Appendix A21.7
Cope Bridge - Architectural Heritage Impact Assessment

BLACKWOOD ASSOCIATES
ARCHITECTS
AND
BUILDING CONSERVATION CONSULTANTS
20, STEPHEN STREET LOWER, DUBLIN 2.
PH: (01) 478 4590 FAX: (01) 478 4561
email:studio@blackwood.ie

DART+ West

Proposed Works at Cope Bridge, Leixlip, Co. Kildare

Architectural Heritage Impact Assessment

June 2022

CONTENTS

1.0 INTRODUCTION

This report has been prepared by Blackwood Associates Architects to accompany the Railway Order application for the DART+ West project. The report will assess the impact of the proposed works on the existing structure and setting at Cope Bridge. The proposed works referred to in this document have been designed by IDOM, the design team lead, for the client, Iarnród Éireann.

2.0 DESCRIPTION OF STRUCTURE

Note: Much of the information below is based on the report provided by Rob Goodbody in the appendices to Chapter 21 – Architectural Heritage (Appendix A21.4 in Volume 4 of this EIAR)

Cope Bridge is a masonry road bridge dating from 1790 and spanning over the Royal Canal in Leixlip, Co. Kildare. The bridge is approximately 1.4km from the centre of Leixlip, accessed from the R149 (Captain's Hill). Immediately to the west of the bridge is Leixlip Confey Train station, built in 1990.

The bridge was extended in c.1846 to provide passage over the railway line, which was introduced alongside the canal at that time as part of the Great Western Railway. The railway line passes directly to the south of the canal. The roads on either side of the bridge are at slightly different angles to each other. The change in angle is corrected in the centre of the bridge, between both arches.

The older portion of the bridge spanning over the canal is identified by a lower elliptical or three-circle arch. The later extension of the bridge over the railway line is characterized by a similarly shaped arch but with its crown raised to accommodate trains passing below.

Figure 1 – East elevation of Cope Bridge showing both arches with the railway on the left hand side and canal on the right hand side.

The bridge is built of a mixture of rubble and squared limestone of varying sizes brought to courses in parts and laid randomly in others. It comprises two arches, one spanning over the canal and one over the railway line. When the bridge was extended over the railway the second arch was constructed with two engaged piers, one of which now sits centrally in the middle of the bridge. A continuous string course and parapet run across the bridge's hump-back shape. Decorative features include arch rings comprising voussoirs, chamfered on their outermost edges and a raised keystone, all in hammer dressed limestone.

Figure 2 – East elevation showing arch ring.

Figure 3 – Chamfer detail on arch voussoirs.

The bridge terminates at land to the north and south with wing walls that curve away from the bridge and slope down towards the canal. The north east wing is topped with rounded concrete flaunching. The north west wing wall does not have coping stones or concrete flaunchings, leaving the wall top open. It appears to have a recently constructed pier at its end. Wing walls to the south are capped with limestone copings, sloping steeply down on both sides. The south east wing is densely overgrown with vegetation.

Figure 4 – North east wing wall with concrete flaunching.

Figure 5 – North west wing wall with pier recently rebuilt. Note the wall is missing coping stones...

Figure 6 – Oblique view of east elevation.

Beneath the arch on the canal side, the abutments are constructed in limestone ashlar in even courses but of varying heights. The underside of the arch is constructed of slender courses of squared limestone, tying into quoins either side.

Figure 7 – Canal arch vault and south facing abutment of limestone ashlar.

Figure 8 – Railway arch and south facing abutment obscured by platform.

Beneath the arch on the railway side, the abutments are mostly concealed by the tail end of the station platform but visible masonry is of coursed squared limestone, to suit corresponding quoins. The underside of the arch is of smaller courses of the same, also tying in with quoins.

The spandrels of the canal arch are faced with squared limestone in slender courses. The spandrels of the railway arch and the engaged piers constructed with it, are in the same style being of random squared limestone.

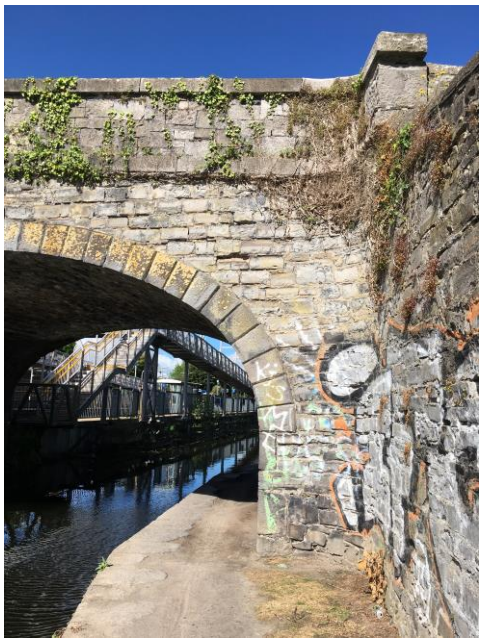

Figure 9 – East facing spandrel of the canal arch showing squared limestone laid in slender courses.

Figure 10 – West facing spandrel of the railway arch showing random squared limestone.

The parapet stonework is a similar style of random squared limestone across the full length of the bridge, demarcated with the continuous string course below. The parapet slopes continuously to the crown of the bridge, which is centred over the railway arch. The parapets are topped with dressed limestone copings on either side with overhanging outer edges. Parapets curve away from the bridge and end with a small pier, resting on the curved wing walls below.

Figure 11 – Random squared limestone parapet and stringcourse across full length of bridge.

On the bridge the deck rises towards the crown over the railway line. The roads leading to the bridge from the south are flanked by random rubble limestone walls topped with large limestone blocks on both sides. To the north of the bridge, once the parapets curve away in the direction of the wing walls below, there is a small clearing between the parapet and a separate free-standing length of wall topped with rounded concrete cappings, on the west side. On the east side, the wall directly abuts the parapet.

Figure 12 – Road leading to the bridge from the south. The wall flanking the road is visible on the left. The crown over the railway arch and the bridge parapet are visible on the right.

Figure 13 – View taken standing on crown of the bridge over the railway arch, looking north. Parapet over canal arch visible with gap between parapet and separate wall, in background.

The parapet wall also widens in depth on the north east side of the bridge. It is clearly visible in the coping stone from above, see Figure 14 below.

Figure 14 – View taken looking down on coping stones on Cope Bridge's north east parapet, showing the depth of the wall top extending into the bridge.

3.0 STATUTORY CONTEXT

Cope Bridge is not currently included in the National Inventory of Architectural Heritage (NIAH).

It is a proposed Protected Structure (Reference No. PPS 20) in the Draft Kildare County Development Plan 2023-2029. As such, it is afforded the same protections as a Protected Structure. A section of the Royal Canal is protected in the neighbouring Fingal County and is recorded in the current Development Plan.

A portion of Leixlip is designated an Architectural Conservation Area, but Cope Bridge is outside its boundary. This is also recorded in the Draft Kildare Development Plan 2023-2029.

Recorded Monuments nearby include Confey Church and graveyard approximately 0.5km north east.

4.0 HISTORY & DEVELOPMENT

Below is an extract taken from the conservation report provided by Rob Goodbody in the Appendix A21.4 to Chapter 21 – Architectural Heritage.

''Cope Bridge was constructed in 1794 to carry the local road between Leixlip and Confey. The bridge was named in honour of William Cope, who was a director of the Grand Canal Company in 1784-85 and of the Royal Canal Company from 1789 to 1802. He is thought to have been the instigator of the project to build the Royal Canal.

To the west of the bridge the canal bank curves to allow for a short length of broader canal to allow boats to pull in away from the main navigation channel. It is likely that this was provided as part of a project for cutting turf for transportation to markets along the canal. Cope Bridge was one of the locations where turf was saved for this purpose, part of an industry that grew up in various locations along the canal route.

With the coming of the Midland Great Western Railway a new bridge was required alongside Cope Bridge and was built in about 1846. In 1990 Leixlip Confey Station was opened on the western side of the railway bridge.''

Map Comparison
Cope Bridge as portrayed in available historic maps generally aligns with its construction date of c.1790 and its latter extension in c.1846 over the railway line. As noted in the extract above, the historic 6inch OS map (Figure 15) shows a wider bay in the canal just west of the bridge, presumably a set down area for canal traffic.

In this OS Map, the railway line has not yet been constructed. Two small structures are recorded where the current day Leixlip Confey Station sits.

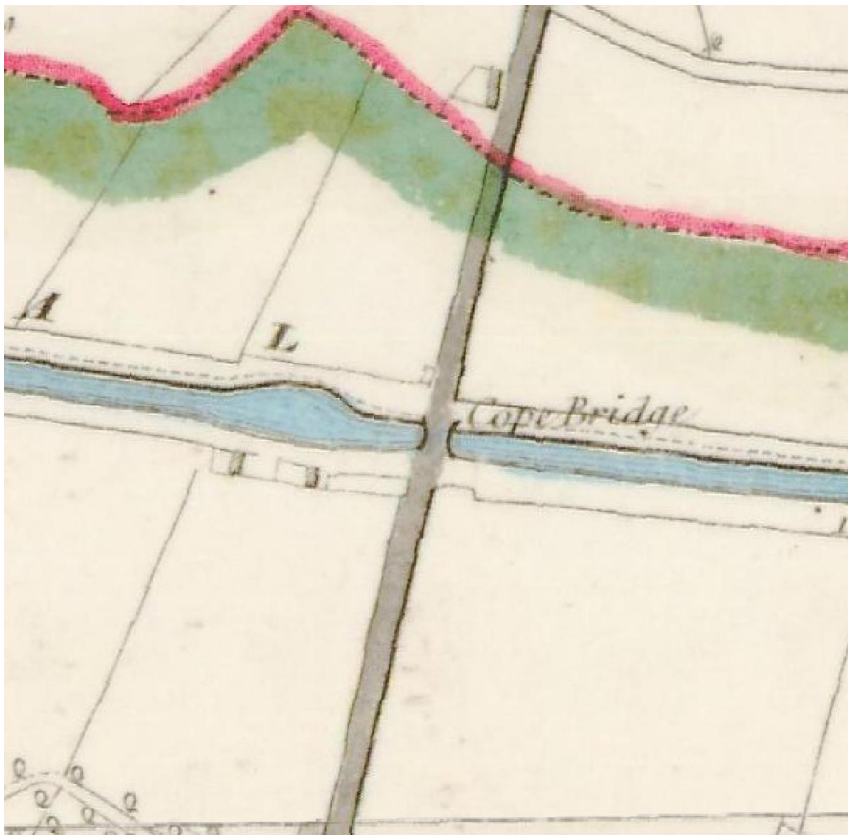

Figure 15 – Extract from 6inch OSI Map 1829 - 1841 showing the original Cope Bridge crossing the Royal Canal.

The 25inch OS Map (Figure 16) records the arrival of the railway line in Leixlip and also documents Cope Bridge in context in greater detail. The wider bay in the canal remains west of the bridge. The bridge is

clearly extended over the railway line, and a slight change in direction is shown on the extended portion to navigate the differing road angels either side of the bridge. Dotted lines to the north west of the bridge indicate an informal route from the road down to the level of the canal. The towpath along the south of the canal is also visible. Pedestrian access to the canal was maintained from the northern banks after the railway line was added.

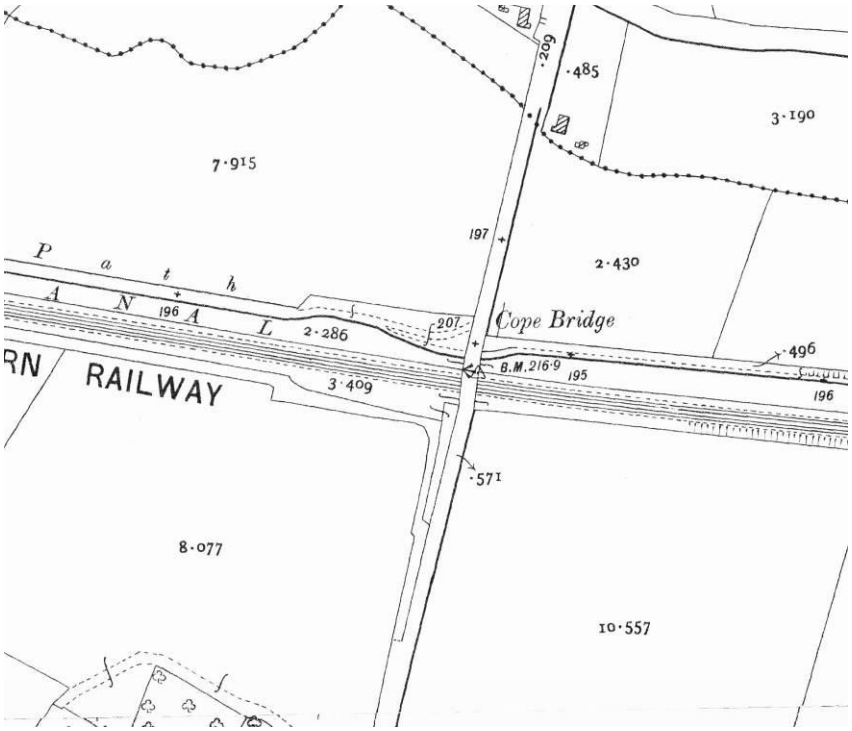

Figure 16 – Extract from 25inch OSI Map 1888-1913 showing the addition of the rail line and the extension to Cope Bridge.

Google satellite imagery from 2022 shows Cope Bridge as it is today with the train station to the west. The pedestrian access to the canal from the north is clearly visible.

Figure 17 – Screengrab taken from Google Satellite Imagery, 2022.

5.0 ASSESMENT OF SIGNIFICANCE

Statement of Significance

The categories of special interest which define a Protected Structure as per the Planning and Development Act 2000 (as amended) are Architectural, Historical, Archaeological, Artistic, Cultural, Scientific, Social or Technical. These categories are not mutually exclusive, and a structure may be attributed with several of the categories.

It is important to note that while the canal and railway bridges are individually a typology of their own, in this instance their compositions and significance must be read together due to their co-dependency and the fact that both are experienced as essentially one symbiotic bridge. This is due to the fact that the canal bridges in many cases were extended to span over the railway line which were constructed adjacent to the canal.

Cope Bridge is a proposed Protected Structure, but it is not recorded by the NIAH. Therefore, it has not been formally prescribed categories of special interest. However, the bridge carries significance for various reasons and we would categorise it as a structure of regional importance. We believe the following categories of special interest are applicable:

Historical
The bridge represents two significant periods in Ireland's transport and industrial heritage in the form of two distinct developments with the construction of The Royal Canal in the 1790s and The Great Western Railway in the 1840s. The fact that the railway line was added after the canal is also important as a layer of history of the overall composition of the bridge. In this, the twin form of Cope Bridge can be read as the embodiment of the period in the history of transport in Ireland, when the canals were superseded by the railways, but continued to function in parallel.

Architectural
Like other canal bridges of this typology, high quality stonework and simple decorative features in carved and dressed limestone contribute to the overall architectural expression of the bridge and testify to the skilled masonry craftsmanship employed in its construction. The bridge and the associated waterway infrastructure of the canal together are also a tribute to the level of technical expertise and engineering advancements, developed at that time.

Social
The bridges along the Royal Canal, including Cope Bridge, each carry social significance for a number of reasons. Bridges act as a connection point between areas previously separated and often provide a sense of identity and place for the people and communities around them. Both the canal and the railway line formed a manmade boundary where the bridges then provided essential connection points. This is especially true for pedestrian bridges as they are more directly experienced by people. Additionally, bridges often survive development around them over a long period of time, as standalone independent structures further reinforcing the sense of identity provided.

Today the bridges are important architecturally as standalone features, acting as nodes of identity along the canal which extends through many towns and communities into the midlands.
The canals and some railway lines around Ireland are now important places used for walking and cycling, especially in urban settings where outdoor recreational infrastructure is limited. The Royal Canal Way is one example on the Royal Canal. The canals are also popularised with barge boating culture and disused railway infrastructure has also been converted into greenways around Ireland.

Relatively few of the railway bridges remain unchanged today, further highlighting the bridge's importance as part of Ireland's industrial architectural heritage.

Taking the above into consideration and noting its status as a proposed Protected Structure, we recommend that Cope Bridge is entered into the NIAH.

6.0 OUTLINE CONDITION ASSESSMENT

Cope Bridge is generally in fair condition considering its proximity to the canal and road, but there are areas where repair works are required.

The stonework of the arches, buttresses and spandrels do not appear to have major structural issues. One of the voussoirs over the canal on the west side appears to have slipped slightly from its original position. No structural cracks were identified. The stonework on the face and the rising wall under the arches generally appears to be in good condition and has not suffered excessive weathering. There are small areas where sections of stone have broken away along weak seams but this is not widespread. The smaller stonework forming the arches is more weathered and there is evidence of consistent moisture penetration from the road deck above. There appears to be a number of phases of pointing on the bridge, some of which is likely to be an inappropriate cement mortar. This pointing has been washed out or fallen away in many areas, particularly beneath the arches and on the spandrels of the canal span.

Figure 18 – Condition of arch stonework.

Figure 19 – Pointing loss on spandrel.

There are three wing walls on the bridge and their condition varies. The wall to the north west is currently being repaired and the pier has been rebuilt at the end of the wall. There are no coping stones on this section of the wall and the core is exposed. The majority of the wall is covered in graffiti and there are small areas of vegetation growing from the joints. The stonework on the southwest wall appears to be sound and historic coping stones remain in place. These copings do not appear to be bedded properly and vegetation is growing over from the rear of the wall. The condition of the stonework on the north east is similar to the north west. There is significant graffiti and extensive vegetation growth at high level. The original copings have been lost and replaced with a concrete capping. The pier at the end of the wing wall appears to have lost some of its height, leaving loose stonework on top and the end of the concrete coping exposed. The walls have been repointed a number of times, some more successfully than others. This pointing is failing in localised areas.

Figure 20 – North West canal wing wall.

Figure 21 – North East wing wall.

Figure 22 – South East wing wall.

Figure 23 – Top of pier lost, exposing end of modern concrete copings on north west wing.

The parapet stonework appears to be sound but closer inspection reveals there may be some structural issues. The joints have been repointed in what appears to be a hard cement mortar. In a number of areas the mortar has broken away from one face which may suggest that there has been some movement in the stone. The north east corner of the parapet has recently been rebuilt but the quality of stonework and pointing is poor. It is difficult to get close to the external face of the parapets but from a distance they appear to be in fair condition. The coping stones appear to have been repositioned at some point. The copings on the west side do not extend as far as the internal face and the gap is filled with a mortar fillet. There are a number of areas of damage on the copings including hairline cracks and a large section of coping over the canal has been lost. Like the rest of the bridge the condition of the pointing varies but in some areas it is in a poor state.

Figure 24 – Mortar broken away from coping stone.

Figure 25 – Coping does not extend to internal face of wall.

Figure 26 – Recent repairs to north east corner.

Figure 27 – Lost section of coping stone over canal.

7.0 PROPOSED WORKS

As identified in the accompanying documentation, it is proposed to demolish the section of existing historic bridge over the railway line to allow for the electrification of the rail system. The existing bridge does not provide the clearance required to allow the Overhead Line Equipment (OHLE) to run under the bridge.

A number of approaches to provide the additional clearance required were considered. These included re-directing the tracks around the bridge, lowering the tracks and demolishing the railway side of the bridge to build a new bridge at a higher level. The evaluation process is detailed in EIAR Volume 4 Appendix A3.3 Option Selection for OHLE Intervention. On completion of this assessment the design team lead and client concluded that the demolition of the existing bridge and re-building at a higher level was the most suitable approach for the overall scheme.

The removal of this section of bridge over the tracks is an irreversible loss of important historic fabric and permanently alters the historic structure and surrounding setting. This section of the bridge has significant historic value, particularly as it was a carefully designed and built extension to the 1790's bridge over the canal. As such, it is very much an important layer of history. To mitigate the loss of the historic fabric as far as possible, the construction of the new bridge arch is being carefully considered. It is essential that the replacement section of bridge is well designed, detailed and executed. The most important consideration in the process is to ensure that the new build element sits comfortably alongside the remaining canal bridge. The stonework from the dismantled railway arch will also be salvaged and used for repairs where required.

Due to the significant raising of the bridge to accommodate the OHLE and the requirement to install a precast concrete arch, it is not possible or desirable to reconstruct the span to match the existing. Instead, a contemporary solution using modern materials is being designed to complement the proportions and style of the remaining canal bridge. The extent of demolition will be confined to the section of bridge between the stone piers to ensure that the reconstructed section will be read as an insertion rather than an entirely new bridge.

A number of finishes and construction methods were assessed during the design process. Initially the preferred option was to re-use the original facing stone but it became clear that this would not be successful due to the technical constraints of the new construction. The string course is an essential element of the existing composition but the increased height of the arch would distort its connection to the string over the canal. The precast arch construction would reduce the existing voussoirs to cladding stones and the facing stone of the spandrels would also become cladding stones tied back to the concrete structure behind. The combination of all these factors made it very difficult to design or build stonework that would sit well alongside the original fabric and there were concerns that it would very much read as modern stone cladding.

Figure 28 – Existing bridge with continuous string course over both arches highlighted.

The use of a weathered steel facade was also explored as this material would tie together the rebuilt bridge and new pedestrian bridges on each side. After careful assessment it was decided to proceed with a concrete structure as this has the potential to sit most comfortably with the remaining original stonework. It is proposed to use a board marked concrete finish on all faces and to select a concrete colour that best complements the original stonework.

Figure 29 - Example of a new board marked concrete insertion in an existing stone structure.

The colour and texture of the concrete finish, along with the quality of the detailing and workmanship is critical to its success. There are many examples of fine concrete work next to historic stonework across Europe, as identified in the image above. The design team is aware that Irish conditions are generally a lot damper than elsewhere, therefore the texture and finish of the concrete will be designed to minimise algae and vegetation growth. The texture created by the board will be controlled to ensure there are no large shelves for vegetation to take root and the surface finish will be carefully specified to limit the number of bugholes present on the finished concrete. It is proposed to use hand sawn boards to provide a finish that is not too uniform. Research into materials and sample panels will be essential prior to construction to ensure the new concrete finish complements the remaining historic stonework.

The form of the new arch and its relationship to the remaining canal arch is of critical importance. The design team have decided not to replicate the original arch exactly as the geometry of that shape would require the bridge to be raised even more than the current proposal. A slightly flatter arch provides the clearance required for both lines with less elevation.

The junctions between old and new will need to be carefully considered during detail design. The presence of the piers on either side of the arch allows the new build to be contained neatly at a natural break. These junctions will still need to be skilfully detailed and executed to ensure the concrete and stonework sit comfortably together. There will be a considerable amount of stone repair and repointing on the piers following the removal of concrete shuttering. These repairs will need to be carried out with great care by a skilled stonemason.

Figure 30 - Existing bridge with piers highlighted. Existing bridge to be removed between piers.

The new concrete parapets will extend up to the height of the original with the additional height provided by the contemporary design discussed below. The original parapet thickness will be carefully designed to ensure the new parapet sits in as neatly as possible with the original. The piers extend up through the parapet externally providing a natural break but there is no detail on the internal face. This creates a challenge that will need to be overcome with careful detailing and skilled craftspeople.

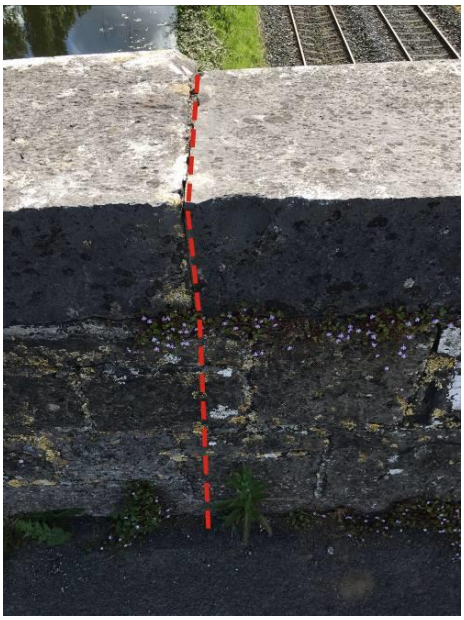

Figure 31 - Image of parapet internally with line highlighting where the junction with the new concrete parapet will be.

It is a safety requirement that the parapets are a minimum of 1800mm high, with the bottom 1200mm solid, in the area of the OHLE. This presents a significant challenge for Cope Bridge and all of the historic bridges along the line, as the existing original parapet heights are lower than 1200mm. A rigorous design process has taken place to identify a solution that will complement the historic setting and maintain a visual connection to the rail lines and surrounding landscape, when on the bridge. It is also essential that the parapet is not the dominant feature while viewing the bridge from the canal. The proposed design is a contemporary, adaptable solution that can be implemented throughout, bringing a degree of uniformity to all interventions along the railway. An alternative option with the extended parapet structure fixed on top of the coping was also assessed. Due to wind loads and the uncertain structural integrity of the parapets a considerable amount of damage to the original fabric would be required to anchor the new structure through the existing parapet to new concrete pads below.

For Cope Bridge it is proposed to provide a solid metal panel from the top of the parapet up to 1200mm with an expanded metal mesh to continue up to 1800mm. The vertical supports and mesh will be carefully designed to ensure the internal face of the parapet is not obscured and that the mesh allows a good visual connection to the surroundings.

Figure 32 – Render of design proposal to increase the parapet height to 1800mm with mesh about 1200mm.

Repair works will be required to the existing parapet before the proposed heightening works can take place. It is anticipated that some re-bedding of stonework will be required when the existing footpath is

removed. There may also be considerable work required to the top of the parapets to ensure the stability of the facing stone and copings. This stone must be carefully dismantled, cleaned down and re-bedded in a suitable lime mortar. All joints will need to be examined and raked out where the existing mortar is lost or failing. Joints will need to be repointed in a suitable lime mortar and protected until satisfactorily carbonated. These works must be carried out by a skilled mason with extensive experience with historic stonework.

Figure 33 – Stonework and pointing on parapet to be repaired.

Cope Bridge is currently a single lane bridge with a footpath on the east side. During discussions with Kildare County Council it was agreed to provide extra carriage width to allow two lanes of traffic, along with a footpath and cycleway. A number of options were examined including demolition of the parapets to allow for the widening of the existing bridge deck, a new parallel road bridge with the existing bridge used for pedestrians and cyclists, and a new pedestrian bridge with the existing bridge retained for road traffic. It was established that there was just enough room to have two lanes of traffic on the existing bridge so it was agreed to retain this bridge for road traffic and provide a new route for the pedestrians and cyclists. It is a requirement of Kildare County Council that pedestrian and cycle routes are provided on both sides of the road. This means that a new bridge is required on both sides.

The proposed bridges are separated from the historic bridge on both sides by 2 metres. This separation is limited by the proximity of the pedestrian bridge in the station that Irish Rail do not want to relocate. Alternative routes for the bridges were assessed but it was determined that it is most beneficial to the community to keep the bridges parallel to the road bridge and remove the temptation to walk or cycle on the narrow roadway.

Figure 34 – Proposed east elevation showing new pedestrian bridge and new concrete face over railway behind.

The new bridges have been designed in a contemporary style using modern materials. This contrasts with the original stone bridge but the aim is for the new bridges to sit comfortably in the historic setting. It is essential that the footbridges are as elegant and light as possible, so the bridge deck is designed to be as shallow as possible to facilitate this. The height requirement for parapets remains at 1800mm over the OHLE but it is proposed to reduce this height along the rest of the bridge to lessen the overall impact of the parapets. The parapet style will be in keeping with the new parapets on the historic bridge with regular vertical elements supporting the parapet screen. These vertical elements will be closer together on the new bridges to reduce the requirement for mesh parapets away from the OHLE.

It is proposed to use a weathered steel for the two new bridges. This will contrast with the concrete and stone of the road bridge but it should be a complementary material if it is detailed and constructed skilfully. The final design of the abutments will be critical to the overall success of the project. The abutments need to be as unobtrusive as possible and screened to reduce their impact on the canal and historic bridge.

The connections to the canal will be altered by the installation of the new pedestrian bridges and provision of a cycleway under the road. The route down to the canal will be extended on both sides of the bridge but the gradients will be much more accessible than the existing.

Figure 35 – Overview render of Cope Bridge with new pedestrian and cycle bridges on each side.

8.0 ARCHITECTURAL HERITAGE IMPACT ASSESSMENT

Proposed Alteration	Negative Impact	Neutral Impact	Positive Impact	Mitigating Measures
Demolition of the section of original bridge over the railway line.	Loss of important historic fabric. Partial loss of one of the few remaining original canal and railway bridges in the area. Alters the historic setting.		Allows for the train system to be electrified.	The demolition will be contained between the stone piers on each side to minimise the loss of historic fabric. A carefully designed replacement section of bridge will be constructed to sit in harmony with the original fabric on each side. The stonework will be carefully dismantled and used for repairs on the historic bridges where necessary.
Removal of original parapets from the section of bridge being removed.	Loss of important historic fabric. Removes the only visible connection to the historic bridge when crossing over.		Allows for the train system to be electrified.	The replacement parapets will be reinstated to the original level. The additional required height will be provided with a modern parapet detail. The parapets will be carefully designed to ensure they connect neatly to the remaining historic parapets on each side.
Construction of the new bridge section over the railway line.	The use of a precast concrete will create a construction joint under the bridge between the arch and board marked concrete face. The concrete arch will read differently to the shuttered concrete on completion.		Concrete colour and texture will be designed to be compatible with the surrounding historic stonework. The junctions between the concrete and original stone will be carefully detailed to ensure the two phases of construction sit comfortably together.	The cast in-situ concrete will be carefully designed to ensure the precast arch is not visible while viewing the original structure in elevation. The surface finish of the concrete will be carefully considered to limit the vegetation growth as much as possible.

Proposed Alteration	Negative Impact	Neutral Impact	Positive Impact	Mitigating Measures
Increase of parapet height.	Obscures the original design intent of the existing parapets to some degree on the internal faces. Visual connection to the top of the coping stones will be lost on internal faces. The connection to the surrounding setting is compromised by increasing the parapet height to 1800mm.		Allows for the train system to be electrified. This approach allows the original parapets to be retained on each side of the rebuilt section.	The new parapet will be carefully designed to minimise the impact on the remaining historic parapets. Fixings into the historic parapets will be minimised and will be installed in joints where required. The majority of the structural load will be transferred to the deck, decreasing the impact on the parapets. The metal mesh will be carefully selected to ensure the visual connection to the surrounding landscape is maintained as much as possible. The parapet supports will be designed to be as slender and elegant as possible to reduce the visual impact on the parapets.
Construction of new pedestrian and cycleway bridges on each side of the original bridge.	Alters the original setting of the historic bridges. The two metre gap between the new and existing bridges is not optimal and it would have benefited from a wider separation. Providing a bridge on both sides prevents the original bridge from being properly viewed from either side. The buttresses may become a dominant feature depending on their final design.		The construction of the pedestrian and cycleway routes allows the original canal bridge to continue to be used as a road bridge. The approach chosen to provide the additional carriage width ensures the original canal bridge remains relatively unaltered.	The new bridges will be designed to appear as light as possible to reduce the visual impact on the original bridge. The proposed design of the new bridges allows the depth of the deck to be kept to a minimum. The detailing of the weathered steel parapets will be carefully considered to ensure an elegant finish on completion. The buttresses will be screened with planting where possible to reduce their impact on the setting.

Proposed Alteration	Negative Impact	Neutral Impact	Positive Impact	Mitigating Measures
Connections to canal walkways and proposed cycle path.	The length of the route from the road down to the canal has been extended.		The gradients on the route to the canal will be improved, making it more accessible for people with impaired mobility, buggies etc.	

9.0 CONCLUSION

The demolition and replacement of the span of Cope Bridge over the railway line is a very significant loss of important historic fabric. This will have a considerable and irreversible impact on the character of the setting, the surrounding environment and the remaining canal bridge, dating from 1794. From a conservation perspective it would be preferable to incorporate the welcomed new infrastructure into the existing setting, while retaining this important historic structure. As identified in Appendix A3.3 Option Selection for OHLE Intervention in Volume 4 of the EIAR, the bridge can be retained, but due to significant financial and programme reasons, removal and replacement has been chosen as the preferred option.

By raising the railway arch, the connection between this and the canal arch is fundamentally altered, so constructing a stone facade on the new bridge section is not considered appropriate. After carefully assessing the alternatives, it was concluded that a contemporary concrete structure would sit most comfortably with the remaining historic stonework. Considerable effort will be required during detail design and construction to ensure the colour and texture of the concrete complement the existing stonework. Careful detailing and execution at the junctions will also be fundamental but these are all achievable and should lead to a successful outcome. Containing the re-build between the piers on each side is positive and will allow the new section of bridge to be read as an insertion into the original rather than a new bridge.

The proposed parapet heightening design provides a flexible solution that can be adapted to each historic bridge along the length of the Dart+ West project. Raising the parapet is a fundamental safety requirement when installing OHLE, so the proposal needs to incorporate these essential requirements. The use of an expanded metal mesh above 1200mm ensures that a visual connection to the surroundings is maintained while on the bridge. The positioning of the new parapet on the internal face also ensures that it reads as a secondary element when viewing the external faces of the bridge. Unfortunately, the raised parapet will obscure the top of the existing coping stones internally, but it is an essential safety requirement to remove any ledges that could be used to climb up on the parapet.

It is unfortunate that site constraints dictate that there is only a two metre separation between the new bridges and the existing, as a greater separation would have lessened the impact on the original structure. From a conservation perspective it would also have been preferable to have a single new cycle and pedestrian bridge so that the original form of the historic bridge could have been read from one side in its entirety.

The new parallel bridges do provide considerable benefits to the original bridge, primarily allowing it to be retained as a road bridge and reverting back to a two lane carriageway without the loss of original features. A heavy road bridge next to this historic structure would have had a detrimental effect on the setting. The materiality, proportions and form complement the original bridge while maintaining as much visual connection as possible considering the existing constraints. The ultimate success of these structures will be determined by the quality of design, detailing and materials specified along with precise fabrication and installation. The well-considered proposal and existing design team should ensure that the bridges are well designed and executed.

It is clear from a conservation perspective that the demolition of the section of bridge over the railway is a major loss to the overall structure and surrounding setting. However, the proposal to reconstruct the arch with a carefully designed and detailed concrete finish should sit comfortably with the remaining canal bridge and reflect a high quality contemporary design. The required conservation and repair works to the existing fabric should also be incorporated into any future works on the bridge. The electrification of the rail network is to be welcomed and the additional carriage width provided by the new bridges and provision for a cycle route along the canal ensures that this upgraded infrastructure will benefit the local community.