

AtkinsRéalis



VRS Preliminary Design Report

Mayo County Council

May 2025

N59 CARROWREVAGH BRIDGE REHABILITATION WORKS



Bonneagar Iompair Éireann
Transport Infrastructure Ireland



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Client signoff

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Client
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1. Project Background

AtkinsRéalis were appointed by **Mayo County Council** as consultants for **EIRSPAN Task Order TO315 Mayo Bridge Assessments and Strengthening 2023** in liaison with **TII Eirspan Northwest**.

As part of this scheme, it has been deemed necessary to install a new **Vehicle Restraint System (VRS)** as part of the proposed works to be carried out to rehabilitate the existing structure on the **N59 National Secondary Road** at **Carrowrevagh Bridge**.

AtkinsRéalis are submitting this VRS Preliminary Design Report with details of all Departures from Standards necessary due to existing site conditions that cannot be mitigated and that preclude the installation of a compliant VRS in accordance with DN-REQ-03034.

1.1 Existing Bridge Structure

Carrowrevagh Bridge is TII structure reference number **MO-N59-053.50**. It is located on the **N59 National Secondary Road (NSR)** approximately 13.0km south of Westport, Co. Mayo. A watercourse passes under the N59 through Carrowrevagh Bridge.

The ITM coordinates at the centre of the structure are **497,100 Easting, 774,523 Northing**.

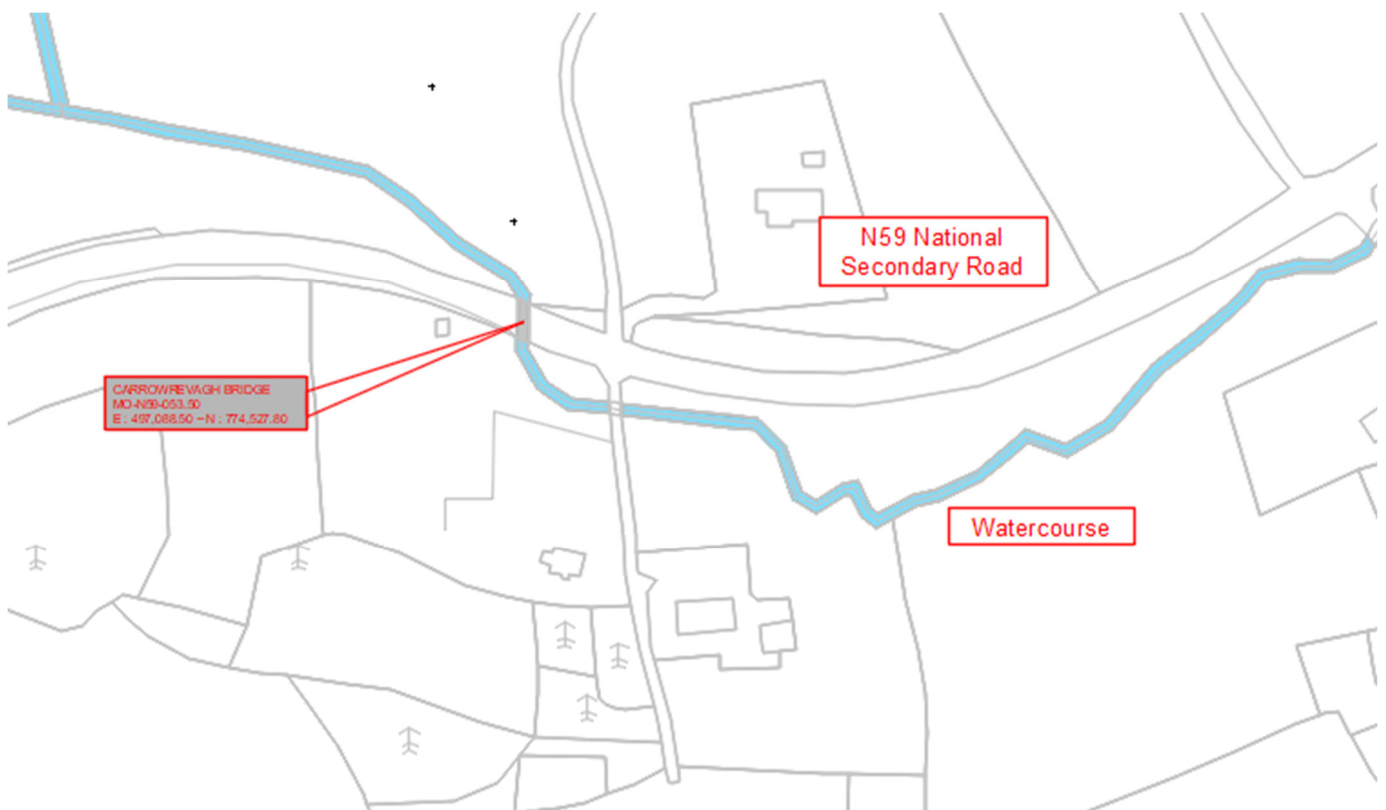


Figure 1 : Site Location Plan



Figure 2 : View looking West



Figure 3 : View looking East

1.2 Existing Carriageway Details

Carrowrevagh Bridge is located on the N59 National Secondary Road which is a Rural Two-Lane Carriageway of nominal 5.90m overall width at the bridge location. The carriageway consists of a westbound lane of 3.0m and an eastbound lane of 2.50m. There are no hard strips / hard shoulders at this location.

The Client project brief for this structure includes :

“The Consultant shall also include.....provision of safety barrier on the approaches and departures to the structure and in compliance with EN1317 and DN-REQ-03034 and DN-REQ-03079 and corresponding referenced technical standards.”

2. VRS Design Process

2.1.1 Design Process Flow

DN-REQ-03079 Design of Road Restraint Systems for Constrained Locations and Existing Structures – May 2024 outlines the VRS Design Process Flow

2.1.2 Reference Documents

The following TII documents have been referenced in the preparation of this Preliminary Design Report:

- **DN-REQ-03034 The Design of Road Restraint Systems (Vehicle and Pedestrian) for Roads and Bridges – May 2019**
- **DN-GEO-03036 Cross Sections and Headroom – May 2023**
- **DN-REQ-03079 Design of Road Restraint Systems for Constrained Locations and Existing Structures – May 2024**
- Sinuosity, Collision Rate Threshold Data, and Indicative Operational Speeds available from **CollisionRatesResults_2016to2018.KML** for importing into Google Earth available from the TII Portal at <https://data.tii.ie/>
- AADT Data available from <https://trafficdata.tii.ie/>

2.2 Bridge Specific Hazards

2.2.1 Existing Carriageway Data

Carrowrevagh Bridge (MO-N59-053.50) is located on the N59 National Secondary Road approximately 13.0km south of Westport, Co. Mayo.

The posted speed limit on this section of road is **80 kph**. The operational speed limit at this location, based on the information as given on the Google Earth KML file noted above, which is derived from the TII National Transport Model (NTpM), is **84 kph**.

The Annual Average Daily Traffic (TMU N59 130.0 S 2024) is **3680 with 2.2% HCV (80)**.

The sinuosity of this section of road is **1.168289 (High)** and the Collision Threshold is **Twice Below Average Rate (Low)**.

A watercourse flows through Carrowrevagh Bridge from south to north under the N59 NSR.

There is an existing crossroads approximately 25m east of the bridge structure. This crossroads consists of a combined domestic/field access on the north side and a Local Access Road on the south side of the N59. There is an existing field access gate approximately 35m west of the bridge location on the south side of the N59.

There are existing, substandard parapet walls, of masonry and mass concrete construction, on both sides of the carriageway.

2.2.2 Existing Hazard Identification

As per **Table 3.1, DN-GEO-03036**, the appropriate Clear Zone at this location measures **6.1m** from the edge of the carriageway lane. This is based the bridge being located on a short straight section between back-to-back horizontal curves of approximately 150m / 175m radius respectively.

The existing hazards at this structure, in accordance with **DN-REQ-03034, Appendix D** within the 6.1m Clear Zone consist of the following:

- Wooden poles or posts with Cross Sectional Area > 25,000mm² that do not have breakaway features.
- Concrete posts with Cross Sectional Area > 15,000mm²
- Water of likely depth > 0.6m
- Bridge Parapets
- Under bridges or retaining walls >0.5m high supporting the road, where a vehicle parapet or vehicle / pedestrian parapet of the required performance class is not provided
- Steep Embankment Slopes, steeper than 1:2 and ≥ 1m height
- Substantial fixed objects eg walls extending above the ground by more than 150mm with projections or recesses ≤ 100mm and running parallel to the road

2.3 AtkinsRéalis Risk Assessment

There are currently no protection measures in place to protect road users from the hazards outlined in section 2.2.2 above. Mitigation and / or removal of the hazards has been considered as follows.

- The existing utility poles on the northern / southern verges cannot be relocated to outside the Clear Zone. Consultation with EIR determined that any relocation of the poles would be difficult due to the services arrangement these poles are carrying. The proposed VRS layout ensures that there is adequate Working Width (0.80m) to the poles in their current location.
- The concrete posts form part of an existing field boundary fence that could be removed and replaced with a suitable fence type. This would involve removing the existing hedgerow along the length of the existing fence and would need the agreement of the Landowner.
- The water course cannot be realigned to outside the Clear Zone without considerable environmental impact and land take requirements.
- The existing parapet walls, which are constructed of masonry on the southern verge and insitu concrete on the northern verge, are of substandard containment. The southern masonry parapet wall is a nominal 0.60m above the adjacent verge. The northern insitu concrete parapet wall is a nominal 0.25m above the adjacent verge. As part of the proposed works, the existing parapet walls will be raised to a nominal 1.0m above the concrete verges with suitable masonry construction.
- The existing underbridge cannot be relocated outside the Clear Zone and will be retained in its location.
- The existing steep embankment slopes cannot be regraded beyond the extent of the clear zone due to site constraints from the watercourse.
- The existing walls, other than the bridge parapet, could be removed to ground level and replaced with suitable fencing. This would require extensive clearance of hedgerows and require the agreement of the Landowner.

There are legacy hazards at Carrowveagh Bridge which require protection by means of a VRS for the road user. Therefore, it was deemed unnecessary to mitigate the hazards associated with the boundaries that could be removed as noted above.

On the northwest verge, the required VRS Length of Need can be achieved. On the northeast verge, the Length of Need is restricted by the existing junction. On the southwest verge, the Length of Need is restricted by the existing field access which cannot be relocated due to the existing topography.

On the southeast verge, the VRS Length of Need is restricted by the existing junction. The side slope leading to the watercourse, which is close to the carriageway, at this location is also a hazard and requires protection. There is an existing VRS east of the Local Access Road junction. It is proposed to utilise this VRS as a Shielding Barrier as per the layout shown in **Figure 3.13, Section 3.26 VRS at Junctions, DN-REQ-03034**.

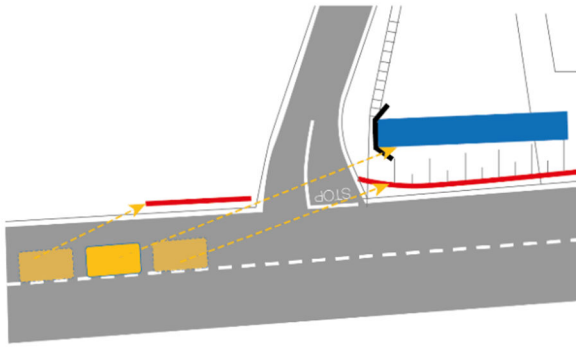


Figure 3.13 Flared Barrier & Shielding Barrier

The layout suggest above will be modified to suit the southeast verge at Carrowrevagh Bridge.

The TII Risk Assessment Procedure outlined in **DN-REQ-03079** for the determination of the requirement for the provision of a VRS is detailed in Section 1.6 below.

2.4 TII Risk Assessment Procedure

As per **Table 1.1, DN-REQ-03079 – Categories of VRS at Constrained Locations**, this location falls under **Category B – Online Improvements / Retrofitting at Existing Structure / Bridge Locations**.

As per **Chapter 5, Section 5.2, DN-REQ-03079**, the Risk Assessment Procedure consists of seven steps in the determination of the justification for a new Vehicle Restraint System (VRS) at **Carrowrevagh Bridge**.

These steps are:

1. Establish if the Hazard is within the Clear Zone and if it can be removed or mitigated

The appropriate Clear Zone dimension for this location, on a short, straight road between back-to-back horizontal curves, with a posted speed limit of 80kph is **6.1m**.

The existing hazards cannot be removed at the structure as per section 2.3 above.

2. Rank the Hazard as per Appendix C

The hazards are ranked as

- **High** – Wooden poles or posts with Cross Sectional Area > 25,000mm² that do not have breakaway features.
- **High** – Concrete posts with Cross Sectional Area > 15,000mm²
- **High** – Water of likely depth > 0.6m
- **High** – Bridge Parapets
- **High** - Under bridges or retaining walls >0.5m high supporting the road, where a vehicle parapet or vehicle / pedestrian parapet of the required performance class is not provided
- **High** - Steep Embankment Slopes, steeper than 1:2 and ≥ 1m height

- **Low** – Substantial fixed objects eg walls extending above the ground by more than 150mm with projections or recesses $\leq 100\text{mm}$ and running parallel to the road

3. Calculate the sinuosity of the section of road

- As per the TII website, the sinuosity of the N59 NSR at the bridge location is given as **High 1.168289 (>1.02)**

4. Assess the Collision Rate threshold for the section of road

- As per the TII website, the Collision Rate Threshold for the N59 NSR at the bridge location is **Twice Below the Average Rate – (LOW)**

5. Assess the risk of a vehicle leaving the road based on the sinuosity ranking / collision rate ranking

- As per **DN-REQ-03079, Table 5.1**, the risk of a vehicle leaving the road is **M (Medium)**

6. Assess the overall risk rating

- As per **DN-REQ-03079, Table 5.2**, the overall risk rating is **H (High)**

7. Undertake a site survey to confirm the need for a VRS

- A site survey was carried out. The existing parapet walls do not provide adequate containment and there is no existing VRS at this structure location.

From the results of the above assessment, a new VRS is required at the location of **Carrowrevagh Bridge and approach roads**.

2.5 VRS Design Process for Constrained Locations

2.5.1 Data Collection and Assessment

1. Apply the Principles of Forgiving Roadsides

The existing carriageway cross section cannot be modified, and the hazards cannot be removed or relocated.

- The existing wooden poles carrying the overhead services are located outside of the working width of the proposed VRS therefore it was deemed that they do not require relocation / replacement.
- The existing bridge structure including parapet walls and concrete fence posts are not being relocated as part of the proposed remedial works. The existing parapet walls are to be raised using masonry construction to a nominal 1.0m height.
- The existing watercourse cannot be realigned to outside of the Clear Zone.

2. Risk Assessment

A risk assessment has been carried out as outlined in Section 2.4 above.

3. VRS Condition Survey



There are no existing VRS at this bridge location.

2.5.2 VRS Preliminary Design Process

1. Development of Preferred VRS Design Options

As there is no existing VRS at this bridge location, the option of retaining the existing layout has been deemed unsatisfactory.

Due to the legacy hazards at this location, the preferred VRS layout consists of a barrier with a containment level of H2 (Refer to Section 2.6 below) to be installed in both verges. With the lack of a Hard Strips / Hard Shoulders on the carriageway, the setback from the existing carriageway edge will be 1.20m on the northern verge. Due to the proximity of the existing bridge parapet wall on the south side, the setback from the existing carriageway edge will be 1.0m on the southern verge.

The overall length of the VRS on the northern verge will be restricted by the junction between the field access / domestic access and the N59 NSR on the northeast side of the structure. This junction is approximately 23m east of the existing bridge and cannot be removed. There is no constraint to the VRS length on the northwest side of the structure.

The overall length of the VRS on the southern verge will be restricted by the junction between the Local Access Road and the N59 NSR on the southeast side of the structure. This junction is approximately 25m east of the existing bridge and cannot be removed.

The proximity of the existing field access 35m west of the bridge, which cannot be removed, will also restrict the overall length of the proposed VRS on the southwest side of the bridge. There is an existing field access gate immediately west of the southern parapet wall. Mayo County Council have agreed with the Landowner that this entrance gate will be closed and relocated to the Local Access Road east of the bridge.

There is an existing VRS on the southern verge east of the Local Access Road. With the constrained layout, the proposed VRS layout on the southern verge will be based on **Figures 3.13, Paragraph 3.26 VRS at Junctions, DN-REQ-03034**.

Appropriate End Terminals and Transitions will be included in the overall layout. The terminal on the southwestern end of the VRS will be flared away from the carriageway at a rate of 1:20 to maximise the sight distance from the existing field access.

The constraints described above will necessitate the Departures from Standards as described in Section 2.7 below.

2.5.3 VRS Preliminary Design Report (PDR)

A **VRS Preliminary Design Report** in accordance with **DN-REQ-03079 Design of Road Restraint Systems for Constrained Locations and Existing Structures – May 2024** (this report reference **0088572-DG-0057**) has been prepared for submission through the TII departures website.

Refer to Appendix A - Drawings

Refer to Appendix B – Containment (Record) Assessment Sheet

Refer to Appendix C – Risk Assessment Sheet for Vehicle Restraint Systems

Refer to Appendix D - Category B VRS Preliminary Design Report Template



2.6 TII Containment Level Assessment Procedure

As per the requirements of **Paragraph 3.11** and **Figure 3.4, DN-REQ-03034, Containment Level Assessment Procedure**, the Designer shall assess the minimum containment levels required at any specific location for VRS in the verges.

As per **Figure 3.4, DN-REQ-03034**, with an overall Hazard Risk Rating of **High** and a speed limit / operational speed of less than **85kph**, the provision of the Minimum Containment shall be as per **Table 3.6, DN-REQ-03034**.

Table 3.6, DN-REQ-03034, states that “At underbridges, underpasses or at retaining walls > 0.5m high supporting the road and a vehicle parapet or vehicle / pedestrian parapet of the required performance class is not provided”, a minimum **H2** Containment level shall be provided at **Carrowrevagh Bridge** and shall be based on the condition “For a minimum of 30m in advance of the approach end and 30m after the departure end of a vehicle parapet or vehicle/ pedestrian parapet.”

Based on current TII guidance documents, a **H2 Containment Level** Vehicle Restraint System (VRS) is required at **Carrowrevagh Bridge and approach roads**.

Refer to **Appendix B** for the **Containment (Record) Assessment Sheet**.

2.6.1 Recommendation

H2 Containment Level Road Safety Barriers with a setback of 1.20m (Northern Verge) and 1.00m (Southern Verge) from the carriageway edge will be provided with the Departures as outlined in Section 2.7 below.

2.7 Departures Required

Departure Nr.1 consists of reducing the overall length of the H2 VRS on the northeastern verge due to the proximity of the junction between the field access / domestic access and the N59 NSR on the eastern side of the structure. The length of the VRS on the northwestern side of the structure will be unaffected. The length of proposed barrier east of the bridge parapet will be 12m including an appropriate Terminal. The overall length of the VRS on the northern verge will be approximately 74.5m, including Terminals, and allowing for adequate sight distance from the junction between the field access / domestic access and the N59 NSR.

Departure Nr.2 consists of reducing the length of the H2 VRS on the southwest verge due to the proximity of the junction between the field access and the N59 NSR on the western side of the structure. The length of proposed barrier west of the bridge parapet will be 28m including an appropriate Terminal.

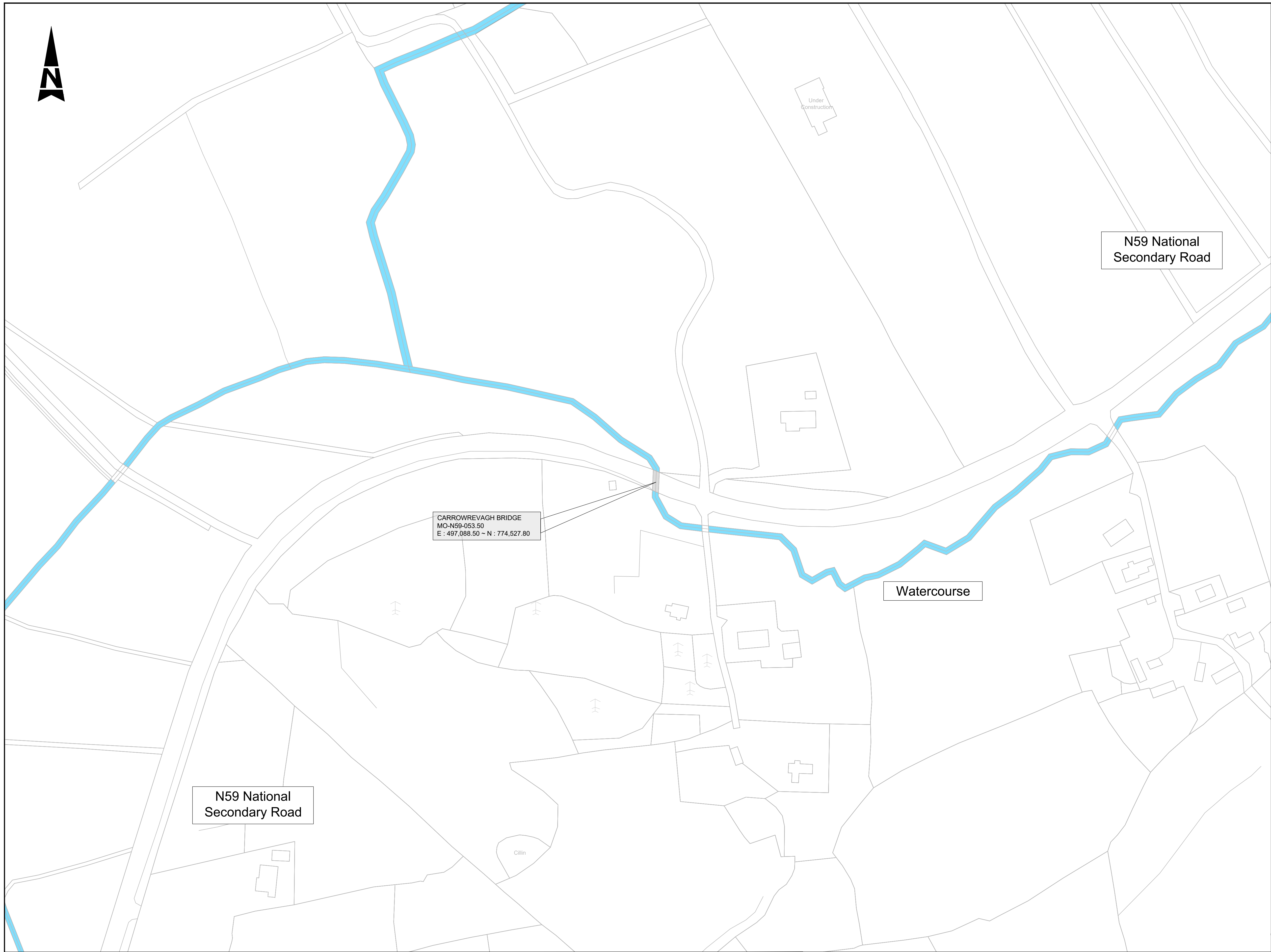
Departure Nr.3 consists of reducing the length of the H2 VRS on the southeast verge due to the proximity of the junction between the Local Access Road and the N59 NSR on the eastern side of the structure. The length of proposed barrier east of the bridge parapet will be 23m including an appropriate Terminal. The proposed layout for the VRS at this location will be based on **Figure 3.13, Paragraph 3.26, DN-REQ-03034** which will consist of the barrier curving at a radius of 20m southwards towards the Local Access Road. This will provide protection for the road user from the embankment sloping towards the watercourse. The existing VRS east of the Local Access Road will be utilised as the Shielding Barrier as suggested in Figure 3.13. The overall length of the VRS on the southern verge will be approximately 60.0m, including Terminals, and allowing for adequate sight distance from the junction between the Local Access Road / field access and the N59 NSR.

Refer to Appendix A for relevant drawings.

APPENDICES

Appendix A. Drawings





- ### GENERAL NOTES
1. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE
 2. ONLY WRITTEN DIMENSIONS SHALL BE USED. NO DIMENSIONS SHALL BE SCALED FROM THE DRAWINGS
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Purpose

ISSUED FOR INFORMATION

Carrowrevagh Bridge
MO-N59-053.50
Existing Site Location Plan

Original Scale		Drawn		Checked		Reviewed		Authorised	
1:1000		AOS		MG		CP		MJ	
Date 02.02.24		Date 02.02.24		Date 02.02.24		Date 02.02.24		Date 02.02.24	
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S2	0088572-ATK-XX-XX-DR-CE-900110							P0	

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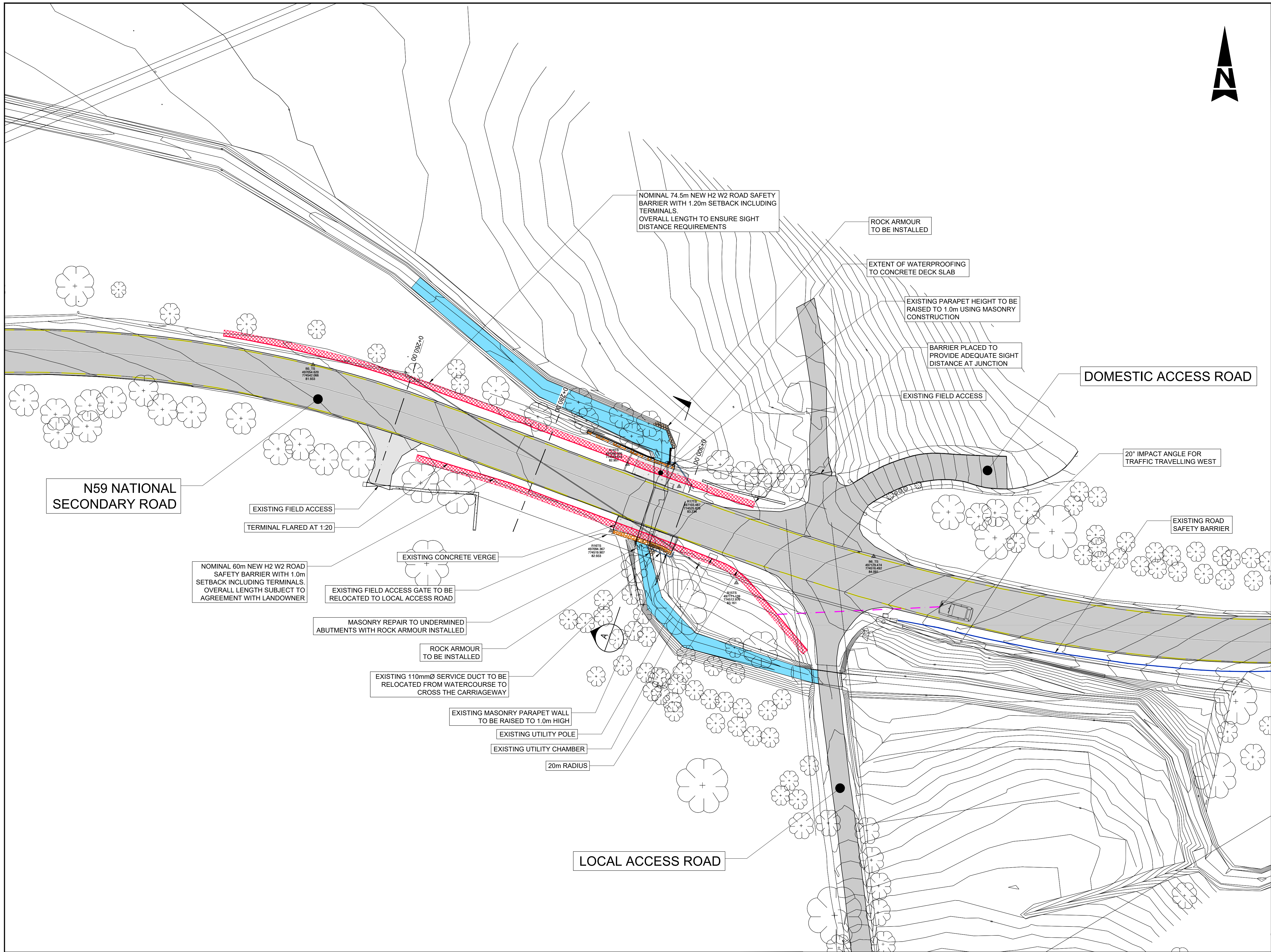
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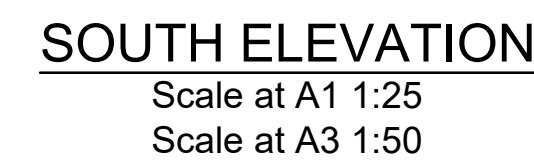
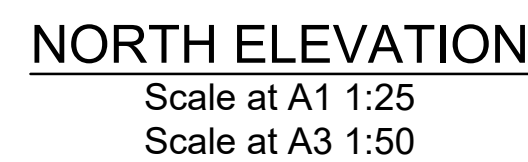
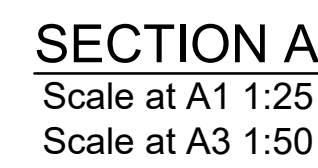
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Purpose		PRELIMINARY ISSUE			
Title		Carrowrevagh Bridge MO-N59-053.50 Proposed Site Layout Plan			
Original Scale	1:50				
	Drawn	AGL	Checked	MG	Reviewed
Status	S0		P03		
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Purpose		PRELIMINARY ISSUE					
Title		Carrowrevagh Bridge MO-N59-053.50 Longitudinal Section and Elevations					
Original Scale		Drawn	Checked	Reviewed	Authorised		
As Shown		AGL	MG	MJ	MM		
		Date 13.03.25	Date 13.03.25	Date 13.03.25	Date 08.03.24		
Status	Drawing Number					Rev	
S0	0088572-ATK-10-XX-DR-CE-900204					P02	

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P02	REVIEW COMMENTS INCORPORATED	AOS	05.25	MG	MJ	M.	
P01	REVIEW COMMENTS INCORPORATED	AOS	04.25	MG	MJ	M.	
P0	ISSUED FOR REVIEW	AGL	03.25	MG	MJ	M.	
Rev	Description	By	Date	Chk'd	Rev'd	Aut	

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Appendix B. Containment (Record) Assessment Sheet



Containment (Record) Assessment Sheet

Barrier Ref.	Design speed (km/h) *	AADT (HGV) *	Hazard description	Hazard Risk Ranking *	Lateral distance to hazard from edge of trafficked lane (m)	Required Clear Zone (m) **	Clear zone requirement satisfied up to (%)	Hazard Proximity Ranking *	Straight / Curved *	Inside or Outside of bend *	Curve radius (m)	Sinuosity Index (SI) ***	Sinuosity Ranking *	Proposed Containment Level	Comment
Northern Verge	80	3680 (80)	Wooden Poles or Posts with Cross Sectional Area > 25,000mm ² that do not have breakaway features	High	2.2m	6.1m	36%	Low	Straight	N/A	N/A	1.168289	High	H2	
Northern Verge	80	3680 (80)	Concrete posts with a cross sectional area > 15,000mm ²	High	2.7m	6.1m	44%	Low	Straight	N/A	N/A	1.168289	High	H2	
Northern Verge	80	3680 (80)	Water of likely depth >0.6m	High	3.0m	6.1m	49%	Low	Straight	N/A	N/A	1.168289	High	H2	
Northern Verge	80	3680 (80)	Bridge Parapets	High	2.7m	6.1m	44%	Low	Straight	N/A	N/A	1.168289	High	H2	
Northern Verge	80	3680 (80)	Under bridges or retaining walls >0.5m high supporting the road, where a vehicle parapet or vehicle / pedestrian parapet or the required performance class is not provided	High	2.7m	6.1m	44%	Low	Straight	N/A	N/A	1.168289	High	H2	

Barrier Ref.	Design speed (km/h) *	AADT (HGV) *	Hazard description	Hazard Risk Ranking *	Lateral distance to hazard from edge of trafficked lane (m)	Required Clear Zone (m) **	Clear zone requirement satisfied up to (%)	Hazard Proximity Ranking *	Straight / Curved *	Inside or Outside of bend *	Curve radius (m)	Sinuosity Index (SI) ***	Sinuosity Ranking *	Proposed Containment Level	Comment
Northern Verge	80	3680 (80)	Steep Embankment Slopes, steeper than 1 :2 and $\geq$ 1m height	High	2.7m	6.1m	44%	Low	Straight	N/A	N/A	1.168289	High	H2	
Northern Verge	80	3680 (80)	Substantial fixed objects eg walls extending above the ground by more than 150mm with projections or recesses $\leq$ 100mm and running parallel to the road	Low	2.7m	6.1m	44%	Low	Straight	N/A	N/A	1.168289	High	H2	
Southern Verge	80	3680 (80)	Wooden Poles or Posts with Cross Sectional Area > 25,000mm ² that do not have breakaway features	High	2.0m	6.1m	33%	Low	Straight	N/A	N/A	1.168289	High	H2	
Southern Verge	80	3680 (80)	Water of likely depth >0.6m	High	2.5m	6.1m	41%	Low	Straight	N/A	N/A	1.168289	High	H2	
Southern Verge	80	3680 (80)	Bridge Parapets	High	1.75m	6.1m	29%	High	Straight	N/A	N/A	1.168289	High	H2	

Barrier Ref.	Design speed (km/h) *	AADT (HGV) *	Hazard description	Hazard Risk Ranking *	Lateral distance to hazard from edge of trafficked lane (m)	Required Clear Zone (m) **	Clear zone requirement satisfied up to (%)	Hazard Proximity Ranking *	Straight / Curved *	Inside or Outside of bend *	Curve radius (m)	Sinuosity Index (SI) ***	Sinuosity Ranking *	Proposed Containment Level	Comment
Southern Verge	80	3680 (80)	Under bridges or retaining walls >0.5m high supporting the road, where a vehicle parapet or vehicle / pedestrian parapet or the required performance class is not provided	High	2.4m	6.1m	39%	Low	Straight	N/A	N/A	1.168289	High	H2	
Southern Verge	80	3680 (80)	Steep Embankment Slopes, steeper than 1 :2 and ≥ 1m height	High	2.7m	6.1m	44%	Low	Straight	N/A	N/A	1.168289	High	H2	
Southern Verge	80	3680 (80)	Substantial fixed objects eg walls extending above the ground by more than 150mm with projections or recesses ≤ 100mm and running parallel to the road	Low	1.75m	6.1m	29%	High	Straight	N/A	N/A	1.168289	High	H2	

** Denotes key steps/parameters in the containment level design process that may influence the final Increased Risk Factor.

** Required Clear Zone as per DN-GEO-03036.

*** As described in the Risk Assessment Procedure section of DN-REQ-03079

Appendix C. Risk Assessment Sheet for Vehicle Restraint Systems



 Risk Assessment Sheet for Vehicle Restraint Systems								Date: 30-04-2025		Completed By: Adrian O'Sullivan			
								Location ID/Description:		Carrowrevagh Bridge (MO-N59-053.50)			
								Site Survey Conducted (Y/N): Yes					
Hazard Type, Start and End Co-ordinates		Is Hazard within the Clear Zone? (Y/N)	Can the Hazard be Mitigated? (Y/N)	(1) Hazard Ranking	Sinuosity Index (SI)	(2) Sinuosity Ranking	(3a) Collision Rate Threshold	(3b) Collision Rate Ranking	(4) Risk of a Vehicle Leaving the Road	(5) Overall Risk Rating	Distance of Hazard (m)	VRS to be Installed (Y/N) Start and End Coordinates	Reasons for Installing / Not Installing the VRS
1	Wooden Poles or Posts with Cross Sectional Area > 25,000mm ² that do not have breakaway features	Y	N	High	1.1683	High	Twice Below Average Rate	Low	Medium	High	2.0 / 2.2m	Yes	The Installation of the VRS is required as there are no other viable means of protecting the road user from the identified hazard
2	Concrete posts with a cross-sectional area > 15,000mm ²	Y	N	High	1.1683	High	Twice Below Average Rate	Low	Medium	High	2.7m	Yes	The Installation of the VRS is required as there are no other viable means of protecting the road user from the identified hazard
3	Water of likely depth > 0.6m	Y	N	High	1.1683	High	Twice Below Average Rate	Low	Medium	High	2.5 / 3.0m	Yes	The Installation of the VRS is required as there are no other viable means of protecting the road user from the identified hazard

Hazard Type, Start and End Co-ordinates		Is Hazard within the Clear Zone? (Y/N)	Can the Hazard be Mitigated? (Y/N)	(1) Hazard Ranking	Sinuosity Index (SI)	(2) Sinuosity Ranking	(3a) Collision Rate Threshold	(3b) Collision Rate Ranking	(4) Risk of a Vehicle Leaving the Road	(5) Overall Risk Rating	Distance of Hazard (m)	VRS to be Installed (Y/N) Start and End Coordinates	Reasons for Installing / Not Installing the VRS
4	Bridge Parapets	Y	N	High	1.1683	High	Twice Below Average Rate	Low	Medium	High	1.75 / 2.7m	Yes	The Installation of the VRS is required as there are no other viable means of protecting the road user from the identified hazard
5	Under bridges or retaining walls >0.5m high supporting the road, where a vehicle parapet or vehicle / pedestrian parapet of the required performance class is not provided	Y	N	High	1.1683	High	Twice Below Average Rate	Low	Medium	High	2.4 / 2.7m	Yes	The Installation of the VRS is required as there are no other viable means of protecting the road user from the identified hazard

Hazard Type, Start and End Co-ordinates		Is Hazard within the Clear Zone? (Y/N)	Can the Hazard be Mitigated? (Y/N)	(1) Hazard Ranking	Sinuosity Index (SI)	(2) Sinuosity Ranking	(3a) Collision Rate Threshold	(3b) Collision Rate Ranking	(4) Risk of a Vehicle Leaving the Road	(5) Overall Risk Rating	Distance of Hazard (m)	VRS to be Installed (Y/N) Start and End Coordinates	Reasons for Installing / Not Installing the VRS
6	Steep Embankment Slopes, steeper than 1:2 ≥ 1m height	Y	N	High	1.1683	High	Twice Below Average Rate	Low	Medium	High	2.7m	Yes	The Installation of the VRS is required as there are no other viable means of protecting the road user from the identified hazard
7	Substantial fixed objects eg walls extending above the ground by more than 150mm with projections or recesses ≤ 100mm and running parallel to the road	Y	N	Low	1.1683	High	Twice Below Average Rate	Low	Medium	High	1.75 / 2.7m	Yes	The Installation of the VRS is required as there are no other viable means of protecting the road user from the identified hazard

L = Low, M = Medium, H = High

(1) Hazard Ranking as per Appendix C

High/Very High (H)
Medium (M)
Low (L)

(2) Sinuosity Ranking

High (H) > 1.02
Medium (M) = 1.004 ≤ SI ≤ 1.02
Low (L) < 1.004

(3a) Collision Rate Threshold

(1) Twice above Expected Rate
(2) Above Expected Rate
(3) Below Expected Rate
(4) Twice Below Expected Rate

(3b) Collision Rate Ranking

High (H) = Twice above Expected Rate
Medium (M) = Above Expected Rate
Low (L) = Below Expected Rate and Twice Below Expected Rate

(4) Risk of a Vehicle Leaving the Road		Collision Rate Ranking		
		H	M	L
Sinuosity Ranking	H	H	H	M
	M	H	M	L
	L	M	L	L

(5) Overall Risk Rating		Hazard Ranking		
		H	M	L
Risk of a Vehicle Leaving the Road	H	H	H	M
	M	H	M	L
	L	M	L	L

Appendix D. VRS PDR Summary



VRS ID / Location: Carrowrevagh Bridge (MO-N59-053.50)			VRS PDR Summary VRS at Structures	
Description: Under Task Order 315 Mayo Bridge Assessments and Strengthening 2023, Carrowrevagh Bridge requires remedial works to the structure. New VRS is required on both verges as part of these works. Length: The new VRS on the northern verge will measure approximately 74.5m including Transitions and Terminals. The new VRS on the southern verge will measure approximately 60m including Transitions and Terminals				

Consultation	Outcome
TII Bridge Management Section	The structure is included under the Task Order 315 Mayo Bridge Assessments and Strengthening 2023
Identify the Hazard(s)	Summary
Wooden poles or posts with Cross Sectional Area > 25,000mm ² that do not have breakaway features.	The existing Utility Poles are not being moved as part of the works at Carrowrevagh Bridge. The proposed VRS layout provides adequate Working Width to these features.
Concrete posts with Cross Sectional Area > 15,000mm ²	The existing concrete posts are not being moved as part of the works at Carrowrevagh Bridge. The proposed VRS layout provides adequate Working Width to these features.
Water of likely depth > 0.6m	The existing watercourse cannot be realigned.
Bridge Parapets	The existing bridge parapets are being raised to a nominal 1m high using masonry construction. The proposed VRS layout provides adequate Working Width to these features.
Under bridges or retaining walls >0.5m high supporting the road, where a vehicle parapet or vehicle / pedestrian parapet of the required performance class is not provided	The existing bridge is not being removed as part of the works at Carrowrevagh Bridge. The proposed VRS layout provides adequate Working Width to these features.
Steep Embankment Slopes, steeper than 1:2 ≥ 1m height	The existing side slopes at the northwest verge and the southeast verge are steep and lead to the existing watercourse. These gradient on these side slopes cannot be flattened. The proposed VRS layout provides adequate Working Width to these features.
Substantial fixed objects eg walls extending above the ground by more than 150mm with projections or recesses ≤ 100mm and running parallel to the road	The existing walls are not being removed as part of the works at Carrowrevagh Bridge. The proposed VRS layout provides adequate Working Width to these features.

Analysis	
Can mitigation measures be implemented (Yes/No)?	If “Yes” include proposals and projected life cycle costs
No	
Can the VRS be designed in accordance with DN-REQ-03034 (Yes/No)?	If “No” identify the constraints
No	The overall length of the H2 VRS on the northern verge is constrained due to the proximity of the junction between the field access / domestic access and the N59 NSR on the eastern side of the structure The overall length of the H2 VRS on the southern verge is constrained due to the proximity of the junction between the Local Access Road and the N59 NSR on the eastern side of the structure and the proximity of the field access and the N59 NSR on the western side of the structure. The layout on the southeastern verge will be based on Figure 3.13, Paragraph 3.26, DN-REQ-03034
Design Speed:	Road Cross Section & Traffic Volumes:
The posted speed limit is 80km/h. The operational speed limit as given by <i>CollisionRatesResults_2016to2018.KML</i>, which is derived from the TII National Transport Model (NTpM) is 84km/h	N59 National Secondary Road which is a Rural Two-Lane Carriageway of nominal 5.90m overall width at the bridge location. The carriageway consists of a westbound lane of 3.0m and an eastbound lane of 2.50m The Annual Average Daily Traffic (TMU N59 130.0 S 2024) is 3680 with 2.2% HCV (80). https://trafficdata.tii.ie/

Design Options Considered (Attach drawings as required)	Relaxations and Departures	Observations
Option 1		
Retaining the existing layout (ie no VRS) was deemed unsatisfactory and there are legacy hazards that require protection for the road users	N/A	N/A
Option 2		
The provision of a new VRS on the northern verge between the existing field access to the west and the crossroads junction between the Farm Access / Domestic Access and the N59 National Secondary Road will provide a level of protection to the road user from the hazards identified at Carrowrevagh Bridge that is not currently available. The provision of a new VRS on the southern verge between the existing field access to the west and the crossroads junction between the Local Access Road and the N59 National Secondary Road will provide a level of protection to the road user from the hazards identified at Carrowrevagh Bridge that is not currently available.	Departure Nr.1 consists of reducing the overall length of the H2 VRS on the northeastern verge due to the proximity of the junction between the field access / domestic access and the N59 NSR on the eastern side of the structure. The length of the VRS on the northwestern side of the structure will be unaffected. The length of proposed barrier east of the bridge parapet will be 12m including an appropriate Terminal. The overall length of the VRS on the northern verge will be approximately 74.5m, including Terminals, and allowing for adequate sight distance from the junction between the field access / domestic access and the N59 NSR. Departure Nr.2 consists of reducing the length of the H2 VRS on the southwest verge due to the proximity of the junction between the field access and the N59 NSR on the western side of the structure. The length of proposed barrier west of the bridge parapet will be 28m including an appropriate Terminal.	

	Departure Nr.3 consists of reducing the length of the H2 VRS on the southeast verge due to the proximity of the junction between the Local Access Road and the N59 NSR on the eastern side of the structure. The length of proposed barrier east of the bridge parapet will be 23m including an appropriate Terminal. The proposed layout for the VRS at this location will be based on Figure 3.13, Paragraph 3.26, DN-REQ-03034 which will consist of the barrier curving at a radius of 20m southwards towards the Local Access Road. This will provide protection for the road user from the embankment sloping towards the watercourse. The existing VRS west of the Local Access Road will be utilised as the Shielding Barrier as suggested in Figure 3.13. The overall length of the VRS on the southern verge will be approximately 60.0m, including Terminals, and allowing for adequate sight distance from the junction between the Local Access Road / field access and the N59 NSR.	
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Preferred Option	Reasoning	Whole Life Cycle Cost Analysis
Option 2	The proposed VRS installation has been deemed to provide the most feasible level of protection to the road user at this location, considering the existing hazards and the existing constraints.	N/A

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