Chapter 4
Description of the Proposed Development

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4. DESCRIPTION OF THE PROPOSED DEVELOPMENT

4.1 Introduction

This chapter presents the description of the proposed DART+ West project.

The EIA Directive requires that the EIAR includes 'a description of the project comprising information on the site, design, size and other relevant features of the project'. The description of the site, design and scale of the project provided in this chapter considers all relevant phases of the life of the project, i.e. from construction through to operation (and in some cases its decommissioning). Chapter 5 details the Construction Strategy for the elements described in this chapter.

The proposed development is described from east to west along the railway corridor. To avoid unnecessary repetition, works required across the entirety of the proposed development are described in Section 4.5 and are not repeated when presenting location specific elements in this chapter. Section 4.5 provides an overview of the infrastructural elements that are common at multiple locations (e.g., bridge interventions, substations, compounds, etc.).

Sections 4.6 to 4.11 describe the end-to-end development, including details of all other elements that are unique to specific areas.

4.2 Project Location

The proposed DART+ West development, referred to hereafter as 'the proposed development', will consist of the electrification of the existing Great Southern & Western Railway (GSWR) and the Midland Great Western Railway (MGWR) rail lines from Dublin City Centre extending west of Maynooth town as far as the proposed depot, and to the M3 Parkway Station. The works extend across four administrative areas/local authority areas, including Dublin City, Fingal, Kildare and Meath County Councils. The total length of the proposed development is approximately 40 kilometres.

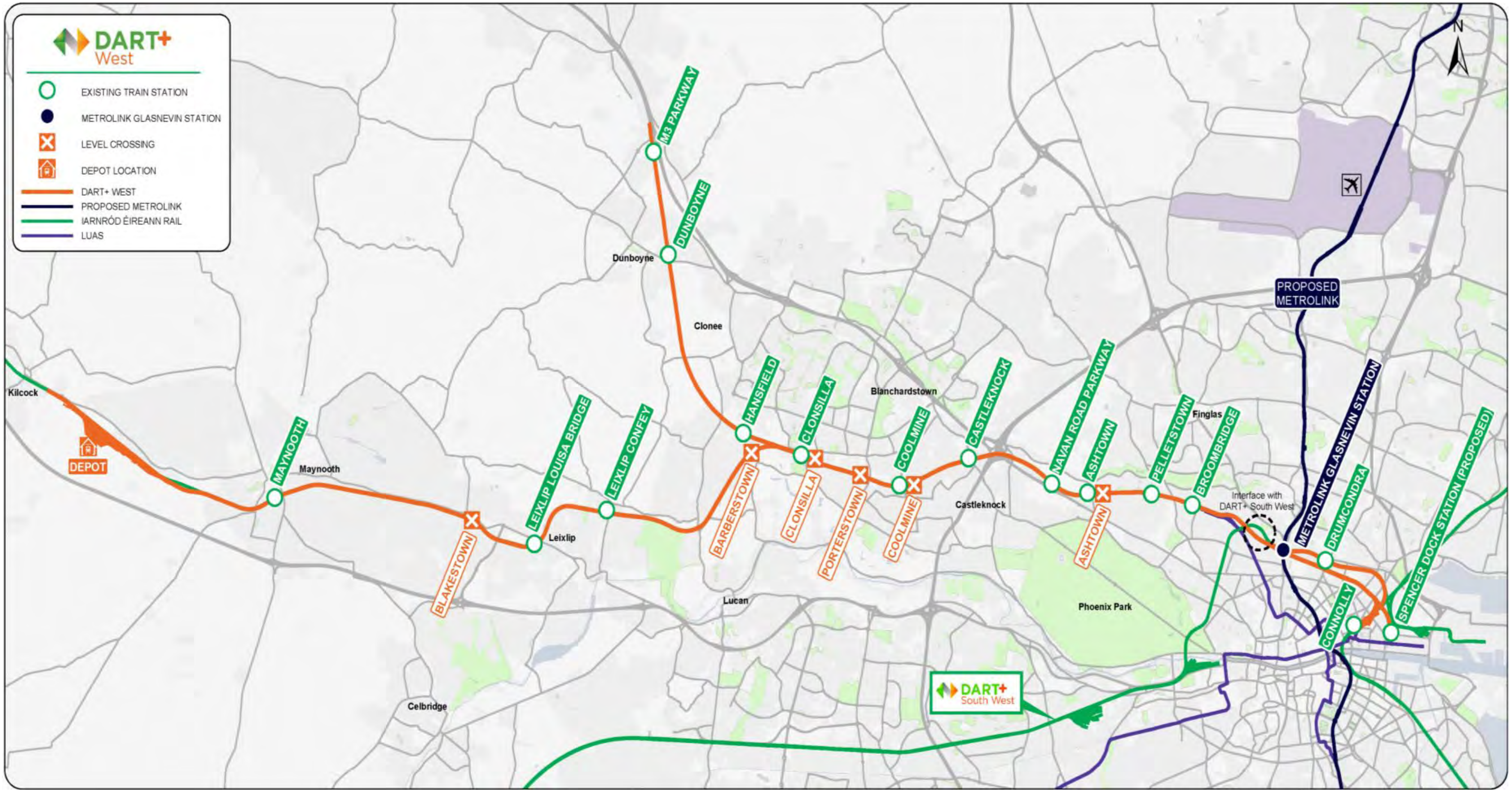


Figure 4-1 Schematic of DART+ West

4.3 Project Overview

The DART+ West project is seeking to significantly increase rail capacity on the Maynooth & M3 Parkway lines. This will be achieved by changing from diesel powered trains to electrified, high-capacity DART trains and increasing the frequency of trains from 6 to 12 trains per hour per direction. The hourly passenger capacity will increase from 5,000 to 13,200. The project will involve the electrification of approximately 40 km of railway line (or the permanent way) from the Dublin City Centre to west of Maynooth, and to M3 Parkway Station and all associated supporting infrastructure. The electrification of the rail line is located predominantly within the existing railway corridor within Iarnród Éireann/CIÉ owned lands however some works will involve the acquisition of private lands to facilitate the project.

The principal infrastructure components of the proposed development are as follows:

- Electrification and re-signalling of the Maynooth and M3 Parkway lines (approximately 40km in length).
- Capacity enhancements at Connolly Station (to include modifications to junctions and the station) to facilitate increased train and passenger numbers.
- Construction of a new Spencer Dock Station, which will better serve the north Docklands area and improve interchange with the Luas and support sustainability mobility.
- Closure of six level crossings (Ashtown, Coolmine, Porterstown, Clonsilla, Barberstown and Blakestown) and provision of replacement access infrastructure (road bridges and/or pedestrian and cycle bridges, as required). There is no replacement access infrastructure proposed at Blakestown level crossing.
- Construction of a new DART depot facility west of Maynooth to facilitate the maintenance and parking (stabling) of trains.
- Interventions at existing bridges along the rail line where there are insufficient clearances for the overhead electrification equipment. (Interventions may include track lowering, bridge modifications and/ or a combination of both) and
- Construction of substations, electrical buildings, and all other civil and ancillary works as necessary to accommodate the project.

The proposed development is described from east to west from Dublin City Centre (Connolly Station/Spencer Dock Stations) to M3 Parkway Station and then reverts back to Clonsilla (east) and continues west to the proposed depot located west of Maynooth. For the purposes of describing the DART+ West project in this EIAR the description of the proposed development has been divided into six geographical zones.

The EIAR zones are described in Table 4-1 and shown in Figure 4-2.

Table 4-1 DART+ West geographical zones

Zone	Location	Description
Zone A	Loop Line Bridge to Phibsborough/Glasnevin (on GSWR line) and East Wall Junction (on Northern line)	Loop Line Bridge (northern side) to Glasnevin (Glasnevin Jct) on GSWR line (largely on viaduct) (including Cabra compound). Connolly Station to East Wall Junction (Tolka river Bridge) on the Northern Line.
Zone B	Spencer Dock Station to Glasnevin Junction	Spencer Dock Station to Phibsborough/Glasnevin (Glasnevin Jct) on MGWR line (largely in cutting)
Zone C	Glasnevin junction/Phibsborough to Clonsilla Station/Junction	Phibsborough/Glasnevin (Glasnevin Jct) to Clonsilla Station (Clonsilla Jct)
Zone D	Clonsilla Station/Junction to M3 Parkway Station	Clonsilla Station (Clonsilla Jct) to M3 Parkway Station (M3 Parkway terminus)
Zone E	Clonsilla Station/Junction to Maynooth Station	Clonsilla Station (Clonsilla Jct) to Maynooth Station

Zone	Location	Description
Zone F	Maynooth Station to Depot	Maynooth Station to Maynooth Depot doubling the track

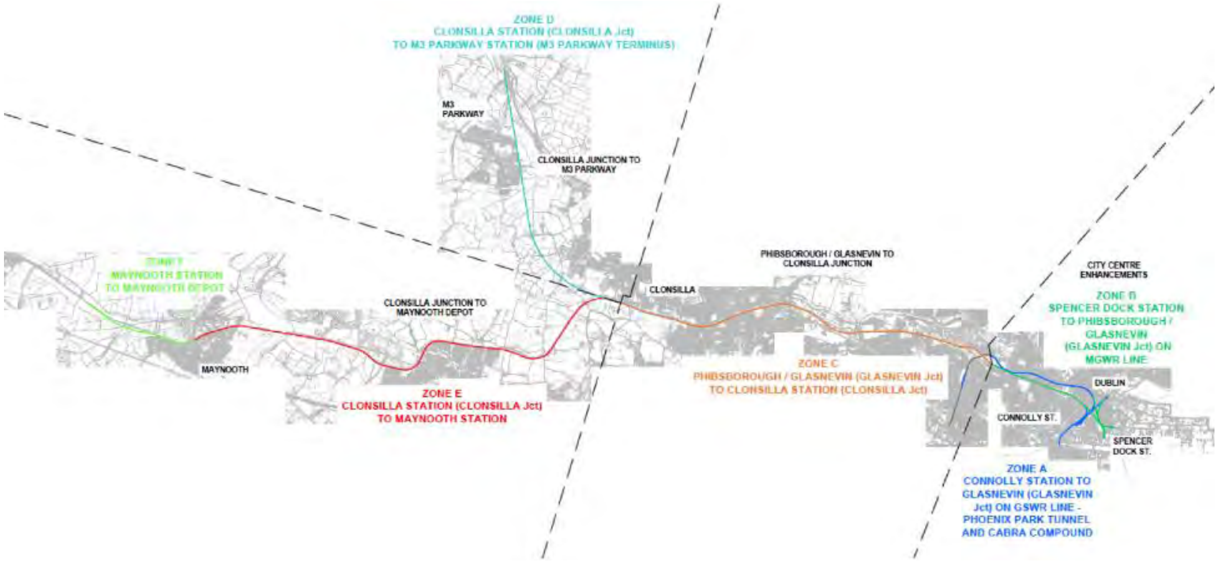


Figure 4-2 DART+ West geographical zones

4.4 DART+ Design Standards

The DART+ West project will introduce electrified high-capacity trains at increased frequency for all stations. The proposed development will increase train services and thus increase passenger capacity. This will be achieved through modernisation of the track infrastructure, closure of level crossings and the purchase of a new fleet of trains.

The following sections provide a description of the main design elements of the proposed development. The elements have been designed with cognizance of the list of guidance documents and standards in Table 4-2.

Table 4-2 Design standards and guidance documents

Design Element	Standard
Roadworks (urban streets, bus facilities, cycle facilities and public realm)	The Design Manual for Urban Roads and Streets (DMURS)
	The National Cycle Manual (NCM)
	Design Manual for Roads and Bridges (DMRB), as relevant for certain technical elements
	The Traffic Signs Manual (TSM)
	BusConnects Design Guidance
Stations	Building Regulation 2010 – Technical Guidance Documents
Track	CCE (Chief Civil Engineer) Department Technical Standards
Depot	Building Regulation 2010 – Technical Guidance Documents
	CME (Chief Mechanical Engineer) Department Standard
HV Power System	SET (Signalling, Electricity and Telecoms) Department Standards
Signalling System	SET (Signalling, Electricity and Telecoms) Department Standards
Communications System	SET (Signalling, Electricity and Telecoms) Department Standards
OHLE System	SET (Signalling, Electricity and Telecoms) Department Standards

Design Element	Standard
Drainage Design	Greater Dublin Regional Code of Practice for Drainage
Utilities Diversions	Irish Water Code of Practice for Water Infrastructure
	Irish Water Code of Practice for Wastewater Infrastructure
	Gas Network Ireland Code of Practice
	ESB Code of Practice
Structures	Design Manual for Roads and Bridges (DMRB), as relevant for certain technical elements
	Eurocodes
	Irish Building Regulations
	IÉ Structure Standards

To ensure the successful delivery of the DART+ West project, the project management procedures in Iarnród Éireann standards are considered, along with the NTA project management guidelines.

There are different operational departments in Iarnród Éireann, each of them in charge of the operation and maintenance of the different subsystems of the railway system. As a result of this there are also numerous different standards. In relation to the proposed development, from the technical point of view, the most important are CCE (Chief Civil Engineer) Department Technical Standards which gives the minimum engineering requirements for track construction, track alignments, layouts and components; SET (Signalling, Electricity and Telecoms) Department Standards which must be followed to design the systems according to IÉ requirements; CME (Chief Mechanical Engineer) Department Standards which set out the requirements for the management of CME Depot facilities and equipment. IÉ has other standards regarding operation, stations, rolling stock and maintenance that also must be followed. NTA general guidelines and TII standards have been considered when necessary to ensure compliance with their respective requirements.

IÉ promotes a culture of safety within the organisation. Consequently, IÉ has implemented a Safety Management System by which IÉ meets its legal obligations and delivers safety policy objectives. The SMS recognises that cultural and behavioural issues are fundamental to the delivery of safety. The SMS has a suite of standards which defines the policy, scope, key elements and implementation parameters, these standards must be followed to ensure the compliance with the legal requirements.

4.5 DART+ West Design Elements

This section provides a description of the general linear works required along the full extent of the proposed development to enable the electrification of the line and the upgrade of the existing network. These works are described in the following sections.

HV (high voltage) traction substations and Overhead Line Equipment (OHLE) will be required to provide electrical power to the network's new electrified train fleet. This will be similar to that currently used on the DART network. Detailed information of high voltage substations is provided in Section 4.5.15.3, and for OHLE in Section 0.

Signalling upgrades and additional signalling furniture will be required for the upgraded infrastructure to allow the trains to run at a higher frequency. Signalling infrastructure will be required at intervals along the entire length of the line and will include the provision of low voltage power supply to provide power to the network and telecommunications buildings. Detailed information is provided in Section 4.5.7.

Improvements to boundary walls and fencing will be provided to ensure that public safety is maintained after the line's electrification. These improvements will require increasing the height of walls and parapets in some locations to provide the necessary protection and physical segregation between public areas and the electrified railway corridor. These works generally relate to parapet heightening on existing bridges. Detailed information is provided in Section 4.5.10.

Alterations to railway tracks, including minor realignments and track lowerings will be required at a number of locations along the tracks (typically existing bridges) to ensure that there is sufficient space for the overhead electrical lines. Detailed information is provided in Section 4.5.2

Utility diversions are required to accommodate new and upgraded infrastructure. Detailed information is provided in Section 4.5.13.

Vegetation management and other ancillary works are also required along the length of the proposed development.

The following sections provide an overview of the infrastructural elements that are common at multiple locations along the proposed development and hence, are not repeatedly described throughout the remainder of the chapter.

4.5.1 Stations

The DART+ West project includes different interventions in three existing stations and the construction of a new station in the Docklands. These stations, along with the associated works are identified in Section 4.5.1.1 below.

4.5.1.1 Station modifications

Station modifications are required in the following existing stations in order to enhance their capacity, accessibility and connectivity between platforms to facilitate increases in passenger capacity associated with the proposed development. Station modifications are required at:

- Connolly Station (Zone A).
- Ashtown Station (Zone C).
- Coolmine Station (Zone C).
- Maynooth Station (Zone F).

With regards to Connolly Station (see Section 4.6.3) a new entrance extending to Preston Street will be required to facilitate the additional passenger capacities. This will include redevelopment and refurbishment of Connolly Station vaults.

Ashtown station modifications consist of a general upgrade to accommodate the changes to traffic as a result of the proposed level crossing replacement. The proposed modifications aim to improve flow for pedestrians and vehicular traffic (see Section 4.8.5).

The proposed design for Coolmine station (see Section 4.8.13) also consists of general upgrades and renovations. These modifications are required to accommodate changes to pedestrian and vehicular traffic as a result of the level crossing replacement.

Proposed works at Maynooth consist of modifications to the existing platforms to adequately serve the new crossover and siding at this location. Further details are given in Section 4.11.3.

A new station will be constructed in the Docklands area on Mayor Street Upper adjacent to the Spencer Dock Luas Station. The new DART station (Spencer Dock) will not only provide access to the MGWR, GSWR and Northern lines (by means of the east wall branch) but will also provide interconnection between the lines. This station is located within Zone B.

4.5.2 Track

The proposed development requires trackwork along the route to alter the existing track alignment where necessary. The track works include the following:

- Changes to track vertical alignment: track works related to changes in the longitudinal profile of the track are necessary to ensure there is sufficient space to fit the electrical infrastructure under existing bridges along the route and, in some instances, to improve the track alignment in line with current standards. The track alterations typically include lowering the railway by approx. 30-60 cm (depending on the location) and associated drainage and utilities works. The alterations apply to track lengths of up to 1 km depending on the location. Changes to vertical alignment are detailed in Section 4.5.2.1.
- Changes to track horizontal alignment and track alterations: new tracks are necessary for the proposed development. The design of the new track alignment follows IÉ standards. It is also necessary to include new crossovers and sidings to improve the operation of the railway line. These activities are described in Sections 4.5.2.2 and 4.5.2.3.

The majority of the existing track along the extents of the proposed development consists of ballast track, though slab track will be constructed in Spencer Dock and its surroundings. Examples of ballast and slab tracks are shown in Figure 4-3 and Figure 4-4 respectively.

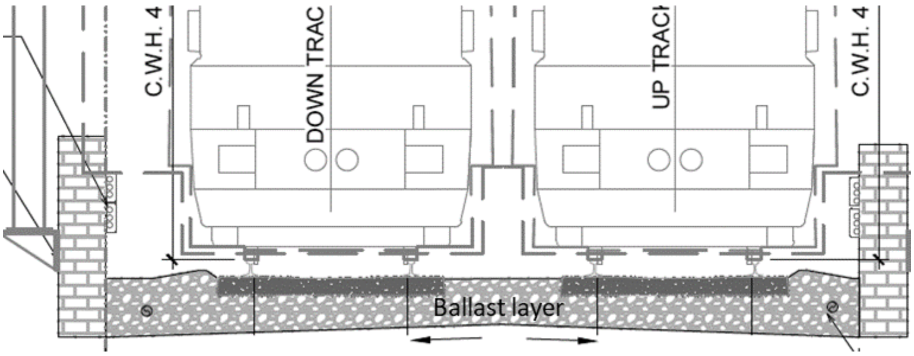


Figure 4-3 Example of ballast track

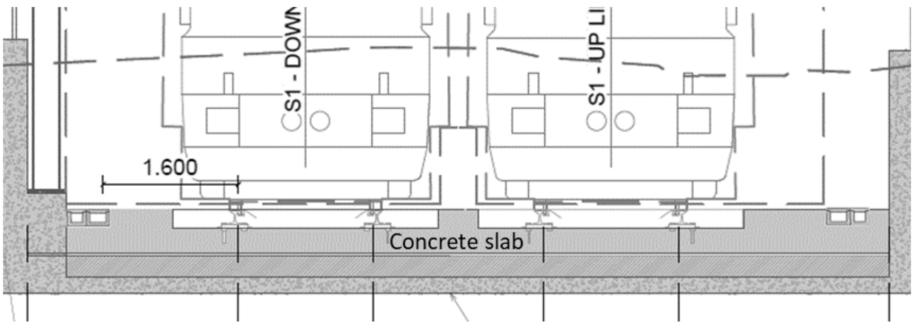


Figure 4-4 Example of slab track

4.5.2.1 Changes to track vertical alignment

Electrifying a railway requires sufficient distance between the Top of Rail (TOR) and any bridges/structures above it to ensure that the Overhead Line Equipment (OHLE) has sufficient clearance. Where insufficient clearance exists, and there is no option to reduce the OHLE clearance, the next solution is to lower the track under the bridge. Track lowering can only be achieved where there is sufficient space to maintain minimum required gradients under the bridges. If significant challenges exist in lowering the tracks, a structural intervention on the bridge is necessary; see Section 4.5.15.1.

Table 4-3 below lists the bridges where track lowering is proposed.

Table 4-3 Bridge structures with proposed track lowering works

Zone	Bridges
Zone A	Prospect Road Bridge (OBO11)
Zone B	Ossory Road Bridge (OBO36), Railway Bridge (OBO35, OBO35A), Railway Bridge (OBD227, OBD227A, OBD227B) Newcomen Bridge (OBD226, OBD226A, UBD233), Clarke's Bridge (OBD225), Clonliffe Bridge (OBD224), Binns Bridge (OBD223), Cross Guns Bridge (OBD222), Maintenance Bridge at Glasnevin (OBD221)
Zone C	M50 Roundabout/Navan Road Bridge (OBG7A)
Zone D	Barnhill Bridge (OBCN286), Dunboyne Bridge (OBCN290)
Zone E	Collins Bridge (OBG13), Pike Bridge (OBG18)
Zone F	n/a

4.5.2.2 *Changes to track horizontal alignment*

New track is proposed at the following locations:

- Proposed Spencer Dock Station.
- Off-line new double-track from Maynooth to the proposed depot.

For most design parameters, three types of limits have been adhered to in accordance with the CCE-TMS-340 Horizontal Curvature Design:

- Design Value and Desirable Limit – the recommended actual limit design value.
- Normal Limit – These values ensure that maintenance costs of the track are kept at a reasonable level.
- Exceptional Limit – their use is as infrequent as possible and has the permission of the Technical Manager, CCE.

The design parameters listed in Table 4-4 are used for horizontal alignment design.

Table 4-4 Limits for horizontal alignment design parameters

Parameters	Desirable limit	Normal limit	Exceptional limit
Radius [R]		200 metres	150 metres
Cant [D]	165 mm	165 mm	185 mm
Unbalanced lateral acceleration – CWR Track (a_q)	0.65 m/s^2	0.76 m/s^2	0.88 m/s^2
Cant Deficiency – CWR Track [I]	110 mm	130 mm	150 mm
Cant Deficiency – Turnouts and Crossovers [I]	90 mm		110 mm
Cant Excess [E]	90 mm	110 mm	
Cant Gradient [dD/ds]	2,50 mm/m	2,70 mm/m	
Rate of Change of Cant [dD/dt]	40 mm/s		60 mm/s
Rate of Change of Cant Deficiency dI/dt	40 mm/s		60 mm/s
Rate of change of unbalanced lateral acceleration da_q/dt	0.24 m/s^3	0.35 m/s^3	
Abrupt Change of Cant Deficiency for Points and Crossings ΔI V ≤ 100 km/h	100 mm	120 mm	
Abrupt Change of Cant Deficiency for Points and Crossings ΔI 100 < V ≤ 170 km/h	133-0,33V mm	141-0,21V mm	
Abrupt Change of Cant Deficiency for Plain Line ΔI V ≤ 70 km/h	50 mm		

Parameters	Desirable limit	Normal limit	Exceptional limit
Abrupt Change of Cant Deficiency for Plain Line ΔI 70 < V ≤ 70 km/h	40 mm		

4.5.2.3 Track alterations for TSS requirements

The Train Service Specification (TSS) addresses the basic operational requirements in terms of rolling stock, frequency of the railway services, peak hours, train routes, etc. For further detail refer to Section 4.12.11. From the modelling and operational analyses results, it has been determined that enhanced infrastructure is required to achieve the proposed TSS.

4.5.2.3.1 Sidings

A siding is a track for the marshalling or stabling of vehicles or where loading/unloading, servicing etc. is performed clear of the running lines.

New sidings are proposed in Clonsilla and at M3 parkway for the off-peak break. A current siding is to be upgraded in Maynooth in order to improve operation of the railway service.

4.5.2.3.2 Crossovers

Crossovers are track railway mechanical devices that allow trains to switch between rail lines to facilitate changes of direction, movement from one track to an adjacent track, or to form a continuous passage between two parallel tracks. Different types of crossovers will be implemented along the track alignment as required.

4.5.2.4 Cable Management System

The cable management system (CMS) relates to the infrastructure required to distribute and protect the required cables for the signalling, telecommunications, low voltage power and catenary feeders.

Lineside cable routes are usually one of the following types:

- Concrete trough route.
- Buried PCV buried.
- Elevated routes (metal trays).
- Elevated GRP troughing on posts.
- Catenary wire (supported by catenary system).

4.5.2.4.1 Concrete trough route

In general, a precast concrete trough solution has been considered as the most appropriate cable route option due to the shallow excavation required. This solution has been implemented wherever possible.

4.5.2.4.2 Buried PVC ducts

Buried PVC ducts will be considered at stations and locations where there is insufficient space to place either a concrete trough or a metal cable tray. Ducts will be surrounded by concrete for protection. Catenary feeders will always be placed in buried PVC ducts.

4.5.2.4.3 Metal cable trays

In areas where space is restricted, such as at bridge crossings, cables will be clamped to the walls/floor and protected with an omega profile. Installation of metal cable trays includes drilling and fixing to existing structures using handheld tools as per the design requirements.

4.5.2.4.4 Elevated GRP troughing on post

When space does not allow for the installation of a precast concrete trough, and metal cable trays are not feasible, the use of elevated GRP routes on posts is considered.

4.5.3 Rolling stock

The current DART fleet is composed of two types of Electrical Multiple Unit (EMU) the 8100 and the 8500 fleets. The 8100 EMU are the first electrical units of the DART fleet and are expected to be out of service in 2027/2028. The 8100 operates as 6-car and 8-car units with trailer and motor cars.

The 8500 fleet (8500, 8510 and 8520) will coexist with the new fleet, a basic unit configuration is a 4-car unit with two trailers and two motor cars, but most of the units will be coupled as an 8-car unit. The maximum length of the new rolling stock is 164 m. The width of the trailer is 2.9 m and the height is 3.87 m.

Córas Iompair Éireann (CIÉ) is in the process of purchasing the new EMU fleet for operation in the expansion of the DART network. The main features of the rolling stock are in line with the CIÉ standards regarding gauge and infrastructure and thus they shall be capable of operating on the routes stated in the Train Infrastructure Interface Specification (TIIS) (CME-NFP-TS-001). The units will operate as HLU (Half Length unit or 5-car unit) or FLU (Full length unit or 10-car unit). The requirements that must be covered by the Supplier of the new rolling stock are outlined in the DART Expansion Train Technical Specification (TTS 2019).

4.5.4 Depot

The depot design is set out in Section 4.11.12 and comprises the following components:

- Civil design: design of the tracks, road network, utilities, earthworks, landscaping, and the rest of the elements of the infrastructure.
- SET design: design of the signalling, electricity, and telecom systems for the depot.
- Structural design: design of the different buildings of the depot.
- MEP design: design of the installations for the depot (HVAC, lighting, water supply, drainage, water sewage system, power supply and firefighting installations).
- Architectural design: design of the buildings, functional areas, staff flows, means of egress, finishes, etc.

4.5.5 HV power system

HV (high voltage) power will be supplied to DART+ West at electrical substation buildings located at intervals along the line. A total of twelve electrical substations are necessary along the DART+ West project extents at the following locations:

1. Spencer Dock.
2. Glasnevin.
3. Ashtown.
4. Castleknock.
5. Coolmine.
6. Dunboyne.
7. M3 Parkway.
8. Hansfield.
9. Leixlip Confey.
10. Blakestown.
11. Maynooth.
12. Maynooth Depot (inside the Maynooth depot area).

Electrical power from the ESB network will be supplied to the substations, and it will be converted from 38 kV to 1,500 V direct current (DC) to power the overhead line electrical system. The electrical substation buildings are divided into two parts. One part for IÉ and one part for ESB. IÉ's part is approximately 6.0 m high x 31 m long x 11 m wide. ESB's part is approximately 5.0 m high x 16 m long x 10 m wide. T he substations will be located within a secure compound, behind palisade fencing for security purposes. Where practicable, substations have been located within CIÉ owned lands. They will have a similar appearance to the substation shown in Figure 4-5.

Figure 4-5 Sample electrical substation

4.5.6 Other technical buildings and cabinets

In addition to the substations, technical equipment cabins are required to support the signalling, electrical and telecommunication infrastructure. These have been located within existing CIÉ owned lands where possible, see Figure 4-6 for reference.

The types of cabins required along the extents of the proposed development include:

- MV 10kV substations, including customer switch room.
- Signalling Equipment Buildings (SEBs).
- Telecommunication Equipment Rooms (TERs).
- Principal Supply Points (PSPs) and Auxiliary Supply Points (ASPs) for low-voltage power.
- Track Paralleling Huts (TPHs).

Figure 4-6 Example equipment cabinet

The equipment cabins are typically fenced off for security. A sample set of cabins is shown in Figure 4-6 above. The approximate sizes of the different types of equipment cabins are detailed below:

- SEB size: 12.0 m x 4.0 m x 2.6 m (length x width x height).

- PSP size: 12.0 m x 4.0 m x 2.6 m (length x width x height).
- ASP size: 2.6 m x 2.0 m x 2.3 m (length x width x height).
- TER size:(internal dimensions): 3.6 m x 2.3 m x 2.6 m (length x width x height).
- TPH size: 4.9 m x 4.4 m x 2.6 m (length x width x height).
- MV substation size (including customer switch room): 7.0 m x 4.3 m x 2.6 m (length x width x height).

4.5.6.1 LV DNO

4.5.6.1.1 DNO general description

A Distribution Network Operator (DNO) consists of a cubicle which allocates the incoming power supply from the power distribution company (ESB).

DNOs will supply new Distribution Cubicles (DC), and DCs will in turn feed the lineside SET and Points Heating equipment. Figure 4-7 shows a schematic diagram of the electrical supply used in the DART+ West project.

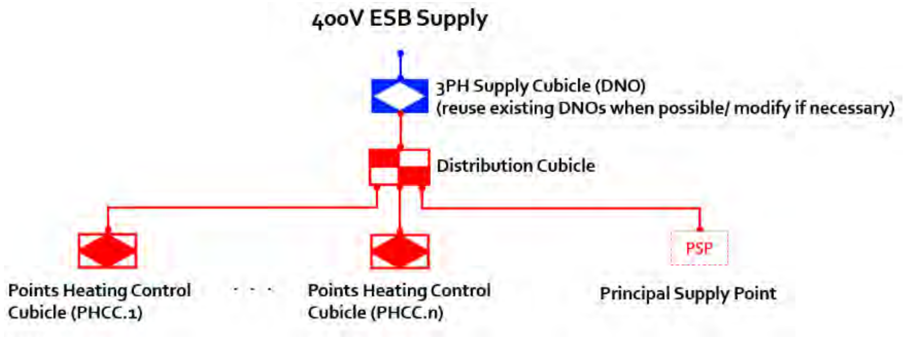


Figure 4-7 Electrical supply schematic diagram

In locations where a new ESB connection is needed, the solution will be to install a double sided DNO/Distribution Cubicle in the fence line, as shown in Figure 4-8. This presents the advantage of providing access to ESB without entering IÉ land, while also providing access to IÉ from the other side. A padlocked access gate would be located beside the cubicle to enable IÉ to access either side of the cubicle as required, avoiding the need to walk long distances trackside.

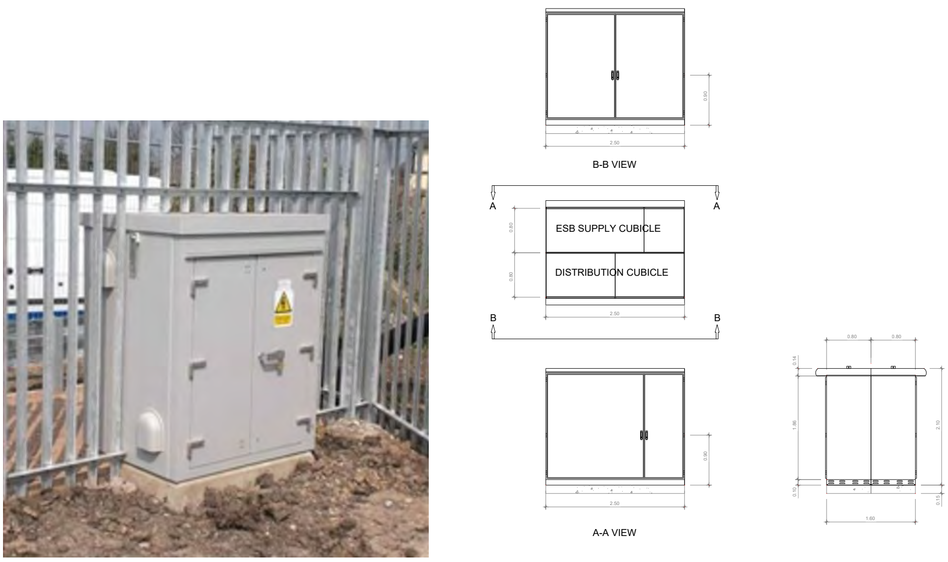


Figure 4-8 Double sided DNO/distribution cubicle

4.5.6.1.2 DNO along DART + West

Along the DART+ West line DNOs will be needed to supply power to Points Heating, telecom equipment and signalling equipment. Existing DNOs will be reused wherever possible and modified when necessary. New equipment will be requested if required; however, this is the last resort.

An assessment has been carried out to determine where DNOs can be retained, reused, or removed and where new DNOs will be required. The results of this assessment are depicted in Figure 4-9. The DNO statuses are colour coded as below:

- Blue: DNO to be reused.
- Green: DNO to be removed.
- Grey: DNO to be retained.
- Red: new double sided DNO/Distribution Cubicle.

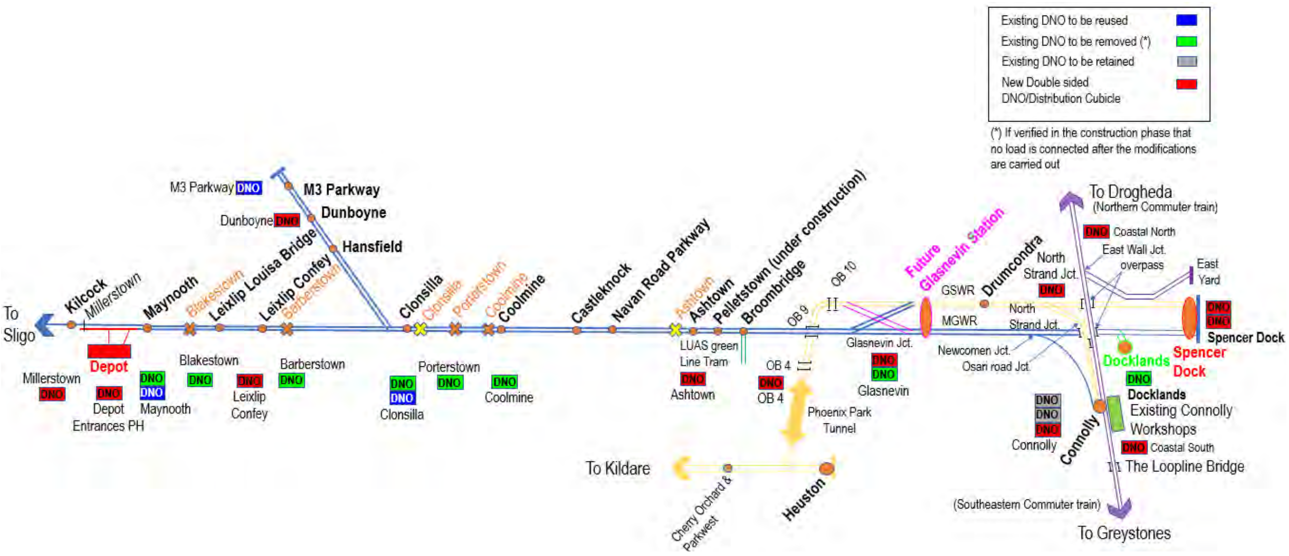


Figure 4-9 DNO provision on the DART+ West project

DNOs required for the proposed development are listed below:

- Spencer Dock (Abercorn Rd.).
- Spencer Dock (Ossory Rd.).
- Glasnevin.
- Interface with DART+ SW line.
- Ashtown.
- Connolly.
- Interface with DART+ Coastal North line.
- Interface with DART+ Coastal South line.
- North strand Junction Newcomen.
- Leixlip Confey.
- Millerstown.
- Depot Entrance (2 DNOs).

4.5.7 Signalling system

The existing railway incorporates signalling infrastructure along its length which includes underground cables, track level sensors and switches, and visible signals on posts or gantries that communicate instructions to the train drivers along the route. As part of the proposed development, the existing signalling system will be replaced with modern technology which will serve the more frequent train service. The proposed signalling system will incorporate similar components to those already in use on the DART line. Signal masts, signal gantries and location cases (LOCs) are depicted in Figure 4-10. An assessment has identified locations where structures (platforms, bridge platforms, gantries, cantilevers) could be required, for example to support areas with greater signal density or due to a lack of space. This is discussed in further detail in the sections below.

Figure 4-10 Sample DART+ West signalling infrastructure (cantilever, signal, LOC, from left to right)

Figure 4-11 illustrates a portal gantry. They will only be used in stations or areas with more than two tracks such as at Connolly Station and Spencer Dock.

Figure 4-11 Sample portal gantry

Cantilever signal structures are used when there is insufficient access to allow a signal mast to be used; or when land take issues preclude using a portal gantry. It consists of a single-legged structure erected over one or more railway tracks, carrying one or more signals. A typical cantilever signal structure is shown in Figure 4-12.

Figure 4-12 Sample cantilever signal gantry

As the existing railway line is currently operating with an associated signalling system, the new signalling infrastructure will need to be installed in parallel with the existing infrastructure to ensure that the existing system can continue to operate and track safety is maintained. For that reason, the current signalling system will be retained for the duration of the construction phase until installation of the new system has been completed.

Signal platforms are used in sections where, due to lack of space or because the embankment has a steep slope, it is necessary to install signalling elements such as LOCs or signals. Signal platforms are depicted in Figure 4-13.

Figure 4-13 Signal and LOC installed on a platform

Bridge platforms are used where it is necessary to install signalling elements and due to lack of space on the bridge, it is necessary to install suspended platforms. An example of signalling equipment installed on a bridge platform is shown in Figure 4-14.

Figure 4-14 Signalling equipment installed on a bridge platform.

As part of the design of the signalling system for the DART+ West project, an assessment has been carried out to identify potential locations for signalling equipment structures.

Particular attention has been given to areas where the Royal Canal is in close proximity to the track and the space available for installation of signalling equipment may be restricted. These areas are described in detail in the following section.

- The first potential platform area is shown in Figure 4-15. The area is located between Ch 52+900 and Ch 53+451 (in the vicinity of Crescent Park). The lack of space on the UP line at this location will make it necessary to build platforms for signalling equipment.

Figure 4-15 Potential platform area 1

- The second potential platform area is shown in Figure 4-16. The area is located between Ch 75+200 and Ch 75+540 (West of Leixlip Station). The lack of space on the UP line at this location will make it necessary to build platforms for signalling equipment.

Figure 4-16 Potential platform area 2

- The third potential platform area identified is shown in Figure 4-17. This area is located between Ch 76+020 and Ch 76+280 (East of Leixlip Louisa Bridge Station) and may include a bridge platform. The lack of space on the UP line at this location will make it necessary to build platforms for signalling equipment.

Figure 4-17 Potential platform area 3

In Dublin City Centre the tracks are mostly elevated and so, much of the installation of signalling equipment will have to be done on platforms and bridge platforms. The areas in Dublin City Centre that have been identified as requiring platforms for signalling equipment are indicated below.

- The first area in Dublin City requiring bridge platforms for signalling equipment is shown in Figure 4-18. This section is located between the River Liffey and Connolly Station.

Figure 4-18 Dublin City potential bridge platform area 1

- The second area in Dublin City requiring bridge platforms for signalling equipment is shown in Figure 4-19. This section is located between Connolly Station and OB013 along the GSWR line.

Figure 4-19 Dublin City potential bridge platform area 2

- The third and final area in Dublin City requiring bridge platforms for signalling equipment is shown in Figure 4-20. This section is located between Connolly Station and the Tolka River.

Figure 4-20 Dublin City potential bridge platform area 3

In addition to the locations identified for platforms and bridge platforms, one area has been identified as potentially requiring a cantilever signal gantry. This area is shown in Figure 4-21. On the DOWN line track, close to OBG13, the signal installation could affect the neighbouring properties due to its proximity to them. A potential solution would be to install a new cantilever on the opposite side of the track, further away from the properties.

Figure 4-21 Potential cantilever area near OBG13

The areas identified in the preceding section that will potentially require installation of structures to accommodate signalling equipment are indicative and subject to confirmation of sighting studies at detailed design stage.

4.5.8 Communications system

Telecommunications for a rail project are critical to ensure that all train movements are managed and regulated safely. Telecommunications provide a link between the remote signalman, the lineside signal/communications infrastructure and the train driver. Communications system infrastructure includes underground cabling, lineside telecom location cases and localised building infrastructure.

Telecommunications are essential in supporting the function of signalling controls, OHLE (overhead line equipment) and other electronically controlled infrastructure along the length of the track. The main communication devices/routers are located at the TERs (telecom equipment rooms). There are wired telecom assets at stations consisting of CCTV, loudspeakers and public information displays for passengers, lineside telephones for maintenance and operations, and other minor wired subsystems. The GSM-R standard (Global System for Mobile Communications – Railway) is a system which allows wireless communication between train drivers and signalling controllers at high speeds, with no loss of communication. The system utilises a radio communication network based on GSM-R technology, which is a variant of traditional GSM, with additional features tailored to the railway environment. This is an existing project to unify the rail communications nationwide, and the DART+ Programme will integrate with the GSM-R project. The DART+ West project will require the GSM-R project to include some additional equipment near the proposed depot to provide coverage to the depot itself (please note that this is a preliminary conclusion to be confirmed during the construction phase). The equipment may include a base station (BTS) installed in a cabinet (LOC), antennas and a pylon (estimated to be no higher than 10 m). The figure below shows an approximate location of the new GSM-R site, which is preliminary and needs to be confirmed after the construction of the depot buildings.

Figure 4-22 Potential location of new GSM-R pylon

The new communications infrastructure will be installed in parallel to the existing, and migration from one system to the other is foreseen.

The proposed DART+ West project involves construction of a new station at Spencer Dock, which will also require GSM-R coverage. A preliminary study of the coverage in the area has concluded that no new GSM-R infrastructure is needed other than a potential new repeater inside the station. This needs to be confirmed once construction of the station has been completed.

4.5.9 OHLE system

The Maynooth and M3 Parkway rail lines will be electrified to support new Electrical Multiple Unit (EMU) trains. The method of electrification is overhead line equipment (OHLE) at 1500 Vdc.

To support the OHLE, portal structures, masts, etc., will be installed along the line, including at the proposed depot. The OHLE support structure type will vary depending on the location and system requirements.

Typical spacing between OHLE support structures will be between 40 m and 50 m, with a maximum spacing of 65 m. The OHLE support heights vary between 6.5 m and 8.5 m.

Vegetation clearance and management for the safe operation of the OHLE equipment shall ensure that vegetation is kept at least 1.5 m from the rear of the OHLE mast or 1.5 m from any wire running between masts.

Apart from its visual impact, the OHLE also generates electromagnetic fields. For that reason, EMC (electromagnetic compatibility) needs to be assessed for each adjacent neighbourhood; to allow for safe design, including earthing and bonding. An EMC assessment has been carried out for the DART+ West project, see Chapter 22 Electromagnetic Effects and Stray Current in Volume 2 of this EIAR.

The appearance of the OHLE design will be similar to that used on the existing DART, as shown in Figure 4-23.

Figure 4-23 Current DART cantilever layout

The following images (Figure 4-24 to Figure 4-26) contain examples of typical OHLE cross-sections that will be used for the proposed development. Due to spatial constraints, single track cantilever is the most common OHLE design. Twin track cantilever is used when there is space available on only one side of the track. Back-to-back cantilever is used (in limited locations) when there is space available between the tracks. Finally, portals are used in viaducts (with sufficient vertical clearance) and at stations where multiple tracks are present.

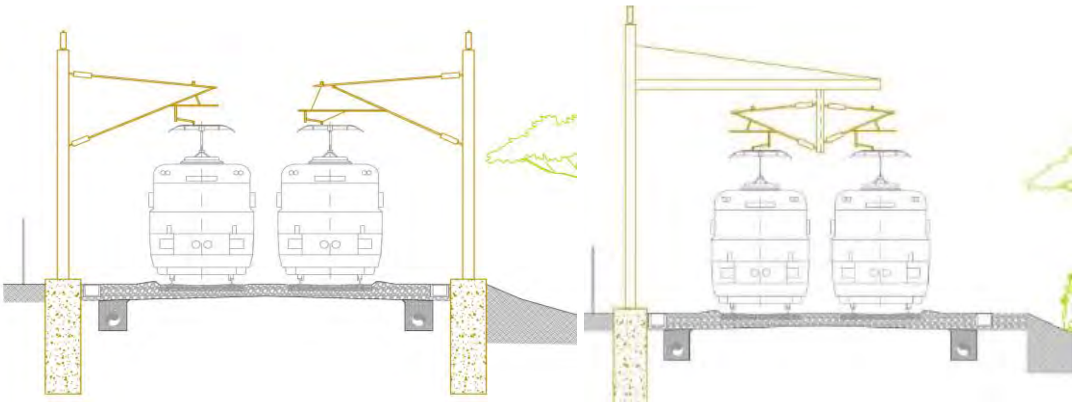


Figure 4-24 Single track cantilever cross section (left) and twin track cantilever cross section (right)

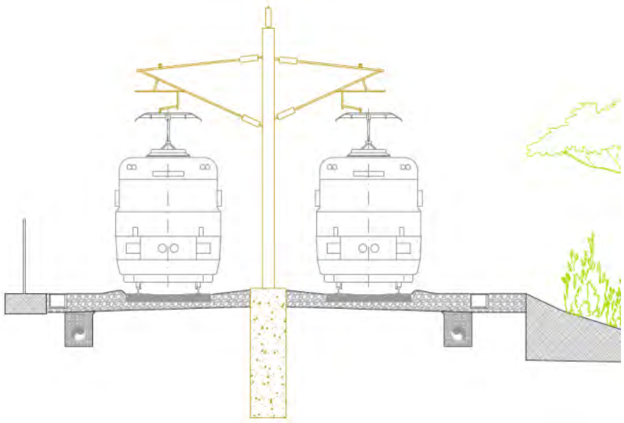


Figure 4-25 Back-to-back cantilever cross section

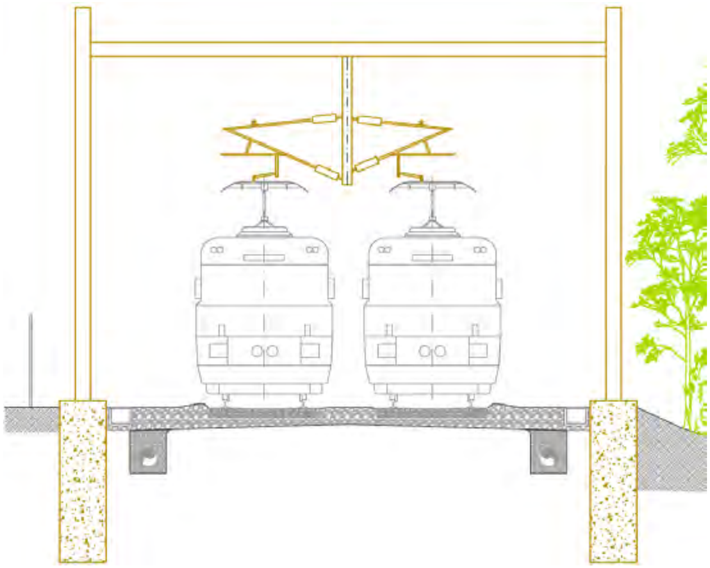


Figure 4-26 Portal cross section

4.5.10 Fencing and boundary treatment

Security of the railway against trespass and vandalism is an essential aspect of the proposed development. It is necessary to ensure that security measures (such as fencing) are put in place to prevent unauthorised access to railway infrastructure. Areas where security measures will be required are:

- Spencer Dock Station area.
- SET buildings (Substation, TER; SEB, others).
- Depot at Maynooth.
- New double track from Maynooth to the Depot.
- Closed level crossings.
- New permanent compounds.
- Fencing which requires restitution due to the impact of the construction works.

The following section details the types of fencing that will be provided on the DART+ West:

Palisade fencing: 2.4 m or 2.65 m palisade fencing shall be placed along railway boundaries, around substations, at level crossing closures, around the Depot area and at other locations to prevent trespass. Palisade fencing can be seen in Figure 4-27.

Figure 4-27 Palisade fence example

Open mesh steel panel fencing for general purpose: open mesh steel panel fencing BS 1722-14:2006 category 1 (Paladin fence) shall be placed in urban areas to prevent trespassing and electrocution. It is used in urban areas where palisade fencing is not required. General purpose fencing is shown in Figure 4-28.

Figure 4-28 General purpose fence example

4.5.11 Drainage design

The main principles of a surface water drainage system are to:

- Prevent the track formation from becoming softened by the presence of water by carrying the flow of rainwater to an outfall.
- Reduce flooding of the track.
- Minimise the risk of blockage or leakage.
- Be accessible for clearing blockages.

- Be adequately protected from accidental damage from sources such as traffic, ground settlement and tree roots.
- Be adequately protected from accidental pollution from foul drain discharge, oil spillages or other pollution sources.

New drainage has been proposed at the following new track sections:

- Spencer Dock slab track: a new drainage system will be provided for the entrance/exit tracks of the proposed Spencer Dock station, MGWR, GSWR, East Wall Chord connection and station tracks. Due to the low ground level at the station (-3.30 m OD Top of Rail), it is a requirement to install an attenuation tank and a pumped system that outfalls to the Newcomen bridge (OBD226) outfall point to the Royal Canal.
- New lineside drainage is required for the double-track between Maynooth (including the station) and the proposed Depot. The first track sections outfalls to the UBG21A. From the OBG23 track diversion to the end, the outfall of the drainage is to the Lyreen River and the adjacent stream.

Track lowering or realignment: the drainage system in sections where track lowering is required will include the following:

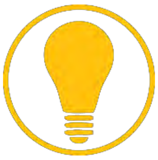
- OBD221-OBD222: The drainage proposal consists of gravity drainage from OBD221 discharging to an existing open ditch that connects with the OBD223 drainage system and outfalls to the Royal Canal (existing outfall).
- OBD223: The drainage proposal consists of gravity drainage from OBD221 discharging to an existing connection at OBD223 to the Royal Canal.
- OBD224-227: The proposal is a gravity drainage solution discharging into an existing connection to the Royal Canal at OBD226. As this outfall is under the canal level when the water level rises, an auxiliary pumped system is also proposed.
- OBO11: Existing carrier drainage runs parallel to the Down line and outfalls into a gravity foul at Claude Rd. A track lowering of 250 mm at the structure means that two existing UTX drainage connections will be impacted. As part of DART+ West, it is proposed to modify the existing carrier drain to allow the track lowering, maintaining a fall of 0.12% towards the outfall at Claude Rd. A collector drain will be installed on both sides of the track and will connect at intervals to the gravity drain.
- OBG7A: A collector drain will be installed on both sides of the track and will connect at intervals to the gravity drain. The outfall proposal is the existing UBG6A culvert.
- OBG13: The drainage proposal consists of gravity drainage from 300 m west of OBG13, discharging to an open ditch.
- OBG18: The vertical alignment low point drainage proposal is a gravity drain from the low point discharging at UBG18A. A gradient of 1 in 1.675 (0.06%) is required to achieve gravity drainage at this location, with an outfall at the lower level of UBG18A.
- OBCN286. The track under the OB currently has an existing drainage system. This existing drainage will be modified to accommodate the new track levels.
- OBCN290. The track under the OB currently has an existing drainage system. T his drainage is not impacted by the track lowering so minor maintenance holes/catchpits adjustments are proposed. OBO36: A drainage solution to mitigate the risk of service interruption due to a potential flooding issue will be required. The solution shall consider the track lowering at the low point and the proximity of the water table and should keep the line in service with optimal conditions for the EMUs.

The new M3 Parkway siding requires earthworks, realignment of existing track and a new crossover placement. These works impact the existing drainage which will be modified accordingly.

To allow this, additional drainage piping will extent to the new track and be connected back to the existing lineside drainage.

4.5.12 Energy efficiency

The energy efficiency approach in the DART+ West project is aligned with the following three key aspects:



- Energy: the proposed development will promote energy saving with a cost-optimal approach by: reducing the energy demand with passive architectural strategies, reducing energy consumption with energy-efficient equipment and producing energy with renewable technologies. Energy is also related to CO2 emissions and IÉ's future Carbon Neutrality goal. Architectural design will consider NZEB (Nearly Zero Energy Building) strategies.

- Water: the proposed development will aim to minimise potable water consumption using low consumption fixtures and through recycling and reuse of greywater.

- Materials: the proposed development will prioritise the use of environmentally friendly materials and the use of recycled and recyclable materials.

4.5.13 Utilities diversion

Existing utilities such as watermains, electricity cables, telecommunications cables and gas mains, both underground and above ground, will require temporary and/or permanent diversion to accommodate the proposed development. These diversions will typically involve relocating the existing services along new routes to make space for the new infrastructure.

Information regarding location-specific utilities' clashes and required diversions are detailed in depth in Chapter 18 Material Assets: Utilities in Volume 2 of this EIAR.

4.5.14 MSDC

At least one main storage and distribution centre (MSDC) will be required to provide materials to the SET construction compounds that will be located along the line, reducing the required local storage space. The chosen site is a property 20 km north-west of Dublin Airport (see Figure 4-29) and it covers an area up to 25 acres.

Figure 4-29 Location of main storage and distribution centre

The objective of this MSDC is to support the SET works for the DART+ West project, providing a main storage area to act as a buffer between material imports and delivery to SET compounds, as well as an area to pre-assemble, test and pack the materials to be delivered to the local area compounds as required.

The selection criteria followed for the study of the MSDC location has been included below:

- Strategic location with access to major road network.
- Adequate size to allow storage of material to serve 1-2 month construction works.
- Secure location, including security fencing and adequate lighting.
- Provide adequate work environment to staff including basic office and welfare facilities and parking spaces.
- Minimise the preparatory works to make the centre operational, providing:
  - Boundary fencing.
  - Flat area to minimise required earthworks.
  - Hard stand for SET material storage and loading/unloading areas.

The following areas will be provided inside the compound:

- Sensitive material storage warehouse 900 m^2.
- Assembly Shed 250 m^2.
- Welfare facilities 150 m^2.
- Office 100 m^2.
- Staff parking 320 m^2 (for 40 employees).

4.5.15 Ancillary infrastructure provision

There are several distinct components or treatments common across the extent of the development at specific locations. To avoid repetition, these are described below to include:

- Interventions at bridges to obtain necessary OHLE clearance.
- Level crossing removals.
- Construction of electrical substations and other ancillary equipment associated with signalling, electrical and telecommunications infrastructure: telecommunication equipment rooms (TER), signalling equipment buildings (SEB), principal supply points (PSP) and auxiliary supply points (ASP) for low-voltage power.
- Compounds.
- Parapets heightening to a minimum height of 1.80 m for bridges over railway according to relevant standards and to avoid the risk of electrocution when installing the new OHLE masts in accordance with EN 50122-1:2011.

An overview of the works is discussed in the following sections. The unique arrangements, specific to each location, are described in detail in Sections 4.6 to 4.11.

4.5.15.1 Interventions at bridges to obtain necessary OHLE clearance

Sufficient clearance at bridges is a critical requirement for DART+ West, as there needs to be sufficient space between the roof of trains and the underside of the bridge to accommodate the new overhead electrification system. Alternative design solutions have been studied at each of the locations where there is insufficient clearance. These solutions include the following:

- Provision of special reduced clearance OHLE solutions.
- Lowering of the railway track with measures to protect against flooding and to ensure rail stability.
- Modification of existing bridges.
- Where bridge deck reconstruction is proposed, the proposed bridge shall provide equivalent standard of connection for vehicles and pedestrians as the existing bridge.
- Realignment of the rail corridor.

Table 4-5 Summary of overbridge intervention locations

Overbridge no.	Local Authority	Common name	Intervention
OBD227/227A/227B	Dublin CC	Railway bridge	Track lowering
OBD226	Dublin CC	Newcomen Bridge	Track lowering
OBD225	Dublin CC	Clarke's Bridge	Track lowering
OBD224	Dublin CC	Clonliffe Bridge	Track lowering
OBD223	Dublin CC	Binn's Bridge	Track lowering
OBG5	Dublin CC	Broome Bridge	Bridge deck reconstruction on this protected structure (National Inventory of Architectural Heritage has included the railway and canal bridges under reference 50060126)
OBG7A	Fingal CC	M50 Roundabout/Navan Road	Track lowering
OBG7C	Fingal CC	M50 Roundabout	Reduced height OHLE solution
OBG9	Fingal CC	Old Navan Road Bridge	Bridge deck lift on this structure
OBG11	Fingal CC	Adjacent to Granard Bridge	Bridge deck reconstruction on this protected structure (National Inventory of Architectural Heritage has included the railway and canal bridges under reference 11354002)
OBG13	Fingal CC	Adjacent to Collins Bridge	Track lowering

Overbridge no.	Local Authority	Common name	Intervention
OBG14	Kildare CC	Adjacent to Cope Bridge	Bridge deck reconstruction and widening on this structure
OBG16	Kildare CC	Louisa Bridge	Bridge deck lift on this structure
OBG18	Kildare CC	Pike Bridge	Track lowering
OBG23	Kildare CC	Jackson's Bridge	Construction of offline track and a new bridge. The proposed OHLE design will not pass under this OB, and therefore no intervention is expected on this structure.
OBCN286	Fingal CC	Barnhill Bridge	Track lowering
OBCN287	Meath CC	Stirling Road Bridge	OHLE solution
OBCN290/290A	Meath CC	Dunboyne Bridge	Track lowering
OBO35/35A	Dublin CC	Railway bridge	Reduced height OHLE solution
OBO36	Dublin CC	Ossory Road Bridge	Track lowering solution (Spencer Dock Slab track)
OBO11	Dublin CC	Cross Guns (on Prospect Road)	Track lowering
OBD222	Dublin CC	Cross Guns (Westmorland Bridge)	Track lowering
OBD221	Dublin CC	Maintenance bridge at Glasnevin	Track lowering

In general, where low impact solutions were not viable, other options were considered. The details of the options studied and assessments undertaken are included in Chapter 3 Alternatives in Volume 2 of this EIAR.

The development requires common structural interventions in some locations, consisting of:

- Modifying an existing flat deck bridge by raising the existing bridge deck between 200 mm and 320 mm. This solution is proposed at Old Navan Road Bridge (OBG9) and Louisa Bridge (OBG16).
- Modifying an existing arch bridge with a replacement precast arch to a higher profile and altering the spandrel and parapet walls. This solution applies to Broome Bridge (OBG5), Castleknock Bridge (OBG11) and Cope Bridge (OBG14).
- Where replacement access or track realignment is proposed in a distinct area, the bridge modifications are addressed in Sections 4.6 to 4.11 below.

4.5.15.2 Level crossing removals

The main aim of the DART+ West project is to increase train frequencies and passenger capacity. Level crossings are a significant constraint to railway operation and surrounding road networks, causing congestion and increased journey times for all modes of transport, including pedestrians and cyclists. The existing level crossings along the line include:

- Ashtown.
- Coolmine.
- Porterstown.
- Clonsilla.
- Barberstown.
- Blakestown.

These are located from east to west: Ashtown, Coolmine, Porterstown, Clonsilla, Barberstown and Blakestown. The level crossings constrain railway capacity due to the need to share the interface with cars, pedestrians and cyclists. Studies to support the proposed development have shown that it is not viable to retain the level crossings in their current form (or with enhancements) and also deliver the proposed enhancement to the rail passenger service successfully. Therefore, the permanent removal of the level crossings is required to achieve the increased train frequency.

Removing the level crossings will improve train efficiencies, enhance safety, and remove the delays caused by the road/rail interface. Their closure will also remove the periodic blockages on the road system, which are currently very pronounced, especially in the morning and evening peak commuter periods (for example, the Ashtown and Coolmine level crossings are closed for approximately 36 minutes and 40 minutes respectively between 08.00-09.00 each weekday).

On removal of the level crossings, the boundary of the railway will be secured with palisade fencing 2.4 m high which will allow Córas Iompair Éireann maintenance access to the railway. Existing rights of way will be extinguished across the line.

Where existing usage patterns of the level crossings exhibit significant activity, alternative equivalent access will be provided by bridges and other roadworks. The infrastructural proposal in respect of each level crossing is described in the relevant section of this chapter (Sections 4.6 to 4.11).

4.5.15.3 Electrical substations and technical buildings

This section provides a detailed description of the traction substations (or substations).

Characteristics

- The exterior and the access of the substations must be illuminated with enough lighting to assure the mobility and the security of any operation during the night.
- Approximate substation dimensions (including IÉ and ESB parts): 48 m x 11 m x 6 m (length x width x height).
- A driveway shall be established to allow for vehicle and pedestrian access to the building. The minimum road access width required by ESB is 4.5 m. The provision of parking spaces for each substation shall also be ensured.
- The finishing proposed for the substations is grey brick/blocks, keeping the same architectural finishes as the existing Iarnród Éireann substations.

A Traction Power Simulation Study has been undertaken. Its output determines the substations required in terms of quantity and location and establishes the power requirements (in MVA) by network and by line. The substations are fed in 38 KV from two ESB connections. The supply is conditioned and converted into a 1500 V DC supply and then connected to the OHLE system. Figure 4-30 shows the typical substation layout, including the ESB area (left) and the IÉ area (right). There is a dual locking system at the entrance of the compound, so that both ESB and IÉ have access.

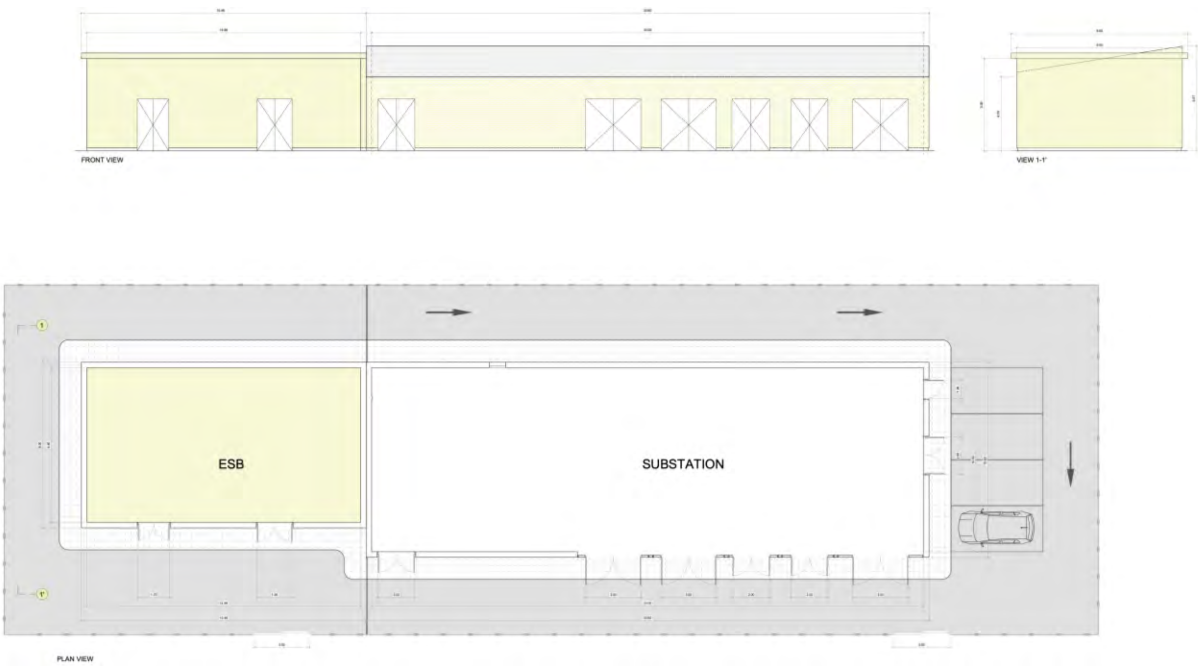


Figure 4-30 Substation layout

The power demand or maximum import capacity (MIC) for each substation (worst case scenario) is presented in Table 4-6:

Table 4-6 DART+ West substations

Substation	Maximum Import Capacity (MIC) in MVA (worst case scenario)
Spencer Dock	3.831
Glasnevin	4.371
Ashtown	4.110
Castleknock	3.751
Coolmine	4.259
Leixlip (Confey)	3.066
Blakestown	2.501
Maynooth	1.873
Depot	6.667
Hansfield	2.393
Dunboyne	1.344
M3 Parkway	1.178

In addition to the substation, some equipment cabins are required to support the signalling, electrical and telecommunication infrastructure. These will be located within existing CIÉ lands where possible and will typically be in stations where similar cabins are currently located.

The various cabins required along the works are described below.

4.5.15.3.1 Signalling Equipment Buildings (SEBs)

Signalling Equipment Buildings (SEBs) centralise all the necessary electronic equipment in locations with a high density of signalling elements, such as at stations and in the surrounding areas. SEBs are where the physical connection between the field equipment (signals, axle counters, track switches, etc.) and the electronic equipment occurs.

SEBs should be located as close as possible to the existing technical buildings to facilitate migration, reduce the duration of works and avoid other constraints (accesses., new compounds, etc.). Examples of SEBs are depicted in Figure 4-31 and Figure 4-32.

The locations of the SEBs are listed below:

- Millerstown SEB.
- Maynooth SEB.
- M3 Parkway SEB.
- Clonsilla SEB.
- Glasnevin SEB.
- Spencer Dock SEB.
- Connolly SEB.

Characteristics

- SEB size: 12 m x 4 m x 2.6 m (length x width x height).
- An external lighting system with motion control will be required in addition to those in the building itself.
- No connection to the Irish water network is required.
- The new SEBs will comply with existing regulations and will not be a source of noise or odour.
- Additionally, the new SEBs shall not emit more noise than those they are replacing.
- The new SEBs will issue no EMF type emissions.
- The energy demand of these buildings will be approximately 18 kW.
- The buildings shall only be accessed occasionally for maintenance work.

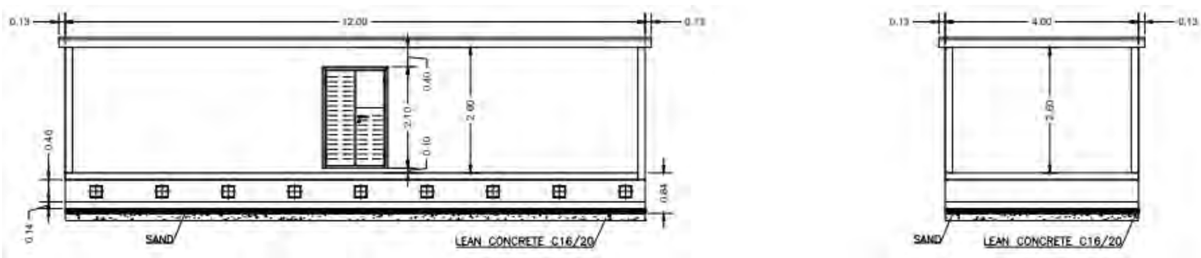


Figure 4-31 SEB dimensions

Figure 4-32 Examples of existing SEBs

4.5.15.3.2 Telecommunication Equipment Rooms (TERs)

Telecommunication Equipment Rooms (TERs) house servers, storage devices, switches, routers, cabling patch panels and any additional passive electronics associated with telecoms systems (access control, CCTV, intrusion detection, patch panels, public address system, voice announcement system, distributed antenna systems). This is where the physical connection between the telecoms related field equipment (station CCTV, telephones, etc.) and the electronic equipment occurs. Typical details of TERs are shown in Figure 4-33 and examples are shown in Figure 4-34.

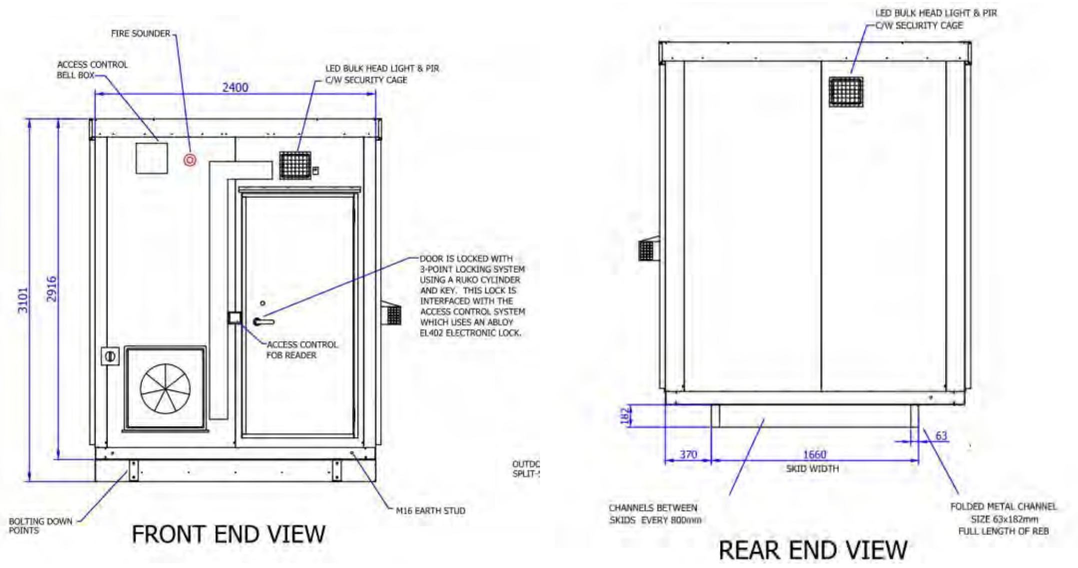


Figure 4-33 TER details

Characteristics

- TER minimum size (internal dimensions): 3.6 m x 2.287 m x 2.6 m (length x width x height). A separate external lighting system with motion control will be required for each TER.
- TERs should be located as close as possible to the centre of stations.
- No connection to the Irish Water network is required.
- The TER will contain cabling, servers, routers, switches, or recording devices (CCTV). It will not contain any active amplification or radiating equipment.
- The new TERs will issue no EMF type emissions.
- The energy demand of this type of building will be approximately 2 kW.
- The new buildings will not require vehicular access, except to allow occasional maintenance vehicles to park nearby.
- TERs will only be accessed occasionally for maintenance or repair activities.
- The external architectural finish for the new TERs will match the existing TERs.

Figure 4-34 Existing TER at Coolmine Station (left) and in Ashtown (right)

TERs will be installed at the following locations:

- Maynooth Station.
- Leixlip Louisa Bridge Station.
- Leixlip Confey Station.
- Porterstown Station.
- Coolmine Station (after carrying out a survey, it was confirmed that there is insufficient space in the current TER to host the new telecom equipment. Consequently, a new TER is needed in Coolmine).
- Castleknock Station.
- Navan Road Parkway Station. There is insufficient space in the current TER to host the new telecom equipment and for that reason, a new TER is needed for this site.
- Ashtown Station. There is insufficient space in the current TER to host the new telecom equipment and for that reason, a new TER is needed at Ashtown.
- Broombridge Station.

The following stations have sufficient space to install a TER inside the station:

- Spencer Dock.
- Connolly.

In Spencer Dock Station, a potential new GSM-R site is being considered to provide signalling coverage in the area. The necessity for this will be confirmed at detailed design stage.

For the rest of the stations, where the existing TERs or SEBs are in good condition, they will be maintained in-situ.

4.5.15.3.3 Principal Supply Points (PSPs) and Auxiliary Supply Points (ASPs) for Low-Voltage Power

There are two types of buildings that supply low voltage electricity to all other facilities. They are called Principal Supply Points (PSPs) for the main supply and Auxiliary Supply Points (ASPs) for auxiliary supply. Both buildings are independent of each other. The PSP locations match those of the SEBs, and the ASPs are included to cover gaps in the areas supplied by PSPs. The location of the PSPs and the ASPs are as follows:

- Millerstown PSP.
- Maynooth PSP.
- Leixlip Confey ASP.
- M3 Parkway PSP.
- Dunboyne ASP.
- Clonsilla PSP.
- Ashtown ASP.
- Glasnevin PSP.
- Spencer Dock PSP.
- Connolly PSP.
- Interface with DART+ SW line ASP.
- Interface with DART+ Coastal North line ASP.
- Interface with DART+ Coastal South line ASP.

PSP buildings distribute the necessary Low-Voltage (LV) power from the given source to the SEB buildings and to the feeders that feed the signalling along the line. The ASP board provides electrical power back-up to the feeders in the case of failure of a PSP.

The minimum size requirements for PSPs are 12 m x 4 m x 2.6 m (length x width x height), as shown in Figure 4-35 below.

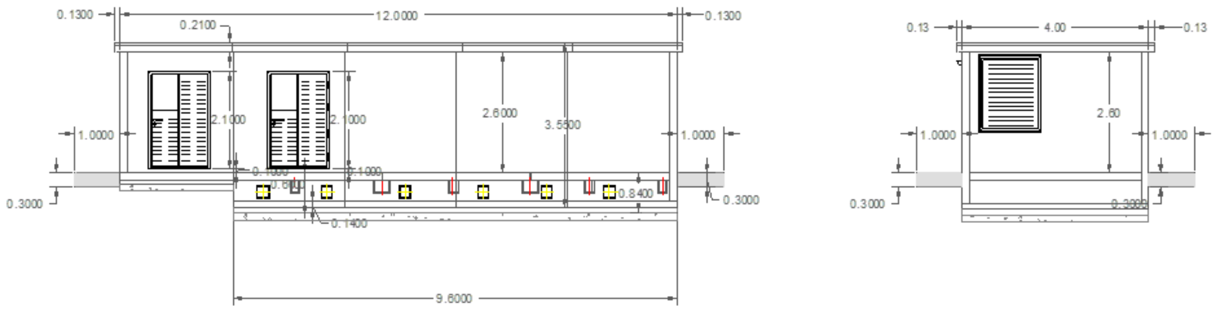


Figure 4-35 PSP details

ASPs are metallic cubicles supplied electrically by a DNO cabinet from the ESB network.

The minimum size requirements for ASPs are 2.6 m x 2.0 m x 2.27 m (width x depth x height), as shown in Figure 4-36.

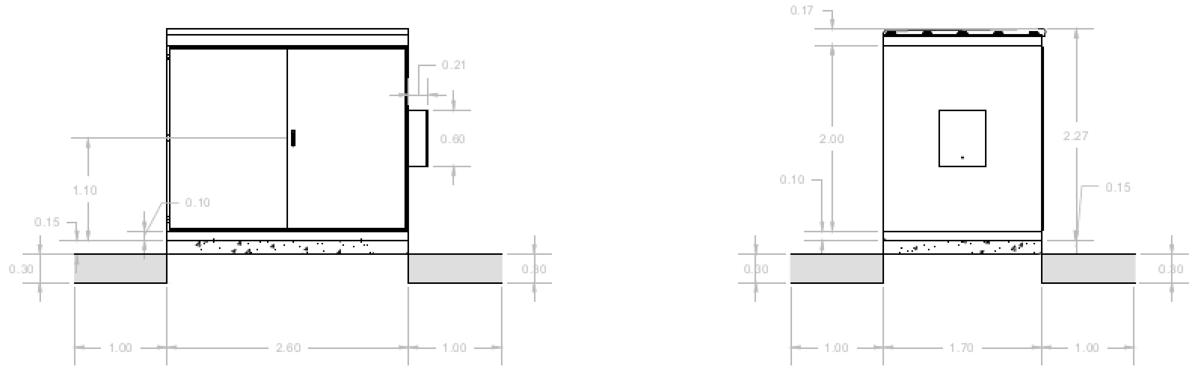


Figure 4-36 ASP details

Characteristics

- The PSP buildings will have a finishing similar to the SEBs.
- No external lighting of the building will be required.
- No connection to the Irish Water network is required.
- The new PSPs and ASPs will comply with existing standards for electrical installations (IS: 10101:2020). There will be a diesel generator inside the PSP buildings to provide power in case of power failure. In the event of a failure, the generator will be activated until the main power supply resumes. During normal operation, it will not be a source of noise or emissions.
- The new PSPs will issue no EMF type emissions.
- The energy demand of this type of building will be approximately 60 kW.
- The new building will not lead to an increase in road traffic in the area.

4.5.15.3.4 Medium Voltage (MV) Substations

An MV substation is a small building that transforms a 10 kV supply from the ESB network to a low voltage supply. They are managed by ESB but have been requested as part of the DART+ West project in certain areas.

They are typically 4.6 m x 4.1 m x 2.6 m (length x width x height). An example of an MV substation is shown in Figure 4-37.

Figure 4-37 Example of an MV substation

Characteristics

- Provision of 24-hour unimpeded access.
- If the only available site for an MV is behind locked gates or a barrier, agreement on the access arrangements shall be made at the design stage with ESB Networks. A key safe shall be installed.
- Access shall be provided from a public road, with minimum clearance of 3 m width and 4 m height.
- The maximum allowable slope of the access road or driveway is 1:10.
- MV substations shall be located at ground level.
- The new building will not lead to an increase in road traffic in the area.

The location of the MV substations are as follows:

- Spencer Dock (Abercorn Rd.).
- Spencer Dock (Ossory Rd.).
- Glasnevin.
- Newcomen.
- Clonsilla.
- M3 Parkway.
- Depot CCE compound.

4.5.15.3.5 Track Paralleling Hut (TPH)

Track Paralleling Huts (TPHs) are part of the HV (high voltage) power supply system. They are used for monitoring, detecting and correcting traction failures in critical sections to increase reliability. There is only one TPH in Clonsilla, which shares the same compound as the other technical buildings.

The minimum size requirements for the TPH are 4.9 m x 4.4 m x 2.6 m (length x width x height), as shown in Figure 4-38.

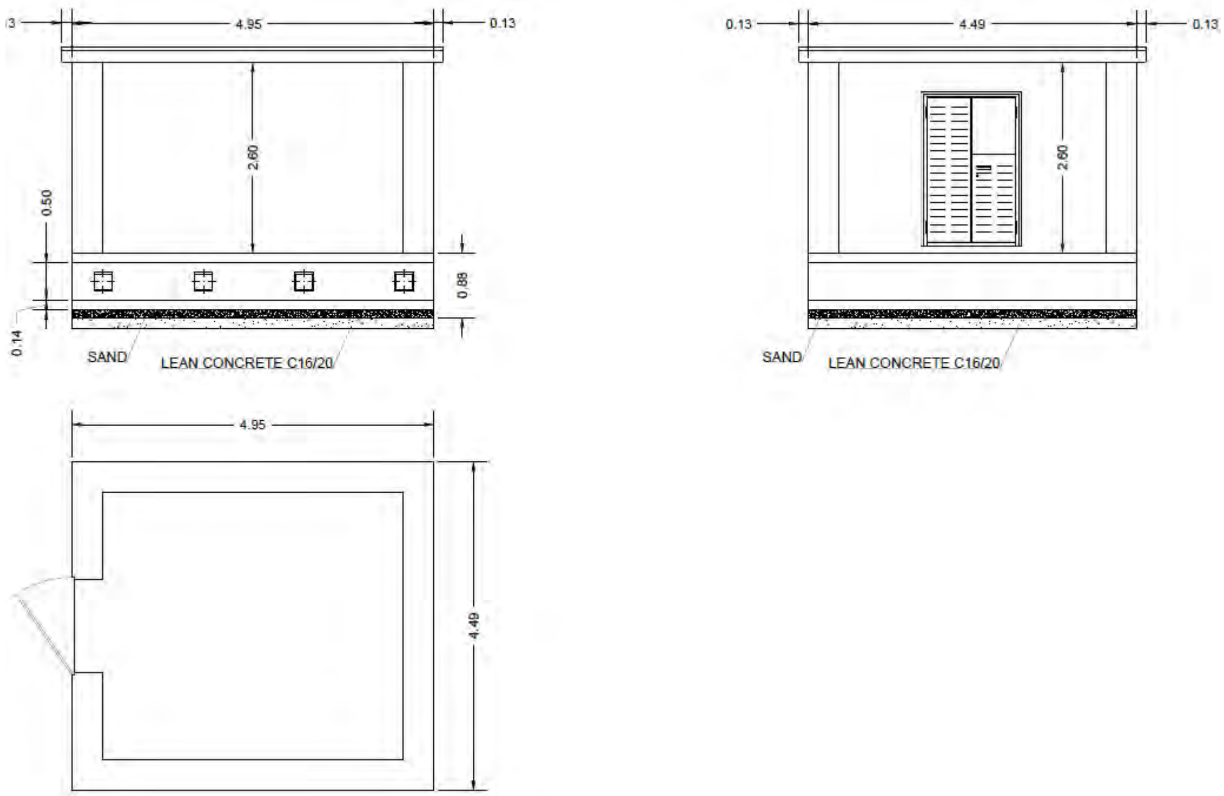


Figure 4-38 TPH details

An example of a TPH is shown in Figure 4-39.

Figure 4-39 TPH typical aspect

Characteristics:

- No connection to the Irish Water network is required.
- The TPH contains electrical cabins, low-voltage power supply and communications equipment.
- The building will only be accessed occasionally for maintenance or repair activities.
- The external architectural finish for the TPH is likely to match the existing TPH.

The location of the only proposed TPH for DART+ West is as follows:

- Clonsilla.

4.5.15.4 Compounds

Several temporary construction compounds and permanent maintenance compounds are required along the length of the proposed development. Temporary and permanent compounds are listed below and are shown on drawing MAY-MDC-RGN-OTHE-DR-Z-0001-D Buildability Design – Compound Location Overview in Volume 3A of this EIAR.

Temporary Construction Compounds

Temporary construction compounds are generally located adjacent to the site of individual elements of infrastructure. For example, they may be located at the depot or where major bridge or station works are required. Construction compounds will only be in place during the construction phase of the DART+ West project. The function of the construction compounds is entirely related to the construction works. The function and location of each proposed compound is summarised in Table 4-7.

Table 4-7 Proposed temporary construction compound locations

Function	Locations
Multi-disciplinary	Docklands (PW/SET/Station/Substation) Castleknock (Structure/Substation/Level crossing) Blakestown (SET/Substation) Millfarm (PW/SET/Structures) Depot (PW/SET) Dunboyne (PW/Substation) M3 Parkway (PW/SET/Substation)
Stations	Connolly, Ashtown and Coolmine
SET	Cabra Road, Reilly's and Reilly's complementary, Navan Road Parkway and Barberstown
Permanent way	Connolly, Glasnevin, Clonsilla, OBG13 Collins bridge, OBG18 Pike bridge and OBCN286 Barnhill bridge
Structures	OBG5 Broome bridge, OBG9 Old Navan Road bridge, OBG14 Cope bridge, OBG16 Louisa bridge; New UBG22A, UBG22B; and New OBG23A
Level crossings	Ashtown, Coolmine, Porterstown, Clonsilla and Barberstown
Substations	Glasnevin, Ashtown, Coolmine, Leixlip Confey, Maynooth and Hansfield

Permanent Maintenance Compounds

To support the existing maintenance compounds along the route, three new operational maintenance compounds are required:

- An additional facility is proposed at the Navan Road Parkway station.
- The proposed depot at Maynooth will also host a maintenance facility.
- The existing maintenance facility at the Docklands will be relocated within lands owned by CIÉ.

4.5.15.5 Parapet heightening

The electrification of DART lines introduces the risk of electric shock to users of structures along the route (bridges and footbridges over the railway and walkways next to walls adjacent to the railway). For this reason, it is necessary to verify that the isolation distances meet the minimum requirements, and if not, to place physical barriers that prevent accidental contact with the power line.

The standards require that the minimum height of parapets must be 1.80 m, where the minimum height of solid infill shall be 1.2 m. The 600 mm difference in height between 1.2 m and 1.8 m must be supplemented with either a solid or mesh type element with a maximum opening of 12.5 mm (IP2X). The standards also require the top of the parapets to be capped such that walking on top of them will not be possible.

4.5.15.5.1 Parapets on bridges

The proposal for the parapet heightening on bridges was developed with the aim of finding solution that can be implemented on each different type of bridge. The solution will be adapted for each bridge but will follow the same general procedure each time. In this way, all the affected bridges will be seen as a single intervention. This solution has been developed in collaboration with Grade 1 Conservation Architect Blackwood & Associates.

The following images (Figure 4-40 to Figure 4-45) show the proposals in more detail.

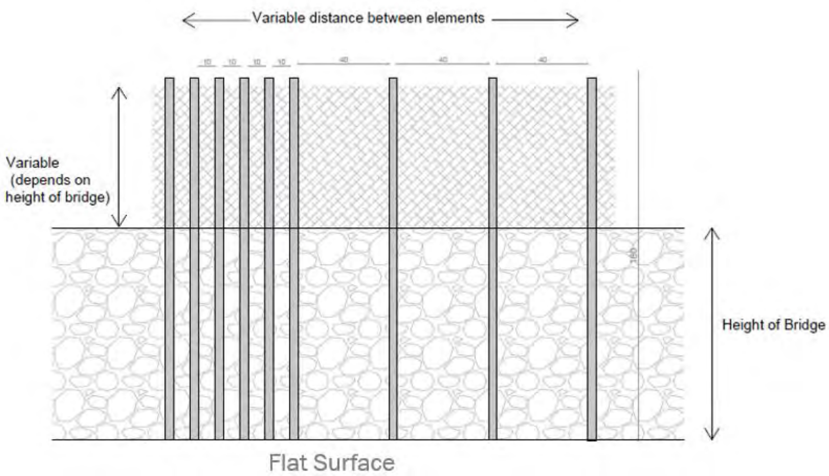


Figure 4-40 Design intent for parapet heightening on bridges - Flat Surface

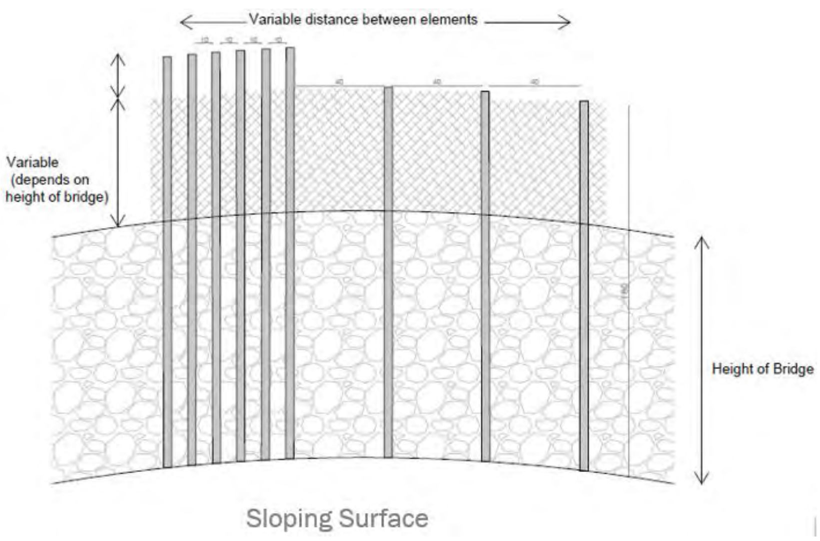


Figure 4-41 Design intent for parapet heightening on bridges - Sloping Surface

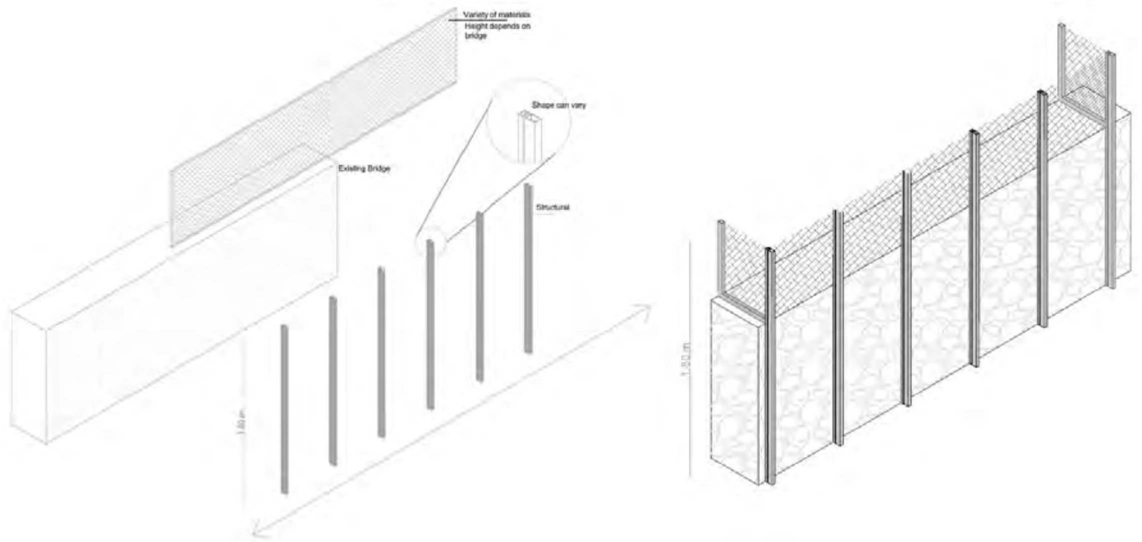


Figure 4-42 Design intent for parapet heightening on bridges - System Preferred Option

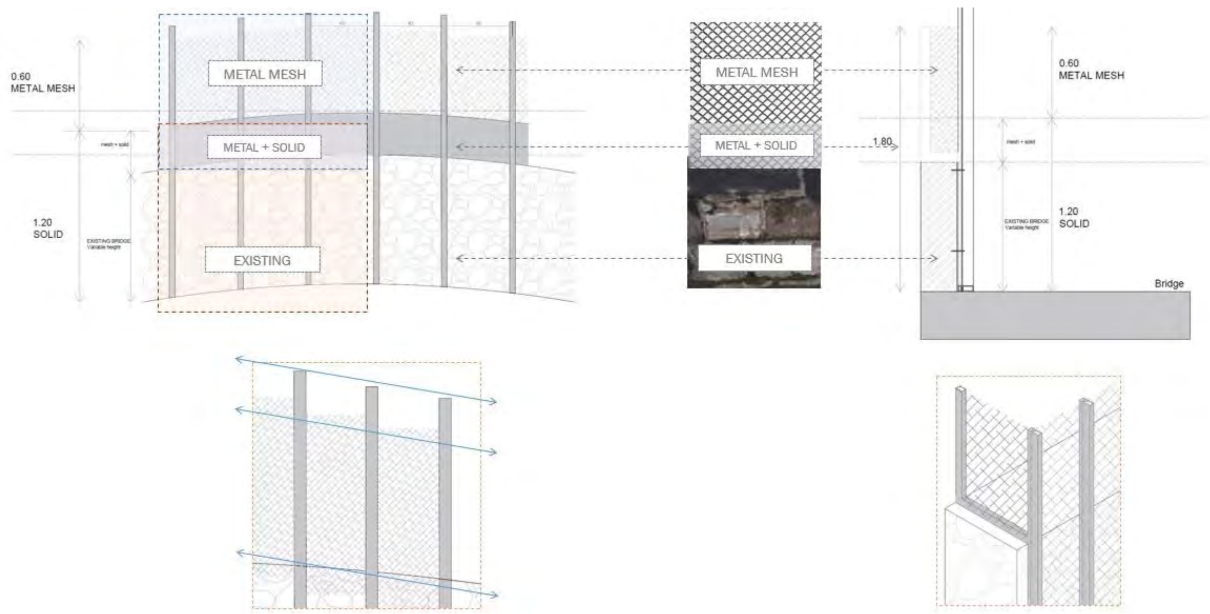


Figure 4-43 Design intent for parapet heightening on bridges - Details

This proposal is also adaptable to historical bridges with significant cultural importance. The original parapet of the bridge is not affected and greater consideration is given to the heritage and preservation of the original structure than would be the case with other more intrusive interventions. The distance between vertical elements can vary and depending on the needs of each bridge the opacity of the material can also vary. Furthermore, it allows the historical bridges to become a feature of the proposed development while maintaining their cultural integrity.

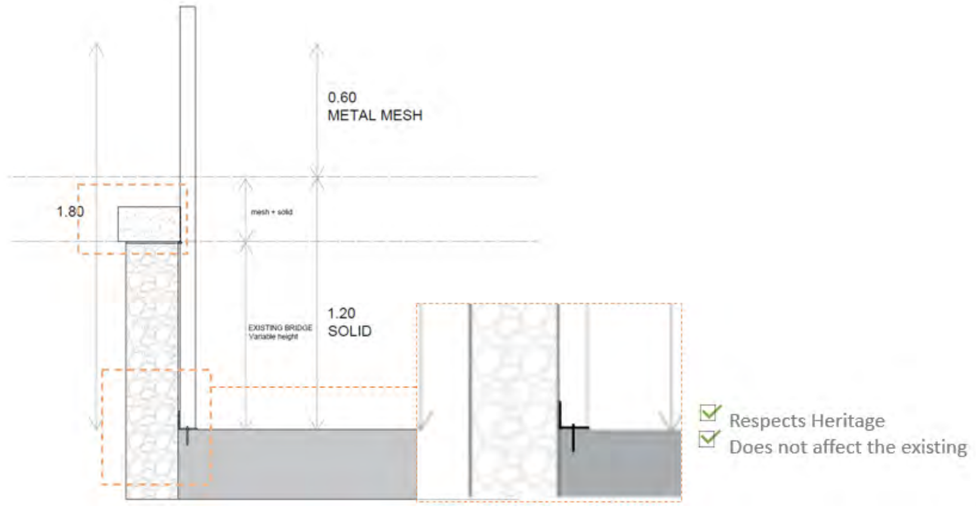


Figure 4-44 Design intent for parapet heightening on bridges - foundation and support detail

Figure 4-45 Design intent for parapet heightening on bridges - 3D image

Overbridges requiring parapet heightening using the method described above are listed in Table 4-8.

Table 4-8 Overbridges requiring parapet modification

Zone	Bridge name and asset number
Zone A. Loop Line - GSWR Branch North Wall to Glasnevin Jct	Prospect Road (OBO11)
	Ossory Road (OBO36)
Zone B. MGWR Branch. Dockland -Glasnevin Jct	Maintenance Bridge at Glasnevin (OBD221)
	Cross Guns Bridge (OBD222)
	Binn's Bridge (OBD223)
	Clonliffe Bridge (OBD224)
	Clarke's Bridge (OBD225)
	Newcomen Bridge (OBD226)
Zone C. Glasnevin to Clonsilla	Diswellstown Road (OBG11C)

Zone	Bridge name and asset number
	Granard Bridge/Castleknock Bridge (OBG11)
	Old Navan Road (OBG9)
	N3 Road (OBG6C)
	R102 Road (OBG6B)
	Broome Bridge (OBG5)
Zone D. Clonsilla Junction to M3 Parkway	Not applicable
Zone E. Clonsilla to Maynooth	Louisa Bridge (OBG16)
	Cope Bridge (OBG14)
Zone F. Maynooth to Sligo	Not applicable

4.5.15.5.2 Parapets on bridges with width restrictions

It is noted that some of the historic bridges have a reduced width and the solution presented in Section 4.5.15.5.1 may not be suitable. Hence an alternative proposal has been developed for these bridges.

It is currently envisaged that this proposal would be implemented on the following bridges:

- OBG18 Pike Bridge.
- OBG13 Collins Bridge.

The alternative proposal places the parapet on top of the historic stone parapet with a structural support inserted through the stone parapet and founded in the deck at 2 m spacing. There will then be intermediate supports every 400 mm that will sit on top of the existing stone parapet. The support joints will be welded together and the solid metal panel required up to a height of 1.2 m will also be welded to the upright supports. IP2X mesh will then be installed up to the required height of 1.8 m. See Figure 4-46 below for details.

As per the proposal outlined in Section 4.5.15.5.1, the distance between vertical elements can vary and depending on the needs of each bridge the opacity of the material can also vary.

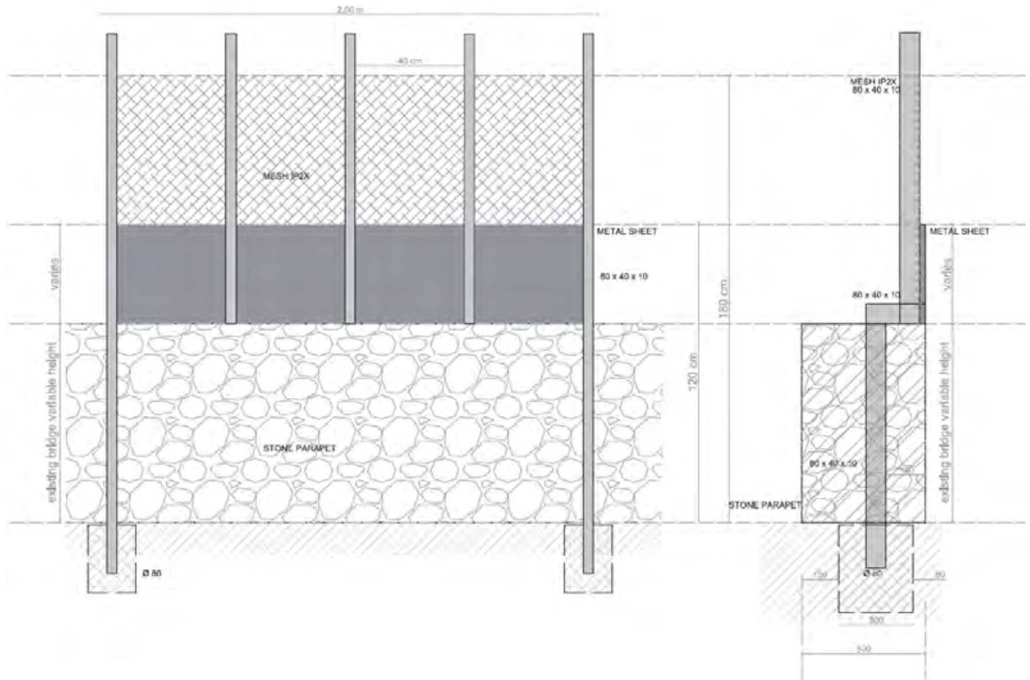


Figure 4-46 Alternative parapet solution for bridges with width restrictions

It is noted that this proposal has a greater impact on the historic parapet due to the requirement to fix the vertical support through the stone parapet at 2 m spacing. However, given the requirements set out in the standards to prevent members of the public coming into contact with the OHLE, this was the option which best followed the same design principles as the solution presented in Section 4.5.15.5.1.

4.5.15.5.3 Parapets on footbridges

Existing footbridges along the extents of the DART+ West project cross a non-electrified line, so the existing parapets are not designed to protect users against electric shock.

Stairs leading to the footbridges are located more than 1.45 m from the electrical elements, so it is unnecessary to place barriers on stairs, as the minimum isolation distance is achieved.

Amendments are required on the sidewalls of the walkways along the tracks.

As with the requirement for bridges, parapets on footbridges are required to have a 1.2 m high solid vertical barrier and extending it up to 1.8 m with either be solid screen or a mesh with a maximum opening of 12.5 mm (IP2X class).

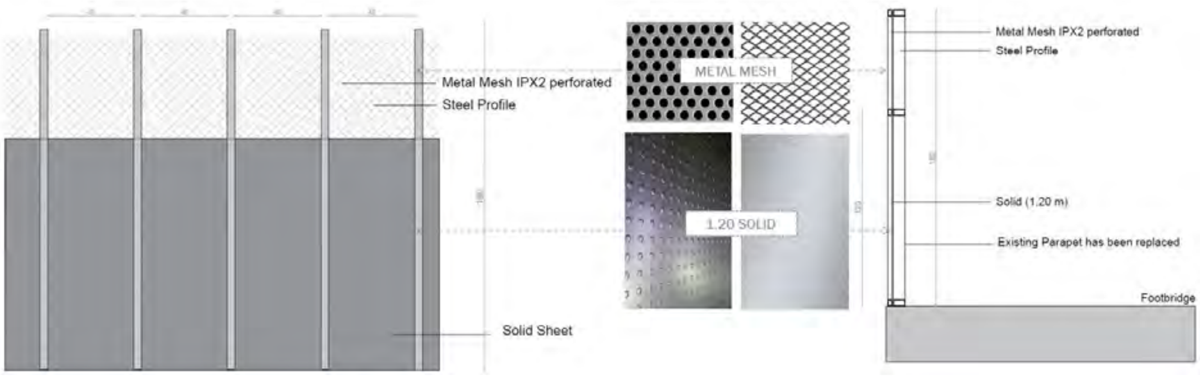


Figure 4-47 Design intent for parapet heightening on footbridges

The proposed solution consists of installing solid sheeting 1.2 m high along the edges of footbridges. The upper part of the screen is proposed to be an open mesh as per Figure 4-47 and will be 600 mm high, in line with current standards.

All existing fencing, particularly fencing of metal construction, shall be appropriately earthed. The existing earthing of the structures shall be checked to ensure that continuity of the earthing system is adequate.

Figure 4-48 3D image of parapet heightening solution for footbridges

Footbridges in which parapet heightening is required as outlined above are as listed in Table 4-9:

Table 4-9 Footbridges requiring parapet heightening

Zone	Location name (bridge number)
Zone A. Loop Line - GSWR Branch North Wall to Glasnevin Jct	Claude Road (OBO12A)
	Drumcondra Station (OBO14A)
Zone B. MGWR Branch. Dockland -Glasnevin Jct	North Strand Road (OBG226A)
Zone C. Glasnevin Jct to Clonsilla	Clonsilla Station Platform (OBG12C)
	Castleknock Station (OBG11A)
	Broombridge Station (OBG4A)
Zone D. Clonsilla Junction to M3 Parkway	Dunboyne Footbridge (OBCN290A)
	Dunboyne Station (OBCN291)
	M3 Parkway Station (OBCN295A)
Zone E. Clonsilla to Maynooth	Maynooth Station (OBG20)
	Leixlip station (OBG15A)
	Leixlip Confey Station (OBG14A)

4.5.15.5.4 Specific solution at OBG12 Clonsilla station footbridge

In consideration of the OBG12 Clonsilla station footbridge's historical and aesthetic aspects, it is proposed to introduce a low-level polycarbonate panel instead of the vertical parapet detailed in Section 4.5.15.5.3. This solid sheet panel would extend horizontally in an arch form over the four central balustrade sections. It would connect under the soffit of the existing bridge via a new metal profile thus preventing any obscurement of the feature bridge itself. The existing bridge will have all defects corrected and made stable to harness the new barrier system. Reference Figure 4-49 to Figure 4-52 below.

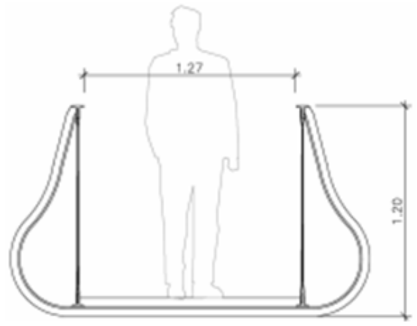


Figure 4-49 Existing section OBG12 Clonsilla station footbridge

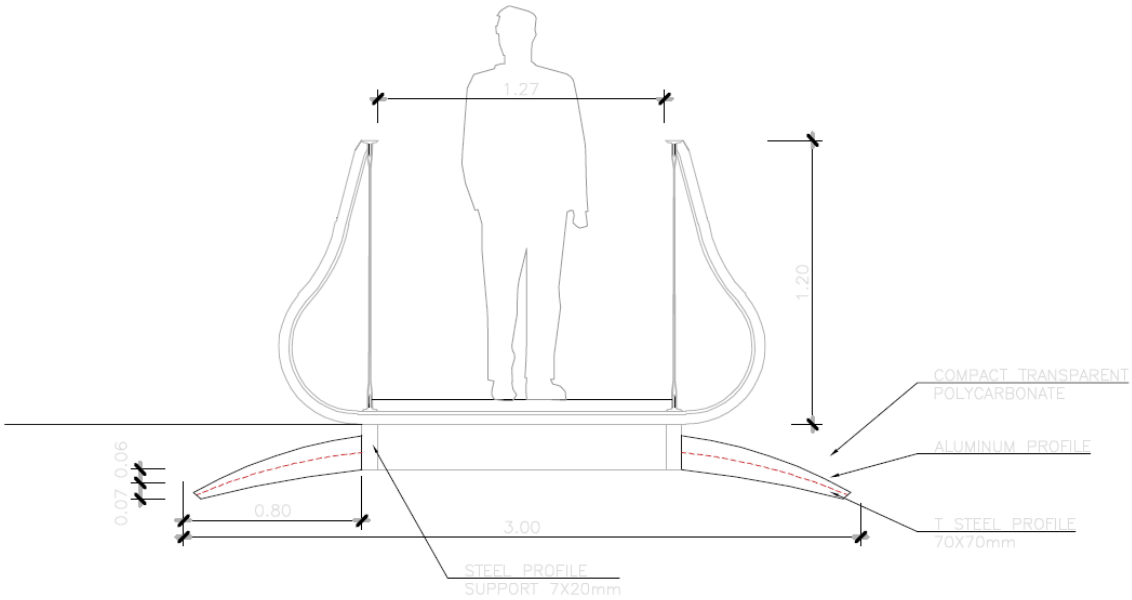


Figure 4-50 Proposed parapet solution at OBG12 Clonsilla station footbridge - section

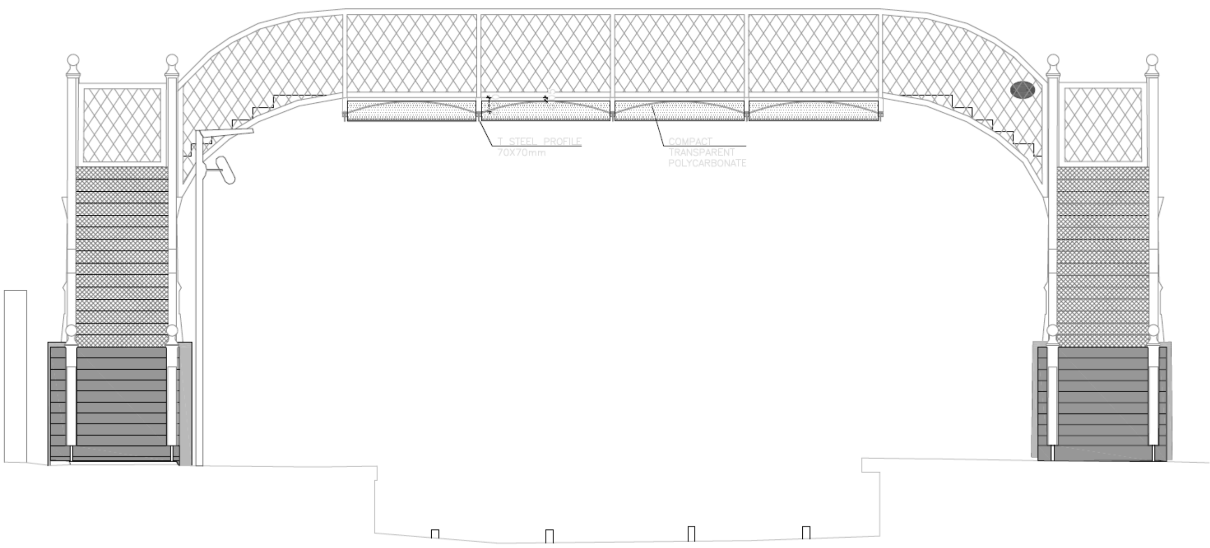


Figure 4-51 Proposed parapet solution at OBG12 Clonsilla station footbridge - elevation

Figure 4-52 Example of proposed solution at OBG12 Clonsilla station footbridge

4.5.15.5.5 Parapets on walls

In locations where the rail line runs in cut (lower than the surrounding terrain) there may be a risk of electrocution if the cables are not positioned at a sufficiently safe distance. However, the DART+ West has few locations where the clearance does not exceed the minimum clearance requirement of 1.45 m.

This risk is most prevalent in localised areas adjacent to where catenary posts are installed and the 1.45 m clearance is not achieved. In these cases, the height of walls will be extended using a similar methodology to that proposed for parapet heightening on bridges in Section 4.5.15.5.1. This design solution is depicted in Figure 4-53.

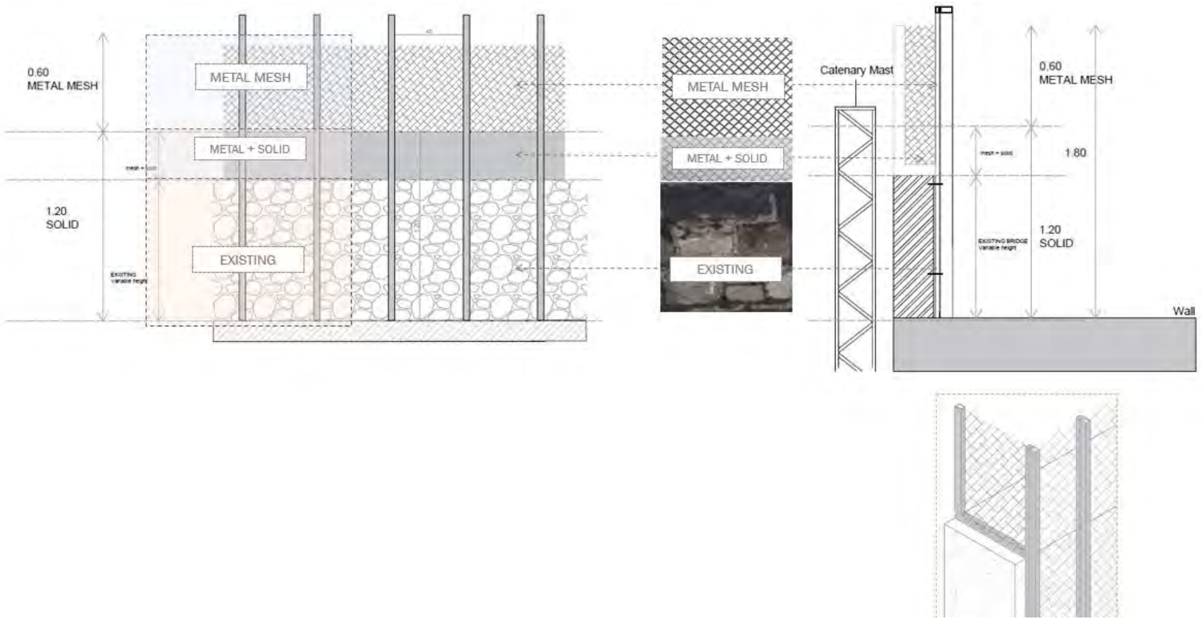


Figure 4-53 Design intent for parapet heightening on walls

Figure 4-54 Wall heightening adjacent to catenary posts

The areas in which the heightening of parapets on walls is proposed are listed in Table 4-10.

Table 4-10 Walls with parapet modification

Zone	Location name (bridge number) (Chainage)
Zone B. MGWR Branch. Dockland - Glasnevin Junction	Wall at Ossory Rd, near OBD226. (50+700 to 50+600) Wall at Sackville Gardens, near OBD225. (51+100 to 51+140) Wall at Plás Whitworth, near OBD223. (51+900 to 51+850) Wall between OBD223 and OBD222. (52+800 to 52+000) up track of DART line Wall at Newcomen bridge (OBD226) down track (41+030 to 41+070)
Zone C. Glasnevin to Clonsilla	Wall at Prospect Rd, near OBO 11 (33+000 to 33+060)

4.5.16 Structures

For the DART+ West project, numerous structures and structural interventions are proposed. The following list provides a summary of these:

- Interventions required at existing structures.
  - Deck reconstruction of the existing arch bridges.
    - OBG5 Broome Bridge, see Section 4.8.3.1.1.
    - OBG11 Granard Bridge, see Section 4.8.10.2.
    - OBG14 Cope Bridge, see Section 4.10.4.2; new East and West footbridges near OBG14, see Section 4.10.4.4
    - To mitigate the impact on the historic structures as much as possible, the essential consideration in the process will be to ensure that the reconstruction sits comfortably alongside the remaining canal bridge. Due to the significant raising of the historic bridges and the requirement to install a precast concrete element to support the new span, it will not be possible or desirable to reconstruct the bridge to match the existing exactly. Instead, a contemporary solution using white cement concrete with timber slats shuttering will be designed between the two existing pillars to complement the proportions and style of the remaining canal bridge. The junctions between old and new bridges will be carefully considered, particularly the change in levels between the two spans and significant features such as the string course, arch voussoirs, stone coursing, and parapets.

- o Deck lifting of existing flat deck bridges.
  - ▪ OBG9 Old Navan Road Bridge, see Section 4.8.9.2.
  - ▪ OBG16 Louisa Bridge, see Section 4.10.6.2.
- o Track lowering structural intervention.
  - ▪ OBD221, OBD222 & OBD225 the proposed track lowering maximum excavation is significantly below the foundation terrain level. Soil improvement around existing foundations using jet-grouting or other methods according to the geotechnical recommendation in the detailed design stage is required before excavation and precast concrete L-form retaining walls will be required near the bridge foundations to protect existing structures.
  - ▪ For other bridges where the track lowering maximum excavation is slightly under the foundation terrain level:
    - List of affected bridges: OBO11, OBG7A, OBG13, OBG18, OBO35, OBO35A, OBO36, OBCN286, OBCN290, OBCN290A, OBD221, OBD222, OBD223, OBD224, OBD224A, OBD225, OBD226 and OBD227.
    - The proposed track lowering depth for all the above bridges is between 106 and 495 mm.
    - Key design points:
      - o Avoid affecting existing foundations: Soil improvement around existing foundation using jet-grouting or other methods according to the geotechnical recommendation in the detailed design stage is required before excavation. This work can be done from the railway without significant impact on existing structures.

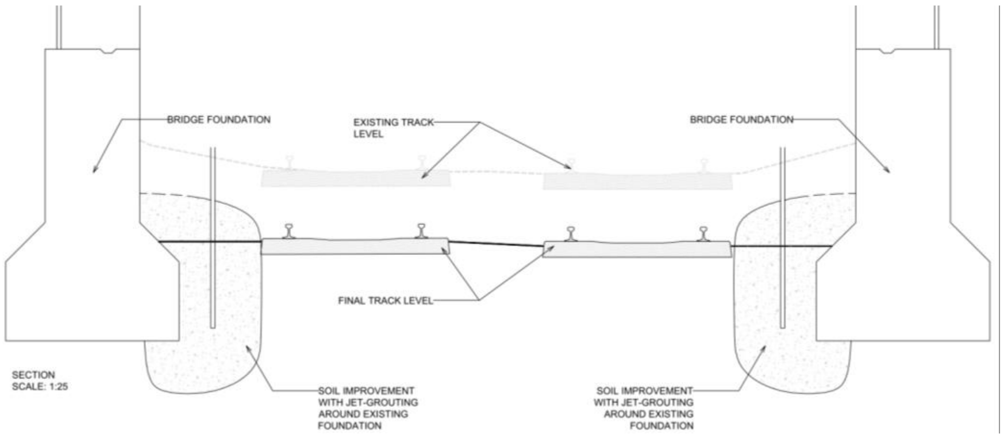


Figure 4-55 Proposed soil improvement around existing foundations prior to excavation

- o Part of OBD228 Sheriff Street Bridge to be reconstructed due to the design of the Spencer Dock Station, see Section 4.7.3.4.
- Proposed new structures:
  - o New pedestrian and cycle bridge proposed at Ashtown Station, with existing in station bridge and pedestrian bridge over the canal demolished, see Section 4.8.5.
  - o New underpass construction at Ashtown to replace level crossing, see Section 4.8.6.
  - o New pedestrian and cycle bridge proposed at Coolmine station, with existing in station bridge and pedestrian bridge over the canal demolished, see Section 4.8.13.
  - o New pedestrian and cycle bridge proposed at Porterstown Level Crossing, with existing level crossing point removed, see Section 4.8.15.
  - o New pedestrian and cycle bridge proposed at Clonsilla Level Crossing, with existing level crossing point removed, see Section 4.8.16.
  - o New road bridge proposed at Barberstown Level Crossing, with existing level crossing point removed, see Section 4.10.3.
  - o OBG23A New bridge proposed for access to the depot and the existing OBG24 will be demolished, see Section 4.11.11.1.
  - o New underbridges UBG22A & UBG22B, see Section 4.11.7.

- New attenuation tank at Spencer Dock, see Section 4.7.3.3.

- Retaining wall and protection slab structures:
  - Due to the design of the Spencer Dock Station, part of the tracks in the area near the Station are below the surrounding ground level and below or very close to the groundwater table. Therefore, a retaining wall and protection slab solution is required along this track area to laterally support soil, and to protect the track from groundwater and against uplift pressure, see Section 4.7.3.2.
- OHLE structures:
  - OHLE support structures, see Section 4.5.8.

4.6 Zone A. Connolly Station to Glasnevin (Glasnevin Jct) on GSWR Line – Phoenix Park Tunnel and Cabra Compound

4.6.1 Overview of alignment in Zone A

Zone A runs east to west from the Loop Line above the River Liffey and Connolly Station to Glasnevin Junction in Dublin City along the GSWR line. It also contains a short section in the branch to the Phoenix Park around Cabra, where a temporary construction compound will be located. The permanent works within Zone A extend only to OBO10 at Glasnevin Cemetery and car park, however due to the requirement for a construction compound further south/west along the line, the construction phase assessment addressed the temporary impacts on this section. The zone is approximately 4.65 km in length (excluding the compound at Cabra). It also includes the Northern Line section between Connolly Station and the Tolka River in the north (1.15 km in length). The extents on Zone A are indicated by the blue track in Figure 4-56.

The GSWR consists of two tracks, the UP track being the northern track with trains running from Glasnevin to Connolly Station and the DOWN track being the southern track with trains running from Connolly Station to Glasnevin.

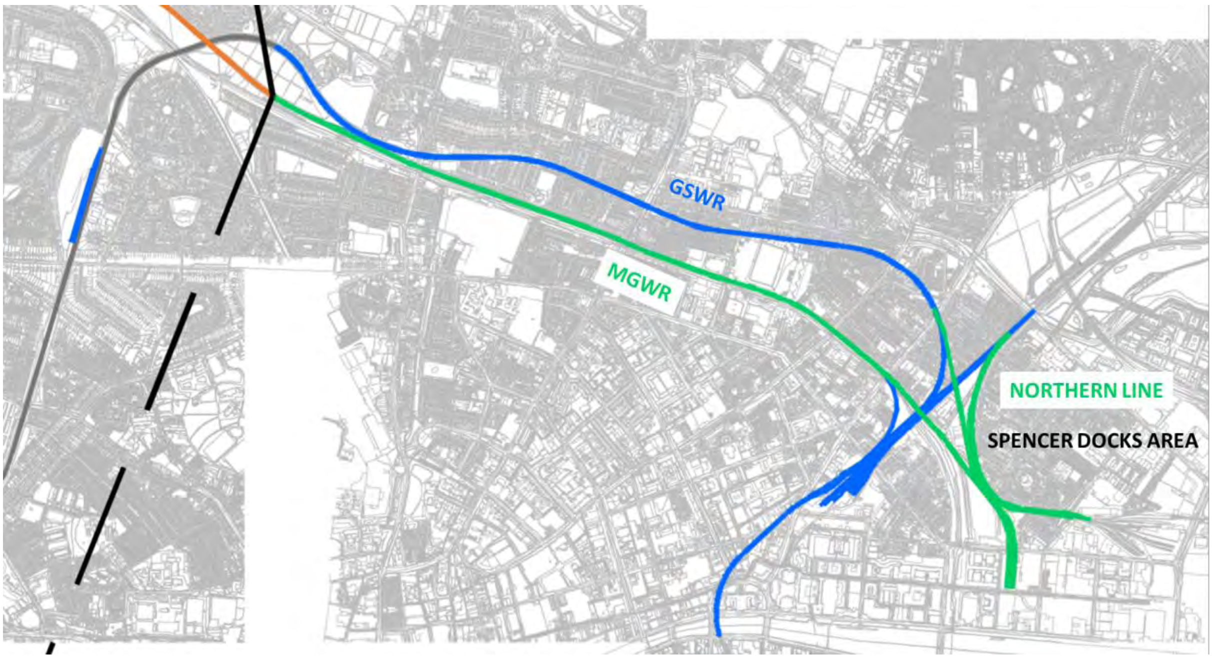


Figure 4-56 Extents of DART+ West Zone A

Zone A includes capacity enhancement works in Connolly Station to maximize the efficiency of the existing rail infrastructure. The northern railway line approach to Connolly Station will be modified with one additional crossover to facilitate the increased train frequency and station capacity. The station will also be upgraded by providing a new access to Platforms 5, 6 and 7 from a new entrance through Preston Street. This new access will require extensive refurbishment of an area of the existing underground 19th Century vaults beneath Connolly Station's platform. New staircases and escalators will also be installed.

Parapet modification works are required at the Drumcondra Station (OBO14A) and Claude Road (OBO12A) bridges to ensure the public health and safety is maintained after the installation of the new Overhead Line Electrification equipment (OHLE).

Electrification of the GSWR line is proposed within Zone A, therefore, the track has to be lowered in the vicinity of the Prospect Road Bridge (OBO11) to achieve the required clearance for the new OHLE under the bridge. This is the only place along the GSWR line where track modification is required. Bridge parapet heightening is also proposed in OBO11 to ensure the necessary health and safety standards are achieved to protect the bridge users from the railway overhead equipment.

West of OBO11, near Glasnevin Junction, the proposed Glasnevin Substation will be constructed in the grounds of St. Vincent's School and will provide the line with the necessary power supply for its electrification.

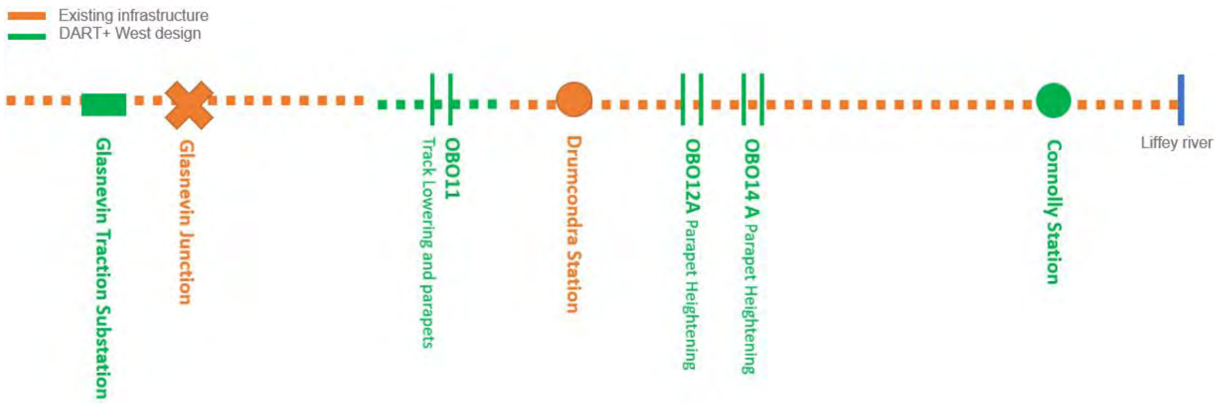


Figure 4-57 Schematic of DART+ West interventions in Zone A

Within Zone A, the Cable Management System (CMS) for Signalling, Electrical and Telecoms (SET) works will be provided. Also, a new CMS is required from the viaduct above the Royal Canal (located north of Connolly) to Glasnevin Junction along the GSWR line.

4.6.2 Interventions at bridges

Zone A requires works at different bridges in order to allow sufficient clearance for OHLE and to provide protection against electrocution. The works consists of track lowering, parapet heightening and structural interventions. The interventions required at bridges in Zone A are listed in the table below.

Table 4-11 Bridge interventions in Zone A

Structure	Protected	Location	Solution	Depth of lowering	Length	Existing parapet	Proposed parapet	Description
OBO14A 	No	Ch	Parapets heightening	N/A	N/A	2.50 m	2.50 m	Parapet heightening as per Section 4.5.15.5.
OBO12A	No	Ch	Parapets heightening	N/A	N/A	1.70 m + kerb	N/A	Parapet heightening as per Section 4.5.15.5.

Structure	Protected	Location	Solution	Depth of lowering	Length	Existing parapet	Proposed parapet	Description
								
OBO11 	No	GSWR line at 2+1459 mileage, in Dublin city (Ch 33+000)	Track lowering & parapets heightening	325 mm	330 m	1.50 m	1.80 m	Track lowering beneath bridge to achieve required clearance for OHLE Parapet heightening as per Section 4.5.15.5.

4.6.3 Connolly Station area

4.6.3.1 Alignment

Connolly Station is a crucial junction for rail traffic to and from the Northern Line (Dublin Connolly - Malahide - Drogheda - Dundalk - Border) and Suburban Line (Connolly - North Strand - Glasnevin - Islandbridge Junction).

The capacity for the station as a terminus for the Northern Line services is constrained by potential conflicts of the rail services at the station's entry and exit points, particularly at platform tracks. A crossover allowing incoming and outgoing rail traffic to be separated is proposed at the northern approach to the station to solve this issue.

The proposed crossover is located between the 0 m 900 yards and 0 m 1025 yards markers on the Northern Line. The crossover will have a constant gradient of 0.796 %, rising towards Connolly Station, with both tracks aligned vertically.

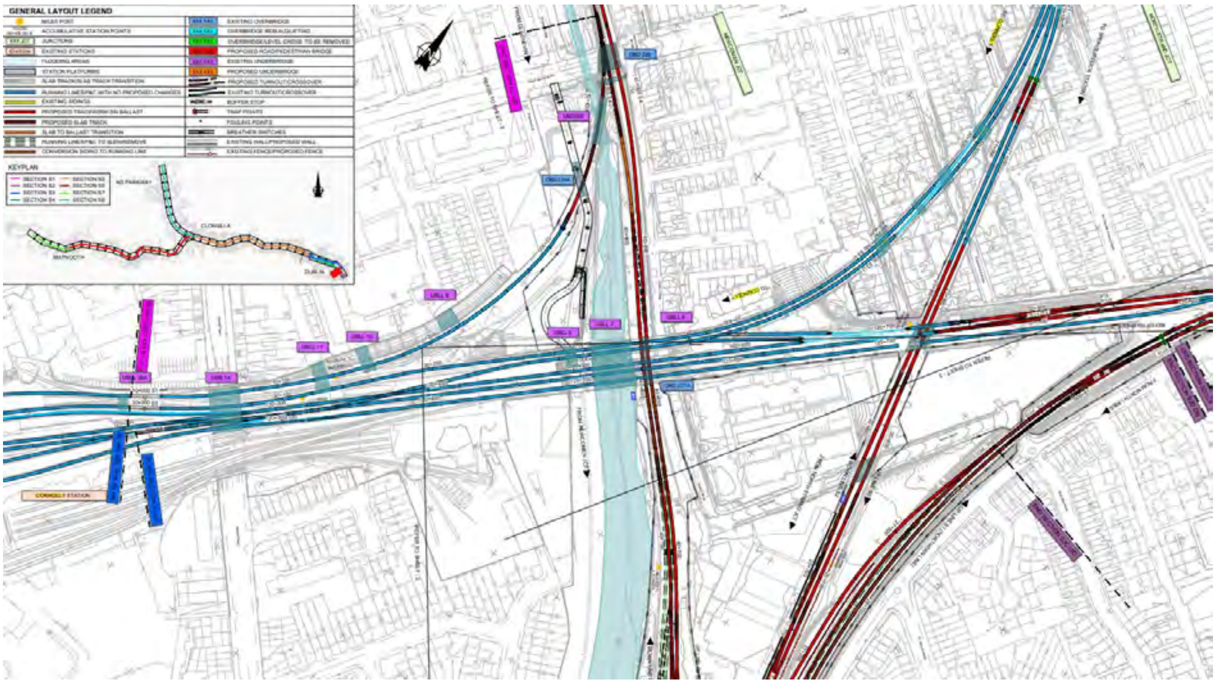


Figure 4-58 Connolly Station track layout

4.6.3.2 Connolly Station

The proposed development includes some interventions in Connolly Station to provide increased passenger capacity at the station. It will require a new access point at Preston Street through the currently disused vaults, to connect with platforms 5, 6 and 7 to manage increased passenger numbers safely. The disused vaults at Connolly are a 19th Century protected structure. A brief description of the proposed developments at Connolly Station is given in the subsequent sections. See Appendix A4.1 Connolly Design Report in Volume 4 of this EIAR for full details of the proposed developments at this location.

Figure 4-59 Plan view of the arches under the platforms. The area in red indicates the location to be refurbished.

Analysis of the station evacuation requirements has been carried out based on the increased capacity of the trains that will serve Connolly Station. It is limited to the platforms impacted by the increased number of passengers: platforms 5, 6 & 7. The analysis focuses on the means of egress and evacuation routes of those platforms. Egress points are located at platform level and are also positioned towards the middle of the platforms, reducing dead-end distances. According to the demand estimate for the station and following accessibility requirements, vertical circulation at the station platforms will be accommodated as follows:

- Platform 5:
  - One staircase 1.60 m wide.
  - One lift.
  - Two escalators (not a capacity requirement, recommended due to vertical distance between platforms exceeding 5 m).
- Platforms 6&7:
  - Two escalators.
  - One staircase 1.60 m wide.
  - One lift.

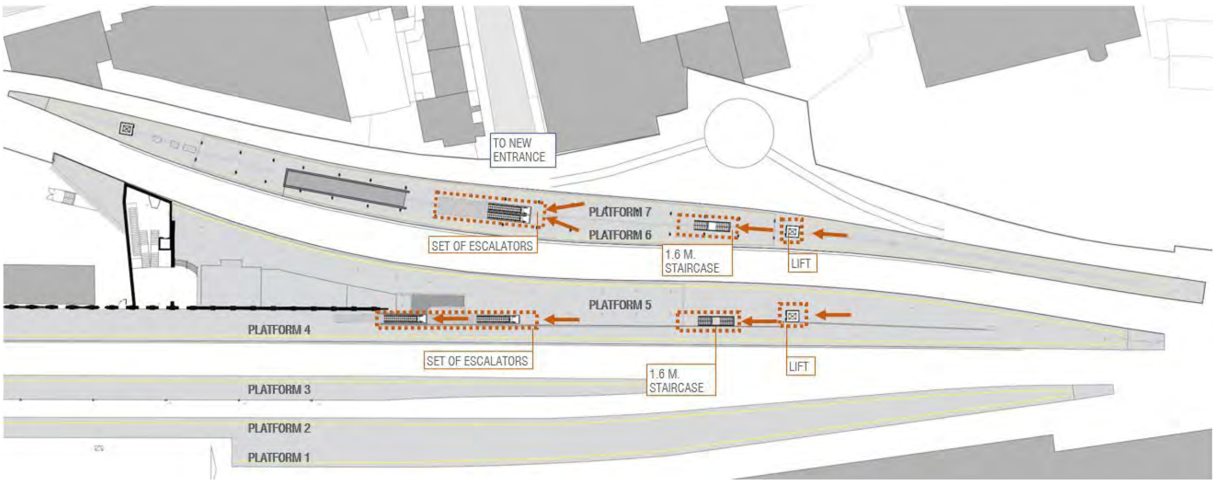


Figure 4-60 Platform facilities - proposed additional means of access to the platforms

The positioning of the stairwells and lifts will leave 2.60 m of platform width at either side of the stairs, allowing for passenger boarding and alighting. The lifts are located opposite the staircases in the centre of the platform. Once directed to street level, passengers will be guided to Preston Street through one of the station vaults. The vault floor will have a slope of 1 to 24 due to the difference in level between the central vault corridor and Preston Street.

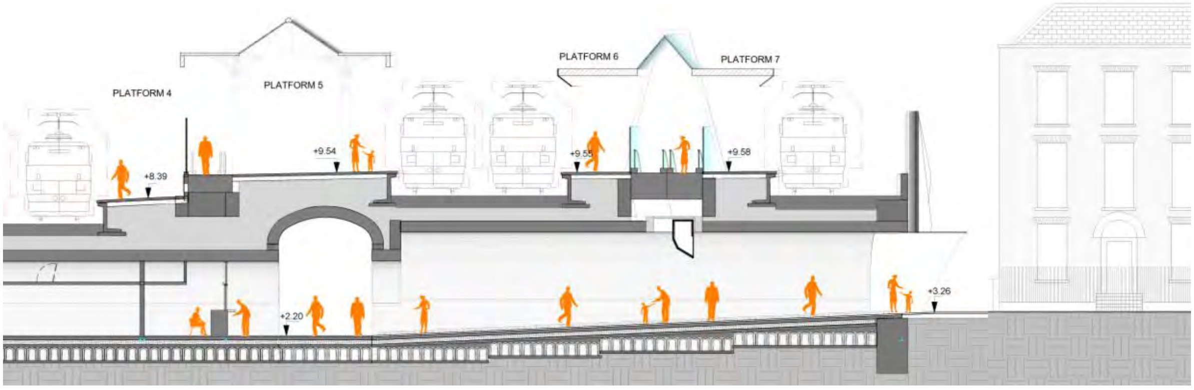


Figure 4-61 Cross section of the design for Connolly Station

4.6.3.2.1 New entrance to the station at Preston Street

Preston Street is proposed as a new access route to the station. At the end of the street, there is an arch that will be converted into the new station entrance. From that arch, passengers will enter a vault leading directly to the central vault corridor. Part of this central corridor will be transformed into a concourse for the new station. A new façade will be created at the entrance point to highlight the new access. The new Preston Street façade will have an opening to a second vault, adjacent to the main entrance, that will house bicycle parking, and also provide direct access to the central corridor.

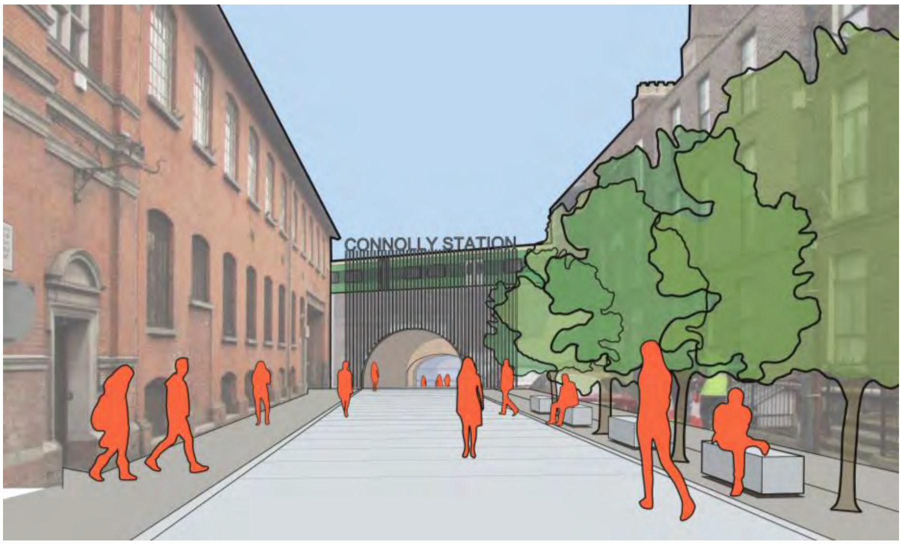


Figure 4-62 Sketch of the proposed façade for the new entrance on Preston Street

Two emergency exits are provided. One of them will be located at the southern end of the central corridor. In the case of an emergency, this will lead the passengers towards Amiens Street and through the Connolly HQ staff carpark. The other emergency exit will be provided at the northern end of the central corridor, heading towards the Fáilte Ireland carpark, where there is a 'right of way' that connects with Seville Place.

Figure 4-63 Plan view of the proposed layout within the Connolly Station vaults

4.6.3.2.2 Current condition of the vaults

The undercroft comprises brick and limestone masonry arched vaults that generally run transversally underneath the rail lines. These are accessed from the central corridor that runs in the same direction as the tracks.

The structure of the vaults and abutments is formed by red brick, while the masonry walls at the end of the vaults are constructed from random sized limestone blocks. The vaults have a span of around 6.2 m, the abutments have a height of 2 - 2.5 m, and the arches have a height of around 2 m.

Figure 4-64 Current condition of the vaults

Most of the visible deterioration in the vaults is produced by water, differential movements, and contamination. This water penetration ranges from minor seepage to constant running water. A significant area of the ground floor is covered by standing water (due to water ingress) and standing oil contamination. Some of the downpipes are corroded, rusting or broken. Some of the arches house stalactites derived from calcite contamination. All of the brickwork surfaces close to locations of water ingress or water seepage are covered with black contamination or white calcite coating. Most of the brickwork damage is caused by the washout of the mortar between bricks due to water ingress. This process has left bricks friable at a depth of 5 mm to 50 mm, or easy to dislodge, due to the absence of infill. Figure 4-64 shows the current condition of the vaults at Connolly Station.

Drainage system

According to the original drawings of the vaults drainage project, the existing drainage system consists of water collection in the upper part of the vaults through provision of pigeon-holed brick shafts. The internal dimensions of the shafts are 18” x 18” (457 mm x 457 mm), and they are covered with a 4” (100 mm) thick stone. There is rubble stone surrounding the brick shafts. The downpipes collect water from the shafts and discharge to the general drainage system that runs under the pavement along the main corridor. This drainage system has long since become unusable due to corrosion, silting and suspected inadequate capacity in its original design.

Existing recommendations

Inspection reports completed to date provide several conclusions and recommendations that have been considered in development of the vault refurbishment proposal.

The main conclusion from previous inspections was that the structural integrity of the vaults and corridors is considered to be sound with no significant cracking, settlement or punching noted. Therefore, the evident water penetration does not imply an imminent danger of structural failure of the undercroft. However, it is certainly causing a loss of brickwork, and the amount of water penetration is significant.

It was also concluded that the water source is either from rain saturated fill above the arches or from leaking water supply or drainage pipes. This conclusion was drawn as the water dripping was continuous despite the inspection being carried out in a dry period. In areas where the water penetration has been less prevalent, there has been a build-up of blackened calcite contamination.

The most critical recommendations included in the inspection reports to date, are listed and commented on below:

- ***It is necessary to stop water from entering the arch backfill by providing an effective drained waterproof barrier and by repairing any leaking water mains and drainage pipes. This will require access from above rather than from within.***

Sealing the arches from within will only be a temporary solution since the intense track live loading and the hydraulic pressure will eventually result in further penetration and structural deterioration.

In order to minimise the operational impact on the lines operating at Connolly Station, the proposed methodology for water collection is a short-term solution that will allow passengers to use the area and is described in Section 4.6.3.2.5 of this chapter.

- ***As a backup provision, the remains of the existing arch drainage system should be inspected and made good as far as is reasonably possible.***

A dilapidation survey will be carried out during the next stage of the DART+ West project to inspect the drainage systems for both the Main Line vaults and the Loop Line vaults. The information obtained in the inspection will assist in selecting the optimum solution for making good the drainage system in the later stages of the project.

- ***Prior to any further inspections, consideration should be given to clearing the surfaces of the brickwork and masonry so that more comprehensive visual inspection is possible. Clearing out the vaults of all building and other debris will also allow better access for ladders, staging and access platforms.***

The dilapidation survey will also include cleaning of vaults and clearing the brickwork and masonry to allow a more comprehensive visual inspection.

- ***In vaults M10, M11, M13 and M14, there was a greater extent and severity of deterioration at the construction joints across the arch at the main access corridor extension. The construction joint has opened to up to 100 mm wide, and depths to mortar can be seen extending back into the brick courses by up to 300 mm.***

An in-depth inspection will be carried out at these vaults once the surface is cleaned to decide if these vaults can be waterproofed with resin injections or if they will also need polycarbonate protection below the structure.

4.6.3.2.3 Architectural concept

The station proposal creates a viable new use for the existing protected structure of the Connolly Vaults. The reuse of an existing structure is a central tenet of architectural conservation principles. The intervention in the vaults aims to fulfil another well-known conservation principle in the Heritage world – *to do as little as possible but as much as necessary* – to provide a pleasant and sustainable station space. Works on the historic vaults will be limited to cleaning and refurbishing damaged parts of the structure and providing low impact interventions that will ensure safe access is provided. These interventions will allow the historic fabric of the vaults to be appreciated when using the platforms.

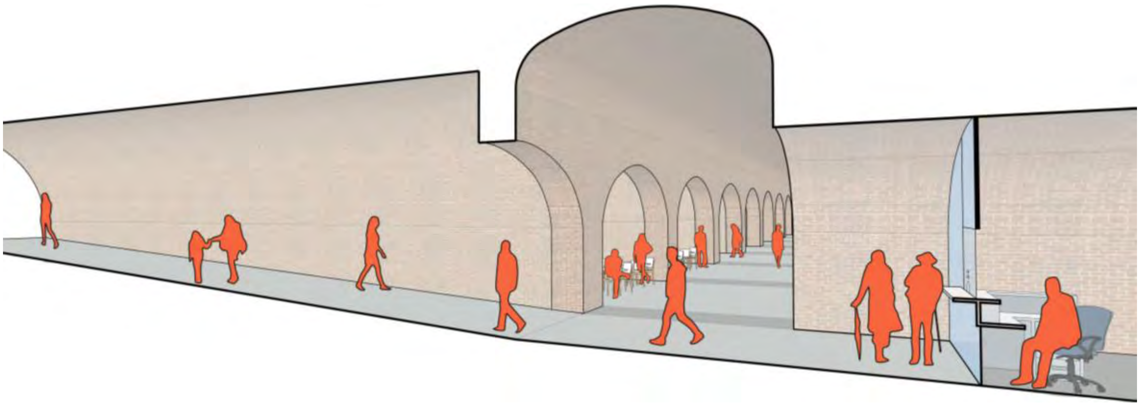


Figure 4-65 Sketch of Connolly Station concourse, the entrance vault and the central corridor

The objective of the refurbishment is to retain as much of the 19th Century look and feel as possible, while making all the vaults visible. This objective is also beneficial in terms of maintenance and inspection of the vaults. Where attending points or retail areas[1] are to be located, glazing will be placed and offset 2 m from the inside edge of the arch, and lighting in the interior of the retail units will collaborate with the lighting in the public spaces.

Granite tiles will be used for the floor to avoid any impact on historical structures . The pavement will stop clear of the fabric walls to reduce the impact on them. This joint between the pavement and the walls will be used for lighting purposes. Quality materials will be used in a contemporary way, maintaining the original character of the station whilst providing a more modern identity. This operation will allow a new use for the existing vaults structures that are currently in a poor conservation state.

For the façade at the entrance of the new station, it is proposed to remove the free-standing wall and door on the vault facing Preston Street, leaving it open. A new louvre façade system will be placed over the access arch and the access to the bicycle parking vault, becoming a visual landmark from Amiens Street. The louvres will be separated from the brick and will include illumination of the existing brick façade.

[1] The provision of retail areas is not part of the RO application.

Figure 4-66 New entrance facade at Preston Street

4.6.3.2.4 Structural criteria

The structural modifications at Connolly Station are limited to the opening of several voids in the platform to connect street level to ground level. To achieve this vertical connection, the structure in the voids will be required to bear and transfer the horizontal loads from the arches, retain the fill between the arches and the platform, and support the stairs in certain locations. It is possible that the foundations of the existing vaults would be able to support the Reinforced Concrete (RC) structure for the openings. However, the worse-case scenario has been considered and a new piled foundation is proposed.

4.6.3.2.5 Waterproofing strategy

The proposed waterproofing strategy is based on acrylic injections that would only be used for the vault of the longitudinal corridor and in some cross vaults such as the access vault from Preston Street (L17) and the ones that provide vertical connection to the platforms (L14, L20, L24, M12, M14, M20 and M24).

The objective of the proposal is to remove the water from those vaults and transfer it to the adjacent ones, where the water seepage would be collected by new down pipes that will replace the existing ones. The proposed drainage system is not completely effective or everlasting since the only definitive solution would be to waterproof the vault structure from the upper side.

In areas where acrylic injections are not proposed, water penetration will be prevented by means of a system of removable polycarbonate umbrellas, that follow the geometry of the vaults. In this way, the water pressure in these vaults would not be increased since the water can seep through the bricks into the vault.

4.6.4 Drainage

OBO11 represents a challenge due to the implementation of the OHLE. The reduced clearance as a result of the OHLE leads to the requirement to lower the track under the OB.

The tracks under OBO11 have an existing drainage system that will be impacted by the track lowering. The existing drainage will be adapted to the new track elevation.

Collector pipes are proposed at both sides of the track, except when passing underneath the OB and in the following stretch where they are located between tracks.

The existing carrier drain will be adapted to the new track levels up until the existing outfall point, next to OBO12A. This outfall point discharges to the gravity foul network between Claude Rd and Wigan Rd. An oil separator is proposed before the outfall.

The drainage system has dimensions ranging from 225 mm to 600 mm in diameter with gradients up to 1 in 318.

4.6.5 Glasnevin substation

The substation is located within a greenfield area adjacent to playing pitches to the north of the railway, near Clareville Court residential area.

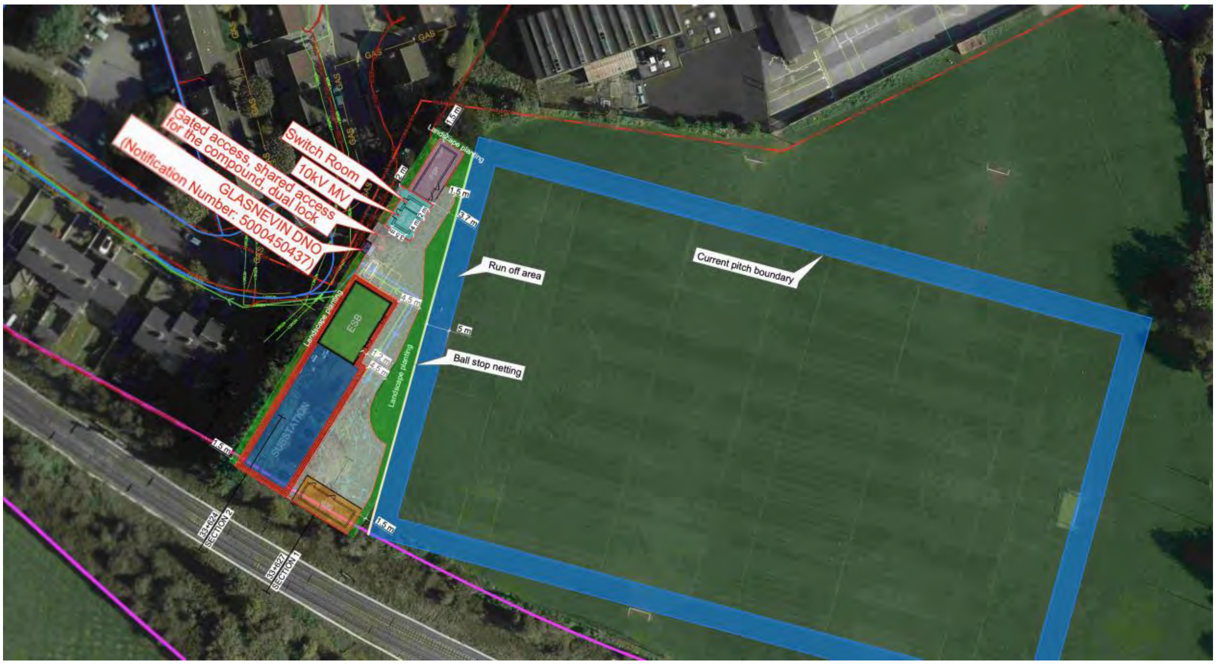


Figure 4-67 Glasnevin substation location and St. Vincent's School GAA pitch

A 5 m runoff area has is required outside of the pitch limits, as shown in Figure 4-67. The layout and dimensions of the pitch will be unchanged by the proposed development. Due to the proximity to the playing pitches and recreational areas additional safety and landscaping measures are proposed around the substation, such as increased ball stop netting along the full end line, fencing, planting and landscape screening.

Two new accesses to the substation compound (one for the substation, PSP and SEB, and one specifically for the 10kV substation) will be provided from the adjacent road on Clareville Court.

4.7 Zone B. Spencer Dock Station to Phibsborough/Glasnevin (Glasnevin Jct) on MGWR Line

4.7.1 Overview of alignment in Zone B

Zone B mainly consists of the MGWR line in Dublin City, but also contains connections to other lines. The green area in Figure 4-68.

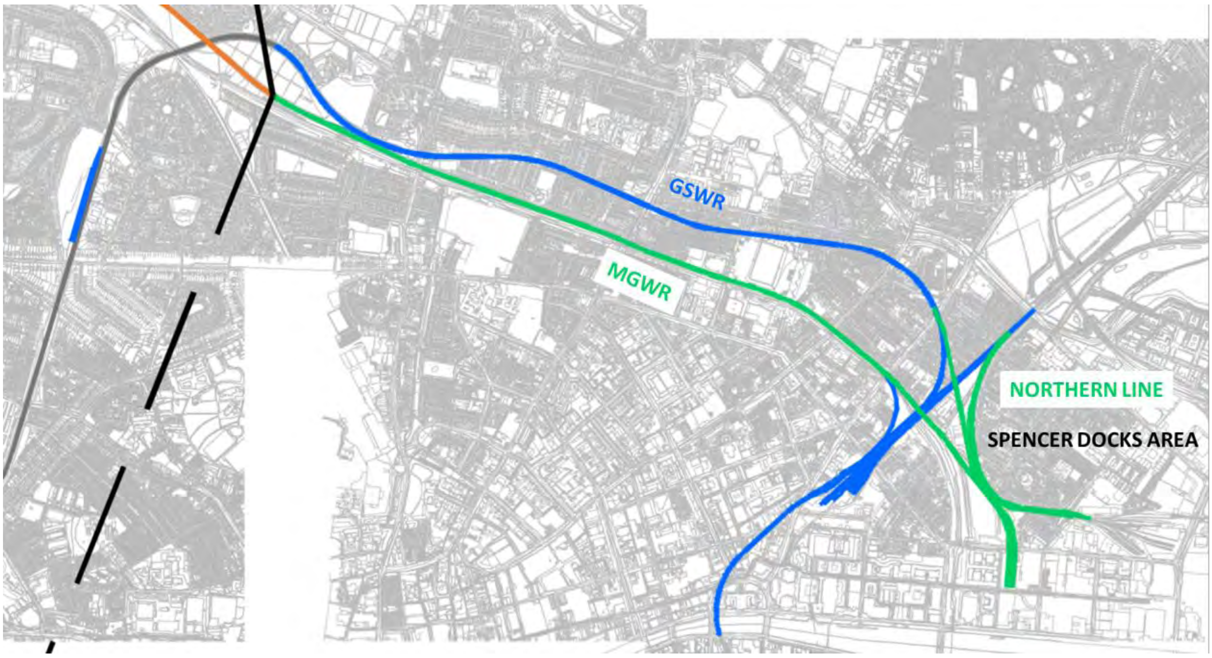


Figure 4-68 Extents of DART+ West Zone B

Zone B runs east to west from the proposed Spencer Dock Station to Glasnevin Junction along the MGWR line. The zone is approximately 3.05 kilometres in length.

The section of track connecting the new Spencer Dock Station with the GSWR line (approx. 1.1 km of track) is also part of Zone B. A small section of the Northern Line in the Docklands area, with a length of 0.8 km, is also considered as part of Zone B.

The extents of Zone B for the DART+ West project are represented schematically in Figure 4-69.

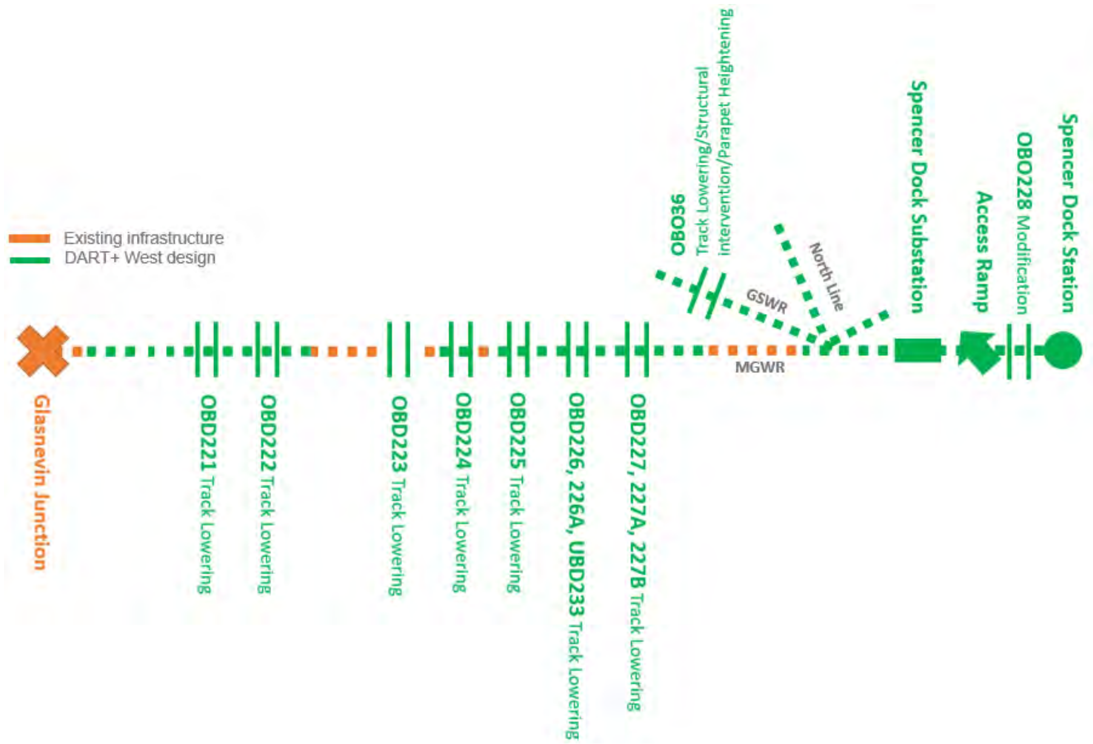


Figure 4-69 Schematic of DART+ West interventions in Zone B

In Zone B, a new station will be constructed at Spencer Dock with the station's platforms aligned with the North Lotts and Grand Canal Dock Planning Scheme gridlines. The existing platforms need to be pushed south to ensure that an acceptable track alignment can be achieved on the immediate approach to the station. The only feasible way to move the platforms southwards is by lowering the top of rail level so the tracks can pass under Sheriff Street Upper overbridge and the entrance of the station with sufficient structural and OHLE clearance.

Changes to the vertical and horizontal track alignment are required to connect the platforms at Spencer Dock Station to the GSWR & MGWR lines.

Next to the station, an access ramp will be constructed in the proposed permanent compound, to provide access to that compound. Works in this area will also involve constructing one substation and auxiliary signalling, electrical and telecommunication buildings in the vicinity of Spencer Dock and Connolly stations. The substation will be positioned northeast of the existing Docklands Station and car park, near the railway junction.

From Spencer Dock Station the proposed slab track alignment will pass below the Sheriff Street Upper overbridge by means of a piled wall solution and will continue then in U-section.

To the East Wall Branch

Realignment and removal of some running lines on the East Wall branch of the track will be required to establish a connection with the proposed Spencer Dock Station.

To the GSWR Line

In the connection with the GSWR line, OBO36 Ossory Road Bridge must be altered due to the track lowering. Parapet heightening is also required for this bridge due to the electrification of the line.

MGWR Line

Upon leaving the new Spencer Dock Station, the route will be constructed on slab track until it reaches ground level, where it will transition to ballasted track. The electrification will continue along the MGWR line until Glasnevin Junction. Track lowering is required at various sections within Zone B and over different lengths below the following successive bridges; from east to west: OBD227, OBD227A and OBD227B railway bridge, OBD226 Newcomen Bridge, OBD226A and UBD233, OBD225 Clarke’s Bridge, OBD224 Clonliffe Bridge, OBD223 Binn’s Bridge, OBD222 Cross Guns and OBD221 railway bridge. The track lowering works will be carried out to allow sufficient clearance beneath bridges for the Overhead Line Equipment (OHLE). Parapet heightening will also be necessary for the aforementioned bridges to protect against the risk of electrocution that arises from the installation of the OHLE. It is also proposed to heighten the parapets at the catenary mast locations for several longitudinal walls running along the line. Specifically, these works will be carried out between OBD222 and OBD227 and near OBO11, and at several footbridges: North Strand Road (OBD226A), Drumcondra Station (OBO14A) and Claude Road (OBO12A). OBD222 Binn’s Bridge is a protected structure and is included in the Record of Protected Structures (RPS) for Dublin City under reference no. 908. The National Inventory of Architectural Heritage (NIAH) has also included Binn’s Bridge under reference no. 50060189. The railway bridge adjacent to Binn’s Bridge is not a protected structure, however, it is included in the NIAH under reference no. 50060296.

The remaining bridges are not protected structures.

4.7.2 Interventions at bridges

Zone B requires works at numerous bridges in order to provide sufficient clearance for OHLE and to provide protection against electrocution. The works consists of track lowering, parapet heightening and structural interventions. For this Zone B, the required interventions are listed in Table 4-12.

Table 4-12 Bridge interventions in Zone B

Structure	Protected	Location	Solution	Depth of lowering	Length	Existing parapet	Proposed parapet	Description
OBD228 Sheriff Street Bridge	No	North of Spencer Dock station. (Ch 20+160/40+160)	Bridge modification	N/A	N/A	N/A	N/A	Demolition of 5 spans and subsequent reconstruction.
OBO36 	No	GSWR line at 4+784 mileage, in Dublin City. (Ch 20+780)	Track lowering & parapets heightening	230 mm	200 m	1.80 m	1.80 m	Track lowering beneath bridge to achieve required clearance for OHLE. Parapet heightening as per Section 4.5.15.5.
OBD227, 227A, 227B 	No	MGWR line at 2+665 mileage, in Dublin City. (Ch 40+820)	Track lowering	406 mm	180 m	N/A	N/A	Track lowering beneath bridge to achieve required clearance for OHLE.
OBD226, 226A, UBD233 	RPS No. 911	MGWR line at 2+588 mileage, in Dublin City. (Ch 41+020)	Track lowering & parapets heightening	385 mm	220 m	1.20 m	1.80 m	Track lowering beneath bridge to achieve required clearance for OHLE. Parapet heightening as per Section 4.5.15.5.
OBD225 	RPS No. 910	MGWR line at 2+380 mileage, in Dublin City. (Ch 41+300)	Track lowering & parapets heightening	308 mm	290 m	1.55 m	1.8 m	Track lowering beneath bridge to achieve required clearance for OHLE. Parapet heightening as per Section 4.5.15.5.
OBD224 	No	MGWR line at 1+1710 mileage, in Dublin City. (Ch 41+780)	Track lowering & parapets heightening	240 mm	185 m	1.22 m	1.80 m	Track lowering beneath bridge to achieve required clearance for OHLE. Parapet heightening as per Section 4.5.15.5.
OBD223 	RPS No. 908	MGWR line at 1+1019 mileage, in Dublin City. (Ch 42+200)	Track lowering & parapets heightening	603 mm	315 m	1.10 m	1.80 m	Track lowering beneath bridge to achieve required clearance for OHLE. Parapet heightening as per Section 4.5.15.5.

Structure	Protected	Location	Solution	Depth of lowering	Length	Existing parapet	Proposed parapet	Description
OBD222 	No	MGWR line at 0+1412 mileage. (Ch 43+080 - 43+240)	Track lowering & parapets heightening	410 mm	575 m	1.40 m	1.80 m	Track lowering beneath bridge to achieve required clearance for OHLE. Parapet heightening as per Section 4.5.15.5.
OBD221 	No	MGWR line at 0+1598 mileage (Ch 43+320)	Track lowering	410 mm	575 m	1.00 m	1.80 m	Track lowering beneath bridge to achieve required clearance for OHLE. Parapet heightening as per Section 4.5.15.5.

4.7.3 Spencer Dock area

The proposed Spencer Dock Station integrates well with the surrounding buildings by aligning the station's platform to the North Lotts and Grand Canal Dock Planning Scheme gridlines. This alignment also makes the layout more compatible with the structure of the buildings above. The existing platforms will need to be pushed south by lowering the top of the rail level so the tracks can pass under the Sheriff Street Upper overbridge and the Spencer Dock Plaza with sufficient structural and OHLE clearance. The resulting level for the platforms is -2.39 m OD.

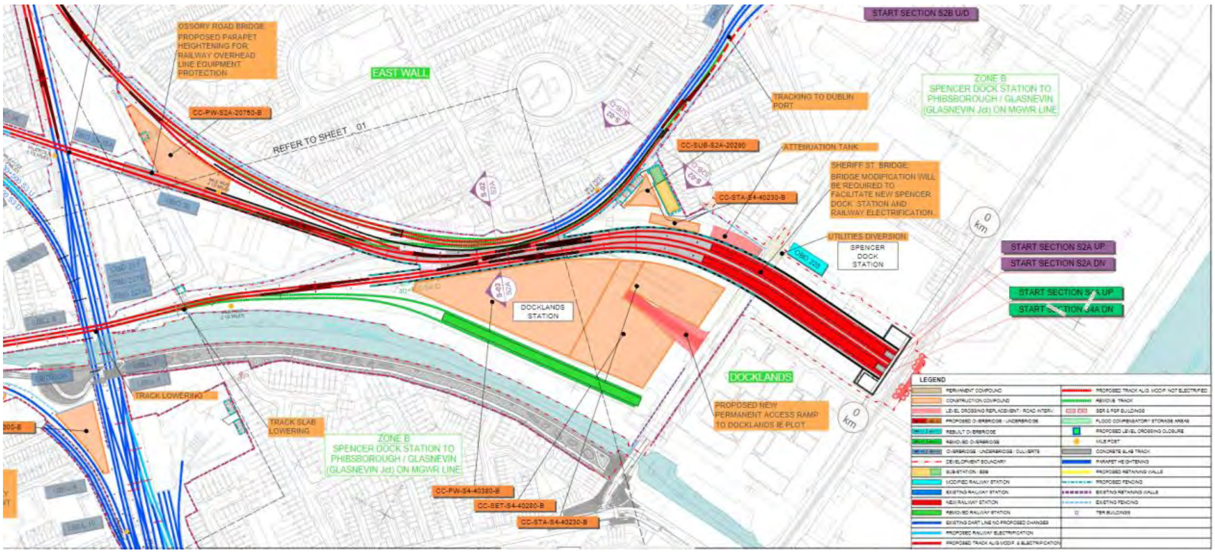


Figure 4-70 Interventions in Spencer Dock area

This proposed configuration will ensure that:

- Platforms and tracks are aligned to the structural grid of the North Lotts and Grand Canal Dock Planning Scheme and the proposed overhead buildings' structural design.
- Preservation of the connection to East Wall Yard via the Northern Line.
- Two island platforms serve four tracks.

The proposed layout allows Spencer Dock Station to:

- Access four platform tracks from the MGWR line.
- Access two platform tracks from the GSWR line.
- Access two platform tracks from the Northern line.
- Interconnect the MGWR, GSWR and Northern Lines, fully complying with operational requirements.

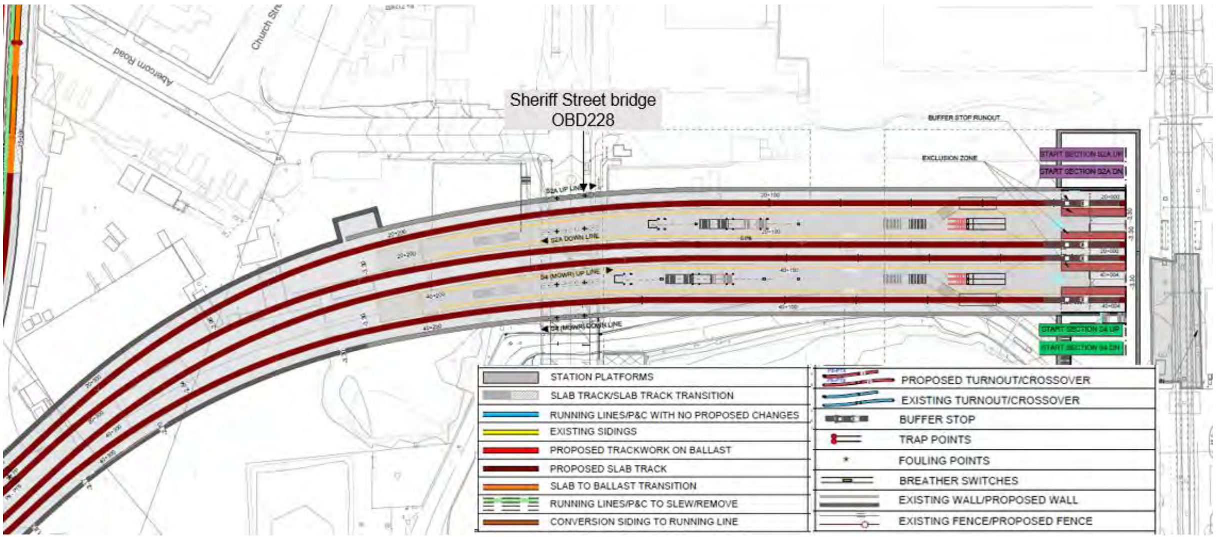


Figure 4-71 Proposed Spencer Dock Station layout

Sheriff Street Upper overbridge (OBD228) must be altered over the proposed station to accommodate the new track layout. These alterations include removal of the old deck and construction of new piers (see Section 4.7.3.4).

Further information about the proposed Spencer Dock Station is provided in Section 4.7.3.6.

4.7.3.1 Alignment

Spencer Dock Station requires the construction of four tracks and two island platforms. The design of these tracks includes the following key features:

- Four platform tracks accessible from the MGWR line.
- Two platform tracks accessible from the GSWR line (Platform 3 and 4).
- Two platform tracks will be accessible from the Northern line (Platform 3 and 4).
- A single-track connection is provided to the East Wall Yard. Assuming freight traffic is to run during the night and off-peak times, such a connection should provide access to the Northern line and to the GSWR line.
- East Wall Branch tracks: Due gradient restrictions for freight trains, the alignment will avoid impacting these tracks as far as is practicable.

Tracks at Spencer Dock Station are at -3.30 m OD, below the water table. As they leave the station, the tracks to the MGWR, GSWR and East Wall Branch rise in elevation to connect with the existing tracks on these lines. For most of this route, the tracks remain below the water table.

Therefore, a retaining wall solution is required along the length of the track in this area to protect it from groundwater and against uplift pressure. The proposed solution consists of a U-section structure (for general cases) and piled wall (for special cases).

For this structural solution, the use of slab track is proposed.

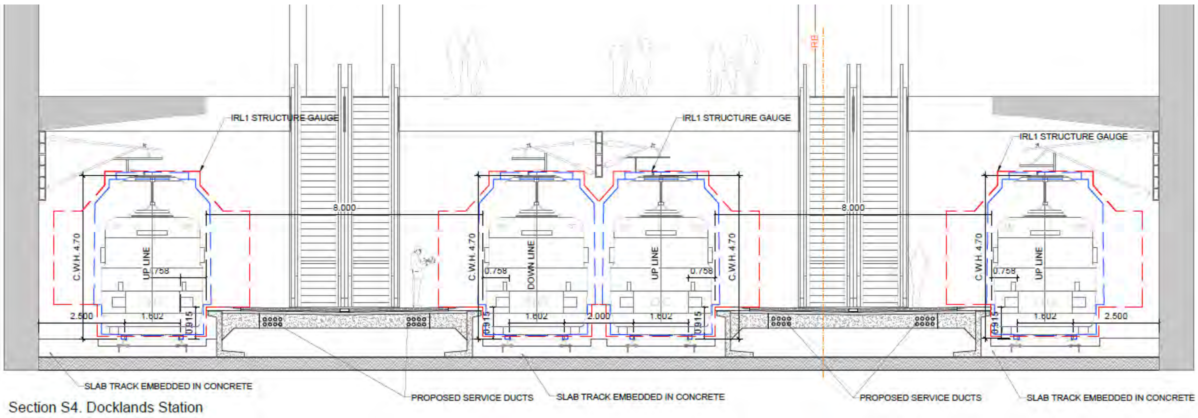


Figure 4-72 Proposed Spencer Dock Station cross section

From Spencer Dock Station the proposed slab track alignment will pass below the Sheriff Street Upper overbridge by means of a piled wall solution and will continue then in U-section (see Section 4.7.3.2). The area where slab track will be established is:

- From Spencer Dock at Ch 20+000 to Ch 20+500 on the East Wall branch.
- From Spencer Dock to OBD227 on the MGWR Line, from Ch 40+000 to Ch 40+500

4.7.3.2 Retaining walls

Part of the tracks near Spencer Dock Station are below ground level and located in an area with a high-water table (circa 0.00 m OD).

Therefore, a retaining wall with a protection slab is required along the track in this area to protect it from groundwater inundation and against uplift pressure.

Figure 4-73 shows the different locations where the structures are proposed in the Spencer Dock area:

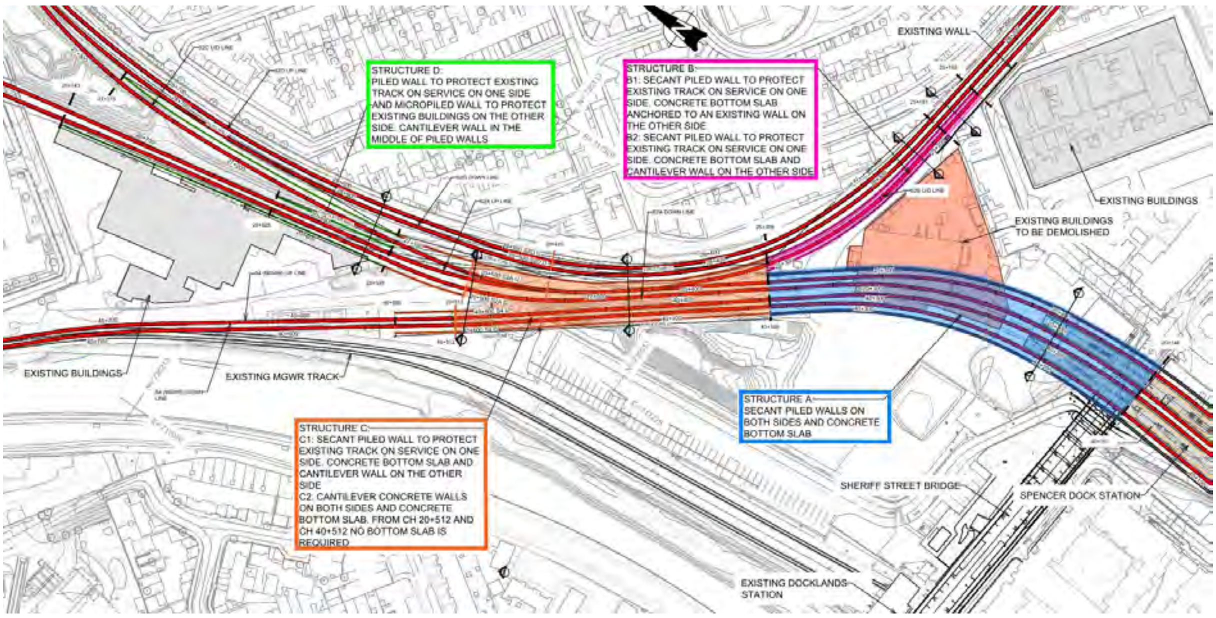


Figure 4-73 Extents of retaining walls and protection slab in Spencer Dock area

The chainages at which the different wall solutions are proposed are summarised below:

- Cantilever walls and protection slabs
  - From 25+191 to 25+309 on one side of the track.

  - o From 40+309 to 40+470 on one side of the track.
  - o From 40+470 to 40+550 on both sides of the track.
  - o From 20+470 to 20+555 on both sides of the track.
  - o From 20+555 to 20+625 on one side of the track.
- Piled Wall
  - o From 20+000 to 20+309 on one side of the track.
  - o From 40+000 to 40+309 on one side of the track.
  - o From 25+165 to 25+309 on one side between S2B U/D line and the existing East Wall branch tracks.
  - o From 20+309 to 20+470 on one side between S2A UP line and the existing East Wall branch tracks.
  - o From 27+110 to 27+275 on one side between S2C U/D line and the existing East Wall branch tracks.
  - o From 20+555 to 20+743 on one side between S2C U/D line and the existing East Wall branch tracks.

The concrete piled wall solution is required between the proposed Spencer Dock Station and the Sheriff Street bridge. This solution is depicted in Figure 4-74 and will require an excavation approximately 6.85 m deep.

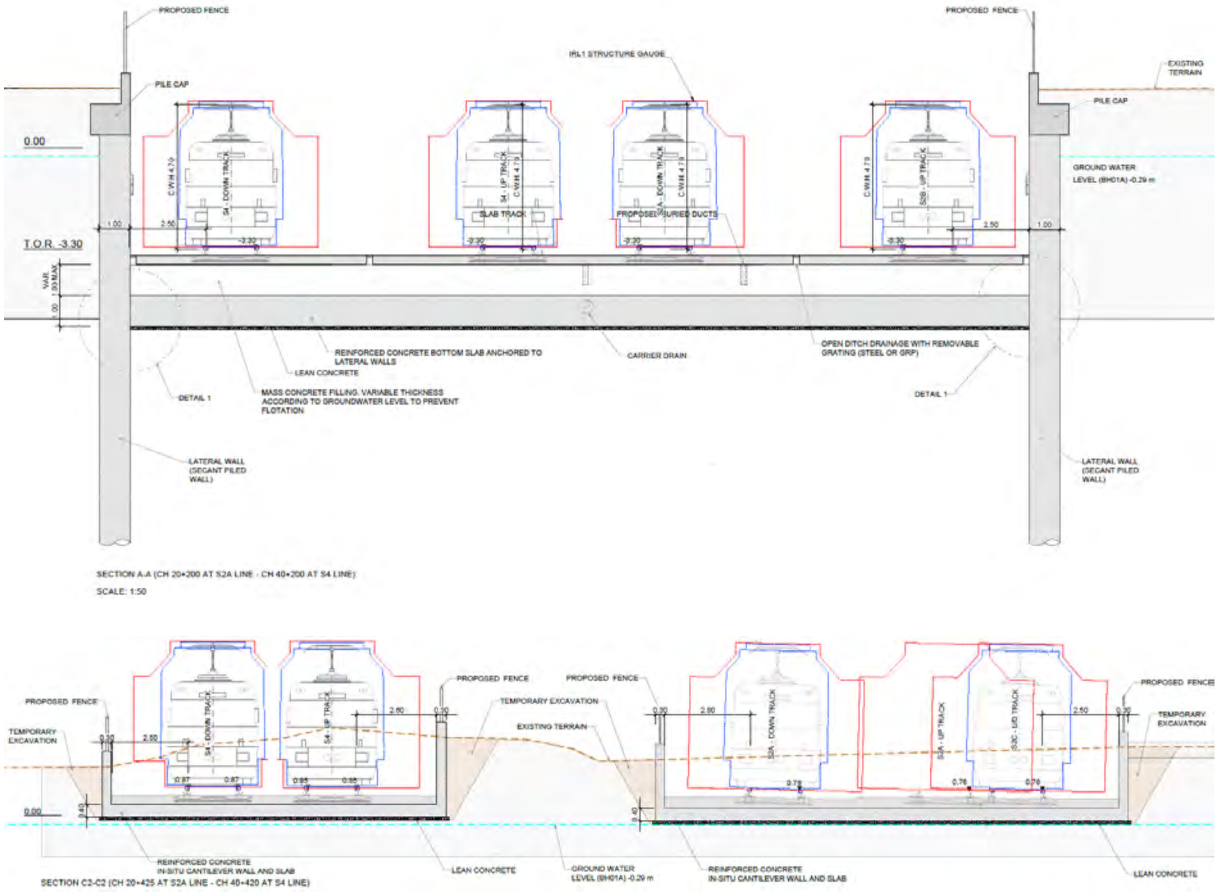


Figure 4-74 Example of concrete piled wall solution (above) and cantilever walls with concrete bottom slab (below)

Due to track realignment a cantilever retaining wall is required at some locations to laterally support soil, so that it can be retained behind the wall at a different level to the track. The existing track does not have OHLE installed and, consequently, it will be necessary to provide sufficient space to install the OHLE masts. Figure Figure 4-75 shows an example of the cantilever retaining wall solution.

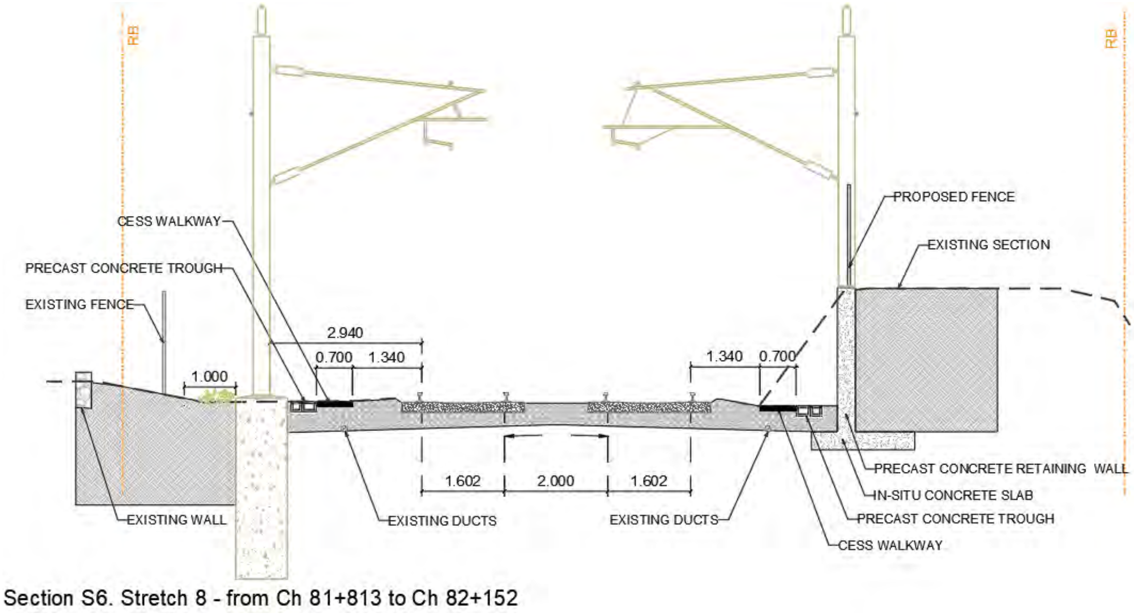


Figure 4-75 Example of cantilever retaining wall solution

4.7.3.3 Drainage

Spencer Dock Station is located at the end of the line, and the ground slopes consistently downwards as it approaches the station. The existing topography in combination with the existing drainage system, the high-water table and the underlying soil conditions require the provision of an attenuation tank for water collection and pumping.

The proposed location of this attenuation tank is outside of the station grounds, northeast of the Sherriff Street Upper overbridge, as indicated in Figure 4-76.

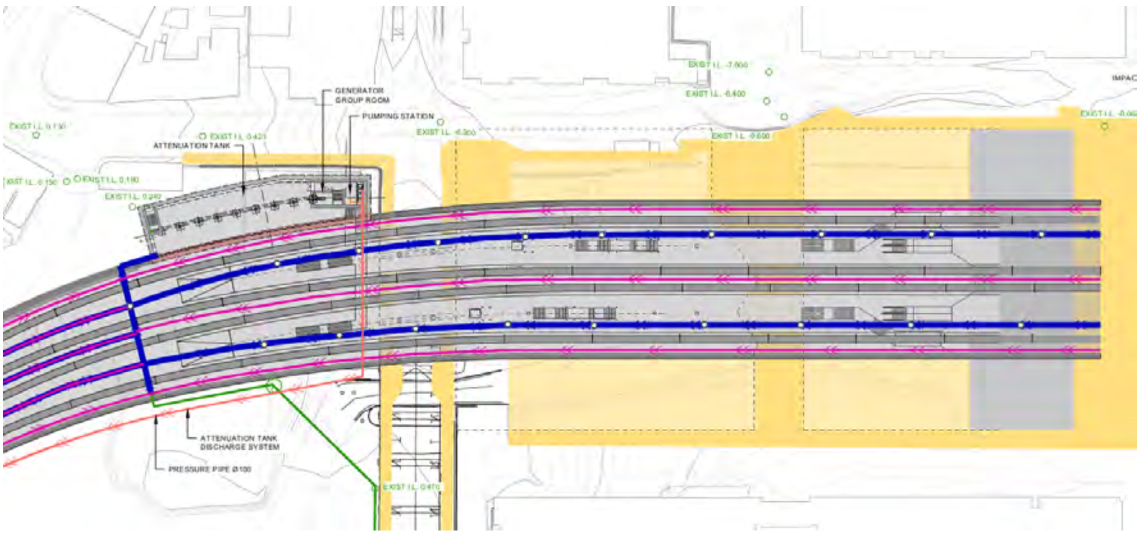


Figure 4-76 Proposed location of attenuation tank at Spencer Dock Station

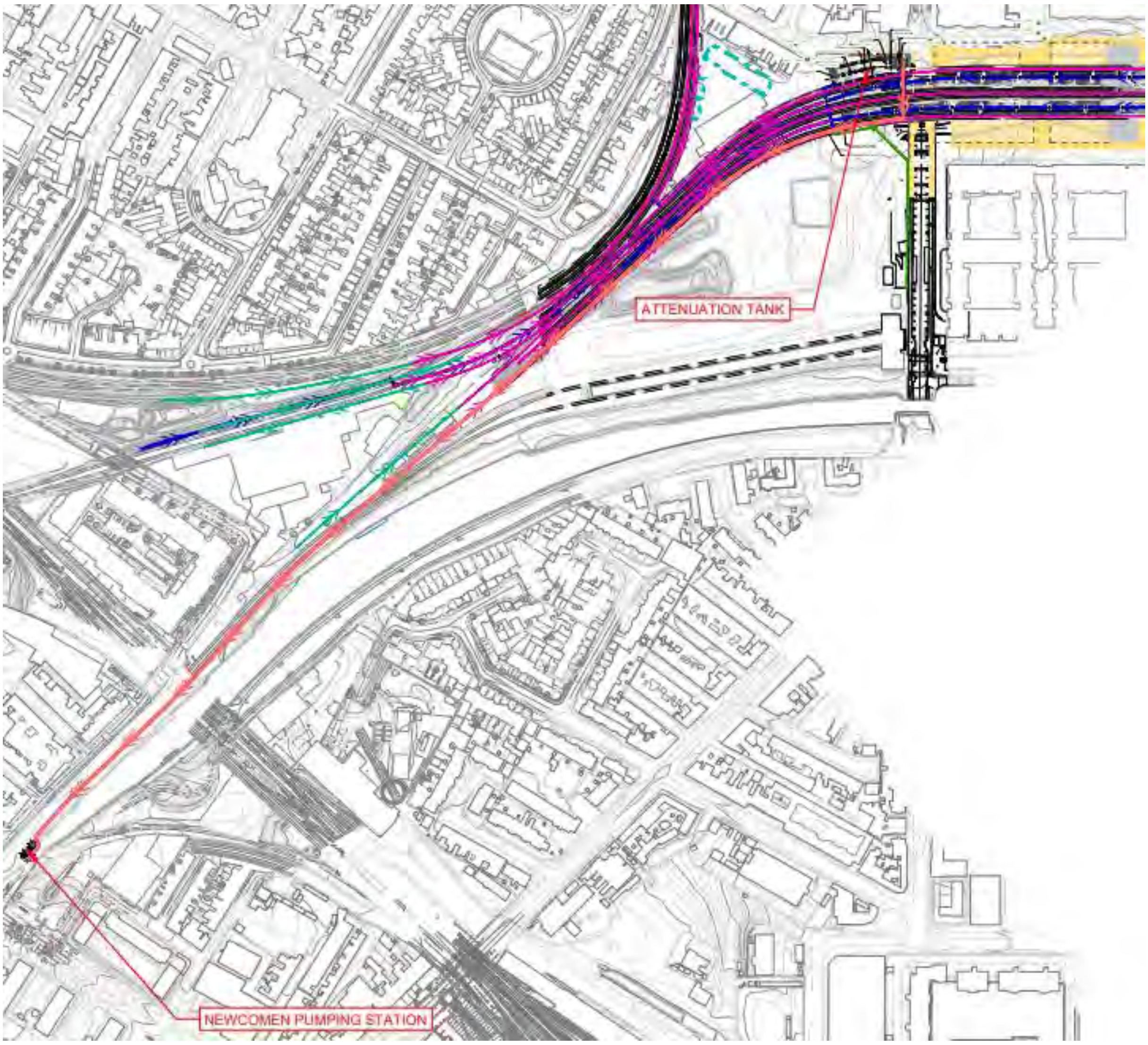


Figure 4-77 Proposed Spencer Dock attenuation tank outfall location

4.7.3.4 OBD228 Sheriff Street Bridge modification

To accommodate the construction of the proposed Spencer Dock Station, part of the existing Sherriff Street bridge must be demolished and will then be rebuilt following completion of the works.

Five spans of the bridge deck will be demolished and rebuilt to their initial elevation to allow connection back to the existing bridge deck. New bridge piers are proposed and have been designed considering the arrangement of the proposed Spencer Dock Station. The vertical clearance under the bridge is approx. 8.00 m from the soffit of the bridge deck to the TOR design level.

The reconstructed section of the bridge has a total length of approximately 53.57 m and will consist of nine 800 mm deep precast concrete beams supporting a deck with a minimum depth of 200 mm.

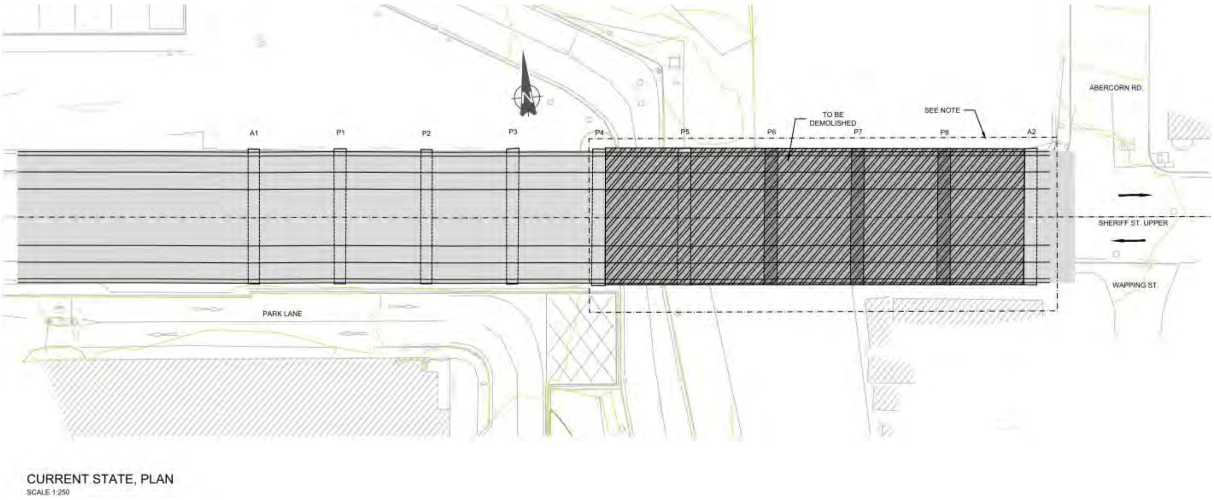


Figure 4-78 Plan view of existing OBD228

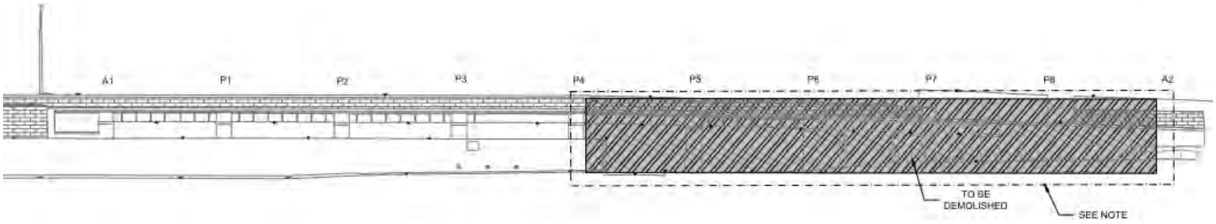


Figure 4-79 Elevation of existing OBD228

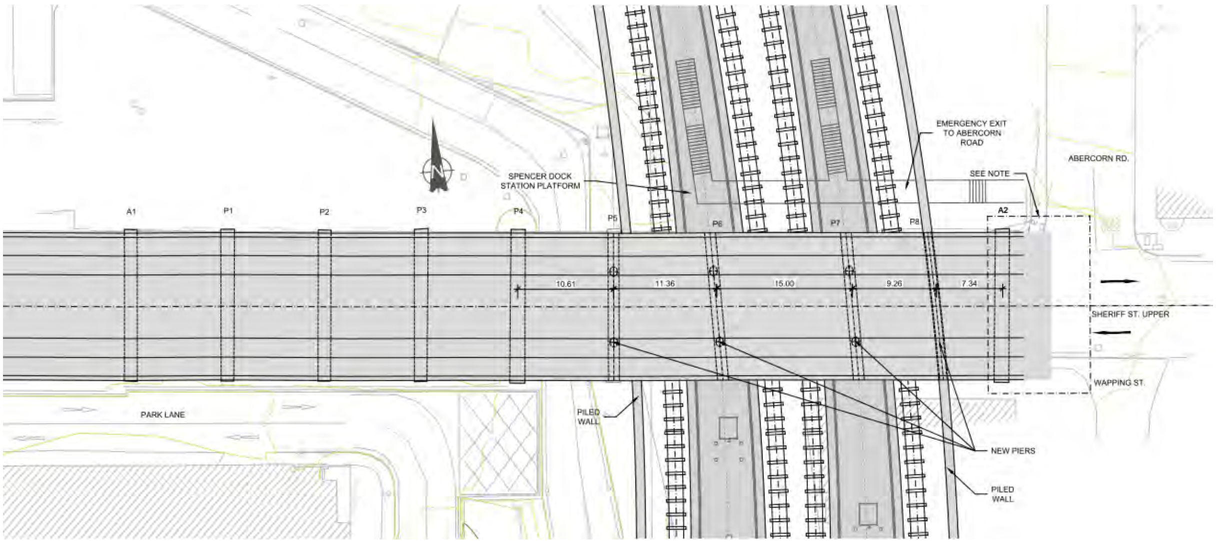


Figure 4-80 Plan view of reconstructed OBD228

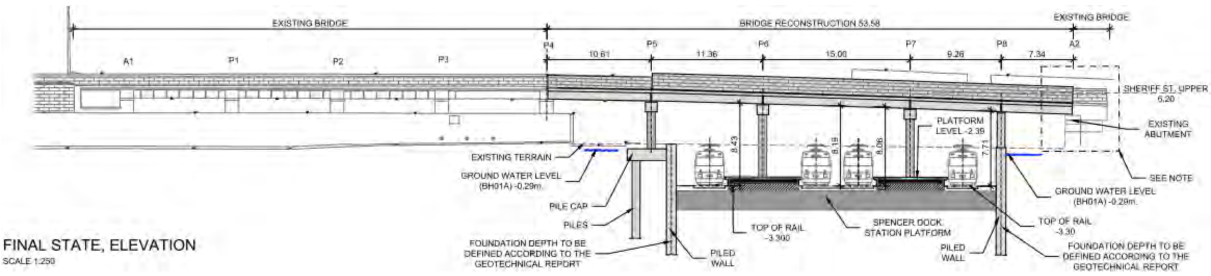


Figure 4-81 Elevation of reconstructed OBD228

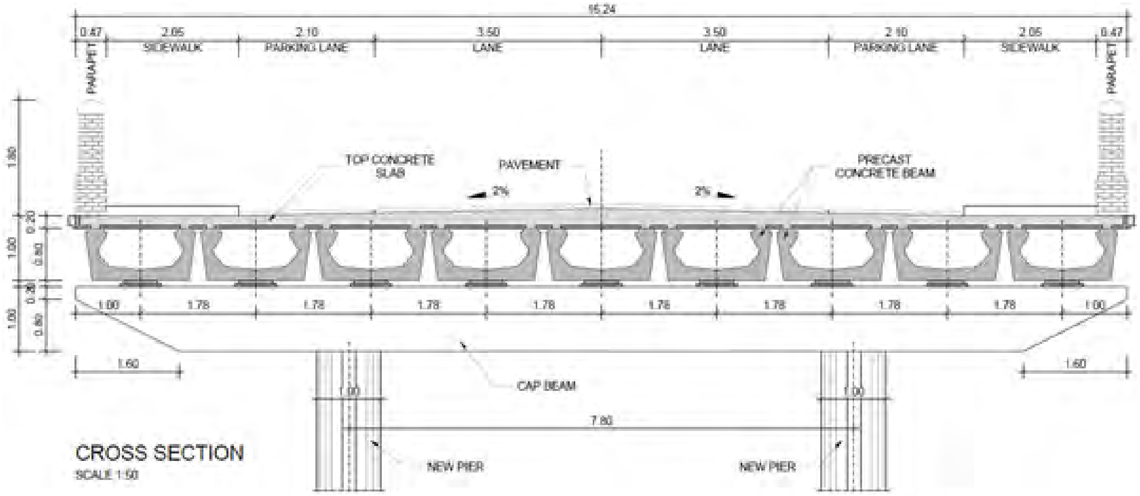


Figure 4-82 Cross section of reconstructed OBD228

4.7.3.5 New access ramp to permanent compound

An access ramp from Sheriff Street is required to provide access to the temporary construction compound and existing Spencer Dock – CCE/SET Permanent Compound which is to be relocated in the East Wall Yard area.

The embankment ramp has a total length of 80 m and a 9 m width, with a maximum slope of 7%, rising towards the east. The ramp will be constructed with fill material. Details of the access ramp can be seen in Figure 4-83 and Figure 4-84.

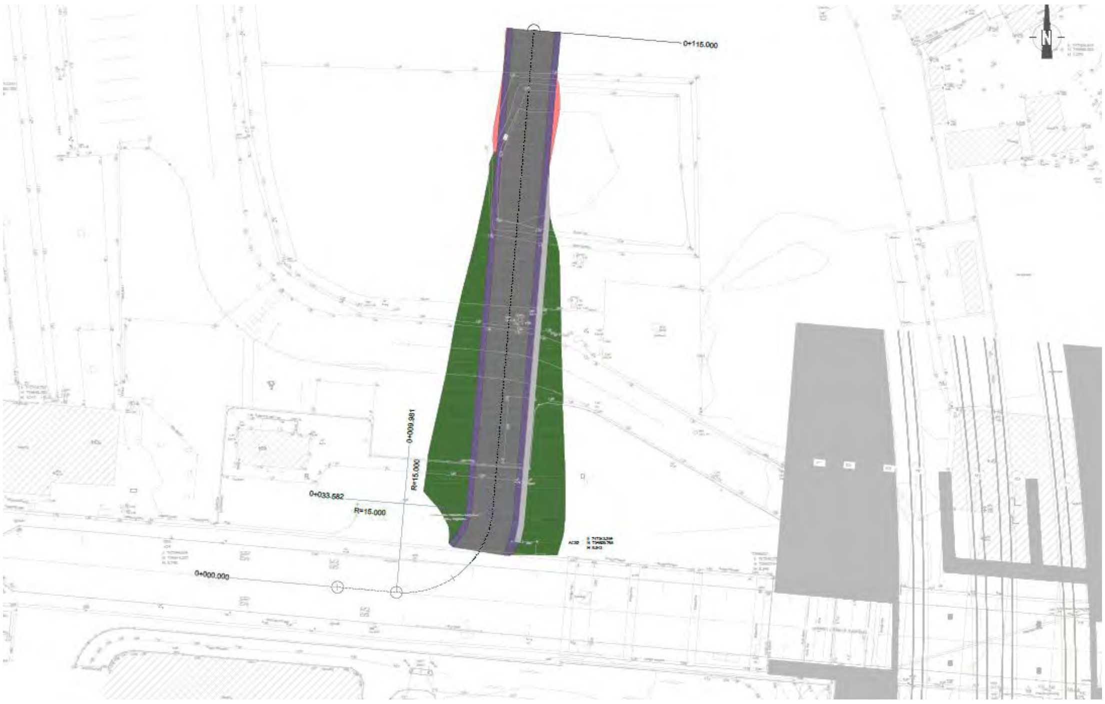


Figure 4-83 Ramp general arrangement

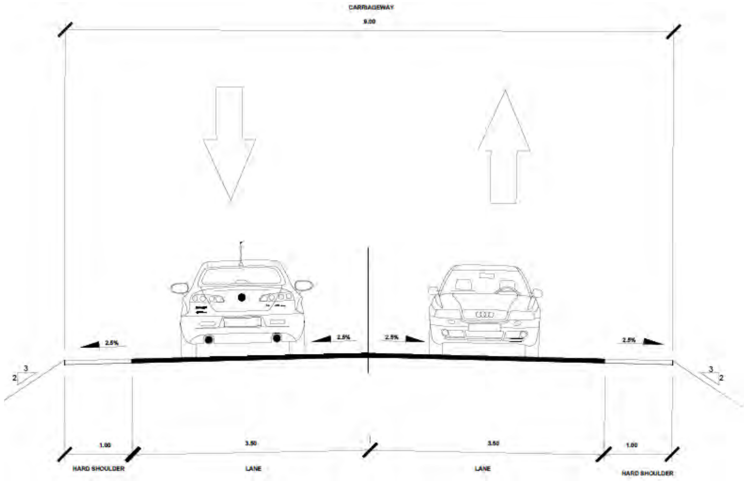


Figure 4-84 Ramp cross-section

4.7.3.6 Spencer Dock Station

A state-of-the-art station is proposed at Spencer Dock with the aim of achieving a high-level passenger experience. The proposed station was designed with two key goals in mind:

- To foster interchange with other means of transport. This will be via the connection with Spencer Dock Luas Station as well as direct access to buses, cycle parking, and provision of a drop-off area for cars and taxis.
- To provide a seamless connection between the city and the platforms, thus achieving a safe and pedestrian-friendly passenger experience.

Figure 4-85 Sketch of main entrance to proposed Spencer Dock Station

Spencer Dock Station has been designed with two island platforms serving four tracks. The size of the platforms and the station facilities can cater to a significant station capacity. A brief description of the proposed developments at Spencer Dock Station is given in the subsequent sections. See Appendix A4.2 Spencer Dock Station Design Report in Volume 4 of this EIAR for full details of the proposed development.

4.7.3.6.1 Integration with the North Lotts and Grand Canal Dock SDZ Planning Scheme

Spencer Dock Station integrates well with the surrounding buildings by aligning the platform of the station to the North Lotts and Grand Canal Dock SDZ Planning Scheme gridlines. This alignment also ensures the arrangement is compatible with the structure of the buildings above. The existing platforms need to be pushed south and track lowering is required under the Sheriff Street Upper overbridge and the Spencer Dock Plaza to provide sufficient clearance. The resulting level for the platforms is -2.39 m OD.

Sheriff Street Upper overbridge must be altered over the proposed station to accommodate the new track layout (refer to Section 4.7.3.4 for further details).

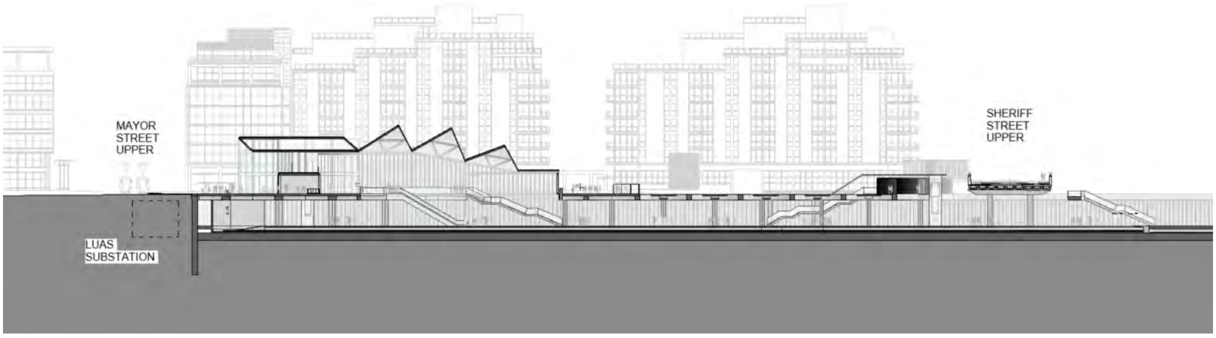


Figure 4-86 Long section through proposed Spencer Dock Station

Access to the proposed station fronts the Spencer Dock Luas station, thus fostering the interchange between the DART and the Luas. The station is located amongst a hub of modern office blocks and apartment buildings and fronts onto the Spencer Dock Plaza.

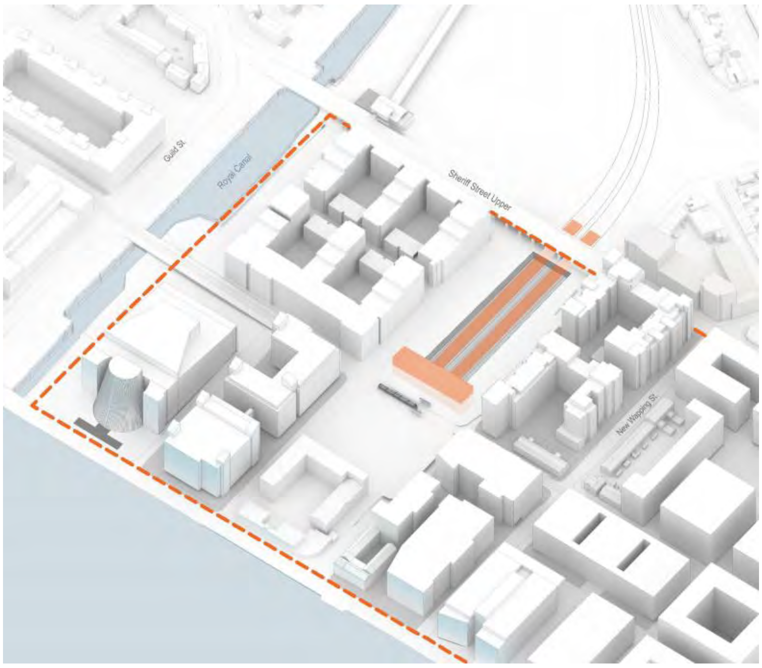


Figure 4-87 Graphical representation of the proposed Spencer Dock Station (in orange)

The construction of the two building blocks (2A & 2C) described in the North Lotts planning scheme is compatible with the layout of the proposed station. The building fronting the Spencer Dock Plaza (named 'landmark building' in the planning scheme) and any block running from East to West, such as the building fronting Sheriff Street Upper, would be required to avoid locating any structural supports within the footprint of the station.

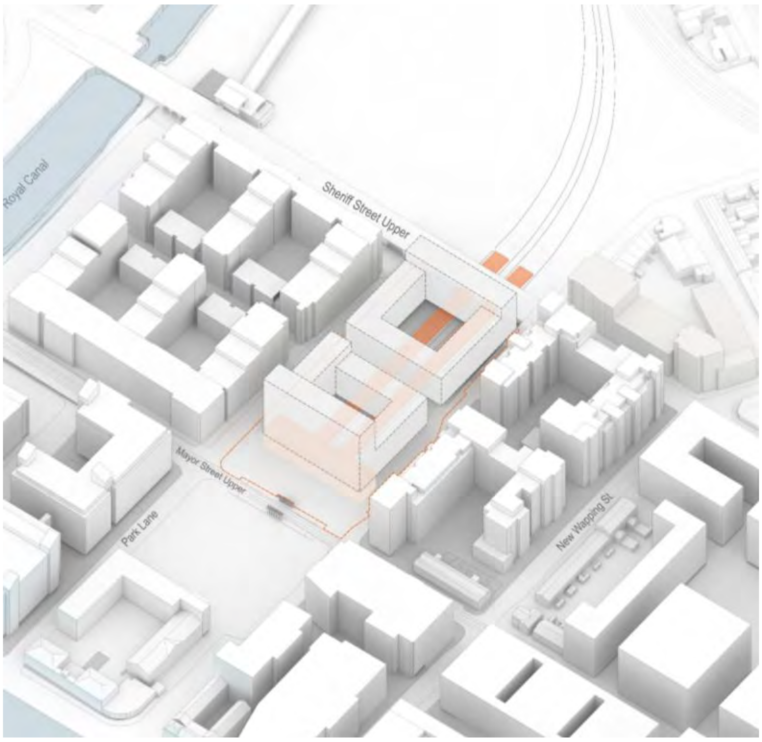


Figure 4-88 Graphical representation of proposed Spencer Dock Station (in orange) including potential over station development

The alignment of the has been chosen to comply with the North Lotts and Grand Canal Dock SDZ Planning Scheme. The design and construction of the Over Station Development (OSD) is outside the scope of the DART+ West project. However, the proposed station design is capable of facilitating an OSD as part of future development.

A potential OSD arrangement, integrated with the proposed station design, is illustrated in Figure 4-89, Figure 4-90 and Figure 4-91.

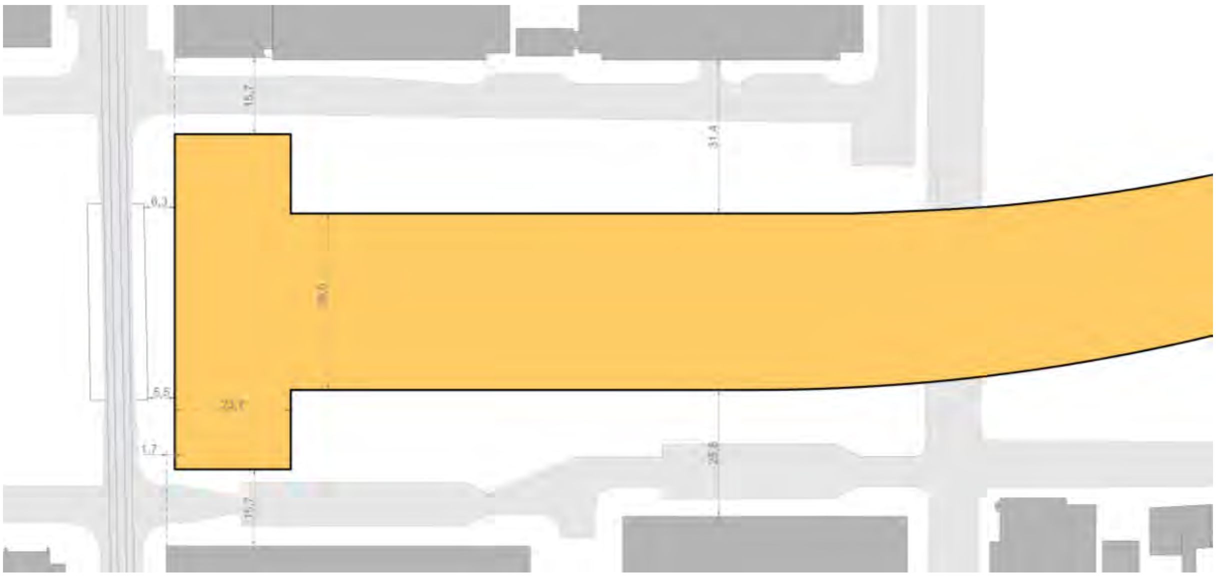


Figure 4-89 Spencer Dock Station footprint below ground

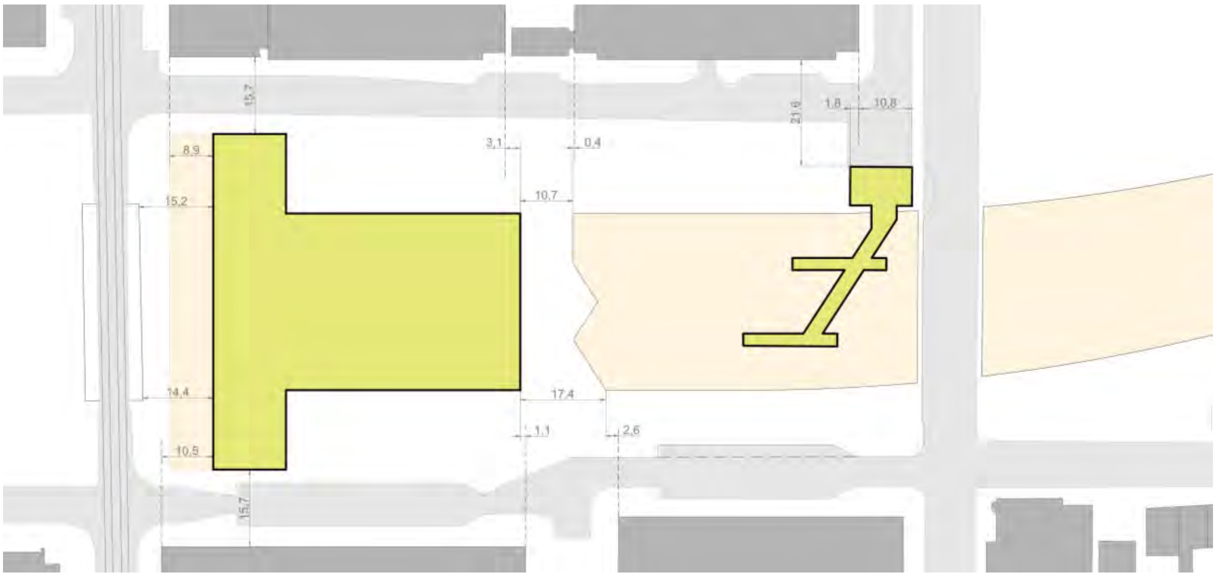


Figure 4-90 Spencer Dock Station footprint above ground

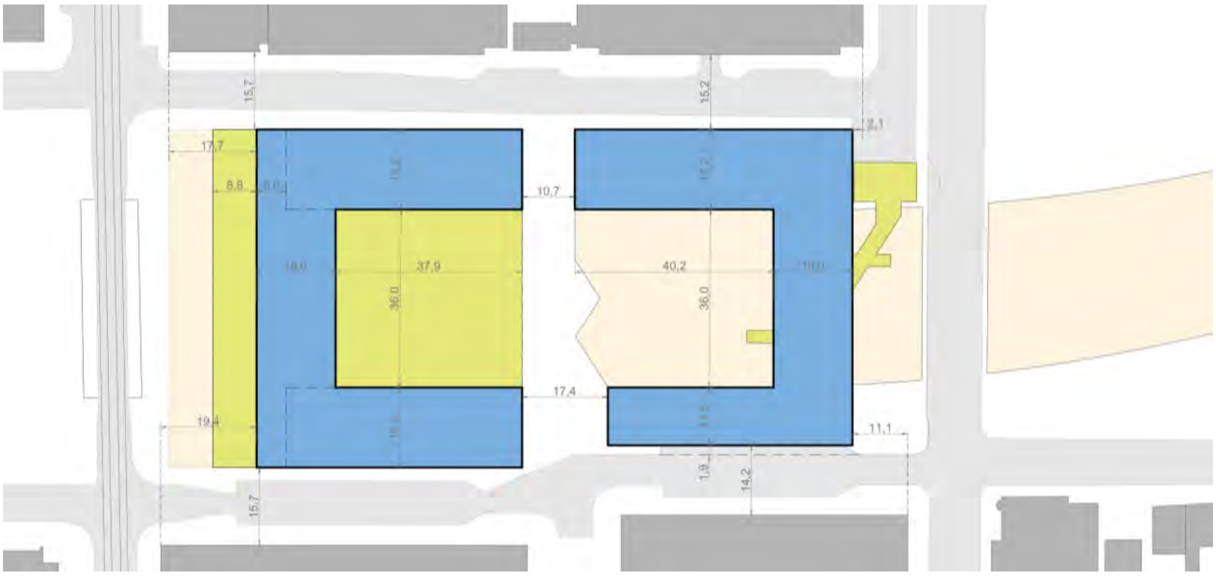


Figure 4-91 Potential arrangement of OSD (blue) integrated with the proposed Spencer Dock Station (green)

A pedestrian laneway is facilitated between blocks 2A and 2C in this design, as required in the North Lotts and Grand Canal Dock SDZ Planning Scheme, to ensure connectivity and continuity to the pedestrian laneways in the surrounding blocks.

4.7.3.6.2 Independent station and OSD structures

The supports of the OSD structure could be placed within the areas on either side of the proposed platforms, thus minimising the interference between the structure of the station and the structure of the OSD.

This approach has some important consequences:

- It allows the construction of the station structure independently of the future Over Station Development structure.
- The future OSD structure will need to incorporate two bridges over the station. One of the bridges will be required to support a 10-storey structure and the other will be required to support an 8-storey

structure. The structure will need to span more than 36 m between cores at either side of the station entrance. This solution is represented in Figure 4-92.

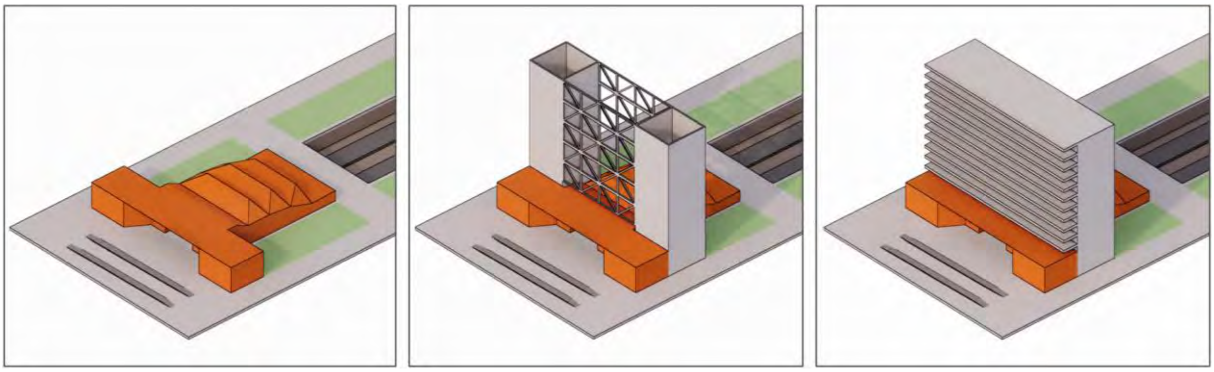


Figure 4-92 Schematic representation of the potential landmark building structure bridging the station entrance

The part of the station corresponding to Block 2A of the North Lotts planning scheme will not be covered as part of the DART+ West project, except for the area corresponding to the platforms, which will be covered to protect the passengers from rain. However, structural columns and beams will be constructed to reduce the size of the retaining walls and the depth of the piling. Provision of these structural elements would assist the construction of a plaza between buildings should future developers be required to cover that space. Drainage provided for the platform canopies will be oversized to allow the collection of rainwater from all the areas of the potential future plaza.

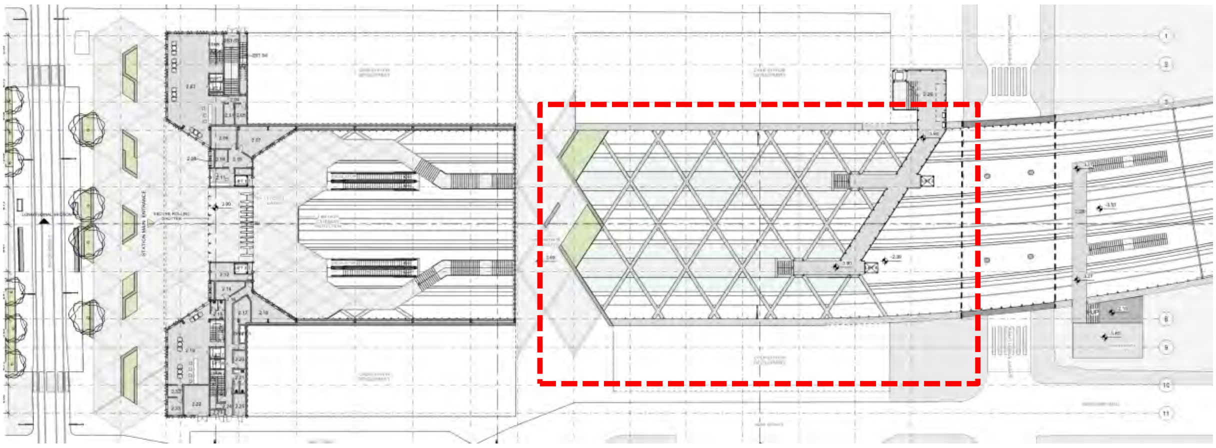


Figure 4-93 Area corresponding to Block 2A of the North Lotts & Grand Canal Dock SDZ Planning Scheme

4.7.3.6.3 Intermodality and accesses

One of the primary motivations behind moving the station from Docklands to Spencer Dock is to foster pedestrian accessibility and intermodal transport.

The station is proposed with two entrances:

- The main entrance is at Mayor Street Upper, fronting the Spencer Dock Luas Station. This access will receive the greater passenger flow due to intermodal passengers arriving via the Luas station, the proximity of significant pedestrian flows and the existence of a covered bicycle parking facility (which will be provided with 120 additional parking spaces).
- The secondary entrance is located at Sheriff Street Upper. This provides easier access to road users than if they were to enter the North Lotts and have to make their way to Mayor Street Upper.

This access will receive passengers arriving to the station by taxi, private car and, by bus. There is an opportunity to increase the number of spaces for buses to stop at this location.

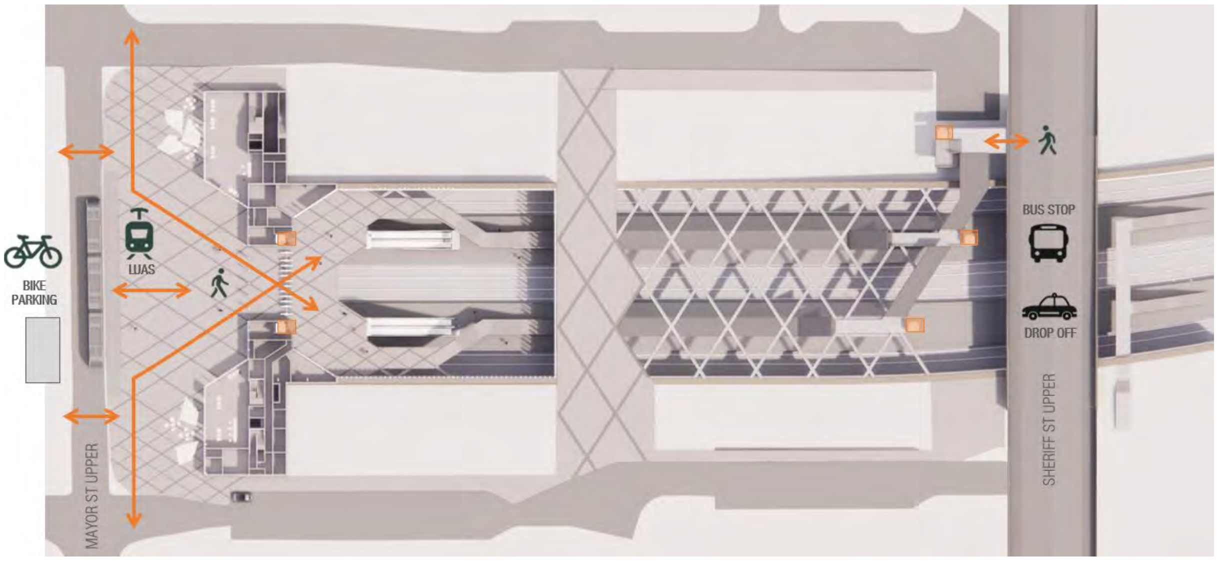


Figure 4-94 Diagram showing the intermodality and accesses to Spencer Dock Station

The illustration in Figure 4-95 shows the longitudinal section through the station with the main access and the secondary access at either end of the platforms. They provide the desired intermodality between a number of methods of transport.

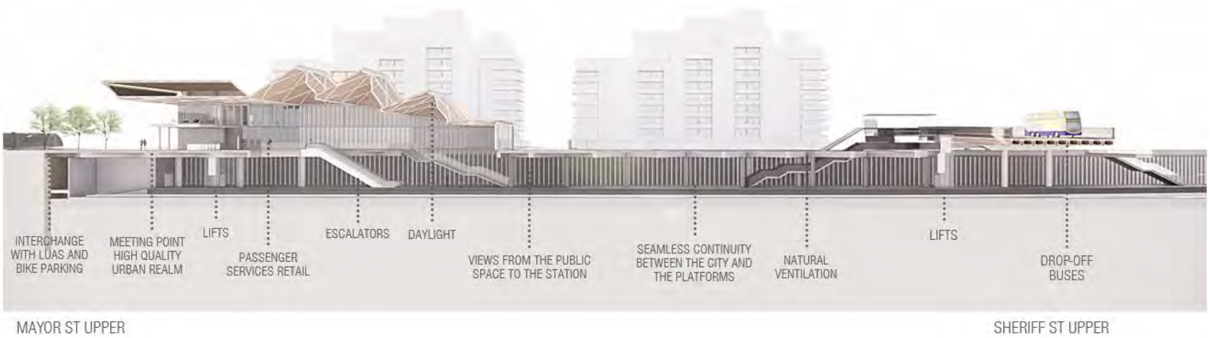


Figure 4-95 Graphic illustrating the section and the primary elements of the proposed station

4.7.3.6.4 Architectural concept

The station main access design intends to achieve the following objectives:

- The access from Mayor Street will be the entrance portal to the DART+ system for the people of Dublin. The building will need to be striking as it will represent the image of IÉ and the new DART+ system to the public. The architectural design of the access as a large opening fronting the Spencer Dock Plaza highlights the idea of the station being the gate to the DART+ system within the city. This main entrance to the station is represented in Figure 4-96.

Figure 4-96 View of Spencer Dock Station's main entrance

- The new entrance will also be the welcoming point and the portal to Dublin for the passengers arriving by train. The first impression of a city is essential for its reputation in terms of tourism, business and international image.

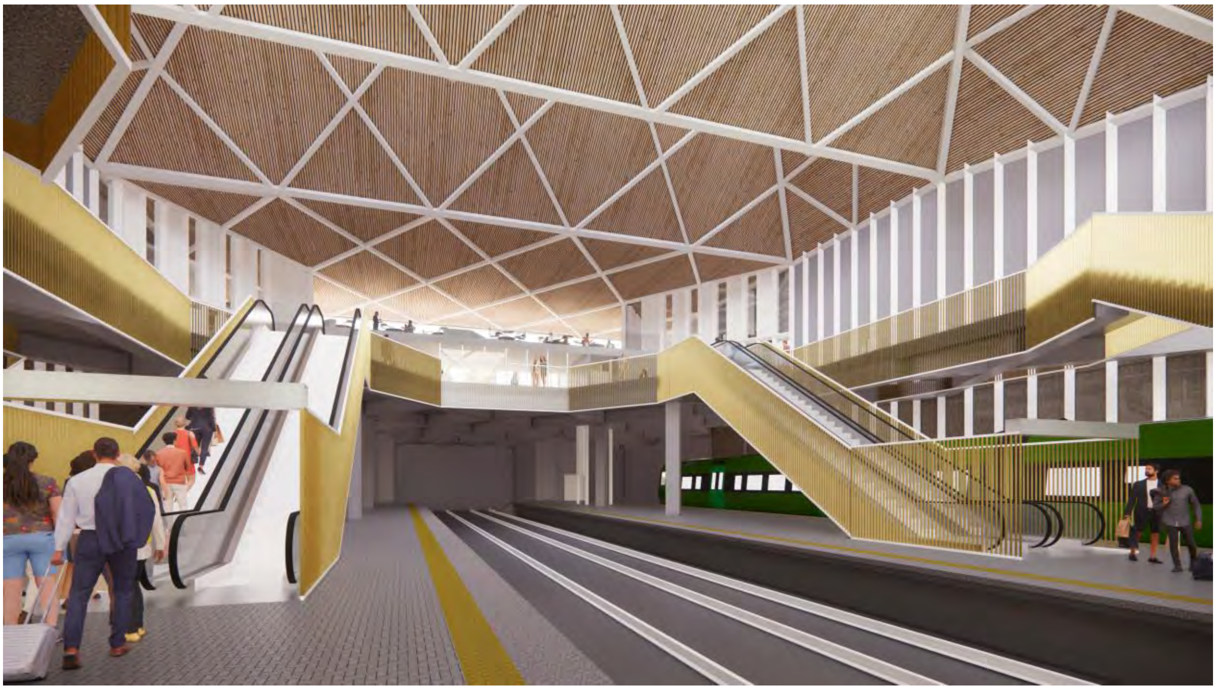


Figure 4-97 View from the platforms

Figure 4-98   View from the concourse

- The station building fronting Spencer Dock Plaza is also envisaged as the basement for the future landmark building planned over the station in the North Lotts and Grand Canal Dock Planning Scheme. The building formed by the access to the station and the two lateral retail units has been designed with consideration of the fact that it will form the basement of a twelve-storey landmark building in the future.
- In order to highlight the importance of intermodal transport, the area between the access to the station and the Spencer Dock Luas station will be transformed into a public concourse for the station. The access to both transportation systems (Luas and DART+), the ticket vending facilities and the retail units will be arranged around this concourse plaza.

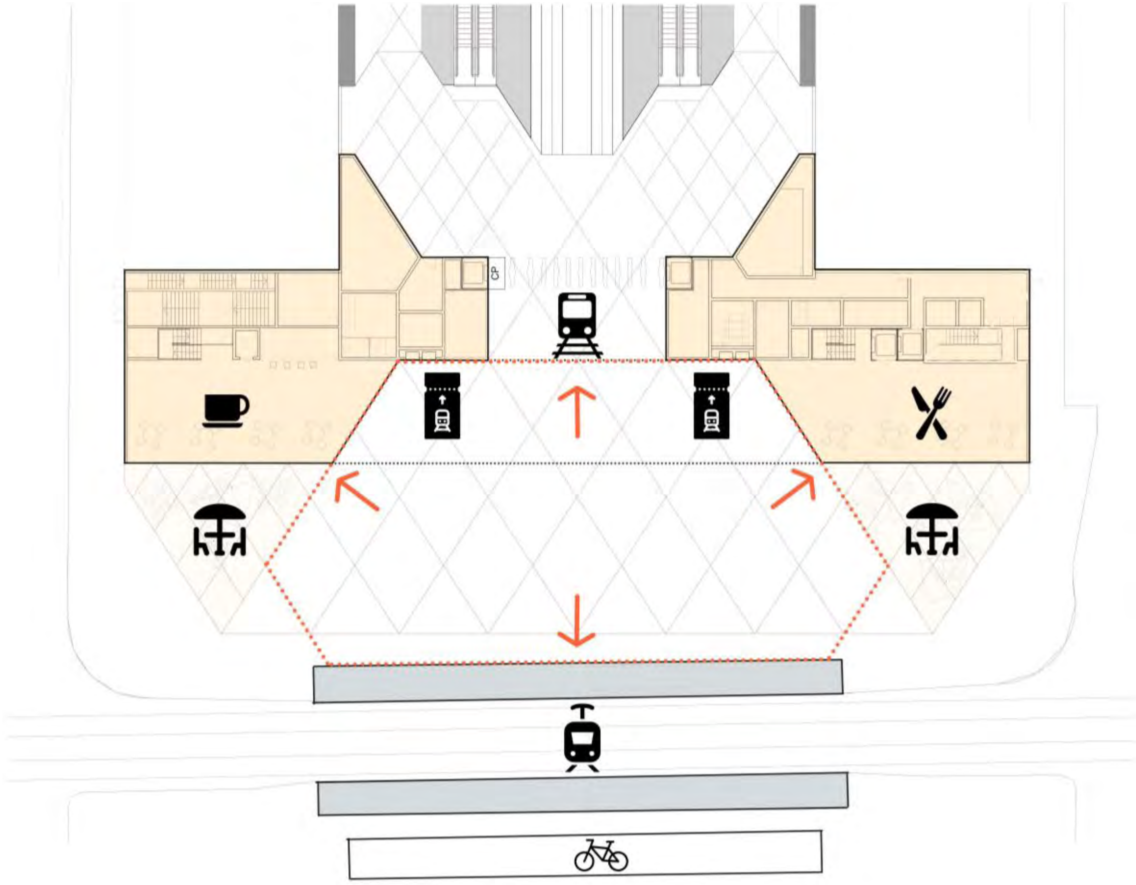


Figure 4-99 Diagram of the public concourse at Spencer Dock Station

4.7.3.6.5 Station layout

The station layout is divided into three main levels as follows:

1. The **platform level** is where the connection with the railway system is produced. This level mainly contains the platforms and tracks. At the southern end of the platforms, there is also a technical area and the basement level of one of the retail units.
   Figure 4-100 shows the proposed station plan at platform level. Two island platforms are proposed to service the four tracks.

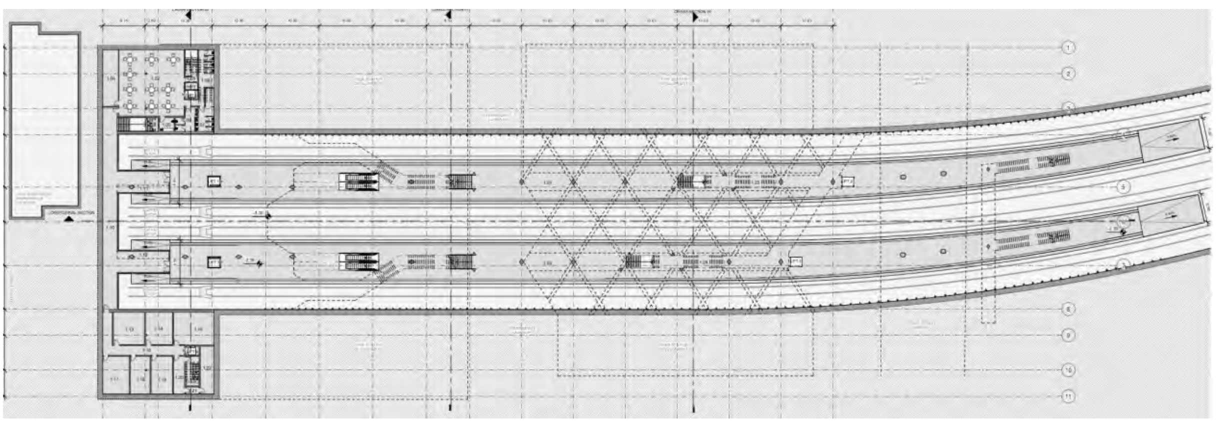


Figure 4-100 Functional layout of the proposed station at platform level

2. The **street level** houses the main access for pedestrians and Luas users. There are two retail units, one at either side of the entrance, with a striking architectural facade fronting the Spencer Dock Plaza. All the staff facilities are placed at this level. At the eastern side of the building, there is an

access to the technical areas of the station and the supplies rooms and cabinets are also housed here. The intermediate laneway that crosses the station connecting Park Lane with the continuation of Abercorn Road is also located at this level.

Figure 4-101 shows the functional layout of the station at street level.

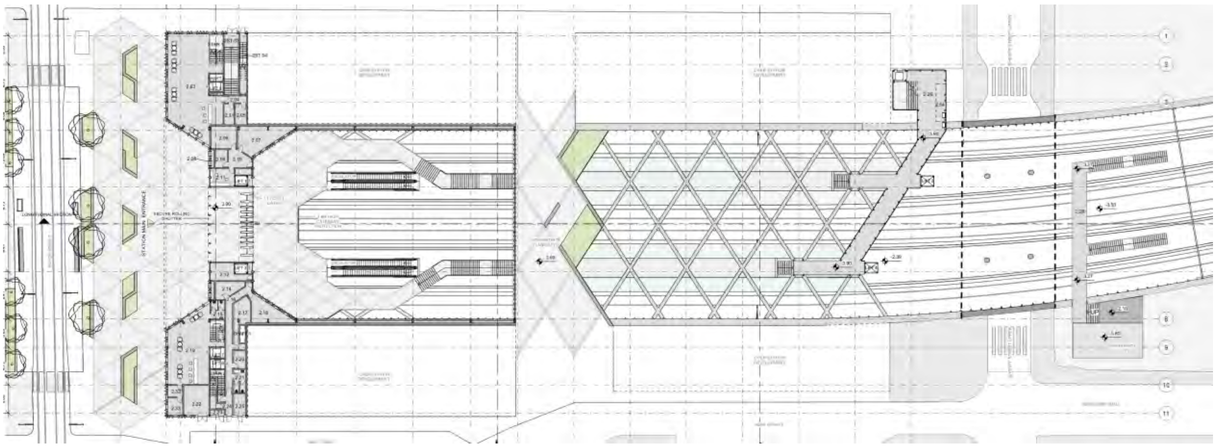


Figure 4-101 Functional layout of the proposed station at street level

3. The **first-floor level** is where the connection with the Sheriff Street Upper drop-off is located. The secondary entrance at the northern end of the station is directly connected with the overbridge that needs to be reconstructed over the tracks at Sheriff Street Upper. A drop-off area for buses and private vehicles can be provided over the bridge that will create a direct link with the platforms through this secondary entrance.

   This level also houses the first floor of the retail units at the southern end of the station. Both retail units share an exterior covered terrace that is placed over the main access.

   Figure 4-102 shows the functional layout of the station at first floor level.

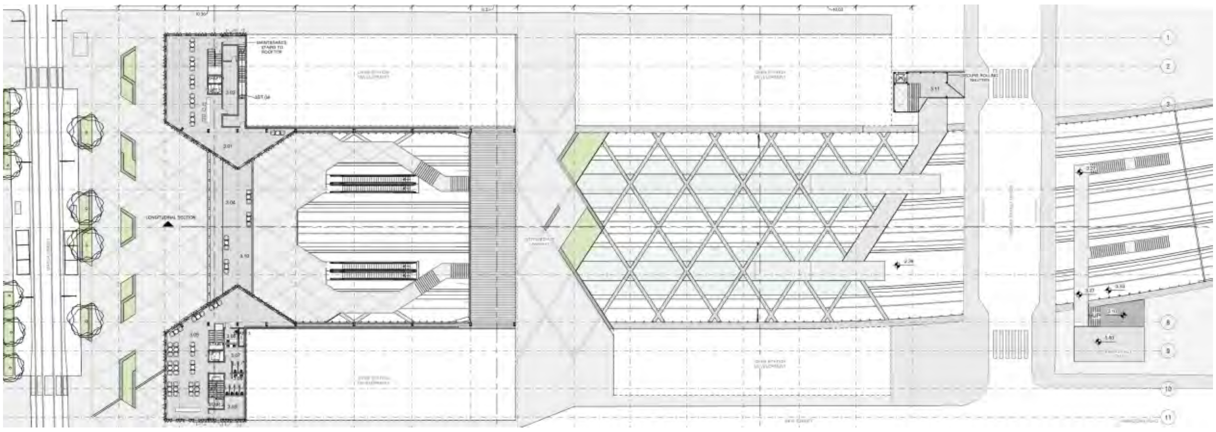


Figure 4-102 Functional layout of the proposed station at first floor level

4.7.3.6.6 *Entrance canopy*

The interior concourse of the station is covered by a canopy that has been designed with the purpose of solving a few different issues:

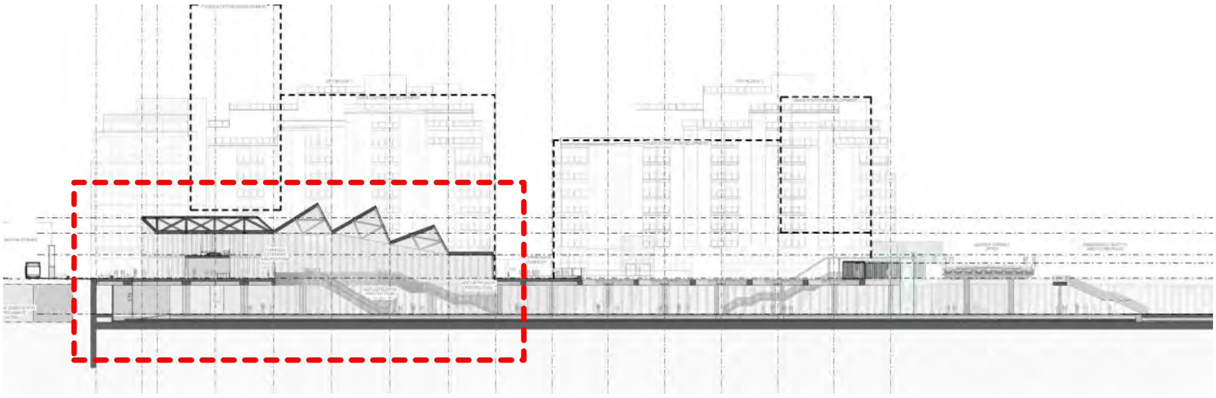


Figure 4-103 Spencer Dock Station longitudinal section through canopy

The canopy is supported on the two lateral walls to avoid any intermediate columns in the central space of the station, thus preventing any interference with the staircases and escalators. This means that the span of the structural trusses will be around 34 metres. In order to achieve this structural requirement, a three-dimensional structure is proposed to cover the entrance and a series of inclined trusses to cover the main circulation area containing the staircases and escalators.

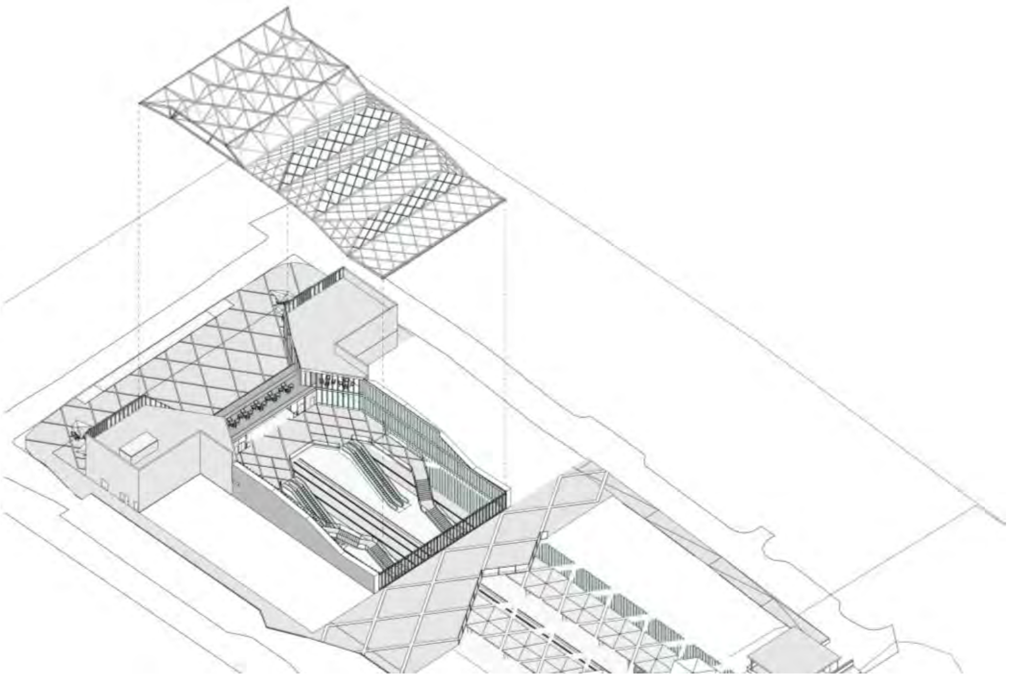


Figure 4-104 Diagram of the entrance canopy

The inclination of the canopy gables changes to match the line of sight of the passengers as they arrive at the station from the city and begin their descent towards the platform area. This will ensure optimum view permeability to the sky and will allow a significant amount of natural light to flood into the entrance hall and platforms, thus minimising the need for artificial lighting. This concept is depicted in Figure 4-105.

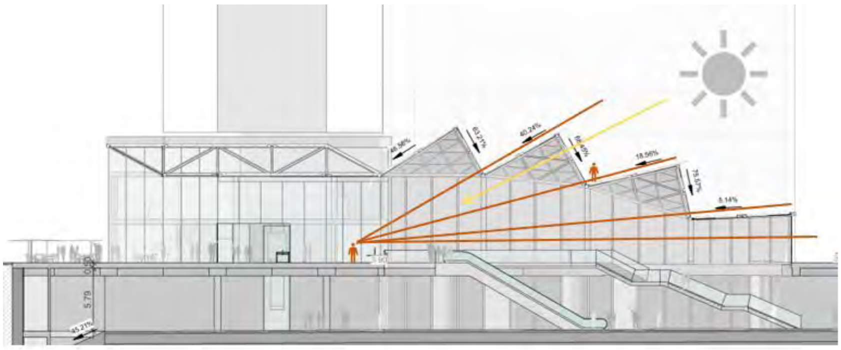


Figure 4-105 Adaption of gable inclination to passenger sightlines

In the case of fire, the design of the canopy allows for increased smoke retention. Smoke exhaust vents will be located in the opaque gables of the canopy to release the smoke. This feature is illustrated in Figure 4-106.

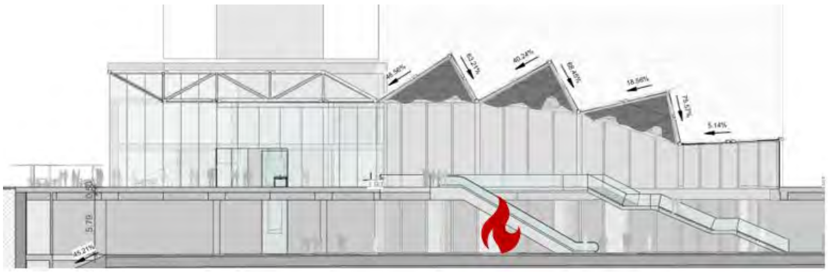


Figure 4-106 Smoke retention in the canopy gables

The design of the canopy will follow the diagonal lines provided by the structure. These architectural lines will continue towards the exterior façade fostering the diagonal flows that the passengers need to follow to reach the station's interior area. These lines are also reflected in the concourse floor with the same purpose of guiding the passenger movements.

The material of the canopy will provide warmth to the station. The ceilings will comprise wooden slats. In addition, a material will be placed on the back of the slats to provide acoustic absorption and ensure a pleasant experience in the interior concourse of the station.

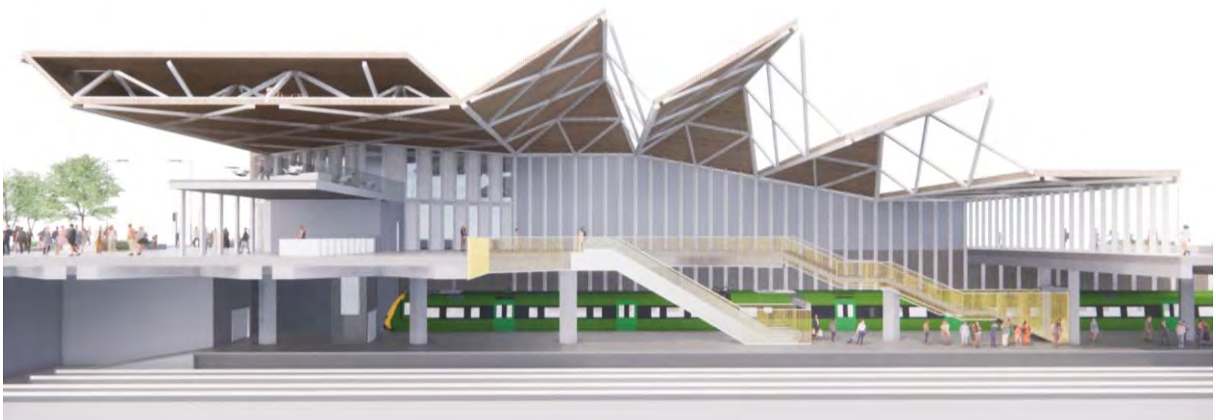


Figure 4-107 Long section through the entrance canopy area

4.7.3.6.7 Structural criteria

Spencer Dock Station has a semi-underground configuration that allows the tracks pass below Sheriff Street Upper overbridge and to maintain the structural gridlines established in the North Lotts and Grand Canal Dock

SDZ Planning Scheme. Structural design of the station also had to account for the high water table at this location, which is almost at street level.

The initial step is to design a structural basin at the lower level that defines the boundary of the structure. This will incorporate:

- **North: Bridge under Sheriff Street Upper**
- **South: Mayor Street Upper (Luas underground substation)**
- **East and West: Over station development buildings**

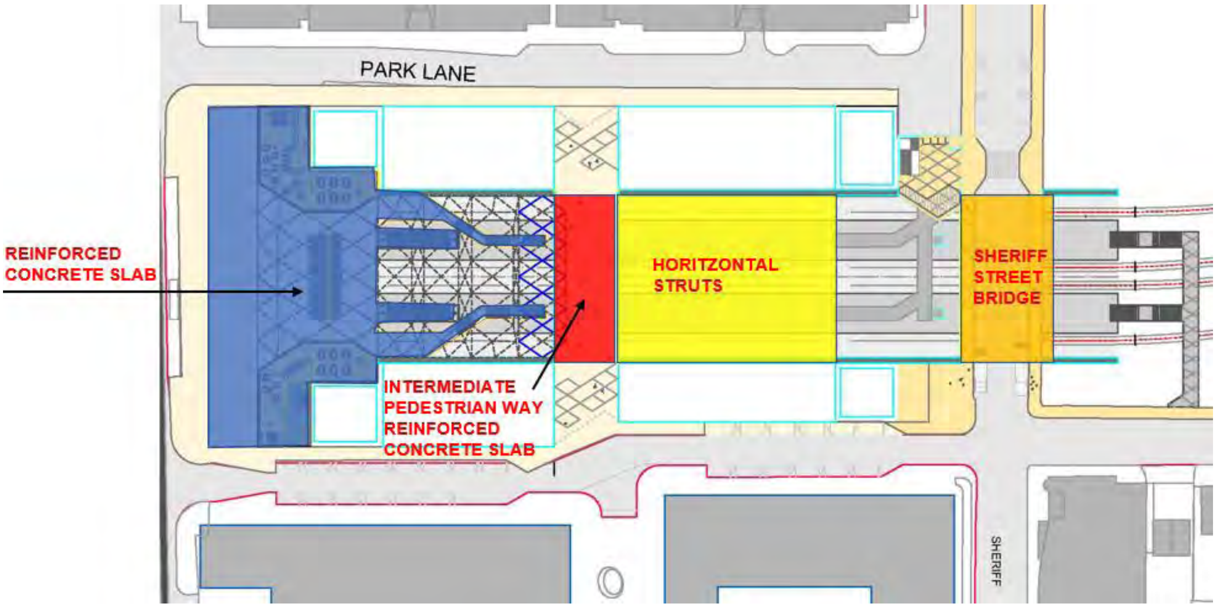


Figure 4-108 Ground level slab typologies

The station boundaries at the platform (-2.39 m OD) and concourse (+3.90 m OD) levels will be constructed as reinforced concrete secant pile walls with struts at the top to improve the capacity of the piles during construction and in the final state. This will limit the containment of lands subject to a very high-water table.

A reinforced concrete slab will be provided at the base of the secant piles.

Parallel to the alignment of the secant piles, there will be a line of interior concrete walls anchored to the slab. These concrete walls will support the different slabs above as well as the temporary and permanent struts. The design will allow the placement of waterproofing sheets between the two structural alignments.

The concourse structure at ground floor level will be constructed from in-situ reinforced concrete. It will be supported by the interior concrete walls and the columns located on the central platforms.

The slab of the upper level of the retail area (+8.00 m OD) will be supported solely on columns.

The roof structure consists of a series of triangulated steel trusses, spanning over the concourse area and incorporating large skylights over the platform area. Lightweight insulated metal panels will be provided as cladding.

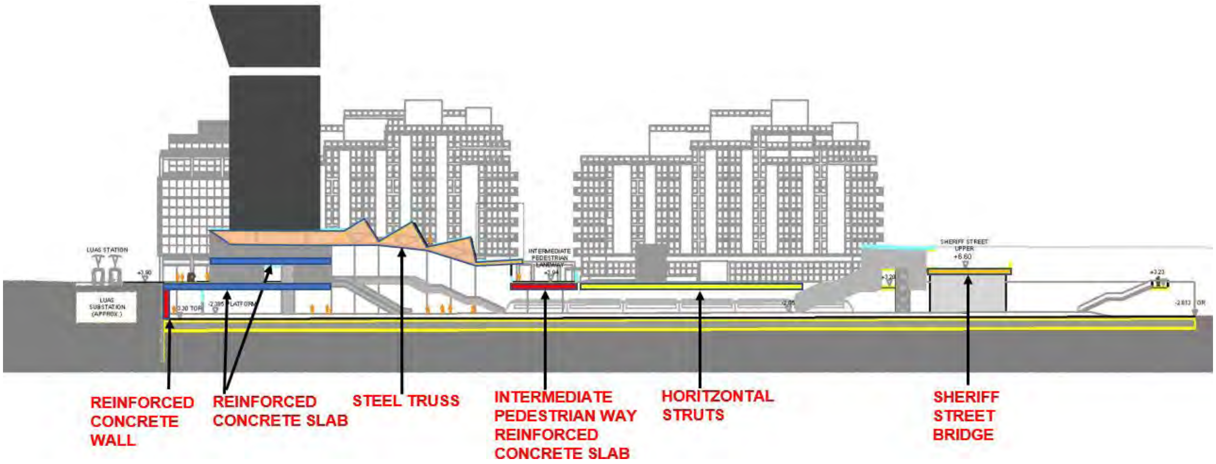


Figure 4-109 Longitudinal section. Structural systems

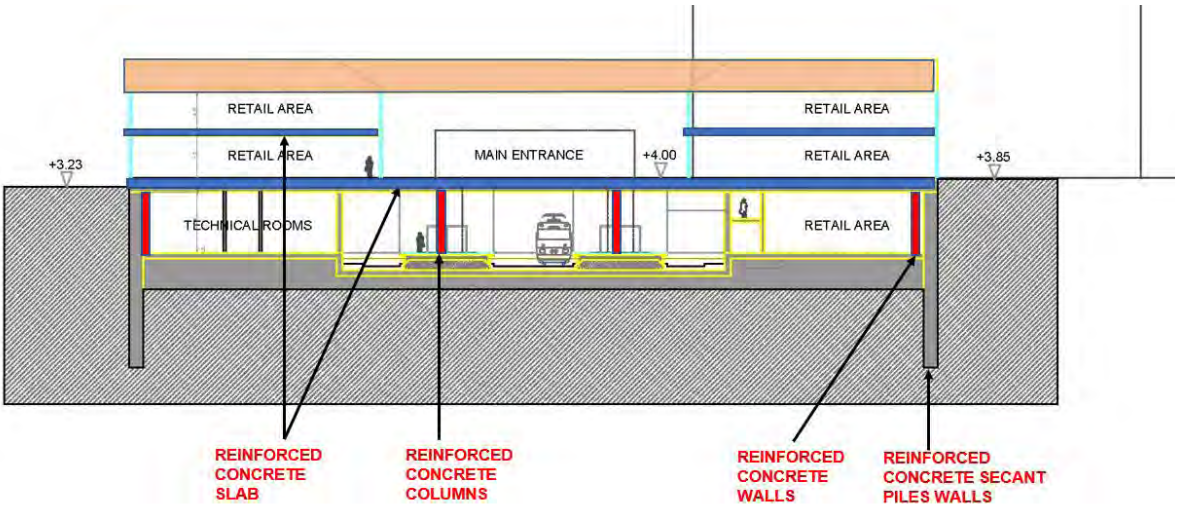


Figure 4-110 Cross-section. Structural systems

There are three types of structures located at the ground level, with different characteristics:

- Intermediate pedestrian laneway (+3.90 m OD). This concrete structure will be supported on the perimeter walls and vertical supports located on the axis of the central platforms.
- Sheriff Street Upper bridge. Demolition and reconstruction of sections of the existing Sheriff Street Upper bridge will be required to accommodate the construction of the station. The reconstructed spans will be supported on vertical supports located in the axis of the central platforms and new supports adjacent to the perimetral walls of the station.
- Horizontal struts will be placed in the uncovered area of the station between boundary walls to increase the capacity of the reinforced secant piles and thus reduce their dimensions. This will also allow for the potential to cover the station, if required as part of any future over station development.

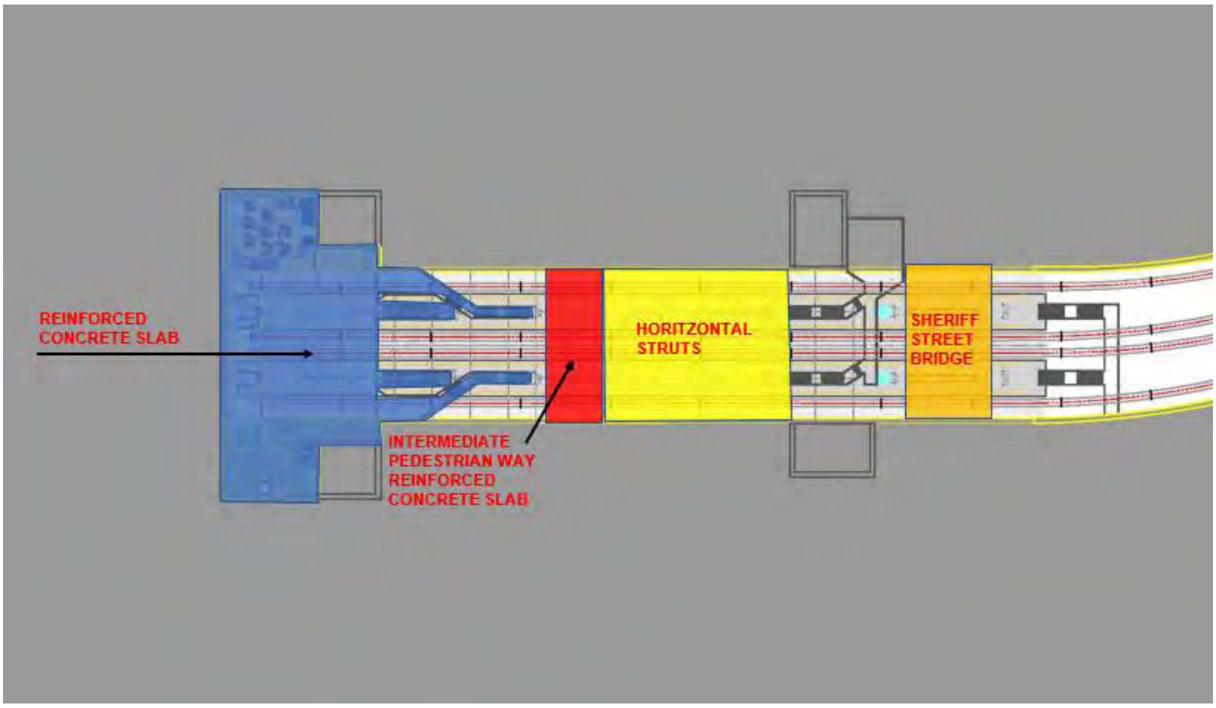


Figure 4-111 Platform level slab typologies

4.7.3.6.8 Interior materials and finishes

The use and variety of materials in Spencer Dock Station will be minimalistic and will contribute to the overall contemporary aesthetic design of the station. The use of materials with high-quality finishes is of particular importance and will have a significant impact on the perception of the space. The materials shall enhance the passenger experience.

4.7.4 Spencer Dock substation

A substation will be located north of the existing Docklands Station and car park, near the railway junction. It will be necessary to accommodate the road access to the substation from Abercorn Road. The proposed location is within the existing CIÉ property boundary and access will be gated. Sewage and watermain connections have been identified in this area. The proposed location for the substation is shown in Figure 4-112.

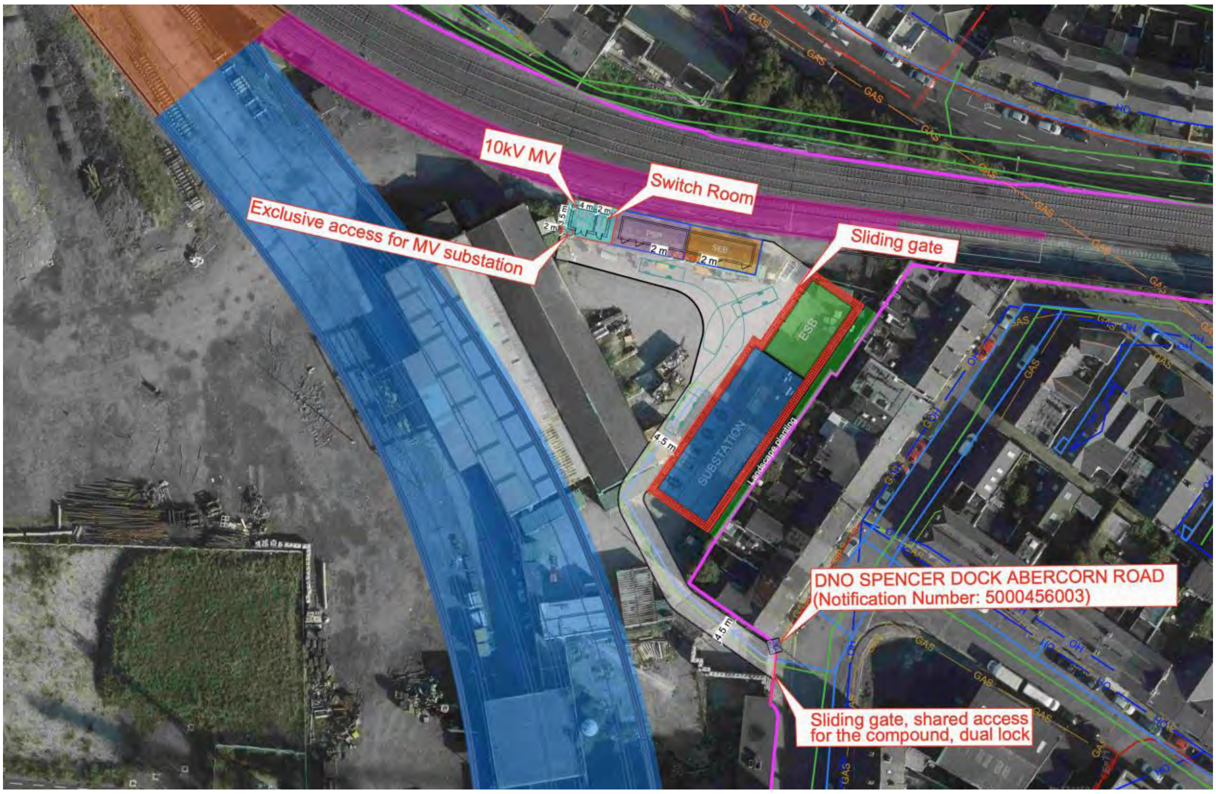


Figure 4-112 Spencer Dock substation arrangement

Northern Line

Due to the construction of the Spencer Dock Station, realignment and removal of some of the running lines along the Northern line is required to connect with the new station.

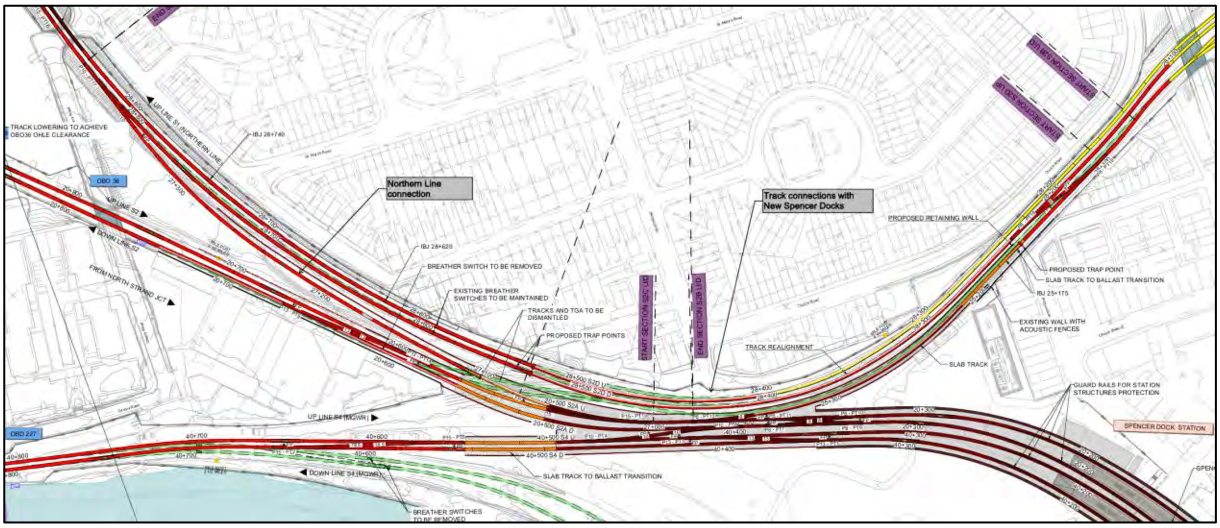


Figure 4-113 Northern line alignment

Currently the track is mainly used for freight trains that travel to the sidings on the East Wall yard. The proposed intervention consists of:

- Realignment of the current track layout to provide a link from the Northern Line to the new Spencer Dock Station. The total length of the realignment is approx.1 km.
- Installation of new crossovers and turnouts to improve functionality and to allow train movements on this line.

4.7.5 Drainage

In areas where track lowering is considered necessary, a new drainage system will be incorporated.

4.7.5.1 OBO36

OBO36 is a local low point, and track lowering is to be implemented at this location. The influence of a high groundwater table as well as restricted horizontal clearance at the bridge impacts the design of the lineside drainage. The main constraints are the lack of available space next to the track and the shallow groundwater table in the area. Due to these factors, a piped drainage system is proposed.

Collector drains are proposed at each side of the track. North of the OB, drains will be placed along both sides of the track. Water will flow under gravity, in a southerly direction, towards and past OBO36. Flow will then continue through a carrier drain and into an attenuation tank. Collector drains on the south side of the OB will divert runoff in the opposite direction towards the nearest manhole, where carrier drains will carry it to the attenuation tank.

Due to the high groundwater level, the collector pipes near the OB will be placed within the ballast. This results in shallow surface drains placed just above the groundwater level, close to the sleepers. This solution will ensure drainage of railroad runoff but also limit the maximum possible groundwater level at OBO36.

4.7.5.2 OBD221- 222- 223

The drainage proposal consists of a gravity drainage system from OBD221, discharging at an existing connection at OBD223 to the Royal Canal. Provision of collector and carrier drains as well as an open channel is proposed. The open channel to be used is an existing open ditch. Its dimensions are 0.2 x 0.4 m and it discharges water from the Up track of OBD221 and OBD222. Where track modification is not required, carrier drains will be laid to the outfall location.

The existing outfall point in OBD223 has a high invert level in comparison to the proposed drainage levels. The proposal is to install two carrier pipes with 300 mm diameters. These pipes are proposed to be placed in concrete to withstand loading from the track.

Shallow surface drains will be constructed due to the presence of the overbridge structure. The structure prohibits collector drains from being placed at significant depth, therefore shallow collector drains are proposed. The runoff will pass OBD223 through channel ditches on each side of the track.

Through OBD221 and OBD222, collector drains are placed on each side of the track in the sub-ballast. After passing OBD222, the runoff will be diverted through a carrier drain in the Down track and an existing open ditch in the Up track.

The drainage system consists of plastic pipes, ranging from 300 mm to 600 mm in diameter, and rectangular concrete channel drains.

At OBD223 the drainage is continued with collector drains that outfall at the existing outfall point to the Royal Canal (see Drawing no. MAY-MDC-TRK-SC04-DR-C-0002-D in Volume 3A of this EIAR).

4.7.5.3 OBD224-225-226-227

The proposal is for a combined gravity and pumped drainage solution that outfalls into an existing connection to the Royal Canal at OBD226 (Newcomen bridge).

From OBD224, the water flows towards the OBD226 outfall point through drainage pipes on both sides of the track, alternating with an open channel with grating in some sections. From OBD227 to the OBD226 outfall point, water flows only through drainage pipes on both sides of the rail track.

At the pumping station, the water outfalls to the Royal Canal at the existing connection under gravity. When the level of the Royal Canal is higher than the level at the outfall point, the pumping system starts and water will be discharged through the same point (see Drawing no. MAY-MDC-TRK-SC04-DR-C-0002-D in Volume 3A of this EIAR).

The outfall rate has been limited to 50 l/sec which is the capacity of the existing drainage pipe. The remainder will be alleviated to the Spencer Dock attenuation tank.

4.8 Zone C. Phibsborough/Glasnevin (Glasnevin Jct) to Clonsilla Station (Clonsilla Jct)

4.8.1 Overview of alignment in Zone C

Zone C runs east to west from Glasnevin Junction in Dublin City to Clonsilla Junction in the Fingal area. The section is approximately 10.1 kilometres in length, from Ch 60+000 to Ch 70+100. An overview of the proposed works within Zone C is provided in Figure 4-114.

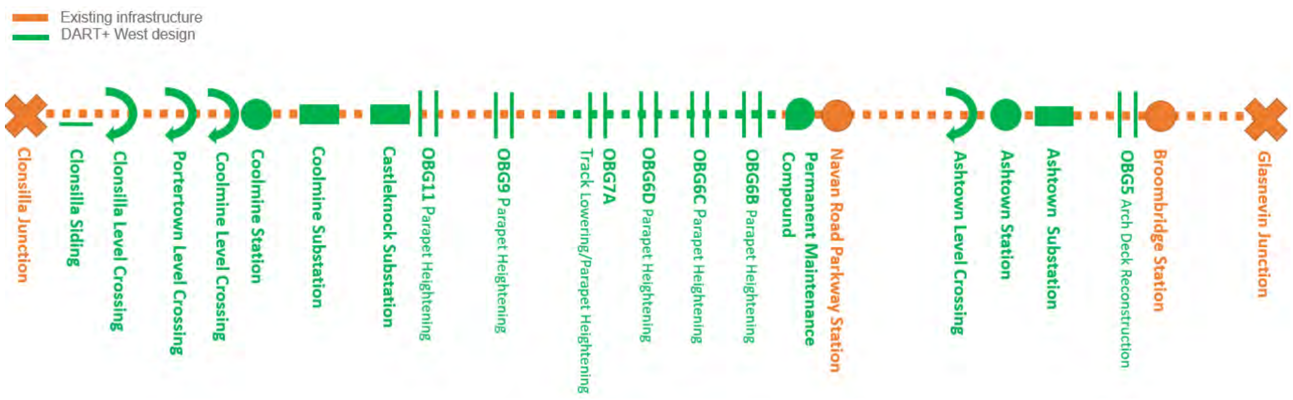


Figure 4-114 Schematic of DART+ West interventions in Zone C

West of Glasnevin Junction, OBG5 Broome Bridge, which is included in the Record of Protected Structures for Dublin City (RPS no. 909), needs to be reconstructed to allow sufficient clearance for OHLE.

In the Ashtown area, the existing Ashtown level crossing will be closed and replaced with a new pedestrian and cycle bridge to maintain connectivity. It will also provide impaired mobility access along Ashtown Road. An underpass is proposed to provide access to both vehicular and non-vehicular road users. In addition, a substation is proposed at Ashtown Station. An access route from the substation will be established that connects to Martin Savage Park.

West of Navan Road Parkway Station, parapet modification works are required on some bridges and footbridges to protect against the risk of electrocution from the new OHLE. These works are proposed at the R102 (OBG6B), the N3 (OBG6C), M50 Roundabout/Navan Road (OBG7A), Old Navan Road (OBG9) and Castleknock Bridge (OBG11) and will include installing a coping piece on the existing parapets to discourage climbing.

OBG11 (Granard Bridge) is located under Castleknock Road, the overbridge is a protected structure (RPS no. 0696). The National Inventory of Architectural Heritage (NIAH) includes the bridge under reference no. 11354002. The adjacent railway bridge is not included in the record of protected structures or the NIAH but is in close proximity to OBG11.

In addition, the track is proposed to be lowered under the roundabout connecting the N3 (Navan Road) to the M50 Motorway to allow the required clearance for the line electrification under the OBG7A bridge (M50 roundabout/Navan Road).

Two new substations, one just opposite of Castleknock Station in Laurel Lodge Park and another close to (to the east of) Coolmine Station are to be constructed.

The existing Coolmine level crossing will be permanently closed. To facilitate pedestrian and cyclist access at this location, a new pedestrian and cyclist bridge will be constructed over the railway and canal, which will also provide impaired mobility access between platforms within the Coolmine station. A series of junction improvements will also be undertaken to accommodate the redistributed road traffic.

The existing Porterstown and Clonsilla level crossings will be closed and replaced by dedicated pedestrian and cyclist bridges over the railway line and the Royal Canal.

Horizontal track modification is proposed to the east of Clonsilla Station to lengthen the existing siding by an additional 44 m for the stabling of trains.

4.8.2 Interventions at bridges

Zone C requires works at different bridges in order to provide sufficient clearance for OHLE and to provide protection against electrocution. T he works consists of track lowering, parapet heightening and structural interventions. Interventions required in Zone C are listed in Table 4-13.

Table 4-13 Bridge interventions in Zone C

Structure	Protected	Location	Solution	Depth of lowering	Length	Existing parapet	Proposed parapet	Description
OBG4A 	No	Broombridge station at Ch 51+300	Parapet heightening	N/A	N/A	1.86 m	1.86 m	Parapet heightening as per Section 4.5.15.5.
OBG5 	No	Maynooth line at Ch 53+700	Bridge modification	N/A	N/A	N/A	N/A	Arch deck reconstruction Parapet heightening as per Section 4.5.15.5.
OBG6B 	No	Maynooth line at Ch 55+540	Parapet heightening	N/A	N/A	1.88 m	1.88 m	Parapet heightening as per Section 4.5.15.5.

Structure	Protected	Location	Solution	Depth of lowering	Length	Existing parapet	Proposed parapet	Description
OBG6C & OBG6D 	No	Maynooth line at Ch 55+700 & 55+740	Track lowering & parapet heightening	Minimal	230 m	1.60/2.00 m	1.8 m	Track lowering beneath bridge to achieve required clearance for OHLE. Parapet heightening as per Section 4.5.15.5.
OBG7A 	No	Maynooth line at 4+804 mileage at the roundabout connecting N3 to M50 Ch 55+840	Track lowering	338 mm	215 m	N/A	N/A	Track lowering beneath bridge to achieve required clearance for OHLE.
OBG9 	No	Maynooth line at Ch 56+100	Bridge modification	N/A	N/A	1.50 m	1.80 m	Flat deck lifting. Parapet heightening as per Section 4.5.15.5.
OBG11 	RPS 0696	Maynooth line at Ch 56+420	Bridge modification	N/A	N/A	N/A	N/A	Arch deck reconstruction Parapet heightening as per Section 4.5.15.5.
OBG11A 	No	Maynooth line at Ch 56+460	Parapet heightening	N/A	N/A	1.83 m	1.83 m	Parapet heightening as per Section 4.5.15.5.
OBG11C 	No	Maynooth line at Ch 56+670	Parapet heightening	N/A	N/A	1.60 m	1.80 m	Parapet heightening as per Section 4.5.15.5.
OBG12 	RPS 0707	Maynooth line at Ch 60+140	Parapet heightening	N/A	N/A	1.20 m	1.20 m	Parapet heightening as per Section 4.5.15.5.

Structure	Protected	Location	Solution	Depth of lowering	Length	Existing parapet	Proposed parapet	Description
OBG12C 	No	Maynooth line at Ch 60+300	Parapet heightening	N/A	N/A	1.60 m	1.80 m	Parapet heightening as per Section 4.5.15.5.

4.8.3 OBG5 Broome Bridge arch deck reconstruction

OBG5 is a limestone arch railway bridge dating back to circa 1845. The railway arch is located next to the Royal Canal arch that is of national importance (Categories of Special Interest: Architectural, Historical, Social, Technical). The bridge (over the Royal Canal) and the Royal Canal drop are date back to 1790. The proposed works on OBG5 consist of increasing the vertical and horizontal clearance by removing and reconstructing the arch to achieve the required OHLE clearance.

4.8.3.1 Alignment

There are no track alterations required in the environs of OBG5. There is insufficient OHLE clearance at the bridge, so arch reconstruction is proposed at this bridge as other options were not considered viable.

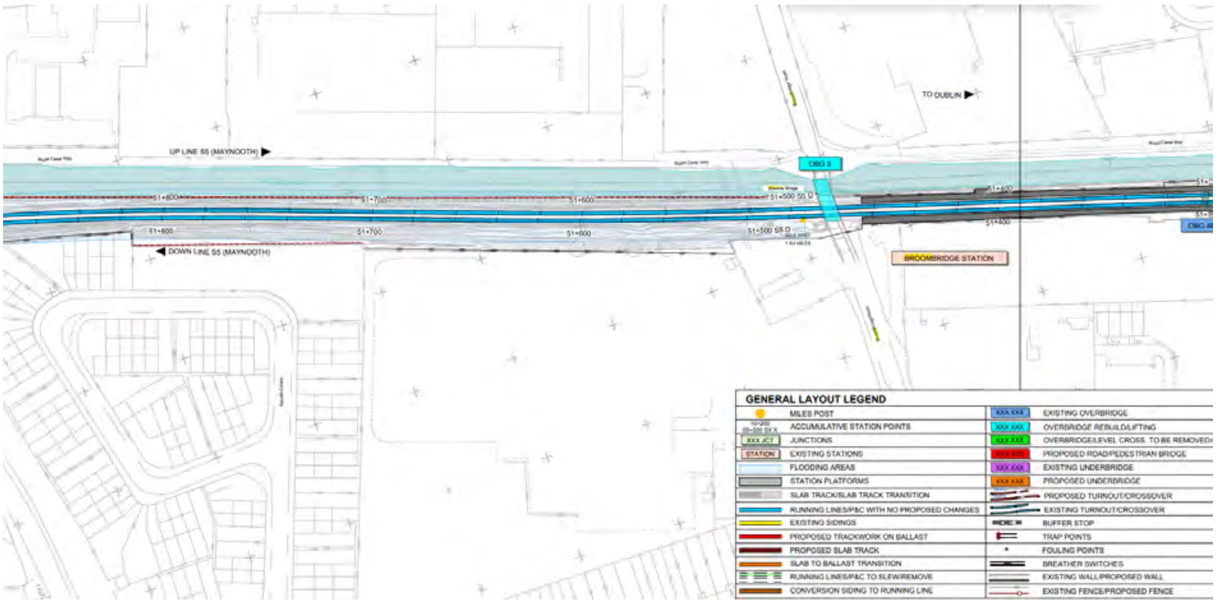


Figure 4-115 Location of OBG5

Details of the reconstruction are shown in Drawing no. MAY-MDC-STR-RS05-DR-C-0002-D Structure Design – OBG5 Bridge Deck Reconstruction in Volume 3A of this EIAR.

4.8.3.1.1 Deck reconstruction

OBG5 carries a single lane road with shuttle traffic. The bridge has an 8.5 m wide span and provides a link between the Finglas south area and the LUAS line and access between Cabra and the Royal Canal towpath.

To achieve sufficient vertical clearance for the catenary equipment under the bridge, a precast arch deck solution has been proposed. The new arched bridge deck shall be installed 620 mm higher than the existing bridge arch position.

With this bridge deck reconstruction and the lifting of the soffit of the arch, no significant impact on the connection of the existing pedestrian bridge to Broombridge Station is expected.

The following figure shows OBG5 Broome Bridge with the precast arch deck solution.

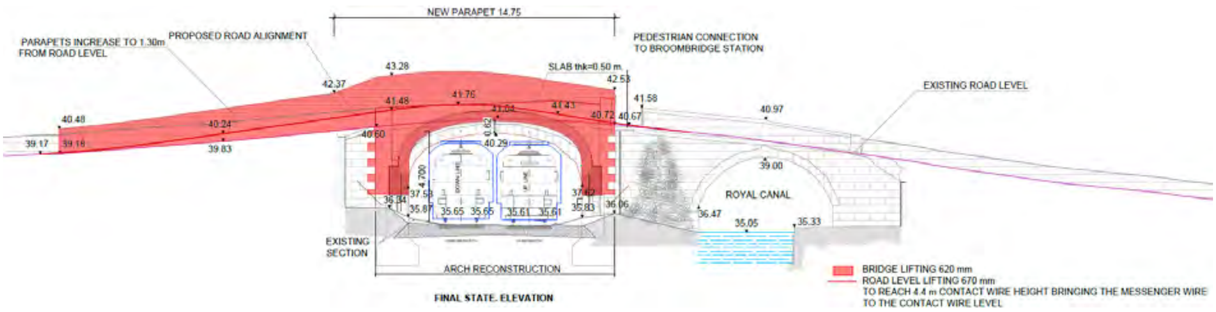


Figure 4-116 Elevation of OBG5 deck reconstruction

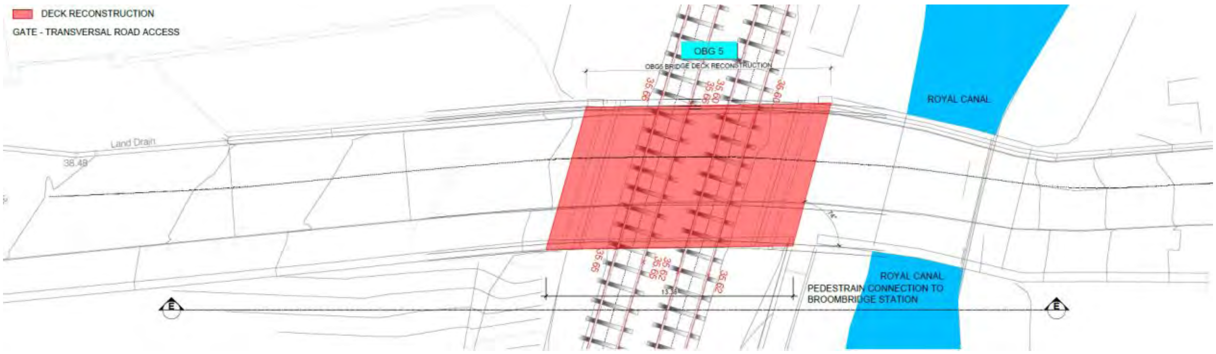


Figure 4-117 Plan of OBG5 deck reconstruction

This structural solution may have an impact on the adjacent arch bridge spanning the Royal Canal. To prevent this, it is proposed to use lightweight fill on the arch up to formation level of the road. This backfill will reduce the additional dead load on the arch and the abutments and minimise the impact to the adjacent bridge.

4.8.4 Ashtown substation

The substation will be located to the south of the railway, east of Ashtown Station. The proposed location is partially within the existing CIÉ property boundary.

Vehicle and pedestrian access to the substation will be established through provision of a short connection to the existing road network via in Martin Savage Park.

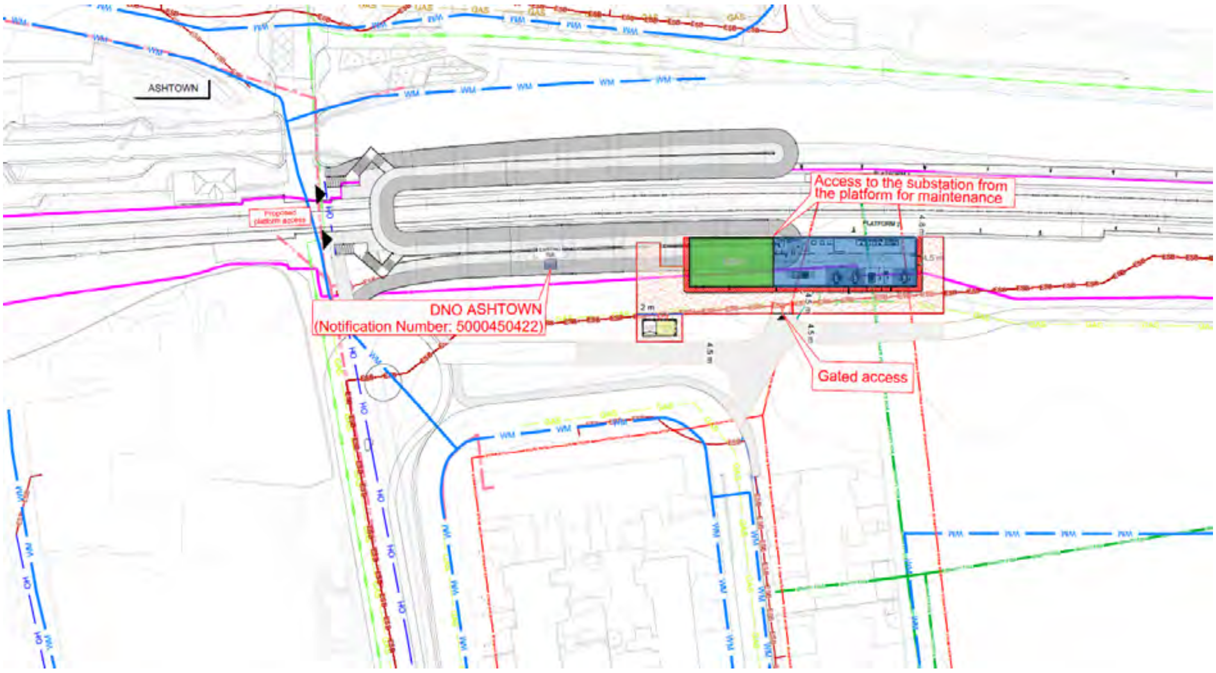


Figure 4-118 Proposed location of Ashtown substation

A connection to the water supply network is proposed at Martin Savage Park and a connection to the foul network is proposed with the existing networks just west of the substation.

4.8.5 Ashtown Station

The design proposal for the Ashtown station essentially consists of a general upgrade and renovation that is required due to the expected traffic changes in both pedestrian flows and vehicular traffic as a result of the level crossing removal.

The station will be upgraded to accommodate these increased flows through the provision of new infrastructure as outlined below. Figure 4-119 shows the current situation and existing facilities.

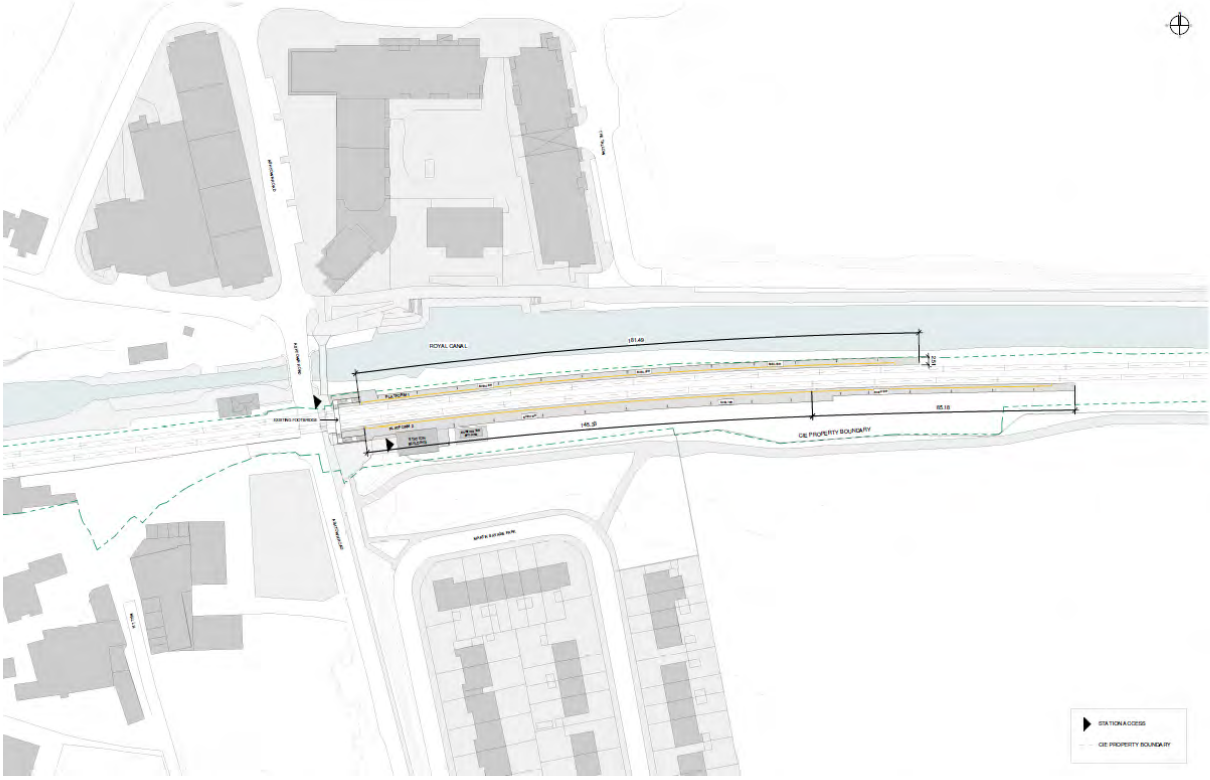


Figure 4-119 Existing arrangement at Ashtown Station

As part of the Ashtown Station upgrades, the construction of a new steel bridge/ramp is proposed. The bridge will be suitable for pedestrians, cyclists and mobility impaired persons and it will allow passengers to cross from the north platform to the south platform and vice versa. It will also provide a connection across the canal.

Since the Ashtown Road level crossing will be permanently closed, the historic bridge, currently used for vehicular traffic, will be converted into a pedestrian and cycle bridge to cross the canal. The new scenario proposes the removal of the existing footbridge. The motivation for this was two-fold. Firstly, it will avoid unnecessary redundancies, and secondly, because of the advantages associated with giving prominence to the historic bridge and improving its visibility and its integration to the landscape.

4.8.5.1 Standard compliance - Ashtown Station

The following standards were adhered to in the design of Ashtown Station:

- Building Regulation 2010 – Technical Guidance Documents.
- Design Criteria for Footbridges (DN-STR-03005-02).
- Requirements for Track and Structures Clearances, I-PWY-1101 (IÉ).
- National Cycle Manual (National Transport Authority).
- Network Rail-Station Capacity Planning Guidance 2016.
- Building for Everyone (ADA-The National Disability Authority).

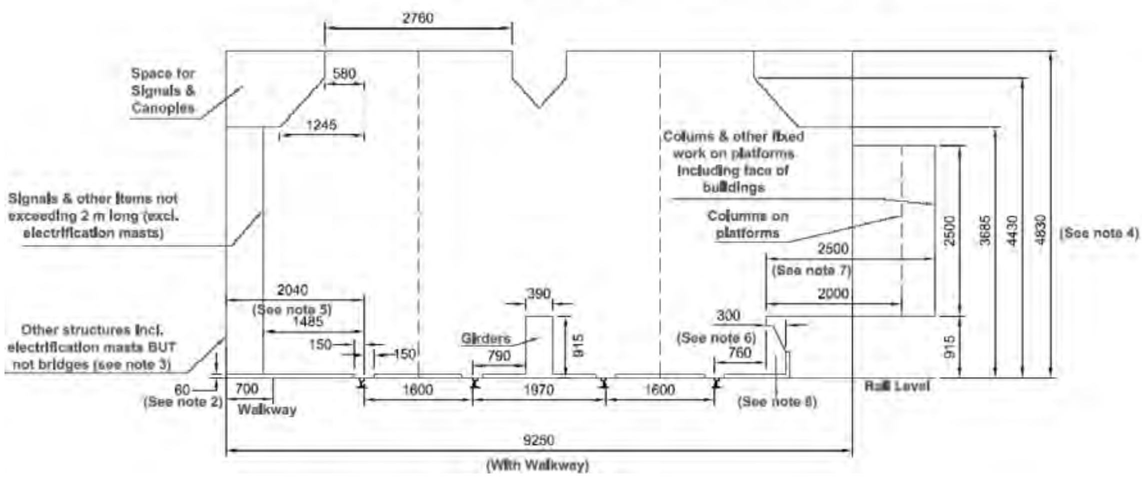
The standards relevant to each design element are outlined in Table 4-14.

Table 4-14 Standard compliance

CONCEPT	Design Criteria for Footbridges (DN-STR-03005-02)	Requirements for Track and Structure Clearances (I-PWY-1101, IÉ)	National Cycle Manual (NTA)	Station Capacity Planning Guidance (NR)	Building for Everyone (ADA)
Main Requirement	**Stairs**: Length of flights **Parapets**: Height	**Line Loading and Construction Gauge**	**Cycle path width** **Parking Provision**	**Platform**: Width and Length Safety, "Yellow zone"	**Ramps**: Maximum length Gradient- Handrails
Standard Sections	Section 6 Section 7 Section 12. Requirements for Combined Use by Pedestrian and Cyclists or Equestrians	Section 6 See below Figure 4-120	7.2 Width Calculation Section 5.5.7	3.3 Platforms	1.5.2 Changes in levels
Notes	Parapets variable height: Minimal height of parapets 1.40 m along the ramp and 1.80 m at the bridge crossing the track.	Additional 2.00 m gap clearance was assumed due to the proposed bridge will be constructed in steel structure, to facilitate the future maintenance.	Parking provision adopted: 2.5% daily boarding	As a reference	

Figure 6.1: IRL1 – The IÉ and NIR Standard Structure Gauge

IRL1 - IE & NIR Interoperability Standard Structure Gauge



Notes

1. Curves
   a) On horizontal curves, due allowance must be made for curvature and cant effects.
   b) On vertical curves, due allowance must be made for the effects of such curvature.
2. The underclearances protrusion limit of 60 mm for structures is subject to all restrictions set down in this standard.
3. Bridge abutments must be 4500 mm from the nearest running edge, except that a minimum of 2500 mm applies when the abutments are designed for collision loading.
4. Bridges
   a) The vertical height of 4830 mm is a finished height. A greater height must be provided if the track has to be lifted for relaying or if improved vertical alignment is required.
   b) Where reduced dimensions for OHLE are agreed, it may be possible to reduce this dimension to 4690 mm.
   c) If electrification is envisaged and there is a level crossing nearby, vertical clearance must be increased sufficiently to provide OHLE clearance up to 6140 mm at the crossing.
5. This dimension includes an allowance for a 700 mm wide walkway. If no walkway is provided, the dimension may be reduced to 1790 mm.
6. The absolute minimum lateral dimension is 730 mm.
7. Single face platforms must be a minimum 3000 mm wide if sub-surface, otherwise a minimum 2500 mm but preferably at least 3000 mm wide; these dimensions apply for speeds up to 165 km/h. The minimum distance from the platform edge to the face of any column must be 2000 mm.
8. As far as is practicable, this space is to be kept clear of permanent obstructions but may be used for signalling apparatus and bridge girders.

Figure 4-120 Structure clearance requirements

4.8.5.1.1 Enhancements at Ashtown Station

As shown in Figure 4-121 and Figure 4-122 the proposal assumes the removal of the existing footbridge. The protected bridge that is currently used by vehicular traffic will become a pedestrian bridge for DART passengers, residents and cyclists, providing a link across the Royal Canal.

Initial works are listed below in Table 4-15.

Table 4-15 Initial works

LEGEND

1	Excavation for new footbridge stairs foundation.
2	Existing footbridge to be demolished.
3	Existing fence to be removed.
4	Existing pedestrian bridge to be demolished.
5	Existing Royal Canal vegetation to be grubbed in order to allow new footbridge foundations.
6	Existing Station Building to be demolished.
7	All existing shelters to be replaced as defined in the report.
8	- Existing street lamps under footbridge footprint to be replaced as described in the report. - Rest of existing street lamps in platform 1 to be relocated adapted to the new footprint of the platform.
9	Proposed footbridge footprint.
10	Vegetation to be removed to allow bike parking.
11	Existing TER Building to be kept.

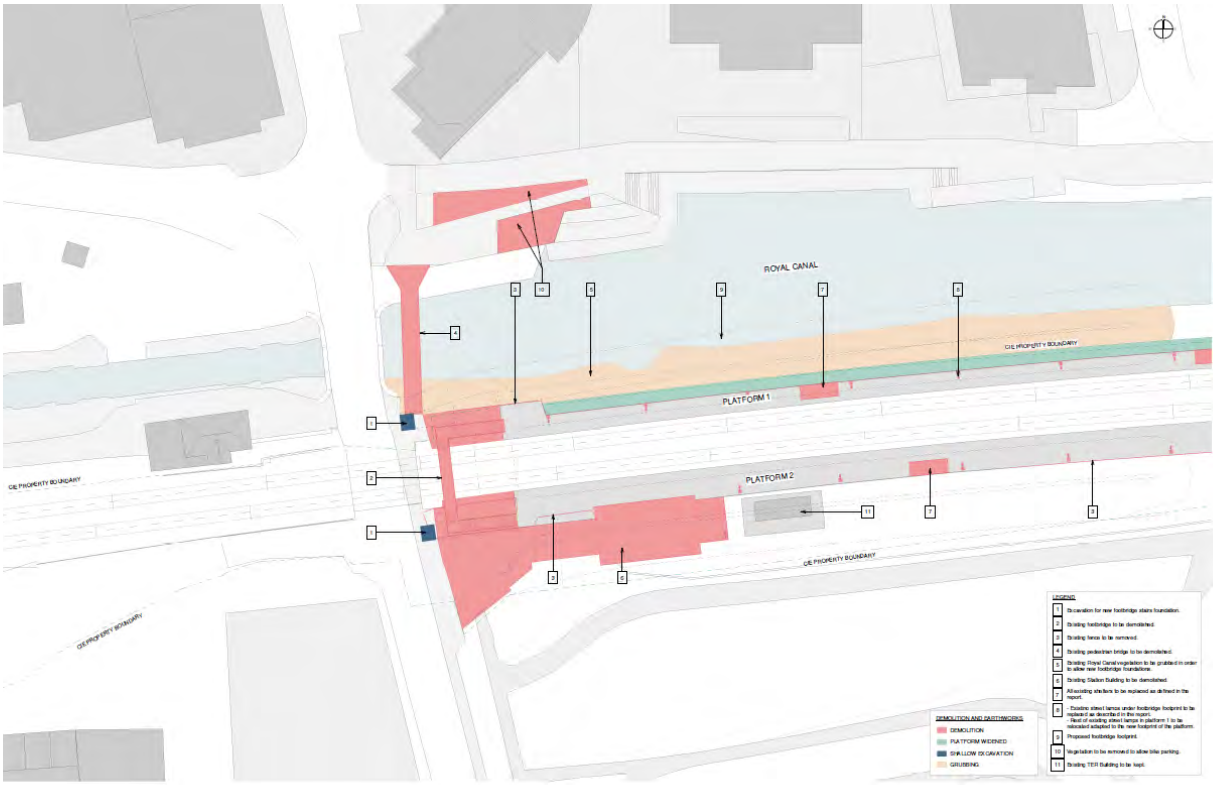


Figure 4-121 Demolition works at Ashtown Station - Sheet 1

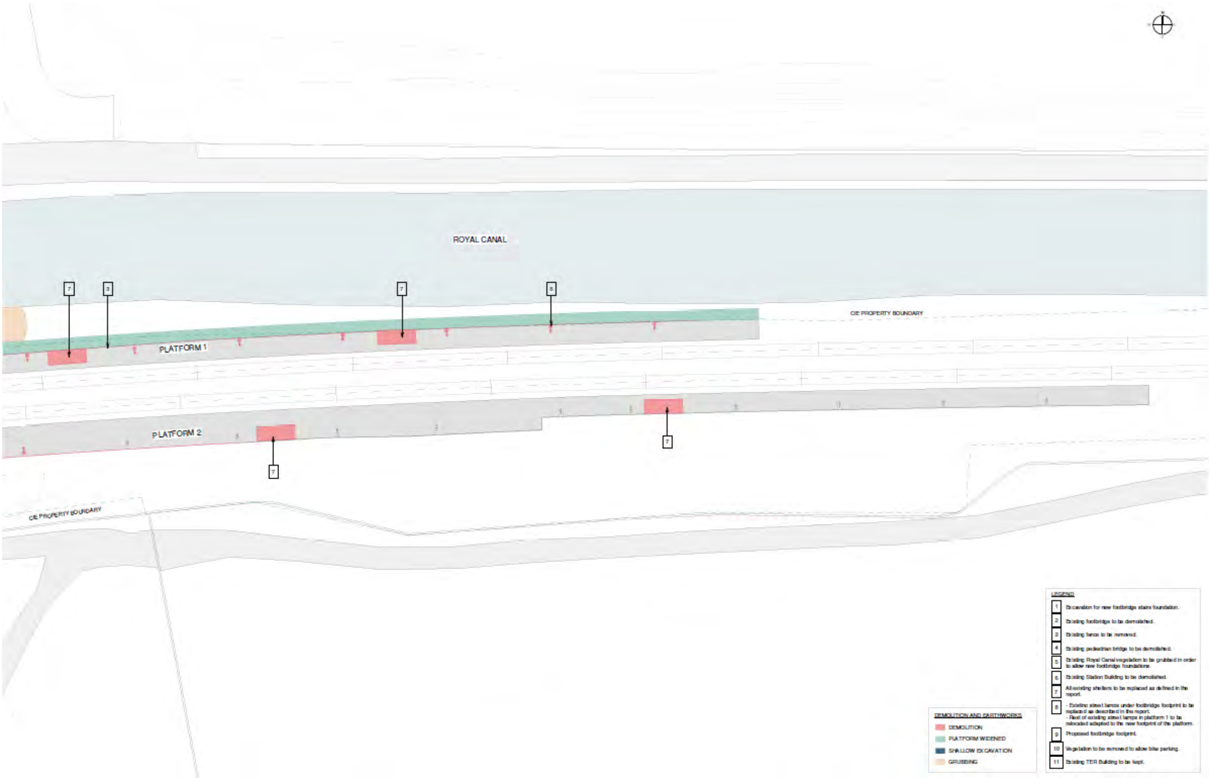


Figure 4-122 Demolition works at Ashtown Station - Sheet 2

4.8.5.1.2 Bridge gauge

The design assumes the reduced dimension for OHLE, 4690 mm (item 4b on Figure 4-120) and a gap of 1860 mm resulting in a total clearance of 6550 mm from the top of rail level, as shown in Figure 4-123.

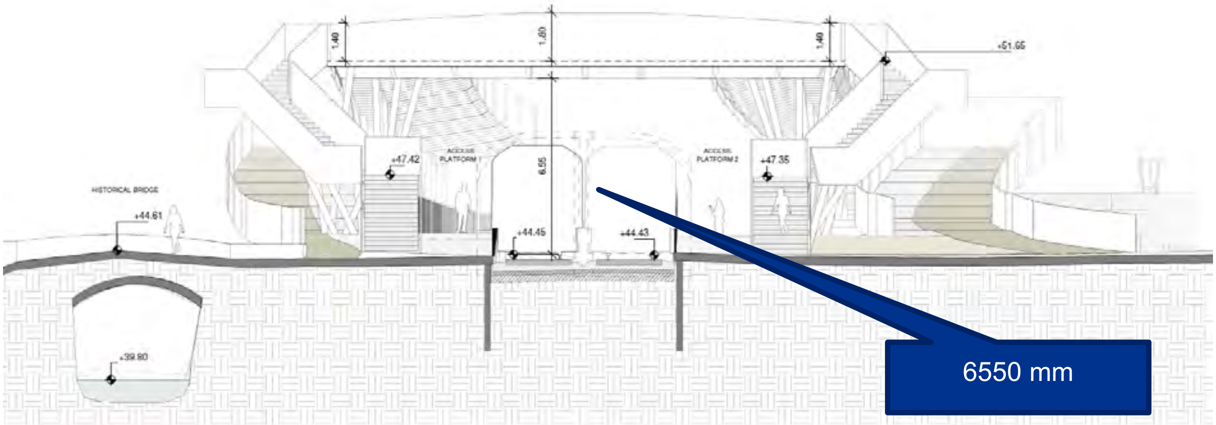


Figure 4-123 Bridge clearance

4.8.5.2 Structural gauges

As per Figure 4-120, the ramp/bridge must comply with minimum clearance distances from the track.

Figure 4-124 shows the section line on the lower level of the ramp corresponding to Figure 4-125. Figure 4-125 indicates the design dimensions which comply with the relevant standards.

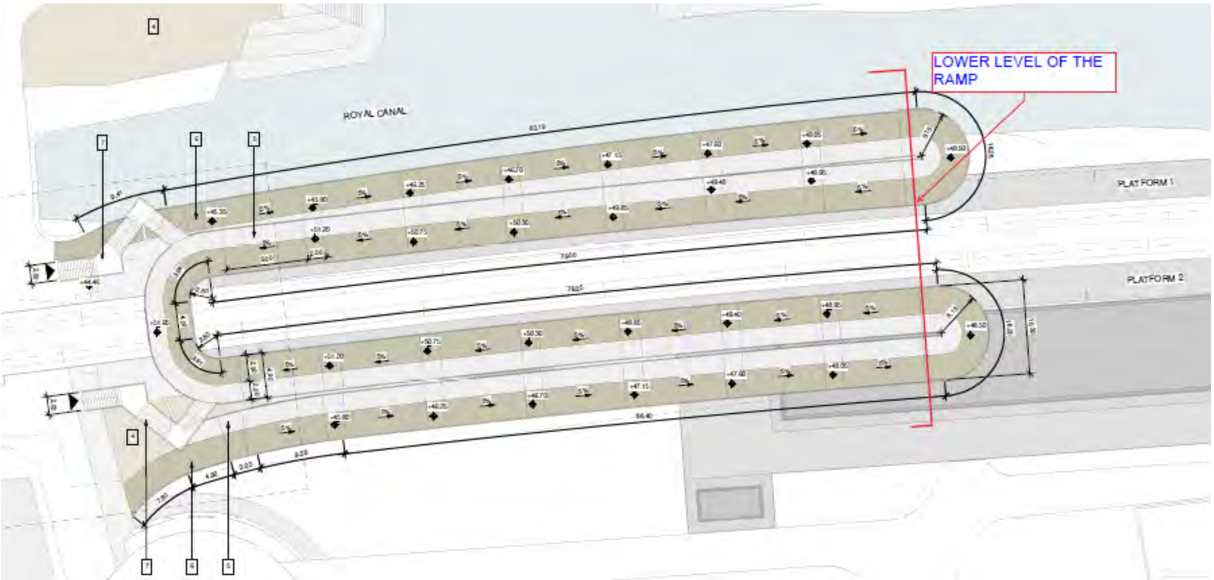


Figure 4-124 Plan of proposed Ashtown bridge with section mark

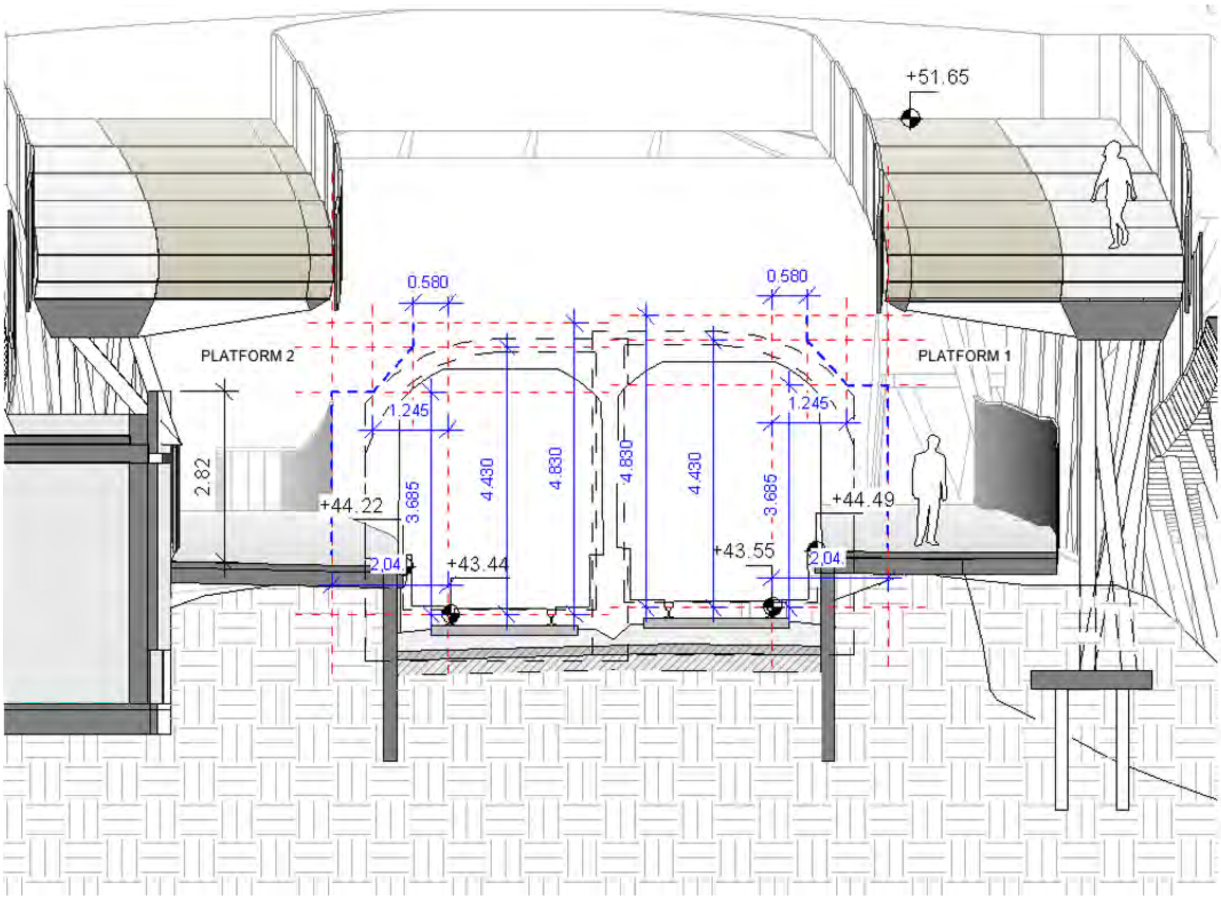


Figure 4-125 Section of proposed Ashtown bridge showing clearances

Since the station is envisaged to operate under an honour system for ticketing, existing barriers will be removed. The new arrangement will include ticketing machines at the entrance to the platforms and smart card validators along the platforms.

As part of the proposed design, the northern platform will be widened 1.57 m to achieve a total width of 4 m. In addition to this, the proposed footbridge provides sheltering to a significant area of the platforms. The areas not reached by this cover will be provided with isolated shelters.

The heritage of the existing masonry road bridge will be protected and enhanced by the removal of the existing footbridge.

4.8.5.3 Bicycle parking provision at Ashtown Station

The amount of bicycle parking to be provided at Ashtown Station is based on guidance from the National Cycle Manual. The manual gives recommendations for the minimum number of spaces to be provided at new private and public facilities in urban areas. This guidance is reproduced in Table 4-16.

Table 4-16 Guidance on provision of bicycle parking

Location	Guideline minimum number of bicycle parking spaces
Housing developments	1 private secure bicycle space per bed space (note - design should not require bicycle access via living area), minimum 2 spaces 1 visitor bicycle space per two housing units
Offices	10% of employee numbers, (subject to minimum of 10 bicycle places or one bike space for every car space, whichever is the greater)
Schools	10% of pupil registration numbers, minimum 10 places Consider separate teacher / employee parking
Other developments	1 bike space per car space, or 10% of employee numbers in general
Shops	1 stand per till / check-out
Public Transport pick-up points (Rail, tram, taxi Ranks & QBCs)	2.5% of number of daily boarders at that point / station, subject to minimum of 10 bicycle places
Off-street car-parks (incl. Multi-storey)	10% of total car-spaces, subject to a minimum provision of 50 spaces
Park and Ride locations	Consider sheltered parking at P+R
On-street (public)	Minimum of 5-10 spaces, depending on expected level of usage
Events	5% of forecast attendees

NOTE: *The above guidance does not preclude the need for compliance with the requirements of the Planning and Development Acts and associated Regulations. The designer should consult with the local Planning Authority for clarification and/or further information in this regard.*

The projected number of boarders at Ashtown Station in the year 2043 for both the do-minimum and do-something scenarios are presented in Table 4-17. These figures are used to calculate the amount of cycle parking required.

Table 4-17 Projected daily boarding passengers at Ashtown in 2043

	Daily Boarding Passenger Numbers 2043	
	DM 2043	DS 2043
ASHTOWN STATION	657	1455

The proposed cycle parking arrangement is illustrated in Figure 4-126.

- 2.5% of daily boarders
- Do-something scenario 2043: 1455 x 2.5% = **37 passengers (rounded up)**
- Area required: 1.65 m^2 x 37 = **61 m^2**

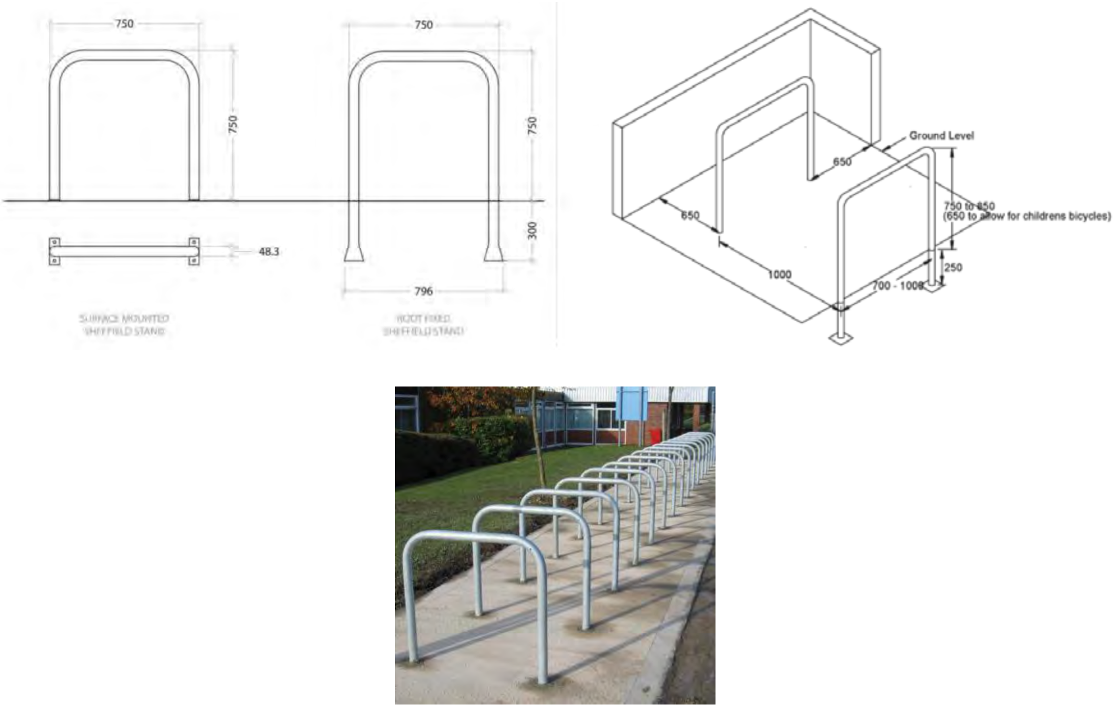


Figure 4-126 Proposed type of bicycle parking

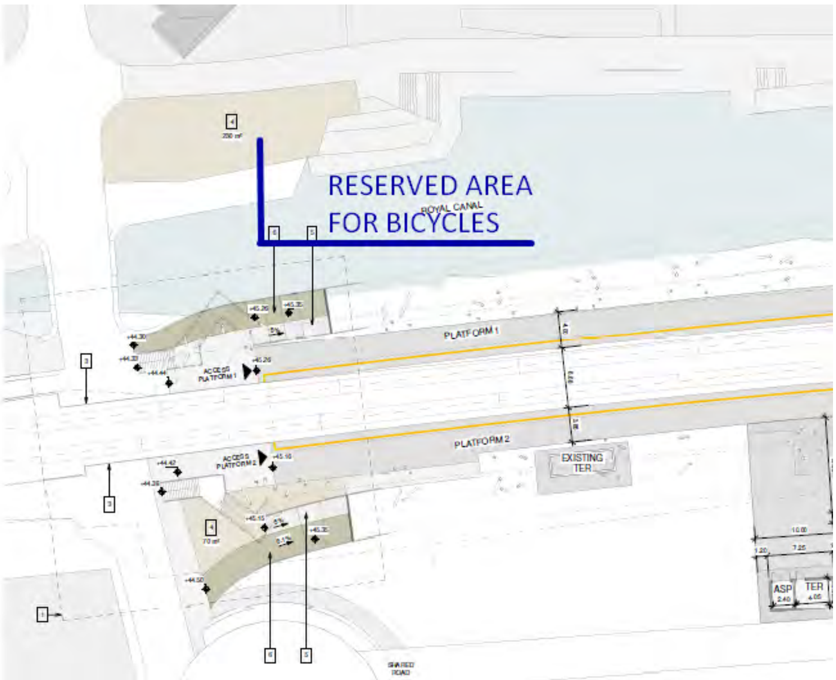


Figure 4-127 Area reserved for bicycle parking at Ashtown Station

4.8.5.4 Cycle and footbridge at Ashtown Station

A new shared use bridge is proposed for pedestrians and cyclists. The footbridge will be constructed using weathering steel (Corten or similar) to reduce maintenance requirements in the future. The footbridge will allow passengers to move between the platforms.

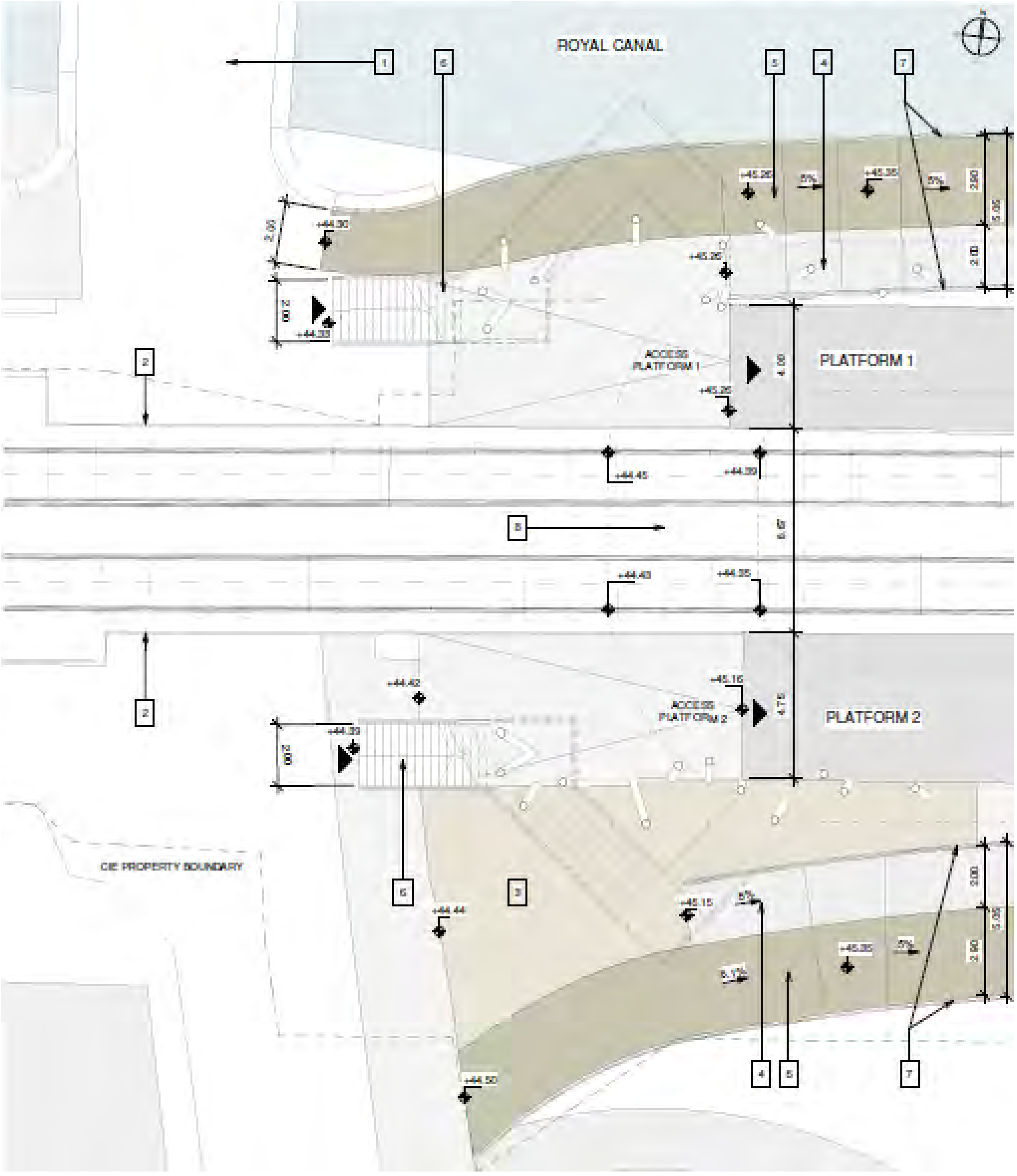


Figure 4-128 Ashtown bridge entrance details

Some of the main dimensions of the proposed bridge are provided below. These dimensions comply with the standards listed in Table 4-14.

Bridge/Ramp Length:	387 m
Gradient:	1/20 (5%)
Landing Length:	2.00 m every 9.00 m
Pedestrian Path:	2.00 m clear width
Cycle path:	2.90 m clear width. See Figure 4-129
Cycle path radius:	Internal radius: 2.25 m/External radius: 5.15 m
Bridge Clearance:	6. 55 m
Parapets:	Variable height 1.40 m/1.80 m

7.2 WIDTH CALCULATOR

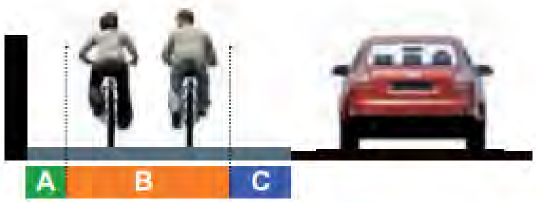
There are three basic elements that determine the width of a cycle lane or track, A, B, and C below.

- The space to the left of the cyclist
- The space required to support the cycling regime (two-abreast, single file, overtaking etc.)
- The space to the right of the cyclist

In addition, there may be additional width required depending on:

- Topography, traffic, locality etc.

The table below provides a simplified means of determining the actual width required for cycle lanes and tracks. Standard wobble is already built into the values in the table.



A Inside Edge		B Cycling Regime		C Outside Edge		D Additional Features	
Kerb	0.25m	Single File	0.75m	30kph, 3.0m wide lane	0.50m	Uphill	0.25m
						Sharp bends	0.25m
Channel Gully	0.25m	Single File + Overtaking, Partially using next lane	1.25m	50kph, 3.0m wide lane	0.75m	Cyclist stacking, Stopping and starting	0.50m
Wall, Fence or Crash Barrier	0.65m	Basic Two-Way	1.75m	Raised kerb, dropped Kerb or physical barrier	0.50m	Around primary schools, Interchanges, or for larger tourist bikes	0.25m
Poles or Bollards	0.50m	Single File + Overtaking, Partially using next lane	2.00m	Kerb to vegetation etc. (ie. cycleway)	0.25m	Taxi ranks, loading, line of parked cars	1.00m (min 0.8m)
		2 Abreast + overtaking (tracks and cycleways)	2.50m			Turning pocket cyclists	0.50m

Example:
To determine required cycle width, select the appropriate Inside Edge, Cycling Regime, Outside Edge and any Additional Features

Channel Gully	0.25m	Single File + Overtaking, Partially using next lane	1.25m	50kph, 3.0m wide lane	0.75m	Around primary schools, Interchanges, or for larger tourist bikes	0.25m

0.25m
+ 1.25m
+ 0.75m
+ 0.25m

Required width = 2.50m Note: This is the maximum width for an on road cycle lane. Cycle tracks can be wider.

Figure 4-129 Recommended widths as per National Cycle Manual

The Ashtown Station site was also designed to accommodate a substation along with other facilities that are required for the network. Due to the significant size of the substation, the proposed footbridge/ramp will be used to integrate it into the surrounding environment. Refer to the following figures for further information relating to the proposed bridge/ramp at Ashtown.

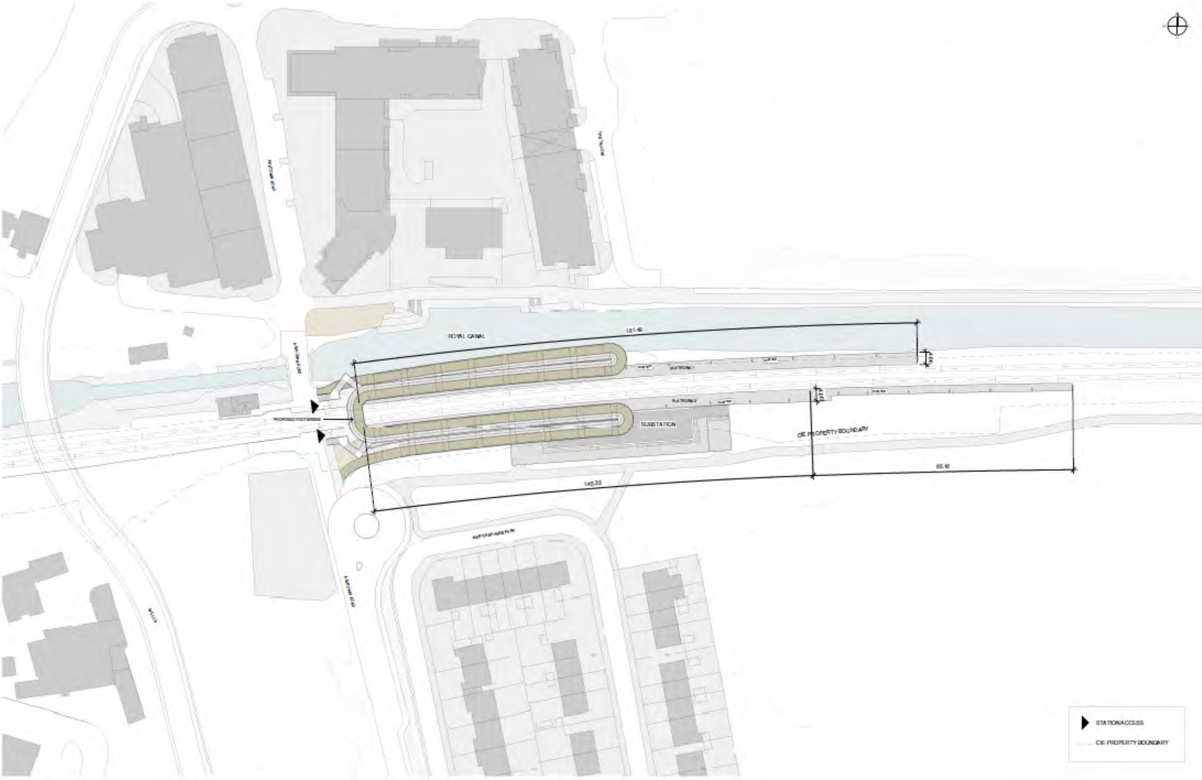


Figure 4-130 Ashtown Station general arrangement

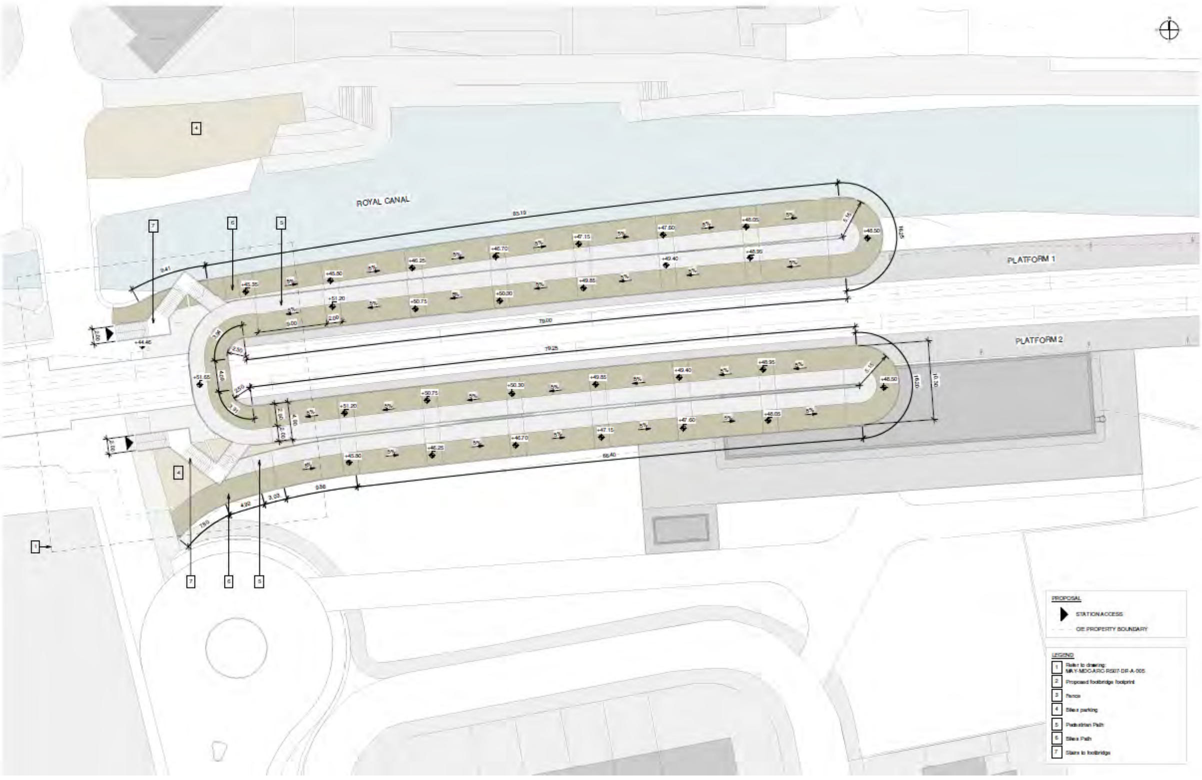


Figure 4-131 Ashtown bridge/ramp in plan

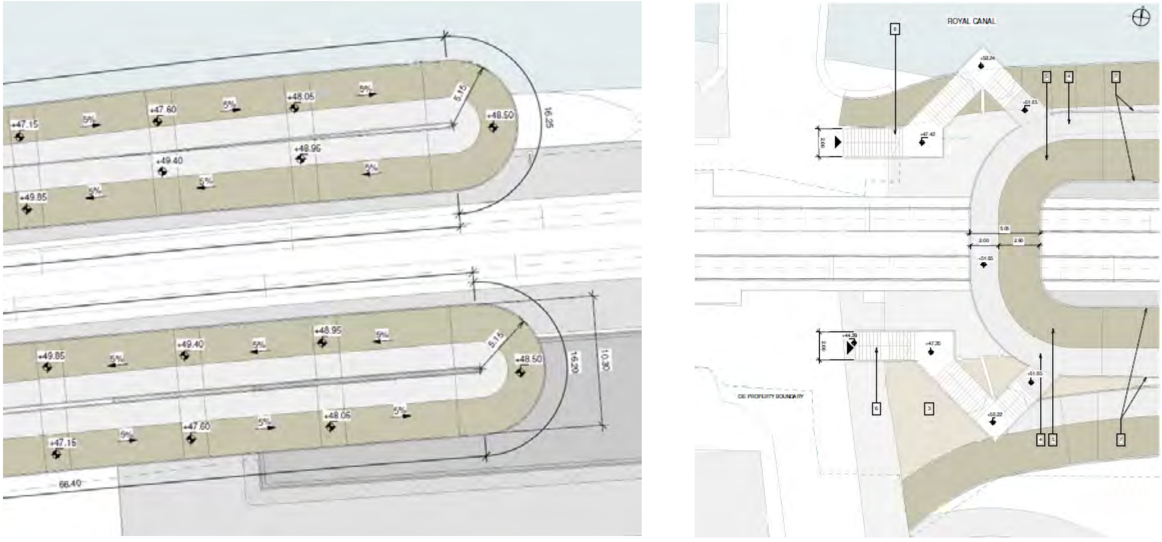


Figure 4-132 Details of radii on Ashtown bridge/ramp

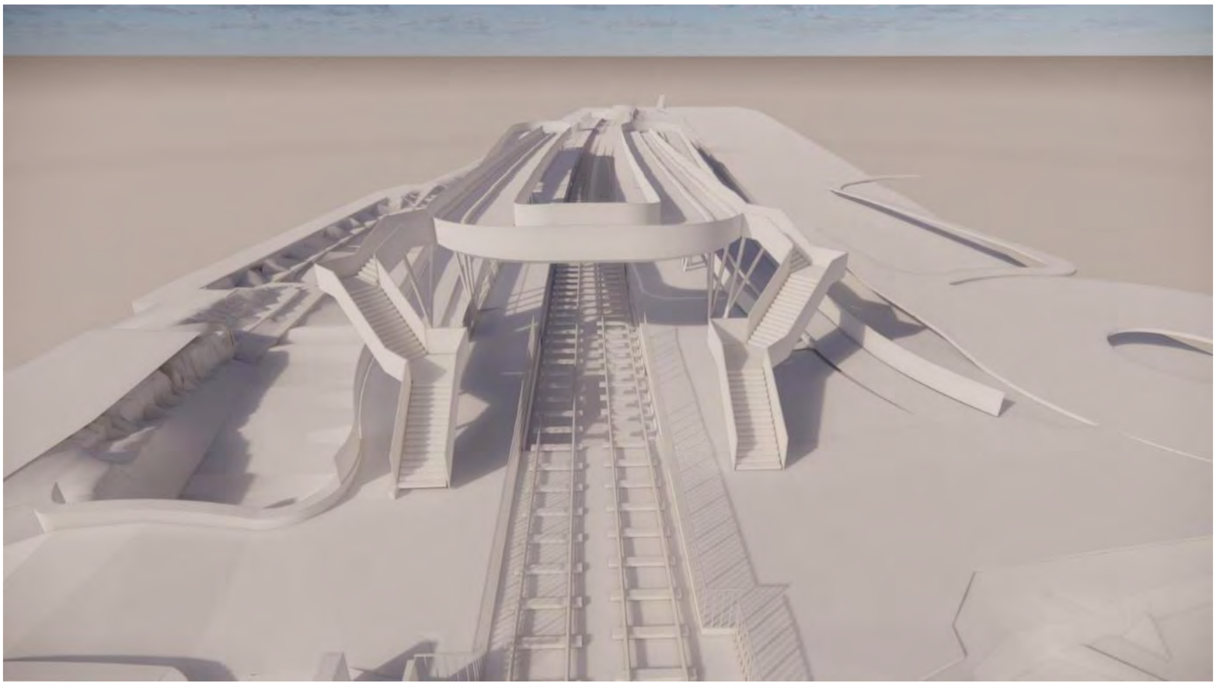


Figure 4-133 3D view of Ashtown from the west

The structure will consist of a ramp system above each of the platforms at Ashtown Station. The northern ramp partially overhangs the Royal Canal which will receive the piles to support the structure. Refer to Figure 4-134 and Figure 4-135 for a representation of the ramp overhanging the canal. Some modification of the canal embankment will be required.

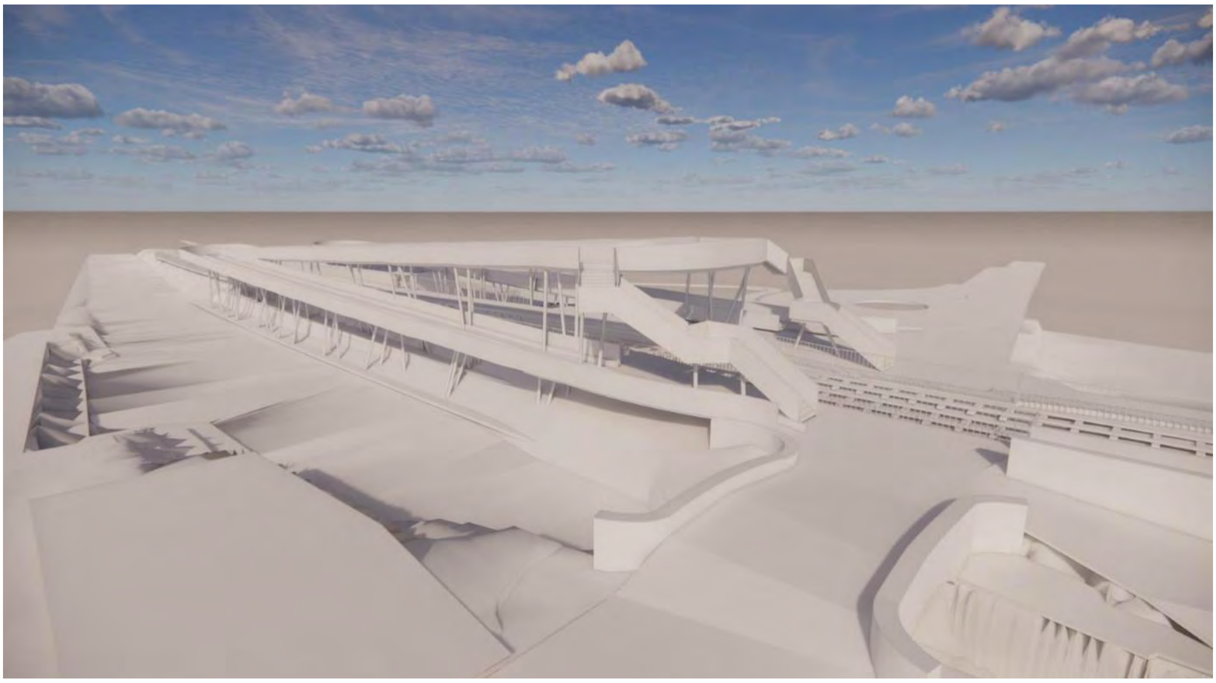


Figure 4-134 Northern ramp at Ashtown Station

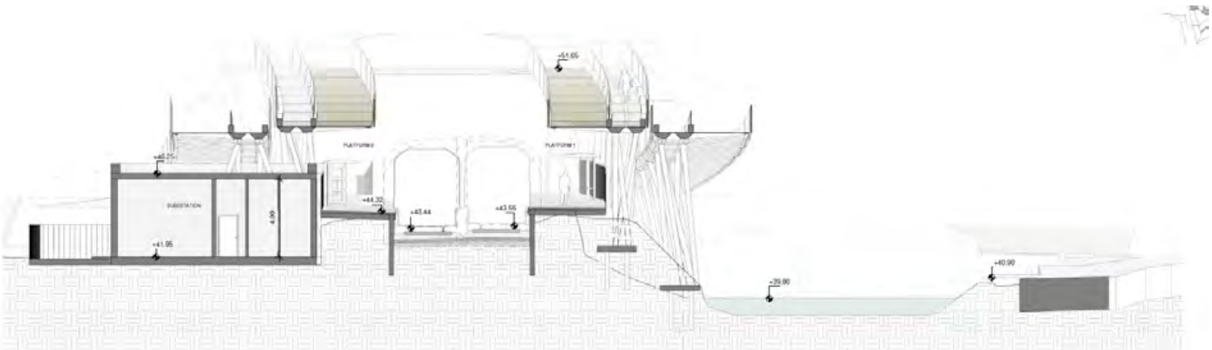


Figure 4-135 Cross section at Ashtown showing the northern ramp overhanging the Royal Canal

The design of the parapets incorporates the safety considerations in DN-STR-03005-02. The height of the parapets on the ramps varies at different locations. The minimum height is 1.4 m and is increased to 1.8 m when passing over the track and the substation. See 4.5.15.5 and 4.5.15.5.3 for reference. Figure 4-138 and Figure 4-139 illustrate how the bridge/ramp will look once constructed.

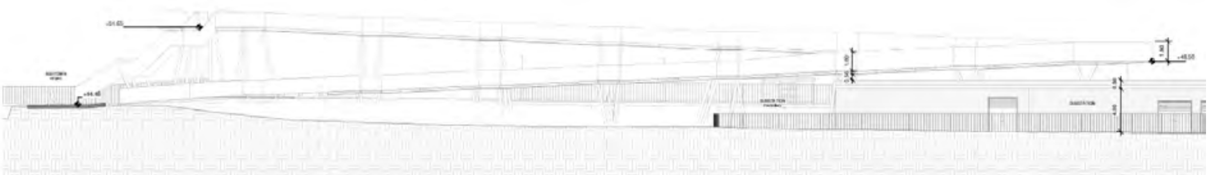


Figure 4-136 Southern elevation of proposed ramp at ashtown

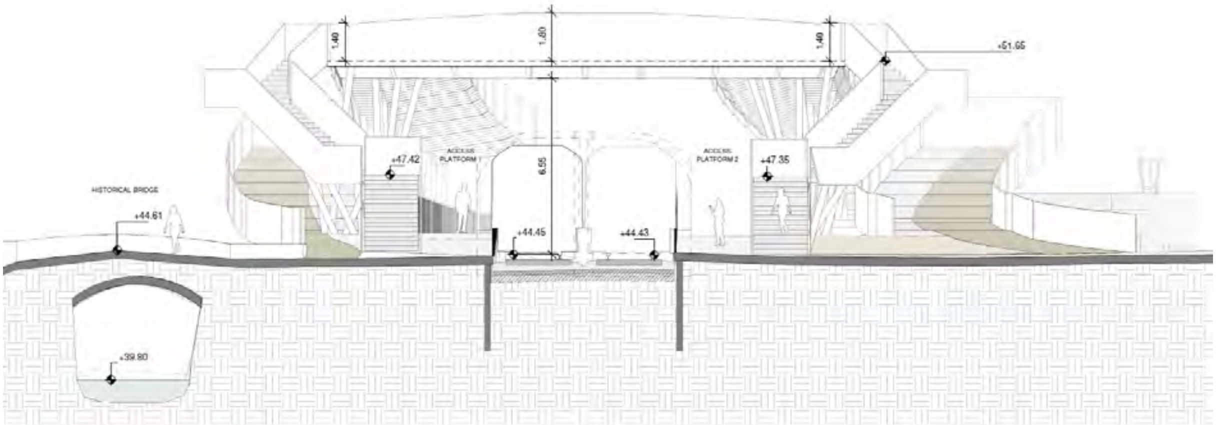


Figure 4-137 Variable parapet heights on proposed Ashtown footbridge

Figure 4-138 View of completed footbridge from the southwest

Figure 4-139 View of completed footbridge from the northeast

4.8.6 Ashtown level crossing

It is proposed to remove the level crossing at Ashtown. The design requires the re-routing of Ashtown Road west along the existing alignment of Mill Lane, which in turn will be diverted to the west. This road will then pass under both the railway and the canal and tie back into Ashtown Road to the north of the canal at the location of the existing roundabout. The diverted road will provide for a 6.5 m wide carriageway with 1.5 m rubbing strip on the western side of the road, and a 3.65 m wide cycleway along the eastern side of the road. The proposed level crossing replacement works at Ashtown will require property acquisition and modifications to existing accesses. Refer to Figure 4-140 below for the plan layout of the proposed works.

Figure 4-140 Proposed works at Ashtown level crossing

South of the railway the realigned Ashtown Road will tie into the existing Ashtown Road approximately 60 m south of the Martin Savage Park entrance. Approximately 40 m from the tie in, a three-arm mini roundabout is proposed. The northern arm will tie into the existing Ashtown Road and provide access to the train station for vehicles, cyclists and pedestrians. The existing access to Martin Savage Park will be retained.

It is proposed that the realigned Ashtown Road will follow Mill Lane northwest from the mini roundabout and veer north approximately 160 m along the road. Some existing properties on Mill Lane, namely Gowan Motors and the Ashtown Gate Office Complex, will be provided with direct access onto the realigned Ashtown Road. A new priority junction and roadway will be provided, off the realigned Ashtown Road, approximately 120 m from the mini roundabout to serve the Mill and Burke Brothers, Son and Co. Ltd. The access road will extend north and turn west, approximately 60 m from the junction, to provide access to the industrial yard and the Mill, each of which are currently accessed off Mill Lane. The proposed access road will be carried over the realigned Ashtown Road via a new two span bridge, the deck of which will be close to existing ground level. The proposed access road will accommodate the new cross section consisting of a 6.5 m carriageway with a 2 m footpath on the west side and a 0.5 m rubbing strip on the east side.

The 1.5 m rubbing strip along the west of the realigned Ashtown Road will be terminated at the entrance to Ashton House, a protected structure (RPS no. 0690). From the lodge to the northern tie in it is proposed to provide a 0.5 m rubbing strip to curtail the impact on the gate lodge and Ashton House demesne. It is necessary to take down the existing boundary wall along Mill Lane north and to reconstruct it with a new alignment, set back to permit widening of the road corridor to accommodate a shared pedestrian/cycle space along the east side of the road. This will also result in the removal of trees along this section of roadway. It is proposed to provide an uncontrolled pedestrian crossing at the entrance to Ashton House. On the southern side of the railway, a mini roundabout, set down area and disabled parking will be provided. North of the railway, a mini roundabout is proposed to provide a turning facility for vehicles as shown in Figure 4-141 below.

Figure 4-141 Ashtown Station after removal of level crossing

The length of the proposed road works along Ashtown Road is approximately 170 m north and 380 m south of the rail line. The proposed road would drop to an approximate level of 37.5 m OD under the railway which is at a level of 45.6 m OD at the bridging point.

4.8.6.1 Pedestrians and cyclists

The design provides for segregated pedestrian and cycle facilities along the proposed realigned Ashtown Road. A 1.8 m footpath is proposed along the southwestern edge of the road to serve commercial and civic properties. Northwest of Gowans, the footpath transitions to a 1.5 m rubbing strip which extends through to Ashton House. A 3.65 m segregated cycleway is proposed along the north-eastern side of the road. It is envisaged that the cycle track will be extended from Ashbrook Apartments to the Navan Road under a separate scheme by the Local Authority/NTA. The design prioritises pedestrians and cyclists by continuing the footpath and cycle track across sideroads and accesses where practical. This includes the new access to Mill Lane (south of the railway) and Supervalu goods entrance and car park entrance (on the northern side of the rail line). The cycleway and shared areas continue across junctions with vertical level differences between the roadway and cycleway, and between cycleway and footpath. On the minor roadside of the junction, the footpath ramps back to road level.

It is intended that the majority of pedestrians wishing to access Rathbourne Village will use the proposed pedestrian/cycle bridge at Ashtown Station. From the east side of the realigned Ashtown Road, pedestrians can access the southern extremity of Rathbourne Village via a shared pedestrian and cycle ramp or continue north to the roundabout at the northern end of Rathbourne Village via a shared area.

The cycle track will commence on the east side of the Ashtown Road 20 m north of Ashbrook, south of the railway. The cycle track will cross the access road to Ashtown Station on the northern side of the mini roundabout with priority provided to cyclists . It will travel north on the eastern side of the realigned Ashtown Road under the railway and Royal Canal. The cycle track will remain raised crossing the new access roadway (Ch 0+120) to Mill Lane. A vertical level difference between the roadway and cycle track will be provided to reinforce priority of cyclists crossing the junction. On the minor roadside of the crossing, the footpath ramps back to road level. As the cycle track heads north under the proposed overbridges, 20 m north of the overbridges, the cycle track will enter a shared area to facilitate an uncontrolled pedestrian crossing. From this location cyclists can access the southern end of Rathbourne Village via a shared pedestrian and cycle ramp or continue north to the roundabout at the northern end of Rathbourne Village via a shared area.

Figure 4-142 Detail of cycletrack/footway segregation – Ashtown level crossing

4.8.6.2 Drainage

The drainage for the proposed re-aligned Ashtown Road will be composed of kerbs, gullies and SuDS elements where practical, which compliments the existing drainage in the area and will connect to the stormwater network on River Road. Refer to drawings provided in Volume 3A of this EIAR.

Based on the information available, the road alignment will be in a rock cutting on approach to the underpass where rock depths are between 5 m and 11 m below existing ground level along the approaches. Rock is typically overlain by a very stiff Dublin boulder clay and made ground in the vicinity of the bridge crossing.

4.8.6.3 Canal and railway underbridge

To mitigate against the proposed closure of the Ashtown level crossing, the proposed Ashtown underpass carries the road beneath a twin track railway, canal and towpath. The underpass approaches are lowered compared to the existing ground level. Structures making up the underbridge are:

Table 4-18 Ashtown underbridge structures

ID	Name	Primary function	Principal Loading	Span
LC01-01	Rail underbridge	Carries the railway including cess walkways over the underpass.	Railway Loading	19 m
LC01-02	Canal aqueduct	Carries the canal and its towpath over the underpass.	Canal water level up to 45.6 m AOD (extg. level on top of upper lock wall). LM4 towpath.	16 m
LC01-03	Mill Lane overbridge	Carries Mill Lane over the proposed road mainline.	Road Traffic	31 m
LC01-04	Northern piled retaining walls	Retains the existing ground where retained height is greater than 6 m.	Groundwater	6 m to 11 m
LC01-05	Northern kingpost retaining walls	Retains the existing ground where retained height is between 3 m and 6 m.	Groundwater	3 m to 6 m

ID	Name	Primary function	Principal Loading	Span
LC01-06	Northern reinforced concrete retaining walls	Retains the existing ground where retained height is less than 3 m.	Groundwater	<3 m
LC01-07	Southern piled retaining walls	Retains the existing ground where retained height is greater than 6 m.	Groundwater	6 m to 11 m
LC01-08	Southern kingpost retaining walls	Retains the existing ground where retained height is between 3 m and 6 m.	Groundwater	3 m to 6 m
LC01-09	Southern reinforced concrete retaining walls	Retains the existing ground where retained height is less than 3 m.	Groundwater	<3 m

Figure 4-143 below is provided to illustrate the location of each of the structural elements associated with the underbridge. The proposal also requires the careful deconstruction of the existing entrance gateway and pillars at Ashton House and reconstruction of same at a new location set back from the road edge.

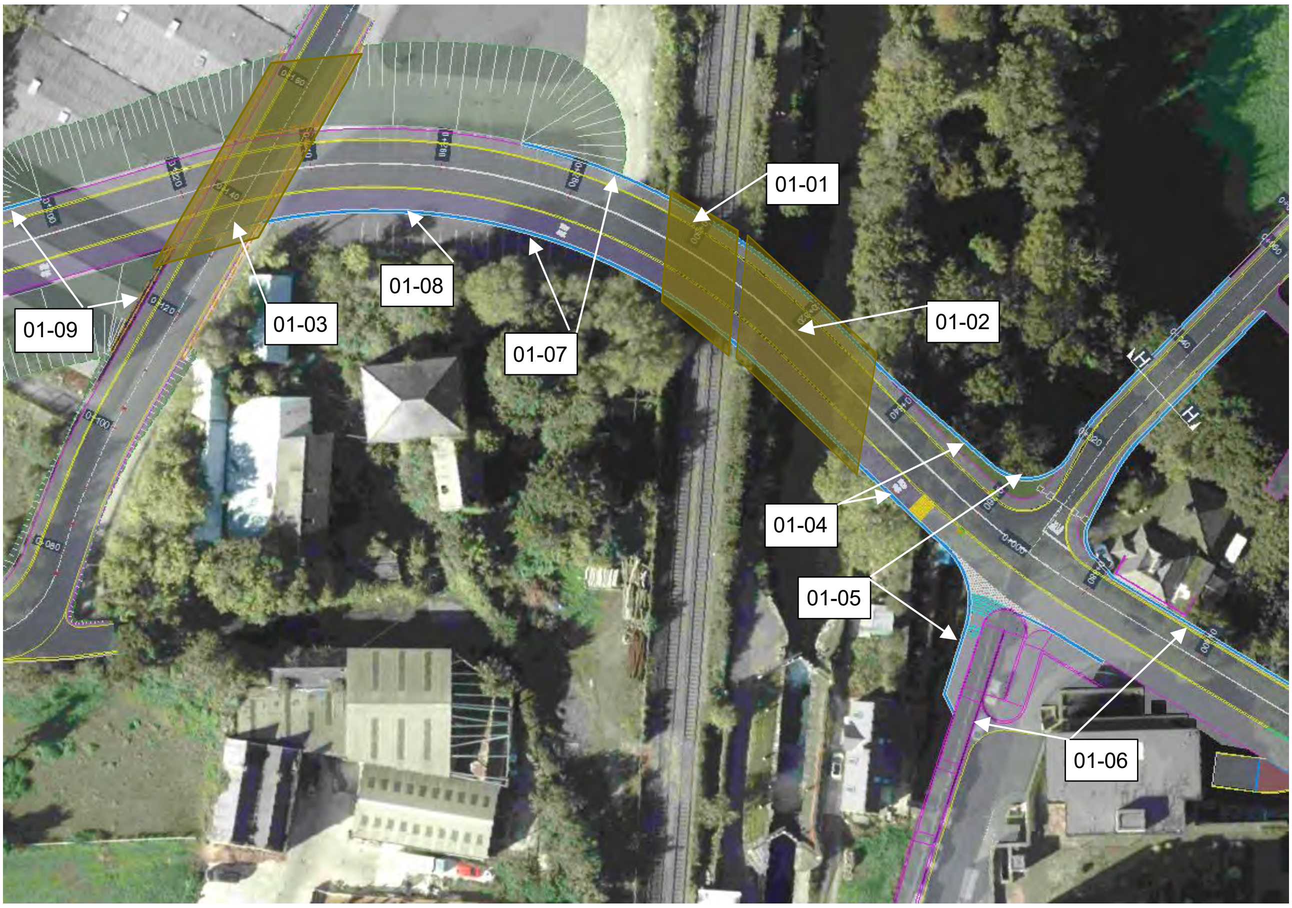


Figure 4-143 Ashtown underpass structures

LC01-01 - The new railway underbridge is a semi-integral composite prestressed concrete structure supported on corner piles with spherical bearings. The abutments comprise a large diameter pile in each corner of the bridge, a sacrificial kingpost retaining wall, and a permanent reinforced concrete retaining wall with stone cladding.

The rail underbridge spans approximately 19.0 m and is 12.5 m wide with a skew angle of 19 degrees. It has a prestressed concrete beam and slab deck with in-situ concrete downstand beams over the abutments acting as end diaphragms. The end diaphragms are supported on bridge bearings at their ends. The bearings sit on bored piles, one pile at each corner of the bridge.

It is expected that the bridge will be built using top-down construction techniques. The bridge deck will be constructed offline in advance of the main works while initial piling operations advance. Once the bearings are installed the bridge deck will be driven into position on the excavated railway . With the railway reopened, the abutment walls will then be constructed under the operational railway. A sacrificial kingpost wall with ground anchors enables the top-down excavation to progress. The kingpost piles are either installed at rail level before the main possession, or under the bridge after the main possession using low clearance rigs and spliced steelwork. Once dug down to base formation level, the permanent abutment is to be built in front of kingpost walls in in-situ reinforced concrete faced with stone cladding. An in-situ reinforced concrete base braces the bottom of the abutments and provides weight to resist uplift from buoyancy. Figure 4-146 and Figure 4-147 provide illustrations of the layout and cross section through the proposed underbridge.

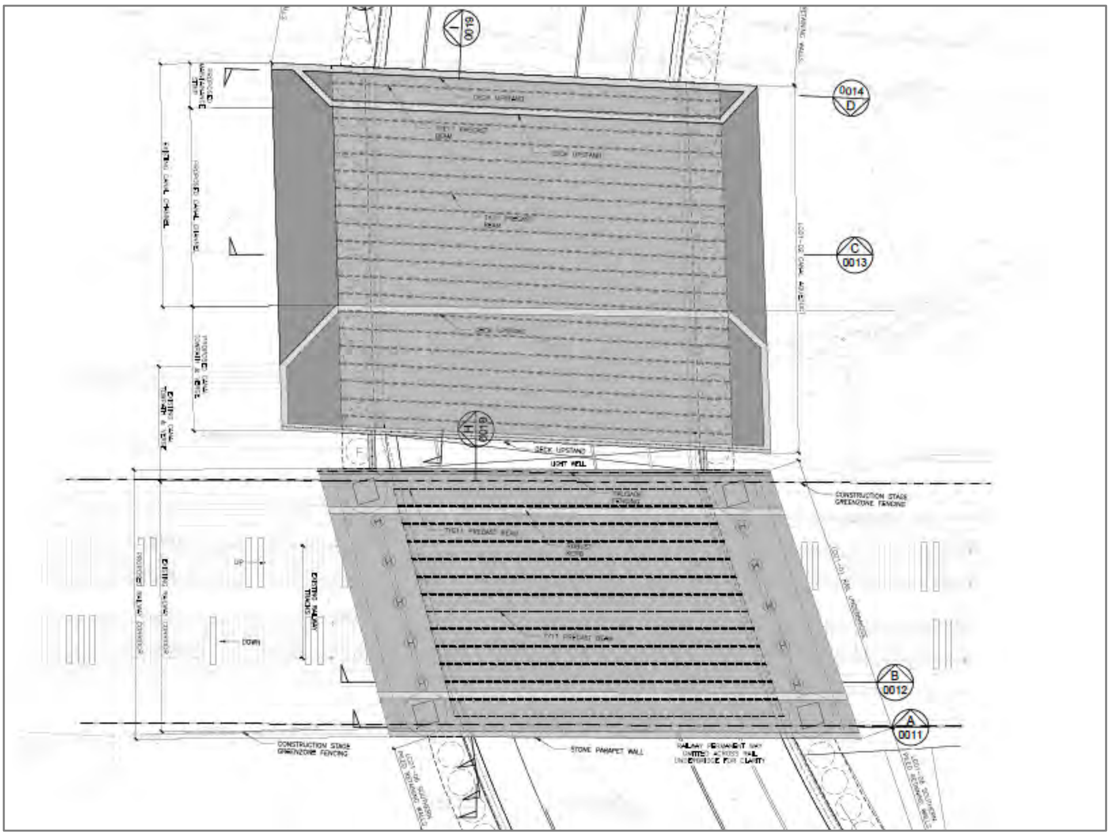


Figure 4-144 Railway and canal underbridge – Plan

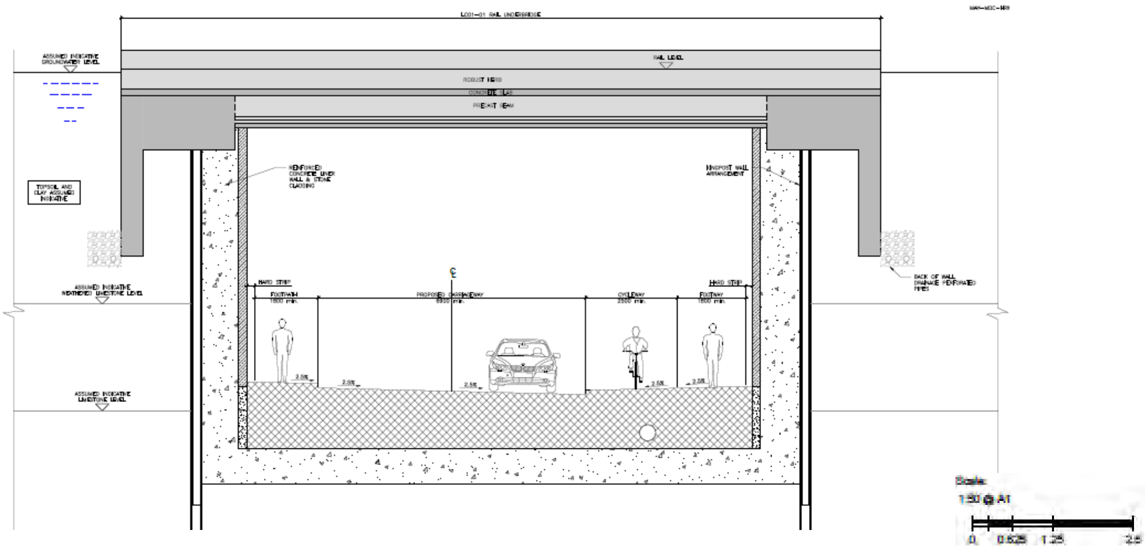


Figure 4-145 Railway underbridge – Cross-section

Figure 4-146 below provides a 3D representation of the proposed bridge looking from the north. It is proposed that the masonry walls are constructed to match existing heritage masonry in the area.

Figure 4-146 Ashtown canal and railway underbridge – 3D image

LC01-02 - The new canal aqueduct is an integral composite prestressed concrete bridge supported by contiguous piled abutments. The abutments comprise contiguous piled walls with a reinforced concrete capping beam and a reinforced concrete liner wall and stone cladding.

The aqueduct spans approximately 17 m and is 17 m wide with a skew angle of 13 degrees. It carries the canal in a channel, the canal towpath, and a maintenance strip. It has a prestressed concrete beam and slab deck with precast concrete "L" walls on top of the slab to contain the canal and fill material.

LC01-03 - The overbridge is approximately 31 m long and is 10.5 m wide with a skew angle of 39 degrees . It carries the Mill Lane access road over the proposed realigned Ashtown Road. It has a prestressed concrete beam and slab deck with piled abutments.

LC01-04 - The piled retaining walls north of the underpass retain the existing ground adjacent to the new road for retained heights of greater than 6 m and are faced with a reinforced concrete liner wall and stone cladding. Where the formation level is through the existing clay strata, a reinforced concrete base slab is provided to contain groundwater.

LC01-05 - The kingpost retaining walls north of the underpass retain the existing ground adjacent to the new road for retained heights between 3 m and 6 m and are faced with a reinforced concrete liner wall and stone cladding. Where the formation level is through the existing clay strata a reinforced concrete base slab is provided to contain groundwater.

LC01-06 - The reinforced concrete retaining walls north of the underpass retain the existing ground adjacent to the new road for retained heights less than 3 m with stone cladding.

LC01-07 - The piled retaining walls south of the underpass retain the existing ground adjacent to the new road for retained heights of greater than 6 m and are faced with a reinforced concrete liner wall and stone cladding. Where the formation level is through the existing clay strata a reinforced concrete base slab is provided to contain groundwater.

LC01-08 - The kingpost retaining walls south of the underpass retain the existing ground adjacent to the new road for retained heights between 3 m and 6 m and are faced with a reinforced concrete liner wall and stone cladding. Where the formation level is through the existing clay strata a reinforced concrete base slab is provided to contain groundwater.

LC01-09 - The reinforced concrete retaining walls south of the underpass retain the existing ground adjacent to the new road for retained heights less than 3 m with stone cladding.

Figure 4-147 shows a graphical representation of the proposed reinstatement of the curtilage wall to Ashton House along Mill Lane north of the Royal Canal, showing the preservation of the historic Gate Lodge. A coursed random rubble masonry wall is proposed to match the existing heritage masonry with coping stones also to match.

Figure 4-147 Reinstatement of curtilage wall to Ashton House – 3D Image:

4.8.6.4 Proposed underbridge deck cross-section

The rail underbridge's deck carries ballasted track. The minimum thickness of ballast is 300 mm below the underside of sleeper. The proposed cross-sectional dimensions are shown in Table 4-19.

Table 4-19 Deck cross sectional dimensions

Cross section dimensions	Width (m)
Up Line parapet upstand	0.275
Up Line services duct (within walkway)	0.5
Up Line walkway	1.5
Up Line robust kerb	0.3
Up Line running edge offset to robust kerb	1.5
Up Line track	1.6
Six foot	1.97 (to match extg.)
Down Line track	1.6
Down Line running edge offset to robust kerb	1.5
Down Line robust kerb	0.3

Cross section dimensions	Width (m)
Down Line walkway	1.5
Down Line services duct (within walkway)	0.3
Down Line parapet upstand	0.25
Total underbridge deck width	**12.295 m**

4.8.6.5 Aesthetic considerations

Although the underpass is in cut and is in close proximity to the historic Mill (RPS no. 0691), every opportunity has been taken to make the environment of the underpass visually open and sympathetic to the local environment. Specific measures include the following:

- *Providing enhanced vertical clearance where practicable through the structure.*
- *Widening and opening the southern approach to the underpass to the maximum degree practicable with a 1 in 3 batter provided east of the road approach. The degree to which visual openness can be achieved is curtailed by the close proximity of the Mill, Ashton House Lodge and the newer commercial development on the northern approach to the underpass.*
- *A masonry finish is proposed to retaining walls in sympathy with the high value heritage sites in close proximity to the underpass including the Royal Canal, Ashton House, the railway and the Mill. A sample panel from an existing boundary wall along mill lane is shown in the photograph in Figure 4-148 below. The construction is of rectangular randomly arranged stones, tightly jointed and laid in courses. Limestone is prevalent. Individual coping stones are used. It is proposed to adopt a coursed masonry construction similar to that illustrated. The coursing is considered important due to the significant height of the walls and the uniformity of quality that can be achieved with this approach. Further consideration will be given to the configuration of the proposed coping during detailed design.*

The rail underbridge soffits are precast concrete elements. The underbridge elevations comprise precast concrete beams, in-situ concrete cantilevering slabs, in-situ concrete upstands, with a stone parapet wall to the southern side, and a palisade fence to the northern side.

Figure 4-148 Image of existing coursed masonry wall along Mill Lane

The gap between the rail and canal superstructures permits natural light into the central part of the covered underpass, helping to break up the soffit.

4.8.6.6 Bridge drainage

The rail underbridge deck falls along its length in the Up direction at 1-in-150 to match the track alignment so that water naturally drains off the slab. A back of wall drain will be provided at the back of the rail underbridge pile caps, the back of the canal aqueduct capping beam, and the back of the kingpost retaining wall. The back of wall drain will discharge to a pipe through the retaining walls.

The canal aqueduct will not be positively drained. Water from the surface of the towpath will shed onto the soft landscaping strip next to the canal. A perforated pipe will be provided as back of wall drainage to the retaining walls forming the towpath and maintenance strip. This back of wall drainage discharges into soakaways at both ends of the aqueduct.

The proposed underpass road surface is positively drained by road gullies connected to a proposed carrier drain running through the underpass. The carrier drain runs down the length of the new road from south to north and discharges into the Tolka River as shown on Drawing MAY-MDC-STR-LC01-DR-C-0200-D in Volume 3A of this EIAR.

The proposed underpass and areas of cut are designed to exclude groundwater. Buoyancy induced by groundwater has been considered. Groundwater level is considered at ground level as being the worst credible level in accordance with Eurocode guidance published by the Institution of Structural Engineers. Groundwater mitigation measures are broken into categories, as below.

Groundwater less than 3.5 m above underside of R.C. base slabs to underpass. Self-weight of base slab and liner walls is sufficient to counteract buoyancy.

Groundwater between 3.5 m and 8.5 m above underside of R.C. slabs to underpass. Base slab, liner walls, foundations, and superstructure are structurally tied together to act monolithically in an uplift scenario to counteract buoyancy.

Groundwater greater than 8.5 m above underside of R.C. slabs to underpass. Detailed assessment of buoyancy required. Additional measures are made to counteract buoyancy, e.g. relief drainage, tension anchors, additional structural mass.

Groundwater less than 3.5 m above underside of R.C. bases to approach retaining walls. Self-weight of base slab and fill is expected to be sufficient to counteract buoyancy.

Groundwater greater than 3.5 m above underside of R.C. bases to approach retaining walls. Detailed assessment of buoyancy required. Additional measures are made to counteract buoyancy, e.g. relief drainage, tension anchors, additional structural mass.

4.8.6.7 Lighting – under, over, supply, fittings and fixtures.

The underpass carries the railway and canal over the proposed realigned Ashtown Road. Public lighting will be required on the road and this will be carried through the underpass. Light fittings are proposed to be supported from the soffit of the underpass. It is also proposed that CCTV cameras be installed at the underbridge with oversight by Iarnród Éireann personnel.

4.8.7 Electrification compound - Navan Road Parkway

A new permanent electrification compound will be constructed beside Navan Road Station. The design features of the compound are discussed in the following sections.

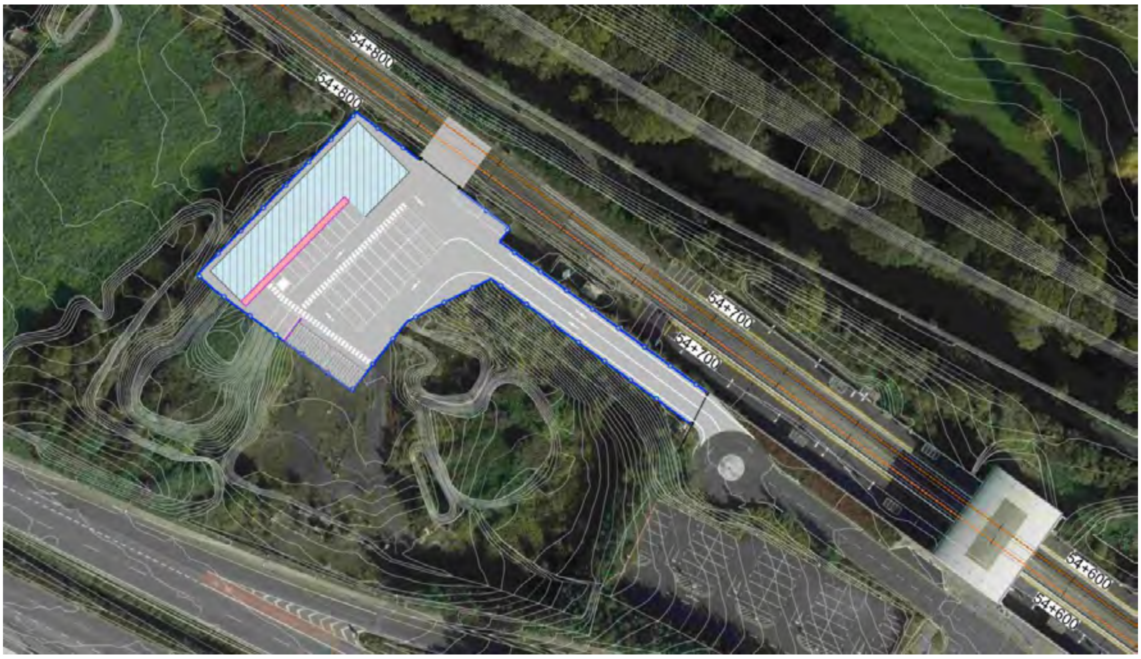


Figure 4-149 General layout of the compound area adjacent to Navan Road

The main access to the compound is through the Navan Road Parkway station, which is directly connected to the R147, which runs parallel to the existing station. The compound has an existing track access point suitable for RRV at the northern area. The carpark has a capacity of 21 vehicles and 15 maintenance vans. Additionally, there is a shelter arrangement for the RRV maintenance vehicles with a height of 5.5 m in the southern part of the compound. The proposed finish for the compound is asphalt in all the parking area, walkways are also provided around the building.

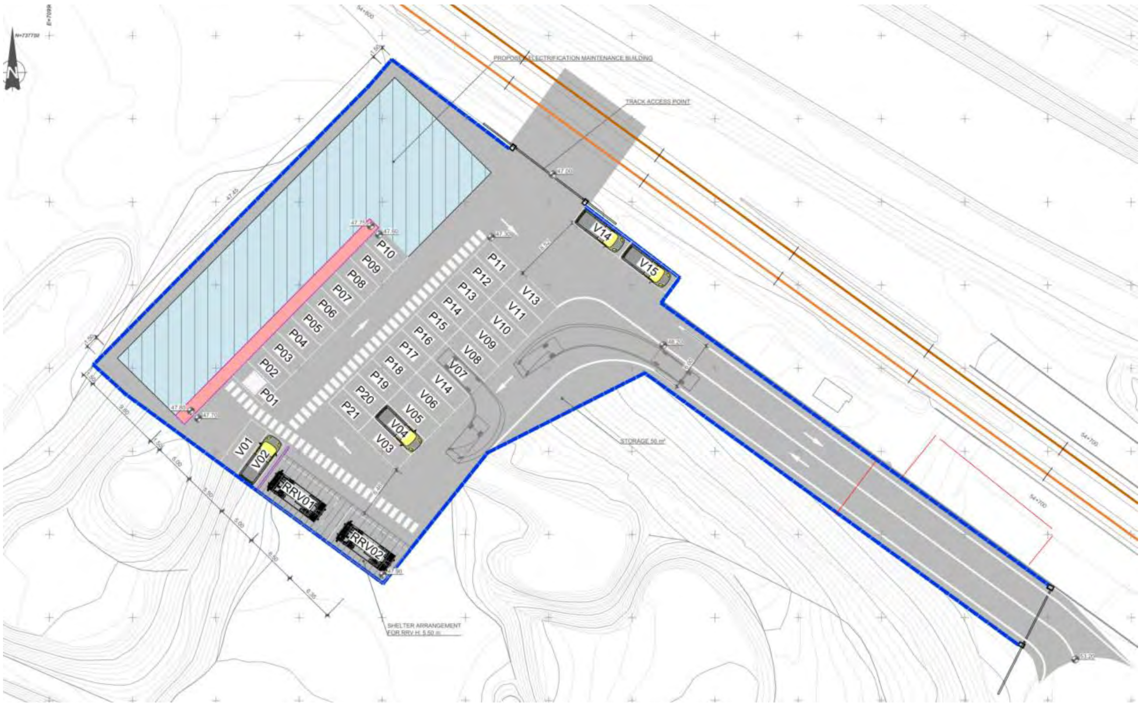


Figure 4-150 Urban development of the compound area adjacent to Navan Road

The building is approx. 44.9 m long and 15.50 m in its wider section. The main areas of the building are:

- Locker rooms and canteen areas for the maintenance staff on the ground floor
- Office areas on the first floor

- Storage area for SET elements at the northern end of the building to provide storage for: cable drums, catenary parts, spares etc.
- Other areas: stairs, MEP rooms, technical rooms, etc.

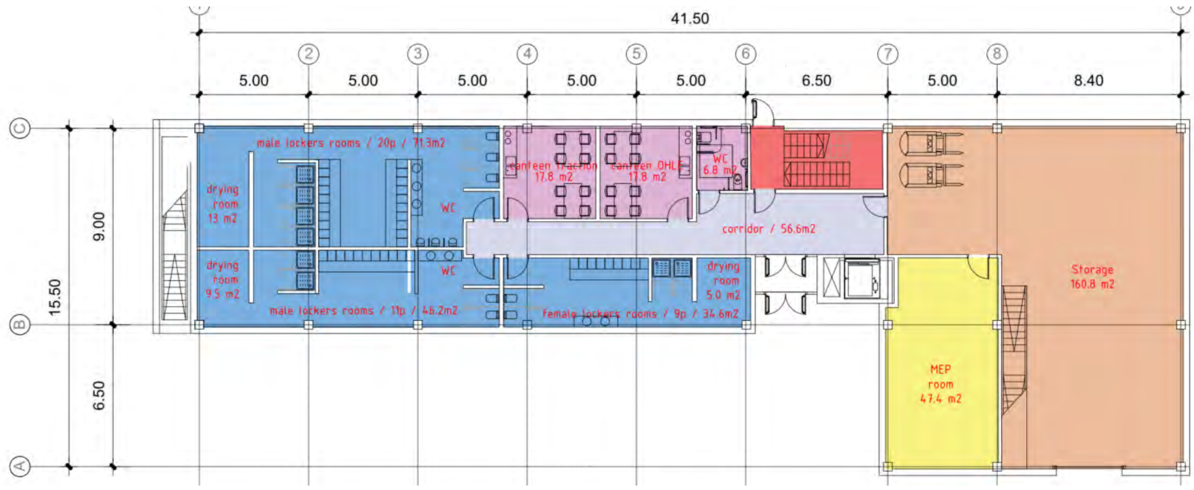


Figure 4-151 Building layout at ground floor

Figure 4-152 Building layout at first floor

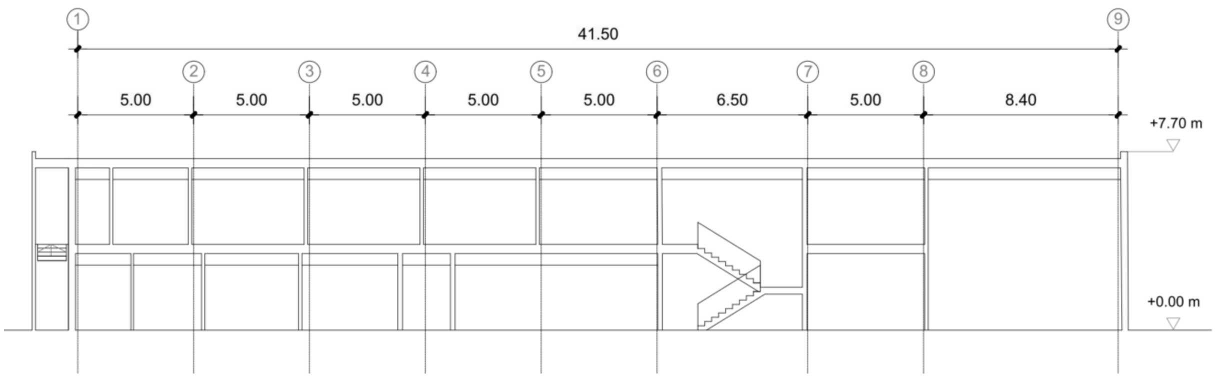


Figure 4-153 Building cross-section

4.8.8 OBG7A Drainage

Due to the lowering of the tracks required to obtain the necessary OHLE clearance at OBG7A, a drainage system has been designed between Ch 55+900 and 55+100.

The drainage solution for this area includes a filter drain with a collector pipe in the Down track and a carrier drain, diverting the collected runoff water to culvert UBG6A.

Before the discharge to UBG6A, a hydrodynamic separator is proposed to capture pollutants such as oil and debris within the surface water runoff.

4.8.9 OBG9 Old Navan Road bridge modification

4.8.9.1 Overview of alignment works

No track modifications are necessary in this area. The only interventions foreseen on OBG9 are the parapet heightening, as well as the structural modification to raise the bridge deck. OBG9 is a flat deck bridge 13.76 m wide and is located along the Old Navan Road. The modifications to the Old Navan Road rail bridge are required to facilitate railway electrification.

4.8.9.2 Structure modification

Old Navan Road is divided into two parts by the M50 Motorway. Currently, there is a crossing, accessible only by pedestrians and cyclists, that connects both sides of the road below the motorway.

It is proposed to lift the deck of OBG9 to increase the vertical clearance under the bridge. This will require modification of the access ramps on both sides of the bridge. The required deck lift for this bridge is 320 mm to obtain sufficient clearance for the OHLE system and to avoid causing a significant modification to the road alignment.

The main deck was reconstructed in 1972 and consists of a precast concrete girder deck with bearings between the abutments and the deck. A new concrete slab was constructed on the west side of the existing deck in 2018/2019, connected with steel plates and anchor bars to the existing deck and supported on bearings between the abutments and the deck.

Therefore, to lift the deck, the pavement requires a vertical cut beyond the end bearing of the deck. The temporary deck lifting structure will be placed and the deck will be lifted to the required level. After lifting the deck to the required level, the newly formed gap between the existing abutment bearing and the newly heightened deck section must be connected with steel bars surrounded in concrete, and concrete should be poured to the new elevation. Finally, the bearings must be repaired to the original positions.

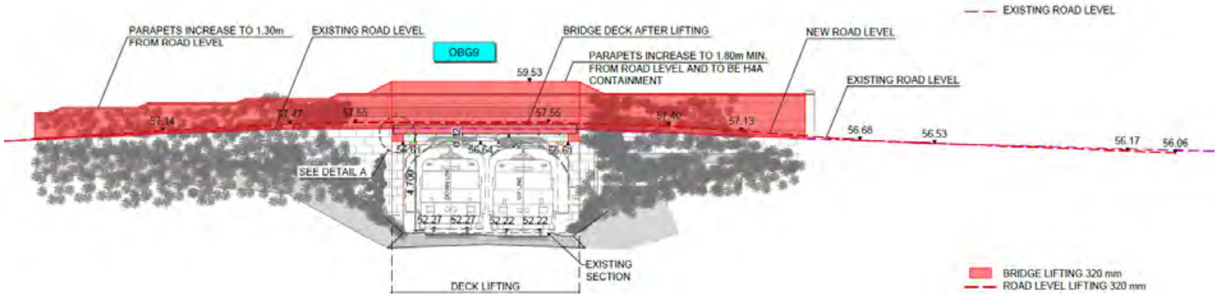


Figure 4-154 Deck lifting of OBG9 - Elevation

4.8.9.3 Parapet heightening

The existing concrete block parapet located on OBG9 is 1.50 m high and 0.26/0.55 m thick; the parapet is considered to be in fair condition. The structural intervention shall include adequate protective measures against electrical hazards, so it is proposed to increase the parapet height to 1.8 m as per Section 4.5.15.5.

Figure 4-155 Existing parapet at OBG9

4.8.10 OBG11 Castleknock Bridge modification

OBG11 is a 19th-century arch bridge and is located next to Granard Bridge, which is a protected structure (Fingal RPS No. 0696, NIAH reference 11354002) and carries Castleknock Road over the railway.

4.8.10.1 Overview of alignment works

There is no track alteration in this section, but bridge modification is required in order to achieve the required OHLE clearance.

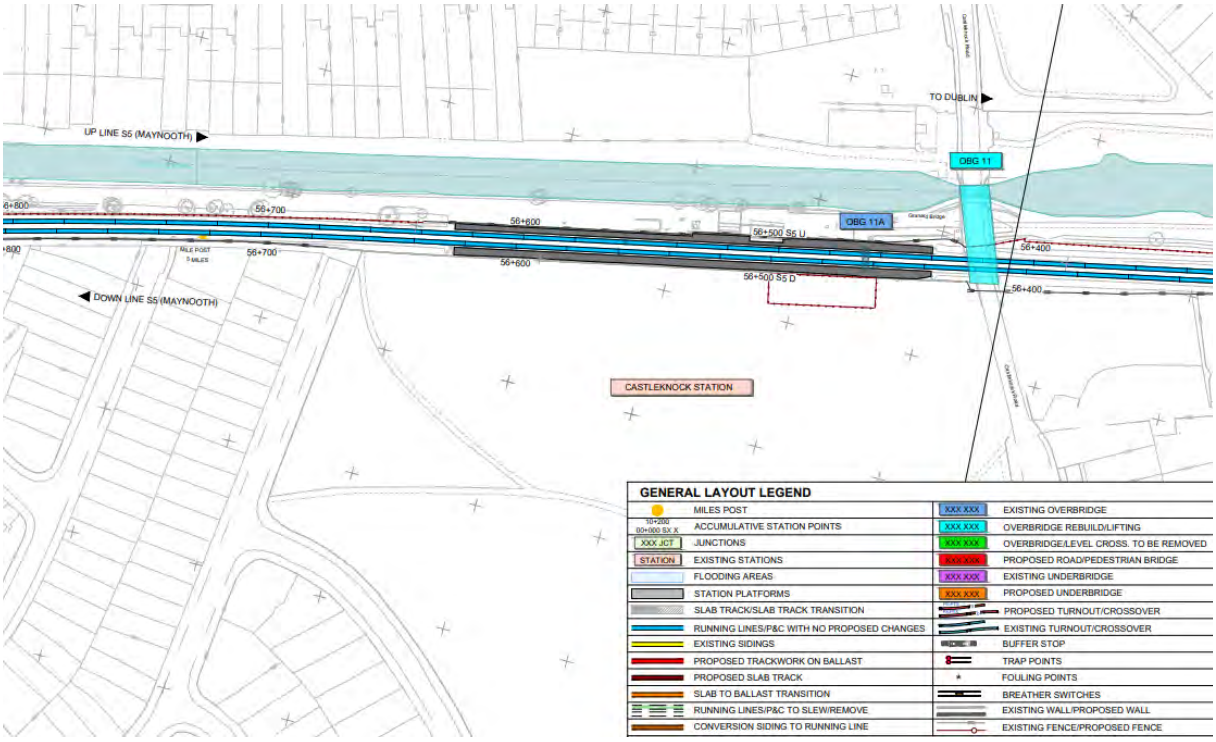


Figure 4-156 Alignment at OBG11

This structure is shown on Drawing MAY-MDC-STR-RS09-DR-C-0002-D Structure Design – OBG11 Bridge Deck Reconstruction in Volume 3A of this EIAR.

4.8.10.2 Structure modification

The following figures show OBG11 Castleknock Bridge with the proposed precast arch deck solution.

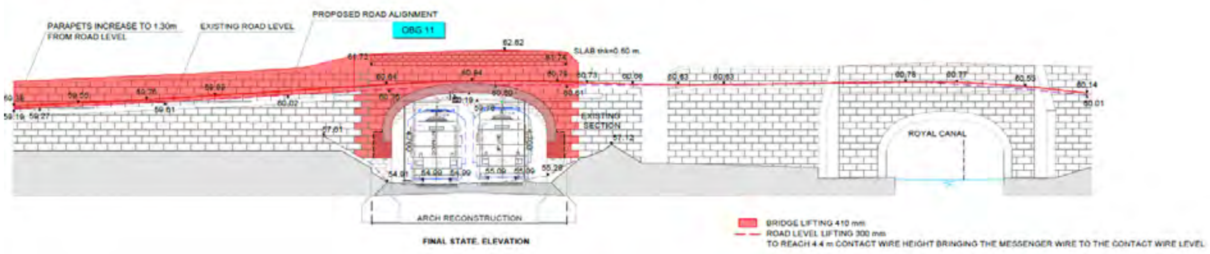


Figure 4-157 Deck reconstruction of OBG11 - Elevation

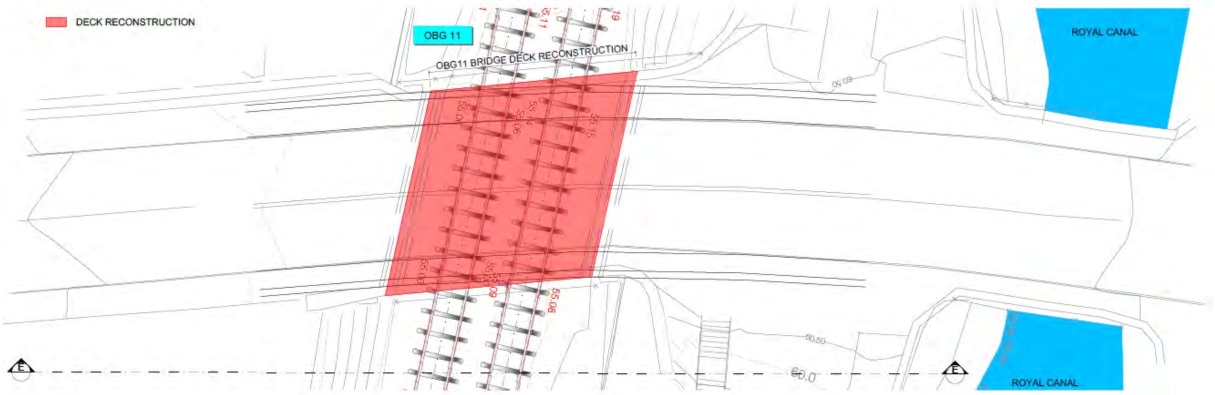


Figure 4-158 Deck reconstruction of OBG11 - Plan view

OBG11 is a two-lane bridge with a 10.95 m wide span, which provides access to the Royal Canal.

To achieve a sufficient vertical clearance for the catenary equipment under the bridge, a precast arch deck solution has been proposed. The new arched bridge deck shall be installed 410 mm higher than the original bridge arch position.

It is proposed to use a lightweight fill for the road backfill to the new elevation to reduce the additional dead load on the arch and the abutments. The load on the arch will be further reduced by replacing the existing backfill with lightweight fill.

Furthermore, load tests shall be carried out at a later stage in the design to assess the need for strengthening of the adjacent arch barrels.

Note 1: The residual risk due to lightweight fill and its impact shall be assessed, and load tests on bridges shall be carried out during the detailed design phase of works.

Note 2: Before performing any modification work on existing structures, the construction contractor should verify the conditions of existing structures to ensure that they meet the conditions considered in the design.

4.8.11 Castleknock substation

The substation will be located south of the railway on the boundary of Laurel Lodge Green, west of the existing R806 Castleknock Road.

It will be necessary to create a pedestrian and vehicular access to Castleknock substation from the existing R806 Castleknock Road. The entrance road will be 3 m wide and approximately 110 m long. As the substation is located on Laurel Lodge Green, some land take will be necessary. The substation perimeter will be fenced but the entrance road will not. The connection to the water supply network will be through the entrance road, connecting to the water main at R806 Castleknock Road. The foul gravity network will connect to the pipe running just to the eastern side of the substation.

Figure 4-159 Location plan of Castleknock substation

4.8.12 Coolmine substation

The substation will be located in Sycamore Green, a green area adjacent to a residential area, located 400 m east of Coolmine Station. Direct road access can be provided to the substation from the existing local road network via Maple Green.

The proposed location is partially within the existing CIÉ property boundary but some additional land take will be required. The terrain at this location is flat and the substation will be developed at the existing ground level.

The water supply connection will be to the eastern side of the substation, from Maple Green. Foul gravity connection will be provided from the same road.

Figure 4-160 Location details and utilities of Coolmine substation

4.8.13 Coolmine Station

Similarly to the design at Ashtown Station, reported in Section 4.8.5, the design proposal for Coolmine Station consists of general upgrades and renovation works required due to changes in both pedestrian flows and vehicular traffic as a result of the proposed development.

The station will be refurbished to accommodate increased capacity and the provision of additional services. Figure 4-161 shows the existing situation at Coolmine Station.

Figure 4-161 Existing arrangement at Coolmine Station

The proposal includes the provision of a new steel bridge with ramps, suitable for pedestrians and cyclists and the bridge will allow passengers at the station to cross from the north platform to the south platform and vice versa.

Given that Carpenterstown Road level crossing will be permanently closed, the historic bridge, currently used for vehicular traffic, will be converted into a pedestrian and cycle bridge to cross the canal. The new scenario proposes the removal of the existing footbridge. This will prevent unnecessary redundance of uses and will further enhance the landscape by giving prominence to the historic bridge and integrating it into the surrounding area.

4.8.13.1 Standard compliance - Coolmine Station

Coolmine Station assumes the same standards and design principles as outlined in Section 4.8.5.

4.8.13.1.1 Bridge gauge

The design assumes an OHLE clearance of 4690 mm plus a gap of 1880 mm resulting in a total clearance of 6570 mm over the track, as shown in Figure 4-162.

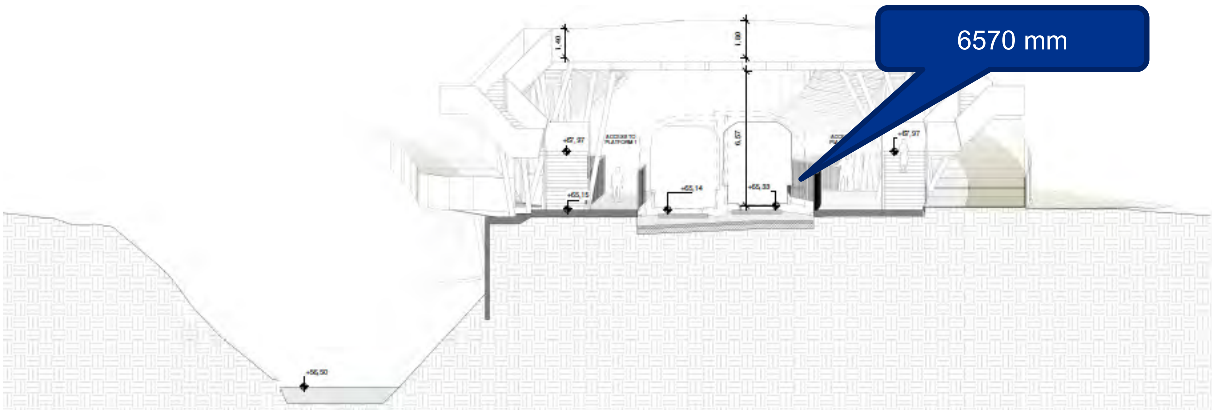


Figure 4-162 Bridge clearance

4.8.13.1.2 Structural gauges

As per Figure 4-120 the ramp/bridge must comply with minimum distances to the track.

Figure 4-163 shows the sections lines on the lower level of the ramp, which correspond to Figure 4-164 and Figure 4-165. The cross sections indicate the design measurements complying with the standards for structural elements.

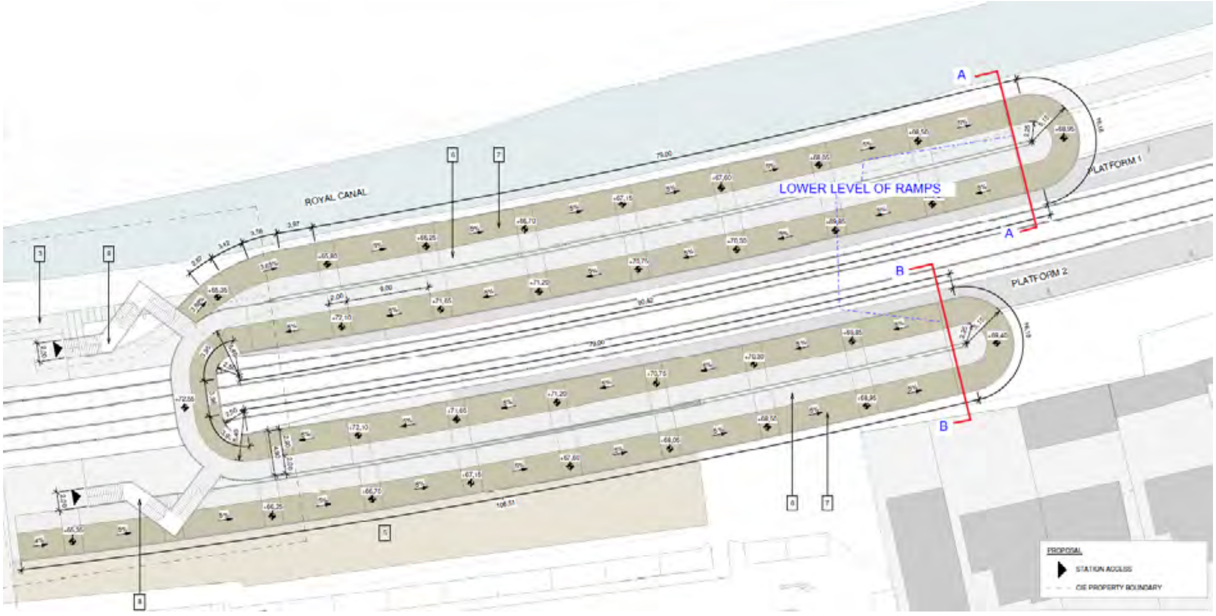


Figure 4-163 Plan of proposed Coolmine Station bridge with section marks

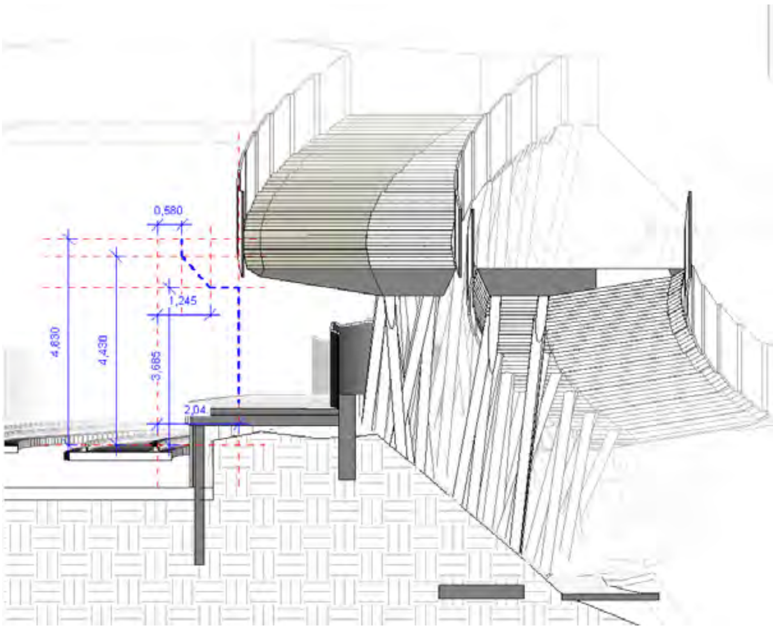


Figure 4-164 Section (A-A) at northern ramp showing structural gauges

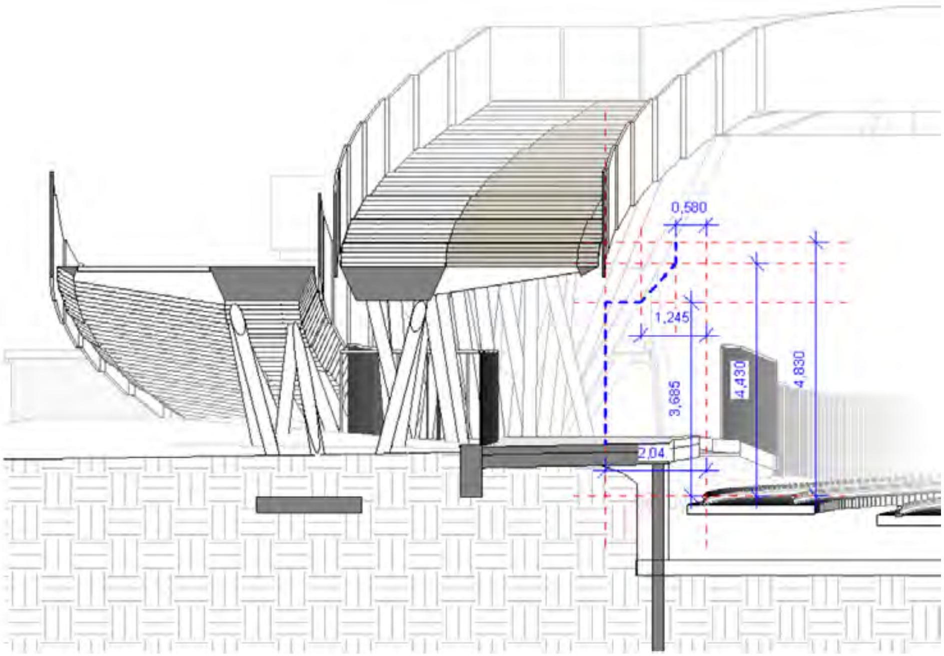


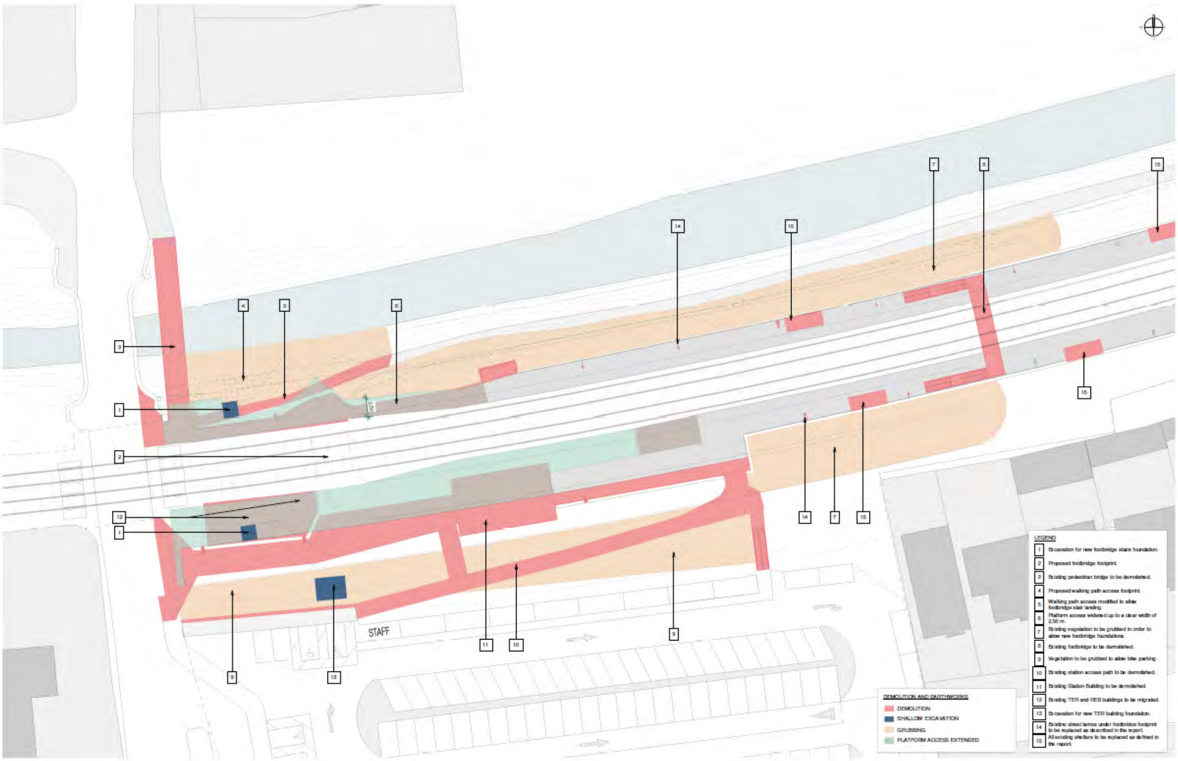
Figure 4-165 Section (B-B) at southern ramp showing structural gauges

4.8.13.2 Enhancements

Figure 4-166 shows the demolition and preparatory works required for the new design. The most significant element of these works is the removal of the existing pedestrian bridge. In the proposed scenario, Carpenterstown Road level crossing will be permanently closed, which means that the historical bridge will become the main pedestrian route across the Royal Canal.

An honour system will be implemented for ticketing at the station and hence, the existing control building is proposed to be removed allowing for visual improvements to the station entrance, particularly on the southern platform which currently presents an unsatisfactory first impression to users.

A summary of initial works is listed below in Figure 4-166.



LEGEND

1	Excavation for new footbridge stairs foundation.
2	Proposed footbridge footprint.
3	Existing pedestrian bridge to be demolished.
4	Proposed walking path access footprint.
5	Walking path access modified to allow footbridge stair landing.
6	Platform access widened up to a clear width of 2,50 m.
7	Existing vegetation to be grubbed in order to allow new footbridge foundations.
8	Existing footbridge to be demolished.
9	Vegetation to be grubbed to allow bike parking.
10	Existing station access path to be demolished.
11	Existing Station Building to be demolished.
12	Existing TER and REB buildings to be migrated.
13	Excavation for new TER building foundation.
14	Existing street lamps under footbridge footprint to be replaced as described in the report.
15	All existing shelters to be replaced as defined in the report.

DEMOLITION AND EARTHWORKS

- DEMOLITION
- SHALLOW EXCAVATION
- GRUBBING
- PLATFORM ACCESS EXTENDED

Figure 4-166 Demolition and preparatory works at Coolmine Station

Included in the envisaged list of enhancements, there is provision for a new entrance to the walkway along the Royal Canal embankment as shown in Figure 4-167.

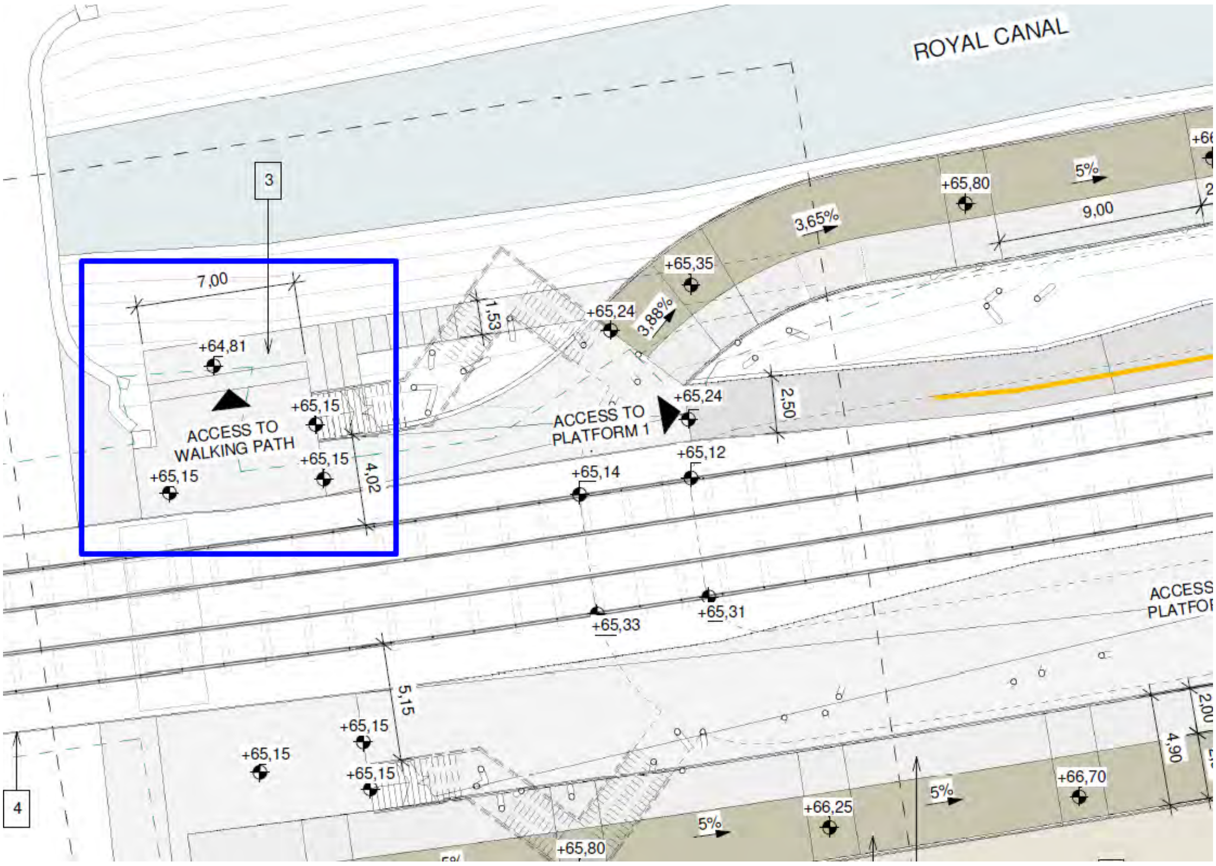


Figure 4-167 Royal Canal walking path

4.8.13.3 Bicycle parking provision at Coolmine Station

The amount of bicycle parking to be provided at Coolmine Station is based on guidance from the National Cycle Manual. The manual gives recommendations for the minimum number of spaces to be provided at new private and public facilities in urban areas. This guidance is reproduced in Table 4-16. Table 4-20 presents the projected number of daily boarders at Coolmine Station in 2043 for both the do-minimum and do-something scenarios. The calculation a cycle spaces required is based on these numbers.

Table 4-20 Coolmine Station Daily Demand

	ALL-DAY BOARDING'S 2043	
	DM 2043	DS 2043
COOLMINE STATION	2662	3987

The minimum number of spaces to be provided is calculated as follows:

- 2.5% of all-day boarding
- Do-something scenario 2043 = 3987 x 2.5% = **100 passengers (rounded up)**
- Area required: 1.65 m^2 x 100 = **165 m^2**

Figure 4-168 shows the area that is reserved for provision of cycle parking.

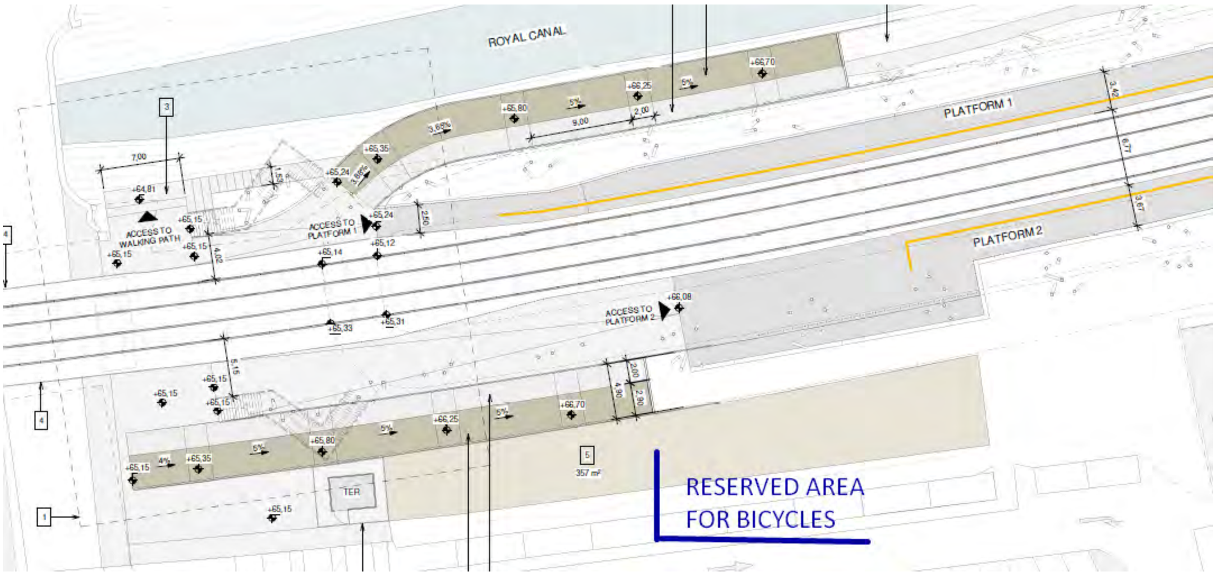


Figure 4-168 Area reserved for bicycle parking at Coolmine Station

4.8.13.4 Cycle and footbridge at Coolmine Station

As mentioned previously, the proposal includes the provision of a bridge/ramp to provide a link between platforms for the passengers.

The bridge is designed using the same principles and standards as the bridge at Ashtown Station. Some of the structures key dimensions are listed below:

Bridge/Ramp Length: 413 m

Gradient: 1/20 (5%)

Landing Length: 2.00 m every 9.00 m

Pedestrian Path: 2.00 m clear width

Cycle path: 2.90 m clear width. See Figure 4-129

Cycle path radius: IR 2.25 m/ER: 5.15, See Figure 4-170

Bridge Clearance: As per Figure 4-120, Note 4 b) 4.69 m + 1.88 m = **6.57 m** (See Figure 4-171)

Parapets: Variable height 1.40 m/1.80 m

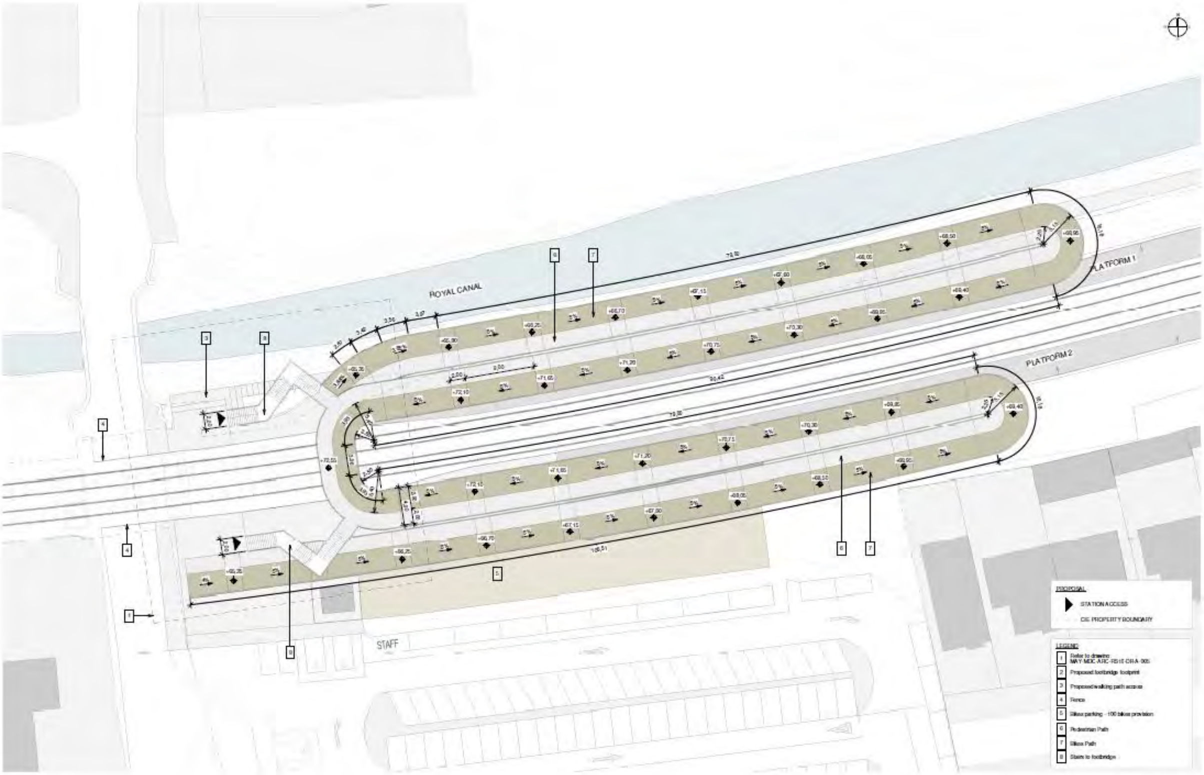


Figure 4-169 Coolmine bridge/ramp in plan

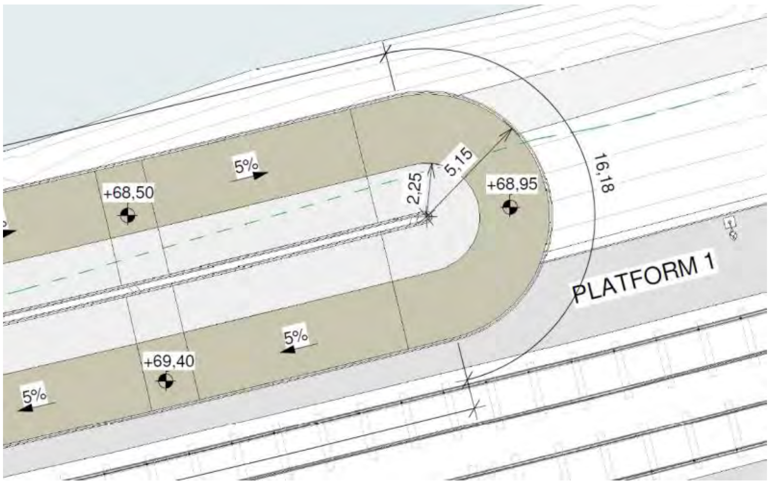


Figure 4-170 Details of radii on Coolmine bridge/ramp

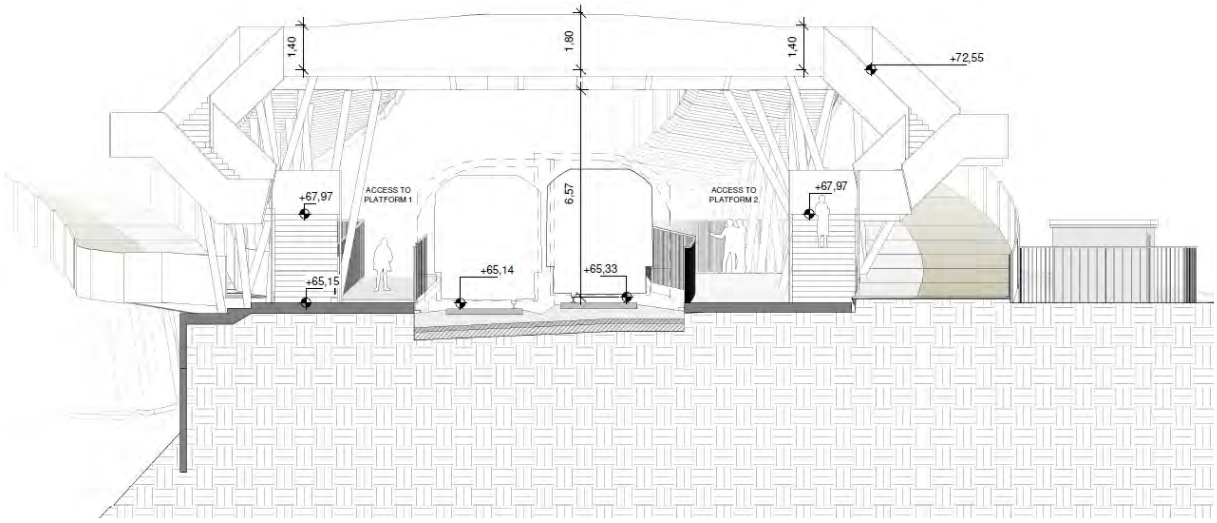


Figure 4-171 Cross section at Coolmine showing variable parapet height

4.8.14 Coolmine level crossing

The proposed design for the level crossing replacement entails the construction of a new shared pedestrian and cyclist bridge over the railway and canal to provide a connection between Carpenterstown Road and Coolmine Road. The provision of the new bridge will facilitate the closure of the level crossing and include the diversion of traffic to surrounding crossings of the railway at Dr. Troy Bridge and Castleknock Bridge. Junction improvements are proposed on the surrounding road network. Traffic analysis has been undertaken to identify the junctions that will require upgrading to cater for increased traffic into the future. These junctions are as follows:

- Diswellstown Road/Porterstown Road Junction.
- Porterstown Road Junction.
- Clonsilla Road/Diswellstown Road Junction.
- Castleknock Road/Park Lodge Junction.

No alteration to track alignment will be required in this section.

Figure 4-172 shows a map of the area with the junctions to be upgraded highlighted in purple.

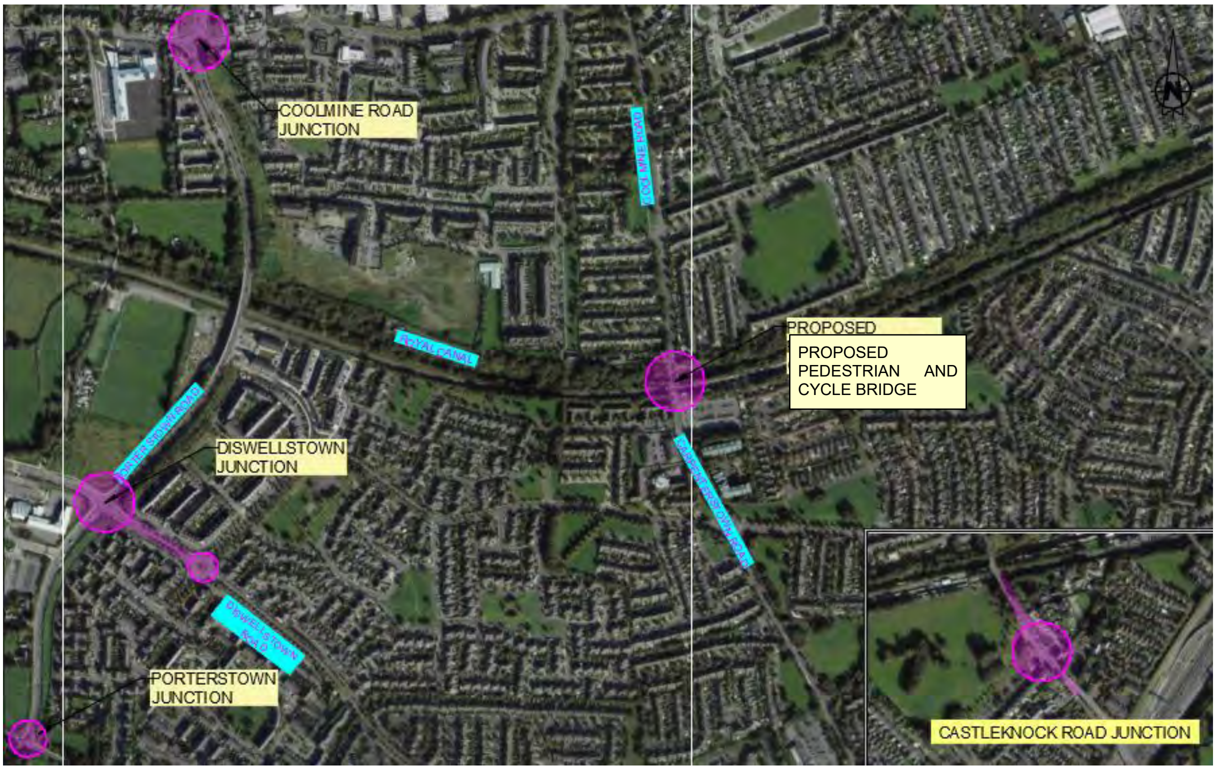


Figure 4-172 Location of junction upgrades as part of Coolmine level crossing replacement works

4.8.14.1 Diswellstown Junction

The proposed works will upgrade the existing four-armed signalised Diswellstown Junction and the link road between the junction and existing roundabout to the east to increase traffic capacity. In addition to traffic capacity upgrades, the junction will be upgraded to a cycle friendly protected junction which provides greater safety for cyclists and pedestrians.

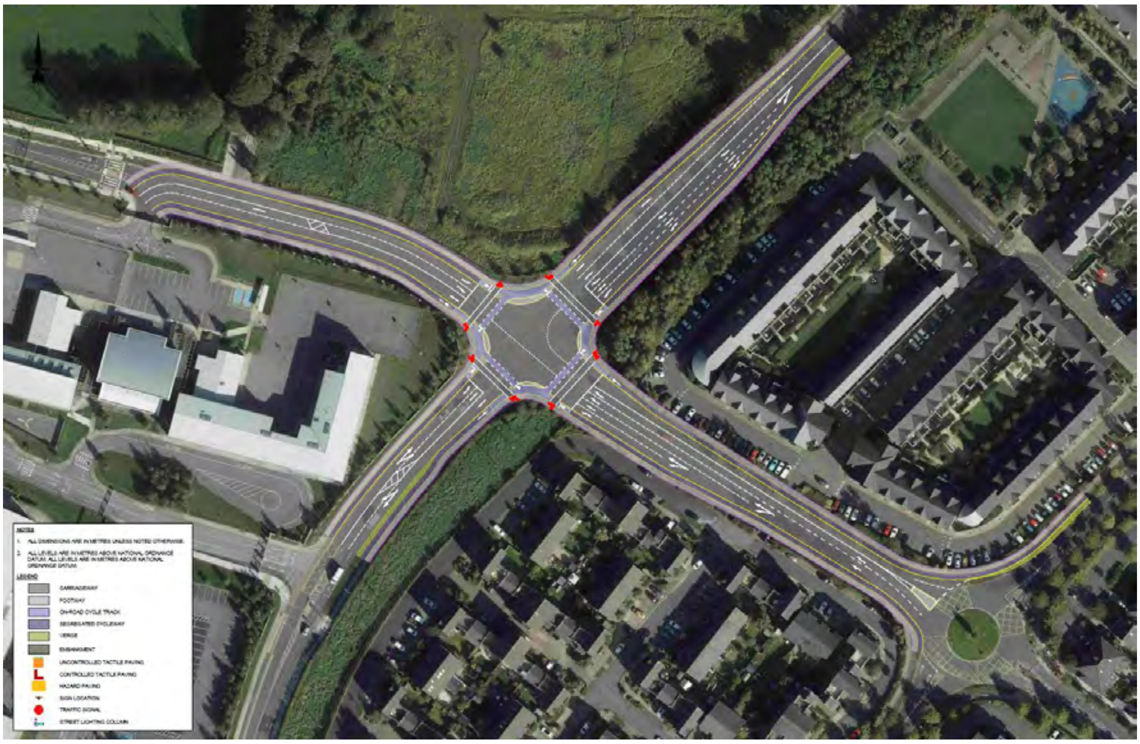


Figure 4-173 Diswellstown Junction

4.8.14.1.1 Link Road/Diswellstown Junction eastern arm

Proposed Layout: Alterations will be required to the western arm of the existing roundabout on the eastern end of the link road to facilitate tie in with existing road network. The proposed layout will provide two westbound lanes, one eastbound lane and a segregated cycle track and footpath on both sides.

The two westbound lanes will develop into four lanes. The four lanes will consist of a dedicated left turn lane (turning south), a dedicated straight lane (west) and two dedicated right turn lanes (turning north). The segregated cycle tracks will drop to road level as it enters the protected junction.

Land take Impacts: To facilitate the inclusion of an additional westbound lane and development of four westbound lanes on approach to the Diswellstown Junction, the existing verges on both sides of the eastern arm link road will be removed. In addition, the roadway boundary will move north into the car parking area of Woodbrook Court/ Woodbrook Square. The existing environment at Woodbrook Court/Woodbrook Square consists of soft landscaping between the boundary wall and car parking . It is intended to remove the soft landscaping and erect a new boundary wall behind the location of the existing car parking. This intervention will continue onto Fernleigh Drive to facilitate a tie-in to the existing kerb lines and boundary wall.

4.8.14.1.2 Diswellstown Junction western arm

Proposed Layout: The proposed layout will retain the existing westbound lane, two east bound lanes, segregated cycle tracks and footpaths on both sides. This will provide a dedicated right (south) turn filter lane, and a combined straight (east) ahead lane and left (north) turn lane . The segregated cycle track on the north side will be extended to the junction and drop to road level on approach to the protected junction.

Land take Impacts: The proposed layout stays within the existing carriageway boundaries on the western arm of the junction. A wooden post and rail fence will be provided at the boundary to match the existing.

4.8.14.1.3 Diswellstown Junction northern arm

Proposed Layout: The proposed layout will upgrade the north bound lane from one lane to two lanes. The proposed second lane will merge into existing single lane approximately 60 m north of the junction. The proposed layout will retain the existing segregated cycle track and footpath adjacent to the traffic lanes. The southbound lanes will be upgraded from two lanes to three lanes. This will provide a dedicated left (east) turn filter lane, a dedicated straight (south) ahead lane and a dedicated right (west) turn lane. A segregated cycle track and footpath will be provided adjacent to the traffic lanes to match the existing.

Land take Impacts: To facilitate the inclusion of an additional north and southbound lane the roadway boundary will move west and east into the existing vegetated area. The existing vegetation consists of a row of hedging/bushes which develops into a section of wooded area (birch). Vegetation clearance is required and will consist of removal of a section of the hedging/bushes. It is not anticipated that any of the wooded area will be removed on the eastern side of the road. To facilitate the widening on the western side, a number of juvenile trees will be removed. To widen the western side of the road the existing embankment will be required to be extended in the fallow grassed area. A wooden post and rail fence will be provided at the boundary to match the existing.

4.8.14.2 Diswellstown Road/Clonsilla Road Junction

It is proposed to convert the existing roundabout at the junction of Clonsilla Road and Diswellstown Road to a signalised junction with additional lanes to increase traffic capacity on certain arms. In addition to traffic capacity upgrades, the junction will be upgraded to a cycle friendly protected junction which provides greater safety for cyclists and pedestrians.

Figure 4-174 Diswellstown Road/Coolmine Road Junction

4.8.14.2.1 Diswellstown Road/Coolmine Road Junction southern arm

Proposed Layout: The proposed layout will realign the existing roadway to provide a single southbound lane and a single northbound lane which develops into three lanes on approach to the proposed traffic signals . The three northbound lanes will consist of a left (west) turning filter lane, a straight (north) ahead lane and right (east) turning filter lane. A separate signalised pedestrian and cyclists crossing will be provided at the mouth of the junction.

Land take Impacts: To facilitate the inclusion of an additional lane the roadway will be realigned into an existing grassed area on the eastern side of the road. To facilitate the additional lanes, a number of trees on approach to the junction will be required to be removed on the east and west side of the road.

4.8.14.2.2 Diswellstown Road/Coolmine Road Junction western arm

Proposed Layout: The proposed layout will realign the existing roadway to provide a single westbound lane and a single eastbound lane which develops into two lanes on approach to the proposed traffic signals. The eastbound lanes will consist of a left (north) turning filter lane, a combined straight (east) ahead and right (south) turn lane. A separate signalised pedestrian and cyclists crossing will be provided at the mouth of the junction.

Land take Impacts: No land take will be required. All works will be within the existing roadway boundary. A section of existing verge on the northwest corner will be required to facilitate the left (north) turning filter lane. A section of existing roadway on the southwest corner will be converted to a landscaped area.

4.8.14.2.3 Diswellstown Road/Coolmine Road Junction northern arm

Proposed Layout: The proposed layout will provide a single northbound lane and a southbound traffic lane and bus lane which develops into three lanes on approach to the proposed traffic signals. The three south bound lanes will consist of a left (east) turning filter lane, a straight (south) ahead lane and right (west) turning filter lane. A separate signalised pedestrian and cyclists crossing will be provided at the mouth of the junction.

Land take Impacts: No land take will be required. All works will be within the existing roadway boundary . To facilitate the inclusion of an additional lane the roadway will be realigned into the existing public grassed area on the western side of the road. A number of juvenile trees on the western side of the road will be required to be removed.

4.8.14.2.4 Diswellstown Road/Coolmine Road Junction eastern arm

Proposed Layout: The proposed layout will realign the existing roadway to provide a single eastbound lane and a single westbound lane which develops into two lanes on approach to the proposed traffic signals. The westbound lanes will consist of a left (south) turning filter lane, a combined straight (west) ahead and right (north) turn lane. A separate signalised pedestrian and cyclists crossing will be provided at the mouth of the junction.

Land take Impacts: No land take will be required. All works will be within the existing roadway boundary. A section of existing verge on the northeast corner will be required to facilitate the proposals. A section of existing roadway on the southeast corner will be converted to a landscaped area.

4.8.14.3 Castleknock Road/Park Lodge Junction

The proposed works will upgrade the existing signalised four-armed junction to increase traffic capacity . In addition to traffic capacity upgrades, the junction will be upgraded to a cycle friendly protected junction which provides greater safety for cyclists and pedestrians.

Figure 4-175 Park Lodge/Castleknock Road Junction

4.8.14.3.1 Castleknock Road/Park Lodge southern arm

Proposed Layout: The proposed layout will widen the western side of the roadway for approximately 150 m south of the junction. A single northbound lane will develop into a straight (north) ahead lane and left (west) turn filter lane, similar to the existing layout. There will be two southbound lanes, a single traffic lane and a bus lane, both of which will tie in with the existing traffic lane and bus lane approximately 150 m south of the junction. A two-stage signalised crossing will be provided at the junction similar to the existing. A footpath will be provided on the eastern side of the road and a verge and footpath on the western side of the road. Northbound, a segregated cycle track will be provided on approach to the junction. Southbound, a segregated cycle track will be provided for approximately 30m before directing cyclists onto the roadway. The segregated cycle tracks are to be extended as part of a separate project developed by Fingal County Council in the future.

Land take Impacts: To facilitate the inclusion of a southbound bus lane on the eastern side of the junction, the roadway will be widened on the western side of the road. This will result in the loss of private green area adjacent to the parking area of a number of new properties within a small development 100 m south of the junction. It will also result in minor loss of parking space at the property behind 1A Park Lodge.

The realignment will tie into the property boundary of 1A Park Lodge. New boundary walls for both these properties will be provided to match the existing. Three mature trees will be required to be removed. There will be no change to the boundary walls on the eastern side of the road.

4.8.14.3.2 Castleknock Road/Park Lodge northern arm

Proposed Layout: The proposed layout will widen the western side of the roadway into Laurel Lodge Park. The proposed layout will provide a single north bound lane and three southbound lanes similar to the existing. The widening of the road will facilitate a longer right turning filter lane to cater for projected additional traffic flows. The widening on the western side of the road will require the construction of a new landscaped earthen embankment within Laurel Lodge Park. An existing stone wall on the western side of the road is to be taken down carefully and rebuilt to the back of the footpath to retain the existing character on approach to the railway bridge.

Land take Impacts: To provide additional capacity it is intended to widen the roadway west into the Laurel Lodge Park. A new landscaped earthen embankment will be constructed as the roadway/park boundary wall with the stone wall replaced at ground level. Several mature trees will be removed to facilitate the widening. There will be no change to the boundary walls on the eastern side of the road.

4.8.14.3.3 Castleknock Road/Park Lodge eastern arm

It is not intended to make any material changes to the western and eastern arms of the Park Lodge and Castleknock Road Junction.

4.8.14.3.4 Castleknock Road/Park Lodge western arm

Proposed Layout: The proposed layout will retain the existing lane configuration. A new segregated cycle track will be provided on the northern side of the road for proximately 30m on approach to the junction. This will require widening of the carriageway to the north for an equivalent distance.

Land take impacts: To provide the segregated cycle track, the carriageway will encroach into a grassed section of Laurel Lodge Park for approximately 30m.

4.8.14.4 Porterstown Road/Diswellstown Road Junction

The proposed works will upgrade northern and eastern arm of the existing signalised three-armed junction including the provision of facilities for cyclists and pedestrians.

Figure 4-176 Porterstown Road/Diswellstown Road Junction

4.8.14.4.1 Northern arm

Proposed Layout: The proposed layout maintains a single northbound lane and segregated cycle track, footpath and verge. The southbound lane develops into a dedicated right (west) turning lane and dedicated (east) turning lane with an on-road cycle track. The road will widen into the grassed area to the east to accommodate this. A footpath is provided on the eastern side of the road.

Land take Impacts: To facilitate the inclusion of an additional turning lane the roadway will be widened into existing grassed area to the east of the roadway. The existing boundary hedgerow will be removed to facilitate the works.

4.8.14.4.2 Eastern arm

Proposed Layout: The proposed layout maintains a single eastbound lane and develops the westbound right (north) turning filter lane earlier to increase right turning capacity. A footpath is to be provided on the northern side of the road.

Land take Impacts: To facilitate the additional right (north) turning capacity the northern boundary of the roadway will widen into the amenity grassed area to the north. The existing stone boundary wall will be realigned to match the existing. It is anticipated that one small tree will be required to be replaced.

4.8.14.5 Geometric design

The proposed junctions will be designed as signalised protected junctions. The protected junction design is based on the recommendations included in the NTA Preliminary Design Guidance Booklet. This guidance booklet was developed for the BusConnects Programme and is being implemented across the proposed BusConnects Core Bus Corridors. This promotes the hierarchy of movement through the junctions with pedestrian and cyclist safety at the forefront.

The proposed junction arrangements allow pedestrians to cross any arm of the junction in one movement/signal stage as opposed to multistage crossings proposed in previous guidance. The primary conflict for cyclists at a junction is the left-turning traffic. The protected junction configuration provides physical kerb buildouts to protect cyclists through the junction. Below are some key features of protected junctions:

- Cyclists are fully segregated from traffic to the junction stop line.
- The cycle track should be ramped down to carriageway level on approach to the junction and proceed to a forward stop line ahead of the vehicular stop line, placing them within view of traffic waiting at the junction. A raised kerb buffer should be provided between the traffic lane and the cycle lane on approach to the junction.
- Kerbed corner islands should be provided to force turning vehicles into a wide turn and remove risk of vehicles cutting into the cycle route at the corner.
- A secondary stop line and stacking room behind the kerb buildouts should also be provided for right-turning cyclist making a hook-turn manoeuvre. Cycle signals will control the second stage of movement of these cyclists.
- Cyclist and pedestrian crossing should be kept as close as possible to the mainline desire line.
- Cyclist and pedestrian crossing should have 2-3 m separation between them when crossing the vehicular lanes.

4.8.14.6 Camber and crossfall

On receipt of the topographical survey, a 3-dimensional model of the existing junctions will be generated. This will include the existing camber and crossfall and indicate whether the existing are up to standard and if there is possible carriageway runoff ponding areas. The proposed design will minimise carriageway reconstruction and follow the existing camber and crossfall if no deficiencies are identified.

4.8.14.7 Drainage

The existing carriageway is drained via positive drainage, i.e., gullies and surface water carrier pipe s. The proposed drainage design for each of the junctions will match the existing systems. New gullies will be connected to the existing drainage network. Additional hardstanding area from the proposed junction upgrades will be negligible and should not increase capacity in such quantities to result in a flood risk. Topographical survey information is currently unavailable for the junctions. However, when survey data is available, the 3-dimensional design of the junctions will be completed, and carriageway runoff quantified.

4.8.14.8 Ground investigation and earthworks design

The Diswellstown Road and Castleknock Road Junctions require widening into existing green space to facilitate the junction upgrades. The Porterstown Road and Clonsilla Road junctions will be upgraded within the footprint of the existing junction. No geotechnical or earthworks design will be required for these junctions.

The northern arm of the Diswellstown Road Junction will be widened into the existing green space on the western side of the carriageway. This will facilitate the construction of an additional lane for the east to north traffic movement. Detailed ground investigation will be undertaken during detailed design stage to determine the ground characteristics and a geotechnical and earthworks design will then progress.

Similarly, the northern arm of the Castleknock Road Junction will be required to be widened into the exiting park, Laurel Lodge. Detailed ground investigation will be undertaken during detailed design stage to determine the ground characteristics and a geotechnical and earthworks design will progress.

4.8.14.9 Pavement

The 3-dimensional pavement design will be undertaken during detailed design stage on receipt of topographical survey information. The design will aim to replicate the existing ground level as much as possible and maintain the existing drainage regime. The junctions will be designed to minimise the requirement for large sections of full depth pavement reconstruction.

4.8.14.9.1 Diswellstown Road Junction

Visual inspection indicates that the existing pavement is a flexible pavement. Detailed ground investigation will determine the make-up and depth of the existing pavement and pavement foundation structure. The widened section of roadway will be designed for the anticipated traffic volumes and tie into the existing pavement in steps in accordance with TII guidance. It is envisaged that the entire junction within the development extents will be treated with a pavement inlay following completion of the works.

4.8.14.9.2 Castleknock Junction

Visual inspection indicates that the existing pavement is a flexible pavement. Detailed ground investigation will determine the makeup and depth of the existing pavement and pavement foundation structure. The widened section of roadway will be designed for the anticipated traffic volumes and tie into the existing pavement in steps in accordance with TII guidance. It is envisaged that the entire pavement within the development extents will be treated with a pavement inlay following completion of the works.

4.8.14.9.3 Porterstown Road and Clonsilla Road Junction

The Porterstown Road and Clonsilla Road Junctions will be upgraded within the footprint of the existing junction. It is anticipated that isolated sections of full depth road reconstruction will be required where existing traffic islands are to be removed. It is envisaged that the entire pavement within the development extents will be treated with a pavement inlay following completion of the works.

4.8.14.10 Utilities

Existing utility records have been requested from all major utility companies and local authorities. The following sections detail the utilities identified within the development extents of the four junctions.

Diswellstown Road Junction

Existing utilities will be reviewed for clashes when the topographic survey is undertaken and the design is completed.

Watermains are in the existing footpath on the link road between Diswellstown Road and Riverwood Road. The depth of these watermains will need to be determined to evaluate whether they need to be lowered or whether a protection slab is required.

Clonsilla Road Junction

A HP gas main crosses the junction from east to west heading in the northerly direction. The proposed works are predominantly surface works. Regardless, the exact depth and location of the HP gas main will be determined and protective measures incorporated into the design if required.

Porterstown Road Junction

Two HP gas mains are within the extents of Porterstown Road Junction. The proposed works include minor alterations to the existing junction. It is not anticipated that the works will interact or affect the gas mains.

Castleknock Road Junction

The proposed works are predominantly surface level works. A number of services are located in footpaths that may become vehicular traffic lanes. The depth of these utilities will need to be determined and the utilities moved into the proposed footpath or protective measures incorporated in the detailed design stage.

4.8.14.11 Proposed pedestrian and cycle bridge

The proposed pedestrian and cycle bridge at Coolmine has been discussed previously under Section 4.8.13.

4.8.15 Porterstown level crossing

Porterstown level crossing is located along Porterstown Road between Coolmine and Clonsilla Stations. There is no track alteration in this area, only the closure of the level crossing.

Figure 4-177 Alignment at Porterstown level crossing

4.8.15.1 Overview of proposed works

The proposed works involves the construction of a new cycle/pedestrian bridge over the railway and canal. The provision of the new bridge will facilitate the closure of the level crossing but would require diversion of traffic to surrounding crossings of the railway. No improvements to the surrounding road network are proposed. Localised reconfiguration of the road network at the level crossing is proposed to provide vehicle turning facilities and passenger drop off.

Figure 4-178 Proposed closure works at Porterstown level crossing

4.8.15.2 Geometric design

The proposed design provides for a mini roundabout to the north and a turning head to the south of the existing level crossing. To the north of the existing level crossing, access is provided to the Old Porterstown Schoolhouse lands which are due for residential development. Access will also be provided to the existing farmhouses to the east of Porterstown Road. A mini roundabout with an inscribed circle diameter of 16 m is provided to allow vehicles to drop off and turn back north. To the south of the crossing, a turning head has been provided for turning manoeuvres to allow vehicles to drop off and turn back south. This turning head also provides access to the existing St Mochta's Football Club grounds.

4.8.15.3 Pedestrians and cyclists

The Porterstown Road was not identified as a potential cycling route in the Greater Dublin Area Cycle Network Plan. Pedestrian and cyclist counts undertaken indicate that an insignificant number of pedestrians and cyclists use the proposed route during peak times. The journeys are likely from the residential area and St. Mochta's School to the north and St. Mochta's Football grounds and Scoil Choilm Community National School to the south. It is envisaged that the pedestrians and cyclists will utilise the proposed shared overbridge. Currently, pedestrian footpaths are provided on the western side of the Porterstown Road, however there are no formal cycling facilities.

4.8.15.4 Drainage

It is anticipated that the proposed roadway will be positively drained with standard road gullies that discharge to the existing public surface water drainage system on the north side of the level crossing.

On the south side it is anticipated that the roadway will drain via over-the-edge drainage to the existing ditch on the eastern side of the roadway, replicating the existing scenario.

4.8.15.5 Ground investigation and earthworks design

No significant ground works or earthworks design is required for the roadworks element of the proposals.

4.8.15.6 Pavement

The proposed roadworks will require local widening on the north side of the level crossing to facilitate the mini roundabout and access into the adjacent properties. From visual inspection it appears that the existing pavement construction on Porterstown Road is flexible pavement and is in relatively poor condition. Slit trenches scheduled as part of the detailed ground investigation at detailed design stage will confirm this assumption and provide the depth of flexible pavement and the pavement foundation build up. The proposed pavement will be designed in accordance with DN-PAV-03021 to cater for future traffic volumes. The proposed pavement will tie into the existing pavement in steps in accordance with TII design guidance.

4.8.15.7 Utilities

An existing utilities desktop study identified the following utilities in the vicinity of the Porterstown level crossing.

- Electricity – ESB underground HV ducts.
- Electricity – ESB underground MV/LV ducts.
- Electricity – ESB overhead MV cables.
- Electricity – ESB overhead LV cables.
- Gas – GNI underground HP pipes.
- Gas – GNI underground MP pipes.
- Telecom – Virgin underground ducts.
- Telecom – Eircom underground ducts.
- Water – IW water main.
- Water – IW gravity foul/combined sewer.

At a minimum the ESB overhead cables will be required to be diverted or undergrounded. Further investigation during detailed design stage is required to determine if additional utilities will need to be diverted.

4.8.15.8 Pedestrian and cycle bridge

A two-span pedestrian, cycle and mobility impaired bridge is proposed over the canal and railway. The main spans will be 30.9 m and 24.5 m in length measured to pier support centrelines. The elevated portions of the superstructure will be cast integrally into the crosshead over pier supports. The main span of the bridge will comprise precast W8 beams with composite precast slab units. The ramped approach to the north and south above the level of the 180-degree turn will consist of precast W5 beam spans with an in-situ deck, while the ramped approaches below the 180-degree turn will consist of a reinforced earth/retaining wall structure. The stairway access to the bridge will be of precast concrete construction, with the intermediate landings being constructed in-situ.

The general arrangement of the bridge is shown in Figure 4-179 below.

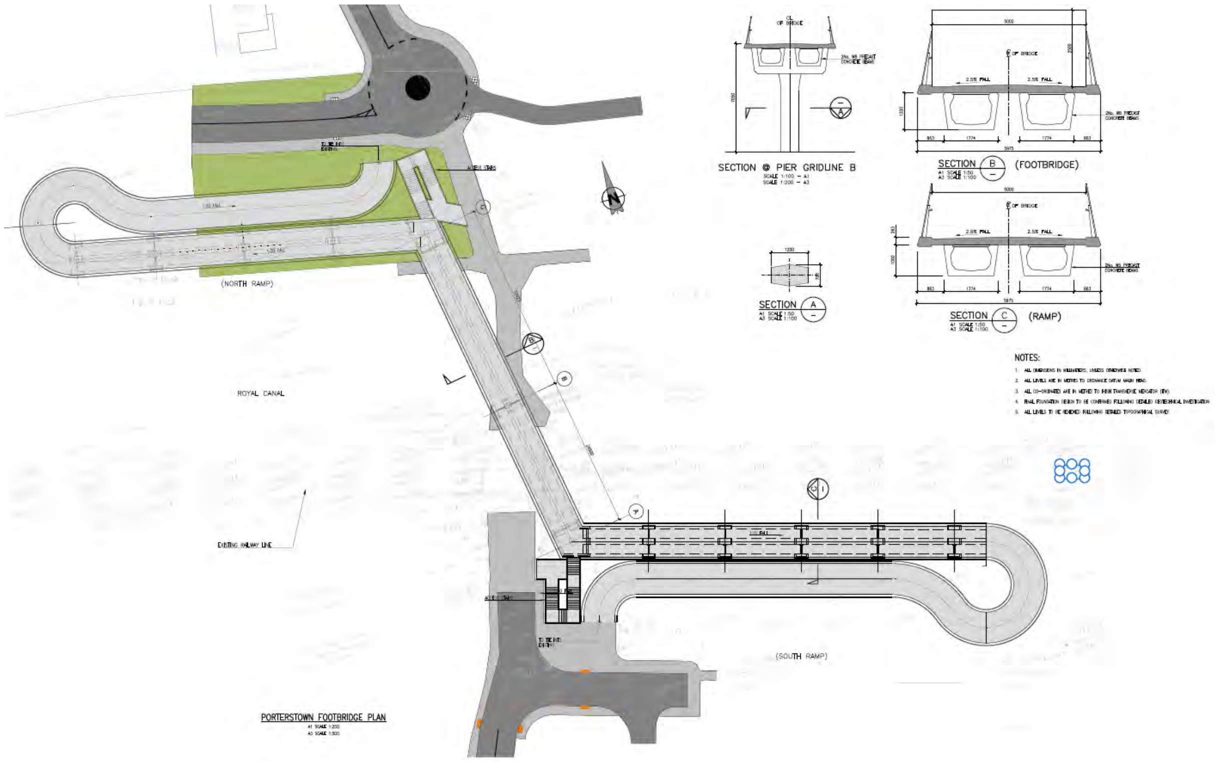


Figure 4-179 Proposed pedestrian and cycle bridge at Porterstown

4.8.15.8.1 Aesthetic considerations

A slender appearance will be achieved by keeping the structural depth to a minimum. The structure will be predominantly comprised of precast concrete elements which will provide a factory quality surface finish.

Further engineering and architectural development and detailing will be required during the detailed design phase to deliver refined design, optimum section sizes, floor details, approach design, lighting, finishes and a complete bridge that integrates into the existing surroundings and with the proposed cycle/pedestrian network in this area.

4.8.15.9 Proposals for the structure

4.8.15.9.1 Span arrangements

A two-span structure is proposed over the railway and canal with spans of 30.9 m and 24.5 m measured between pier support centres. The width of the bridge deck will be 5.0 m. The upper sections of the north approach ramp will consist of 2 no. 21.0 m spans and 1 no. 23.0 m span while the upper sections of the south approach ramp will consist of 3 no. spans ranging from 21.5 m to 23.5 m.

The lower sections of the ramps will be supported via a combination of reinforced earth and earth embankments, with retaining walls adjoining the ramp abutments to support the banked earth where necessary.

The proposed arrangement incorporates a segregated cycle and pedestrian walkway with 1.35 m high parapets increasing to 1.85 m in height over the canal and railway sections. The structure provides 5.3 m vertical clearance over the existing railway. The 1.85 m solid parapets will also run along the north face of the upper section of the south approach ramp, where it abuts the railway line.

4.8.15.9.2 Minimum headroom

Minimum headroom of 5300 mm plus allowances for bridge deflection and settlement will be provided from all rail-running edges to the underside of the structure. This will allow the clearance required for the electrification of the existing railway line beneath the structure.

4.8.15.10 Approaches including run-on arrangements

The southern ramped approach will start at ground level close to the entrance of St. Mochta's football club and will rise in an easterly direction, supported by a reinforced earth structure on the southern edge and an embankment on the northern edge. Reinforced earth will be employed on the southern edge for aesthetic reasons while also reducing the footprint within the football club to maintain as much parking as possible. The south ramp reinforced earth structure will then turn through 180 degrees before rising in a westerly direction toward the main span, where the construction will change to 3 no. elevated spans consisting of precast W5 beams with a composite in-situ concrete deck. A reinforced concrete abutment will form the transition between the reinforced earth structure and the elevated superstructure, with a reinforced concrete retaining wall adjoining the abutment to support the banked soil from the lower section of the ramp.

The northern ramped approach will start at ground level close to Porterstown Road, and will rise in a westerly direction, supported by a reinforced earth structure on the northern edge and an embankment on the southern edge. Reinforced earth will be employed for aesthetic reasons while also limiting the footprint to avoid clashing with the Old Porterstown School which is a protected structure. The north ramp reinforced earth structure will then turn through 180 degrees before rising in an easterly direction toward the main span, where the construction will change to 3 no. elevated spans consisting of precast W5 beams with a composite in-situ concrete deck. A reinforced concrete abutment will form the transition between the reinforced earth structure and the elevated superstructure, with a reinforced concrete retaining wall adjoining the abutment to support the banked soil from the lower section of the ramp.

4.8.15.11 Foundation type

The majority of the piers and abutments are to be founded on reinforced concrete spread foundations. The construction will be remote from the canal and as such, it is not envisaged that damming or dewatering of the canal will be required.

The central pier beneath the two main spans will be constructed between the railway and Kennan Bridge, a protected structure (RPS no. 0698). The location of the pier has been optimised to ensure sufficient clearance from the rail, while also aiming to ensure the foundations of Kennan Bridge will not be compromised and the required clearance for the towpath can be maintained. In order ensure a discrete solution, the foundation beneath this pier will consist of a single 1.2 m diameter bored pile and a 2.8 m x 1.7 m pile cap. There is a watermain crossing the canal within the fill of Kennan Bridge but the pile and the pile cap are not expected to clash with this.

4.8.15.12 Substructure

The substructure will consist of in-situ reinforced concrete piers supporting the concrete beam and slab bridge superstructure. The piers will be constructed with in-situ crossheads to support the beams prior to being integrally cast into the diaphragms. As mentioned in Section 4.8.15.10, the lower section of the ramped approaches will consist of a combination of reinforced earth, retaining walls and embankments at various locations.

4.8.15.13 Superstructure

The main-span superstructure will consist of precast prestressed W8 beams acting compositely with precast concrete deck units. The precast units will contain openings to allow them to be stitched over the webs of the W5 beams. The beam design will consider shear link locations to match with these openings. The solid concrete parapets will also form part of these precast units. There are significant advantages to the use of this form of construction for the structure in question:

- The parapets can be precast into the slab unit, eliminating the need for a stitch and eliminating difficult/dangerous propping of parapets over the canal and railway during construction.
- Less railway possessions required for concrete pours.
- No large pours are required over the canal, limiting the risk of environmental impacts.

The upper section of the southern and northern ramps will consist of precast prestressed W5 beams acting compositely with an in-situ concrete deck. The precast prestressed beams will be lifted onto the crossheads cast over the piers before being cast integrally into diaphragms, followed by casting of the in-situ deck slab. The parapets along the ramped approaches will consist mainly of 1.35 m high steel parapets which will be bolted to the in-situ edge beams. The northern edge of the upper section of the southern approach ramp will have a 1.85 m high precast concrete parapet, which will be stitched to the ramp deck slab.

4.8.15.14 Articulation arrangements, joints and bearings

Fully integral connections are proposed between the diaphragms of the main span and ramped approach spans, eliminating the need for joints or bearings.

4.8.15.15 Drainage

The bridge deck will have a minimum 1:100 longitudinal fall as well as a 2.5% cross fall to avoid pooling of water. Due to the size of the area to be drained, it is envisaged that intermittent drainage will be needed on the ramped approaches as well as on the main span at the location of each pier. This will require the installation of gullies and downpipes within the superstructure. The gully will be brought through the deck, along the outside face of the crosshead, and down the side of the piers. The downpipe may be recessed into the pier to reduce visual impact if possible following detailed design.

4.8.15.16 Inspection and maintenance

As the bridge is to be integral, maintenance requirements are minimised for the design life of the structure.

The structure is to be inspected every 6 years or as required by Iarnród Éireann's Bridge Management System, by suitably qualified personnel who shall be responsible for providing the relevant equipment and establishing traffic management and a safe system of work appropriate to the type of inspection being carried out. Maintenance and clearing of drains shall be carried out as required.

4.8.15.17 Lighting – under, over, supply, fittings and fixtures.

Lighting on the structure will be incorporated into the parapets and orientated downwards so as to minimise impact on bat sightlines. The parapets will be of solid construction to prevent shedding of light into the canal corridor.

A lighting specialist will be engaged at detailed design stage to develop the lighting design for the proposed development in accordance with the requirements of Iarnród Éireann.

4.8.16 Clonsilla level crossing

The proposed works at Clonsilla involve the construction of a new cycle/pedestrian bridge over Clonsilla level crossing to provide access over the railway and canal. The provision of the new bridge will facilitate the closure of the level crossing but would require diversion of traffic to surrounding crossings of the railway. No improvements to the surrounding road network are proposed. Localised reconfiguration of the carriageway in the vicinity of the level crossing will be required to facilitate the proposed overbridge and provide adequate turning facilities for vehicles.

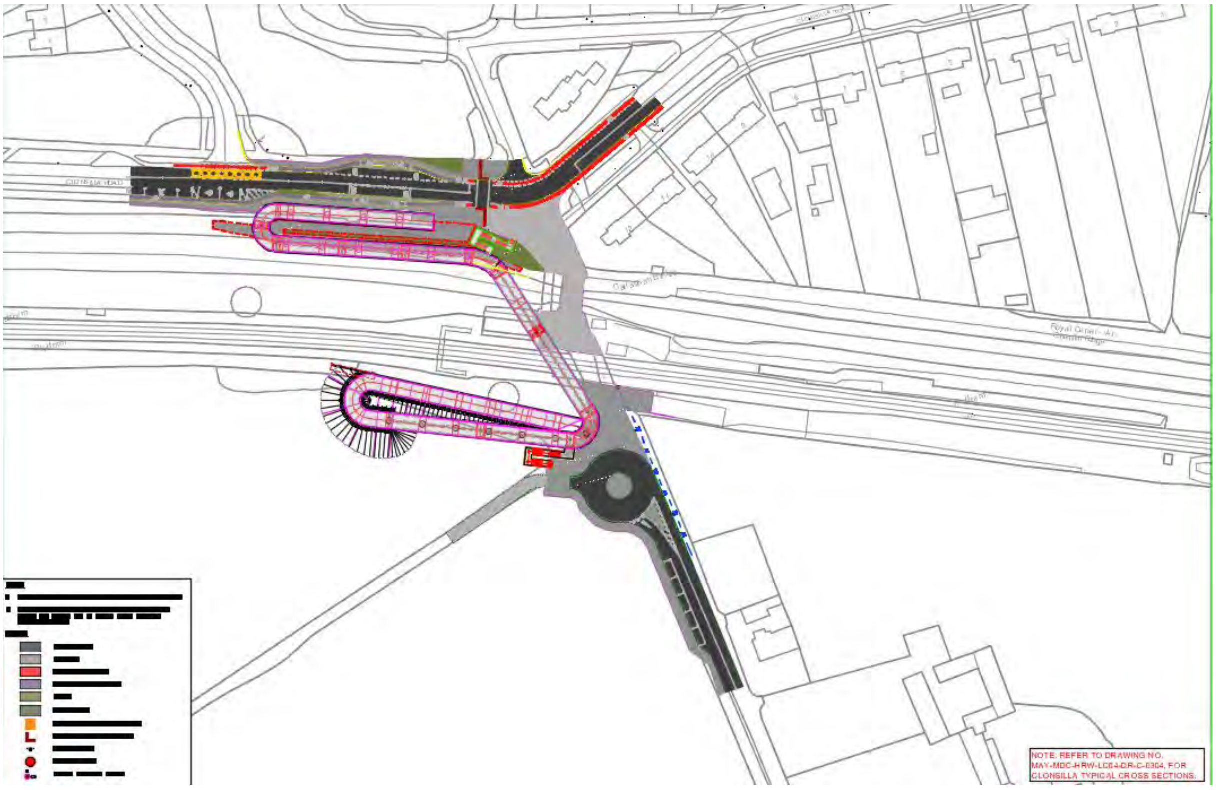


Figure 4-180 Plan of proposed works at Clonsilla level crossing

On the northern side of the level crossing, the proposed overbridge approach ramps are positioned over the existing footway along L3015 Hansfield Road at the location of an existing bus stop and to the north of the Royal Canal Greenway. Offline cycle tracks are currently provided to the east and west of the bus stop, with cyclists transferred onto the road through the junction and past the bus stop. To provide a buffer between the overbridge parapet and stopping buses, the off-road segregated cycle track and footpath will be extended across Clonsilla Road and join the existing cycle track further west. An island bus stop, in accordance with NTA guidance, will be provided. The existing bus stop on the north side of the road will also become an island bus stop. The pedestrian crossing will be upgraded to a toucan crossing to facilitate cyclist movements at the junction. The existing towpath is to be realigned and a shared ramp provided from the towpath to the footpath on the north side of the canal bridge.

On the southern side, a mini roundabout and drop off spaces will be provided to facilitate passenger drop offs at the station and allow vehicles to turn around. The entrance to Beech Park Allotments will be altered to accommodate the revised carriageway layout.

Figure 4-181 Proposed closure works at Clonsilla level crossing

4.8.16.1 Geometric design

The proposed design provides for localised alterations to the carriageway to the north of the level crossing and a mini roundabout with provision for passenger drop off to the south. The proposed design will maintain existing levels as much as possible to reduce the need for major alterations to the pavement.

Island bus stops have been incorporated into the design in accordance with NTA design guidance.

4.8.16.2 Pedestrians and cyclists

Offline segregated cycle lanes are currently provided on the southern side of the Clonsilla Road to the east and west of the junction. The proposed design closes the southern arm of the junction and provides a 2 m wide segregated offline cycle track through the junction on the southern side, connecting the existing cycle facilities to the east and west. The cycle track ramps down to road level at the proposed toucan crossing and ramps back up after the crossing. West of the toucan crossing an island bus stop is proposed. The cycle track diverts behind the bus stop island along a gentle curve with a 12 m radius, which is comfortable for cyclists. A shared space provides access for pedestrians to the bus island. Cyclists are directed to yield by road markings. The existing disabled parking bays will be reinstated immediately west of the bus island. A ramp, with a 5% gradient, will be provided from the towpath up to the level of the footpath to provide access for pedestrians and cyclists between the public roadway/shared bridge and the canal towpath.

On the northern side of Clonsilla Road, an existing offline cycle track terminates at Porters Gate View to the west of the junction. Cyclists are transferred onto the road, through the bus stop and junction with an online cycle track east of the junction. The proposed design brings the cyclists offline after Porters Gate View and diverts cyclists around the back of the proposed bus island. Cyclists are then ramped down to road level at the toucan crossing and an online cycle lane connects to the existing cycle lane east of the junction.

The area between the level crossing and the junction is to be pedestrianised with access limited to emergency vehicles and maintenance vehicles only.

To the south of the level crossing the existing roadway will be widened to the west to provide additional space for drop off facilities. A mini roundabout is provided to facilitate safe vehicle turning. The accesses to Beech Park Allotments and the existing Clonsilla Station will be maintained with some alterations to facilitate the proposals.

4.8.16.3 Drainage

The existing carriageway is drained via positive drainage, i.e., gullies and surface water carrier pipes. The proposed drainage design for each of the junctions will match the existing. New gullies will be connected to the existing drainage network. Additional hardstanding area from the proposed junction upgrades will be negligible and should not increase runoff in such quantities to result in a flood risk. Topographical survey information is currently unavailable for the junction. Once survey data is available at detailed design stage, the 3-dimensional design of the junctions will be progressed, and carriageway runoff quantified.

4.8.16.4 Ground investigation and earthworks design

No significant ground works or earthworks design is required for the roadworks element of the proposals.

4.8.16.5 Pavement

The 3-dimensional design will be undertaken on receipt of topographical survey information during detailed design stage. The design will be produced with to the aim of replicating existing ground level as much as possible and maintaining the existing drainage regime. The junction will be designed to minimise the requirement for large sections of full depth pavement reconstruction. It is envisaged that all areas of Clonsilla level crossing that lie within the development extents will be provided with an inlay at a minimum.

4.8.16.6 Utilities

A utilities desktop study identified the following utilities in the vicinity of the level crossing.

- Electricity – ESB overhead LV cables.
- Gas – GNI underground HP pipes.
- Gas – GNI underground MP pipes.
- Telecom – Virgin underground ducts.
- Telecom – Eircom underground ducts.
- Water – IW water main.
- Water – IW gravity foul/combined sewer.
- Water – Local Authority storm water sewer.

At a minimum, the ESB overhead LV cables will be required to be diverted. Further investigation during detailed design stage is required to determine if additional utilities will need to be diverted.

4.8.16.7 Proposed pedestrian and cycle bridge

A two-span pedestrian, cycle and mobility impaired bridge is proposed over the railway and canal. The spans will be 31.5 m and 37.0 m in length measured to support centrelines. The bridge and upper sections of the ramped approach are to comprise precast concrete W-beams, with a composite in-situ reinforced concrete deck slab. The upper section of the southern ramped approach will consist of 2 no. 15.0 m W-beam spans and an in-situ reinforced concrete span for the upper curve, while the lower section of the southern ramped approach will consist of a reinforced earth/retaining wall structure. The upper section of the northern ramped approach will consist of 4 no. straight W-beam spans, while the lower section will consist of a combination of in-situ reinforced concrete spans and a retaining wall structure. The stairway access to the bridge will be of concrete construction.

The general arrangement of the bridge is shown in Figure 4-182 below.

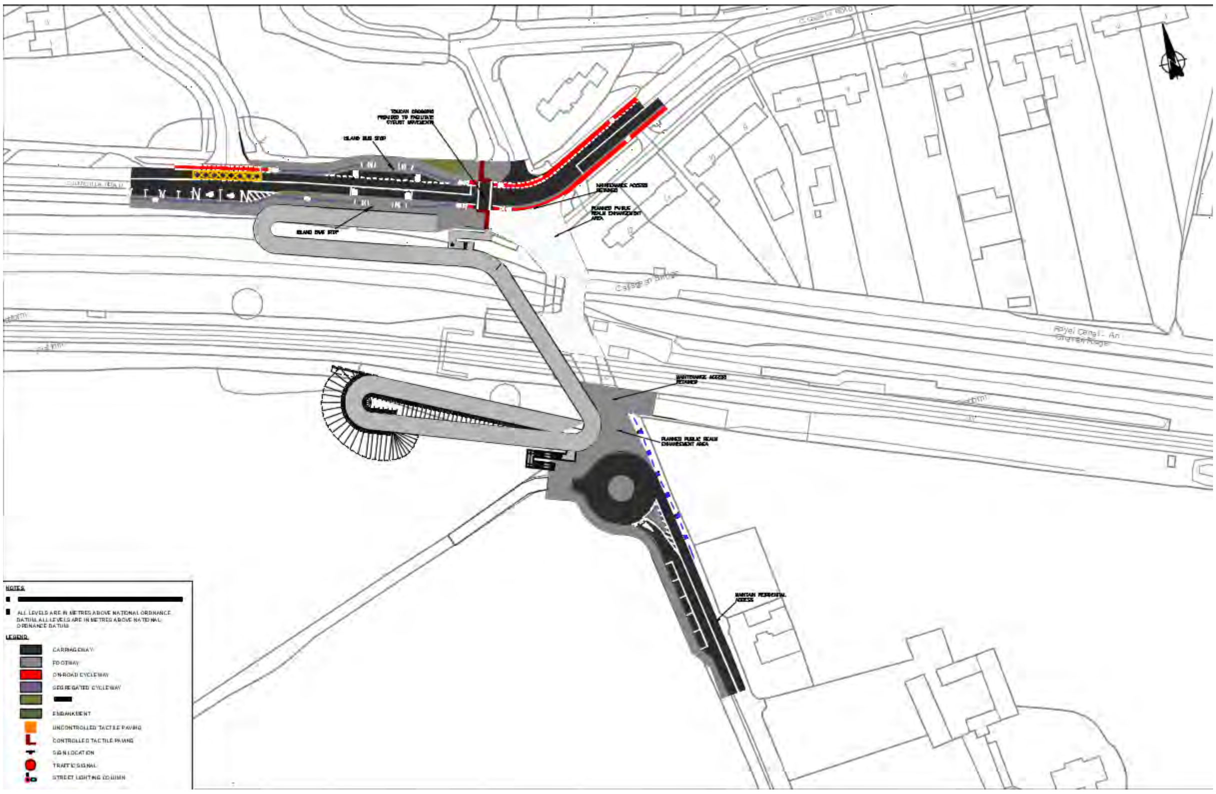


Figure 4-182 Proposed pedestrian and cycle bridge at Clonsilla

4.8.16.8 Aesthetic considerations

A slender appearance will be achieved by keeping the structural depth to a minimum. The structure will be predominantly comprised of precast concrete elements which will provide a factory quality surface finish.

Further engineering and architectural development and detailing will be required during the detailed design phase to deliver refined design, optimum section sizes, floor details, approach design, lighting, finishes and a complete bridge that integrates into the existing surroundings and with the proposed cycle/pedestrian network in this area.

4.8.16.9 Proposals for the structure

4.8.16.9.1 Span arrangements

A two-span, 5.0 m wide structure is proposed over the railway and canal, while the ramped approaches will consist of a combination of reinforced earth structures, retaining wall structures, multi-span beam and slab structures and reinforced concrete spans. W8 beams are proposed for the main span with W5 beams on the straight portions of the ramped approaches. The reinforced concrete spans within the ramped approaches will be constructed to match the form and finish of the prestressed beams, to limit the visual impact of the change in construction type.

The proposed arrangement incorporates a segregated cycle and pedestrian walkway with 1.45 m high parapets increasing to 1.85 m in height over the railway. The structure provides 5.5 m vertical clearance over the existing railway.

4.8.16.9.2 Minimum headroom

Minimum headroom of 5300 mm plus allowances for bridge deflection & settlement will be provided from all rail-running edges to the underside of the structure, to provide the clearance required for the electrification of the existing railway line beneath the structure.

4.8.16.9.3 Approaches including run-on arrangements

As mentioned previously, the southern ramped approach will begin as a reinforced earth/retaining wall structure which rises parallel to the railway line in a westerly direction. The southern ramped approach will then turn through 180 degrees and rise back in the direction of the bridge where the superstructure will transition into a multi-span precast prestressed concrete structure on reinforced concrete piers. The upper curve where the ramped approach meets the main span will be of reinforced concrete construction.

The northern approach will tie in to Clonsilla Road adjacent to the new proposed pedestrianised area. The structure will rise in a westerly direction supported on both sides by a reinforced earth structure, before turning 180 degrees and rising in an easterly direction towards the bridge. The 180 degree curve will be formed with an RC box girder section, which will be constructed at ground level on site and lifted into position during construction. The upper section of the north approach ramp will consist of 3no. W-beam spans with an insitu deck. The upper curve where the ramped approach meets the main span will be reinforced concrete construction.

4.8.16.10 Foundation type

The structure is to be founded on reinforced concrete spread foundations. The majority of the piers and abutments are assumed to be founded on reinforced concrete spread foundations. The design will require construction within the canal or on the towpath for a number of foundations and piers . It is envisaged that this will require damming and dewatering of the canal.

The central pier beneath the two main spans will be constructed between the railway and the existing Callaghan bridge protected structure, in close proximity to the railway station. In order ensure a discrete solution, the foundation beneath this pier will consist of a single 1.2 m diameter bored pile and a 2.8 m x 1.7m pile cap. There is a watermain crossing the canal at this location, but the pile and pile cap are not expected to clash with this. The construction of foundations and bridge piers near to the Clonsilla station building is likely to impact on access and temporary pedestrian diversions will be required during construction. Depending on excavation requirements a possession may also be required.

The foundations will primarily be pad foundations and will be developed further at detailed design stage following completion of the ground investigation.

4.8.16.11 Substructure

The substructure is to be in-situ reinforced concrete piers supporting the concrete slab/concrete beam and slab bridge superstructure. A reinforced earth/retaining wall structure will form the lower section of the southern ramped approach, while a retaining wall structure will form the lower section of the northern ramped approach where it ties in with the new pedestrianised area to the north of the canal.

4.8.16.12 Superstructure

The main-span superstructure is to be precast prestressed W8 beams acting compositely with an in-situ reinforced concrete deck. The transition from the main bridge spans into the ramps at the north and south ends of the bridge will be of precast reinforced concrete construction. The southern ramp will then transition into 2 no. 15.0 m prestressed concrete beam and slab spans followed by a reinforced earth/retaining wall structure which will turn through 180 degrees before returning to ground level. The northern ramp will transition into 1 no. 10.3 m and 3 no. 15.0 m prestressed concrete beam and slab spans. The 180 degrees turn in the northern ramp will be formed with a precast reinforced concrete span acting integrally with the concrete diaphragms over the piers, followed by a retaining wall-supported structure which will tie in at the R121 road and associated at grade works.

Due to the shape and size of the reinforced concrete sections of the superstructure, it is envisaged that these sections will be fabricated on site and lifted into place before being cast integrally into the support crossheads. This will eliminate the need for extraneous traffic management and mitigate the environmental risks associated with large concrete pours over the canal.

4.8.16.13 Drainage

The bridge deck will have a minimum 1:100 longitudinal fall as well as 2.5% crossfalls to prevent pooling of water. Due to the size of the area to be drained, it is envisaged that intermittent drainage will be needed on the ramped approaches as well as on the main span. This will require the installation of gullies and downpipes within the superstructure. Downpipes will be located within/behind the pier supports to limit visual impact.

4.8.16.14 Lighting – under, over, supply, fittings and fixtures.

Lighting on the structure will be incorporated into the parapets and orientated downwards so as to minimise impact on bat sight lines. The parapets will be of solid construction to prevent shedding of light into the canal corridor.

A lighting specialist will be engaged at detailed design stage to develop the lighting design for the proposed development in accordance with the requirements of Iarnród Éireann.

4.8.17 Clonsilla siding

From the modelling and operational analyses results, it has been found that enhanced infrastructure is required to handle the proposed Train Service Specification (TSS). For the off-peak break, a siding is required at Clonsilla.

The existing siding located in Clonsilla will need to be extended to 296 m. The existing track measuring 176 m shall be renewed, and a new track measuring 120 m shall be added as an extension. Additional works to be implemented include using or replacing the current P10-10 siding access turnout and trap point, modifying the vertical and horizontal alignment, potentially replacing the existing superstructure depending on its condition, and installing a friction buffer stop.

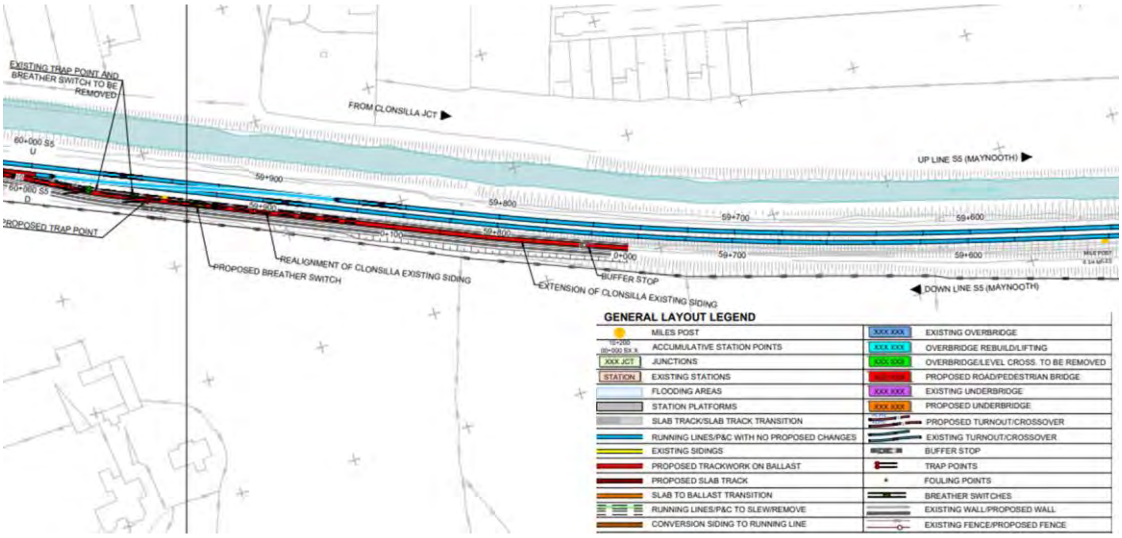


Figure 4-183 Location of Clonsilla siding

The location of the existing siding is considered suitable for this function. These works will take place inside the CIÉ property boundary.

4.9 Zone D. Clonsilla Station (Clonsilla Jct) to M3 Parkway Station (M3 Parkway Terminus)

4.9.1 Overview of alignment in Zone D

Zone D stretches from Clonsilla Junction in Fingal to M3 Parkway Station in Co. Meath and is approximately 7,500 m in length.

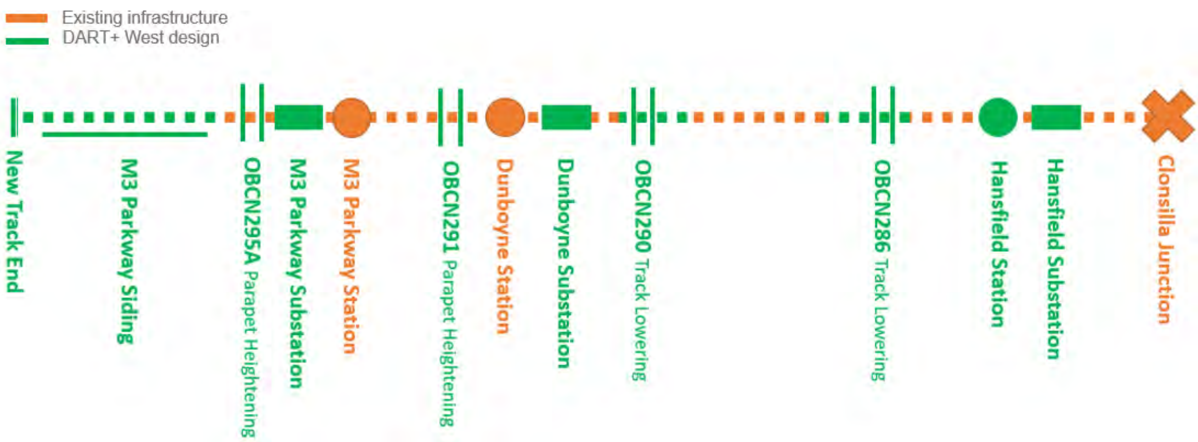


Figure 4-184 Schematic of DART+ West interventions in Zone D

Zone D will include the construction of substations in the vicinity of Hansfield, Dunboyne and M3 Parkway stations.

An ASP building is to be built adjacent to Dunboyne Station. An SEB, PSP and a 10kV MV substation with customer switch room are to be built next to M3 Parkway station.

The track is proposed to be lowered under Barnhill Bridge (OBCN286) for approximately 325 metres and under Dunboyne Bridge (OBCN290/290A) for 215 metres, to allow the required clearance for the line electrification. In addition, modifications to existing parapets for Dunboyne footbridge (OBCN290) and Dunboyne Station footbridge (OBCN291) are proposed.

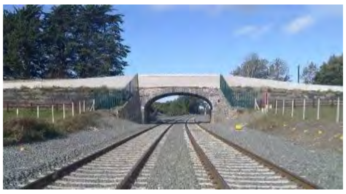
Parapet modification works are required on some footbridges to prevent electric shock that arises from the installation of the new Overhead Line Equipment (OHLE). It is proposed to modify the existing parapets on M3 Parkway Station footbridge (OBCN295A) as per Section 4.5.15.54.5.15.5. Further information is included in the sections below.

Tracks north of M3 Parkway Station shall be adapted to be used as sidings by extending the double track and placing a crossover for the operation.

4.9.2 Interventions at bridges

Zone D requires works at different bridges in order to provide sufficient clearance for OHLE and to provide protection against electrocution. The works consists of track lowering, parapet heightening and structural interventions. For this zone in particular, the interventions are listed in the table below.

Table 4-21 Bridge interventions in Zone D

Structure	Protected	Location	Solution	Depth of lowering	Length	Existing parapet	Proposed parapet	Description
OBCN286 Barnhill Bridge 	RPS 0712	M3 Parkway line at 8+513 mileage (Ch 101+710)	Track lowering	357 mm	325 m	N/A	N/A	Track lowering beneath bridge to achieve required clearance for OHLE.
OBCN290 Dunboyne Bridge OBCN290A Dunboyne Footbridge 	No	M3 Parkway line at 10+493 mileage (Ch 104+910)	Track lowering & parapet heightening	395 mm	215 m	2.65 m	2.65 m	Track lowering beneath bridge to achieve required clearance for OHLE Parapet heightening as per Section 4.5.15.5.
OBCN291 Dunboyne Station 	No	Dunboyne station at Ch 105+000	Parapet heightening	N/A	N/A	2.16 m	2.16 m	Parapet heightening as per Section 4.5.15.5.
OBCN295A M3 Parkway Station 	No	M3 Parkway station at Ch 107+000	Parapet heightening	N/A	N/A	2.15 m	2.15 m	Parapet heightening as per Section 4.5.15.54.5.15.5.

4.9.3 Hansfield substation

The substation will be located at the south of the railway, near Hansfield Station, on its eastern side.

It will be necessary to create a pedestrian and vehicular access route from the substation to Barberstown Lane North.

The proposed substation is within existing CIÉ land boundary. Therefore, no major additional land take is envisaged with this option.

The terrain at this location is almost flat, therefore, no significant earthworks are envisaged. There is no possible connection to water supply and foul drainage networks, as there is no network close to this location, as shown in Figure 4-185.

A new 3 m wide and 175 m long access road is needed for the substation access, which will be constructed partially within the CIÉ property boundary and will connect to an existing road outside of the property line and later into Barberstown Lane North. Some land take is required for the access road.

Figure 4-185 Location details and utilities in Hansfield Substation

4.9.4 Dunboyne substation

The substation will be located north of the railway, near Dunboyne Station, to its western side.

As the substation will be immediately adjacent to the station, access to and from the substation will be shared with that of the station. Therefore, it will not require the undertaking of significant works to accommodate road access from the L2228.

The proposed location is within the existing CIÉ property boundary; therefore, no additional land take is envisaged.

The terrain at this location is flat. Therefore, no significant earthworks are envisaged. Connection to the foul gravity network will be just to the north of the substation. As shown in Figure 4-186, connection to the water supply will be through the station entrance road, connecting to the existing water main in the L2228 road.

The road access will be through the existing access to the station and parking area. There is space for locating two parking spaces next to the substation, and there are also spaces within the station parking area. Some road modifications are required, as shown in figure below marked in orange.

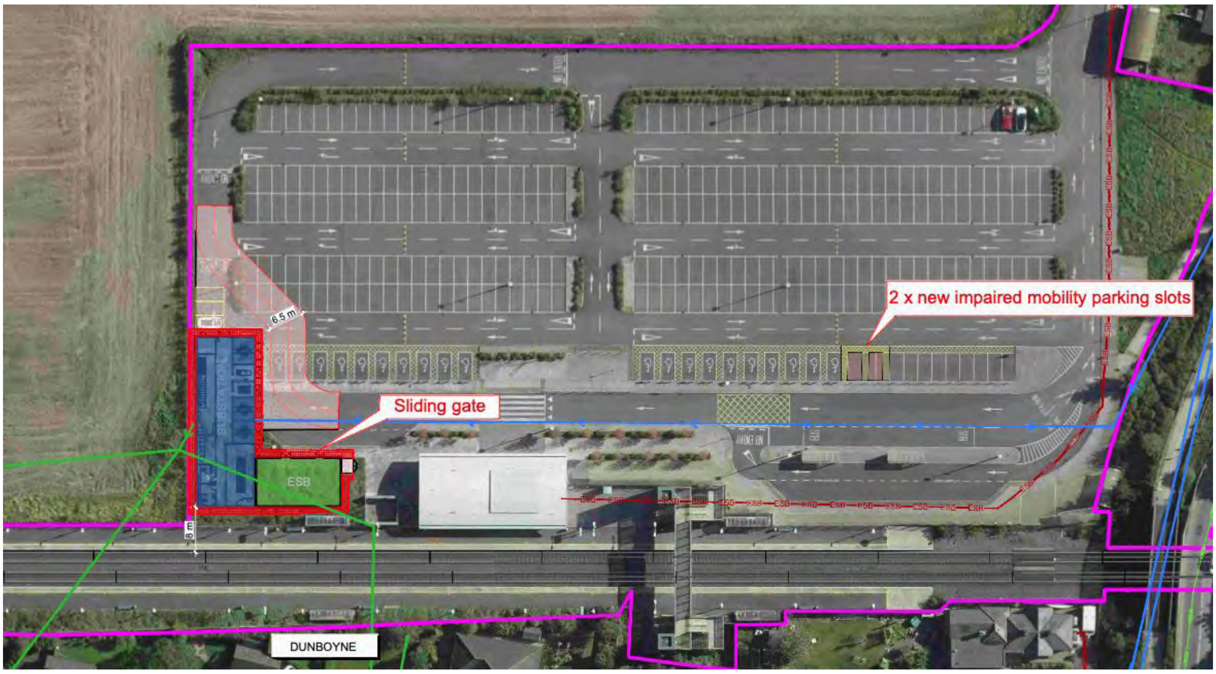


Figure 4-186 Dunboyne Substation

4.9.5 M3 Parkway substation

The substation will be located at the south of the railway, near the M3 Parkway Station, on its eastern side.

It will not require the undertaking of significant works to accommodate road access from the R157.

The proposed location is within the existing CIÉ property boundary. The road access will be through the existing access in the station and parking area, but a road rerouting will be needed for providing the substation with parking spaces.

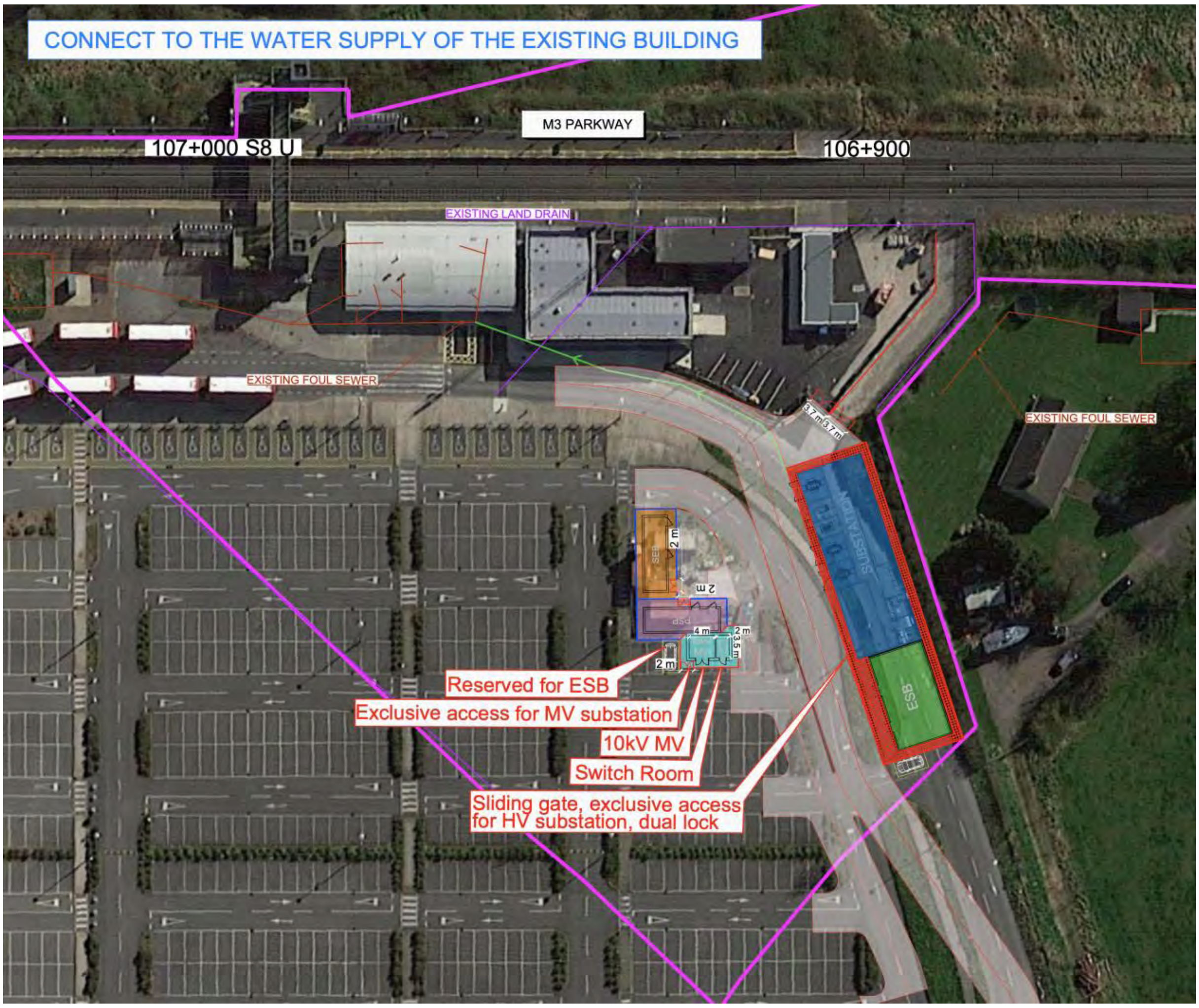


Figure 4-187 M3 Parkway Substation

4.9.6 M3 Parkway sidings

For the off-peak break, two sidings are required at M3 Parkway.

Currently, the double-track extends circa 200 m after the M3 Parkway Station, converting into a single track for 240 m until the track ends at a buffer stop. These tracks are to be adapted to be used as sidings, extending the double track and ending it 130 m before the current track end. This extension is inside the CIÉ property boundary.

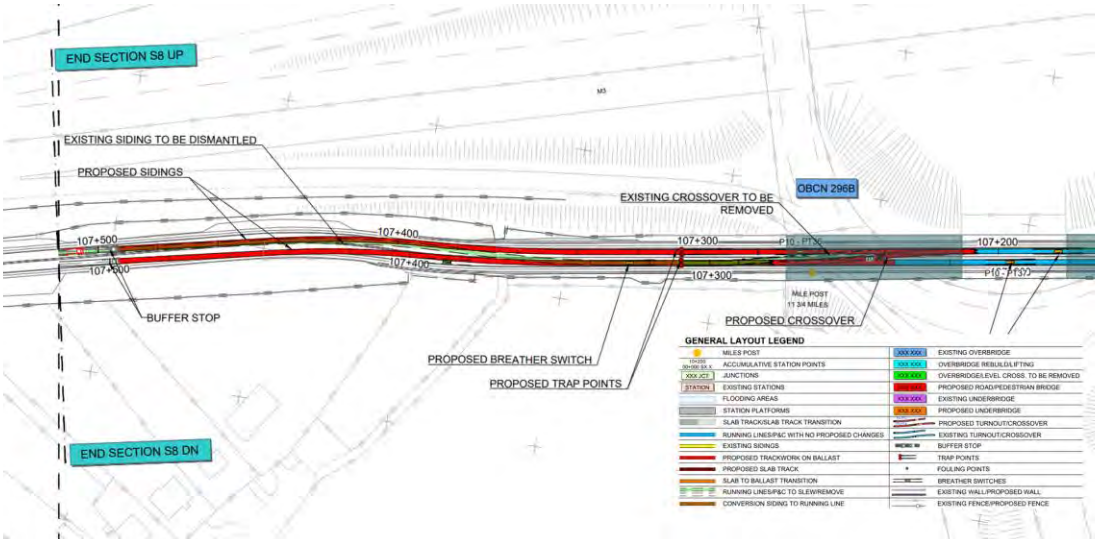


Figure 4-188 M3 Parkway sidings to the north of the station

4.9.7 Drainage

It is necessary to lower the tracks along the section from Clonsilla to M3 Parkway at OBCN286 (Barnhill) and OBCN290 (Dunboyne) to obtain the clearance necessary for the new electrification of the line.

The existing track drainage system passing through these OBs must be modified and adapted to the proposed track gradient.

The existing siding at M3 Parkway has an associated drainage system. The provision of the new siding and the need for the realignment of the existing siding will impact upon the existing drainage system, which will be required to be reinstated in a new position. In addition, a new drainage system will be installed for the new track.

4.10 Zone E. Clonsilla Station (Clonsilla Jct) to Maynooth Station

4.10.1 Overview of alignment in Zone E

Zone E stretches from Clonsilla Station in Fingal to Maynooth Station in Co. Kildare and is approximately 15.6 km in length.

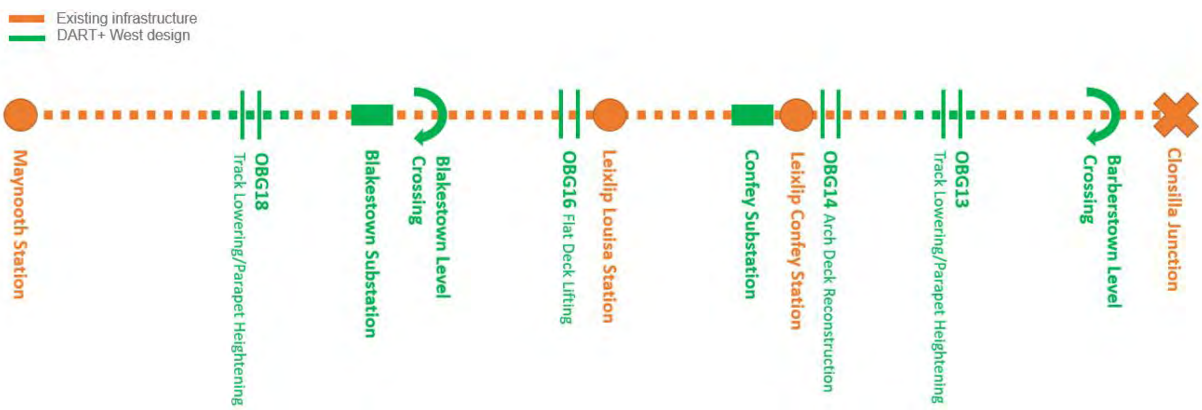


Figure 4-189 Schematic of DART+ West interventions in Zone E

The existing Barberstown level crossing will be permanently closed. A vehicular and pedestrian bridge is proposed south of the existing Barberstown level crossing over the railway line and the Royal Canal. It will connect with the Ongar Distributor Road proposed as part of the Barnhill Local Area Plan 2017 - 2023.

Approximately 530 metres of the track will require modifications in the vicinity of Colins Rail Bridge (OBG13). A track lowering is necessary to provide enough clearance for the new OHLE. Parapet modification works for Colins Rail Bridge are required to prevent electric shock that arises from the installation of the new OHLE.

As part of the proposed development, Cope Rail Bridge (OBG14) will require deck modification to allow the required clearance for the line electrification, which requires the removal of the upper part of the existing arch bridge while retaining the vertical walls. The precast concrete wall blocks shall be placed and anchored to the existing walls. Lastly, the precast concrete arch deck shall be placed on the concrete wall blocks. In order to facilitate two lane traffic on the existing historic bridge, two new pedestrian and cycle bridges will be constructed either side of the historic bridge. Intervention in Leixlip Station OBG15A is also required. A new substation will be constructed in the vicinity of Leixlip Confey station.

Next to the Leixlip Louise station, Louisa Bridge (OBG16) will require a bridge deck lift to allow the required clearance for the line electrification. Parapet modification works are required to prevent the risk of electric shock that arises from the installation of the new OHLE.

A new substation will be constructed in Blakestown near Deey Bridge, necessary for the power supply to the electrified line. Approximately 500 metres of the track will require modifications in the vicinity of Pike Bridge (OBG18). Parapet modification works are required to prevent the risk of electric shock that arises from the installation of the new OHLE.

Within Zone E, auxiliary electrical, signalling and telecommunication buildings are proposed in the Leixlip Confey, Louisa Bridge, Blakestown and Maynooth areas.

4.10.2 Interventions at bridges

Zone E requires works at different bridges in order to provide sufficient clearance for OHLE and to provide protection against electrocution. The works consists of track lowering, parapet heightening and structural interventions. For this zone in particular, the interventions are listed in the table below.

Table 4-22 Bridge interventions in Zone E

Structure No. & image	Protected (Reference/ No.)	Location	Solution	Depth of lowering	Length	Existing parapet	Proposed parapet	Description
OBG13 Collins Rail Bridge 	RPS 0713	Maynooth line at 8+1674 mileage (Ch 72+760)	Track lowering & parapet heightening	583 mm	365 m	0.80 m	1.8 m	Track lowering beneath bridge to achieve required clearance for OHLE. Parapet heightening as per Section 4.5.15.5.
OBG14 Cope Bridge 	No	Leixlip Confey station at Ch 74+690	Bridge modification	N/A	N/A	N/A	N/A	Arch deck reconstruction. 2x new pedestrian and cycle bridges to be installed alongside historic bridge. Parapet heightening as per Section

Structure No. & image	Protected (Reference/ No.)	Location	Solution	Depth of lowering	Length	Existing parapet	Proposed parapet	Description
								4.5.15.54.5.15.5.
OBG14A Leixlip Confey Station Footbridge 	No	Leixlip Confey station at Ch 74+710	Parapet heightening	N/A	N/A	2.50 m	2.50 m	Parapet heightening as per Section 4.5.15.54.5.15.5.
OBG15A Leixlip Station Footbridge 	No	Dunboyne station at Ch 76+480	Parapet heightening	N/A	N/A	2.16 m	2.16 m	Parapet heightening as per Section 4.5.15.54.5.15.5.
OBG16 Louisa Bridge 	No	West of Louisa Bridge station at Ch 76+520	Bridge modification	N/A	N/A	N/A	N/A	Flat deck lifting. Parapet heightening as per Section 4.5.15.54.5.15.5.
OBG18 Pike Bridge 	RPS B06-13	Maynooth line at Ch 80+000	Track lowering & parapet heightening	459 mm	415 m	0.60/1.00 m	1.80 m	Track lowering beneath bridge to achieve required clearance for OHLE. Parapet heightening as per Section 4.5.15.54.5.15.5.

4.10.3 OBG13 Barberstown level crossing

Barberstown level crossing is approximately 1.2 km from Clonsilla Station. The Dublin to Maynooth railway line crosses the local road linking the R121 Kellystown Road and Barberstown Lane/R149 Barnhill Road. The crossing is immediately adjacent to the Royal Canal, which is spanned by Packenham Bridge, a protected structure (RPS no. 0711). All lands in the vicinity of the Barberstown level crossing are currently rural in character with areas to the south of the crossing zoned as local amenity area and lands to the north zoned for residential development within the Fingal Development Plan 2017 - 2023.

Barberstown level crossing, currently under CCTV control, is lightly trafficked. The area is zoned for residential development within the Fingal Development Plan 2017 – 2023. Although lightly trafficked, closure of the crossing to vehicular traffic would result in a detour of approximately 8 km.

Figure 4-190 Barberstown level crossing

4.10.3.1 Overview of proposed works

The proposed works at Barberstown level crossing include the construction of a new road bridge with pedestrian and cycle facilities which will cross the Dublin to Sligo railway and the Royal Canal approximately 200 m west of the existing level crossing. The proposals include for the construction of approach roads on raised embankments which tie into the proposed Barnhill to Ongar Road scheme to the north and to the existing road network south of the railway.

The general arrangement of the proposed level crossing replacement works is provided in Figure 4-191 below.

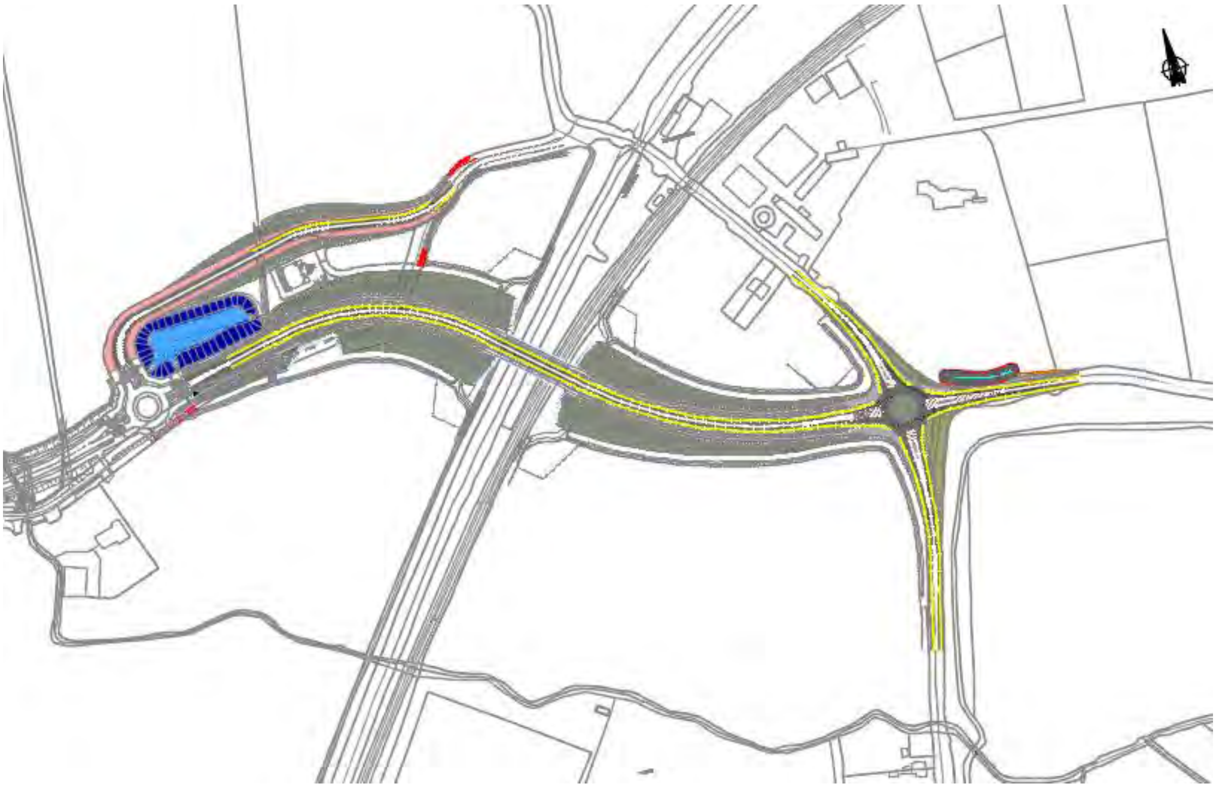


Figure 4-191 Barberstown level crossing general arrangement

4.10.3.2 Vertical alignment

The proposed road alignment ties into the Ongar-Barnhill link road between chainages 0+000 to 0+050 vertically. At chainage 0+050 the alignment enters a sag curve and ascends between chainage 0+050 and 0+250. The alignment features a crest curve passing over the railway, between chainages 0+250 and 0+300.

Upon exiting the crest curve, the alignment descends between chainages 0+300 and 0+450. At this point the alignment ties into the proposed roundabout at Luttrellstown Road.

4.10.3.3 Horizontal alignment

The alignment commences at the tie into the proposed Ongar-Barnhill link road. The mainline enters a 130 m curve between chainages 0+050 to 0+250. Upon crossing the railway, the mainline enters a 200 m curve between chainage 0+300 to 0+450. The mainline then ties into the proposed roundabout at Luttrellstown Road.

4.10.3.4 Pedestrians and cyclists

The proposals extend the cycling provisions from the Ongar-Barnhill Link Road, which are segregated with a 2.0 m wide cycleway and a 2.0 m wide footway. These continue across the structure on both sides of the alignment, terminating at the proposed roundabout at Luttrellstown Road. A segregated 2 m wide pedestrian and cycle link has also been provided from near the Ongar-Barnhill Link Road tie in.

4.10.3.5 Safety barriers

It is anticipated that safety barriers will be required to reduce hazards along the mainline that cannot be eliminated through the forgiving roadsides process. A vehicle restraint system to DN-REQ-03034 (May 2019) will be provided over both the railway and canal. This will consist of H4a reinforced concrete parapet panels at least 1.85 m in height. The parapet will terminate 3 m beyond the end of the wingwall slopes, supported on a separate reinforced concrete base. Here, the parapet transitions to a H4a safety barrier for 45 m on all approaches and departures. After this point where the embankment is greater than 6 m high with slopes of 1-in-2, the H4a barrier transitions to an N2 barrier. Where the embankment height is than less than 6 m, the slope gradient is reduced to 1-in-3 and no barrier is required.

4.10.3.5.1 Drainage

It is proposed that the surface water drainage for the Barberstown Level Crossing works are separated into four networks. Three networks have been proposed to the north of the level crossing, and the final network has been proposed to the south of the crossing. All four networks outfall into attenuation ponds sized for a 1:100-year return period.

4.10.3.6 Ground investigation and earthworks design

The proposed realigned Milestown Road is on approximately 10 m of embankment north and south of the proposed overbridge.

4.10.3.7 Pavement

The Barberstown proposals consist of the construction of a new alignment that ties into the Barnhill-Ongar Link Road. It is anticipated that the Barnhill-Ongar Link Road will be of bituminous construction, and therefore the proposed road will match this. The proposed pavement will tie into the existing pavement in steps in accordance with TII design guidance – Specification for Road Works Series 900 – Road Pavements – Bituminous Materials.

4.10.3.8 Utilities

An existing utilities desktop study identified the following utilities in the vicinity of the level crossing.

- Electricity – ESB underground MV/LV ducts.
- Electricity – ESB overhead MV cables.
- Electricity – ESB overhead LV cables.
- Gas – GNI underground HP pipes.
- Telecom – Virgin underground pipes.
- Telecom – Aurora underground ducts.

- Telecom – Vodafone underground ducts.
- Telecom – 3rd Party Fibre Bank
- Water – IW water main.

A third party bank of 12 fibre ducts has been identified on Barberstown Lane. The bank of ducts travels from Barberstown Lane under the canal and railway and turns southwest onto the R121. From previous discussions with consultants, this fibre bank is high value and uneconomical to divert. The northern bridge approach ramp has been aligned to avoid a possible clash. Further discussion with the operator of the fibre bank will be required in the detailed design stage.

4.10.3.9 Proposed road bridge

A single-span bridge is proposed as part of the Barberstown level crossing replacement works. The bridge has a total span of 42.2 m. Inspection and maintenance of the structure has been minimised as far as reasonably practicable by utilising a fully integral structural form. The bridge has precast concrete W beams, with a composite in-situ reinforced concrete deck slab. The abutments are in-situ reinforced concrete and foundations will either be piled or reinforced concrete spread foundations subject to detailed geotechnical investigation.

An elevation and a section of the proposed bridge are shown in Figure 4-192 and Figure 4-193 respectively.

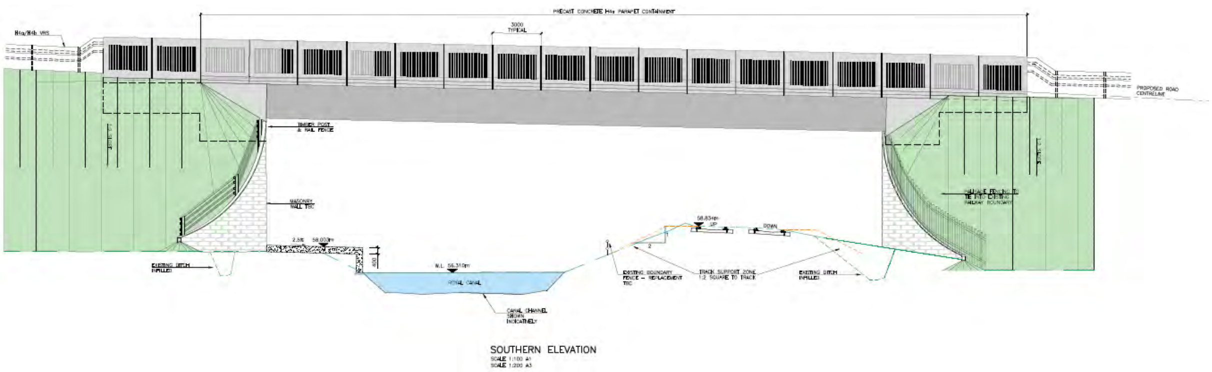


Figure 4-192 Barberstown level crossing bridge elevation

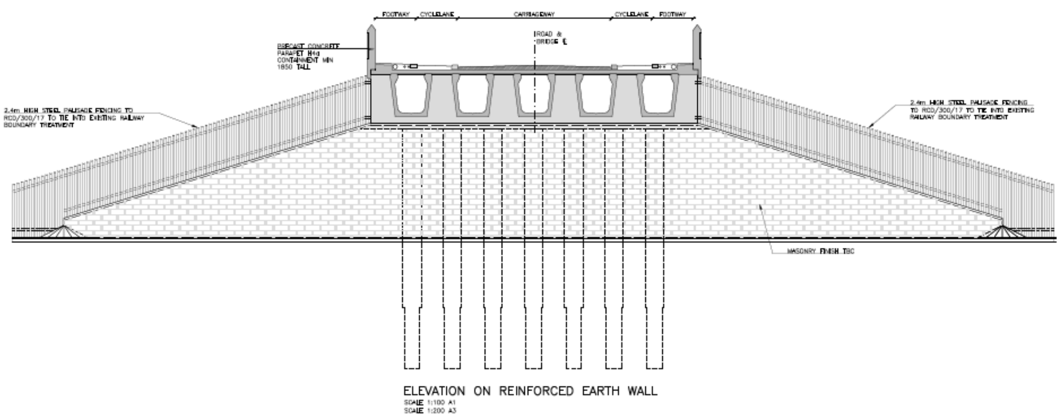


Figure 4-193 Barberstown level crossing bridge cross section

4.10.3.9.1 Aesthetic considerations

A slender appearance will be achieved by keeping the bridge structural depth to a minimum. An open aspect will be achieved by providing a single span structure. The structure will be predominantly comprised of precast concrete elements which will provide a factory quality surface finish. A Reckli type finish is proposed to the bridge parapets. Reinforced earth panels are proposed to have a patterned profile finish.

4.10.3.9.2 Proposals for the structure

A single-span bridge is proposed with a total span of 42.2 m measured to support centrelines and a width of 16.3 m.

The rail overbridge has a minimum headroom of 5300 mm plus allowances for bridge deflection and settlement from all rail-running edges to the underside of the structure, to provide the clearance required for the electrification of the existing railway line beneath structure. The minimum headroom provided to the canal towpath is 4500 mm.

The road at each end of the structure is constructed on fill material. Reinforced concrete wingwalls are provided to retain the approach fill at the abutments. The bridge will either be founded on piled foundations or reinforced concrete spread foundations subject to detailed geotechnical investigation. The bridge substructure elements are in-situ reinforced concrete skeletal type abutments. The bridge superstructure is of precast prestressed W-beams acting compositely with an in-situ reinforced concrete deck. Non-participating permanent formwork is used between the precast beams.

For the bridge, a fully integral structure is proposed. A DN-STR-03006 Type 2 expansion joint is provided at both ends of the structure to accommodate rotations and thermal movements.

A vehicle restraint system to DN-REQ-03034 (May 2019) is provided over both the railway and canal. This consists of H4a reinforced concrete parapet panels with a minimum height of 1.85 m. The parapet terminates 3 m beyond the end of the wingwall slopes where they transition to a H4a safety barrier for 45 m on all approaches and departures to the bridge. After this point, where the embankment is greater than 6 m high with slopes of 1-in-2, the H4a barrier transitions to an N2 barrier. Where the embankment height is then less than 6 m, the slope gradient is reduced to 1-in-3 and no barrier is required.

4.10.3.9.3 Drainage

The carriageway drains along the pavement, with the gullies being located off the bridge. As an integral structure, back-of-wall drainage is provided to the abutments.

4.10.3.9.4 Inspection and maintenance

As the bridge is to be integral, maintenance requirements are minimised as far as current best practice foresees for the design life of the structure. The configuration of the structure has been designed to provide easy access for inspection and maintenance.

The structure is to be inspected at regular intervals as required by the IÉ Bridge Management System.

4.10.3.9.5 Lighting – under, over, supply, fittings and fixtures

Lighting on the bridge is required to be consistent with the proposed Barnhill to Ongar Distributor Road project. The lighting design for the road will be provided in accordance with the recommendations of BS 5489 Code of Practice for Road Lighting and the Institution of Lighting Professionals (ILP) Professional Lighting Guide PLG02 – The Application of Conflict Areas on the Highway. The lighting design will comply with the requirements of Fingal County Council's Street Lighting Technical Specification.

Details of the lighting design are to be confirmed but it is envisaged that 10 m high lighting columns are located at the ends of the bridge. Lanterns on lighting columns will be full cut off type, with shielding when adjacent to future residential properties to minimise light spillage. The proposed lanterns, and the limitation of their mounting angle to 5 degrees or less above the horizontal, will limit spillage of light as far as practicable.

This lighting arrangement is designed to avoid any impact on/conflict with railway signals and to minimise any visual impact resulting from the illumination of this elevated section of roadway.

4.10.4 OBG14 Cope Bridge

OBG14 is located east of Leixlip Confey Station and consists of a 7.6 m wide bridge operating as a single lane shuttle system.

4.10.4.1 Overview of alignment works

There are no track alterations in this area. Deck reconstruction of the OBG14 is proposed, and parapet heightening is required on both OBG14 and OBG14A. Two new pedestrian and cycle bridges are proposed alongside the existing historic bridge to allow two lane traffic to flow over OBG14.

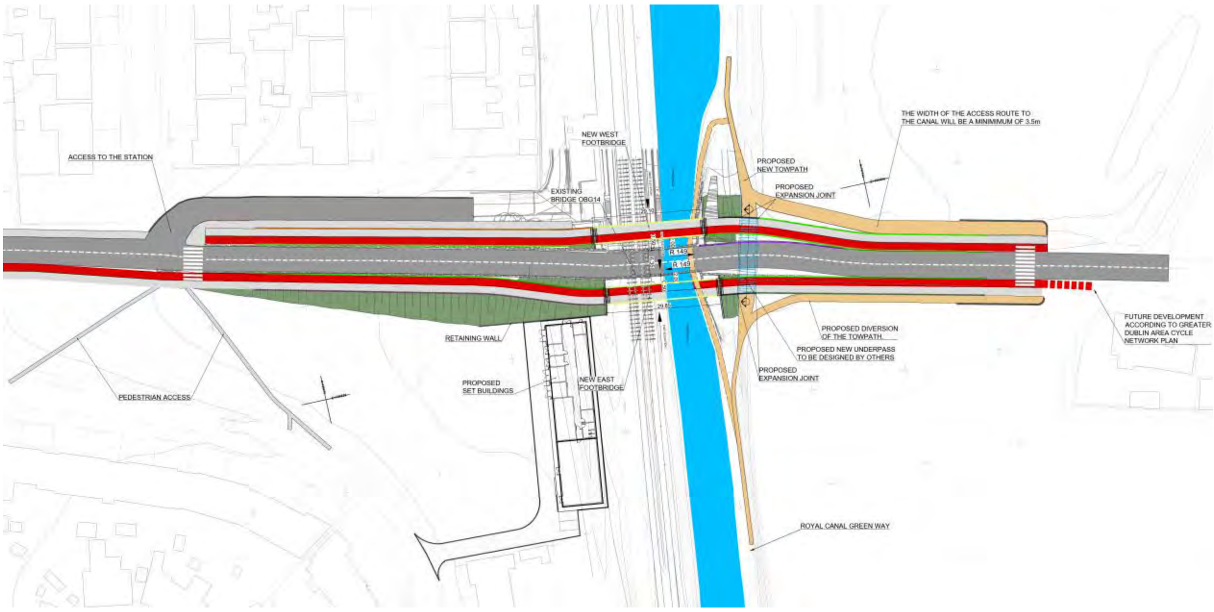


Figure 4-194 Plan view of revised OBG14 Cope Bridge layout

4.10.4.2 Deck reconstruction

Figure 4-195 and Figure 4-196 below show OBG14 Cope Bridge with the precast arch deck solution.

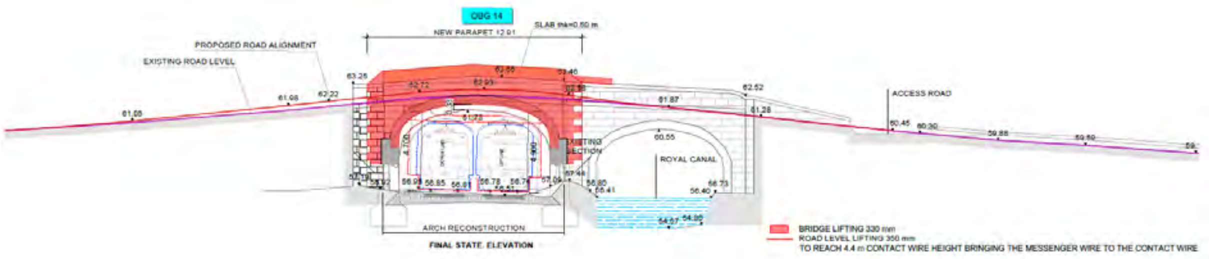


Figure 4-195 Deck reconstruction of OBG14 - Elevation

Figure 4-196 Deck reconstruction of OBG14 - Plan view

To achieve sufficient vertical clearance for the catenary equipment under the bridge, the precast arch deck solution has been proposed. The new arched bridge deck shall be installed 330 mm higher than the original bridge arch position.

To avoid impacting on the adjacent arch bridges it is proposed to use a lightweight fill for the road backfill to the new elevation to reduce the additional dead load on the arch and the abutments. The load on the arch will be further reduced by replacing the existing backfill with lightweight fill.

4.10.4.3 Parapet heightening

Parapets on the reconstructed OBG14 will be heightened in line with Section 4.5.15.5.

Figure 4-197 Existing parapet at OBG14

4.10.4.4 New pedestrian and cycle bridges to the east and west of OBG14

A bridge upgrade at OBG14 has been proposed to meet Kildare County Council (KCC) requirements, to accommodate future development plans for the area, and to take the opportunity to benefit the wider community.

The proposed widening solution is to build two pedestrian and cycle bridges adjacent to the existing OBG14, spanning both the railway line and the Royal Canal, to accommodate two lane traffic on the existing OBG14 bridge. The new walkways are parallel to the bridge in such a way that they allow users to maintain views of the surroundings and the existing bridge, as well as increase their safety.

The new pedestrian and bicycle bridges have two main elements:

- **The structural beams.** Made of weathered steel, the beams are placed at both sides of the footbridge. They have a variable section to respond to the structural needs, thus allowing for economical and environmentally sustainable use of the material.
- **The vertical metal profiles.** Made of stainless steel, the vertical elements provide the required protection from falls and catenary equipment. Parapet height will vary, achieving 1.8 metres above the railway track and 1.45 m on the rest of the footbridge.

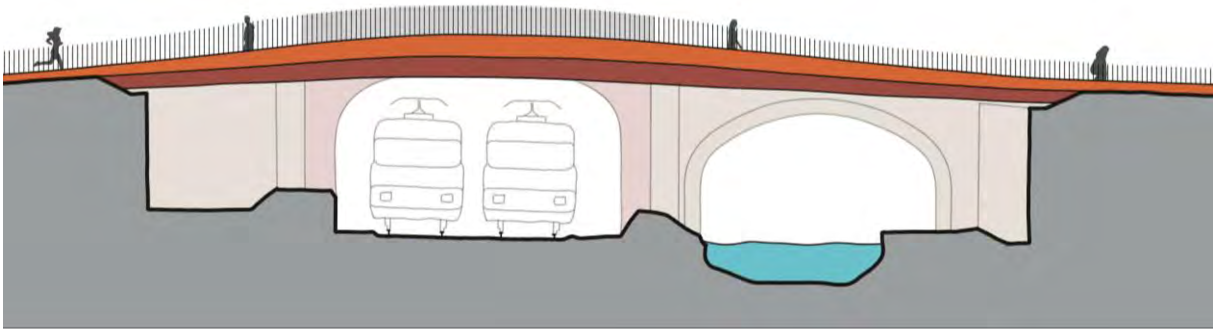


Figure 4-198 Sketch of the elevation of one of the footbridges

As this proposed solution will significantly impact the heritage value of the canal arch bridge, the structural design work has been carried out working closely with the design architects and conservation architects (Blackwood & Associates), and the proposal has been agreed upon from a structural and heritage perspective in a collaborative manner.

The design intent is to achieve an elegant and slim footbridge structure that does not compete with the existing bridge and fosters the views between the canal and the footbridge. A slender appearance is achieved by keeping the structural depth of the weathered steel beams to a minimum.

The use of weathered steel compliments the existing protected bridge and has the added benefit of being a low maintenance material.

The vertical elements, being constructed of reflective stainless steel, will reflect the bright sky, thus minimising the visual impact of the bridge.

Figure 4-199 View of the footbridge

Further engineering and architectural development and detailing will be required during the detailed design phase to deliver refined design, optimum section sizes, floor details, approach design, lighting, finishes and a complete bridge that integrates into the existing surroundings.

The total span of each structure is around 30 m. The new footbridges structures will only carry the pedestrian and cyclist traffic, and the existing OBG14 will carry the road traffic. With this proposed arrangement, the new footbridges can be designed as lighter structures and can therefore mitigate the visual impact on the Royal Canal arch. The new footbridges will be structurally independent of the existing bridge.

The new bridges are proposed to the east and west of the existing bridge, keeping 2 m from it, as shown in Figure 4-200 below:

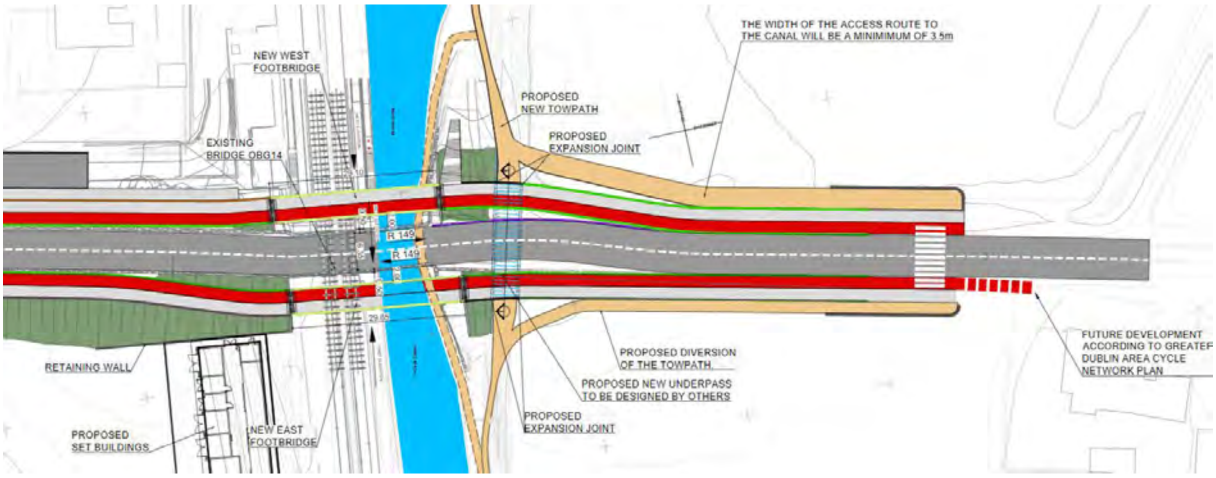


Figure 4-200 Plan of proposed footbridges to east and west of OBG14

The following figure shows an elevation of the proposed footbridges from the East with the historic bridge.

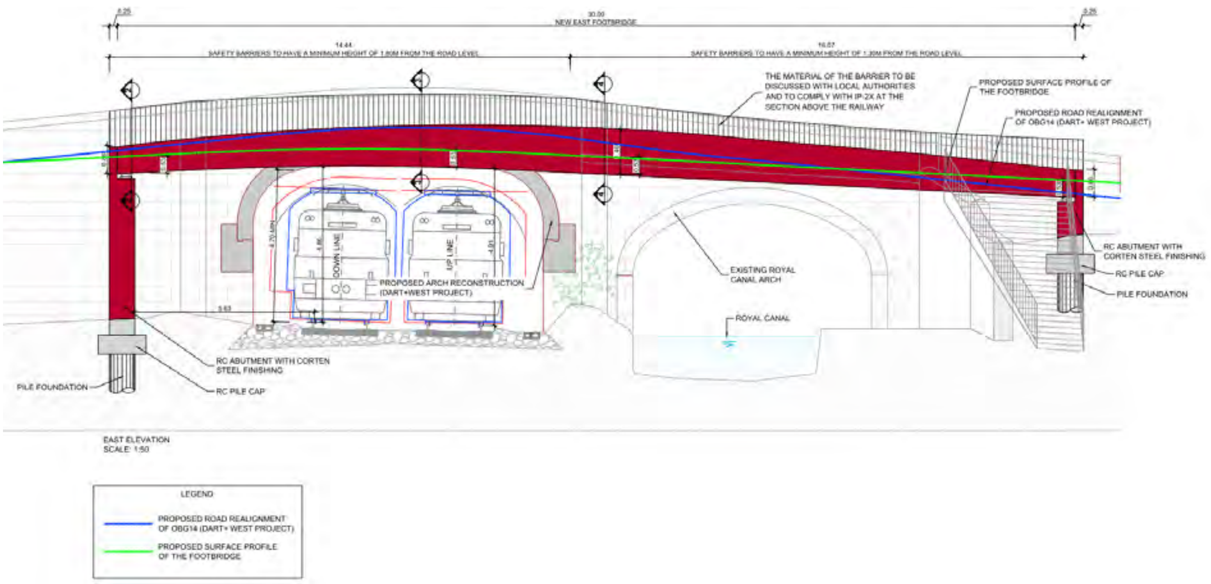


Figure 4-201 Proposed footbridge east of OBG14 - East Elevation

4.10.5 Leixlip Confey substation

The substation will be located to the south of the railway, near the existing Leixlip Confey Station, on its eastern side.

The proposed location is outside of the existing CIÉ property boundary.

The green space to the east of the approach road to OBG14 Cope bridge will be impacted by the substation, which will also impact upon the amenity lands within the Glendale area. The substation will be fenced for security purposes and landscape planting will be placed to ensure the visual impact of the substation is minimised as far as possible.

Both the foul gravity and water supply connection will be through the road entrance and connect each of them to the pipes running on the Glendale Road.

Figure 4-202 Leixlip Confey substation

4.10.6 OBG 16 Louisa Bridge

OBG16 is a flat deck bridge, west of Louisa Bridge Station.

4.10.6.1 Overview of alignment works

There are no track alterations in this area.

4.10.6.2 Deck lifting

OBG16 is a two-lane bridge with a 14 m wide span. Leixlip Louisa Bridge train station access and pedestrian parking access is located close to this bridge.

The required deck lift for this bridge is 290 mm to obtain a sufficient clearance for the OHLE system and prevent significant modification of the road alignment and the adjacent canal bridge.

This OB was designed as a composite deck with bearings between the abutments and the deck.

Therefore, to lift the deck, the pavement requires a vertical cut beyond the end bearing of the deck.

After lifting to the required level, the newly formed gap between the existing abutment bearing and the newly heightened deck section will be connected with steel bars surrounded in concrete, and concrete should be poured to the new elevation. Finally, the connection between the deck and the abutment must be repaired.

This structural solution may have an impact on the adjacent arch bridge; therefore, it is proposed to use a lightweight fill for the road backfill to the new elevation to reduce the additional dead load on the arch and the abutments. The load on the arch will be further reduced by replacing the existing backfill with lightweight fill.

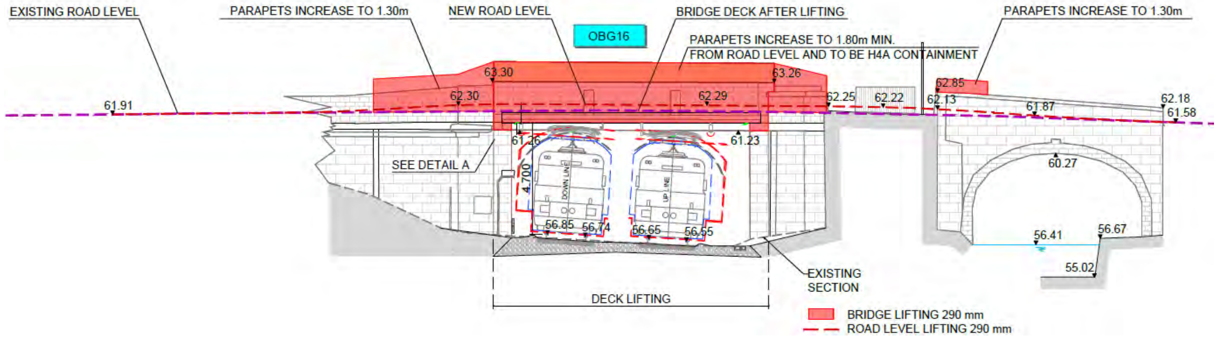


Figure 4-203 Deck lifting of OBG16 - Elevation

Figure 4-204 Deck lifting of OBG16 - Plan view

4.10.6.3 Parapet heightening

For OBG16, on the reconstructed bridge, parapets will be heightened in line with Section 4.5.15.5.

Figure 4-205 Existing parapet at OBG16

4.10.6.4 Drainage

OBG16 is located at Ch 76+460, next to Leixlip Louisa Bridge Station. This structure is identified as a potential flooding area. Drainage will be designed to evacuate water from the lowest point of this structure to the nearest culvert (to be assessed at detailed design stage).

4.10.7 Blakestown level crossing

There are no works proposed at Blakestown in respect of the level crossing closure other than the removal of the level crossing furniture and securing the railway boundary with fencing and gates for maintenance access.

4.10.8 Blakestown substation

The substation will be located at the south of the railway, near the existing level crossing. Deey Bridge, a protected structure (RPS no. B06-14) is located to the north of the substation. The substation is located 1.8 km west of Leixlip (Louisa Bridge) Station.

The proposed location is not within existing CIÉ property boundary. Therefore, it will be necessary to purchase additional land.

It will be necessary to create access to the substation from the existing road.

The substation is located within a rural area and is not positioned in the vicinity of or within the footprint of buildings, car parking areas or walkways. Beside the substation access road, two parking spaces will be provided inside the substation boundary.

At this location, the terrain is almost flat. The substation will be at +60.00 m OD, and the connection road at +60.29 m OD.

The connection to the water supply will be next to the substation. There is no connection to the public sewer network at this location so no toilets will be provided. Facilities can be accessed at neighbouring stations.

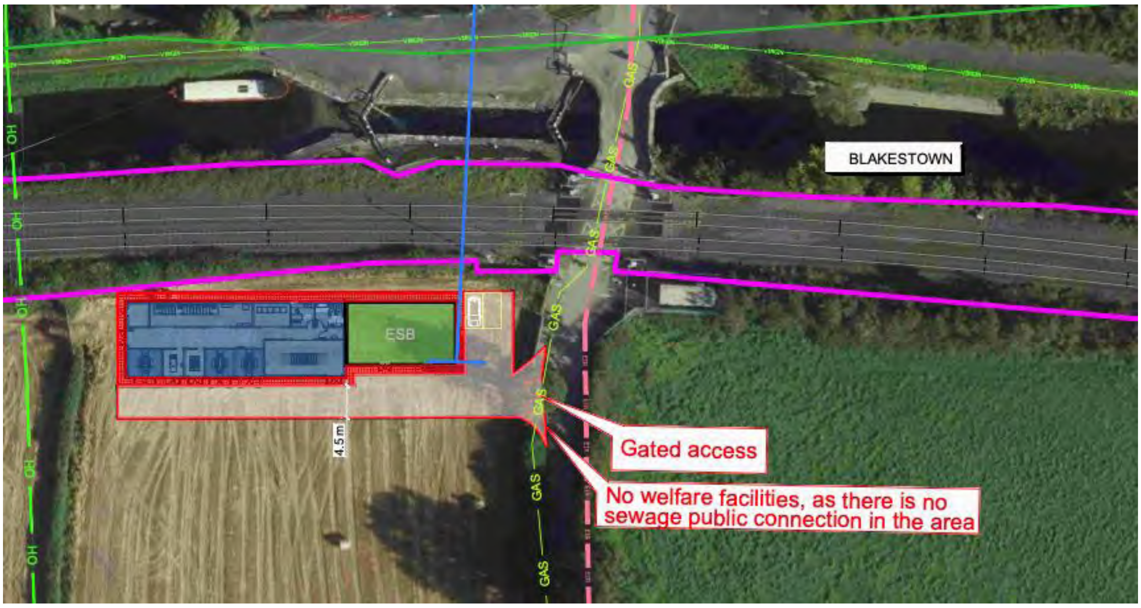


Figure 4-206 Blakestown substation location

4.10.9 Drainage

In this section, at OBG13 and OBG18, track lowering is considered the preferred option to achieve the required OHLE clearance. For this reason, a new drainage system has been designed.

4.10.9.1 OBG13

The drainage system is located between Ch 72+460 and 73+030, the outfall point being located at Ch 73+030.

The drainage proposal consists of gravity drainage from 300 meters west of OBG13, discharging to a natural channel at Ch 73+030.

A set of collector drains has been proposed at each side of the tracks from OBG13 and connected with a proposed carrier drain west of OBG13, which discharges into a natural channel after passing through an oil separator tank.

The drainage system comprises plastic pipes, ranging from 300 mm to 600 mm in diameter.

4.10.9.2 OBG18

To provide drainage to the low point of the vertical alignment (Ch 80+040) a drainage run is proposed discharging at UBG18A, located approximately 1.20 kilometres west of OBG18.

Collector pipes are proposed at both sides of the tracks, joining at the low point of the vertical alignment. At that point, both pipes will connect to a carrier drain that runs along the down track and discharges at UBG18A, west of OBG18.

The proposed longitudinal gravity drainage runs along the cess of the north track. To provide drainage at the low point of the vertical alignment (Ch 72+800) a gravity drain is proposed from the low point to UBG13B.

4.11 Zone F. Maynooth Station to Maynooth Depot

4.11.1 Overview of alignment in Zone F

Zone F stretches from Maynooth Station to Maynooth depot in Co. Kildare.

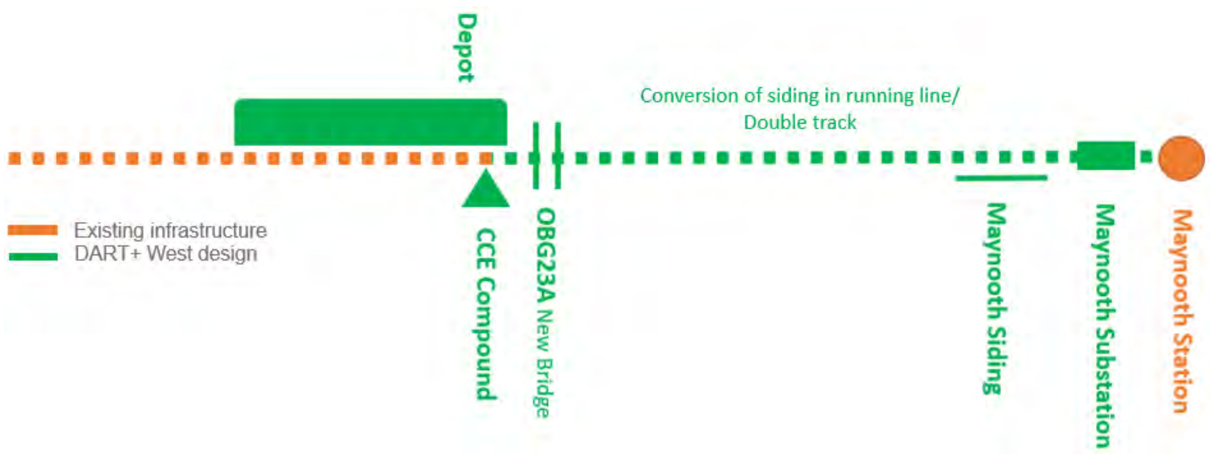


Figure 4-207 Schematic of DART+ West interventions in Zone F

Maynooth Station will require track modifications to improve the existing siding to the west of the station and make it suitable for the use of an FLU (Full length unit or 8-car unit). The crossover to be provided for the Down siding operation requires modification of the alignment of the tracks at the entrance to the station platforms. Platform remodelling will consist of shortening on the western side and extending the length on the eastern side.

The rail line (referring to the mainline) is currently a single line west of Maynooth station. It will be upgraded to a twin-track between Maynooth and the new depot.

This zone includes the construction of approximately 1,500 m of new alignment offline to Jackson's Bridge from Maynooth (i.e. to the south of the existing track). This will prevent the need for works to increase clearance at the bridge, thus avoiding direct negative impacts to Jackson's Bridge, a protected structure.

The proposed development crosses a flood-prone area in the vicinity of Jackson's Bridge. For that reason, the track levels will reach the minimum 61.06 m protection level. Due to the track elevation, an ESB 220 kV electric line requires diversion as existing clearance will be insufficient.

Due to the new track alignment, the L5041 local road is diverted through the new OBG23A that also serves as access to the depot. The construction of two new structures across Lyreen River (UBG22B and UBG22A) is also proposed, which allows a crossing over a stream and a pedestrian and cycle underpass.

Finally, the proposed development requires the construction of a new maintenance depot connected to the Maynooth railway line between Kilcock and Maynooth. The depot will be used as a stabling location for the trains and for maintenance, more detail is given in Section 4.11.12.

4.11.2 Interventions at bridges

Zone F requires works at different bridges in order to provide sufficient clearance for OHLE and to provide protection against electrocution. The works consists of track lowering, parapet heightening and structural interventions. For this zone in particular, the interventions are listed in the table below.

Table 4-23 Bridge interventions in Zone F

Structure No. & image	Protected (Reference / No.)	Location	Solution	Depth of lowering	Length	Existing parapet	Proposed parapet	Description
OBG20 Maynooth Station 	No	Maynooth station at Ch 82+300	Parapet heightening	N/A	N/A	1.88 m	1.88 m	Parapet heightening as per Section 4.5.15.5.
OBG23A	No	Ch 92+840	Bridge construction	N/A	N/A	N/A	N/A	New bridge construction.

4.11.3 Maynooth Station

A new crossover needs to be placed between the siding and the station platform for the existing siding operation that allows movement to the Up-track platform.

The crossover placement requires modification of the alignment of the tracks at the entrance to the west station platforms. It is necessary to demolish and decommission the platforms on the western side.

The current platforms have a length of 222 m (Platform 1) and 214 m (Platform 2).

It was agreed that the length of platforms 1 and 2 at Maynooth Station, as part of DART+ West, would be 174 meters. Consequently, the platforms will be demolished and reconstructed as shown in Figure 4-208.

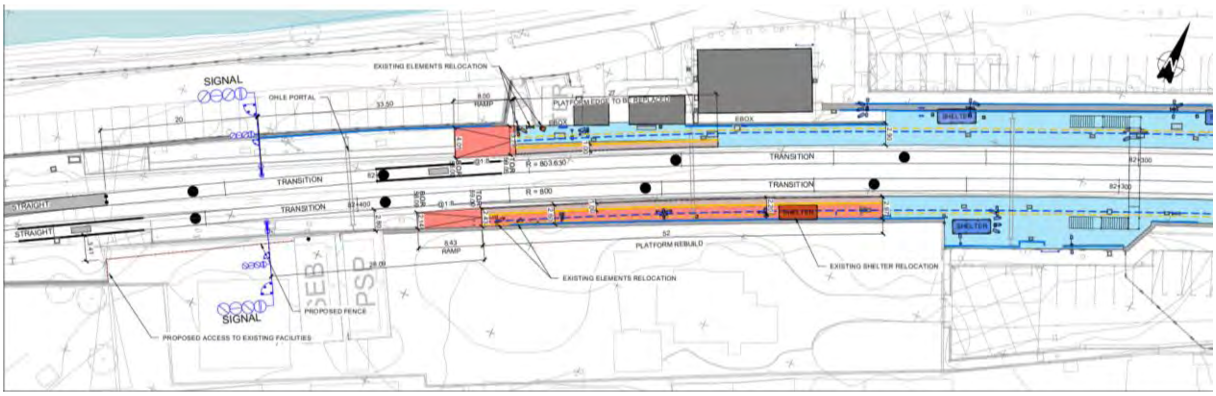


Figure 4-208 Maynooth Station alignment

4.11.4 Maynooth substation

A substation is proposed within the car parking area of Maynooth Station to the south of the railway, opposite the canal and beside the R406.

The proposed location is within the existing CIÉ property boundary. Therefore, no major additional land acquisition is envisaged.

This location clashes with an existing footbridge. The access road to the station will have to be modified at the substation location . The existing access road will be displaced towards the south, while the pedestrian ramp will be reconstructed and diverted behind the substation, granting people with impaired mobility access to the station. Nine parking areas will be impacted, as three of them will be reserved for ESB staff. No disability spots are impacted.

The pedestrian walkway is rerouted as per the grey area around (east and north) the substation to maintain access to the existing footbridge, as shown in Figure 4-209 below.

Figure 4-209 Maynooth substation

The water supply connection will be from the watermain located on the eastern side of the substation, on the R406. The foul drainage network will be from the pipe to the south of the substation, in Silken Vale Road.

4.11.5 Maynooth siding

There is an existing siding at the southern border of the railway mainline in the Maynooth Station area. The existing siding on the Down track in Maynooth Station is suitable for the operation with certain upgrades to improve its functionality.

The current siding requires infrastructure improvements to allow for proper functionality:

- Vertical alignment of the siding: the longitudinal gradient of the siding, currently 1 in 188, will be modified to comply with CCE-TMS-300 Track Construction Tolerances. The horizontal gradient is designed to not compromise the design of the buffer stop. Both elements are spatially constrained. Therefore, providing a retaining wall between the siding and the Down track allows a viable solution.
- Horizontal alignment: the siding axis will be modified to comply with the I-PWY-1101 Requirement for Track and Structures Clearances. The spacing of a siding to the adjacent running line must not be less than 3400 mm (where shunting operations are performed). This distance has been increased to 4.0 m considering the effects of end/centre throw and cant.
- Earthworks and track substructure: due to the vertical and horizontal realignment, it is necessary to carry out earthworks. The longitudinal siding gradient is to be modified with backfill and the formation layers (sub-ballast/subgrade) will follow this.
- The new track will consist of flat-bottomed steel rails (54 E1) supported on prestressed concrete sleepers laid on ballast (300 mm minimum under the sleeper).
- A P10L-13 crossover is to be placed between the station platforms and the siding turnout. To allow operation of the siding:
  - The horizontal alignment of the tracks is to be modified to allow the implementation of a straight crossover. This requires the demolition of 43.5 m of the platform on the Down track and the removal of 14.7 m of the platform on the Up track.
  - The current P15-18.5 crossover is eliminated.
- Existing P10L-10 contraflexure siding access turnout (see Figure 4-210): the position of the current turnout is to be modified slightly. The IAMS information indicates that the turnout is from 1997, nearing the end of its design life. The track realignment allows for a straight turnout. For these reasons, the consideration is being given to replacing the turnout with a new one.

Figure 4-210 Current siding P10-10 turnout. Source IAMS

- Trap point: a contraflexure (curve radius 300 m) left-hand trap point is proposed at the siding to protect the running line. The IAMS information indicates that the existing contraflexure left-hand trap point (see figure below) is from 1996. For these reasons, consideration is being given to its replacement.

Figure 4-211 Current siding trap point. Source IAMS

- Breather switch: the design proposes a new breathing switch on the siding to protect the trap point and turnout from the effects of thermal movement. The track at this point has a radius of 746.9 m radius. Because the breather is in a curve with a radius of less than 1,000 m, the provision of a check rail is considered through the breather switch.
- Friction buffer stop: due to the presence of OBG21, there is no insufficient space available for the standard configuration of a friction buffer stop with 6 m in front of the buffer, 12 m of run-out length and an additional 8 m to obtain a 20 m Exclusion Zone from the front of the friction buffer stop.

Figure 4-212 Current siding buffer stop. Source IDOM

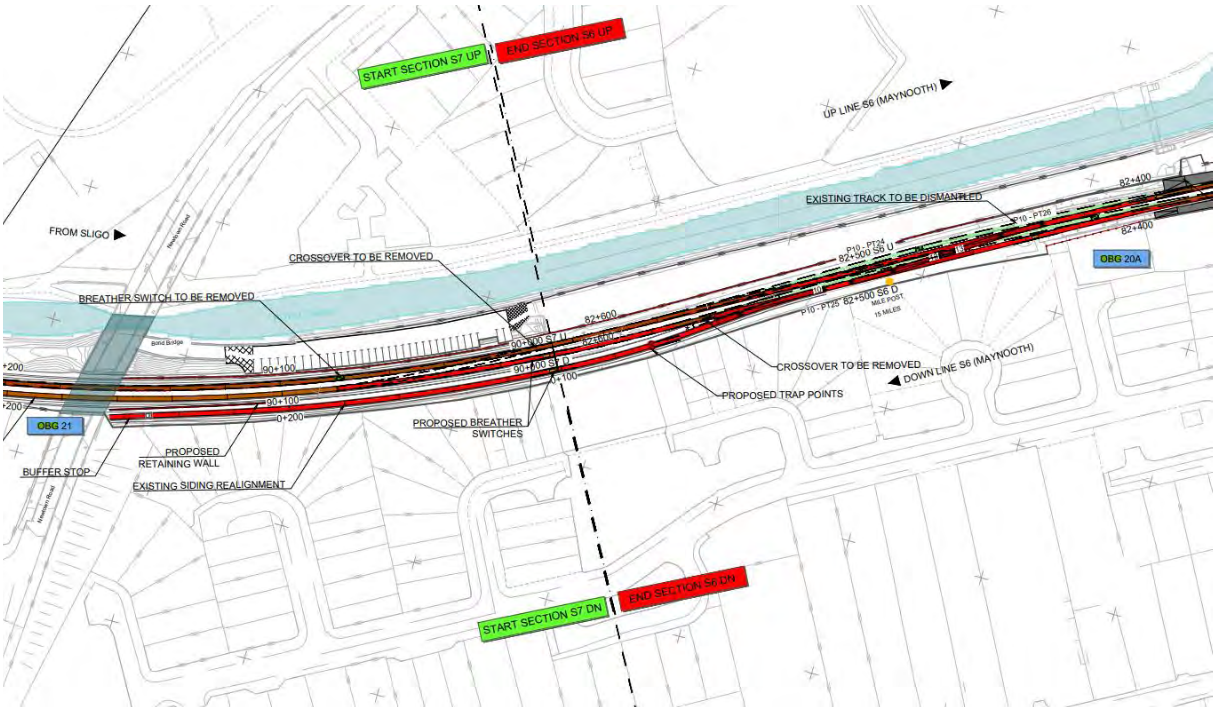


Figure 4-213 Alignment at Maynooth siding

4.11.6 Maynooth siding to running line and double track

The existing siding, on the southern side of the existing track at Ch 82+400 will be converted into the new running line (Down track) that will continue with the new double track diversion, explained further in Section 4.11.7, until the end of the alignment at Ch 93+030. The existing siding is approximately 395 m long.

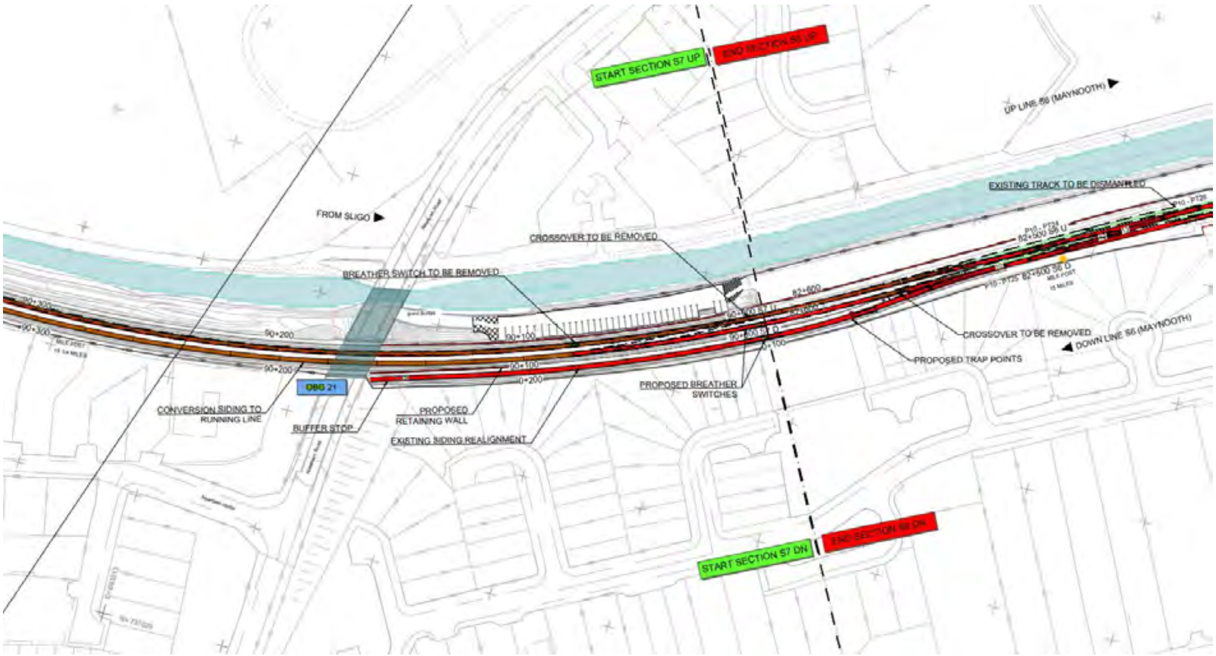


Figure 4-214 Alignment of Maynooth siding converted to running line

Figure 4-215 Left: siding to be converted into a running line. Right: siding with wood sleeper and without cant

After the curve at Maynooth Station, the alignment continues parallel to the Royal Canal In this section, a new second track is to be built between the existing track and the Royal Canal, from Ch 90+520 to Ch 91+000, as shown in Figure 4-216 below.

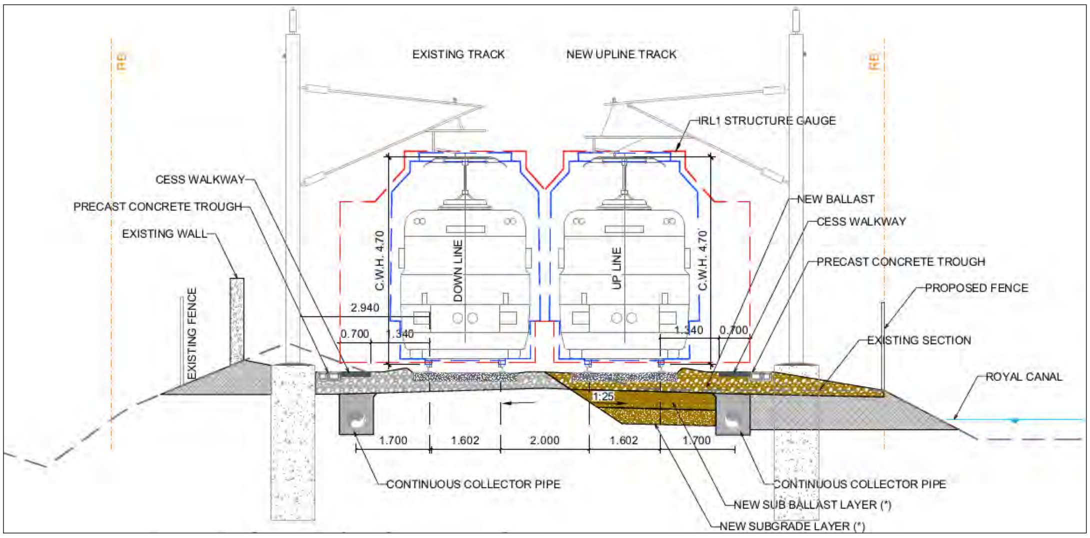


Figure 4-216 Section of new track (Up Track)

4.11.7 New double track diversion

A new off-line alignment, south of the existing track, is to begin at Ch 91+000, just outside the Maynooth urban area. This off-line solution is proposed to prevent any works to OBG23 Jackson Bridge, a protected structure (RPS no. B05-36) with insufficient OHLE clearance. This new alignment ends at Ch 92+500, after the eastern entrance to the depot, with a total length of 1.5 km. The design speed of this section is 120 km/h. The cross-section is presented in the figure below.

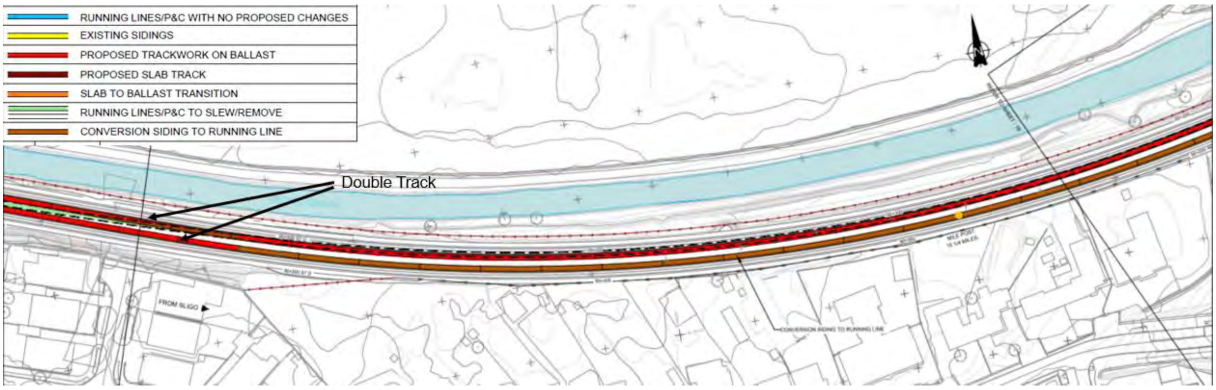


Figure 4-217 Alignment of new double track

At Ch 92+150, the new alignment turns north to connect to the existing track at Ch 92+500.

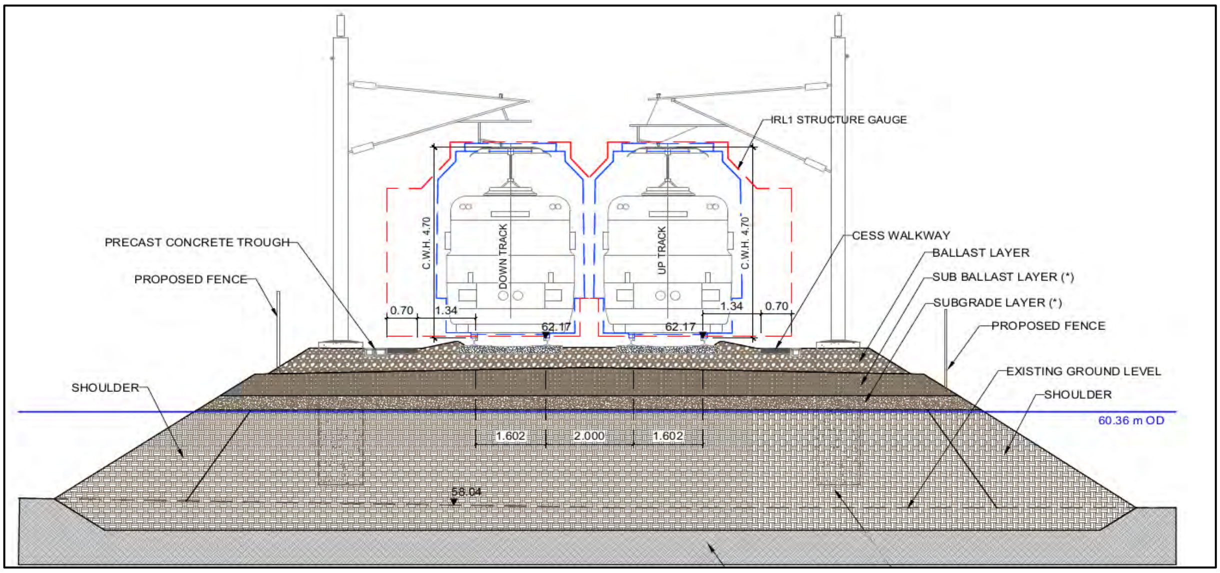


Figure 4-218 Section of new double-track alignment

Before the connection with the depot the alignment crosses the Lyreen River and two structures are necessary to provide for this (UBG22B and UBG22A) as shown in Figure 4-219 below.

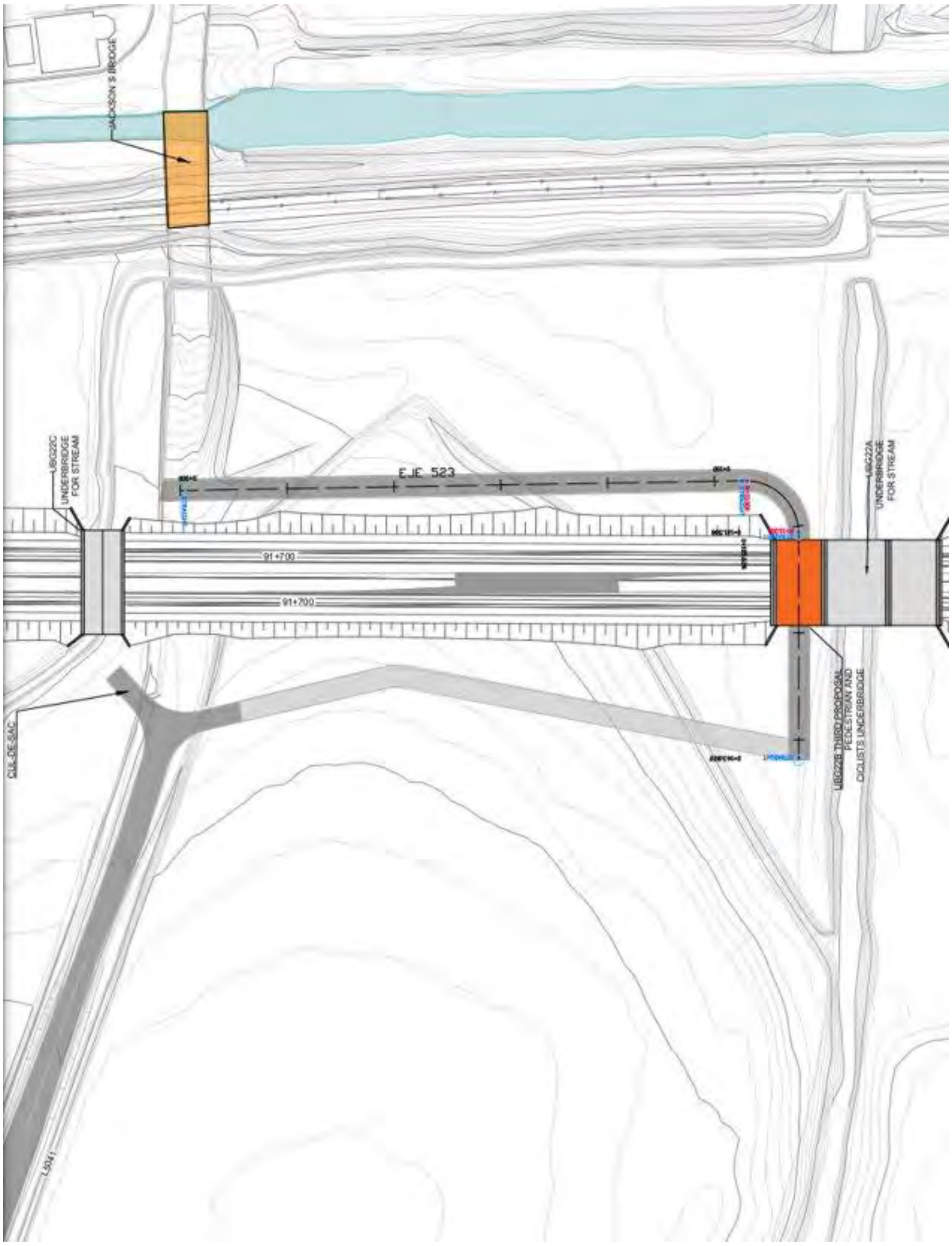


Figure 4-219 New structures UBG22B and UBG22A

At Ch 91+750, 30 m before the Lyreen River (UBG22) a 220 kV ESB line crosses over the railway line.

It is proposed to provide a minimum track level of 61.06 m OD due to flood risk in the area. It is also necessary to divert the existing ESB 220 kV overhead power line due to this track realignment.

4.11.8 End of double track section - New Down track

At Ch 92+600, the mainline returns to the current footprint, using the existing track as the Up track with a new track being developed on the southern side, as per the cross-section shown in Figure 4-220 below. The double-track ends at Ch 93+040. The proposed parallel track is around 440 m in length.

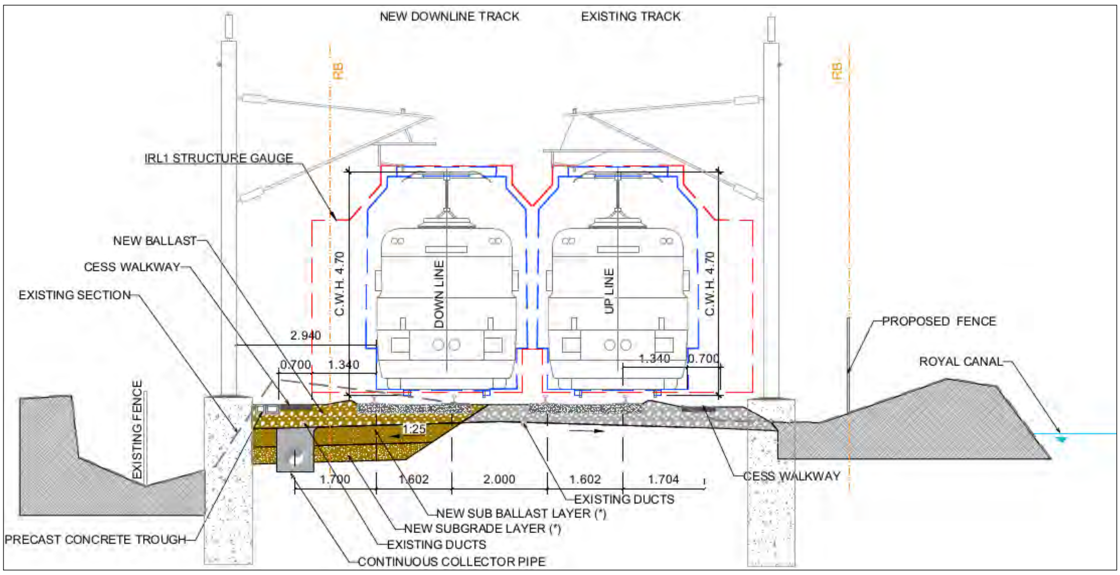


Figure 4-220 Section of new track (Down Track)

4.11.9 Track drainage

4.11.9.1 From Maynooth Station (Ch 90+200) to Ch 91+700

A drainage system has been designed between Ch 91+700 and Maynooth Station. From both points, collector drains capture runoff and discharge into an existing local network (UBG21A) at Ch 90+200, next to OBG21.

The drainage system consists of plastic pipes, ranging from 300 mm to 600 mm in diameter.

4.11.9.2 From Ch 91+700 to depot (Ch 92+031)

From the end of the double track section (Ch 93+025) in the direction of UBG22B, piped collector drains are proposed at both sides of the tracks, discharging to a detention pond located at Ch 92+900. From this pond, the drains discharge to the watercourse through a trapezoidal ditch in the direction of UBG22B.

The drainage system consists of plastic pipes, ranging from 300 mm to 600 mm in diameter.

The total storage volume needed in the pond is 950 m^3.

4.11.10 CCE compound

A new CCE (Chief Civil Engineering) compound is to be located next to the depot. The main purpose of the CCE Compound is to provide storage areas for ballast and track elements such as sleepers or rails. It will also contain space to stable maintenance vehicles and accommodation and facilities for the maintenance workers.

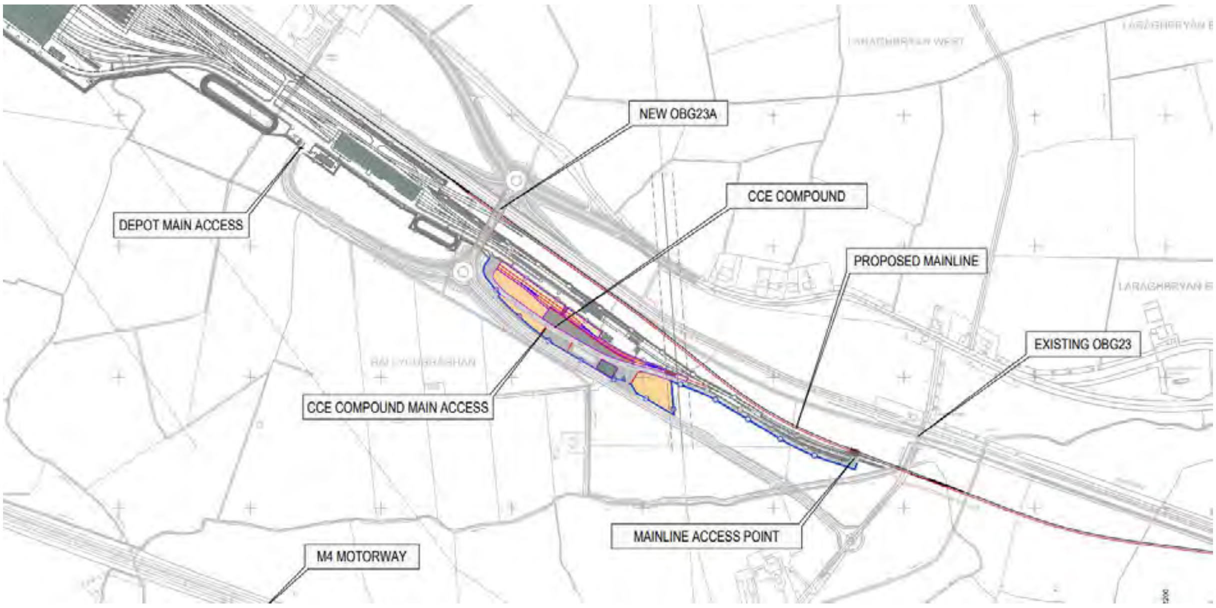


Figure 4-221 CCE compound location

The CCE compound building is proposed in the southern part of the depot and will be provided with a road access from the L5041. It is provided with parking spaces on its east side (capacity for 32 cars). In the building two parts are clearly distinguished: the storage area and the personnel services area (canteen, lockers and installations). Dimensions of this building are 33 m x 19 m and 5 m high.

The storage area is configured as follows:

- OHLE: storage containers for tools and materials and storage for replacement materials (cantilevers, contact wire, etc)
- CCE: storage containers for tools and materials

Figure 4-222 CCE compound building - 3D view

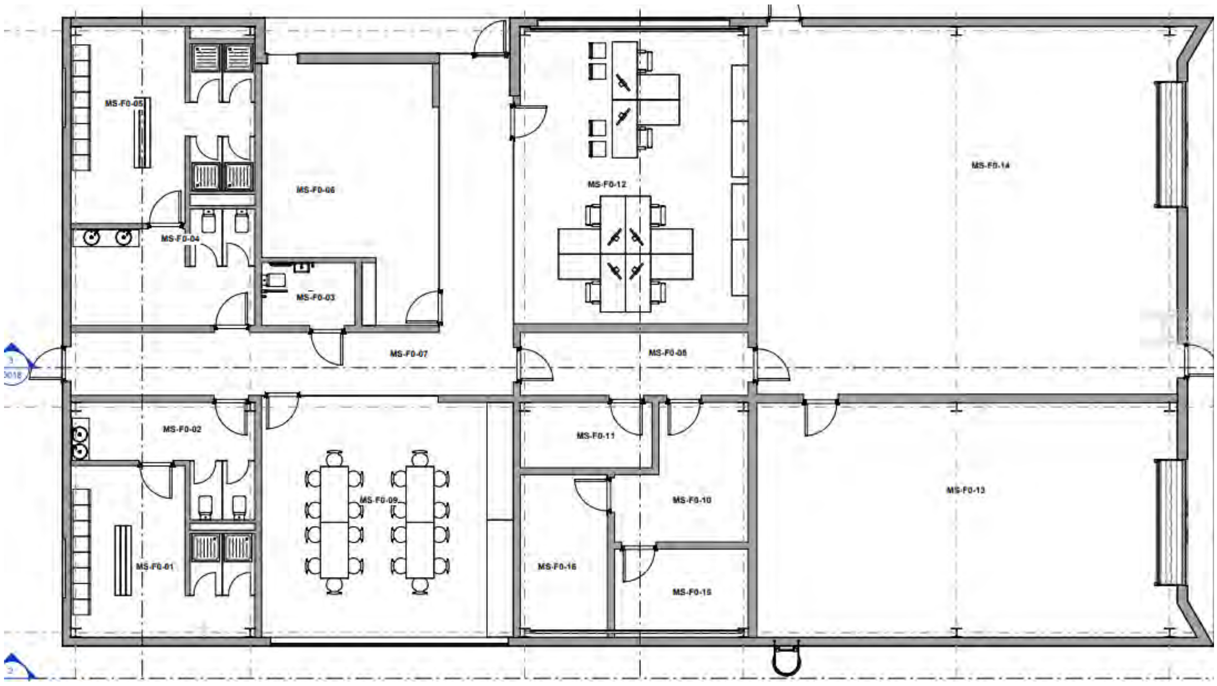


Figure 4-223 CCE building layout ground floor

4.11.10.1 Drainage

The storm drainage and sewerage systems will be designed as separate networks, so that rainwater is collected, treated as necessary by means of sand and oil separators and discharged into the depot surface water network, which leads to the ponds.

4.11.11 L5041 diversion

4.11.11.1 New bridge OBG23A

A new bridge, OBG23A, will be constructed to access the depot crossing the Royal Canal from the R148 Kilcock Road.

Figure 4-224 Location of OBG23A

This new OBG23A provides separate road access to the depot and connects to the existing road network (R148 and L5041).

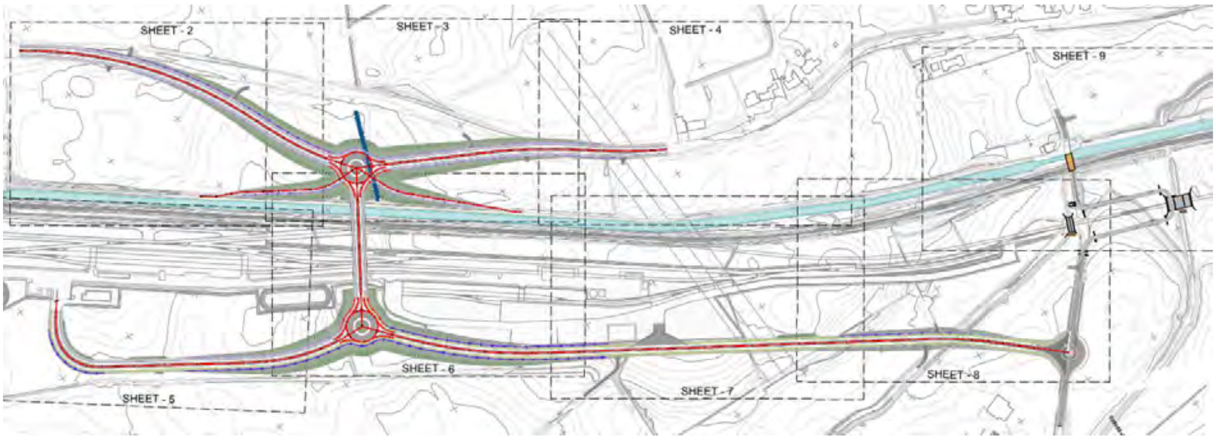


Figure 4-225 General view of OBG23A

To ease the review of the information provided in this section, the road alignment has been split into different sections as shown below.

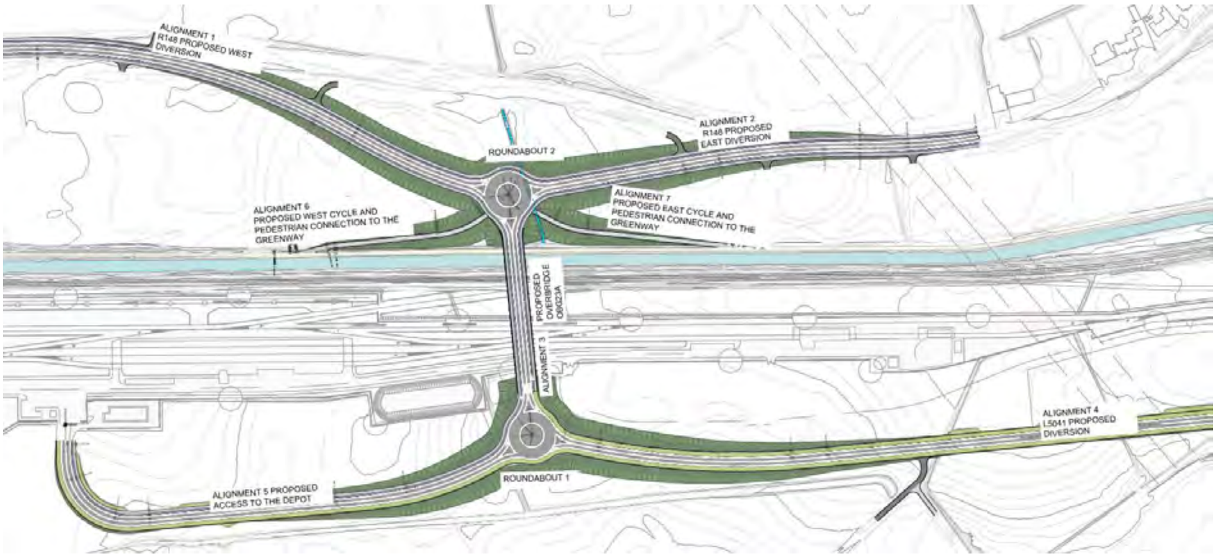


Figure 4-226 Proposed road alignments for the OBG23A road network

The structural solution for the bridge must minimise the deck depth to maintain clearance to the railways and avoid a sharp rise in the longitudinal gradient of the road alignment. The current bridge design has a minimum vertical clearance from the top of the rail to the soffit of at least 5.30 m, as per I-PWY-1101 Requirements for Track and Structures Clearances.

South of the track, the alignment is constrained by the connection to the depot access road. Due to geometrical constraints, a roundabout will be incorporated to achieve a reasonable gradient in the road alignment.

The northern side of the bridge connects to the R148. Due to similar constraints here, a roundabout has also been proposed to achieve a reasonable gradient. The proposed bridge solution is a 5-span precast concrete beam deck.

The total length of the bridge is approximately 107.5 m, consisting of 5 spans of 21.5 m each. Total width is 16.80 m. The bridge has two lanes, two segregated cycleways of 2 m width and two footways of 2 m width. The required deck thickness is approximately 1.0 m with a 0.2 m top slab. The positions of the piers have been designed with consideration of the positioning of the railway lines to the depot, the Royal Canal and the internal road.

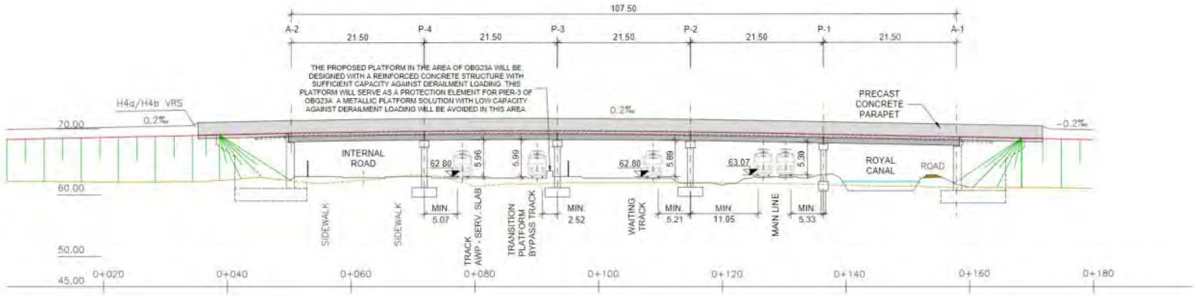


Figure 4-227 Proposed span arrangement for OBG23A - elevation

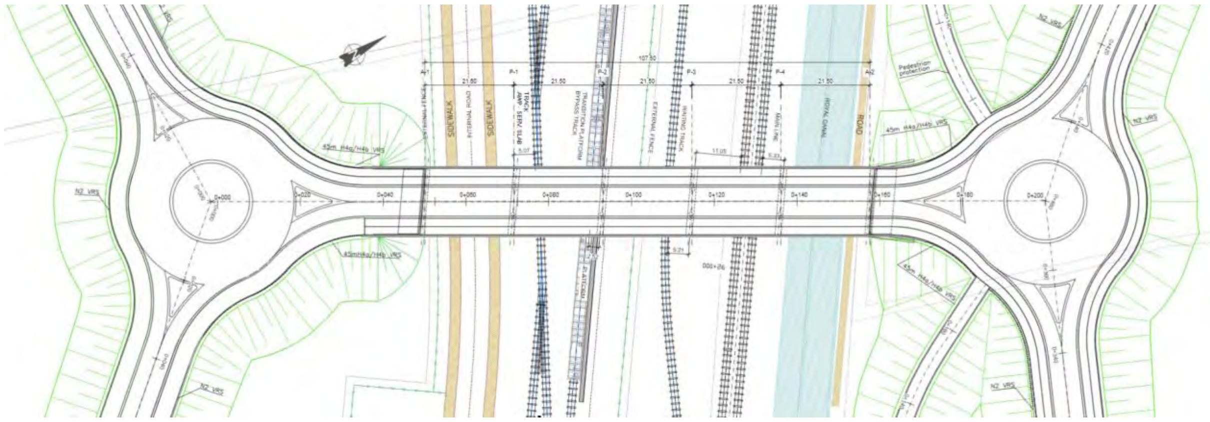


Figure 4-228 Bridge plan view

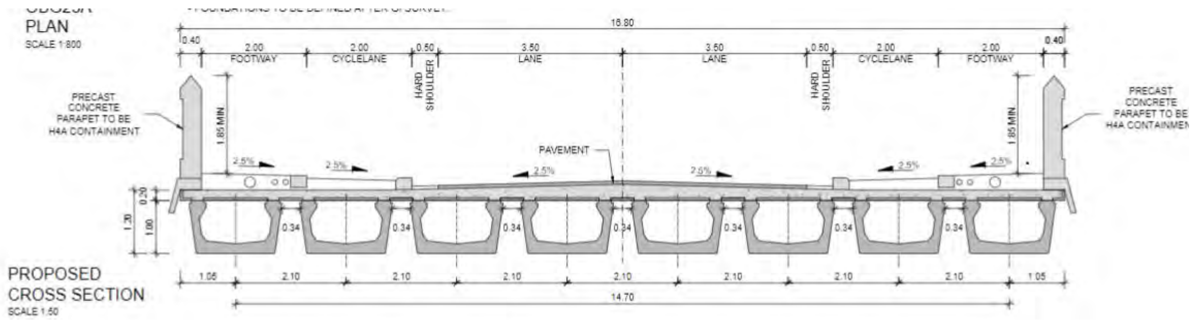


Figure 4-229 Cross-section

4.11.11.2 L5041 Road diversion

The L5041 local road extends from the L5042 local road at its southern end to the R148 Maynooth-Kilcock road at the north, crossing the existing M4 motorway and bridging over the Royal Canal and rail line at Jackson Bridge (OBG23) at its northern end.

The proposed road diversion starts 70 m south of Jackson's Bridge on the L5041 and turns off to the west. The new route shall head west (Alignment 4) approximately 900 m where a new roundabout (Roundabout 1) shall take traffic to the new depot entrance (Alignment 5 – westbound spur) or over the new bridge OBG23A (Alignment 3 – northbound spur) where it shall connect to the R148 via another new roundabout system (Roundabout 2) heading west and east bound on Alignments 1 and 2 respectively (see Figure 4-226).

There are two primary constraints in connecting the L5041 diversion with the R148 running to the north of the Royal Canal and parallel to it. The first is the height that must be reached to pass over the railway tracks and the second is the flooding problem that exists in the area. Due to these restrictions, the proposed solution is to raise the road (by up to 10 metres in some locations) with respect to the existing alignment.

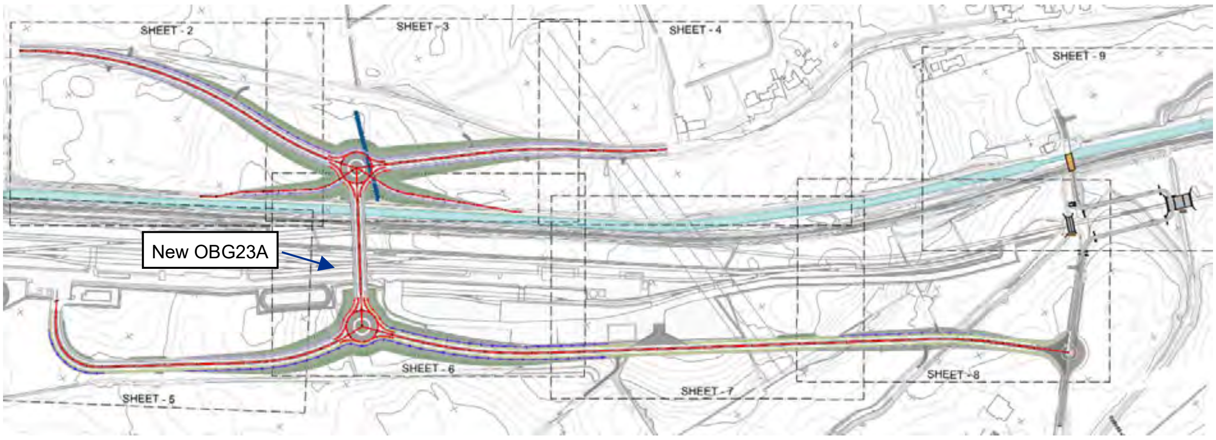


Figure 4-230 L5041 diversion

The L5041 diversion starts with a "T" junction and runs towards the west until you reach the southern roundabout. The diverted road will have an 8 m wide carriageway (0.5 m hard shoulder on each side and two 3.5 m lanes) and 4 m wide grass verges on both sides of the road. The severed section of the L5041 north of the T junction will provide local access to lands. The new roundabout provides access to the depot to the west and the new OBG23A crossing to the north over the tracks and the Royal Canal to connect to the R148 road.

The depot access road (also 8 m wide cross-section) provides pedestrian and cyclist facilities (2 m wide cycle track and 2 m wide footpath) to the north of the road to facilitate access for vulnerable road users travelling to work at the new depot. At the south lane, a 4 m wide grass verge is provided. For the new bridge section, a 2 m wide cycle track and 2 m wide footpath should be provided at both sides.

At the northern end of the bridge, a new roundabout will tie in the L5041 with the R148, which must be diverted at both sides of the roundabout. Pedestrian and cyclist facilities (2 m wide cycle track and 2 m wide footpath) are provided on both sides of this R148 road diversion.

In addition, access for pedestrians and cyclists is provided to the greenway north of the Royal Canal from the roundabout.

Due to the railway diversion south of Jackson's Bridge, the existing L5041 will be severed at this location. Therefore, in order to provide continuity for both pedestrians and cyclists and to maintain the use of Jackson's Bridge (protected structure), a route will be provided below UBG22A to allow pedestrians and cyclists to pass through. The existing ground level has been maintained through the structure (see Figure 4-231).

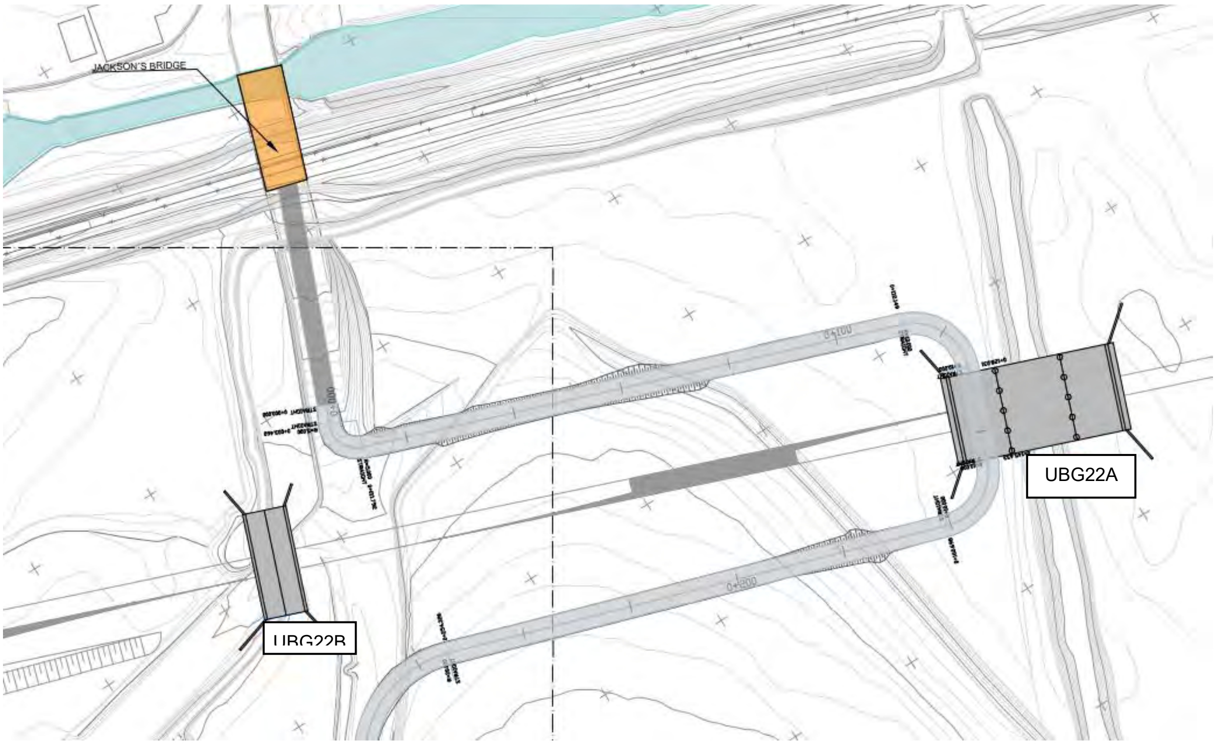


Figure 4-231 Pedestrian and cyclist diversion below UBG22A

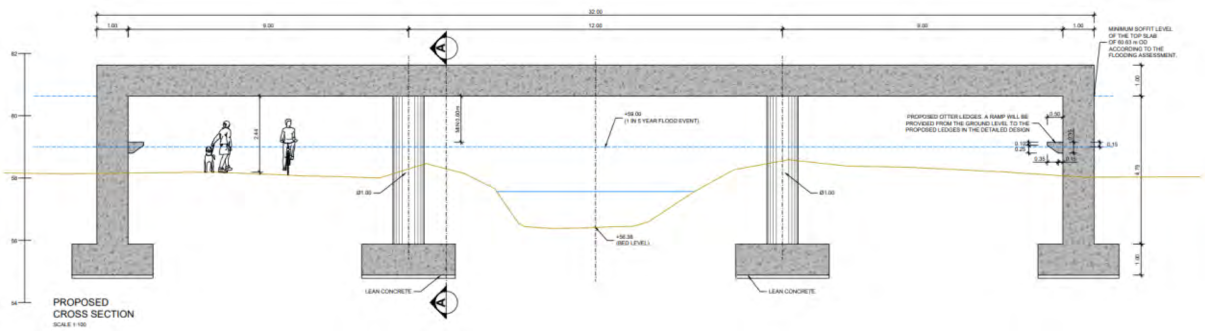


Figure 4-232 UBG22A cross section

4.11.11.2.1 L5041 Drainage

Selection of the type of surface water drainage has been carried out in accordance with DN-DNG-03022 Drainage Systems for National Roads, in which available solutions for road drainage are described.

The existing R148 has no formal drainage according to the latest utilities surveys. There are, however, several gullies that drain to the land or to open ditches where available. The new drainage system will be independent of the existing one and will discharge through gullies to open ditches where available.

Kerbs and gullies: This surface water drainage system will be implemented where there are footways along the carriageway. Embankments will also be provided with toe ditches carrying the water to streams. Petrol interceptors will be placed in manholes to treat water prior to discharge.

Over the edge drainage is proposed in verges for all embankments above 1.5 m in height, especially where there is an open channel next to the embankment. Over-the-edge drainage can provide some degree of pollution control as road runoff is allowed to filter through vegetation on the slope. This drainage system is proposed in the stretch of road that connects with L5041 (Alignment 4 as shown in).

Grassed surface water channels: This surface water drainage system is proposed in verges for low embankments less than 1.5 m in height. Therefore, it will be implemented mostly in Alignment 4, and in part of Alignment 5 (road connecting to the depot access) as shown in Figure 4-233 below.

The drainage system to be implemented for each of the alignments is summarised in Figure 4-233 below.

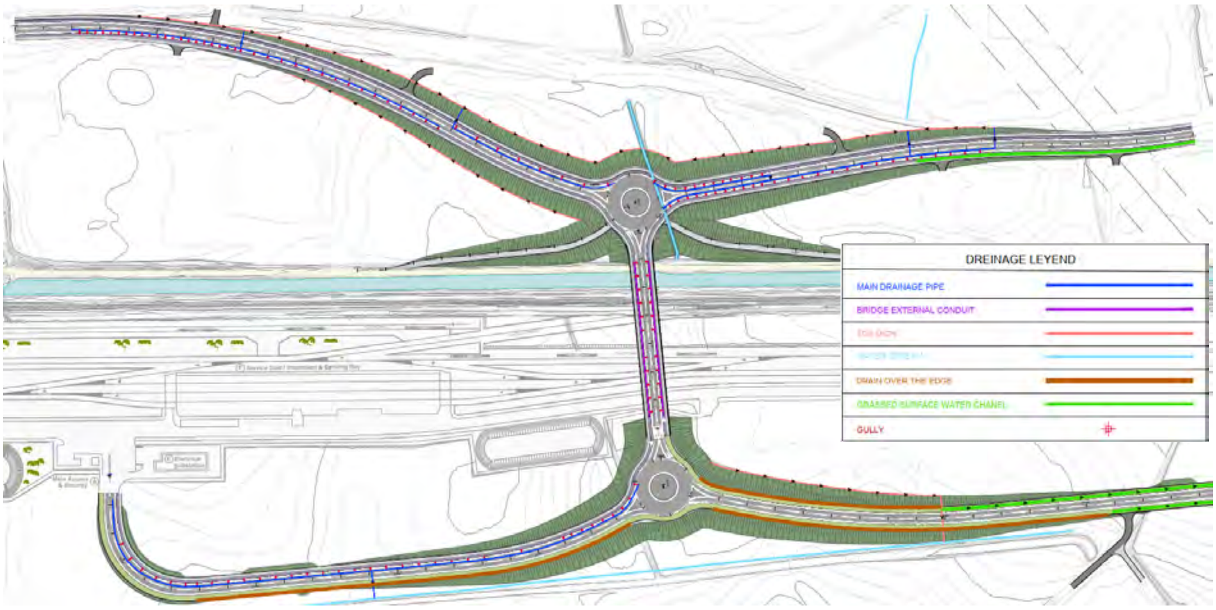


Figure 4-233 L5041 Drainage system proposed for each alignment

Two existing streams pass under the proposed L5041 realignment. At the northern roundabout, a 1.50 x 1.00 m concrete frame is proposed to carry the stream at this location. To the east of Alignment 4, a culvert has been proposed that wraps around the entire stream channel.

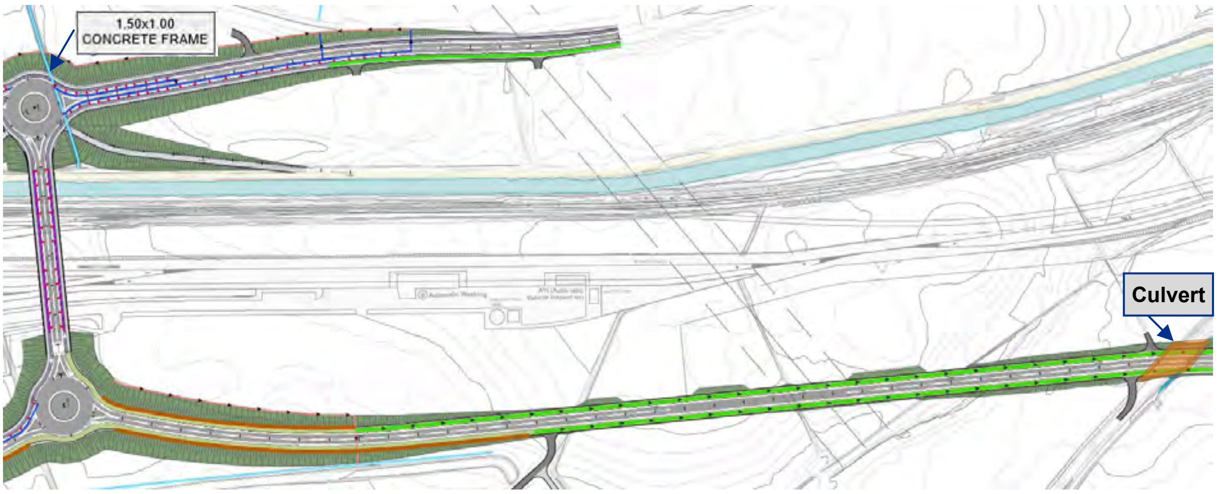


Figure 4-234 Concrete frame and underbridge for water streams under L5041

4.11.12 Depot

4.11.12.1 Introduction

The proposed depot is located on agricultural lands between Maynooth and Kilcock, parallel to the mainline. It will have two railway connections to the mainline and new road access from R148.

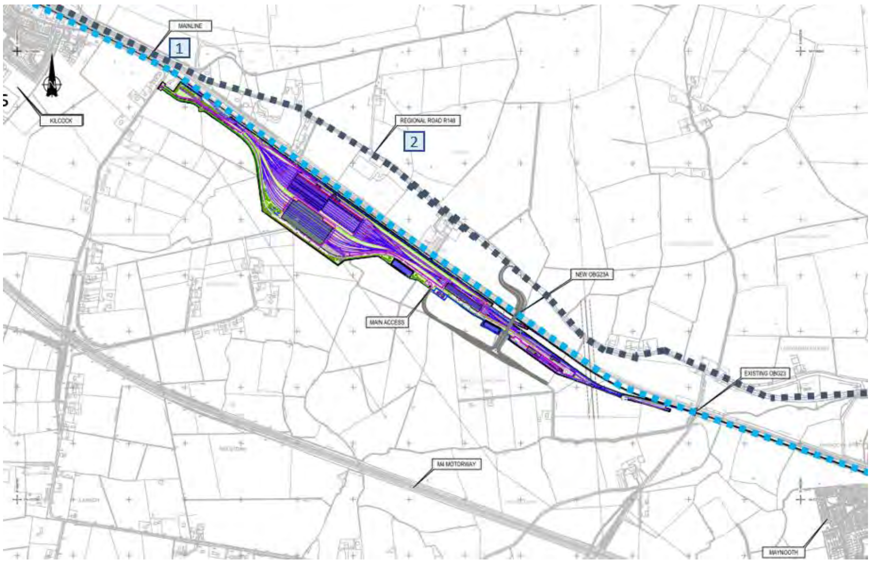


Figure 4-235 Depot location

The key features of the depot are:

- Area 32.6 Ha
- Length 2.58 km
- Maximum width 260 m

The depot track configuration is influenced by the internal distribution of the depot facilities and the connections to the mainline. The design proposal consists of providing a double track along the existing alignment. The track between Kilcock and Maynooth is predominantly straight for 2.2 km along the site of the depot, with curves at either end.

4.11.12.2 Access to the depot

Figure 4-236 below provides an overview of the two connections to the mainline and the road access.

Figure 4-236 Connections to mainline and road access.

The depot will be accessed only through the approved site entrance to maintain site security. The proposed road access to the depot is from the R148 (connecting traffic to Maynooth and Kilcock interchanges). This connection requires the construction of a new bridge crossing the Royal Canal and the track mainline as discussed previously (see Section 4.11.11).

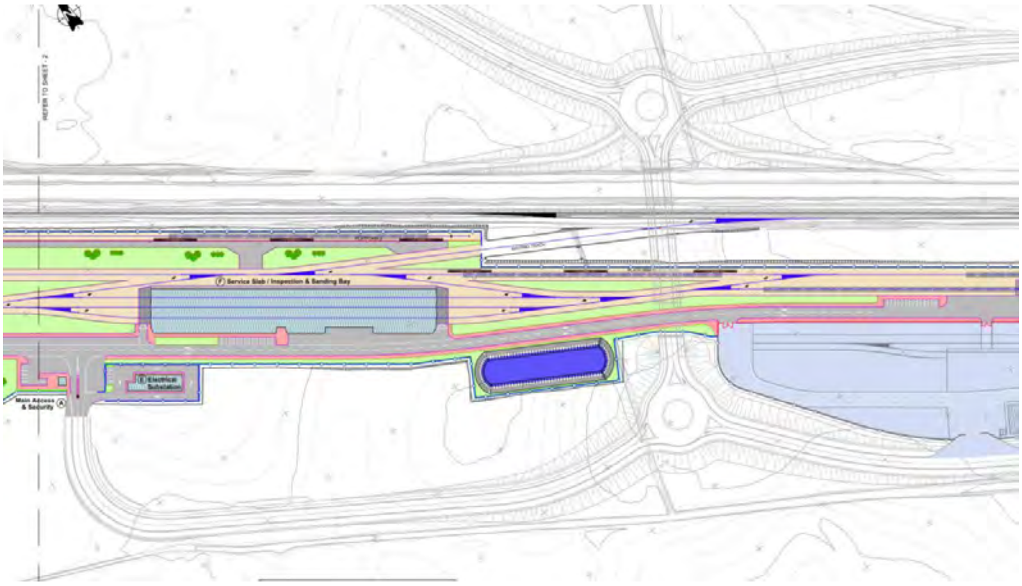


Figure 4-237 Proposed road access to depot

4.11.12.3 Depot layout

The train operation and the functionality of the depot are the most important design aspects. They have direct influence on the internal road network design, which has been adapted to suit the operational needs of the depot.

Figure 4-238 Depot layout

The road layout for the depot has been designed to allow HGVs around the site. Consideration has been given to special HGVs required to transport rolling stock around the depot. Road access will be provided to all facilities for servicing and maintenance.

The design and the arrangement of the facilities will minimise crossing points between railways and road and pedestrian routes. Consideration has been given to pedestrian and vehicular traffic flows to and from every building within the complex.

The depot shall be provided with a carpark for staff and visitors. To determine the number of parking spaces needed for the depot, the working shift with the highest number of people working simultaneously has been taken into consideration. The carpark outside the main building provides space for 125 vehicles.

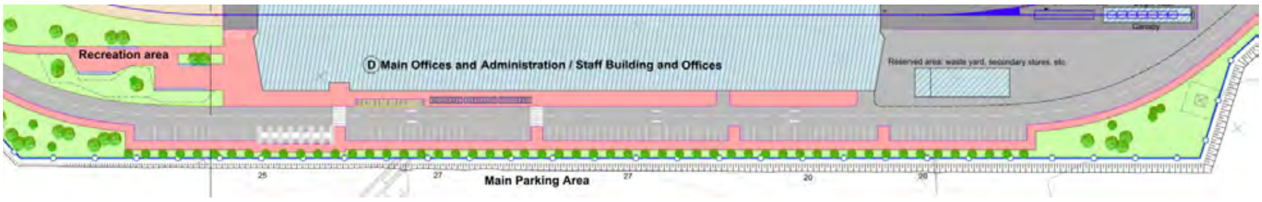


Figure 4-239 Main parking area

The service slab building has a carpark with capacity for 15 vehicles. 12 additional parking spaces for visitors have been provided near the main access.

The access control building is located close to the depot entrance gate to provide security control for access/egress to the depot facilities. The access control room shall be glazed to facilitate monitoring of the site and entrance.

Adjacent to this zone, there is a space reserved for the electrical substation. This zone will be appropriately fenced and provided with pedestrian and road access from the main road.

The current topography of the site ranges in elevation from approximately +65.9 m OD on the western side to +60.3 m OD at the eastern connection. Consequently, along the length of the complex, the TOR (Top of rail level) will be adapted to the facilities and the track configuration of the depot. This will be achieved by providing some platforms at a 0% gradient. The representative levels of these platforms are:

- AWP and Service Slab: +62.8 m OD
- Stabling area/Main building: +65.3 m OD

4.11.12.4 Depot facilities: plant and equipment at the depot

There are seven main facilities shown Figure 4-240 below.

1. Access building.
2. Main depot building.
3. Stabling area.
4. The service slab facility.
5. The automatic washing plant.
6. The electrical substation.
7. The CCE compound area.

Figure 4-240 Depot facilities

The **access building** is located at the entrance of the depot.

The **main depot building** is in the southern part of the complex, parallel to the stabling yard. It is composed of three main areas. The northern side for drivers and cleaners' facilities is proposed to be accessed by an underpass corridor from the main lobby of the building. The central part of the building consists of the maintenance shed with all the maintenance tracks, and the southern part of the building contains the workshops, storages, administration and staff amenities.

The maintenance shed has train access from both sides of the building. Consequently, the road and staff access to the building is by the road and pedestrian paths to the facility's south side. There is space reserved for a recreation area with trees, landscaping, benches, and walking paths on the western side. At the eastern side of the building, connected to the heavy maintenance tracks, there is the unloading bay for train carriages, with an exterior yard of 34 m x 110 m for the manoeuvring of delivery vehicles.

The wheel lathe equipment is not centred in the building but offset 30 m to the west. This is to allow 170 m of the track to have a 0% gradient at both sides of the wheel lathe.

Figure 4-241 Main depot building

The **stabling area** is placed parallel to the main building and the test track. The dimensions are 354 m in length and 82.5 m wide. The length of the stabling area is considered for berthing two FLU (Full Length Units or 10-car units) with additional aprons at both sides of concrete slab track to allow the passing of vehicles. The stabling yard is composed of a ballast track and platforms for accessing the trains. Access to the trains is provided through ladders and ramps on the platforms.

The stabling area has direct access from the drivers and cleaner's facility on the northern side of the main building. In addition, future provision has been made for a second washing plant to be installed in a track between the bypass track and the test track, parallel to the stabling yard, with a proper road connection for deliveries. Moreover, an area for more AVI equipment is provided if necessary.

The **service slab facility** is an enclosed building with the eastern and western façades opened to allow trains to pass through the facility. The dimensions are 186 m in length and 28 m in width. The southern margin of the building contains the staff amenities and the technical rooms and equipment. There is staff access to the building from the road and pedestrian paths to the south side of the building.

The **automatic washing plant** (AWP) is placed at the depot entrance, on the main ingress route for the trains. It is located after the AVI facility. The AWP is 42 m long and 9.5 m wide. The AWP has an adjacent control room for the control panel, equipment, tanks, etc. Th ere is staff access to the building from the road and pedestrian paths to the facility's south side. The geometry allows HGVs to turn around for deliveries in the AWP and the service slab area.

The **electrical substation** is located at the entrance with a stand-alone road network connection.

The **CCE compound area** is an independent design and is outside of the depot footprint. A fence will be provided between both areas. The main access to the CCE compound will be through the new OBG23A road south of the depot, but secondary access will be provided through the internal road. The CCE compound will be composed of the unloading tracks, the compound building, storage zones outside the building, and an RRV parking area. This area is described in Section 4.11.10.

The depot buildings have generally been designed as steel structures with spread foundations. More detail is given in Table 4-24 below.

Table 4-24 Depot buildings

Building	Building dimensions (width x length)	Height	Materials	Foundation
Workshop	77 m x 216 m	10.5 m	Steel columns Steel rafter	Isolated foundations
Drivers & Cleaners Area	11 m x 128 m	10.5 m	Steel columns Steel rafter	Isolated foundations
Administrative area	18 m x 136 m	10.5 m	Concrete columns Concrete slab Steel rafter	Isolated foundations
General Storage Area	18 m x 80 m	10.5 m	Steel columns Truss	Isolated foundations
Service Slab	23.7 m x 184 m	9.0 m	Steel columns Steel rafter	Isolated foundations
Automatic Washing Plant Building	8.7 m x 40 m	7.0 m	Steel columns Steel rafter	Isolated foundations
Electrical Substation	11 m x 48 m	6.0 m	Concrete columns Concrete beams	Isolated foundations
Access Control Building	5 m x 5 m	3.0 m	Steel columns Steel beam	Single footings

4.11.12.5 Architectural concept

Without neglecting aesthetics, the depot buildings are designed to meet strict functional and structural criteria, while also allowing a harmonious dialogue with the environment. There is a need to develop an eminently industrial design, but architectural design has been considered as well. The result is a building suitable for its use but also possessing clear aesthetic qualities.

Siting & Design. The proposed depot will be located in a rural landscape, surrounded by fields and meadows. Industrial infrastructure of this nature will substantially affect the environment. To integrate the building into the environment, the criteria issued by Kildare County Council will be followed, as set out in the specific County Development Plan 2017-2023. In relation to industrial and warehousing development, the plan prescribes that individual buildings should exhibit a high quality of modern architectural design and finish (including the use of colour). In two or more industrial/warehouse units, a uniform design is required for boundary treatments, roof profiles and building lines.

Image. Given the large size of the main buildings, it is appropriate to make them as simple and neutral as possible. This is to prevent them from having excessive visual prominence in the environment. Simple straight lines have been sought. In this way, the buildings will be as unimposing on the landscape as possible and will better carry the passage of time. As required by the County Development Plan, which prescribes modern architecture, the current design offers a solution that lies midway between an industrial and a technological building. To achieve this, metal panelling finishes have been chosen, arranged vertically to modulate and texture the resulting long facades.

Figure 4-242 Main depot building

Corporate Image. The depot buildings offer a corporate image to the public. In this sense, the CIÉ logo will be integrated into specific elevated points of the most significant facades. This signage can be done simply with the logo or with the logo plus the corporate name. The visual suitability will be studied from the other side of the Royal Canal and at the main building entrance.

Daylighting and ventilation. Special care will be taken to study architectural strategies to introduce as much natural light and ventilation as possible into the depot buildings. In a working environment, natural light is essential and lends positively to many of the activities and uses within a building and can enhance the quality and experience of using interior spaces.

The offices oriented to the south will receive natural light through the windows located in the facade. Windows will have horizontal wooden louvres that protect from the direct incidence of solar rays. The aim is to comply with the Building Regulations, Part L, Conservation of Fuel and Energy, Section 1.3.5 “Limiting the Effects of Solar Gain in Summer”. These slats will have a wide separation (40-60 cm), stopping the sun's direct rays but allowing an unobstructed view through them. The windows shall have a manual opening system that allows them to be opened for ventilation and for cleaning. There will be roller blinds provided inside, which can be used to further control glare.

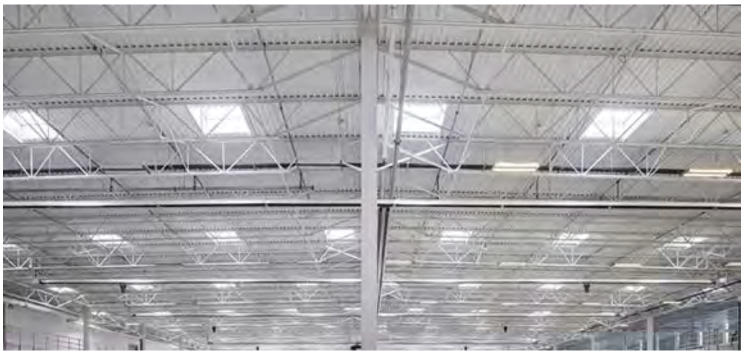


Figure 4-243 Industrial building lighting by skylights

Visual design: signage. Within the signage package, we have advanced a solution to identify buildings through large-format letters located on the main access doors. Coding buildings is a useful strategy for identifying buildings, especially for visitors and external personnel. This coding should be represented on the information panel located at the access to the depot.

Landscaping. As required by CIÉ, a recreation area has been created beside the main building, close to the general entrance. It will have benches and trees to provide shade . Small mounds will isolate users from the rest of the plot. The proximity to the building allows workers to go directly from the canteen to the recreation space. The design does not interfere with the free passage for vehicles and people towards the track area.

Figure 4-244 General view

4.11.12.6 Cross-sections

Track types

There are three different types of tracks in the depot:

- Ballast track (depot yard and stabling yard)
- Slab track embedded in concrete (maintenance shed and level crossings for road traffic and pedestrian access)
- Tracks on pillars (maintenance shed)

The ballast track section within the depot is designed according to CCE-TMS-300 Track Construction Requirements and Tolerances. Consequently, the rail profile to be used is the 54E1, and the sleepers shall be made of concrete. The minimum ballast depth is 300 mm.

Figure 4-245 shows an indicative section of the proposed ballast track cross-section.

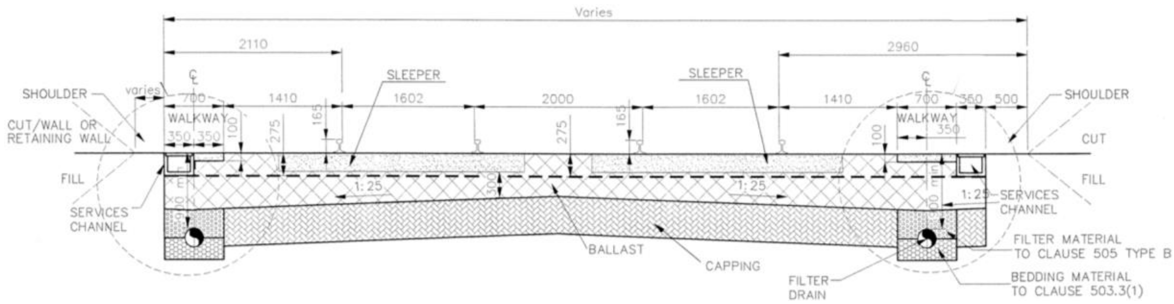


Figure 4-245 Indicative ballast track section

The ballast track is mainly used in the depot yard area outside of the buildings and facilities. The slab track sections embedded in concrete are used in the maintenance shed and the road crossings with the railway line. Figure 4-246 shows an indicative section of the concrete slab track.

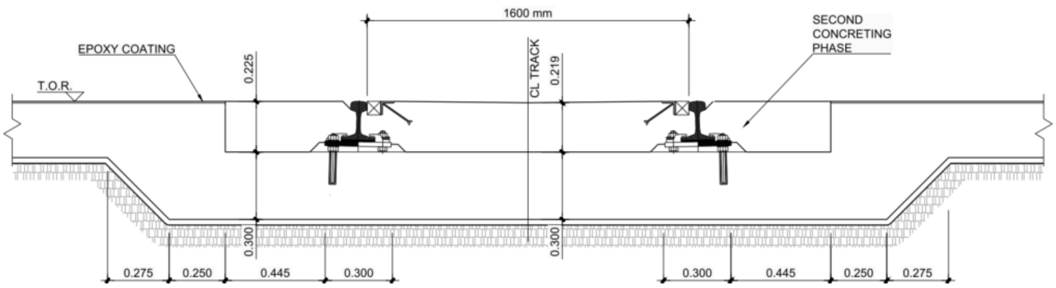


Figure 4-246 Indicative concrete slab track section

The light maintenance tracks will have pedestal mounted rails in the maintenance shed to provide access underneath the vehicles. The track will have an interior pit of 0.7 m. In the continuous pit area of the light maintenance tracks, the level will be 1.1 m below the TOR. Figure 4-247 is an indicative section of the track on pillar.

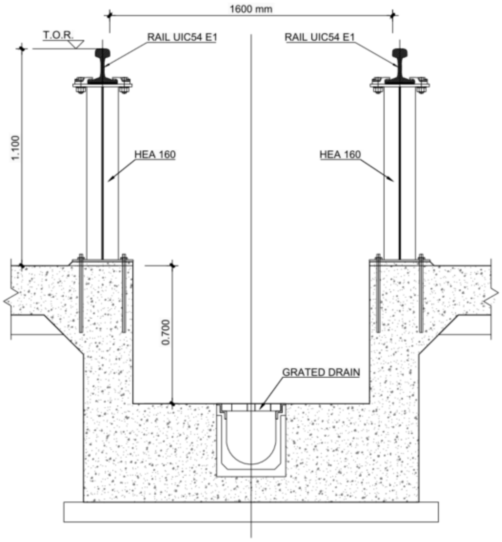


Figure 4-247 Indicative light maintenance track section

There is a platform in the stabling area between two tracks to provide access to the train for the cleaner's brigades and the drivers. A cross-section is shown in Figure 4-248 below.

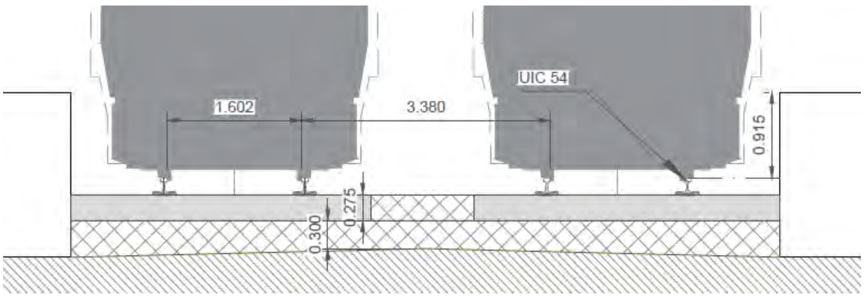


Figure 4-248 Indicative stabling area cross-section

Road cross-section

Figure 4-249 shows the proposal for the road cross-section for the road network in the depot.

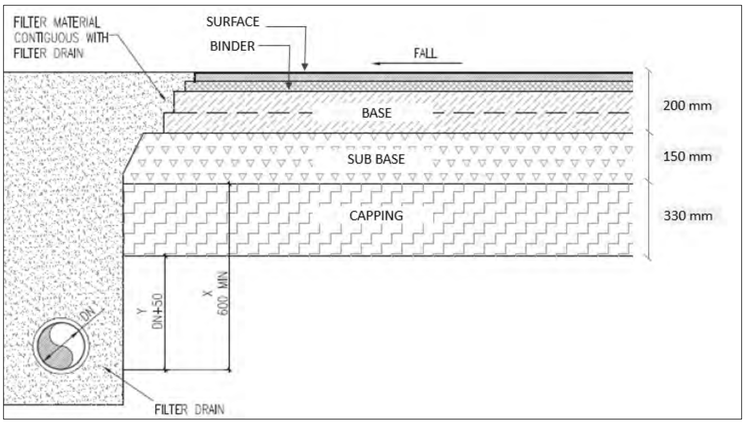


Figure 4-249 Road cross-section

It is important to note that the road cross-section and materials are dependent on the results of geotechnical investigations that are to be carried out at the depot site. However, the current design approach considered is conservative at this stage.

External security fence

Security provision is required for the depot. The site shall be completely enclosed with security fencing along the whole perimeter.

The main characteristics of Security Purpose (SP) fencing are listed below:

- The fencing shall be 2.4 m tall (the top of the fencing pales shall be 2.4 m above ground level).
- Pales shall be 3.0 mm thick and corrugated with a 'W' profile. The maximum spacing of pales, centre to centre, shall be 155 mm. The minimum face to view (width) shall be 70 mm.
- The top centre of posts shall be 2.75 m. The posts shall be set in concrete in the ground to a minimum depth of 750 mm.
- A minimum of two horizontal rails shall be installed.

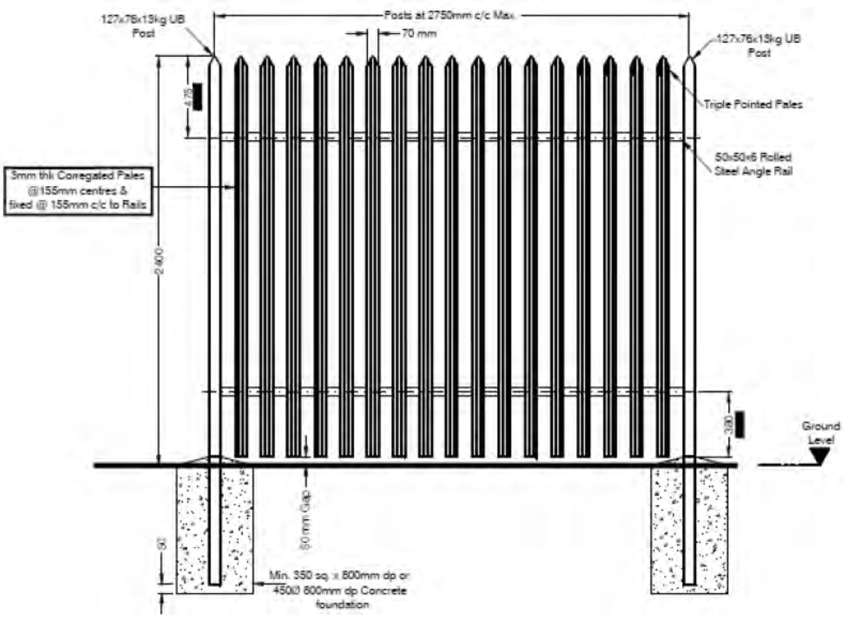


Figure 4-250 Security Purpose (SP) fencing

4.11.12.7 Depot drainage

The area consists of gently sloping terrain towards the southeast of the site. Sub-catchments of the site have been investigated, and the area drains to a stream south of the depot, which connects to the Lyreen River, east of the depot.

An existing stream connecting to the Lyreen River will be diverted via the perimetral ditch around the depot. This stream is covered by vegetation, as shown in Figure 4-251 below. The approximate width of the existing stream is around 4.5 m and the diversion will have a length around 600 m.

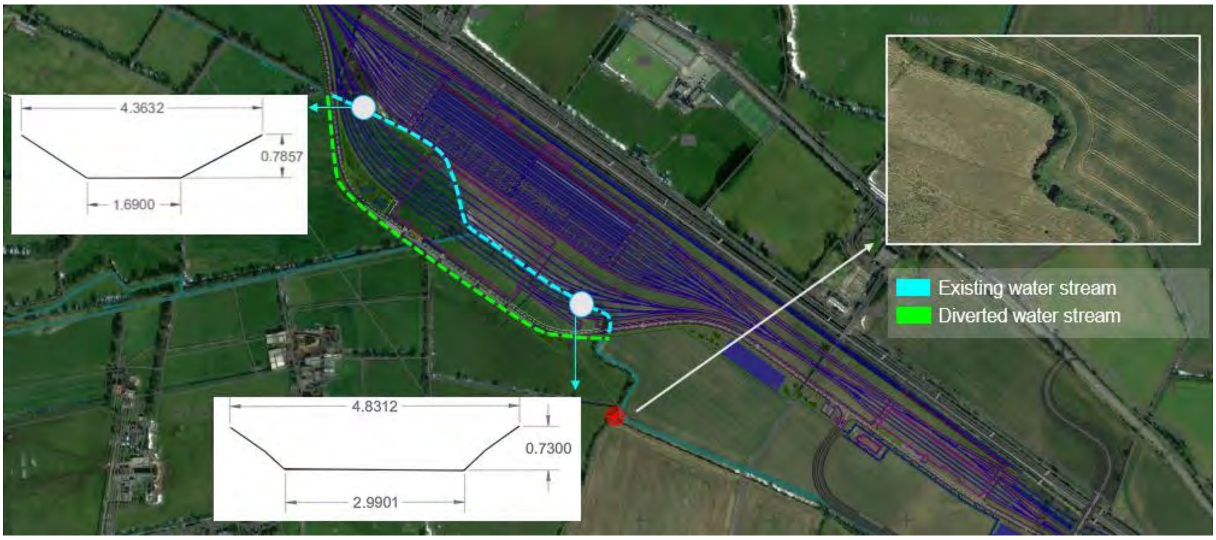


Figure 4-251 Proposal for diversion of the existing water stream

There are seven separated surface water sub-catchments, each of them leading to a discharge point as shown in Figure 4-252. Sub catchment 1 discharges into the perimetral ditch before passing through filter strips. Sub catchments 2,3, 4 and 5, discharge into the main attenuation pond, and sub-catchments 6 and 7 discharge into the eastern attenuation pond. CCE compound surface drainage will also discharge to the eastern pond.

Once in the ponds, the surface water runoff is discharged into the existing water stream south of the depot at a controlled flow rate, which is to be the greenfield runoff rate.

Figure 4-252 Surface drainage sub catchments

The two attenuation ponds are features with a permanent pool of water that provide both attenuation and treatment of surface water runoff. Runoff from each rainfall event is detained and treated in the pool. The pool acts as the main treatment zone and helps to protect fine deposited sediments from resuspension. The top water level of the attenuation ponds should be at the invert level of the outlet structure.

The drainage network will incorporate Sustainable Drainage Systems (SuDS), which are to be designed following the relevant sections of the Building Regulations, BS EN 752 and EN 12056, and the CIRIA SUDS Manual.

Figure 4-253 Surface drainage, SuDS

The main elements of the sustainable urban drainage system labelled in Figure 4-253 above are as follows:

- Filter strips (1).
- Pervious pavements (2).
- Attenuation ponds (3).

4.11.12.8 Depot utilities connections

Two different **sewerage networks** have been included - one for the industrial drainage from workshop building utilities, which will also collect the water from the AWP and service slab, and the other for the sewage effluent from other buildings.

Waste (grey) water produced during the washing of the trains in the automatic washing plant will be recycled for reuse (up to 80%), leaving the rest for discharge into the industrial drainage system. Industrial wastewater generated in the workshop will be collected and treated in the water treatment plant.

The wastewater discharged from the water treatment plant in the depot will be collected for discharge into the public sewerage network.

The **water supply system** will be connected from the public supply network by Irish Water to deliver potable water to storage provided by two separate water tanks.

Water supply pipes should be sized to keep friction losses under peak flow conditions to a manageable level. The selection of pipe diameters requires an understanding of projected flows for the service life of the system. Maximum velocities may range up to 2.5 m/s, or as needed, to keep the head loss gradient to a maximum of 10 m per kilometre. The pipelines will have gate and non-return valves, reduction cones and disassembly joints, air valves at high points and scour valves at low points.

The gas network for the depot area will connect to the gas network west of the depot in Kilcock. As stated by GNI, this is their preferred option, which would avoid putting pipework through the new OBG23A. The gas network will have to convey gas safely to the depot. All trenches constructed to accommodate a gas main shall allow for a minimum cover of 750 mm. Gas mains shall not be laid with cover greater than 1200 mm. The total trench width shall amount to the outside diameter of the gas pipe plus 300 mm. Sand or pea gravel of a minimum of 150 mm shall surround the gas main.

4.11.12.9 Operational power demand

The analysis of the depot power demand has been carried out in the MEP depot Design. The total power demand estimation takes diversity factors into account. The minimum available spare capacity for future expansions shall be 20%.

The buildings power demand is based on different ratios (W/m2) considering the activities and uses of each area. The power demand for production is based on the available data of depots with similar operation.

The following load schedule is shown below:

- RW+RSM+O: Railway LV-SET, Rolling Stock Maintenance and Operation loads.
- Building: Building loads without electric vehicle (small power, lighting, HVAC, IT, etc.).
- EV: Electric Vehicle loads.

Table 4-25 Depot load schedule

				B	R	V	B+R+V				
			Ratio	Building	RW+RSM+O	EV	TOTAL	DISTRIBUTION (kW)			
Code	Building /Area	Area	(W/m2)	(kW)	(kW)	(kW)	(kW)	MDSB 1.1	MDSB 1.2	MDSB 2.1	MDSB 2.2
A	Main Access & Security Building	22	237	5.2	0.0	5.4	10.6	0.0	0.0	10.6	0.0
B	Automatic Washing Building	424.4	25	10.5	55.5	0.0	66.0	0.0	0.0	0.0	66.0
F	Service Slab / Inspection & Sanding Bay Building	4686.4	21	99.7	30.0	7.2	136.9	0.0	0.0	136.9	0.0
AVI			-	3.0	12.5	0.0	15.5	0.0	0.0	0.0	15.5
	Main Fire Pump	64	-	225.1	0	0.0	225.1	0.0	0.0	0.0	225.1
C	Main Maintenance Workshop Building	21 239.8	22	473.8	442.8	52.2	968.8	526.0	442.8	0.0	0.0
D	Main Offices and Administration / Staff Building	2983.31	48	143.3	0.0	0.0	143.3	143.3	0.0	0.0	0.0
D	DMC workstations and Servers	146.04	200	29.2	50.0	0.0	79.2	0.0	79.2	0.0	0.0
G	Stabling Area	30 656.0	8	245.2	0.0	0.0	245.2	245.2	0.0	0.0	0.0
TC	Trash Compactor		-	7.5	0.0	0.0	7.5	7.5	0.0	0.0	0.0
	Outdoor areas/External Lighting + water pumps	235 524	0.25	58.9	0.0	0.0	58.9	39.3	0.0	19.6	0.0
LV-SET	Points Heating		-	0.0	544.0	0.0	553.0	0.0	415.0	138.0	0.0
LV-SET	Signalling		-	0.0	75.2	0.0	75.2	0.0	75.2	0.0	0.0
LV-SET	SET-TER			0.0	10.0	0.0	10.0	0.0	10.0	0.0	0.0
MDB	TOTAL POWER			1301.4	1220.0	64.8	**2595.2**	**961.3**	**1022.2**	**305.1**	**306.6**
EMDSB	TOTAL RAILWAY CRITICAL POWER			29.2	135.2	0.0	**164.4**	**0.0**	**164.4**	**0.0**	**0.0**
P	Permanent Way Maintenance / Storage Area	1108.1	23	25.8	0.0	10.8	36.6	0.0	0.0	0.0	36.6

In order to size the transformers – which feed the MDB (Main Distribution Board) – and the permanent emergency generator – which feeds the EMDSB (Essential Main Distribution Switchboard) – a diversity factor of 0.7 is used, which is the estimated maximum peak power demand.

Table 4-26 Maximum peak power demand

		MAXIMUM PEAK (kW)			
	Total MDB	MDSB 1.1	MDSB 1.2	MDSB 2.1	MDSB 2.2
Connected Load (kW)	**2595**	961.3	1022.2	305.1	306.6
Diversity factor between panelboards	0.7	0.7	0.7	0.7	0.7
Diversified Load (kW)	**1817**	672.9	715.5	213.6	214.6
Power Factor	0.95	0.95	0.95	0.95	0.95
Total Power Demand (kVA)	**1912**	**708**	**753**	**225**	**226**
Installed Transformer power (kVA)	**2800**	**1000**	**1000**	**400**	**400**
Spare load	**46%**	**41%**	**33%**	**78%**	**77%**

Table 4-27 Total EMDSB

	Total EMSDB
Connected Load (kW)	**164**
Diversity factor between panelboards	0.7
Diversified Load (kW)	**115**
Power Factor	0.8
Total Power Demand (kVA)	**144**
Installed Generator power (kVA)	**180**
Spare load	**25%**

Usually, less power will be required as some loads such as the point heating, fire pump and workshop small power are very occasionally used, so a diversity factor of 0.4 is estimated in that case. The table below gives the design load for a transformer in the case that the other fails, or the expected temporary generator load to be connected.

Table 4-28 Typical consumption

	Total MDB	TYPICAL CONSUMPTION (kW) MDSB 1.1	MDSB 1.2	MDSB 2.1	MDSB 2.2
Connected Load (kW)	**2595**	961.3	1022.2	305.1	306.6
Diversity factor between panelboards	0.4	0.4	0.4	0.4	0.4
Diversified Load (kW)	**1038**	384.5	408.9	122.0	122.6
Power Factor	0.95	0.95	0.95	0.95	0.95
Total Power Demand (kVA)	**1093**	**405**	**430**	**128**	**129**
Installed Transformer power (kVA)	**1400**	**1000**		**400**	
Spare load	**28%**	**20%**		**55%**	

The power demand estimations shall be updated in the detailed design phase based on real data for all the loads to be supplied.

4.11.12.10 External lighting

Outdoor lighting shall be LED type, with the following features:

- Glare and lighting pollution control according to CIE 126-1997 and 150-2003: luminaires will be pole or wall-mounted with the suitable optic and no tilt. Uplighting will be forbidden.
- High energy efficiency (whole luminaire over 120 lm/W).
- Minimum service life of 50,000 hrs (L80/B10) at = 25 degrees C.
- Suitable dust and waterproofing: IP65.
- The BMS (building management system) will control external lighting: It will be automatically turned off during daylight hours; work and inspection areas may be dimmed or turned off and turned on at a whole level when a worker is detected.

According to applicable standards (CIBSE) and best practices, the minimum lighting levels shall be the following (horizontal illuminance unless otherwise stated):

Table 4-29 Depot lighting levels

EXTERNAL AREAS	ILLUMINANCE	U0
Tracks, railway yards and marshalling area	10 lux	0.4
Stabling (walking, floor)	10 lux	0.4
Stabling (train servicing, floor)	20 lux	0.4
Stabling (train vertical side)	20 lux	0.25
Storage areas	20 lux	0.25
Car road and walkways	15 lux	0.4
Car parking	10 lux	0.25

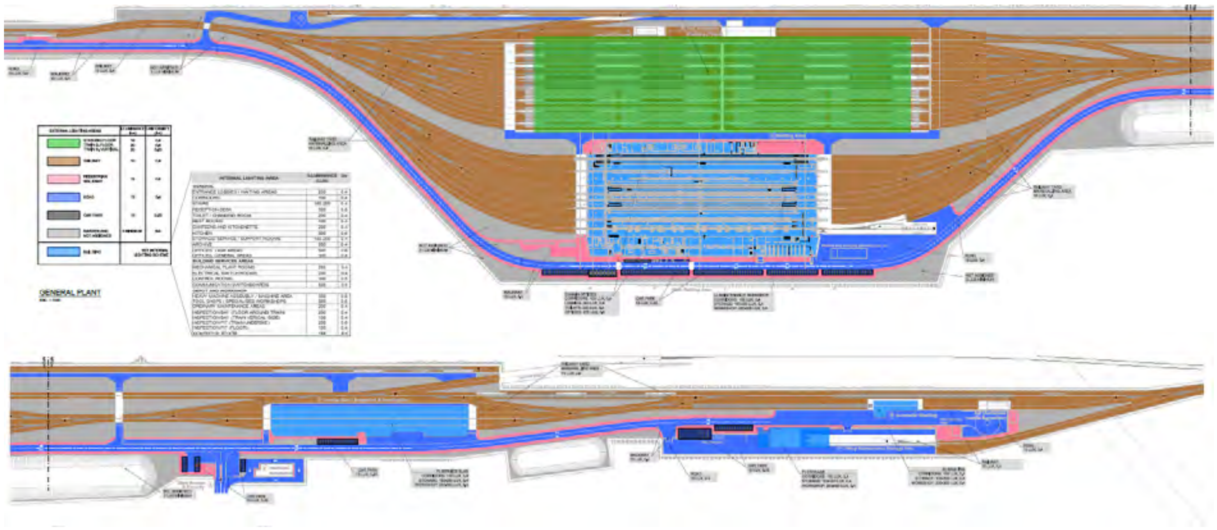
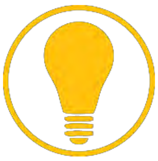


Figure 4-254 Depot lighting levels

A number of night-time photomontages are provided in Volume 3B of this EIAR to present the lighting levels at the proposed depot.

4.11.12.11 Sustainability strategy

The objective of the depot design is to be functional, providing efficient and comfortable buildings with minimum environmental impact, being a Nearly Zero Energy Building (nZEB) and achieving EXEED certification. For the progression of this strategy, the design is focused on three key aspects:



- Energy: With CIÉ's objective of achieving nZEB, the proposed development will promote energy saving with a cost-optimal approach by reducing the energy demand with passive architectural strategies, reducing energy consumption with energy-efficient equipment and producing energy with renewable technologies. Energy is also related to CO_2 emissions and CIÉ's future carbon neutrality goal.

- Water: Minimise potable water consumption by using low consumption fixtures and through recycling and reuse of greywater.

- Materials: Prioritise the use of environmentally friendly materials and the use of recycled and recyclable materials.

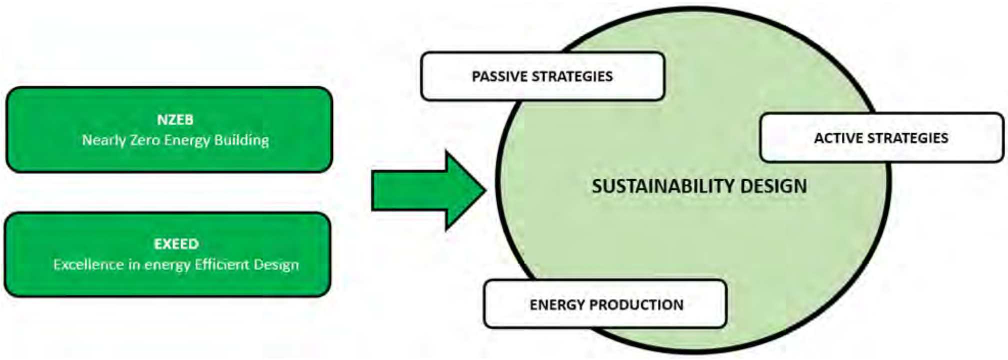


Figure 4-255 Sustainability strategy

4.11.12.11.1 Energy

The buildings are designed to comply with the amendments to Part L of the Building Regulations, giving effect to Nearly Zero Energy Building (NZEB). For this reason, and following the European Energy Performance in Buildings Directive (EPBD), a cost-optimal methodology is proposed, focusing the efforts on: reducing the energy demand with the use of passive architecture strategies, followed by reducing the energy consumption with the use of highly efficient active systems, and lastly, with the use of renewable energies. This multi-step process is summarised in the sections below.

4.11.12.11.1.1 Climate analysis

The first step in every sustainable building design, consists of understanding the climate in order to adapt to its characteristics and respond to the external conditions by providing design strategies capable of reducing the energy needs and maximising internal comfort. A detailed analysis of the climate was carried out, with consideration of historical climate data, average temperatures, humidity ratios, solar radiation, solar height and variation of the aforementioned parameters throughout the year.

4.11.12.11.1.2 Bioclimatic study

A bioclimatic study was carried out considering the 8,760 hours per year of the weather file. This data was plotted against bioclimatic strategies on a psychrometric chart as seen in Figure 4-256. According to the analysis, hypothermal comfort conditions are only reached during some hours in July, and thermal gains would be needed for the remainder of the year to improve comfort conditions. The recommendations on the chart are solely based on external conditions and need to be investigated further with the use of energy simulations to find the optimum situation for a specific building.

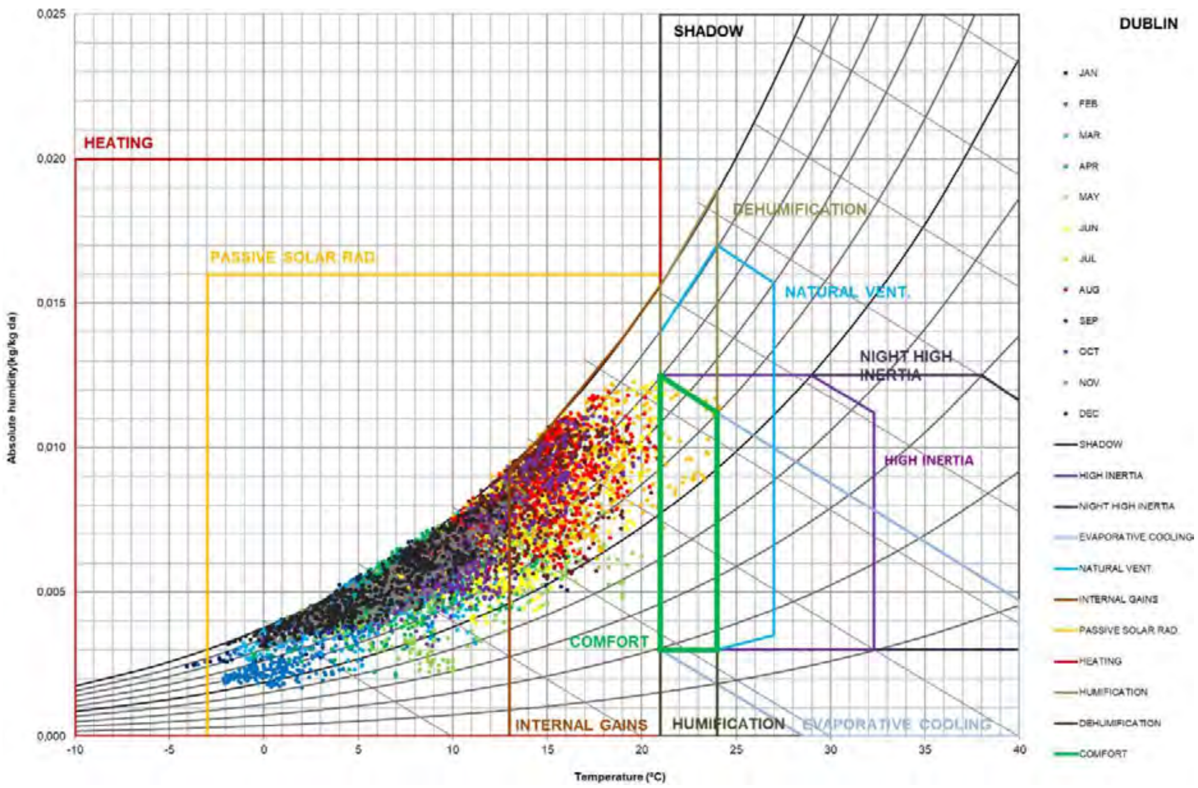


Figure 4-256 Givoni's bioclimatic chart

4.11.12.11.1.3 Preliminary guidelines for architectural design

Guidelines for architectural design were developed to reduce energy consumption which considered passive strategies, active strategies, renewable energies, ISO 50001 and EXEED certification.

Passive strategies include:

- Envelope and insulation (use of high insulation values to reduce thermal losses).
- Solar control (allowing solar radiation to enter the building in cold months, whilst preventing it in warmer months).
- Natural ventilation (the design should allow for natural ventilation without creating air drafts).
- Daylight (the design should maximise use of natural light to reduce the energy needs associated with artificial lighting).

Active strategies include reducing energy consumption related to:

- Hot water generation (use of heat pumps, residual heat from air compressors and gas condensing boilers).
- HVAC systems (use of AHUs with heat recovery where natural ventilation is not possible).
- Lighting (including the use of infra-red sensors, variable illuminance levels and programmable time functions).
- BMS and metering (the installation of a building management system and metering to control and measure the different systems and their respective energy consumptions).

Renewable energy will be produced on-site and solar and wind energy producer technologies should be installed to achieve nZEB and carbon neutrality goals. It is considered that solar photovoltaic energy has the better efficiency of the two technologies.

The ISO 50001 is an energy management system that helps organisations better manage their energy use, thus reducing consumption. It involves developing and implementing an energy policy, setting achievable targets for energy use, and designing action plans to measure progress. This might include implementing new energy-efficient technologies, reducing energy waste or improving current processes to cut energy costs. Iarnród Éireann is certified to ISO 50001 and it is also a requirement that EXEED design certification is achieved for the depot.

The SEAI states that “Excellence in Energy Efficiency Design (EXEED) enables organisations to establish a systematic approach to design, construction, and commissioning processes for new investments and upgrades to existing assets. The EXEED Certified program aims to influence and deliver new best practices in energy efficient design management. EXEED designs, verifies, and manages optimum energy performance and management at the earliest stages of the lifecycle.”

4.11.12.11.1.4 Preliminary energy efficiency simulations

The building needs to achieve a certain energy performance (BER certification) to be considered an nZEB, and among other indicators, three main aspects are being targeted: primary energy, CO2 emissions and the Renewable Energy Ratio (RER). To assist in the design, a simplified energy model has been developed in the Design Builder software and further detailed simulations must be developed in future project stages.

Data inputs into the energy model include building models, lighting strategies, PV panels and HVAC systems.

A number of different options incorporating different combinations of heating methods, AHU systems, domestic hot water (DHW) systems, renewable energy and control systems in the different depot buildings were explored. These options and results are summarised in Figure 4-257 below.

	CONDENSING BOILERS + AHUs - Option 1															CONDENSING BOILERS + PANEL HEATERS - Option 2						HEAT PUMPS + CONDENSING BOILERS + PANEL HEATERS - Option 3						HEAT PUMPS AND PANEL HEATERS - Option 4					
	Option 1.1			Option 1.2			Option 1.3			Option 1.4			Option 1.5			Option 2.1			Option 2.2			Option 3.1			Option 3.2			Option 4.1			Option 4.2		
	Workshop	Admin. building	Drivers building	Workshop	Admin. building	Drivers building	Workshop	Admin. building	Drivers building	Workshop	Admin. building	Drivers building	Workshop	Admin. building	Drivers building	Workshop	Admin. building	Drivers building	Workshop	Admin. building	Drivers building	Workshop	Admin. building	Drivers building	Workshop	Admin. building	Drivers building	Workshop	Admin. building	Drivers building	Workshop	Admin. building	Drivers building
HEATING																																	
Condensing boiler + radiators		✓	✓		✓	✓		✓	✓		✓	✓		✓	✓		✓	✓		✓	✓												
Heat pumps																							✓	✓		✓	✓		✓	✓		✓	✓
Ahu	✓			✓			✓			✓			✓																				
Radiant panels																✓			✓			✓			✓			✓			✓		
AHU																																	
Control							✓			✓			✓																				
Heat recovery							✓			✓			✓																				
Ductwork leakage tested							✓			✓			✓																				
Air handling unit testing							✓			✓			✓																				
DHW																																	
Condensing boiler		✓			✓			✓			✓			✓																			
Dedicated condensing boiler																	✓			✓			✓			✓							
Heat pump																													✓			✓	
RENEWABLE ENERGY																																	
Heat pumps																							✓			✓			✓			✓	
Max PV panels					✓			✓			✓						✓						✓						✓				
Min PV panels														✓						✓						✓						✓	
M2 PV panels					2136			2136			2136			1692			2136			752			2136			534			2136			0	
CONTROL																																	
Metering provision											✓			✓			✓			✓			✓			✓			✓			✓	
Central time control											✓			✓			✓			✓			✓			✓			✓			✓	
Optimum star/stop control											✓			✓			✓			✓			✓			✓			✓			✓	
Local time control											✓			✓			✓			✓			✓			✓			✓			✓	
Local temperature control											✓			✓			✓			✓			✓			✓			✓			✓	
Weather compensation control											✓			✓			✓			✓			✓			✓			✓			✓	
ENERGY																																	
BER																																	
A1 <0,17																																	
A2 ≥0,17																	←			←			←			←			←			←	
A3 ≥0,34								←			←			←																			
B1 ≥0,50																																	
B2 ≥0,67					←																												
B3 ≥0,84		←																															
Primary energy kwh/m2/yr		229,41			205,58			111,8			111,56			116,52			59,85			75,29			59,6			77,68			51,04			74,87	
Indicator		0,89			0,8			0,43			0,45			0,45			0,23			0,29			0,23			0,3			0,2			0,29	
kgCO2/m2/yr		44,77			40,08			21,73			22,65			22,65			11,38			14,42			11,39			14,95			9,9			14,59	
Emissions indicator		0,9			0,81			0,44			0,46			0,46			0,23			0,29			0,23			0,3			0,2			0,29	
CPC (min 1,15)		**1,84**			**1,65**			**0,89**			**0,89**			**0,93**			**0,57**			**0,72**			**0,55**			**0,73**			**0,55**			**0,71**	
EPC (min 1)		**1,78**			**1,6**			**0,87**			**0,87**			**0,9**			**0,56**			**0,7**			**0,54**			**0,71**			**0,54**			**0,68**	
RER (min 0,1)		**0**			**0,1**			**0,18**			**0,18**			**0,14**			**0,29**			**0,1**			**0,31**			**0,1**			**0,31**			**0,15**	

Figure 4-257 Simulated energy efficiency options and results

4.11.12.11.1.5 Conclusions

The results of the simulations showed that heat pumps are the cost optimal design for DHW generation and are more efficient than boilers. There is also a 75% reduction in CO2 emissions when using heat pumps in comparison to using boilers. For the heating of the main workshop, it is not recommended to use AHUs. Simulations with radiant panels and natural ventilation led to a better BER rating with greatly reduced CO2 emissions in comparison. PV panels should be installed but the number required to achieve the necessary RER rating varies depending on the simulated system. Lastly, including a control system in the building to control all areas independently, depending on weather conditions and internal temperature led to significant efficiency improvements.

4.11.12.11.2 Water

The design of the depot focuses on reducing the use of potable water by implementing a number of strategies as outlined below.

1. Grey water recycling and water reuse (i.e. recycling of used water in train cleaning process).
2. Rainwater harvesting (i.e. for supply of water to stabling and deep cleaning areas).
3. Water consumption metering (i.e. installation of submetering to control water use and detect leakages in potable water supply).
4. Water efficient sanitary fixtures (i.e. installation of low water consumption fixtures including low-flow showers and percussion type spray/aerated taps in washbasins).

5. Site water management (i.e. surface-water attenuation and storage systems to reduce runoff, water traps and storage and isolation systems to manage contaminated water).

4.11.12.11.3 Materials

The depot design intends to achieve something close to a zero-waste building and promote the lowest possible environmental footprint. Best practice is followed regarding material selection and waste production. In order to achieve these objectives, the design should give cognisance to the following headings.

4.11.12.11.3.1 Low environmental impact materials

- Locally produced and manufactured materials shall be used to reduce the environmental impact caused by material transportation. Materials manufactured within an 800 km radius will be preferred to minimise the impact of transport to site.
- The use of natural, recycled (or with high amount of recycled content) and recyclable materials should be prioritised. For example: recycled steel structure and cladding panels.
- Products with an Environmental Product Declaration (EPD) should be prioritised.
- Sustainable wood: all the timber used in the proposed development should be certified (PEFC, FSC or similar) ensuring the sustainable provenance and management.
- Materials with less CO2 emission and lower carbon footprint should be used.
- Refrigerants used within the building's plant/services should have zero Ozone Depleting Potential.
- Insulation materials with low GWP should be prioritised.
- Waste reduction strategies will be implemented (space provision, waste segregation, etc.) and incorporated in the construction contract.
- Where possible, the generated material waste should be recycled in-house to avoid sending the waste directly to a landfill.
- Materials to have minimum cleaning requirements.

4.11.12.11.3.2 Indoor air quality

- The proposed development should ensure the best indoor air quality with the use of non-toxic and solvent free materials. Low Volatile Organic Compound (VOC) materials should be used in all internal spaces. Other toxic materials such as heavy metals will be avoided when feasible.

4.11.12.11.3.3 Durability

- Durability will be considered in the different stages and parts of the proposed development.
- Designing for robustness. Appropriate design and material selection should minimise future reparation and maintenance costs, by minimising the frequency of replacement and maintenance.
- The life cycle end and replacement of elements of the proposed development should be scheduled insofar as practicable.

4.11.12.11.3.4 Modular & prefabricated construction design

- Material and water savings due to modular and prefabricated construction design. Traditional construction methods require additional materials that lead to increased waste.
- Shorter construction times, weather factor has less impact on construction, planning is more accurate and delays less likely.
- Flexibility - modular structures can be easily disassembled and relocated to different sites.
- Consistent quality, standards and quality checks throughout the entire process. In addition, work can be done indoors and in better conditions than in traditional construction.
- Reduced site disruption, less site traffic, less noise and less dust.

4.11.13 Compensatory storage area

The lands between Maynooth and Kilcock have a significant history of flooding that effects the existing rail line at Jackson's Bridge (OBG23), the M4 motorway and lands southeast of Kilcock (proposed depot site). The DART+ West project requires the realignment of the rail line to the south to address the complex hydraulic constraints present at OBG23. This will ensure that the proposed development can achieve an appropriate standard of flood protection while maintaining the existing flood regime upstream and downstream of the development. Compensatory storage will be required to manage displaced flood waters and flood risk.

The provision of “like for like” compensatory storage is a requirement of The OPW Guidelines (2009) and the 2017-2023 Kildare County Development Plan Strategic Flood Risk Assessment.

An exercise in determining requirements for the “like for like” compensatory storage has been undertaken. Existing ground levels will need to be adjusted (lowered) to provide the required volumes. The primary factors in determining suitable areas for compensatory storage are:

- Appropriately located
  - The flood compensation should be as near as possible to where the loss of flood storage occurs and should be hydraulically linked to the local flood cell.
- Completely Free Filling and Draining
  - The flood compensation must be able to fill and drain under gravity, to be available should back-to-back flood events occur.

Estimated required compensatory volumes are given below:

- Adjacent to OBG23: ~38,800 m^3 + 24,200 m^3 over excavation
- Depot lands: ~45,800 m^3 + 13,700 m^3 over excavation

The provision of these volumes of compensatory storage will require an excavation of ~123,000 m^3 of overburden. As per the above determining factors and volume requirements, compensatory storage is proposed as follows:

Flooding adjacent to OBG23: The proposed compensatory storage at this location comprises making amendments to existing floodplain levels. The outline area required is presented in the figures below. The provision of the “like for like” compensatory storage ensures that the minimum area of land is inundated in each flood event i.e. less area is flooded in the 1 in 10 year event than the 1 in 100 year event.

Flooding within the proposed depot lands: The interaction of the existing flood regime and proposed development at this location necessitates both the provision of compensatory storage for displaced flood waters and the realignment of the watercourse itself. To minimise future maintenance requirements (and potential for flooding due to blockages) the watercourse will be diverted and kept in open channel. It should also be noted that due to the generally flat topography at the depot lands, a larger land take is required to compensate for a smaller volume in comparison to the proposed measures at OBG23. The most suitable lands for compensatory storage are identified as the lands between and adjacent to the historic channel and the current route of the channel as shown in the figure below. A minor bund is to be provided along the eastern and southern boundary of the compensatory storage area adjacent to the depot with a height no greater than 1m above existing ground levels.

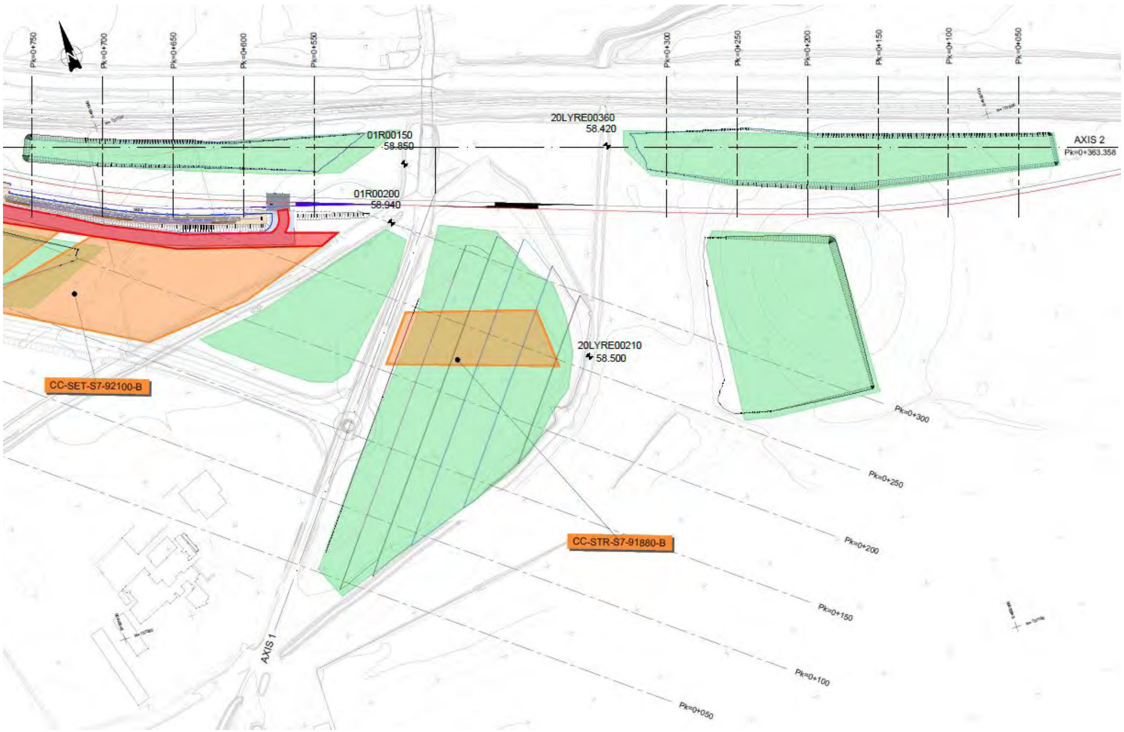


Figure 4-258 Compensatory storage area adjacent to OBG23 (c.9ha)

Flood conveyance culverts are proposed through the new road (L5041) and rail embankments (in the OBG23 area). These will ensure that flow paths through the floodplain are maintained and impacts to the existing flood regime minimised. The maximum width of these elements is 6 m, with heights ranging 0,5 m to 2,7 m. Figure 4-259 shows an indicative image of these culverts.

Figure 4-259 Indicative flood relief culvert

Figure 4-260 Compensatory storage area within proposed depot lands (c.16.5 ha)

4.12 Operational Phase

4.12.1 New Spencer Dock Station

Spencer Dock Station will have two access points, a main entrance on Mayor Street and a secondary entrance on Sheriff Street Upper.

The main pedestrian entrance is on Mayor Street Upper, fronting the Spencer Dock Luas Station. This access will receive the greatest passenger flow due to intermodal passengers coming from the Luas station, the proximity of significant pedestrian flows and the existence of covered cycle parking.

This entrance will be secured with a roller shutter at the access point to the concourse. Fronting the exterior plaza, two ticket vending machines will be placed at both sides of the entrance and a ticket issuing window will be located to one side with a direct view towards the gate line.

The gate line at the main entrance will have eleven ticket validation gates, two of them with an increased width for use by passengers with restricted mobility and passengers with trolleys of luggage.

The secondary entrance is located on Sheriff Street Upper. This access will receive the passengers coming to the station by bus and drop off by taxis and private cars. There is an opportunity to increase the number of spaces for buses to stop at this location. This entrance will also be secured with a roller shutter placed at the access point from Sheriff Street Upper. Two ticket vending machines will be located at the lower level of the entrance building.

The secondary entrance will not operate with ticket validation gates but with ticket validation poles (smartcard readers). Three poles will be placed at the lower level of the entrance.

Fronting the main entrance plaza, space will be provided for two retail units at both sides of the access to the station. They will operate independently of the station, with accesses and back of house also independent.

4.12.2 Connolly Station

The works proposed for Connolly Station will create a new entrance to the station from Preston Street through the existing vaults which date from the 19th Century. The vaults currently support the platform level and will facilitate enhanced pedestrian capacity at the station. Preston Street will be converted into a pedestrian priority street. The existing car parking spaces will be removed with sporadic access to the Parcels Postal Office building facilitated during non-peak hours. The public realm improvement of Preston Street will include new trees, benches and public lighting as well as a new pavement that will continue into the station vaults.

The station access control system is determined by the geometry of the vaults, making it impossible to include the number of ticket validation gates required by the projected passenger demand. Therefore, a smart-card-reader pole system is proposed here. Seven poles are needed for the station operation. They will be placed in the vaults that lead to the staircases, lifts and escalators.

The passenger demand calculations also show the need to provide four ticket vending machines for passengers using platforms 5, 6 and 7. It is proposed to provide three ticket vending machines in this new entrance. It is envisaged that some passengers will still use the main entrance to the station to reach these platforms. The ticket vending machines will be placed fronting the central corridor of the vaults as well as the ticket issuing window.

4.12.3 Universal access

Accessibility for all is a crucial consideration in the design or modernisation of stations for Iarnród Éireann, as stated in the Station Design Guide (Córas Iompair Éireann, 2004). The implications of providing vertical circulation for all passengers, including the young, the elderly, the mobility impaired, the encumbered and those with disabilities, are profound and will affect the design from inception to completion.

The new stations will comply with the requirements of the following legislation, regulations, guidance and design standards. Modifications will also be carried out at existing stations to meet these standards.

- The Disability Act: 2005.
- The Building Regulations, particularly Part B, Part K and Part M.
- Station Design Guide: Iarnród Éireann.
- Commission Regulation (EU) No 1300/2014 on the technical specifications for interoperability (TSI) relating to accessibility of the Union's rail system for persons with disabilities and persons with reduced mobility.
- CCE-TMS-312 Design Guidance for Accessibility of Railway Stations.
- RSC-G-008-E Guideline for the Process of Authorisation for Placing in Service Railway Sub Systems.
- IE-STR-6310 – Civil Engineering Structures Design Standard.

The TSI and Building Regulations are mandatory regulations that must be adhered to. Where possible, we have used the TSI, however where in some cases this is limited, we have referred to the Building Regulations. There are also a number of guides and Codes of Practice that have been considered.

The guidelines from the NDA "Building for Everyone: A Universal Design Approach" have also been taken into consideration. They provide comprehensive best practice guidance on how to design, build and manage buildings/spaces so that they can be readily accessed and used by everyone, regardless of age, size ability or disability.

4.12.4 Suburban stations

There is a tendency towards operating the new suburban stations with ticket validation poles instead of ticket validation gates. Currently both systems coexist at suburban stations.

Some stations operation systems will need to be changed to an ungated system. Ashtown Station needs to be ungated to integrate the new pedestrian bridge, Coolmine Station will be ungated too. Other stations, such as Drumcondra, Clonsilla and Maynooth, will need to increase the number of ticket validation gates, or alternatively change to an ungated system, to deal with the increase of passengers.

4.12.5 Level crossings

All level crossings will be closed will include suitable signage on approach roads to indicate a cul-de-sac and will be treated with turning heads at a suitable location. A suitable palette of materials and landscaping will be proposed as appropriate. The existing level crossing gates will be removed, and palisade fencing will be installed in their place to protect against unauthorised personnel entering a live and electrified railway line. All level crossings will remain accessible to CIÉ and utility providers for maintenance works.

Ashtown Level Crossing

The Ashtown Road is to be realigned along the route of Mill Lane. The realigned road will facilitate through traffic that would have crossed the level crossing in its existing configuration. The existing Ashtown Road will become a cul-de-sac on both the northern and southern side of the rail line. On the southern side, road users (pedestrians, cyclists and vehicles) wishing to access Ashtown Station will be provided with an upgraded roadway via a junction off the realigned access to Martin Savage Park. A mini roundabout will be provided on the western side of the station to facilitate vehicle turn around. A set down area will be provided to allow vehicles and coaches to drop off passengers without impeding other traffic. Two disabled parking bays will be provided adjacent to the train station to ensure train services are accessible to mobility impaired users. It is envisaged that the access road to the station will be a shared street, low speed environment, with vehicles and cyclists sharing the roadway. Vehicle speeds will be controlled by the implementation of a shuttle system, where sections of the roadway will only allow a single line of vehicles to pass and opposing traffic will be required to yield. A footpath, with a vertical upstand, will be provided on the eastern side of the roadway, along the line of the existing footpath. The station access road will be finished with high-quality materials and soft landscaping to provide an enhanced public realm environment. The existing trees on the eastern side of the roadway are to be protected in place to retain the vegetation screen to Martin Savage Park. The level crossing will be fenced and gated to secure the rail line from unauthorised access while allowing maintenance access to the rail line.

On the northern side, a mini roundabout is to be provided to allow vehicles that entered Rathbourne Village to safely turn back north and drop passengers off at the northern side of the rail line. The residential property on the northern bank of the canal is to be accessed off the mini roundabout. The mini roundabout and adjacent areas will be finished in the same materials as the existing Rathbourne Village public realm.

It is envisaged that Supervalu storeroom will operate a one-way system for deliveries. Deliveries will access the stores via the ramped access from the realigned Ashtown Road and exit into Ashtown Village and head north towards the existing roundabout. T he existing car park entrance will operate as normal with two-way access and unimpeded travel north or south onto the realigned Ashtown Road.

Coolmine Level Crossing

On the northern side of the level crossing, the Coolmine Road will become a cul-de-sac. A mini roundabout will be provided to allow vehicles to turn back, with an arm off the roundabout providing access to Sheepmoor Lane. A set down area will be provided immediately north of the mini roundabout to allow vehicles to stop and drop off passengers without impeding general traffic. The area between the mini roundabout and canal bridge will be paved and be provided as a pedestrian area with occasional vehicular access as required for maintenance of the bridges, Royal Canal and rail line. It is envisaged that the paved area will incorporate public realm features such as high-quality materials and soft landscaping. It is intended that the level crossing will be fenced and gated to secure the rail line from unauthorised access while allowing maintenance access to the rail line.

On the southern side, following completion of the works, the Carpenterstown Road will become a cul-de-sac. The level crossing will be gated to secure the rail line from unauthorised access while allowing maintenance access to the rail line. The layout of the existing train station car park is to be altered to accommodate the new shared pedestrian and cyclist overbridge. It is anticipated that the access and egress to the car park will continue to operate as currently . The loop back of the existing car park is to operate as a facility for vehicles to turn back south. The paved area at the steps of the proposed shared overbridge is to include public realm features such as high-quality materials and soft landscaping.

Porterstown Level Crossing

On the northern side of the level crossing, following completion of the works, the Porterstown Road will become a cul-de-sac. A mini roundabout will be provided to allow vehicles to turn back north. On the western side of the roundabout, an arm will be provided to allow access to the Old Schoolhouse lands which is subject to an ABP SHD proposal. On the eastern side of the roundabout, the existing access to a private residence will be altered and new access provided off the roundabout. A new 1.8 m footpath will be provided along the eastern side of the roadway and an uncontrolled crossing provided on the southern side of The Village housing estate.

On the southern side of the level crossing, following completion of the works, the Porterstown Road will become a dead end. The area immediately south of the level crossing, around the entrance to the overbridge steps and ramp to the overbridge will be paved. The level crossing will be gated to stop unauthorised access to the rail line while maintaining access by CIÉ for maintenance. Vehicles will be provided with a hammerhead to allow them to turn back south. A new entrance and gate into St. Mochta's football club will be provided.

Clonsilla Level Crossing

On the northern side of the level crossing, the existing four-armed signalised junction will be altered to a three-arm junction with the southern arm heading south being removed and a toucan crossing provided. The existing offline cycle track coming from the east on the southern side of Larch Grove will be extended west to tie back in with the existing offline cycle track. On the northern side of Clonsilla Road, a new segregated cycle track will be provided from the junction with Porter's Gate View to the toucan crossing. From the crossing, the cycle track will go on road to connect to an existing on road cycle track at Larch Grove.

The area from Clonsilla Road to the canal bridge will incorporate public realm features such as high-quality materials and soft landscaping. The rail line will be fenced and gated to prevent unauthorised access and allow access by CIÉ for maintenance.

On the southern side of the level crossing, following completion of the works, the Clonsilla Road will become a dead end. A mini roundabout will be provided to allow vehicles to turn back, with an arm of the roundabout providing access to lands to the west. A set down area will be provided to allow vehicles to drop passengers to the train station without impeding other traffic. A footway will be provided adjacent to the set down area to provide access to the shared overbridge. The area between the roundabout and the rail line will be paved and incorporate public realm features such as high-quality materials and soft landscaping. The rail line will be fenced and gated to stop unauthorised access and allow access by CIÉ for maintenance.

Barberstown Level Crossing

On both side of the level crossing fences and gates will be provided to stop unauthorised access to the rail line and provide access to CIÉ for maintenance.

4.12.6 Substations and technical buildings

The substations are generally unattended buildings, as they are managed by SCADA system from the control centre (CTC at Connolly and future NTCC at Heuston). There is no permanent staff required to operate the buildings, as they are monitored and controlled remotely. However, there will be preventive maintenance activities to be performed. The substation preventive maintenance is the regular and routine maintenance of substation equipment and assets in order to keep them running and prevent any costly unplanned downtime from unexpected equipment failure. This is based on a maintenance strategy with dedicated planning and scheduling of maintenance of equipment before a problems occur.

In the case of an unforeseen incident or malfunction, CIÉ and ESB have 24/7 unimpeded access to the building to ensure that maintenance staff can reach the substation and repair any issue that might arise.

In the event of a power outage there is a generator that will operate until a maintenance van arrives to fix the fault. In the case of required substitution of heavy plant such as a transformer, the machinery used to fix the fault shall be similar to the machinery used for the construction phase (truck or crane, depending on the size of the asset to repair). The occurrence of unexpected maintenance is rare . Regular maintenance activities are performed about twice a year.

Smaller technical buildings, such as PSP, SEB, TER are also unattended. These assets are managed remotely from CTC and NTCC. For preventive maintenance, not foreseen more than twice a year, the largest expected vehicle to be brought to site is a truck. For unexpected issues, a maintenance team may arrive on site with a car, pick-up or truck.

4.12.7 Depot

The new depot will be the main maintenance facility for the DART fleet. The depot will operate 24 hours a day throughout the year. It will be fenced and protected by security gates and a CCTV system.

The depot will provide for a proper maintenance regime and overnight stabling for the trains of the DART network. With consideration of CIÉ requirements in terms of rolling stock maintenance, the different tasks to be carried out on the fleet are the following:

- Daily Maintenance:
  - Service slab activities.
  - Internal cleaning.
  - Exterior washing.
- Preventive Maintenance:
  - Light maintenance activities.
  - Heavy maintenance activities.
  - Wheel lathe activities.
- Corrective Maintenance and other unscheduled activities.
- Deep Cleaning activities:
  - remove dirt from areas that AWP cannot access for example at body ends.
  - remove graffiti or conduct a biological clean post animal strike or fatality.
  - change vinyl on the units and small paint repairs.
  - manually wash down train fronts and intermediate ends with power washers.

4.12.7.1 Daily maintenance

4.12.7.1.1 Internal cleaning

The internal cleaning of trains includes the interior surfaces (box, floor, ceilings, information elements, monitor screens, seats, handles, doors, cabin and driving desk) and all the normally accessible elements. These activities are generally carried out during the night in the stabling yard while the vehicles are berthed in one of the stabling tracks once the service is ended for the day. It is proposed to have three different levels of cleaning that are to be performed dependent on the train condition.

The three different levels of cleaning are described as follows:

- Daily maintenance cleaning:
  - Waste collection and floor sweeping.
  - Cleaning of windows and interior sides of trains with cloth.
  - Light seat cleaning.

    - Floor scrubbing with double bucket mop or scrubbing machine.
- Main cleaning:
    - Waste collection and floor hoovering.
    - Cleaning of windows and interior sides of trains with brush.
    - Cleaning of exposed steelwork, seats and vehicle intermediate ends.
    - Thorough scrubbing of the floor with mechanical disc scrubber.
- In depth cleaning:
    - Waste collection and floor hoovering.
    - Thorough cleaning of windows and interior sides of trains.
    - Cleaning of steelwork, seats, stain removal and total washing.
    - Cleaning of train intermediate ends exterior and interior.
    - Cleaning of ceilings, niches of fire extinguishers, alarm, etc.
    - Thorough scrubbing with mechanical disc scrubber.

4.12.7.1.2 Service slab activities

The service slab activities are the following:

- CET (Toilet Tank) discharge and water fill.
- Sanding system top-up.
- Fluid top up including windscreen wash.
- Front and rear cleaning with long-handled brushes.

These activities are to be carried out every second day, but the sanding is more dependent on the operation and the weather conditions during the seasons.

The AWP only washes sides and eaves of the train, and because of that, additional cleaning of the front cab and rear of the train must be performed in the service slab. This activity will be carried out by an operator with a long-handled brush.

4.12.7.1.3 Exterior washing

The AWP will be a drive-through type and it is located at the entrance of the depot after the AVI facility, which is on the same track, and before the access to the service slab, stabling yard and maintenance shed. The washing will be unidirectional and capable of washing the sides and eaves of the vehicles. Washing speed will not exceed 5 km/h, considering optimal 3 km/h.

The trains will be washed every second day as a requirement from CIÉ. The washing strategy for the DART fleet will be based on different time windows: AM off-peak period, PM off-peak period and during the night, but, if possible, all the trains are washed during their removal from the mainline.

4.12.7.2 Preventive maintenance

The scheduled maintenance of the DART fleet is based on balanced distance examination. The preventive maintenance of the rolling stock is split into three types:

- Light maintenance: activities with more frequency than heavy maintenance activities, shorter duration, performed normally in tracks with platform and pit. These are mainly related to functional tests and visual inspections.
- Heavy maintenance: activities carried out with less frequency than light maintenance activities, longer duration, performed in tracks with lifting jacks. Mainly related to heavy component changeout activities.
- Wheel lathe: activity carried out periodically. However, it is possible that an unusual (corrective) intervention must be performed due to undesirable conditions, such as flat spots.

4.12.7.2.1 Light maintenance activities

These activities are cyclic maintenance based on balanced distance examination. Most of the tasks are checking, visual inspections, measuring, verification and replacement. This maintenance will be done mostly in tracks with pits and overhead platforms.

The balanced distance examinations are carried out within a schedule based on the mileage and the operation of individual units. Since operation is normally fixed, the mileage could be expressed on a time basis as well. For the balanced distance approach, the duration of different exams will be the same.

Basically, there are two types of exams:

- Periodical Inspection A: it will comprise the most basic exam for the fleet. It is performed every 30 days, and it is composed of basic tests, checks and visual inspections.
- Periodical Inspection C (C1 to C6): C exams will be split into different sections depending on the part of the train to be examined: there will be electrical, body and mechanical exams, all of them performed for every level of maintenance. The different C exams are performed every 30,000 km. Considering the current operation, that means a C exam every 60 days, and each of the C exams once a year. The inspections completed within the A exam are also considered in the C exams.

4.12.7.2.2 Heavy maintenance activities

These activities are related to a heavy component change out that, in most cases, requires having the train lifted, especially to assemble and disassemble the bogies. Usually, these activities are carried out at the heavy maintenance track. Some tasks can, however, be carried out at the light maintenance tracks, such as the air dryer change, HVAC change, or windscreen change, depending on the availability of the tracks and the maintenance schedule. The capacity of the cranes installed at the light maintenance tracks shall be able to accommodate these heavy maintenance activities.

Some of the activities considered are the following:

- Air dryer change.
- Pantograph change.
- Coupler change.
- Compressor change.
- HVAC system change.
- Windscreen change.
- Bogies and wheelset change.
- Changes of other underframe components.

The duration and the cadence of these activities are dependent on the lifecycle of the elements as well as the rolling stock.

4.12.7.3 Corrective maintenance and unscheduled activities

This will comprise the unforeseen maintenance activities due to incidents or breakdowns that arise during the regular use of the units. In general, it can be performed on pit and lifting tracks.

If the maintenance tracks are free, some unscheduled activities (upgrades, changes of image, commissioning activities, etc.) can be performed.

4.12.7.3.1 Deep cleaning activities

The deep cleaning facility is a multifunctional facility that enables several activities related to cleaning, changes of image, bodyworks, etc. to be carried out. The main activities are:

- Washing and removal of dirt from areas that AWP cannot access, for example at body ends or underframe. In addition, it facilitates manual washing down of the train fronts and intermediate ends with power washers.
- Removal of graffiti as well as biological cleaning post animal strike or fatality, or other activities that will need the use of chemicals and specialised products.
- Changes of vinyl on the units and small paint repairs.

4.12.7.3.2 Stabling

The stabling area is positioned parallel to the main building and the test track. It is 354 m long and 87.5 m wide. The length of the stabling area is designed for berthing two FLU with additional aprons of concrete slab track at both sides, to allow the passage of vehicles.

The stabling yard is composed of ballast track and ramps for accessing the trains. Access to the trains is by means of ladders and ramps, which have been located to provide access to drivers cabs and first passenger doors for both FLU and HLU compositions. Ramps are 6 m, 20.4 m and 12 m long.

The stabling area has direct access from the drivers and cleaner's facility in the northern side of the main building. There are also power sockets and water points for the cleaner's brigade to clean the trains.

4.12.7.4 Train movements

The following tables shows the projected number of train movements during one normal day of operation . The movements include the deployment from the stabling to the main line, the ingress movements coming through the servicing route or directly to the stabling, and the movement between the mainline or the stabling and the workshop.

Table 4-30 Number of daily train movements in the depot

Movement	Morning (start of service)	Afternoon (start of AM off peak)	Afternoon (start of PM peak)	Night (end of service)
Deployment	29		10	
Ingress for servicing		10		23
Ingress (no servicing)				6
Main line/Stabling – Workshop	Between 2 and 10, depending on scheduled maintenance			

4.12.7.5 Other operations

Apart from the train maintenance operations, there are other activities to be carried out in the depot:

- The administration area is located on one side of the building and distributed over two storeys, with over 3,330 m^2 of floor space. It offers the following uses for administration, operations, and welfare services:
  - Administrative area
  - Depot Control Centre (DCC)
  - Maintenance and installations offices
  - Training area
  - Break rooms and canteen
  - Toilets, lockers: CME staff, TSSSA staff, Vehicle warranty, Vehicle manufact
  - Subcontractors
- Performance of train tests at the test track.
- Maintenance of the depot assets (track, buildings, green areas, roads, SET elements, etc.).
- Storage of goods and materials, and a waste yard for proper waste management.
- Delivery of goods and materials necessary for the depot activities.

4.12.8 CCE compound

The Chief Civil Engineering (CCE) compound operations comprise all the necessary activities to carry out maintenance of the CCE assets. The complex is fenced and protected by security gates and a CCTV system.

Some of the key operating features are as follows:

- Accommodation and facilities for maintenance personnel.
- Storage for different elements (OHLE and CCE elements).
- Storage and loading/unloading of ballast.
- Storage and loading/unloading of spoil material.
- Storage for track panels and P&C elements and an area for their assembly.
- Tracks to place rail maintenance vehicles and a carpark for the road-rail vehicles.
- Delivery of goods and materials by road and rail is foreseen.

4.12.9 Navan Road compound

The Navan Road compound is for the electrification department of CIÉ. The building will be used primarily as a storage area and a facility for rail workers for changing and breaks between shifts. The complex will be fenced and protected by security gates and a CCTV system.

The key operating features include:

- Accommodation and facilities for the maintenance personnel.
- Storage area.
- Carpark for the road-rail vehicles.

4.12.10 Communications system

As part of the DART+ West project the existing PA system will be renewed at all stations on the Maynooth line. The system will allow manual or automated announcements to be made to inform passengers when trains are entering or leaving a station. The functionality of the PA system will be the same as the existing system. However, the increase in the frequency of trains may also increase the number of announcements at stations. It will be possible to configure the system to reduce the number of announcements, should it be required.

At the new depot near Maynooth, a PA system will also be implemented to warm staff of trains entering or leaving the maintenance workshop and the service slab. Speakers will be installed inside these buildings only.

4.12.11 Operating railway system

Most of the traffic in the DART+ area will consist of Electric Multiple Units (EMUs). The new fleet will operate as FLUs (Full length units or 10-car units) with a length of 168 m. It is possible, during lower demand hours, to uncouple half of the trainset and operate as a HLU (Half Length Unit or 5-car unit).

Diesel, hybrid or battery-electric trains will operate on services that run beyond the DART+ area.

EMUs are serviced and maintained at depots. This will primarily be at the newly constructed Maynooth depot, but also at Drogheda and Fairview. The maximum service level will require the scheduling of 72 EMUs to operate on the DART+ network.

4.12.11.1 Operating pattern and increase of number of trains on the line

Operational analysis has been carried out for the DART+ Programme. In general, it is assumed that commercial (passenger) services start at approximately 06:00 (some exceptions apply for trains from more distant stations to arrive at the Dublin city centre before 07:00) and finish between 24:00 and 01:00. Technical runs, related to morning deployment from depots or stabling locations start at 04:30 (Maynooth line) or 05:00

(other lines). Passenger train services cease at 01:00 to allow for overnight maintenance and servicing of railway infrastructure.

Based on IÉ requirements, modelling was carried out for different options of train service specifications. The Baseline Scenario, preferred by IÉ, provides for an increased number of trains on each of the lines leading to the city centre area. On several lines, multiple services operate with both DART trains and commuter/long-distance services sharing the same lines.

The following table shows the difference between the current number of trains and the future maximum number of trains that will likely run during the peak hour in each zone:

Table 4-31 Current vs future number of trains per hour per direction (tphpd)

Name	Current number of trains (trains per hour per direction)	Maximum number of trains after DART+ West
Zone A	6 tphpd from Connolly Station to Glasnevin Junction on the GSWR line	8 tphpd from Connolly to North Strand Jct 4 tphpd from Spencer Dock to North Strand Jct 12 tphpd from North Strand Jct to Glasnevin on the GSWR line
Zone B	2 tphpd from Docklands Station to Glasnevin Junction on the MGWR line	7 tphpd from Spencer Dock Station to Glasnevin Junction on the MGWR line
Zone C	6 tphpd	12 tphpd
Zone D	2 tphpd	4 tphpd
Zone E	3 tphpd	8 tphpd
Zone F	2 tphpd	2 tphpd

The figure below shows the number of trains per hour per direction (tphpd) for the peak hour in the DART+ area for the preferred option (Baseline Scenario):

Figure 4-261 Service levels on DART+ network – initial assumptions and results of modelling

4.12.11.2 Scheduling exercise and modelling process

The scheduling exercise and modelling were based on the Baseline Train Services Specification (TSS), which was agreed on the basis of the Revised TSS Option 1 – Balanced City Centre Distribution (Systra & Jacobs, DART Expansion Programme Option Assessment – Addendum Report; August 2018), with adjustments in the city centre area related mainly to discontinuation of use of line 3a (Newcomen Chord).

The Baseline TSS (initial step of modelling) envisaged the priority of the Coastal Line services through Connolly. However, since the number of north-south services is not adequate to cater for the needs of the central-southern segment (particularly – Connolly – Grand Canal Dock), services coming from the north are to be supported by services coming from the west, particularly from Maynooth and Hazelhatch via Phoenix Park Tunnel. In the model, those services are treated proportionally with regard to potential traffic between the south (line 7, Bray or Grand Canal Dock) and the west (Hazelhatch or Maynooth).

For scheduling, certain assumptions were adopted with regard to rolling stock. Three different types of rolling stock for three categories of trains were taken under consideration:

- Intercity fast train (DMU/locomotive-hauled).
- Commuter (DMU).
- DART (EMU).

Each type of rolling stock has different features because of the different characteristics of the associated traffic demand. Intercity services that involve high-speed services and few stops need powerful units with smooth acceleration and an aerodynamic form. For commuter/DART trains, high acceleration is more important than high speed due to frequent stops at short distances.

For modelling purposes, the Stadler FLIRT trainset was chosen as it is one of the most popular suburban EMU trains in the world, with very good tractive parameters and data available for different compositions of trainsets (including a 2x4-car set).

A summary of the basic parameters of the rolling stock used in the model is presented in the following table:

Table 4-32 Rolling stock summary

Rolling stock summary			
Category	Intercity (fast)	Intercity/Commuter	DART
Name	201	22000	Stadler FLIRT
Type	loco-hauled	traction unit (DMU)	traction unit (EMU)
traction type	diesel	diesel	electric
no. of units	1	2	2
no. of coaches	8	3	4
trailer (m)	189	0	0
max speed (km/h)	160	160	145
length (m)	207	140	149
weight (t)	352	378	276

As agreed with the IÉ, all DART services were modelled as new EMUs. This does account for gradual introduction of the new rolling stock and parallel use of older and newer units. The transition period will, in such a case, entail a possible reduction of the number of services because of the poorer traction characteristics of the old rolling stock.

Commuter services that go onto non-electrified lines are modelled as DMUs. So is the case of most long-distance Intercity services (including Enterprise trains between Connolly and Belfast). Locomotive-hauled services are modelled (along with DMUs) on long-distance services from/to Heuston.

To eliminate the effect of different driving habits and high consumption of energy, acceleration in normal operations was reduced to 1 m/s^2.

Modelling shows that interdependence of traffic on several lines causes the transfer of gaps and the potential transfer of disturbances between them. Specifically, when prioritising the most difficult line in terms of providing equally distributed traffic (the northern line), there was a knock-on effect on the entire system.

Connections between Connolly and the west are subject to gaps in the schedule of long-distance and commuter trains on the northern line.

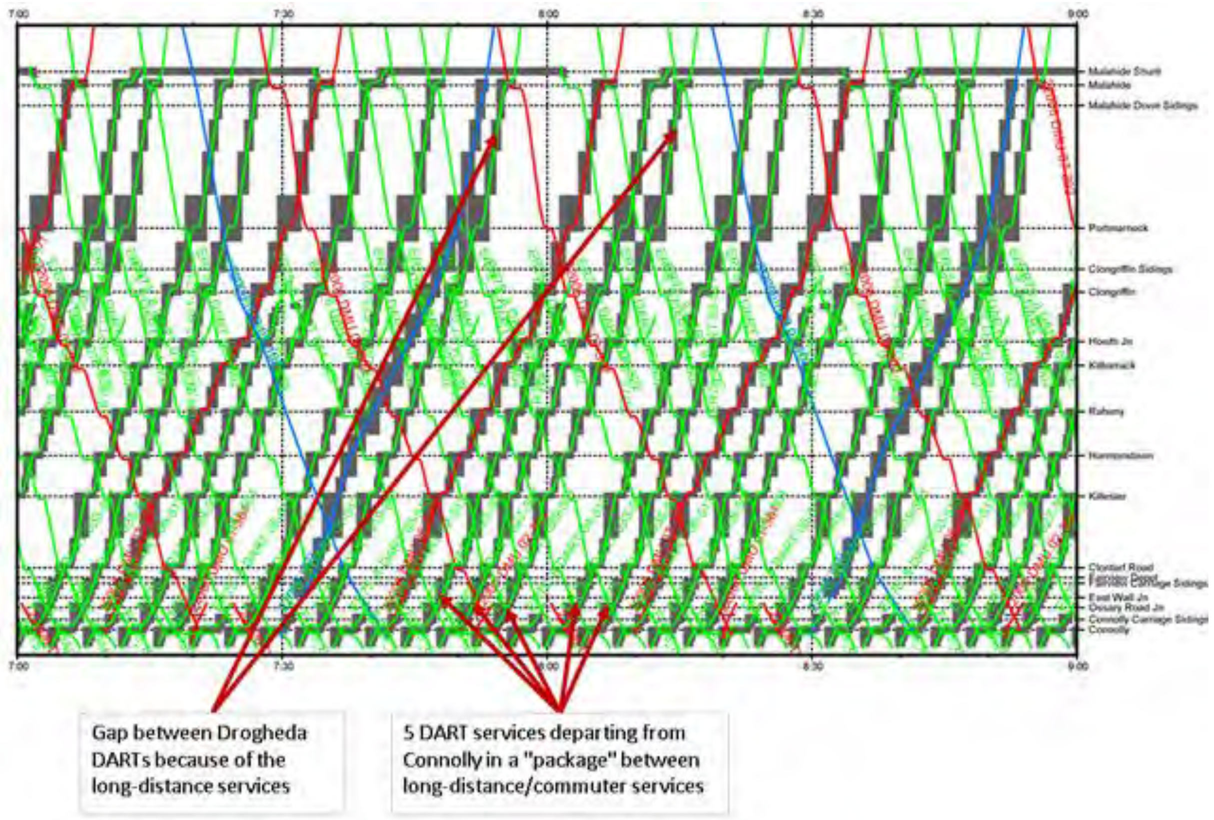


Figure 4-262 Approach to Connolly from the north: unequal distribution of DART services

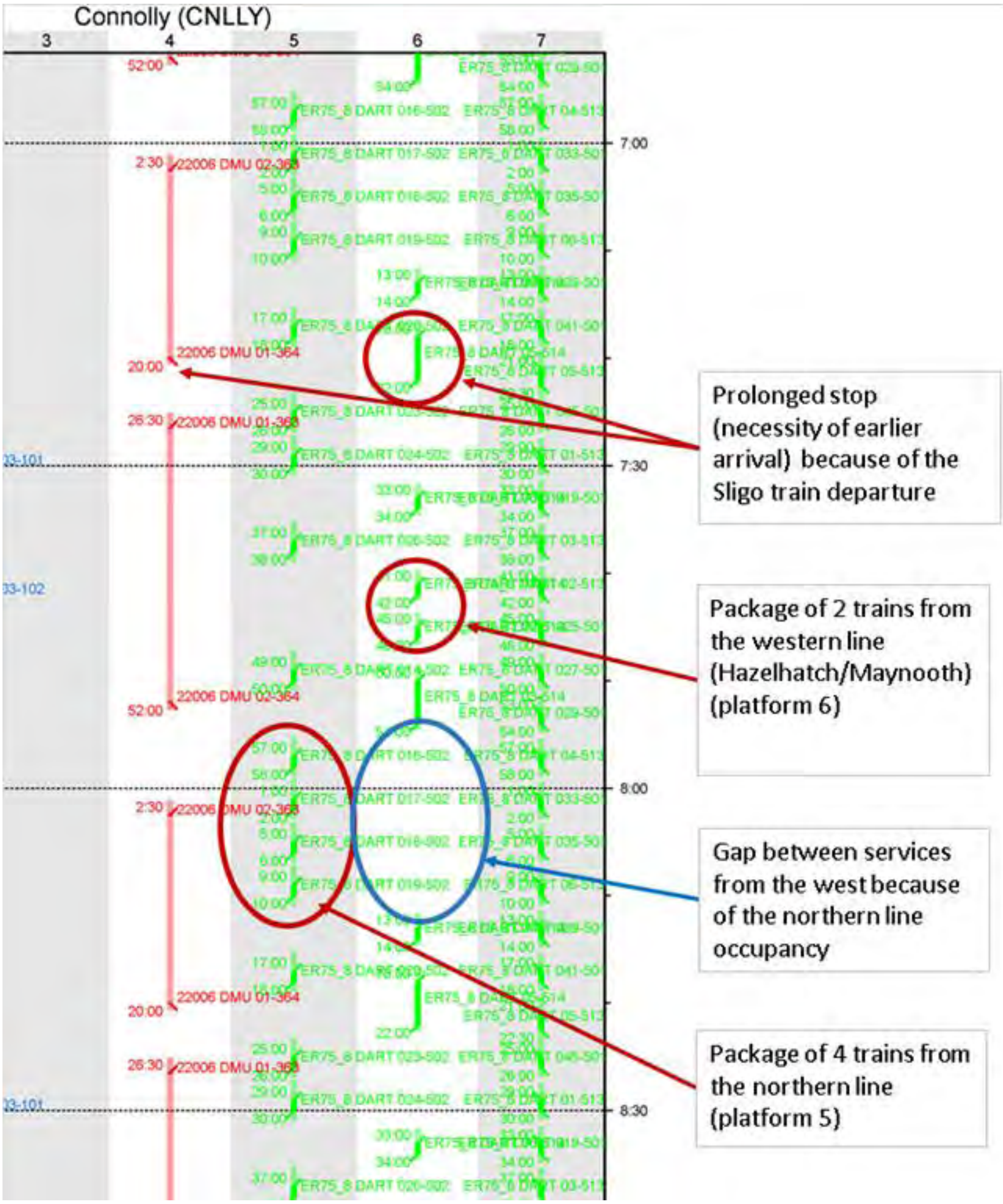


Figure 4-263 Example of transfer of gaps and packages from the northern line onto other services

Transfer of gaps and "packaging patterns" have a crucial role in the efficient functioning of the train traffic for the entire DART+ Programme. As result, the feasible level of train service will be a reduction from initial assumptions.

The table below provides details with regard to the number of trains as per the Baseline TSS and the number of trains projected as a result of modelling.

Table 4-33 Service levels on particular sections – after modelling

Line no.	Section		Baseline TSS - number of trains	Modelling average number of trains	Difference	
					Number of trains	% of Baseline TSS
1	Connolly	East Wall Jct.	13	12	-1	92%
	East Wall Jct	Howth Jct.	13	12	-1	92%
	Howth Jct.	Clongriffin	13	12	-1	92%
	Clongriffin	Malahide	10	10	0	100%
	Malahide	Balbriggan	7	8	1	114%
	Balbriggan	Laytown	7	8	1	114%
	Laytown	Drogheda	7	6*	-1	86%
	Drogheda	Dundalk (Belfast)	3	3	0	100%
1a	Howth Jct.	Howth	6	6	0	100%
2	Connolly	North Strand Jct.	10	8	-2	80%
	North Strand Jct.	Glasnevin Jct.	15	12	-3	80%
	Glasnevin Jct.	Islandbridge Jct.	10	7	-3	70%
3	Docklands	Newcomen Jct.	10	7	-3	70%
	Newcomen Jct.	Glasnevin Jct.	10	7	-3	70%
	Glasnevin Jct.	Clonsilla	15	12	-3	80%
	Clonsilla	Maynooth	10	8	-2	80%
	Maynooth	Longford (Sligo)	2	2	0	100%
3a	Connolly	Newcomen Jct.	0	0	0	
4	Clonsilla	M3 Parkway	5	4	-1	80%
5 (fast)	Heuston	Islandbridge Jct.	12	12	0	100%
	Islandbridge Jct.	Park West	12	12	0	100%
	Park West	Hazelhatch	12	12	0	100%
	Hazelhatch	Kildare	12	12	0	100%
6 (slow)	Heuston	Islandbridge Jct.	4	4	0	100%
	Islandbridge Jct.	Park West	14	10	-3	79%
	Park West	Adamstown	14	10	-3	79%
	Adamstown	Hazelhatch	14	10	-3	79%
7	Connolly	Pearse	18	15	-3	83%
	Pearse	Grand Canal Dock	18	15	-3	83%
	Grand Canal Dock	Dun Laoghaire	12	12	0	100%
	Dun Laoghaire	Bray	9	12	3	133%
	Bray	Greystones	2	2	0	100%
	Greystones	Wicklow (Rosslare)	1	1	0	100%
9	East Wall Jct	Docklands	0	0	0	
9a	North Strand Jct.	Docklands	5	4	-1	80%
*Laytown – Drogheda: 2 tphpd run empty to terminate at Drogheda sidings						

The level of services at the crucial station – Connolly - are as follows:

Table 4-34 Connolly station service levels (tphpd)

From	To	Baseline TSS	Modelling result
Connolly	North	13	12
Connolly	South	18	15
Connolly	West	10	8
Connolly	**All**	**41**	**35**

With regards to DART origin and destination pairs, the level of service is the following:

North – South – 9 tphpd:

- Drogheda – Bray – 5 tphpd (2 tphpd start/finish passenger service at Laytown and turn-back at the depot siding in Drogheda).
- Clongriffin – Bray – 2 tphpd.
- Malahide – Greystones – 2 tphpd.

Howth shuttle (Howth – Howth Junction) - 6 tphpd.

West – South:

- Maynooth – Bray – 3 tphpd.

West – Docklands:

- Maynooth – Docklands – 3 tphpd.
- M3 Parkway – Docklands – 4 tphpd.

Phoenix Park Tunnel to Grand Canal Dock:

- Hazelhatch – Grand Canal Dock – 3 tphpd.

Phoenix Park Tunnel to Docklands:

- Hazelhatch – Docklands – 4 tphpd.

Heuston DART:

- Hazelhatch – Heuston – 4 tphpd.

4.12.11.3 DART+ Programme summary – to inform the cumulative assessment/operation phase

The Maynooth depot will be the main stabling and maintenance facility for all the DART+ Programme fleet. This facility will be crucial for the daily operation of the DART network since it will be dedicated to ensuring the availability of the fleet through regular maintenance of the trains.

The total fleet required in the maximum capacity scenario consists of 72 EMUs operating across the DART+ network.

The increase of trains in operation will lead to an increase in the need of stabling locations. Maynooth depot will accommodate this, stabling almost 40% of the fleet.

4.13 Maintenance Works and Noise Management

The DART and suburban rail routes provide essential transport services to Dublin City and the Greater Dublin Area 7 days a week between approximately 06:00 am and 00:30 am.

The railway infrastructure, the tracks and OHLE in particular, requires regular maintenance during night-time when the railway services are not in operation. These maintenance works generate noise that must be mitigated and monitored.

The DART+ West project does not involve substantial changes to existing track maintenance regimes. However, the electrification of the City Centre and Maynooth lines will involve additional maintenance work compared to the current situation.

Works to the tracks will improve parts of the lines, which may decrease maintenance needs in the short term. On the other hand, the increase in train frequency may lead to the need for increased maintenance work in the long term.

It is worth noting that although track and OHLE maintenance works are done 6 days/week, they are carried out in a particular section each night and then progress to other locations, so the impact at a specific point is limited to a single night or couple of nights. As a reference estimate, the introduction of OHLE may increase the frequency of maintenance works at a specific point from once every 4-5 years to once every 2-3 years.

It should be noted that the sources of noise from OHLE maintenance work are much less and have a much lower impact than those caused by track maintenance work. Further detail can be found in Chapter 14 Noise and Vibration.

4.13.1 Noise management

IÉ Strategic Noise Maps are provided for public access in accordance with the legislative requirements of the Environmental Noise Regulations 2006.

The strategic noise maps graphically display the exposure of the receiving environment to noise generated by annualised daily train movements along defined sections of the Iarnród Éireann network.

IÉ's maintenance works have stipulated a system for noise management:

- Noise Management Plan: before maintenance activities are done, a Noise Management Plan assesses the activities to be carried out and the potential sources of noise. Noise mitigation measures are proposed to be integrated into the works method statements and included in briefings to internal and contract staff for the duration of the works.
- Noise monitoring surveys: continuous noise monitoring surveys are conducted, especially when maintenance works are carried out in noise-sensitive residential areas.
- Environmental Noise Monitoring Reports provide baseline environmental noise data and maintenance phase noise data.

4.13.2 Maintenance works

4.13.2.1 OHLE

As they are on the live line, OHLE maintenance activities need to be undertaken using track possession strategies to identify dates/hours of minimum rail operation (nights, weekends, etc.), unless the equipment requires urgent attention. The maintenance vehicles to be used are the same as those used for construction, with hybrid vehicles from the nearest compound being utilised.

OHLE maintenance vehicles are multipurpose self-propelled units designed for OHLE maintenance and installation of new OHLE, using special tools installed onboard.

As a reference for the frequency of the OHLE maintenance works, the electrified Coastal line maintenance works are carried out 6 nights per week, reviewing the whole line 4 times per year.

4.13.2.2 Rail maintenance

The main maintenance operations that are most frequently performed on ballasted lines are:

- Alignment and levelling of tracks performed by levelling machines. This task is considered corrective maintenance work, therefore is not scheduled maintenance as it depends on the condition of the track. This maintenance task is to be done whenever a track defect (poor horizontal line, incorrect cross-level, cant, poor vertical line, or dipped joints) is detected during the periodic inspections.
- Track tamping. The process of repacking the ballast under the bearing areas of sleepers, using a track-mounted machine fitted with vibrating tines. Ballast tampers perform this maintenance activity. The frequency of this maintenance task depends on the maintenance strategy. Based on IÉ information, tamping works are carried out every 5 years.

Aside from the tasks mentioned above, several other maintenance operations are to be carried out.

4.13.2.2.1 Visual inspections

The track layout must be inspected to detect and control a series of parameters relating to the wear of the track, the condition of the rail, geometry of the track, rail fastening and welding, among others.

These inspections will have a frequency that guarantees the correct durability of the infrastructure according to its service life. Depending on the system to be inspected, the frequency may be monthly, quarterly, or at even greater intervals.

4.13.2.2.2 Preventive maintenance

Periodic preventive maintenance operations will have to be carried out on the network.

Ballast track reprofiling:

Ballast track infrastructure is profiled to ensure it maintains the proper geometry by redistributing the ballast.

A tamper-levelling machine carries out this operation. The frequency of this task varies depending on the maintenance plan but can be considered roughly every two years depending on the status of the track superstructure.

Ballast track replacement:

Ballast track replacement (complete removal of existing ballast and new ballast placement) is carried out every 20-25 years.

A ballast cleaning machine removes the ballast, ballast cars/hoppers lay the ballast on tracks and a tamper-levelling machine levels the tracks.

Rail and manholes cleanliness:

Inspections of the status of the formation should be scheduled at least once every four months to determine the condition of the track.

These inspections present a good opportunity to open a number of randomly selected drainage manholes and check on their condition.

These activities are to be done by one or two people walking through the network.

Points and crossing cleaning:

Complete cleaning of switches including electric devices will be undertaken at least once every week. In rainy seasons, it may be carried out twice a week.

Points and crossing tamping:

Points and crossing tamping is carried out every 2.5 yards.

Track geometry inspection:

In order to evaluate the condition of track geometry and plan maintenance activities, track inspection cars run over the track at night-time when there is no railway traffic to monitor and record geometry. This is done annually and/or according to track condition.

4.13.2.2.3 Corrective maintenance

If failures are detected in the system's track installations and civil works (inadequate parameters, damaged or deteriorated parts, etc.), the defects will be immediately corrected by means of corrective maintenance.

4.13.2.3 Machinery

There is a whole range of machines used in the operation and maintenance of the railway network from large scale track relaying trains down to spot sleeper changing machines. Commonly used machines are:

- Tamper – for lifting track to levels and packing ballast.
- Liner – for slewing track to a design alignment. This function is often combined with the tamper.
- Ballast regulator – for distributing and shaping the ballast profile along the track.
- Dynamic track stabiliser – for consolidating newly placed bottom ballast prior to a final tamp to level.

Also, a large range of road-rail machines including tampers, excavators, dozers, elevating platforms, load carriers, personnel carriers, and specialist function machines, can circulate both on road and on rail track.