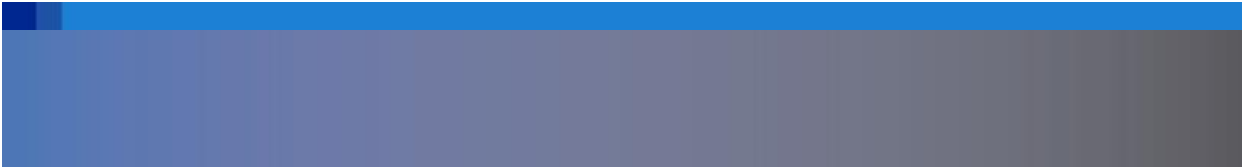


Design Summary Document App D-000001 - Overbridge Options Report



P e l l F r i s c h m a n n

Barnham Eastergate Westergate

Options Report

New Bridge Over Existing Railway

Date: January 2022

Report Ref: 13394-PEF-XX-BR-RP-S-000001

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Executive Summary

Pell Frischmann has been commissioned by CC Projects, Ashmarden Ltd and Hanbury (PM) Ltd (promoting the site together as 'The Southern Consortium') to provide transport planning and highways consultancy services in connection with emerging masterplan proposals for a strategic residential-led mixed use development on land forming part of the site allocation at Barnham/ Eastergate/ Westergate, (BEW), West Sussex. The application site comprises land south of Barnham Road and north of the railway as well as the route of the A29 realignment including the early connection referred to as the Hanbury Link (the 'Site'). The development is referred to as BEW Parcel SC1.

The purpose of this report is to identify and assess the buildability of the most suitable structural arrangement, for the new bridge over the railway. The most suitable option can be taken forward to preliminary design and Approval in Principle (AIP) stages.

The proposed structure will carry the realigned A29 carriageway and will be aligned approximately north south, spanning perpendicular to the existing railway.

A key design requirement is to provide a headroom clearance above the existing railway. Currently this has been agreed to be 5.8m with Network Rail. This can be achieved through provision of an appropriate vertical highway alignment and optimal structural bridge proposal.

From this study, two proposals have been identified as viable options:

- Option 1: Single span prestressed precast concrete girder bridge
- Option 2: Single span multi-girder steel composite bridge

Option 1 is the preferred solution, primarily owing to reduced capital and operational costs.

1 Introduction

1.1 Scope

Pell Frischmann (PF) has been appointed by CC Projects, Ashmarden Ltd and Hanbury (PM) Ltd to develop a feasibility study for a new bridge over the railway as part of A29 realignment.

The structure will carry the new realigned A29 over the existing West Coastway railway line between Woodgate and Barnham at the OS Grid Reference 494797E 104338N (see Figure 1).

Outline planning permission (with all matters reserved except for the A29 realignment) for the demolition of existing structures and mixed use development to provide residential dwellings (Use Class C3), care home/senior living accommodation (Use Classes C2/C3), flexible retail and community floorspace (Use Classes E/F2/sui generis), a primary school, plus associated open space, landscaping, drainage and all other associated ancillary works; and realignment of the A29 and early connection to existing A29, including construction of a new road carriageway, junctions and associated infrastructure.

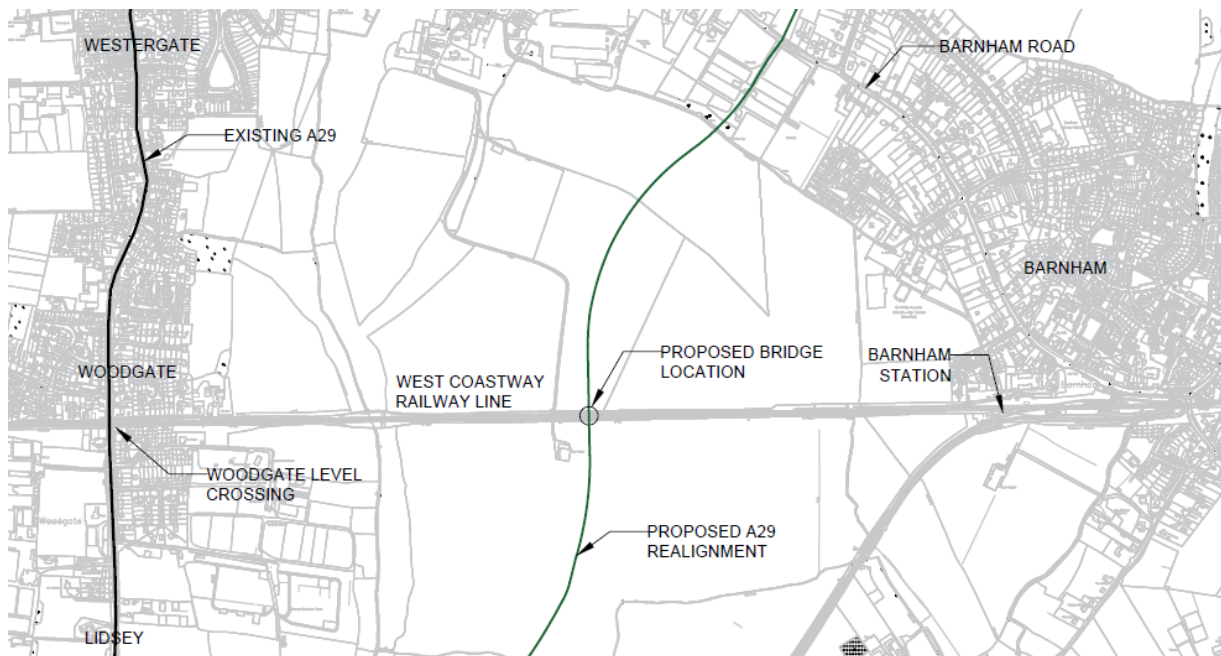


Figure 1 – Location Plan

1.2 Purpose

The purpose of this report is to identify and assess the buildability of the different structural arrangements that are deemed suitable for the new bridge over the railway. In doing so, the most suitable option can be taken forward to Approval in Principle (AIP) development and preliminary design.

Network Rail (NR) have been engaged during the feasibility study to confirm their requirements for the new overbridge.

1.3 Existing Site

The existing site comprises mainly open fields with no previous land developments (see Figure 2). There is a two-track railway line that passes through the development site between Woodgate and Barnham and is part of the West Coastway Line. The Engineers Line Reference (ELR) is TBH2 and the proposed location of the new overbridge is approximately at track mileage 23m 00ch. The closest station is at Barnham (track mileage 22m 29ch). There is also a private level crossing (see Figure 2 and Figure 3) approximately 140m to the west of the proposed overbridge, at track mileage 23m 07ch, that gives access to an abandoned building.



Figure 2 – Existing site – South of private level crossing looking East over railway

The existing two-track railway at the proposed bridge location is located in a shallow cutting on a straight alignment, with cutting slopes either side of the track (see Figure 3).

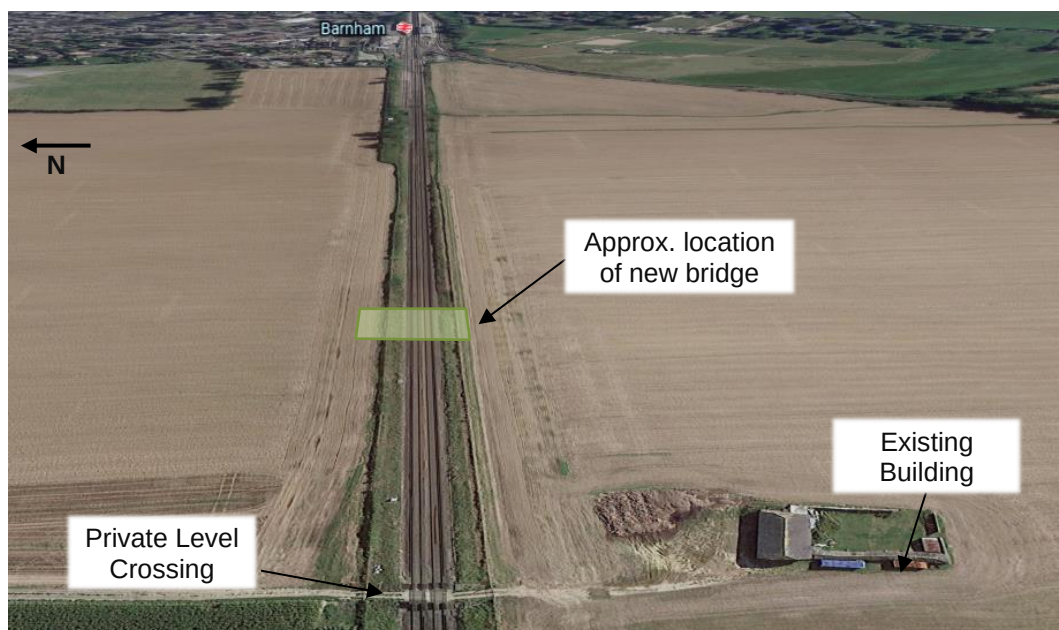


Figure 3 – Railway Aerial photo, looking East towards Barnham, Google Earth

2 Design Considerations

2.1 Design Requirements

Highway Cross Section

The proposed highway cross-section comprises a 4m segregated footway/cycleway and a 0.5m verge adjacent to the carriageway over the structure. The width of the single lane carriage way is 7.3m (3.65m each lane) as shown below in Figure 4.

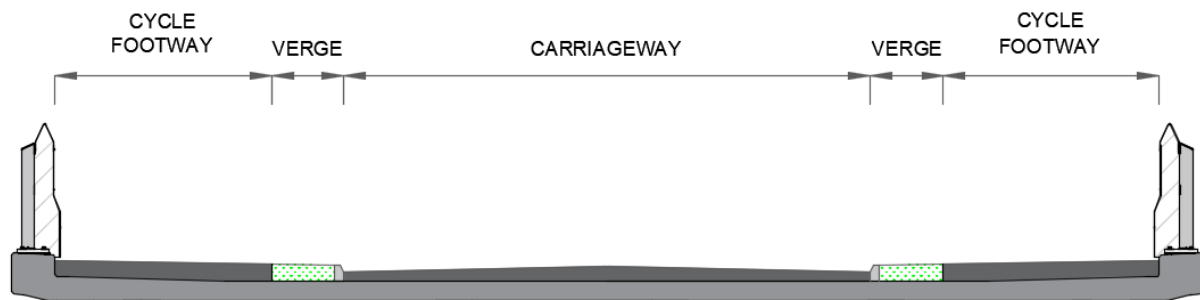


Figure 4 – Highway Cross Section

Vehicle Restraint System

In accordance with CD 377 'Requirements for Road Restraint Systems', a H4a containment level vehicle parapet shall be provided over the railway. Safety barriers shall be provided on both sides of the vehicle parapet approaches. The vehicle parapet height shall be 1.8m on both east and west sides. The H4a parapet will provide a restraint system for the pedestrians and cycleway users over the railway line. Beyond the extents of the bridge a N2 restraint system will be required with a minimum height of 1.5m to ensure pedestrian and cyclist safety.

Future Maintenance and Inspections

The future maintenance of the structure will be considered as part of this optioneering report.

- Safe access to the structure for maintenance and inspection purposes is to be provided. Provision includes a 5m wide maintenance lane to be considered alongside each embankment providing access to the substructure and deck soffit and a parking area at the end of each maintenance lane.
- Routine inspections and maintenance works can be undertaken from the proposed 3m wide pedestrian access route between the Network Rail boundary fence and abutments. Requirements for possessions to undertake maintenance will depend on the nature of the proposed works and may be subject to Network Rail approval.
- Integral abutments shall be proposed where appropriate. This will eliminate the need for bearings and expansion joints and the associated cost, health and safety risks and impact to stakeholders and the public.

2.2 Design Constraints

Topography

A topographical survey has been carried out. The top rail levels are to be confirmed at detailed design stage.

The existing topography is level and open with no previous land developments in the surrounding areas. In order to provide a crossing over the existing railway, embankments will need to be provided on the approaches, with the height determined based on Network Rail requirement for the minimum headroom to the bridge soffit (see additional information below).

Existing Railway

The existing railway comprises two non-electrified tracks and is part of the West Coastway Railway Line, ELR TBH2. The proposed overbridge is located between Barnham and Woodgate at approximately mileage 23 and will cross perpendicularly the railway. There is a private level crossing to the West side of the proposed overbridge location that provides access to a farm outbuilding.

Network Rail property is defined by a boundary fence installed along the railway approximately 7.2m away from the outermost running rail on both sides of the line.

A 1960's survey provided by NR shows catch pits at the South and along the railway within NR boundary fence (see Figure 5).

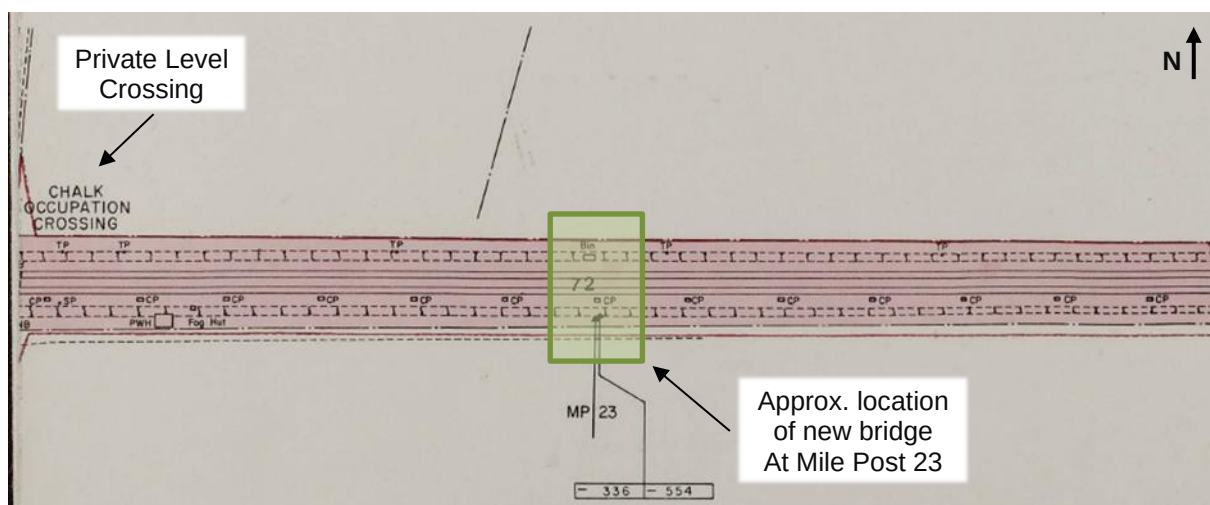


Figure 5 – 1960 Network Rail survey

No other assets, e.g. culverts, are listed in NR database in the immediate surroundings.

Headroom

The minimum headroom clearance as identified through initial discussions with Network Rail shall be 5.8m. This clearance is defined as the distance between the top of the running rail and the soffit of the structure as shown in Figure 6. This clearance allows for passive provision for OLE (Overhead Line Equipment) if required in the future.

Span

The proposed bridge is required to span the existing railway line and a specified 4m pedestrian/cycle access route on both sides beyond the existing boundary fence. A clear span

of 28.1m between supports (piers or abutments) will be required, as shown in Figure 6 below. Initial discussions with NR have indicated that this would be acceptable.

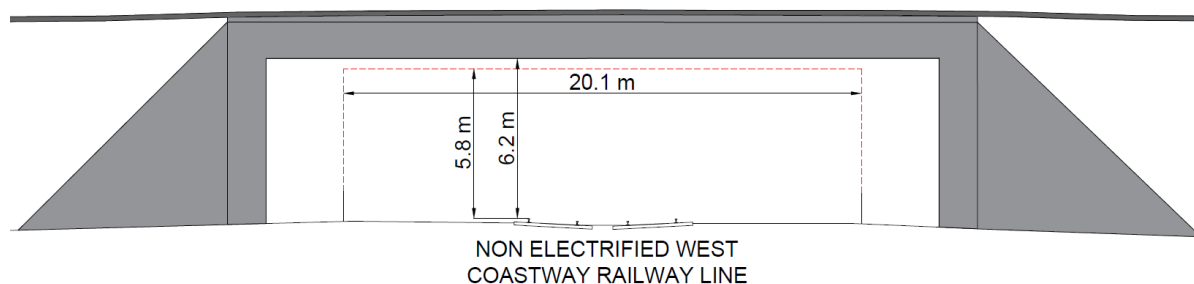


Figure 6 – Railway Headroom and Span Requirements

Utilities

Many service providers use the Network Rail lines to install cabling and services to reach different areas. From the Utilities Constraint Report (A13394-VAA – USR-001), it was noted that there are Virgin Media, Vodafone and Instalcom lines along the railway.

Network Rail mapping system showed Virgin Media, Vodafone, Network Rail electric cables and historic cable routes withing NR boundary fence. No buried services were shown immediately outside the boundary fence.

To eliminate and mitigate the risk of damage and disruption to any services, it is recommended that appropriate surveys and enquiries are undertaken during the preliminary design stage to the area outside NR boundary fence where the substructure is proposed to be located.

Geotechnical

A Geotechnical and Geo-Environmental Desk Study (A13394-PF-C-ZZ-XX-RPT-0001) was carried out by Pell Frischmann. General ground conditions based on available published information are summarised below:

Table 1 – Ground Stratigraphic Profile

Strata	Top of stratum (m below ground level)	Thickness (m)
Topsoil	0.00	0.45
Alluvium / River Terrace Deposits	0.45	2.55
London Clay	3.00	Not proven (>2.00)

- Groundwater estimated depth is between 0.6m and 1.6m below ground level.
- Medium risk to UXO if deep excavations are required.
- Low to moderate risk associated with metal, metalloids and other inorganic contaminants

- Low to moderate risk associated with organic contaminants such as PAHs due to historical agriculture use.
- Moderate risk associated with asbestos fibres associated with the railway line and sewage works in the vicinity of the site.

At this stage of the design process, it is anticipated that piled foundations will be required. To further establish ground conditions, an appropriate ground investigation will need to be undertaken during preliminary design. This would include boreholes with associated in situ and laboratory testing in order to determine the strata and parameters for the design, undertake a quantitative assessment for ground contamination and undertake groundwater testing to characterise its aggressivity. Where deep excavations/works are expected a detailed UXO survey will be carried out. A Geotechnical Design Report will need to be subsequently produced as part of the Technical Approval requirements.

2.3 Environment and Sustainability

An Arboricultural assessment has been undertaken to evaluate the overall condition of the trees on and adjacent to the site. An ecologic study to record the key habitat types on site, assess the potential for these habitats to support protected or notable species and determine key ecological constraints related to the proposed development will be undertaken as part of the wider project, as the scheme progresses.

The use of steel and concrete cannot be avoided in the construction of the works. Their impact on sustainability can be managed through appropriate attention to design, specification, procurement and construction, taking a balanced approach to environmental and socio-economic issues.

The design can be optimised to reduce the use of materials, waste and costs at the construction stage and during the structure service life. Some considerations are given below:

- Ensuring optimal span requirements with consideration to the required lengths of approach embankments.
- Provision of a suitable headroom clearance and appropriate tolerances minimising height of abutments and approach embankments.
- Providing cycleways/footways and green spaces to promote and encourage the community to use alternative and cleaner ways of transport.
- Specifying more sustainable materials (e.g: use of weathering steel where appropriate).

In accordance with best practice guidelines, integral abutments shall be considered. This eliminates the need for bridge deck expansion joints and bearings therefore avoiding associated impact of maintaining these elements.

2.4 Further Site Investigations

To inform the design in the next stages it is recommended to carry out the following site investigation:

- Topographical Survey to confirm the rail levels.
- GPR survey to the area outside NR boundary fence where the substructure is proposed to be located in order to confirm the existence or not of any services.

- Ground investigations, including boreholes with associated in situ and lab testing in order to determine the strata and parameters for the design. Undertake a quantitative assessment for ground contamination and undertake groundwater testing to characterise its aggressivity.
- Detailed UXO survey as it is expected the bridge to have deep foundations.
- Ecological Survey to identify protected habitats and species.

The need to undertake the above or any other additional investigations should be re-evaluated during preliminary design

3 Bridge Options

3.1 Span Arrangements

Both a 3-span and single span arrangement are considered feasible to carry the new road over the existing railway and pedestrian route.

3 Span Arrangement

A 3-span option with open side spans would provide an aesthetically pleasing arrangement. With clear and open sight lines through the structure, a more pleasing user experience would be provided to the users of the proposed pedestrian access beneath the bridge.

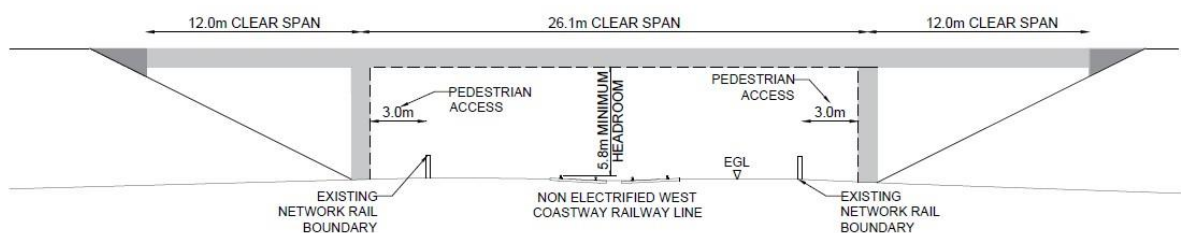


Figure 7: 3 Span Arrangement

The option would require a total of an additional 24m length of deck over the side spans to give an overall length of 50.1m. Although cost savings result from less fill material for the approach embankment, the additional length of bridge deck required for a relatively wide bridge (with a cross section of 18.5m) would outweigh these cost savings.

Careful consideration will also need to be given to the deck construction. Were the deck to comprise precast prestressed concrete beams, these are likely to involve separate beams for each span, simply supported on bearings. An alternative deck would comprise steel composite deck with girders spanning continuously over the piers. For ease of transportation, the steel girders would need to be transported to site in lengths of up to 30m, then spliced together post installation. For both deck types, installation of the beams or girders for the central span would need to be undertaken during possession of the railway. For the side spans, the need for possessions or appropriate measures will need to be discussed and agreed with Network Rail.

Single Span Arrangement

A single span arrangement would require full height abutments without side spans creating a more enclosed structure from the perspective of the pedestrians.

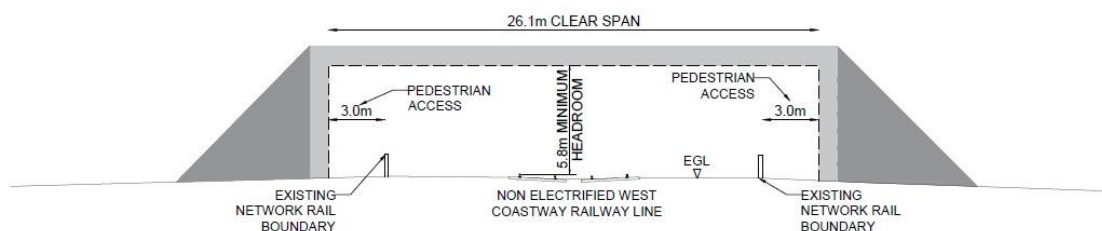


Figure 8: Single Span Arrangement

This option consists of a shorter length of deck supported on full height abutments with reinforced concrete wing walls, providing a more economical solution to the 3-span option. Both precast concrete and steel composite decks would be appropriate and allow for simple installation and construction during possession of the railway.

Although a 3-span solution may provide a more aesthetically pleasing structure, the bridge deck would involve a more complex construction sequence with anticipated capital costs of 30% more than a single span arrangement. With a larger bridge deck, the maintenance and replacement costs would also be greater, considerably increasing the whole life cost of a 3 span bridge. A single span bridge will therefore be taken forward as the preferred arrangement.

3.2 Discounted Options

3.2.1 Network Rail Conarch

Conarch is a precast concrete arch solution, typically used to replace aging brick arch structures on the rail network. Often the existing abutments are reutilised. The simple and prefabricated nature of Conarch construction often results in short programme durations and capital costs savings.

Conarch is discounted as an option as it has a maximum span capability of 9.4m.

3.2.2 In-situ Concrete Box

An in-situ deck (RC voided deck) would likely result in a shallower construction depth, minimising the approach embankment and abutment requirements to achieve the necessary headroom clearance over the rail.

A voided slab structure has been discounted owing to the requirement for temporary formwork and increased works over the railway during possessions, likely leading to significant programme and cost implications.

3.3 Proposed Options

With respect to the single span arrangement discussed above, the following bridge options are considered most appropriate given the constraints identified for this site:

1. Option 1 - Single Span Pre-Stressed Concrete Bridge
2. Option 2 - Single Span Multi Girder Composite Bridge

Both options consider a bridge with a clear span of 26.1m to carry the new A29 realignment over the exiting railway. A 3m wide pedestrian access shall be provided between the abutments and existing Network Rail boundary fence to the north and south ends of the bridge (see Figure 9 below). This will allow for routine visual inspections and maintenance access without causing disruption to the railway services or requiring access to the Network Rail property.

The proposed bridge deck shall be fully integral with the bridge abutments in accordance with the requirements of CD 350 The Design of Highway Structures (subject to preliminary design and agreement from the Technical Approval Authority). An integral articulation removes the need for expansion joints and bearings, thereby eliminating the costs and health and safety risks associated with maintaining those elements.

Movements due to thermal expansion/contraction, shrinkage, braking and acceleration forces and structural flexure at deck level can create large stresses within the substructure due to the monolithic diaphragm connection. For this reason, it is preferable for the abutments to be designed with a degree of flexibility so any movement at deck level can be accommodated with minimal stress build-up in the substructure.

As discussed earlier in the report, a minimum headroom clearance of 5.8m has been initially agreed with Network Rail.

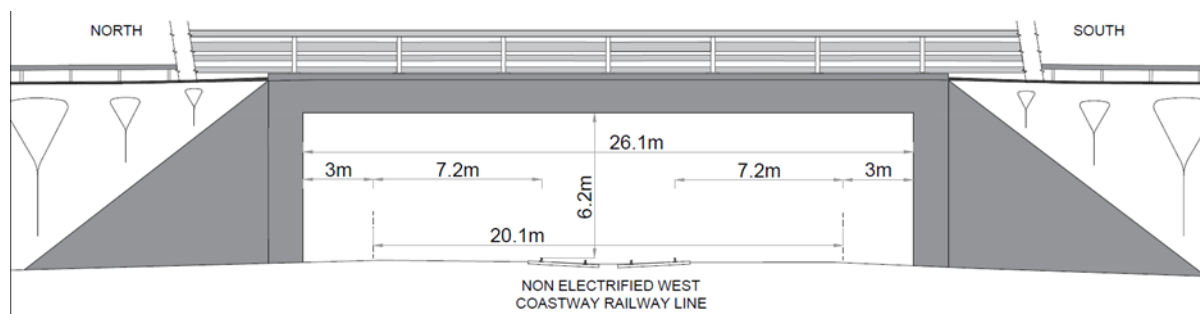


Figure 9 – Proposed Bridge – West Elevation

Option 1 - Single Span Prestressed Concrete Bridge

The proposed deck comprises 6 No. W10 prestressed precast beams at 3.0m centres with a depth of 1.4m and length of approximately 29.6m. The reinforced concrete deck slab shall be 250mm deep with a permanent glass fibre reinforced plastic formwork (see Figure 10). The H4a Vehicle Restraint System shall be anchored to precast concrete units or reinforced concrete cantilevered edge beam.

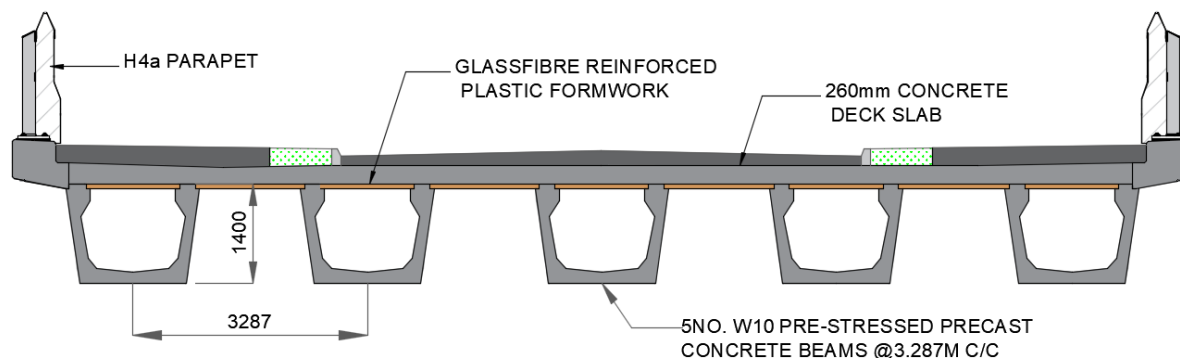


Figure 10 – Option 1a – Deck Cross Section

The Prestressed Precast Concrete Beams provide larger depths of construction when compared with Multi Girder Composite Decks.

Precast prestressed concrete beams offer a high level of durability and will therefore require minimal maintenance. The lack of connection details within the span arrangement also enables inspections to be undertaken from ground level outside of Network Rail boundaries by means of binoculars.

Option 2 - Single Span Multi Girder Composite Bridge

The proposed deck comprises 6 steel longitudinal girders at approximately 3.25m centres with a depth of 1.10m. The longitudinal girders will be braced together at the supports for stability and have shear studs at the top flange to ensure the composite behaviour between the reinforced concrete slab and the steel girders. Intermediate bracing shall be provided at regular intervals along the steel girders. The reinforced concrete deck slab shall typically be 250mm deep with a permanent glass fibre reinforced plastic formwork. The H4a Vehicle Restraint System is to be anchored to the reinforced concrete edge beam (see Figure 11).

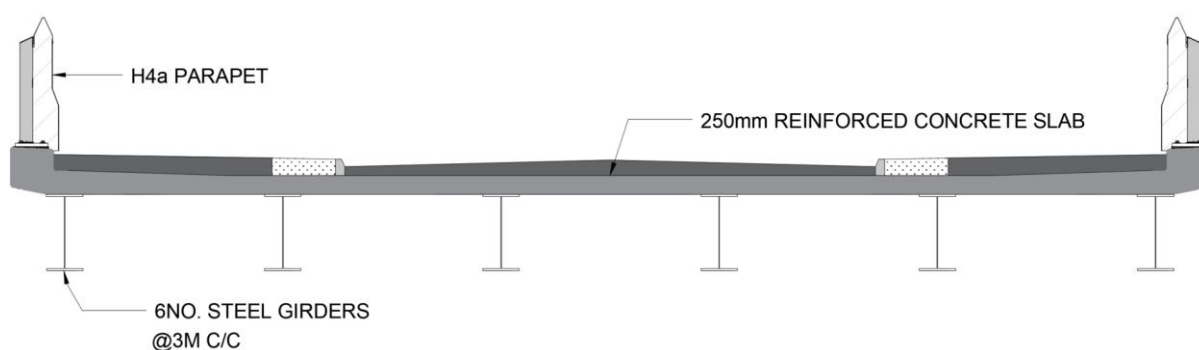


Figure 11 – Option 1b – Deck Cross Section

When compared with the precast prestressed concrete deck proposal, the multi girder composite deck provides a shallower construction depth therefore enabling a reduction in height of the abutments and approach embankments whilst maintaining the required headroom.

The steel beams have high durability when combined with efficient anti-corrosion paint protective systems. However, these systems have a relatively short lifespan (approximately 15 – 20 years) and will require regular repainting during the life cycle of the structure.

Weathering steel offers an alternative solution which is the preferred recommendation for this option. This would eliminate the need for regular reapplication of a paint protective system,

therefore minimising the disruption associated with such maintenance works throughout the lifecycle of the structure. Selection of weathering steel will increase the capital costs, as section sizes have to be increased to account for the sacrificial layers of steelwork. However, it is anticipated that the increase will be offset by the future maintenance cost savings

Substructure

In accordance with CD 350 and best practice integral abutments should be proposed for structures with skews less than 30° and spans less than 60m, by providing a monolithic connection with the deck. Integral abutments have economic and functional advantages, including improved durability as they don't require expansion joints and bearings. This also reduces replacements and maintenance costs associated with these elements over the serviceable life of the structure.

Two types of integral arrangements are suitable for full height abutments with both steel composite and prestressed precast bridge decks:

- a) Frame Abutment
- b) Flexible Abutment

A frame abutment is monolithic with the deck, creating a portal frame (see Figure 12). Bending moments, shear forces and axial loads are transferred directly to the abutment stem. These abutments also act as the retaining wall for the back-fill material and are founded in deep or shallow foundations. Thermal movement, braking and acceleration forces create horizontal displacement at the top of the abutments. To avoid displacement on foundation and huge stresses on the abutments, the stem is designed with a degree of flexibility.

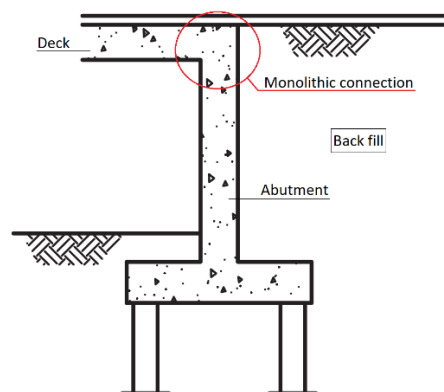


Figure 12 – Frame Abutment

A flexible abutment supports the deck through a series of columns/piles. At the top of the columns, a diaphragm provides interface through a monolithic connection between the deck and columns. This type of abutment can avoid interaction with the soil by a) sleeving the columns/piles within the soil or, b) locating the columns in front of a reinforced soil wall (see Figure 13).

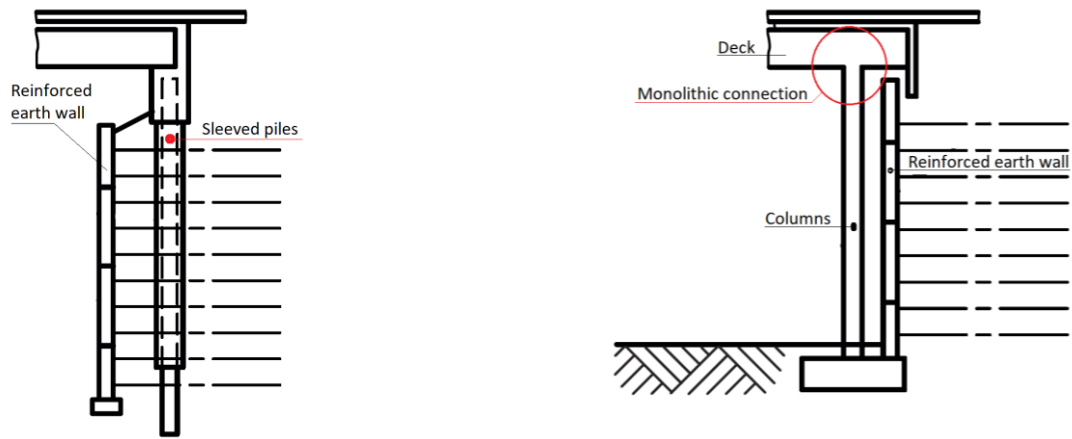


Figure 13 – Flexible Support Abutments. Left: with sleeved piles. Right: with columns

The columns/piles are designed to be slender to allow for flexure, creating greater rotations at the top of the abutment. A sleeved arrangement is normally provided by concrete manhole rings or PVC pipes around the columns. The arrangement which may be considered as a critical hidden element requires careful detailing to ensure durability with consideration for future inspections.

Positioning the columns outside the reinforced soil eliminates the issues associated with the columns being hidden for future maintenance and inspection. The solution is also easier to construct by avoiding the use of a sleeve within the reinforced soil arrangement. However, they may be considered less aesthetic to users under the bridge.

Foundation

Due to the existing high water table and London Clay strata (Geotechnical and Geo-Environmental Desk Study, refer to section 0) it is recommended to have the abutments founded in deep foundations. The use of deep foundations will eliminate settlements of the approach embankments and reduce ground collapse issues during construction. It is also a proven solution as it was successfully used on the 16-span viaduct over Barnham to Bognor Regis railway.

The ground parameters for design are to be determined with further geotechnical investigations (refer to section 2.4).

3.4 Buildability

Given the structural form for both options being similar, there is little variation in construction methodology. The assumptions made for design need to be taken into consideration for the construction sequence. The following sequence provide a high-level guidance for the construction of an integral bridge:

1. Construction of the substructure to the deck soffit level. The abutments need to be at a suitable curing stage before the installation of the superstructure.
2. Prestressed precast concrete / steel beams to be placed on supports (thin rubber pads).
3. Deck slab to be cast in situ.
4. Cast stitches between the deck and the abutment (end screen wall and capping beam).

Casting the deck slab prior to the connection between the deck and the abutment will minimise the build-up of stresses at the abutments due to the deck self-weight and shrinkage.

To cast the concrete deck in situ the permanent formwork needs to be installed carefully and all the joints must be sealed properly to avoid concrete leakage to the railway. Temporary works are required to create a working platform for the deck installation.

The installation of beams will require lifting operations over the railway and will need to be carried out during possessions. No major constraints to lifting operations are foreseen as there is no overhead line equipment (OLE) installed to the railway and the surrounding area is an open field.

The steel beams are lighter than the prestressed precast concrete beams and can also be paired before construction, requiring fewer overall lifts. This could result in time saving to the construction programme and fewer possessions to build the bridge deck. As the steel composite deck is lighter, sizing of the foundations is likely to be smaller, which may lead to savings in the construction programme.

Depending on the size of individual sections, the transportation of beams from factory to site may require special transport operations with planned routes that may require temporary road closures and diversion routes for other road users.

The existing NR boundary fence is to be maintained throughout the works to prevent unauthorized access to NR property.

The waste material from the piling rig or other sources, e.g. cuttings, within the scheme could be used as infill material for the embankments if deemed as suitable from further analysis.

No road closures are foreseen as the construction site will be located at an open field. However, there may be other constraints arising from the development of the major scheme.

4 Cost Comparison

The cost estimate for Option 1 and Option 2 returned the following prices:

Cost Comparison		
Option No.	Option Description	Estimate
1	Single Span Prestressed Concrete Bridge	£2,715,000
2	Single Span Steel Girder Composite Bridge	£3,076,000

At this stage, the costs given are indicative only as the scheme is in a very early stage. As the structural form of both Options is similar the difference in price comes from the pilling activity and deck structural form. The Steel Girder Composite Deck is lighter which leads to a smaller foundation, however the steel beams have a high initial cost as the steel is more expensive and the fabrication may take longer due to customized girder profiles. The solution for the steel girder composite deck assumes weathering steel.

The cost data and rates have been sourced by *Spon's Civil Engineering and Highway Works Price Book 2020* and do not account for the following:

- Temporary Works
- Design Costs
- Costs associated with Network Rail processes and approvals
- Future Maintenance Costs

The bridge dimensions may vary following finalised highway alignment and levels.

The cost estimate was undertaken as if the bridge was as standalone scheme, independent of the wider project described in Section 1.1. This may result of some repeated costs when combining the estimates for the complete A29 realignment scheme.

Duplication may be present in cost estimates for Series 100 (preliminaries), Series 200 (site clearance), Series 500 (drainage and services duct), Series 700 (pavements) and Series 1100 (kerbs, footways and paved areas).

5 Options Review

	Option 1 (Single Span Prestressed Concrete Bridge)	Option 2 (Single Span Multi Girder Composite Bridge)
Cost Estimate	£2,715,000	£3,076,000
Capital Cost	✓✓	✓
Programme	✓	✓✓
Buildability	✓	✓✓
Relative Indicative Whole Life Cost	✓✓	✓
Aesthetics	✓✓	✓
Environment	✓✓	✓✓
Total	10	8

Performance against each of the selected criteria indicates that the preferred option will be Option 1 – Single Span Prestressed Concrete Bridge.

Due to the lighter weight and possibility of pairing, reducing the number of lifting operation and requiring lighter lifting plant, Option 2 offers advantages for the Construction Programme and Buildability. However, Option 1 offers the best value for Capital Cost. Prestressed concrete is also highly resistant to weathering and corrosion and may require less future maintenance reducing its whole life cost. It is also more environmentally friendly and specifying sustainable concrete will help reducing the structure carbon footprint. Use of prestressed concrete beams would also enable inspections to be undertaken from ground level outside of Network Rail boundaries by means of binoculars, further reducing operational costs.

Note that this report has been based on the available information at the time of writing. Any additional design considerations will be addressed as part of the AIP and detailed design stages.

6 Hazard and Risk Mitigation

The health and safety risks associated with the preferred options for the new bridge over the railway have been considered alongside with other factors that influence the design, such as client aspirations, design constraints, cost, aesthetic and environmental impact.

A risk register has been developed and can be found in Appendix B. This includes a log of health and safety risks identified at this stage and how they may be addressed. Below is a summary of key recommendation that have been based on health and safety considerations:

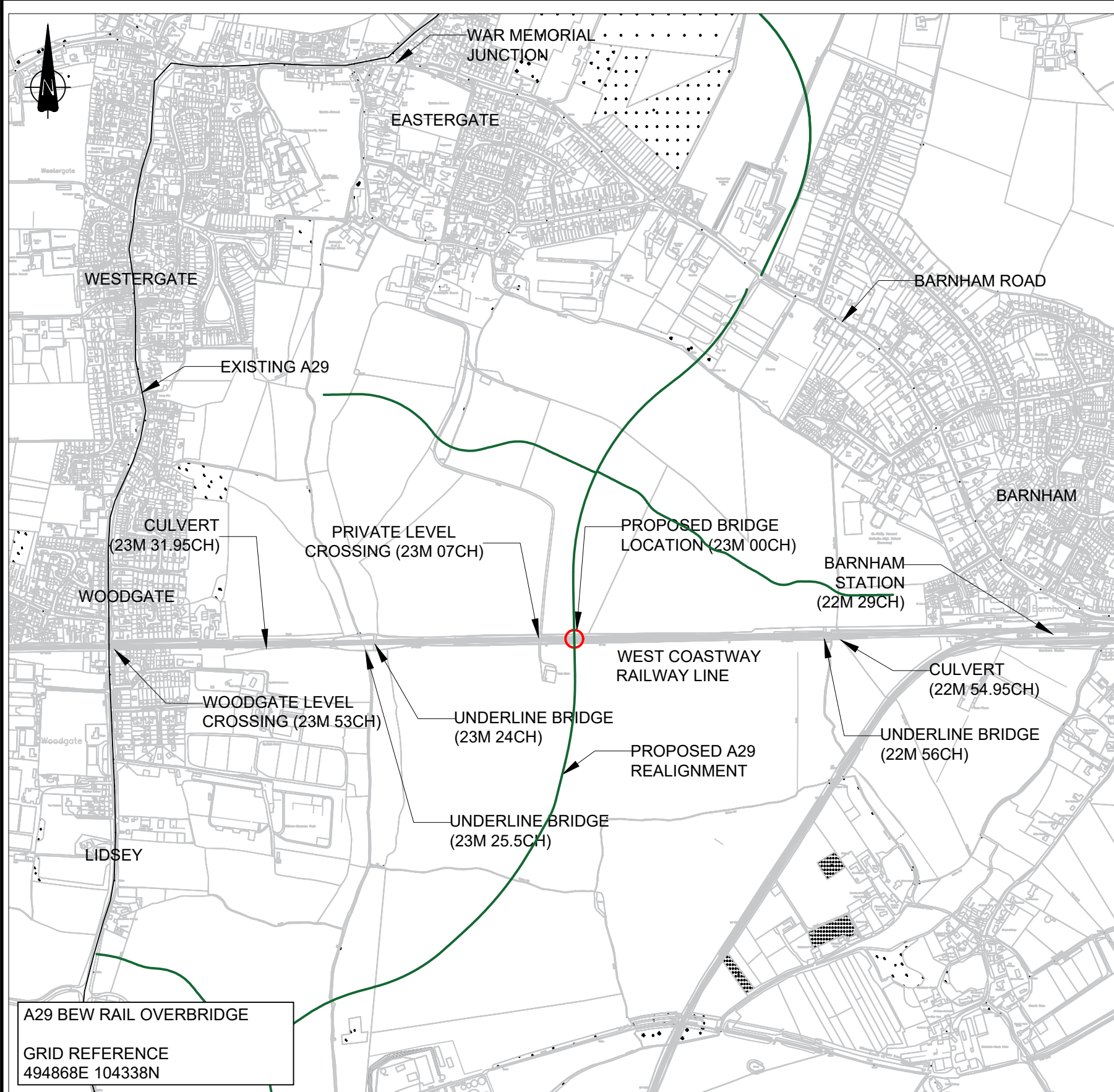
- Construction methods and sequencing to be considered during the design stages to ensure that prefabricated elements can be safely handled and lifted into position.
- Choose structural form during the design stage considering future maintenance. This may reduce the number of elements that will need inspection, repairs or replacement and therefore reduce the workers exposure to some hazards.
- Consider access to the structure for future maintenance and inspection.
- Provide a Design Risk Assessment to inform the Contractor about the risk that may arise from the design.

The risk register is a live document that must be updated throughout the different design stages.

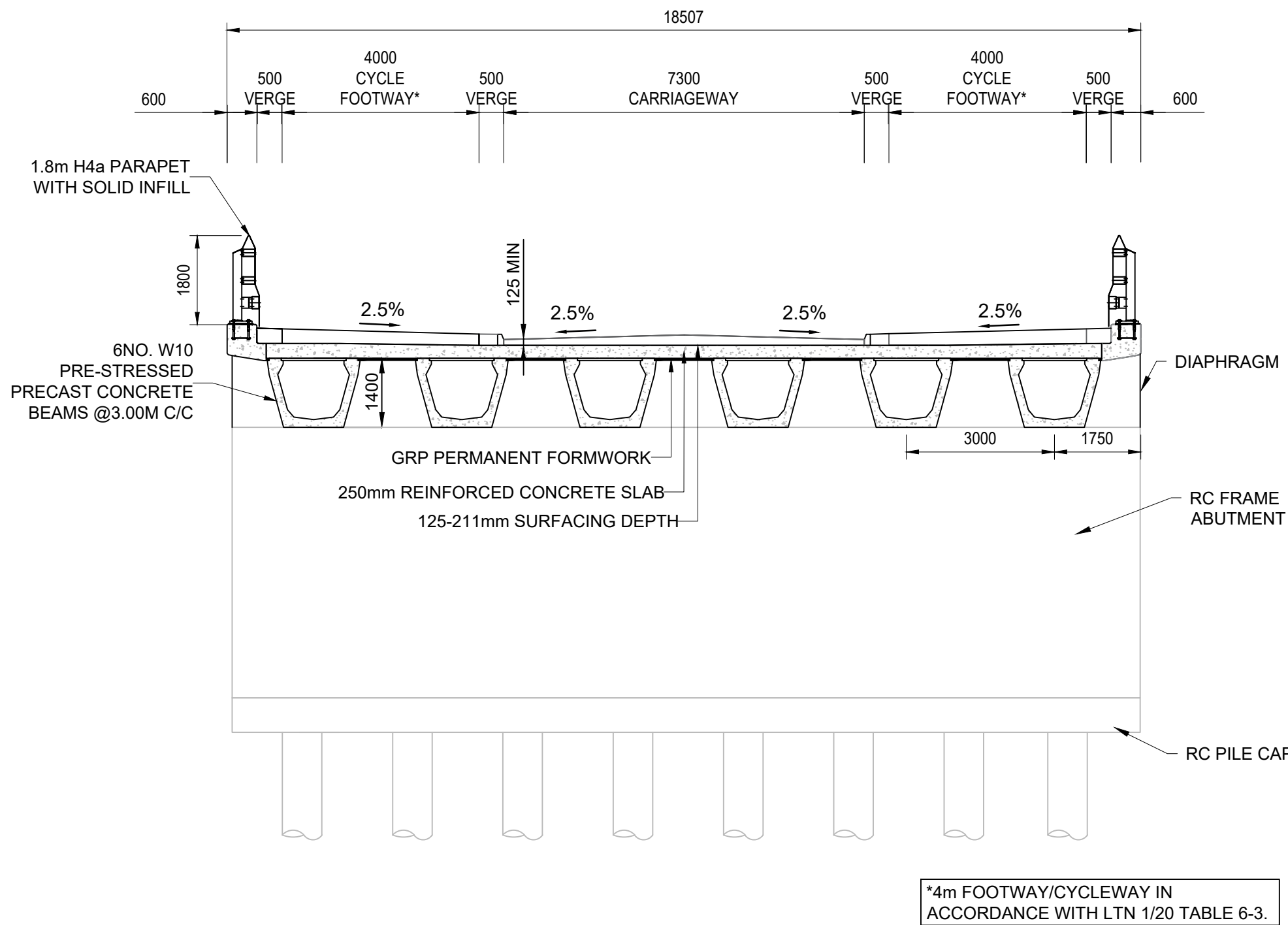
Also, under the CDM regulation, a health and safety file is to be compiled by the principal designer during the pre-construction phase. This document must be reviewed and updated regularly to reflect any changes that have occurred to the design.

General Arrangement Drawing

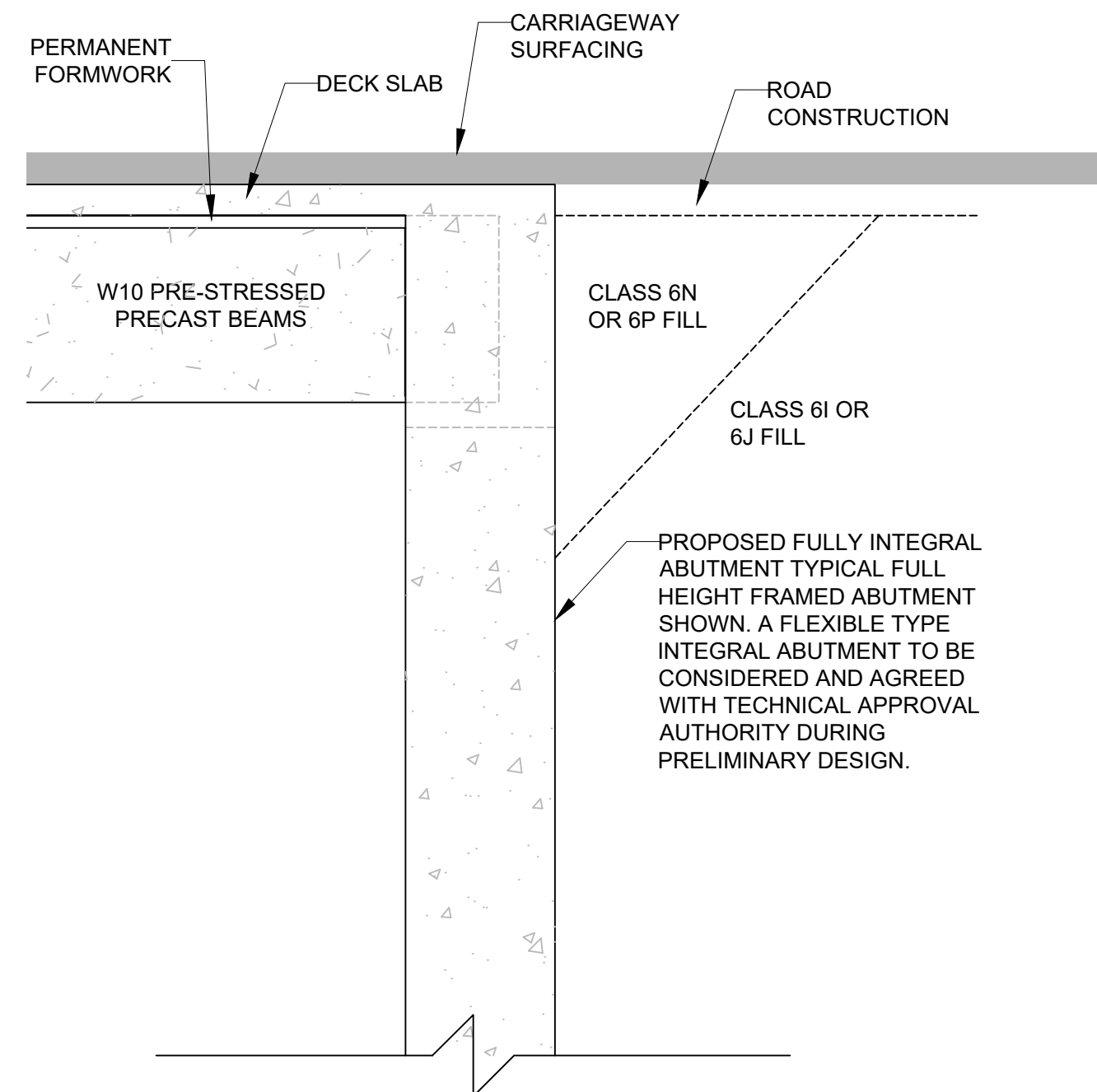
Appendix A



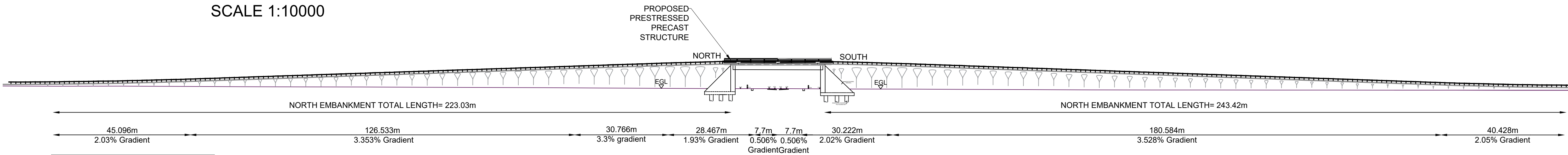
LOCATION PLAN
SCALE 1:10000



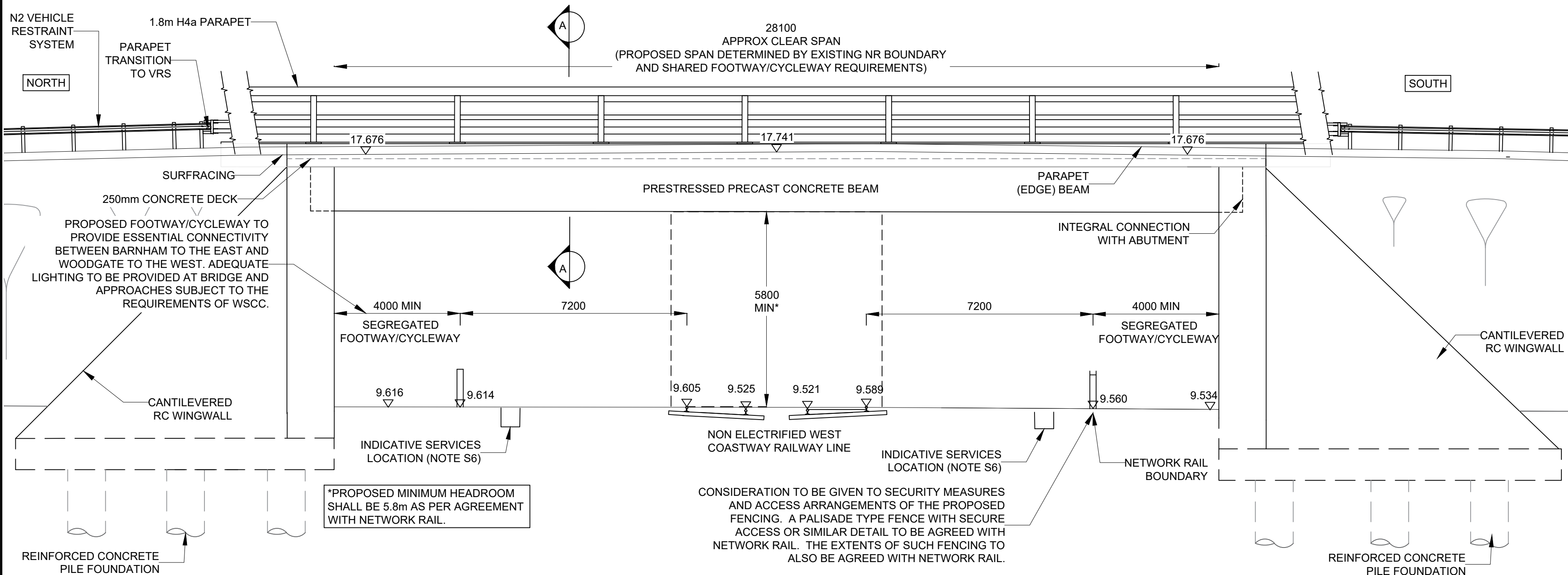
SECTION A-A
PRE-STRESSED PRECAST CONCRETE BEAMS DECK
SCALE 1:100



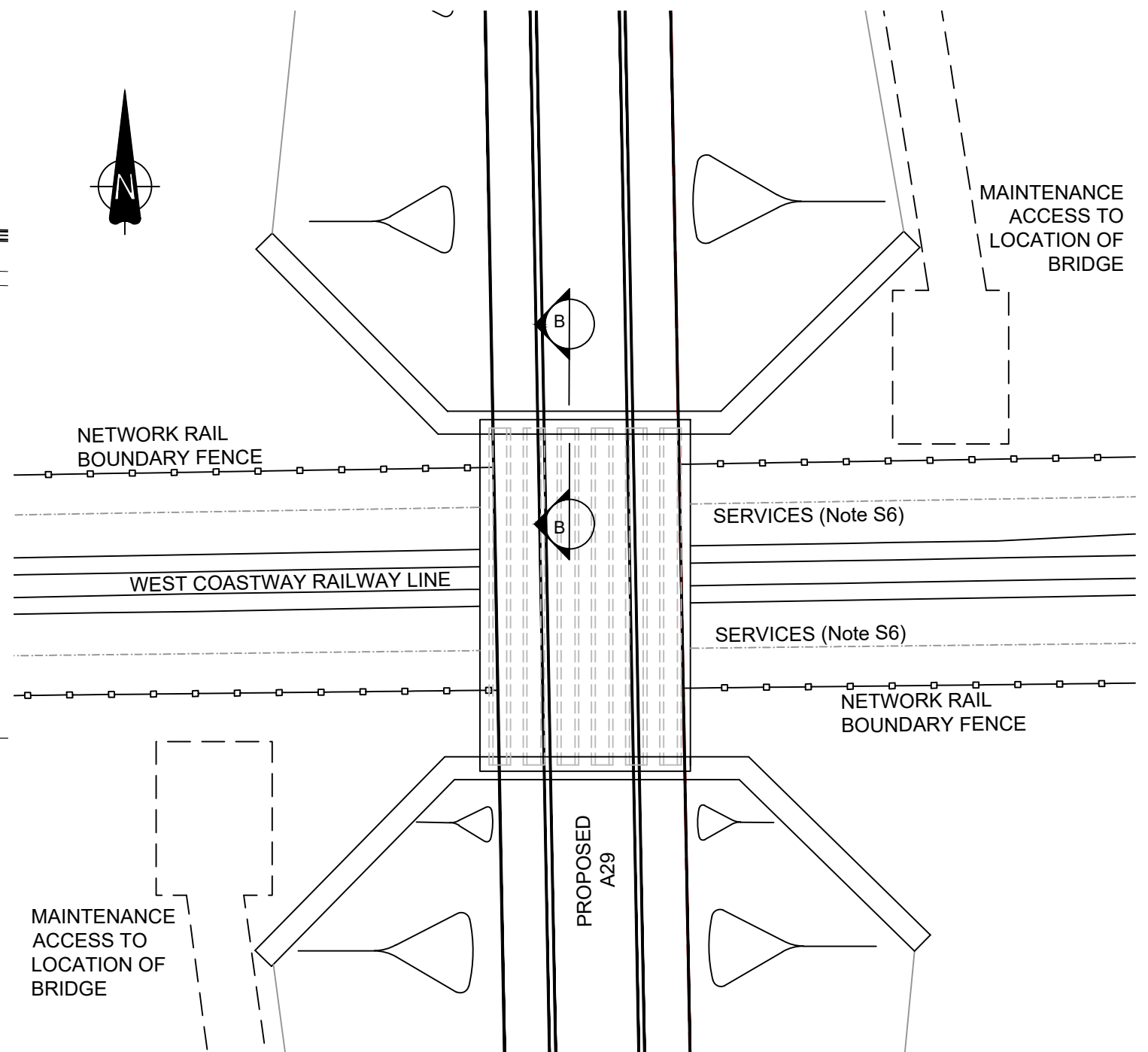
SECTION B-B
SCALE 1:50



WEST ELEVATION
SCALE 1:750



WEST ELEVATION
SCALE 1:100



PLAN
SCALE 1:500

- GENERAL NOTES
- G1. DO NOT SCALE FROM THIS DRAWING.
 - G2. ANY DIMENSIONAL DISCREPANCIES SHOULD BE NOTIFIED TO THE ENGINEER IMMEDIATELY.
 - G3. ALL DIMENSIONS ARE IN MILLIMETRES - (mm) AND ALL LEVELS ARE IN METRES - (m) AND ARE ABOVE ORDNANCE DATUM AT NEWLYN, CORNWALL UNLESS NOTED OTHERWISE.
 - G4. NORTH SHOWN INDICATIVE ONLY
 - G5. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT SPECIFICATIONS, DRAWINGS, DETAILS AND OTHER DESIGN INFORMATION.
 - G6. ALL DRAWINGS AND WRITTEN MATERIAL CONTAINED WITHIN, CONSTITUTE ORIGINAL AND UNPUBLISHED WORK OF THE ENGINEER AND MAY NOT BE DUPLICATED, USED, REPRODUCED OR DISCLOSED WITHOUT WRITTEN CONSENT OR EXPRESS PERMISSION FROM THE ENGINEER.
 - G7. ALL INFORMATION CONTAINED IN THIS DOCUMENT IS COPYRIGHT
 - G8. WHERE THE CONTRACTOR UNDERTAKES OR ENGAGES A THIRD PARTY TO UNDERTAKE TEMPORARY WORKS DESIGN, OR VARIES THE PELL FRISCHMANN DESIGN IN ANY WAY, THEN THE CONTRACTOR WILL TAKE FULL RESPONSIBILITY AND LIABILITY FOR ALL DESIGN ASPECTS, INCLUDING A DESIGN RISK ASSESSMENT. THE CONTRACTOR SHALL INFORM PELL FRISCHMANN OF ANY PROPOSED VARIANCES TO THE DESIGN.
 - G9. PROPOSED DESIGN SHALL BE IN ACCORDANCE WITH THE DEPARTMENT FOR TRANSPORT'S MANUAL OF CONTRACT DOCUMENTS FOR HIGHWAY WORKS (MCHW) SPECIFICATION.
 - G10. PROPOSED DESIGN SHALL BE IN ACCORDANCE WITH THE DEPARTMENT FOR TRANSPORT'S DESIGN MANUAL FOR ROADS AND BRIDGES (DMRB) AND EUROCODES.
 - S1. ALL WORKS TO BE UNDERTAKEN IN ACCORDANCE WITH THE DEPARTMENT FOR TRANSPORT'S MANUAL OF CONTRACT DOCUMENTS FOR HIGHWAY WORKS (MCHW) SPECIFICATION.
 - S2. BACKFILL MATERIAL TO THE STRUCTURE SHALL BE OF CLASS 6I OR 6J IN ACCORDANCE WITH SPECIFICATION FOR HIGHWAY WORKS.
 - S3. TEMPORARY POSSESSION OF THE RAILWAY IS REQUIRED DURING INSTALLATION OF PRECAST BEAMS.
 - S4. PROPOSED WATERPROOFING SYSTEM SHALL BE IN ACCORDANCE WITH APP 20/01 OF THE SPECIFICATION.
 - S5. AN ADDITIONAL PROTECTIVE LAYER (APL) SHOULD ONLY BE USED WHEN REQUIRED BY INDIVIDUAL WATERPROOFING SYSTEM. WHERE APL IS USED IT SHOULD BE APPLIED IMMEDIATELY ABOVE THE PROPRIETARY WATERPROOFING SYSTEM. IN SUCH CASES A SEPARATE BBA ASSESSMENT OF THE SYSTEMS RESISTANCE TO AGGREGATE INDENTATION IS REQUIRED IN ACCORDANCE WITH IAN 96/07.
 - S6. INSTALCOM, VIRGIN MEDIA AND VODAFONE HAVE CABLES AND DUCT TRENCHES RUNNING ALONG THE RAILWAY LINE. THIS INFORMATION WAS OBTAINED FROM STATUTORY UNDERTAKERS AND OTHERS AND THEREFORE SERVICES LOCATION IS NOT ACCURATE AND IS SHOWN INDICATIVELY ONLY IN THIS DRAWING. NEW STATUTORY UNDERTAKER ENQUIRES MUST BE UNDERTAKEN BY THE CONTRACTOR PRIOR TO ANY CONSTRUCTION WORKS. GPR SURVEY, TRIAL HOLES OR SIMILAR METHODS MUST BE ADOPTED TO CONFIRM LOCATION OF THE SERVICES ON SITE.
 - S7. THE LAND LOCATED NORTH AND SOUTH OF THE NETWORK RAIL BOUNDARY FENCE IS OWNED BY THE CHURCH COMMISSIONERS FOR ENGLAND AND IT IS REGISTERED UNDER THE FOLLOWING TITLE NUMBERS:
NORTHERN AREA: WSX309559 (74.60HA)
SOUTHERN AREA: WSX309592 (49.13HA)

P04	CHANGE TO CLIENT NAME (CC PROJECTS)	KK	AK	AK	14/01/2022
P03	SCALE BAR ADDED AND CHANGE TO CLIENT NAME	KK	IR	AK	15/11/2021
P02	ISSUE FOR INFORMATION	AG	AK	AK	05/05/2021
P01	DRAFT	AG	IR	AK	20/11/2020
REV	DESCRIPTION	DRN	CHK	APP	DATE

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Client	CC PROJECTS ASHMARDEN Ltd AND HANBURY (PM) Ltd
Project	BEW PARCEL SC1
Drawing Title	GENERAL ARRANGEMENT SINGLE SPAN BRIDGE

Drawing Title				
GENERAL ARRANGEMENT SINGLE SPAN BRIDGE				
OS Ref: SU9489504352 Structure Type: Over Rail Bridge ELR/Mileage: TBH2 / 23M 00CH				
Drawn	Name	Date	Scale	AS SHOWN @A1
Designed	KK	05/08/21	Suitability	S2
Checked	AK	25/08/2021	Drawing Status	FOR INFORMATION
Approved	AK	25/08/2021		
Drawing No.				Revision
13394-PEF-ZZ-XX-M2-S-000001				P04

Risk Register

Appendix B

Item No	Date Raised	Phase	Hazard Description	Risk Description	Unmitigated Risk Score	Mitigation Plan	Mitigated Risk Score	Owner	Status	Date Closed
1	23/07/2020	Construction	Long beams to be transported from factory to site	This will require the use of special vehicles which have greater risk of having/causing an accident		Plan in advance the vehicles route to identify possible constraints and any road closure.		Contractor	Open	
2	23/07/2020	Construction	Heavy plant and Crane lifting operations	Risk of injury to the workforce, overturning of the crane and collision with other structures/objects		Use proprietary designed elements with well know history of successfull installation		Contractor	Open	
3	23/07/2020	Construction	Working from height during construction works	Injury, potential fatality		Plan works in advance. Provide safe system of work.		Contractor	Open	
4	23/07/2020	Construction	Structural failure - abnormal loads during construction	Injury, potential fatality		Principal contractor to provide construction phase plan before the works start on site. Designer to provide construction sequence. Any change that may occur during construction to be communicated to the designer.		Contractor	Open	
5	23/07/2020	Construction	Delivery of materials and removal of waste	Excessive manual handling leading to muscular skeletal disorders		Reduce manual handling to the minimum necessary. Make loads lighter, modify work space to reduce carrying distances.		Contractor	Open	
6	23/07/2020	Design	Lack of geotechnical information	Unsafe, inappropriate or uneconomic foundation design. Lack of appropriate knowledge that would allow contractor to understand geotechnical risk and develop suitable safe systems of work.		Carry out geotechnical investigation to determine design parameters.		Designer	Open	
7	23/07/2020	Construction	Anti-social hours working	Effects on workers - fatigue, long term welfare.		Construction programme to consider number and length of shifts		Contractor/ Client	Open	
8	23/07/2020	Construction	Conflict with utilities	Execution of works disturbs or conflicts with utilities leading to contact with electrical services causing electrocution with potential death and disruption of services		Undertake GPR survey and other investigations to locate, trace and map services, identify potential clashes, discuss options with service provider and inform contractor.		Designer	Open	
9	23/07/2020	Construction	Damage to beam elements during lifting operation	Risk of injury to the workforce		Ensuring lifting hoops have enough anchorage for stable lifting purpose.		Designer	Open	
10	23/07/2020	Construction	Geometrical tolerance	Major delays to the works and considerable cost impact		Implementation of QA processes to check detail design drawings and specifications. Use of BIM tools to identify geometrical constraints.		Designer	Open	
11	23/07/2020	Construction	Unexploded Ordnance - UXOs may be present on the site	Injury/death to site operatives. Presence of UXOs may impose restrictions on groundworks.		Carry out a detailed UXO survey. Apply mitigation actions for ground works.		Designer	Open	
12	23/07/2020	Maintenance	Difficult access for future maintenance	Higher risk of injury to the workers when trying to access the structure and while carrying tools/equipment with them.		Design to consider people and vehicle access to the structure		Designer	Open	
13	01/10/2020	Construction	Unauthorized access to Network Rail property	Injury/death to site operatives		Keep existing Network Rail boundary fence in place during construction works		Designer/C ontractor	Open	
14	01/10/2020	Operation	Strike by train	Injury/death to railway and bridge users		Liaise with Network Rail to determine lateral clearances and headroom requirements.		Designer	Closed - Eliminated	
15	01/10/2020	Operation	Vehicle impact to the parapet	Vehicle incursion onto railway. Damage to Network Rail infrastructure. Injury/death to bridge users.		Provide vehicle restraint system (VRS) with H4a containment level (very high) as required on CD377 for bridges over the railway.		Designer	Closed - Eliminated	
16	01/10/2020	Maintenance	Replacement of VRS areas after impact	Some areas of the VRS may be damaged and require replacement after a vehicle impact		Connection between VRS and deck edge beam to be designed to allow VRS replacement with minimal effect to deck, waterproofing and disruption to highway/railway		Designer	Open	