DART+ Coastal North

Public Consultation No.2

Annex 3.2 E6: Option Selection OBB81 Report

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Tionscadal Éireann Project Ireland 2040
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1. INTRODUCTION

This report documents the optioneering assessment for the pedestrian overbridge at Drogheda Station (OBB81) to enable the electrification of the railway line beneath this bridge. The existing vertical clearance beneath this structure is insufficient to accommodate electrical wiring without some form of physical intervention (to either the track below or the bridge itself). This report documents the various options considered and recommends a preferred option for progressing to the next stage of the design process.

2. SITE AND LOCATION

2.1 Location

The pedestrian bridge at Drogheda Station (IÉ reference OBB81) is located within the confines of the station at approximate chainage 31 mi 1259 yds. The bridge provides pedestrian access between Platform 1 and Platforms 2/3 with stairs and lift access at both ends. The stairs and lift at Platform 2/3 also provide maintenance access to the depot via OBB81C.

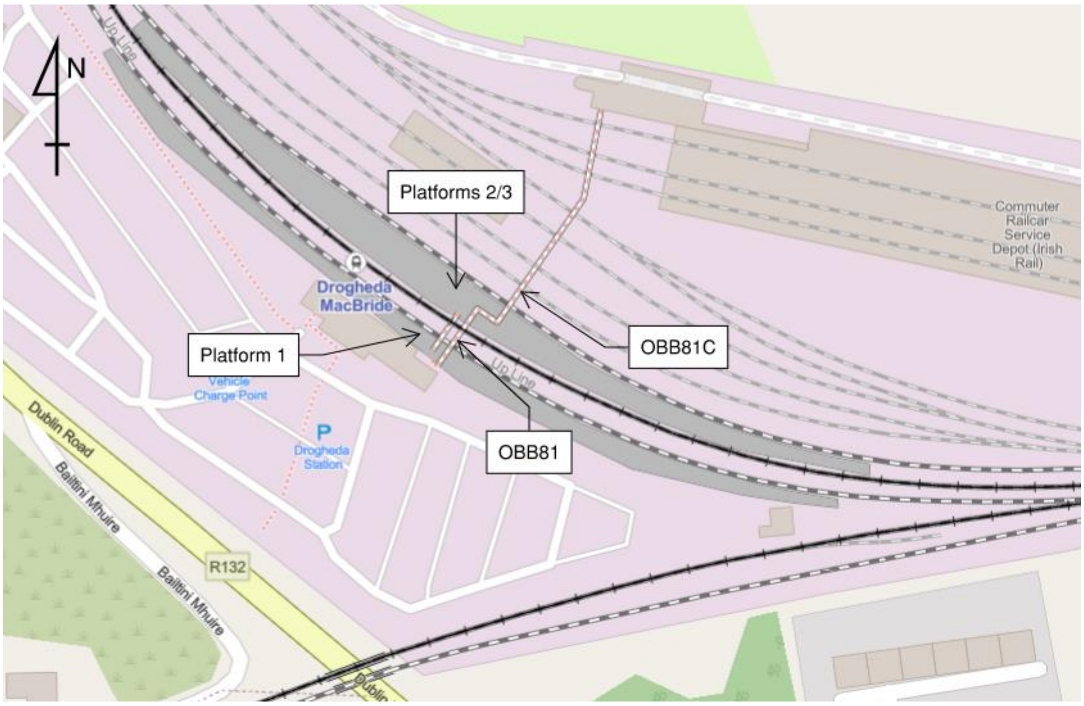

Figure 1: Bridge location

2.2 Station Heritage

Drogheda MacBride Station is a Protected Structure (LCC RPS DB-055). The listing notes this railway station retains a great deal of its original fabric and is a well composed architectural set piece. Five additional structures in the station complex are also included in the Record of Protected Structures. These are:

- Engine Shed LCC RPS DB-395;
- Water Tower LCC RPS DB-397;
- Parcel Office LCC RPS DB-396;
- Boiler House LCC RPS DB-398; and
- Toilet Block LCC RPS DB-399.

All of these structures are also included in the NIAH where they are rated of Regional Importance for reasons of architectural, technical and social interest. The NIAH notes the high-quality workmanship in stone and brick detailing, developments in railway architecture as evidenced in the buildings and the sensitivity of modern interventions.

The station does not fall within an Architectural Conservation Area (ACA) and there are no historic gardens included in the NIAH Garden Survey, in the vicinity of it.

2.3 Existing structure

OBB81 is a 17m single span footbridge crossing over the main line. The superstructure comprises two steel plated girders with a cast-in-situ deck slab between. The girders act as 1.0m high parapets to the walkway over the bridge, with a steel roof canopy supported off the girders. Three transverse bracing members, used to brace the compression flange, contain a horizontal member which projects below the soffit of the deck and encroaches on the rail clearance envelope below.

The bridge is framed either side by a flight of stairs and lift shaft. The steel superstructure is supported on a reinforced concrete and masonry frame at its ends, which also provide the landing for the top of the stairs the lift. The girders appear to be supported directly off the concrete/masonry frame, without the presence of any bearings.

The current bridge was constructed in 1953 replacing an older steel plated structure with a curved soffit (built circa 1855). No remnants of the original structure appear to remain. The existing structure has been modified in recent years, with the girder cut and additional supports provided at its north-eastern end to allow maintenance access to OBB81C.

Design drawings, survey information and inspection reports have been obtained for the bridge. A principal inspection was carried out on all elements of the structure above ground by IÉ on 28/04/2020 and the overall condition was deemed fair. An inspection of the bridge site was carried out by Arup on 01/09/2021.

Figure 2: OBB81 bridge elevation and stairs access from Platform 1

Figure 3: OBB81 modification to bridge at north-eastern end to allow access to OBB81C

2.4 Existing track levels

2.4.1 Bridge Clearance

A topographical survey of the bridge was commissioned to accurately determine the minimum clearances beneath the bridge. The survey was carried out on the 15/07/2021 and recorded a minimum vertical clearance of 4.464 m from the track to the underside of the bridge.

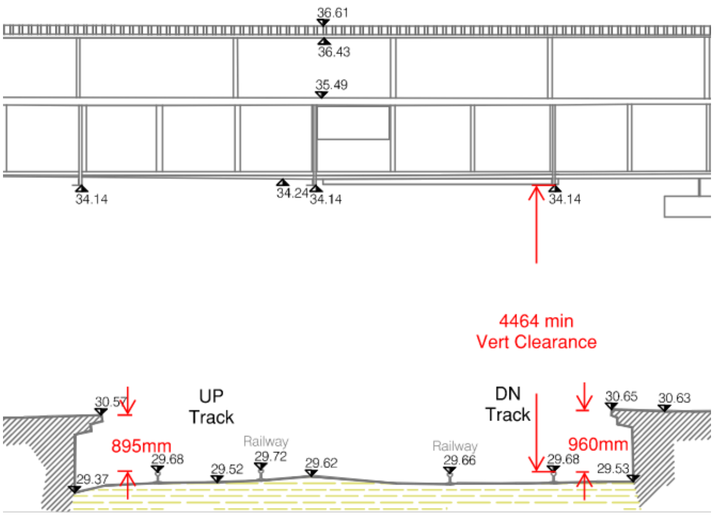

Figure 4: Clearances beneath OBB 81 (northern elevation)

2.4.2 Platform clearances

A review of the platform clearances at this location was undertaken to access whether there was any opportunity to lower the tracks while maintaining the existing platform levels, hence potentially providing additional vertical clearance to the soffit of the bridge without altering the surrounding infrastructure.

The standard vertical platform clearance (vertical offset from rail leading edge to the platform level) is 915mm in accordance with I-PWY-1101. Refer to Figure 5 below.

Figure 5: Required platform clearance (extract from I-PWY-1101- Figure 2.1)

The existing vertical track clearance on the UP-track side of the platform is ~895mm (refer to Figure 4 above), meaning that there is potential to provide an additional 20mm clearance at this location.

The existing vertical track clearance on the DN-track side of the platform is ~960mm, meaning that there is no potential to lower the track here. The minimum vertical clearance to the existing structure is also located here, hence raising the track to comply with the 915 mm requirement will further reduce the available clearance to the existing bridge.

Hence, the above review concludes that there is no opportunity to provide additional clearance to the existing bridge by lowering the track levels without altering the station platforms.

The above review identifies the risk of raising the track levels on the DN-track side and the potential impact on vertical clearances. However, it is noted that this is only an issue for the existing structure due to the steel elements that project beneath the soffit of the bridge deck, creating the pinch point on the DN track side – see Figure 6. When considering options which propose a modification to the bridge superstructure, it is assumed that the proposed bridge would not have any elements projecting below the soffit and hence the constriction imposed on the DN-track side is removed and the UP-track side becomes the side which governs the vertical clearance envelope. In this situation, there is sufficient clearance such that raising the track by 45mm (960mm – 915mm) at the DN-track side of the platform does not impact on the clearance envelope as it will still be governed by the UP-track side. Refer to Option 2 for the modified bridge option in which the clearances to the proposed soffit are illustrated.

Figure 6: Soffit of existing bridge showing steel sections beneath soffit

3. DESIGN REQUIREMENTS

An assessment of bridge clearances required for electrification of the Northern Line has been carried out at this location based on the topographical survey of the existing rail and bridge arrangement. This assessment has found that the existing clearance from the rails to the underside of the bridge is insufficient to cater for a compliant electrical solution without the need for a derogation.

The table below shows the additional clearances required to achieve an electrical solution based on the hierarchical cases outlined in the project's functional specification. A contact wire height (CWH) of 4.400m cannot be provided with the current vertical bridge clearance. A CWH of less than 4.400m will require a derogation.

Electrical Case	Nominal CW height (mm)	Minimum soffit height for case (mm)	Additional clearance required at structure (mm)
1	4700	5620	1156
2	4700	5420	956
3	4700	5220	756
4	4700	5080	616
5	4600	5295	831
6	4600	5095	631
7	4600	4955	491
8	4500	5170	706
9	4500	4970	506
10	4500	4830	366
11	4400	5070	606
12	4400	4870	406
13	4400	4710	246
14	4350	4640	176
14_OBB81	-	-	-
15	4270	4490	26

Figure 7: Electrical case hierarchy at OBB 81

The table below shows the minimum vertical clearances required to achieve a minimum contact wire height of 4.400m, considering different values for tolerances.

25kV passive provision is a requirement for new infrastructure, however it is not to be strictly applied to the adaptation of existing infrastructure where to do so would create significant cost/complexity. For comparative purposes, clearances to achieve 25kV standards are included to evaluate the impacts to the design. The last column in the table shows the minimum height required for 25kV passive provision, which would require a minimum contact wire height of 4.600m.

	OBB81	OBB81	OBB81	OBB81	OBB81	OBB81
Current Structure Parameters						
Is the Structure Listed	N	N	N	N	N	N
Width of Structure	2.82	2.82	2.82	2.82	2.82	2.82
Worst Clearance -	**4725**	**4745**	**4775**	**4795**	**5085**	**5020**
Structure type	Flat	Flat	Flat	Flat	Flat	Flat
Bridge Constraints	Drogheda station	Drogheda station	Drogheda station	Drogheda station	Drogheda station	Drogheda station
OHLE proposed solution	**H. Case 13** Contenary with zero encumbrance	**Hierarchy Case 13 + normal electrical clearances** Contenary with zero encumbrance	**Hierarchy Case 13 + TMTA 100 mm** Contenary with zero encumbrance	**Hierarchy Case 13 + normal clearances + TMTA 100 mm** Contenary with zero encumbrance	**H. Case 11** OHLE solution with minimum dropper of 300 mm	**Hierarchy Case 7 + 25kV electrical clearances** Contenary with zero encumbrance and 25 kV clearances
Proposed Solution Parameters						
OHLE Arrangement	**Free Running**	**Free Running**	**Free Running**	**Free Running**	**Free Running**	**Free Running**
Static Clearance (Csc) - 1500Vdc	100	150	100	150	150	270
Dynamic Clearance (Cdc) - 1500Vdc	80	100	80	100	100	150
Minimum Position of the Contact Wire (considering tamping)	4261	4261	4211	4211	4226	4436
Actual Design Contact Wire Height (Cdcl) (After Tamping)	4400	4400	4400	4400	4400	4600
Maximum Design Contact Wire Height [Pre-Tamping]	4450	4450	4500	4500	4450	4675
OHLE System Depth (Csd)	0	0	0	0	300	0
OHLE Uplift (Cwu)	70	70	70	70	110	70
OHLE Construction/ Installation (Cct) + Maintenance Tolerance (Cmt)	50	50	50	50	50	50
Structure Construction Tolerance (St)	20	20	20	20	20	20
Track Maintenance Tamping Allowance (Tla)	50	50	100	100	50	75
Track Construction Tolerance (Tct)	0	0	0	0	0	0
Track Maintenance Tolerance (Tmt)	25	25	25	25	25	25
Considered OHLE span through the overbridge (as per hierarchy cases)	15	15	15	15	30	15
Sag and Ice Load	39	39	39	39	74	39
Survey Tolerance	5	5	5	5	5	5
Loading Gauge	4064	4064	4064	4064	4064	4064
Mechanical Clearance	80	100	80	100	400	150
Speed through the structure	50km/h - 30 mph	50km/h - 30 mph	50km/h - 30 mph	50km/h - 30 mph	50km/h - 30 mph	50km/h - 30 mph
Acceptance - CCE	Mechanical clearance 80 mm TMTA 50 mm	Mechanical clearance 100 mm TMTA 50 mm	Mechanical clearance 80 mm	Mechanical clearance 100 mm	TMTA 50 mm	Mechanical clearance 150 mm TMTA 75 mm
Acceptance - SET	CW<4700 mm Reduced electrical clearances	CW<4700 mm	CW<4700 mm Reduced electrical clearances	CW<4700 mm	CW<4700 mm	CW<4700 mm
Derogation - SET	No	No	No	No	No	No

Figure 8: Electrical case hierarchy at OBB 81

Figure 9 below illustrates the minimal vertical clearance require to achieve an electrical solution with a contact wire height of 4.400m. This image shows the UP-track side viewed looking north.

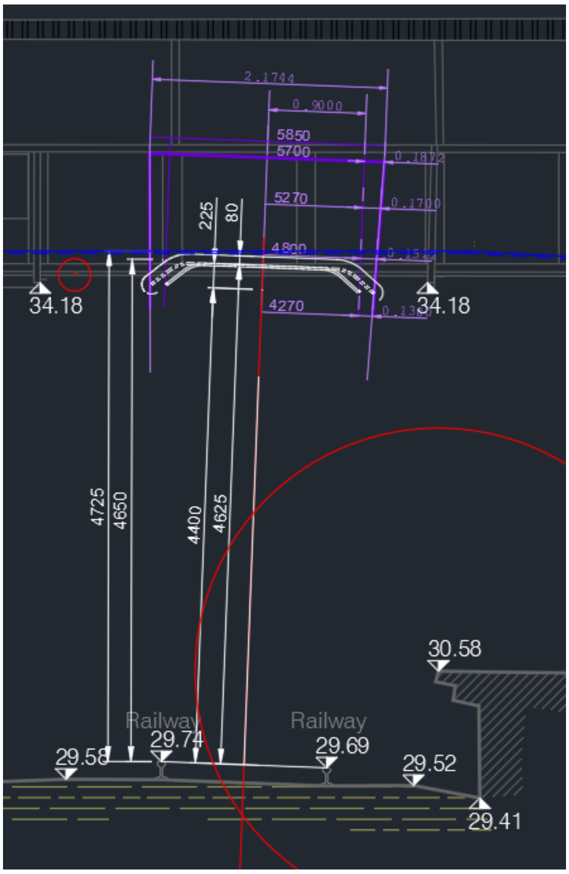

Figure 9: Pantograph envelope utilising a CWH of 4.400 m (UP-track looking north)

4. OPTIONS CONSIDERED

A number of options have been considered to enable the electrification of the track beneath this bridge. These options generally consider electrical solutions which would either require a derogation, the modification or replacement of the bridge structure and the lowering of the track.

4.1 Option 1 - Electrical solution requiring a derogation

This option involves providing a slab track through the station to allow for a bespoke electrical solution which retains the existing rail and bridge soffit levels. This requires the removal of tracks and ballast, construction of a concrete slab, which would need to run the full length of the platform, and reinstatement of the tracks on the new slab. This requires the reduction of some design tolerances to achieve an equivalent hierarchy case 15 electrical solution with a nominal contact wire height of 4270mm, further details of this are provided below. This option would require a derogation.

Table 4.1: Potential electrical solution parameters with CWH < 4400mm (Derogation required)

Potential OHLE solution	Contenary with zero encumbrance
OHLE Arrangement	Free Running
Static Clearance (Csc) - 1500Vdc	100
Dynamic Clearance (Cdc) - 1500Vdc	80
Minimum Position of the Contact Wire (considering tamping)	4223
Actual Design Contact Wire Height (Cdcl) (After Tamping)	4270
Maximum Design Contact Wire Height [Pre-Tamping]	4270
OHLE System Depth (Csd)	0
OHLE Uplift (Cwu)	25
OHLE Construction/Installation (Cct) + Maintenance Tolerance (Cmt)	30
Structure Construction Tolerance (St)	0
Track Maintenance Tamping Allowance (Tla)	0
Track Construction Tolerance (Tct)	5
Track Maintenance Tolerance (Tmt)	5
Considered OHLE span through the overbridge (as per hierarchy cases)	10
Sag and Ice Load	17
Survey Tolerance	5
Loading Gauge	4064
Mechanical Clearance	104
Speed through the structure	50km/h - 30 mph
Acceptance - CCE	Slab track Mech. clearance 104mm

Potential OHLE solution	Contenary with zero encumbrance
Acceptance - SET	CW<4700mm Reduced electrical clearances OHLE construction + maintenance tolerance 30mm OHLE Uplift 25mm
Derogation - SET	CWH – 4270mm

As outlined in Section 2.3, the existing track level relative to the platform level has been identified as being below the standard requirement. Hence, should the track be raised at this location to comply with the 915mm vertical offset, then this would reduce the vertical clearance and impact on the viability of this option.

4.2 Option 2 - Superstructure replacement which retains the landing levels

This option involves replacing the existing bridge superstructure while retaining the level of the existing stairs and landing arrangements. This can be achieved by providing a profiled soffit to the bridge, which slopes up at its ends to acquire the required clearance before levelling off above the tracks. This option would require the demolition and removal of the existing bridge superstructure and construction of a new superstructure in the same location. The existing sub structure may need to be partially modified to accommodate the proposed bridge superstructure however the existing landing levels would be reinstated. Retention of the landing levels either side avoids adjustments to the stairs and lifts that would otherwise be necessary.

This proposal provides a minimum vertical clearance of approximately 4.79m utilising a ramp gradient of 1:15 over a short length of approximately 5m.

The option of providing a new superstructure with a profiled soffit would provide up to approx. 325mm of additional clearance, allowing for an electrical solution which utilises a contact wire height of 4.400m at this location.

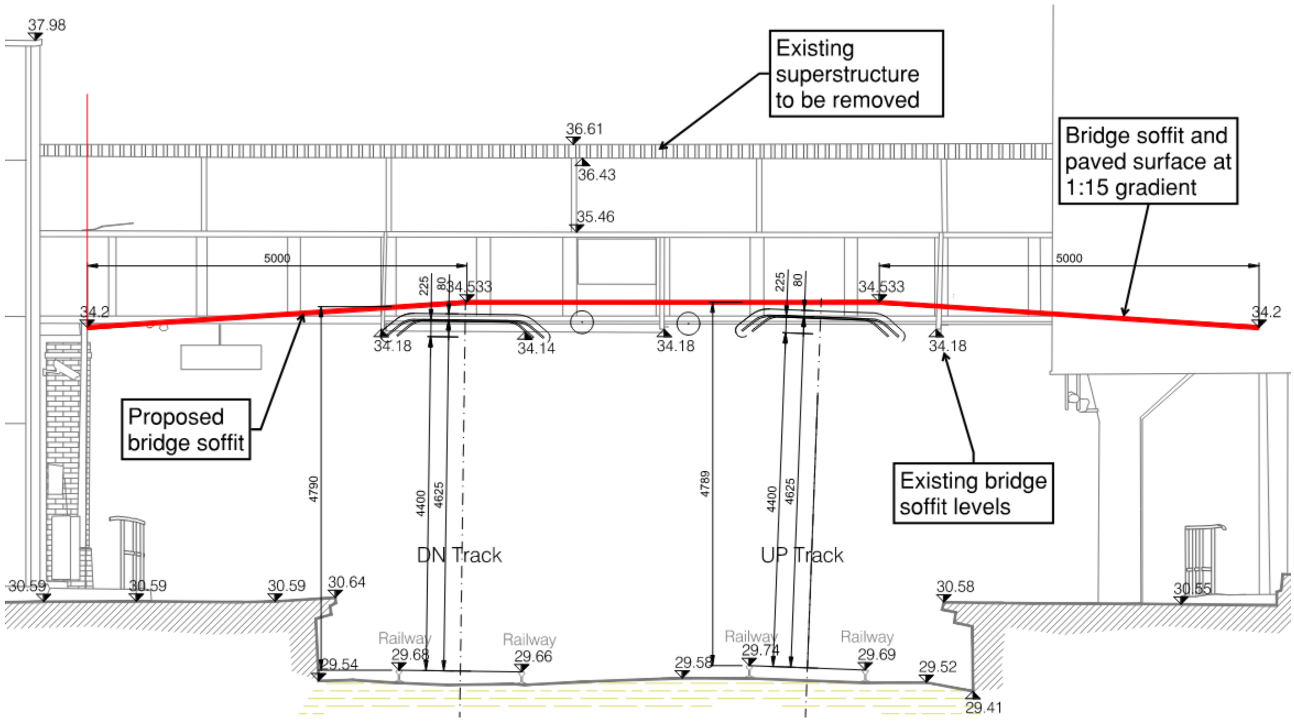

Figure 10: Elevation of proposed superstructure replacement at OBB81

There is potential to remove the existing deck and replace it with the new superstructure in a relatively short period, minimising disruption to the operation of the station and avoiding the need for a temporary access bridge to be erected during construction.

4.3 Option 3 - Raising of superstructure

This option involves raising of the bridge superstructure and modification of the existing stairs and landing arrangements. This solution can be achieved by providing a new bridge superstructure or possibly by jacking the existing bridge superstructure (pending structural assessment). The existing stairs, landings and lifts would need to be reconfigured to tie in with the revised landing levels. Maintenance access to OBB81C would also be impacted.

The amount by with the superstructure can be raised will depend partly on the extent to which the steps can be re-profiled. An initial review of the stairs suggests the existing rise per tread is approximately 175mm. This limits the ability to retain the existing footprint of the stairs and any raising of the upper landing would require additional steps.

To provide sufficient clearance to cater for the scenario of 25kV passive provision, the bridge would need to be raised by approximately 560mm, requiring approximately 4 additional steps.

4.4 Option 4 - New bridge to the North of existing bridge

This option involves the construction of a new bridge in a new location to the North of the existing bridge and the subsequent removal of the existing bridge. The new bridge would be set at a level to provide a vertical clearance suitable to cater for future 25kV provision. A vertical clearance of 5.3m has been shown in the image below, however the solution can accommodate a clearance of up to 5.8m if necessary.

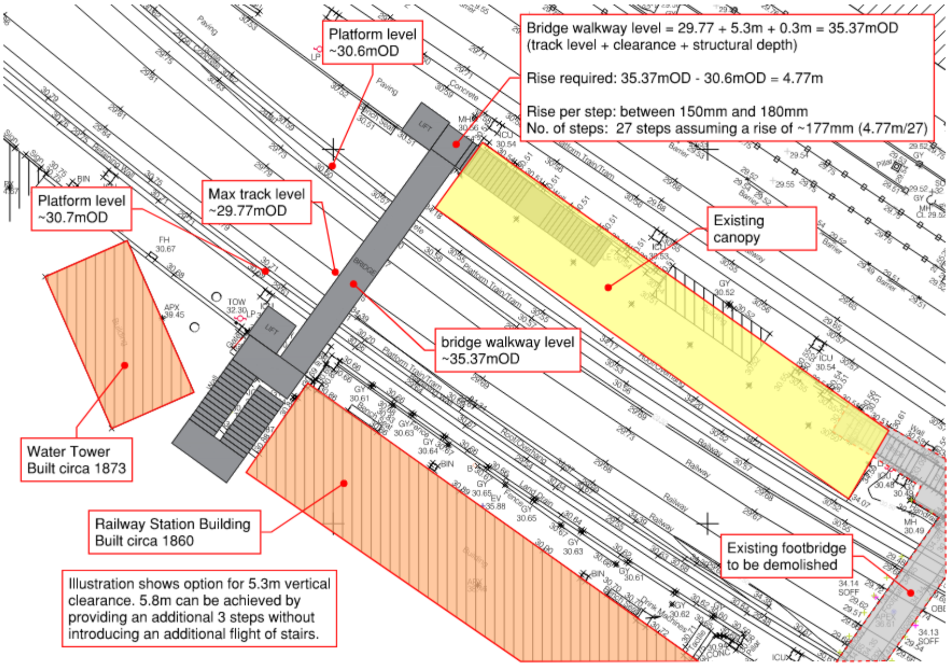

Figure 11: Plan view showing new bridge option north of existing crossing

This option would allow for the new structure to be built away from the existing, which can continue to operate and provide access for passengers and maintenance staff during construction of the new bridge.

There is sufficient space between the existing heritage buildings to place stairs without altering these historic structures.

Note, once the new bridge is constructed, it is proposed to demolish/remove the superstructure of the existing bridge. The stairs and lift on Platform 2 would be retained for access to the depot via OBB81C. It is still uncertain at this stage as to whether the stairs on Platform 1 would be removed or retained given their heritage value. Either way, this option will have an impact on the visual character of the station.

4.5 Option 5 - New bridge adjacent existing bridge

This option involves the removal of the existing bridge structure and the construction of a new bridge in a new location. The new bridge would be set at a level to provide a vertical clearance of up to 5.8m.

This option proposes to align the bridge with OBB81C. The existing stairs and lift shaft would either need to be modified or demolished and re-built to suit the location of the new bridge.

Figure 12: Plan of new bridge in revised location at OBB81

This option requires a significant interface with the existing bridge to tie back into the stairs and lifts and would require a temporary access bridge to be built while these works are carried out.

4.6 Option 6 - Track lowering

This option involves lowering of the tracks through the station to allow for an electrical solution while retaining the existing bridge levels. This requires the removal of tracks and ballast, lowering of the formation and reinstatement of the tracks at a lower level. A minimum lowering of approximately 250mm is required to attain a contact wire height of at least 4.400m beneath the existing bridge.

Lowering of the track at this location would also have significant impacts on the surrounding infrastructure. The platforms would need to be lowered along with adjustments to areas impacted by the lowering of the platform (station building, stairs, lifts etc). The lowering of the tracks may also impact on switches depending on the extent of lowering and length of tie-ins. Surrounding services and drainage may also be impacted.

This option is least preferred due to the significant knock-on effects it will have on the surrounding infrastructure.

5. CONCLUSIONS AND RECOMMENDATIONS

Based on the above assessment, Option 2 (superstructure replacement with profiled soffit) has been assessed as the preferred option as it provides a cost-effective solution that minimises disruption to services during construction while also maintaining the visual character of the station. This option provides a minimum vertical clearance of approximately 4.78m allowing for an electrical solution which utilises a contenary solution with zero encumbrance and a contact wire height of 4.400m. This option can either be installed with reduced electrical clearances and 100mm TMTA, or with standard electrical clearances and 75mm TMTA.

This option is of simple construction and allows the existing substructure to be retained, giving a cost-effective solution that does not require the construction of new bridge foundations. Only minor works are required to the existing stairs, landing and lifts, minimising the impact on the station and disruption to commuters. The heritage value of the station will be maintained, by retaining the existing stairs and providing a structure that is similar in form to the existing.

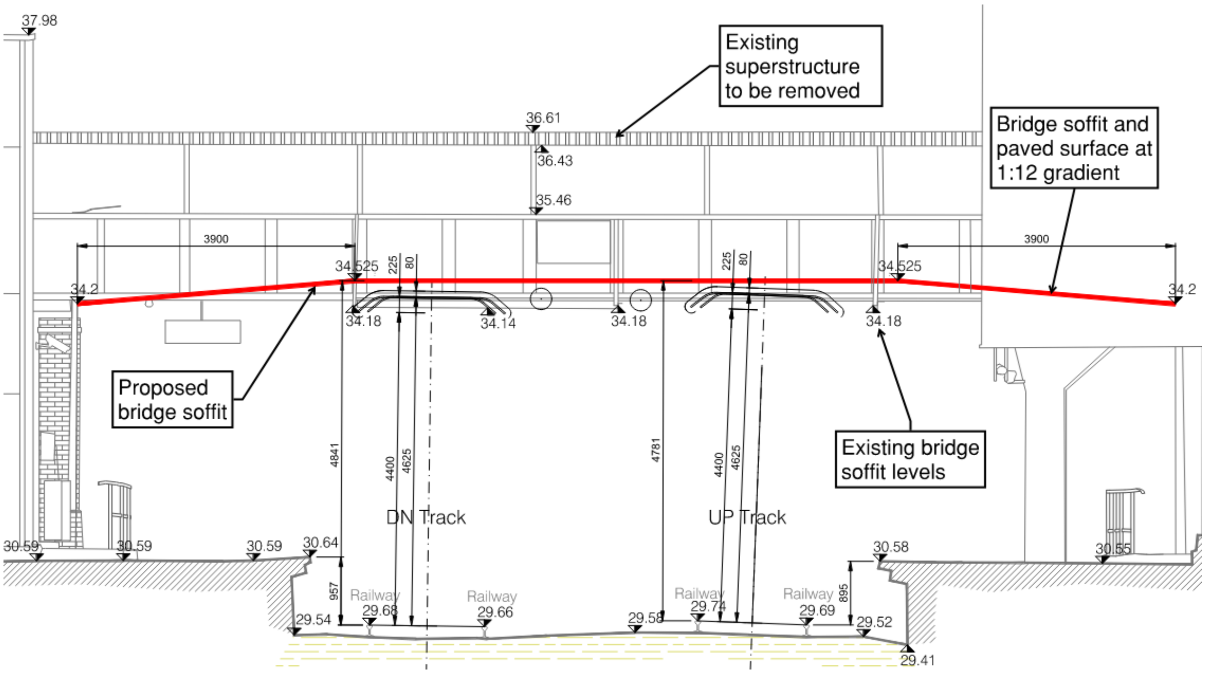

Figure 13: Preferred solution (Option 2)