DART+ South West

Technical Optioneering Report

Park West to Heuston Station

Area around Sarsfield Road Bridge (UBC4)

Iarnród Éireann

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Glossary of Terms

Reference	Description
ABP	An Bord Pleanála
ACA	Architectural Conservation Area
APIS	Authorisation for Placing in Service
ASA	Application for Safety Approval
AsBo	Assessment Body
ASPSC	Application Specific Project Safety Case
ATP	Automatic Train Protection
CAF	Common Appraisal Framework
Cantilever	OHLE structure comprising horizontal or near horizontal members supporting the catenary projecting from a single mast on one side of the track.
Catenary	The longitudinal wire that supports the contact wire.
CAWS	Continuous Automatic Warning System
CBI	Computer-Based Interlocking
CCE	Chief Civils Engineers Department of IE
CCRP	City Centre Re-signalling Project
CCTV	Closed Circuit Television
CDP	County Development Plan
CIE	Córas Iompair Éireann
Contact wire	Carriers the electricity which is supplied to the train by its pantograph.
CPO	Compulsory Purchase Order
Cross overs	A set of railway parts at the crossing of several tracks which helps trains change tracks to other directions.
CRR	Commission for Rail Regulation (formerly RSC – Railway Safety Commission)
CSM RA	Common Safety Method for Risk Evaluation and Assessment
CTC	Central Traffic Control
Cutting	A railway in cutting means the rail level is below the surrounding ground level.
D&B	Design & Build (contractor)

Reference	Description
DART	Dublin Area Rapid Transit (IÉ's Electrified Network)
DART+	DART Expansion Programme
DeBo	Designated Body
Direct Current (DC)	Electrical current that flows in one direction, like that from a battery.
DCC	Dublin City Council
DRR	Design Review Report
DSR	Design Statement Report
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EIS	Environmental Impact Statement
Electrification	Electrification is the term used in supplying electric power to the train fleet without the use of an on-board prime mover or local fuel supply.
EMC	Electromagnetic Compatibility
EMU	Electric Multiple Unit (DART train)
EN	European Engineering Standard
EPA	Environmental Protection Agency
EPO	Emerging Preferred Option
ERTMS	European Rail Traffic Management System
ESB	Electricity Supply Board
Four-tracking	Four-tracking is a railway line consisting of four parallel tracks with two tracks used in each direction. Four track railways can handle large amounts of traffic and are often used on busy routes.
FRS	Functional Requirements Specification
FSP	Final Supply Points
GDA	Greater Dublin Area
GI	Ground Investigation
HAZID	Hazard Identification
Horizontal Clearance	The horizontal distance between a bridge support and the nearest railway track is referred to as horizontal clearance. Bridge supports include abutments (at the ends of the bridge) and piers (at intermediate locations).

Reference	Description
HV	High Voltage
IA	Independent Assessor
IÉ	Iarnród Éireann
IM	Infrastructure Manager (IÉ)
IMSAP	Infrastructure Manager Safety Approval Panel
Insulators	Components that separate electricity live parts of the OHLE from other structural elements and the earth. Traditionally ceramic, today they are often synthetic materials.
KCC	Kildare County Council
Lateral Clearance	Clearances between trains and structures.
LCA	Landscape Character Area
Mast	Trackside column, normally steel that supports the OHLE.
MCA	Multi-criteria Analysis
MDC	Multi-disciplinary Consultant
MEP	Mechanical electrical and plumbing
MFD	Major Feeding Diagram
MMDC	Maynooth Multi-disciplinary Consultant
MV	Medium Voltage
NDC	National Biodiversity Data Centre
NIAH	National Inventory of Architectural Heritage
NoBo	Notified Body
NTA	National Transport Authority
OHLE	Overhead Line Equipment
Overbridge (OB)	A bridge that allows traffic to pass over a road, river, railway etc.
P&C	Points and Crossings
Pantograph	The device on top of the train that collects electric current from the contact wire to power the train.
PC	Public Consultation
Permanent Way	A term used to describe the track or railway corridor and includes all ancillary installations such as rails, sleepers, ballast as well as lineside retaining walls, fencing and signage.

Reference	Description
POAP	Plan-On-A-Page, high-level emerging programme
PPT	Phoenix Park Tunnel
PRS	Project Requirement Specification
PSCS	Project Supervisor Construction Stage
PSDP	Project Supervisor Design Process
PSP	Primary Supply Points
QA/QC	Quality Assurance/Quality Control
RAM	Reliability, Availability, Maintainability
RC	Reinforced Concrete
Re-signalling	Re-signalling of train lines will regulate the sage movement of trains and increase the capacity of train services along the route.
RMP	Record of Monuments and Places
RO	Railway Order
RPS	Record of Protected Structures
RSC-G	Railway Safety Commission Guideline
RU	Railway Undertaking (IÉ)
SAM	Safety Assurance Manager
SAP	Safety Approval Panel
SDCC	South Dublin County Council
SDZ	Strategic Development Zone
SET	Signalling, Electrical and Telecommunications
Sidings	A siding is a short stretch of railway track used to store rolling stock or enable trains on the same line to pass
SMR	Sites and Monuments Records
SMS	IÉ Safety Management System
TII	Transport Infrastructure Ireland
TMS	Train Management System
TPH	Trains per Hour
TPHPD	Trains per Hour per Direction

Reference	Description
TPS	Train Protection System
Track Alignment	Refers to the direction and position given to the centre line of the railway track on the ground in the horizontal and vertical planes. Horizontal alignment means the direction of the railway track in the plan including the straight path and the curves it follows.
TSI	Technical Specifications for Interoperability
TSS	Train Service Specification
TTAJV	TYPSA, TUC RAIL and ATKINS Design Joint Venture (also referred to as TTA)
Underbridge (UB)	A bridge that allows traffic to pass under a road, river, railway etc. The underneath of a bridge.
VDC	Direct Current Voltage
Vertical Clearance	For overbridges, an adequate vertical distance between railway tracks and the underside of the bridge deck (soffit) must be provided in order to safely accommodate the rail vehicles and the OHLE. This distance is known as vertical clearance and it is measured from the highest rail level.
WFD	Water Framework Directive

1. Introduction

1.1. Purpose of the Report

The purpose of this report is to provide technical input to the Preliminary Option Selection Report. This report shows the options considered as part of the project development and why the emerging preferred option was chosen.

This report provides the technical assessment of the area from West of Sarsfield Road Bridge (UBC4) to the West of Memorial Road Bridge (OBC3). This report presents the approach to option development, options assessment, and options selection. This optioneering process incorporates assessment by the following Design Workstreams and specialist Project Teams:

- Permanent Way
- Civils and Structures
- Signalling, Electrical and Telecommunications
- Overhead Line Equipment (OLE)
- Environment
- Highways
- Geotechnical

The report provides:

- An area overview and a detailed description of the existing railway infrastructure and challenges.
- The Project Requirements for this area.
- The technical and environmental constraints, including the horizontal and vertical clearances at structures.
- The options considered for this area.
- The option selection process is leading to the identification of the Emerging Preferred Option, including the Sifting process and the Multi-Criteria Analysis process.

1.2. DART+ Programme Overview

The DART+ Programme is a transformative railway investment programme, that will modernise and improve the existing rail services in the Greater Dublin Area (GDA). It will provide a sustainable, electrified, reliable and more frequent rail service, improving capacity on rail corridors serving Dublin.

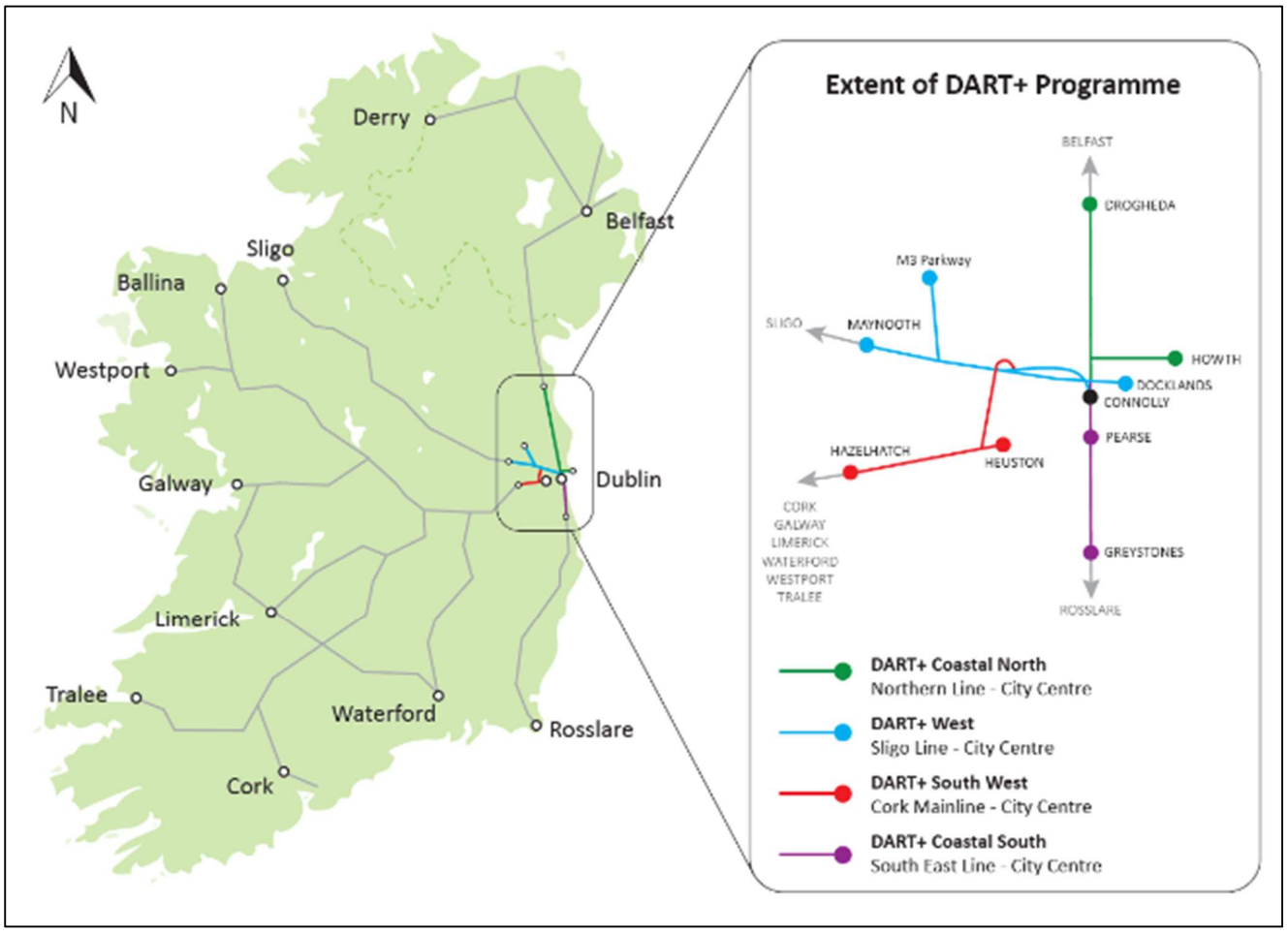

Figure 1-1 Schematic of Overall DART+ Programme

The current electrified DART network is 50km long, extending from Malahide / Howth to Bray / Greystones. The DART+ Programme seeks to increase the network to 150km. The DART+ Programme is required to facilitate increased train capacity to meet current and future demands, which will be achieved through a modernisation of the existing railway corridors. This modernisation includes the electrification, re-signalling, and certain interventions to remove constraints across the four main rail corridors within the Greater Dublin Area, as per below:

- DART+ South West (this Project) – circa 16km between Hazelhatch & Celbridge Station to Heuston Station and also circa 4km between Heuston Station to Glasnevin, via the Phoenix Park Tunnel Branch Line.
- DART+ West – circa 40km from Maynooth & M3 Parkway Stations to the City Centre.
- DART+ Coastal North – circa 50km from Drogheda to the City Centre.
- DART+ Coastal South – circa 30km from Greystones to the City Centre.

The DART+ Programme also includes the purchase of new electrified fleet to serve new and existing routes.

The DART+ Programme is a key element to the national public transportation network, as it will provide a high-capacity transit system for the Greater Dublin Area and better connectivity to outer regional cities and towns. This will benefit all public transport users.

The Programme has also been prioritised as part of Project Ireland 2040 and the National Development Plan 2018-2027 as it is integral to the provision of an integrated, high-quality public transport system.

Delivery of the Programme will also promote transport migration away from the private car and to public transport. This transition will be achieved through a more frequent and accessible electrified service, which will result in reduced road congestion, especially during peak commuter periods.

Ultimately, the DART+ Programme will provide enhanced, greener public transport to communities along the DART+ Programme routes, delivering economic and societal benefits for current and future generations.

1.3. DART+ South West Project

The DART+ South West Project will deliver an electrified network, with increased passenger capacity and enhanced train service between Hazelhatch & Celbridge Station to Heuston Station (circa 16km) on the Cork Mainline, and Heuston Station to Glasnevin via Phoenix Park Tunnel Branch Line (circa 4km).

DART+ South West Project will complete four-tracking between Park West & Cherry Orchard Station and Heuston Station and will also re-signal and electrify the route. The completion of the four-tracking will remove a significant existing constraint on the line, which is currently limiting the number of train services that can operate on this route. DART+ South West will also deliver track improvements along the Phoenix Park Tunnel Branch Line, which will allow a greater number of trains to access the city centre.

Upon completion of the electrification of the DART+ South West route, new DART trains will be used on this railway corridor, similar to those currently operating on the Malahide / Howth to Bray / Greystones Line.

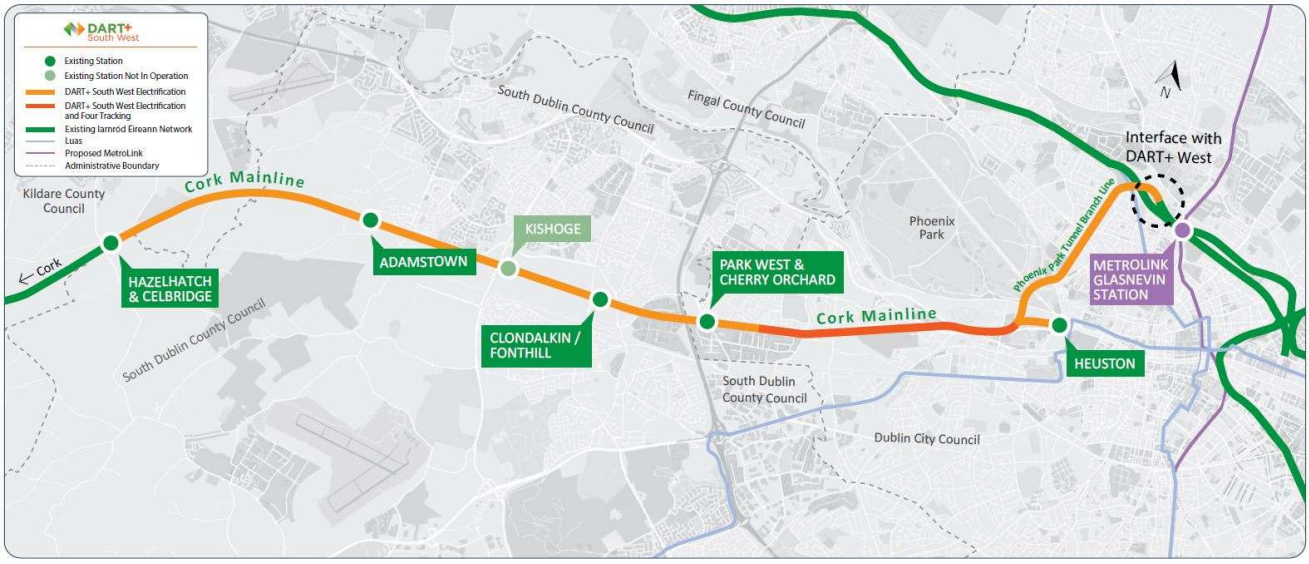

Figure 1-2 DART+ South West Route Map

1.4. Capacity increases associated with DART+ South West.

DART+ South West will improve performance and increase train and passenger capacity on the route between Hazelhatch & Celbridge Station to Heuston Station and through the Phoenix Park Tunnel Branch Line to the City Centre, covering a distance of circa 20km. It will significantly increase train capacity from the current 12 trains per hour per direction to 23 trains per hour per direction (i.e. maintain the existing 12 services, with an additional 11 train services provided by DART+ South West). This will increase passenger capacity from the current peak capacity of approximately 5,000 passengers per hour per direction to approximately 20,000 passengers per hour per direction. Upon completion of the DART+ South West Project, train services will be increased according to passenger demand.

1.5. Key infrastructural elements of DART+ South West Project

The key elements of DART+ South West include:

- Completion of four-tracking from Park West & Cherry Orchard Station to Heuston Station, extending the works completed on the route in 2009.
- Electrification of the line from Hazelhatch & Celbridge Station to Heuston Station and also from Heuston Station to Glasnevin, via the Phoenix Park Tunnel Branch Line, where it will link with proposed DART+ West.
- Undertaking improvements / interventions of bridges to achieve vertical and horizontal clearances.
- Remove rail constraints along the Phoenix Park Tunnel Branch Line.
- Feasibility report and concept design for a potential new Heuston West Station.

The 'Emerging Preferred Option' will be compatible with the future stations at Kylemore and Cabra, although the construction of these stations is not part of the DART+ South West Project.

1.6. Route Description

The existing rail corridor extends from Heuston Station to Hazelhatch & Celbridge Station, the route also extends through the Phoenix Park Tunnel to Glasnevin. The area descriptions and extents are set out in **Table 1-1** below.

Table 1-1 Route Breakdown

Area Name	Sub-area Description	Extents	Main Features
Hazelhatch to Park West	Area from Hazelhatch to Park West	West side of Hazelhatch & Celbridge Station to 50m to west of Cherry Orchard Footbridge (OBC8B)	Hazelhatch & Celbridge Station Adamstown Station Clondalkin/Fonthill Station Park West & Cherry Orchard Station Cherry Orchard Footbridge (OBC8B)

Area Name	Sub-area Description	Extents	Main Features
Park West to Heuston Station	Area around Le Fanu Bridge (OBC7)	West of Cherry Orchard Footbridge (OBC8B) to the East of the proposed Le Fanu Road Bridge (OBC7)	Le Fanu Road Bridge (OBC7)
	Area around Kylemore Bridge (OBC5A)	East of the proposed Le Fanu Road Bridge (OBC7) to the East of IE700B (i.e. the points for the Inchicore headshunt turnout)	Kylemore Road Bridge (OBC5A)
	Area around Inchicore Works	East of IE700B (i.e. the points for the Inchicore headshunt turnout to the west of Sarsfield Road Bridge (UBC4)	Inchicore Works Depot
	Khyber Pass Bridge (OBC5)	Vicinity of Khyber Pass Footbridge (OBC5)	Khyber Pass Footbridge (OBC5)
	Area around Sarsfield Road Bridge (UB4)	West of Sarsfield Road Bridge (UBC4) to the West of Memorial Road Bridge (OBC3)	Sarsfield Road Bridge (UBC4)
	Area around Memorial Bridge (OBC3)	Vicinity of Memorial Road Bridge (OBC3)	Memorial Road Bridge (OBC3)
	Area around South Circular Road Junction	East of Memorial Road Bridge (OBC3) East of St John's Road Bridge (OBC0A)	South Circular Road Junction South Circular Road Bridge (OBC1) St Johns Road Bridge (OBC0A)
	Area around Heuston Station and Yard	Area at Heuston Station Yard, including all platforms and sidings	Heuston Station Sidings around Heuston Station
St John's Road Bridge to Glasnevin Junction	Area from East of St John's Road Bridge (OBC0A) to East of Phoenix Park Tunnel	East of St John's Road Bridge (OBC0A) to East of Phoenix Park Tunnel	Potential new Heuston West Station Liffey Bridge (UBO1). Conyngham Road Bridge (OBO2) Phoenix Park Tunnel

Area Name	Sub-area Description	Extents	Main Features
	Area from Phoenix Park Tunnel to Glasnevin Junction	West of Phoenix Park Tunnel to South of Glasnevin Junction	McKee Barracks Bridge (OBO3) Blackhorse Avenue Bridge (OBO4) Old Cabra Road Bridge (OBO5) Cabra Road Bridge (OBO6) Fassaugh Avenue Bridge (OBO7) Royal Canal and LUAS Twin Arches (OBO8) Maynooth Line Twin Arch (OB09) Glasnevin Cemetery Road Bridge (OBO10)

2. Existing Situation

2.1. Overview

This section is 470m (approx.) in length and extends from the west side of Sarsfield Road Bridge (UBC4) to 50m west of Memorial Road Bridge (OBC3). The Permanent Way in this area consists of 3 No. tracks. The tracks fall in level from west to east towards Heuston Station. There is currently no longitudinal drainage system installed along the Permanent Way.

The area has 1 No. road underbridge. Sarsfield Road Bridge (UBC4) carries 3 No. rail tracks over the single-carriageway Sarsfield Road below. Sarsfield Road Bridge (UBC4) is a major feature of the area. It is a single-span highly skewed steel rail bridge supported on masonry abutments with steel bearings.

Sarsfield Road facilitates traffic moving in a north-south direction beneath the rail corridor. The carriageway width beneath the bridge is narrow. A yield system is in operation which permits only a single lane of traffic beneath the structure. Sarsfield Road is in a deep cutting that is supported by masonry retaining walls on all 4 No. sides of Sarsfield Road Bridge (UBC4); the bridge is a major feature of the area.

The Truck Rental is a commercial property located on the south-east side of Sarsfield Road Bridge (UBC4). The property is retained along Sarsfield Road with a masonry retaining wall. Its northern boundary with the rail corridor is formed with a masonry and blockwork retaining wall. A steel Portal Signal Gantry (OBC3A) is located 190m (approx.) west of Sarsfield Road Bridge (UBC4). A horse sanctuary/field is located on the north side of the corridor opposite the Truck Rental/Logistics Company.

At Sarsfield Road Bridge (UBC4), the rail corridor is on an embankment. Further to the east, the railway is at grade then generally returns to a cutting which gradually steepens on approach to Memorial Road Bridge (OBC3). The south side of the rail corridor is retained with a battered masonry retaining wall. The north side of the rail corridor is formed with earthwork cutting slope. The area does not currently have any provisions for electrification. The major infrastructure features of the area are illustrated in the **Figure 2-1** below.

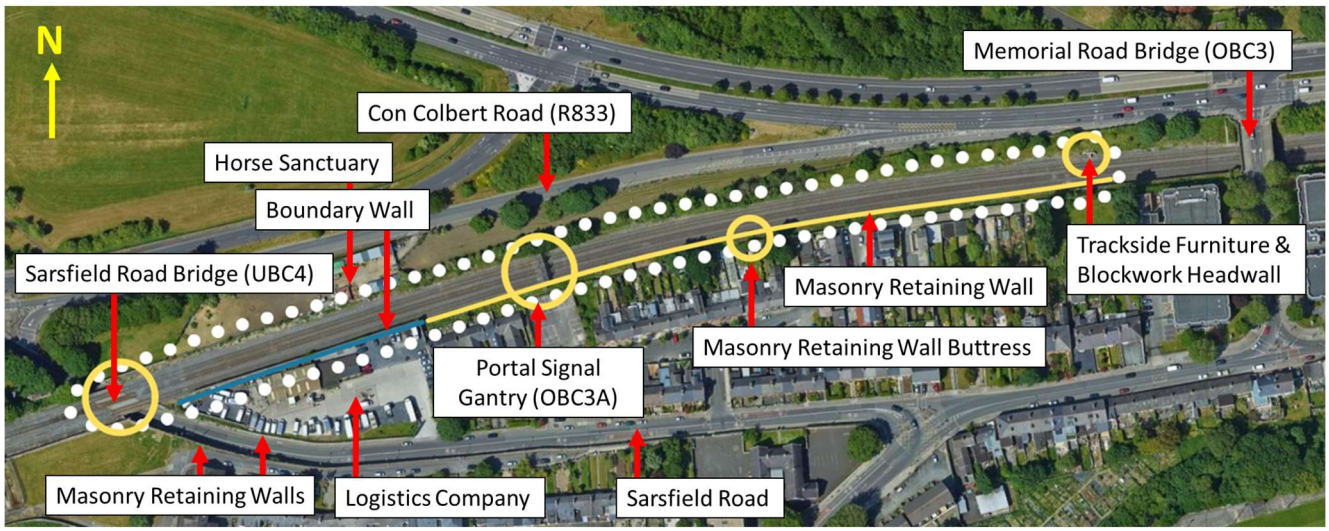

Figure 2-1 Aerial view (white dotted outline of area)

The main Environmental features are described in **Section 2.8** below.

2.2. Challenges

The project objective is to increase the number of tracks between Park West & Cherry Orchard Station and Heuston Station to 4 No. tracks and to electrify 2 No. tracks (northern side) from Hazelhatch & Celbridge Station to Glasnevin Junction. There are significant challenges that constrain the options available to achieve the Permanent Way and Overhead Line Electrification (OHLE) project requirements.

The existing Sarsfield Road Bridge (UBC4) structure, which currently carries 3 No. tracks, has insufficient width to carry an additional track. The intervention options proposed to involve reconstructing the bridge with new structures that have sufficient width for 4 No. tracks. The additional fourth track may be installed to the north of the existing track or to the south. As this structure is an underbridge, the installation of overhead line electrification (OHLE) at the bridge is not a significant challenge.

Sarsfield Road is in a deep cutting. Masonry retaining walls up to 5m (approx.) retain the adjacent grounds on all 4 sides of the structure. The Sarsfield Road Bridge (UBC4), although not protected, is noted as part of the Dublin Industrial Heritage associated with the Phoenix Park Tunnel Branch Line. Minimising the potential impact on the walls and abutments and maintaining their stability is a challenge.

The low point on Sarsfield Road is beneath the existing bridge. The road levels increase to the north and to south along the road (i.e. away from the bridge). A replacement structure capable of carrying 4 No. tracks would be wider than the existing bridge. The soffit level of this bridge would be positioned at a suitable (higher) level where required so that the existing vertical clearance from the road below of 4.37m is maintained. A large culvert combined sewer culvert located (with limited road cover) under the northbound carriageway below the bridge and the departs the roadway to the south of the structure (at the confluence of combined sewer systems from the north and south) and passes under the retaining wall and railway continuing in north easterly direction. There are a significant number of utilities beneath the existing Sarsfield Road. These existing services present a challenge in terms of reducing levels on Sarsfield Road.

2.3. Structures

Sarsfield Road Bridge (UBC4)

UBC4 carries 3 No. rail tracks over the single-carriageway Sarsfield Road. It is a single-span highly skewed steel rail bridge supported on masonry abutments with steel bearings. The rails are directly fixed to the bridge deck. The bridge incorporates maintenance access walkways on the north and south side of the structure. The vertical clearance from Sarsfield Road below to bridge soffit is 4.37m. The clear (skewed) span of the structure is 11m (approx.). The carriageway beneath the structure is 5m (approx.) wide (square dimension). There are 2 No. footways beneath the structure. The footway is 1.6m wide on the west side and 1m wide on the east side.

Figure 2-2 Sarsfield Road Bridge (UBC4) - South Elevation

Figure 2-3 Sarsfield Road Bridge (UBC4) - North Elevation

Figure 2-4 Sarsfield Road Bridge (UBC4) - East footway & West abutment

Figure 2-5 Sarsfield Road Bridge (UBC4) Deck level - Facing East

Figure 2-6 Sarsfield Road Bridge (UBC4) East & West abutments

Portal Signal Gantry OBC3A

Portal signal gantry (OBC3A) is a portal signal gantry located 190m (approx.) west of Sarsfield Road Bridge (UBC4). The steel gantry is supported by a steel gantry column leg on the north side and is supported by a short steel column leg positioned on top of the battered masonry retaining wall on the south side. The gantry has secured ladder access at north support to facilitate access for inspection and maintenance. This portal gantry will need to be removed to facilitate four-tracking and electrification.

The gantry supports signals HN253, HN254 and HN255. They protect the Points and Crossovers (P&C) at Inchicore. A banner repeater (BR) is located on the south retaining wall at Ch 251+020.

Figure 2-7 Portal signal gantry (OBC3A) - west of Sarsfield Road Bridge (UBC4)

Retaining Walls

There are 2 No. existing retaining walls along the rail line in the area. A battered masonry retaining wall runs west along the south side of the tracks for 330m (approx.) from the east boundary of the area. This wall is typically 2m (approx.) high and increases to 3m (approx.) at the east boundary of the area. The wall appears to be in good condition generally. The wall incorporates a buttress which is located 170m from the east boundary of the area. The wall provides support to the south side of the portal signal gantry (OBC3A) located 190m (approx.) west of Sarsfield Road Bridge (UBC4).

A second retaining wall forms the northern boundary of the Truck Rental/Logistics Company with the rail line. The bottom of the wall is constructed in masonry. The upper section has been extended in blockwork to a total height of 3m (approx.). This wall adjoins the west end of the masonry retaining wall described above.

Sarsfield Road Bridge (UBC4) is abutted by retaining walls on all 4 sides. These walls retain the adjacent existing ground level to facilitate a significant drop in vertical levels on Sarsfield Road to bring the carriageway under the rail corridor at Sarsfield Road Bridge (UBC4). The retaining walls are up to 5m high and are constructed in masonry. The retaining walls are highest on the south side of Sarsfield Road Bridge (UBC4). There are a number

of cast iron service pipes protruding from the south-east and south-west walls. The retaining walls incorporate anchors along their lengths on the south-east and south-west sides. The anchor caps are visible at road level. The walls also incorporate buttresses along their length for stability.

Figure 2-8 Masonry Retaining Wall on the south side of the rail corridor

Figure 2-9 Masonry retaining wall buttress & logistics company retaining wall

The existing southern track is in close proximity to the face of the walls. All options should consider that the renewal of the track may cause instability of this wall.

Figure 2-10 Sarsfield Road south-west retaining & south-east retaining walls

Figure 2-11 Sarsfield Road north-west & north-east retaining walls

Other Structures

A blockwork head wall creates space for trackside furniture at the toe of the cutting slope near the east boundary of the area. The headwall is located 10m (approx.) from the east boundary of the area on the north side of the tracks.

Figure 2-12 Blockwork headwall at on the north side of tracks (east end of the area)

2.4. Permanent Way and Tracks

The west end of the area is at project chainage (h 251+340, and the east end is at Ch 250+860. There are 3 No. tracks, named from north to south as Up Main, Down Main and Relief Line. The maximum speed is 40mph (refer to Figure below).

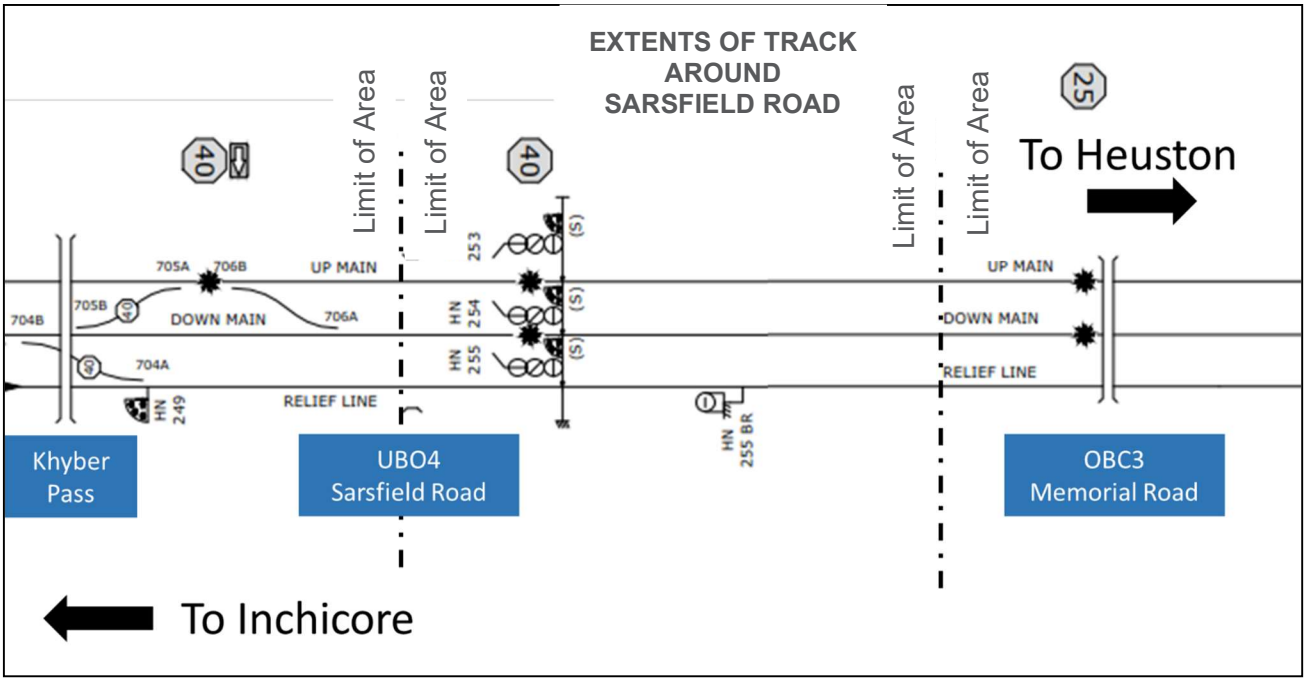

Figure 2-13 Track diagram showing the area

The railway corridor transitions from being at grade at the east side, to a cutting in west end (tracks at a lower level than the surroundings). The Sarsfield Road Bridge (UBC4) deck is skewed with a relative angle between the road axis and tracks of 40 degrees (approx.). The track-form over the bridge is a direct fix system, where the rails are directly fixed to the bridge deck. This system is chosen to maximise the vertical road clearance. The transitions between the direct fix system and the ballasted track are the weak point of this solution. The geometry through the transitions is difficult to maintain, and as a result, the wear rate of the track components is greater.

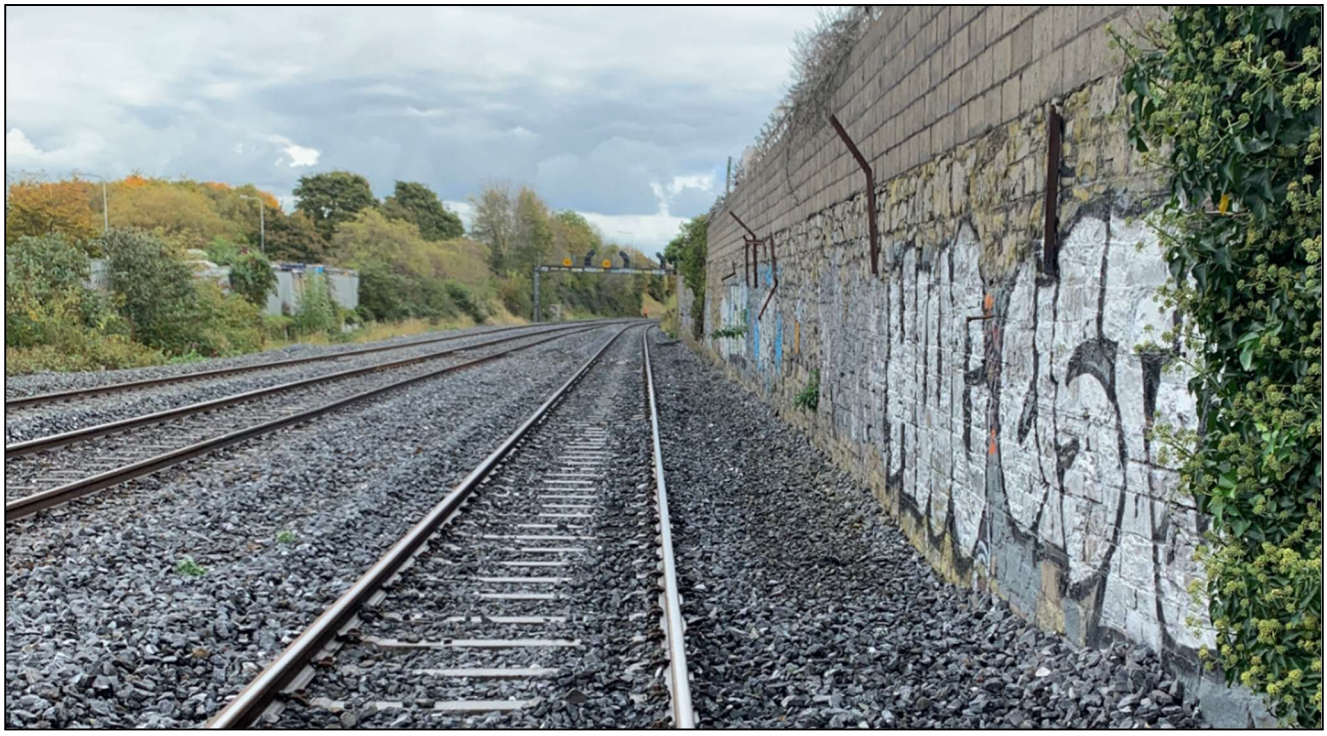

Figure 2-14 Clearance from boundary wall to outer rail is 1.7m - Facing East

To the east of Sarsfield Road Bridge (UBC4), on the south side, the corridor width is limited by the boundary wall between the Truck Rental/Logistics Company property and the rail corridor. This wall is at 1.7m to the nearest rail. This is adjoined by a masonry retaining wall to the east which continues to Memorial Road Bridge (OBC3).

Figure 2-15 View of the 1000m radius curve - Facing East

The track geometry is straight over Sarsfield Road Bridge (UBC4) and then ties into a 1000m (approx.) radius curve which continues to the east boundary of the area. The track gradient is 1% (approx.) and falls towards

Heuston. The track-form is comprised of a ballasted track with 54E1 rail and concrete sleepers. Adjustment switches protect the bridge from thermal forces.

Figure 2-16 Adjustment switches on Relief Line (LHS) and Down Main (Centre).

2.5. Other Railway Facilities

There are no other facilities (such as access points) in the area.

2.6. Road Network

The low point on Sarsfield Road is beneath the existing bridge. The road levels increase to the north and to south along the road (i.e., away from the bridge). A large culvert combined sewer culvert located (with limited road cover) under the northbound carriageway below the bridge and the departs the roadway to the south of the structure (at the confluence of combined sewer systems from the north and south) and passes under the retaining wall and railway continuing in north easterly direction. There are a significant number of utilities beneath the existing Sarsfield Road. These existing services present a challenge in terms of reducing levels on Sarsfield Road.

The proximity of Sarsfield Road Bridge (UBC4) to Memorial Road Bridge (OBC3) and South Circular Road Bridge (OBC1) links the rail crossing points in terms of traffic management. This road is part of the Liffey Valley Bus Connects route; while the scheme proposal in its current form proposes no change to the current yield arrangement on approach to the bridge, it nevertheless prioritises this as a key public transport route. Temporary traffic management and works sequencing proposals will take due consideration of the same.

The carriageway beneath the structure is 5m (approx.) wide (square dimension). There are footways beneath the structure; one 1.6m wide on the west side and 1m wide on the east side.

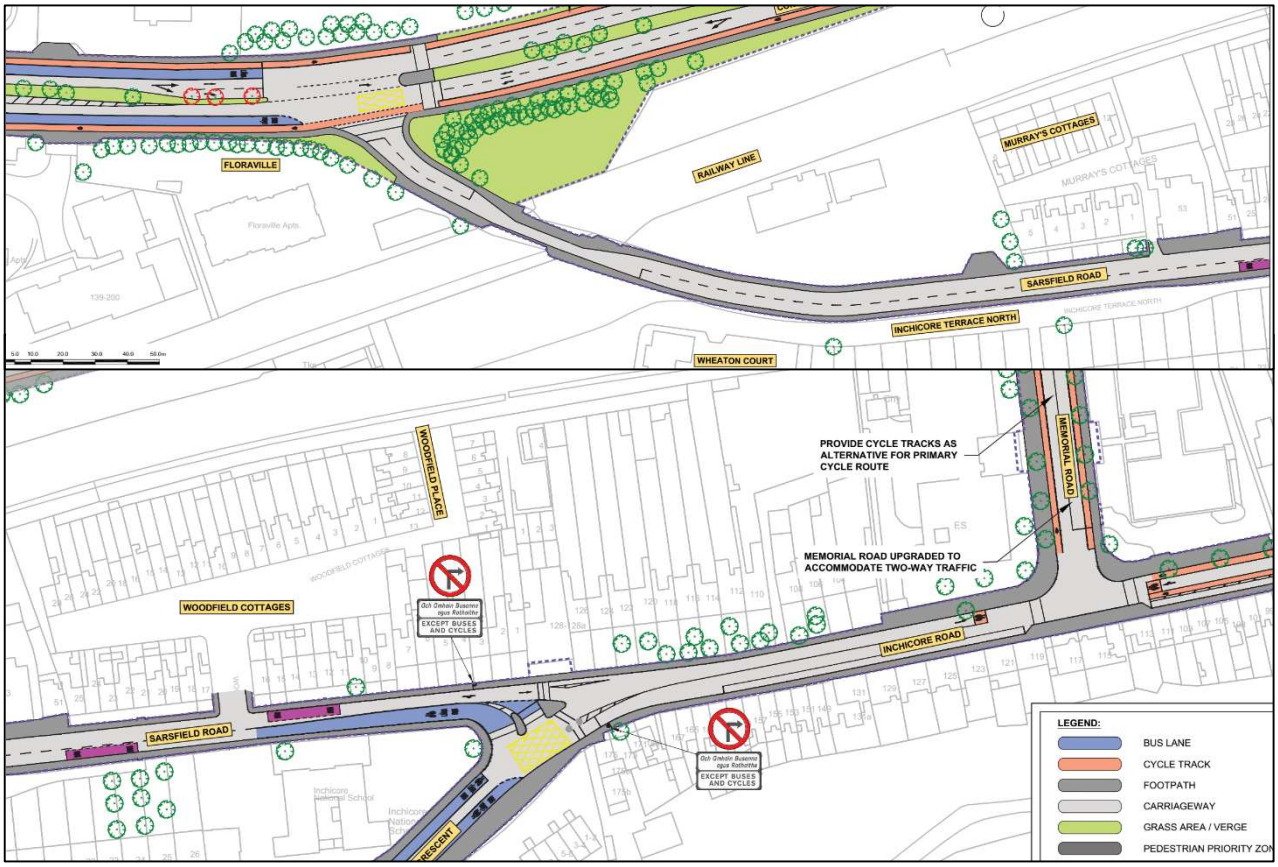

Figure 2-17 Proposed Liffey Valley BusConnects Scheme (Sarsfield Road)

2.7. Ground Conditions

The topography of the area is generally flat and slopes gently south-east to north-west. The railway is situated on a small embankment on the westerly approach to Sarsfield Road Bridge (UBC4). Further east of Sarsfield Road Bridge (UBC4), the railway then transitions from at grade to cutting towards Memorial Road Bridge.

To the east of Sarsfield Road Bridge (UBC4), a long and narrow strip plot (known colloquially as 'horse fields') and the Con Colbert Road bound the railway to the north, and commercial/residential buildings are present close to the southern boundary of the railway.

The general superficial deposits within this area are shown to comprise 2 No. different superficial deposits. To the west of Sarsfield Road Bridge (UBC4), the superficial geology is shown to comprise of till. To the east of Sarsfield Road Bridge (UBC4), the area is shown to comprise of urban (made ground) deposits, which are likely to be overlying a layer of till. The bedrock deposits across the entire area are shown to comprise limestone and shale.

Ground investigation information was reviewed from five boreholes within 50m of Sarsfield Road Bridge (UBC4) close to the railway corridor.

Ground conditions located 25m west of the Sarsfield Road Bridge (UBC4) encountered a thin layer of topsoil underlain by made ground between 0.2m below ground level (bgl) (25.67m AOD) and 5.8m bgl (20.07m AOD). The borehole was terminated at 5.8m bgl as a culvert had been encountered during drilling.

Ground conditions encountered 35m west of the Sarsfield Road Bridge (UBC4) comprised of clay and gravel between ground level and 5.5m bgl (20.50m AOD). There was no recovery between ground level 5.5m bgl (20.5m AOD); therefore, limited information is available for this material. The clay and gravel were underlain by a firm to locally soft clay, becoming hard at depth. Bedrock consisting of strong to very strong limestone with moderately strong mudstone and shale was met at 16.2m bgl (9.80m AOD).

Two (2 No.) boreholes (one inclined) were both completed in a similar location south-east of the bridge within the Logistics Company premises. The made ground was recorded between ground level and 1.2m bgl (24.61m AOD). The made ground was underlain by clay and gravel. Firm to stiff clay was recorded below the clay and gravel. Bedrock was recorded between 18.60m bgl (9.54m AOD) and 17.37m bgl (8.40m AOD) and comprised strong to very strong limestone and moderately strong mudstone and shale. No recovery was noted in places within the superficial deposits.

Ground conditions 40m south of Sarsfield Road Bridge (UBC4) comprised topsoil overlying made ground between ground level and 1.2m bgl (24.35m AOD). The made ground was underlain by clay, recorded locally as firm to stiff and very sandy overlying bedrock deposits. Bedrock described as moderately strong to strong limestone and moderately strong to weak mudstone and shale was encountered at 12.82m bgl (12.73m AOD). No recovery was recorded between ground level and 2.5m bgl (23.05m AOD).

No groundwater was encountered during the drilling within any exploratory holes adjacent to Sarsfield Road Bridge (UBC4).

2.8. Environment

Sarsfield Road Underbridge, although not listed as an RPS or a NIAH feature is none the less noted as part of the industrial heritage record associated with the Phoenix Park Tunnel Branch Line. West of this bridge on the southern side of the rail corridor, there is a truck rental company. The land use then gives way to residential development associated with Sarsfield Road, Woodfield, and Murray's Cottages. This area also hosts two features listed on the Record of Protected Structures for Dublin City: Cleary's Pub and the Inchicore National School.

North of the corridor at Sarsfield Road Bridge there is a strip of open space, a horse sanctuary/field (opposite Truck Rental/Logistics company), before giving way to sparse planting. Further north is Con Colbert Road. The open green space associated with Liffey Gaels GAA club is located to the north-west and the open space associated with the National War Memorial Gardens to the north-east.

Refer also to Section 4.1 (Environment).

2.9. Utilities

The area contains a significant number of utilities typical of an urban environment such as this. Service providers with network assets in this area include the following:

- ESB Networks
- Gas Networks Ireland
- Dublin City Council Road Drainage (Storm Water Sewers)
- Dublin City Council / Irish Water (Foul Water Sewers)
- Dublin City Council / Irish Water (Water Supply)
- Dublin City Council Public Lighting

- Private water supply pipe (possibly Irish Rail owned)

Data in the form of utility service records have been gathered from all providers in the area. The majority of services are present at road level, most of which are following the road alignment to pass under the railway at this location.

The Creosote Stream is located directly under the abutments of this bridge, the stream flowing in a north-easterly direction. All other services in the road are likely crossing above this culvert and hence are at a shallow depth below the road/footpath surface level.

As the majority of services are located within the existing street at this location, where modifications are required to the existing bridge and/or to the adjacent road network, impacts on utilities would be inevitable.

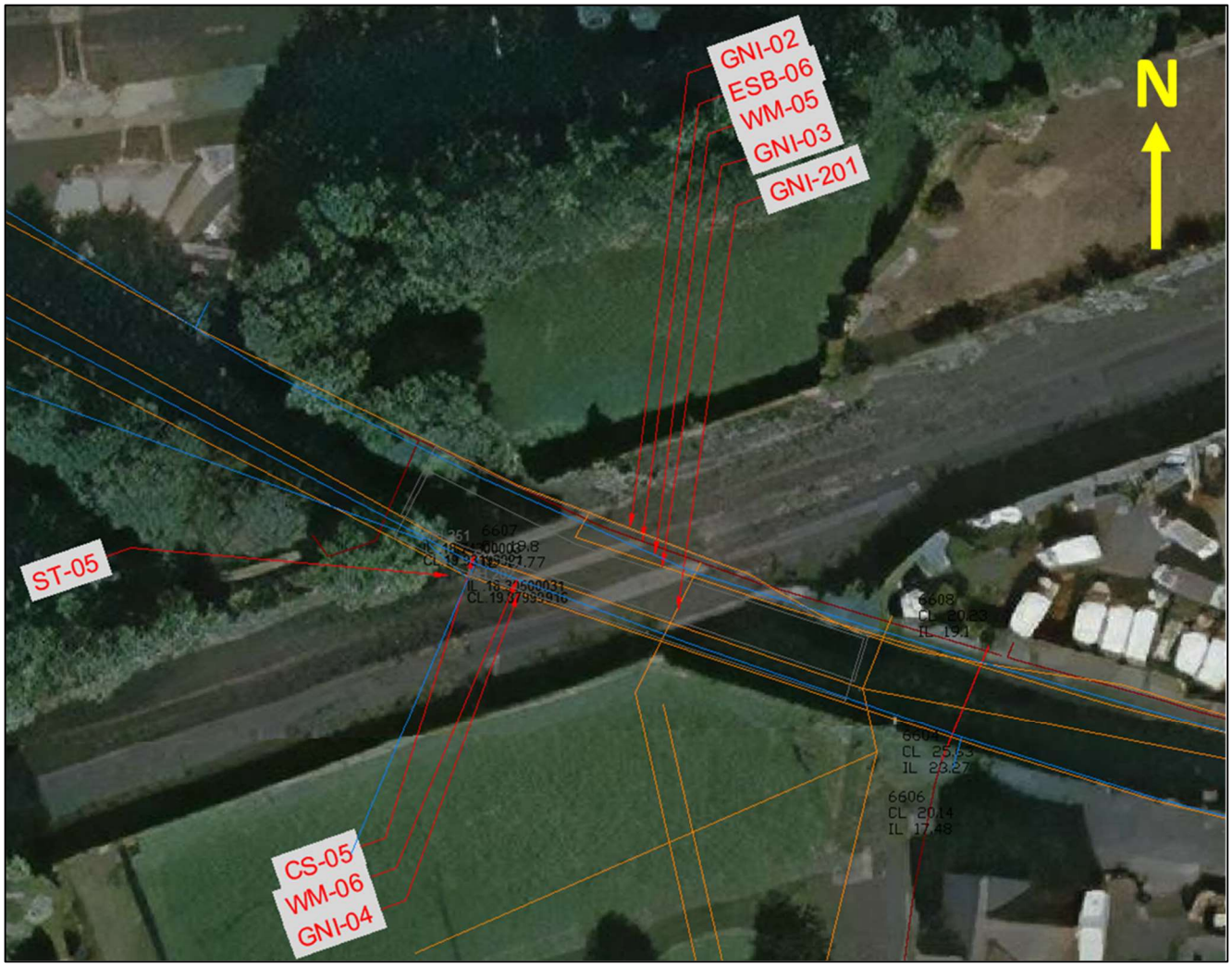

Figure 2-18 Existing Utilities at Sarsfield Road Bridge (OBC3)

3. Requirements

3.1. Specific Requirements

- Increase the number of tracks from 3 No. tracks to 4 No. tracks
- Electrification of 2 No. tracks for DART+ South West
- Provide vertical electrical clearance through existing structures or amend or reconstruct structures to provide the required clearance.
- Maintain functionality of existing roads.

3.2. Systems Infrastructure and Integration

In addition to the track and civil infrastructure modifications relating to them DART+ South West Project, there is a requirement to provide Overhead Line Electrification Equipment (OHLE) signalling and telecoms infrastructure.

The electrification system will be similar in style to that currently used on the existing DART network and integrated and compatible across the DART+ Programme. There will be a potential requirement to provide 6 additional power substations along the rail line to provide the requisite power for the network demand. It is envisaged that a standardised approach to electrification will be adopted, but those area-specific interventions will also be required.

The Low Voltage and Telecommunications networks required for Signalling will be 'global systems' and are unlikely to vary significantly between or within the various areas. In order to achieve the necessary capacity enhancements and performance required for the introduction of the new electric multiple unit (EMU) fleet, it will be necessary to upgrade the existing signalling system as well as replacing some of the legacy signalling system. This will include provision of Relocatable Equipment Buildings (REB) where required along the route to accommodate signalling equipment and associated power supplies and backup.

Significant upgrades to the existing telecommunications infrastructure will be required to facilitate improvements to the radio-based technologies used on the network and for signalling and communication with the existing and future network control centres.

3.2.1. Electrification System

The OHLE system architecture is currently being developed. The Dart wide programme will adopt a 1500V Direct Current (DC) OHLE system to provide electrical power to the network's new electric train fleet.

It should be noted that all OHLE diagrams in this report are for visual information only. Final dimensions, lengths, heights and cantilever types are to be defined in the reference design and subsequent design stages of the project.

The OHLE concept comprises a pre-sagged simple (2-wire) auto-tensioned system, supported on galvanised steel support structures.

In 4 No. track areas, Two Track Cantilevers (TTCs) will generally only be placed on the north side of the line, to support OHLE on the northern two tracks. Supporting the OHLE by utilising structures positioned on the south side of the 4 No. tracks is not considered to be a feasible solution due to the loads involved.

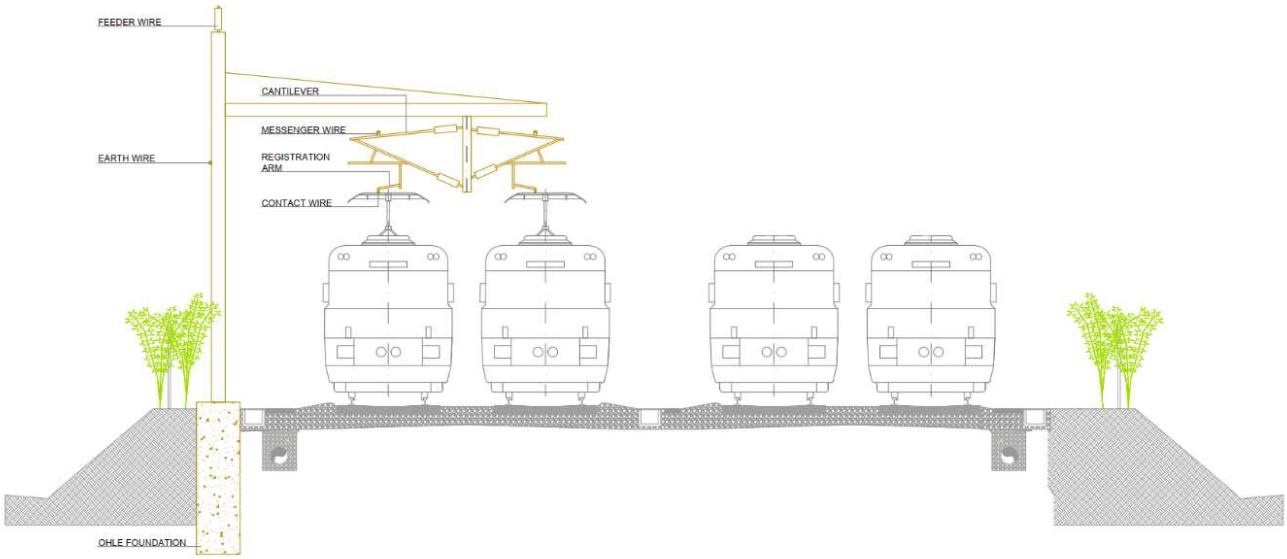

Figure 3-1 Typical OHLE arrangement in four track open route.

Nominal contact wire height is 4.7m, and heights through stations may be slightly higher to achieve minimum protection by clearance distances. Minimum contact wire height without a derogation is 4.4m under all conditions including sag, and it may be necessary at certain bridges to place the contact wire height at 4.2m under all conditions.

Additional feeder cables will be supported from the masts at heights between 6.5m and 8m on each side of the track. An earth wire will also be suspended from the masts.

Maximum tension length is 1600m, and maximum half tension length is 800m. Overlaps will comprise three spans, with spring tensioners used throughout. Midpoint Anchors (MPAs) will generally be of the tie-wire type, although the portal type may be needed in some locations.

At intervals of up to 1500m the OHLE wires will be anchored at an arrangement known as an overlap, and a new set of wires will take over. The anchors provide the mechanical tension that the wires need to perform reliably and safely. In areas of crossovers and junctions, additional wiring will be provided for the extra tracks, and these will also be provided with anchors.

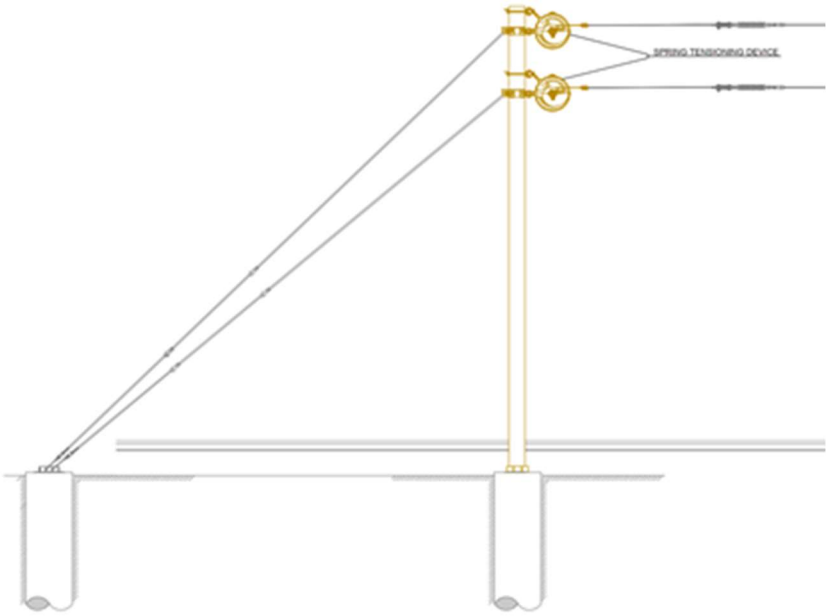

Figure 3-2 Typical anchor structure

3.2.2. Substations

In order to facilitate the introduction of the new OHLE scheme across the DART+ network, a power supply study has been carried out. There is a requirement to provide 6 new substations at the following locations:

- Islandbridge
- Le Fanu
- Park West
- Kishoge
- Adamstown
- Hazelhatch

In principle, there are no proposed substations for this area.

3.3. Design Standards

Please refer to Annex 3.2 for the design standards that will be used for the scheme.

4. Constraints

4.1. Environment

The key constraints for this sub-area relate to the proximity of the truck rental/logistics company to the south of the corridor as well as the residential development, also to the south. From a landscape perspective, the War Memorial Gardens is a designated area. The Sarsfield Road Bridge (UBC4), although not protected, is noted as part of the Dublin Industrial Heritage associated with the Phoenix Park Tunnel Branch Line.

4.2. Roads

The existing clearance from the road surface to the soffit of the bridge is signed as 4.37m. The existing underpass approach road gradients are 3.5% (approx.) and 4.75% (approx.), to the north and south, respectively. An extension of the bridge footprint north or south of the existing parapets to accommodate a revised track arrangement, without track raising and/or changes to bridge structural depth, would require a lowering of the road.

The culvert beneath the road at the existing Sarsfield Road Bridge (UBC4) location is the main impediment to being able to lower the road. There are also several of utilities located in the carriageway and footpaths that also cross above the culvert. at depths that are not considered preferable for utility companies; and as such these utilities also constraint the ability to lower the road.

The existing road cross-sectional widths between existing bridge abutments provide limited opportunity to improve the safety for cyclists and pedestrians; if further design development deemed it a requirement to lower and reinstate the road.

4.3. Property

The density and proximity of the residential properties along the south side of the rail corridor is a major constraint in terms of achieving the four-tracking requirements by adding the additional track to the south side of the corridor. Please refer to Property Boundary lines on the Bridge and Permanent Options Drawings in Appendix C.

Figure 4-1 Residential and Commercial Property Locations in the Area

4.4. Permanent Way

Details of existing rail corridor widening constraints in the area are demonstrated in **Table 4-1**below.

Table 4-1 Details of the constraints to install the 4 No. tracks along the area

ID	Name	Description
1	Existing width of the railway corridor	The existing width of the railway corridor is not adequate for the installation of an additional track.
2	Existing masonry retaining wall	Any modification to the existing retaining wall on the south would involve a major reconstruction of the wall and a possible impact on the properties.
3	Chapelizod Bypass	The widening of the railway corridor to the north for the additional 4th track is constrained by the Chapelizod Bypass.
4	Safety and Maintainability	The existing alignment contains areas of insufficient clearance to structures (retaining walls). The new design should consider the provision of adequate horizontal clearances for safety and maintenance inspections. This requirement is a constraint.
5	Track alignment in the area	The alignment design must be compatible with that in adjacent areas around the Inchicore Yard and Memorial Road.
6	Track levels at Sarsfield Road Bridge (UBC4)	The track levels on Sarsfield Road Bridge must be compatible with the rail levels at Khyber Pass Footbridge (OBC5) due to their proximity.
7	Sarsfield Road	The direct fix system does not make it possible to modify the track geometry through the bridge. Modifications in levels or horizontal positions of the rails would require reconstruction of the bridge deck.

The clearance requirements for the positioning of new/renewed track from property boundaries are shown in the Figure below. The space required for the installation of new property walls, OHLE masts and walkways are considered.

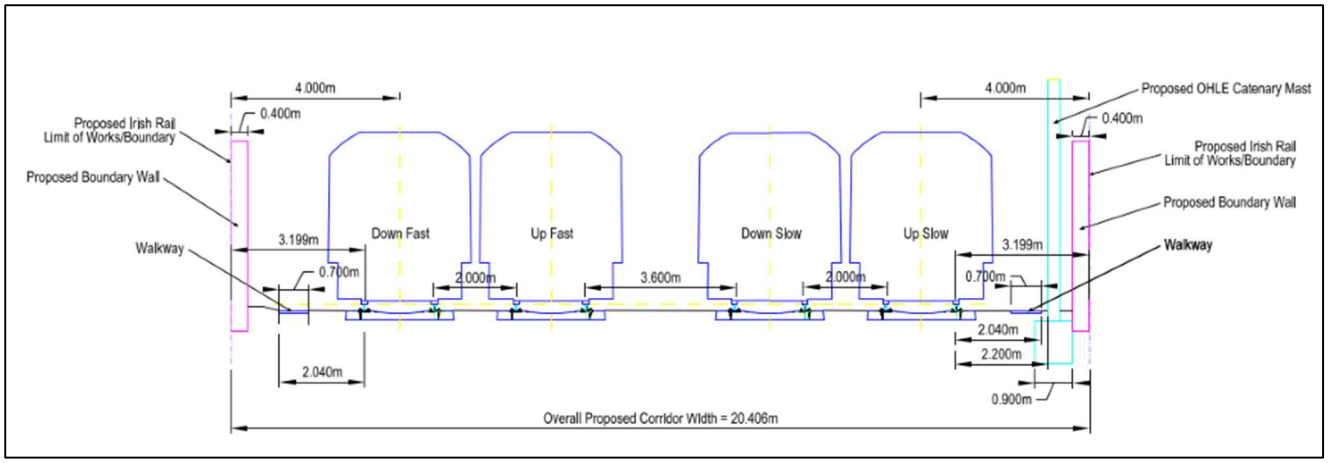

Figure 4-2 Minimum distance from property boundary to the nearest track.

Figure 4-3 Rail Corridor Width

4.5. Existing Structures

The existing Sarsfield Road Bridge (UBC4) structure, which currently carries 3 No. tracks, has insufficient deck width for placement of an additional track. A replacement structure option capable of carrying 4 No. tracks would be wider than the existing bridge. The soffit level of this bridge would be positioned at a suitable (higher) level where required so that the existing vertical clearance from the road below of 4.37m can be maintained. This, in turn, requires higher rail levels and vertical constraints on the Perway design. Options that include proposals to increase the span would require increased structural depth. This also imposes a constraint in terms of the vertical levels to road and rail at the structure. A non-ballast slab track design would minimise the structural depth required for any span considered.

A large culvert (river) runs beneath the structure from south-west to north-east. This is a constraint in terms of the foundation design for replacement bridge Options. An additional track and/or realigned tracks on the approaches to UBC4 will impart horizontal forces on the back of the existing masonry retaining walls. As such the walls would need to be stabilised as required for these Options. The retaining walls are of historical interest and proposals that impact the walls need to be minimised.

4.6. Geotechnical

Based on the existing information, onerous ground or groundwater conditions are not anticipated throughout the area. A culvert carrying the Creosote River runs south-west north-east directly beneath Sarsfield Road Underbridge. This poses a constraint in terms of the foundation design for possible replacement bridge Options. There is insufficient room between the existing retaining walls and cutting slopes to place an additional track.

Where Options require additional horizontal space is required to place a 4th track in the north cutting slopes, it is proposed that a cantilever retaining wall would be used for shallow cuttings (i.e. adjacent to horse sanctuary field) and a bored pile retaining wall would be used for deep cuttings.

Where track lowering is required, the stability of the existing retaining walls along the southern boundary would be affected. This may necessitate below ground ties, anchors or walls, depending on the extent of track lowering in Options.

Existing nearby walls, buildings, structures and earthworks may require monitoring (e.g. vibration monitoring) during piling of any new structures to ensure no structural damage is caused during construction to the proposed foundation construction works.

The condition of the existing masonry walls that support Sarsfield Road Bridge (UBC4) is unknown as is their ability to retain additional loads from the proposed railway onto the back of the wall. The existing retaining walls may need to be stabilised via ground anchors (at road level) to accommodate the additional horizontal loading from the new tracks. New retaining walls would be required to provide the necessary horizontal width for the railway.

4.7. Existing Utilities

The significant number of utilities in the area will be constraints during both the design and construction phases.

At track level, there is evidence of a private water supply main. It is understood that IÉ has installed shallow pipework between Inchicore and Heuston which provides water supply to train wash facilities within Heuston Yard. This service is currently undocumented but is known to exist within the bridge deck at this location. It is likely that alterations or replacement pipework will be required due to the necessity for track layout works.

Most services are located at road level along Sarsfield Road. Any works to the abutments of this bridge are likely to impact directly or indirectly (due to proximity) on existing buried services. All services in the existing road corridor would need to be maintained or outage durations absolutely minimised. All existing utilities pose constraints to the area-wide options at this location. Where conflicts exist, their potential treatment is being discussed with the utility providers.

5. Options

5.1. Options Summary

The existing Sarsfield Road Bridge (UBC4) structure, which currently carries 3 No. tracks, has insufficient deck width for placement of an additional track. The potential intervention options are to either full reconstruct the bridge with new decks or to endeavour to reuse the existing bridge and add a new adjacent deck to carry 1 No. additional track. The bridge span does not present an issue in terms of providing OHLE above it. In addition, the bridge must be compatible with the permanent way solution through Inchicore.

A total of 4 No. Options have been developed for the area. The Options include a 'Do-Nothing' Option and a 'Do-Minimum' Option.

- A Do-Nothing option means that the design endeavours to achieve the project requirements without any intervention to the existing infrastructure.
- A Do-Minimum option, in this case, means that the design endeavours to achieve the project requirements with the lowest level of intervention required to achieve the four-tracking and OHLE requirements.

Design development is by nature an iterative process; and as such the Emerging Preferred Option will be further developed and presented in greater detail at PC2.

A summary of Options is presented in the table below. A detailed description of each Option is included in **Section 5.2** below. Please refer to **Section 5.4** for a description of the permanent way Options for the area (that are compatible with the bridge Options referred to in **Table 5-1** below).

Table 5-1 Options Summary

Option	Description
Option 0: Do Nothing	The existing infrastructure remains unchanged. There are no interventions.
Option 1: Do Minimum	This option proposes to reuse the existing 3 No. tracks on the existing bridge and provide 1 No. additional track on a new bridge on the south side of the existing structure.
Option 2	This option proposes to replace the existing bridge with 2 No. new decks capable of carrying 4 No. tracks.
Option 3	This option proposes to retain the existing bridge (width of 2 No. tracks) and placement of ballast on top to become a ballasted bridge structure. A new bridge would be constructed on the southern side of the existing bridge (carrying 2 No. new tracks).

5.2. Options Description

This section describes the Options that have been considered. Except for Option 0 (Do-Nothing), there are some design disciplines that have technical features that are common to all Options (e.g. OHLE and Cable & Containment). Similarly, there are technical aspects that have been considered but are determined to have no (or insignificant) bearing on the development or selection of Options. To remove repetition among the Option descriptions, these issues are addressed at the end of the Option description section.

5.2.1. Option 0: Do-Nothing

The Do-Nothing Option proposes no changes to the existing road or rail infrastructure. The rail corridor would not be widened (inside or outside the Iarnród Éireann property boundary). The horizontal constraints at Sarsfield Road Bridge (UBC4) would not be resolved. As such, this option would not facilitate the inclusion of the additional 4th track. The project requirements would not be achieved.

5.2.2. Option 1: Do-Minimum

This Option proposes to reuse the existing 3 No. tracks on the existing Sarsfield Road Bridge (UBC4) and provide 1 No. additional track on a new bridge that would be located on the southern side of the existing structure. However, this option is not feasible as the rails on the existing bridge cannot be adjusted, and their current line and level are not compatible with horizontal and vertical permanent way design constraints for the area.

5.2.3. Option 2

This option proposes to replace the existing Sarsfield Road Bridge with 2 No. new bridges each carrying 2 No. tracks.

The existing bridge would be replaced with 2 No. new bridges, each carrying 2 No. tracks. The northern bridge would have a span of 14m (approx.) and positioned at the existing abutment location, while the southern bridge would have a span of 21m (approx.) and be positioned to the south of the existing abutments. Both bridges would be supported on piled abutments positioned behind the existing abutments and retaining walls. The decks would be supported on steel bearings. Each of the proposed bridges would have a width of 8.3m (approx.) and carry 2 No. tracks with a 1.4m (approx.) wide walkways on the outer side of each structure (see **Figure 5-1** below for a cross section through one deck). The inner longitudinal beams would be steepled to prevent them from being climbed or used to cross the bridge (along span). The top of the existing retaining walls would need to be removed (in some localised areas) to allow for the construction of the new bridges. Anchoring of the retaining walls at the new bridge location is anticipated. This would be to counteract the destabilising effects of horizontal forces that would be imparted to the back of the walls due to the additional track and the realignment. Retaining walls would be required to support the track on the approach and departure to the structures to minimise land take requirements. The final alignment of the bridges, their spans and equally the deck type would depend on the Perway solution in the area.

Road Analysis:

- Owing to the constraints previously listed, carriageway lowering is not being considered. Track raising along with revised superstructure design depths will be used to accommodate the necessary changes to achieve the same minimum signed clearance of 4.37m to highest carriageway level at bridge entry.
- During construction, traffic travelling south to north would be diverted via Memorial Road Bridge (OBC3); while traffic travelling north to south would need to be accommodated via the South Circular Road junction with Con Colbert Road (R148). If BusConnects' (Lucan and Liffey) schemes are implemented prior to DART+ South West (this project) then there would also be opportunity to divert north to south traffic via Memorial Road.
- The aim would be to replace the bridge using a short duration (weekend) track closure; resulting in a full road closure for the same or nominally longer period to allow for site preparation.

Utilities Analysis:

- Utilities diversions would likely be required to facilitate piling works for the new bridge structure; particularly to protect gas and electrical mains. There diversions may require localised temporary lane closures on approach to the bridge but it this stage the aim would be to avoid full underpass closure.

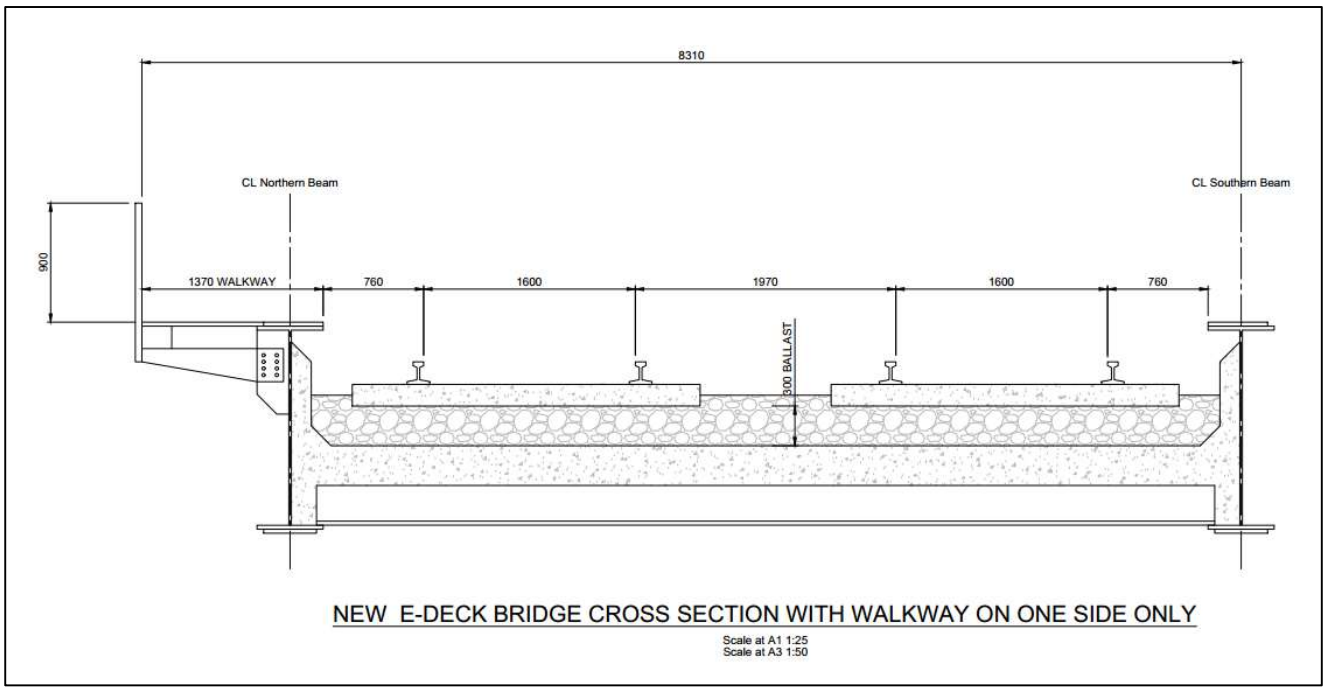

Figure 5-1 Typical cross-section of a ballasted track deck for one of two bridges

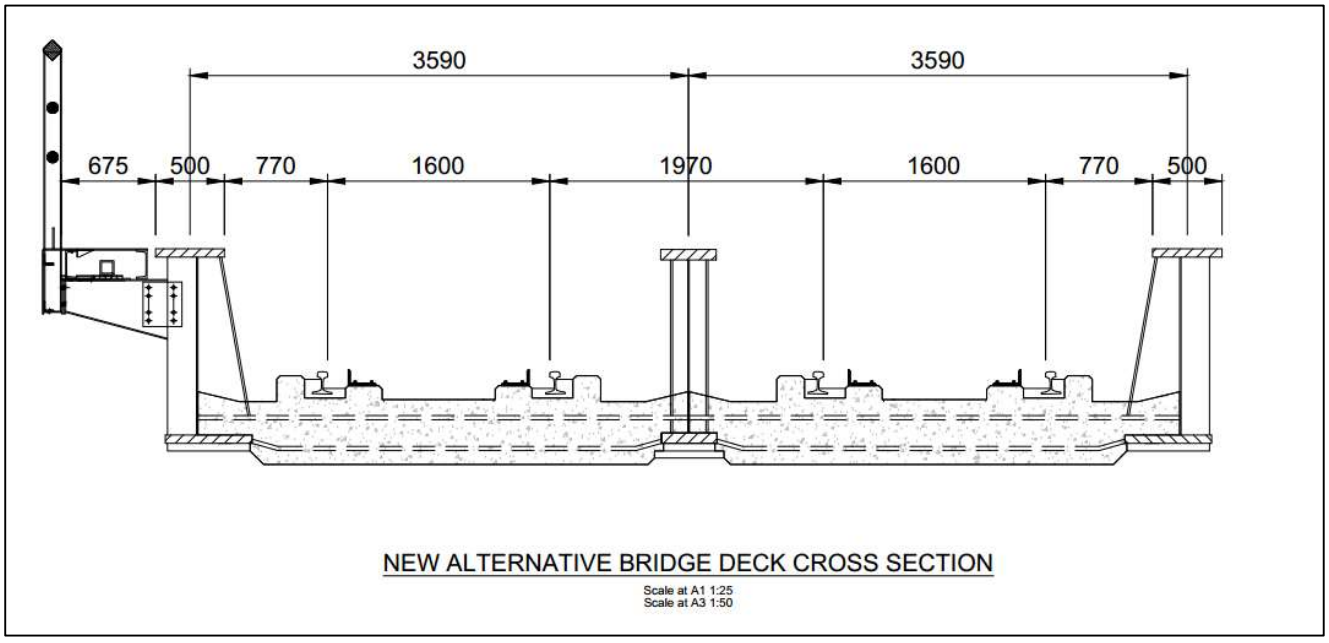

Figure 5-2 Typical cross-section of a slab track deck for one of two bridges.

5.2.4. Option 3

This Option proposes to retain the existing bridge and place 300mm depth of ballast on top with a new track alignment for 2 No. of the proposed realigned four track arrangement. A new E-type ballasted bridge carrying 2 additional tracks would be constructed to the south. However, the existing bridge would not be suitable to receive a 300mm depth of ballast and as such this Option is not considered feasible.

5.3. OHLE arrangement – All Options

The length of the underbridge is such that OHLE structures can be positioned clear of the underbridge structure, to remove any requirement for OHLE fixings to the bridge.

The proposed bridge deck options include walkways, and for some options, a central girder. These would form standing surfaces which would need assessment for electrical safety clearances. These are expected to be compliant since the contact wire height at this location would be 4.7m.

The metallic elements of the reconstructed bridge are likely to require bonding in accordance with the project earthing and bonding strategy, which would be developed at a later stage in the design development.

5.4. Permanent Way

There are 2 No. Perway Options for the area. In the Permanent Way Option 1, the widening would be to the north of the existing tracks while in the Permanent Way Option 2 the track widening would be to the south. The differences between the options are related to the design alternatives at Inchicore (also to the north or to the south).

The Permanent Way Options proposals provide for a standard 10-foot dimension between the Slow and Fast lines. The vertical alignment would not be significantly changed to reduce potential interventions required in the area east of the bridge and to integrate with the track configuration on approach to the Inchicore Works. For all intervention Options, the track formation would be completely renewed. It is proposed that a new track drainage system would be installed and connected to a proposed attenuation facility located near Heuston Station, before discharging to the River Liffey. The drainage design will be developed during the next design development phase.

Table 5-2 Permanent Way Options

Name	Drawing Number
Permanent Way Option 1	Please refer to drawing DP-04-23-DWG-PW-TTA-55830
Permanent Way Option 2	Please refer to drawing DP-04-23-DWG-PW-TTA-55831

5.5. Geotech (All Do-Something Options)

All engineering options (excluding Bridge Option 0) require some form of four tracking and electrification and will require a detailed geotechnical design for the following elements:

- Earthworks and track-bed formation design for new tracks
- Overhead Line Equipment foundation (preliminary) design

For Bridge Options 1 through to Option 3 (inclusive), any new bridge or existing bridge modifications would also require detailed geotechnical design.

The proposed structural elements that fall into this category include:

- New bridge abutment piles and/or new decking and wingwall modifications (e.g. ground anchors to retain existing retaining walls).
- New retaining wall designs along with much of the northern and southern boundary of the railway. The retaining walls would be required to provide the necessary horizontal width for the four-tracking. These are likely to be a combination of reinforced cantilever retaining walls and bored pile retaining walls.

- Existing nearby walls, buildings, structures, and earthworks may require monitoring (e.g. vibration monitoring) during any nearby piling works for new structures to ensure no structural damage or instability is caused.
- New earthworks or retaining walls likely to require encroachment on land outside the existing southern railway boundary to the east of Sarsfield Road Bridge (UBC4) to accommodate the new alignments.

5.6. Roads (All Intervention Options)

All Options would require the provision of new lighting under the bridge to replace existing lighting; the specification of which would be provided by Dublin City Council.

All Options would require negotiation with BusConnects to co-ordinate implementation programmes where possible, as well as the sequencing of this bridge construction with respect the interventions proposed at Memorial Road Bridge (OBC3) and South Circular Road Junction, respectively.

5.7. Cable and Containments (All Do-Something Options)

Except for Option 0, all Options would require the relocation of a variety of track side service cables, utilities and containments throughout the area.

6. Options Selection Process

6.1. Options Selection Process

A clearly defined appraisal methodology has been used in the selection of the Emerging Preferred Option for the Project. Consistent with other NTA projects, it is based on 'Guidelines on a Common Appraisal Framework for Transport Projects and Programmes' (CAF) published by the Department of Transport, Tourism, and Sport (DTTAS), March 2016 (updated 2020) and informed by TII's Project Management Guidelines (TII PMG 2019). The Option Selection Process involves a three-stage approach as summarised below:

- Stage 1 Preliminary Assessment (Sifting)
- Stage 2 Multi Criteria Analysis (MCA)
- Stage 3 Emerging Preferred Option

The starting principle of the optioneering process and a focus of the Project Team has been to reduce the potential impacts on the surrounding environs by accommodating necessary works and interventions within the existing rail corridor, where practicable. However, it is acknowledged that as the Cork Mainline is an existing operational rail line operating in a pre-defined corridor, the options to accommodate the necessary works at some locations along the route are limited due to spatial constraints.

6.2. Stage 1 Preliminary Assessment (Sifting)

The Stage 1: Preliminary Assessment (Sifting) involves an initial assessment of a long list of options, each of which are assessed against Engineering, Economics and Environmental criteria.

The assessment is typically based on whether an option meets the Project Objectives / Requirements and whether the option is technically feasible. All feasible options are brought forward to the second stage of the assessment process (MCA) to be explored in greater detail.

The length of the section under consideration covers 470m (approx.) and extends from West of Sarsfield Road Bridge (UB4) to the West of Memorial Road Bridge (OBC3). A total of 3 No. Options were initially developed for this area.

The options assessed, ranged from a 'Do-Nothing' Option, Do-Minimum' Option to a range of 'Do-Something' Options, each of the options were assessed to determine if they were feasible and met the Project Objectives / Requirements.

The 'Do-Something' Options in this area involve the widening of the existing rail corridor to accommodate the required 4 No. tracks. Widening of the rail corridor is proposed on the north and south sides of the existing tracks to minimise impact on the private residential and commercial properties located on the southern side of the existing rail corridor. Existing structures in this area were analysed to determine if they could accommodate the additional tracks and installation of the new Overhead Line Electrification (OHLE) system. The restriction to OHLE clearances is minimal in the area and are mainly posed by the existing signalling gantry; while the main horizontal constraints to four-tracking (as previously mentioned) are the adjacent properties and the Permanent Way boundary retaining walls. The proximity of the area to the adjacent Inchicore yard tie-in poses the greatest constraint to variability of vertical profile changes and along with the existing Sarsfield Road (with its associated under carriage utilities/drainage) this poses a further constraint to achieving a preferred underbridge clearance

through road lowering; however the existing bridge clearance under the track is considered a minimum acceptable clearance).

6.3. Preliminary Assessment (Sifting)

Table 6-1 Preliminary Assessment (Sifting)

Option	Requirements		Description
0	Engineering	Constructability	Not applicable. No intervention proposed.
		Geometrical fitness for intervention	Not applicable. No intervention proposed.
		Safety	Not applicable. No intervention proposed.
		four-tracking Park West-Heuston	FAIL. No intervention proposed. four-tracking is not achieved.
		Electrification of DART+ tracks	FAIL. No intervention proposed. Electrification of the DART+ tracks not achieved.
		Vertical electrical clearance in structures	PASS. Vertical electrical is achieved as it is an Underbridge.
		Bridge Design Standards	Not applicable. No intervention proposed.
		Keep current functionality of roads	PASS. No intervention proposed.
	Economy		Compatible with the investment guidelines and programme for DART+
	Environment		No impact on Environmental sites of National of International significance.
	SIFTING OUTCOME		**FAIL. Do not progress to Stage 2 Assessment**
1	Engineering	Constructability	PASS. No issue.
		Geometrical fitness for intervention	FAIL. Reusing the existing tracks at their current line and level is not compatible with Perway vertical and horizontal design constraints.
		Safety	PASS. No issue.
		four-tracking Park West-Heuston	PASS. This option would achieve the 4 tracking.
		Electrification of DART+ tracks	PASS. This option would achieve the electrification of DART+ tracks.
		Vertical electrical clearance in structures	PASS. Vertical electrical is achieved as it is an Underbridge.
		Bridge Design Standards	PASS. Noted that it is not proposed to increase 4.37m from road level to bridge soffit level.
		Keep current functionality of roads	PASS. Changes to the carriageway layout are not proposed.
	Economy		Compatible with the investment guidelines and programme for DART+.
	Environment		No impact on Environmental sites of National of International significance.
	SIFTING OUTCOME		**FAIL. Do not progress to Stage 2 Assessment**
2	Engineering	Constructability	PASS. It would be possible to construct this option.
		Geometrical fitness for intervention	PASS. No issues.
		Safety	PASS. No issues.
		four-tracking Park West-Heuston	PASS. This option would achieve 4 tracking.
		Electrification of DART+ tracks	PASS. This option would achieve electrification of DART+ tracks.
		Vertical electrical clearance in structures	PASS. Vertical electrical is achieved as it is an Underbridge.
		Bridge Design Standards	PASS. Noted that it is not proposed to increase 4.37m from road level to bridge soffit level.
		Keep current functionality of roads	PASS. Changes to the carriageway layout are not proposed.

Option	Requirements		Description
	Economy		Compatible with the investment guidelines and programme for DART+
	Environment		No impact on Environmental sites of National of International significance.
	SIFTING OUTCOME		**PASS. Proceed to Stage 2 Assessment**
3	**Engineering**	Constructability	FAIL. Current structure not suitable for the amendments proposed.
		Geometrical fitness for intervention	PASS. No issues.
		Safety	PASS. No issues.
		four-tracking Park West-Heuston	PASS. This option would achieve 4 tracking.
		Electrification of DART+ tracks	PASS. This option would achieve electrification of DART+ tracks.
		Vertical electrical clearance in structures	PASS. Vertical electrical is achieved as it is an Underbridge.
		Bridge Design Standards	PASS. Noted that it is not proposed to increase 4.37m from road level to bridge soffit level.
		Keep current functionality of roads	PASS. Changes to the carriageway layout are not proposed.
	Economy		Compatible with the investment guidelines and programme for DART+
	Environment		No impact on Environmental sites of National of International significance.
	SIFTING OUTCOME		**FAIL. Do not progress to Stage 2 Assessment**

6.4. Preliminary Assessment Summary

A total of 3No. Main Bridge Options were developed for the area. Following the assessment completed as part of the Sifting Process, as shown in the table below, a total of 1 No. Option; namely Option 2 was shortlisted and progressed to Stage 2 (MCA) of the assessment process.

Table 6-2 Summary of Sift Process Results

Option	Sifting Process Result
Option 0: Do Nothing	FAIL
Option 1: Do Minimum	FAIL
Option 2	PASS
Option 3	FAIL

The following options did not meet the necessary Engineering Feasibility and Project Requirements and were not brought forward to Stage 2 (MCA) of the assessment process:

- **Option 0** - The Do-Nothing Option proposes no changes to the existing road or rail infrastructure, as such, this option would not facilitate the inclusion of the required 4 No. tracks or the installation of the OHLE system. The project requirements would not be achieved as such this option was not brought forward.
- **Option 1 -** This Option proposes to reuse the existing 3 No. tracks on the existing Sarsfield Road Bridge (UBC4) and provide 1 No. additional track on a new bridge on the south side of the existing structure. However, this option is not feasible as the rails on the existing bridge cannot be adjusted, and their current line and level are not compatible with horizontal and vertical Perway design constraints for the area.

- **Option 3 -** This option proposes to retain the existing bridge and place 300mm depth of ballast on top with a new track alignment for 2 No. tracks. A new E-type ballasted bridge carrying 2 additional tracks would be constructed to the south. The existing bridge is not suitable to receive a 300mm depth of ballast and as such this option is not feasible.

Since there is only 1 No. Option being brought forward for the bridge, the Options Selection Process was completed at Stage 1 – Sifting. The Emerging Preferred Bridge Option for the area is therefore Option 2.

6.5. Emerging Preferred Option

This Option 2 proposes to replace the existing Sarsfield Road Bridge (UBC4) with 2 No. new bridges.

There were significant constraints on the options available to achieve the project requirements in this area. Primarily these were the Sarsfield Road, the Inchicore Works and the residential properties on the southern boundary (east of the bridge) but equally those along Landen Road the west of the bridge.

The raising of the track over the road is constrained by the horizontal and vertical rail alignment to the area west of Sarsfield Road Bridge (UBC4). Vertically by the Inchicore Works (gradients/levels within the works), horizontally by the impact on the residential properties and the Inchicore Works to the south and/or the residential properties to the north of the current railway corridor.

In addition, there is the combined sewer which includes the flow of the Creosote Stream that runs under Sarsfield Road. This stream flow through an old culvert structure with limited cover which restricts the ability to lower the road locally to improve bridge vertical clearance to the road surfaces.

The masonry block retaining walls and abutments of the bridge are considered of historical significance and every effort will be made during the detailed design stage to ensure impacts on the these are limited.

Signalling, Telecommunications and Low Voltage cable containments would be moved to new positions based on the final permanent way alignment selected. OHLE masts would be installed along the northern side of the rail corridor.

The final bridge superstructure type and arrangement for the Emerging Preferred Option will be designed to be compatible with the final permanent way alignment selected. Drawings DE-04-23-DWG-ST-TTA-55956 to DE-04-23-DWG-ST-TTA-55959 are representative for Option 2, and are included in Appendix C.

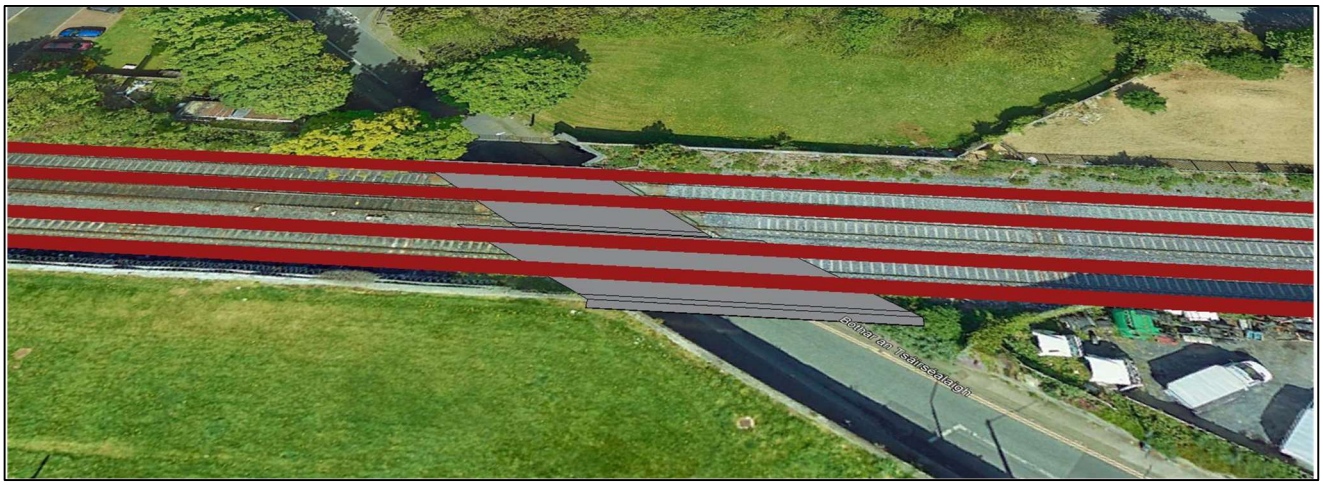

Figure 6-1 Sarsfield Road Bridge (UBC4) – Option 2 in Plan

The Emerging Preferred Option is considered the optimum solution in terms of minimising impacts on third party property owners. Based on the level of information and design available at this time for Public Consultation No.

1, the extent of permanent works is not envisaged to interfere with third party residential or commercial property rights. There may be temporary interference of property rights during construction along the rail corridor and around the bridge works however technical and construction related solutions will seek to minimise these. Construction requirements (including potential temporary interference of property rights) and methodologies will be presented at Public Consultation No. 2.

Appendix A – Sifting Process Backup

Appendix B – Supporting Drawings

The following drawings accompany the Technical Report for this area:

Bridge Drawings

DE-04-23-DWG-ST-TTA-55956

DE-04-23-DWG-ST-TTA-55957

DE-04-23-DWG-ST-TTA-55958

DE-04-23-DWG-ST-TTA-55959

Permanent Way Drawings

DP-04-23-DWG-PW-TTA-55830

DP-04-23-DWG-PW-TTA-55831