issue of concern raised by NIE was that, in past schemes, some delays have resulted from land owners refusing access to lands to carry out the necessary works and for the provision of wayleaves for NIE equipment.

NI Water

The proposed scheme will intersect existing watermains along the existing A32 mainline, the Cavan Road and the Derrynaseer Road. NI Water provided a C3 estimate and diversion details, an outline of which is given below.

Recent consultation with NI Water has determined that the existing watermain network can be modified to facilitate the works in the following manner. The existing watermain on the Derrynaseer Road will be temporarily stop ended on either side of the main cutting of the proposed realignment. This will allow the water supply to be maintained during construction. The Derrynaseer Road watermain to the north of the main cutting will then be diverted along the proposed Derrynaseer Link Road and will connect back into the A32 mainline supply via the realigned Capehill Road. To the southeast of the main cutting the existing watermain running along the retained section of the existing Derrynaseer Road will be stop ended beyond the property at No. 2 Derrynaseer Road and connected to the realigned Cavan Road supply. The current A32 Mainline supply will be diverted and connected to the proposed Cavan Road realignment.

Wayleaves or easements will not be required, however; to facilitate the diversion works outlined above, NI Water will be required to replace some 500m of watermain on the Cavan Road approximately 1 mile southeast of the proposed scheme (to be carried out by NI Water at some time in the future).

The C3 estimate received from NI Water is an all inclusive price for mains laying by an NI Water contractor. NI Water have stated a preference for either nominating a suitable sub contractor or providing a list of approved contractors to carry out the diversion works however, they have noted that it will be sufficient that a principal contractor with a history of mains laying carry out the works.

4.6 Geotechnical Considerations

4.6.1 General

The preferred option has a southern tie-in with the existing A32 carriageway at chainage 300 – chainage 400 in the area of the Shannaragh Road/A32 Junction. From there it begins to diverge to the east of the existing A32, approaching the Owenreagh River crossing on a low embankment. The river crossing occurs at approximate chainage 650.

Once across the Owenreagh River, the route continues on a low embankment before crossing over the existing carriageway at approx chainage 775. The route at this stage has entered the main section of cutting to the northwest of the existing A32.

The route passes through an area of high ground via the main cutting, through the glacial till drumlin between chainage 750 - 1200. The route then rejoins the existing carriageway at chainage 1200 before heading across the low-lying plain on a long embankment section between chainage 1200 - 1900.

From the low-lying plain embankment section, the route rises up towards higher ground before entering the northern cutting at chainage1900 where it once again crosses the existing A32. The northern cutting is also through a glacial till drumlin.

Upon emerging from the northern cutting the route continues on a low embankment section between chainage 2130 – 2400, crossing the Mullaghbane Drain at chainage 2260. The route rejoins the existing A32 carriageway at the northern tie-in at chainage 2400 - 2480.

4.6.2 Site Investigation

A Preliminary Sources Study was produced in November 2008. The Phase 1 Ground Investigation was carried out at key locations along alternative route alignments from December 2008 to January 2009 by Central Procurement Directorate Geotechnical Unit. This work consisted mainly of bore holes and dynamic probes. The Phase 2 Ground Investigation was undertaken during April and May 2009 with any outstanding works completed in January 2010. It was carried out by Soil Mechanics Limited (SML), Road Service Soils Investigation Term Contractor.

The Phase 2 Ground Investigation consisted of; 12 boreholes, 3 window samples, 25 trial pits, 7 inspection pits, 193 dynamic probes and 5 Ground Penetrating Radar long sections. Samples were tested for soil strength and compressibility, earthworks assessment and contamination.

The Investigations indicate that the site is underlain by firm to stiff glacial till of a depth in excess of 18.0m below ground level, glacial deposits including sand and gravel of up to 3.55m below ground level, and organic silt and peat deposits of up to 5m below ground level. In the area of the Owenreagh River, mudstone is present near the surface. Further details and results of these investigations are published in the 'Phase 2 Ground Investigation Report'.

4.6.3 Ground Conditions, Geology and Geomorphology

4.6.3.1 Drift Geology

The Geological Map of Northern Ireland, Drift Edition, 1:250,000 series indicates that the superficial deposits underlying the A32 and surrounding area mainly comprise Glacial Till. The soil characteristics can be summarised as poor draining and gleyed.

The ground investigation found the following varieties of drift deposits:

Peat:

Areas of peat exist at the southern tie-in and also in the low-lying northern section of the route. Extensive peat probing was undertaken recording locations of probes and depths of soft material penetrated.

In both these areas of peat deposits, the proposed embankments will require ground treatment such as excavation, disposal and replacement of peat/associated soft sediments, slackened side-slopes, surcharging/rest periods, additional land-take during construction or combinations thereof.

The peat was generally spongy pseudo-fibrous black to dark brown slightly sandy slightly silty PEAT with localised wood fragments.

Alluvial:

Close to the southern tie-in, an area of alluvium associated with the Owenreagh River lies beneath the proposed embankment section. A similar area of alluvium associated with the Mullaghbane Drain, underlies another area of proposed embankment before the northern tie-in.

In both these areas the alluvium will be consolidated over a four month period. These consolidation works will need to be phased during the contract.

The deposits generally comprise clays, silts and gravels and the thickness of these deposits varies.

Glacial Deposits:

Glacial till is the predominant soil type encountered across the topographically higher areas of the route and is generally comprised of stiff to very stiff slightly sandy slightly gravelly clay or stiff to very stiff sandy gravelly silt.

Till is found to be thickest in the central drumlins where the route lies in cuttings. The main cut has a depth of up to 12.5m at its deepest point and the northern cut has a maximum depth of 5m.

Sands and gravels are found across the route. These are fairly shallow with a maximum depth of approximately 3.5m in the south.

Made Ground

The only made ground encountered is where the route meets the existing A32 carriageway. This occurs at the northern and southern tie-ins but also at three places in-between; where it crosses the A32 and side roads in the main cut, where it runs on top of the A32 on an embankment section after leaving the main cut, and where it again crosses the A32 on an embankment section before the start of the northern cut.

4.6.3.2 Solid Geology

The Geological Map of Northern Ireland, Solid Edition, 1:250,000 series indicates that the bedrock underlying the A32 within the study area mainly comprises Upper Devonian of the Shanmullagh Formation (Frasnian and Famennain Group) dipping at around 14° to the west. The lithological description for the Shanmullagh Formation is sandstone, purple/brown, fine to medium grained and purple/red siltstones and mudstone

The ground investigation encountered rock in three main areas. Firstly, in the vicinity of the Owenreagh River crossing, mudstone bedrock is found at an approximate depth of 2.5m Below Ground Level (BGL) and is overlain by glacial till. Mudstone bedrock was also encountered through the main cutting at depths ranging between approximately 8m BGL and 13.5m BGL, again overlain by glacial till. Finally, sandstone bedrock was found at a depth of 7.75m BGL adjacent to the northern tie-in.

4.6.4 Foundations

The foundation for the proposed Owenreagh River Bridge is a 5m wide concrete spread footing, part-founded directly on the bedrock. Where soft alluvial sediments occur below formation level, they are to be removed and replaced with Class 6N/6P granular fill to formation level.

The two culverts, Capehill Drain crossing and Mullaghbane Drain diversion are all founded on competent strata. The chemical analysis of the groundwater along the entire route found near neutral results meaning that minimum measures are required for protection against buried concrete.

Within both areas of cutting the required capping thickness ranges from 350mm to 600mm depending on ground conditions; with better sub-grade present in the centre of the cuttings. In areas of embankment a carriageway constructed on 310mm of capping with removal of the local peat deposits and construction of conventional filter drains would be adequate for the anticipated soil deposits.

4.6.5 Import and Export of Material

Topsoil of 0.30m thickness excavated on the site may be used as Class 5 topsoil.

Peat and soft cohesive soils excavated as soft spots /areas beneath the embankments will not be suitable for reuse as engineering fill.

A proportion of excavated soils within the main and north cuts are potentially suitable for reuse as Class 2 material as general cohesive fill within the earthworks.

Class 6A imported fill will be required in areas of peat/soft sediment dig out and replacement.

4.6.6 Contaminated Land

Historically the site has been used for agricultural purposes with no potential sources of contamination related to this identified. Based on this information, the risk of encountering contaminated material during construction of the cutting and embankment sections is considered to be low.

However, there is a potential for the tar used within the existing road to contain excessive levels of Speciated Petroleum Hydrocarbons, BTEXs and Speciated PAH (16). Roads Service carried out road coring at key areas of the existing road and appropriate testing was undertaken to confirm the levels of the potential contaminants.

On receipt of the test results, a potential issue of contamination impacting on reuse or disposal of existing tar (derived from coal-gas works in the past) was notified by Road Service.

If abandoned roads are to remain then their treatment by punching would be recommended as set out in Clause 707 of the Specification for Highway Works.

If tar is to be removed, either for re-use or disposal, then cognisance of this potential contamination is required. This is discussed in further detail in Section 6.2.2.

4.6.7 Drainage, Hydrology and Hydrogeology

Drainage

To intercept the runoff from the exterior (natural) catchments (lands draining towards the cuttings and embankments), it is proposed to provide cut-off drains at the tops of cuttings and at the toes of embankments where water from the adjoining land

may flow towards the road, as recommended in DMRB HD 33/06. Flows from cutting slopes will be intercepted by counterforte drains and will be conveyed by combined filter drains located at the base of cuttings. Herringbone & counterforte drains are proposed to reduce the likelihood of slips (slope displacements).

Standard drainage measures are adequate for the majority of the embankments. Ground starter layers are recommended for embankments across flood plains. Any peat replacement is recommended to be carried out using Class 6A to 0.25m above the level of the water table. Class 2 cohesive fill is acceptable above the Class 6A replacement fill, with the interface of the two materials separated by a geotextile separator.

Hydrology

The Owenreagh River travels from northwest to southeast and cuts across the southern part of the study area. In addition to this there are four streams, which are tributaries to the larger Owenreagh River. Two of the tributaries of the Owenreagh River require culverting in the preferred route option; the Capehill Drain which crosses at chainage ch1320, and the Mullaghbane Drain which crosses at chainage ch2260. The southern flowing Mullaghbane Drain is to be realigned so as to avoid the need for culverting under the embankment section between chainage ch1740 - ch1800. A number of field ditches and springs have also been identified.

All of the waterways flow roughly north to south before discharging into the Drumragh River, which flows north before discharging into Lough Foyle

Hydrogeology

The site comprises relatively impermeable glacial till in the form of drumlins. There are several areas where the ground is waterlogged and is comprised of peat. The main watercourses have associated fluvial plains with alluvial sands and gravels.

Piezometers were installed during the investigations and monitoring levels have been undertaken over a period for variations in water table, particularly for the cutting sections.

4.7 Construction Methodology

The majority of the construction works are off-line from the existing mainline A32 carriageway, however there are several points along the proposed alignment where the new road crosses the existing road, and others where it runs parallel to it at the central junction location and at each tie-in. The construction of the side-road realignment and the mainline deep cut will necessitate road closures of the Capehill and Derrynaseer roads for long periods during the works, however suitable feasible alternative diversion routes exist. It is anticipated that temporary full road closures of the A32 will be required to construct the new road at the cross-over areas, particularly to facilitate the careful excavation and suspension of the BT ducts.

The approach embankments to the new Owenreagh River crossing will require to be constructed early in the programme of works to facilitate surcharging of the underlying soft alluvium for a four-month period.

Access to land and property would be maintained throughout the work. The works are not complex and no particular difficulties are foreseen with the construction – with the exception of the earthworks. It is anticipated that significant quantities of material won from the deep cutting will be suitable for re-use within the embankments. The material is moisture-susceptible and progress is likely to be weather-dependent. Excavation and replacement of the peat material has the potential to cause problems, particularly if during periods of wet weather.

At this stage, the programme for the construction period is expected to be 12 months, weather-permitting.

5 Traffic and Economic Assessment

5.1 Introduction

A detailed assessment of the traffic aspects of the proposed A32 Shannaragh Realignment scheme has been carried out during the Stage 3 assessment.

The COBA (Cost Benefit Analysis) program has been used to perform the economic assessment for the scheme, using manually produced traffic flow forecasts.

COBA compares the cost of a scheme with the associated user benefits from reduced journey times, accident savings, etc. COBA assesses the costs and user benefits over a 60-year period after road opening. Procedures and guidance for developing and applying COBA are set out in the Design Manual for Roads and Bridges (DMRB: Volume 13).

5.2 Traffic Modelling

In order to provide opening and future year traffic flows for the scheme, a suite of traffic surveys were commissioned to record the volume and turning movements of vehicles on the roads within the study area. This combination of peak hour manual classified counts and two week-long automatic traffic counts was used as the basis of a spreadsheet-based model, with the extents defined between Kildrum Road to the south and the A32/ B4 Drumlish Road junction to the north. The B4 junction with Capehill Road, directly north of the A32 was also included in the spreadsheet.

It was considered that the Shannaragh Realignment Scheme itself would not induce traffic to transfer from the B4 onto the A32, and therefore the use of a spreadsheet model was considered reasonable for assessment purposes.

In addition to the traffic survey data, a further 300 trips per day were added to the daily forecast flows in association with the transfer of trips between Omagh and Enniskillen Hospitals. This decision was taken as the traffic survey data was recorded in 2008, whereas in March 2009 acute facilities were removed from Tyrone County Hospital in Omagh which necessitated alternative acute journeys to/from the Erne Hospital in Enniskillen. These additional trips would not originally have been accounted for in the 2008 survey data and were therefore manually added to the figures.

A set of ‘Do Minimum’ and ‘Do Something’ flows for the A32 were produced, the Do Minimum representing conditions without the scheme in place and the Do Something representing conditions with the scheme. As it was agreed that the A32 improvements would not induce traffic to transfer from other routes, the only difference between the Do Minimum and Do Something flows would be due to revisions to the junctions at Cavan Road, Capehill Road and Derrynaseer Road.

5.3 Traffic Forecasting

The 24 hour 7-day Annual Average Daily Traffic (AADT) volumes on the A32 recorded over the past few years as part of the ongoing Roads Service Traffic Census are shown in Table 5.1, revealing a growth in traffic of 19.4% between 2000 and 2008. Further analysis of this data reveals an average per annum growth rate of 2.33%. Even if only the period 2004-2008 is considered, traffic growth still equated to a per annum increase of over 2%.

CP NO.	7-DAY AADT								
	2000	2001	2002	2003	2004	2005	2006	2007	2008
619	7020	7020	6770	6870	7720	7890	8240	8370	8380

Table 5.1 - A32 Historic 7-Day AADT (Roads Service Census Reports)

In comparison to the National Road Traffic Forecasts [NRTF] the above observed rate of 2.33% is higher than the 'High' NRTF rates, these being 17.6% for the period 2000-08 with a per annum growth rate of approximately 2.0%.

In order to ensure that future traffic forecasts are robust, the observed rate of 2.33% was applied linearly to the base year (2008) traffic flows to produce forecasts for the opening year (2013) and fifteen years after opening (2028). These flows were then used in the respective traffic, noise and air quality assessments.

It should be finally noted that the additional 300 trips per day associated with the hospital were not subjected to traffic growth, i.e. they remained at 300 even at the 2013 and 2028 assessment years.

RATE / PERIOD	2008 – 2013	2013 – 2028
Local Growth	12.2%*	41.2%*
NRTF Central	7.8%	18.1%
NRTF High	9.4%	23.5%

**equivalent to 2.328% per annum*

Table 5.2 – Traffic Growth Factors used

5.4 Effects of Scheme

The 24-hour 7 day average daily traffic flows at 2013 (opening year) and 2028 (future year), both with and without the scheme, are shown in Appendix C.

5.5 Economic Performance of Scheme

COBA modelling was undertaken for the Do Minimum and Do Something schemes. Node-Link diagrams for each are shown in Appendix C. Further details of the economic assessment undertaken are contained in the Economic Appraisal Report.

The economic benefits attributable to an improvement option were calculated by comparing the user and capital costs incurred in the proposed (Do Something) scheme with those on the existing (Do Minimum) road network. The comparison has been carried out with regard to link transit, junction delay and accident costs as well as the capital cost of the improvement using the assessment programme COBA. A summary of the COBA output is shown in Appendix D.

The Programme Scheme Estimate of the Preferred Option is shown in Table 5.3.

Element	Cost
Base Cost Estimate (£)	5,847,514
HARM Risk Allowance (£)	545,247
OB (£) (10% of Base Cost Estimate)	584,751
Total Cost Estimate (£)	**6,977,513**

Table 5.3 – A32 Shannaragh Realignment COBA Construction Costs (£)

Preparation costs were assumed at 10% and Supervision costs at 5% of the construction and land costs total.

Present Value of Costs (PVC)
The PVC represents the net capital expenditure incurred in the construction and maintenance of the improvement scheme and indirect tax revenues.

The PVC for the Preferred Route is £5.321m discounted to 2002 prices.

Present Value of Benefits (PVB)
The PVB represents the reduction in user-costs that would result from the construction of the Do Something scheme.

The total of these related benefits gives a PVB for the Preferred Route of £8.053m, discounted to 2002 prices.

Net Present Value (NPV)
The NPV is calculated by the subtraction of the PVC from the PVB. This represents the financial benefit due to the construction of the improvement scheme over a 60-year evaluation period.

The NPV for the Preferred Route for the A32 Shannaragh Realignment is £2.732m, discounted to 2002 prices.

Benefit to Cost Ratio (BCR)
The BCR is calculated by the division of the PVB by the PVC and represents the financial benefit in relation to the financial cost of the scheme over a 60-year evaluation period.

The BCR for the Preferred Route for the A32 Shannaragh Realignment is 1.513.

6 Environmental Assessment

6.1 Introduction

An Environmental Statement has been carried out as part of the assessment process. Below is a summary of the findings of the report.

AST tables are included in Appendix A of this report.

6.2 Overview of Assessment Conclusions

6.2.1 Land Use

The effects of the scheme on land use are predominantly related to land take issues associated with new planning applications either active or pending. The areas of BMV land affected are significant as the scheme is included within an agricultural area

The following loss of land will take place as a result of the scheme:

A loss of development land (planning applications) – 1,982m^2; and

A loss of 88,508m^2 of BMV land.

In addition, the scheme will impact upon eight agricultural landowners and sever a number of agricultural lands and their accesses.

Taking into account the identified mitigation measures, the scheme will result in a **slight adverse** impact on land use.

6.2.2 Geology and Soils

The proposed scheme has the potential to cause slight adverse effects on geology, geomorphology and soils along the proposed scheme. Land take over the length of the proposed scheme would entail disruption of surface materials (drift and soils) during construction.

The major potential source of contamination arising from the proposed scheme is the coal tar that is a constituent of the construction of the present A32. The road design that has been developed in discussion with NIEA for the adjacent Mullaghbane section of the A32 will be incorporated into the design for the A32 Shannaragh scheme, in order to circumvent potential impacts from release of coal tar-derived pollutants. The adoption of this design will minimise any impacts on water quality during construction and also in the long-term during the operational life of the road surface. The proposed mitigation measures will seal any contaminated material within the proposed scheme make up and hence minimise the potential for leaching of soluble contaminants to the groundwater and surface water. Following mitigation, the significance of any impact would be neutral.

A Discovery Strategy that will be prepared to manage any unexpected ground contamination exposed during the construction phase of the scheme will prevent any adverse effects on local groundwater, surface water, land and air receptors.

It is assessed that the scheme will have a negligible impact on local geology soils, and that there will be no change in the status of pollutants associated with known contaminated land sites. It is assessed that the significance of the impact of the proposed scheme on the features under consideration will be **slight adverse.**

6.2.3 Water Quality and Drainage

The realignment of this section of the A32 has the potential to adversely affect the surface water environment. During the construction phase, works will be required to construct a new bridge across Owenreagh River and culverts across Capehill Drain, Mullaghbane Drain, and other minor watercourses. In addition, a temporary and a number of permanent diversions are required in addition to the installation of new drainage structures (i.e. outfalls). However, providing mitigation measures are implemented potential adverse impacts on the surface water environment can be reduced to neutral. In the long-term the

permanent loss of habitat and secondary effects on aquatic ecology and water quality will be offset by the like for like replacement of some culverts plus the replacement of currently culverted stretches of watercourse with new open channels, leading to moderate beneficial to neutral impacts, depending on the importance of the watercourse. During the operation phase there is also the potential for adverse impacts on the water environment from discharges of contaminated routine runoff and from spillages. A quantitative assessment has been carried out to assess the likely effects of routine runoff and spillage risk on surface water quality. The results for both assessments suggest that no adverse impacts are expected (providing mitigation measures are implemented).

The assessment has identified that potential adverse impacts may occur during the construction and operational phase of the proposed scheme in relation to hydrogeology. The adverse impacts are considered to range from being neutral to moderate significance. Most of the identified impacts are during the construction phase and can be mitigated by following good site practice and management, and adhering to pollution prevention guidance during the construction phase. Consequently, the majority of the impacts highlighted are unlikely to occur if the mitigation measures are followed, and would be temporary if they did.

With implementation of the mitigation measures, the impact of the proposed scheme on flood risk has been assessed to be **neutral**. However, there is the potential for **slight adverse** impacts on river flooding during construction with proposed instream works.

6.2.4 Ecology and Nature Conservation

The greatest potential impact of the scheme is on mature trees and on ecological connectivity. Design and construction methods will reduce this impact considerably, and post construction impacts will be moderated by the use of mitigation measures. The scheme will require the removal of habitats of generally low conservation value. A number of roadside trees and hedges will be lost, but compensatory planting will replace these and will provide more extensive features. The scheme impacts upon a site recorded as used as a roost by a single bat on some occasions. Mitigatory provision of roost space in the new bridge will compensate for this loss. Impacts on a bat flightline will be reduced by targeted planting. Impacts on badgers and otters will be overcome by the provision of fencing and mammal underpasses, which have the potential to reduce the current road casualty rate of the former species. Overall impacts on breeding bird populations are likely to be neutral, with a potential for positive effects as created habitats reach maturity.

The scheme will have a minimal impact on the ecology and nature conservation interest of the study area. Overall, the significance of impacts on the features considered in this section, with mitigation, is assessed to be **slight adverse.**

6.2.5 Landscape Effects

Overall, landscape impacts are very localised and planting proposed as part of the landscape mitigation strategy will largely integrate the scheme into the receiving landscape, which is already influenced by the existing A32 road. The landscape impact is assessed as **slight adverse,** due to the long term impact of proposed cuttings and embankments on landscape pattern, cultural features (setting of possible Rath) and Landcover, none of which are significant effects.

Of the twenty three visual receptors identified (the majority of which comprising residential dwellings) four significant adverse visual impacts are identified in the winter of the year of scheme opening: One Moderate Adverse, Two Substantial-Moderate Adverse, and One Substantial Adverse. Three of these impacts can be successfully mitigated through proposed planting by year 15; the one remaining impact would remain Substantial Adverse due to limited opportunities for mitigation. There would also be one significant beneficial impact in year 15 which would be of Moderate Beneficial significance.

6.2.6 Cultural Heritage

A total of 29 sites were recorded within the study area of the preferred route for the A32 Shannaragh Road realignment. These spanned from the Early Christian period to the modern era. The majority of the sites are either post-medieval or undated. There are no recorded sites of prehistoric or medieval date within the study area.

The assessment concluded that there is a low potential for previously unrecorded archaeological remains for the prehistoric periods and a low to moderate potential for the Early Christian period. Sites of a medieval date are considered to have a low-moderate potential whilst those of post-medieval origins are deemed low. The area has seen little in the way of systematic archaeological investigation and this has contributed to the absence of known sites.

Northern Ireland Environment Agency has requested a program of archaeological work within the footprint of the proposed works, adjacent to the possible Rath. This will be evaluation excavation prior to any construction activities.

The overall significance of effect was considered to be **moderate adverse**.

6.2.7 Air Quality

A qualitative assessment of the potential impacts during the construction phase was performed.

If the recommended mitigation measures are adopted then the distance over which the impacts of construction will be felt should be reduced significantly, and the degree of impact kept to acceptable levels. These mitigated impacts can be described as being of '**slight adverse significance**'.

The key conclusions from the Operational Phase Assessment are as follows:

All receptors were predicted to be exposed to NO_2 and PM_{10} concentrations well below (<75%) the UK objective and EU limit values in all modelled scenarios;

Concentrations of both NO_2 and PM_{10} were predicted to decrease relative to 2008, irrespective of whether or not the proposed road realignment goes ahead or not;

Detrimental NO_2 impacts of imperceptible magnitude were predicted at a small number of receptors due to changes to the road realignment bringing traffic closer to receptors;

Beneficial NO_2 impacts of imperceptible to medium magnitude were predicted at several receptors where the realignment diverts traffic away from a receptor. The largest decrease of 3.8 $\mu g/m^3$ was predicted at Receptor 15, located close to the existing A32, but relatively distant from the proposed alignment;

The magnitude of change in PM_{10} concentrations was predicted to be imperceptible at all modelled receptors;

Overall NO_2 and PM_{10} impacts were considered to be of **negligible** significance.

6.2.8 Noise and Vibration

Overall, in terms of noise nuisance, the Do Something scenario will be beneficial compared to the Do Minimum scenario. This is because although the traffic flows do not alter between the Do Minimum and Do Something scenarios, the realigned road effectively results in the noise source being generally moved further away from residential properties.

The assessment of the impact on vibration nuisance indicates the Do Something scenario sees a reduction in properties which will experience vibration nuisance when compared with the Do Minimum scenario, and up to 8 properties are predicted to experience a decrease in vibration nuisance.

It has been determined that no properties will qualify for treatment under the Noise Insulation Regulations (NI) 1995. Additional noise mitigation is not required, but it has been assumed that low noise road surfacing will be used on the new sections of road.

At this stage a detailed assessment of the impact of noise and vibration from the construction work has not been undertaken as this will require detailed information on the type of plant and work scheduling which, in general, is not available until contractors have been appointed. However, details on available guidance have been provided and should best practicable means of noise and vibration mitigation be adopted adverse impacts should be minimised.

6.2.9 Pedestrians, Cyclists, Equestrians and Community Effects

Slight increases in journey time (local NMUs travelling north west) associated with the relocation of the new bus lay-by at the Shannaragh Road Junction will have a minimal overall impact on journey times during construction.

The two new bus lay-bys at the Capehill/Cavan Road Junction are expected to improve local transport links but may introduce slight severance for any NMUs crossing to access opposite footpaths.

Equestrians and cyclists using the A32 as a rural route for recreational purposes between Omagh and Dromore will have access to an improved road alignment with improved sight lines.

Overall, the scheme will have a **slight beneficial** impact in terms of local NMU transportation provision.

6.2.10 Vehicle Travellers

The views from the existing A32 Shannaragh Road are predominantly restricted to intermittent. There are some restricted views due to mature vegetation, the rolling landscape and bends in the current road layout. The scheme will improve views from restricted/intermittent to generally intermittent. The views from the scheme will vary based on the proposed earthworks and the surrounding topography.

The A32 Shannaragh Road in its present condition is a source of driver stress. The stress relates to the existing carriageway requiring traffic to slow so drivers can enter / exit minor roads and private accesses. There is also fear of accidents with non motorised users. All of these issues are not conducive to the steady and safe flow of traffic.

The scheme will have a positive effect through improving traffic flows and junction safety. Conditions will be substantially improved, thereby improving road safety. Route uncertainty may increase for a short period of time during and after construction as local users navigate construction works and proposed scheme layout. The Northern Ireland Ambulance Service (NIAS), Western Division, who use the route frequently, will experience reduced journey times and improved sight distances along the route.

The scheme will have a **moderate beneficial** impact on both driver stress and views from the road as there will be a reduction in driver frustration and fear of accidents experienced by road users. Views will also open up in places allowing more of the open countryside to be seen.

6.2.11 Disruption Due to Construction

The scheme has the potential to cause a number of impacts. The scheme will require the disposal of a large volume of excavated material, the importation of fill, and other construction materials, with associated traffic. Within 100m of the scheme there are ten residential premises and seven businesses. All of these premises may be exposed to dust, noise and vibration associated with the construction of the scheme.

Pre-construction archaeological investigations will be required in an area adjacent to a possible Rath. The possible Rath is outside of the landtake for the proposed scheme, but there is the potential for undiscovered archaeology within the proposed landtake.

Ecological impacts include the removal of habitats of generally low conservation value. The scheme impacts upon a site recorded as used as a roost by a single bat on some occasions. Mitigatory provision of roost space in the new bridge will compensate for this loss. Impacts on a bat flightline will be reduced by targeted planting. Impacts on badgers and otters will be overcome by the provision of fencing and mammal underpasses, which have the potential to reduce the current road casualty rate of the former species. While the disruption associated with the construction of the scheme will be temporary, it may last with varying intensity for approximately 52 weeks.

Ultimately the significance of construction impacts will depend on the details of construction and how mitigation is implemented, which will be decided by the contractor. Based on the information available at EIA stage, the significance of the impact of the scheme in terms of 'disruption due to construction' is assessed as **slight adverse** due to the identified potential impacts on a number of properties, archaeological and ecological sites and the existing road network. This is contingent on the effective implementation of mitigation measures.

6.2.12 Policies and Plans

The scheme conforms to the policies set out in the 'Regional Development Strategy for NI 2025' and its 'daughter' document, the' Regional Transport Strategy for NI 2002 – 2012'. The scheme will improve passenger journeys and freight transport links between Omagh and Dromore, as well as onwards to Enniskillen and the Border.

There are several aspects of the scheme which may have **major significant impacts** before mitigation measures are put in place. These include ecology, landscape, cultural heritage and the water environment. Under 'PPS 21: Sustainable Development in the Countryside', these impacts must not be allowed to be significant and therefore mitigation will be required.

There is potential for major impacts on watercourses and their fish populations and bat populations within the study area. 'PPS2: Planning and Nature Conservation' strives to maintain the effective conservation of wildlife and mitigation will be required to achieve this recommendation.

6.2.13 Aquatic Ecology and Fisheries

The Owenreagh River is regarded as a locally important salmonid river, with considerable potential as a fishery. However, the water continues to suffer from a sustained level of pollution, as indicated by the mainly pollution-tolerant macroinvertebrate assemblage. Although there is potential for additive pollution of the river from construction activities and as a result of operation of the proposed scheme, it is assessed that, with mitigation, there will be a minor adverse impact on the fisheries and aquatic ecology interests of the river. In particular, measures will be taken to minimise ingress of suspended solids into the river during demolition of the existing bridge, and of construction of the new river crossing. Timing of demolition and construction will ensure that potential for adverse impacts during the critical egg and larval stages of the salmonid life cycle will be avoided. Overall, it is considered that the impact of the scheme on the fisheries and aquatic ecology of the Owenreagh River will be of **neutral** significance.

The Mullaghbane Drain and Capehill stream support low-diversity, mainly pollution-tolerant macroinvertebrates, and have limited fisheries value. As with the Owenreagh River, there is a potential for additive pollution of the river from construction activities and as a result of operation of the proposed scheme, but it is assessed that, with mitigation, there will be a minor adverse impact on the fisheries and aquatic ecology interests of the watercourses. An increased length of stream will be shaded as a result of new crossings, and the significance of impacts on the features considered in this section is considered to be **slight adverse**.

7 Project Programme

Based on information provided by Roads service, the current programme for the scheme is set out below:

- Complete Stage 3 Scheme Assessment — September 2010
- Publish Draft Orders — October 2010
- Gateway 2 Approval (VO & DO operative) — May 2011
- Commence construction — December 2011

8 Conclusions

AECOM (previously Faber Maunsell), were commissioned in July 2008 to assist Roads Service in the completion of the Statutory Procedures to improve the A32 Trunk Road at Shannaragh.

A 'Stage 1 Scheme Assessment Report' dated June 2009 produced by AECOM, included the consideration of existing conditions, alternative scheme options, buildability, engineering and environmental assessment as well as appraisal against the five key Government Objectives of Environment, Accessibility, Safety, Economy and Integration. The conclusion of the Stage 1 assessment was to progress the standard single carriageway strategy within a defined and constrained corridor. This received Gateway 0 approval in June 2009.

Subsequently a 'Stage 2 Scheme Assessment Report' dated December 2009, prepared by AECOM, included the consideration of three alternative options. The three options were assessed in accordance with DMRB requirements and appraised against the Government's five key Objectives. The Stage 2 assessment concluded that the most favourable option for onward progression was the Pink Option. This received Gateway 1 approval in December 2009, allowing the progression of the assessment process to Stage 3.

Since receipt of Gateway 1 Approval, the design development of the scheme has progressed to a level to allow confidence in the proposed vested land boundary.

The total cost estimate for the Preferred Option is **£6,977,513**, which provides a Benefit to Cost Ratio (BCR) of 1.513.

It is therefore concluded that the amended Pink Option is the preferred improvement for the A32 at Shannaragh.

Appendices

Appendix A – ASTs

Appraisal Summary Table: A32 Shannaragh Realignment (Stage 3 v?) 05.10.10

Option: A32 Shannaragh Realignment (Preferred Option)		**Description**: Improvements to the alignment of the existing single lane carriageway between Omagh and Dromore, Co. Tyrone.	**Problems:** Sub-standard vertical and horzional alignment leads to reduced journey times.	**PVC to Public Accounts:**
OBJECTIVE	**SUB-OBJECTIVE**	**QUALITATIVE IMPACTS**	**QUANTITATIVE ASSESSMENT**	**ASSESSMENT**
ENVIRONMENT	**Noise**	The preferred route results in a few properties potentially being affected by noise and vibration; however there will be more beneficial impacts than adverse impacts, with properties experiencing a reduction in noise and vibration in the future year (2028).	Two fewer people will be affected by noise as a result of the scheme.	TAG Assessment £48,276.38 Slight Beneficial
	Local Air Quality	Beneficial and detrimental impacts were predicted at receptors within 200 m of the route. Detrimental impacts of only 'imperceptible' magnitude were predicted, whereas beneficial impacts of up to 'medium' magnitude were predicted. However, given the low ambient concentrations, overall the impacts may be described as negligible.	The number of properties that will experience a benefit or dis-benefit has not been calculated for Stage 3. However based on the DMRB assessment, all receptors were predicted to be exposed to NO_2 and PM_{10} concentrations well below (<75%) the UK objective and EU limit values in all modelled scenarios. The detrimental impact of greatest magnitude was 0.3 $\mu g/m^3$ (NO_2) The beneficial impact of greatest magnitude was 3.8 $\mu g/m^3$ (NO_2)	Local air quality scores have not been calculated for Stage 3.
	Greenhouse Gases	For Stage 3 the change in annual carbon emissions has not been calculated, however based on the Stage 2 calculations and analysis of the Stage 3 traffic data, it is likely that total emissions will decrease, but to a negligible extent.	The change in annual carbon emissions has not been calculated for Stage 3.	The NPV has not been calculated for Stage 3.
	Landscape	Adjacent rural valley landscape is predominantly good quality and of medium sensitivity to change. The scheme will be constructed on embankments or within large scale cuttings along much of its length, which, due to the scale and proximity of the proposals, would have a detrimental effect upon local topography, field pattern and the setting of the possible rath site. Mitigation proposals would include significant mass planting which would largely integrate the scheme in the medium to long term and have some limited benefit in terms of land cover, tranquillity and general character. However, proposed planting would not fully mitigate the impacts of the large scale cuttings.	Not applicable	Slight Adverse
	Townscape	Rural location therefore not applicable	Not applicable	Not applicable
	Heritage of Historic Resources	There will be adverse impacts on seven archaeological sites and two built heritage sites.	Not applicable	Moderate Adverse
	Biodiversity	No impacts on statutory nature conservation sites. Risk of adverse impact to salmonid Owenreagh River. A small area of mixed woodland of low species and structural diversity will be removed, along with a drain close to the route supporting communities of wetland and heathland plants. Badger territories are likely to be crossed, but no setts are present in close proximity to the route. Appropriate avoidance, impact reduction and mitigation measures will offset potential adverse impacts.	Not applicable	Slight Adverse
	Water Environment	The removal of the existing bridge across the Owenreagh River and replacement of some culverts with new open channels will have a beneficial impact on the water environment.	Appropriate treatment and spillage containment measures are proposed to mitigate potential adverse impacts from runoff. Taking into account the proposed design and mitigation measures, flood risk and hydrogeological impacts are neutral during operation.	Slight Beneficial
	Physical Fitness	The two new bus bays at the Capehill/Cavan Road Junction are expected to improve local transport links. Slight increases in journey time (local NMUs travelling north east) associated with the relocation of the new bus lay-by at the Shannaragh Road Junction will have a minimal overall impact on journey times during construction and on completion. Cyclists using the A32 as a rural route for recreational purposes between Omagh and Dromore will have access to an improved road alignment with improved sight distances.	Not applicable.	Neutral
	Journey Ambience	The views from the existing A32 Shannaragh Road are predominantly restricted to intermittent. Existing restricted views are due to mature vegetation, the rolling landscape and bends in the current road layout. The scheme will improve views from restricted/intermittent to generally intermittent. The scheme will have a moderate beneficial impact on both driver stress and views from the road as there will be a reduction in driver frustration and fear of accidents experienced by road users. Views will also open up in places allowing more of the open countryside to be seen.	Up to 10,000 travellers in the design year (2028) per day will benefit from scheme.	Moderate / Large Beneficial
SAFETY	**Accidents**	The proposed scheme will improve the alignment of the carriageway and provide improved overtaking opportunities and sight distances. Using COBA analysis this shows benefits in monetary terms and also in terms of reduced number and severity of accidents.	Total reduction in number of accidents; 34.0 Reduction in Fatal; 1.5 Reduction in Serious; 8.3 Reduction in Slight; 45.3	Accidents PVB £2.428m
	Security	Provision of right turning facilities removes slow right turning vehicles from carriageway. A moderate benefit may be achieved from improved sightlines and visibility.	N/A	Moderate Beneficial
ECONOMY	**Public Accounts**	The proposed realignment scheme generates positive NPV and BCR which demonstrates that the scheme is economically viable.	BCR: 1.344 NPV: £2.077m	PVC £6.034m
	TEE: Business Users & Transport Providers	Positive net benefits to business users and transport providers in terms of time savings, delay savings and vehicle operating costs.	£2.959m	PVB £2.959m

	TEE: Consumers	Positive benefits to consumer users in terms of time savings, delay savings and vehicle operating costs.	£2.725m	PVB £2.725m
	Reliability	The A32 Shannaragh realignment will improve journey time reliability and increase speeds due to an improved alignment. The realignment will also improve journey time reliability and increase achievable speeds for ambulances travelling to the new Erne Hospital in Enniskillen.	N/A	Slight Beneficial
	WEI	The proposed realignment of the A32 at Shannaragh, in tandem with the other improvements along the A32, will collectively enhance the attractiveness of the existing A32 trunk road. The improvements at Shannaragh will directly reduce journey times between Omagh and both Dromore and Enniskillen, improving links for strategic traffic and making the route more attractive to use. In terms of local accessibility, it is intended that the scheme will maintain as much access to the immediate vicinity as possible. One disbenefit will be severance of farmlands and the destruction of fertile farming land.	N/A	Slight Beneficial
ACCESSIBILITY	**Option values**	The proposed realignment scheme presents no foreseeable changes to the availability of transport services.	N/A	Neutral
	Severance	Severance of farm land, but no additional community severance as a result of the scheme	N/A	Neutral
	Access to the T.S.	No improvements under consideration as part of the proposed realignment works. However enhanced access to bus-stops has been provided.	N/A	Neutral
INTEGRATION	**Transport Interchange**	No transport interchange is being considered as part of this study.	N/A	Neutral
	Transport & Land-Use Policy	Support for the scheme is reflected in the Regional Development Strategy for Northern Ireland 2025 and its 'daughter' document, the Regional Transportation Strategy for Northern Ireland 2002-2012. The scheme will provide more reliable journey times and increase the efficiency of the transport system which should positively contribute to the regional economy.		Beneficial
	Other Government Policies	Economic improvements policies are supported.		

Policy Level	Compliant	Compliant (with mitigation)	Neutral	Non-Compliant
National	7	5	2	0
Regional	34	30	14	0
Local	6	2	0	0
Total	47	37	16	0

Appendix B – Drawings

N W E S

To Kesh

B4 Drumlish Road

To Omagh

MULLAGHBANE SCHEME COMPLETED SUMMER 2010 (SHOWN IN BROWN)

Northern Tie - in

Capehill Drain

Capehill Road

A32 Clarabogan Road

Lisgarty Road

OVERTAKING DISTANCE NORTH TO SOUTH = 716.5m

Mullaghbane Drain

Derrynaseer Road

Cavan Road

OVERTAKING DISTANCE = 458m

Owenreagh River

OVERTAKING DISTANCE = 636.5m

To Fintona

Southern Tie - in

NOTE: NO NEED FOR RECONSTRUCTION IN THIS AREA - OVERLAY ONLY

A32 Clarabogan Road

Shannaragh Road

To Dromore

LEGEND

- EXISTING GATE/FARM ACCESS TO BE MAINTAINED
- EXISTING GATE/FARM ACCESS TO BE REMOVED
- PROPOSED FARM ACCESS
- POSSIBLE ABANDONMENT OF EXISTING ROAD
- HARDSTANDING/ACCESS TRACK
- FOOTWAYS
- PEAT OVERDIG
- PROPOSED BITMAC HARDSTANDING TO FARM GATE
- AREA OF FORESTRY
- EXISTING FLOOD PLAIN SUPPLIED BY RIVERS AGENCY
- STRATEGIC FLOOD PLAIN SUPPLIED BY RIVERS AGENCY
- Q100 FLOOD PLAIN FROM HYDRAULIC MODEL
- PEAT BOG (AREAS ESTIMATED FROM THE GEOLOGICAL MAP OF NORTHERN IRELAND, SOLID EDITION, 1:250,000 SERIES.)
- STRUCTURE
- PROPOSED DEVELOPMENT SITE
- POSSIBLE RATH
- WATERCOURSE
- MINOR WATERCOURSE / FIELD DRAIN
- ASSUMED EXISTING WATERCOURSE ALIGNMENT BENEATH EXISTING ROAD
- PROPOSED CULVERT
- PROPOSED BRIDGE
- PROPOSED WATERCOURSE DIVERSION
- EXISTING DRAIN STOPPED UP
- VRS SAFETY BARRIER
- PROPOSED FENCELINE
- DETENTION POND - INDICATIVE LAYOUT ONLY
- PROPOSED ALIGNMENT

Rev	Date	Detail	Made	Chk'd	App'd
C	31.08.10	UPDATED ALIGNMENT & FENCELINE	DMcM	AD	CA
B	07.06.10	UPDATED ALIGNMENT	DMcM	AD	CA
A	28.04.10	UPDATED ALIGNMENT	DMcM	AD	CA

Status: SAR 3

Client: ROADS Service

Project: A32 SHANNARAGH REALIGNMENT

Title: STAGE 3 PREFERRED OPTION PROPOSED ALIGNMENT

Design:	DMcM	CAD:	DMcM
Chk'd:	AD	App'd:	CA
Date:	Jan 2009	Scale:	1:5000

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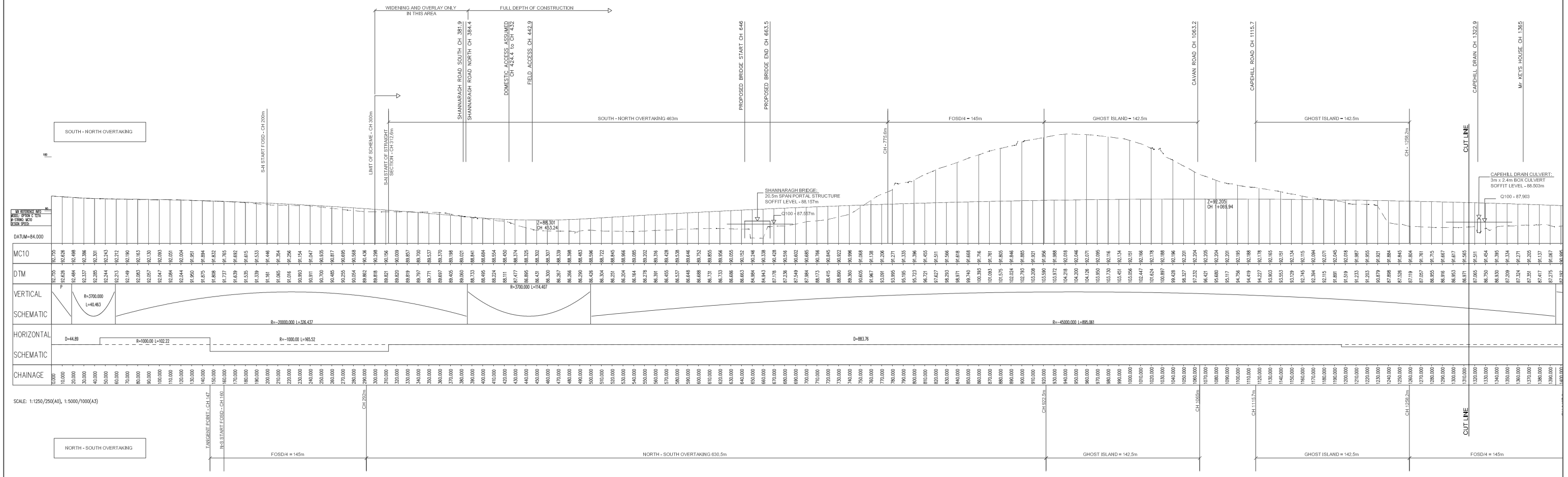
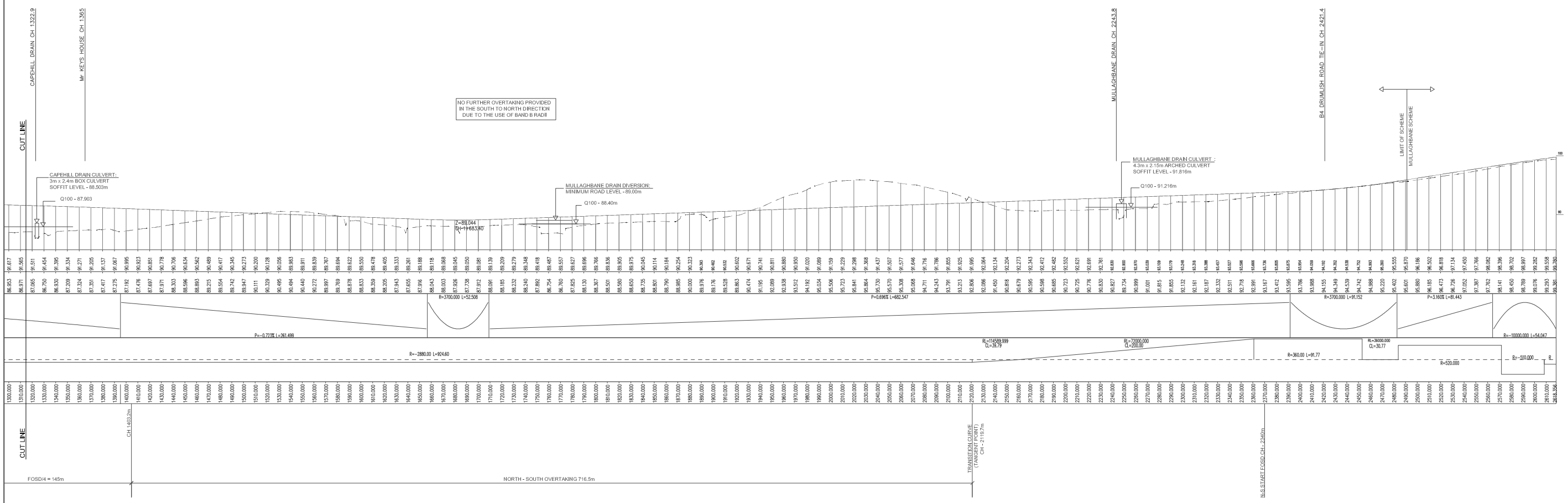
No. 60050885/030/C(94)L300 Rev: C

cm A1

NOTES





LEGEND

EXISTING GROUND LEVEL

PROPOSED ALIGNMENT

Rev	Date	Detail	Issue	Chk'd	Appr'd
C	19.07.10	OVERTAKING REVISED	DMcM	AD	CA
B	15.06.10	OVERLAY AREA INDICATED	DMcM	AD	CA
A	28.04.10	UPDATED ALIGNMENT	DMcM	AD	CA

Status: SAR 3

Client: ROADS Service

Project: A32 SHANNARAGH REALIGNMENT

Title: STAGE 3 PREFERRED OPTION LONGITUDINAL SECTION

Design:	DMcM	CAD:	DMcM
Chk'd:	AD	Appr'd:	CA
Date:	13.01.10	Scale:	1:1250

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No. 60050885/030/C(94)L301 Rev: C

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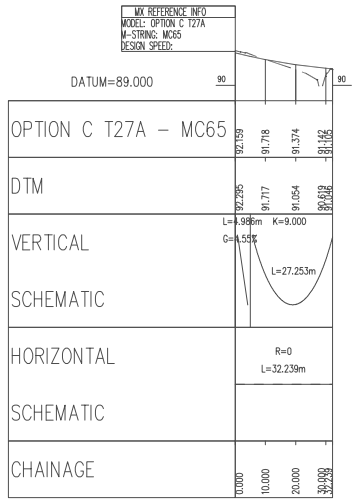

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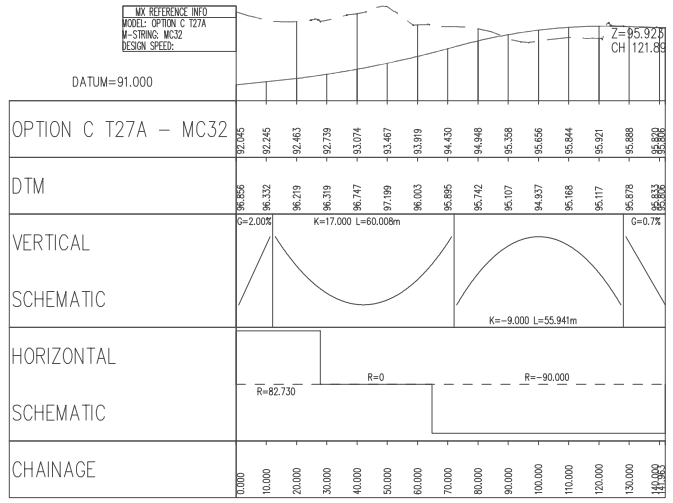

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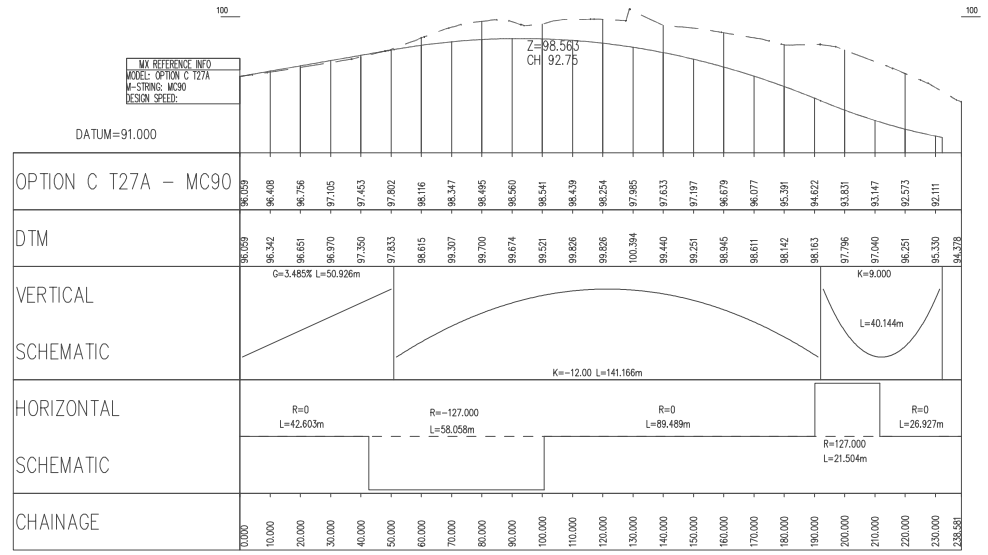

CAPEHILL ROAD LONG SECTION
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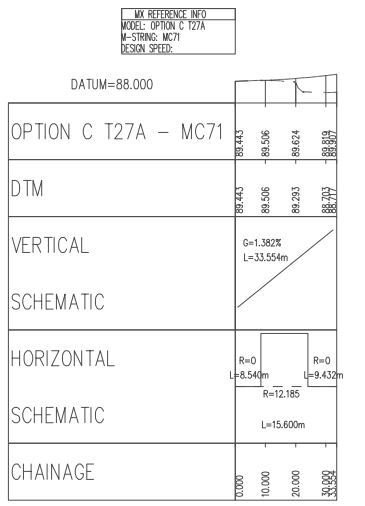

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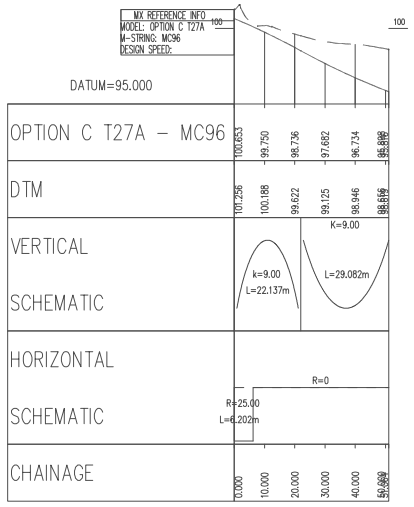

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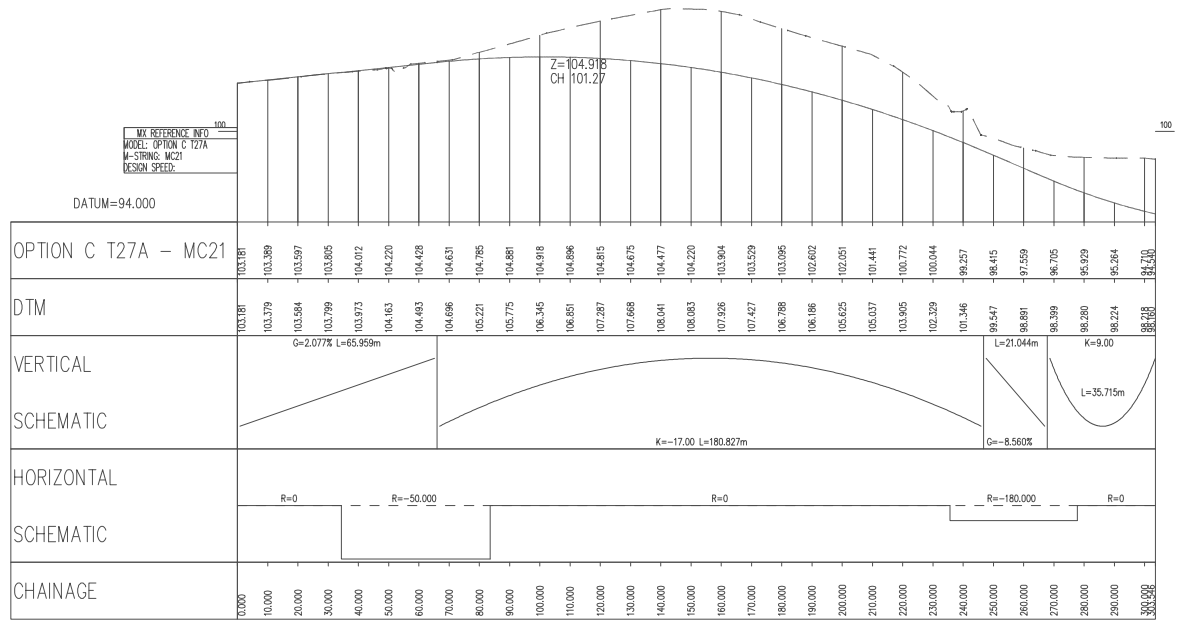

DERRYNASEER - CAPEHILL LINK ROAD LONG SECTION
SCALE: 1:1250/250(A1), 1:2500/500(A3)

LEGEND

EXISTING GROUND LEVEL

PROPOSED ALIGNMENT

Rev	Date	Detail	Made	Chk'd	App'd
E	20.08.10	ACCESS CH 1838 UPDATED	DMcM	AD	CA
D	02.07.10	CAVAN ROAD UPDATED	RPW	AD	CA
C	17.06.10	UPDATED ALIGNMENT	RPW	AD	CA
B	24.05.10	DERRYNASEER ROAD UPDATED	RPW	AD	CA
A	28.04.10	UPDATED ALIGNMENT	DMcM	AD	CA

Status: SAR 3

Client: ROADS Service

Project:
A32
SHANNARAGH
REALIGNMENT

Title:
STAGE 3
PREFERRED OPTION
SIDE ROAD
LONG SECTIONS

Design:	DMcM	CAD:	DMcM
Chk'd:	AD	App'd:	CA
Date:	April 2010	Scale:	H 1:1250 V 1:250

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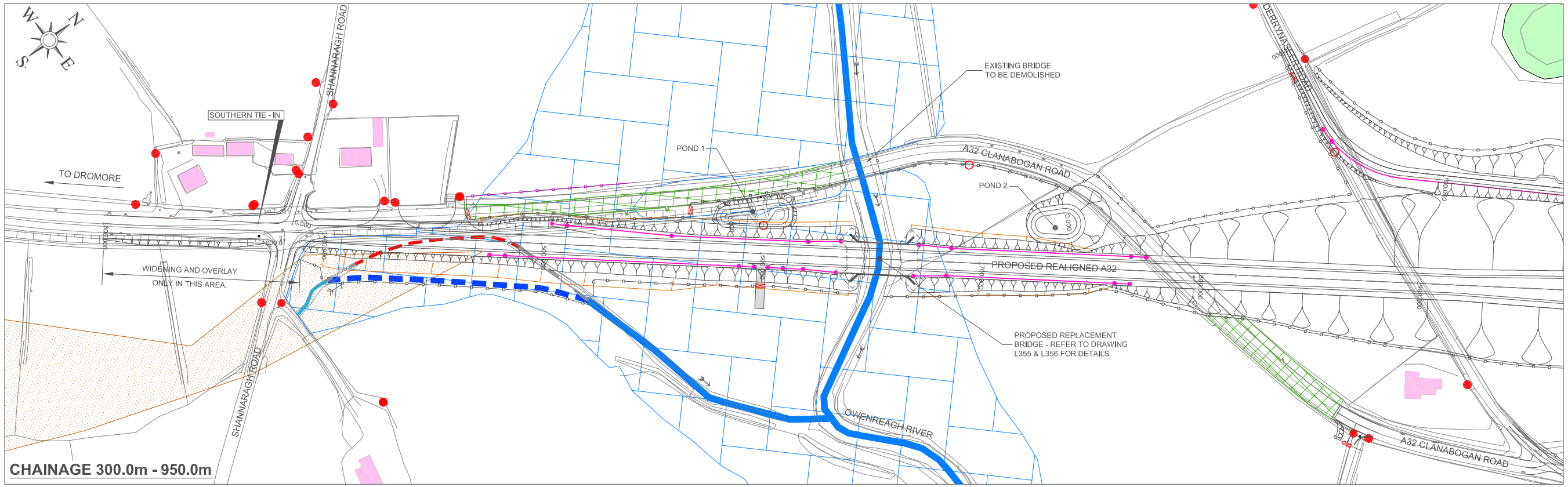

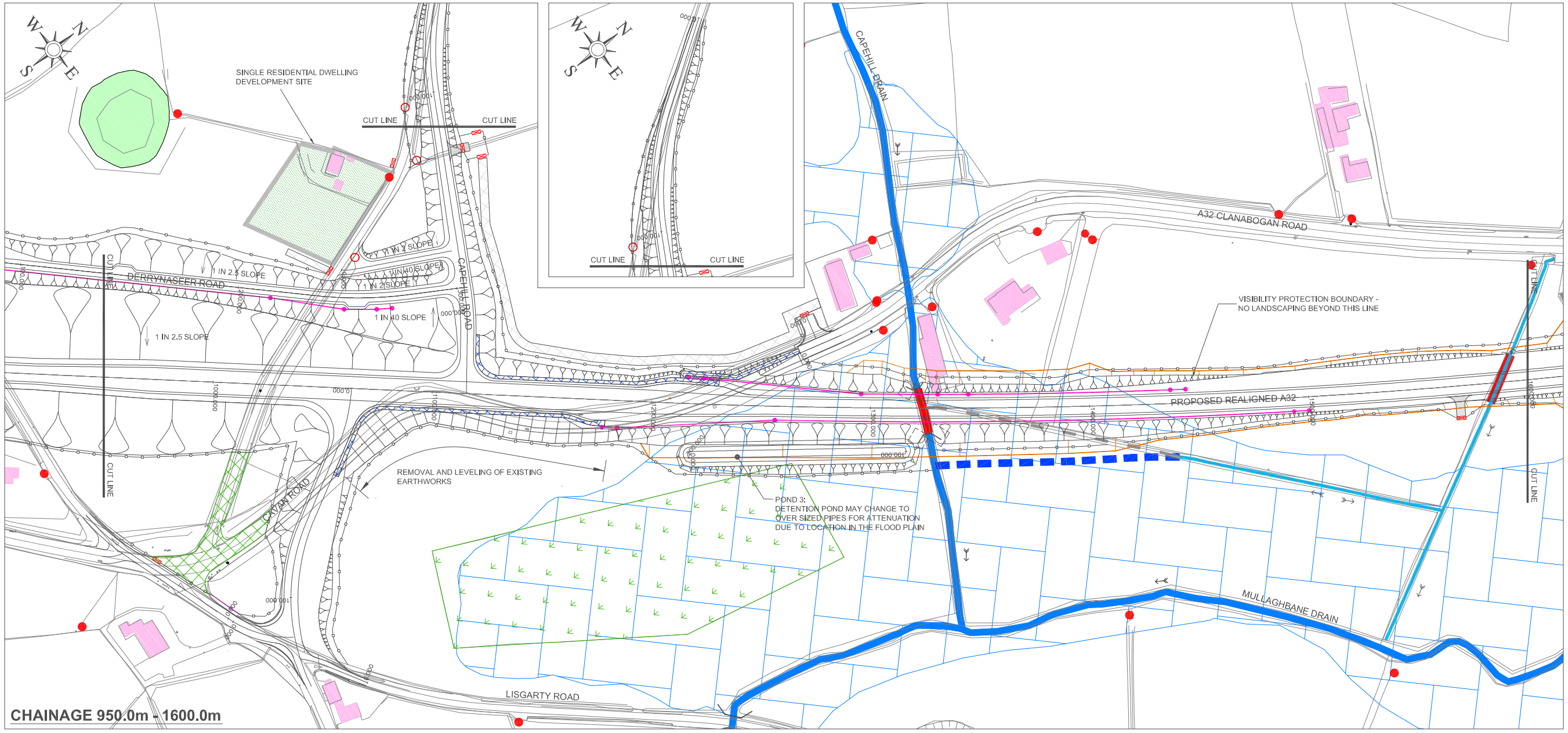

LEGEND

- EXISTING GATE/FARM ACCESS TO BE MAINTAINED
- EXISTING GATE/FARM ACCESS TO BE REMOVED
- PROPOSED FARM ACCESS
- POSSIBLE ABANDONMENT OF EXISTING ROAD
- HARDSTANDING/ACCESS TRACK
- FOOTWAYS
- PEAT OVERDIG
- PROPOSED BITMAC HARDSTANDING TO FARM GATE
- AREA OF FORESTRY
- EXISTING FLOOD PLAIN SUPPLIED BY RIVERS AGENCY
- STRATEGIC FLOOD PLAIN SUPPLIED BY RIVERS AGENCY
- Q100 FLOOD PLAIN FROM HYDRAULIC MODEL
- PEAT BOG (AREAS ESTIMATED FROM THE GEOLOGICAL MAP OF NORTHERN IRELAND, SOLID EDITION, 1:250,000 SERIES.)
- STRUCTURE
- PROPOSED DEVELOPMENT SITE
- POSSIBLE RATH
- WATERCOURSE
- MINOR WATERCOURSE / FIELD DRAIN
- ASSUMED EXISTING WATERCOURSE ALIGNMENT BENEATH EXISTING ROAD
- PROPOSED CULVERT
- PROPOSED BRIDGE
- PROPOSED WATERCOURSE DIVERSION
- EXISTING DRAIN STOPPED UP
- DIRECTION OF FLOW
- VRS SAFETY BARRIER
- PROPOSED FENCELINE
- STOCK PROOF FENCING
- DETENTION POND - INDICATIVE LAYOUT ONLY
- PROPOSED ALIGNMENT

Rev	Date	Detail	Made	Chk'd	App'd
C	31.08.10	ALIGNMENT & FENCELINE UPDATED, WATERCOURSE DIVERSIONS REVISED	RPW	AD	CA
B	20.07.10	FENCE UPDATED	RPW	AD	CA
A	07.07.10	CAVAN ROAD UPDATED	RPW	AD	CA

Status: SAR 3

Client: ROADS Service

Project: A32 SHANNARAGH REALIGNMENT

Title: STAGE 3 PREFERRED OPTION PROPOSED ALIGNMENT SHEET 1 OF 2

Design:	DMcM	CAD:	RPW
Chk'd:	AD	App'd:	CA
Date:	MAY 2010	Scale:	1:1000

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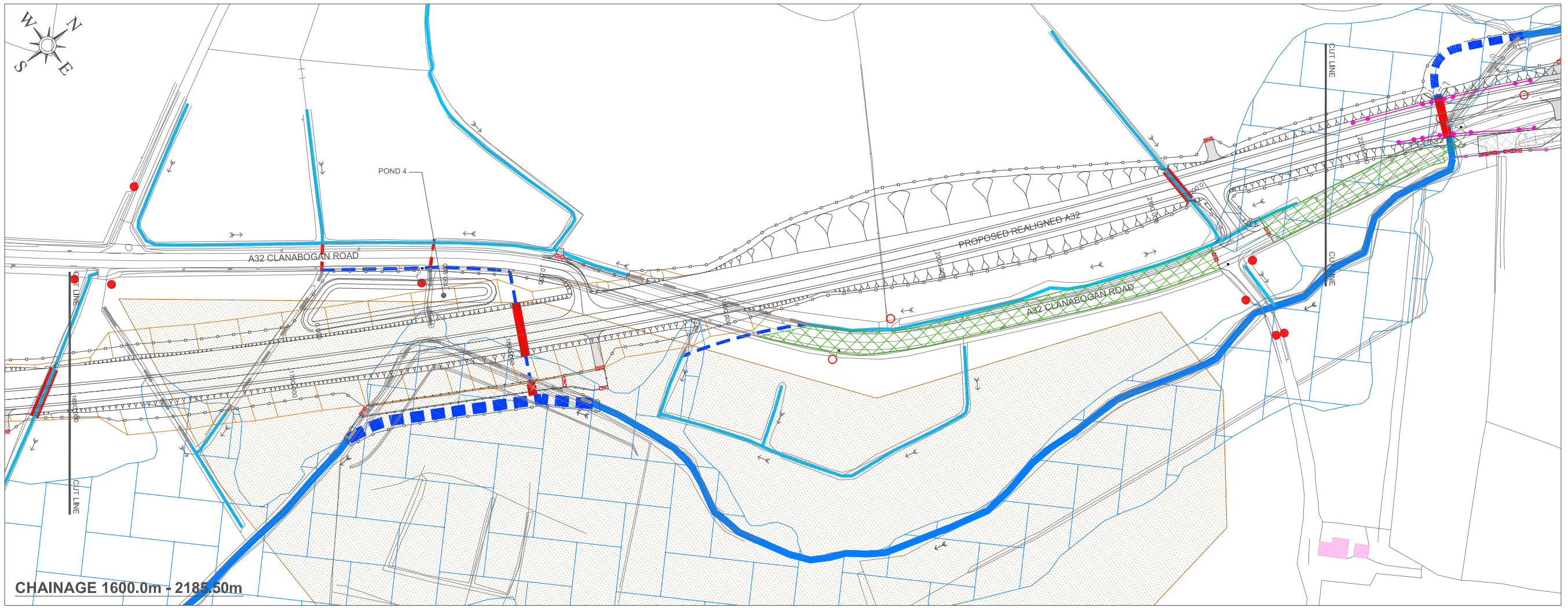

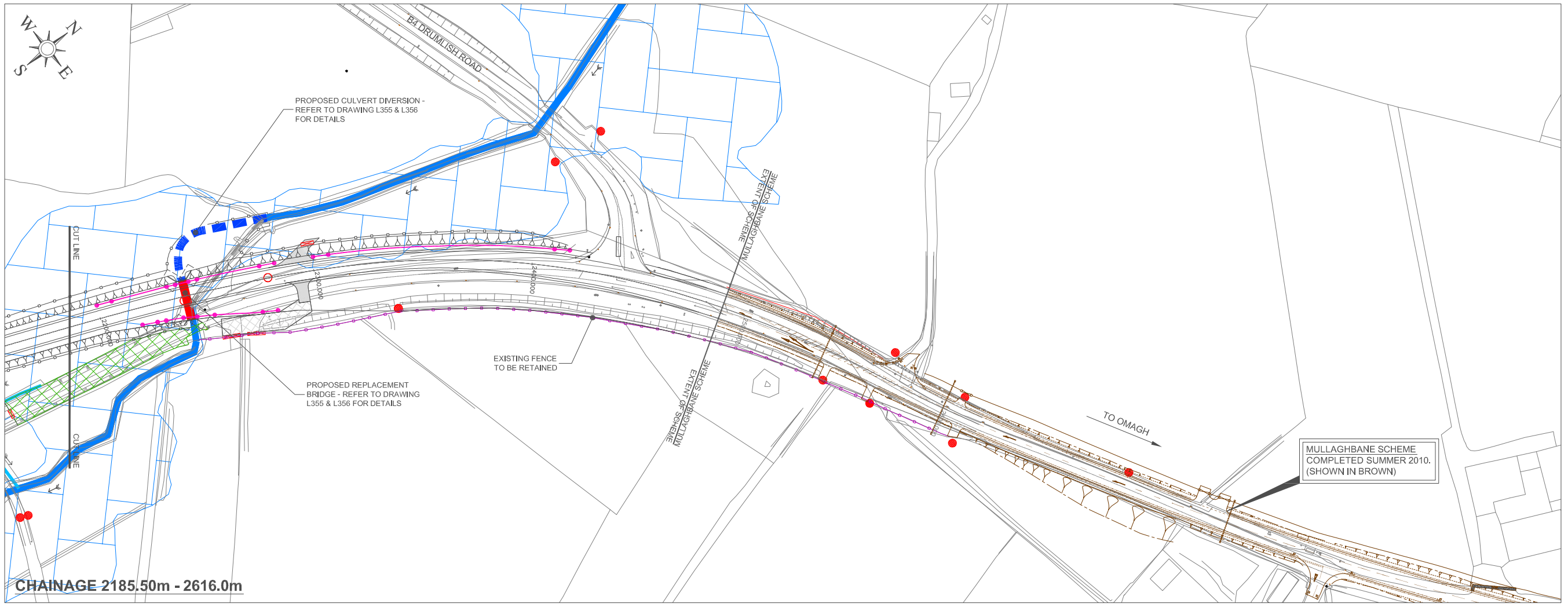

LEGEND

- EXISTING GATE/FARM ACCESS TO BE MAINTAINED
- EXISTING GATE/FARM ACCESS TO BE REMOVED
- PROPOSED FARM ACCESS
- POSSIBLE ABANDONMENT OF EXISTING ROAD
- HARDSTANDING/ACCESS TRACK
- FOOTWAYS
- PEAT OVERDIG
- PROPOSED BITMAC HARDSTANDING TO FARM GATE
- AREA OF FORESTRY
- EXISTING FLOOD PLAIN SUPPLIED BY RIVERS AGENCY
- STRATEGIC FLOOD PLAIN SUPPLIED BY RIVERS AGENCY
- Q100 FLOOD PLAIN FROM HYDRAULIC MODEL
- PEAT BOG (AREAS ESTIMATED FROM THE GEOLOGICAL MAP OF NORTHERN IRELAND, SOLID EDITION, 1:250,000 SERIES.)
- STRUCTURE
- PROPOSED DEVELOPMENT SITE
- POSSIBLE RATH
- WATERCOURSE
- MINOR WATERCOURSE / FIELD DRAIN
- ASSUMED EXISTING WATERCOURSE ALIGNMENT BENEATH EXISTING ROAD
- PROPOSED CULVERT
- PROPOSED BRIDGE
- PROPOSED WATERCOURSE DIVERSION
- EXISTING DRAIN STOPPED UP
- DIRECTION OF FLOW
- VRS SAFETY BARRIER
- PROPOSED FENCELINE
- STOCK PROOF FENCING
- DETENTION POND - INDICATIVE LAYOUT ONLY
- PROPOSED ALIGNMENT

Rev	Date	Detail	Made	Chk'd	App'd
C	31.08.10	ALIGNMENT & FENCELINE UPDATED, WATERCOURSE DIVERSIONS REVISED	RPW	AD	CA
B	20.07.10	FENCE UPDATED	RPW	AD	CA
A	07.07.10	CAVAN ROAD UPDATED	RPW	AD	CA

Status: SAR 3

Client: ROADS Service

Project: A32 SHANNARAGH REALIGNMENT

Title: STAGE 3 PREFERRED OPTION PROPOSED ALIGNMENT SHEET 2 OF 2

Design:	DMcM	CAD:	RPW
Chk'd:	AD	App'd:	CA
Date:	MAY 2010	Scale:	1:1000

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N
W E
S

To Kesh

B4 Drumlish Road

No. 14 Drumlish Road

No. 213 Clanabogan Road

LCZ 1

Capehill Road

No. 215 Clanabogan Road

Capehill Drain

A32 Clanabogan Road

No. 222 Clanabogan Road

Old Creamery Site

No.6 Capehill Road

LCZ 2

Possible Rath Site and Tree Ring

Derrynaseer Road

Mullaghbane Drain

Cavan Road

No. 170 Cavan Road

No. 2 Derrynaseer Road

Owenreagh River

Shannaragh Bridge

Southern Tie - in

A32 Clanabogan Road

Shannaragh Road

To Dromore

To Omagh

MULLAGHBANE SCHEME COMPLETED SUMMER 2010 (SHOWN IN BROWN)

Northern Tie - in

Lisgarty Road

To Fintona

LEGEND

- EXISTING GATE/FARM ACCESS TO BE MAINTAINED
- EXISTING GATE/FARM ACCESS TO BE REMOVED
- PROPOSED FARM ACCESS
- POSSIBLE ABANDONMENT OF EXISTING ROAD
- HARDSTANDING/ACCESS TRACK
- FOOTWAYS
- PEAT OVERDIG
- PROPOSED BITMAC HARDSTANDING TO FARM GATE
- AREA OF FORESTRY
- EXISTING FLOOD PLAIN SUPPLIED BY RIVERS AGENCY
- STRATEGIC FLOOD PLAIN SUPPLIED BY RIVERS AGENCY
- Q100 FLOOD PLAIN FROM HYDRAULIC MODEL
- PEAT BOG (AREAS ESTIMATED FROM THE GEOLOGICAL MAP OF NORTHERN IRELAND, SOLID EDITION, 1:250,000 SERIES.)
- STRUCTURE
- PROPOSED DEVELOPMENT SITE
- POSSIBLE RATH
- LOCAL CHARACTER ZONE
- WATERCOURSE
- MINOR WATERCOURSE / FIELD DRAIN
- ASSUMED EXISTING WATERCOURSE ALIGNMENT BENEATH EXISTING ROAD
- PROPOSED WATERCOURSE DIVERSION
- EXISTING DRAIN STOPPED UP
- DETENTION POND - INDICATIVE LAYOUT ONLY
- PROPOSED ALIGNMENT

Rev	Date	Detail	Made	Chk'd	App'd
A	28.09.10	ISSUED FOR SAR	RPW	AD	CA

Status: SAR 3

Client: ROADS Service

Project: A32 SHANNARAGH REALIGNMENT

Title: STAGE 3 SCHEME CONSTRAINTS MAP

Design:	RPW	CAD:	RPW
Chk'd:	AD	App'd:	CA
Date:	AUG 2010	Scale:	1:5000

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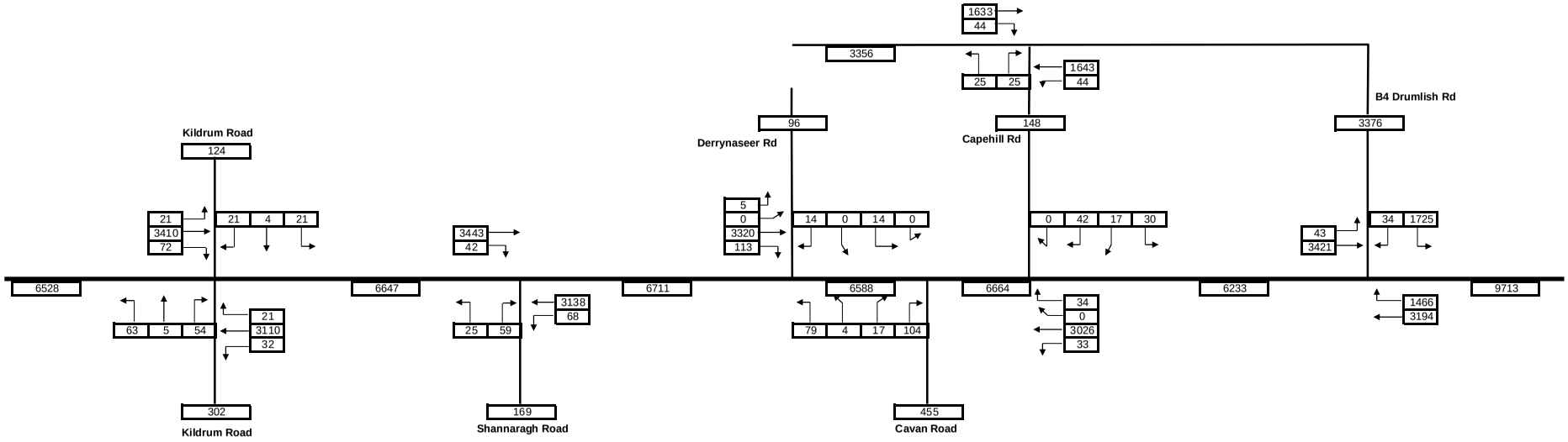
Appendix C – Traffic Flow Diagrams

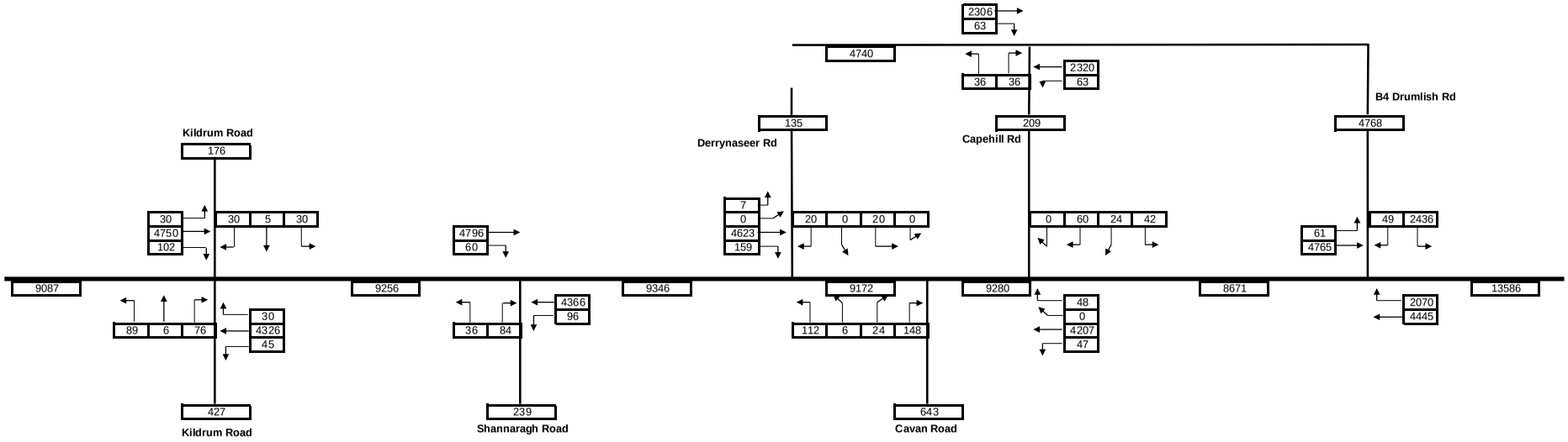


AECOM

2013 Flows using local growth rate + Hospital Trips

Time Period: 24 HOUR 7-DAY FLOWS

A32 Shannaragh (Stage 3) DO MINIMUM

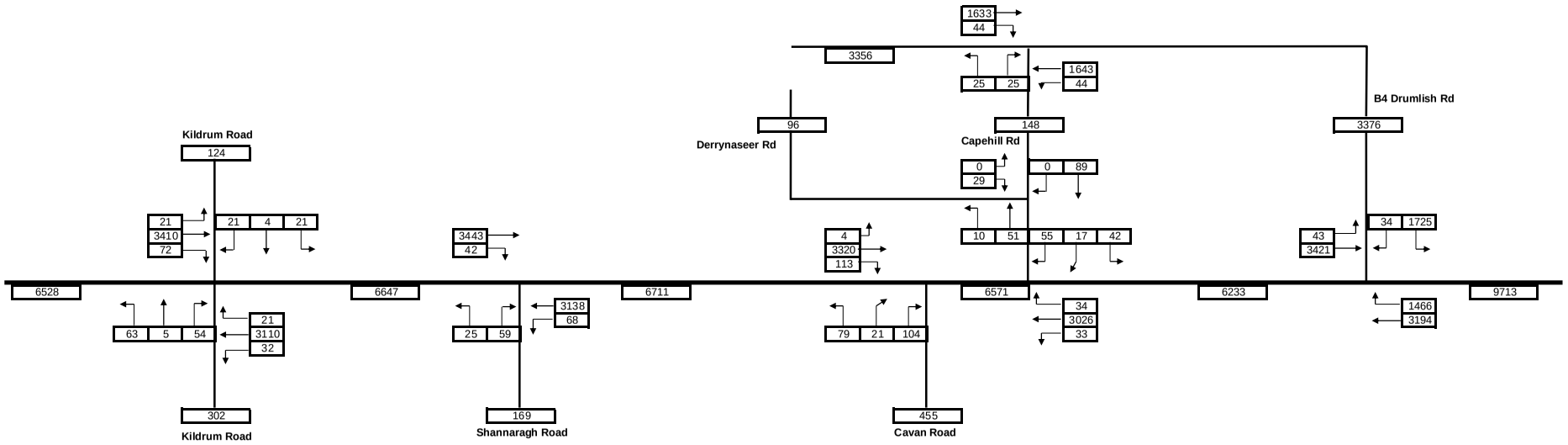


AECOM

2028 Flows using local growth rate + Hospital Trips

Time Period: 24 HOUR 7-DAY FLOWS

A32 Shannaragh (Stage 3) DO MINIMUM

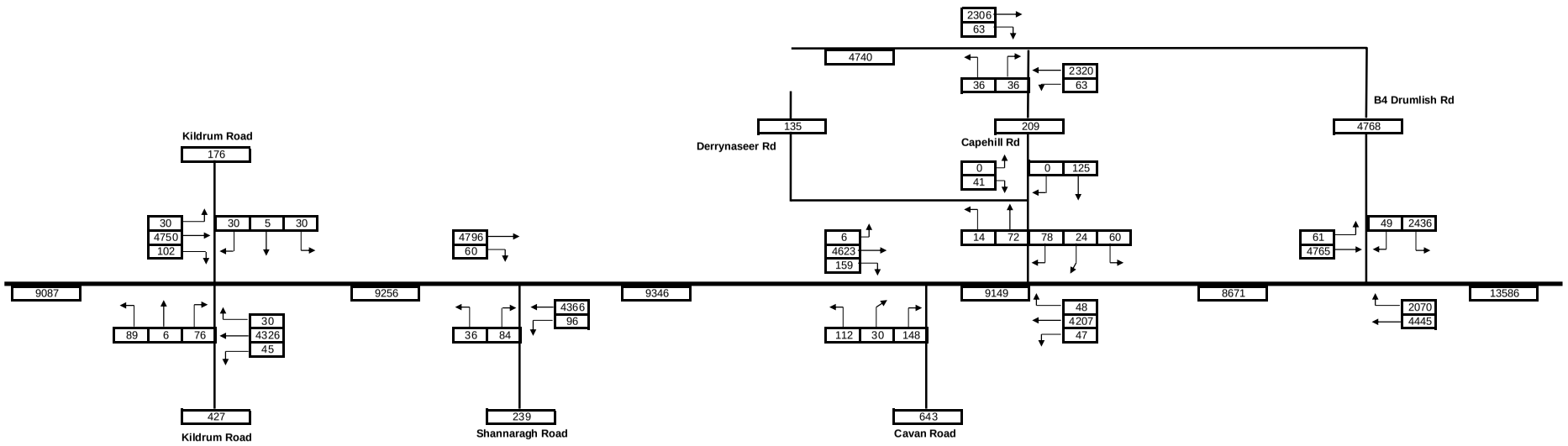


AECOM

2013 Flows using local growth rate + Hospital Trips

Time Period: 24 HOUR 7-DAY FLOWS

A32 Shannaragh (Stage 3) DO SOMETHING

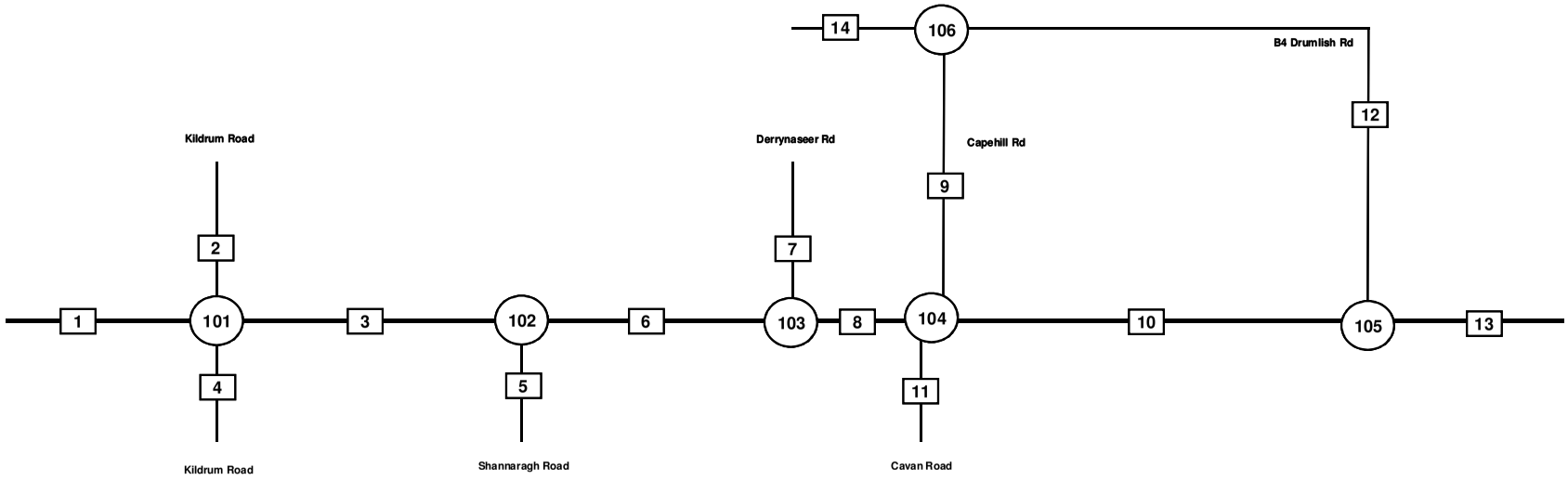


AECOM

2028 Flows using local growth rate + Hospital Trips

Time Period: 24 HOUR 7-DAY FLOWS

A32 Shannaragh (Stage 3) DO SOMETHING



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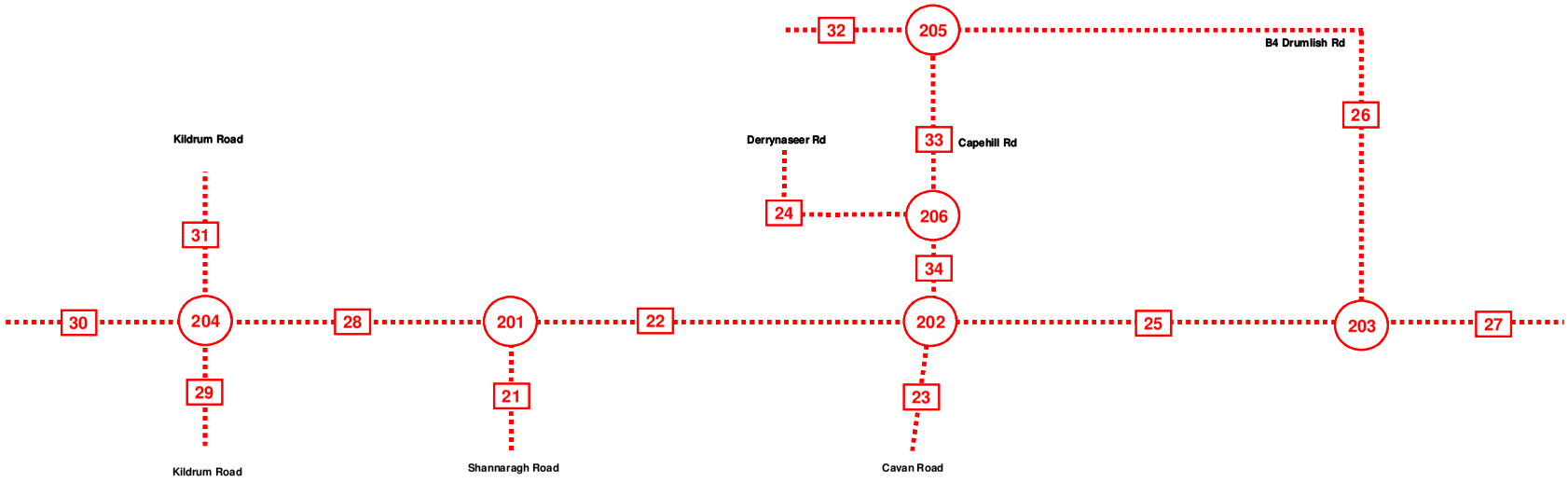
Do Minimum Network

COBA Node Link Diagram

A32 Shannaragh (Stage 3)



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Do Something - Preferred Route

COBA Node Link Diagram

A32 Shannaragh (Stage 3)

Appendix D – COBA Summary

A32 SHANNARAGH REALIGNMENT
A32 SHANNARAGH - STAGE 3 PREFERRED ROUTE

TABLE 15A E C O N O M I C E F F I C I E N C Y O F T H E R O A D S Y S T E M
I N M A R K E T P R I C E S

IMPACT	TABLE REF	TOTAL	CARS AND PRIVATE LGVs	GOODS VEHICLES AND BUSINESS LGVs	BUS AND COACH
CONSUMER USER BENEFITS					
Travel time		2,560	2,493	-	68
Vehicle operating costs		67	67	-	-
Travel time and vehicle operating costs:					
During construction		0	-	-	-
During maintenance		0	-	-	-
NET CONSUMER USER BENEFITS	(1)	2,628	2,560	-	68
BUSINESS USERS					
User Benefits					
Travel Time		2,708	1,657	1,026	25
Vehicle Operating costs		284	11	273	-
Travel Time and Vehicle Operating Costs:					
During construction		0	-	-	-
During maintenance		0	-	-	-
Subtotal	(2)	2,992	1,668	1,299	25
Private Sector Provider Impacts					
Operating Costs	(3)	19	-	-	19
Other Business Impacts					
Developer and other contributions	(4)	0			
NET BUSINESS IMPACT	(5)	3,011	1,668	1,299	43
TOTAL					
Present Value of Transport Economic Efficiency Benefits	(6)	5,639			

THIS ANALYSIS IS BASED ON USER DEFINED LOW TRAFFIC GROWTH
AND DEFAULT LOW ECONOMIC GROWTH

COSTS IN 2002 PRICES IN MULTIPLES OF A THOUSAND POUNDS AND DISCOUNTED TO 2002

EVALUATION PERIOD 60 YEARS FIRST SCHEME YEAR 2013 CURRENT YEAR 2009

DISCOUNT RATE 3.5 PERCENT FOR 30 YEARS THEREAFTER 3.0 PERCENT FOR 46 YEARS

THEREAFTER 2.5 PERCENT

A32 SHANNARAGH REALIGNMENT
A32 SHANNARAGH - STAGE 3 PREFERRED ROUTE

TABLE 15B P U B L I C A C C O U N T S

IMPACT	TABLE REF	TOTALS
Local Government Funding		
Operating Costs		0
Investment Costs		0
Developer and Other Contributions	(7)	0
NET IMPACT		0
Central Government Funding		
Operating Costs		-15
Investment costs		5,355
Developer and Other Contributions		0
Indirect Tax Revenues		-20
NET IMPACT	(8)	5,321
Present Value of Costs (PVC)	(9)	5,321

THIS ANALYSIS IS BASED ON USER DEFINED LOW TRAFFIC GROWTH
AND DEFAULT LOW ECONOMIC GROWTH

COSTS IN 2002 PRICES IN MULTIPLES OF A THOUSAND POUNDS AND DISCOUNTED TO 2002

EVALUATION PERIOD 60 YEARS FIRST SCHEME YEAR 2013 CURRENT YEAR 2009

DISCOUNT RATE 3.5 PERCENT FOR 30 YEARS THEREAFTER 3.0 PERCENT FOR 46 YEARS

THEREAFTER 2.5 PERCENT

A32 SHANNARAGH REALIGNMENT
A32 SHANNARAGH - STAGE 3 PREFERRED ROUTE

TABLE 15C A N A L Y S I S O F M O N E T I S E D C O S T S A N D B E N E F I T S

IMPACT		TABLE REF	TOTALS
TEE Benefits			
Consumer User Benefits		(1)	2,628
Business Benefits		(2)	2,992
Private Sector Provider Impacts		(3)	19
Accident Benefits		(10)	2,414
Emissions Benefits		(11)	0
Present Value of Benefits	(PVB)	(12)	8,053
Government Funding			
Present Value of Costs	(PVC)	(9)	5,321
Overall Impact			
Net Present Value	(NPV)	*(12)-(9)	2,732
Benefit to Cost Ratio	(BCR)	*(12)/(9)	1.513

THIS ANALYSIS IS BASED ON USER DEFINED LOW TRAFFIC GROWTH
AND DEFAULT LOW ECONOMIC GROWTH

COSTS IN 2002 PRICES IN MULTIPLES OF A THOUSAND POUNDS AND DISCOUNTED TO 2002

EVALUATION PERIOD 60 YEARS FIRST SCHEME YEAR 2013 CURRENT YEAR 2009

DISCOUNT RATE 3.5 PERCENT FOR 30 YEARS THEREAFTER 3.0 PERCENT FOR 46 YEARS

THEREAFTER 2.5 PERCENT

NOTE: There may also be other significant costs and benefits, some of which cannot be presented in monetised form. Where this is the case, the analysis presented above does NOT provide a good measure of value for money and should not be used as the sole basis for decisions.

Appendix E – Structures Assessment and Drawings

Project:	**A32 Shannaragh Realignment**	Job No:	**60050885**
Subject:	**SAR 3 – Structures Assessment**		
Prepared by:	**Sarah Roberts**	Date:	**27/09/10**
Checked by:	**Anthony Dale**	Date:	**27/09/10**
Approved by:	**Clare Anderson**	Date:	**27/09/10**

1.1 Introduction

The purpose of this Technical Note is to present the results of the Stage 3 Structures Assessment. It presents structural options, initial designs for the proposed structures, along with cost estimates and a discussion on environmental mitigation measures to be adopted.

It also includes a discussion on options for making the appearance of the proposed Owenreagh River Bridge sympathetic to its surroundings.

1.2 Owenreagh River Underbridge (approx chainage 660.0)

A bridge structure is required to carry the realigned A32 over the Owenreagh River. The new bridge will be constructed approximately 30m downstream of the existing structure.

The existing structure is a twin arch masonry bridge with a cumulative span of 12.9m. The abutments and central pier are situated in the river; however the new structure will have a larger span so that construction works are not required in the water. Once the new road is open to traffic, the existing bridge will be demolished and so the aesthetic appearance of this structure will not be considered during the design of the new structure.

The Owenreagh River has a Salmonid River designation and so the impact of construction on the river must be minimised, particularly with regard to the ingress of mud and construction materials. It also means that a single-span structure is preferable as this will minimise interference with the watercourse and allow for a natural river bed to be maintained below the structure. The removal of the existing structure will cause disturbance to the watercourse in the short term during the construction phase, although the removal of the constraints to the watercourse will have significant long-term benefits for the watercourse.

The Owenreagh River is prone to flooding and the proposed portal structure has been designed so that it will not increase afflux upstream of the bridge.

Otters are present within the river catchment, which requires that mammal access along the banks of the river must be maintained. As the river breaks its banks at the 1 in 2 year flood level, it is not practical to build a structure large enough to maintain riparian access for otters at all times and so a mammal crossing at a higher level will be provided.

It was also noted during ecological surveys that a single bat was found resting in the existing bridge. Bat bricks will be provided in the new structure to provide a roost once the existing bridge has been removed.

The ground investigation indicates that, in the vicinity of the structure, around 1.75m of soft silty material overlies a dense moderately weathered mudstone. It is proposed that the silt will be excavated down to the mudstone and replaced with imported stone fill to formation level of the foundations. This avoids the need for piling under the foundations of the structure.

The options considered for this structure include precast arches, with and without wingwalls, as well as a precast concrete infill deck with full height in-situ abutments. Precast construction has been considered in all cases as this provides the maximum protection for construction operatives working over the stream as well as minimising the likelihood of construction materials being deposited into the watercourse. A 1.0m wide riparian buffer strip either side of the watercourse has been maintained, which will aid buildability as well as decreasing the adverse

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environmental impact of the structure. This gives a clear span of 21.2m for the Owenreagh River bridge crossing. The proposed bridge will be integral in accordance with guidance given in BD 57, reducing the long-term maintenance requirements for the structure.

The precast arch options were not feasible as there was not sufficient headroom under the new carriageway alignment for a large enough rise for this span.

The structure type for which costs have been provided is a single span bridge with full-height abutments. An infill type deck with Y beams placed adjacent to each other has been assumed as this construction method is cost effective as well as providing safety and environmental advantages. The cost for the replacement Owenreagh River Bridge is estimated at £465,750**.

Aesthetic considerations:

As the structure is in a rural location it is desirable to investigate that the appearance of the bridge is sympathetic to its surroundings. Various options have been considered, including providing cladding on the abutments and wingwalls as well as masonry parapets. The costs of these options, together with some discussion about their relative merits follow;

Cladding of the abutments

Providing masonry cladding on the abutments would be the most cost-effective way to change the appearance of the structure.

However, very careful detailing would be required to avoid making the cladding look like an add-on; the structure would clearly have a concrete superstructure (with both precast and insitu concrete being visible), and possibly a steel parapet. The addition of masonry cladding on the abutments would add an additional material to the elevation of the bridge and this frequently detracts from the overall appearance of the structure as it becomes confused and unattractive.

In this case, the bridge will not frequently be seen in elevation as there is no provision for pedestrian access alongside the river. The wingwalls will be designed to minimise their appearance for road users, who will be viewing the bridge from a reasonable speed and will not have time to observe details.

It is therefore considered that although this would be a relatively inexpensive way to improve the appearance of the structure it is unlikely to provide significant benefit for stakeholders. The cost for provision of Random Rubble abutment cladding is estimated at £25,200, while the cost of Ashlar Stone would be £94,500.

Parapets

The parapets are the element of the structure which will be most obvious to road users as they cross the bridge. Current parapet standards are very stringent, meaning that it is difficult to provide improvements to the appearance of parapets without incurring departures from standard.

Alternatives considered include the provision of masonry parapets or masonry-clad reinforced concrete parapets. Another option would be to construct masonry lead-in parapets which then connect onto standard steel parapets over the bridge, allowing road users a view as they cross the structure.

TD 19/06 indicates that, with prior agreement from the Overseeing Organisation, masonry clad reinforced concrete is the preferred option when parapets are to be constructed in keeping with local surroundings. TD 19/06 also sets out specific requirements for masonry facings, stating that uncoursed work is not permitted on the front face of parapets and surface undulations should not exceed 30mm.

One of the benefits of masonry cladding is that the main core of the parapet will be reinforced concrete which will enable a full connection with the adjacent safety barrier therefore minimising the number of departures required. As the bridge is in a rural location, a random rubble facing would be preferable as this would be both cost effective and be in keeping with the local surroundings. However, this would require a departure from standard as it does not comply with the surface texture requirements as set out in TD 19/06. The use of masonry parapets may require a number of departures from standard. BS 6779-4 requires measures to prevent cracking in masonry parapets, which would necessitate the use of coursed masonry requiring a departure from TD19/06. This would be a

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disproportionately expensive solution and so a departure from standard would be required to use a random rubble construction without crack prevention measures. In addition to this, a departure from standard would be required for the structural connection between the masonry parapet and the adjacent safety barrier.

Outline cost estimates** along with a summary of the departures required for each option are given below in Table 1.1.

Parapet	Cost (per m)	Total cost (for 71m)	Departures
Metal parapet (assumed aluminium)	£180	£12,780	-None
Ashlar-clad reinforced concrete	£1,103	£78,278	-None
Random rubble-clad reinforced concrete	£588	£41,727	-Departure for substandard cladding
Ashlar masonry	£2187	£155,277	-Either continue safety barrier across structure in front of parapet or departure for substandard connections - Possibly require departure for design to BS 6779 as this does not appear to be permitted in TD 19/06
Random rubble masonry	£702	£49,842	-Departure for substandard parapet design - cracking in masonry -Either continue safety barrier across structure in front of parapet or departure for substandard connections - Possibly require departure for design to BS 6779 as this does not appear to be permitted in TD 19/06

Table 1.1 – Owenreagh Bridge – Parapet Cladding Costs

1.3 Capehill Culvert (approx chainage 1325.0)

An existing culvert passes under the current A32 alignment at this location. The structure is a precast concrete pipe. This structure will remain in place as this section of the existing road will be retained to provide access to lands and properties.

Various structural options were considered for this structure; however only a rectangular reinforced concrete box culvert satisfied the necessary environmental, capacity and freeboard criteria. The proposed structure may be either precast or insitu depending on the preferences of the contractor. The base of the culvert is to comprise randomly pitched stones in concrete screed, to encourage the bed to naturalise as quickly as possible. The structure will have a low-flow channel as well as high level mammal ledges.

The box structure has a clear span of 3.2m and an internal height of 2.75m. A freeboard of 750mm has been provided allowing for a clearance of 150mm between the peak water levels and the mammal ledge, plus 600mm headroom for the mammal ledge. This is greater than the recommended minimum 600mm freeboard.

It is proposed that the wingwalls for this structure will be used as headwalls for highways drainage outfalls into the drain.

The cost for the proposed Capehill Culvert is estimated at £101,250**.

1.4 Mullaghbane Culvert (approx chainage 2240.0)

There is an existing culvert crossing the A32 alignment at this location. The existing structure is a corrugated steel arch with a 3m span and a 1.5m rise, which is showing some signs of rusting, but is generally in a good condition.

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While the Mullaghbane Drain does not have an environmental designation, it is a tributary of the Owenreagh River, which is a designated Salmonid River. This means that construction work undertaken over the Mullaghbane Drain must avoid adversely affecting the water quality of the Owenreagh River where possible.

The existing structure is not suitable for reuse and so will be replaced. The watercourse will be realigned at this location meaning that a shorter length of the drain will be culverted. Realigning the watercourse also means that only one diversion will be required as the drain can continue along its existing line until the new channel is finished.

Various structural options were considered for this structure; however only a rectangular reinforced concrete box culvert satisfied the necessary environmental, capacity and freeboard criteria. The proposed structure may be either precast or insitu depending on the preferences of the contractor. The base of the culvert is to comprise randomly pitched stones in concrete screed, to encourage the bed to naturalise as quickly as possible, therefore the new culvert will not degrade the ecological quality of the environment in the long term. The structure may be either precast or insitu depending on the preferences of the contractor. A low-flow channel and high level mammal ledges are to be provided through this structure.

It is proposed that the wingwalls for this structure will be used as headwalls for highways drainage outfalls into the drain.

The cost for the proposed Mullaghbane Drain Culvert is estimated at £135,000**.

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(** These estimates are exclusive of preliminaries and ancillaries and are based on SPON'S Civil Engineering and Highway Works Price Book (with a Regional Adjustment factor of 0.90 applied))

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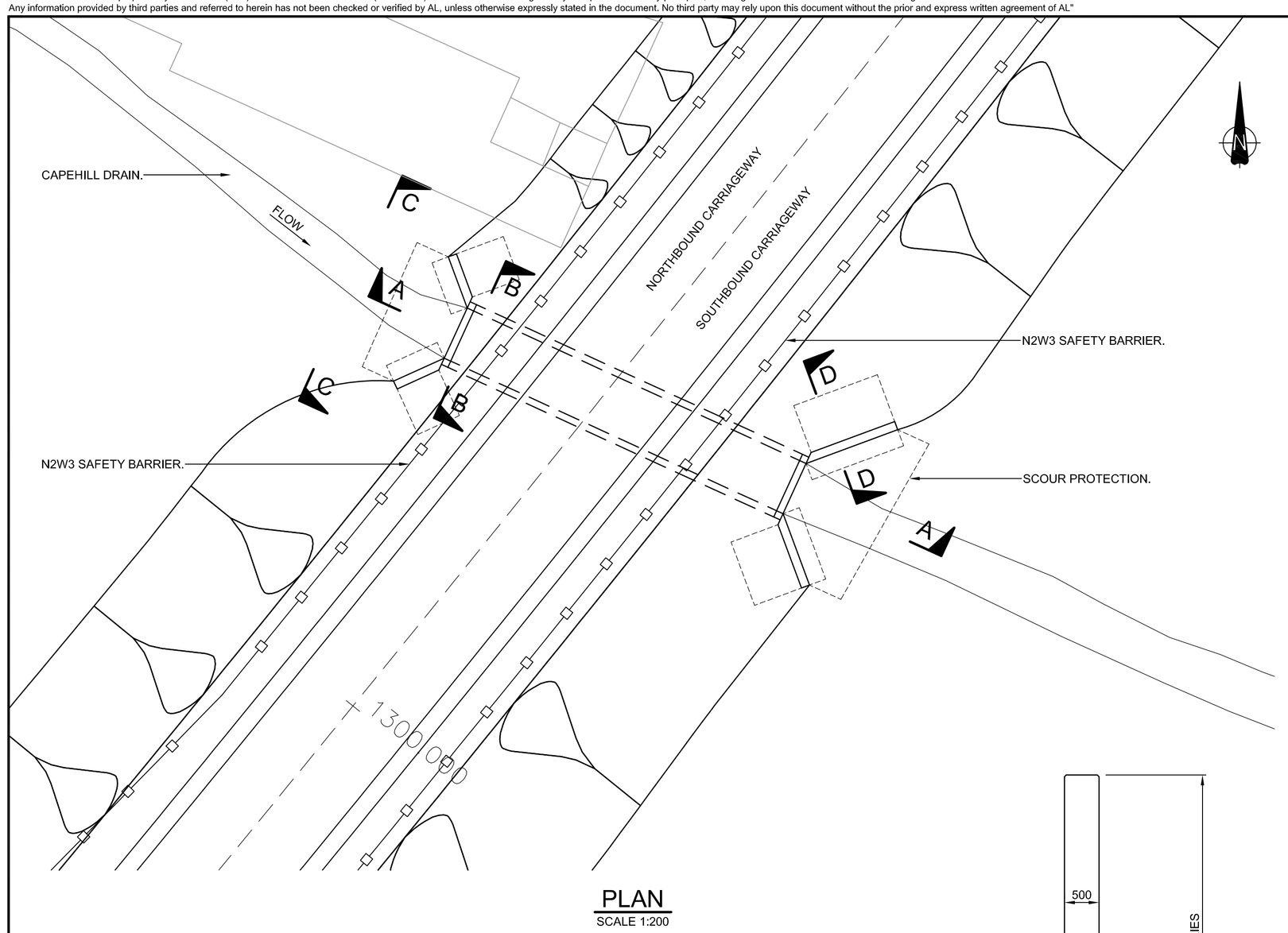

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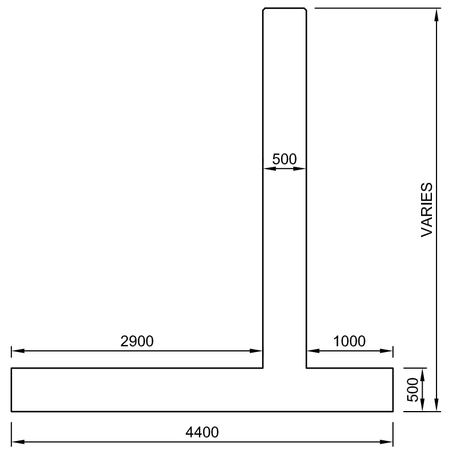

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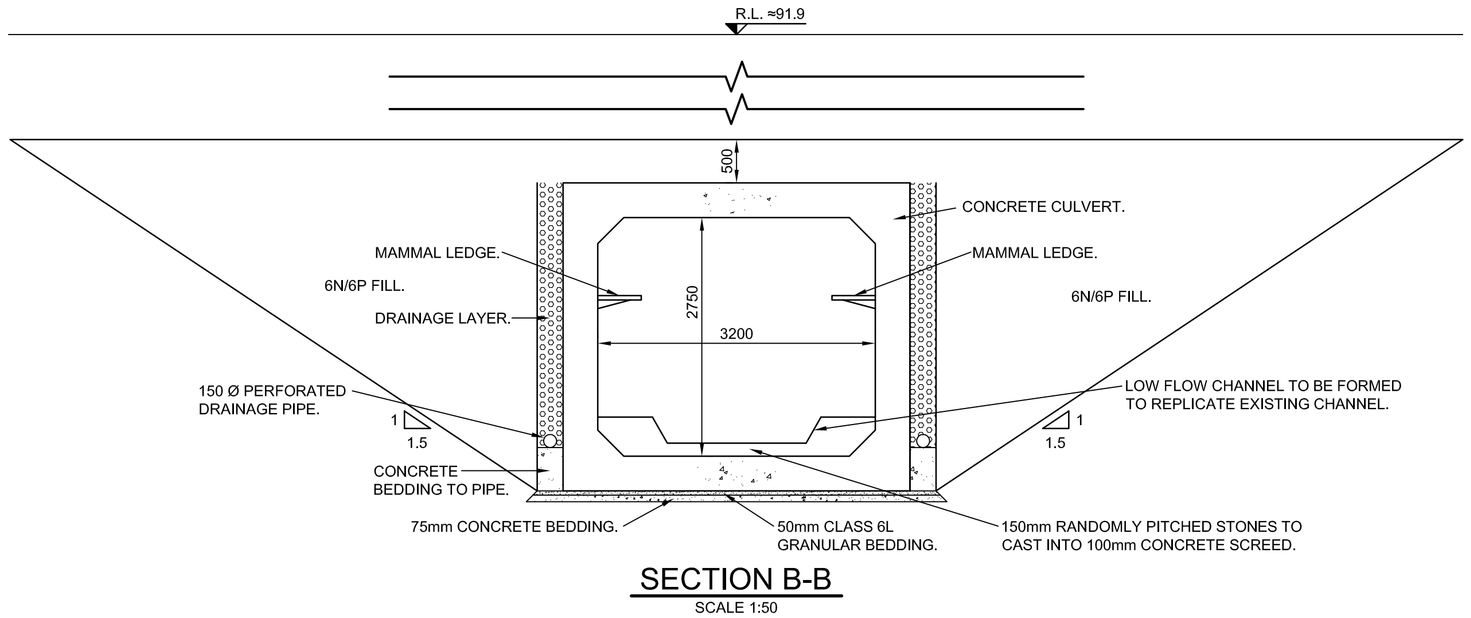

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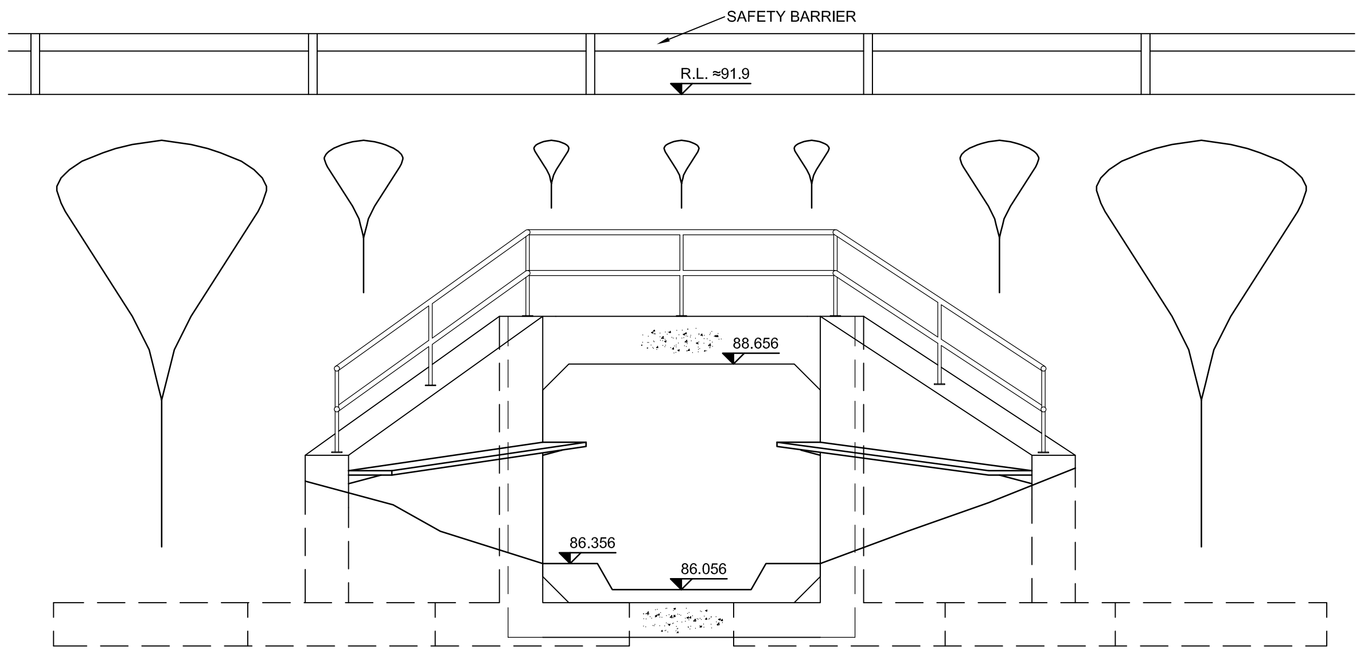

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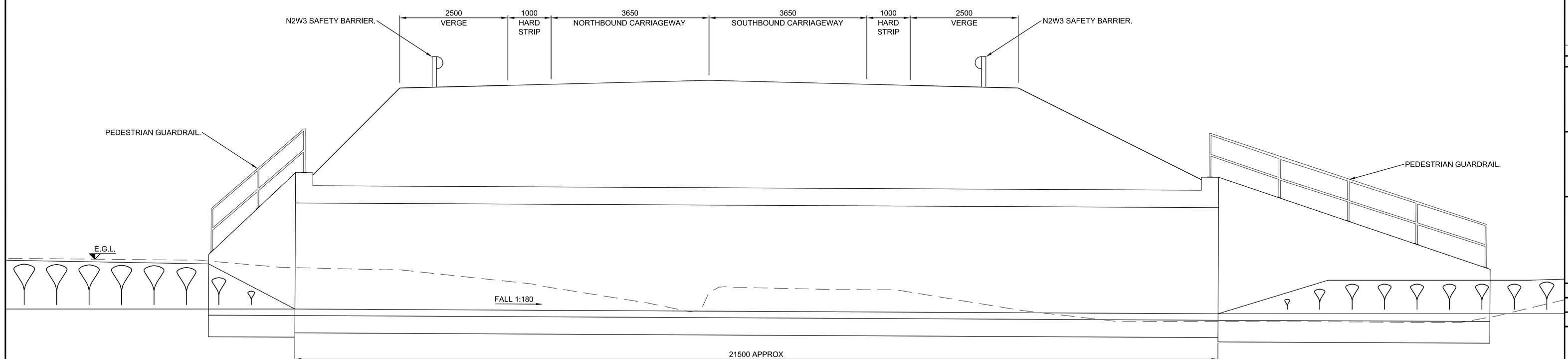

SECTION A-A
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NOTES

1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS OTHERWISE NOTED. DO NOT SCALE.

Rev	Date	Detail	Made	Chk'd	App'd
A	20/05/10	FIRST ISSUE	B.M.	S.R.	R.S.R.

Client: ROADS Service — An Agency within the Department for Regional Development www.roadsni.gov.uk

Project: A32 SHANNARAGH REALIGNMENT

Title: CAPEHILL CULVERT

Design:	S.R.	CAD:	B.M.
Chk'd:	S.R.	App'd:	R.S.R.
Date:	MAY 2010	Scale:	AS SHOWN

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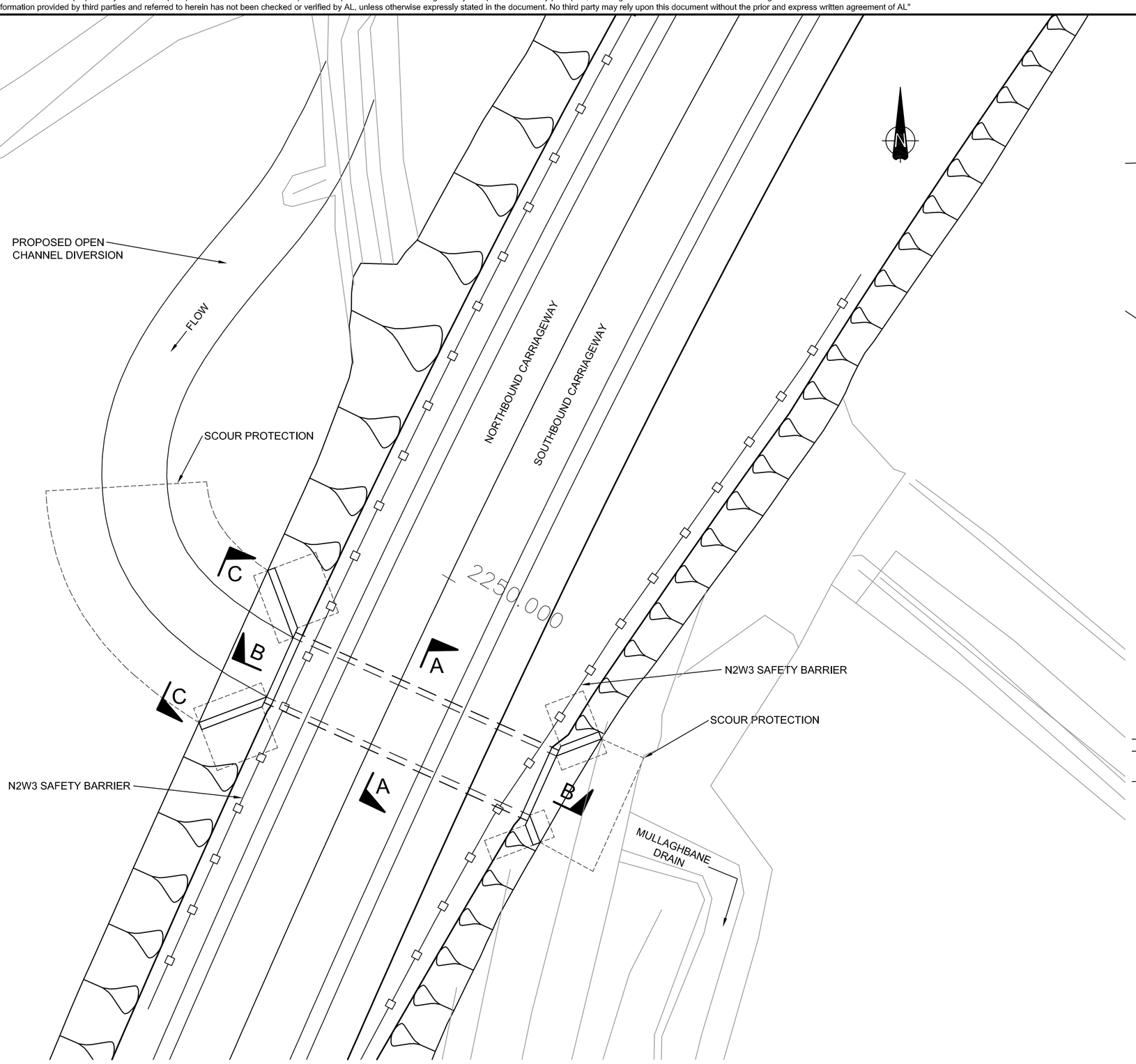
No. 60050885/ST/C1/P/001 Rev: A

A1



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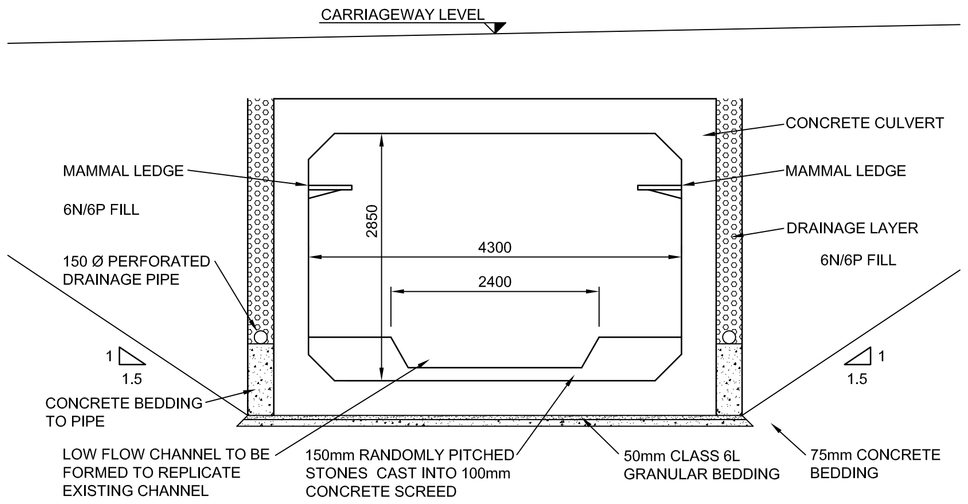

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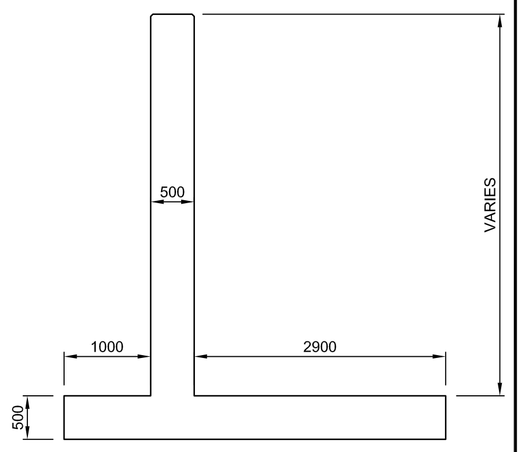

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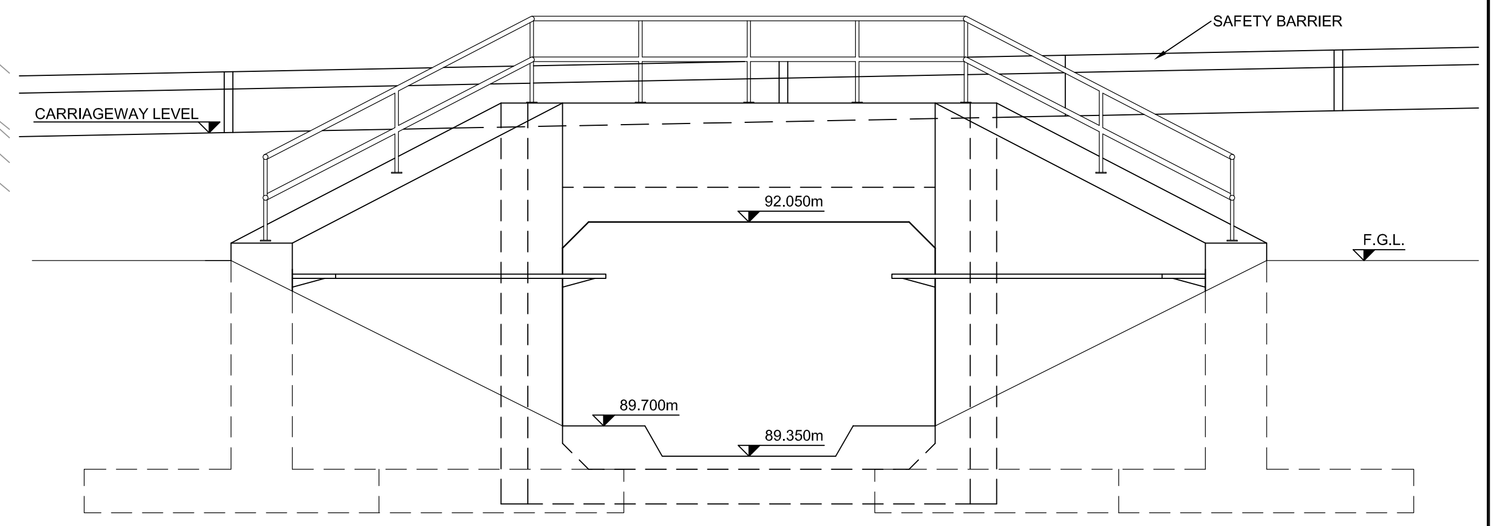

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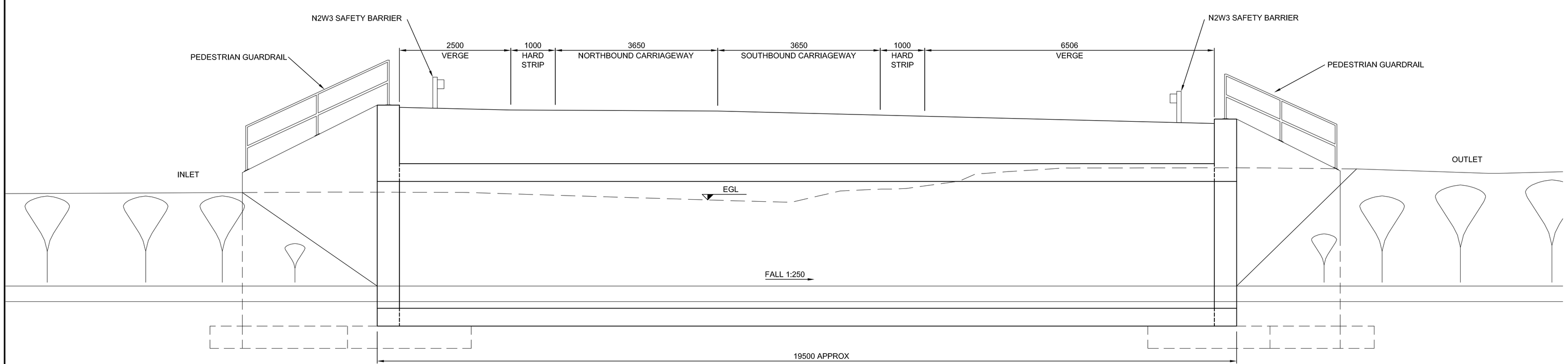

SECTION B-B
SCALE 1:50

NOTES

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A	20/05/10	FIRST ISSUE	JH	SR	RSR

Client: ROADS Service — An Agency within the Department for Regional Development

Project: A32 SHANNARAGH REALIGNMENT

Title: MULLAGHBANE CULVERT

Design: SR	CAD: JH
Chk'd: SR	App'd: RSR
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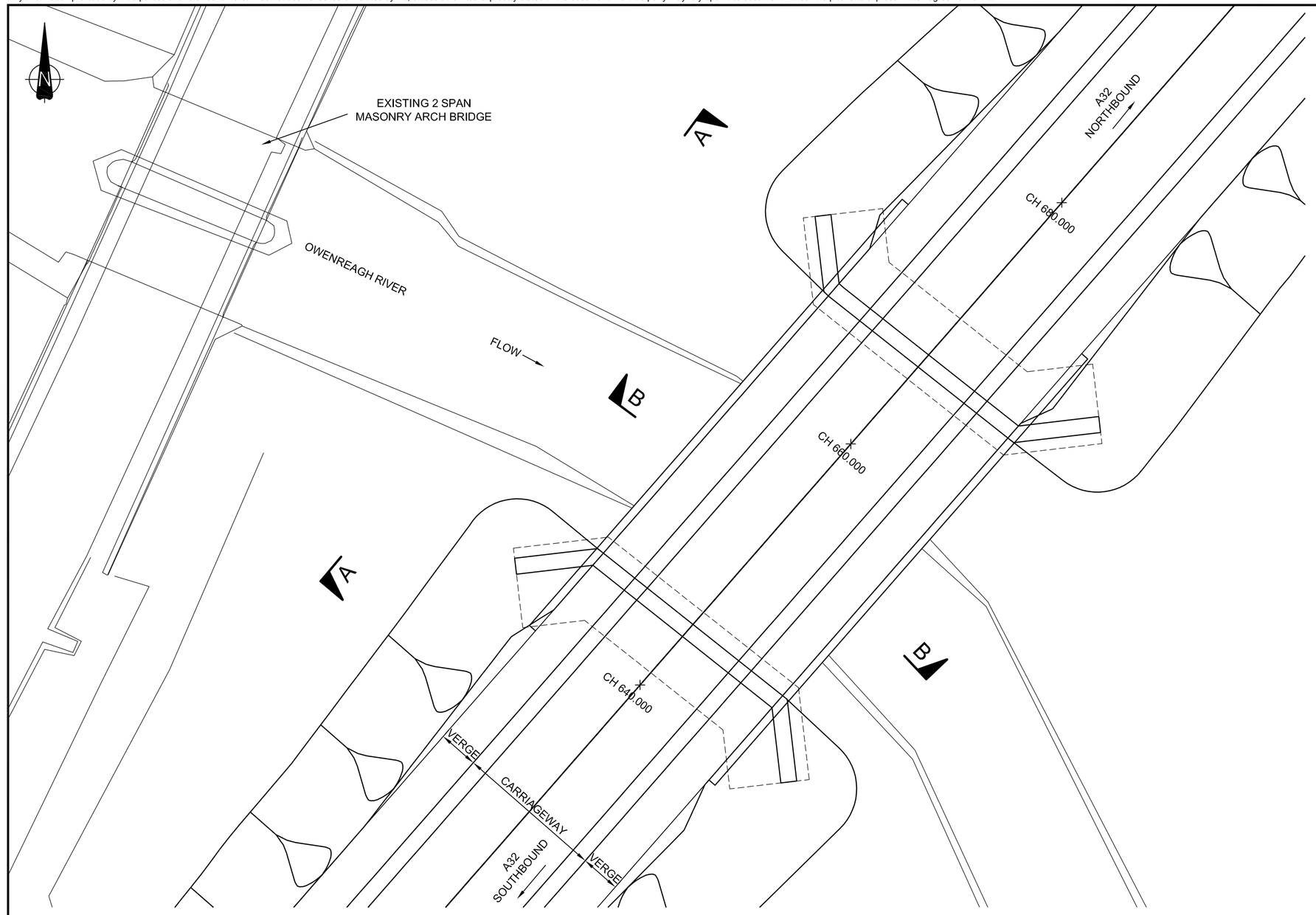
A1



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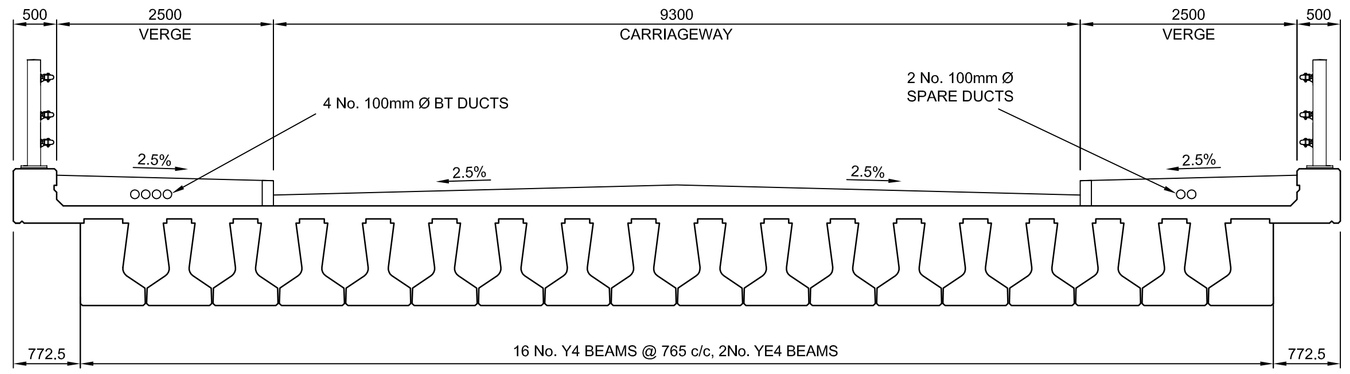

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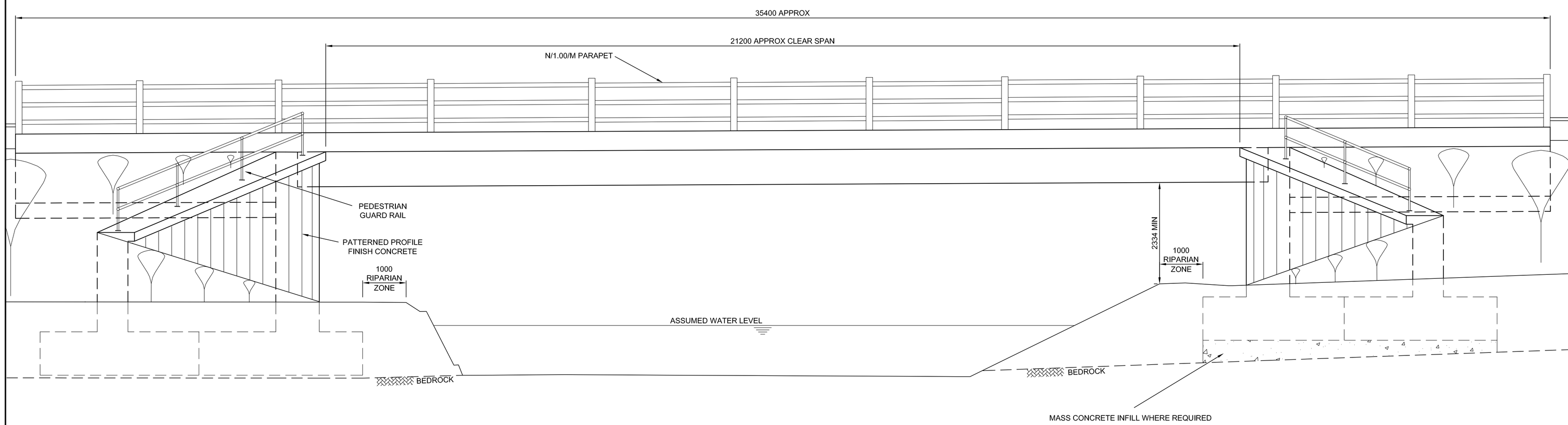

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NOTES

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Rev	Date	Detail	Made	Chk'd	App'd
C	03/06/10	EARTHWORKS AND WINGWALLS UPDATED	JH	SR	RSR
B	04/05/10	SERVICE DUCTS ADDED	JH	SR	RSR
A	23/04/10	FIRST ISSUE	JH	SR	RSR

Client:
ROADS Service
An Agency within the Department for Regional Development
www.drdni.gov.uk

Project:
A32 SHANNARAGH REALIGNMENT

Title:
OWENREAGH RIVER BRIDGE

Design: SR	CAD: JH
Chk'd: SR	App'd: RSR
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