DART+ South West

Volume 3A – Technical Optioneering Report – Hazelhatch to Park West

Iarnród Éireann

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Glossary of Terms

Reference	Description
ABP	An Bord Pleanála
ACA	Architectural Conservation Area
AOD	Above Ordnance Datum
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
CIÉ	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
CSS	Construction Support Site, Interchangeable with Construction Compound
CTC	Central Traffic Control
Cutting	A railway in cutting means the rail level is below the surrounding ground level.

Reference	Description
D&B	Design & Build (contractor)
DART	Dublin Area Rapid Transit (IÉ's Electrified Network)
DART+	DART Expansion Programme
DeBo	Designated Body
DC	Direct Current, 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).
HV	High Voltage

Reference	Description
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.
POAP	Plan-On-A-Page, high-level emerging programme
PPT	Phoenix Park Tunnel

Reference	Description
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
STC	Single Track Cantilever
TII	Transport Infrastructure Ireland
TMS	Train Management System
TPH	Trains per Hour
TPHPD	Trains per Hour per Direction
TPS	Train Protection System

Reference	Description
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)
TTC	Two Track Cantilever
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 Report

The purpose of this report is to provide technical input to the Option Selection Report to inform Public Consultation no.2 (PC2). This report shows the options considered as part of the project development and why the preferred option for PC2 was chosen.

This report provides the technical assessment of the area from Hazelhatch to Park West 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, Electrification and Telecommunications (SET) and Low Voltage Power
- Overhead Line Equipment (OLE)
- Environment
- Highways
- Geotechnical
- Substations
- Construction Compounds

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 leading to the identification of the Preferred Option, including the Sifting process and the Multi-Criteria Analysis process.
- A summary of the feedback received from the first public consultation which was held in May and June 2021.
- An update on the design development.
- An overview of the proposed construction methodology and requirements in terms of construction compounds.

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. It will provide a sustainable, electrified, reliable and more frequent rail service, improving capacity on rail corridors serving Dublin.

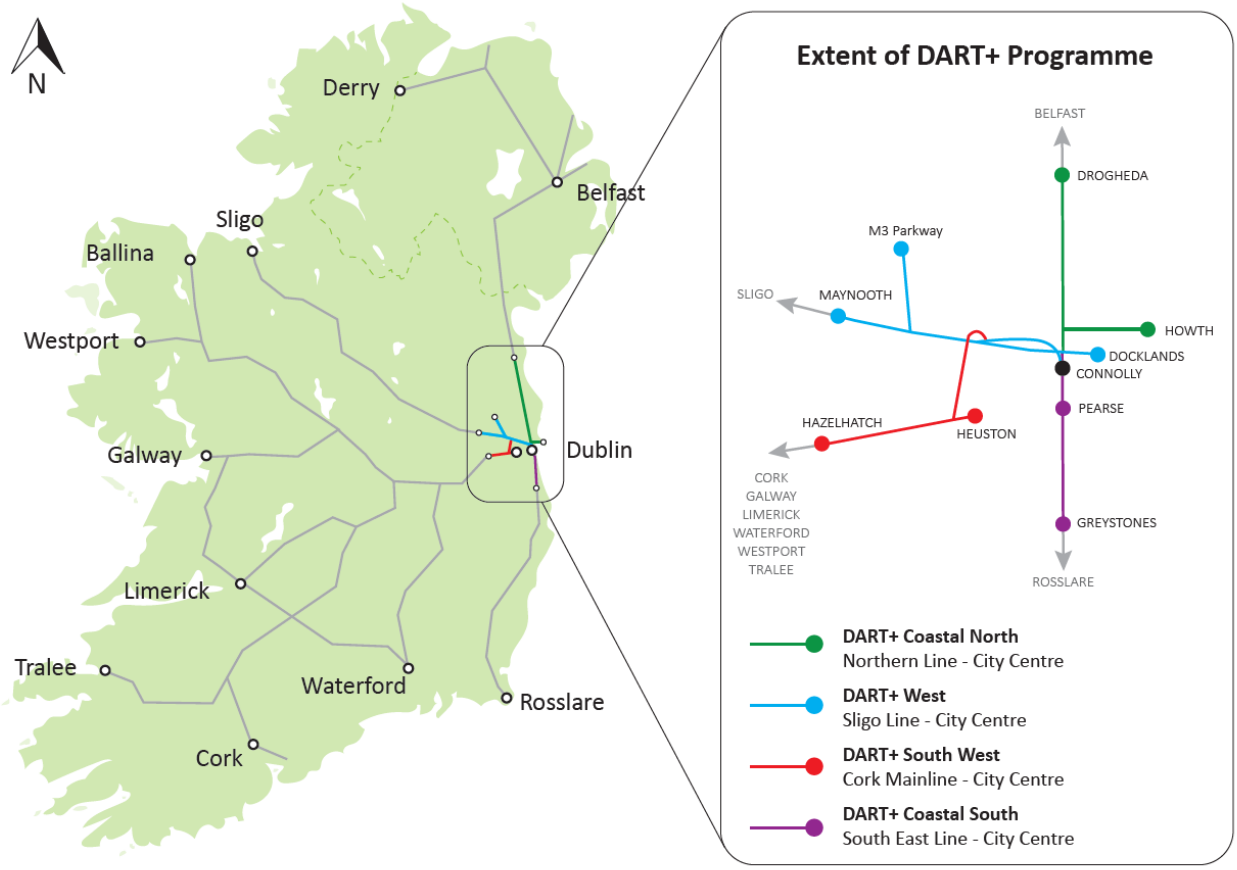


Figure 1-1 Schematic of Overall DART+ Programme

The current electrified DART network is 50km long, extending from Malahide / Howth to Bray / Greystones, and 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 and Heuston Station and also circa 4km between Heuston Station and Glasnevin Junction, 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 2021-2030 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 electrificationof 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.

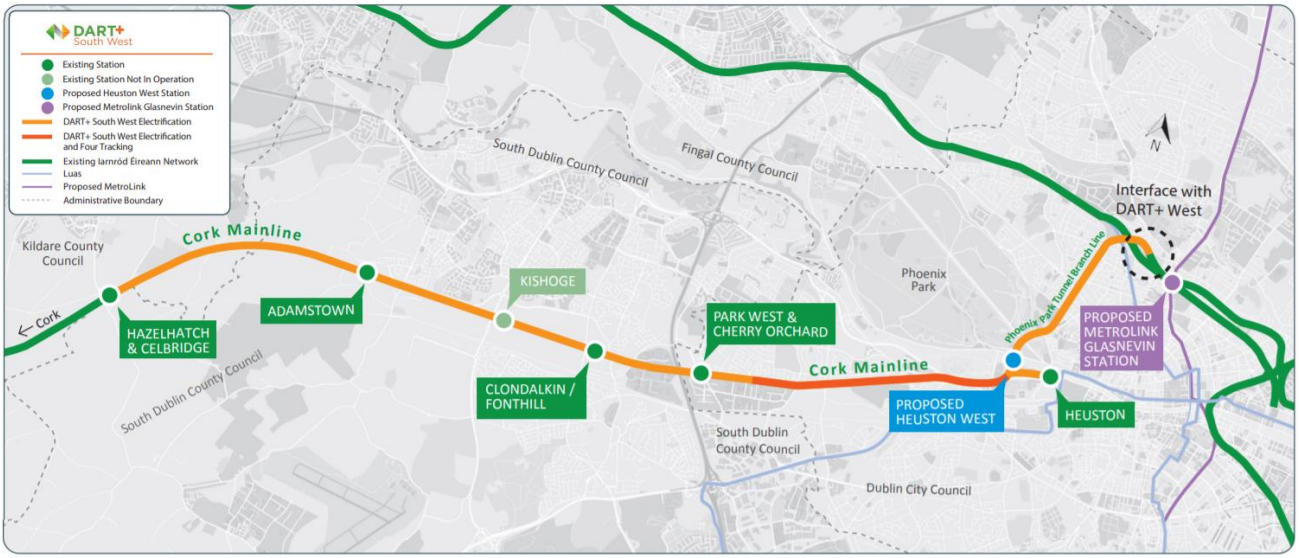


Figure 1-2 DART+ South West Route Map

1.4. Capacity Increase Delivered by 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 Junction, via the Phoenix Park Tunnel Branch Line, where it will link with the proposed DART+ West.
- Undertaking improvements / interventions of bridges to achieve vertical and horizontal clearances.
- Remove rail constraints along the Phoenix Park Tunnel Branch Line.
- Delivery of a new Heuston West Station.

The '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** and **Figure 1-2**.

Table 1-1 Route Breakdown

Area Name	Sub-area Description	Extents	Main Features
Hazelhatch to Park West	Area from Hazelhatch to Park West (Volume 3A)	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
Park West to Heuston Station	Area from Park West to Le Fanu (Volume 3B)	West of Cherry Orchard Footbridge (OBC8B) to the East of the proposed Le Fanu Road Bridge (OBC7)	Cherry Orchard Footbridge (OBC8B) Le Fanu Road Bridge (OBC7)
	Area from Le Fanu to Kylemore (Volume 3C)	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 Name	Sub-area Description	Extents	Main Features
	Area from Kylemore to Sarsfield (Volume 3D)	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 Footbridge (OBC5)
	Area from Sarsfield to Memorial (Volume 3E)	West of Sarsfield Road Bridge (UBC4) to the West of Memorial Road Bridge (OBC3)	Sarsfield Road Bridge (UBC4)
	Memorial Road (Volume 3F)	Area around Memorial Road Bridge	Memorial Road Bridge (OBC3)
	Area from Memorial Road to South Circular Road Junction (Volume 3G)	East of Memorial Road Bridge (OBC3) to 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 (Volume 3H)	Area at the South side of the Heuston Station Yard (non-DART+ tracks)	Heuston Station Sidings around Heuston Station
Heuston West Station	New Heuston West Station (Volume 3I)	Area to the West of Heuston Station, adjacent to Liffey Bridge (UBO1)	Heuston West Station
St John's Road Bridge (Islandbridge) to Glasnevin Junction	East of St John's Road Bridge (OBC0A) (Islandbridge) to North of Phoenix Park Tunnel (Volume 3J)	East of St John's Road Bridge (OBC0A) (Islandbridge) to North of Phoenix Park Tunnel	Liffey Bridge (UBO1). Conyngham Road Bridge (OBO2) Phoenix Park Tunnel
St John's Road Bridge to Glasnevin Junction	North of the Phoenix Park Tunnel to Glasnevin Junction (Volume 3K)	North 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)

Area Name	Sub-area Description	Extents	Main Features
			Maynooth Line Twin Arch (OBO9) Glasnevin Cemetery Road Bridge (OBO10)

1.7. Stakeholder Feedback

A large volume of stakeholder submissions were received during the six week public consultation period, which ran from 12th May 2021 to 23rd June 2021, an additional week was provided, extending the consultation period until 30th June 2021. All submissions received either via email, post, telephone, or through the online feedback form, were analysed and recorded by the project team on a dedicated consultation database. Each individual submission was analysed to identify the themes that were raised by the respondent and each submission was classified according to the themes raised. All feedback provided, was then anonymised before being analysed under each of the themes. In addition, further engagement with relevant local authorities and prescribed stakeholders has been ongoing. Engagement with potentially affected landowners has also taken place since the commencement of PC1.

All submissions received as part of the first round of public consultation have fed into the design process and the selection of the Preferred Option. The project team has analysed the submissions and considered all relevant information in re-evaluation and further development of design options leading to the selection of the Preferred Option.In summary, the PC1 stakeholder feedback for the provision of DART services to existing stations between Hazelhatch and Park West were welcomed. However, it was noted within the feedback that the stations are located around large undeveloped areas and there was concern for the lack of stations within existing urban neighbourhoods.

The importance of extending the DART to Hazelhatch was cited as being a vital contribution to the local infrastructure and would contribute to the overall development and accessibility of Celbridge. However, Hazelhatch station was cited as being located between towns with no safe cycling infrastructure, no pedestrian crossing infrastructure and as being designed for only for park and ride users. Notwithstanding this, the overall response to the extension of the DART to Hazelhatch was encouraging. It is also noted that submissions by owners of landholdings in the area stated that they can accommodate local road development to make Hazelhatch station more accessible to the people of Celbridge.

Appropriate pedestrian access at Adamstown station was flagged as an issue by stakeholders and was requested to be updated at Adamstown station.

The opening of Kishoge station was cited as being a priority and a phasing requirement of the Strategic Development Zone Planning Scheme that should be considered as part of DART+ South West. Stakeholders noted the need for Kishoge station, which would be vital in developing the interface with the surrounding urban core development, and the need for more frequent and reliable services.

Stakeholder feedback expressed disappointment at the location of the Park West & Cherry Orchard station and other concerns deemed it too far away for those commuting. Suggestions for relocating the station were cited, including a pedestrian walkway from the old Clondalkin station at Station Road bridge along the railway line into Park West. Other submissions noted poor accessibility for wheelchair users at the station and the need for additional stations between Park West & Cherry Orchard.

Further details of the Stakeholder Feedback are captured in the **Public Consultation No. 1: Findings Report, Volume 4**.

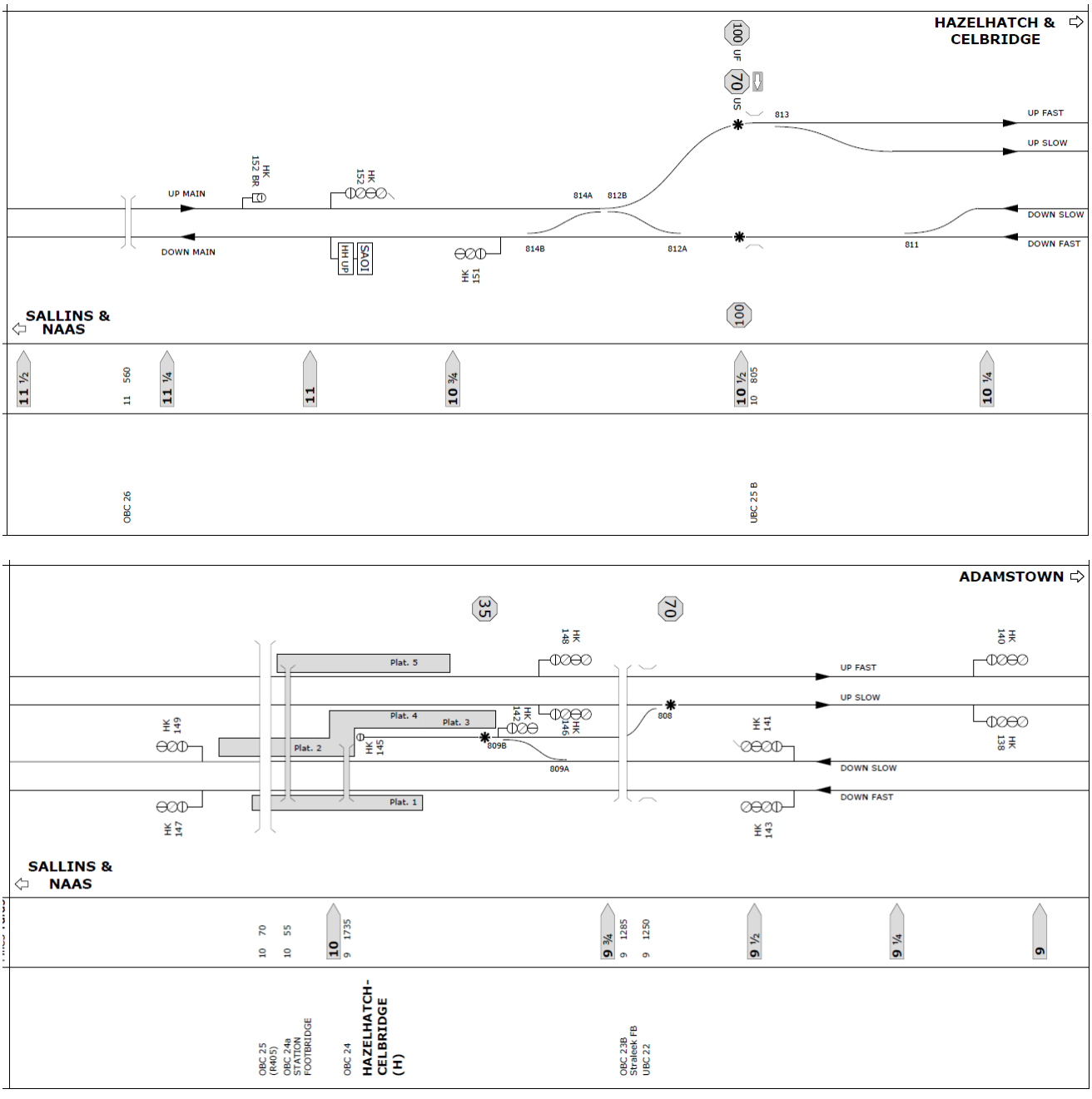
Similarly, all feedback received on the Preferred Option at Public Consultation No.2 will feed into the development of the preliminary design, Railway Order and Environmental Impact Assessment Report (EIAR).

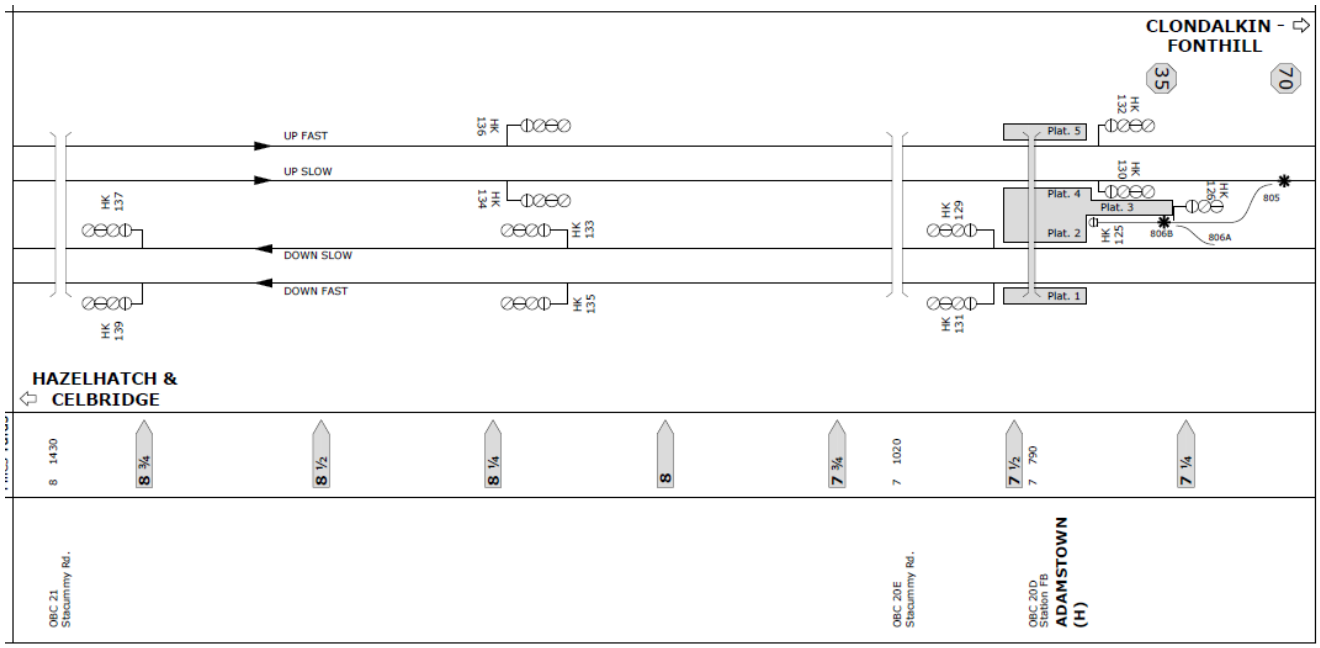
2. Existing Situation

2.1. Overview

The subject area extends from the west side of Hazelhatch & Celbridge Station to Park West Station – approximately 9 km. Currently, the four-track section on the Cork Mainline commences on the south side of Hazelhatch Station where the two running lines, Up Main and Down Main, diverge into four lines – Up Fast, Up Slow, Down Slow and Down Fast. These continue on through Park West Station, west of Le Fanu Road Bridge (OBC7) before converging to two lines before reaching the location for the proposed future station at Kylemore Road Bridge (OBC5A) (Not part of the scope of this project). At Kylemore Road Bridge (OBC5A), the two tracks are joined by an additional siding, and the three tracks continue until they pass Inchicore works where the configuration is then three running lines.

The existing track layout schematic is shown in **Figure 2.1**.




CLONDALKIN - FONTHILL
35
70
UP FAST
UP SLOW
DOWN SLOW
DOWN FAST
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HK 133
HK 139
HK 135
HK 132
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HK 126
HK 125
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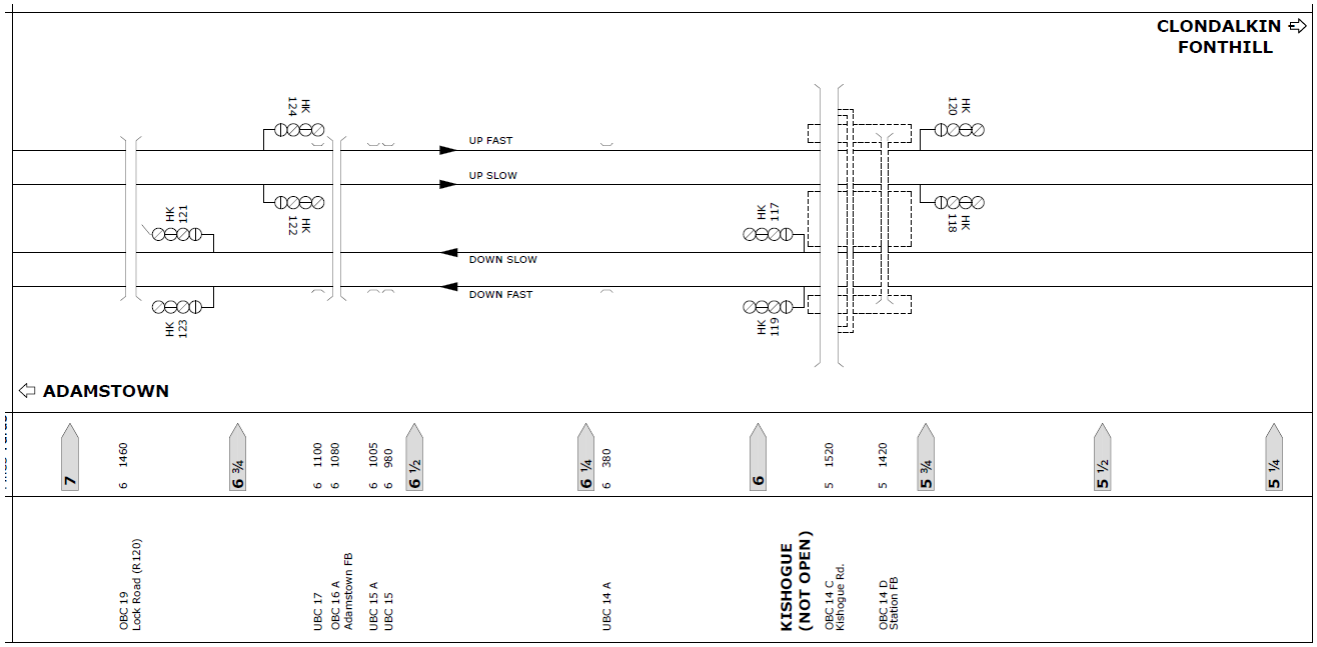
ADAMSTOWN (H)


CLONDALKIN FONTHILL
HK 124
HK 121
HK 122
HK 123
UP FAST
UP SLOW
DOWN SLOW
DOWN FAST
HK 117
HK 119
HK 120
HK 118
ADAMSTOWN
7
6 1460
6 ¾
6 1100
6 1080
6 1005
6 960
6 ½
6 ¼
6 380
6
5 1520
5 1420
5 ¾
5 ½
5 ¼
OBC 19 Lock Road (R120)
UBC 17
OBC 16 A Adamstown FB
UBC 15 A
UBC 15
UBC 14 A
KISHOGUE (NOT OPEN)
OBC 14 C Kishogue Rd.
OBC 14 D Station FB

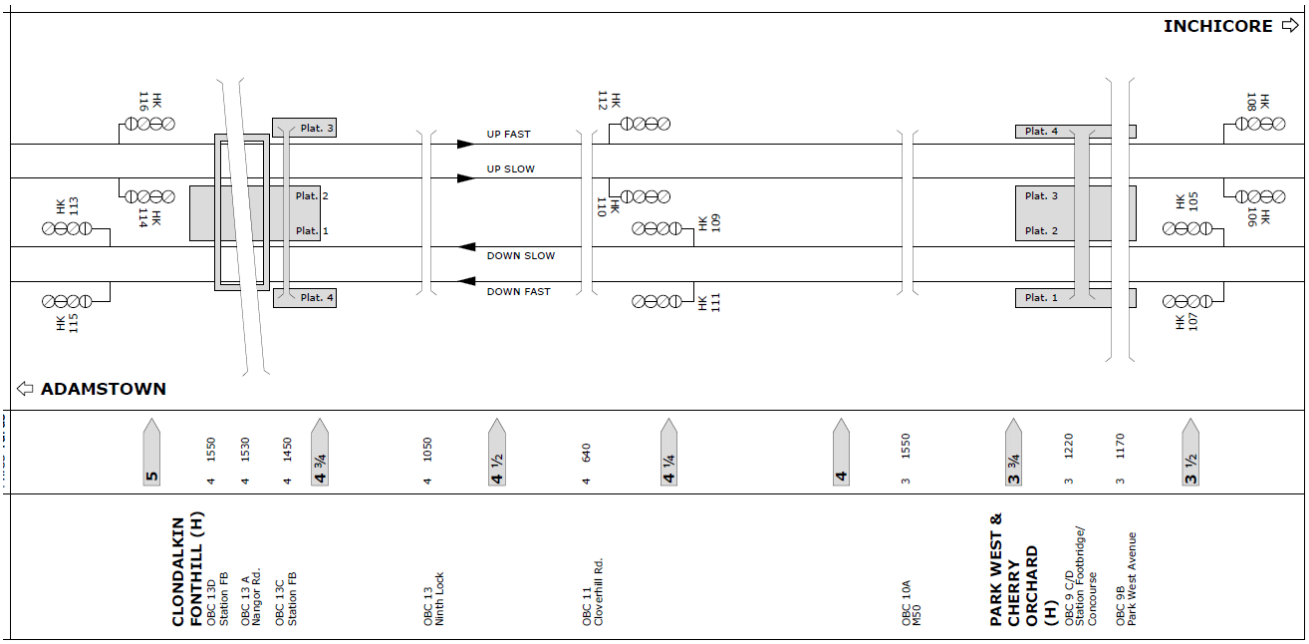


Figure 2-1 Existing track layout (Extracted from IÉ Route Information Book 1)

The project scope in this area ivolves the reconfiguration of the existing 4 running lines to convert them to Up Slow, Down Slow, Up Fast, Down Fast and to electrify the two tracks on the north side (Slow tracks) for the DART services. New Points and Crossings (P&C) layouts will be required in order to achieve the operational requirements, which will be explained in **Section 5 Options**.

Additionally, four tracking will continue on through the railway corridor heading east towards Heuston Station.

The study area has numerous notable structures within its extents, including 10 road overbridges, plus footbridges and station concourses – all detailed in **Section 2.3 Structures** of this document. The bridges in this area which were reconstructed as part of the Kildare Route Project were designed and constructed to take into account the furture requirement for electrification based on current standards and 1,500V DC requirements. The major infrastructure features are illustrated in the **Figure 2-2**.


OBC23B
N
Hazelhatch Station
OBC24
Hazelhatch Rd Bridge OBC25
OBC24A
Google


N
OBC2OE
OBC21

Figure 2-2 Aerial view of study area Hazelhatch – Park West

The rail corridor is predominantly at grade (i.e. the rail level is at the surrounding ground level) – though there are several retaining wall structures in the vicinity of Park West Station between 3 ¼ MP (Milepost) and 4 MP.

There are a number of existing Environmental features present. These include a mix of residential and commercial properties, community facilities, designated landscape areas, a heritage site and biodiversity constraints (e.g. invasive species).

2.2. Challenges

The project objectives for the Hazelhatch to Park West area are as follows:

- Reconfiguration of the four-tracking between Hazelhatch and Park West (DART Slow lines to the north, Intercity services on the Fast lines to the south).
- Electrification of DART+ tracks, i.e. 2 slow tracks to the North.
- Electrical clearance to structures for electrification.
- Keep current functionality of the existing network and Public roads.
- Track alignment and drainage requirements (in accordance with their respective standards).

2.3. Structures

The following section describes the various structures present along this section of the route, presented in sequence commencing in Hazelhatch and moving in an easterly direction towards Park West. This area was upraded as part of the original Kildare Route Project and already accommodates four-tracks, therefore the structures are not expected to significantly constrain reconfiguration of the horizontal track alignment.

Detailed topographical surveys have been undertaken along the full route, the vertical clearances of each structure have been measured, further details are provided in this section. To fulfill the project requirement of providing electrification, each bridge shall achieve a 4.91m vertical clearance to ensure that there is there sufficient clearance to accomdate the installation of the necessary electrical infrastructure, more details in relation to the electrfication requirements are outlined in Section 3.2.1.

Bridges which do not currently meet this 4.91m vertical clearance requirement will be subject to optioneering to provide a technical solution, details of which are provided in Sections 5 & 6 of this report.

2.3.1. Hazelhatch R405 Road Bridge (OBC25)

Hazelhatch R405 Road Bridge (OBC25) is a two span bridge that carries the R405 Road over four railway tracks and the Hazelhatch & Celbridge station platforms. The bridge is located at mileage 10-0439, and it has a vertical clearance above rail of 5.023 m, this bridge has sufficient vertical clearance to accommodate electrification without intervention. The deck is constructed with precast concrete beams. **See Figure 2-3.**

Figure 2-3 Hazelhatch R405 Road Bridge (OBC25) East Elevation

2.3.2. Hazelhatch Footbridge (OBC24A)

Hazelhatch Footbridge (OBC24A) is a two span footbridge over four railway tracks and the Hazelhatch & Celbridge Station platforms. The bridge is located at mileage 8-1419, and it has a vertical clearance above rail of 5.634 m this bridge has sufficient vertical clearance to accommodate electrification without intervention. The superstructure consists of a warren truss and steel floor panels. The substructure consists of steel columns, access stairs and lift shafts. **See Figure 2-4.**

Figure 2-4 Hazelhatch Footbridge (OBC24A) East Elevation

2.3.3. Hazelhatch Footbridge (OBC24)

Hazelhatch Footbridge (OBC24) is a single span footbridge over two railway tracks, from the central platform of Hazelhatch & Celbridge Station to the downside platform. The bridge is located at mileage 10-0050, approximately 90m north of Hazelhatch R405 Road Bridge (OBC25). This structure will not pose a constraint to the electrification works as the two tracks that pass under it are to serve intercity services only (non-electrified tracks). The superstructure consists of a lattice truss supported on cast iron columns and trimmers, which also support the access stairs. This is a protected structure (RPS) and is closed off to public access. The bridge will not be impacted by the electrification works since the two tracks under are to serve intercity services only (non-electrified tracks). See **Figure 2-5**.

Figure 2-5 Hazelhatch Footbridge (OBC24) West Elevation

2.3.4. Straleek Footbridge (OBC23B)

Straleek Footbridge (OBC23B) is a single span footbridge over four railway tracks, located in the townland of Straleek. The bridge is located at mileage 9-1285, and it has a vertical clearance above rail of 5.009 m, this bridge has sufficient vertical clearance to accommodate electrification without intervention. The superstructure consists of a steel truss on steel bearings. See **Figure 2-6**.

Figure 2-6 Straleek Footbridge (OBC23B) West Elevation

2.3.5. Stacumny Bridge (OBC21)

Stacumny Bridge (OBC21) is a single span bridge that carries Tubber Lane over four railway tracks. The bridge is located at mileage 8-1419, and it has a vertical clearance above rail of 4.864 m, this bridge has insufficient vertical clearance to accommodate electrification, as such it will be subject to the option selection process to determine a suitable technical solution. The deck is constructed with precast concrete beams. See **Figure 2-7.**

Figure 2-7 Stacumny Bridge (OBC21) West Elevation

2.3.6. Crowley's Bridge (OBC20E)

Crowley's Bridge (OBC20E) is a four span bridge that carries a third-party road over four railway tracks and Adamstown Avenue. The bridge is located at mileage 7-1018, and it has a vertical clearance above rail of 4.924 m, this bridge has sufficient vertical clearance to accommodate electrification without intervention. The deck for spans 1 and 2 is constructed with precast concrete beams. The deck for spans 3 and 4 is constructed with steel girders. See **Figure 2-8.**

Figure 2-8 Crowley's Bridge (OBC20E) East Elevation

2.3.7. Adamstown Station Building (OBC20D)

Adamstown Station Building (OBC20D) is a two span bridge that supports the Adamstown Station building over four railway tracks and the station platforms. The bridge is located at mileage 7-0790, and it has a vertical clearance above rail of 5.111 m, this bridge has sufficient vertical clearance to accommodate electrification without modification. The deck is constructed with steel beams. See **Figure 2-9.**

Figure 2-9 Adamstown Station Building (OBC20D) East Elevation

2.3.8. Finnstown R120 Road Bridge (OBC19)

Finnstown R120 Road Bridge (OBC19) is a two span bridge that carries the R120 road over four railway tracks and Adamstown Avenue. The bridge is located at mileage 6-1464, and it has a vertical clearance above rail of 4.813 m. this bridge has insufficient vertical clearance to accommodate electrification, as such it will be subject to the option selection process to determine a suitable technical solution. The deck is constructed with precast concrete beams. See **Figure 2-10.**

Figure 2-10 Finnstown R120 Road Bridge (OBC19) East Elevation

2.3.9. Adamstown Footbridge (OBC16A)

Adamstown Footbridge (OBC16A) is a two-span footbridge that carries Haydens Lane over four railway tracks and Adamstown Avenue. The bridge is located at mileage 6-1002, and it has a vertical clearance above rail of 5.290 m, this bridge has sufficient vertical clearance to accommodate electrification without intervention. The deck is constructed with precast concrete beams. See **Figure 2-11.**

Figure 2-11 Adamstown Footbridge (OBC16A) West Elevation

2.3.10. Kishoge Road Bridge (OBC14C)

Kishoge Road Bridge (OBC14C) is a single span bridge that carries the Kishoge Road over four railway tracks and the Kishoge Station platforms. The bridge is located at mileage 5-1514, and it has a vertical clearance above rail of 5.101 m, this bridge has sufficient vertical clearance to accommodate electrification without intervention. The deck is constructed with precast concrete beams. See **Figure 2-12.**

Figure 2-12 Kishoge Road Bridge (OBC14C) West Elevation

2.3.11. Kishoge Station Bridge (OBC14D)

Kishoge Station Bridge (OBC14D) is a two span structure that supports the Kishoge Station building over four railway tracks and the station platforms. The bridge is located at mileage 5-1419, and it has a vertical clearance above rail of 5.190 m, this bridge has sufficient vertical clearance to accommodate electrification without intervention. The deck is constructed with precast concrete beams. See **Figure 2-13.**

Figure 2-13 Kishoge Station Bridge (OBC14D) East Elevation

2.3.12. Clondalkin / Fonthill Station Building West (OBC13D)

Clondalkin / Fonthill Station Building West (OBC13D) is a two-span structure that supports the Clondalkin / Fonthill West Station building over four railway tracks and the station platforms. The bridge is located at mileage 4-1550, and it has a vertical clearance above rail of 5.066 m, this bridge has sufficient vertical clearance to accommodate electrification without intervention. The deck is constructed with precast concrete beams. See **Figure 2-14.**

Figure 2-14 Clondalkin / Fonthill Station Building West (OBC13D) East Elevation

2.3.13. Nangor Road Bridge (OBC13A)

Nangor Road Bridge (OBC13A) is a single span bridge that carries the Nangor Road over four railway tracks and the Clondalkin / Fonthill Station platforms. The bridge is located at mileage 4-1525, and it has a vertical clearance above rail of 4.92 m, this bridge has sufficient vertical clearance to accommodate electrification without intervention. The deck is constructed with precast concrete beams. See **Figure 2-15.**

Figure 2-15 Nangor Road Bridge (OBC13A) West Elevation

2.3.14. Clondalkin / Fonthill Station Building East (OBC13C)

Clondalkin / Fonthill Station Building East (OBC13C) is two span structure that supports the Clondalkin / Fonthill Station East building over four railway tracks and the station platforms. The bridge is located at mileage 4-1450, and it has a vertical clearance above rail of 5.119 m, this bridge has sufficient vertical clearance to accommodate electrification without intervention. The deck is constructed with precast concrete beams. See **Figure 2-16.**

Figure 2-16 Clondalkin / Fonthill Station Building East (OBC13C) East Elevation

2.3.15. Ninth Lock Bridge (OBC13)

Ninth Lock Bridge (OBC13) is a single span bridge that carries the Ninth Lock Road over four railway tracks. The bridge is located at mileage 4-1055, and it has a vertical clearance above rail of 4.909 m, this bridge has sufficient vertical clearance to accommodate electrification without intervention. The deck is constructed with precast concrete beams. See **Figure 2-17.**

Figure 2-17 Ninth Lock Bridge (OBC13) East Elevation

2.3.16. Cloverhill Road Bridge (OBC11)

Cloverhill Road Bridge (OBC11) is a single span bridge that carries the Station Road over four railway tracks. The bridge is located at mileage 4-0644, and it has a vertical clearance above rail of 5.076 m, this bridge has sufficient vertical clearance to accommodate electrification without intervention. The deck is constructed with precast concrete beams. See **Figure 2-18.**

Figure 2-18 Cloverhill Road Bridge (OBC11) East Elevation

2.3.17. M50 Motorway Bridge (OBC10A)

M50 Motorway Bridge (OBC10A) is a single span bridge that carries the M50 motorway over four railway tracks. The bridge is located at mileage 3-1550, and it has a vertical clearance above rail of 5.068 m, this bridge has sufficient vertical clearance to accommodate electrification without intervention. The deck is constructed with precast concrete beams. See **Figure 2-19.**

Figure 2-19 M50 Motorway Bridge (OBC10A) East Elevation

2.3.18. Park West Station Building Bridge (OBC9D)

Park West Station Building Bridge (OBC9D) is a two-span bridge that supports the Park West Station building over four railway tracks and the Park West Station platforms. The bridge is located at mileage 3-1240, and it has a vertical clearance above rail of 6.093 m, this bridge has sufficient vertical clearance to accommodate electrification without intervention. The deck is constructed with steel girders. See **Figure 2-20.**

Figure 2-20 Park West Station Building Bridge (OBC9D) West Elevation

2.3.19. Park West Station Concourse Bridge (OBC9C)

Park West Station Concourse Bridge (OBC9C) is a three span bridge that supports the Park West Station concourse over four railway tracks and the Park West Station platforms. The bridge is located at mileage 3-1200, and it has a vertical clearance above rail of 6.149 m, this bridge has sufficient vertical clearance to accommodate electrification without intervention. The deck is constructed with precast concrete beams. See **Figure 2-21.**

Figure 2-21 Park West Station Concourse Bridge (OBC9C) East Elevation

2.3.20. Park West Avenue Road Bridge (OBC9B)

Park West Avenue Road Bridge (OBC9B) is a single span bridge that carries Park West Avenue over four railway tracks and the Park West Station platforms. The bridge is located at mileage 3-1170, and it has a vertical clearance above rail of 5.248 m, this bridge has sufficient vertical clearance to accommodate electrification without intervention. The deck is constructed with precast concrete beams. See **Figure 2-22.**

Figure 2-22 Park West Avenue Road Bridge (OBC9B) East Elevation

2.3.21. Retaining Walls

The following retaining walls are recorded at the following locations (see **Table 2-1**):

Table 2-1 Existing Retaining Walls

Track Section	Asset ID	Start Mileage	End Mileage	Side	Wall Type	Wall Height	Description
Heuston - Hazelhatch (East of Park West & Cherry Orchard Station)	RWC008UC	3mls 0158yrds	3mls 0401yrds	Up (North of Track)	Gabions	2.5m	Earth Retaining
Heuston – Hazelhatch (East of Park West & Cherry Orchard Station)	RWC008UD	3mls 0854yrds	3mls 1115yrds	Up (North of Track)	Gabions	2.5m	Earth Retaining
Heuston – Hazelhatch (East of Park West & Cherry Orchard Station)	RWC008UE	3mls 1115yrds	3mls 1205yrds	Up (North of Track)	Mass Concrete	2.5m	N/A

2.4. Permanent Way and Tracks

As described in **Section 2.1 Overview,** there are 4 tracks in this area - Up Fast, Up Slow, Down Slow and Down Fast - with the Fast lines operating at 100mph (160km/h) and the Slow lines at 70mph (110 km/h). **N.B.** Speeds quoted are maximum operational speeds for the respective Fast and Slow lines.

The track gradient at Hazelhatch is nominally flat before rising at 1 in 323 to a crest at the mid-point between Hazelhatch & Celbridge Station and Adamstown Station, before falling at 1 in 243 on the approach to Adamstown Station. The track gradient is then nominally flat to a point east of Park West & Cherry Orchard Station near Park West Avenue Road Bridge (OBC 9B).

Ballasted track with concrete sleepers is found in the area. The P&Cs are normally with wooden / timber sleepers but also some units with concrete bearers. The P&Cs are normally protected by adjustment switches.

2.5. Other Railway Facilities: Stations

There are 5 stations located in this area, in a four-track corridor, currently with a Fast-Slow-Slow-Fast configuration. The stations are, from east to west:

- Hazelhatch & Celbridge
- Adamstown
- Kishoge
- Clondalkin / Fonthill
- Park West & Cherry Orchard

The scope of this project is to assess the adequacy of existing stations to meet the predicted growth in demand and usage.

Figure 2-23 shows the location of the existing stations.

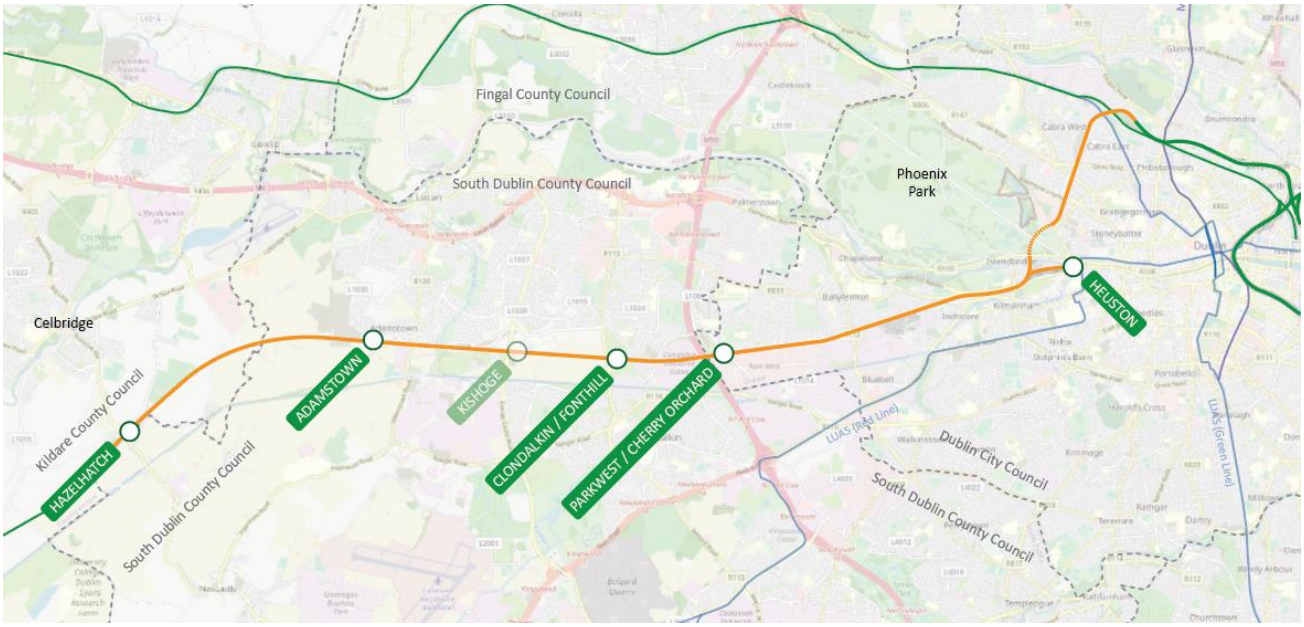


Figure 2-23 Cork Mainline - Existing Stations.

Each of the stations have a similar arrangement, with a central island platform providing up and down side platforms. The passengers are distributed from the station building that crosses above the tracks. The only exception to this scheme is Hazelhatch, which has an entrance building north of the tracks and provides access to platforms through a footbridge, having also the central island / up and down side platforms arrangement.

According to the project´s objectives the service will change to Slow-Slow-Fast-Fast (north to south), see **Figure 2-24**, which is feasible based on the current configuration of the stations.

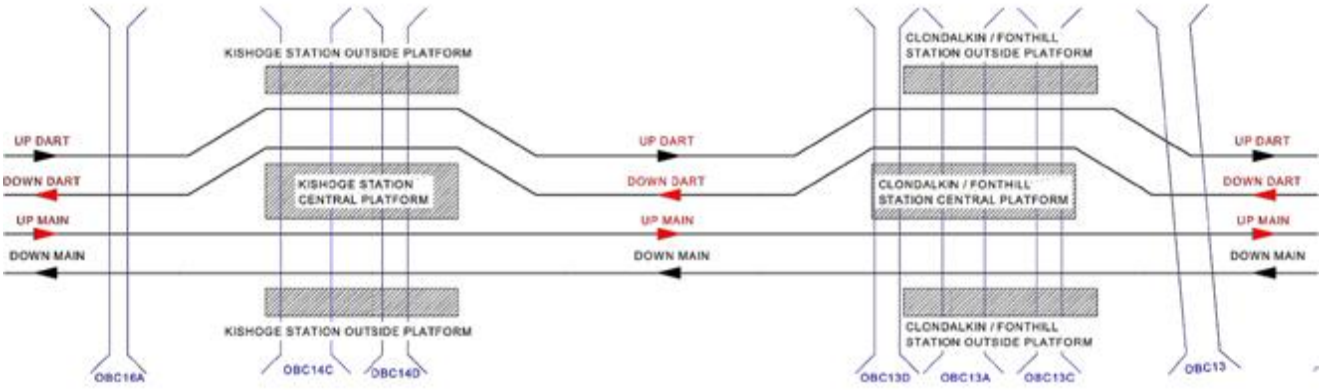


Figure 2-24 Future Line diagram. Kishoge and Clondalkin / Fonthill stations

The change of the operation scheme to Slow-Slow-Fast-Fast and the future increase in passenger demand requires the analysis of the station sizing and the access to the platforms. Typically, the north (Up) platforms are not currently in use in these stations. See **Figure 2-25** for the typical platform arrangement at Clondalkin/ Fonthill Station and **Figure 2-26** for the typical platform arrangement at Park West and Cherry Orchard Station.

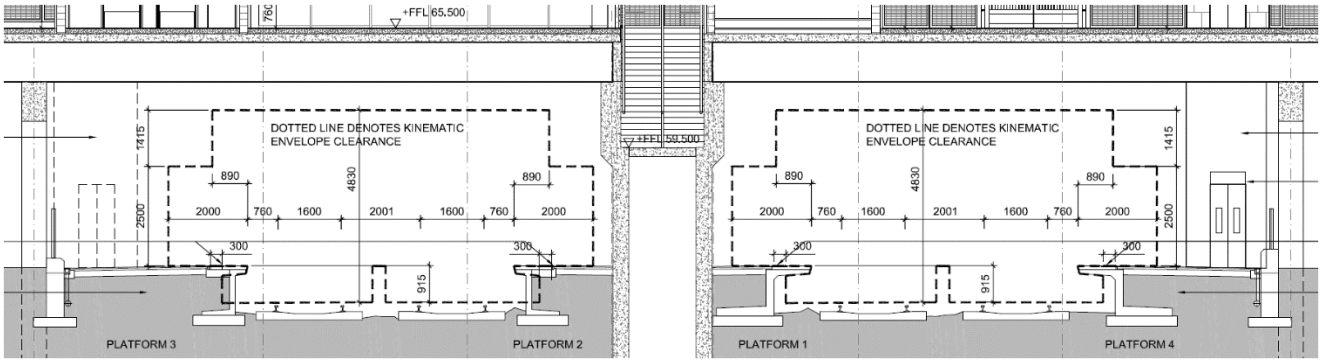


Figure 2-25 Typical platform arrangement at Clondalkin / Fonthill station

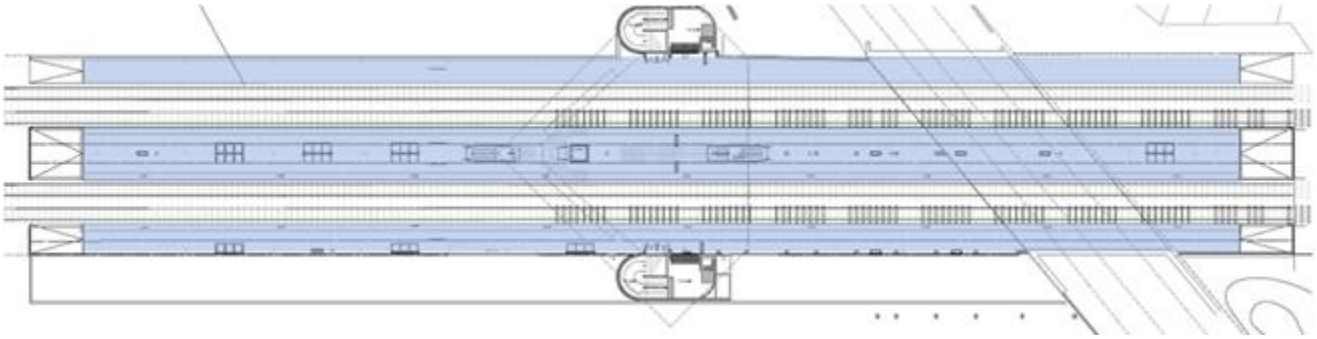


Figure 2-26 Typical platform arrangement. Park West & Cherry Orchard Station

As indicated in **Section 2.3 Structures** of this report, the structure clearances in the station buildings are suitable for the electrification of the future DART tracks.

2.5.1. Hazelhatch & Celbridge

Hazelhatch & Celbridge Station is located approximately 2km south of Celbridge town on regional road R405. The station straddles the border between counties Kildare and Dublin.

The station layout consists of one central and two side platform areas with a turnback provided at the eastern end of the station, i.e. 5 platforms in total, see **Figure 2-27** and **2-28**. The platforms are provided in an offset arrangement, with the central and southern platforms extending west below Hazelhatch R405 Road Bridge (OBC25). The station will operate as terminus station for proposed DART trains. Hence, the turnback service will be enhanced for Heuston and PPT / Dublin Connolly services.

The access building is on the platform level, to the north of the track area. A pedestrian footbridge provides access via stairs and lifts to the platforms.

The central platform area includes a number of historic buildings including the original station building and a pedestrian footbridge, both dating back to the 19th century.

Figure 2-27 Hazelhatch & Celbridge Station. Aerial view.

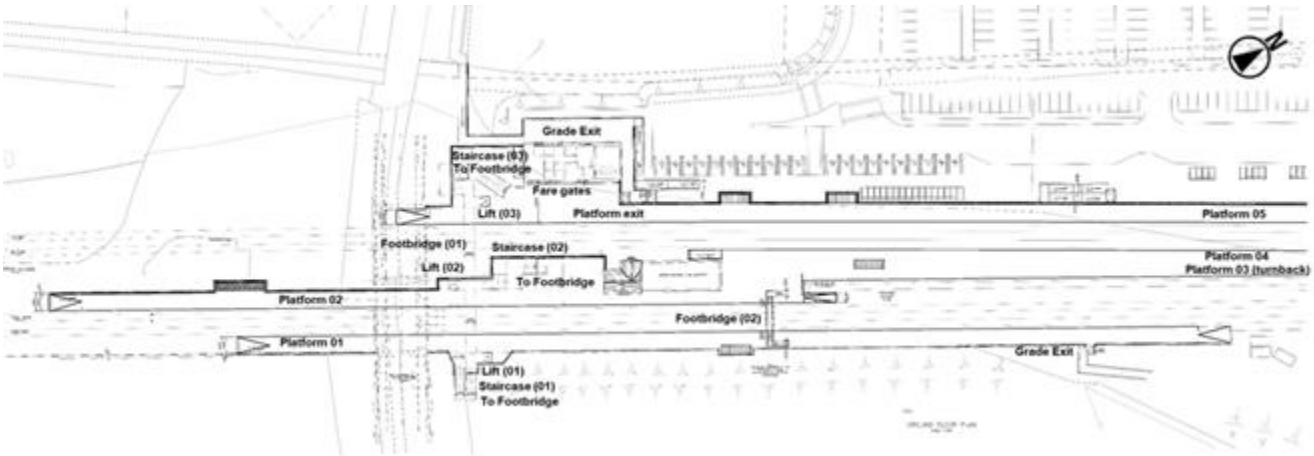


Figure 2-28 Hazelhatch & Celbridge Station. General plan.

2.5.2. Adamstown

Adamstown Station is a bridge-type station located approximately 300m west of the Adamstown development area. Access is provided from the northern side of the railway where a local road runs parallel to the track. The platform layout includes a terminal / turn-back platform which is located on the eastern side of the station. The building design and layout is similar to that at Park West & Cherry Orchard Station. See **Figure 2-29** and **2-30.**

Figure 2-29 Adamstown station. Turnback platform at the East

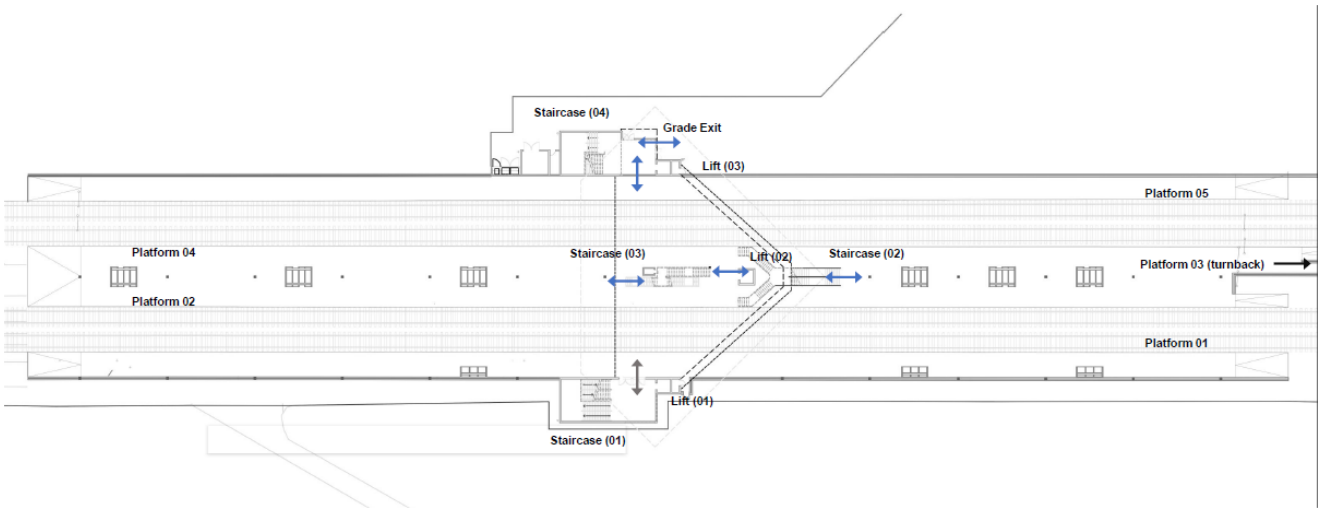


Figure 2-30 Adamstown station. Platform level plan

2.5.3. Kishoge

Kishoge station building is adjacent to the eastern side of Kishoge bridge (OBC14C). It is similar in layout to the east concourse building at Clondalkin / Fonthill. The three platforms are aligned, centred below the building. The station is not currently operational. See **Figure 2-31** and **2-32.**

Access to concourse is provided from the R136 via two footbridges.

A new car park has been developed to the south of the station, similar to the one at Clondalkin / Fonthill Station.

Figure 2-31 Kishoge station. Aerial view.

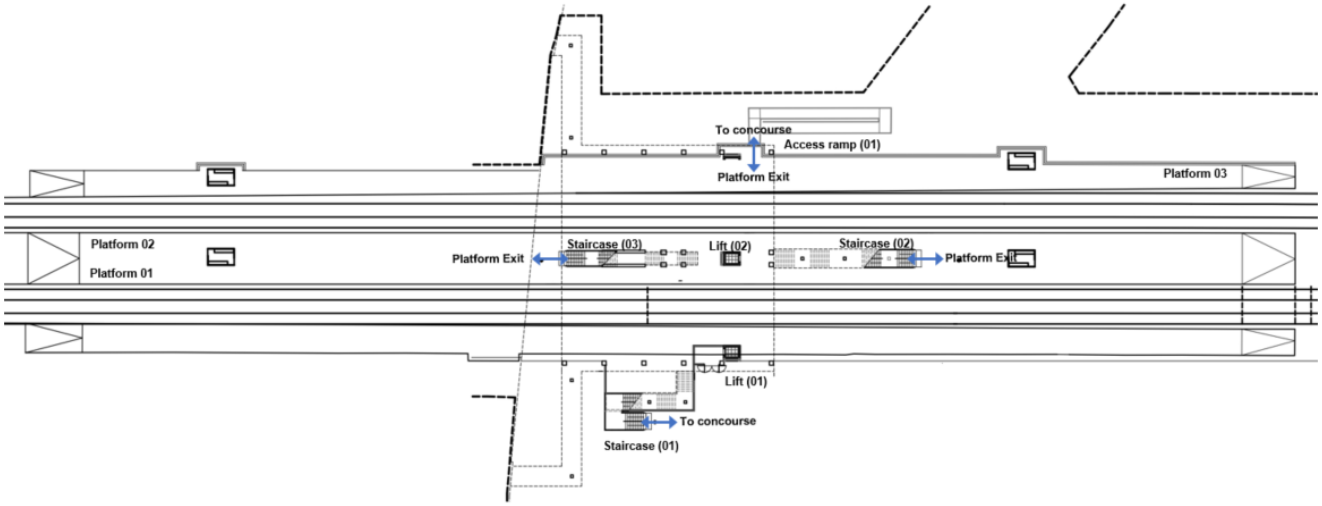


Figure 2-32 Kishoge station. Platform level plan.

2.5.4. Clondalkin/ Fonthill

Clondalkin / Fonthill station has two concourse buildings, located either side of regional road R113.

The side platforms are located on the eastern side of the bridge only, while the central platform is continuous throughout and covers both station buildings. See **Figure 2-33** and **2-34.**

The west building was designed to provide access to the central platform, and is currently closed. The east building currently provides access to all platforms. An operational car park is located to the south. In the east building, public access is both provided to the platforms and a car park to the south.

Figure 2-33 Clondalkin / Fonthill station. Aerial view

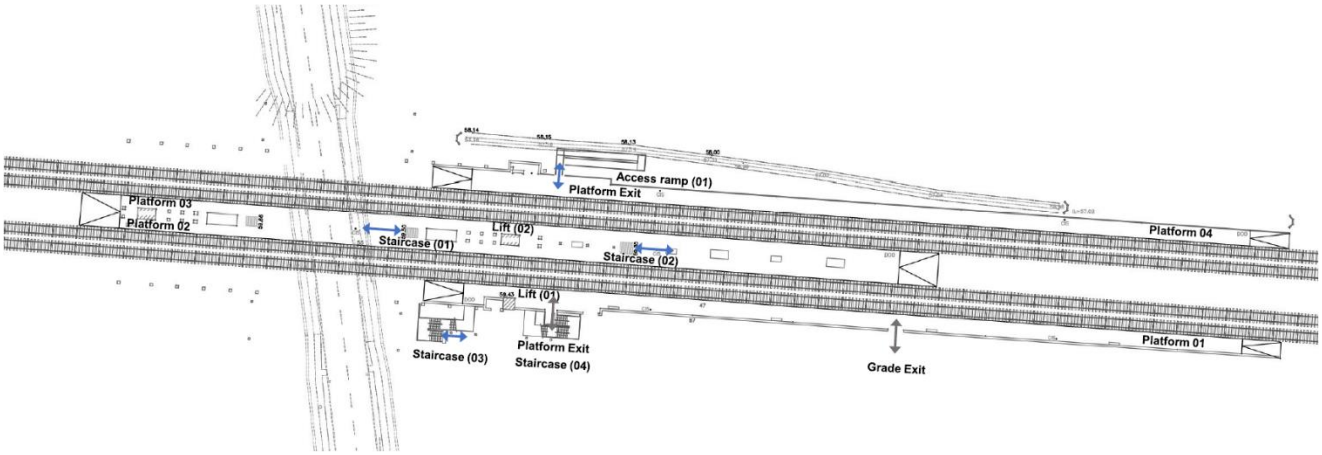


Figure 2-34 Clondalkin / Fonthill station. Platform level plan

2.5.5. Park West & Cherry Orchard

Similar to Adamstown Station, Park West & Cherry Orchard Station is an existing bridge-type station, adjacent to the Park West Avenue bridge. See **Figure 2-35** and **2-36**.

Public access is provided from the bridge and a covered concourse distributes the access to the central and side platforms.

Figure 2-35 Park West & Cherry Orchard Station. Aerial view.

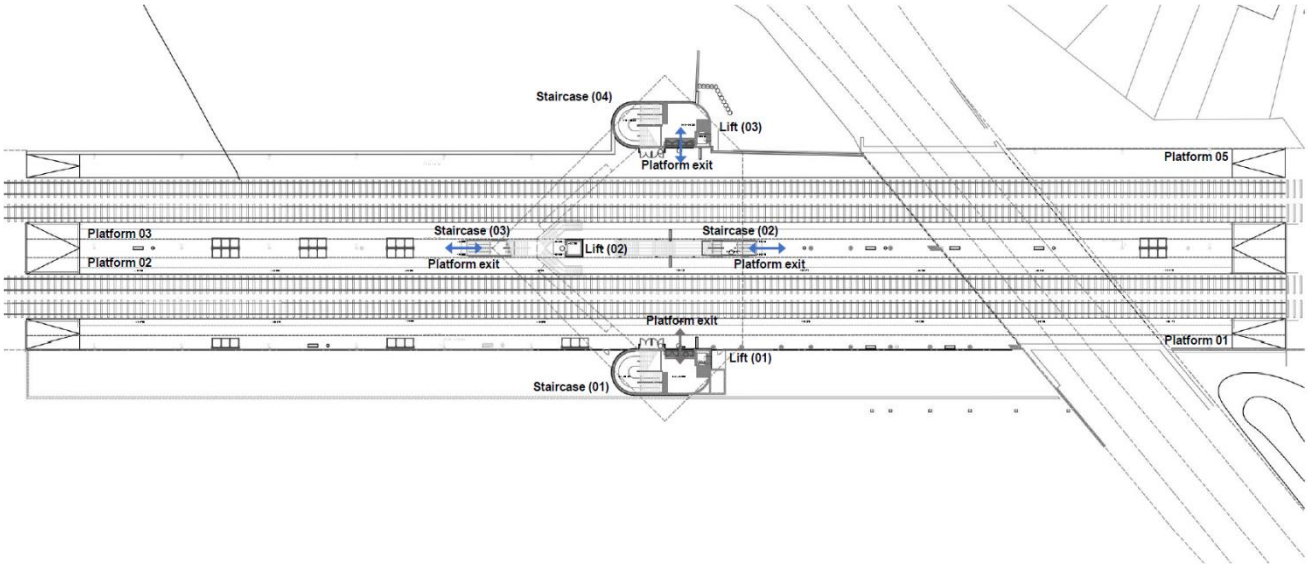


Figure 2-36 Park West & Cherry Orchard Station. Platform level plan.

2.5.6. Future Station Enhancement Works

Current Capacity Review studies have concluded that the sizing of the existing stations sizing will be adequate to accommodate forecaseted future passengers demand generally. However, specific local improvement measures necessary to meet current building regulations and / or other project-specific parameters have also been identified and will inform the requirement for future enhancement works, which are not within the scope of this project.

The western portion of Clondalkin / Fonthill station is currently closed, it is assumed that the public will continue to use the eastern portion of the building to access station platforms. The west building may provide further services at later date if required.

2.6. Road Network

There are several roads crossing the railway within the subject area all of which all are via overbridges identified in **Section 2.3 Structures**. There are no interventions foreseen for these sections of road.

2.7. Ground Conditions

Ground investigation works were completed at three sites as part of the four tracking of the railway between Hazelhatch & Celbridge Station and Park West & Cherry Orchard Station in 2006. The ground investigation typically recorded a thin layer of topsoil underlain by a firm to very stiff silt/clay with locally soft silt/clay and occasional gravel and sand. Gravel was generally described as medium dense with limestone cobbles. Bedrock recorded as moderately strong limestone was encountered at depths ranging from 1.3m bgl (61.28m AOD to 9.2m bgl (51.30m AOD).

Peat was recorded between chainage 274+800m and 275+000m (East of Kishoge), however there were traces of organic material within a number of other exploratory holes throughout the area. Route-wide dynamic probes also identified potential soft deposits at several isolated locations within the rail corridor throughout the area but predominately encountered between chainage 274+600 (Kishoge) and 271+000 (Park West).

In the area west of Hazelhatch & Celbridge Station, historical ground investigation was completed to investigate an area of brownfield immediately west of the station. Anecdotal evidence indicated that there was previously a quarry that had been backfilled. Ground conditions typically encountered made ground between ground level and 9.20m bgl. Made ground generally comprised of firm to stiff clay, very loose gravel of ash, clinker, spent coal and boiler slag. Made ground was underlain by very soft silt, clay, sand and gravel. Bedrock consisting of a strong limestone was confirmed at depths ranging from 3.80m bgl (53.06m AOD) to 9.30m bgl (47.60m AOD).

The general topography of the subject area is flat and sloping gently towards the north. To the east of the existing Park West & Cherry Orchard Station the railway is in a cutting. To the west of Park West & Cherry Orchard Station, the height of the cutting gradually decreases and thereafter the railway is generally at grade or minor cutting throughout the study area.

The general superficial geology in the area is anticipated to comprise till overlying bedrock (limestone and shale). Isolated outcrops of limestone and shale at or near the ground surface is noted in places immediately to the east and west of the existing Adamstown Station between Stacummy and the R120 at Adamstown. A pocket of gravel overlying bedrock (limestone and shale) is shown underlying the track at Moorfield.

Existing historical ground investigation between Hazelhatch & Celbridge Station and Kylemore Road Bridge (OBC5A) show the ground conditions to comprise ballast overlying dark clay. Dense to medium dense gravel/sand and cobbles were occasionally recorded underlying both the clay and ballast strata. Bedrock was met in several exploratory holes underlying the superficial deposits at depths ranging between 0.50m bgl (58.34m AOD) and 4.40m bgl (53.15m AOD). Shallow bedrock encountered at less than 1.0m bgl was generally encountered between chainage 276+000 (Adamstown) and 277+200 (Adamstown Station).

A Ground Investigation is currently ongoing to verify the ground conditions.

2.8. Environment

This encompasses the area from west of Hazelhatch R405 Road Bridge (OBC25) to Park West Avenue Road Bridge (OBC9B). This area has been the subject of previous rail enhancements as part of the Kildare Route Project Phase 1.

2.8.1. Area Around Hazelhatch

The area west of Hazelhatch & Celbridge Station is broadly rural in nature with large open field systems, however there are also small clusters of residential development, notably houses along Lord's Road to the northwest of the station. These houses are within the 200-300m buffer area of the rail centreline at this location. The settlement of Celbridge town is located approximately 2km to the north.

There are a collection of built heritage features in the vicinity of the train station including Hazelhatch R405 Road Bridge (OBC25), Hazelhatch Footbridge (OBC24) and the train station, all listed as NIAH (although the Hazelhatch Road Bridge (OBC25) was replaced as part of the Kildare Route Project (KRP) Phase 1).

Then there is another grouping of mainly residential properties either side of the existing line and on the north-west side of Hazelhatch & Celbridge Station. On Balscott Lane (L6005) near the station, there are the gates/railings/walls of Hazelhatch & Celbridge Station, which is classed as both an NIAH and an RPS feature. The station building is also classed as an NIAH and RPS. The footbridge (OBC24A) (near the Hazelhatch Road) crossing both the up and down train lines is classed as an NIAH, while another footbridge (OBC24) crossing just the down line/ southern track is classed as an RPS. On Balscott Lane, just on the border of KCC and SDCC administrative boundary, there is a small stand of Japanese knotweed noted during the 2020 ecology survey, around the Iarnród Éireann junction box; it extends up-slope and into a private hedgeline.

Of note is an NBDC record of otter potential for the Castletown River. During the 2011 EIS, invasive plant species were noted at Hazelhatch. The Castletown Stream is located in the station area and flows north to the Liffey. It has Unassigned Water Framework Directive (WFD) ecological status. There is evidence of otter from National Biodiversity Data Centre (NBDC) records at the station car park and some evidence of invasive plant species in the vicinity of the station from previous ecological surveys. The Hazelhatch area has experienced multiple significant flood events in recent decades.

There are a number of commercial properties in the Stacumney area, mainly on the north side of the existing line within 100m-200m of the rail line. Just on the northern side adjacent to the existing line is an old bungalow-type building which was noted for bat roost potential during ecology field surveys. On the southern side of the line, the old lime kiln was also noted for bat roost potential during the 2011 EIS. There are two RMPs/SMR Zones – a church and a graveyard. Stacumney House, a historic house/demesne, is also located here. On the south side of the line Approximately100m is an RMP site (Stacumney Cottage, an enclosure). There is a Pitch n Putt course between the existing rail line and the Loughlinstown Road. A 110 kV overhead line also crosses the rail line in this area. This area is north and south is part of the Kildare LCA (Northern Lowlands). On the southern side of the line at Hazelhatch station, the LCA is mainly covered by SDCC LCA (Newcastle Lowlands). A faultline also trends NE-SW traversing the rail line on approach to Stacumney.

2.8.2. Area Around Adamstown

There is significant residential development at Adamstown, north of the existing line along Adamstown Avenue. Adamstown is also an SDZ. There are also several schools adjacent to the existing line on Station Road (L5787): Kishoge Community School; Adamstown Community College; Saint John the Evangelist National School; and Adamstown Castle Educate Together National School. Adamstown is also an SDZ The rail corridor then traverses more open greenfield/suburban landscape with a number of commercial properties found in the Stacumney area, mainly on the north side. There is a Pitch'n'Putt course between the rail line and the Loughlinstown Road. At Hazelhatch, there is another grouping of mainly residential properties either side of the existing line and on the north-west side of Hazelhatch & Celbridge Station.

Further north again are various NIAH, RPS, features on the Record of Monuments and Places (RMP) and Sites and Monuments Records (SMR). West of the Adamstown Road and south of the existing rail line and is an RMP (castle tower house) with an associated SMR Zone. There are two RMPs/SMR Zones – a church and a graveyard. Stacumney House is a historic house/demesne, and Stacumney Cottage is an RMP. Hazelhatch &

Celbridge Station is both an NIAH and an RPS feature, as are the station gates/railings. The footbridge (near the Hazelhatch Road) crossing both the up and down train lines is an NIAH, while another footbridge crossing just the down line/ southern track is classed as an RPS.

Around the Adamstown area, the landscape character area (LCA) for South Dublin County Council indicates these green spaces are part of the Lucan LCA (Suburban South Dublin). Approximately 100m to the south side of the existing rail line and to the west of the Adamstown Road, there is an RMP (a castle tower house) with an associated encircling SMR Zone designation. Approximately 250m south of Adamstown Railway Station is an RMP (enclosure) with an associated SMR Zone designation. There is bedrock at or near the surface along a section of the existing rail line at Adamstown.

2.8.3. Area Around Park West

Commencing in the west and heading towards Park West & Cherry Orchard Station, the rail corridor passes under the M50 where, just to the west of this crossing there has been recent linear replanting along the rail line. West of the M50 toward Station Road is predominantly commercial and industrial premises both north and south of the rail corridor, including an industrial estate, the Clondalkin Industril Estate located to the south of the corridor and two EPA-licensed industrial emissions facilities: Greyhound Recycling & Recovery and Metal Processors Limited.

Between Lucan-Newlands Road and Station Road, Clondalkin there are residential properties north and south of the existing corridor. Residential estates include Moorfields Estate to the north and John Connelly Estate to the south [within 200m of the existing rail line]. Kishoge & Griffeen Community College is located north of the existing line (within 250-300m buffer band from the rail centreline). Lynch's park is in closer proximity to the rail corridor and has traveller's accommodation.

There are several features listed on the National Inventory of Architectural Heritage (NIAH) in the area including: the Station Road (L1006) Bridge, Clondalkin over the rail line; the Railway Station House; the bridge over Lucan-Newlands Road; and two houses just to the south of the existing rail line (within 50m). On the northern side of the existing line (within 50-100m) is Coolevin House which is also listed on the NIAH and furthermore is included on the list of Record of Protected Structures (RPS) for the county. Further north again, located between the Lucan-Newlands Road and the Neilstown Road, is Neilstown Lodge which is an NIAH and an RPS. There is also a castle and a 16th/17th century house, further to the north of the line both registered on the Record of Monuments and Places (RMP) and Sites and Monuments Records (SMR). Approximately 150m to the west of Clondalkin / Fonthill Station, there is an enclosure site (RMP) located within the 50-100m buffer band, however its associated encircling SMR zone designation covers a wider area and is in proximity to the existing rail line. To the south of Clondalkin and around the canal, is Clonburris Strategic Development Zone (SDZ) which includes road proposals and new communities, residential development and businesses.

A 220 kV overhead line crosses the existing rail line a number of times: near the M50, three times at Adamstown, and at Loughlinstown near Hazelhatch. There are two 38 kV underground lines which also cross the corridor near Park West Avenue and at Grange Castle Road (R136). Many of the urban/residential areas are serviced by the low and medium pressure gas pipeline network, crossing the rail corridor mainly at road crossings. There are two high pressure pipeline crossings – at the Fonthill Road North (R113) and the Grange Castle Road.

Much of the groundwater vulnerability underlying this area is rated between high and extreme/rock near surface. Much of the subsoils traversing the area are comprised of till derived from limestones; limestone gravels are found around Adamstown.

It is noted that Ninth Lock Bridge (OCB13), Cloverhill Road Bridge (OBC11) and the Finnstown R120 Road Bridge (OBC19) were all replaced as part of the previous KRP Phase 1, although they remain listed as NIAH.

2.9. Utilities

The roads network and rail corridor contains a significant number of utilities, albeit more sparsely spread than other areas along the Cork Mainline. Service providers with network assets in this area include the following:

- Aurora Telecom
- EIR
- ESB Networks
- Virgin Media
- Gas Networks Ireland
- ZAYO (T-50 Network Operators)
- South Dublin County Council Road Drainage (Storm Water Sewers)
- South Dublin County Council / Irish Water (Foul Water Sewers)
- South Dublin County Council / Irish Water (Water Supply)
- South Dublin County Council Public Lighting

Data in the form of utility service records have been gathered from all providers in the area. The majority of services are located within existing roads/streets and rail line bridge crossings.

A number of services are also present at track level, crossing the railway corridor above or below the tracks. Consideration of the impacts on these services will also be necessary.

A number of key network infrastructure elements for particular utility providers are present and may be challenging to deal with given that only limited service outage time (if any) will be permissible to the service and its customers. Significant forward planning and coordination will be necessary for such instances where service conflicts cannot be avoided by design.

3. Project Requirements

3.1. Area-Specific Requirements

In addition to the general feasibility requirements of constructability, general fitness for intervention and safety, the specific requirements for this area are:

- Signalling reconfiguration of the four-tracking between Hazelhatch and Park West (slow DART+ lines to the north, fast Intercity lines to the south).
- Electrification of the two tracks to the north to accommodate DART and the associated electrical power substations and connections to the ESB power network.
- Electrical clearance to structures.
- Maintain current functionality of the existing network and public roads and services/utilities (electricity, gas, water, etc).
- Track alignment and drainage requirements (in accordance with their respective standards).

3.2. Systems Infrastructure and Integration

In addition to the track and civil infrastructure modifications relating to the 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. It is proposed that a standardised approach to electrification will be adopted, but area-specific interventions will also be required. Four power substations will be provided along this segment of the rail line to provide the requisite power for the network demand.

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 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 equipment rooms, including Relocatable Equipment Buildings (REB) to accommodate signalling equipment and associated power supplies and backup.

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 DC (Direct Current) 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. Construction details will be determined during Detail Design, which will be developed at later stages of the project..

The OHLE concept comprises a simple (2-wire) auto-tensioned system, supported on galvanised steel support structures. See **Figure 3-1** for a typical OHLE arrangement in a two track open route.

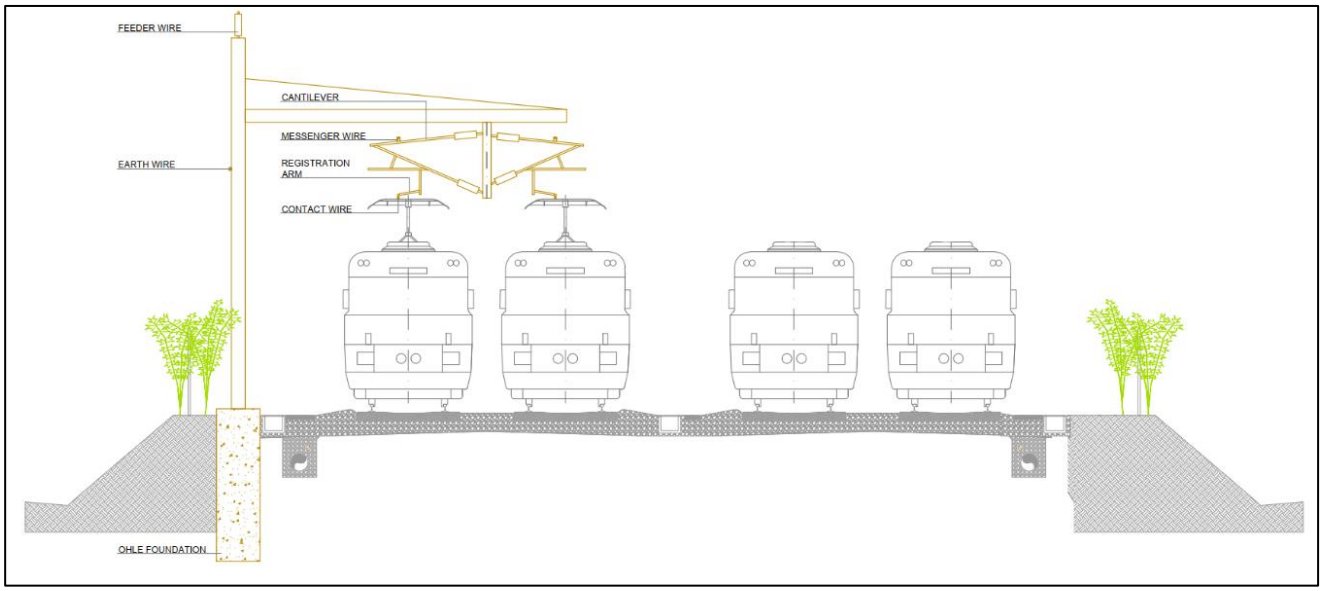


Figure 3-1 Typical OHLE arrangement in four track open route - Facing East

In the four track areas, Two Track Cantilevers (TTCs) will generally be placed on the north side of the line, to support OHLE on the northern two tracks. The project aims to achieve a minimum contact wire height of 4.4m throughout to ensure compliance with the relevant design standards, localised special conditions may be required.

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. 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.See **Figure 3-2** for a typical anchor structure.

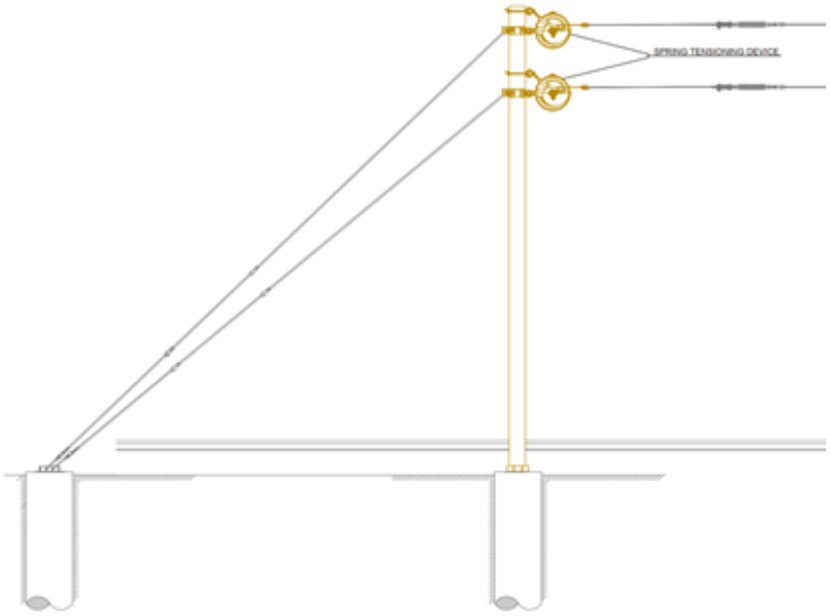


Figure 3-2 Typical anchor structure

The OHLE configuration through the overbridges for each track have been assessed using a clearance assessment tool derived from the System Wide Functional Requirement Specification (FRS) relating to Overhead Line Equipment (OHLE) and a set of configurations agreed with Irish Rail Signalling and Electrification Department through the Interface Coordination Document (ICD) process This includes level and graded free running options, as well as level and graded options with elastic bridge arms fitted to the bridge. See **Figure 3-3** for a typical arrangement on approach to a low bridge.

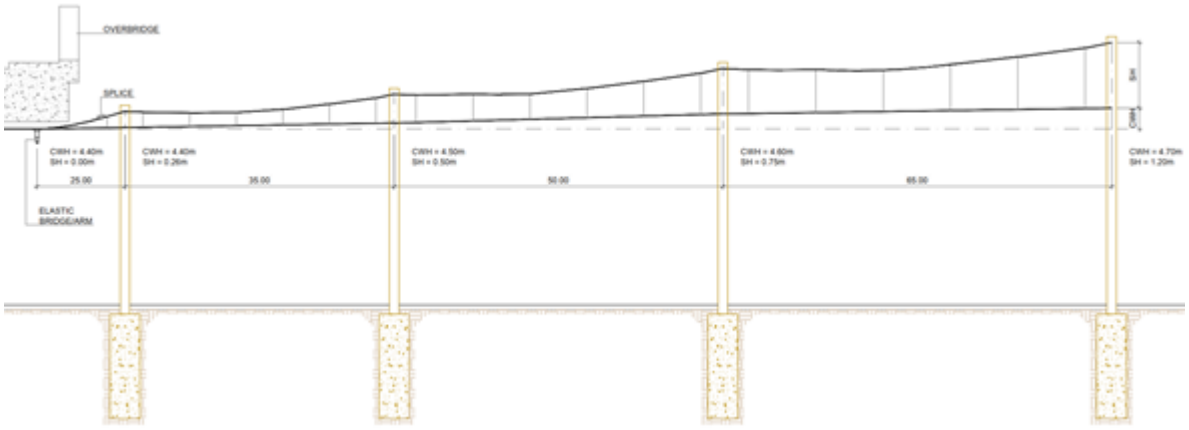


Figure 3-3 Typical arrangement on approach to a low bridge

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 six new substations on the DART+ South West scheme, four substations are required on this section of the route, at the following locations:

- Hazelhatch
- Adamstown
- Kishoge
- Park West

3.2.2.1. Requirements and Considerations

The siting technical requirements for substations for the DART+ South West Project which inform the Option selection process include:

- The initial substation location is an output of the DART+ Programme power study, and an input to the Optioneering process undertaken by DART+ South West, which will refine the final location, using the constraints listed below. Further details on section.
- The substation locations must be accessible to the ESB network. While the actual connections to the grid will be determined by ESBN following their in-house technical assessment process.
- The substations will be connected to the IÉ power distribution network and OHLE system which will deliver traction power to the electric train units. These cables will be installed in buried routes for additional protection. Hence, proximity to the railway corridor is a fundamental siting consideration.
- The substations must be accessible from the local road network for construction and maintenance purposes. 24-hour unimpeded access for ESB staff and Iarnród Éireann maintenance staff is required. The vehicular access route must be at least 3 m wide and the maximum allowable slope of the access route is 1:10.
- Consideration will be given to the land-use and development context of potential locations.
- Where practicable, substations will be located on Irish Rail property and positioned to have minimal impact on adjacent properties.

The substations will comprise a secured, fenced compound surrounding a building which will house all the necessary electrical switching and feeding equipment. Welfare facilities are also required for Irish Rail's maintenance teams. The characteristics of the substation compound and buildings for the DART+ South West Project are as follows:

- The footprint of the substation compound will generally be 50m (length) x 20m (wide). The substation dimensions will generally be 35 m (length) x 10 m (width) and 6 m (height).
- Consistent with the existing Irish Rail substations,
    - The substation compound will be secured by a 2.4 m high palisade / security fence, or similar.
    - The architectural finish will be grey brick / blocks. However, there may be site specific areas where a high architectural finish is required.
- The substation must be located at ground level in order to facilitate the installation or replacement of heavy electrical equipment, the immediate area around the substation should be level.
- Substations must be located so that the access doors open outwards onto a clearly marked low-risk fire area.
- The exterior and the access of the electrical substation must be illuminated with sufficient lighting to assure the mobility and the security of any operation during the hours of darkness.
- The design of the substations will be subject to further development during subsequent design phases and the inclusion of ESB requirements. The sizing of the proposed substations has been taken from information obtained from ESB.

3.2.2.2. DART+ Programme Power Study Requirements

As noted previously, a Power Study was commissioned by IÉ with the primary objective of ensuring uniformity and compatibility of equipment and systems across the IÉ network. The Power Study provides a power simulation study across the DART+ Programme providing a basis upon which consistency in design decisions can be made

with regard to traction, and operational power demand, establishing the existing KVA and future KVA demands for all areas across the DART+ network.

Regarding substation locations, the power simulation study assumed the locations proposed in the "DART Expansion – Electrification Assessment Report" previously commissioned by IÉ and produced by SYSTRA Ltd. The power simulation study then undertook a validation process of these locations, applying updates and modifications as necessary so that stated minimum criteria in relation to the following technical parameters were achieved (refer to Section 4.4 of the Power Study document):

- Rolling Stock – modelling of the proposed rolling stock taking into account power consumption, acceleration / deceleration profiles, line speed limits, etc.
- Railway Operation – modelling of the power demands due to the operational restrictions along the railway, accounting for stopping patterns, dwell time at stations and train services schedules
- Railway Alignment – modelling the proposed rolling stock and operational constraints against the known topography of the proposed railway alignment, taking account of longitudinal gradients and curve resistance along the proposed route as well as regenerative braking effects
- Substations – modelling to take account of max power demand / load, number of substations, feeder arrangements and line sectioning
- Overhead Line Equipment (OHLE) – modelling is undertaken to ensure that voltage and current values remain within technically acceptable limits for both normal and degraded conditions. The OHLE system within the model considers all aspects with regard to electrical characteristics of the rails, electrical feeders connecting the substations to the OHLE, return feeders connecting the rails back to the substations and operating temperature limits.
- Technical Operational Limits – other technical operational limits in terms of permissible minimum (1000V) and maximum (1800V) voltage values and currents (determining train traction power) are considered and the model 'tested' to ensure compliance with relevant technical standards in this regard.

The power simulation was run for a number of scenarios, including normal service (i.e. all substations operational) and degraded scenarios (i.e. various combinations of service disruptions at selected substations).

A key output of the power simulation is the optimal distribution of electrical substations across the network. The Study identified the following locations for proposed traction power sub-stations for the DART+ South West Project: Hazelhatch, Adamstown, Kishoge, Park West, Kylemore, Island Bridge.

3.2.2.3. Substation Location Requirements

Table 3-1 is an extract from Section 5.3.2 of the DART+ Programme Power Study and identifies the locations for the proposed substations on the DART+ South West project. It should be noted that the Datum point (i.e., 0.00km) for all distances provided is the overbridge at Glasnevin Cemetery (OBO10).

Table 3-1 – DART+ South West Substations location (Source: DART+ Programme Power Study)

Line number	Station	km	Substation	km	Normal conditions (kW)	Degraded conditions (kW)	Fast speed Charging system (kW)	Depot power (kW)	MIC normal (kVA at 0.9 power factor)	MIC degraded (kVA at 0.9 power factor)
6	-	4,03	Islandbridge (New substation)	4,03	1956	3114			2173	3460
6	-	6,05								
6	Kylemore Road	7,10	Kylemore (New substation)	7,10	2655	3697			2950	4108
6	Park West & Cherry Orchard	8,90								
6			Park West (New substation)	9,83	2751	3792			3057	4213
6	Fonthill Road	10,75								
6	Kishogue	12,40								
6			Kishogue (New substation)	12,70	2531	3300			2812	3667
6	Adamstown	15,00								
6			Adamstown (New substation)	16,00	1945	3066			2161	3407
6	Hazelhatch and Celbridge	19,10	Hazelhatch (New substation)	19,10	1592	2439	3250		5380	6321

The locations identified in the DART+ Programme Power Study are an input to the DART+ South West Project and proposed substation site options have been identified and separation distances checked to ensure that compliance with the parameters of the power simulation model are maintained. Following acceptance of the proposed locations by ESB Networks, the power simulation to be updated to verify the network design. If the locations proposed are outside the tolerance limits, creating significantly longer distances between substations than those proposed by the Power study, further power modelling will be required to assess their viability for the DART+ South West programme prior to Railway Order.

To ensure the selection of potential substation sites are technically feasible, the distance provided between Datum (Glasnevin Cemetery Bridge OBO10) and Islandbridge must not be exceeded, i.e. 4.03km. Similarly, the distances proposed between all other subsequent substations (assuming an east to west sequential order) must not be exceeded so that the parameters of the power simulation commissioned by Irish Rail are not exceeded.

3.3. Design Standards

The project design is governed by various technical and safety guidelines, which include European, National and Iarnród Éireann internal standards and specifications.

Compliance with these standards will be ensured via internal and external technical and safety assurance processes throughout the delivery and commission stages of the project.

4. Constraints

4.1. Environment

Following fieldwork and desktop assessment, additional environmental constraints have been considered in addition to those identified in **Section 2.8 Environment.**

Ecological field surveys of the route have been carried out to establish the baseline ecological conditions. Surveys for mammals (badger, bats), amphibians, invasive alien species, birds and terrestrial and freshwater habitats have been carried out to date. Bat activity monitoring using a static bat detector has been carried out at 2 locations [at a location near Hazelhatch and a location near Clondalkin/Fonthill station].

In relation to Built Heritage, a comprehensive desktop assessment of built heritage assets within 50m either side of the railway centreline has been undertaken by a Heritage Specialist. This assessment confirmed the designated status of the features of heritage interest due to their Protected Structure status and/or inclusion in the NIAH record, and/or inclusion in the Industrial Heritage Record.

There are 5 no. stream and river crossings between Hazelhatch and Park West. The Hazelhatch and the Shinkeen watercourses crosses the railway line at two locations at the Hazelhatch area. The Hazelhatch area has experienced multiple significant flood events in recent decades. The Eastern Catchment Flood Risk Assessment and Management Study (ECFRAM) flood maps and the most recent Kildare County Council Hazelhatch Further Study indicate risk of fluvial flooding in the 1% and 0.1% Annual Exceedance Probability (AEP) flood levels. The Coneyburrow Stream crosses the railway line. The ECFRAM maps indicated no risk of flooding for the Coneyburrow crossing. The Lucan stream crosses the railway line at Adamstown. The ECFRAM maps indicate no risk of flooding. The Griffeen River crosses the railway line to the east of Lucan. The ECFRAM maps indicate the Griffeen River is impacted by river flooding in the 0.1% fluvial AEP event.

A Flood Risk Assessment (FRA) is currently under preparation. The FRA will be completed in accordance with “The Planning System and Flood Risk Management – Guidelines for Planning Authorities” (DOEHLG, 2009). Detailed mitigation measures will be specified in the final FRA and will inform the EIAR which will be submitted to An Bord Pleanála for Railway Order approval.

4.2. Permanent Way

The vertical and horizontal alignment is constrained by the elements summarised in **Table 4-1**.

Table 4-1 Permanent Way Geometrical Constraints

ID	Name	Description
1	Track geometry: location of tie-in to existing alignment	There exists a length of plain line that is supported by piled formation, located on the proposed slow track west of Hazelhatch & Celbridge Station. It is a requirement to tie-in the proposed alignment to the existing track prior to this piled area. In order to do this it may be necessary to install a double junction (including a diamond crossing) which may be difficult to maintain.
2	Existing station and depot functionality	The location of the P&C on the east side of Hazelhatch & Celbridge Platform 2 means that the switch toe is only 5m from the end of the existing platform, so there may need to be a localised alteration to the platform to accommodate end throw of trains traversing the points.

The design speed through this section is a project objective:

- Fast lines 100mph (160km/h)
- Slow lines 70mph (110km/h) - DART services (to be electrified)

As an exception to the above, it is noted that where trains diverge across P&C's the local speed in the vicinity of the turnout may be limited to the operational speed capacity of the P&C - i.e. the track geometry emanating from a turnout is a limiting factor.

Track spacing will nominally be thus:

- Up Slow to Down Slow – standard sixfoot (2.0m between tracks)
- Down Slow to Up Fast - standard tenfoot (3.6m between tracks)
- Up Fast to Down Fast – standard sixfoot (2.0m between tracks)

Points and Crossings (P&C's) will, wherever possible, be located on straight parallel track that is separated by standard sixfoot intervals (as a minimum) to enable the use of standard P&C units. This will be the approach for all connections in this section.

In this area there are requirements for:

- Provision of bi-directional running to facilitate access to the turnback platforms at Hazelhatch & Celbridge and Adamstown Stations and a new turnback platform at Park West & Cherry Orchard Station for the DART services.

The required electrification of the northern two tracks in the four-tracking area means that space is required between the track and the railway boundary for OHLE masts and foundations. This is a key constraint on the options available.

In addition to the constraints that will have an effect on the track alignment, there is no track drainage system installed in this area. Although there are no known drainage issues in the area, the proposed track formation and vertical design may require the installation of a new and positive drainage system.

This section already accommodates a four-track railway, so it is envisaged that the reconfiguration of the tracks from Up Fast, Up Slow, Down Slow, Down Fast to Up Slow, Down Slow, Up Fast, Down Fast with provision for the electrification of the two tracks on the north side (Slow tracks) for the DART services will fit within the existing boundary. Therefore it is expected that no additional land will be required.

4.3. Existing Structures

As outlined in **Section 2.3 Structures**, this section of the route was upgraded as part of the original Kildare Route Project, and currently accommodates four-tracks, as such, the reconfiguration of the tracks can be accomodated with minimal interventions to existing structures.

With regards to electrification of the two northern tracks, a topographical survey has been completed, and the vertical clearances under existing structures have been verified. The latest information suggests that a compliant OHLE solution can be achieved at the majority of structures in this area with minimal structural interventions. Two structures have been identified which do not comply with the clearance requirements as outlined in Section 3. The two structures Finnstown R120 Road Bridge (OBC19) and Stacumny Bridge (OBC21), do not provide sufficient clearance to facilitate electrification without intervention, both structures will go through the optioneering process to determine a suitable technical solution.

4.4. Geotechnical

Onerous ground or groundwater conditions are not anticipated in the majority of the study area based on the existing information. Shallow bedrock at or near the ground surface is likely to be present immediately to the east and west of the existing Adamstown Station.

Isolated locations of soft compressible cohesive material has been noted in existing historical ground investigation locations between Ch 274+600m (Kishoge) and 271+000m (Park West). The exact frequency and extents will be further analysed upon receipt of further ground investigation.

Elsewhere, anecdotal evidence suggests that a backfilled quarry is present on the northern side of the railway to the west and south west of Hazelhatch & Celbridge Station and the existing 100m section track is piled at this location. Due to the significant thickness, variable composition of made ground and variable depth of bedrock, new sections of piled tracks may be required.

4.5. Existing Utilities

The various utilities in this area will be constraints during both the design and construction phases. As such, their treatment in the temporary and permanent situations has been carefully considered during the development of options.

The majority of utilities that cross the rail corridor are concentrated in several road bridges and train stations throughout the area as shown in **Section 2.3 Structures**. There are several crossings that occur underneath the tracks, such as Irish Water pipes and ESB ducts. There are also several crossings above the tracks, in which all are ESB overhead cables. The services that are located in existing structures spanning the rail corridor are unlikely to be affected by any option as these structures will not be modified. The main constraints regarding utilities in the area are as follows:

- Utilities crossing under the tracks may affect the placement of foundations for rail electrification infrastructure. These are minor constraints as in most cases the foundations can be placed either side of the service, avoiding any disruption. Consultations are ongoing with service providers to find the exact location of these pipes / ducts by GPR and / or slit trenches.
- Various ESB cables cross over the tracks in this area. The main issue with overhead cables is the required clearance for rail electrification and any electrical interference that may occur. The height of OH cables is indicative of the voltage, the higher the voltage the higher the cables. Please see in **Table 4-2** a list of existing OH cables and voltages and whether they are identified as constraints.

Table 4-2 ESB OH Cables Constraints

ESB Cables	Location	Constraint
220 kV OH	Various crossings between Cherry Orchard Footbridge (OBC8B) and Hazelhatch.	Diversion not required. These cables have sufficient vertical clearance.
110 kV OH	Crosses over tracks 350m and 500m west of Cloverhill Road Bridge (OBC11).	Diversion unlikely. These cables most likely have sufficient vertical clearance, however, this is to be confirmed with ESBN
38 kV OH	Crosses over tracks at Park West & Cherry Orchard Station.	Diversion required. The vertical clearance is insufficient. Talks are ongoing with ESBN
MV OH	Crosses over tracks; west of Kishoge Station, 200m west of Finnstown R120 Road Bridge (OBC19), Celbridge Golf Club	Diversion required. The vertical clearance is insufficient. Talks are ongoing with ESBN
LV OH	Crosses over tracks; west of Cloverhill Road Bridge (OBC11), south of Straleek Footbridge (OBC23B).	Diversion required. The vertical clearance is insufficient. Talks are ongoing with ESBN

5. Options

This section presents the options associated with the following elements between Hazelhatch and Park West:

- Civil and OHLE infrastructure solutions
- Substations
- Construction Compounds

5.1. Civil and OHLE

5.1.1. Civil and OHLE Options Summary

Based on the information presently to hand, it would appear that electrification and track reconfiguration can be achieved with minimal bridge interventions throughout this area.

Permanent way options comprise realignments to provide standard clearances, both vertically and horizontally.

A total of 2 no. 'Main Options' were developed and presented at PC1 - 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 means that the design endeavours to achieve the project requirements with only minor intervention to the existing infrastructure.

A summary of the Main Options presented at PC1 as part of the Emerging Preferred Option Selection process is presented in **Table 5.1**.

Table 5-1 Options Summary

Option	Description
Hazelhatch to Park West Option 0: Do Nothing	Leave as is.
Hazelhatch to Park West Option 1: Do Minimum	Addition of P&Cs to provide the functionality to reconfigure the existing 4-track to S-S-F-F for the DART services. Track lowering at OBC19 and OBC21.

Option Variations are elaborated within the Main Option text. With the exception of Option 0 (Do-Nothing) and Option 1 (Do-Minimum), 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 Corridor Options in this area (e.g. ground conditions). To remove repetition among the Option descriptions, these issues are addressed at the end of the Option description section.

5.1.1.1. Option 0: Do Nothing

Do-Nothing represents the scenario of leaving the area as is without any intervention from IE.

5.1.1.2. Option 1: Do Minimum

This Do minimum option examines the track modifications required to reconfigure the tracks to facilitate the Slow lines for the DART services to the north side of the railway corridor, whilst the Fast services are relocated to the south.

The constraints in the corridor section between Hazelhatch to Park West that must be taken into account for design purposes include:

- Hazelhatch Station: ideally, the proposed modifications to tie-in with the existing track outside the platform extents to avoid negatively impacting the existing platforms.
- Hazelhatch Footbridge (OBC24A) and R405 Hazelhatch R405 Road Bridge (OBC25): these two structures are located at the western end of Hazelhatch Station and care must be taken regarding lateral and vertical clearances.
- Existing piled track: at the West side of Hazelhatch Station, there is an area where the two upper tracks are running on piled track foundations (due to poor ground conditions in the area). Alignment alteration around this area is not recommended in order to avoid complications in relation to track foundations.
- Two existing crossovers with assumed P13-13 turnouts located between the main lines to the immediate west of Hazelhatch & Celbridge Station: ideally to be kept unaltered, comprising 1 facing and 1 trailing crossover providing operational flexibility in case of degraded conditions.
- Further P&C interventions to existing 4 tracking: crossovers are required between the Up Slow and Down Slow lines at Hazelhatch & Celbridge and Adamstown to permit access to their respective turnback platforms, 2 options were initially considered for this area.
- Finnstown R120 Road Bridge (OBC19) and Stacumny Bridge (OBC21), do not provide sufficient clearance to facilitate electrification without intervention, the Do Minimum Option involves localised track lowering to achieve the required clearances.

Two perway design options were intially condidered, the first one involved a double junction and other involved single turnouts (no diamond crossing) that provide the same functionality, of connecting the Slow lines to the Fast lines, to the west of Hazelhatch & Celbridge Station. The drawback of the diamond crossing is that it is a maintenance liability, whereas the single turnout solution is a lower maintenance option but occupies a greater track length with its footprint.

In summary, the following outlines the advantages and disadvantages on the inclusion of a diamond crossing:

- Advantages:
  - There is an optimization of space in a very constrained area.
  - The two existing crossovers at the western end are not affected.
  - The eastern tie-ins in the Slow Lines (upper lines) are located before reaching the existing piled track, so no alterations to it at this area.
- Disadvantages:
  - The Double Junction layout is not a preferred layout, introducing a diamond that is not a good design feature and one which is difficult to maintain while in service.

A common constraint on both options is to tie-in with the existing tracks before the piled track (proposed Slow lines west of Hazelhatch & Celbridge Station). No intervention on this piled track area is desirable, due to the risk of differential formation stiffness.

There is a proposed scissors crossing on the eastern side of Hazelhatch & Celbridge Station. The toes of the proposed scissors will be close to the end of the Platform 2 of Hazelhatch & Celbridge Station, set 5m away from the end of the platform. It may be difficult to increase this distance, so some local alteration of the end of the platform may be required (probably 10m). The platform is longer than 174m, at 220m, so it should not be an issue.

5.1.1.3. OHLE Arrangements

Option 0 does not meet the project requirements and so has not been considered in terms of electrification.

Option 1 for the Hazelhatch to Park West area has been developed to be capable of supporting electrification. It should be noted that the required contact wire height can be achieved throughout except for OBC21 and OBC19, where localised track lowering is proposed to meet the necessary clearance requirements.

The electrification through this area will comprise STC structures in two track areas and TTC structures in four tracking area, as detailed in **Section 3.2.1 Electrification System**. The area through the stations at Hazelhatch & Celbridge, Adamstown, Kishoge, Clondalkin / Fonthill and Park West & Cherry Orchard and will be provided with TTCs on the platform. This is the subject of further design development.

The following passage refers to multiple bridge structures, numerous times. For conciseness only the bridge numbers have been used; please refer to 2.3 Existing Structures for full names.

Overbridge OBC24 is located on the non-electrified tracks, so an OHLE assessment is not required for this bridge.

For footbridges OBC16A and OBC24A, the bridges are sufficiently high in their existing configuration for the OHLE to pass through the bridge without connection to them. OHLE masts are expected to be positioned around 20m from each outer edge of the bridge for OBC16A. OBC24A is adjacent to OBC25. The mast positioning here will be designed based on OBC25. Routing of parallel feeders will be dependent on the development of the system design but could either be an aerial insulated conductor or a ground-level insulated cable in trough route.

For overbridges OBC10A, the bridges are sufficiently high in their existing configuration, but the OHLE will need to be connected to the bridges as it passes through due to the length of the bridge. These connections will not be visible from road level. They will be wired using a fitted arrangement using cantilevers with small system height.

For overbridges OBC11, OBC13, OBC19, OBC20E, OBC21 and OBC25, the bridges are sufficiently low in their existing configuration that the OHLE will need to be connected to the bridges as it passes through.

These connections will not be visible from road level. They will be wired using a fitted arrangement using elastic bridge arms, with a contact wire height of 4.4m. For OBC11 and OBC25, a normal dynamic clearance could be achieved.

For OBC23B footbridge, the bridge is sufficiently low in its existing configuration that the OHLE will need to be fitted as it passes through, but the bridge itself cannot accommodate fitment. It will be wired using a fitted arrangement with elastic bridge arms and a contact wire height of 4.4m, with an OHLE mast placed directly next to the bridge to support the OHLE. Normal dynamic clearance could be achieved.

For OBC9B, OBC13A and OBC14C, the overbridges are adjacent to station buildings and the bridges are sited directly above station platforms. The bridges are sufficiently low, and sufficiently long, in their existing configurations that the OHLE will need to be connected to the bridges as it passes through. These connections will not be visible from road level but will be visible from platform level. The OHLE configuration will be graded contact wire, with either small system height or twin contact equipment (zero system height), and a contact wire height of 4.4m through the bridges under all conditions. OHLE through the bridge will be fitted, either using small system height cantilevers supported from the bridge, or elastic bridge arms supported from the bridge. For either option these connections will be at multiple locations due to the bridge length. Minimum electrical clearances will be 100mm static, and 80mm dynamic. Allowance has been made for 25mm of upward track movement. The opportunity exists to begin grading the contact wire up from 4.4m towards nominal wire heights, and this will assist with achieving minimum separation distances at the station platform. The opportunity will also be taken to open up a system height under the bridge, removing the need for further elastic bridge arms.

OHLE masts are expected to be positioned around 20m, 55m and 105m from the outer edges of the bridge before reverting to normal spacings. Routing of parallel feeders will be dependent on the development of the system design but could either be an aerial insulated conductor or a ground-level insulated cable in trough route.

5.1.1.4. Permanent Way

For PC2, one Permanent Way configuration has been developed for this area, the alignement follows the existing rail corridor footprint as closely as possible, refer to the alignment drawings in **Appendix C Supporting Drawings**.

5.1.1.5. Geotechnical

All do-something options propose electrification and new track alignments/layouts and will require detailed geotechnical design for the following elements:

- Earthworks and track bed formation design for new tracks

Overhead Line Equipment foundation (preliminary) design

5.1.1.6. Cable and Containments

Existing containment routes consist of buried duct, surface troughing and ladder rack/tray. Option 1 will require the relocation of various cables and containments.

Where new containment is required to interface with proposed SET installation these shall be interfaced appropriately with the existing containment runs. Where cable ducts are required to pass under the railway track, they shall be contained by a suitable under track crossing.

Where there is a required change of direction for cabling draw-chambers shall be installed (surface or otherwise). Draw-pits will be of adequate size to enable cables to be drawn in without damage and accommodating the cable bending radius.

These containment solutions shall be utilised for all SET cabling requirements with services separated as far as is reasonably practical.

5.1.1.7. Drainage

As there are no significant alterations planned to the existing track alignment in this section, the performance of the existing track drainage has not been assessed.

5.2. Substations

The Do Nothing Option does not meet the project requirements and as such has not been considered further. All Do Something Options which propose the installation of new electrical substations to support electrification of the route have been brought forward for consideration as part of the option selection process.

The OHLE system will be supplied with electrical power at regular intervals, at locations known as substations. The preferred locations for the proposed substations have been identtified, based on the findings from the power simulation study. The proposed locations were assessed as part of the options selection process. A total of six substations are required for the DART+ South West Project, four of the substations are located in the section from Hazelhatch to Park West at the following locations:

- Hazelhatch
- Adamstown
- Kishoge
- Park West

Details of the current status of design for optioneering are outlined in **Section 6 Options Selection Process**.

Based on the power simulation outputs, **Table 5-2** outlines the maximum distance between proposed substations.

Table 5-2 Maximum Substation Separation (Source: DART+ Programme Power Study)

	Power Study Locations From Datum (km)	Distance between Substations
OBO 10	0.00	
Island Bridge	4.03	4.03
Kylemore	7.10	3.07
Park West	9.83	2.73
Kishogue	12.70	2.87
Adamstown	16.00	3.30
Hazelhatch	19.10	3.10

The above locations were mapped in accordance with the DART+ Programme Power Study which is based on the defined datum point 0.00km at Glasnevin Cemetery bridge (OBO10).

The above locations were mapped with each substation located as close as technically feasible to the above identified locations to ensure compliance with the DART+ Programme Power Study.

In addition, the proposed substations are considered an integral operational element of the railway infrastructure and as such would be located as close as possible to the railway corridor which it serves. Furthermore, the power simulation did not envisage locating any substation away from the railway corridor which would add unnecessary length to cabling and negatively impact on voltage calculations. Therefore, only sites which share a boundary with the railway corridor would be considered feasible from a technical perspective. Property impact should also be considered in this regard. Locating a substation away from the railway corridor may lead to 3rd party land issues where installation of connecting cables is required and which may introduce 3rd party cable easements etc. In locating the substation immediately adjacent to the railway, there is greater opportunity for use of existing Irish Rail lands (i.e. reduced potential for acquisition of privately owned lands). Hence, to aid site identification, the study area at each location is limited to only those properties bounding the railway. As an aid to identification of same, the study area is mapped using a 50m lateral offset from the existing boundary fence on either side off the railway corridor.

5.2.1. Hazelhatch Substation

The power study determined the requirement for an electrical substation in Hazelhatch. It is a rural area on the Kildare / Dublin County boundary. The proposed location is predominantly surrounded by agricultural land with the exception of Hazelhatch and Celbridge train station and a number of private dwellings located on the L5063 Lords Road to the northwest and Railway Cottages to the southeast of the station. See **Figure 5-1**.

Figure 5-1 – Hazelhatch Substation Study Area

5.2.1.1. Constraints and Challenges

The main constraints for this location are as follows:

- Existing and proposed land use – there is a materials storage / handling area adjacent to the railway, with direct access from the L5063 Lords Road. The surrounding area is generally rural in nature with domestic housing developments to the west of the railway.
- Grid connections – There is no immediate or obvious solution for providing a nearby ESB high voltage (HV) connection and the solution will require ESB to advise further on a feasible connection method to a substation in this area. ESB low voltage (LV) infrastructure is located nearby along the L5063 Lords Road. The nearest 38kV is further north at the edge of Celbridge town, about 2km away and there is also a MV network immediately east of Hazelhatch station which crosses the tracks into the nearby golf course.
- Road Network - the adjacent road network is quiet, however during peak commuter times traffic volumes on the surrounding road network increase, in particular along the R405 connecting Hazelhatch station to Celbridge.
- Power simulation – Based on the preferred solution at Adamstown, the study area at Hazelhatch is focussed on a point not exceeding 3.10km from Adamstown substation.
- Environmental / Other - The existing maintenance yard to the west of Hazelhatch station has been highlighted as an environmentally sensitive area with known contamination issues. Historical ground investigation was completed to investigate this area of brownfield immediately west of the station. Anecdotal evidence indicated that there was previously a quarry that had been backfilled. Ground conditions typically encountered made ground between ground level and 9.20m below existing ground level. Made ground generally comprised of firm to stiff clay, very loose gravel of ash, clinker, spent coal and boiler slag.

5.2.1.2. Options

Two options have been identified in this area:

Option 1 – is located on a brown field site, a disused residential dwelling in the ownership of IÉ, see **Figure 5-2**. The site is located adjacent to the Hazelhatch Station carpark and other disused dwellings also owned by IÉ. It is situated to the east of Hazelhatch Station with direct access to the local road network. This is a large site and provides a number of options in terms of the proposed substation positioning and configuration. It is understood that existing drainage attenuation measures associated with the carpark are located to the north of this site potentially discharging to the existing watercourse located further north of the site.

Option 2 - is located within an IÉ owned maintenance yard on the northern side of the railway and to the west of Hazelhatch train station. Road access is via an existing Right of Way access track across private lands to the L5063 Lord's Road. It is located to the rear of existing private dwellings.

Figure 5-2 Hazelhatch Proposed Substation Locations

5.2.2. Adamstown Substation

The power study determined the requirement for an electrical substation in Adamstown, the area is predominantly rural in nature with the exception of the ongoing residential and mixed-use development at Adamstown to the north and east of the study area. The area is characterised by agricultural use of the surrounding countryside. See **Figure 5-3**.

Figure 5-3 – Adamstown Substation Study Area

5.2.2.1. Constraints and Challenges

The main constraints for this location are as follows:

- Existing and proposed land use – the rural setting and abundance of open field areas indicate predominately agricultural use, although it is acknowledged that the Adamstown development zone is nearby to the east as well as existing quarry operations.
- Grid connections – ESB infrastructure is at a minimum for all potential Options and localised network expansion may be required in order to serve the selected option in terms of 38kV or MV availability. It is noted that an existing 220kV circuit passes through the study area and ESB Networks is currently constructing a 220kV substation in the vicinity of Crowley's Bridge. Connection to the 220kV grid is not under consideration. The final position of the substation will be subject to design development and confirmation from ESB in relation to suitability for incoming power supply connection.
- Road Network – There is an existing access road that serves an existing pump station located on the southern side of the railway corridor. However, this track is not separated from the trackside environment. There are no similar access tracks to the north of the railway.
- Power simulation – Based on the preferred solution at Kishoge, the study area at Adamstown is focussed on a point not exceeding 3.30km from Kishoge substation.

5.2.2.2. Options

Two Options have been identified and are outlined below, see **Figure 5-4**:

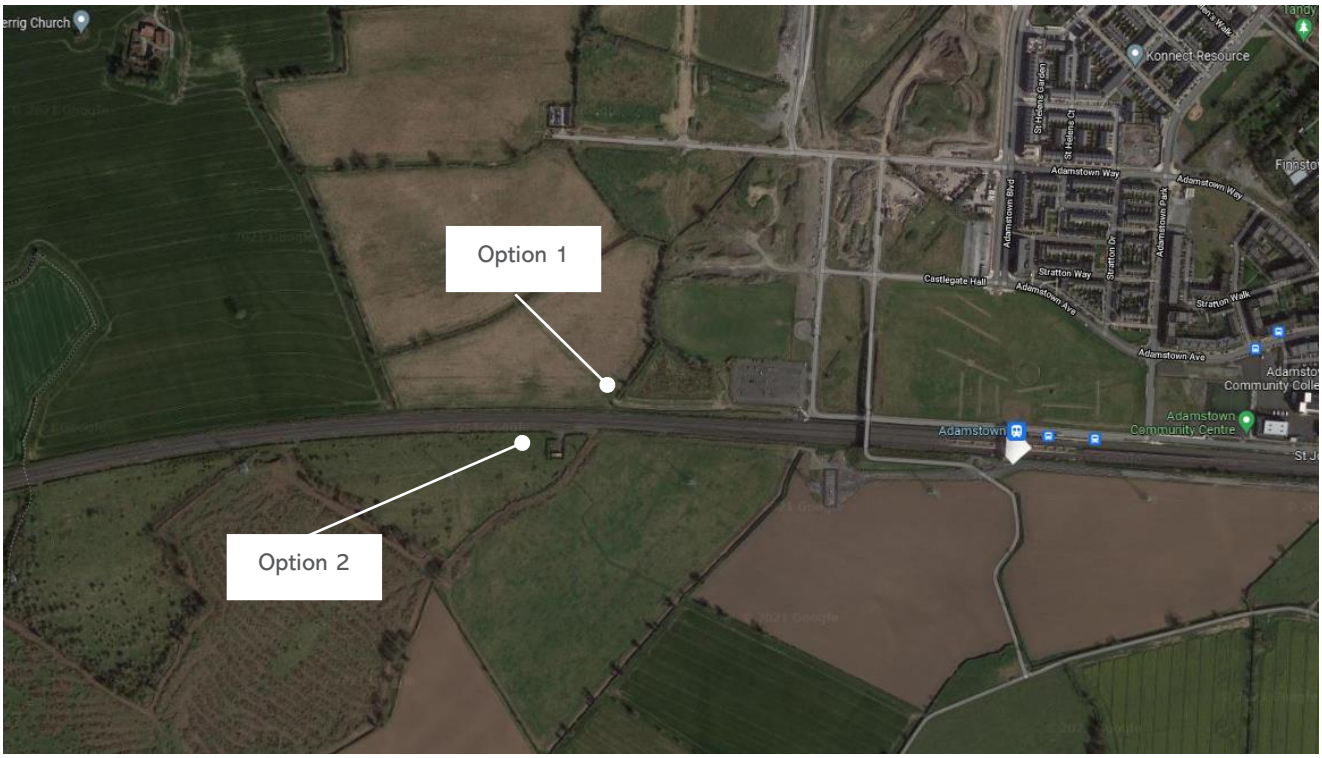


Figure 5-4 Adamstown Proposed Substation Location Options

Option 1 - is located in a green field site currently in private ownership to the north of the railway. There are currently no access roads to Option 1, potentially limiting access in and out.

Option 2 - is located in a green field site currently in IÉ ownership. It is located to the south of the railway and adjacent to an existing pump station. There is an existing access track that runs adjacent / parallel to the railway providing an established access route between the proposed site and the public road network to the west. However, currently this track does not have any physical separation from the live railway.

5.2.3. Kishoge Substation

The power study determined the requirement for an electrical substation in Kishoge, which is located in west Co Dublin. There is an existing station at this location which is currently not in use pending future / planned development in the area. A carpark has been constructed for the new station and is located on the southern side of the railway corridor. Located to the west of the station and on the southern side of the track is an existing halting site. To the north of the tracks and east of the station is an existing education facility. **Figure 5-5** outlines the study area in Kishoge.

Figure 5-5 – Kishoge Substation Study Area

5.2.3.1. Constraints and Challenges

The main constraints for this location are as follows:

- Grid connections – ESB infrastructure is located nearby along the R136. This is a busy link road that runs north to south linking the N4 to the N7. There is an existing ESB substation located to the north west of the study area. The final position of the substation will be subject to design development and confirmation from ESB in relation to suitability for incoming power supply connection.
- Road Network - the R136 is a busy link road that runs north to south linking the N4 to the N7. There is also a level differential between the trackside environment and the adjacent road network of up to 5m.
- Power simulation –Based on the preferred solution at Park West, the study area at Kishoge is focussed on a point not exceeding 2.87km from Park West substation.
- Existing and proposed land use - The study area is located within the Clonburris Strategic Development Zone (SDZ) - and specifically Development Area 6 – Kishoge Urban Centre. Key objectives include:
    - To develop a high-quality mixed-use centre to support the community of Kishoge.
    - To provide for significant commercial (non-retail) provision at areas of high accessibility to public transport.

A stand-alone utilitarian / service building such as a substation will not be in compliance with the SDZ especially in high profile locations within Kishoge Urban Centre. Innovative design solutions will be required and integrated into wider development proposals. See **Figure 5-6.**

Figure 3.3.13 | Kishoge Urban Centre

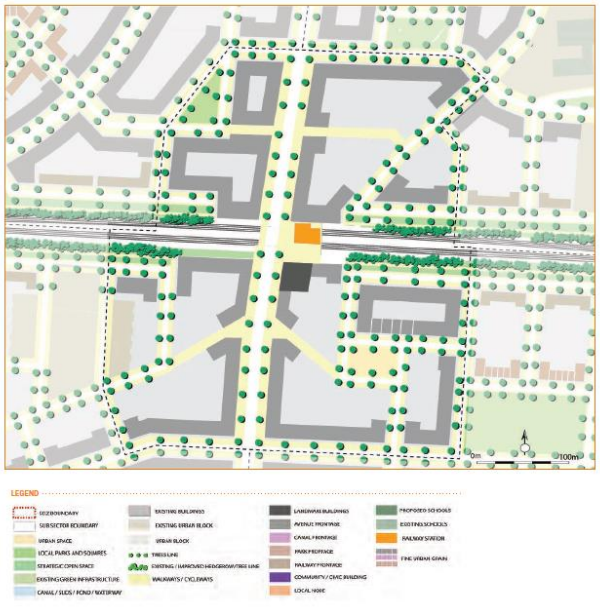


Table 3.3.6 | Kishoge Urban Centre

Area character type	The centre will contain a diverse, mixed use development, containing the main commercial and retail uses for the new Urban centre based around a public plaza and a transport interchange on the Outer Ring Road.	
Net development area	10.94ha	
No of units (Target)	1,039	
Net Density	**Sub Sector**	**Net Density Range**
	KUC-S1	65-125
	KUC-S2	65-125
	KUC-S3	65-125
	KUC-4	65-125
	** See also Table 2.1.5 for full range of density*	
Affordable/Social dwellings	To be negotiated in accordance with relevant legislation and SDCC Housing Policy	
Non-retail commercial development	11,800 sqm min	
Retail development	3,500 sqm max	
Community	1,500 sqm min	
Building height	**Sub Sector**	**Building Height**
	KUC-S1	3-8 storey
	KUC-S2	2-8 storey
	KUC-S3	2-8 storey
	KUC-S4	2-8 storey
	** See also Figure 3.3.2 Building Height Concept*	
Public open space	3,700 sqm	

Figure 5-6 – Kishoge Urban Centre

5.2.3.2. Options

Three Options have been identified and are outlined below, see **Figure 5-7**. Given the requirements of the Clonburris SDZ with regard to development of high quality buildings, options that retain the substation structure in close proximity to the existing station and bridge have been selected.

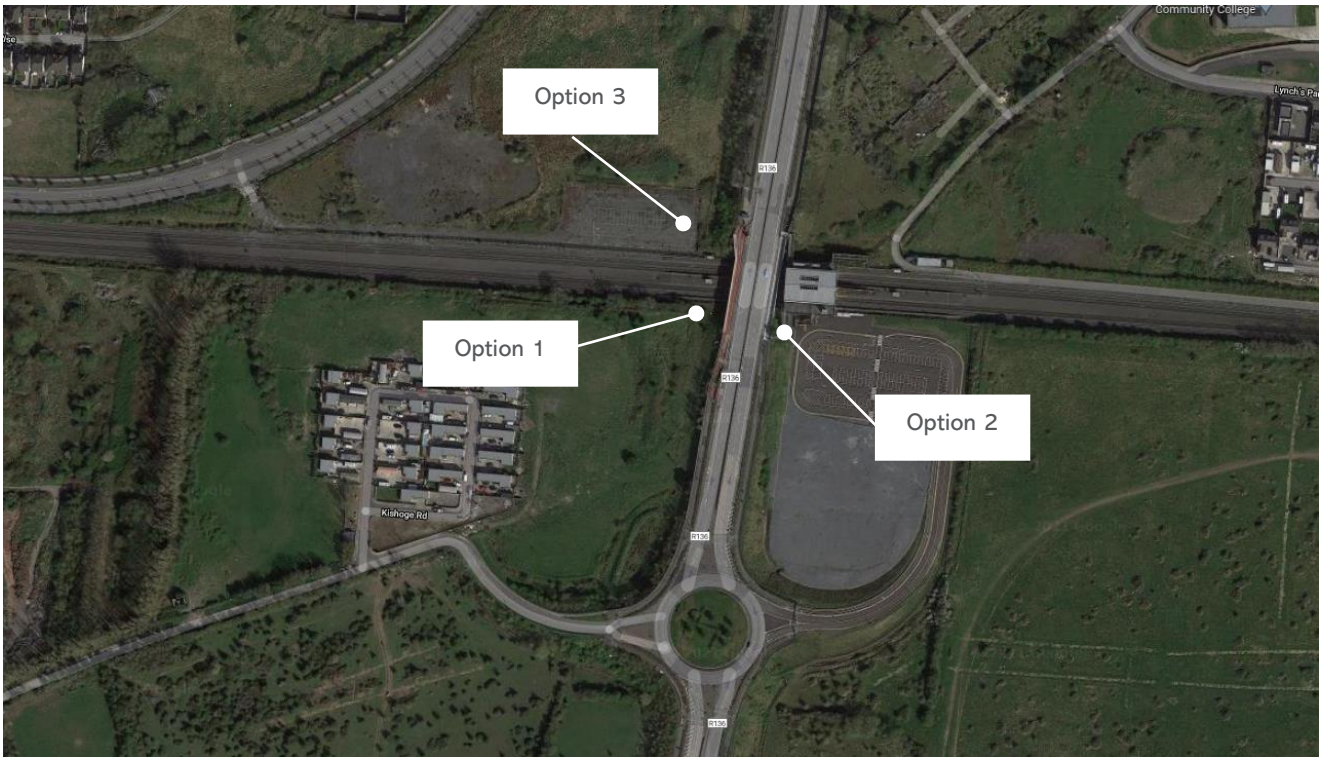


Figure 5-7 Kishoge Proposed Substation Location Options

Option 1 - is located to the west of the R138 regional road and to the south of the railway corridor. It is in a green field site in private ownership in close proximity to the existing halting site. Access to the adjacent road network would be provided via a newly constructed access road.

Option 2 - is located to the east of the R138 regional road in an on the southern side of Kishoge station. It is located within the existing carpark. The proposed site is in the ownership of IÉ. Access to the road network would be via the carpark entrance.

Option 3 - is located to the west of the R138 regional road and to the north of the railway corridor. It is in a brown field site in private ownership. Access to the adjacent road network would be provided via a newly constructed access road.

5.2.4. Park West Substation

The power study determined the requirement for an electrical substation in Park West, the area is a densely populated to the north, to south of the rail corridor are mainly industrial units, and to the east and west is a mixture of both industrial units and brown field sites. The M50 motorway runs in a north – south direction and effectively splits the study area. **Figure 5-8** outlines the study area in Park West.

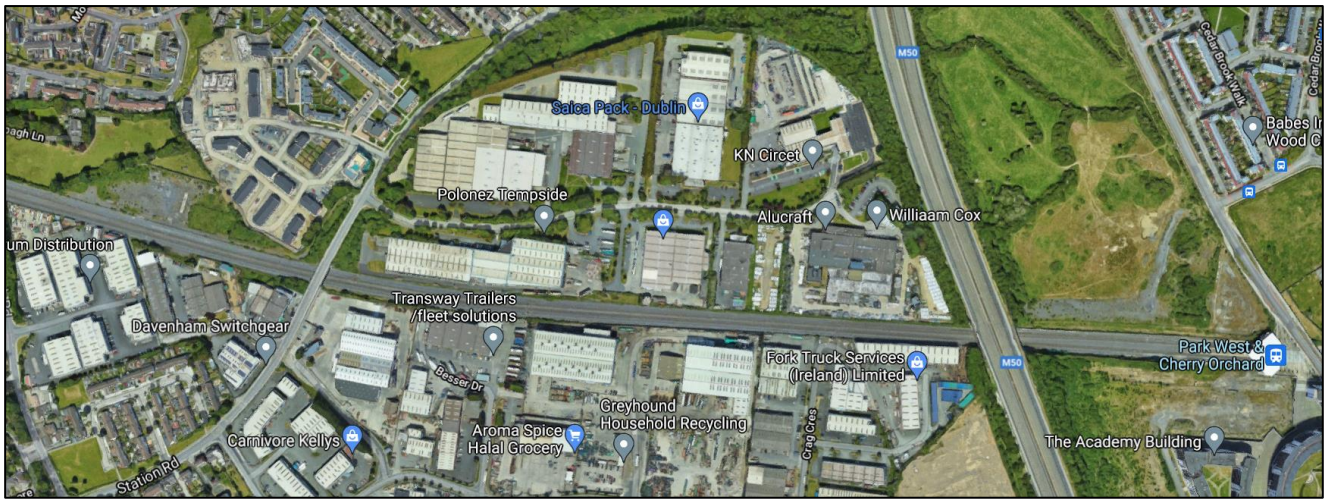


Figure 5-8 – Park West Substation Study Area

5.2.4.1. Constraints and Challenges

The main constraints for this location are as follows:

- Existing and proposed land use – the urban setting and presence of the adjacent industrial units means that the local area is dominated by privately owned commercial developments/infrastructure. Potential open field sites are at a minimum due to the surrounding infrastructure and commercial developments
- Grid connections – ESB infrastructure is located nearby along Park West Avenue. This is a busy link road that runs through Park West Business Park. Further ESB network connectivity may exist to the south of the railway and west of the M50. The final position of the substation will be subject to design development and confirmation from ESB in relation to suitability for incoming power supply connection.
- Road Network - the adjacent road network is busy, with HGV traffic dominating due to the industrial nature of the area.
- Power simulation – Based on the preferred solution at Kylemore, the study area at Park West focuses on an area not exceeding 2.73km from Kylemore substation.

5.2.4.2. Options

A total of four options for substation locations were identified. These options are outlined as follows and illustrated in **Figure 5-9**.

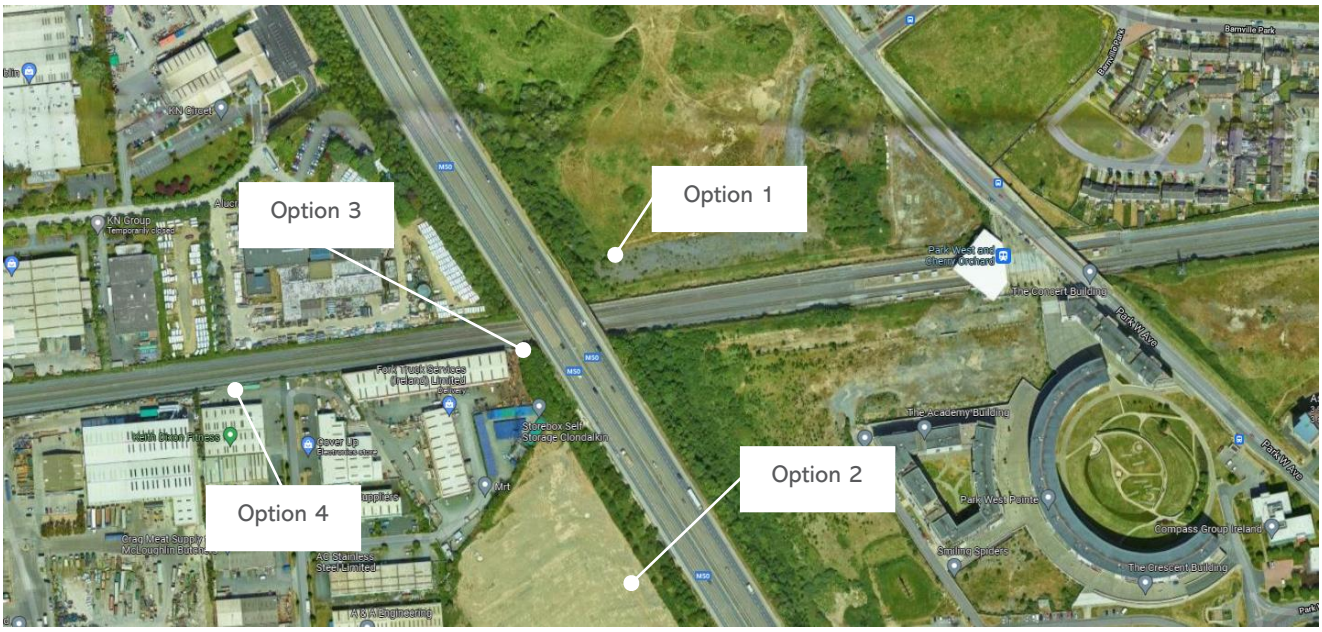


Figure 5-9 Park West Proposed Substation Locations

Option 1 - is located to the north of the railway and immediately east of the M50 motorway. This is a brownfield site in the ownership of Dublin City Council. Direct road access is via Park West Avenue to the east. The existing Park West Station is located to the east and existing housing developments in the Cherry Orchard area are located further east of Park West Avenue. Existing ESB 38kV network is located immediately east of Park West Avenue.

The area around Option 1 is identified within the Dublin City Development Plan as a Strategic Development Regeneration Area (SDRA 4) and is zoned Z14: "to seek the social, economic and physical development and/or rejuvenation of an area with mixed use, of which residential and Z6 (employment/enterprise uses) would be the prominent uses. The area for Option 1 forms a small part of this to the north of the railway and is suggested as a good location for a convenience store in the local area plan (LAP).

Option 2 - is located south of the railway corridor and immediately west of the M50 motorway. This is a brownfield site and was formerly in use as a maintenance depot by a major telecommunications provider. ESB 220kV and 38kV networks are located on this site. Access to the local road network is via existing industrial estate roads to the west.

Option 3 - is located south of the railway corridor and immediately west of the M50 motorway. It is located within existing industrial estate premises / yards. Hence this option is closer to the railway boundary fence than Option 2 above. Road access is more complex insofar as maintenance / operation personnel would be required to cross existing private yards / property. ESB 220kV and 38kV networks are located further to the south

Option 4 - is located immediately adjacent to the south of the railway corridor, midway between the M50 bridge to the east and Station Road to the west. It is located within existing industrial estate premises / yards. Road access is more complex insofar as maintenance / operation personnel would be required to cross existing private yards / property. There is little availability in terms of existing ESB 38kV or MV network.

5.3. Construction Compounds

Two Construction Compounds are required between Hazelhatch and Park West, proposed locations:

- Hazelhatch
- Park West

5.3.1. Hazelhatch Construction Compound

A Construction Compound is required in Hazelhatch for undertaking electrification works along the corridor from Hazelhatch to Park West in addition to localised works including the installation of new trackwork to facilitate the turnback of trains. This will include the installation of new permanent way, signalling, electrification and telecoms including OHLE foundations. For the selection of a suitable construction compound in this area, it has been assumed that access will be required from the northern side of the railway direct to the northern rail line that will be electrified as part of the DART+ South West project. This site is also adjacent to the proposed electrical substation.

The preferred location for the construction compound at Hazelhatch is on the north side of the corridor in a section of the station car park located on Irish Rail property, a portion of the car park would be utilised for the compound, leaving the remainder of the parking for regular users of the station. Station car parks are good locations for construction compounds due to the existing infrastructure already in place, which can make operation of the construction compound easier and requires less enabling works. See **Figure 5-10**.

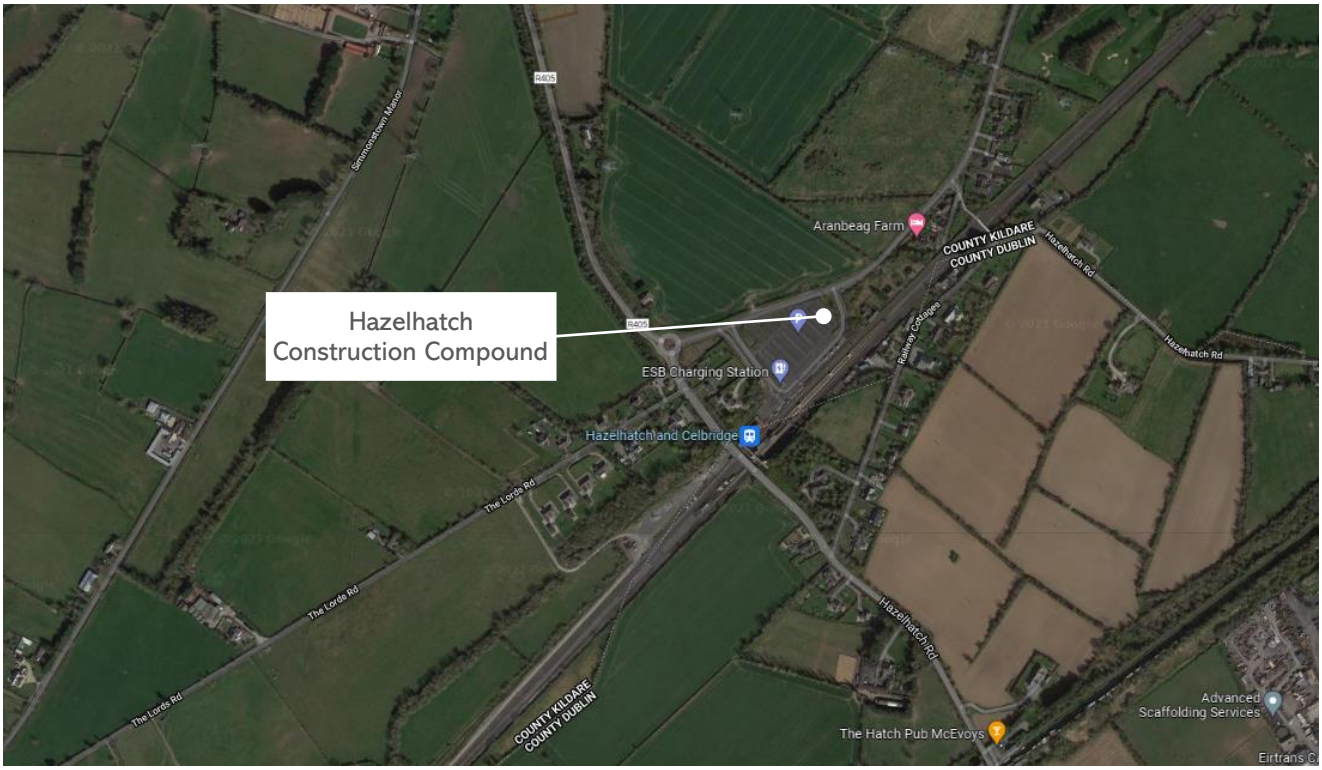


Figure 5-10 – Hazelhatch Propsed Construction Compound Location

5.3.2. Park West Construction Compound

As the rail rail corridor from Hazelhatch to Park West and Cherry Wood station was four tracked as part of works completed on the route in 2009, the amount of significant Civils works along this section of the route is reduced in comparison to those sections further east. For this reason, the location of the second construction compound can be located a reasonable distance from the compound at Hazelhatch.

In addition to the requirement for a compound for the lineside electrification and associated civils work, it is proposed that that this site will be used as the main compound, main storage area and area for deliveries to be received for this section of the project.

Park West station is located almost at the midpoint along the Cork section of the route and therefore a compound close to this area would provide the best location in terms of efficient delivery of materials to the other sites and for the lineside work itself. Compounds located close to stations often provide some of the necessary infrastructure required for that compound including connections to roads, access to the railway and potential connection to existing services.

It is noted that the Park West area is also the preferred location for a new electrical substation, thus meaning some construction work will be required in the vicinity, which could be combined with the installation of a new compound. The proposed area is located on a brownfield site adjacent to Park West station which would need to be temporarily acquired. It is immediately adjacent to the north side of the rail corridor and road access is via Park West Ave.

As noted earlier, this compound is proposed as the main storage and staging area for the transfer of the overhead electrification equipment and materials to the various worksites along the route. The electrification works are taking place on the two northern tracks, and the proposed site is located on the north side of the rail corridor, thereby providing easy access. See **Figure 5-12**.

Figure 5-11 Park West Proposed Construction Compound Location

6. Options Selection Process

6.1. Option Selection Process Summary

A clearly defined appraisal methodology has been used in the selection of the Preferred Option for the Project. Consistent with other NTA projects, 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 two stage approach (if / as appropriate):

- Stage 1 Preliminary Assessment (Sifting)
- Stage 2 Multi Criteria Analysis (MCA)

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, a number of discrete elements extend beyond the boundary of the existing railway. The optioneering process has focused on these elements for which alternative options manifest, options which are markedly different from one another, and which have varied impact on the local environment. Examples of such include four tracking, bridge replacements, and options for the location of substations and construction compounds.

The above selection process has been used to asess the options associated with the following elements on the section between Hazelhatch and Park West:

- Civil and OHLE Infrastructure
- Substations
- Construction Compounds

6.1.1. Stage 1 Preliminary Assessment Process (Sifting)

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

The assessment is 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 options assessed for selecting the Preferred Option for the Project, 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. Where the sifting results in only one feasible option, a multi-criteria analysis (MCA) is not required for that one option.

6.1.2. Stage 2 Multi Criteria Analysis (MCA)

Stage 2 of the optioneering process comprises a detailed multi-disciplinary comparative analysis of the feasible options that passed through Stage 1: Preliminary Assessment (Sifting).

The options are assessed against the criteria of Economy, Safety, Environment, Accessibility and Social Inclusion, Integration and Physical Activity in line with the criteria required for multi-criteria analysis under the Department of Transport, Tourism and Sport (DTTAS), Common Appraisal Framework (CAF) for Transport Project and Programmes (March 2016). These parameters were split into a number of sub-criteria considered relevant to the DART+ South West Project.

The assessment compares the options, identifying and summarising the comparative merits and disadvantages of each alternative under all applicable criteria and sub-criteria leading to a Preferred Option.

Relevant considerations include:

- This is a comparative analysis between the various options, not an impact assessment of each option. The impact from the Emerging Preferred Option will be assessed in the environmental impact assessment report (EIAR) in the next phase of the development.
- Not all sub-criteria and qualitative and/or quantitative indices may be relevant in every case.
- For each Option there are potential design variations. In due course design variations will be subject to detailed technical analysis (in respect of the Preferred Option).
- For each Option an indicative envelope was identified for permanent and temporary works, property and/or land take; a worst-case scenario was considered. Detailed design, technical and construction related solutions will seek to minimise land take in respect of the Emerging Preferred Option.
- The envelope around each Option was used to spatially represent environmental constraints within / proximate to the options.

The options which were brought forward from the Preliminary Screening were developed further to facilitate the more detailed Stage 2 Multi Criteria Analysis.

The stage adopted for the Stage 2 MCA involved assessing the performance of each option against relevant quantitative and qualitative indicators, the assessment was carried out by a multi-disciplinary team including commercial, technical, safety and environmental specialists.

Presented in a matrix format, each specialist included a commentary of his/her analysis for each option. They then compared the options relative to each other based on whether an option had a ‘some’ or ‘significant’ advantage or disadvantage over other options or whether all options were ‘comparable / neutral’. This basis of comparison is consistent with the NTA Guidelines which use the following five-point ranking scale when comparing options against each other for comparative analysis.

Table 6-1 Comparison Criteria

Comparison Criteria Legend
Significant Comparative Advantage over Other Options
Some Comparative Advantage over Other Options
Comparable to Other Options / Neutral
Some Comparative Disadvantage over Other Options
Significant Comparative Disadvantage over Other Options

6.1.3. Civil and OHLE Option Selection

6.1.3.1. Stage 1 Sifting

As outlined in Section 5, two options were considered in relation Civil and OHLE the Hazelhatch to Park West Corridor.

- Do-Nothing represents the scenario of leaving the area as is without any intervention from IE.
- This Do minimum option examines the track modifications required to reconfigure the tracks to facilitate the Slow lines for the DART services to the north side of the railway corridor, whilst the Fast services are relocated to the south.

Table 6-2 provides details of the assessment undertaken as part of the Stage 1 Preliminary Assessment (Sifting) Process, used in the selection of the Preferred Option for the Civil and OHLE elements of Hazelhatch to Park West corridor (see **Appendix A Sifting Process Backup**).

Options which were assessed as feasible and fulfilled the project requirements were brought forward to Stage 2 MCA for a more detailed assessment.

Table 6-2 Sifting Process for Civil and OHLE Elements

Option	Requirements		Description
Option 0	Engineering	Constructability	Not applicable. No intervention proposed.
		Geometrical fitness for intervention	Not applicable. No intervention proposed.
		Safety	Not applicable. No intervention proposed.
		New track configuration SSFF, with two Slow Tracks on the North	FAIL. No intervention proposed. 4-tracking configuration is not achieved.
		Electrification of DART+ tracks	FAIL. No intervention proposed. Electrification of the DART+ tracks not achieved.
		Provide access to DART platforms from Slow lines	FAIL. No intervention proposed. No connection to new DART+ platforms.
		Track alignment and drainage (standards)	FAIL. No intervention proposed. Track alignment and drainage not achieved.
	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**
Option 1	Engineering	Constructability	PASS. Minor interventions to the rail corridor are possible.
		Geometrical fitness for intervention	PASS. Minor interventions without geometrical fitness concerns are possible.
		Safety	PASS. Minor interventions that pose no safety concerns are possible.
		New track configuration SSFF, with two Slow Tracks on the North	PASS. Minor interventions may achieve 4-tracking configuration. Addition of P&Cs to provide the functionality.
		Electrification of DART+ tracks	PASS. Minor interventions may achieve electrification of the DART+ tracks. Localised track lowering at OBC21 and OBC19 to achieve required electrical clearances.
		Provide access to DART platforms from Slow lines	PASS. Minor interventions may provide connection to new DART+ platforms.
		Track alignment and drainage (standards)	PASS. Minor interventions to the rail corridor in accordance with standards are possible.
	Economy		Compatible with the investment guidelines and programme for DART+.

Option	Requirements	Description
	Environment	No impact on Environmental sites of National of International significance.
	SIFTING OUTCOME	**PASS. Proceed to Stage 2 Assessment**

Option 0 does not meet the project requirements in terms of electrification as well as on providing direct link between DART lines and platforms.

Option 1 for the Hazelhatch to Park West area has been developed to be capable of supporting electrification. It includes for localised track lowering at bridges OBC21 and OBC19 to meet the necessary clearance requirements.

As only one option is assessed to meet the project requirements, a multi-criteria analysis (MCA) is not required for that one option. Option 1 is the preferred option for Civil and OHLE, this option aligns with all do-nothing or do-minimum options to develop the electrification works under the existing bridges, which requires no intervention to the bridges with no impact to the existing roads. Localised track lowering is required at OBC19 and OBC21 where the electrical clearance is sub nominal, no intervention required to the the bridge.

6.2. Substations

A total of six substations are required for the DART+ South West Project, four of the substations are to be located in the section from Hazelhatch to Park West at the following locations:

- Hazelhatch
- Adamstown
- Kishoge
- Park West

The locations for the proposed substations are based on the findings from the power simulation study. The proposed locations were assessed as part of the options selection process. The following sections outline the associated selection process. See **Appendix C Drawings** for drawings of the proposed substation locations.

6.2.1. Option Selection Process Description

6.2.1.1. Stage 1 Preliminary Assessment Process (sifting)

Stage 1: Preliminary Assessment (Sifting Process): as outlined in Section 5, the Do Nothing Option does not meet the project requirements and as such has not been considered further, all Do Something Options have been considered as part of the option selection process. The process commenced with the Project Team identifying a study area within which a number of substation Option locations were possible. All potential substation Options within the study area were identified and mapped.

Consistent with CAF, the headline criteria which the options were assessed against included Engineering; Environment; and Economy. Of these, the key ‘pass’ or ‘fail’ criteria was Engineering and whether an option was ‘Feasible’ and met the Project objectives and requirements. The other sub-criteria considered as part of the process included:

- **Electrification**
  It is a fundamental project requirement to provide an electrification system that is the same as that to be deployed across all DART+ Projects. A standardised approach to the provision of traction power across the proposed DART+ projects is to be adopted. This aspect considered the feasibility of fitting a standardised ESBN / IÉ substation layout at each considered location / option and the feasibility of connecting to the existing ESB 38kV and/or MV grids.

- **Constructability**

  Constructability considers the installation of substation buildings, proposed access routes for construction traffic (plant and materials delivery) and installation / connectivity of feeder cables etc to the proposed DART lines (slow lines). Option specific constraints such as geographical location and topography are considered here.

- **Safety**

  Safety covers all aspects of the construction, operation and maintenance phases of the project. Given that the proposed substations will be newly constructed it is assumed that all solutions will meet a minimum safety standard. However, where minimum standards in terms of health and safety cannot be met due to local constraints / conditions the option will be deemed unfeasible.

Project objectives and requirements for substation Options include:

- **Proximity to the Railway Line**

  Ideally proposed substations would be located immediately adjacent to the proposed slow lines to allow for ease of connectivity of feeder cables to OHL equipment. Naturally, this aspect would favour existing vacant plots in the ownership of IÉ. However, other privately owned Options may also be considered. To avoid extensive cable easement requirements across privately owned lands or the requirement for extensive land acquisition any Option located more than 50m from the existing railway boundary fence would be considered unfeasible for the purposes of this assessment.

- **Vehicular Access**

  Fundamentally, given the Project is focused on an existing railway line and the interventions required are very localised; detailed design considerations (such as road design standards) have a direct bearing on the feasibility or otherwise of particular options. The proposed substations will require periodic access by maintenance staff from both IÉ and ESB Networks. Hence, the feasibility of a proposed access route between the substation and the public road network is considered under this criterion.

Substation options which failed to meet the necessary Engineering Feasibility and Project Requirements were discounted. Options which met the necessary Engineering Feasibility and Project Requirements were brought forward to Stage 2: MCA for more detailed assessment.

6.2.1.2. Stage 2 Multi Criteria Analysis (MCA)

Following the Phase 1: Sifting, the Design Team developed the feasible options for presentation and consideration by a multi-disciplinary team in the next stage of the optioneering process.

Following a review of the CAF criteria, Physical Activity was not considered appliable to the process in that the criteria does not directly address matters that will differentiate substation options and will therefore yield a 'No comparative difference / Neutral' for the purpose of the comparative evaluation of options. The remaining CAF parameters were split into a number of sub-criteria considered relevant to substation Option selection for the DART+ South West Project.

The CAF parameters, criteria and considerations for comparative analysis are set out in **Table 6-3**. These include qualitative and quantitative indices.

The assessment was informed by substation locations, access arrangements and typical arrangement drawings A spatial envelope for each option including the likely extent of permanent and temporary works required was identified. The spatial envelope and GIS software was used to collate, map and analyse information in relation to environmental and other data sets to assist the specialists in undertaking the Stage 2: MCA.

The key environmental data / constraints are available in Technical Appendices Volume 2.2 Environmental Constraints Reporting. This baseline data informed the baseline characteristics of the environmental topic / CAF sub criteria under consideration. It, inter alia, identified areas or Options with specific statutory protection, which

are recognised as important and / or sensitive from a planning and environmental perspective e.g., European and National designated Options, Protected Views, Record of Protected Structures etc.

Relevant considerations include:

- The assessment is a comparative analysis between options presented, not an impact assessment of each option. The impact from the Preferred Option will be assessed in the Environmental Impact Assessment Report in the next phase of the development.
- Not all sub-criteria may be relevant in every case. Those that are relevant to the assessment, i.e., that have differentiated options, are highlighted in the narrative.
- For each option there are potential design variations. In due course design variations will be subject to detailed technical analysis (in respect of the Preferred Option and Railway Order design).
- For each option an indicative envelope was identified for the extent of permanent works required; a worst-case scenario was considered. The extent of temporary works was also considered.
- The envelope around each option was used to spatially represent environmental constraints within / proximate to the options.
- There are direct and indirect effects associated with either or both the construction and operational activities (including maintenance) associated with the options. These are highlighted where relevant, and in particular where they have differentiated options under particular sub-criteria.
- The changes in land use are considered under the planning policy consideration under the CAF Integration criteria (specifically Land Use Integration).
- The changes in traffic and associated impacts on the 'economy' are addressed under the CAF Economic criteria (specifically Traffic functionality and associated economic activities and opportunities) and are not duplicated as part of the Environment Assessment.

Table 6-3 CAF Parameters, Criteria and Considerations for Comparative Analysis

CAF Parameters	Criteria	Basis for Comparative Analysis	Qualitative and/or Quantitative Considerations (as appropriate)
1. Economy	Capital Expenditure (CAPEX): construction, land acquisition, servicing requirements, temporary works required to implement the option.	This sub-criterion considered comparative cost of construction, land cost (if any) and temporary works cost, servicing requirements of each Option. A high-level cost comparison was undertaken for each option (including potential land acquisitions (permanent and temporary, zoned or un-zoned land). The lowest comparative cost option was preferable to higher cost options.	Estimated high level comparative cost of construction of option. Extent and type of 3rd party lands required permanently. Extent and type of 3rd party lands required temporarily for temporary works during construction (where known).
	OPEX: day to day operational costs (IE or other entities), potential for obsolescence to maintain the option.	This sub-criterion considered long term maintenance costs. The option with less risk for long term maintenance issues (and hence cost) was preferable to options with greater risk of long-term maintenance issues.	Estimated risk of maintenance cost associated with the improvement or deterioration of the condition of the substation.

CAF Parameters	Criteria	Basis for Comparative Analysis	Qualitative and/or Quantitative Considerations (as appropriate)
2. Integration	Equipment integration	The option which best integrates with existing equipment and other infrastructure and services was preferable to other options.	Minimising distance of the Option to the proposed slow lines (future DART lines), i.e. northern most tracks). Minimising distance to nearest MV and/or 38kV network. Note – connection to 38kV grid is 'preferred' under this assessment.
	IE land use integration	The option which best integrates with existing IÉ-owned property / facilities and IÉ land use strategies was preferable to other options.	Compatibility with IÉ land development potential Buildability of the solution during operation. Potential to impact rail service / IR operations during construction.
	Road access integration	The option which best accesses the road network was preferable to other options.	Consideration of ease of access for ESB Networks and IÉ staff for ongoing / periodic maintenance purposes.
	Other Land use integration	The option with greater consistency and compliance with planning policy was preferable to others.	Consistency with land use strategies, regional and local plans including: Changing character of area (future urban regeneration proposals, extant planning permission etc). The extent to which an option provides / supports opportunity for regeneration - such as an improved urban environment.
	Geographical Integration	The option which minimise disruption and accessibility during construction was preferable.	Potential to impact on external links during construction. Potential to impact on external links during operation. Consideration for any community severance impacts.
		The option with greater consistency and compliance with other government policy was preferable to others.	Integration with Government Policy, Smarter Travel, Investment Programmes, Climate Action Plan etc.
	Adaptability in the future (robustness in the solution)	The option with greater adaptability for the future was preferable to others.	Ability to continue to function successfully despite future changes in circumstances

CAF Parameters	Criteria	Basis for Comparative Analysis	Qualitative and/or Quantitative Considerations (as appropriate)
3. Environment - considers impacts, such as emissions to air, noise, and ecological and architectural impacts.	Noise and Vibration	The Option which minimises potential effects on the environmental factor under consideration was preferable to other options.	Based on the professional judgement of specialists qualified in the specialist areas taking into consideration sensitivity of the sub-criteria and the significance of the likely effect, and in general terms whether potential effects can be mitigated.
	Air quality and Climate		
	Landscape and Visual		
	Biodiversity (flora and fauna)		
	Cultural Heritage, archaeological and architectural heritage		
	Water resources		
	Agricultural and non-agricultural		
	Geology and soils (including waste)		
4. Accessibility and Social Inclusion - considers social deprivation, geographic isolation and mobility and sensory deprivation	Neighbours	The option which can provide a higher level of amenity to neighbours is preferable.	Maximised distance to residential properties.
5. Safety - Safety is concerned with the impact of the investment on the number of transport related accidents.	Rail Safety	The option which provided the best rail safety solution was preferable.	Manageable acceptable conditions of the structures above, below and alongside the railway. Manageable acceptable conditions for safe operation of the railway.
	RAM	The option which provides the best performance in terms of Reliability, Availability and Maintainability of the option	A brief assessment of the Reliability, Availability and Maintainability.
	Users / People's Safety	The option which provides the best safety solution for maintenance staff and passers-by. The focus is on operational phase not construction.	

6.2.2. Hazelhatch Substation

6.2.2.1. Preliminary Assessment (Sifting)

Two Options excluding the 'Do Nothing' option have been identified for the area. Option 0 'Do Nothing' does not meet the fundamental project requirement to provide electrification of the railway and hence is discounted from further consideration.

- Option 1 - is a brown field site to the north of the railway in the ownership of CIE. It is located adjacent to the Hazelhatch Station carpark and other disused dwellings also owned by CIE It is situated to the east of Hazelhatch Station with direct access to the local road network.
- Option 2 - is located within a CIE owned maintenance yard on the northern side of the railway and to the west of Hazelhatch train station. Road access is via an existing Right of Way access track across private lands to the L5063 Lord's Road. It is located to the rear of existing private dwellings.

Table 6-4 Hazelhatch Substation Sifting Summary

Main Option	Result	Comments	Brought forward to MCA
Option 0: 'Do Nothing'	**FAIL**	Electrification, new track configuration, access to DART platforms, and track alignment and drainage not achieved	**No**
Option 1:	**PASS**	Feasible	**Yes**
Option 2:	**Fail**	Not Feasible - Does not comply with the power study requirements	**No**

Option 1 was assesed as a feasible option and hence was brought forward for further detailed assessments. Option 2 does not meet with the power study requirements as it falls outside of the study area, as such it does not meet a fundamental engineering requirment for the project. Full details of the initial sifting assessment are provided in Appendix A Sifting Process Backup of this report.

6.2.2.2. Multi Criteria Analysis

As only one option (Option 1) meets with the necessary Engineering Feasibility and Project Requirements, it is the Preferred Option. Stage 2: MCA was not required.

6.2.2.3. Preferred Option

Option 1 has been identified as the Preferred Option for the location of the substation at Hazelhatch, it s a brown field site to the north of the railway in the ownership of IE. It is located adjacent to the Hazelhatch Station carpark, the indicative location is shown in the figure below.

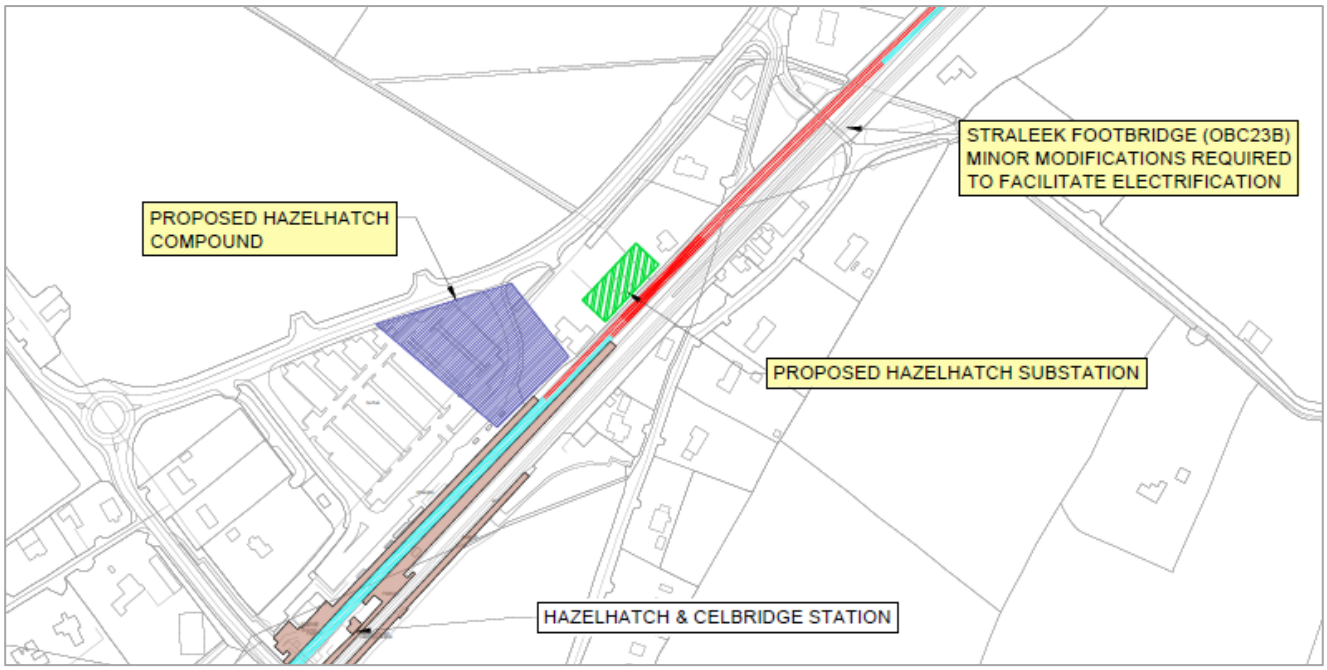


Figure 6-1 Hazelhatch Substation Preferred Location

6.2.3. Adamstown Substation

6.2.3.1. Preliminary Assessment (Sifting)

Two Options excluding the 'Do Nothing' option have been identified for the area. Option 0 'Do Nothing' does not meet the fundamental project requirement to provide electrification of the railway and hence is discounted from further consideration.

- Option 1 - is located in a green field site currently in private ownership to the north of the railway. There are currently no access roads to Option 1, potentially limiting access in and out.
- Option 2 - is located in a green field site currently in IÉ ownership. It is located to the south of the railway and adjacent to an existing pump station. There is an existing access track that runs adjacent / parallel to the railway providing an established access route between the proposed site and the public road network to the west. However, currently this track does not have any physical separation from the live railway.

Options 1 and 2 meet the necessary Engineering Feasibility and Project Requirements for a substation location and are brought forward to Stage 2: MCA for detailed assessment. A summary of the Preliminary Assessment findings are outlined in **Table 6-5**. Full details of the initial sifting assessment are provided in **Appendix A Sifting Process Backup** of this report.

Table 6-5 Adamstown Substation - Sifting Assessment Summary

Adamstown Sifting	Result	Comments	Brought forward to MCA
Option 0: 'Do Nothing'	FAIL	Electrification not achieved	No
Option 1	PASS	Feasible	Yes
Option 2	PASS	Feasible	Yes

6.2.3.2. Multi Criteria Analysis

Options 1 and 2 meet the necessary Engineering Feasibility and Project Requirements for a substation location and are brought forward to Stage 2: MCA for detailed assessment. The **Table 6-6** provides a summary of the MCA findings, full details of the assessment matrix are available at **Appendix B MCA Process Backup** of this report.

In terms of Economy, Option 2 performs favourably due to ease of access and constructability. Option 2 can be accessed via an IÉ-owned track which joins the public road network at Stacumney Bridge. It is assumed this track would require work to effectively separate it from the permanent way and thus permit access by ESB Networks personnel (unaccompanied by IÉ TSC's). Options 2 is also currently owned by IÉ.

In terms of Integration, Option 2 offers a significant comparative advantage due to the ease of access to the adjacent road network and preferred buildability due to the existing access track. With regard to Environmental criteria, Option 2 performs marginally better due to an expected lesser noise impact as this Option is located further away from existing and proposed residential developments. Option 2 performs favorably in terms of Accessibility and Social Inclusion as it is located further away from nearby residential developments. All Options are comparable in terms of Safety.

Table 6-6 Adamstown Substation - MCA Summary

CAF Parameters	Option 1 Assessment	Option 2 Assessment
1. Economy	Significant Comparable Disadvantage over Other Options	Significant Comparable Advantage over Other Options
2. Integration	Significant Comparative Disadvantage over Other Options	Significant Comparable Advantage over Other Options
3. Environment	Some Comparative Disadvantage over Other Options	Some Comparable Advantage over Other Options
4. Accessibility and Social Inclusion	Significant Comparative Disadvantage over Other Options	Significant Advantage over Other Options
5. Safety	Comparable to Other Options / Neutral	Comparable to Other Options / Neutral
6. Physical Activity	Comparable to Other Options / Neutral	Comparable to Other Options / Neutral
Conclusion		Preferred Option

6.2.3.3. Adamstown Substation – Preferred Option

Option 2 is the Preferred Option for the location of the proposed Adamstown Substation. It is located to the south of the railway and adjacent to an existing access road. The property is in IE ownership, the indicative location is shown in the figure below.

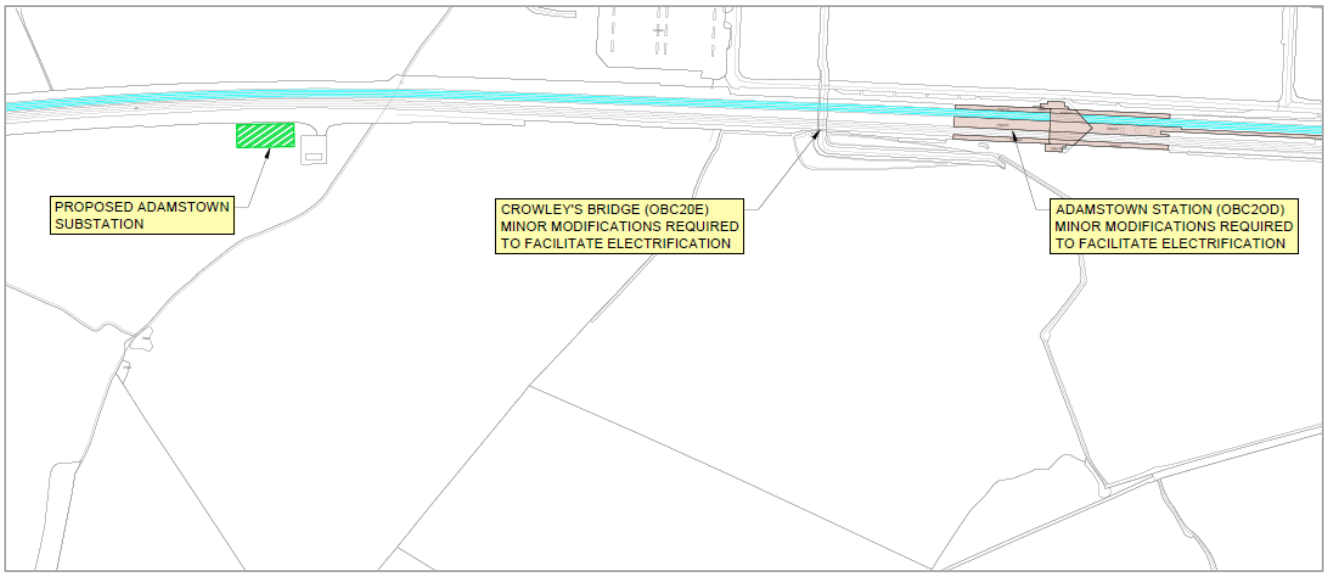


Figure 6-2 Adamstown Substation Preferred Location

6.2.4. Kishoge Substation

6.2.4.1. Preliminary Assessment (Sifting)

Three Options excluding the 'Do Nothing' option have been identified for the area. Option 0 'Do Nothing' does not meet the fundamental project requirement to provide electrification of the railway and hence is discounted from further consideration.

- Option 1 - is located to the west of the R136 regional road and to the south of the railway corridor. It is in a green field site in private ownership in close proximity to the existing halting site. Access to the adjacent road network would be provided via a newly constructed access road.
- Option 2 - is located to the east of the R136 regional road in an on the southern side of Kishoge station. It is located within the existing carpark. The proposed site is in the ownership of CIÉ. Access to the road network would be via the carpark entrance.
- Option 3 - is located to the west of the R136 regional road and to the north of the railway corridor. It is in a brown field site in private ownership. Access to the adjacent road network would be provided via a newly constructed access road.

Options 1, 2 and 3 meet the necessary Engineering Feasibility and Project Requirements for a substation location and are brought forward to Stage 2: MCA for detailed assessment. A summary of the Preliminary Assessment findings are outlined in **Table 6-7**. Full details of the initial sifting assessment are provided in Appendix A Sifting Process Backup of this report.

Table 6-7 Kishoge Substation - Sifting Assessment Summary

Kishoge Sifting	Result	Comments	Brought forward to MCA
Option 0: 'Do Nothing'	**FAIL**	Electrification not achieved	**No**
Option 1	**PASS**	Feasible	**Yes**
Option 2	**PASS**	Feasible	**Yes**
Option 3	**PASS**	Feasible	**Yes**

6.2.4.2. Multi Criteria Analysis

Options 1, 2 and 3 meet the necessary Engineering Feasibility and Project Requirements for a substation location and are brought forward to Stage 2: MCA for detailed assessment. The **Table 6-8** provides a summary of the MCA findings, full details of the assessment matrix are available at **Appendix B MCA Process Backup** of this report.

In terms of Economy, Option 2 performs favourably due to ease of access and constructability due to close proximity and existing accesses to the R136. ESB grid connection is likely to be comparable to other options.

All Options are comparative in terms of Integration with Option 2 offering a slight comparative advantage over other options due to the ease of access to the adjacent road network.

With regard to Environmental criteria, Option 2 performs marginally better due to an expected lesser noise impact as this Option is located further away from existing residential developments when compared to the other options. This Option can be most easily incorporated into the existing station building envelope, with high quality objectives of the SDZ met through appropriate design and siting.

Option 2 performs favourably in terms of Accessibility and Social Inclusion as it is located further away from nearby residential developments. All Options are comparable in terms of Safety.

Table 6-8 Kishoge MCA Summary

CAF Parameters	Option 1 Assessment	Option 2 Assessment	Option 3 Assessment
1. Economy	Some Comparative Disadvantage over Other Options	Some Comparative Advantage over Other Options	Some Comparative Disadvantage over Other Options
2. Integration	Significant Comparative Disadvantage over Other Options	Significant Comparative Advantage over Other Options	Some Comparative Advantage over Other Options
3. Environment	Some Comparative Disadvantage over Other Options	Some Comparative advantage over Other Options	Some Comparative Disadvantage over Other Options
4. Accessibility and Social Inclusion	Significant Comparative Disadvantage over Other Options	Significant Advantage over Other Options	Some Comparative advantage over Other Options
5. Safety	Comparable to Other Options / Neutral	Comparable to Other Options / Neutral	Comparable to Other Options / Neutral
6. Physical Activity	Comparable to Other Options / Neutral	Comparable to Other Options / Neutral	Comparable to Other Options / Neutral
Conclusion		Preferred Option	

6.2.4.3. Preferred Option

Option 2 is the Preferred Option for the proposed Kishoge substation, it is located to the east of the R136 regional road in an on the southern side of Kishoge station. It is located within the existing carpark. The proposed site is in the ownership of CIÉ. Access to the road network would be via the carpark entrance. The indicative location is shown in the figure below.

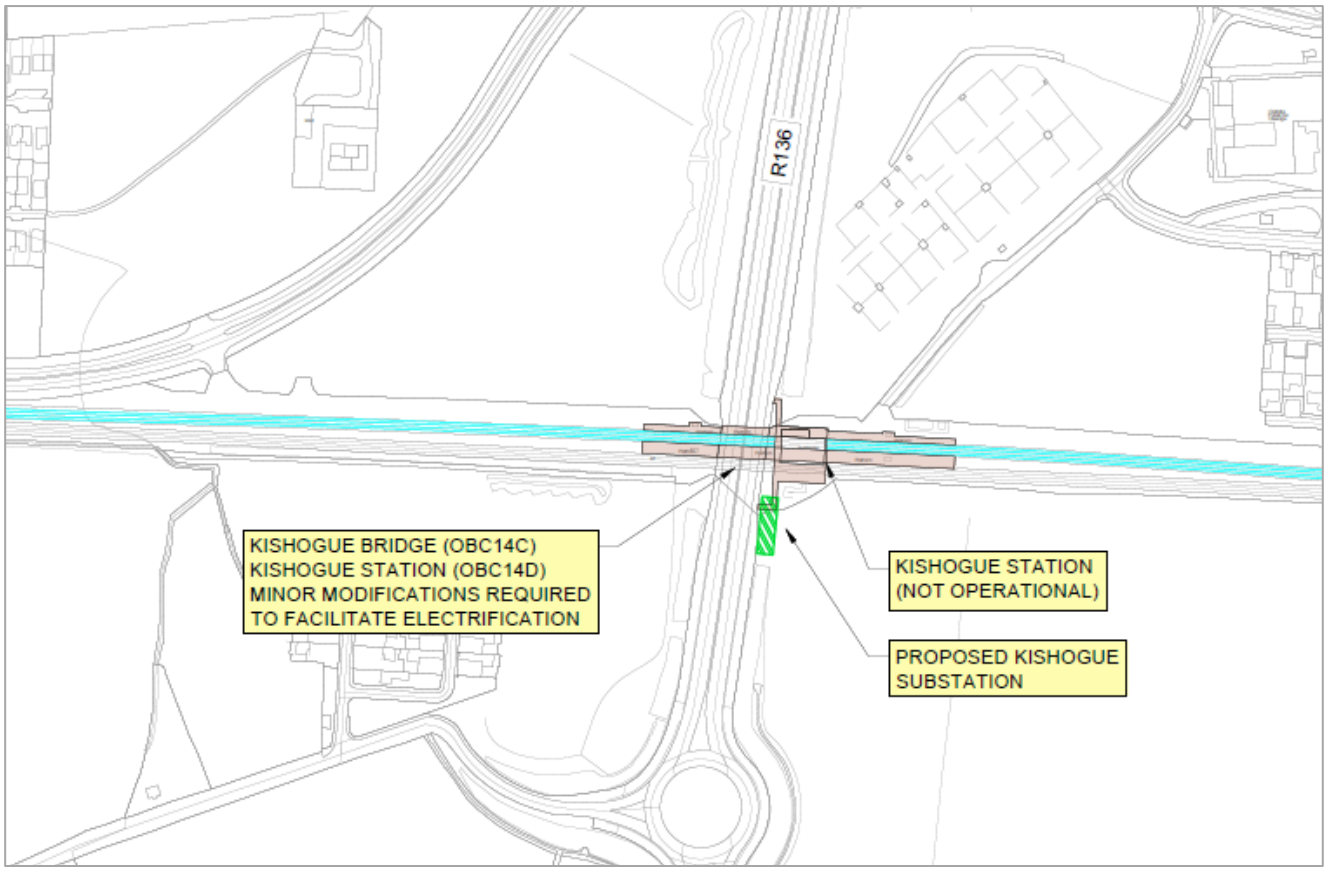


Figure 6-3 Kishoge Substation - Preferred Location

6.2.5. Park West Substation

6.2.5.1. Preliminary Assessment (Sifting)

Three Options excluding the 'Do Nothing' option have been identified for the area. Option 0 'Do Nothing' does not meet the fundamental project requirement to provide electrification of the railway and hence is discounted from further consideration.

- Option 1 - is located to the north of the railway and immediately east of the M50 motorway. This is a brownfield site in the ownership of Dublin City Council. Direct road access is via Park West Avenue to the east. The existing Park West Station is located to the east and existing housing developments in the Cherry Orchard area are located further east of Park West Avenue. Existing ESB 38kV network is located immediately east of Park West Avenue.

  The area around Option 1 is identified within the Dublin City Development Plan as a Strategic Development Regeneration Area (SDRA 4) and is zoned Z14: "to seek the social, economic and physical development and/or rejuvenation of an area with mixed use, of which residential and Z6 (employment/enterprise uses) would be the prominent uses. The area for Option 1 forms a small part of this to the north of the railway and is suggested as a good location for a convenience store in the local area plan (LAP).

- Option 2 - is located south of the railway corridor and immediately west of the M50 motorway. This is a brownfield site and was formerly in use as a maintenance depot by a major telecommunications provider. ESB 220kV and 38kV networks are located on this site. Access to the local road network is via existing industrial estate roads to the west.

- Option 3 - is located south of the railway corridor and immediately west of the M50 motorway. It is located within existing industrial estate premises / yards. Hence this option is closer to the railway boundary fence

than Option 2 above. Road access is more complex insofar as maintenance / operation personnel would be required to cross existing private yards / property. ESB 220kV and 38kV networks are located further to the south

- Option 4 - is located immediately adjacent to the south of the railway corridor, midway between the M50 bridge to the east and Station Road to the west. It is located within existing industrial estate premises / yards. Road access is more complex insofar as maintenance / operation personnel would be required to cross existing private yards / property. There is little availability in terms of existing ESB 38kV or MV network.

Options 1, 3 and 4 meet the necessary Engineering Feasibility and Project Requirements for a substation location and are brought forward to Stage 2: MCA for detailed assessment. Options 2 was ruled out as it is located too far from the rail corridor and hence was not brought forward to the MCA assessment.

A summary of the Preliminary Assessment findings is outlined in **Table 6-9**. Full details of the initial sifting assessment are provided in **Appendix A Sifting Process Backup** of this report.

Table 6-9 Park West Substation - Sifting Assessment Summary

Park West Sifting	Result	Comments	Brought forward to MCA
Option 0: 'Do Nothing'	**FAIL**	Electrification not achieved	**No**
Option 1	**PASS**	Feasible	**Yes**
Option 2	**FAIL**	Located too far from the rail corridor	**No**
Option 3	**PASS**	Feasible	**Yes**
Option 4	**PASS**	Feasible	**Yes**

6.2.5.2. Multi Criteria Analysis

Options 1, 3 and 4 were put forward for detailed assessment. Full details of the assessment matrix are available at **Appendix B MCA Backup Process** of this report. **Table 6-10** provides a summary of the MCA findings.

In terms of Economy, Option 1 performs favourably due to ease of access and constructability due to close proximity to Park West Avenue. ESB grid connection is likely to be comparatively simple when compared to other options. While all options considered are owned by 3rd parties, this location is in public ownership (Dublin City Council), thus offering the potential for a simplified acquisition / negotiation process.

In terms of Integration criteria, Option 1 is located on the northern side of the tracks and hence provides a more favourable trackside location for connection of feeder wires for OHLE equipment. It provides a better option in terms of constructability and ease of access for both the construction and operation phases.

With regard to environmental criteria, all options performed comparably.

As distance to neighbouring residences is maximised, Option 1 offers a slight comparable advantage over other options regarding Integration and Social Inclusion.

In terms of safety Option 1 preforms better as the location is away from members of the public in an open brown field site, other options are located within industrial estates in close proximity to members of the public.

Table 6-10 Park West MCA Summary

CAF Parameters	Option 1 Assessment	Option 3 Assessment	Option 4 Assessment
1. Economy	Some Comparative Advantage over Other Options	Some Comparative Disadvantage over Other Options	Some Comparative Disadvantage over Other Options
2. Integration	Some Comparative Advantage over Other Options	Some Comparative Disadvantage over Other Options	Some Comparative Disadvantage over Other Options
3. Environment	Comparable to Other Options / Neutral	Comparable to Other Options / Neutral	Comparable to Other Options / Neutral
4. Accessibility and Social Inclusi	Some Comparative Advantage over Other Options	Some Comparative Disadvantage over Other Options	Some Comparative Disadvantage over Other Options
5. Safety	Some Comparative Advantage over Other Options	Some Comparative Disadvantage over Other Options	Some Comparative Disadvantage over Other Options
6. Physical Activity	Comparable to Other Options / Neutral	Comparable to Other Options / Neutral	Comparable to Other Options / Neutral
Conclusion	**Preferred Option**		

6.2.5.3. Preferred Option

Option 1 is the preferred location for the substatio at Park West, the preferred location is to the north of the railway and immediately east of the M50 motorway. This is a brownfield site in the ownership of Dublin City Council. Direct road access is via Park West Avenue to the east. The existing Park West Station is located to the east, the indicative location is shown in the figure below.

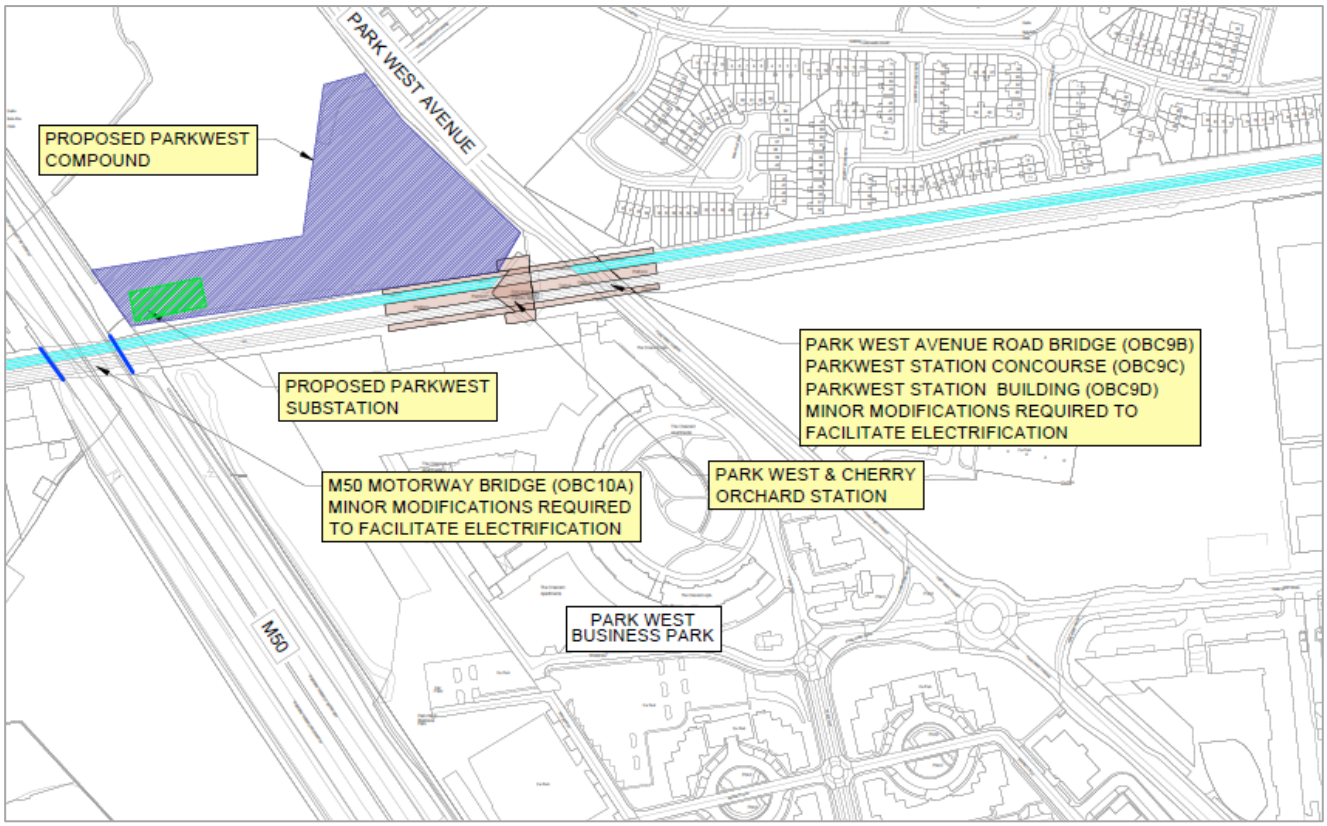


Figure 6-4 Park West Substation Preferred Location

6.3. Construction Compounds

As outlined in Section 5, to faciliate construction works along this section of the rail corridor, two Construction Compounds are required. The preferred location for one of the sites has been identified at Hazelhatch Station, in the existing station car park, adjacent to the preferred location for the proposed electrical substation.

The second is a brown field site adjacent to Park West Station, this compound will also be used for the construction of the proposed Park West electrical substation which is proposed for this area. As there are no other suitable alternative locations for this area, multi-criteria analysis was not required for these two locations. Please refer to Section 8.6 for further details in relation to the Construction Compounds.

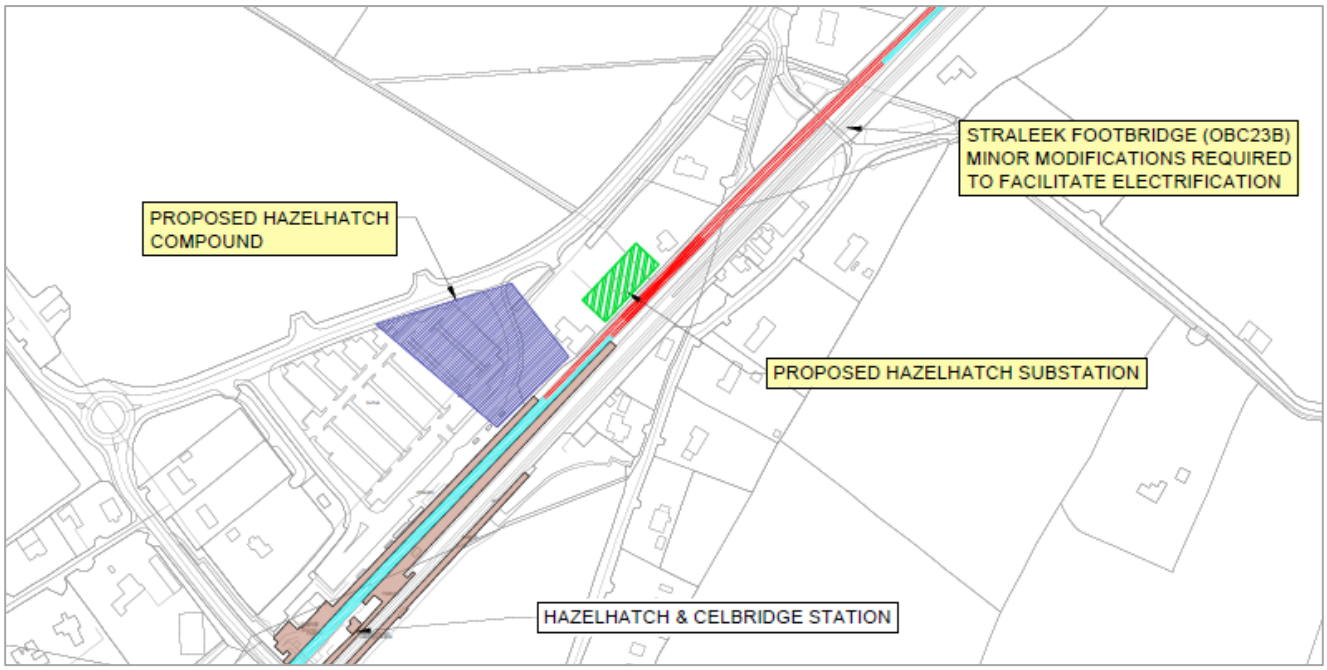


Figure 6-5 Proposed Hazelhatch Construction Compound

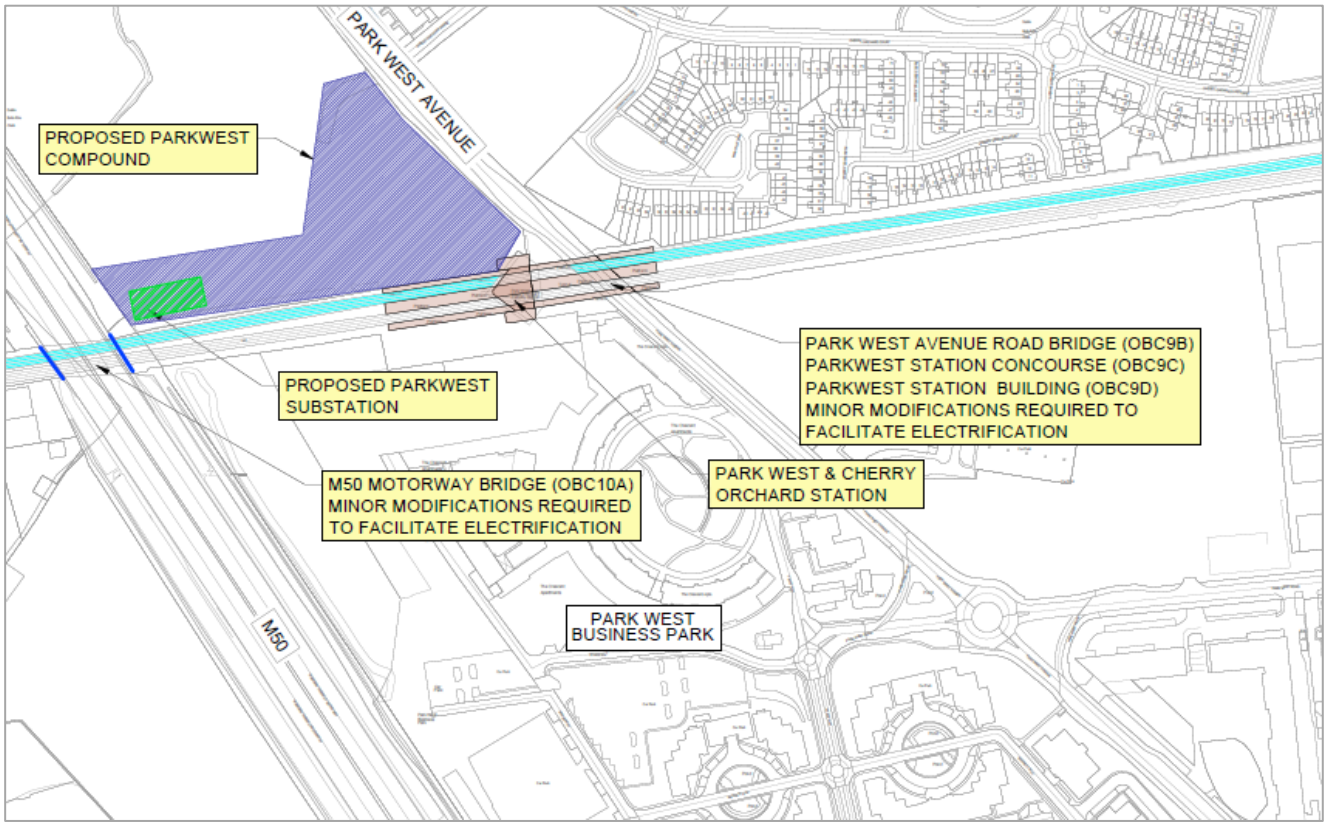


Figure 6-6 Proposed Park West Construction Compound Location

7. Preferred Option Design Development

7.1. Review of Preferred Option

The baseline information or outcomes of design development since PC1 (inclusive of stakeholder input) have not materially impacted the optioneering and MCA outcomes that resulted in the selection of Option 1 as the Preferred Option for the Civil and OHLE infrastructure at the Hazelhatch to Park Way Corridor.

In light of the above, the Option has been validated, and its design progressed as the Preferred Option.

7.2. Review of Stakeholder Feedback

Stakeholder feedback has mainly been limited to the impact of construction activities which has been considered in **Section 8 Construction** of the report.

7.3. Design Development

For PC1 the 4-track widening bridges were originally classified as new builds for which the IE structural clearance of 5.3m was a requirement. Subsequently the work to the bridges has been classified as reconstruction, resulting in reduced clearance requirements,.the minimum 4.4m contact wire height has been accepted as applicable in order to reduce the impact on third party land owners in the immediate vicinity of the Railway Corridor. This allowed for the further development of a geometirically compliant rail alignment along much of the 4-tracking section of the project.

The following sub-sections provide greater clarity on the development of the design of the preferred option, this section includes the following:

1. Structures
2. Permanent Way
3. Signalling, Electrical and Telecommunications (SET)
4. Roads
5. Drainage

7.3.1. Structures

There are no new or modified bridge or retaining wall structures anticipated in this section. Please refer **Section 2.3 Structures** for details of the existing structures along this section of the route, as noted earlier, a detailed topographical survey has been undertaken along the route. This information was used to reassess the bridge clearances in this area to ensure compliance with the OHLE requirements.

All of the bridges in this section have sufficient vertical clearance with the exception of OBC19 and OBC21. Localised track lowering is required at both locations to ensure the necessary bridge clearances are achieved. Roads.

No road works have been identified for this section.

7.3.2. Permanent Way

The Operational requirements informed the development of the perway layout for PC2, confirming the operational requirements to be met by the DART SW+ Project.

Park West & Cherry Orchard Station – the existing 4 track layout here is preserved in terms of physical infrastructure, although the line designations will change to reflect the segragation of electrified DART services on the Slow lines to the north, with the non-electrified Fast lines to the south, see **Figure 7-1**:

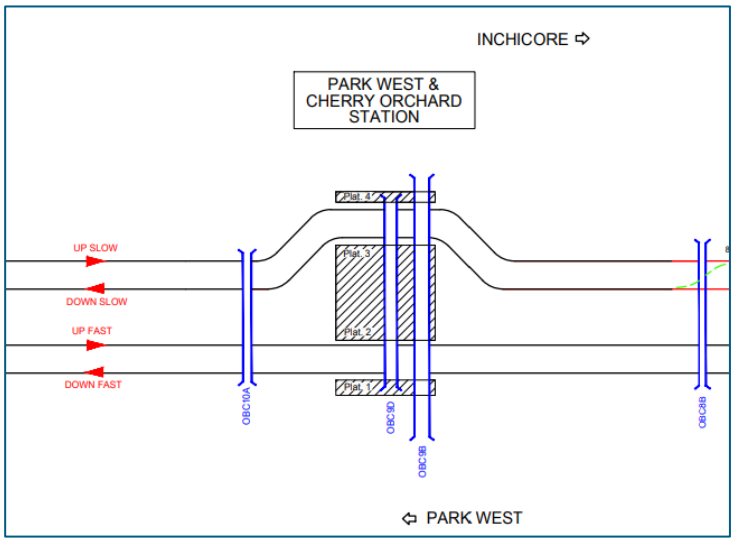


Figure 7-1 Park West & Cherry Orchard Station – Track Plan Layout

For Adamstown Station the project requires modification to the existing P&C to fulfil operational requirements, with the removal of an existing connection into the turnback on the central platform. See **Figure 7-2**.

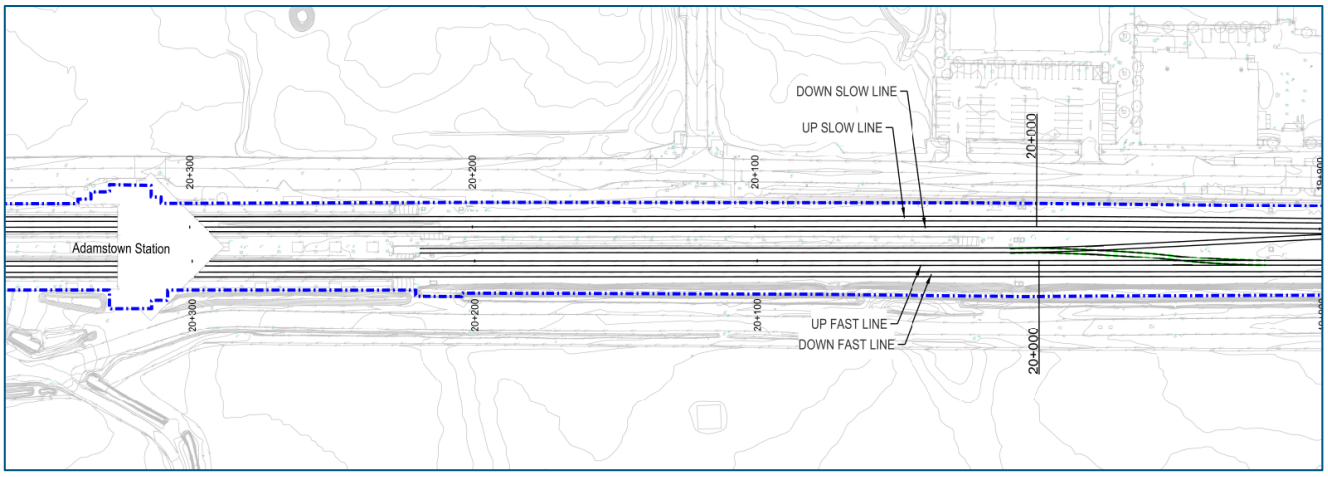


Figure 7-2 Adamstown Station – Track Plan Layout (1 of 2)

Track to be removed are shown in dashed green; additionally, a new crossover will be provided to the slow lines to the east of Adamstown Station, see **Figure 7-3**.

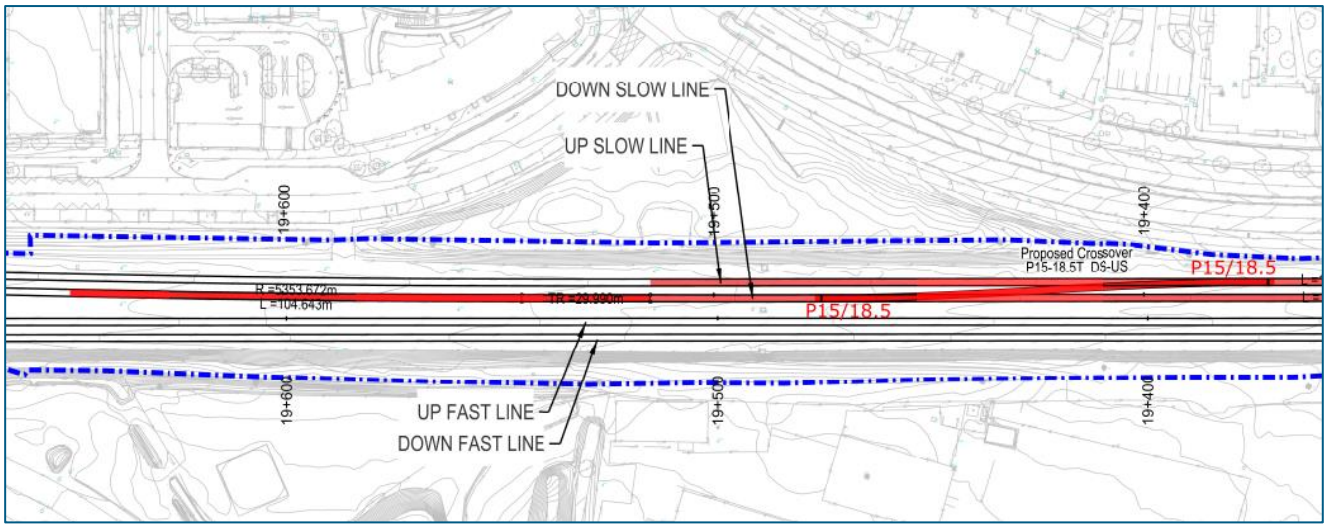


Figure 7-3 Adamstown Station – Track Plan Layout (2 of 2)

At Hazelhatch & Celbridge Station there will be major modifications to the track footprint (new P&C, track realignment, provision of a new siding to the north) to facilitate the DART services on the electrified Slow lines to the north side of the corridor. The changes are illustrated from east to west, see **Figure 7-4**.

On the approach to the station provision of a new crossover between the Slow lines provides access to the existing turnback (whilst a redundant connection that is to be removed is shown dashed green). A new scissors crossover to the immediate east of the platforms provides required functionality.

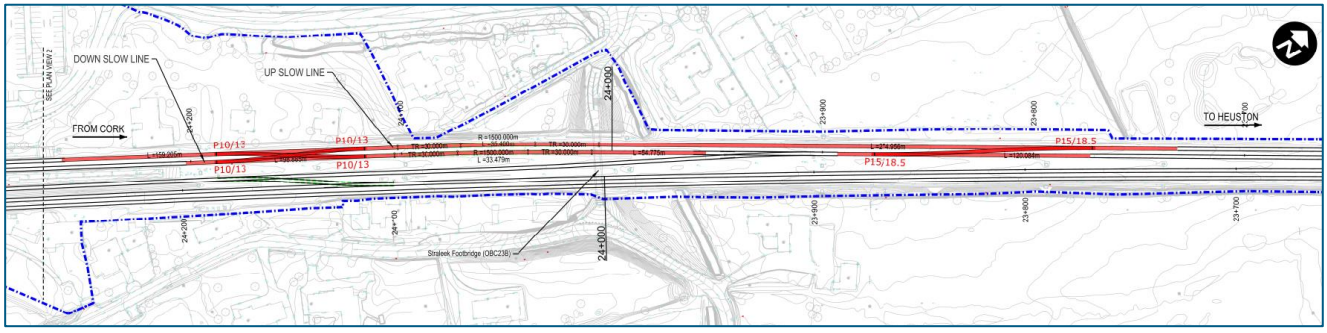


Figure 7-4 Adamstown Station – Track Plan Layout (1 of 3)

To the west of the station, the major change is the introduction of a new Turnback Siding (circa 356m in length, to accommodate 2 no. 8-car units) seen on the north side of the corridor. A new crossover on the Slow lines provides access into the siding from both Up and Down directions, see **Figure 7-5**.

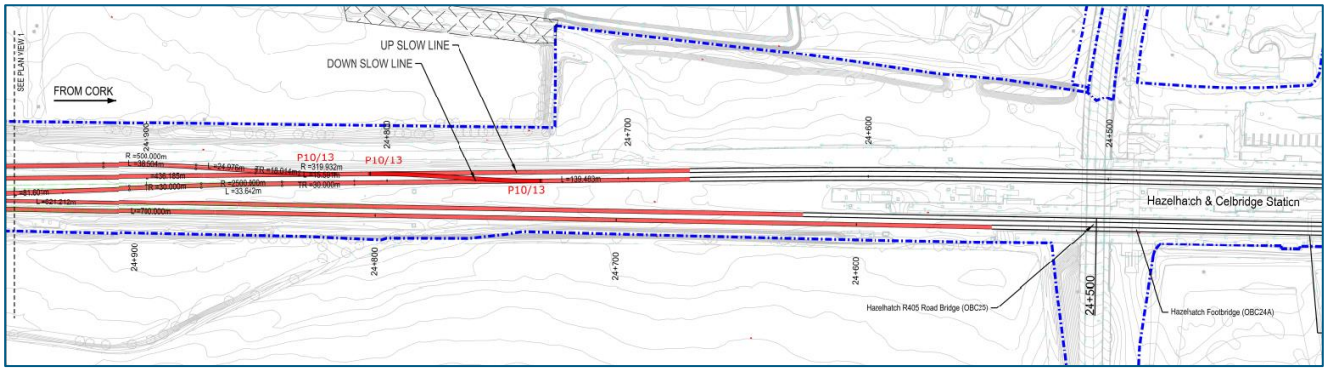


Figure 7-5 Adamstown Station – Track Plan Layout (2 of 3)

Figure 7-6 shows the additional crossovers between Fast and Slow lines that fulfil the operational requirements (train movements) at this new Hazelhatch Junction:

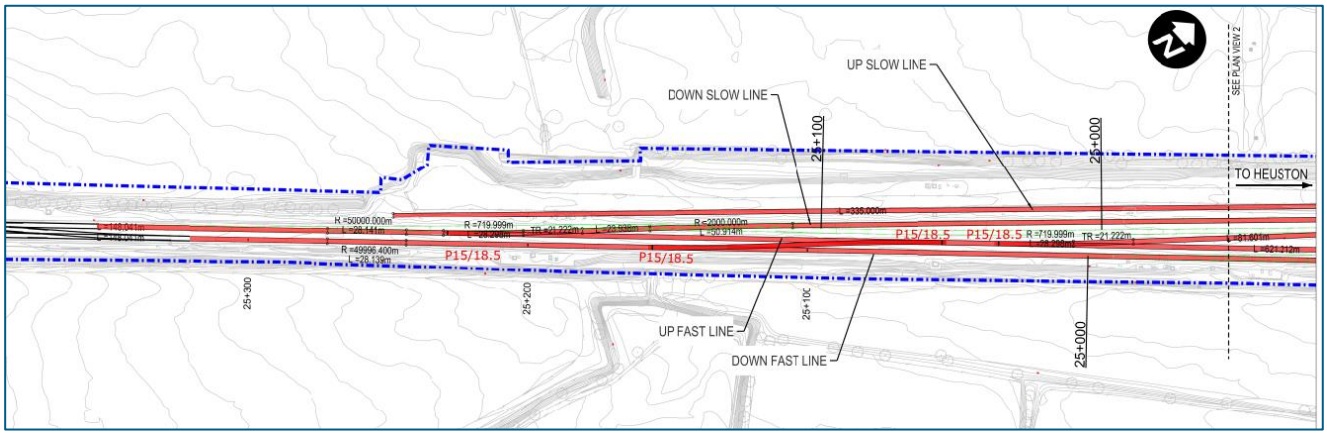


Figure 7-6 Hazelhatch & Celbridge Station – Track Plan Layout (3 of 3)

The alignment in the vertical plane essentially matches the existing track throughout this area (Park West & Cherry Orchard Station through to Hazelhatch & Celbridge Station), with the implementation of necessary minor modifcations to ensure that crossovers are situated on a level plane to ensure their correct operation.

7.3.3. Signalling, Electrical and Telecommunications (SET)

This section provides detail on the proposed SET equipment and components which will be distributed along this section of the railway. More information on the typical SET equipment is included in **Volume 2 Option Selection – Technical Report**.

7.3.3.1. Signalling

The signalling system is used to safely control and monitor train movement on the Irish Rail network. The system comprises a network of sensors, controls, signs and lights. It also includes localised control cabinets and cabins.

A Signalling scheme plan has been developed for the entire route, the scheme plan shows the proposed number and type of signals that will be allocated on this section of the route and the points and crossings that they interface with. The following section details the physical signalling infrastructure that will be installed.

The physical signalling infrastructure has been developed and is indicated in **Figure 7-7** to **Figure 7-11**. Infrastructure highlighted as follows:

- Blue box – Object Controller Cabinet
- Black box – Location case / Electrical element

It is proposed that the signalling equipment will be located within the existing IE land boundary where possible to minimise the impact to third party property owners.

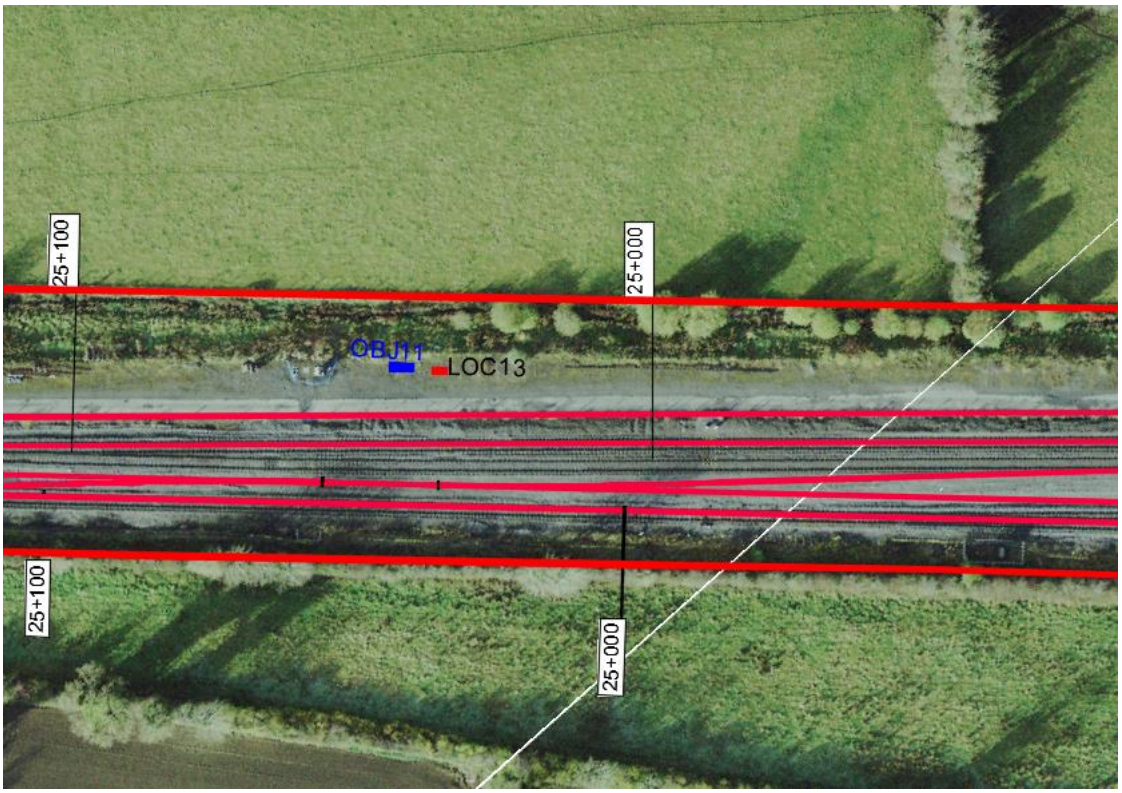


Figure 7-7 New Signalling / LV Infrastructure location (Approx 400m west of Hazelhatch Station)

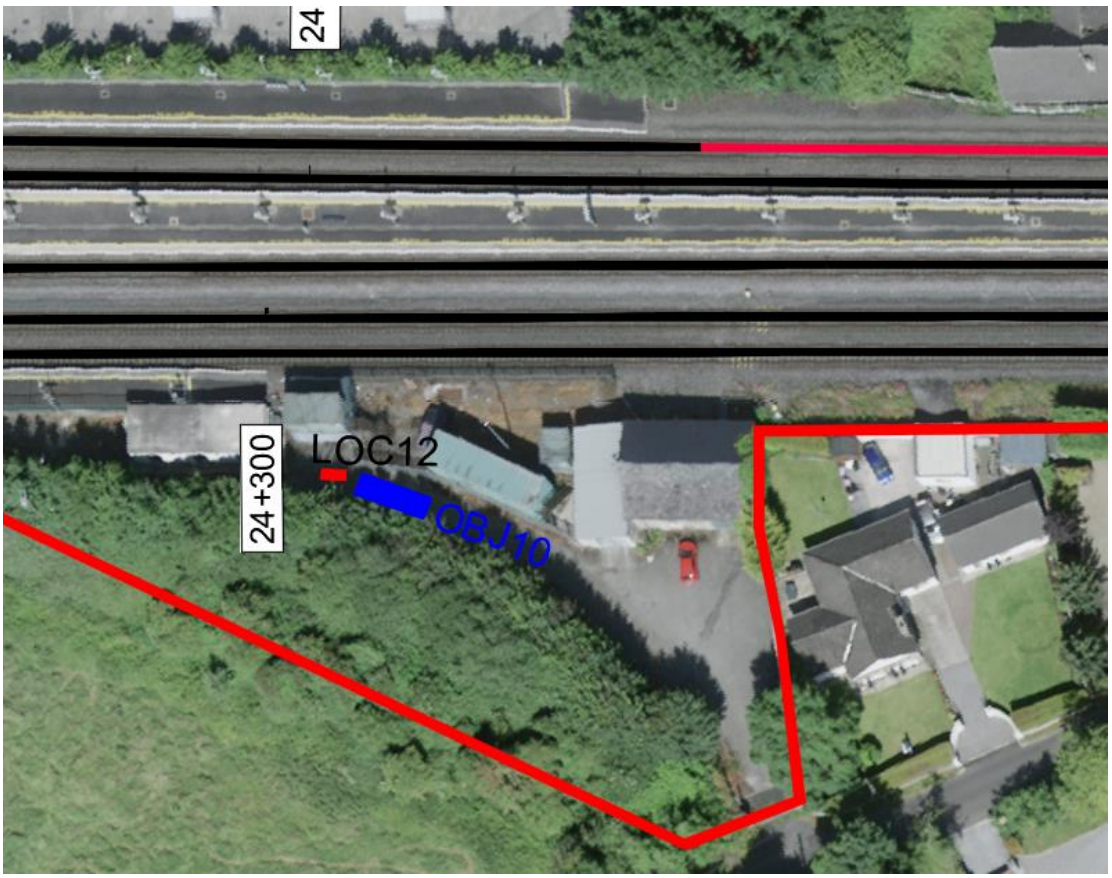


Figure 7-8 New Signalling / LV Infrastructure location (Adjacent to Hazelhatch Station)

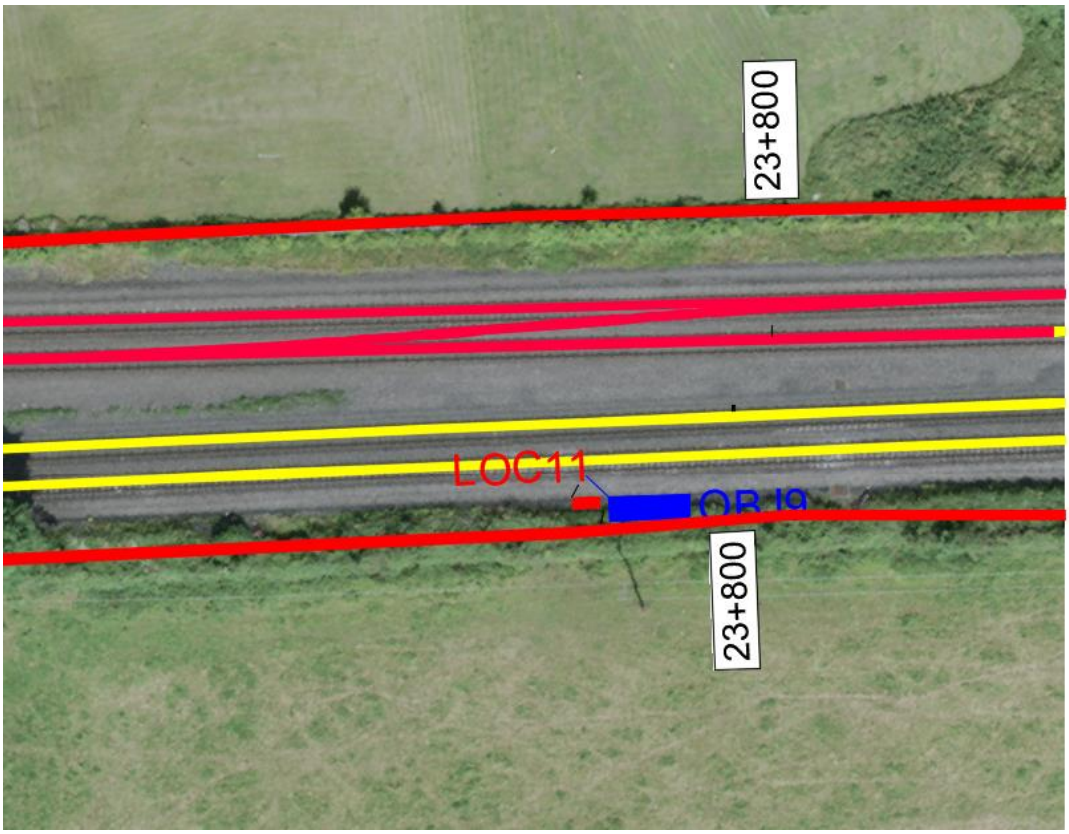


Figure 7-9 New Signalling / LV Infrastructure location (Approx 500m east of Hazelhatch Station)

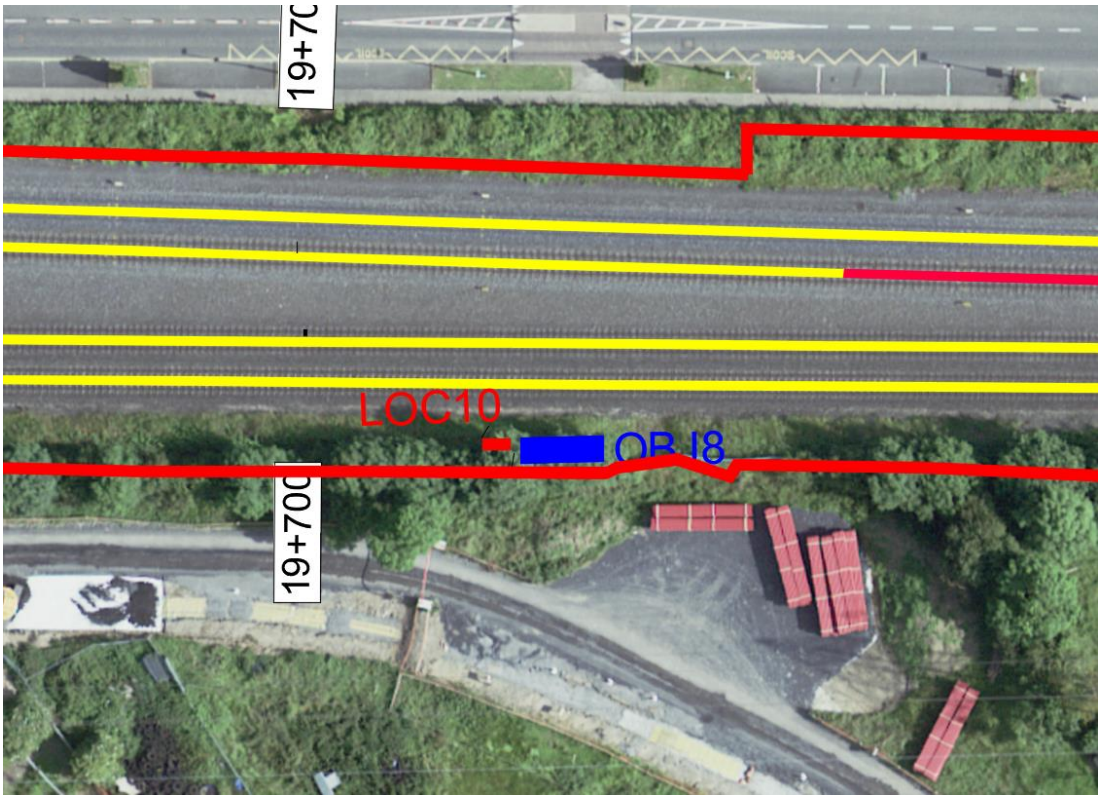


Figure 7-10 New Signalling / LV Infrastructure location (Approx 700m east of Adamstown Station)

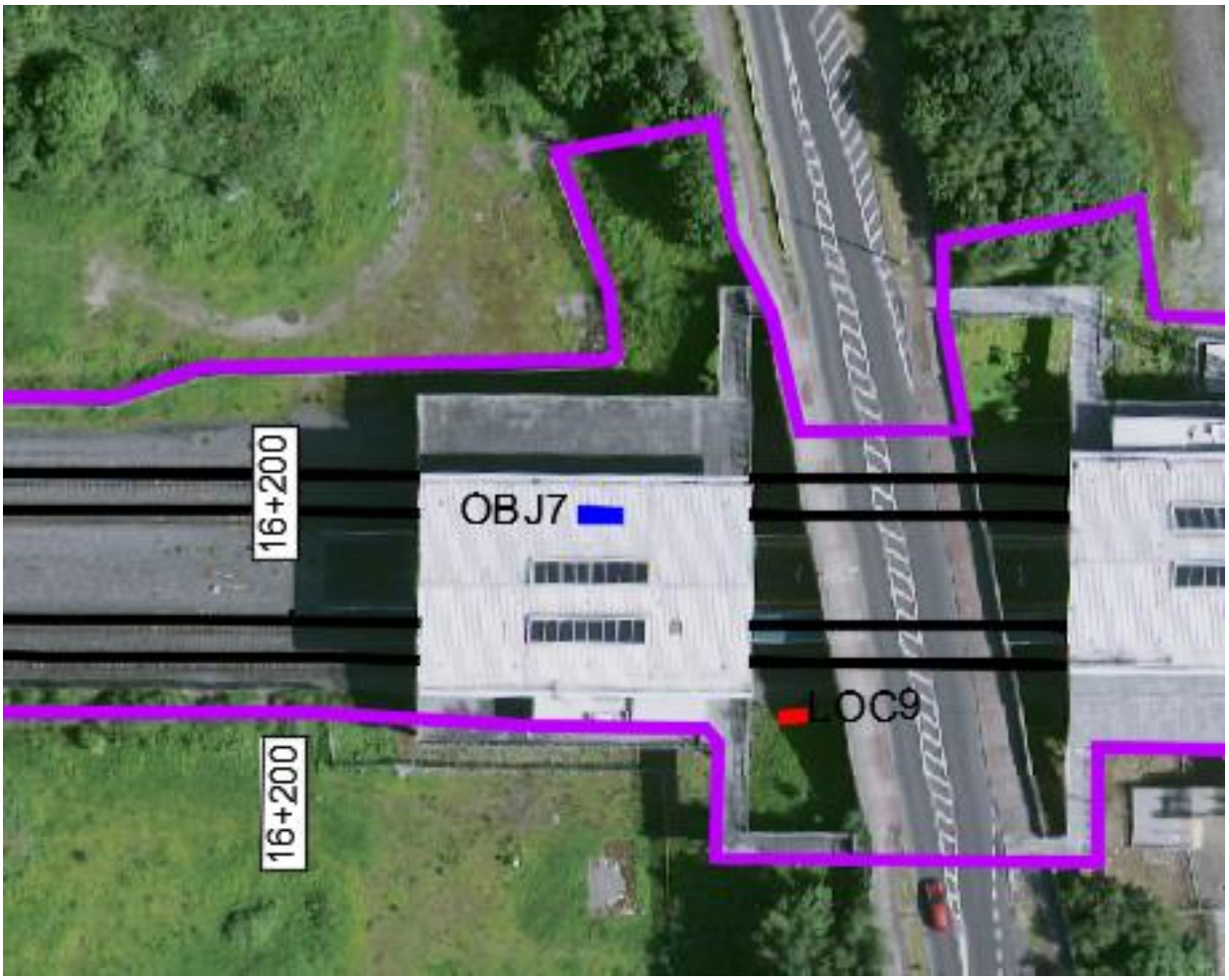


Figure 7-11 New Signalling / LV Infrastructure locations (Clondalkin Fonthill Station)

7.3.3.1.1. Signalling Post

There are currently no proposed signalling cantilevers or gantries in this section and trackside signals would be located on signal posts adjacent to trackside. A typical signal post is shown in **Figure 7-12**.

Figure 7-12 Typical Signal Post

7.3.3.1.2. Object Controller Cabinet (OBJ)

In the railway system, the movement of the train is controlled by an interlocking system. Such an interlocking system consists of different parts. From a logical perspective, there is a central device (computer) that controls and senses the condition of important equipment such as switches, signals, track circuits, etc. This equipment is collectively referred to as an object or rail side object. The equipment that handles the interface between the central device and the object is referred to as an object controller. A typical Object Controller Cabinet is shown in **Figure 7-13**.

Figure 7-13 Typical Object Controller Cabinet (OBJ)

7.3.3.1.3. Location Case

Location Cases (Locs) accommodate railway signalling equipment to detect the location of trains, control the trackside signals and switch the points. They link the physical asset to the control equipment within. Additionally, they are used to accommodate the required power distribution to the signalling equipment. A typical Location Case is in **Figure 7-14.**

Figure 7-14 Typical Location Cases

7.3.3.2. Cable Containment

A cable containment strategy has been progressed and following review of several alternatives such as traditional concrete troughing and direct burying cable routes and secure anti-slip walkways (see **Figure 7-15**), with ladder rack being used on the tunnel walls. Secure troughing occupies the same footprint as concrete troughing but is of lighter more manageable construction. As this trunking also acts as a designated non-slip walkway it will help to mitigate space constraint issues along the route as well as minimise the aesthetic impact to the public. It also has the added advantage that it provides security of cabling from theft and damage as well as providng easy maintenance going forward.

Figure 7-15 Containment walkway

The cable containment route will run adjacent to the track in accordance with standard railway practice and will cross under the track where required using under track crossings (UTX) and secure turning chamber. Type of containment at each stage of the track will be shown at the permanent way cross section drawings. See **Appendix C Drawings**.

7.3.3.3. Telecommunications

The purpose of the Telecom Equipment Building (TER) is to house servers, storage devices, switches, routers, cabling patch panels and any additional passive electronics to provide IT services (access control, CCTV, intrusion detection, patch panels, public address system, voice announcement system, distributed antenna systems) in the station and its area of influence. This is where the physical connection between the field equipment (signals, train detectors, etc.) and the electronic equipment takes place. See **Figure 7-16**.

Figure 7-16 Typical Telecom Equipment Building

TERs will typically be located within stations. They will typically be located as close as possible to the centre of a station, and at a maximum distance of 200 metres from the centre.

For existing stations, a new TER room will be considered when the existing TERs lack sufficient capacity for new equipment to be deployed by DART+.

The following requirements apply to TER rooms/buildings:

- The Station TER shall be as per current IE specifications – e.g.: min 4m x 3m, false floor, air conditioned, dedicated power board, 24hr access, access monitoring, fire detection
- Telecommunication Equipment Rooms (TERs) shall be built as close as possible to the existing TER to facilitate the migration of the existing infrastructure into the new facility.
- DART+ TER's shall accommodate different systems like UPS, telecoms station systems, comms nodes, etc.
- Secured external light switch shall activate the internal equipment room lights

According to the current design, it is expected to implement two TER rooms that will house the new equipment needed for the existing stations.

- New TER room proposed for Adamstown Station (see yellow rectangle at **Figure 7-17**)
- New TER room proposed for Parkwest Station (see yellow rectangle at **Figure 7-18**)

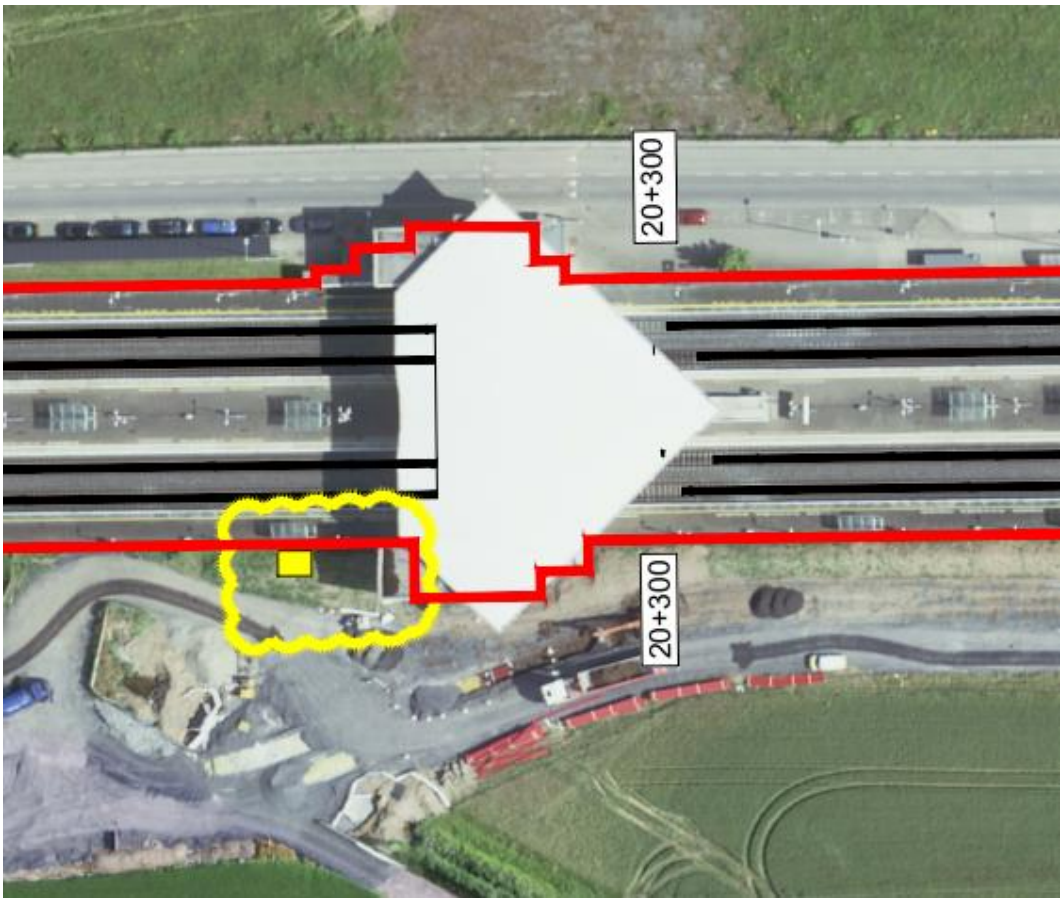


Figure 7-17 Proposed location for new TER room at Admstown station

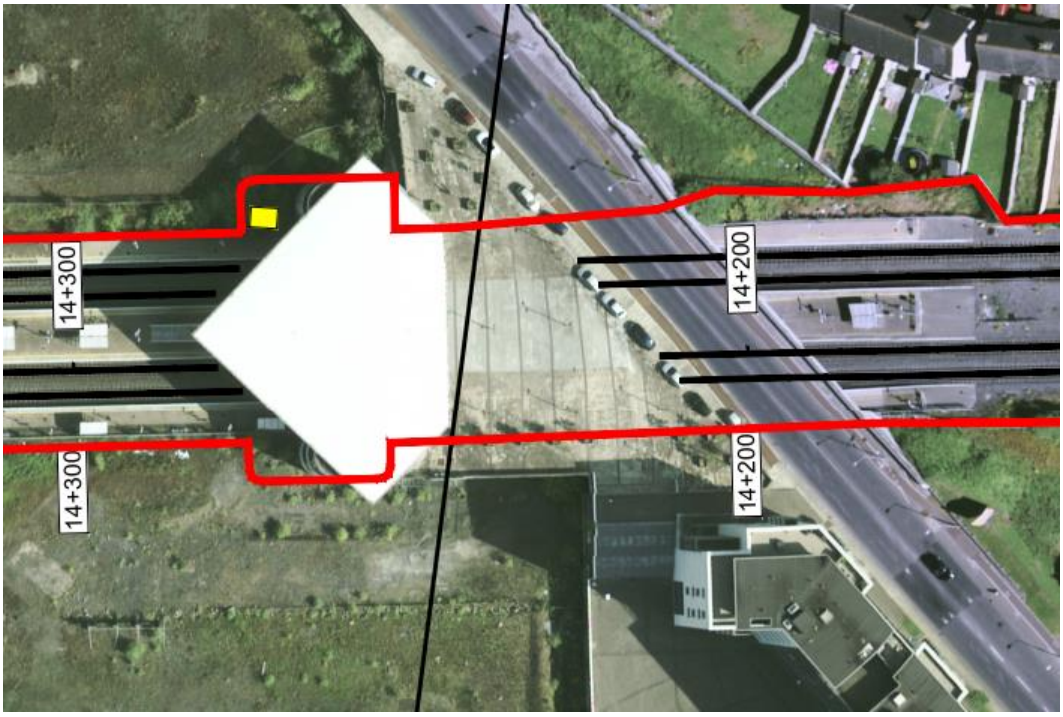


Figure 7-18 Proposed location for new TER room at Parkwest station

7.3.3.4. Electrification

In the Park West to Hazelhatch section, in 4 track area, the electrification equipment will be suported by TTC structures and STC structures where the OHLE to be terminated with anchor arrangement requried in limited space, as detailed in **Section 3.2.1 Electrification System**. **Figure 7-19** shows a typical OHLE TTC arrangement in a four track open route.

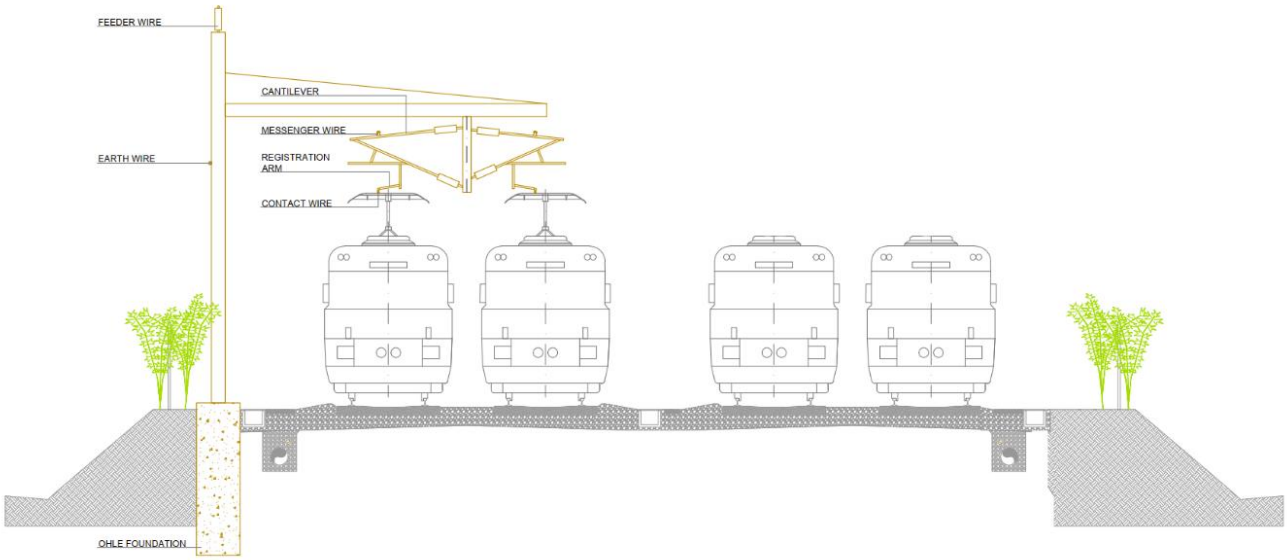


Figure 7-19 Typical OHLE TTC arrangement in four track open route - Facing East

The area through the stations at Hazelhatch & Celbridge, Adamstown, Kishoge, Clondalkin / Fonthill and Park West & Cherry Orchard and will be provided with TTCs or Portals on the platform, see **Figure 7-20**.

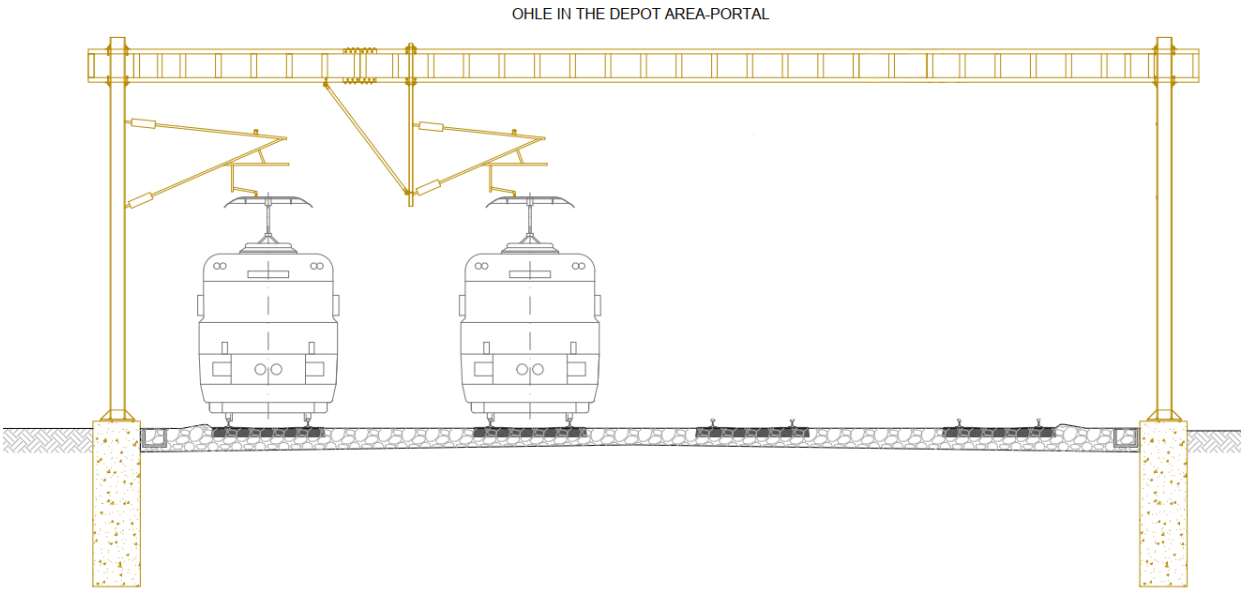


Figure 7-20 Typical OHLE portal arrangement in four track open route - Facing East

7.3.4. Drainage Requirements

No track drainage structures are proposed for this area. The drainage catchments of the railway track remain as existing, and therefore, no additional drainage system is required for this section.

8. Construction

This section of the report sets out the approach in relation to the construction methodology for the works along the section between Hazelhatch and Celbridge Station sidings and up to the Parkwest and Cherry orchard Footbridge.

8.1. Summary of the Proposed Works

The section includes reconstruction of siding turnouts as well as associated P&Cs adjacent to Hazelatch and Celbridge Station in addition to Adamstown Station. Work in the section includes the electrification of 2 no. slow tracks along this existing 4-track section, and the construction of 4 new substations to facilitate the electricification of the two slow lines.

8.2. Bridges

Minimal bridge work and associated road closures are currently anticipated in this section of the project.

8.3. Permanent Way

Works will comprise:

- Diversion or closure of the operational track, utilities and ancillary infrastructure
- Where excavations are significant, support of adjacent operational track
- Excavation of track bed
- Excavation of sub strata
- Replacement of utilities and ancillary infrastructure
- Construction of new track bed

8.4. OHLE Infrastructure

OHLE structures will be required at a maximum spacing of 60m along the track to support the catenary cables. The support structures are generally supported from one side of the track (cantilever) or from both sides (portal) depending on the permanent way layout. Where there are adjacent walls the support structure can be fixed to the walls negating the need for vertical supports (stanchions).

Support structures will be either founded by means of piles or spread foundations, depending on soil conditions or the contractor's preferred methodology.

It is envisaged that the OHLE will be constructed in safe zones adjacent to the live railway or in night-time possessions. The phasing of the works will endeavour to keep a minimum of two working railway tracks during construction on the Cork line, it is envisaged that a safe zone will be possible for construction in this area.

8.5. Substations

Four new substations will be constructed in this area. From a constructability perspective, the substations are relatively straightforward; the main consideration for each site is the large equipment that needs to be brought to site and installed within the buildings. This may necessitate cranage from either within the site or in an adjacent suitable position. The buildings will need to be designed for constant access for maintenance and equipment replacement. Structures to be set more than 4.5m from th erunning edge otherwise derailment loading to be considered. Land will need to be purchased unless the land is already within Irish Rail ownership. Secure fencing will be required around each site to prevent unwanted entry.

The typical duration of construction for an electrical substation is six months, including civil, mechanical and electrical works. The area reserved for construction works is approximately 1000 m2.

8.6. Construction Compounds

Works on this linear scheme will require Construction Compounds at specific locations. The sites will need to accommodate offices for the contractor and client teams, storage facilities, recycling facilities, parking for cars and plant and potentially fabrication areas. It is a prerequisite that the compounds are located close to and ideally with direct access to the site. The sites must be fully serviced with electricity, water, sewerage and telecoms and must have good access to the public road.

The compounds are required at specific construction sub-sites and also distributed along the scheme by geographical features. For example, compounds will be required at each of the bridge reconstruction locations plus will be required to for material processing and storage of construction components. The compounds will be used to support earthworks, ecological clearances, enabling works, site clearance, utility diversions work, civil works, the demolition of bridges, OHLE, track installation, signalling and telecoms equipment and all ancillary works.

Fencing and in some cases screening along with topsoil bunds where topsoil has been removed may be required for each construction compound. Noise screening and temporary guide rail fencing may be required at access locations to the railway corridor. Security fencing will be required for security purposes of both the workforce and the public. Gated access to the site and compounds will be required to check vehicles and personnel arriving on site are permitted to gain access. An access road will also be required from each compound to the site and also joining up to the public road. These access roads will be the main route for vehicles entering the site, including deliveries and arrival and departure of the workforce.

The construction compounds will be located such that they require minimal modification, if any, over the duration of the construction programme. The compounds will typically consist of areas of hardstanding for vehicles and materials and therefore the water runoff will be managed and treated as required.

Section 5 Options outlines the preferred locations for the two construction compounds required for this area; **Section 6 Options Selection Process** provides more detail of the option selection methodology.

A Construction Compound is required in Hazelhatch for undertaking electrification works along the corridor, in addition to localised works including the installation of new trackwork to facilitate the turnback of trains at the station. The preferred location for the site is on the north side of the corridor, it is located on Irish Rail property within the existing station car park – a portion of the car park would be utilised for the compound, leaving the remainder of the parking for regular users of the station.

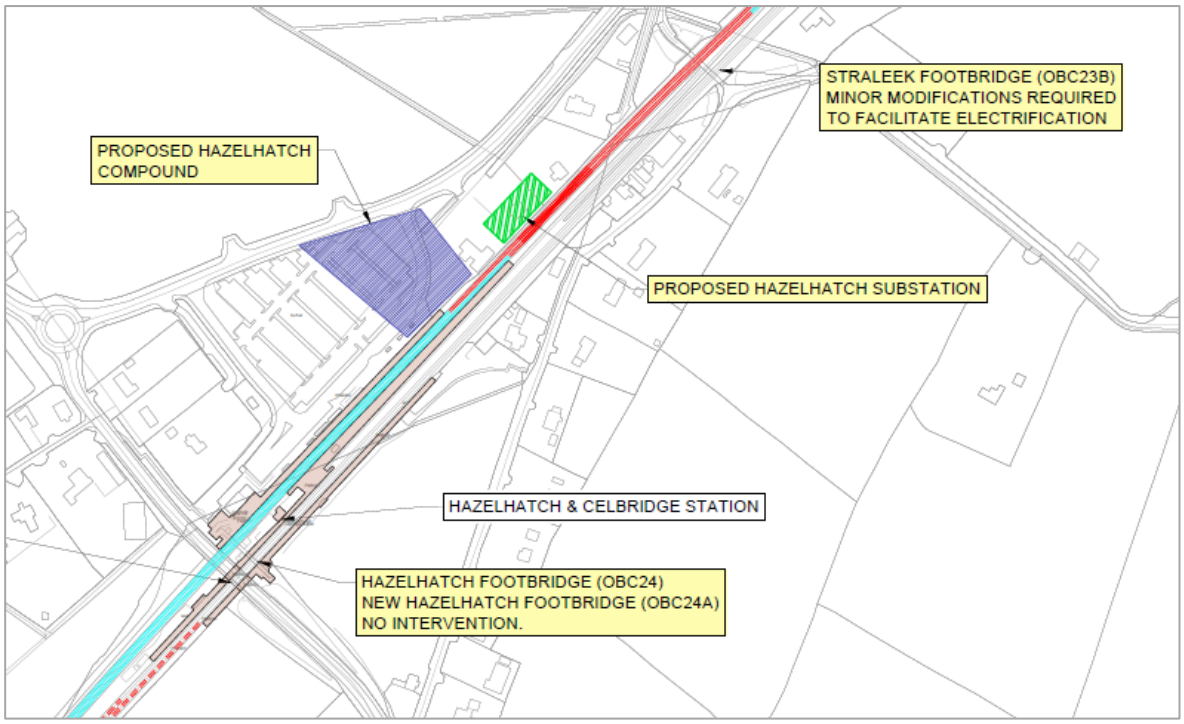


Figure 8-1 Hazelhatch Preferred Construction Compound Location

Another Construction Compound is required at Park West to facilitate the electrification works and the construction of a new electrical substation, the preferred location is on a brownfield site in the ownership of Dublin City Council. Direct road access is via Park West Avenue to the east. The existing Park West Station is located to the east and existing housing developments in the Cherry Orchard area are located further east of Park West Avenue. This area is also the preferred location for a new electrical substation, it is envisaged that the construction compound will also be used to facilitate the construction of the new electrical substation

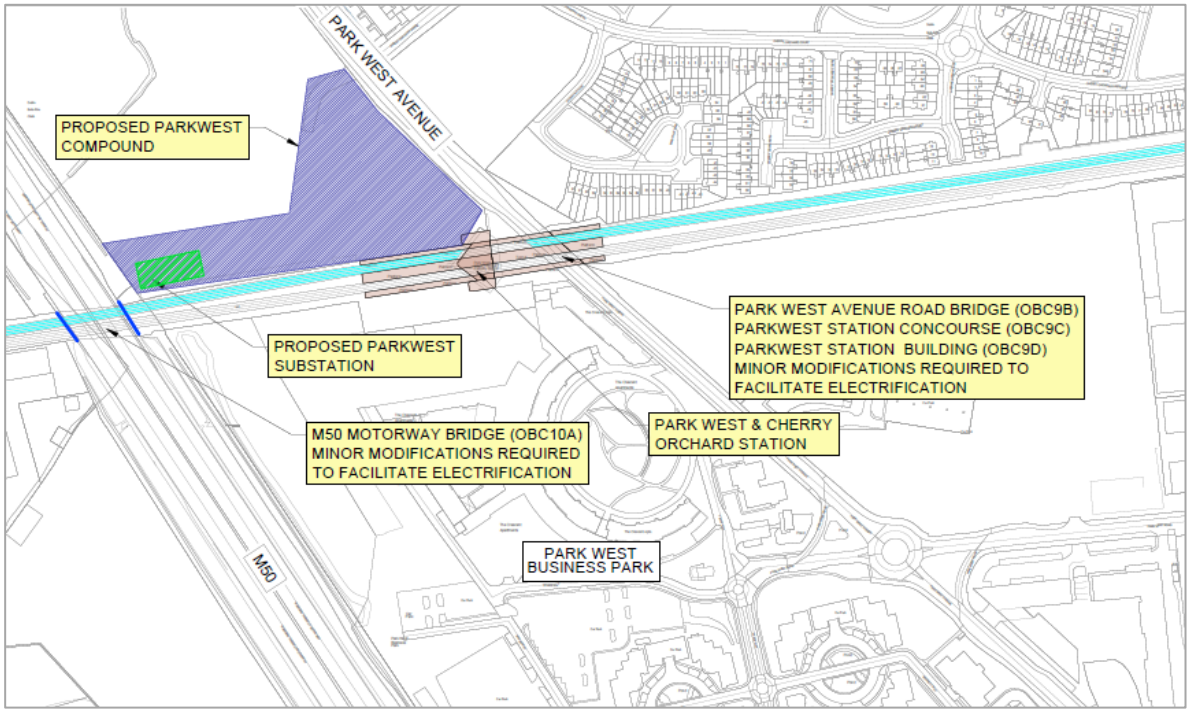


Figure 8-2 Park West Preferred Construction Compound Location

8.6.1. Temporary Traffic Management

As the majority of the works are confined to the rail corridor, the impact on local traffic is expected to be minimal, as such, no temporary traffic management arrangements are envisaged for this section of the project.

8.7. Restrictions

There are restrictions associated with working on or adjacent to the live railway line. Irish Rail will mandate a safe system of work which will invariably include barriers between the live tracks and the working area or full possession of the railway (no trains running).

Every attempt will be made to restrict materials delivery times to outside peak traffic hours; particularly for construction HGV's known to restrict natural flow of traffic. In addition where possible long duration night works will be limited in residential areas unless appropriate noise mitigation can be provided.

A full methodology of the setup and construction methods will need to be sympathetic to both the railway operations, as well as local residents and/or employers in the area. The methodologies will be fully reviewed by the Irish Rail team before the works are given approval to proceed (taking account of all stakeholder concerns from the public consulation phases as well as planning compliance criteria stipulated in the Railway Order).

Appendix A – Sifting Process Backup

A.1 Sifting Process Backup - Hazelhatch to Park West corridor

A.2 Sifting Process Backup - Substations Site Location

- Hazelhatch
- Adamstown
- Kishoge
- Parkwest

Appendix B – MCA Process Backup

B.1 MCA Process Backup – Traction Substations Site Location Selection

- Adamstown
- Kishoge
- Parkwest

Appendix C – Drawings

The following drawings accompany this Technical Report:

Permanent Way Drawings

DP-04-23-DWG-PW-TTA-67391: Adamstown Track Plan Layout

DP-04-23-DWG-PW-TTA-67392: Hazelhatch Track Plan Layout

Substations Drawings

DP-04-23-DWG-EL-TTA-09426: Hazelhatch – IE Proposed Substation Location

DP-04-23-DWG-EL-TTA-09425: Adamstown – IE Proposed Substation Location

DP-04-23-DWG-EL-TTA-09424: Kishoge – IE Proposed Substation Location

DP-04-23-DWG-EL-TTA-09423: Park West – IE Proposed Substation Location