7 Consideration of Alternatives

Contents

List of Abbreviations

Acronym	Meaning
ATO	Automatic Train Operation
AW2	Standard comfort level on Trains - 4 pass/m^2 standing and with and seats ≥ 20%
BCR	Benefit Cost Ration
BRT	Bus Rapid Transit
CAF	Common Assessment Framework
CAPEX	Capital Expenditure
CCTV	Closed Circuit Television
DCU	Dublin City University
DART	Dublin Area Rapid Transit
EIA	Environmental Impact Assessment
EIAR	Environmental Impact Assessment Report
EPR	Emerging Preferred Route
ERM	Environmental Resources Management
FRA	Flood Risk Assessment
GAA	Gaelic Athletic Association
GDA	Greater Dublin Area
GoA	Grade of Automation
HGV	Heavy Goods Vehicles
KDC	Key District Centre
km	Kilometre
LAP	Local Area Plan
MCA	Multicriteria Analysis
MSZ	Metro Station Zone
NMN	New Metro North
NPF	National Planning Framework
NTA	National Transport Authority
OPEX	Operational Expenditure
pphpd	Passengers per hour per direction
SAC	Special Area of Conservation
SDRA	Strategic Development and Regeneration Areas
SDZ	Strategic Development Zone
SEA	Strategic Environmental Assessment
SPA	Special Protection Area
SUDS	Sustainable Urban Drainage Systems
SWDR	Swords Western Distributor Road
tph	Trains per hour
TBM	Tunnel Boring Machine
TCD	Trinity College Dublin
TII	Transport Infrastructure Ireland

7. Consideration of Alternatives

7.1 Introduction

Article 5(1)(d) of Directive 2011/92/EU, as amended by Directive 2014/52/EU (European Union 2014) requires an Environmental Impact Assessment Report (EIAR) to include '*a description of the reasonable alternatives studied by the developer, which are relevant to the project and its specific characteristics, and an indication of the main reasons for the option chosen, taking into account the effects of the project on the environment'.*

The Guidelines on the Information to be contained in Environmental Impact Assessment Reports (EPA 2022) notes the following in respect of alternatives:

"The objective is for the developer to present a representative range of the practicable alternatives considered. The alternatives should be described with 'an indication of the main reasons for selecting the chosen option'. It is generally sufficient to provide a broad description of each main alternative and the key issues associated with each, showing how environmental considerations were taken into account in deciding on the selected option. A detailed assessment (or 'mini-EIA') of each alternative is not required." (EPA 2017, p.34)

This Chapter describes the main alternatives considered at all stages of the MetroLink project development (hereafter referred to as the proposed Project) in order to clearly outline:

- The robust decision-making process that has led to the proposed Project;
- How environmental analysis was integrated into the proposed Project development from the earliest stages of the proposed Project;
- The main reasons, environmental and otherwise, for choosing the proposed Project or the specific element of the proposed Project from the reasonable alternatives
- The likely evolution of the current state of the environment without implementation of the project (do nothing scenario).

Refer to Table 7-1 for an outline of how alternatives have been considered and assessed from plan and policy development through to the proposed Project development. The consideration of alternatives is considered in chronological order through the development of the proposed Project.

Table 7-1: Outline of Alternatives Considered during the Development of the Proposed Project

Alternatives Considered	Description	Section of this Chapter
(Old) Metro North		
Old Metro North	Outline of the consideration of alternatives as relevant to Metro North having regard to environmental effects.	Section 7.2
Strategy/Policy where Alternatives to Metro type project considered		
Fingal North Dublin Transport Study/Transport Strategy for the Greater Dublin Area	Outline of the consideration of alternatives having regard to environmental effects as referred to in the Fingal North Dublin Transport Study 2005 as it informed the Transport Strategy for the Greater Dublin Area.	Section 7.3
Do-Nothing' – Alternative		
'Do Nothing' Scenario	This is a general description of the key environmental effects that would be expected for the Do Nothing scenario should the proposed Project not proceed.	Section 7.4
Identification of the Emerging Preferred Route		
Alternative options for the proposed project	This section summarises the proposed Project alternatives considered leading to the Emerging Preferred Route having	Section 7.6

Alternatives Considered	Description	Section of this Chapter
including an analysis of a "Modified Old Metro North" Scenario.	consideration of the potential environmental effects.	
Refinement of the Preferred Route		
Further assessment of alternative options for the proposed project	This section summarises further alternatives assessments undertaken to determine the preferred route having regard to public consultation feedback.	Section 7.7
Alternative Project Level Design	This section summarises the proposed Project alternatives considered having regard to environmental effects leading to decisions made on project design fundamentals including: ▪ Tunnelling Strategy ▪ Depot Location; ▪ Luas Green Line Deferral: and ▪ Grid Connection & ESBN Substation Location.	Sections 7.7.2, 7.7.4 7.7.7 and 7.7.13
Alternative Technologies	Discussion of alternative technologies considered having regard to environmental effects leading to decisions made on project covering: ▪ Rolling Stock, GOA4 operation; and ▪ The overhead catenary system.	Section 7.7.5 and Section 7.7.6
Alternative Alignments	Alternative alignment options which were assessed having regard to environmental effects to determine the preferred project alignment: ▪ Crossing the M50 Motorway; ▪ Route Alignment at Lissenhall; ▪ Route alignment along R132;and ▪ Realignment under TCD.	Section 7.7.3 and Section 7.7.9
Station locations and layouts	Discussion on how the specific station locations and layouts emerged based on the project design decisions at EPR and PR stage having regard to constraints of each site and potential environmental effects.	7.7.10
Construction Alternatives	This section examines the chapter considered alternatives assessed having regard to environmental effects as they relate to the Construction Phase of the proposed Project: ▪ Tunnel Boring Machine (TBM) launch sites; ▪ Location of Construction Compounds; and ▪ Construction of Stations.	Section 7.8

7.2 Old Metro North (2001 – 2011)

During the development of the (Old) Metro North project a number of fundamentally different alternatives were assessed as part of the process of identifying a preferred transport option to serve the transport requirements of the strategic transport route from Swords to Dublin City Centre via Dublin Airport. The options assessed were as follows:

- *Iarnród Éireann Link*: An option was considered that provided a link to the airport from the Iarnród Éireann network. This option was not approved as it failed to achieve the Government's objectives for the (Old) Metro North project. In particular it was considered that the Iarnród Éireann Link would not serve as a commuter system for north Dublin city and county and would only serve people wishing to make direct connections between the city centre and the airport. The link would have to connect either to the existing northern suburban rail line or the Maynooth suburban rail line to access the city centre. This would negatively impact on the existing capacity of the existing network.

- *"Pre-Metro"*: A Pre-Metro would be similar in concept to the existing LUAS with a high degree of unsegregated street running. Importantly, it would be capable of future segregation through alterations to the infrastructure. While the Pre-Metro concept would have significant advantages in terms of initial capital cost, the overall investment to bring it up to metro standard in the future is likely to exceed the capital cost of building to metro standard from the outset. The future upgrade would be very disruptive, involving for example the replacement of street running sections with elevated tracks, and is likely to require long term interruptions to the metro service while it is implemented. For these reasons, the Pre-Metro alternative was rejected.
- *Fully Automated Metro:* A fully automated railway was assessed. However, at time it was adjudged not to be an appropriate system because it would require very high levels of security and intruder detection that at the time were very costly and generally only used for routes with very high passenger volumes , which could justify the higher capital costs involved. In addition, the provision of a fully automated system was considered to offer a major constraint to the development of Metro West and to any future extensions of (Old) Metro North. In addition, the technology involved at the time could only be procured from two or three sources internationally and once selected would have to be applied to all future extensions. Competition at that stage would be very limited. For these reasons, a fully automated metro concept was rejected.
- *Maglev:* During the feasibility study for the (Old) Metro North scheme, RPA were invited to consider a magnetically levitated guided system (Maglev) by a manufacturer of these systems. Since it was first introduced into commercial service at Birmingham Airport about 20 years ago this technology has been developed in Germany and Japan primarily for very high-speed long-distance travel. Maglev would be very expensive to implement, has a slow and complex track switching mechanism, would represent a significant technical risk and would not meet the need for relatively short distance travel within the airport corridor or the requirement for further extensions. A Maglev system would be impossible to ever integrate with Luas. For these reasons, a Maglev concept was rejected.
- *Metro North:* The preferred option was a fully segregated Metro system along the busiest sections of the route between the city centre and Swords and has a limited number of road crossings in the outer suburban areas north of Swords. The proposed (Old) Metro North was a high-performance state of the art metro system designed to combine good accessibility and competitive journey times with high levels of productivity and relatively low unit operation costs.

Once a decision was made to progress with the (Old) Metro North option, a route selection process was undertaken to identify a preferred route for (Old) Metro North by way of a multi-criteria analysis. Three main options (West route, Central route and East route) were assessed along with a number of variations on these route options based on the following criteria:

- Compliance with transport and land use strategy;
- Minimising environmental impacts including congestion and associated pollution problems;
- Generating social and economic benefits;
- Delivering good quality transport integration;
- Optimising capital and operating costs;
- Delivering a safe and operationally efficient system; and
- Achieving efficiency and minimising risk during construction.

All criteria were judged to be of equal importance and so no weighting was applied to any of the criteria. The environmental element of the assessment of alternatives was undertaken by way of an assessment under the following headings:

- Air Quality;
- Protected Structures;
- Archaeology;
- The Natural Environment;
- Townscape and landscape;
- Noise; and
- Human Beings.

A summary of the assessment is presented in Table 7-2: and this assessment identified that the preferred route option was the "Alternative Central Route" which consisted of a proposed 18km corridor from Belinstown, north of Swords, to St Stephen's Green in the city centre via Dublin Airport.

Table 7-2: Assessment of Alternative Route Options for (Old) Metro North

Criteria	Analysis
Compliance with Transport & Land Use Strategy	The Fingal Development Plan 2005 – 2011 provided for a metro route through the county. In response to statutory consultation, Fingal County Council stated a preference for the metro route to provide a direct link between the strategic development sites of Swords, Metropark, Ballymun and DCU and from there to the centre of Dublin. Only the Central and Alternative Central Routes, which serve Ballymun and DCU, fully meet these objectives. In response to statutory consultation, Dublin City Council stated a preference for the metro route to serve Ballymun and DCU to underpin the significant investment in Ballymun, a prime urban centre in the City Development Plan. Only the Central and Alternative Central Routes fully meet these objectives.
Minimising Environmental Impacts	The Central Route Option is ranked second favourite of the options assessed. It has a high percentage (32%) of tunnelled sections and some 8km (47%) running in parallel with or within existing road infrastructure. This results in a comparatively low number of major constraints, as there is a reduced level of land use change, greenfield land loss or new severance. Thus, the Central Route Option has the best potential to reduce the net impacts of the proposed scheme. The city centre section of the Central Route Option was estimated to impact on approximately 860m of very high-risk archaeological areas through cut and cover construction and associated infrastructure. Between the River Liffey and the Mater Hospital the route has the potential to impact on up to 49 protected structures, though only 5 such structures were identified within the proposed station locations. The likely loss of habitat for fauna and flora on the Central Route Option (65m) is significantly less than the West Route Option (3.2km). The Central Route Option would result in 0.9km of new severance. The Alternative Central Route Option is the best overall performing route. It is almost identical to the Central Route Option in its tunnel sections. There is the potential to encounter very high risk and high-risk areas for archaeology, but the length potentially impacted was estimated as being 800m shorter than that of the Central Route Option. The overall number of protected structures within a 30m corridor width of the Central Route Alternative Option is 59 of which only 4 are within proposed station locations. The likely loss of habitat for fauna and flora on the Alternative Central Route Option (65m) is the same as the Central Route Option.
Generating social and economic benefits	The Alternative Central Route performs best in terms of forecast patronage on (Old) Metro North and in terms of generating patronage on the overall public transport network. The West Route, being the longest, has the greatest overall catchment and serves the highest number of disadvantaged people in terms of unemployment and education level. The Alternative Central is ranked second in this respect, closely followed by the Central Route. All routes are broadly equal in terms of serving inner city RAPID (Revitalising Area by Planning Investment and Development) areas. The Central and Alternative Central Routes serve the largest RAPID site in the study area at Ballymun. The Alternative Central Route had the highest benefit to cost ratio.
Delivering good quality transport integration	All routes terminate at St. Stephen's Green in the city centre and are thus considered neutral in terms of interchange with the proposed Interconnector and with the Luas Green Line. However, the Alternative Central Route offers significantly better quality of interchange with the Luas Red Line than all other routes. The Alternative Central Route, the East Route and the East Route Variant all have excellent interchange with the Maynooth Suburban Railway Line at Drumcondra. This is a strategically important interchange given the role of this line in the proposed restructured DART network.
Optimising capital and operating costs	The Central Route had the lowest capital cost, marginally less than the Alternative Central Route and East Routes.

Criteria	Analysis
	It was estimated that the Alternative Central Route had the lowest maintenance and operating costs overall.
Delivering a safe and operationally efficient system	In relation to the operational efficiency of the proposed Transport 21 transport network, the West Route considerably shortens the required length of Metro West and offers the shortest journey time from Blanchardstown to the city centre on that line. The Central and Alternative Central Routes offer acceptable journey times on Metro West. All routes have very high degrees of segregation and are considered neutral in terms of operational reliability. Safety considerations are also considered neutral across all route options.
Achieving efficiency and minimizing risk during the construction	The West Route has three separate tunnelled sections which adds to the total amount of work to be managed, though offers opportunities for parallel working to reduce overall construction timescales. The West Route is the least attractive against this criterion, while the Central, Alternative Central, East and East Route Variants perform similarly. The Central and Alternative Central Routes require no significant property acquisition in the city centre. In terms of construction programme and risk, the West Route is the most complex overall due to its greater length and the need to tunnel in poorer ground conditions in the city centre. It also has a significant interface risk at Broadstone, where two existing bus depots would have had to be relocated prior to works commencing. The Central Route has a major interface at the Mater Hospital, where the timing of the Mater Development and the Metro project would have required close coordination. The Alternative Central, East and East Route Variant Routes involve constructing a number of underground stations on the strategic Swords Road corridor, though some of these could be relocated off-street. The Central and West Routes would have had the most significant impact on roads in the city centre. The Alternative Central Route, incorporating a partly mined station at O'Connell Bridge, would have reduced construction disruption compared to all of the other routes which involve full cut and cover stop construction. Overall, the Alternative Central Route performs best in respect of this objective.

Following the selection of the preferred route for (Old) Metro North, further alternatives analysis was undertaken to identify the following:

- Proposed stop locations;
- Access and design including the proposed Metro West interchange;
- Detailed horizontal and vertical track alignment between stops;
- Location of crossovers and turn backs between tracks;
- Location and design of Park & Ride car parks; and
- Depot location and design.

This analysis led to the identification of a proposed project that would serve an 18km corridor from Belinstown in the north of County Dublin to St Stephen's Green in the city centre via Dublin Airport. The proposed (Old) Metro North project was a metro system running under full signal control on a segregated alignment between St. Stephen's Green and Fosterstown Stops and running on a line-of-sight basis, at grade, in underpasses or on elevated sections between Fosterstown and Belinstown. It was proposed that the (Old) Metro North project would run in a mix of bored and cut and cover tunnels beneath the city and in bored tunnels beneath Dublin Airport. The preferred option was then brought forward through the Railway Order process, with the required documentation submitted including an Environmental Impact Statement. In October 2010, (Old) Metro North was granted a Railway Order by An Bord Pleanála ('the Board') (Reference PL06F.NA0003). The Railway Order is cited as Railway (Metro North – Belinstown to St Stephen's Green) Order 2010. The Board approved the Railway Order with the exception of the following elements, which were not approved:

- The originally proposed depot and ancillary facilities (including a station) at Belinstown;

- The proposed line and stop at Lissenhall; and
- The station at Seatown.

In response, a subsequent Railway Order application was lodged for the proposed depot relocated to a site at Dardistown (Reference PL06F.NA0007). This additional Railway Order was granted in 2011, referred to as Railway (Metro North Dardistown Depot and Spoil Management Strategy) Order 2011.

However, following the economic downturn that commenced in 2008, The Infrastructure and Capital Investment 2012 – 2016: Medium Term Infrastructure Framework (DPER, 2011) laid out a plan to defer a number of major infrastructural projects including the (Old) Metro North project in order to achieve fiscal consolidation.

7.3 Fingal North Dublin Transport Study

In 2014 the National Transport Authority (NTA) commissioned 'Fingal/North Dublin Transport Study' (NTA 2015) to identify the optimum long term public transport solution to connect three core areas, namely Dublin City Centre, Dublin Airport and Swords, running north/south through the Fingal and Dublin City local authority areas. The study considered alternative transport solutions for the provision of transport infrastructure for the year 2035.

The strategic context for the proposed public transport infrastructure is based on the assumption that the travel demand within the study area will grow by approximately 40% by 2040 as determined by transport modelling for a Do Minimum Scenario undertaken for the Fingal/North Dublin Transport Study' (NTA 2015).

The study was undertaken in two distinct stages:

- Stage 1 was concerned with identifying the strategic context for future development within the study area. In response to this demand, a list of 25 potential public transport schemes was identified for the area. Each of these was developed to a conceptual level and appraised, with a shortlist of six potential schemes for future development recommended;
- Stage 2 provided an opportunity for further development of the analysis of each of the six shortlisted schemes to enable a more detailed appraisal. The technical and operational feasibility, environmental impact and cost of each scheme was developed, and detailed transport modelling was undertaken to understand how each scheme might respond to future travel demand within the study area. The outcome of Stage 2 is the identification of one preferred public transport scheme for future development within the study area.

As part of Stage 2, all technically feasible options were subject to detailed appraisal in accordance with the Department of Transport's Guidelines on a Common Appraisal Framework (CAF) for Transport Projects and Programmes' (DTTAS 2016).

The assessment resulted in the identification of one preferred public transport scheme for future development within the study area.

7.3.1 Alternatives Considered

The 25 alternative transport options to serve the Fingal/North Dublin Corridor in Stage 1 are listed in Table 7-3. The options assessed included for heavy rail, light rail Bus Rapid Transit (BRT) options in addition to combination options.

Table 7-3: Summary of Stage 1 Analysis

Option Ref	Stage 1 Option	Stage 1 Analysis
Heavy Rail Options		
HR1	Heavy Rail Clongriffin to Airport	HR1 does not meet the basic project objective to serve Swords

Option Ref	Stage 1 Option	Stage 1 Analysis
		and was therefore eliminated from further consideration.
HR2	Heavy Rail extension of HR1 to Swords	HR2 performs well against economic criteria and serves a reasonably good level of population per extra kilometre of track and integrates reasonably well with policy and existing public transport. As a result, it was included for further consideration.
HR3	Heavy Rail Malahide to Airport via Swords	HR3 performs poorly against the economic criteria and serves less passenger numbers per kilometre than HR2 and as a result was therefore eliminated from further consideration
HR4	Heavy Rail North Malahide Estuary to Airport via Swords West	HR4 performs similarly to HR3 and as a result was eliminated from further consideration
HR5	Combination HR1 + HR3	HR5 performs similarly to HR3 but with lower passenger numbers and as a result was eliminated from further consideration
HR6	Combination HR1 + Spur Malahide to Swords	HR6 performs poorly on the economic criterion as it involves constructing a relatively large length of track to serve a small population. Furthermore, it does not align with land use policy and as a result it was eliminated from further consideration.
HR7	Heavy Rail Maynooth Line (Broombridge) to Swords via Airport	HR7 was ruled out from further consideration as it is a long route with high journey times. As a result, it was eliminated from further consideration.
HR8	Heavy Rail Maynooth Line (Drumcondra) to Airport-Swords, under Glasnevin	HR8 serves a highly populated catchment, is very well integrated with existing land use policy and existing public transport. As a result, it was included for further consideration.
HR9	Heavy Rail Heuston to Swords via Phoenix Park Tunnel, Under Glasnevin	HR9 was significantly constrained by the Phoenix Park tunnel. As a result, it was eliminated from further consideration.
HR10	Metro Dublin (scheme from St James's Hospital to Malahide.	HR10 was eliminated due to constraints in connecting St James's hospital to Heuston Station and constraints using the Phoenix Park tunnel. As a result, it was eliminated from further consideration.
Light Rail Options		
LR1	Broombridge to Finglas	LRI eliminated from further consideration as it did not meet key project objectives of providing connectivity to Swords.
LR2	Broombridge to Swords via Airport and Finglas	The estimated journey time for this option was very long when compared to other options and as a result, it was eliminated from further consideration.
LR3	LCC to Swords via Airport, under Glasnevin	It was considered that LR3 merited further assessment and as a result it was included for further consideration.
LR4	LCC to Swords via Airport, via Phibsborough	It was considered that LR4 merited further assessment and as a result it was included for further consideration.
LR5	LCC to Swords via Airport, via Drumcondra (Luas D2)	It was considered that LR5 merited further assessment and as a result it was included for further consideration.
LR6	(Old) Metro North	This option scores well in terms of potential benefits, but it scores poorly on cost. As a result, option LR7 was developed to provide a lower cost alternative to (Old) Metro North. LR6 was eliminated from further consideration.
LR7	Optimised Metro North (The same alignment as LR6 but includes a number of significant variations such as shorter platforms, smaller stations, reduced	LR7 provides a similar service to "Metro North" but at reduced costs. LR7 was included for further consideration.

Option Ref	Stage 1 Option	Stage 1 Analysis
	rolling stock, fewer stations and vertical alignment changes).	
LR8	Dublin City Access Transit (CAT). An option proposed that entailed an extension of LUAS Cross City to Swords via Dorset St and Drumcondra Road.	LR8 had significant journey time to the airport and would cause significant traffic disruption as it operates at street level. As a result, LR8 was eliminated from further consideration.
Bus Rapid Transit		
BRT1	Clongriffin to Airport via Malahide	BRT5 was included for further consideration which included BRT 2,3 & 4
BRT2	Clongriffin to Airport	
BRT3	City Centre to Airport via Ballymun	
BRT4	Docklands to Swords via Tunnel	
BRT5	Combination of BRT2, BRT3, BRT4	
Combined Options		
C1	Combination of HR1 and LR3	C1 was brought forward for further consideration as it provides high capacity and low journey times.
C2	Combination of HR1 and high-capacity BRT Swords -Airport	C2 was eliminated from future consideration as it failed to provide a fixed rail commuting service to Swords and had limited ability to cater for the future long-term corridor needs.

The Stage 1 analysis reduced these options down to six reasonable options based on an assessment of the feasibility of the option and on the consideration of whether the scheme meets the fundamental project objectives by serving Swords, Dublin Airport and the city centre.

The short-listed options were then subject to further analysis by way of a Multi-Criteria Analysis (MCA) having regard to Environment, Economy, Safety, accessibility and Social Inclusion and Integration (Refer to Table 7-4 for the outputs of the stage 2 analysis. The six options considered were as follows:

- HR2: A heavy rail spur from Clongriffin to the Airport and Swords;
- HR8: A heavy rail spur from the South Western Commuter Line to the Airport and Swords via tunnel under Glasnevin;
- TLR3: A light rail connecting Luas Cross City to the Airport and Swords. Two variations of this option were considered for the city centre section to account for tunnelled and surface options. However further analysis identified that the at grade option does not have sufficient capacity to meet future demand;
- LR 7: An optimised version of Old Metro North with cost savings as a result of scaling down the system and replacing sections of tunnelling with surface sections;
- BRT5: Proposed BRT services; and
- C1: An option that combines a heavy rail connection from Clongriffin to the Airport with an extension of LUAS Cross City to the Airport and Swords.

Table 7-4 Summary of Stage 2 Analysis

Option Ref	Stage 1 Option	Stage 2 Analysis	Stage 2 Environmental Analysis
Heavy Rail Options			
HR2	Heavy Rail extension of HR1 to Swords	HR2 score worst of all short-listed options under Safety, Economy, Accessibility and Social Inclusion and Integration.	**Noise and Vibration (N&V):** Potential N&V impacts during the progression of the TBM under Swords and Dublin Airport, but least impact from noise and vibration during the Operational Phase; **Landscape:** Potential for significant landscape impacts arising from Clongriffin to Dublin Airport due to proposed elevated section.

Option Ref	Stage 1 Option	Stage 2 Analysis	Stage 2 Environmental Analysis
			Biodiversity: Along the Airport to Clongriffin section there are likely impacts on biodiversity due to the removal of hedgerows. Watercourse crossings and possible connectivity to designated Natura sites also needs to be assessed in more detail **Land Use:** Likely significant impacts arising as a result of impacts on "greenbelt" zoning from Clongriffin to Dublin Airport. **Cultural Heritage:** Potential adverse impacts on a high concentration on sites and monuments between Malahide Road and Clonshaugh Road.
HR8	Heavy Rail Maynooth Line (Drumcondra) to Airport-Swords, under Glasnevin	Further analysis at Stage 2 identified that HR8 would not have the capacity to respond to future travel demand and as such has not been subject to further analysis.	HR8 was not feasible and as a result did not meet future demand requirements. As a result, it was not subjected to environmental assessment.
Light Rail Options			
TLR3	Tunnelled option from LCC (Broadstone) to Swords via Airport, under Glasnevin	This option scores well in terms of Environment, Economy and Accessibility and Social Inclusion. However, LR7 scores better on economy.	**N&V:** Potential impacts during Construction Phase due to tunnelling activity. **Cultural Heritage:** Temporary removal or relocation of monuments during construction, in particular the siting of TBM launch sites. **Land Use:** Temporary/permanent changes to land use likely, particularly at Broadstone. *Landscape and Visual Quality:* Potential impacts of LR3 development include the removal of trees, street furniture and paving to accommodate the alignment and stations, especially within Ballymun and on the R132 alignment.
LR7	Optimised Metro North (The same alignment as LR6 but includes a number of significant variations such as shorter platforms, smaller stations, reduced rolling stock, fewer stations and vertical alignment changes).	Appraisal of the shortlisted scheme options has demonstrated that LR7 is the most advantageous option for delivery in the long term under all relevant headings of Environment, Safety, Economy, Accessibility and Social Inclusion and Integration.	**Air Quality:** Once operational, the proposed scheme would have little or no negative impact on air quality along the alignment. Any changes in local air quality would be associated with changes in traffic flows on Dublin's road network as a result of the proposed scheme; **N&V:** Some residual noise impacts during construction and operations which will be minimised through design and mitigation measures. Vibration impacts during construction would need to be assessed in detail while no significant vibration impacts post-construction are likely due to tunnel depths; **Landscape:** Some impacts from construction compounds, hoarding and removal of landscape features are expected. Mitigation measures can be applied. Some high or very high significance impacts during operation are possible where views are blocked. Mitigation measures can be implemented; – *Biodiversity:* Some temporary loss of habitat of low nature conservation value during construction is expected. Some permanent loss of semi-natural habitat which is deemed insignificant due to the low species diversity it supports. When

Option Ref	Stage 1 Option	Stage 2 Analysis	Stage 2 Environmental Analysis
			operational the proposed scheme will have no significant impact on habitats and surrounding wildlife; **Cultural Heritage:** Temporary removal or relocation of monuments during construction is possible. Removal of the curtilage of some buildings with architectural merit is possible. In addition, there are residual impacts from the visual impact of above ground structures on the existing environment;
Bus Rapid Transit			
BRT5	Combination of BRT2, BRT3, BRT4	Further analysis at Stage 2 identified that BRT5 would not have the capacity to respond to future travel demand without the provision of significant additional infrastructure work. As such it has not been subject to further analysis.	BRT5 was not feasible and as a result did not meet future demand requirements. As a result, it was not subjected to environmental assessment.
Combined Options			
C1	Combination of HR1 and LR3	C1 scores worst of all short-listed options on Environment and is neural compared too other options under safety, Economy, Accessibility and Social Inclusion and Integration.	**Air Quality:** Once operational, C1 would have limited impact on air quality. Any changes in local air quality would be associated with changes in traffic flows as a response to delivery of the scheme. **N&V***:* Consideration needs to be given to the potential construction impacts of tunnel boring at Glasnevin and under the Airport. Once operational, HR1 will generate noise impacts within the surface/elevated sections from Clongriffin to the tunnel portal. The noise impacts of LR3 are less significant as the route runs mainly on existing busy traffic routes. **Landscape:** Elevated structures on LR3, such as over the M50, will result in visual impacts in addition to the area from Clongriffin to the Airport where HR1 would be elevated over arable land that is flat in nature; **Biodiversity:** Within the Airport to Clongriffin section there are likely impacts on biodiversity due to the removal of hedgerows. Surface sections of LR3 north of the Airport may also have negative impacts on biodiversity; **Cultural Heritage:** C1 would have potentially significant impacts on sites of archaeological and architectural heritage. HR1 runs through an area with a high concentration of sites and monuments between Malahide Road and Clonshaugh Road. These include a variety of sites e.g., single ditched enclosures, wells, churches and graveyards etc. In addition, the impact of tunnelling under Glasnevin for LR3 is to be determined;

Further detail on each of these options and the findings of the full assessment undertaken can be found in the 'Fingal/North Dublin Transport Study' (NTA 2015).

7.3.2 Main Reasons for Choice

The assessment identified an Optimised Metro North (LR7) as the best medium- and long-term transport project for the Greater Dublin Area for the following reasons:

- It was the most economically advantageous scheme when compared to other options, delivering the highest benefit to cost ratio (BCR) of 1.5, almost double the BCR of the next best scheme (Tunnelled Luas);
- It generated the highest level of transport benefits when compared to other options, with the highest number of additional public transport trips generated in the morning peak travel period;
- It provided a new strategic public transport corridor, avoiding reliance on either the existing heavy rail lines or the Luas Cross City line;
- It delivered a connection right into the centre of the city, serving O'Connell Street and St. Stephen's Green;
- It retained the opportunity to extend Luas Cross City to Finglas, which would not be feasible if the tunnelled LUAS options were selected, and it avoided reducing the service level on LUAS Cross City to Cabra and Broombridge;
- Due to the high level of segregation, it was considered to significantly increase capacity to allow for potential future growth along the corridor, when compared to other options;
- It could potentially be extended southwards in the longer term to alleviate high travel demand on the LUAS Green Line, and ultimately form a complete north south metro corridor traversing both the north and south city; and
- This option delivered the highest safety benefits when compared to other options.

7.3.3 Comparison of the Environmental Effects

Having regard to the environmental assessment that informed the choice of LR7, some of the other findings were as follows:

- Noise & Vibration: Some noise impacts were identified during the construction and Operational Phases, that could be minimised by design development and the implementation of mitigation measures.
- Air Quality & Climate: This option has the highest positive environmental impacts through the improvements in air quality and the highest reduction in greenhouse gas emissions when compared to other options
- Landscape & Visual: Some potential for impacts associated with construction compounds, hoarding and the removal of landscape features. However, mitigation measures could be adopted to reduce impacts. The assessment also identified some impacts associated with the tunnel portals as well as the surface sections in rural areas south of Swords.
- Biodiversity: Some temporary loss of habitat of low conservation value was expected during the Construction Phase. This option was the preferred option from a Biodiversity perspective. Once, operational the proposed project will have no significant impacts on habitats and surrounding wildlife.
- Cultural, Archaeological and architectural heritage: The proposed Project could result in temporary removal or relocation of monuments during the Construction Phase, with the potential for the removal of the curtilage of some buildings of architectural merit. Overall, the LR7 option was considered the preferred option from a cultural heritage perspective.
- Land Use, Soils and Geology: Potential impacts due to land take and severance in addition to potential impacts on soils due to soil usage and degradation during the Construction Phase.
- Water Resources: The assessment identified potential for residual impacts on groundwater of low significance, with residual impacts on surface water resources considered to be of a low magnitude with negligeable to low significance.
- Accessibility and Social Inclusion: The preferred option scores well by providing the most benefit as it passes through 12 deprived areas along the route.

The study identified that the optimized Metro North project could be delivered in phases, or with the delivery of the full alignment with fewer stations. However, such an approach would result in lower benefit to cost ratios when compared to a full project delivery.

7.3.4 The Transport Strategy of the Greater Dublin Area 2016 - 2035

As detailed in Chapter 3 (Background to the MetroLink Project), The Transport Strategy for the Greater Dublin Area 2016-2035 (hereafter referred to as the Transport Strategy for the GDA) provides a framework for the planning and delivery of transport infrastructure and services in the GDA over the next two decades. The strategy identified that the Fingal/North Dublin Transport Study assessed a range of heavy rail, light rail and bus rapid transit options and recommended Optimised Metro North (LR7), a scheme that follows the same alignment as the previously proposed (Old) Metro North scheme, but which incorporates a number of significant variations, including shorter platforms permitting smaller stations, reduced rolling stock, fewer stations and vertical alignment changes.

On the basis of the Fingal/North Dublin Transport Study, the Transport Strategy for the GDA recommended that the Optimised Metro North (LR7) or "New Metro North" be further developed in order to further develop the light rail network in Dublin. This project was later re-named as "MetroLink".

It should be noted that the Transport Strategy for the GDA and the draft Greater Dublin Area Transport Strategy 2022-2042 (hereafter referred to as the draft transport Strategy for the GDA) supports the proposed MetroLink project by identifying it as one of the major projects supported by the strategy. The draft strategy does not provide any further alternatives or options for the proposed project

7.4 Do Nothing Scenario

The development of a metro to link Swords and Dublin Airport to the City Centre, has been a central element of transport planning for Dublin for over 20 years as discussed in detail in Chapter 3 (Background to the MetroLink Project)of the EIAR.

7.4.1 Implications of Do-Nothing Scenario for MetroLink Project Objectives

The overall project objective for the proposed Project, as established by the National Transport Authority (NTA) and Transport Infrastructure Ireland (TII) and as informed by planning policy context is as follows, MetroLink will:

'provide a sustainable, safe, efficient, integrated and accessible public transport service between Swords, Dublin Airport and Dublin City Centre'. (National Development Plan 2021-2030, Box 9.1).

The Do-Nothing option would not deliver the project objective. With no improvements made to the current transport systems, transport travel demand will continue to increase, and the current transport system will not increase its capacity sufficiently to meet the future predicted demand as identified in the Fingal North Dublin Transport Study (NTA 2015) and as discussed further in Chapter 3 (Background to the MetroLink Project).

With the predicted increases in transport demand due to predicted population increases, use of the private car will also increase, leading to an increase in traffic congestion levels causing detrimental environmental impacts. As a result, the Do Nothing Scenario would result in environmental impacts as summarised below:

Traffic and Transport: The Do-Nothing scenario considers the existing transport network simply in terms of its suitability to meet future demand, with no improvements being made to current systems.

With no improvements made to the current transport systems, transport travel demand will continue to increase, but the current transport system will not increase its capacity to accommodate this.

In terms of public transport provision, the bulk of the study area has bus services only with relatively small catchment areas served by the heavy rail line. The existing and committed public transport provision do not serve the existing or future demand in the key nodes of Dublin Airport and Swords. This means that there are currently very high levels of private car based transport particularly on a number of key routes within the study area for the proposed Project:

- Swords to City Centre: 75% of trips are currently by road, with just 21% of trips by public transport;
- Trips within Swords: 49% are by road, with just 8% by public transport;
- Trips to/from Dublin Airport: 72% are by road with just 22% by public transport.

Assessment of the expected future transport and land use scenario indicates that a large proportion of trips within the study area, in particular north of the M50, will be car based. Without improved public transport provision, the road network will struggle to cope with increased travel demand into the future. The Fingal / North Dublin Transport Study modelling indicated significant delay, with travel times increasing by 72% and average speeds decreasing by 19%. Similarly, the bus network will experience overcrowding as demand increases.

- Analysis undertaken and presented in Chapter 9 (Traffic and Transport) has also identified that in the absence of the proposed Project existing public transport corridors will be beyond capacity by as early as 2030: Dart Northern Line will be over capacity particularly on approach to Dublin City Centre by 2030 (for Scenario A, where MetroLink does not occur, but other committed public transport projects are delivered);
- All key bus corridors are over capacity by 2030, except corridor N1 Drumcondra for Scenario A; and;
- All key bus corridors are above capacity for 2030 except the Dublin Airport Corridor which is predicted to be at capacity under Scenario B (which is where all other projects proposed under the Transport Strategy for the GDA are delivered, except MetroLink).

Further details can be found in Chapter 9 (Traffic and Transport), Section 9.5.

Population and Human Health: In the event that the proposed Project does not proceed, whilst population and employment continue to grow, the absence of the proposed Project is likely to be a constraint on the economic and physical growth of the region and at the local level for the following reasons:

- Significant areas of land have designated land use zoning to support this public transport system, particularly in the Fingal County Council area and any land identified as Metro Economic Corridor would require redesignation if the proposed Project does not proceed.
- Connectivity and accessibility would be likely to deteriorate within the Study Area and wider Dublin region in the absence of the proposed Project given the anticipated population growth within the Study Area and capacity constraints on the existing transport infrastructure network. Restrictions could therefore be placed on residential, commercial and industrial development in the absence of the proposed Project.
- It should also be noted that in the absence of the proposed Project, those buildings that need to be acquired would remain in their current ownership and those likely significant effects on amenity of the local population would not arise.

Human Health: Human Health impacts will arise due to increases in emissions to air and noise levels associated with increased traffic congestion.

Noise & Vibration: In the Do Nothing Scenario there will be no increases in emissions to air due to the Construction Phase. However increased traffic congestion during the Operational Phase of the proposed Project would result in increases of noise levels in the absence of MetroLink.

Noise monitoring undertaken for the proposed Project has identified that existing noise levels in the area are dominated by traffic noise. Exceedances of the noise criteria used in this assessment have been recorded all along the alignment of the proposed Project (Refer to Table 13.20 in Chapter 13 (Airborne Noise & Vibration) for further details of the criteria) and these exceedances are primarily related to traffic noise. While exceedances were recorded at almost every location along the alignment, they were particularly notable at residential locations along the R132 and at city centre locations. In the absence of the proposed Project and other public transport enhancement projects elevated noise levels associated with traffic will continue.

Air Quality: In the Do Nothing Scenario there will be no increases in emissions to air due to Construction Phase. However, modelling presented in Chapter 16 (Air Quality) identified 74 exceedances in the annual mean concentrations of NO2 (for both "Northern Peak Scenario" and "Southern Peak Scenario" for the Do Nothing Scenario.

Increased traffic congestion in the absence of the proposed Project would result in increases of emissions to air. Chapter 16 (Air Quality) identifies that emissions of NOx, NO2, PM10, PM2.5, HC, CO, Benzene and Butadiene will be higher for the Do Minimum scenario when compared to the Do Something scenario for the opening year and the design year.

Climate: The construction of the proposed Project will result in the generation of an additional 5kT CO2eq when compared to the Do Nothing scenario.

The Do Nothing scenario assumes no changes to the road infrastructure within the extents of the Proposed Scheme takes place. Under this scenario, the GHG emissions experienced within the study area will remain largely unchanged. In contrast, the Do Minimum is a defined scenario within the traffic modelling exercise in Chapter 9 (Traffic and Transport) shows a reduction of GHG emissions resulting from the proposed Project when compared to the Do Minimum scenario for the opening year (9 - 11 Kt CO2eq) and the design year (0.51 - 45 Kt CO2eq).

The DN Scenario for the vulnerability of the environment to climate change assumes no changes to the road infrastructure within the extents of the Proposed Scheme. Under this scenario, the vulnerability of the existing environment to climate change will remain largely unchanged.

Hydrology/Hydrogeology: In the event of the proposed Project not being constructed, there would be no potential impacts on surface water resources along the alignment of the proposed project during the Construction Phase as identified in Chapter 18 (Hydrology) and Chapter 19 (Hydrogeology). However, in the absence of the proposed project continued low density development would result in increased potential impacts on the watercourses and groundwater within the study area.

Soils and Geology: In the "Do Nothing Scenario" there would be no direct impact on the soils and geology baseline. However, future development along the proposed Project corridor would be of less density, resulting in impacts on a greater area of soils (and underlying geology), due to the greater area required to accommodate the future population requirements.

Land Take/Agronomy: The proposed project will require land take in order to provide sufficient land for the construction of the proposed project and for the infrastructure to be provided by the proposed project. In the Do Nothing Scenario, the land take needed as identified in Chapter 21 (Land take) will not be required. Furthermore, impacts of agricultural enterprises as presented in Chapter 23 (Agriculture) will not be required in the Do Nothing scenario.

However, in the absence of the proposed project, it would be much more difficult to provide compact, higher density growth required to meet the future population projections. This would mean that future development would progress at a lower density, requiring a relatively larger land take.

Infrastructure and Utilities: The proposed Project will impact on existing Infrastructure and Utilities and will require realignment and diversions of this infrastructure as outlined in Chapter 22 (Infrastructure and Utilities). In the Do Nothing scenario, there will be no impact on existing infrastructure and utilities.

Materials & Waste Management: In the Do Nothing scenario the material and resource requirements identified in Chapter 24 (Materials & Waste Management) will not be required. Furthermore, the material and waste generation predicted in the Chapter will not be generated.

Archaeology & Cultural Heritage: In the Do Nothing Scenario there will be no impacts on sites of archaeological heritage or areas of archaeological heritage potential as identified in Chapter 25 (Archaeology & Cultural Heritage). However, less compact development predicted in the absence of the proposed Project would result in increased impacts on sites of archaeological value.

Architectural Heritage: In the Do Nothing Scenario there will be no impacts on sites of archaeological heritage or areas of archaeological heritage potential as identified in Chapter 26 (Architectural Heritage).

Landscape & Visual: In the Do Nothing scenario, there will be no landscape and visual impacts associated with the proposed Project (Positive or negative).

7.5 Assessment of Alternative Route Options

The Transport Strategy for the GDA includes for a high-frequency, light-rail service serving Swords, Dublin Airport and the south of the city centre, which it described as New Metro North. The Transport Strategy for the GDA gave a general indication of the route for New Metro North, but on the basis that the alignments and details of proposed transport projects set out were indicative only and were to be subject to further development as the design and planning processes for individual projects progress. Accordingly, the proposed Project is in line with that strategy.

The assessment of alternatives to identify a preferred route for the proposed Project has been undertaken based on an assessment of a number of route sections, route options and station locations. In March 2018 following a comprehensive assessment of the route options along the corridor NTA and TII published the Alignment Options Report identifying the Emerging Preferred Route (EPR), for the proposed project. The EPR was subject to non-statutory public consultation in 2018 and the key observations and submission are referred to in Chapter 8 (Consultation). A review of the submissions arising from the public consultation and further design development led to the establishment of a Preferred Route for the Project which was subject to a further non- statutory public consultation in April 2019. The key observations and findings from that consultation are referred to in Chapter 8 (Consultation).

The assessment of alternatives leading to the preferred alignment is discussed in this section having regard to decisions made in the development of the EPR and the Preferred Route.

7.6 Identification of an Emerging Preferred Route

7.6.1 Introduction

The NTA and TII commissioned an Alignment Options Study to determine the EPR for New Metro North proposed in the Transport Strategy for the GDA. The New Metro North Alignment Options Report (TII 2018) and all relevant appendices can be reviewed at www.metrolink.ie

The study area for New Metro North was based around a corridor from Swords to Dublin City Centre via Dublin Airport and was consistent with the Transport Strategy for the GDA.

7.6.2 Study Area Identification

"The study area for New Metro North was the Swords to Dublin City Centre part of Corridor A (Drogheda to Dublin City Centre) from the Transport Strategy for the GDA.

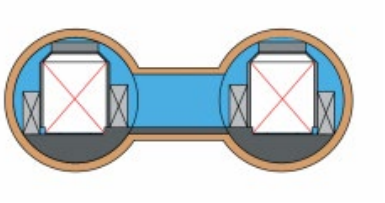
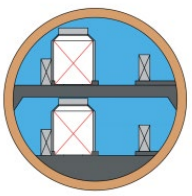
An Environmental Constraints Report was prepared to identify environmental constraints having regard to all environmental disciplines. The constraints study had particular regard to the following disciplines which directly influenced the development of the route options:

- *Architectural Heritage:* Identification of Recorded Protected Structures (RPS), Architectural Conservation Areas (ACA's) and National Inventory of Architectural Heritage (NIAH) structures within each study area;
- *Archaeology:* Identification of national monuments and recorded monuments in each study area;
- *Biodiversity:* Identification of Natura 2000 sites (Special Areas of Conservation (SAC) and Special Protection Areas (SPA)) and proposed Natural Heritage Areas (pHNAs)), within each study area; and
- *Landscape and Visual:* Identification of areas of specific character and visual sensitivity including urban landmarks, land uses, spaces and streetscapes.

7.6.3 Tunnel Options Assessment

In the development of the EPR, a comprehensive tunnel configuration study was undertaken to determine the most appropriate tunnel type for the proposed Project (This report can be reviewed at www.metrolink.ie). The study reviewed a number of potential tunnel options for New Metro North, now referred to as MetroLink. The options assessed are presented in Table 7-5.

Table 7-5: Tunnel Options Considered

Option Type	Option Description	
Twin Bore Single Track	Twin bore option with a single track in each bore linked by cross passages. Three sub-options for station depths considered and these were: ▪ Ultra-shallow box; ▪ Shallow box; and ▪ Deep Box. ▪ The only feasible station platform configuration considered was island configuration.	
Single Bore Twin Track	Single bore option that contains two tracks side by side in a single bore. Two sub-options for station depths considered and these were: ▪ Shallow box; and ▪ Deep Box. ▪ Feasible station platform configuration sub-options were also considered.	
Single Bore Twin Tack (Stacked)	Single bore option that contains two tracks "stacked" in a single bore. The only feasible station depth considered was a "deep box". The only feasible platform configuration for this option was stacked platforms.	
Monotube	Larger single bore tunnel allowing for the inclusion of the station box within the tunnel. The only feasible station depth considered was a "deep monotube". The only feasible platform configuration for this option were stacked platforms.	

A three-stage assessment was undertaken to identity the preferred tunnel option for the EPR. The 3 stages were as follows:

- Stage 1: Review of recent developments in tunnelling/underground engineering technology, fire engineering, as well as standards and compliance requirements;
- Stage 2: Identification of constraints and on this basis the development of feasible options;
- Stage 3: Development and undertaking of an MCA analysis using criteria under the headings of economy, Environment and Accessibility and Social Inclusion as outlined in Table 7-6.

Table 7-6 MCA Analysis Criteria for Tunnel Options Assessment

Assessment Criteria	Assessment sub-criteria	Metric
Economy	Capital Cost	Quantitative appraisal of potential infrastructure costs of proposed options including.
Environment	Landscape & Visual	Qualitative appraisal of landscape and visual impacts of options based on the relative size (plan area) of the surface elements in the completed scheme.
	Property	Qualitative appraisal of property acquisition impacts required to construct the station (permanent plus temporary land take).
	Archaeology/Architectural and Cultural Heritage	Qualitative appraisal of potential impacts of proposed options on potential sub-surface archaeology and impact on foundations and above ground elements of architectural heritage. Based on tunnelling impact and/or land take (temporary and permanent).
	Settlement	Qualitative appraisal of settlement related to each of the options in terms of likely number of properties affected, rather than the severity of impact.
Accessibility and Social Inclusion	Passenger Experience	Qualitative appraisal of capacity of options to facilitate the movement of people between the street and station/rail system, and within the system and the likely ease of navigation around the station.
	Accessibility	Qualitative appraisal of capacity of options to provide ease of access for the mobility and visual impaired.

7.6.3.1.1 Environmental Assessment

The monotube option, which is a single tunnel with the train alignment contained within, in additional to stations and all other elements is the favoured option from an environmental perspective as it has the smallest area footprint required at the surface and as a result, the smaller the impact. In addition, this option is deeper in the ground allowing for a reduced risk of settlement effect.

The options with shallower tunnels were considered the least favoured from an environmental perspective, as they result in an increased risk of settlement.

7.6.3.1.2 Overall Conclusions

The MCA analysis was undertaken of these tunnel type options, and certain ones were ruled out as not being viable, while the study recommended preferred options for further analysis. The MetroLink tunnel configuration study can be reviewed in full athttp://data.tii.ie/metrolink/tunnel-configuration-study/metrolink-tunnel-configuration-study.pdf . The options that were considered for further analysis were as follows:

- Twin Bore Single Track options with an ultra-shallow box, shallow box and a deep box.
- Single Bore Twin Track options with a shallow and deep station box option. The deep option was considered to be less cost effective, but performed better under environmental, accessibility and social inclusion criteria.
- The single bore stacked and Monotube options (Deep) were also considered feasible and appropriate for further consideration.

The assessment did not identify a preferred option but identified that it was appropriate to keep a number of options open for further consideration during design development.

For the purposes of developing a design for the Alignment Options Study a twin bored tunnel solution was adopted. This twin bore option was developed for a tunnel progressing from north of Dublin Airport to St Stephen's Green.

The Construction Phase of this option required one twin-bore tunnel to be bored using 2 Tunnel Boring Machines (TBM). The tunnel would run from just north of the Airport to Griffith Park where the two TBMs would have been removed and dismantled. A second pair of TBMs would at the same time have bored from Griffith Park southwards to Charlemont. The tunnel construction site and spoil removal activities would be located on the CLG Na Fianna pitches at Mobhi Road. At this location, an extensive construction site would have been required for the temporary storage of both excavated and construction materials.

7.6.4 Options Identification

The identification of route options for New Metro North was undertaken as follows:

1. Characterisation of the receiving environment for a defined study area which was equivalent to the Swords to Dublin City Centre section of "Demand Corridor A" from the Transport Strategy for the GDA to identify environmental constraints, potential tie-ins, interchange locations and key trip attractors.
2. To capture all possible options for assessment in a rigorous and robust manner the Demand Corridor A or overall study area was sub-divided into three distinct geographical areas (Refer to Diagram 7.1). Each area was then subject to an in-depth constraints assessment which informed the development of route options within each geographical area.
3. Initial identification of potentially feasible and practicable route options within these three distinct geographical areas covering the alignment of the proposed Project as follows;

    a. Area A: Dublin City Centre – Glasnevin/Drumcondra to Luas Green Line;

    b. Area B: Ballymun/Airport – Dublin Airport North Portal to Glasnevin/Drumcondra; and

    c. Area C: Swords – Estuary to the Dublin Airport North Portal.
4. Preliminary assessment of the feasible options within each geographical area to generate a series of Assessment Options.
5. Multi-criteria assessment of developed assessment options within each geographical area followed by a further assessment of combined end-to end route options with the conclusion being the selection of the EPR.

These steps are described below in more detail.

7.6.4.1 Initial Identification of Options

'Feasible and practical' route options were defined as alignments running south to north through the study area with station locations selected to serve transport demand.

The first activity was to identify Metro Station Zones (MSZs) within which a station could be located. MSZs were defined as broad areas of high transport demand, high employment density, with key trip attractors and with opportunities for interchange with other transport modes. The MSZs were generated on the basis of modelled output from the Eastern Regional Model (ERM) which generated predicted transport demand within the model area for 2035 having regard to predicted future population growth, predicted development and predicted transport patterns. The model outputs provide a robust estimate of future transport scenarios because

- It takes account of all proposed transport projects (under the GDA strategy) in the assessment area and the interactions between these modes;
- It provides output that identify the areas within the modelled area that are predicted to generate strong levels of demand that meet the requirements for a metro type system; and
- The study area is derived from the GDA strategy, so utilisation of the 2035 strategy demand figures as a starting point for this analysis are appropriate.

In determining the location of MSZs, due consideration was given to the environmental constraints identified in in the environmental constraints study. Once potential MSZs were developed, geometrically feasible route options which connected feasible MSZs were generated.

Only those feasible route options, which met the project objectives, were carried forward in the assessment process.

7.6.4.2 Preliminary Assessment of Options

Preliminary Assessment comprised a more detailed qualitative assessment using relevant criteria to establish the merits of the feasible and practicable routes identified, in order to develop the most appropriate feasible options for consideration at the next stage. The Preliminary Assessment Criteria used are listed in Table 7-7.

Table 7-7 Preliminary Assessment Criteria

Criteria	Qualitative
Potential for Interchange	This criterion considers the potential of each route option for interchange with heavy rail and Luas. Interchange with core bus corridors and BRT has also been considered
Potential Trip Demand	This criterion considers the likely trip demand of each route option based on the 24-hour trip demand data for all modes of transport extracted from the NTA's East Regional Model (extracted for the future year 2035). The potential trip demand per Metro Station Zone (as identified in Section 5) are summed together to give a high-level trip demand estimate for the overall route under consideration
Key Trip Attractors	This criterion considers what key trip attractors are served by each route option, relative to proposed station locations.
Directness/Journey Time	This criterion considers the directness of route options using length as a proxy for directness. In assessing the directness of route options, consideration was also given to the demand generated by these routes and the availability of more suitable alternatives. Direct routes with high demand were preferred to routes which were not considered to be direct or did not offer any additional demand by routing away from the primary north-south direction of travel within the study area. Directness/length is also used as a proxy for cost at this stage of the assessment.

In considering the feasibility of options during the Preliminary Assessment the interaction of routes between study area sections to ensure that all suitable connections between study areas were considered at the Stage 1 Multi-Criteria Assessment Stage.

The preliminary assessment identified six feasible route options in Study Area A, nine in Study Area B, and five in Study Area C. These are outlined in Table 7-8. Refer to Diagram 7.1 for an outline of the Study Areas A,B and C and Diagram 7.4 - Diagram 7.2 for an outline the route options assessed.

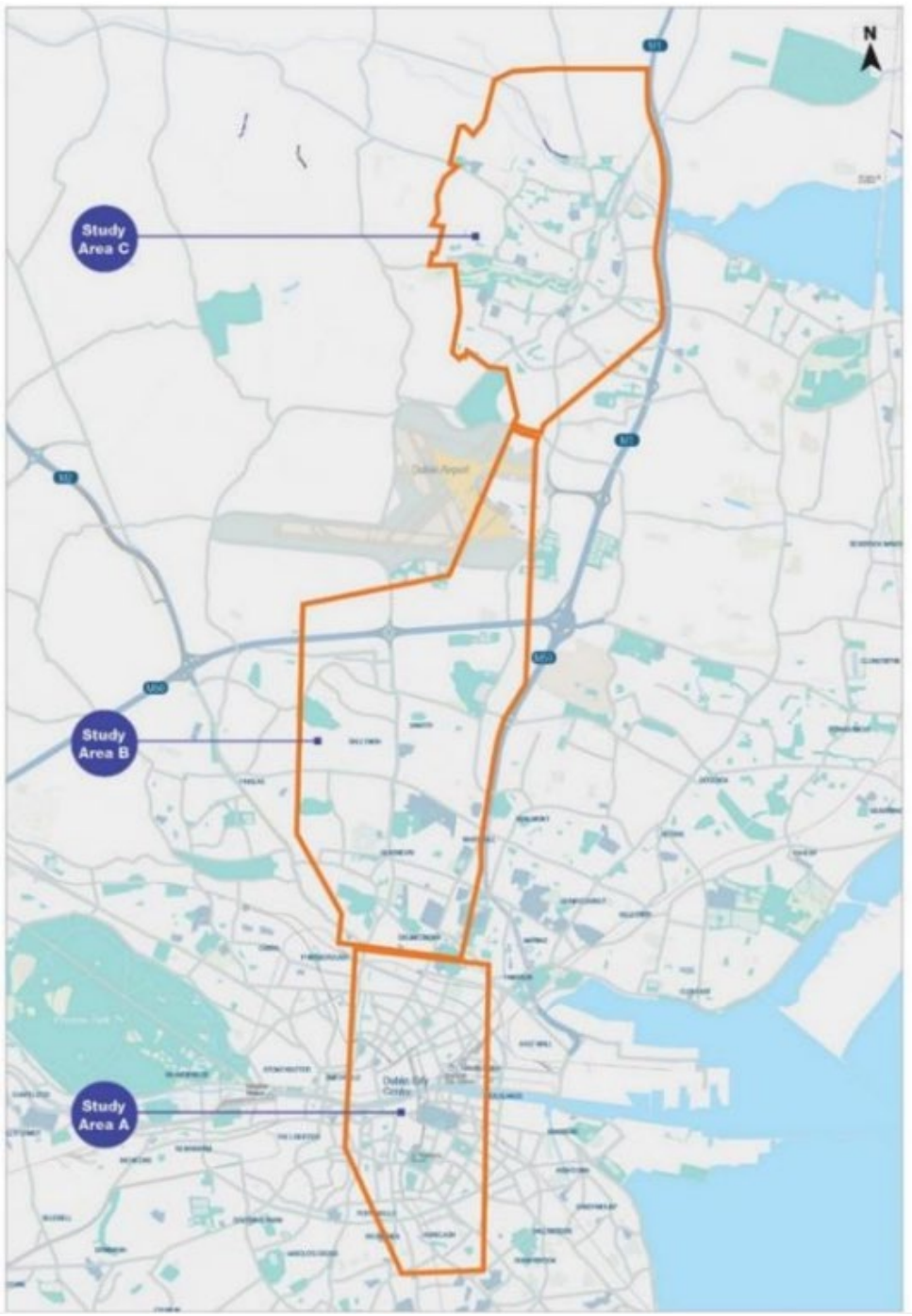


Diagram 7.1 Study Areas for EPR

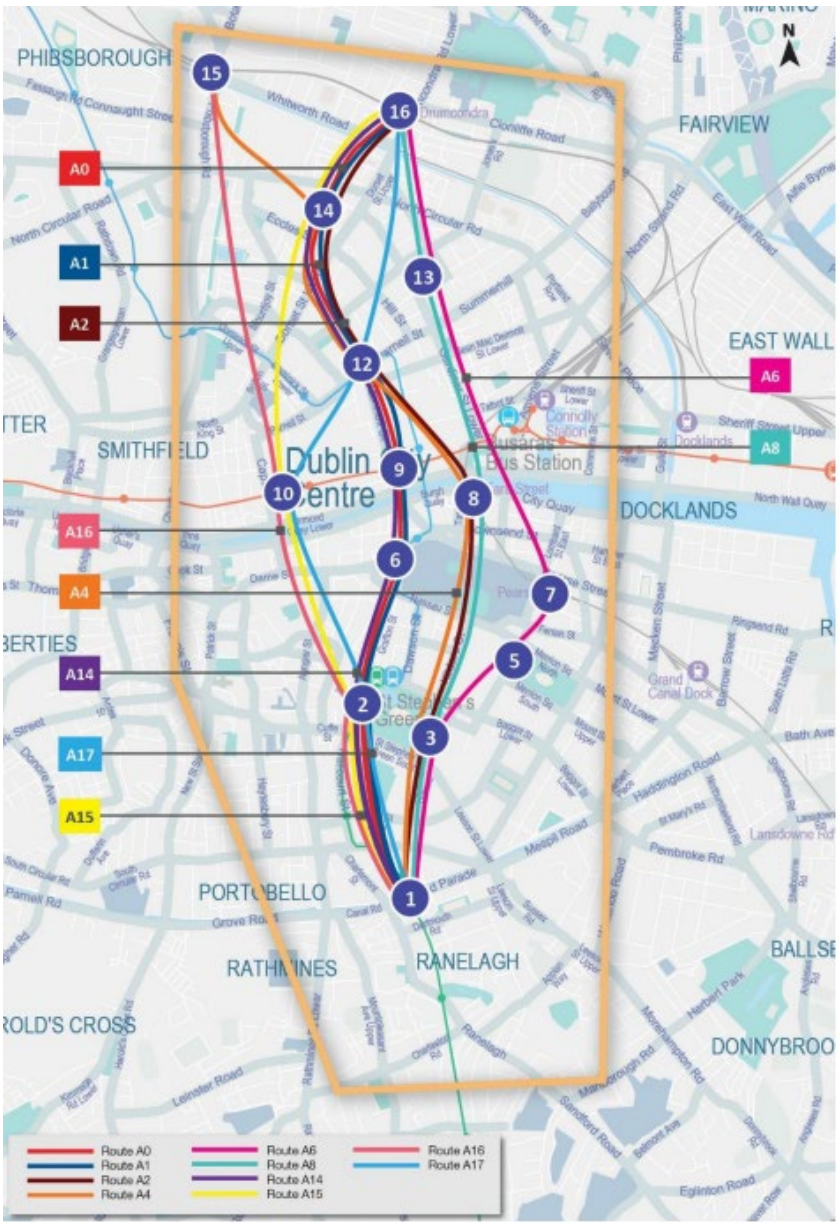


Diagram 7.2 Route Options for Study Area A

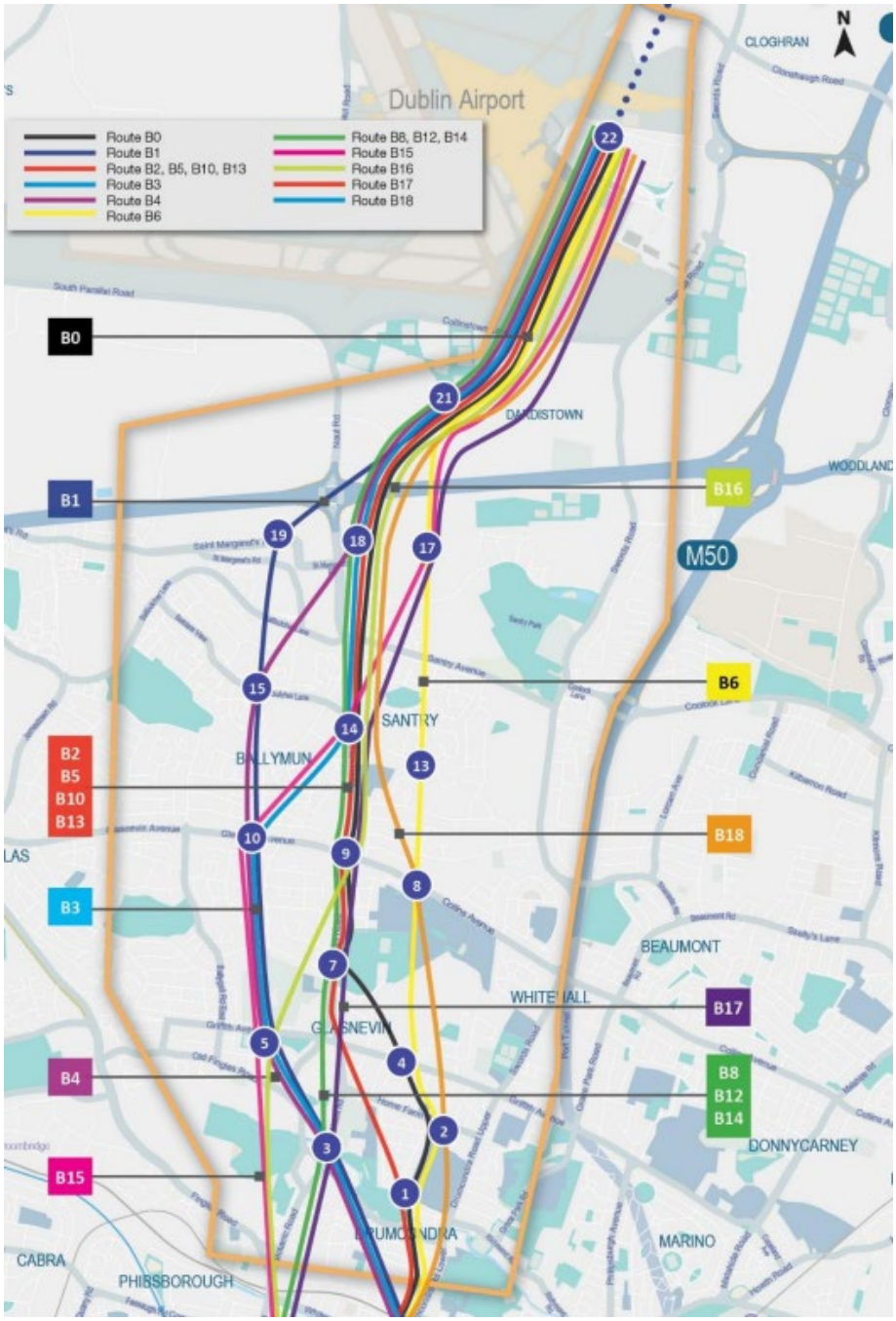


Diagram 7.3 Route Options for Study Area B

Diagram 7.4 Route Options for Study Area C

As identified in Diagram 7.2 ten route options were assessed for study area A, six of which were considered to be feasible and practicable. The rationale for the choice of options to be brought forward to the next phase of analysis are presented in Table 7-8.

As identified in Diagram 7.3, 16 route options were assessed for study area B, nine of which were considered to be feasible and practicable. The rationale for the choice of options to be brought forward to the next phase of analysis are presented in Table 7-8.

As identified in Diagram 7.4, eight route options were assessed for study area C, four of which were considered to be feasible and practicable. The rationale for the choice of options to be brought forward to the next phase of analysis are presented in Table 7-8.

Table 7-8: Assessment Options - Feasible Route Options which Passed Preliminary Assessment

Study Area	Route Option	Stations	Rationale for Further Assessment
A	A0 (Old Metro North)	▪ Charlemont (Elevated) ▪ St. Stephen's Green West (Underground) ▪ O'Connell Street (Underground) ▪ Parnell Square (Underground) ▪ Mater Hospital (Underground) ▪ Drumcondra (Underground)	This route option represents Old Metro North. This route option provides good interchange opportunities with other modes and serves important key trip attractors in the study area. While this option is slightly longer than some other options considered, it would attract the highest potential trip demand of all options considered in Study Area A. For these reasons, this route option is progressed to the next assessment stage.
	A1	▪ Charlemont (Elevated) ▪ College Green (Underground) ▪ Parnell Square (Underground) ▪ Mater Hospital (Underground) ▪ Drumcondra (Underground)	This route option provides good interchange opportunities and serves important key trip attractors in the study area. This option also takes a direct and short route through areas of high demand in the centre of the study area. For these reasons, this route option is progressed to the next assessment stage.
	A2	▪ Charlemont (Elevated) ▪ St. Stephen's Green East (Underground) ▪ Tara Street (Underground) ▪ O' Connell Street (Underground) ▪ Mater Hospital (Underground) ▪ Drumcondra (Underground)	This route option provides good interchange opportunities and serves important key trip attractors in the study area. This option also takes a direct and short route through areas of high demand in the centre of the study area. For these reasons, this route option is progressed to the next assessment stage.
	A4	▪ Charlemont (Elevated) ▪ St. Stephen's Green East (Underground) ▪ Tara Street Underground) ▪ O'Connell Street (Underground) ▪ Mater Hospital (Underground) ▪ Glasnevin (Underground)	This route option provides good interchange opportunities and serves important key trip attractors in the study area. It also serves a high demand alignment. Whilst the additional length to serve Glasnevin Station adds journey time to the route in Study Area A, it reduces journey time for options in Study Area B as there are suitable options through the centre of Study Area B which align with this western edge of Study Area A. For this reason, this route option is progressed to the next assessment stage.
	A8	▪ Charlemont (Elevated) ▪ St. Stephen's Green East (Underground) ▪ Tara Street (Underground) ▪ Mountjoy Square (Underground) ▪ Drumcondra (Underground)	This route option provides good interchange opportunities and serves key retail trip attractors both north and south of the River Liffey. The route is short and direct through the centre of the study area and would attract a comparably good potential trip demand. For these reasons, this route option is progressed to the next assessment stage.
	A14	▪ Charlemont (Elevated) ▪ St. Stephen's Green West (Underground) ▪ O'Connell Street (Underground) ▪ Mater Hospital (Underground) ▪ Drumcondra (Underground)	This route option represents Optimised Metro North as per the Fingal/North Dublin Transport Study. This route option provides good interchange opportunities with heavy rail, Luas and previously proposed BRT. This route option also serves key trip attractors north and south of the River Liffey. In terms of demand, this option penetrates the central portion of the study area, which would have a high potential demand. For these reasons, this

Study Area	Route Option	Stations	Rationale for Further Assessment
			route option is progressed to the next assessment stage
B	B0	▪ Griffith Avenue ▪ DCU at Ballymun Road ▪ Ballymun Village ▪ Northwood West ▪ Dardistown ▪ Dublin Airport	This route option represents Old Metro North. This route option provides a direct route through the centre of Study Area B serving key trip attractors. This route option would have a high potential trip demand compared to other route options in the study area. For these reasons, this route option is progressed to the next assessment stage.
	B2	▪ St. Patrick's College West ▪ DCU at Ballymun Road ▪ Ballymun Village ▪ Northwood West ▪ Dardistown ▪ Dublin Airport	This route option represents Optimised Metro North as per the Fingal/North Dublin Transport Study. This route option provides a direct route through the centre of Study Area B serving key trip attractors in the area. This route option would have a high potential trip demand compared to other route options in the study area. For these reasons, this route option is progressed to the next assessment stage.
	B5	▪ St. Patrick's College West ▪ DCU at Ballymun Road ▪ Ballymun Village ▪ Northwood West ▪ Dardistown ▪ Dublin Airport ▪	This route option provides a direct route through the centre of Study Area B serving key trip attractors in the area. This route option would have a high potential trip demand compared to other route options in the study area. Furthermore, this option provides an opportunity for cut and cover construction through Ballymun which offers an alternative to the above ground running of Route Option B2.
	B6	▪ St. Patrick's College West ▪ DCU at Collins Avenue West ▪ Santry Village ▪ Northwood Central ▪ Dardistown ▪ Dublin Airport	This route option provides a direct route through the centre of Study Area B, offset to the west of Ballymun Town Centre, serving key trip attractors in the area. Although this route option would have a lower potential overall trip demand than other options, it does offer one of the shortest route options with less stations which has benefits in terms of journey time and cost. For these reasons, this route option is progressed to the next assessment stage.
	B8	▪ Griffith Park West ▪ DCU at Ballymun Road ▪ Ballymun Village ▪ Northwood West ▪ Dardistown ▪ Dublin Airport	This route option provides a direct route through the centre of Study Area B serving key trip attractors in the area. This route option would have a high potential trip demand and is one of the shortest route options considered in Study Area B which has benefits in terms of journey time and cost. Additionally, this route option offers an alternative connection at the southern end of Study Area B which could connect a potential option emerging from Study Area A at Glasnevin. This option would be provided as a surface section which may have the potential for cost savings over a tunnel alignment.

Study Area	Route Option	Stations	Rationale for Further Assessment
	B10	▪ St. Patrick's College West ▪ DCU at Ballymun Road ▪ Ballymun Village ▪ Northwood West ▪ Dardistown ▪ Dublin Airport	This route option provides a direct route through the centre of Study Area B serving key trip attractors in the area. This route option would have a high potential trip demand compared to other route options in the study area. Furthermore, this option provides an opportunity for an TBM tunnel alignment through Ballymun which offers an alternative to options B2 and B5 along the same route.
	B12	▪ Griffith Park West ▪ DCU at Ballymun Road ▪ Ballymun Village ▪ Northwood West ▪ Dardistown ▪ Dublin Airport	This route option provides a direct route through the centre of Study Area B serving key trip attractors in the area. This route option would have a high potential trip demand and is one of the shortest route options considered in Study Area B which has benefits in terms of journey time and cost. Additionally, this route option offers an alternative connection at the southern end of Study Area B which could connect a potential option emerging from Study Area A at Glasnevin. This route option runs along the same route as option B8 but offers a tunnel alignment.
	B13	▪ St. Patrick's College West ▪ DCU at Collins Avenue Junction ▪ Ballymun Village ▪ Northwood West ▪ Dardistown ▪ Dublin Airport	This route option provides a direct route through the centre of Study Area B serving key trip attractors in the area. This route option would have a high potential trip demand compared to other route options in the study area. This option provides an elevated version of Route Option B2.
	B14	▪ Griffith Park (West) ▪ DCU at Collins Avenue Junction ▪ Ballymun Village ▪ Northwood West ▪ Dardistown ▪ Dublin Airport	This route option provides a direct route through the centre of Study Area B serving key trip attractors in the area. This route option would have a high potential trip demand and is one of the shortest route options considered in Study Area B which has benefits in terms of journey time and cost. Additionally, this route option offers an alternative connection at the southern end of Study Area B which could connect a potential option emerging from Study Area A at Whitworth. This option provides an elevated version of Route Option B8.
C	C0	▪ In tunnel from the Dublin Airport station to Dublin Airport North Portal located in green belt lands north of the Naul Road. ▪ From here at surface level in a segregated corridor before entering an underpass under the junction of the R132 Swords Bypass with Nevinstown Lane/L2300. ▪ A surface station (Fosterstown) is then provided in lands to the north side of Airside Retail Park.	This route option represents Old Metro North and Optimised Metro North. This route option provides an alignment along the eastern side of Study Area C serving key trip attractors in the area. This route option is located entirely within the Metro Economic Corridor, as designated in the Fingal Development Plan. Although this route option would have a lower potential overall trip demand than other options, it does provide opportunity for surface and above ground running in the median of the R132 Swords Bypass. For this

Study Area	Route Option	Stations	Rationale for Further Assessment
		▪ The alignment then rises on to a viaduct to run elevated over the Pinnock Hill Roundabout. ▪ Then returns to surface running in a segregated corridor along the median of the R132 Swords Bypass with the next station, Swords Central, provided at surface level. ▪ From here the alignment enters an underpass under the Malahide Roundabout before returning to surface running as far as the next station at Seatown ▪ It then returns to a viaduct to run over the Seatown Roundabout and stays elevated running along the median until it passes the Estuary Roundabout where it returns to the surface, running along the western side of the R132 Swords Bypass as far as the final station at the Park and Ride Facility.	reason, this route option is progressed to the next assessment stage.
	C1	▪ In tunnel from the Dublin Airport station to a portal located in green belt lands north of the Naul Road. ▪ From here it runs at surface level in a nonsegregated corridor before joining the R132 Swords Bypass at a signalised junction which will replace the Pinnock Hill Roundabout. ▪ A surface station is then provided in lands to the north side of Airside Retail Park. ▪ The alignment then continues to run at surface level along the median of the R132 Swords Bypass to the Swords Central station, ▪ From here the route crosses through the signalised junctions which replace the Malahide Road and Seatown Road Roundabouts continuing at the surface to Seatown Station. ▪ The alignment then continues through the last signalised junctions which replaces the Estuary Roundabout where it transitions to run along the western side of the R132 Swords Bypass as far as the final station at the Park and Ride Facility.	This route option provides a route along the eastern side of Study Area C serving key trip attractors in the area. This route option is also located entirely within the Metro Economic Corridor, although has a potential lower overall trip demand up to the 2035 assessment year in the ERM than some other options. The option provides opportunity for surface level running in the median of the R132 Swords Bypass. For these reasons, this route option is progressed to the next assessment stage.
	C3	▪ Route Option C3 runs in tunnel from the Dublin Airport station to a portal located in green belt lands north of the Naul Road. ▪ From here it runs at surface level in a segregated corridor before entering an underpass under the junction of the R132 Swords Bypass with Nevinstown Lane/L2300.	This route option represents a variation of Old Metro North and Optimised Metro North which runs underground (cut and cover) between Pinnock Hill and Malahide Road Roundabouts. This route option provides an alignment along the eastern side of Study Area C serving key trip attractors in the area. Although this route option would have a lower potential overall trip demand than other

Study Area	Route Option	Stations	Rationale for Further Assessment
		▪ Fosterstown station is provided at surface in lands to the north side of Airside Retail Park. The alignment then rises on to a viaduct to run elevated over the Pinnock Hill Roundabout. ▪ After this roundabout, the alignment drops to enter an underpass structure under the median between the Pavilions Shopping Centre to the west and the Barrysparks Development lands to the east where the next station, Swords Central, is provided. ▪ From here the alignment stays in the underpass under the Malahide Roundabout before returning to surface running as far as Seatown station. ▪ The alignment then returns to a viaduct to run over the Seatown Roundabout and stays elevated running along the median until to passes the Estuary Roundabout where it returns to surface running along the western side of the R132 Swords Bypass as far as the final station at the Park and Ride Facility.	options up to 2035, is located entirely within the Metro Economic Corridor and is therefore likely to attract longer term patronage from development within these lands. It does provide opportunity for surface and above ground running in the median of the R132 Swords Bypass, with the main difference between this Option and C0 being an extended section of cut and cover tunnel south of the R132/Malahide Road junction to better improve accessibility to and from the metro from adjacent zoned high-density development lands. For these reasons, this route option is progressed to the next assessment stage.
	C4	▪ In tunnel from the Dublin Airport station to a portal located in green belt lands north of the Naul Road. ▪ From here it runs at surface level in a segregated corridor before entering an underpass under the junction of the R132 Swords Bypass with Nevinstown Lane/L2300. ▪ Fosterstown station is then provided in lands to the north side of Airside Retail Park. ▪ The alignment then rises on to a viaduct to run elevated over the Pinnock Hill Roundabout. It stays elevated along the median of the R132 Swords Bypass with the next station, Swords Central provided ▪ Staying on an elevated viaduct it then continues to the next station at Seatown before crossing over the Seatown and Estuary Roundabouts where it returns to surface running along the western side of the R132 Swords Bypass as far as the final station at the Park and Ride Facility.	This route option represents a further variant of Options C0 and C3, with an extended elevated section running along the R132 between Pinnock Hill and Estuary Roundabouts on the R132. This route option provides an alignment along the eastern side of Study Area C serving key trip attractors in the area. Again, this option is located entirely within the Metro Economic Corridor and, while travel demand within its catchment is relatively low compared with some other options up to 2035, the option is likely to attract longer term patronage from development within the Metro Economic Corridor. For these reasons, this route option is progressed to the next assessment stage.
	C11	▪ In tunnel from the Dublin Airport station to a portal located in green belt lands north of the Castlegrange Green. ▪ Intermediate stations are provided underground at Airside Retail Park	This route option provides a route through the centre of Study Area C serving key trip attractors in the area and the centre of Swords Village. This route option would have a lower potential trip demand than other options in Study Area C. This option would be

Study Area	Route Option	Stations	Rationale for Further Assessment
		West on the northern side of the junction of the R132 Swords Bypass and Nevinstown Road and in Swords Village. ▪ The alignment transitions to segregated surface running along the western side of the R132 Swords Bypass from Castlegrange Green to the to the final station at the Park and Ride Facility.	provided underground as far as green field space to the north of Castlegrange Green where it transitions to run at surface level as far as Estuary. For these reasons, this route option is progressed to the next assessment stage.

7.6.4.3 Stage 1 Multi-Criteria Analysis

Concept designs were developed for the Assessment Options. A Stage 1 Multi-Criteria Analysis (MCA) was then carried out for each study area separately, with a view to identifying route options that could be combined to form potential end-to-end options across the entirety of Study Areas A, B and C. Those end-to-end options would then be subject to a second stage of MCA. An Environmental Constraints Report, appended to the Study, identified constraints and opportunities and defined project objectives in order to inform the establishment of project-specific route options assessment criteria.

These criteria were aligned with the Guidelines on a Common Appraisal Framework for Transport Projects and Programmes' (CAF) published by the Department of Transport, Tourism and Sport (DTTAS 2016), which sets out the requirements of MCA on publicly funded projects.

The Environmental sub-criteria considered at Stage 1 MCA were established by reviewing the Environmental Constraints Report and determining whether there are significant differences across the study area in terms of differentiating routes. Further details on the assessment methodology and the rationale for using selected environmental sub-criteria as differentiators and not others can be reviewed in Appendix A7.1 (Fosterstown Options Report).

Table 7-9 Assessment Criteria

Assessment Criteria	Assessment Sub-Criteria
Economy	Capital Cost
	Transport Reliability
	Journey Time
	Station Catchment Transport Demand
Integration	Land Use Policy Integration
	Public Transport Integration
	Integration with Other Modes
Accessibility & Social Inclusion	Key trip Attractors
	Deprived Geographic Areas
Environment	Soils and Geology
	Landscape & Visual
	Archaeology, Architectural and Cultural Heritage

For each of the sub-criteria assessed, the options were compared against each other based on a five-point scale, ranging from having significant advantages to having significant disadvantages over other options.

Route Options A1, A2, A4, B6, B10, B12, C4 and C11 proved to be the most advantageous options and therefore were taken forward to be component parts of end-to-end options for assessment in the stage

2 MCA. Refer to Table 7-9 for an outline of the analysis rationale for progressing each of the route options to Stage 2 MCA.

7.6.4.3.1 Study Area A

Table 7-10 provides an outline of the multi-criteria analysis undertaking for the route options considered for study area A with a description provided hereunder.

Summary of Environmental Analysis

Option A2 scores well across all sub criteria and is considered to be the best option in terms of minimising potential environmental impacts. Option A1 and A8 also score well but there is more risk of impact on Archaeology, Architecture and Cultural Heritage, and Landscape and Visual.

Option A4 scores comparatively worse under all environmental considerations except Soils and Geology.

Option A14 scores well under Biodiversity and Soils and Geology but would have significant impacts in terms of Landscape and Visual.

Option A0 would have similar impacts in terms of Landscape and Visual and score comparatively worse than other options with the exception of Soils and Geology. In terms of accessibility and social exclusion, Options A0, A2, A4 and A14 serve a similar number of key trip attractors and are comparably higher than Options A1 and A8. Deprived Geographic Areas is not a differentiator in Study Area A.

Summary of Overall Analysis (Area A)

The assessment shows that A0, (Old Metro North), compares poorly to other options considered, primarily due to cost.

While Option A1 offers a good option in terms of economy, it compares poorly under other assessment criteria including environment.

Option A8 compares slightly worse than the best options in terms of Economy, and particularly so in terms of potential trip demand. Furthermore, it serves less Key Trip Attractors than other route options and as such compares poorly under Accessibility and Social Inclusion.

While A14 scores well in terms of economy and Accessibility and Social Inclusion it does not integrate as well with the wider public transport network and has more impacts on the receiving environment.

Based on the assessment undertaken, on balance, Route Option A2 appears to offer more benefits over other options because

- It can be delivered at a low cost compared to other options;
- It serves a high potential trip demand;
- It integrates well with the existing and future public transport network;
- it provides opportunity for interchange with all other modes;
- It serves a large number of key trip attractors; and
- It has the least potential impact on the receiving environment compared to other options.

Route option A2 connects to Study Area B at Drumcondra Rail station. While Route Option A4 is slightly more expensive to construct, it provides an alternative connection to Study Area B at a potential new station at Glasnevin (Whitworth). Route Option A4 delivers similar benefits to A2, however it results in slightly more potential environmental impacts when compared to Option A2.

Overall, Route Option A4 is also considered to be a good option in Study Area A. Both of these route options however follow a broadly similar route corridor within Study Area 1, with the primary variant being the interchange location with rail at either Drumcondra or Glasnevin.

In order to compare and assess a variant corridor in terms of detailed demand and economic appraisal at Stage 2 MCA, a third option along a more central corridor is also brought forward from Study Area A. While Route Option A14 serves slightly more key trip attractors, Route Option A1 is the cheapest of the options considered and would serve a greater potential trip demand than A14. Furthermore, Option A14 would have a significant impact on Landscape and Visual. As such, A1 also emerges from the Stage 1 MCA process.

Overall, Route Options A1, A2 and A4 were progressed to the Stage 2 MCA for further, more detailed consideration.

Table 7-10: Stage 1 Multi-Criteria Analysis Outputs – Study Area A

Assessment Criteria	Assessment Sub-criteria	A0 (OMN)	A1	A2	A4	A8	A14
Economy	Capital Cost						
	Transport Reliability						
	Journey Time						
	Station Catchment Transport Demand						
	Land Use Policy Integration						
	Public Transport Integration						
	Integration with Other Modes						
	Key trip Attractors						
	Deprived Geographic Areas						
	Biodiversity						
	Landscape and Visual						
	Cultural Heritage						
	Soils and Geology						

7.6.4.3.2 Study Area B

Table 7-11 provides an outline of the multi-criteria analysis undertaking for the route options considered for study area B with a description provided hereunder.

Summary of Environmental Analysis

Biodiversity is not considered to be a differentiator in Study Area B. In terms of Landscape and Visual, Route Option B2 and B8 are considered to have the greatest impact due to the visual effect on Ballymun

Road by virtue of running at grade and the need to physically segregate to meet the scheme operating objectives.

Similarly, options B13 and B14 are considered to have a significant impact on Landscape and Visual due to the provision of an elevated structure in an established residential and commercial area. Option B5 which combines a tunnel and cut and cover option, as well as elevated is also considered to have significant impact. Full TBM Route Options B6, B10 and B12 are considered to have the least impact in terms of Landscape and Visual. Under the Archaeology, Architecture and Cultural Heritage sub-criterion, Route Options B0, B2, B5, B8, B13 and

B14 rank poorest as they all have potential to directly impact on sites of archaeological, architectural and cultural heritage significance. Full TBM options B6, B10 and B12 are considered more favourable options in terms of this criteria as there is the potential to reveal subsurface archaeology at top-down station locations only rather than along the entire route.

In terms of Soils & Geology (Ground Movement) full TBM Route Options B6, B10 and B12, have comparatively higher risk of ground movement and as such receive the lowest comparable rankings. Options B2 and B8 which run surface level, as well as elevated B14 are considered to be the most favourable under this sub criterion.

There is relatively little differentiation between routes in terms of accessibility and social inclusion, with the exception of Option B6, owing to its route further to the east of Ballymun Village centre. Deprived Geographic Areas is not a differentiator in Study Area B.

Summary of Overall Analysis (Area B)

Options B2, B5, B10 and B13 are effectively scheme option variants along the same general route, with the differences between each option being the vertical alignment arrangement. Of these options, B2 and B13 in particular rank poorly in terms of potential impacts on environment, primarily because of visual impact through Ballymun Village.

B5 has less impact on the environment but would cost significantly more to construct and as such scores poorly under economy.

B10 scores well across all criteria and as such is the preferred option along this section of the alignment. Similarly, Route Options B8, B12 and B14 run along the same route through Study Area B.

B8 and B14 compare poorly against Economy and Environment, largely due to smaller potential trip demand and the impact in terms of landscape and visual. B12 by comparison, scores well across all criteria.

Although Route Option B6 scores well under environment, it is comparatively poor in terms of Economy, Integration, Accessibility, and Social Inclusion. Based on the assessment undertaken, Route Options B10 and B12 appear to offer more benefits over other options for the following reasons

- They are comparatively cost efficient;
- They serve high potential trip demand areas with efficient journey times;
- They integrate well with the existing and future transport network;
- They serve a large number of key trip attractors; and
- They have less impact on the environment compared to other options.

Route Options B10 and B12 broadly follow, the same alignment and are considered the best options, through the central Ballymun area, with the difference being the interchange tie-in location at either Drumcondra or Glasnevin. In order to compare and assess a variant corridor in terms of detailed demand and economic appraisal at Stage 2 MCA, Route Option B6, which follows a more direct route from Drumcondra, also emerges from the Stage 1 MCA process. For the reasons outlined above, Route Options B6, B10 and B12 were progressed to the Stage 2 MCA for further, more detailed consideration.

Table 7-11 Multi-criteria Stage 1 for Study Area B

Assessment Criteria	Assessment Sub-criteria	B0 (OMN)	B2	B5	B6	B8	B10	B12	B13	B14
Economy	Capital Cost									
	Transport Reliability									
	Journey Time									
	Station Catchment Transport Demand									
	Land Use Policy Integration									
	Public Transport Integration									
	Integration with Other Modes									
	Key trip Attractors									
	Deprived Geographic Areas									
	Biodiversity									
	Landscape and Visual									
	Cultural Heritage									
	Soils and Geology									

7.6.4.3.3 Study Area C

Table 7-12 provides an outline of the multi-criteria analysis undertaking for the route options considered for study area C with a description provided hereunder.

Summary of Environmental Analysis

Under Environment, Biodiversity is not considered to be a differentiator in Study Area C.

Option C0 is seen to score well across all sub-criteria. C1 scores well in terms of Soils and Geology but not in terms of other criteria.

All other options score well in terms of Landscape and Visual but poorly against Archaeology, Architecture and Cultural Heritage.

C11 does not score well in terms of Soils and Geology as this option is in tunnel and there is more potential for ground movement. In terms of Accessibility and Social there is little to differentiate routes in terms of key trip attractors. Similarly, Deprived Geographic Areas is not a differentiator in Study Area C.

Summary of Overall Analysis (Area C)

At a corridor level, Option C11 along Swords Main Street is not considered to have the same potential to support regional and local growth objectives for Swords and environs as other options. Options along the R132 Swords Bypass route by comparison, which are fully within the designated Metro Economic Corridor can better initially support, and subsequently benefit from, in terms of patronage, strategic land-use development objectives.

Considering the Options along the R132 route (options C0, C1, C3 and C4), Option C1 is the cheapest option and the one that best replicates the 'Optimised Metro North' recommendation arising from the NTA's Fingal/North Dublin Transport Study. Relatively cheaper initial capital cost benefits are however considered to be countered-balanced longer term by its lack of journey time reliability as it does not deliver full route segregation. In order to achieve segregated metro level of service, Option C0 along the R132 would require segregation from traffic, together with general pedestrian movement across the proposed Project alignment. While this may be acceptable along the R132 in its current context, a permanent barrier along the R132 introduces future restrictions in the planned development of a more urban form along this corridor.

By contrast, C4 also runs along the R132 but runs on an elevated structure in the median for most of its length. This maintains the potential to develop access routes across the R132 for all modes of transport while at the same time allowing development of the adjacent lands and maintaining the potential for the R132 to be developed into a street including the potential to simplify vehicular access arrangements to adjoining development lands.

C3 would also be similar to C4, achieving slightly improved accessibility to the proposed Project but at a considerable additional capital cost. As C4 has the potential to future proof the proposed Project in terms of capacity and level of service provision in terms of full route segregation, whilst also integrating with land use plans, and is cost comparable, it is deemed the optimum R132 option. Based on the assessment undertaken, Route Option C4 appears to offer more benefits over other options on the R132 corridor within the Study Area for the following reasons:

- It can be delivered at a low cost;
- It provides good transport reliability and journey times through provision of full segregation from other modes;
- It provides a consistent vertical alignment which does not require multiple changes in elevation and thus improves the quality of the journey;
- It integrates best with the existing and future proposals along the R132 including proposals at Barrysparks Local Area Plan (LAP) and Swords Pavilions;
- It compares favourably of the potential to minimise impact on the environment.

In order to compare and assess a variant corridor in terms of detailed demand and economic appraisal at Stage 2 MCA, Route Option C11, which follows the Swords Main Street Corridor, also emerges from the Stage 1 MCA process. For this reason, Route Options C11 and C4 were progressed to the Stage 2 MCA for further, more detailed consideration.

Table 7-12 Multicriteria Stage 1 for Study Area C

Assessment Criteria	Assessment Sub-criteria	C0 (OMN)	C1	C3	C4	C11
Economy	Capital Cost					
	Transport Reliability					

Assessment Criteria	Assessment Sub-criteria	C0 (OMN)	C1	C3	C4	C11
	Journey Time					
	Station Catchment Transport Demand					
	Land Use Policy Integration					
	Public Transport Integration					
	Integration with Other Modes					
	Key trip Attractors					
	Deprived Geographic Areas					
	Biodiversity					
	Landscape and Visual					
	Cultural Heritage					
	Soils and Geology					

Stage 1 MCA options Assessment

At the completion of the Stage 1 MCA the following route options progressed to the next stage of assessment and were combined into ten individual End to End route options for Stage 2 assessment:

- Area A: Route Options A1, A2 and A4
- Area B: Route Options B6, B10 and B12
- Area C: Route Options C11 and C4

7.6.4.4 Stage 2 Multi-Criteria Analysis

The ten individual End to End route options which progress to stage 2 MCA are as follows:

- Option 1 (A1-B6-C4);
- Option 2 (A1-B6-C11);
- Option 3 (A1-B10-C4);
- Option 4 (A1-B10-C11);
- Option 5 (A2-B6-C4);
- Option 6 (A2-B6-C11);
- Option 7 (A2-B10-C4);
- Option 8 (A2-B10-C11);
- Option 9 (A4-B12-C4); and

- Option 10 (A4-B12-C4).

Stage 2 of the MCA was carried out based on the following sub-criteria Economy, Integration, Accessibility and Social Inclusion and Environment in line with the 'Guidelines on a Common Appraisal Framework for Transport Projects and Programmes' (DTTAS 2016).

The Environmental sub-criteria considered at Stage 2 MCA were established by reviewing the Environmental Constraints Report and determining whether or not there are significant differences across the study area in terms of differentiating routes. Further details on the assessment methodology and the rationale for using selected environmental sub-criteria as differentiators and not others can be reviewed in Appendix A7.1.

Table 7-13 Assessment Criteria

Assessment Criteria	Assessment Sub-Criteria
Economy	Benefit Cost Ratio
	Total Cost
	Patronage
	Journey Time
Integration	Land Use Policy Integration
	Public Transport Integration
Accessibility & Social Inclusion	Key trip Attractors
Environment	Soils and Geology
	Landscape & Visual
	Archaeology, Architectural and Cultural Heritage

The analysis of the ten individual End to End route options is presented Table 7-14.

Table 7-14 Stage 2 Multi-Criteria Analysis Outputs

MCA 2 Route Option	Analysis of MCA 2 Route Options
Option 1 (A1-B6-C4); Tunnel from the Green Line Tie-in to north of the Naul Road via Drumcondra Station. Surface level from the Naul Road to the R132 at the junction with Nevinstown Lane / L2300 Underpass under the R132 Surface level to Pinnock Hill Roundabout Elevated from Pinnock Hill Roundabout to north of Estuary Roundabout Surface level to Estuary Park & Ride alongside the R132	*Economy:* The Benefit Cost Ration (BCR) and Patronage (predicted passenger Number) estimates are unfavourable for this route option. However, the Total Cost is highly favourable for Option 1, compared to other options. The journey time is among the fastest of all ten options and therefore represents a time saving for patronage on this end-to-end option *Integration:* Option 1 is considered to have some disadvantages from an Integration perspective over other route options due to less favourable integration with land use policy in the central area and lack of integration with the DART network in the city centre and bus network in the central area. *Accessibility and Social Inclusion:* Option 1 is considered to have some disadvantages over other route options from an Accessibility and Social Inclusion perspective due to serving less key trip attractors in the city centre and central study areas. *Environment* In terms of potential impact on Landscape and Visual amenity, Option 1 has the potential for direct impact on key spaces and views in the city centre but there is little to differentiate it from other route options elsewhere along the alignment. In terms of potential impact on Archaeology, Architecture and Cultural Heritage, Option 1 has potential to impact on architectural heritage assets of national significance in Study Area A in addition to potential for archaeological finds in the area. Within Study Area C, in the Swords area, Option 1 follows the R132 on an elevated structure which has known sites of archaeological importance from the work on the previous metro project. However alternative alignments through Swords village also have similar potential impacts. In overall terms, therefore Option 1 is considered to have some disadvantages over other options from an Archaeology, Architecture and Cultural Heritage perspective due to the potential impacts within Study Area A. In

MCA 2 Route Option	Analysis of MCA 2 Route Options
	terms of Soils and Geology (Ground Movement), the fact that Option 1 is elevated in the Swords area means that there is reduced potential for ground movement when compared with routes that are entirely in tunnel. Therefore, in terms of soils and geology, Option 1 is considered to have some advantages over other options, which are entirely in tunnel. Overall, from an environmental perspective, Option 1 performs more poorly than other route options having regard to Landscape and Visual and Archaeology, Architecture and Cultural Heritage. However, Option 1 has some advantages over other options when considering Soils and Geology due to reduced potential for ground movement.
Option 2 (A1-B6-C11); Tunnel from the Green Line Tie-in to north of Swords Village in playing fields adjacent to the R132 Surface level to Estuary Park & Ride alongside the R132	*Economy:* The estimated total cost is favourable for Option 2 when compared to other route options, however, the Benefit Cost Ratio (BCR) and Patronage (predicted passenger numbers) is unfavourable. The journey time is the fastest of all ten options and therefore presents a time saving for passengers on this route option. *Integration:* Option 2 is considered to have some disadvantages from an Integration perspective when compared to other route options due to less favourable integration with land use policy in the central and Swords areas and lack of integration with the DART network in the city centre and bus network in the central and Swords areas. *Accessibility & Social Inclusion:* Option 2 is considered to have some disadvantages over other route options from an Accessibility and Social Inclusion perspective as it serves less key trip attractors in the city centre and central study areas than other options. *Environment:* In terms of potential impact on Landscape and Visual, Option 2 has the potential for direct impact on key locations and views in the city centre. In overall terms, therefore Option 2 is considered to have some disadvantages over other options from a Landscape and Visual perspective due to the potential impacts in Study Area A. In terms of potential impact on Archaeology, Architecture and Cultural Heritage, Option 2 has potential for impact on architectural heritage assets of national significance in Study Area A. In overall terms, therefore Option 2 is considered to have some disadvantages over other options from an Archaeology, Architecture and Cultural Heritage perspective due to the potential impacts in Study Area A. In terms of Soils and Geology (Ground Movement), the fact that Option 2 is in tunnel in the Swords area means that there is an increased potential for ground movement when compared with routes that are not in tunnel in Study Area C. Therefore, Option 2 is considered to have some disadvantages over other options, which are not entirely in tunnel. In Summary, for Option 2 from an Environmental perspective, has some disadvantages over other route options.
Option 3 (A1-B10-C4); Tunnel from the Green Line Tie-in to north of the Naul Road via Drumcondra Station. Surface level from the Naul Road to the R132 at the junction with Nevinstown Lane / L2300 Underpass under the R132 Surface level to Pinnock Hill Roundabout Elevated from Pinnock Hill Roundabout to north of Estuary Roundabout Surface level to Estuary Park & Ride alongside the R132	*Economy:* The Benefit Cost Ratio (BCR) and Patronage (Predicted Passenger Numbers) is highly unfavourable for Option 3 when compared to other route options, however, the Total Cost is highly favourable compared to other route options. The journey time is the fourth fastest of all ten route options and therefore represents a moderate time saving for patronage on this end-to-end option. However, overall, Option 3 is considered to have significant disadvantages over other options in the economic assessment. *Integration:* Option 3 is considered to have disadvantages over other route options in terms of Integration due to the lack of integration with the DART network in the city centre, whilst acknowledging that it has some advantages over other options in terms of Integration with Land Use Policy in the central and Swords area. *Accessibility & Social Inclusion:* Option 3 is considered to have some disadvantages over other route options from an Accessibility and Social Inclusion perspective due to serving less Key Trip Attractors in the city centre. *Environment:* In terms of potential impact on Landscape and Visual, Option 3 has the potential for direct impact on key spaces and views in the city centre. Overall, Option 3 is considered to have some disadvantages over other options from a Landscape and Visual perspective due to the potential impacts in Study Area A.

MCA 2 Route Option	Analysis of MCA 2 Route Options
	In terms of potential impact on Archaeology, Architecture and Cultural Heritage, Option 3 has potential for impact on architectural heritage assets of national significance in Study Area A. The risk of identifying significant archaeological deposits in this area is also very high. In overall terms, therefore Option 3 is considered to have some disadvantages over other options from an Archaeology, Architecture and Cultural Heritage perspective due to the potential impacts in Study Area A. In terms of Soils and Geology (Ground Movement), the fact that Option 3 is elevated in the Swords area has a reduced potential for ground movement when compared with route options that are entirely in tunnel. Therefore, Option 3 is considered to have some advantages over other options, which are entirely in tunnel. In Summary, for Option 3 from an Environmental perspective, Landscape and Visual and Archaeology, Architecture and Cultural Heritage has some disadvantages over other options and Soils and Geology has some advantages over other options.
Option 4 (A1-B10-C11); Tunnel from the Green Line Tie-in to north of Swords Village in playing fields adjacent to the R132 Surface level to Estuary Park & Ride alongside the R132	*Economy:* The Benefit Cost Ratio (BCR) and Patronage (Predicted Passenger Numbers) is unfavourable for Option 4 when compared to other route options, however the Total Cost is favourable compared to other options. The journey time is among the fastest of all ten options and therefore represents a time saving for patronage on this end-to-end option. *Integration:* Overall Option 4 is considered to have some disadvantages over other route options in terms of Integration due to less favourable integration with Land Use Policy in the Swords area and less favourable Public Transport Integration due to lack of integration with the DART network in the city centre and bus network in the Swords area. *Accessibility & Social Inclusion:* Option 4 is considered to have some disadvantages over other route options from an Accessibility and Social Inclusion perspective due to serving less Key Trip Attractors in the city centre. *Environment:* In terms of potential impact on Landscape and Visual, Option 4 has the potential for direct impact on key spaces and views in the city centre. In overall terms, therefore Option 4 is considered to have some disadvantages over other options from a Landscape and Visual perspective due to the potential impacts in Study Area A. In terms of potential impact on Archaeology, Architecture and Cultural Heritage, Option 4 has potential for impact on architectural heritage assets of national significance in Study Area A. The risk of identifying significant archaeological deposits in this area is also very high. In overall terms, therefore Option 4 is considered to have some disadvantages over other options from an Archaeology, Architecture and Cultural Heritage perspective due to the potential impacts in Study Area A. In terms of Soils and Geology (Ground Movement), the fact that Option 4 is in tunnel in the Swords area has an increased potential for ground movement when compared with route options that are not in tunnel in Area C. Therefore, Option 4 is considered to have some disadvantages over other options, which are not entirely in tunnel. In Summary, for Option 4 from an Environmental perspective, Landscape and Visual, Archaeology, Architecture and Cultural Heritage and Soils and Geology has some disadvantages over other options.
Option 5 (A2-B6-C4); Tunnel from the Green Line Tie-in to north of the Naul Road via Drumcondra Station. Surface level from the Naul Road to the R132 at the junction with Nevinstown Lane / L2300 Underpass under the R132 Surface level to Pinnock Hill Roundabout Elevated from Pinnock Hill	*Economy:* The Benefit Cost Ratio (BCR) is favourable for Option 5; however, the Total Cost and Patronage (Predicted Passenger Numbers) is unfavourable compared to other route options. The journey time is among the slowest of all ten route options and therefore does not offer as significant a time saving for patronage on this end-to-end option when compared to others. *Integration:* Overall Option 5 is considered to have some disadvantages over other route options in terms of Integration due to being less favourable on integration with Land Use Policy in the central area and less favourable Public Transport Integration with the bus network in Santry. *Accessibility & Social Inclusion:* Overall Option 5 is considered to have some advantages over other route options from an Accessibility and Social Inclusion perspective due to serving more Key Trip Attractors in the city centre *Environment:* In terms of potential impact on Landscape and Visual, Option 5 has the

MCA 2 Route Option	Analysis of MCA 2 Route Options
Roundabout to north of Estuary Roundabout Surface level to Estuary Park & Ride alongside the R132	potential for direct impact on key spaces and views in the city centre, however the impact is not as significant compared to other options. In overall terms, therefore Option 5 is considered to have some advantages over other options from a Landscape and Visual perspective due to the lesser potential impacts in Study Area A. In terms of potential impact on Archaeology, Architecture and Cultural Heritage, Option 5 has potential for impact on architectural heritage assets of national significance in Study Area A, however the impact is not as significant when compared to other routes. In overall terms, therefore Option 5 is considered to have some advantages over other options from an Archaeology, Architecture and Cultural Heritage perspective due to the lesser potential impacts in Study Area A. In terms of Soils and Geology (Ground Movement), the fact that Option 5 is elevated in the Swords area has a reduced potential for ground movement when compared with routes that are entirely in tunnel. Therefore, Option 5 is considered to have some advantages over other options, which are entirely in tunnel. In Summary, for Option 5 from an Environmental perspective, Landscape and Visual, Archaeology, Architecture and Cultural Heritage and Soils and Geology has some advantages over other options.
Option 6 (A2-B6-C11); TBM from the Green Line Tie-in to north of Swords Village in playing fields adjacent to the R132 Surface level to Estuary Park & Ride alongside the R132	*Economy:* The Benefit Cost Ratio (BCR) and Patronage (Predicted Passenger Numbers) is favourable for Option 6; however, the Total Cost is highly unfavourable compared to other options as it is mostly tunnelled. The journey time is mid-range of all ten route options and therefore represents a moderate time saving for patronage on this end-to-end option. *Integration:* Option 6 is considered to have some disadvantages over other route options in terms of Integration due to being less favourable on integration with Land Use Policy in the central and Swords area and less favourable Public Transport Integration with the bus network in Santry and Swords Main Street. *Accessibility and Social Inclusion:* Option 6 is considered to have some advantages over other route options from an Accessibility and Social Inclusion perspective due to serving more Key Trip Attractors in the city centre. *Environment:* In terms of potential impact on Landscape and Visual, Option 6 has the potential for direct impact on key spaces and views in the city centre, however the impact is not as significant compared to other options. In overall terms, therefore Option 6 is considered to have some advantages over other options from a Landscape and Visual perspective due to the lesser potential impacts in Study Area A. In terms of potential impact on Archaeology, Architecture and Cultural Heritage, Option 6 has potential for impact on architectural heritage assets of national significance in Study Area A, however the impact is not as significant when compared to other routes. The risk of identifying significant archaeological deposits in this area is also very high. In overall terms, therefore Option 6 is considered to have some advantages over other options from an Archaeology, Architecture and Cultural Heritage perspective due to the lesser potential impacts in Study Area A. In terms of Soils and Geology (Ground Movement), the fact that Option 6 is in tunnel in the Swords area has an increased potential for ground movement on a quantifiable basis when compared with routes that are not in tunnel in Area C. Therefore, Option 6 is considered to have some disadvantages over other options, which are not entirely in tunnel. In Summary, for Option 6 from an Environmental perspective, Landscape and Visual and Archaeology, Architecture and Cultural Heritage has some advantages over other options and Soils and Geology has some disadvantages over other options.
Option 7 (A2-B10-C4); Tunnel from the Green Line Tie-in to north of the Naul Road via Drumcondra Station. Surface level from the Naul Road to the R132 at the junction with	*Economy:* The Benefit Cost Ratio (BCR) and Total Cost is unfavourable for Option 7; however, the Patronage (Predicted Passenger Numbers) is favourable compared to other options. The journey time is the slowest of all ten route options and therefore does not present a time saving for patronage on this end-to end option. *Integration:* Option 7 is considered to have some advantages over other route options in terms of Integration due to favourable integration with Land Use Policy in the Ballymun and Swords area and favourable Public Transport Integration in the city centre, central and Swords area.

MCA 2 Route Option	Analysis of MCA 2 Route Options
Nevinstown Lane / L2300 Underpass under the R132 Surface level to Pinnock Hill Roundabout Elevated from Pinnock Hill Roundabout to north of Estuary Roundabout Surface level to Estuary Park & Ride alongside the R132	*Accessibility & Social Inclusion:* Option 7 is considered to have some advantages over other route options from an Accessibility and Social Inclusion perspective due to serving more Key Trip Attractors in the city centre. *Environment:* In terms of potential impact on Landscape and Visual, Option 7 has the potential for direct impact on key spaces and views in the city centre, however the impact is not as significant compared to other options. In overall terms, therefore Option 7 is considered to have some advantages over other options from a Landscape and Visual perspective due to the lesser potential impacts in Study Area A. In terms of potential impact on Archaeology, Architecture and Cultural Heritage, Option 7 has potential for impact on architectural heritage assets of national significance in Study Area A, however the impact is not as significant when compared to other routes. In overall terms, therefore Option 7 is considered to have some advantages over other options from an Archaeology, Architecture and Cultural Heritage perspective due to the lesser potential impacts in Study Area A. In terms of Soils and Geology (Ground Movement), the fact that Option 7 is elevated in the Swords area has a reduced potential for ground movement on a quantifiable basis when compared with routes that are entirely in tunnel. Therefore, Option 7 is considered to have some advantages over other options, which are entirely in tunnel. In Summary, for Option 7 from an Environmental perspective, Landscape and Visual, Archaeology, Architecture and Cultural Heritage and Soils and Geology has some advantages over other options.
Option 8 (A2-B10-C11); Tunnel from the Green Line Tie-in to north of Swords Village in playing fields adjacent to the R132 Surface level to Estuary Park & Ride alongside the R132	*Economy:* The Benefit Cost Ratio (BCR) and Total Cost is unfavourable for Option 8; however, the Patronage (Predicted Passenger Numbers) is highly favourable compared to other options. The journey time is among the slowest of all ten options and therefore does not represent a significant time saving for patronage on this end-to-end option. *Integration:* Option 8 is considered to have some disadvantages over other route options in terms of Integration due to less favourable integration with Land Use Policy and Public Transport Integration in the Swords area. *Accessibility & Social Inclusion:* Option 8 is considered to have some advantages over other route options from an Accessibility and Social Inclusion perspective due to serving more Key Trip Attractors in the city centre. *Environment:* In terms of potential impact on Landscape and Visual, Option 8 has the potential for direct impact on key spaces and views in the city centre, however the impact is not as significant compared to other options. In overall terms, therefore Option 8 is considered to have some advantages over other options from a Landscape and Visual perspective due to the lesser potential impacts in Study Area A. In terms of potential impact on Archaeology, Architecture and Cultural Heritage, Option 8 has potential for impact on architectural heritage assets of national significance in Study Area A, however the impact is not as significant when compared to other routes. In overall terms, therefore Option 8 is considered to have some advantages over other options from an Archaeology, Architecture and Cultural Heritage perspective due to the lesser potential impacts in Study Area A. In terms of Soils and Geology (Ground Movement), the fact that Option 8 is in tunnel in the Swords area has an increased potential for ground movement on a quantifiable basis when compared with routes that are not in tunnel in Area C. In Summary, for Option 8 from an Environmental perspective, Landscape and Visual and Archaeology, Architecture and Cultural Heritage has some advantages over other options and Soils and Geology has some disadvantages over other options.
Option 9 (A4-B12-C4); Tunnel from the Green Line Tie-in to north of the Naul Road via Whitworth Station. Surface level from the Naul Road to the R132 at the junction with	*Economy:* The Benefit Cost Ratio (BCR), Total Cost and Patronage (Predicted Passenger Numbers) is highly favourable for Option 9. The journey time is the second slowest of all ten options and therefore does not represent a significant time saving for patronage on this end-to-end option compared to other options. *Integration:* Option 9 is considered to have some advantages over other route options in terms of Integration due to favourable integration with Land Use Policy in the Ballymun and Swords area, and favourable integration with Public Transport Integration

MCA 2 Route Option	Analysis of MCA 2 Route Options
Nevinstown Lane / L2300 Underpass under the R132 Surface level to Pinnock Hill Roundabout Elevated from Pinnock Hill Roundabout to north of Estuary Roundabout Surface level to Estuary Park & Ride alongside the R132	in the city centre, Ballymun and Swords area. *Accessibility & Social Inclusion:* Option 9 is considered to have some advantages over other route options from an Accessibility and Social Inclusion due to serving more Key Trip Attractors in the city centre *Environment:* In terms of potential impact on Landscape and Visual, Option 9 has the potential for direct impact on key spaces and views in the city centre. In overall terms, therefore Option 9 is considered to have some disadvantages over other options from a Landscape and Visual perspective due to the potential impacts in Study Area A. In terms of potential impact on Archaeology, Architecture and Cultural Heritage, Option 9 has potential for impact on architectural heritage assets of national significance in Study Area A. The risk of identifying significant archaeological deposits in this area is also very high. In overall terms, therefore Option 9 is considered to have some disadvantages over other options from an Archaeology, Architecture and Cultural Heritage perspective due to the potential impacts in Study Area A. In terms of Soils and Geology (Ground Movement), the fact that Option 9 is elevated in the Swords area has a reduced potential for ground movement on a quantifiable basis when compared with routes that are entirely in tunnel. In Summary, for Option 9 from an Environmental perspective, Landscape and Visual and Archaeology, Architecture and Cultural Heritage has some disadvantages over other options and Soils and Geology has some advantages over other options. Therefore, overall Option 9 is considered to have some disadvantages over other options.
Option 10 (A4-B12-C4).	*Economy:* The Benefit Cost Ratio (BCR) and Patronage (Predicted Passenger Numbers) is highly favourable for Option 10; however, the Total Cost is unfavourable compared to other options. The journey time is mid-range of all ten options and therefore does not represent a significant time saving for patronage on this end-to-end option compared to other options. *Integration:* Option 10 is considered to have some disadvantages over other options in terms of Integration due to less favourable integration with Land Use Policy and Public Transport Integration in the Swords area. *Accessibility & Social Inclusion:* Option 10 is considered to have some advantages over other options from an Accessibility and Social Inclusion perspective due to serving more Key Trip Attractors in the city centre. *Environment:* In terms of potential impact on Landscape and Visual, Option 10 has the potential for direct impact on key spaces and views in the city centre. In overall terms, therefore Option 10 is considered to have some disadvantages over other options from a Landscape and Visual perspective due to the potential impacts in Study Area A. In terms of potential impact on Archaeology, Architecture and Cultural Heritage, Option 10 has potential for impact on architectural heritage assets of national significance in Study Area A. The risk of identifying significant archaeological deposits in this area is very high. In overall terms, therefore Option 10 is considered to have some disadvantages over other options from an Archaeology, Architecture and Cultural Heritage perspective due to the potential impacts in Study Area A. In terms of Soils and Geology (Ground Movement), the fact that Option 10 is in tunnel in the Swords area has an increased potential for ground movement on a quantifiable basis when compared with routes that are not in tunnel in Area C. Therefore, Option 10 is considered to have some disadvantages over other options, which are not entirely in tunnel. In Summary, for Option 10 from an Environmental perspective, Landscape and Visual, Archaeology, Architecture and Cultural Heritage and Soils and Geology has some disadvantages over other options. Therefore, overall Option 10 is considered to have some disadvantages over other options.

The following were the main conclusions emerging from the Stage 2 MCA process:

- The most direct end-to-end route options are the cheapest options to construct as they are the shortest in length, and would have a comparatively high Benefit Cost Ration (BCR), but would have low patronage;
- Options which serve the heavy rail line at Drumcondra or Glasnevin (previously referred to as Whitworth) plus interchange with the DART at Tara Street are considered to integrate with the existing and planned public transport network better than options which serve other alignments;
- Options which serve Glasnevin better integrate with the Transport Strategy for the GDA than those options which serve Drumcondra, due to the overall better integration with the existing and planned public transport network, especially the heavy rail network. Furthermore, Glasnevin Station has higher patronage than Drumcondra Station and facilitates a better passenger experience. Further details on the comparative assessment are provided below in Section 7.6.4;
- Options which serve Swords Main Street have slightly higher patronage than the equivalent options which serve the R132 Swords Bypass in Swords. However, the additional cost of the end-to-end route options which serve Swords Main Street is €235m; and
- Options along the R132 Swords Bypass are better in terms of supporting land-use policy integration and planned future growth.

7.6.5 Drumcondra v Glasnevin

A key difference between the route options assessed is the location of a potential interchange station connecting to the Maynooth and Kildare Railway Lines, being at either the existing Drumcondra railway station or the development of a new station at Glasnevin. The difference in performance between options interchanging at Drumcondra or Whitworth is considered in more detail having regard to being consistent with the Transport Strategy for the GDA, maximizing patronage on the integrated public transport system and allowing for interchange between the different public transport modes:

Since "Old Metro North, the Phoenix Park Tunnel Link (PPT) reopened for commuter passenger services as proposed in the Transport Strategy for the GDA. The PPT provides a connection between Heuston station and Connolly Stations. This connector runs from Islandbridge junction, just west of Heuston Station, crossing the river Liffey and continuing northwards through Cabra, under the Royal Canal and the Maynooth line before heading eastwards around the north side of Glasnevin cemetery to Glasnevin Junction, where it joins the Maynooth line, immediately to the west of the R108 - Prospect Road i.e., Proposed MetroLink Glasnevin Station location. There is currently no railway station at this location. The line then continues eastwards through Drumcondra Station and onwards to Connolly Station. The line can also access the North Wall via North Strand Junction at Glasnevin.

The Dart Plus Programme consists of a number of major railway upgrade projects that are being designed to enhance the public transport network in the Greater Dublin Area. The programme aims to increase the electrified railway network in the Greater Dublin Area from 50km to 150km, allowing for a much more integrated transport system with increased capacity on all routes. The following projects are included on the Dart Plus programme include:

- Dart + West: Maynooth and M3 Parkway to the City Centre; The electrification of the railway line from Maynooth into the city centre providing capacity for 13.2k passengers per hour.
- Dart + South West – Kildare Line from Hazelhatch & Celbridge to the City Centre: Electrification of the railway line from Celbridge Hazelhatch to the city centre providing capacity for 20,000 passengers per hour.

In order to meet the aims and objectives of the Transport Strategy for the GDA, achieving the optimum interchange with these two upgraded transport corridors will be critical to the MetroLink project.

The Transport Strategy for the GDA sets out a vision on how transport services will be provided in the future and includes reference to the construction of additional heavy rail stations at appropriate locations in areas with sufficient demand.

The choice of a station location at either Drumcondra or Glasnevin has been considered in the context of the achievement of the Transport Strategy for the GDA having particular regard to maximizing the interchange opportunities between different services and to provide fast and convenient access to

major transport destinations such as Dublin city centre and Dublin Airport. It is considered that the provision of a station at Glasnevin will better meet the requirements of the Transport Strategy for the GDA for the following reasons:

- It will facilitate a seamless transfer/interchange with both the Maynooth (Western Commuter line) and Kildare railway line (South-Western Commuter line) because the PPT and Maynooth lines are at their closest point horizontally and vertically at Glasnevin, thereby providing the opportunity for a MetroLink station to capture transfer to and from these lines more effectively than at Drumcondra.
- The Glasnevin location also facilitates the construction of an integrated metro station as the two heavy rail lines are beneath the existing ground level, making it possible to connect via an underground concourse to all three rails in a short plan distance. At Drumcondra, the connection to both lines would require a connection of approximately 110m with more significant vertical connections between the two lines also required.
- The further advantage of Glasnevin is that it is located approximately 1km to the west of Drumcondra. This saves over 2 minutes in journey time by offering the opportunity for passengers to transfer sooner from heavy rail to MetroLink at Glasnevin to access city centre locations to the south or to the Airport/Swords to the north.
- Route options serving the Glasnevin station are forecast to have approximately 6000 additional passengers per day when compared to an interchange station at Drumcondra. This is largely due to the increased interchange opportunity at Glasnevin.
- Passengers transferring from the Maynooth or Kildare lines to MetroLink and travelling on to Dublin city centre will experience shorter journey times (approximately 3 minutes).

Environmental analysis of the station locations identified that there is potential for significant impacts in the absence of mitigation measures during the Construction Phase at each location related to the fact that both station locations are within existing urban areas with a number of sensitive receptors in close proximity. This means that during the Construction Phase, in the absence of mitigation measures, there is potential for significant noise and vibration impacts, air quality and dust emissions and traffic congestion at each location.

At Glasnevin there is greater potential for impacts on hydrology and biodiversity, due to their proximity to the Royal Canal, although these are likely to be managed through appropriate mitigation measures. Both options would require demolition of buildings with potential for significant impacts on architectural heritage, due to the required demolition of the Brian Boru public house building, partial demolition of the railway tunnel, and construction impacts on the railings associated with Dalcassian Downs at Glasnevin.

However, once the Construction Phase is complete, the proposed station location at Glasnevin offers a much better interchange station location for passengers as discussed above.

7.6.6 Emerging Preferred Route

Based on the conclusions of the MCA, Option 9 (A4-B12-C4) was recommended as the EPR for NMN for the following primary reasons:

- In terms of Economy, it delivers substantially more benefits than most of the options resulting in the joint highest BCR;
- It performs among the best in terms of public transport usage i.e., boarding's over 24 hours;
- It integrates better with the wider transport network with better potential for seamless interchange with other modes, particularly heavy rail in the city centre and bus in Swords, than other options considered;
- It integrates better with current Land Use Policy particularly in Ballymun and Swords; and
- In terms of Environment, while there are some impacts in terms of Landscape and Visual and Archaeology, Architecture and Cultural Heritage, these impacts can largely be mitigated.

Refer to the New Metro North Alignment Options Report (TII 2018) for further details of the analysis undertaken. The EPR is shown in Diagram 7.5.

Diagram 7.5: Emerging Preferred Route

7.7 Identification of a Preferred Route and further design changes

7.7.1 Introduction

Submissions made by stakeholders and the public during the Public Consultation in 2018 on the EPR were carefully analysed and are outlined in Chapter 8 (Consultation). Taken together with other proposed route alignment and design improvements, design responses to consultation submissions have resulted in a number of changes to the EPR leading to a Preferred Route.

While based on the EPR alignment, the Preferred Route developed on and improved on earlier design considerations. There are a number of significant project developments that have impacted the alignment, the construction and the operation of the proposed Project as compared to the EPR, and these are as follows:

- Tunnel configuration from twin bore to single bore and location of Tunnel Launch Sites as discussed below in Section 7.7.2;
- Crossing of the M50 Motorway as discussed below in Section 7.7.3
- The location of the proposed Project Depot at Dardistown as discussed below in Section 7.7.4
- Development of an Operational Phase Strategy.
- The deferral of MetroLink running on the existing Luas Green Line as discussed below in Section 7.7.7;
- Alterations to the Alignment when compared to EPR as discussed below in Section 7.7.9 ;
- Modifications to Station Locations as discussed below in Section 7.7.10;
- Design and location of intervention Shafts as discussed below in Section 7.7.11; and
- Alterations to the proposed Substation Locations as discussed below in Section 7.7.12.

The adoption of each of these significant design changes was based on a multi-disciplinary analysis undertaken comparing alternative design options to the EPR option. For full details of the analysis undertaken refer to the Preferred Route Design Development Report (TII, 2019) and the relevant appendices which can be viewed on www.metrolink.ie.

Each multi-disciplinary analysis was undertaken based on a set of defined criteria and sub-criteria having regard to the 'Guidelines on a Common Appraisal Framework for Transport Projects and Programmes' (DTTAS 2016). The analysis undertaken to inform design changes included a full environmental analysis of all feasible design options proposed.

7.7.2 Tunnelling Strategy

As discussed above in section 7.6.3, the assessment for the EPR identified that there were a number of feasible options. The EPR included for a single tunnel running from just north of Dublin airport all the way under the airport, the M50 motorway and subsequently to the project end point.

However, as part of an analysis undertaken in the development of the PR, the following alternatives were assessed by a multi-disciplinary team:

- Twin Bore v Single Bore Tunnel; and
- Single tunnel v Two Tunnels: Single tunnel commencing from North of Dublin Airport v to two separate tunnels, one commencing north of the M50 in Dardistown and one commencing south of the M50 at Northwood.

7.7.2.1 Twin Bore to Single Bore

For the EPR, in order to complete the proposed Project within an efficient construction programme, it was considered necessary to have at least two concurrent tunnelling operations using four TBMs operating at the same time. Otherwise, the time taken to complete all tunnel boring and lining work (which needs to completed before the tunnels could be fitted out with track, power and systems) would have doubled. The construction site was therefore sized to cater for four tunnel bores being delivered simultaneously. The CLG Na Fianna pitch location was identified as a TBM launch site and subsequent station location for Griffith Park Station.

Following public consultation on the EPR in 2018, a review of submissions received identified that there were significant objections to the proposed usage of the CLG Na Fianna pitch as a construction compound and a TBM launch site based on potential for impacts during the Construction Phase on the amenity value of the CLG Na Fianna club sports grounds and on the nearby schools and residential properties.

Further analysis was undertaken to identify if there was potential to remove the TBM launch site from this location having regard to the potential impacts on the local population during the Construction Phase. Noting the significant objections to the proposals, TII considered whether the change to a single bore tunnel might negate the need for a TBM launch site at CLG Na Fianna club sports ground.

Further assessment was undertaken to identify the most appropriate tunnel options i.e., twin bore v single bore having regard to engineering, fire safety strategy, Construction Phase, operational environmental, planning and cost criteria.

7.7.2.2 Environmental Analysis

A key element of the assessment of alternatives having regard to decision on whether to progress with a single bore tunnel or a twin bore tunnel was the environmental assessment.

This assessment considered all environmental disciplines, but the following were the principle environmental outcomes of the analysis:

From an environmental perspective there was very little to differentiate between the options;

- During the Construction Phase, the use of a single bore tunnel would require the construction of two intervention shafts with potential impacts on the local populations during this phase. The twin bore tunnel would not require the provision of intervention shafts.
- Both tunnelling options would generate significant volumes of spoil to be managed, however the twin bore option would generate slightly more.
- Both options would generate noise &vibration during the TBM advancement. However, the single bore TBM has slightly greater potential impacts due to a larger diameter TBM. This was offset by the requirement for blasting of the cross passages that are required for the twin bore, but not required for the single bore. In addition, the twin bore option would require 2 TBMs to advance in the parallel tunnels resulting in an increased potential for a noise and vibration impact.
- Both options have potential for an impact on groundwater if not mitigated due to the potential for impacts on wells and potentially groundwater.
- Single bore tunnels have advantages over twin bore in that they offer enhanced access and egress arrangements from ground level during emergencies.

The analysis identified that the two options are very similar, although the assessment has found that the single-bore option would have reduced impacts on materials use and waste, and the noise and vibration effects associated with the single-bore option would be of reduced duration. Therefore, from an environmental perspective, the single bore configuration should be slightly preferred.

7.7.2.2.1 Overall Conclusions

This analysis identified that a single bore tunnel option offered significant benefits for the proposed Project when compared to the twin bore solution advanced at EPR stage. detailed below:

- It would allow for passenger evacuation onto tracks in a safer and faster manner than lateral evacuation onto walkways;
- It would allow for increased space for emergency services access and working space adjacent to a train in the tunnel;
- The single-bore configuration would facilitate enhanced evacuation safety conditions and provides better tunnel visibility when compared to the twin bore solution during fires;
- A single-bore tunnel could be constructed more quickly as:

- There is no requirement for cross-passages, which are slow to construct and need to be mined as separate/later construction activities;
- It is not affected by extra mined/cut & cover sections required for track crossovers in twin bore tunnels;
- A larger diameter tunnel can allow for some parallel working including the fitting out work, which could not be achieved as effectively in the smaller diameter twin bore tunnels;

- Building programme and construction activities within underground stations are impacted only once by drive through/pull through of TBM (compared to twice for twin bore tunnels); and
- Reduction in spoil quantities and associated handling and disposal costs compared to twin-bore tunnel.

- The single-bore tunnel could be constructed at lower cost than twin bore tunnels due to the reduced construction works and shorter construction programme;
- The single bore tunnel allows for a reduced environmental impact during the Construction Phase when compared to the twin bore configuration due to the shorter construction period and the lower quantities of spoil generated; and
- The use of a single bore tunnel would negate the requirement for the location of a TBM launch site at Griffith Park and would significantly reduce the scale of construction works required at Griffith Park.

By using a single-bore tunnel solution the city tunnel TBM Launch site could be relocated at Northwood which is further removed (than the Griffith Park location) from sensitive receptors such as schools, sports facilities and residential areas, and so the potential environmental impacts arising from the location would be less significant.

The Northwood location is located in very close proximity to the M50 Motorway Junction 4, which would allow HGV traffic to quickly move onto the motorway network, thereby reducing potential for traffic congestion impacts on the local population when compared to the Griffith Park site.

The TBM launch site at Northwood is currently unused and so the proposal to use this site would not result in the displacement of other economic, social or community activity.

On the basis of the multicriteria, multidisciplinary analysis as presented above, having regard to potential environmental effects, it was identified that a single-bore tunnel was the preferred option. (Refer to MetroLink Preferred Route Design Development Report (TII, 2019) for further details which can be viewed at www.metroLink.ie).

7.7.2.3 Continuous Tunnel – City Centre to Fosterstown vs Two Tunnel Sections – Airport & City Centre.

The EPR for the proposed Project serving the Swords-Dublin Airport-City Centre transport corridor was developed as a continuous twin bore tunnel running from just south of Fosterstown to south of Charlemont. For the PR the tunnelling route was divided into two distinct sections. An Airport tunnel section (Just south of Fosterstown to Dardistown) and a City Centre tunnel Section (Northwood to Charlemont).

- *Airport tunnel:* would be constructed by TBM which would be launched from Dardistown and progress north beneath Dublin Airport emerging north of the Naul Road and south of Fosterstown Station.
- *City Tunnel:* tunnel would be constructed by TBM which would be launched from Northwood and progress south beneath the city centre to just south of Charlemont Station where the line would terminate.

This alternative tunnelling strategy allowed for a surface level depot to be established at Dardistown mid-route as opposed to being located at the end of the line at Estuary as proposed in the EPR. A surface level depot at Dardistown would offer improved operational and maintenance benefits for the scheme. This alternative tunnelling strategy therefore resulted in the need for two tunnel launch sites, one at Dardistown, south of Dublin Airport and another at Northwood, south of the M50.

7.7.2.4 Environmental Analysis

Airport Tunnel

An environmental assessment has been undertaken on the proposal to construct a tunnel portal in this location in order to identify any potential significant environmental constraints and opportunities. These findings were considered when identifying the preferred option. The following are the principle environmental considerations identified when assessing the preferred option:

- The location of the portal and alignment is situated over an identified site listed on the Record of Monuments and Places as an enclosure (DU014-121).
- The construction of the tunnel portal location will require management in line with the requirements of daa given that the southern end of a runway is located 250m from the northern most aspect of the portal. Measures will be required to ensure that Construction Phase plant and machinery does not impact on the safety zones for approaching aircraft to the runway. In addition, it will be critical to ensure that the construction site does not attract bird activity in close proximity to the runway. The location of the portal has been chosen to ensure the runway RESA can be lengthened in future as outlined in this report.
- During the Construction Phase a significant volume of traffic will be generated from the site and this has potential to impact on the local road network. However, the proximity to the M50 motorway will ensure that Heavy Goods Vehicles (HGVs) potentially used for the transport of spoil material can quickly access the motorway and thereby minimising impacts on local roads. The anticipated access and egress arrangements are noted in Section 5.5 of this report.
- The proposed portal location is located on land currently utilised for agricultural purposes which will be impacted during construction. This is because the TBM will be launched from this location requiring a significant work area to be set aside. During operation the area will be segregated by the overland section of track reducing the area available for agricultural production. However, it should be noted that this area is zoned for future commercial development.
- The Dardistown area is notable for the presence of several sports and leisure facilities. Careful Construction Phase management will be required at the construction site to ensure that any impacts on these facilities are mitigated.
- The land is currently zoned for General Employment Uses in the Fingal Development Plan 2017-2023 and is located within the Dublin Airport Outer Safety Zone. The lands are also subject to the Dardistown Local Area Plan 2017-2022. It is considered that appropriate measures can be adopted into the design to mitigate the potential environmental impacts noted in this report. These proposed mitigation measures will be developed as part of the preparation of the Environmental Impact Assessment Report for the project.

City Tunnel

An environmental assessment has been undertaken on the proposed new location for the TBM launch site for the city tunnel at Northwood to identify any potential significant environmental constraints and opportunities. These findings were considered when identifying the proposed site. The following are the principle environmental considerations identified when assessing the proposed site:

- There is sufficient space available to construct a TBM launch site adjacent to the proposed new station location. The final footprint of the construction compound will need to have regard for current zoning and land use requirements in this area;
- There is potential for construction related impacts arising from the TBM launch site on residential receptors. The TBM launch site is located across the R108 road from new residential properties to the east and around 200m from a school to the south west;
- Increased traffic disruption on the R108 during the operation of the TBM launch site;
- The tunnelling work will continue over several years and will generate a high volume of Heavy Goods Vehicles (HGVs) truck movements, which will involve careful traffic management to mitigate against congestion in the local area. However, the proximity to the M50 motorway will ensure that HGVs potentially used for the transport of spoil material can quickly access the motorway and thereby minimising impacts on the local road network.

7.7.2.5 Overall Conclusions

This assessment identified that the proposal for two separate tunnels would result in additional environmental effects associated with the tunnelling activity and the tunnel launch sites as outlined above. However, these impacts could be largely mitigated by introducing mitigation measures identified in this EIAR.

Having two distinct tunnel sections and an alternative to a single continuous tunnel section offers significant project advantages which are as follows:

- It allows for two separate tunnelling contracts during the Construction Phase which means that tunnel boring can progress in parallel on two tunnels concurrently, thereby reducing the Construction Phase duration for the proposed project.
- It would provide improved operational benefits for the proposed Project as it would allow the depot to be located in Dardistown.

Please refer to the MetroLink Preferred Route Design Development Report (TII, 2019) which can be viewed at www.metrolink.ie for further details).

7.7.3 Crossing the M50 Motorway

The EPR for the proposed Project was developed with a twin-bore tunnel from the city centre to just north of the airport. This meant that the M50 motorway would be traversed by way of a tunnel underneath the motorway.

However, as described in 7.7.2 above, for the PR, a single bore tunnel would be provided with a proposed portal for the City Tunnel at Northwood, just south of the M50 Motorway and a portal for the Airport Tunnel at Dardistown. These two tunnels would be connected by a bridge crossing over the M50 Motorway, which means that the alignment between the two tunnel portals is a combination of elevated (on a bridge over the M50), at grade and in cut through the Dardistown area.

Crossing the M50 using a bridge effectively resulted in two separate tunnels as discussed in Section 7.7.2.3 , the airport tunnel and the city tunnel. This has a significant advantage as it allows for two separate tunnelling contracts during the Construction Phase which means that tunnel boring can progress in parallel on two tunnels concurrently, thereby reducing the Construction Phase duration for the proposed project. In addition, a bridge across the M50 motorway better facilitates the operation of a depot at Dardistown. Please refer to the MetroLink Preferred Route Design Development Report (TII, 2019) which can be viewed at www.metrolink.ie for further details).

An analysis was also undertaken to identify if a pedestrian and cycle lane could be added to the M50 Viaduct. However, it was determined not to be feasible because, there would need to be significant separation from the running train alignment for safety reasons and this would result in a much more significant bridge structure spanning the M50 than that required for the proposed Project.

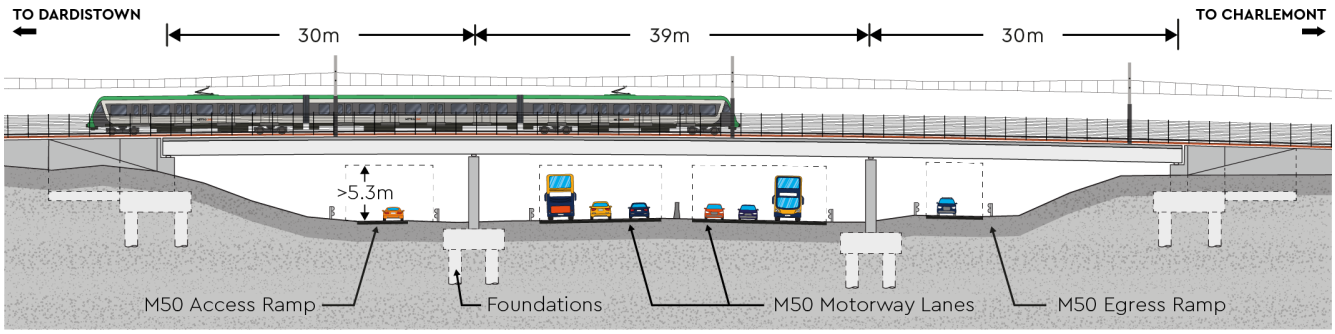


Diagram 7.6: Outline of Proposed M50 Viaduct

7.7.4 The location of the Proposed Project Depot at Dardistown

The identification of a preferred site for the depot for the proposed Project was undertaken in two principal stages which are as follows:

- Assessment of an option to locate the depot at Estuary and at an alternative site at Dardistown,
- Assessment of localised alternative locations within the Dardistown area.

No other locations were assessed for a depot location, as there are very limited site options of a sufficient scale along the alignment to accommodate a depot.

7.7.4.1 Estuary versus Dardistown

The EPR identified Estuary as the preferred location for the scheme depot. During the development of the PR the possibility of locating the depot mid-route was considered and a multi criteria assessment was carried out to determine the viability of a locating the depot at Dardistown as an alternative to Estuary.

Environmental Analysis

This assessment considered all environmental disciplines, but the following were the principle environmental outcomes of the analysis:

- *Hydrology & Biodiversity:* The proposed Estuary Depot site is located to the west of the R132 road and north of the Broadmeadow River with potential for impacts on water quality if not mitigated. The Broadmeadow River flows into several designated European sites downstream (namely Broadmeadow/Swords Estuary SPA and Malahide Estuary SAC). The proposed depot location also lies in close proximity to an area prone to flooding along Broadmeadow River. However, the proposed depot site at Dardistown is located in proximity to the Mayne River with potential for impacts on water quality if not mitigated. A drainage ditch that flows to the Mayne River may require a diversion. The area in the immediate vicinity of the Mayne River is prone to flooding. Both locations have potential for an impact on hydrology if not mitigated, however the proximity of the proposed Estuary site to more significant areas at risk of flooding and to designated European sites mean that this location is more sensitive to potential impacts.
- *Population and land use:* The Emmaus Retreat and Conference Centre, now used for refugee accommodation is regarded as a sensitive receptor in close proximity to the potential Estuary Depot site. In addition, there are residential properties, and nearby agricultural enterprises in the vicinity of the proposed depot location. The provision of a depot at this location would result in potential impacts in terms of noise, vibration and dust during Construction Phase and the Operational Phase. Local sensitivities in Dardistown include sports clubs located further north and north-west of the site near the future Dardistown Station location and some residential properties along the Old Airport Road. However, overall, it is considered that the population at Dardistown would be less sensitive to disruption during the Construction Phase and or the Operational Phase when compared to Estuary as there are fewer sensitive locations in close proximity to the proposed site and those that are present are already exposed to high levels of noise from Dublin Airport and the M50 Motorway.
- *Landscape & Visual:* The development of a depot at Estuary would result in potential landscape and visual impacts in this predominantly open agricultural area, with an area just east of the R132 defined in the Fingal Development Plan 2017 – 2023 (FCC 2017) as a Highly Sensitive Landscape. The proposed depot location at Dardistown is located within a mainly agricultural plot of land bounded by the Old Airport Road south of Dublin Airport, the R108 and industrial/commercial buildings to the west; a long-term airport car park to the east; and the M50 motorway to the south. The landscape in this area is not defined as being sensitive. It is considered that the proposed development of a Depot at Dardistown would be more in keeping with existing land use and future proposed development as per the Fingal Development Plan 2017 – 2023 (FCC 2017) and as such potential for landscape and visual impacts at this location would be less significant.
- *Sustainability*: The proposed Estuary depot site is located at a considerable distance from Dublin Airport or Swords. This location would not represent the optimal location for long term efficient

economic and environmentally sustainable operation of the rail service, in comparison with options closer to Dublin Airport at Dardistown. The proposed Dardistown area for the depot is ideally positioned to maximise the long term efficient economic and environmentally sustainable operation of the rail service.

- *Noise & Vibration:* At Estuary, the two main noise-sensitive receptors would be Emmaus Retreat and Conference Centre as well as Lissenhall Vet Hospital which are located approximately 250m from the proposed site. The development of a depot location at Dardistown has potential for noise impacts during both the construction and Operational Phase. However, the proposed site is not in close proximity to sensitive receptors. Furthermore, the area would not be considered sensitive with already elevated ambient noise levels due to the location in close proximity to Dublin Airport and the M50 motorway.
- *Property and Land take:* Similar land take would be required for a depot at either location. At Estuary there would be a requirement to demolish an existing farm buildings. At Dardistown required demolitions would be dependent on precise location of the depot location, but the only potential demolition and relocation of a private wastewater treatment plant. At both locations future development land would be occupied by the proposed Depot site. However, the site at Dardistown would impact on more valuable land due to its proximity to the M50 and the designation under the Fingal Development Plan 2017 – 2023 (FCC 2017) as "High Technology".
- *Planning:* For old Metro North the Railway Order approval granted identified that Bellinstown (located just north of Estuary) was not an appropriate location for the proposed Depot due to non-compliance with planning objectives in that area and the increased risk of flooding. The landholdings at Dardistown are within the functional area of Fingal County Council and have zoning objectives of 'GE – General Employment' and 'HT – High Technology' in the Fingal Development Plan 2017-2023 (FCC 2017). The lands will also be subject to the draft Fingal Development Plan 2023-2029 (FCC 2022) once adopted. Under the Fingal Development Plan 2017-2023, a Metro Depot is not identified as 'Permitted in Principle' or as 'Not Permitted' under either of the zoning objectives. In this regard, it is considered that a Depot is permissible at this location, particularly given the recognition of the depot within the Dardistown LAP.

7.7.4.1.1 Overall Conclusions

On the basis of multicriteria analysis the proposed depot has been located at Dardistown, just south of Dublin Airport . A summary of a detailed environmental and planning assessment of the two options for the required depot is presented above and can be reviewed in full in the MetroLink Preferred Route Design Development Report (TII, 2019) which is available at www.MetroLink.ie The main reasons behind this decision are as follows:

- The operations of the system would be better served by a more centrally located depot site at Dardistown, which would mean that vehicles could come into service more quickly and efficiently with less empty running trains.
- The section of the alignment from Dublin Airport to Charlemont will have the highest passenger demand with the requirement for more vehicles to operate on that section of the alignment. A depot location at Dardistown would ensure vehicles could enter services quickly and immediately service on the busiest section of the alignment.
- If there are mechanical failure of vehicles, the location of a depot at Dardistown means that vehicles can be moved more easily to the depot site for maintenance when compared with a depot at the northern extent of the alignment.
- Maintenance activity along the alignment can be more effectively managed as vehicles can commence maintenance activity more quickly from Dardistown compared to Estuary and
- The location of a depot at Dardistown has potential for less significant environmental effects when compared to the proposed site at Estuary. It is also possible to mitigate the majority of the potential impacts identified utilising the proposed mitigation measures outlined in the relevant chapters of the EIAR.

Please refer to the MetroLink Preferred Route Design Development Report (TII, 2019) which can be viewed at www.metrolink.ie for further details).

7.7.4.2 Dardistown Depot Local Options Assessment

Once a decision was made that Dardistown was a better location for the proposed depot, it was necessary to determine the most appropriate location for the depot site within the Dardistown area. A multi-criteria analysis was undertaken to review a number of possible locations either side of the proposed Project alignment, with different rail access arrangements into them. All of the options were within the area of land bounded by the M50 Motorway to the south, the airport to the north, the R108 Ballymun Road to the west, and premises off the R132 Swords Bypass to the east. This land is all identified in the Fingal Development Plan 2017-2023 (FCC 2017) and the draft Fingal Development Plan 2023-2029 (FCC 2022) as extended for development, some for "General Employment" and some, mostly to the south-east, for "High Technology" development.

In 2019, an emerging preferred site option for the proposed depot was identified to the south east corner of the study area and this proposed location for the Dardistown Depot was subject to public consultation as part of the preferred route public consultation in April 2019. This site was chosen as it had potential to minimize the impact on the receiving environment by:

- Ensuring a separation of the proposed site from the Mayne river;
- Removing the proposed depot site from a number of residential properties to the north west of the study area;
- Providing a separation distance between the proposed depot site and a number of community facilities to the north of the Dardistown area, such as playing pitches used by a number of GAA and Football clubs; and
- Ensuring a separation distance between the Depot site and known sites of archaeological significance (a cremation pit, burnt mound and enclosure have been recorded within the LAP lands).

However, following further design development the requirement for a grade separated mainline access for safety and operational reasons was identified. A "delta type junction was considered adequate for low frequency operations whereby lower number of trains would access and depart the depot. However, in order to facilitate efficient and safe movement of trains required to facilitate a headway of up to 90s, a grade separated junction is required. This required further analysis of location options for a depot site. (Refer to Diagram 7.7 for options assessed.

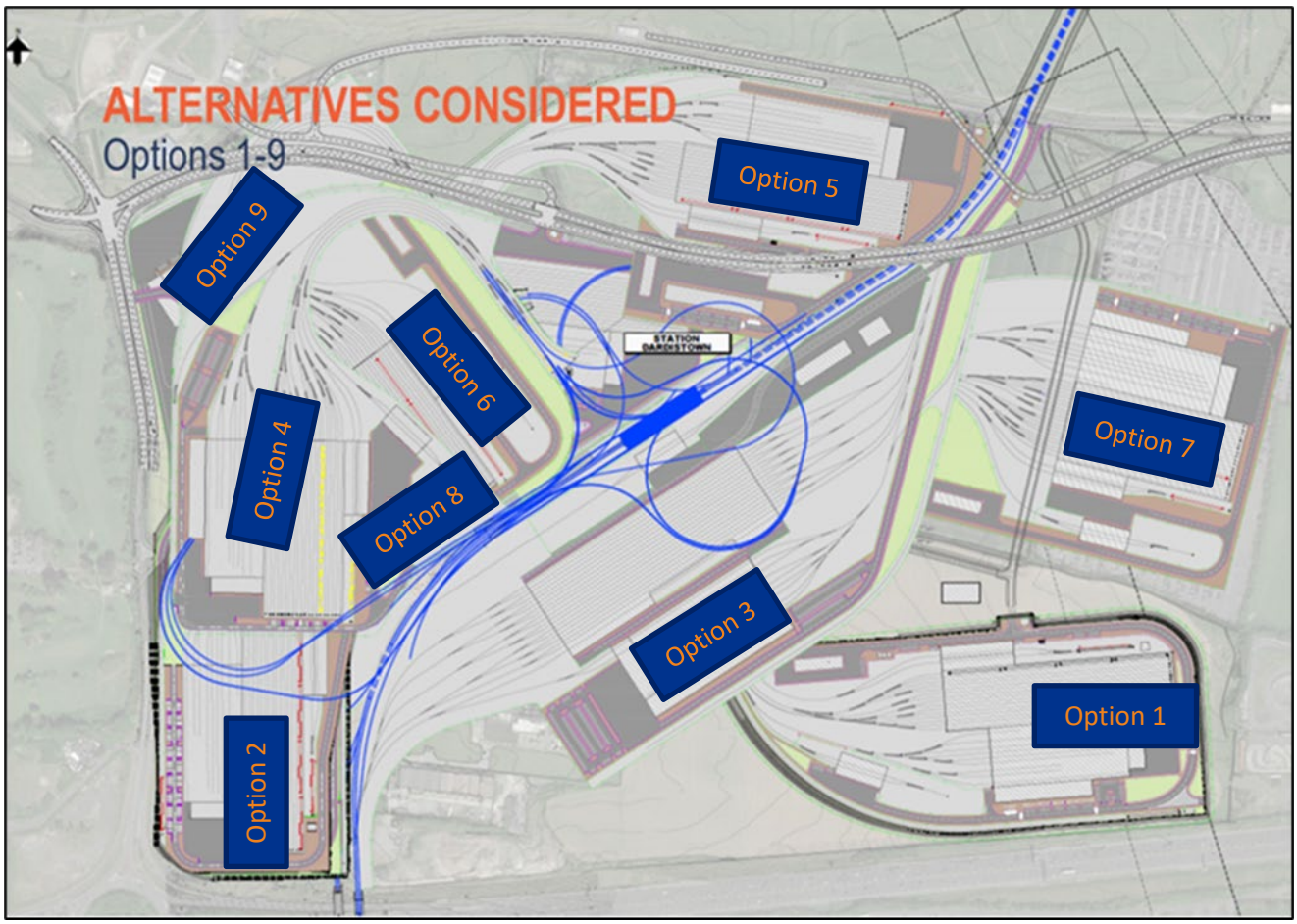


Diagram 7.7 Dardistown Depot Location Options

A multi-criteria analysis was undertaken of nine main options and various sub options depending on internal functional layouts and possible main-line connections. This additional analysis was undertaken in order to:

- Maximise the development potential of the proposed development lands zoned in the Dardistown area, having regard to consultation undertaken with Fingal County Council;
- To ensure the optimal access arrangements for rolling stock to the depot site having regard to further design development; and
- To minimise the potential environmental impacts on identified environmental constraints within the study area.

7.7.4.3 Environmental Analysis

This assessment considered all environmental disciplines, but the following were the key environmental considerations with regard to the choice of the preferred depot site (Option 8a - Refer to Diagram 7.8 for location) when compared to alternatives assessed, including the option previously identified:

- *Property and Land take:* Land-take for this option would be from agricultural land and sports pitches. The footprint of this option is large, as the railway access route into the site would sterilise a significant area of land between the Metrolink line and the depot lines and buildings. However, this option would be largely in the "General Employment" zoning area, leaving more of the land with higher development potential (High Technology). It should also be noted that the depot at this location would be in the " Outer Public Safety Zones", which restrict high density development in proximity to the Dublin airport runways. The depot development is appropriate for this restricted area;
- *Hydrology/ Hydrogeology:* One of the rail loops into the depot would be built over a drainage channel that flows into the River Mayne, with the potential for impacts on hydrology, water quality

and aquatic ecology. There will also be a requirement for a diversion of the upper reaches of the Turnapin Stream to facilitate the location of the Dardistown Depot. There is potential for effects on hydrogeology, as the site is within 300m of a well. However, the diversion of the Turnapin stream can be mitigated by improving the channel of the stream/drain already present and by adding a significant development free riparian zone along the new channel;

- *Biodiversity:* There is potential for impacts on biodiversity, including on bats and breeding birds, through removal of vegetation and from noise, lighting and dust during construction, as well as from noise and lighting during operation. Mitigation measures as identified in Chapter 17 Biodiversity will assist in reducing these impacts;
- *Archaeology:* There is potential for direct or indirect environmental impacts on locations identified in the Record of Monuments and Places including a burnt mound (DU014-119) cremation pit (DU014-120) and a medieval enclosure (DU014-121). Any impacts on these features will be mitigated by way of preservation in situ or full archaeological excavation as described in Chapter 27 of this EIAR ; and
- *Population:* The proposed Depot location will ensure that the impacts on playing pitches to the north and north west of the Dardistown area will be minimised subject to some pitch realignments and enhancements.

The preferred option has potential for environmental effects under a number of disciplines and potential impacts will required mitigation to ensure that these impacts are minimised.

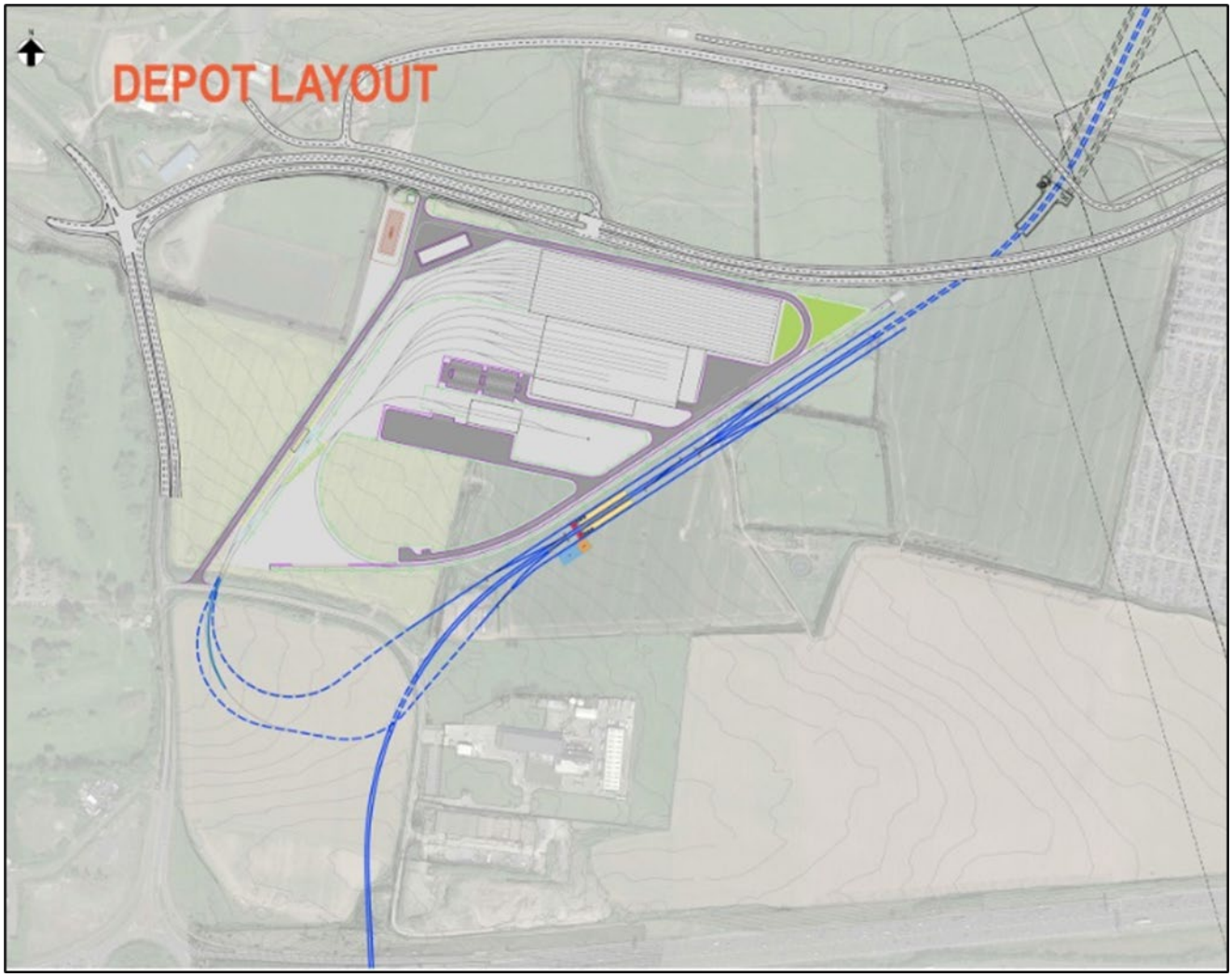


Diagram 7.8 Proposed Location for the Dardistown Depot (Option 8a)

7.7.4.4 Overall Conclusions

This analysis identified a preferred site option (Option 8a) for the location of the Depot to the north west of the proposed Project alignment, on lands in the north west corner of the Dardistown area (Refer to Diagram 7.8).

This proposed location for the Dardistown Depot has a number of advantages over alternative site locations including the following:

- This site has more limited encroachment on lands zoned for "High Technology" development in the Dardistown Local Area Plan than other site options assessed. The majority of the proposed site occurs within areas designated for "General Employment" development. It is preferable that the site occupies the "General Employment" area as this area is more limited in terms of its future development potential than the "High Technology" zoned land as it is restricted by the presence of Outer Public Safety Zones which restricts the density of development allowed due to proximity to the runways at Dublin Airport.
- The approach tracks to this option does not sterilise as much land when compared to other options. This means that there is a reduced land area required for this Depot site option including lands effected by the access tracks. This means that impacts on development land in the area is reduced (when compared to other options);
- Operation of the depot is enhanced by allowing additional tracks and switches accessing the stabling area.

Please refer to Depot Location Options Report in Appendix A7.6 for details of the full assessment.

7.7.4.5 Dardistown Depot Alternative "Option 10"

Following consultation with a major landowner in the Dardistown area, further analysis was undertaken to review whether an alternative site location proposed by that developer would be a feasible option for the proposed Depot. This option is referred to as Option 10 and is at a similar location to Option 1 previously assessed. However, Option 10 is located approximately 200m further west than Option 1 and extends into the Dublin Airport Public Safety Zones (PSZs). It is important to note that Option 1, which is like Option 10 was not previously selected as the preferred option for key reasons relating to planning and the interface with the proposed alignment for the Greater Dublin Drainage (GDD) sewer.

Nonetheless, a further multicriteria analysis was undertaken, which compared Option 10 to the previously identified preferred option (Option 8a).

Having regard to the environmental criteria assessed, it was concluded that Option 10 would have a slight advantage over option 8A due to the fact that it is more removed from sensitive receptors, with less potential for impacts during both the construction and Operational Phases. Also, Option 10 does not have any direct impact on known archaeology, although it is acknowledged that this area in general does have a high potential for archaeology. It should be noted however that Option 10 would require the acquisition of two commercial properties, and demolition and replacement of the wastewater treatment plant, which would have a potentially negative impact on local business. Option 10 would also impact directly on the proposed Greater Dublin Drainage (GDD) sewer at two locations while Option 8a impacts on the proposed sewer at one location. Option 10 would require the excavation of a significant volume of material to level the site, which would require disposal and significant transport impact. While Option 10 is marginally better than Option 8A when considering it from an environmental perspective, the impacts identified for both options could be mitigated during both the construction and Operational Phases.

However, the overall conclusions of the multicriteria analysis concluded that Option 8A has a number of advantages over Option 10 in terms of; 'Planning, Land Use, and Property Impact', 'Dardistown Station Functionality', 'Utilities & Roads', 'Land Take' and 'Construction' criteria, and no significant disadvantages when compared to Option 10. Therefore, the overall conclusion reached is that Option 8A, should remain as the Preferred Option for the following reasons:

- Option 8a lies outside of the Airport Inner PSZ where depot use is permitted. Option 10 lies within the Inner PSZ where depot development is not permitted;
- Option 8a has less impact on the FCC planning zones for employment use (c.70% of the depot lies within the 'General Employment Zoning') and therefore preserves more of the "high technology" zoned lands for future development, compared to the Option 10 depot which is c.50% within the 'High Technology Zone';
- Option 8a is fully compliant with the Dardistown LAP 2012 (extended up to 2022). Option 10 is not fully compliant because of its encroachment onto the 'Hub' lands;
- Option 8a has no interface with the GDD Sewer Project, whereas Option 10 will require the GDD sewer to be realigned or an engineering solution developed to accommodate the GDD. This will impact the GDD planning application consenting period, introduce additional risks to its potential assessment and decision. This project interface presents a risk of delay and additional cost to the MetroLink Project
- Option 8a does not impact the wastewater treatment plant that supports a food processing business. Option 10's connecting tracks run through the site of the wastewater treatment plant thereby requiring its demolition and replacement, as well compensation to support or extinguish the business served by the plant. Any negotiation is likely to present a risk of delay and will generate additional cost for Metrolink;
- Option 8a land requirements do not extend outside of single ownership, and it is mostly located on lower value land. The footprint of Option 10 extends over more than one landowner onto existing businesses (Go-karting facility and garage businesses will need to be closed) and higher value land;
- The construction cost for Option 8a will be less than for Option 10 mainly because of the requirement for deeper excavations alongside the M50 (c.800m length of retaining structures required to support a cut 4-5m deep), major earthworks with a 4m cut below ground level at the west boundary requiring extensive retaining structures c.400m in length, and a maximum embankment of 2m height above ground level at the east boundary.
- While earthworks are likely to be similar for both options, more fill is required for Option 8A and this has a positive impact on the MetroLink Project environmentally in terms of overall material balance compared to Option 10, which requires more cut;
- Option 8a has the advantage of having been developed through to Preliminary Design which delivers all the necessary facilities for efficient MetroLink operations. The relatively low design maturity of Option 10 presents an increased risk of subsequent schedule and cost increases as its design is developed;
- Option 8a provides good access from the M50 compared to access from surrounding roads for Option 10, noting that Option 8A also allows for the future airport road diversion along the north boundary of the site;
- Option 8a provides good Station access compared to Option 10 that has significant disadvantages due to the Station being located between rail junction structures thereby providing a poor passenger/user experience, poor opportunity for future urban integration (requiring long underpasses or bridge structures), and a long walk between the station and depot; and
- While both options require the realignment of the Turnapin stream or Mayne River, at the location of Option 8A (Turnapin Stream) it is more of a field drain than a stream and therefore easier to manage. Option 10 however will require the Mayne River to be diverted or culverted with the protective corridor for the stream likely to restrict the depot layout. There will also be limited opportunity for Option 10 to reinstate an adequate riparian zone in accordance with the Fingal County Development Plan 2017 – 2023.

Please refer to Depot Location Options Report in Appendix A7.6 for details of the full assessment.

7.7.5 Alternative Technologies

In terms of identifying the most appropriate technologies for the proposed Project, the following were the key areas of consideration:

- Rolling Stock & Level of Automation; and
- The Overhead Catenary System.

7.7.5.1 Rolling Stock

An assessment was undertaken to identify the optimum rolling stock for the proposed Project. The analysis was based on a project requirement to minimise future passengers overall journey times within the GDA whilst minimising capital and operation costs, staff requirements, energy consumption, maintenance needs and ensuring a sustainable system with reduced potential for environmental effects. Furthermore, the rolling stock vehicles are required to offer passengers a service of the highest safety and quality, and one that is capable of delivering the transport capacity required in the future.

In deciding on the choice of rolling stock for the proposed Project there were two major considerations, and these were as follows:

- The level of automation of the vehicles; and
- The type and capacity of the vehicles.

7.7.5.1.1 Level of Automation

An analysis was undertaken to review the relative merits of a fully automated system (GoA4 Automatic Train Operation (ATO) technology), compared to a manually operated system and intermediate solutions entailing different levels of automation.

7.7.5.1.2 Train Type and Capacity

The passenger demand requirements and level of automation are key drivers of the type of train to be used for the proposed Project. In effect the predicted future demand identified for the proposed Project requires high capacity rolling stock.

7.7.5.2 Environmental Analysis

This assessment considered all environmental disciplines, but the following were the principle environmental outcomes of the analysis:

- From an environmental perspective the fully automated system means that the system is the most efficient possible offering significant energy savings and GHG emissions when compared with less efficient systems during the Operational Phase;
- The fully automated system combined with the high floor vehicles provides a more reliable service with better adherence to the timetable, offering opportunity for more frequent services to meet the passenger demand into the future. The system enables the proposed Project to satisfy the target peak hour demand in 2060 of 20,000 passengers per hour per direction (pphpd) with the shorter trains and a 'comfort level' of AW2 – signifying a good level of comfort (Kittleson & Associates (2003). This option offers significant benefits from the population perspective by providing the best possible public transport services to commuters.
- The GOA4 system combined with the use of high floor vehicles mean that future passenger demand (20,000 pphd) can be provided by using proposed MetroLink vehicles that are 64m in length rather than the previously proposed 90m vehicles to serve the passenger demand. This means that stations and platforms can be significantly reduced in size (compared to those required for longer vehicles) which results in significant savings in GHG emissions, material requirements for construction and construction programme.

Having regard to potential environmental effects, it has been identified that the proposed fully automated system (using high floor vehicles) provides significant environmental advantages when compared to less efficient and longer vehicles. (Refer to MetroLink Preferred Route Design Development Report (TII, 2019) for further details).

7.7.5.3 Overall Conclusions

7.7.5.3.1 Level of Automation

Based on the analysis undertaken it is proposed that the proposed Project should be an automated (driverless) system. This means that the vehicles will be fully automated and not driver operated or assisted. The operation of the automated system is possible because the proposed Project will be fully segregated from all other traffic, including pedestrians and cyclists. This allows for automatically controlled trains that can travel at shorter headways, allowing shorter but more frequent trains to be used when compared to a manual system.

The proposed Project system will model itself on the Copenhagen Metro and the fully automated lines on the Barcelona Metro, which utilise proven automated train control systems. The trains are supervised from a control centre run by operational, security and safety staff who can monitor every carriage, station and platform through CCTV and communicate with passengers by public address. Passengers can contact controllers directly from their carriage. The use of an automated system was considered as a preferred option over and above manual or semi-automated systems for the following reasons:

High Performance Levels: Manual operation (GoA1 & GoA2) would not allow the MetroLink to reach the frequency of service required (up to 40 trains per hour (TPH)). Well driven GoA1 services would allow frequencies of up to 28 TPH but beyond that delays in response times and lack of driving consistency will cause service instability. The alternative approach would be to build larger stations and longer rolling stock to cater for this future demand. Given the spatial challenges associated with locating stations in a historic medieval city it was felt that station sizes should be kept as compact as possible to minimise the impact on the built environment during construction and reduce the overall all capital cost of the scheme. GoA3 and GoA4 operation increase capacity further by reducing the time taken to reverse trains in a siding as there is no longer a requirement for a driver to walk from one end of the train to the other for it to change direction. This means that an intensive service can be reversed off fewer sidings, reducing the cost and disruption of operating at high service frequencies, while enhancing reliability (fewer point machines and a less complex track layout) and sustainability (less embodied carbon and smaller construction sites). GoA4 means that no additional platforms are required at termini stations to allow crew changes, comfort breaks and cope with the variability that humans introduce to a system (staff being 30s late for a shift can have significant consequences on the capacity of a high intensity service). A GoA4 system does not require these extra platforms as there are no on-train staff to consider. "MetroLink will be a GoA4 metro, which will allow for Unmanned Train Operation. Staff will be deployed to provide customer support, revenue protection and maintenance of the system. GoA4 operations would also deliver operational and maintenance savings over the whole life of the project and GoA4 would offer a more efficient service to customers and a better work environment for staff delivering the service.

Flexibility and Resilience: Fully automated operation enables MetroLink to operate a demand-based rather than a timetable-based service (as traincrew management is no longer a constraint) and enables service levels to be dynamically adjusted to meet the real-time (or predicted) demand or in response to external events.

Cost effectiveness and Value for Money: Automation enables precise optimisation of railway operations, whether in the operation of an individual train, the optimisation of a train service, or the ability to minimise the amount of infrastructure to meet a required level of capacity. Automatic driving will make most efficient use of coasting while maintaining journey time and capacity requirements, and therefore reduce the use of traction power. Automated driving will also co-ordinate train movements to make the most effective use of traction power savings through maximising the opportunities for regenerative braking. The smoother operation and reduced use of braking will reduce wear on system components, reducing the embodied carbon in replacement parts and maintenance activities.

Highest Safety Standards: During normal operation, automated systems will be undertaking the basic functions of routing trains and supervising the service to identify the first signs of an anomaly. These systems can do this faster and with a lower error rate than a human operator, and without the risk of distraction. This significantly reduces the risk of incidents being initiated by staff error and gives the

control centre staff the ability to take a wider view of the service and the infrastructure, potentially identifying issues that an automated system would be less likely to detect and being able to intervene before they threaten the safety of the railway. Passenger safety at platforms is greatly enhanced by the platform screen door, generally adopted in most GoA4 systems.

7.7.5.3.2 Train Type and Capacity

As discussed above, the adoption of GoA4 trains will allow for shorter (64m) higher capacity trains which can achieve capacity in excess of 500 passengers. This in turn allows for a reduced station size as platforms can be shorter. The high capacity required for these trains can only be provided using high floor vehicles. High floor trains have more capacity than low floor trains and this combined with the planned use of (GoA4) Automatic Train Operation (ATO) technology, enables the proposed Project to satisfy the target peak hour demand in 2060 of 20,000 passengers per hour per direction (pphpd) with the shorter trains and a 'comfort level' of AW2 – signifying a good level of comfort. The proposed system will allow for capacity increase if required in the future. This can be accommodated by either a decrease in the comfort level, at peak times, or increasing train frequency slightly. Under these circumstances, the system could typically increase its peak hour capacity by up to 40% if required.

7.7.6 Overhead Contact System

In the design development for the proposed project, alternative options were considered for the proposed overhead contact system.

The Overhead Contact System (OCS) transmits the power to the rolling stock in a safe and efficient way using a series of supported cables and/or conductors above the rolling stock envelope. The key characteristics of the OCS are dictated by the power to be used, by the vehicles and the geometric characteristics of the alignment.

The Overhead Contact System (OCS) term is generally used to the overall contact systems, when Overhead Conductor Rail is referred to in the report the term OCR will be used. Two contact systems are proposed for MetroLink:

- OCS – Overhead Contact System: the OCS is formed by contact wire and messenger/catenary wire. It has spans of up to 55 m between supporting poles. (Refer to Diagram 7.9)
- OCR – Overhead Conductor Rail: OCR is formed by a rigid aluminium bar and contact wire supported by poles above the train. This system has spans of between 10 - 12 m between supporting poles. (Refer to Diagram

Diagram 7.9 Overhead Contact System Visualisation

Diagram 7.10 Overhead Contact Rail example (in tunnel)

The MetroLink project includes a significant proportion of the alignment in tunnel, cut and cover and above ground sections (retain-cut and at grade) but there are also section of the alignment that are ground level, on embankments or viaducts.

The general design of the overhead contact system will be required to meet the following requirements

- Ensure compliance with the applicable safety rules, regulations and standards (EN 50119, EN 50367, etc).
- Provide a reliable source of power to the vehicle under temperature variations, wire wear, and wire burning
- Have low whole life cost consideration (installation versus maintenance);
- Be able to fit within available space constraints;
- Considers the space provision for the OCR in the tunnel and its effect on the dimension of the tunnel
- Meet the clearances for protection against direct contact in public and restricted areas according EN-50122-1.

An environmental assessment identified that OCR on the above ground sections would have potential for a significant visual impact due to the fact that there would be a need for supporting poles every 10m compared to 55m for the OCS. In addition, the overhead rail is more visually intrusive than the alternative (for the OCS) of a wire.

Based on the comparative analysis undertaken it has been identified that the OCR is the preferable solution for MetroLink from a technical and financial perspective. However due to the potential for impacts on the receiving environment it has been decided that on any above ground sections of the alignment, the less visually impactful OCS system would be used with the OCR system used on the sections that are underground and in cut.

7.7.7 Luas Green Line Deferral

The Transport Strategy for the GDA includes proposals for an extension to the Swords to City Centre metro scheme called "Metro South". This would extend the proposed Project to Sandyford (and onto Cherrywood) as an integrated high-capacity metro system. For the EPR, it was proposed to continue the proposed Project on the Luas Green Line south of Charlemont to a terminus station at Sandyford, and an interchange with the Sandyford to Cherrywood Luas line. The MetroLink project design team reviewed and took cognisance of the significant amount of feedback received on this proposal during the EPR Public Consultation process.

In addition, design development involved the use of GoA4 driverless vehicles. These vehicles are typically high floor type vehicles which a higher carrying capacity that comparable low floor vehicles currently in use for Dublin's Luas light rail system. The use of Goa4 high floor vehicles for MetroLink is critical as it provided the metro system with sufficient capacity to meet future transport demands while minimising the potential for environmental impacts (as discussed in more detail in Section 7.7.5.1).

These use of GoA4 high floor vehicles would provide the following significant advantages:

- Higher Capacity can be delivered through automation. Trains can run at closer headways and higher frequency with service trains being cable of running at frequencies as low as 90 seconds. Increase capacity is provided through higher frequency rather than longer trains. The is a critical concern for MetroLink and enables the scheme to deliver the required passenger carrying capacity using shorter 64m long vehicles that would be required for a non-automated system. The length of the rolling stock is a key determinant of the overall size of the station and its platforms. Using short 64m train lengths enables smaller more compact stations which lessen their environmental impacts during the construction (reduced materials, excavated spoil, landscape and visual impacts) and operations phase. The smaller stations also enable significant cost savings.
- The GoA4 system for the proposed Project will be safer for passengers due to the reduced potential for human error and also allows for more efficient running of trains, meaning that higher capacity on the network can be achieved than would be the case with manually controlled trains.

The use of GoA4would result in potential for more significant impacts on the Luas Green Line during its intended upgrade to Metro standard. As a result, analysis was undertaken to assess the effects of the two following option:

- Continuation of MetroLink to Sandyford along the existing Luas Green Line using an automated system (GoA4);
- Termination of MetroLink at Charlemont with an interchange with Luas to be provided at Charlemont.

The analysis undertaken identified the following potential impacts on the Luas Green Line if the option to upgrade to Metro standard was included as part of the proposed Project:

- The existing green line would require significant upgrade involving platform, track and electrical works, to bring it to metro standard. To construct these works the Green Line would need to be closed for substantial periods of time with passengers diverted to other forms of transport during the periods of closure.
- The existing green line would need to be converted into a completely segregated running line requiring the construction of overbridges at Dunville Avenue and St Raphaela's Road. These works would also require the closure of the Luas Green Line and disruption to services.
- The structures and other proposed measures associated to the establishment of segregated running would lead to the perception of local community severance, even with proposed migration measures being put in place. Local resident living in close proximity to the works would also be significantly impacted during the construction of these works.

7.7.4.3 Environmental Analysis

This assessment considered all environmental disciplines, but the following were the principal environmental considerations with regard to whether to progress with the upgrade of the Luas Green Line to metro standard as part of the proposed project:

- *Noise & Vibration/Air Quality:* The tunnel boring machine would continue for a further 650m south of Charlemont but would be below ground. Impacts due to noise could affect sensitive receptors in the proximity, such as Viktor Frankl Institute, Yoga institutes, Ranelagh Seventh day Adventist Church, Ranelagh Multi Denominational Schools etc. The tunnel also would pass under a number of private properties and their residents may be impacted by the noise generated from the TBM. Furthermore, there would be potential for significant noise & vibration and Air Quality impacts associated with the construction and upgrade of the Luas Green Line to facilitate metro

system operations. The option to terminate at Charlemont would mean that the TBM would progress 360m south of Charlemont. There will be potential noise and vibration impacts associated with the TBM advancement, but this will cover a significantly reduced geographical extent compared to the alternative option. In addition, airborne noise and air quality impacts associated with surface level construction works will not occur where the proposed Project terminates at Charlemont;

- *Population:* The proposed Metro South would result in the provision of high-capacity public transport provision for the population along the Luas Green Line required to meet future transport demand. However, the Construction Phase required to implement the Metro South project would result in significant disruption to existing Luas services along the proposed alignment for a prolonged period of time. The option to terminate MetroLink at Charlemont would mean that the Construction Phase impacts associated with the upgrade of the Luas Green Line to Metro standard would be avoided. As discussed below in section 7.7.10.11.2 increasing passenger capacity along the Luas Green line can be achieved to meet predicted demand up to 2042.
- *Property and Land take:* The proposed Metro South project would result in the requirement for additional land take and demolition of properties on Dartmouth Road and Northbrook Road. This land take would not be required for the option where the proposed Project terminates at Charlemont.
- *Architectural Heritage:* The continuation of the alignment south of Charlemont would result in additional potential for impacts on properties listed on the Dublin City Councils Record of Protected Structures. While the 360m long tunnel south of Charlemont would mean that there would be a risk from vibration or settlement associated with the tunnelling activity, this risk is much less that resulting from a longer tunnel.
- *Landscape & Visual:* The requirement for a retained cut section and a proposed retaining wall would have a permanent impact on the landscape and visual receptors of Northbrook Avenue, Northbrook Road, Orchard Lane and Ranelagh Road. Residents of the surrounding properties, especially those in the immediate proximity at Dartmouth Road, Dartmouth Terrace, Northbrook Road and Orchard Lane have the potential to be impacted. In the option, where these is no extension on to the Luas Green Line these potential impacts would not be realised.

A decision not to proceed with the proposed Metro South alignment would mean that the majority of environmental effects associated with the Construction Phase and Operational Phase of this element of the proposed Project could be avoided.

7.7.7.1 Overall Conclusions

Based on the assessment of potential impacts of the proposed alignment on the Luas Green Line operations and on the surrounding population, the Project Team reviewed the existing Luas Green Line system to determine if alterations to the existing infrastructure and the addition of longer light rail vehicles could provide for future capacity requirements, without upgrading to metro standard.

Modelling projections suggest that further upgrades to the Luas Green Line to achieve a 30 trams per hour Luas service between Sandyford and St. Stephen's Green, would accommodate Luas demand to approximately 2039 in a "high projection" scenario or to approximately 2049 in the "low projection" scenario.

Over the next two decades, passenger demand levels on the Green Line is forecast to reach approximately 11,000 passengers in the northbound direction which can be accommodated by an enhancing the existing Luas System. However, passenger demand of approximately 13,000 passengers is predicted by 2057. This is beyond the carrying capacity of a standard Luas system and further interventions will be required to meet that demand at that stage. (Refer to Table 7-15)

Table 7-15 Potential Green Line Capacity for Different Levels of Upgrade

Service	Vehicle Capacity (passengers)	Peak hour frequency (trams per hour)	Capacity (passenger per direction per hour)
Current Green Line Services	408	20	6407

Service	Vehicle Capacity (passengers)	Peak hour frequency (trams per hour)	Capacity (passenger per direction per hour)
Green Line Capacity Enhancement	408	24	8813
Further Upgrade of Green Line	408	30	11016

It was determined that the medium-term capacity requirements for the Luas Green Line could be achieved within its own permitted operations, without a need to significantly interrupt the Luas operations. By doing so, the proposed Project would avoid impacts on a key transport artery at a time when significant construction impacts will occur in Dublin city centre impacting on transport movements. The proposed Project has been designed to ensure that a metro extension onto the Luas Green Line (or any other potential metro extension alternatives developed in future transport policies) are not precluded, and the impact on the proposed Project operations during these future tie-in works is unaffected.

It should be noted that further analysis undertaken to inform the draft Transport Strategy for the GDA has identified that the cost of MetroLink in advance of 2042 could only be justified on the Swords-Dublin Airport – City Centre Corridor based on passenger predictions. The draft strategy also identifies that the difficulties outlined above with the upgrading of the Luas Green Line to a metro standard is not required under the strategy. Instead, the capacity and frequency of services along the Luas Green Line will be increased to meet demand up to 2042.

The draft strategy also identifies that Charlemont is the optimal location for an interchange with the Luas Green Line and as an appropriate location to facilitate any future extensions to the MetroLink system.

7.7.8 MetroLink Southern Terminus Location

Once a decision was made not to upgrade the Luas Green Line to Metro standard as part of the proposed project, it was necessary to determine the most appropriate termination location for the MetroLink project.

The location of the MetroLink SSG East Station was determined primarily as an intermediate station location between two critical interchange points at Charlemont (tie in with Luas Green Line) and Tara Street (DART interchange). Its location on the east side of the park and not the west side as in previous alignments was dictated by restrictions on railway curvature between the two adjacent stations. As a result, with the current alignment being driven by the project requirement to achieve interchange with other modes of transport, a termination location at St Stephen's Green west was not considered feasible.

Having regard to the current MetroLink alignment and the requirement for an interchange at Tara Street with the existing DART services, two feasible termination locations were considered, and these were:

- St Stephen's Green East; and
- Charlemont.

An analysis was undertaken of these proposed options to determine the most appropriate termination point for MetroLink having regard to the key project requirement to interconnect with the Luas Green Line. The analysis considers all environmental disciplines, but the main outcomes of the analysis are presented below in Table 7-16.

Table 7-16 Summary to Identify Southern Termination Point for MetroLink

Analysis	Charlemont	St. Stephen's Green
Passenger Interchange	The proximity of the metro to the Luas line at Charlemont provides for a positive customer experience for all users with short interchange distance and due to the proximity,	Sub-Optimal Interchange with more than 5 minutes required to interchange with Luas. Passengers wishing to interchange between Luas and metro at the St Stephens Green terminus would face a 500m-walk along a route either through St Stephens Green park or along the footpath north of the park,

Analysis	Charlemont	St. Stephen's Green
	clear wayfinding and high visibility of interchange. The interchange arrangements at Charlemont provide for significantly better interchange arrangements compared to an interchange at St Stephens Green station. Charlemont also provides a service to an area with key trip attractors including residential areas and office/workplace locations with high passenger boarding and alighting predicted in peak hours. During the AM peak at Charlemont station the predictions show 1800 passengers alighting and 2300 passengers boarding and in the PM peak, 1299 passengers alighting and 2276 passengers boarding.	which adds significantly to the time for interchange and therefore the overall journey time for passengers and a less positive customer experience for all interchange users. This passenger experience would be reduced further for those with mobility or visual impairments as well as those travelling to/from the airport with luggage. The section of MetroLink route between St Stephens Green and Charlemont Stations serves a significant area of the south city of Dublin and offers enhanced access from the local area to the city centre and a direct connection to Dublin Airport. It serves key trip attractors including residential areas and offices / workplace locations, with high passenger boarding and alighting figures1 in the peak hours. During the morning peak, at Charlemont station the flows include 1,800 passengers alighting, 2,300 boarding and 1,229 passengers alighting, 2,276 boarding during the evening peak. The passenger numbers contribute significantly to the overall benefits of the scheme and the effect of these benefits outweigh the additional costs that are associated with the delivery and operation of the section from St Stephens Green to Charlemont station.
Train Operations	Reduced risk of overcrowding on Luas Green Line on-street section.	Increased transfer time to LUAS (5 minutes) and slower commute time from St Stephen's Green to Charlemont when compared to MetroLink. In the absence of a MetroLink Station at Charlemont, there is a limit to the potential of the Luas to provide additional capacity in the on street non-segregated section of the Luas Green Line from Charlemont northwards through the city centre. The nature of this route and the fact that it currently crosses several road junctions (Adelaide Road, Harcourt Street / Hatch Street upper and Harcourt Street / St Stephens Green south) limit the service to a maximum of 24 trams per hour per direction. The projected demand for this section would require a higher frequency of up to 30 trams per hour and this demand cannot be met with on-street systems (Luas / bus).
Cost Benefit	Reduced capital expenditure (CAPEX) of future Luas Green Line connection but higher CAPEX and Operational Expenditure OPEX for MetroLink.	Reduced CAPEX and OPEX but reduced revenue due to reduced passenger demand.
Future Connectivity	Does not preclude any future connection.	Connection to the Luas Green Line would require mining to achieve connection.
Environment	Enhanced public transport provision but potential significant impacts on local residents at Charlemont during the Construction Phase if not mitigated.	Potential for increased impacts on St Stephen's Green if not mitigated due to requirement for turnback's consisting of an additional 360m long tunnel. This would mean a larger construction at this sensitive location. However, this option would avoid Construction Phase impacts at Charlemont.
Planning	Supported by the draft Transport strategy for the GDA.	Not supported by the draft Transport strategy for the GDA.
Overall	Better location for a future connection to locations further south but requires an additional	Shorter tunnel and the requirement for one station less, resulting in reduced Construction Phase impacts. However poor interchange with Luas Green line.

Analysis	Charlemont	St. Stephen's Green
	length of tunnel and an additional station with associated Construction Phase impacts.	

The table above highlights the interchange penalty for MetroLink at SSG East to and from Luas which is located at the opposite side of St Stephen's Green and is almost 5 minutes away for pedestrians. It can be argued that this fact alone should rule out St Stephen's Green East as a southern terminus point for the Metrolink system when compared to a Charlemont terminus as the achievement of interchange with other modes of transport is one of the key project aims. Other issues also considered include the difficulty in construction of a tunnel from St Stephen's Green East and Charlemont in the future and the need for a 360m long straight turnback tunnel at St Stephen's Green East. The loss of substantial revenue if Charlemont Station was not included was a strong consideration also. Please refer to Terminus Station at Charlemont compared to St. Stephens Green Report in Appendix A7.9 for details of the full assessment.

In summary, the analysis identified Charlemont as the preferred location for a termination station, driven by the following the key rationale:

A shorter interchange walking distance at Charlemont with almost 5 minutes shorter interchange time when compared to St Stephen's Green (Refer to Diagram 7.11 and Diagram 7.12);

- Charlemont allows for future proofing of the extension of Metro further south, either by way of a connection to the Luas Green Line or an alternative metro route alignment to the south of the city;
- Charlemont bypasses capacity constraints on the Luas on-street running section between St Stephen's Green;
- Charlemont provides additional public transport connectivity to key trip attractors south of St Stephens Green, with high demand for services in this area predicted.
- Charlemont provides additional fare/revenues collected with a favourable Cost Benefit ratio likely; and
- Charlemont avoids more significant environmental impacts on St Stephen's Green.

Diagram 7.11 MetroLink Luas Interchange at Charlemont

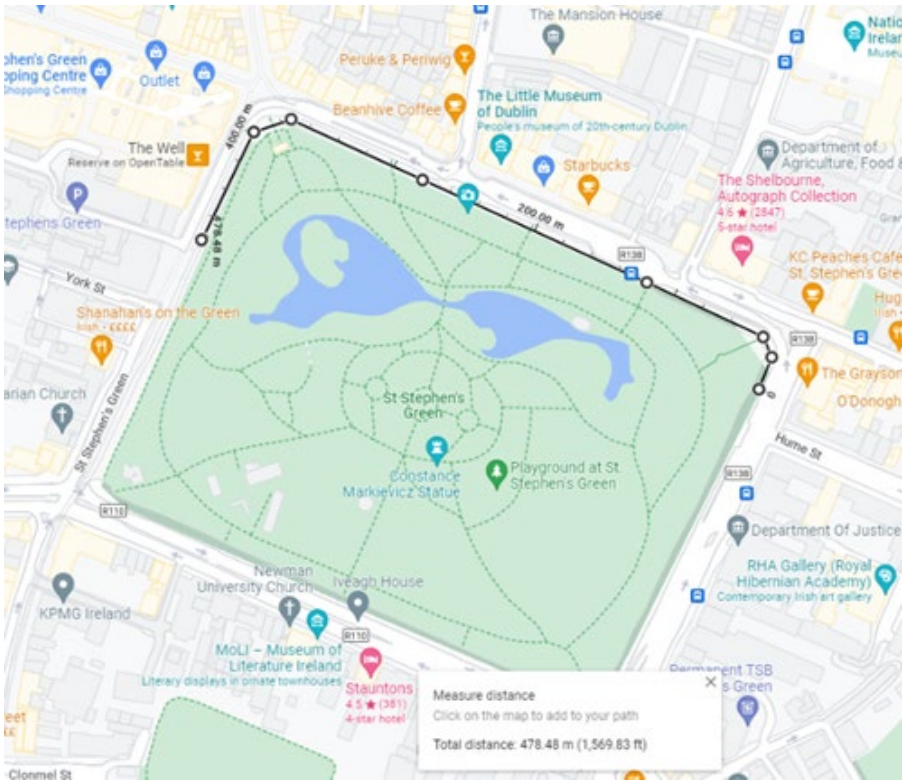


Diagram 7.12 MetroLink Luas Interchange on St Stephen's Green

7.7.9 Alterations to the Alignment

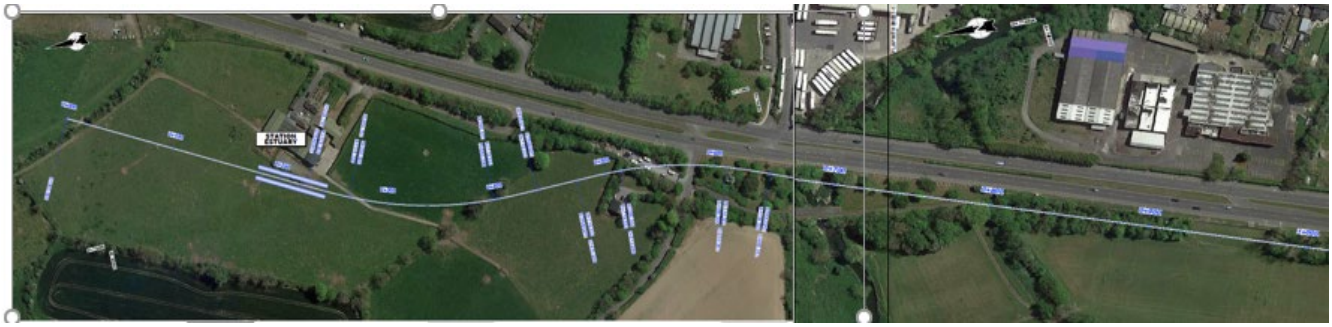
Following public consultation on the EPR a number of localised alignment changes to the proposed Project were considered and assessed in response to the submissions received from the public. The alignment changes which were assessed are as follows:

- Realignment of the EPR at Lissenhall;
- Realignment of the EPR along the R132 Swords Bypass through Swords;
- Realignment of the EPR over M50 Motorway and to Ballymun;
- Realignment of the EPR at O'Connell St Station; and
- Alignment under Trinity College Dublin (TCD).

7.7.9.1 Realignment of the EPR at Lissenhall

Consultation undertaken with key stakeholders including the Department of Culture Heritage and the Gaeltacht and Fingal County Council identified the importance of Lissenhall Bridge. The Department identified that the architectural heritage value of the bridge meant that it would be designated as a National Monument based on information provided to the Department by the Project Team. In order to minimize the potential impacts on Lissenhall Bridge and having regard to the constraints listed below, three feasible route options were developed and assessed in order to reduce potential impacts in this area. Refer to Diagram 7.13.

Option 1



Option 2

Option 3

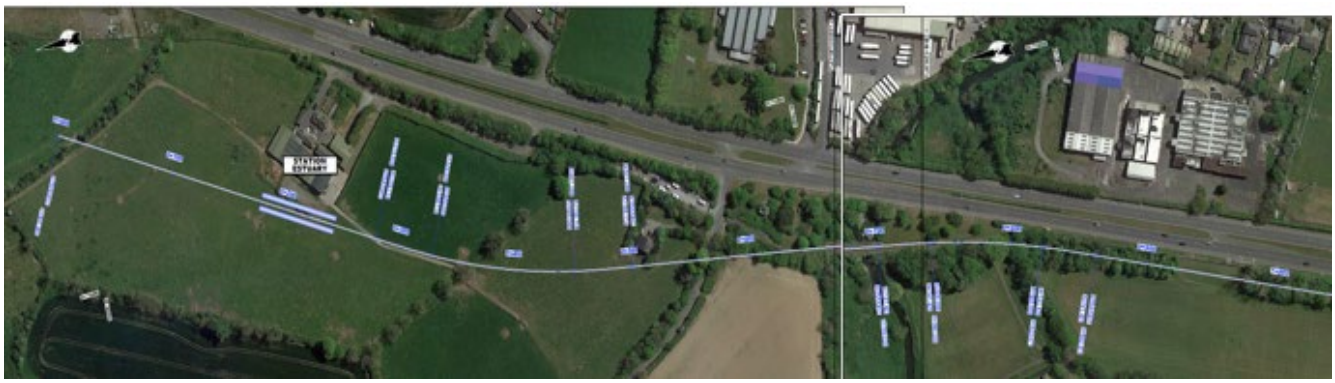


Diagram 7.13 Lissenhall Alignment Options

7.7.9.1.1 Environmental Analysis

A full environmental assessment was undertaken in order to inform which alternative option for alignment was optimum. The principal environmental considerations arising from the analysis are as follows:

- ***Biodiversity:*** The proposed Option 1 and Option 3 alignment (EPR option) have potential for an impact on biodiversity as they impact directly on a significant number of a stand of trees surrounding the Lissenhall Bridge. Option 2 avoids the majority of trees in this area;
- ***Landscape & Visual:*** As with Biodiversity Options 1 and 3 have the greatest potential for effect due to the loss of trees when compared with Option 2. This would result on an impact on the setting of the national monument.
- ***Architectural Heritage:*** Option 3 route alignment was proposed to cross Lissenhall Bridge. However, this would potentially impact on a location to be designated as a National Monument. (DU011-081)). Both Options 1 &2 would avoid any direct impact Lissenhall Bridge.
- ***Traffic and Transport:*** There will be potential traffic impacts to Ennis Lane and the R132 arising from each option during the Construction Phase. Vehicle movements associated with earthworks and transport of material for the construction of buildings and tracks will be via the R132.

7.7.9.1.2 Overall Analysis

Option 2 option has potential for environmental effects if not fully mitigated, however this option is preferred over the other options as it has potential to avoid some significant environmental impacts as discussed above.

A Flood Risk Assessment (FRA) prepared for the proposed Project identified potential for flooding in the vicinity of the Broadmeadow and Ward Rivers and further south in the Balheary area. As a result, the EPR proposal for the alignment to be constructed on a raised embankment through this area with bridge crossings over the rivers was replaced by a viaduct that traverses the identified flood plain for 261m (Refer to Diagram 7.14). This design change will avoid the alignment being subjected to flood water during flood events and will also minimise any flood displacement that would have resulted from the proposed embankment in the event of flooding. Please refer to the MetroLink Preferred Route Design Development Report (TII, 2019) which can be viewed at www.metrolink.ie for further details).

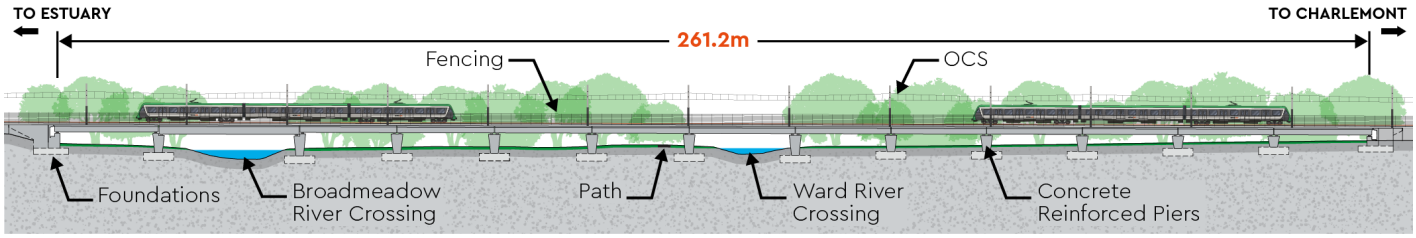


Diagram 7.14 The Proposed Broadmeadow and Ward River Viaduct

7.7.9.2 Route Alignment along R132 Swords Bypass

The EPR alignment north of Swords was designed to run along the R132 Swords Bypass median on an elevated viaduct to pass over the roundabouts at Estuary, Seatown, Malahide and Pinnock Hill. An alternative option identified as 'Alternative Option A: Fosterstown and Estuary Station' was also presented as part of the EPR public consultation documents. In Alternative Option A the majority of the alignment was intended to run at surface level along the central median of the R132 Swords Bypass with grade separation required at the roundabouts. The public consultation process raised concerns about aspects of these EPR proposals. Key observations received from members of the public and other stakeholders included the following:

- Visual impact of the elevated section in Swords on residential areas located along the R132 Swords Bypass;
- Visual intrusion from pedestrian overbridges on adjacent residential areas:
- Concerns from several stakeholders in relation to how the EPR would impact on their proposed developments or planning applications;
- Concerns over how the proposed by integrated with the cycling, walking and bus networks;
- Need for additional Park and Ride locations;
- Impacts on surrounding properties during construction due to vibration and ground movement;
- Disruption due to increased traffic movements from construction traffic accessing the site;
- Health and safety concerns due to construction generated dust and noise;
- Concerns as to why the preferred route does not serve Swords main street directly;

Following the public consultation process and further consultation with Fingal Co Council, further design development was undertaken, and a number of alternative route options were identified and assessed proposed alignment along the R132.

The alternative route options included design variations on the elevated viaduct structure (two sub-options); an alignment in cutting in the road median (two sub options); and an alternative alignment in a mix of open-cut and cut-and cover and bridge structures along the eastern side of the R132 Swords Bypass. A multi-disciplinary analysis was undertaken on these route options and sub-options which included a full environmental assessment. (Refer to the MetroLink Preferred Route Design Development Report (TII, 2019) which is available on www.metrolink.ie for details of the full assessment.

The outcomes of the MCA analysis identified route Option 3 as the preferred route option for the alignment along the R132. The preferred route option is illustrated in Diagram 7.15

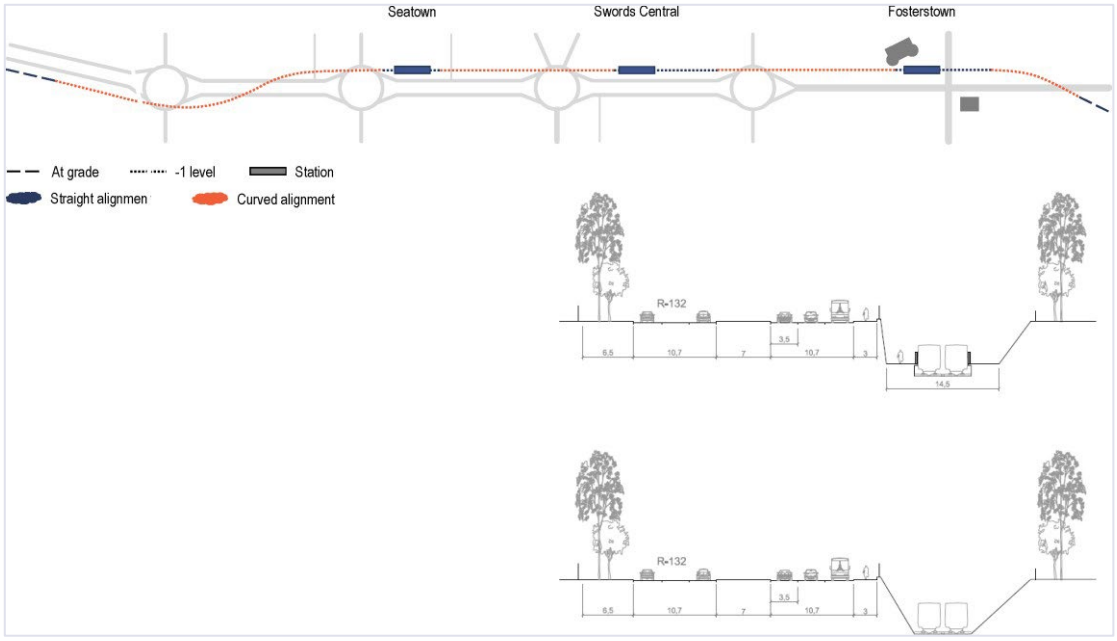


Diagram 7.15 Preferred Route Alignment along R132 Swords Bypass and Typical Cross Sections (Option 3)

7.7.9.2.1 Environmental Analysis

This assessment considered all environmental disciplines, but the following were the principle environmental considerations with regard to the assessment of the alignment options along the R132:

- *Landscape and visual.* The elevated section of track proposed for a number of the route options and sub-options would result in significant landscape and visual impacts on the surrounding landscape and on sensitive residential receptors mainly because of its appearance in relation to the nearby pattern of development, which is relatively low level and low density. The preferred option is primarily in cut, cut and cover or at grade and this horizontal alignment would result in significantly reduced landscape and visual impacts when compared to the elevated options. Any landscape and visual impacts can be mitigated through the implementation of a high-quality design with appropriate landscaping. Refer to Chapter 4 of the EIAR for details of the architectural and landscape design.
- *Population:* The preferred route alignment facilitates much improved permeability, pedestrian connectivity and cycling provision across both sides of the alignment and removes the concept of potential perceived community severance associated with an elevated alignment and/or with trains running in the central median of the R132. The revised alignment enables Fingal County Council to deliver on its strategy to connect the town's urban environment across the R132 by changing the character of the road to a more urban boulevard. The revised station designs associated to the new alignment also provide for a higher quality urban design that will enhance the area and provide high quality hubs for future development in the area.
- *Property and Land take:* The preferred option would require more significant land take than other options which were aligned along the central median of the R132. Furthermore, the preferred route also requires the demolition of a retail unit at Airside Retail Park which results in it being less favoured from a property and land take perspective. Any property and land take impacts can be mitigated through the implementation of a high-quality design to minimise land take while providing compensation for properties impacted.
- *Utilities and Infrastructure:* All route options along the R132 would result in the requirement for utility diversions. However, the preferred option would have potential for more significant impacts, due to the requirement for more significant utility diversions when compared to other route options. Impacts on utilities have been assessed in Chapter 22 of the EIAR. Impacts on utilities will primarily arise due to the requirement to divert utilities in advance of the Construction Phase. Such impacts will be mitigated by way of effective management to reduce the levels of outages or disruption to services. All diverted utilities will be replaced with new infrastructure.

- *Traffic and Transport.* There will be potential impacts on traffic during construction of all potential route options, whether within the median or on the roadway. However, the preferred route option has less length directly impacting roadways and as a result would cause less traffic disruption. Chapter 9 of the EIAR assesses the potential impacts on traffic during the construction and Operational Phase. These impacts will be mitigated through the implementation of a traffic management plan during the Construction Phase. During the Operational Phase, the proposed Project will result in modal shift with more people using MetroLink for transport, thereby helping to reduce traffic congestion.

7.7.9.2.2 Overall Conclusions

Arising from the overall analysis undertaken the recommendation was that the Preferred Route north of Swords should include an alignment along the eastern side of the R132 Swords Bypass with consequent changes to the station design details at Seatown, Swords Central and Fosterstown (Diagram 7.15). The principal reasons for the choice of the Preferred Route are as follows:

- Potential for impacts on the landscape and visual amenity;
- Lower potential impacts on traffic along the R132 Swords Bypass during the Construction Phase;
- Improved access to stations; and
- Lower overall construction costs.

Please refer to the MetroLink Preferred Route Design Development Report (TII, 2019) which can be viewed at www.metrolink.ie for further details).

7.7.9.3 O'Connell Street

The EPR placed the proposed O'Connell Street Station underground in the median of O'Connell Street Upper, in Dublin City Centre.

Following the EPR non statutory public consultation in March 2010, TII further developed the design for the proposed station. During this development phase the challenges associated to constructing a station in the O'Connell street became apparent. These challenges included the negative impact on the pedestrian, cyclist, bus/taxi and Luas services during required road and pavement closures to construct the station.

In late 2018, TII/NTA became aware of the possibility to relocate the O'Connell Street station from its EPR location to a new location on the site of the former Carlton Cinema site in the ownership of Dublin Central GP Ltd. (DCGP). During this period, DCGP were in the process of developing a masterplan for a mixed residential and commercial development the Dublin Central Scheme on the site below 43-58 O'Connell Street, including the former Carlton Cinema at 52-54 O'Connell Street, to the west and slightly south of the EPR station location developed as part of the Concept Design.

Locating the station within the extents of this Development offered the opportunity to:

- Overcome many of the Key EPR Constraints identified above including the avoidance of significant disruption to key public transit operations such as Luas Cross City for a protracted period.
- Reduce the overall impact of the MetroLink station on O'Connell Street and environs during construction
- Reduce the cumulative environmental impacts on O'Connell Street of the construction of these two discrete schemes.
- Mitigate significant impacts on pedestrians, cyclists, and public transport. In addition, this station location would mitigate the hazard of hundreds of passengers evacuating from the station in close proximity to operating Luas services, bus services and general traffic either side of the median in the case of the EPR option.

A multi-disciplinary assessment was undertaken to review the potential re-aligned route option and station location and the EPR option.

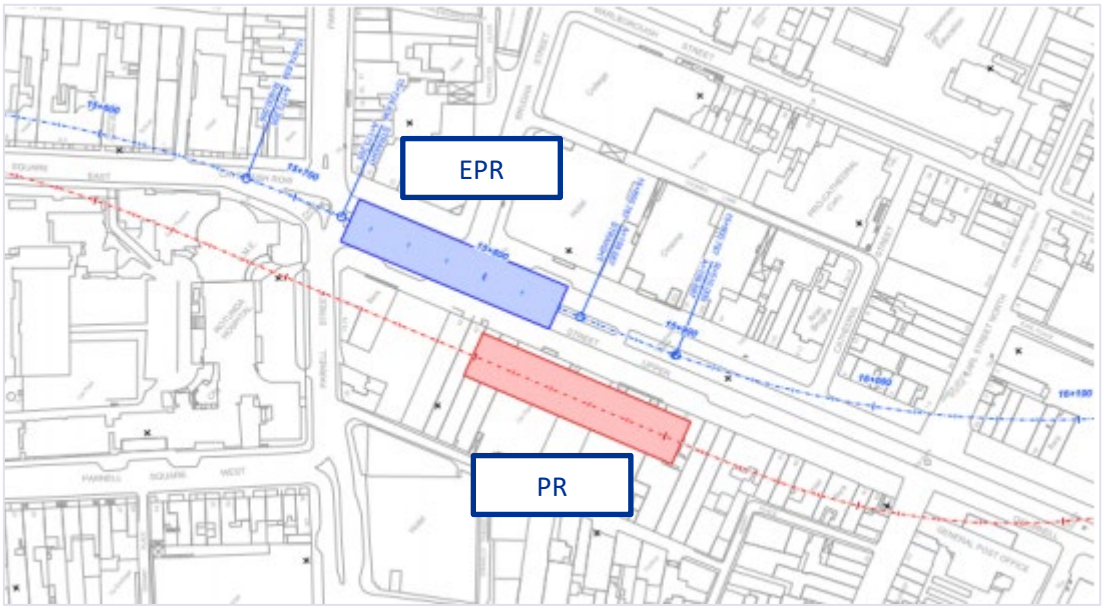


Diagram 7.16 Proposed Alternative Alignment at O'Connell Street

Relocating the proposed station to the proposed development site enables some of the key environmental impacts of the EPR proposed station location to be significantly reduced or avoided. These include:

- *Traffic and Transport:* There would be potential for significant disruptions to traffic and public transport including Dublin Bus and Luas along O'Connell Street during the construction of the station box if located in the centre of the street as proposed at EPR stage. This potential impact would be significantly reduced for the PR option as it will not impact on the Luas line or traffic lanes on O'Connell St. An assessment of the traffic impacts of the proposed Project are presented in Chapter 9 Traffic and Transport of the EIAR. A Scheme Traffic Management Plan has also been prepared and this can be viewed in Appendix A9.5.
- *Population:* The proximity of both of the proposed station locations to a number of commercial buildings including several hotels means that construction activity could result in potential Construction Phase impacts such as restricted access, Construction Phase dust, noise and vibration generation. Significant disruption to O'Connell St as an important public transport corridor would/could be minimised by progressing with the PR station location option. A CEMP has been prepared for the project which will be further developed by a contractor to manage Construction Phase impacts such as those mentioned above. The CEMP for the proposed Project can be viewed in Appendix A5.1. On completion of the Construction Phase the proposed Project (and the proposed Dublin Central Development) will provide a significant economic boost to the area by increasing footfall by attracting passengers to the MetroLink station and also customers to the proposed retail, offices and hotels proposed. The existing derelict and underused area between O'Connell St Upper and Moore St will be transformed into an attractive, safe and busy part of the city providing employment for the local population and a destination for Dubliners and tourists alike.
- *Architectural Heritage:* The alignment proposed in the EPR also had potential to impact on important architectural heritage in the area due to the location of the development including on the Charles Stewart Parnell Monument which is a National Monument (DU018-425). Furthermore, it should be noted that the EPR proposed station site is located within the O'Connell St Architectural Conservation Area. The PR station option is also located within the O'Connell St ACA and is close to or underneath a number of buildings listed on the Record of Protected Structures including 42-44 O'Connell St, 52-54 O'Connell St and 57 – 58 O'Connell St. The requirement for the demolition of part of a number of these buildings would be required for the proposed development of a third-party development at this site, or if this development does not proceed the development of the MetroLink station. As outlined in Chapter 26 Architectural Heritage, protected facades would be retained for whichever of these scenarios progresses. The removal of other non-protected

elements of the buildings will be appropriately mitigated through the replacement with buildings of high-quality design and materiality, while detailed recording of existing fabric will be undertaken by competent specialists. It can be argued that potential impacts on these historic properties is not in keeping with best practice, however this position should be considered in the context of already degraded, underused and derelict sites throughout this area with for example an empty plot on the site of the former Royal Hotel building which was demolished in 2010. The combined MetroLink/Dublin Central development will use this vacant plot to create a new street between O'Connell Street Upper to Moore land and onto Moore St thereby providing significant enhancement to this derelict area. The station location is closer to 14-17 Moore St (number 16 is a National Monument) than the EPR option. These buildings are of historical interest due to associations with the 1916 Rising and each of these buildings is listed on the Record of Protected Structures. However, the proposed station location would be separated from these buildings by Moore Lane with no direct impacts predicted. Furthermore, an analysis undertaken in the EIAR having regard to both settlement and groundborne vibration have identified that there will be no impacts on the national monument as outlined in Chapter 26 Architectural Heritage of the EIAR.

- *Landscape & Visual:* The construction of the station location for the EPR option within O'Connell Street would result in potential significant visual impacts during the Construction Phase due to the construction activity required at this location in the absence of appropriate mitigation. In the Operational Phase there would be a requirement for elements of the station at surface level on O'Connell St that would result in potential long terms impacts. However, the construction of the proposed station location underneath a proposed development on the site of the former Carlton Cinema site does not require the construction to progress in the centre of O'Connell St. This station location also benefits from being constructed under a proposed development site, whereby the construction of the station box would occur at a location where construction activity was proposed to progress anyway. In addition, there would be no permanent elements of the station located at the surface level on O'Connell St. However, if the proposed third-party development does not occur, then there is potential for significant impacts arising from the requirement to demolish part of a number of buildings on O'Connell St as discussed in Chapter 26 of the EIAR. On completion of the proposed MetroLink station and the proposed Oversite development the currently underused and derelict sites of Upper O'Connell St will be transformed by the retention of protected buildings and the provision of high quality modern infill development surrounding these structures.
- *Noise & Vibration:* The EPR alignment option has potential to impact on sensitive buildings along Parnell Square East during the advancement of the TBM as a result of groundborne noise and vibration and ground settlement in the absence of appropriate management. The alignment would also pass in close proximity to the Parnell National Monument, Rotunda Hospital, the Gate Theatre and the Ambassador Theatre. The proximity to these sensitive locations also raises the potential for electromagnetic interference and ground borne noise and vibration impacts during the Operational Phase if not mitigated. The PR station location option would also result in potential for significant noise and vibration generation during the Construction Phase if not effectively mitigated. Any potential impacts arising from groundborne noise and vibration during the construction and Operational Phases are presented in Chapter 14 Groundborne Noise & Vibration and these impacts can be largely mitigated. The PR alignment could result in neutral to imperceptible impacts on sensitive equipment at the Rotunda Hospital or the Gate Theatre, however these potential impacts can be largely mitigated as discussed as Chapter 12 Electromagnetic Compatibility and Stray Current.

7.7.9.3.1 Overall Conclusions

Overall, the PR station location to the west of O'Connell St was preferred. This location would allow for a design solution that could be integrated into a prestigious new city centre development. The opportunity to integrate the proposed Project into this new development would greatly enhance the entire north city centre area. Relocation of the station out of O'Connell Street and into the development area immediately to the west of the street would retain the benefits of this city centre location and its interchange opportunities with the Luas Cross City Line without impacting the operation of the Luas Green Line during the Construction Phase.

The new off-street location will also avoid the need for significant traffic diversions and temporary traffic management along O'Connell Street. In terms of impacts to underground utilities, the location as proposed for the Preferred Route will have significantly less impact to utilities when compared with the EPR station location.

The tunnel realignment required to relocate the station location can be incorporated into the overall alignment with limited change to the EPR alignment, with a maximum deviation of just over 30m at the station location. The alignment would pass closer to the Rotunda Hospital and the Gate Theatre, but with appropriate mitigation this is not envisaged to introduce significant new impacts compared to the EPR. Please refer to the MetroLink Preferred Route Design Development Report (TII, 2019) which can be viewed at www.metrolink.ie for further details).

Following consultation with the Department of Heritage Culture and the Gaeltacht and Dublin City Council with regard to architectural heritage of the buildings on the west side of O'Connell Street, TII agreed with DCC to retain a number of additional buildings and to revise the proposed station (and oversite development) design to ensure that the architectural heritage of these buildings is not impacted. The buildings that will be retained are numbers 42, 59 and 60 O'Connell Street. If the construction of the proposed Project takes place at this location before the oversite development, TII will prop those facades pending future development.

7.7.9.4 Alignment under Trinity College Dublin

Analysis undertaken for the EIAR identified potential impacts on sensitive equipment at Trinity College Dublin (TCD) arising from Electromagnetic Interference (EMI) and Groundborne Noise in the absence of mitigation. The identified impacts could be reduced by implementation of mitigation measures outlined in Chapter 12 Electromagnetic Compatibility and Stray Current (active cancellation) and Chapter 14 Groundborne Noise & Vibration (floating slab track). For EMI, the proposed mitigation measures required would need to be implemented at the location of the sensitive equipment, rather than in the tunnel as mitigation measures within the tunnel would not be effective.

Following consultation with TCD on the potential impacts, TII proceeded to assess potential alternatives to the tunnel alignment under TCD to reduce potential effects and reduce the requirement for mitigation measures at the location of sensitive equipment. The alignments assessed as part of this analysis are presented on Diagram 7.17 and are as follows:

- **Option 0 Preliminary Design Alignment (R=400m):** This is the original alignment from the emerging preferred route (EPR), retained as the current Preliminary Design alignment, with a 400m curve radius (R= 400) past the TCD campus and under Government Buildings to the south.
- **Option 1 (**R=400m) **:** Modified PD **–** this retains the same horizontal alignment as Option 0 but with an adjusted vertical profile to increase rail depth below Leinster House and TCD buildings. (i.e., essentially the PDR Option 0 mitigated to reduce currently assessed impacts on the buildings above). No change to the Tara and St Stephen's Green station locations.
- **Option 2** (R=350m) **:** An alternative horizontal alignment running to the west of Option 1 and with the same adjusted vertical profile (increased depth) as per Option 1. Taking advantage of the proximity of Tara Station and the fact that all commercial trains will be stopping there, the transition curve south of and next to the station is shortened to 30m to assist the westward movement of this alignment option.
- **Option 3** (R=302m)**:** An alternative horizontal alignment running to the west of Option 2 and with the same adjusted vertical profile (increased depth) as per Option 1.
- **Option 4 (R=302m + 1 degree rotation):** New 302m Alignment including a 1-degree rotation of Tara station in order to further increase the westwards movement of the metro alignment past the TCD campus.

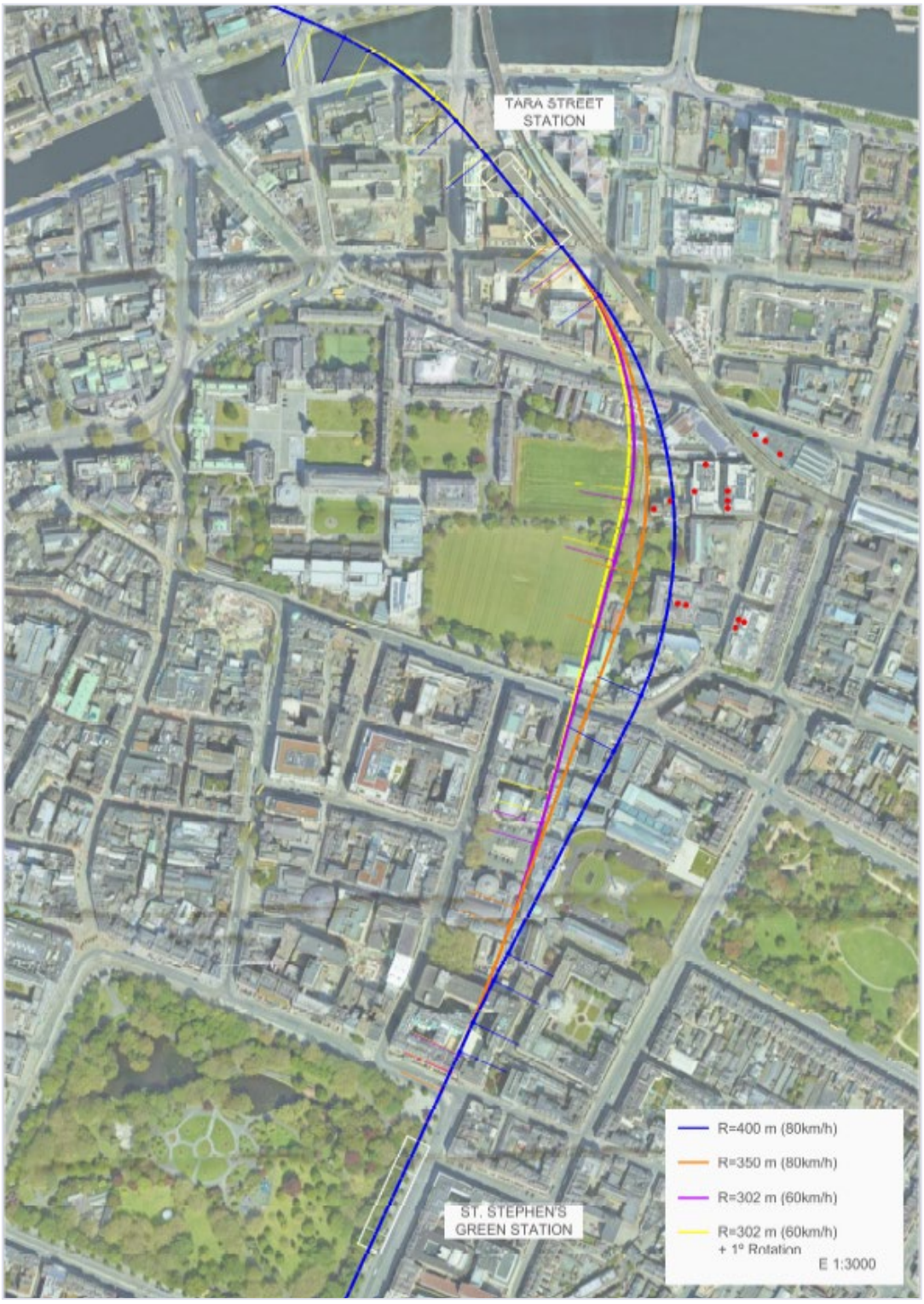


Diagram 7.17 Option Alignments Tara Street to St Stephen's Green

A Multi Criteria Analysis (MCA) of these alignment options has been undertaken in line with The Common Appraisal Framework (CAF) for Transport Projects and Programmes. This MCA process for this Options assessment adopted a 2 Stage process. Stage 1 was a high-level pass/fail assessment including consideration of environmental criteria from which a Stage 2 more detailed assessment is undertaken of the remaining options with a full assessment of potential environmental effects. For full details of the assessment methodology and assessment outputs refer to Appendix A7.10 Trinity College - Alignment Options Assessment.

7.7.9.4.1 Outcomes of the Analysis

The outcomes of the assessment are as follows:

Option 0 - the current PDR horizontal and vertical alignment. This alignment requires the provision of Floating Slab Track (FST) through this section to mitigate operational noise and vibration together with Active Cancellation measures at all identified TCD sensitive equipment locations to mitigate EMI effects. It would have slightly worse noise and vibration impacts than other options due to the alignment passing directly under some TCD buildings and would require additional damping at track to mitigate a specific vibration frequency arising from the FST impacting equipment in the SNIAM and Fitzgerald buildings.

Option 1 – the current PDR horizontal alignment, but with lowered vertical alignment would provide improved settlement and noise mitigation compared to Option 0. However, it does not provide any significant benefit in terms of EMI or vibration effects on TCD equipment, which would continue to require provision of Active Cancellation measures for all assessed equipment, noting that this is a proven method for mitigation of EMI effects and has been successfully used elsewhere. It would continue to require additional damping measures at track for the specific equipment in the SNIAM and Fitzgerald buildings.

Option 2 - provides both a revised horizontal and vertical alignment, remaining compatible with design parameters along the alignment and with no impact on train operation speeds. It provides improved settlement and noise mitigation compared to Option 0 and is a significant improvement in terms of potential EMI/EMC effects at TCD. Residual mitigation of remaining EMI effects can be addressed through the introduction of Active Cancellation at a number of locations. Active Cancellation is an accepted and proven method of addressing this issue and is compatible with the equipment identified. It would be an effective mitigation for those items of equipment that would potentially still require some protection and TII have previously committed to funding this form of protection. This option would also require some additional mitigation at track to address the potential localised specific vibration frequency issue.

Option 3 - incorporates a further reduction to 302m for the horizontal curve radius and maintains the lowered vertical alignment. This option would provide a further westward movement of the alignment and our assessment indicates that no Active Cancellation measures would be required at known TCD equipment locations under this Option and no additional damping required for the track. However, this alignment has particular disadvantages:

- It would reduce or remove current design tolerance between train and tunnel furniture, limiting future construction and operator design options and which will remain a constraint on the system for its operational life. Such restrictions at this design stage are not considered desirable due to the future construction/operation risks introduced.
- There would be additional risk during the TBM drive of potential further speed limitations if the tunnel drive deviated from the design alignment and needed correction through tighter curves.
- It would have a permanent speed restriction due to the tighter radius curve south of Tara Station, impacting journey time and incurring an ongoing economic cost incurred over the life of the system.
- An exceptional element would be introduced within the overall alignment, outside the proposed design parameters for MetroLink.
- The risk of wheel rail interface issues arising during the Operational Phase is considered to significantly increase on curves down to 300m radius or less, with a 350m radius recommended as the minimum radius.

Option 4 – incorporating 302m radius curves both north and south of Tara station, with an associated 1-degree rotation of the station, was shown to provide only around a 5m additional westward movement of the alignment compared to Option 3 at sensitive TCD equipment locations. It would have the same concerns and constraints as Option 3 and was not considered to provide any additional benefit to the EMI mitigation whilst increasing the construction and operational impacts associated with the two tighter 302m curves required compared to the minimum 350m curve adopted elsewhere.

7.7.9.4.2 Overall Conclusions

The overall assessment has considered the balance of advantages and disadvantages of all the options equally. It is considered that Option 2 offers advantages over Option 0 (the PDR alignment), and when considered against the other alternatives is the preferred Option to be taken forward.

It is therefore recommended than an amendment is made to the proposed alignment. The horizontal alignment was adjusted by moving it west of the preferred route proposed alignment using a 350m horizontal curve and further adjusted in the vertical section to deepen the alignment by approximately 3m under the TCD Campus area.

TII will continue to work with TCD with respect to provision of appropriate mitigation to protect sensitive equipment at locations that would still require some protection based on this revised alignment.

7.7.10 Station Locations

The alternative design and alignment analysis outlined in the sections above have resulted in alternatives to the stations proposed at EPR stage at the majority of stations. In addition, due to the identification of site specific conditions and constraints further changes to station locations, design and layouts have fed into the design process. Additional information that informed this design development process arose from the following:

- A review of the outputs of Public and Stakeholder Consultation;
- Identification of additional constraints in the immediate vicinity of the proposed station locations; and
- Development of the design in the context of the surrounding environment.

This section of the chapter provides an outline on a station-by-station basis of alternative station locations (micro-siting), layout or design changes. For full details of the analysis undertaken refer to the Please refer to the MetroLink Preferred Route Design Development Report (TII, 2019) which can be viewed at www.metrolink.ie for further details).

7.7.10.1 Estuary Station

At the EPR stage, Estuary Station was located in lands west of the R132, just south of M1 Junction 5 (Lissenhall Junction). (Refer to Diagram 7.18) The station was proposed to be constructed at surface level (i.e., at existing ground level), located adjacent to a new multi-storey Park and Ride facility. (Refer to Diagram 7.19) However, this station location was further modified due to the following issues:

- *Potential for a clash with the proposed Swords Western Distributor Road:* Fingal County Council have identified a planning objective to build a new distributor road named the Swords Western Distributor Road (SWDR). The road is proposed to pass around Swords and to the north of Estuary Station before connecting to the R132 Swords Bypass;
- *Property Impacts:* The EPR alignment had potentially avoidable impacts that would require the demolition of a property north of Ennis Lane; and
- The area surrounding the Broadmeadow River is designated as "Open Space" in the Fingal Development Plan 2017 – 2023 (FCC 2017) and the draft Fingal Development Plan 2023 – 2029 (FCC 2021).

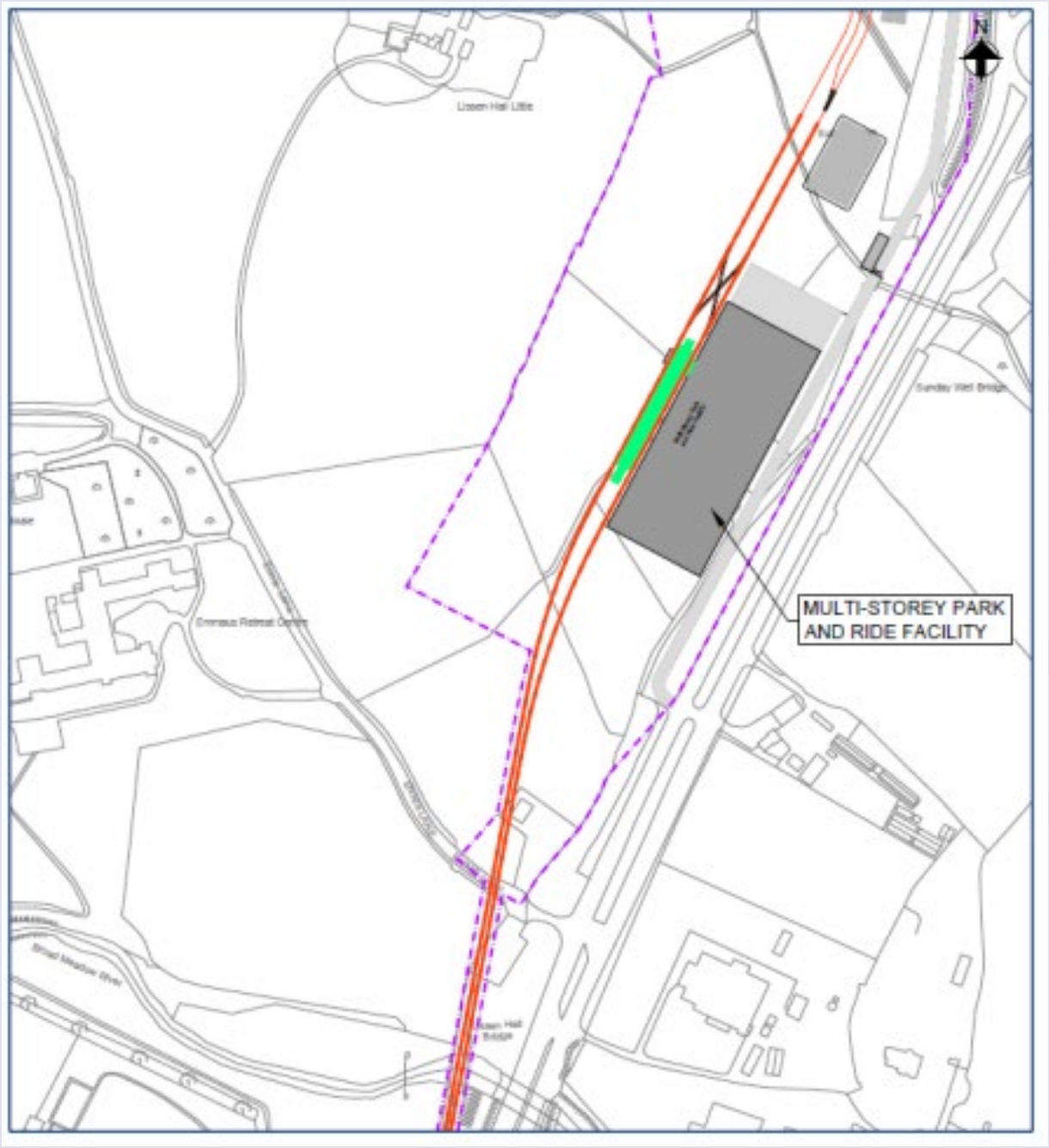


Diagram 7.18 EPR Estuary Station Location

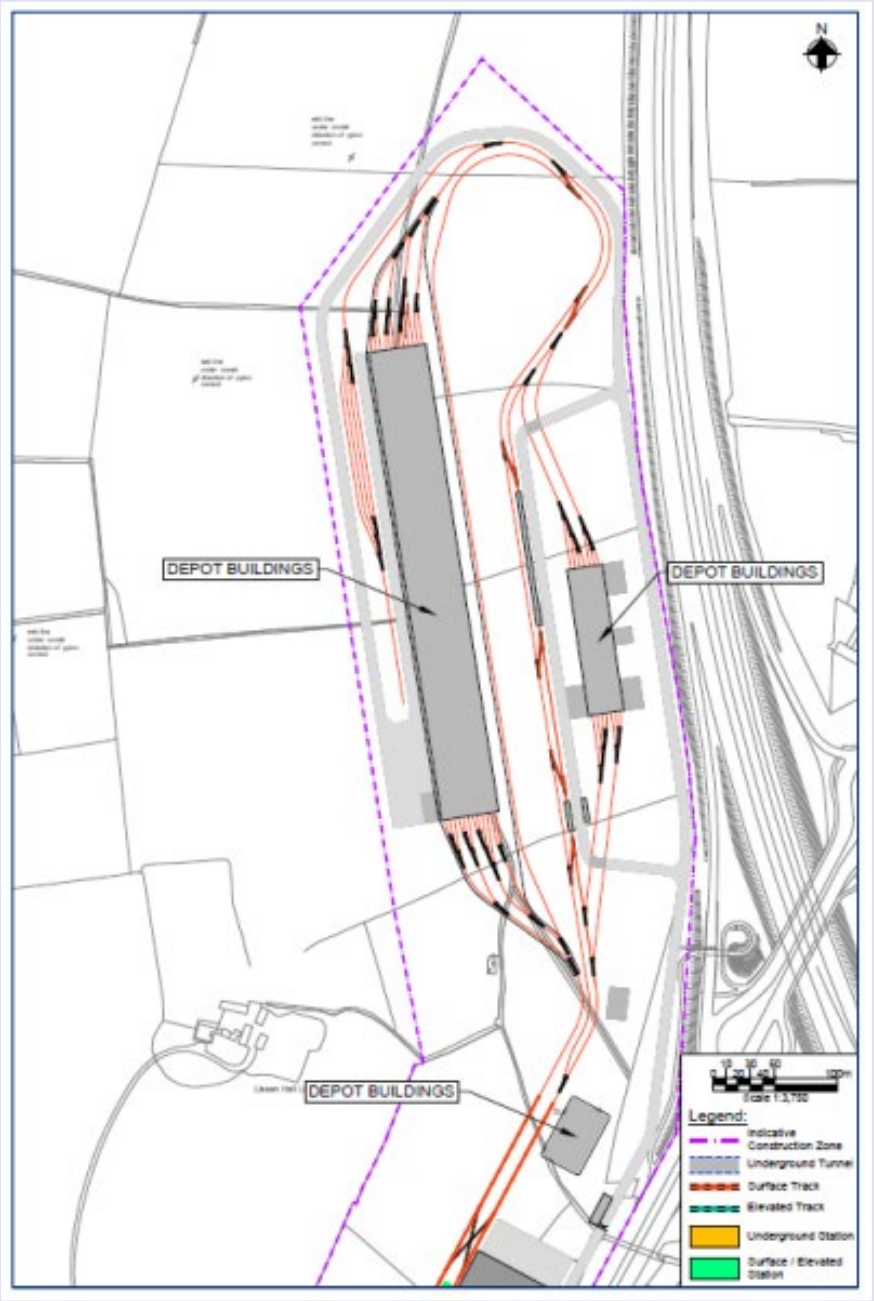


Diagram 7.19 EPR Park & Ride Location

In response to the identified constraints to the EPR, as discussed above an alternative location for the station and P&R was identified. (Refer to Diagram 7.20).

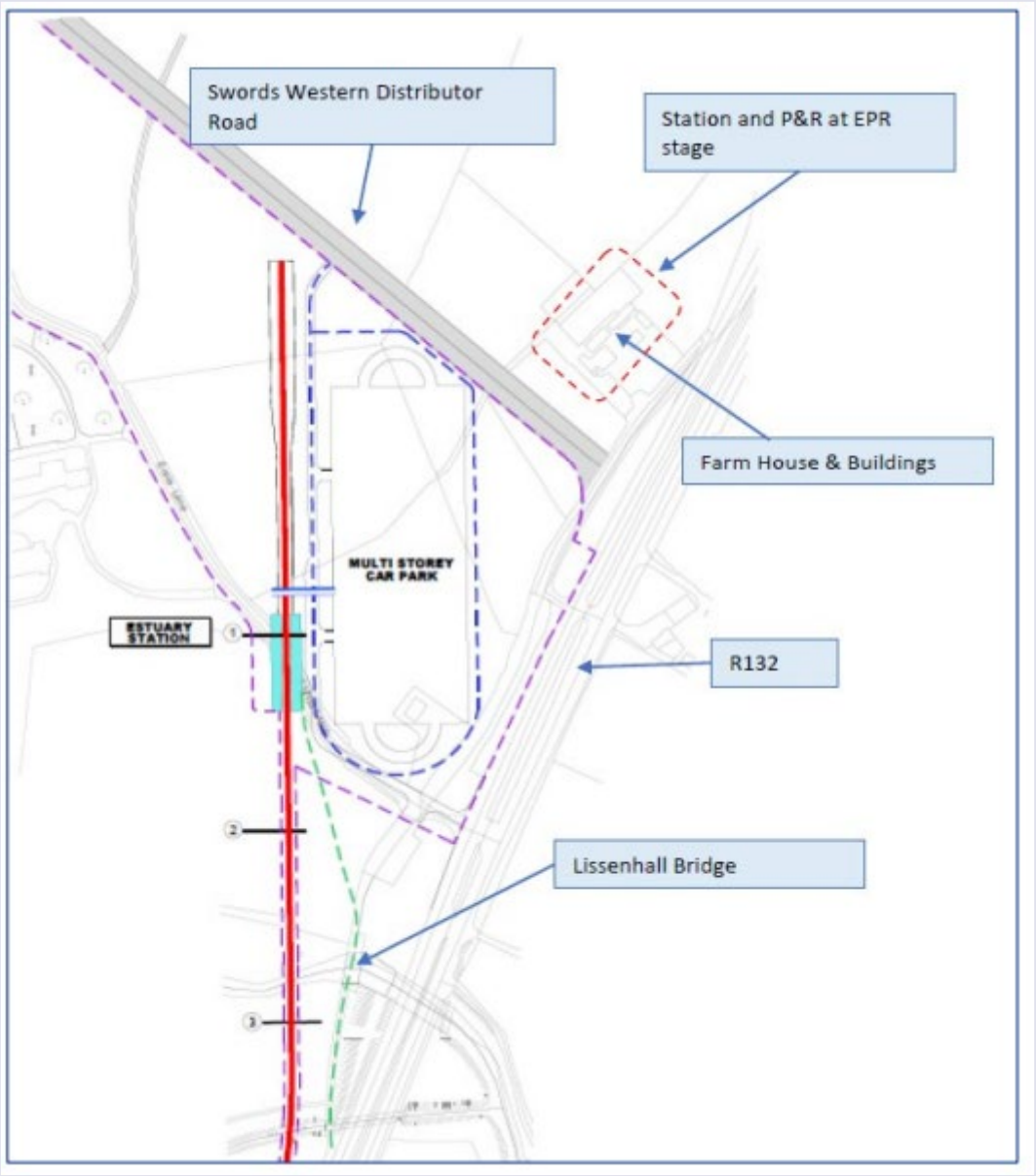


Diagram 7.20 Preferred Route Proposal for Estuary Station and P&R

7.7.10.1.1 Environmental Analysis

In addition to the principal constraints mentioned above in section 7.7.10.1, a number of environmental constraints were considered when comparing the EPR site option to a new station and P&R location and these were:

- The proposed EPR station and P&R site is located to the west of the R132 road and north of the Broadmeadow River with potential for impacts on water quality if not mitigated. The Broadmeadow River flows into several designated European sites downstream (namely Broadmeadow/Swords Estuary SPA and Malahide Estuary SAC);
- There are potential ecological impacts at a local level due to the scale of the station and P&R facility and supporting infrastructure proposed. Local level impacts include habitat loss and increased levels of disturbance (i.e., lighting, noise) to bats and birds species that use the area. The potential impacts listed for the EPR on surface water bodies and on the downstream SAC and SPA are slightly elevated for the preferred option as the station and P&R location are in closer proximity to the Broadmeadow River. However, these potential impacts have been mitigated by design development that has moved any element of hard infrastructure associated with the station and P&R outside of the riparian area of the Broadmeadow river and further outside of the area designated as "Open space" in the Fingal Development Plan 2017 - 2022 and in the draft

Fingal Development Plan 2022 – 2029. Further mitigation measures as presented in Chapter 15 (Biodiversity) and in the Natura Impact Assessment Report will ensue that there are no impacts on protected European sites or species.

- The Emmaus Retreat and Conference Centre (now used to house refugees) is regarded as a sensitive receptor in this area. In addition, there are residential properties, and nearby agricultural enterprises in the vicinity of the proposed location. The provision of a station and P&R facility at the proposed EPR location could result in potential impacts in terms of noise, vibration and dust during both the Construction Phase and Operational Phases, particularly on the Emmaus centre. However, the PR option is actually located in closer proximity to the Emmaus centre resulting in potentially increased noise levels during the construction and Operational Phases. These impacts can be mitigated by measures outlined in Chapter 13 (Airborne Noise & Vibration);
- The proposed P&R facility is a multi-story structure that will be visually prominent once constructed in an area that is primarily agricultural with a low level of development. The potential station and P&R buildings impacts are exacerbated due to their contrast to the existing open agricultural landscape and the proximity to an area to the east of the R132. The impacts associated with the EPR P&R location and PR location are considered similar;
- There will be potential traffic impacts to the R132 during construction. Vehicle movements associated with earthworks and transport of material for the construction of buildings and tracks will be via the R132;
- Arising from the EPR station and P&R location there would be potential archaeological impacts during construction and from the footprint of the proposed station. Evidence exists of potential archaeology including possible banks, walls and stone features. Similarly for the PR location there will be potential archaeological impacts during construction and from the footprint of the proposed station. Within the proposed footprint of the Park & Ride building there is evidence of an enclosure including a ditch and pits which is archaeological in nature and not associated with modern agriculture. Evidence exists of potential archaeology including possible banks, walls and stone features to the south of the location. Potential impacts on archaeology can be mitigated as outlined in Chapter 25 (Archaeology & Cultural Heritage).

7.7.10.1.2 Overall Assessment

The PR station and P&R location was chosen as preferred because

- The revised alignment avoided conflict with the proposed SWDR alignment;
- The revised alignment in this area mitigates the potential for direct impacts on an existing property; and
- The location of the proposed Estuary Station and Park and Ride Facility has been moved further north to ensure that there are no buildings or structures (other than the proposed viaduct crossing and attenuation basins) within the designated "Open Space" area in the vicinity of the Broadmeadow River.

Please refer to the MetroLink Preferred Route Design Development Report (TII, 2019) which can be viewed at www.metrolink.ie for further details).

7.7.10.2 Seatown

The EPR in 2018 had the proposed Project alignment elevated above the median of the R132 Swords Bypass in this area. However, following multi-disciplinary analysis as described above in Section 7.7.9.2, a decision was made to relocate the station for the Preferred Route to the east of the R132 Swords Bypass. The design developed for the Preferred Route had footbridges proposed across the R132 to allow access to the station. However, the requirement for these footbridges was removed due to the Fingal County Council proposals to develop the R132 upgrade project which aims to turn the road into an urban road with direct pedestrian and cycling access across the roadway to Seatown station.

7.7.10.3 Swords Central

Similar to Seatown, the EPR in 2018 had the proposed Project alignment elevated above the median of the R132 Swords Bypass in this area. However, following analysis as described above in Section 7.7.9.2,

a decision was made to relocate the station for the Preferred Route to the east of the R132 Swords Bypass in the Barrysparks area. The design developed for the Preferred Route had footbridges proposed across the R132 to allow access to the station. However, the requirement for these footbridges was removed due to the Fingal County Council proposals to develop the R132 upgrade project which aims to turn the road into an urban road with direct pedestrian and cycling access across the roadway to Swords Central station.

7.7.10.4 Fosterstown

Fosterstown Station was identified in the EPR was as being located just north of Airside Retail Park on the R132 Swords Bypass. However, following multi-disciplinary analysis as described above in Section 7.7.9.2, a decision was made to relocate the station for the Preferred Route to the east of the R132 Swords Bypass in the vicinity of Airside Retail Park. The design developed for the Preferred Route had footbridges proposed across the R132 to allow access to the station. However, the requirement for these footbridges was removed due to the Fingal County Council proposals to develop the R132 upgrade project which aims to turn the road into an urban road with direct pedestrian and cycling access across the roadway to Fosterstown station.

Further Multi-criteria analysis (MCA) was undertaken to identify the preferred location for the station in this area taking into consideration the potential for direct impacts on commercial properties in the Airside Retail Park, and on traffic movements on the R132 road. The existing (preliminary design) station location as identified in Diagram 7.21 was compared to a number of alternative options which were as follows (Refer to Diagram 7.22):

- Preliminary Design (base case) Option - Alignment to east of R132 and station on the Retail Park site
- Alternative Option 1A - Station moved to the **north**. Minor displacement of the track alignment to west but avoiding permanent impact on the R132 alignment.
- Alternative Option 1B - Station moved to the **south**. Minor displacement of the track alignment to west but avoiding impact on the R132.
- Alternative Option 2A – The station is moved to the **north**. MetroLink alignment moved west to fully avoid the Airside building and runs partially under the R132 in cut and cover section**.**
- Alternative Option 2B – The station is moved to the **south**. MetroLink alignment moved west to fully avoid the Airside building and runs partially under the R132 in cut and cover section**.**

Diagram 7.21 Preliminary Design (base case) Option

Diagram 7.22: Alternative Fosterstown Options

The analysis consisted of a two stage MCA. Stage 1 MCA was a preliminary high-level analysis using the criteria outlined in Table 7-17.

Table 7-17 Stage 1 Assessment Criteria

Criteria	Sub-Criteria	Criteria Description	Note
Project Objectives	Demand/Property impact/Planning	Does the Option satisfy the stated project objectives set out below	Should the option not satisfy the objects it fails and is removed from further assessment
Environment / Planning	Potential for adverse impacts	Minimise the potential for adverse impact on the natural and built environment and the community.	Environmental criteria were assessed to ensure compatibility with the objectives of the FDP and Swords Masterplan Criterion also assesses the comparative impact of options on the environment.
Engineering	Constructability / Safety	This criterion considers if the station option can be constructed having regard to the identified constraints and opportunities within the study area and relative differences in construction risk/safety	The constructability criterion was assessed given the potential differentiation between the construction of different station location options and associated track alignment changes.
Economy	Cost	This criterion considers the broad capital and operation costs of each of the proposed options.	This criterion was assessed given the capital and operational cost implications of differing options

The Stage 2 MCA assess the remaining options after the stage 1 assessment in accordance with the criteria outlined below

- **Alignment** – Is the proposed option feasible based on metro alignment standards;
- **Demolition of buildings** – an assessment of the number and type of buildings that would require demolition during construction of the Option at Fosterstown Station;
- **Masterplan compliance -** placing the station at Fosterstown meets the policy and objectives of the Fingal Development Plan 2017-2023 and the Swords Masterplans 2019;
- **Road/Traffic Impacts** – an assessment of the main traffic impacts and disruption during construction for all road users and pedestrians;
- **Environment & Planning** – a summary of the main potential impacts associated with each option development;
- **Urban integration** – how well will the Metro station integrate into the urban environment; and
- **Economy / Costs** – a comparative assessment of the Metro station costs, including construction, risk, and property costs.

7.7.10.4.1 Stage 1 MCA Outputs

Stage 1 analysis outputs are summarised in Table 7-18.

Table 7-18 Summary of Stage 1 MCA

	Option PD (Base)	Option 1A	Option 1B	Option 2A	Option 2B
Project Objectives					
Environmental/Planning					
Engineering					
Economy					
Score					

Options 1B and 2B performed less well in terms of planning requirements particularly in terms of the Fosterstown Masterplan. Option 1B as it does not meet project objectives and requires demolition of the end of terrace retail unit and 2B station construction has greater environmental impacts and a more significant impact on the Nevinstown junction. Both options permanently impact the R132 due to the station footprint and associated rail track alignment. These two options were therefore discarded and not considered further.

Overall Option 1A does not meet project objectives as it requires demolition of property in the Airside park as well as potentially requiring private property to the west of the R132 to accommodate the R132 realignment. It will affect the operation of the R132 during construction. The horizontal and vertical geometry, although compliant, is not desirable when compared to the geometry for other options. This option is not as well aligned with the Fosterstown Masterplan as the Base case and has moderate environmental impacts. This option was therefore discarded.

Option 2A avoids the demolition of the end of terrace retail warehouse unit which results in it performing well from an environmental viewpoint. From a planning perspective, it is not as well aligned with the Fosterstown Masterplan as the Preliminary design. The horizontal and vertical geometry are compliant, though the horizontal alignment is not desirable when compared to the Preliminary Design (base case) Option. The construction of this option is considered to have a moderate impact on the R132 during the Construction Phase. This option is taken forward to the second stage.

The Preliminary Design (base case) option performs well under all criteria with the exception of environment as a result of the need to demolish the end of terrace retail warehouse unit. The vertical and horizontal geometry of this option is preferred over Option 2A. This option is taken forward to the second stage.

Based on the initial multi-criteria analysis, it was concluded that the Preliminary Design (base case) Option and Option 2A were the emerging preferred options.

7.7.10.4.2 Stage 2 MCA Outputs

STAGE 2 MCA	Option PDR (Base)	Option 2A
Alignment		
Demolition of Buildings		
Masterplan compliance		
Road/Traffic Impacts		
Environment and planning		
Urban realm Integration		
Economy / Costs		
Result	Preferred Option	

7.7.10.4.3 Overall Conclusions

All options were subjected to an initial multidisciplinary analysis to provide an Initial appraisal of these options. From this assessment the two best performing options – The preliminary Design Option and Option 2A were subject to more detailed comparison.

The more detailed MCA comparison indicated that Option 2A – avoiding the Airside building – although considered cost neutral compared to the Preliminary Design, had significant disadvantages compared to the proposed Preliminary Design option. It would have more extensive construction impacts, including additional utility diversion requirements; significant impact on the R132 traffic and other road users over an extended length of the R132 and with an approximate 5-year construction period; a poor urban integration of the station adjacent to the R132; and the introduction of a poor horizontal track alignment which would constrain the operational speed of trains in this area.

On this basis, we have concluded that the best available option for the MetroLink alignment and the Fosterstown station location past Airside is that now adopted for the Preliminary Design, and which will form part of the Railway Order documentation.

7.7.10.5 Northwood

The EPR location for the Northwood Station was proposed just north of the Gulliver's Retail Park. However, following multi-disciplinary analysis as described above in Section 7.7.3 a decision was made to change the alignment to allow for an alternative Northwood Station location from that proposed at EPR stage. The EPR station location was based on having an underground alignment progressing under the M50 Motorway as intended at EPR stage. However, as the alignment was no longer underground, the alignment and station location needed to be altered to accommodate the revised alignment. Two alternative route options were considered for the revised station location at Northwood, and these were

- Relocation of the station to the west of the R108 Ballymun Road, closer to Ballymun; and
- Relocation of the station under and across the R108 Ballymun Road.

The option to place the station west of the R108 Ballymun Road was not considered to be feasible and was discounted as it would provide poor accessibility from the station to the Gulliver's Retail Park east of the R108; and it would be too close to Ballymun Station to provide efficient operational metro services.

7.7.10.5.1 Environmental Analysis

An environmental assessment was undertaken on the proposed PR location of the Northwood Station under the R108 to identify any potential significant environmental constraints and opportunities when compared to the EPR. The environmental assessment was undertaken having regard to all environmental topics, but the principle environmental issues are as follows:

- *Population:* Positive socio-economic impacts to local businesses through increased footfall arising from Northwood Station for the PR option when compared to the EPR option. Furthermore, the station would span across the R108 and thereby acting providing connectivity across the roadway.
- *Property:* The PR option is to have a viaduct crossing over the M50 with an at grade/elevated embankment from Northwood Station to the M50 Viaduct would result in direct impacts on private property. The EPR option would not result in an impact on property in this area as the alignment is entirely underground at this location.
- *Noise & Vibration:* The PR option would be re-aligned such that it would pass by or under larger numbers of residential properties, thereby resulting in potential increased noise & vibration impacts during construction and operation. These impacts can be largely mitigated as discussed in Chapter 13 and Chapter 14. However, the EPR option resulted in an alignment that would passed directly under the Metro Hotel, thereby resulting in a potential impact at that location from noise & vibration, which would be exacerbated by the deep piled foundations of that building.

- *Biodiversity/Hydrology:* The EPR station location was proposed to be to the east of the R108 in a wooded area within the Santry Demesne. This station location would have resulted in the requirement for significant additional felling of trees along the Santry river when compared to the PR route option. Furthermore, this option would have impacted directly on the channel of the Santry river where otter were identified during survey work. The PR station location (and associated alignment) would be to the west of Santry Demesne and would result in tree felling but not within the Deems itself. Furthermore, this option requires a minor culvert extension over the Santry river and so potential impacts on the river would be much less than those arising from the EPR station location here.

All of the above mentioned potential environmental impacts that have been assessed in full in the EIAR and require mitigation measures to ameliorate effects.

7.7.10.5.2 Overall Conclusions

The preferred location for the revised station at Northwood was to incorporate the station at a skew angle under the R108, south of the Retail Park. This would allow passengers to access the station from either side of the R108 and pedestrians to cross the R108 through the station without having to cross a busy road. In addition, the revised station location will lie adjacent to the proposed tunnel launch site for the tunnelled route southwards to Charlemont and will form part of the overall construction works in this area. There will be potential impacts on the R108 during Construction Phase of the station and appropriate traffic management and diversions around the site to maintain safe movement of road users and pedestrians will be designed to mitigate these potential impacts. Please refer to the MetroLink Preferred Route Design Development Report (TII, 2019) which can be viewed at www.metrolink.ie for further details).

7.7.10.6 Ballymun

The EPR had the station at Ballymun located underneath the R108 Ballymun Road adjacent to the "Old" Ballymun Shopping Centre.

The alignment for this route option was close to a hotel and a number of residential receptors, increasing the potential magnitude of adverse impacts associated with noise, vibration and visual amenity during the Construction Phase. As the station would have been constructed beneath the existing road, a road diversion during the Construction Phase would have been required, potentially delaying the re-development of adjacent brownfield land for other uses.

Due to the potential for impacts arising from the EPR station location as described above, a Multi-disciplinary Analysis was undertaken to compare the EPR station location option with a station location moved further to the west of the R108 Ballymun Road, directly adjacent to the "old" Shopping Centre site but removed from the R108.

7.7.10.6.1 Environmental Analysis

An environmental assessment was undertaken on the proposed PR location for Ballymun Station adjacent to the Old Ballymun Shopping Centre site to identify any potential significant environmental constraints and opportunities when compared to the proposed EPR station location, underneath the R108. The environmental assessment was undertaken having regard to all environmental topics, but the principle environmental issues are as follows:

- *Traffic and Transport:* The development of the EPR station location option would require significant traffic diversion requirements for a significant period during the construction of the proposed Project. However, the PR station location option would not require these traffic diversions to occur.
- *Noise & Vibration:* Noise & vibration during construction impacts would be potentially more significant for the EPR options when compared to the PR option as the site would be in closer proximity to residential receptors and a nearby hotel.

- *Property:* The EPR option Construction Phase would require additional land for temporary traffic diversions which would preclude development on this development land until the proposed MetroLink project was completed. The PR option would allow for the development of a site adjacent to the R132 roadway, thereby removing the requirement for traffic diversions across development. During the Operational Phase of the project, the development of a MetroLink station in the area would enhance the development potential of the area.

Overall, from an environmental perspective the PR option is favoured above the EPR option.

7.7.10.6.2 Overall Conclusions

This alternative route option and station location would mean that the alignment would be located slightly further away from the nearby Metro hotel and other identified sensitive residential receptors. Furthermore, all of the construction works would be removed from underneath the R108 Ballymun Road which would significantly reduce potential Construction Phase impacts on traffic movements in the area. Please refer to the MetroLink Preferred Route Design Development Report (TII, 2019) which can be viewed at www.metrolink.ie for further details).

7.7.10.7 Collins Avenue

The EPR route identified a location for the Collins Ave station in the green space in front of Our Lady of Victories Catholic Church. This location was chosen as it was the only significant open space in this immediate area that would avoid the requirement to impact directly on any buildings to generate sufficient space to allow for the construction of the station. This proposed location for the station has a number of other advantages including:

It ensures that significant traffic disruption would be avoided during the Construction Phase when compared to other options. Locating the proposed station under the Ballymun road (R108) and Collins Avenue was ruled out on the basis of the very significant traffic congestion impacts that would result during the Construction Phase.

This station location also allowed the station to serve as an effective interchange with a number of bus services. Within a 600m buffer from Collins Avenue Station there are more than 22 bus stops located along R108, R103 and Saint Pappin Road. The bus stop directly south of Collins Avenue Station is served by routes 4 (Monkstown Avenue to Harristown); 9 (Charlestown to Limekiln Avenue); 11 (Wadelai Park to Sandyford Business District); 13 (Grange Castle to Harristown); and 155 (Ikea towards Bray Rail Station). Other relevant bus routes with stops within this buffer include route 17A (Blanchardstown to Kilbarrack); and 104 (Clontarf to DCU). The Collins Avenue Station is also located along the proposed E1 and E2 Spine as part of the Bus Network Redesign proposals and is in close proximity to Orbital routes N4, serving Blanchardstown to Killester and Dublin City Centre. Routes E1 and E2 will have frequencies of 8 to 10min on weekdays giving the Spine E a combine frequency of 5min during weekdays. The N4 orbital route will have a frequency of 10-15 minutes. There is also another 'city bound route', the 19, which also runs past the proposed Collins Avenue Station with a frequency of one bus every hour every day.

The proposed Collins Avenue Station serves a very significant catchment. It is located close to Dublin City University and residential catchments on Glasnevin Road, Dean Swift Road and Clonmel Road. The university and residential areas are located within a 15minute walking distance of the proposed Station.

During consultation on the EPR in 2018, concerns were raised about the impact of construction of this station on Our Lady of Victories church and the nearby Our Lady of Victories National School.

A reasonable alternative to this location could not be identified as:

- The area is heavily urbanised and the location of a station at any other location in the area would require the demolition of buildings. Consideration was given to locating the station in Albert College Park; however, this location is not desirable or optimum as it is removed from the busy Collins Ave junction and bus routes that utilise that route. The station location would also be some distance from Dublin City University which is one of the key trip attractors in the area.

- The placement of a station within Albert College Park, would also require the provision of an intervention shaft between that location and Ballymun station in an area where there is very limited space for such a shaft in the absence of demolition.

7.7.10.8 Griffith Park

For the EPR, Griffith Park station was located on the CLG Na Fianna grounds. At EPR stage it was proposed that a tunnel launch site would also be located at this site. However, as outlined in Section 7.7.2 an alternative site for the proposed tunnel launch site has been identified at Northwood for the Preferred Route.

Furthermore, a multi-disciplinary analysis was undertaken taking full consideration of all environmental disciplines to review and identify the optimum location for the proposed station having particular regard to the potential impacts during the Construction Phase on the local population. This location is identified as being sensitive due to the location of a number of educational facilities including Whitehall College of Further Education, Scoil Mobhi, Scoil Mobhi and Gaelscoil Áine , and sport facilities (CLG Na Fianna and Homefarm FC) at this location in addition to the proximity of sensitive residential receptors in the area. The following options were assessed by way of a multi-disciplinary analysis:

- Griffith Park Station located on CLG Na Fianna grounds but with no TBM launch facilities;
- Griffith Park Station located on Home Farm FC grounds with no TBM launch facilities;
- No station or TBM launch facilities in this locality.

The option of omitting a station at this location was not considered feasible as a distance of 2,600m between Collins Avenue and Glasnevin Stations would mean that there would be a requirement for two intervention shafts between these stations to allow for access and egress from the tunnel in the case of an emergency. The works required to construct the intervention shafts would be less than the construction of a station box but would still require a significant engineering effort involving mobilisation of a substantial quantity of machinery, materials and other auxiliary equipment at each site. As a result, it was considered that the potential impacts associated with the construction of an intervention shaft were not significantly less than that of a station to merit the omission of a station from this location. Furthermore, the omission of this station would result in a reduction of passenger numbers using the metro system, making it less viable overall.

7.7.10.8.1 Environmental Assessment

An environmental assessment was undertaken to identify the preferred location for a station at Griffith Park. The environmental assessment was undertaken having regard to all environmental topics, but the principle environmental issues are as follows:

- *Population:* The construction of a station underneath the GLG Na Fianna playing pitches would have potential for a significant impact on the operation of an important community-based organisation. The alternative location for the proposed construction of a station underneath the Home Farm FC playing pitches would also result in potential for a significant disruption to the operations of this club, but they would be significantly less than those at GLG Na Fianna because Home Farm have their main playing pitches further east of this location. Construction of any of the station location options assessed would have potential to impact on the local schools in the absence of sufficient mitigation measures due to potential for short term increases in traffic congestion, increased noise levels and dust generation.
- *Noise & Vibration:* Both proposed station location options would have potential to impact on local sensitive receptors during the Construction Phase due to the generation of noise and vibration, if not sufficiently mitigated.
- *Hydrology/Biodiversity:* In the absence of mitigation measures there is potential for uncontrolled discharges to the Tolka River that would cause environmental effects on the water quality and biodiversity. As the proposed station location at Home Farm FC grounds is in closer proximity to the Tolka, the potential impacts are slightly higher for this proposed station location. However, there is an historic culverted river channel progressing underneath the GLG Na Fianna site which would have potential to be impacted. Both proposed station locations have potential impacts on

biodiversity due to the requirement for vegetation clearance and tree felling. There may also be potential for impacts on winter birds (House Sparrow, Herring Gull and Swift) identified within 30m of this area.

- *Architectural Heritage:* The proposed station location at the Home Farm site would be in closer proximity to Whitehall College which is on the DCC Record of Protected Structures (RPS 7746), however both station location options have potential to impact on the curtilage of this protected site.

Overall, from an environmental perspective the PR option is favoured above the EPR option.

7.7.10.8.2 Overall Conclusions

Consideration was given to siting the proposed station beneath playing pitches at Home Farm pitch and at the CLG Na Fianna club pitches. Through consultation with the two clubs, it is understood that the disruption during construction would be more significant for CLG Na Fianna, as the site contains the clubs principle playing pitches and training ground, whereas the Home Farm Club has its main playing and training facilities at Drumcondra Road Upper. Furthermore, TII have agreed to provide temporary facilities to Homefarm FC before reinstating and enhancing the playing pitches at the Griffith Park location.

Both locations have sensitive receptors nearby, including residential properties, schools, nurseries and hospitals, meaning that, for either option, mitigation measures during construction would be required. Many of the identified sensitive receptors are relevant to both station location options. The key difference between the options are the potential impacts on the sports facilities and as a result it was recommended that the proposed station location would be located at the Home Farm site. Please refer to the MetroLink Preferred Route Design Development Report (TII, 2019) which can be viewed at www.metrolink.ie for further details).

7.7.10.9 Tara

The proposed Tara Station is located close to the existing Tara Street DART Station, in order to provide transport interconnectivity with the DART and other rail services at this location. However, achieving this interchange is very challenging due to the built-up area surrounding the existing Tara Station, with very limited undeveloped space.

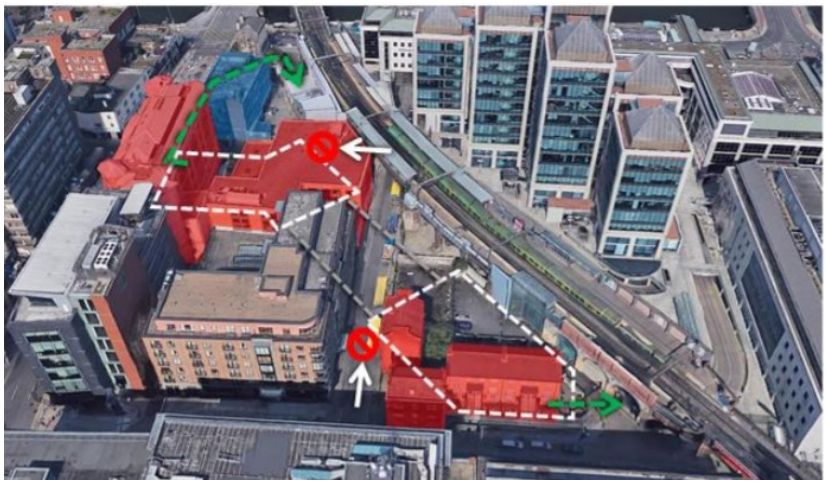
Option 0: Proposed station location, adjacent to the Tara Dart station

Option 1: Location moved to the west of Tara Street under the Hawkins development

Option 2: Location moved Northwards and Re-Aligned under Tara Street

Option 3: Location moved southwards under Townsend Street (Open box with top-down construction)

Option 3a: As Option 3 but station box to be formed through mining



Option 4: Station location as Option 0 but constructed as a mined station

Diagram 7.23 Station Location Options (a) Option 0 (b) Option 1 (c) Option 2 (d) Option 3 (e) Option 4 [

A number of locations were developed and assessed in order to identify a preferred station location at Tara Street as identified in Diagram 7.23 and Diagram 7.24 and these were:

- Modified EPR Station Location (Option 0): This proposed station location is located adjacent to the Tara Street DART Station, but with a shorter station length than that proposed for the EPR. This location forms the proposed station location for the MetroLink Tara station;
- Station Option under Hawkins Development (Option 1): This proposed station would be located parallel to Tara Street and integrated under the new Hawkins development site.
- A station location option further north than that proposed in the EPR (Option 2). This option would be located in a north west to south westerly direction just north of the existing EPR station location.
- An option further south (Option 3), aligned under Townsend Street with station entrances to the north and south of Townsend Street. Two options were considered, one comprising a top down box construction (Option 3) and an alternative construction adopting a mined tunnel under Townsend Street (Option 3a). Both options would involve realignment of the tunnel route to the south. Buildings at Townsend Street and Spring Garden Lane would need to be removed under both options with Townsend St. closed during Option 3 construction and Spring Garden Lane closed during Option 3 and 3a construction. Passenger transfer to the DART Tara Station would use the existing southern access, which would need to change from a peak hour access to a permanent access.
- Option 4 assessed an option in the same location as the proposed station location, but constructed using mining techniques rather than open cut, in order to try to reduce the amount of demolition required.
- Additional Options locating the MetroLink station to the east of the Tara Street DART station (Option 5 to 8) were also considered, in order to mitigate construction impacts on the Markievicz leisure centre and College Gate apartments. Options 5 and 6 considered alignments to bring a station parallel to Moss Street; Option 7 located the station south of Townsend Street and east of the Dart line. Option 8 aligned the new station to the east of the Tara Dart station directly under the Georges Quay development, requiring demolition of this business complex to accommodate the station construction. In addition, the alignment would pass under the DART viaduct foundations twice for each of these options.
- Option 9: A further option was assessed whereby the option to locate most of the underground Metrolink station under the existing DART station viaduct was analysed. The several arrangements could be as shown in Diagram 7.25 below, where the station cavern is mined below the viaduct structure supporting the DART station. Buildings at the two shaft locations, one each side of the railway, would have to be demolished and it would need to be ensured that the Victorian era railway viaduct would not be put at risk during the Construction Phase. Depending on the orientation of the tunnel this option would lead to a longer cavern length than the Option 0: Base

Case, although this could be mitigated by reducing the width of the access shafts. Several multi-storey office buildings could be impacted by this Option.

- Option 10: TII were advised that there is a potential for the Dublin Fire Brigade (DFB) building on the south side of Townsend Street to be vacated in the future because of a planned relocation of the HQ to another city location. This could present an opportunity as a potential location for siting the MetroLink Tara Station, which would mean demolition of commercial properties instead of residential buildings. The orientation of a station in this location is constrained by the fixed locations of the nearest stations on each side, namely; O'Connell Street to the north and St Stephens Green (SSG) to the south. The initial concept for the Tara Station under this Option 10 is shown in Diagram 7.26. It can be seen that the track alignment would be substantially altered to maintain the locations of O'Connell Street and SSG stations, while still achieving acceptable radius curves. The figure also shows a closer view of the station box, and it can be seen that as well as the current DFB building, a hotel and several other properties would need to be acquired for demolition.

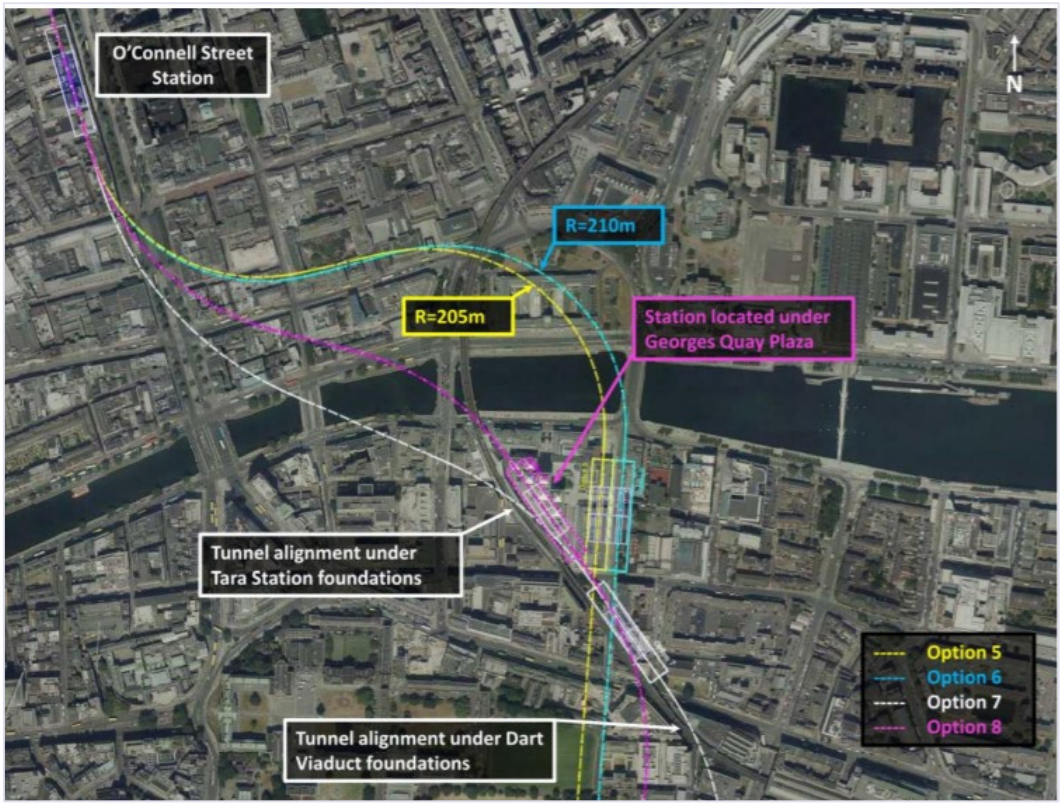


Diagram 7.24 Station Location Options 5 to 8

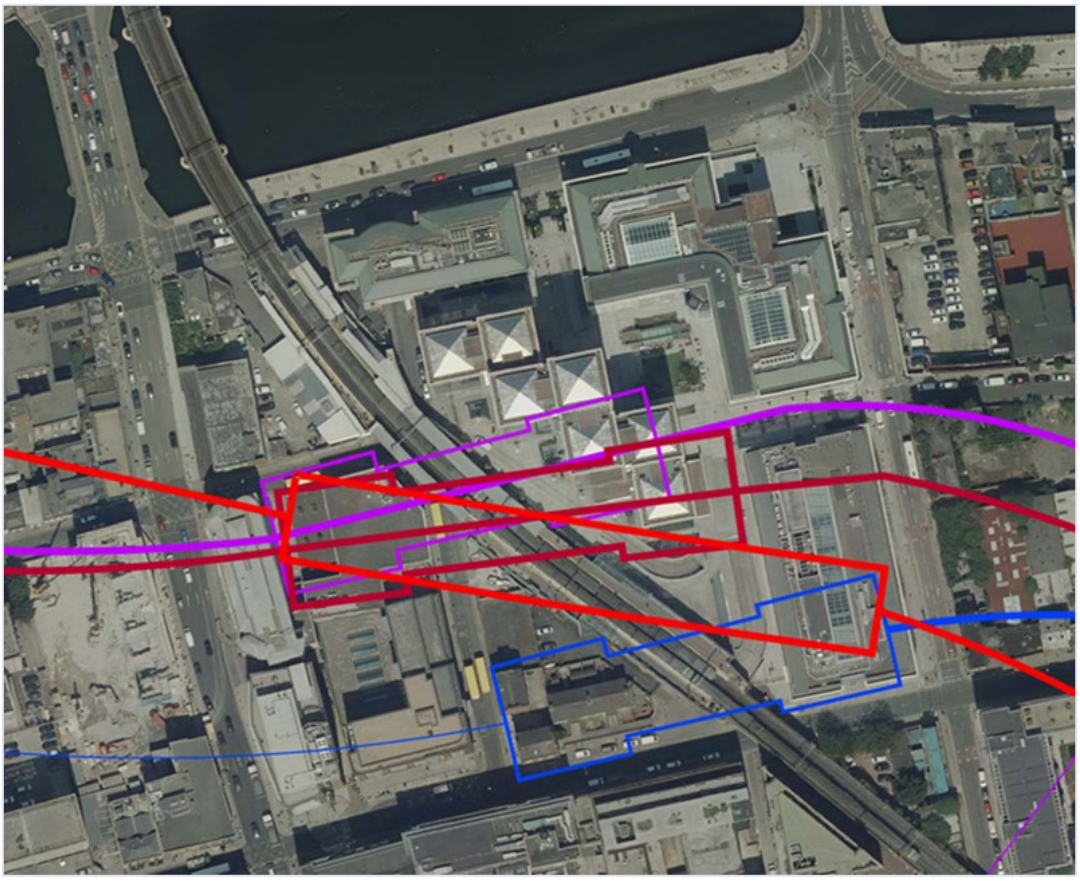


Diagram 7.25 Station Location Option 9

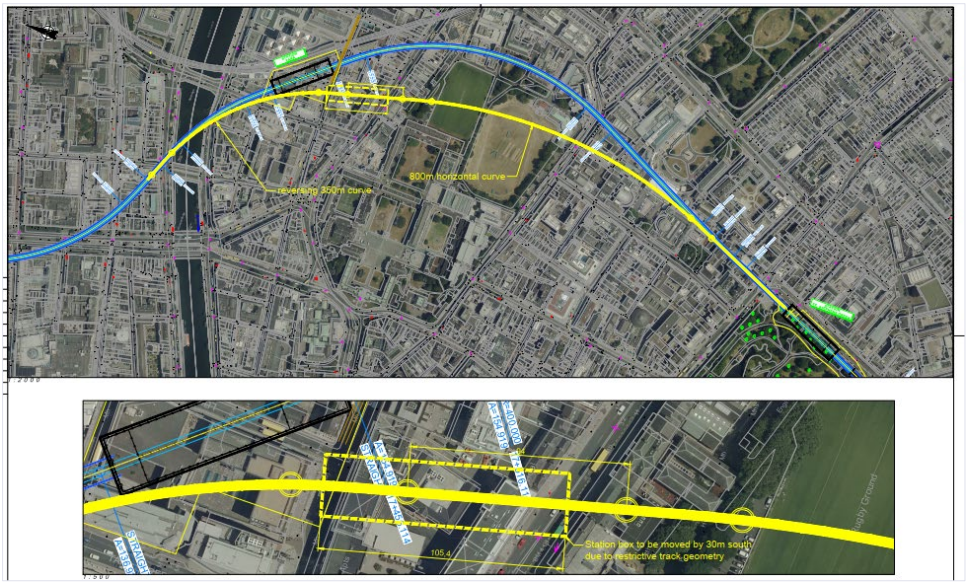


Diagram 7.26 Station Location Option 10

7.7.10.9.1 Overall Analysis

- *Option 0* – This was the original solution proposed for the EPR and whilst the station box and station arrangement have been modified to suit the single bore tunnel, the station arrangement remains essentially in the same location. It retains good interchange with the DART Tara Station. This option also has the lowest construction costs, is safer to build and is much less disruptive to traffic and existing utilities. However, this option has significant property impacts on the College

Gate Apartment building and would result in a loss of important leisure facilities at the Markievicz Centre.

- *Option 1* – Moving the station to the west would require a significant change to the tunnel alignment. This is not viable due to the unacceptably low track radii needed to align O'Connell Street and Tara stations, which means that TBM tunnel construction would not be possible. As a result, this option was not considered feasible.
- *Option 2* – Moving the station northwards would have significant impacts on Tara Street during construction with traffic disruption over an extended period affecting wider city traffic movements. There would also be significant impacts arising from utility diversions. Overall construction costs are likely to be higher than the other options considered. This option also has significant property impacts to the entire city block between Tara Street and Corn Exchange Place. For these reasons this option is not recommended.
- *Option 3* – This option moves the station box southwards, and this cannot be delivered without significant disruption to key elements of the Dublin sewer network running along Townsend Street (including a 100-year-old 2.4m circular brick foul sewer and 1.2m circular concrete foul sewer). This sewer is one of the key elements of the sewer network in Dublin and transports sewage to Ringsend, serving a population of approximately 270,000 people. Any disruption to this sewer would be a very significant issue. This option would require diversions to this sewer which would be a major engineering challenge in this built-up area, with significant local disruption and risk to maintaining the integrity of the systems being an important constraint on this option. These are considered a key concern against this option, so this option is not recommended.
- *Option 3a* – This sub-option attempts to avoid impacting the sewer in Townsend Street by shortening the open station box by approximately one third and replacing that section under Townsend Street by a mined cavern. Concept design work demonstrates that there is insufficient vertical clearance below the sewers to provide useful space for station facilities and the risk of damage to the sewers remain. For this reason, this sub-option is not recommended.
- *Option 4* – This option involves the mining of a cavern below the existing College Gate buildings, which carries substantially more safety risks during its construction than all the other options. The risks are associated with constructing in such close proximity to the College Gate buildings resulting in an increased risk to the building structural integrity from settlement and vibration. Whilst the initial construction cost would be slightly more than Option 0, the potential for additional risk associated with mining could easily lead to increased costs during construction and it could be expected that the tendered cost would make allowance for such risk. While Option 4 would retain the College Gate building there would be significant disturbance to residents because of the shaft construction directly adjacent to the building and the mining of the tunnel directly underneath part of the building. These construction activities are estimated to take up to 2 years. During this period there would be risk to the building from the mining activities including potential for structural damage, and significant construction disturbance, including noise and vibration. These factors mean that everyone would need to move out of the building during the construction for a period of up to two years. For these reasons this option is not recommended.
- *Option 5* – In order to achieve this alignment, there is a very sharp radius curve introduced into the Metro alignment coming from O'Connell Street station. The curve radius of 205m is too tight making it impossible to construct a bored tunnel using a tunnel boring machine. This radius is also too tight to ensure the safe operation of the MetroLink services, at required speed limits.
- *Option 6* - There is a similar tight radius (210m) required as for Option 5 making this option similarly not viable.
- *Option 7* - The lack of direct station connectivity between DART and Metrolink at this location fails the strategic objective of building a station at this location. In addition, the alignment passes under the Dart viaduct foundations twice. This would result in increased risk of settlement and/or structural damage with this option on the existing railway infrastructure and on the frontage of St Marks church. For these reasons this option is not recommended.
- *Option 8* – Would require demolition of the Georges Quay business blocks with significant business disruption and high associated costs. In addition, the alignment would pass under the DART viaduct foundations twice and the open cut station construction would take place in proximity to the foundations of the Irish Rail DART Station resulting in increased risk from settlement and vibration. For these reasons this option is not recommended.

- *Option 9* – Would involve tunnelling under the DART viaduct structure with inevitable risk of damage to the structure and service disruption. There is also the need to demolish the Works & Pension building as well as other low-rise residential properties along Townsend Street. With similar tunnelling issues as Option 4 this Option is not recommended.
- **Option 10** – This option depends on the Dublin Fire Brigade re-locating from their HQ on Townsend Street. It also depends on the feasibility of mining under both Townsend Street and Pearse Street. These factors as well as the reduced interchange connectivity with the DART station are the reasons that this option is not recommended.

7.7.10.9.2 Environmental Analysis

An environmental assessment was also undertaken to feed into the overall identification of the preferred location for a station at Tara St. The environmental assessment was undertaken for all feasible station location having regard to all environmental topics, but the principle environmental issues are as follows:

- Population: The loss of a number of residential buildings required to build the Option 0 will result in a significant environmental effect and will require the rehousing of all the residents of these units. In addition, the loss of the Markievicz leisure centre will impact on the local population as it serves as the only public swimming pool in this area. However, the other feasible options (Options 2, 3,3a and 4, 9 and 10) also require significant property demolition, but would avoid impacting on the College Gate Apartment building and the Markievicz leisure centre. Option 4 is a mined version of Option 0 and would allow retention of the College Gate Apartment building and the Markievicz leisure centre but still require the demolition of a number of buildings including the Dublin City Council housing units on Townsend St.
- Property: From a material assets perspective, the loss of property resulting under Options 0, 2, 3, 3a and 4, 9 and 10 is a significant impact.
- Utilities and Infrastructure: The proposed station locations 3 and 3a (a mined version of 3) would potentially impact directly on the Townsend Sewer, which is a major sewer connecting the Ringsend WwTP. Station location 3 would require an additional major project in order to divert this significant sewer with all the potential impacts of that project. Traffic impacts during the Construction Phase would be very significant as a result.
- Noise & Vibration: All station location sites have potential for significant impacts during the Construction Phase, if not effectively mitigated, due to the close proximity of nearby properties, such as the Irish Times building. However, the mined options (options 3a and 4) have potential for increased noise and vibration due to the requirement to use road headers and other plant to excavate beneath existing buildings and utilities. The assessment identified that if option 4 were to proceed (mined option beneath College Gate apartments), the residents of the apartment block would have to move out for the duration of the excavation period i.e., up to 2 years.
- Archaeology: All station location options have potential to impact on archaeology due to the significant archaeological resources in this area, being in such close proximity to the River Liffey. Options 0 and 4 would potentially impact on two sites listed on the Record of Monuments and Places. They are DU018-020648 (chapel and graveyard site) and DU018-020061 (chapel site). Option 2, 3 and 3a also lies in an area of significant archaeological potential due to its proximity to the river.
- From an environmental perspective Option 4 would have advantages over other options as it would allow for the retention of the College Gate Apartment Building and the Markievicz leisure centre.

7.7.10.9.3 Overall Conclusions

Overall, however, the results of the multi-disciplinary analysis undertaken has identified Option 0 as the preferred station location. This option is considered to provide the best combination of cost certainty, reduced impact on traffic and utilities during the Construction Phase and will adopt the safest form of construction. This proposed station location also retains a good interchange facility with the Tara Street Dart Station, a key requirement of a metro station at this location. There are however potential for significant environmental effects due to the requirement to remove a number of buildings to facilitate the construction of a proposed station. TII/ will work closely with residents and building users in order to minimise potential impacts. The main procedures to mitigate impacts are as follows:

- The acquisition of property will be undertaken in line with the MetroLink Land Acquisition Strategy (TII, 2022). This strategy outlines the process that will be followed in order to ensure that

- Clear communication channels are opened with property owners to ensure there is a clear understanding of the process;
- Support is provided to property owner to ensure that the process is managed to reduce the burden on property owners and
- Appropriate compensation is agreed with the property owner.

- The MetroLink Land Acquisition Strategy (TII, 2022) also has provision to assist residential property occupiers in ensuring that sufficient time is provided to find alternative accommodation and to assist qualifying tenants with finding alternative accommodation.
- TII will work closely with Dublin City Council to provide an alternative to the Markievicz leisure centre.

7.7.10.10 St Stephen's Green

The EPR identified St Stephen's Green East as the preferred location for a station at St Stephens Green.

Following the identification of St Stephen's Green East as the emerging preferred location for a station a number of studies were undertaken in order to identify the optimal location, design and construction methodology for the proposed station:

- St Stephen's Green Report (Appendix A7.3) presents an analysis of seven potential locations on St Stephen's Green East and Earlsfort Terrace for he proposed station;
- St Stephen's Green Station Study - Alternative Station Location within St Stephens Green East Carriageway (Appendix 7.7) presents an analysis of the potential for a station wholly under St Stephens Green East roadway in order to avoid any direct impacts on St Stephen's Green;
- St Stephen's Green - Mined Options Report (Appendix A7.5) presents an analysis of potential options for a "mined station" under St Stephen's Green park in order to minimise direct impacts on St Stephen's Green;
- St Stephen's Green Station Options Assessment Summary (Appendix A7.8) presents a re-analysis of all options considered for the proposed St Stephen's Green station on St Stephen's Green East.

A summary of each of these assessment is presented here with full details presented in the Appendices.

7.7.10.10.1 St Stephen's Green Report

An analysis was undertaken in order to identify the optimum location for a station at St Stephens Green East having regard to Engineering, Environmental and Economy criteria. This analysis entailed a four stage process as detailed in Appendix A7.3 St Stephen's Green Report and summarised below:

- Stage 1: Review of the receiving environment to identify constraints to the provision of a proposed station location.
- Stage 2: Identification and Description of Potential Station Locations.
- Stage 3: Preliminary Analysis to assess the feasibility of the proposed station locations having regard to the project objectives, Engineering, Economy and Environmental constraints.
- Stage 4: Analysis of short listed options having regard to Economy and Environmental criteria.

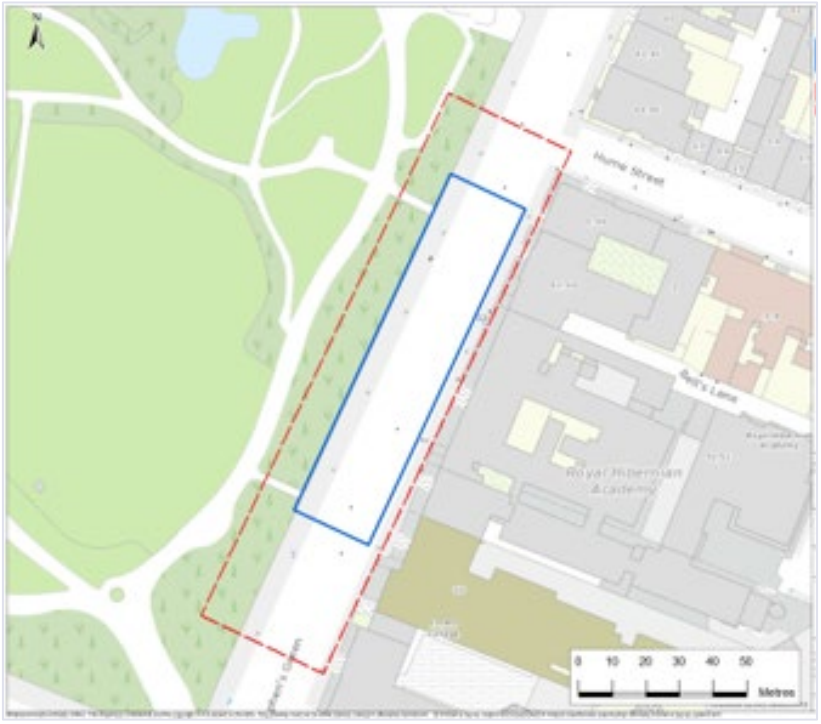
On completion of (Stage 1) the identification of constraints to the proposed station locations, seven potential station locations were identified in Stage 2 on St Stephens Green East and Earlsfort Terrace. These locations were assessed having regard to the following:

- The importance of St Stephen's Green Park as a historical public park which maintains its Victorian layout and features extensive tree, shrub and flower planting that enhance the architectural features of the park. The park is one of the most important green spaces in the centre of Dublin and attracts significant numbers of visitors each year.

- The Architectural Heritage of the area having particular regard to St Stephen's Green Park which is designated as a National Monument (RMP DU018-020334) and is listed on the Dublin City Council Record of Protected Structures (RPS 7751-7761). Furthermore, there are a number of buildings on the east side of St Stephen's Green which may be impacted by potential station locations as they feature extensive cellars that protrude underneath the roadway.
- The importance of St Stephen's Green East as a transport corridor for public transport, private vehicles, cyclists and pedestrians. It should be noted that during the AM peak hour, 384 buses used the corridor to access the City Centre.
- The presence of multiple utilities underneath the roadway on St Stephen's Green East and the requirement for major diversions of those utilities. Particular attention was given to the requirement to divert a 1,800mm brick "ovoid" Victorian sewer under St Stephen's Green East and 1,710mm reinforced plastic mortar ovoid sewer situated underneath Hume Street as diversions of these utilities could extend the construction period by 12 months or more, causing significant additional impacts.
- The requirement for an intervention shaft between the St Stephen's Green Station and Tara Street in the event that the distance between these stations is greater than 1,000m. An intervention shaft is a significant structure that would be required to allow for emergency services to access the tunnel in the event of an emergency. The intervention shaft would need to be located between Tara Street and St Stephen's Green and would cause significant additional impacts if required.

The seven alternative locations identified and assessed in order to identify a preferred station are as follows:

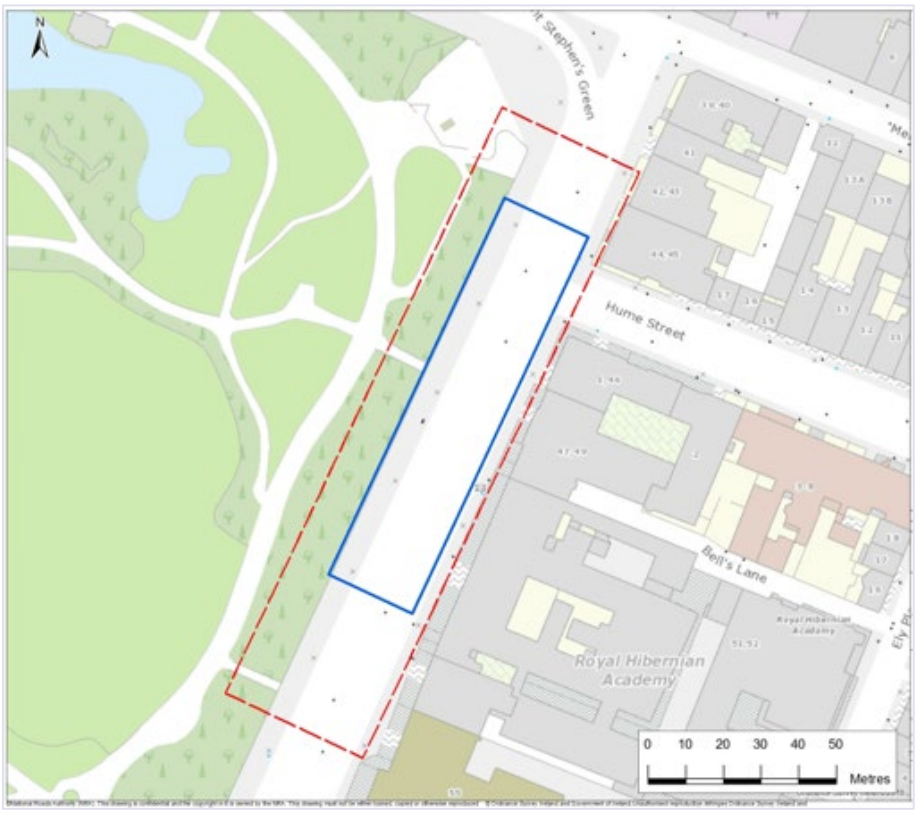
Location 1: Proposed station location within the carriageway of St Stephen's Green East with the western extent of the proposed station in line with the western fence line of St Stephen's Green park.



Location 2: Proposed station location is further west than Location 1 with the western extent of the station box located 17m within the fence line of St Stephen's Green park.

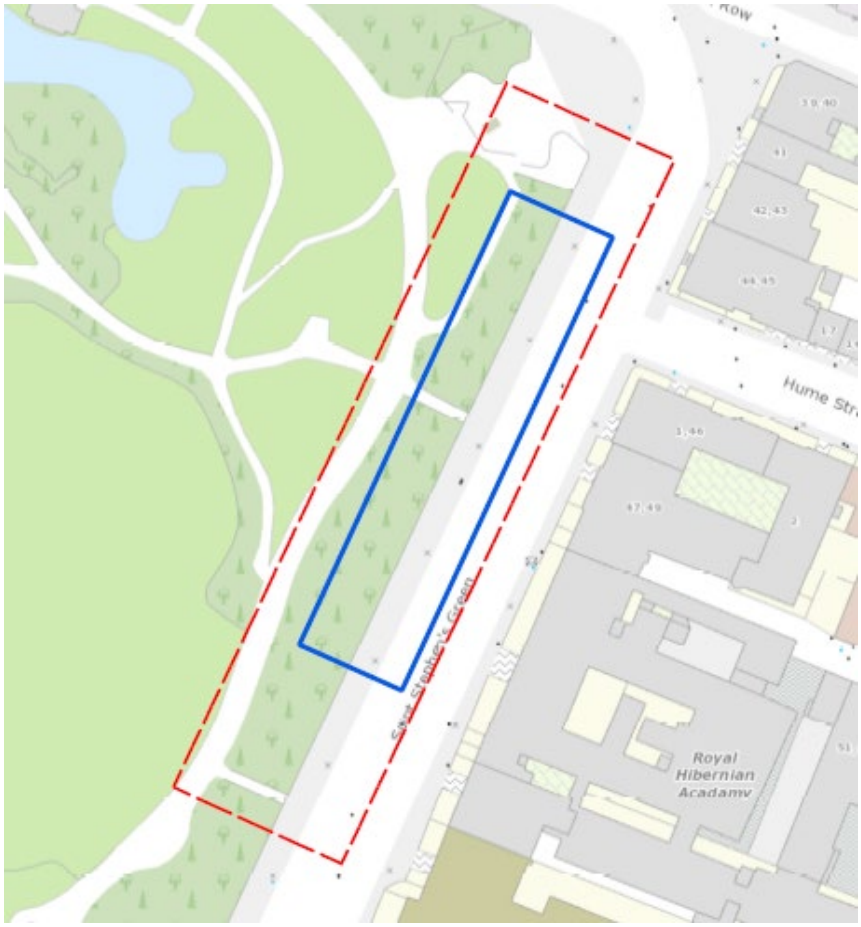
Location 3: Proposed station location at the same north/south alignment as Location 1 and 2 but with the station box entirely within the extent of St Stephen's Green park.

Location 4: **Further north than the proposed station location 1, and within the carriageway of St Stephen's Green East with the western extent of the proposed station in line with the western fence line of St Stephen's Green park.**

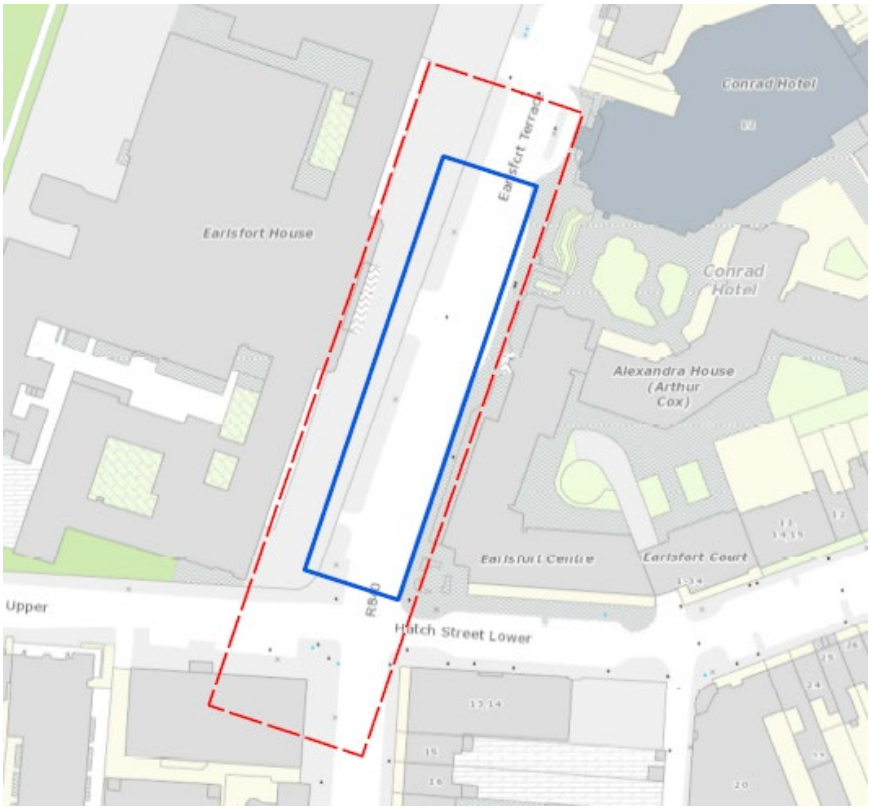


Location 5: Further north than the proposed station location 2 and further west than Location 4 with the western extent of the station box located 17m within the fence line of St Stephen's Green Park.

Location 6: **Further north than the proposed station location 3 and further west than Location 5 with the western extent of the station box located entirely within St Stephen's Green Park.**



Location 7: **Located on Earlsfort Terrace.**



Locations 1 – 3 and 7 would all require an intervention (evacuation) shaft between these station locations and Tara Station for safety reasons due to the fact that there would be more than 1000m between these station location options and Tara Station. However, these station box locations were considered for assessment as they avoided significant impacts on utilities at the junction of St Stephen's Green East and Hume St.

Environmental Assessment:

The environmental assessment was undertaken in 2 stages as outlined above to identify the preferred location for a station at St Stephen's Green East. The environmental assessment was undertaken for feasible station location having regard to all environmental topics, but the principle environmental issues are as follows:

- *Architectural Heritage:* All station locations would impact on St Stephen's Green Park which is a National Monument (DU018-020334-) and on protected structures within the National Monument curtilage including the eastern perimeter fence railings and plinth wall (RPS 7751) and bollards and lampposts (RPS 7752) would be directly impacted. However, station locations with a smaller footprint in St Stephen's Green park would have a less significant impact on the National Monument i.e., Location 1, 4 and 7. Station locations furthest east that require the diversion of the Victorian Sewer (station location 1 and 4) have potential to impact directly on the cellars of a number of buildings listed on the Dublin City Council RPS along the eastern side of the St Stephen's Green road.
- *Utilities and Infrastructure:* St Stephen's Green East and Earlsfort Terrace is a significant route for utilities. Both streets contain a strategically important 1,800mm Victorian sewer along with multiple other utilities. While it would be possible to divert the sewer, it would be a significant engineering project in its own right which would result in a disruption to service during the construction period and would have impacts on traffic during the Construction Phase. Station locations which are located further to the east of St Stephen's Green East would impact on this sewer requiring its diversion and they are Location 3 and 6. In addition, any station location within Earlsfort Terrace would require the diversion of this sewer. The station locations with the largest footprint in St Stephen's Green park would have potential to impact on less of the utilities and would ensure that the Victorian Sewer would not need to be relocated.
- *Traffic and Transport:* Station Location 1 and 4 would have the most significant impact on traffic and transport along St Stephen's Green East during the Construction Phase as the construction of this station would require the closure of all traffic lanes. This would have a significant impact on traffic movements, HGV movements and public transport on this corridor. Station location 2 and 5 would require the closure of one lane resulting in some impacts on traffic movements. However, station location options located fully within St Stephen's Green would result in no impacts on traffic movements during the Construction Phase as there would be no requirement for lane closures associated with these options.
- *Landscape and Visual*: The construction of a station would require the clearing of vegetation and felling of trees within St Stephen's Green. The extent of vegetation clearance and tree removal would be a function of the station footprint and construction area within the park area. Those station location options with the smallest footprint within the green would result in lower numbers of trees being felled. i.e., Location 1, 4 and 7.
- *Property:* Station location options that require an additional intervention shaft i.e., station locations 1,2,3 and 7 would require additional land take at a location between Tara Street and St Stephen's Green for an intervention shaft and associated access roads and other elements.

Overall Conclusions

The Stage 3 assessment identified that options that were fully out of the park (Station locations 1 and 4) were not feasible because they performed poorly against a number of criteria and resulted in the following impacts:

- Diversion of the Victorian sewer and Hume Street sewer and associated impacts resulting from a more extensive construction area and duration;

- The closure of St Stephen's Green East to public transport and traffic during the Construction Phase; and
- Direct impacts on buildings listed on the RPS on St Stephen's Green East.

In addition, station locations further south (Station locations 1, 2,3 &7) were also ruled out as they would have potential for a significant impact on an additional site with associated environmental effects due to the requirement to have an intervention shaft between St Stephen's Green and Tara St.

The Stage 4 assessment comprised a comparative analysis of the station location 5 and station location 6. The preferred station location option (station location 5) was chosen as it significantly reduces the impact on St Stephen's Green Park when compared to options fully within the park (station location 6). This option also allows for traffic and public transport lanes on St Stephen's Green East to remain open during the Construction Phase and removes the need for a prolonged Construction Phase as an intervention shaft or significant utility diversions would not be required. Furthermore, the choice of station location allows for the long-term impacts of the station to be significantly mitigated by replanting trees and other vegetation, in addition to the reinstatement of existing elements of architectural heritage associated with the park i.e., park railings and monuments. In addition, high-quality design of station "pop-ups" would allow for the development of a high-quality urban environment in the north eastern corner of St Stephen's Green. Please refer to Diagram 7.27 for the preferred station location and to Appendix A7.3 St Stephen's Green Report for full details of the analysis undertaken.

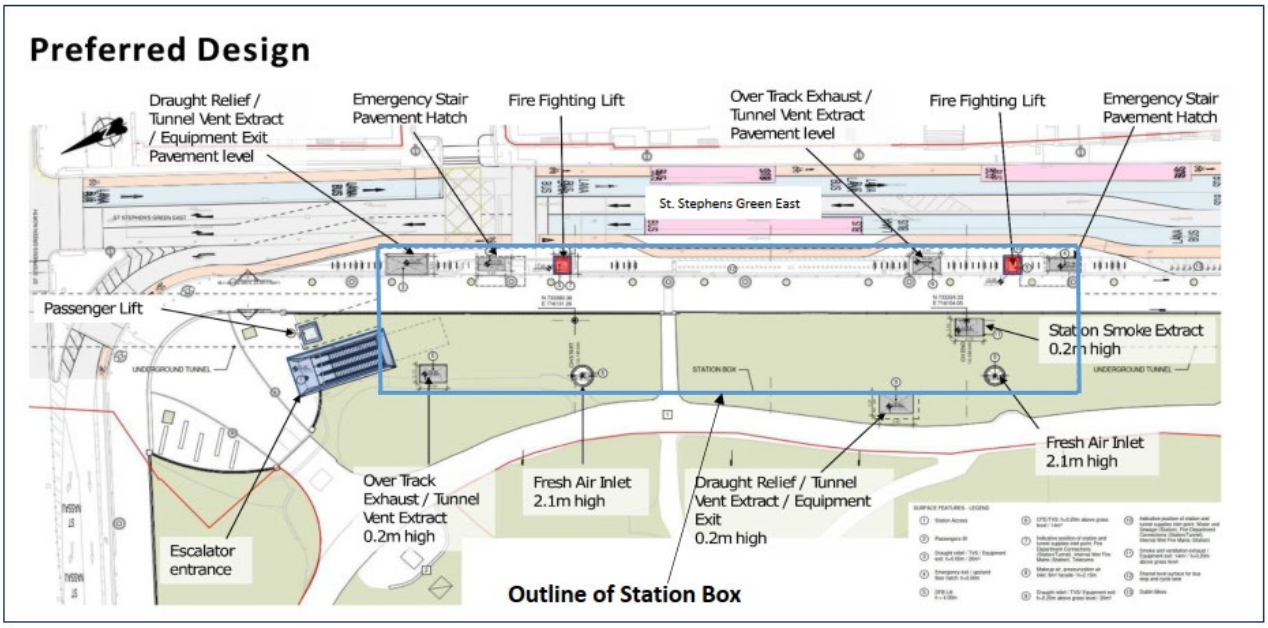


Diagram 7.27: Preferred Station Location on St Stephen's Green East

7.7.10.10.2 St Stephen's Green Station Study: Alternative Station Location within SSG East Carriageway

Following concerns raised by the Office of Public Work and the Department of Culture Heritage and the Gaeltacht (DCHG)) with regard to potential for direct impacts on St Stephen's Green, TII undertook further analysis to identify the feasibility of constructing a station fully located outside of the area of St Stephen's Green park. This analysis was undertaken by way of a comparative analysis between the proposed station location (Station Location 5) and an alternative station location fully within St Stephen's Green East with no footprint in St Stephen's Green park (Option 8). The key findings of this analysis were that Station Location 5 remained the preferred station location for the following reasons:

- A station located entirely outside of St Stephen's Green park would cost 67% more to build than the preferred station location;
- The complexity of the alternative construction methodology and the necessity to carry out extensive utility diversions would increase the overall construction programme of between 15 months and 27 months when compared to the preferred station location;

- The proximity of buildings to the construction area for the option wholly within St Stephen's Green East would make it very likely that these buildings would need to be vacated for much of the construction period. This would not be required for the preferred station location;
- The station location wholly within St Stephen's Green East will require the diversion of a significant number of critical utilities including a major Victorian sewer and a major ESB cable route. This diversion work would result in extensive disruption to services while this work will be undertaken. This disruption would be largely avoided by progressing with the preferred station location;
- The closure of St Stephens Green East and Hume Street during the Construction Phase would require the diversion of traffic, pedestrians and public transport for a number of years. These impacts would be avoided by progressing with the preferred station location;

This piece of analysis confirmed previous findings that Station Location 5 was the preferred station location for the St Stephen's Green station.

7.7.10.10.3 Analysis of Mined Station Option for St Stephen's Green

An additional analysis was undertaken to identify if the proposed station at St Stephen's Green west could be constructed by way of "mining". In order to undertake this analysis four possible mined station solutions were developed based on the following principles:

- Main station entrance design was required to align with the current design;
- All physical infrastructure (vents/extraction fans etc) are to be located outside the St. Stephen's Green Park fence line;
- The main footprint of the station box is to be as per current design i.e., predominantly located beneath the Park along the centreline of the current alignment;
- The current station box would have to be significantly redesigned to take account of the various mined options available; and
- Minimum traffic lanes to be maintained on St. Stephen's Green East are a single bus and a single car lane northbound, cycle lane northbound, single bus lane southbound, single cycle lane southbound. Left turn on to St. Stephen's Green North to be maintained.

The options assessment was undertaken in four stages as follows:

- **Stage 1:** Review of the receiving environment to identify constraints to the provision of a proposed station;
- **Stage 2:** Identify and describe additional mined station location options that minimise impact on St. Stephen's Green Park;
- **Stage 3:** Preliminary analysis to assess the feasibility of the proposed new options having regard to the Project Objectives, Engineering, Economy and Environmental criteria; and
- **Stage 4:** Multi Criteria Analysis (MCA): Comparative analysis of the short-listed options to the current Preliminary Design, using more detailed assessment criteria.

The Options developed in Stage 1 and 2 and assessed at Stage 3 and 4 are outlined in Diagram 7.28.

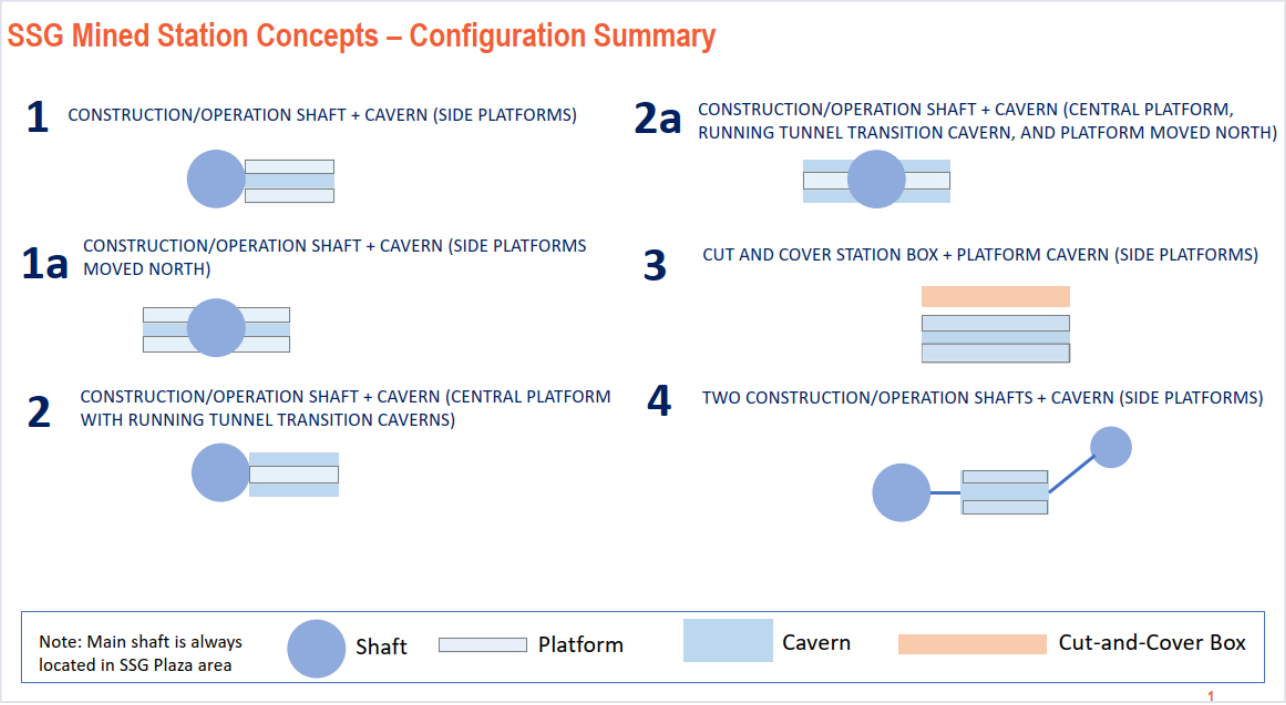


Diagram 7.28 Mined Station Concepts

Option 1, Construction / Operation Shaft + Cavern (side platforms): The entrance to the station is located within the footpath of St. Stephen's Green North. This connects to the main access shaft located in the park entrance plaza at the north east corner of St Stephen's Green. The entrance in turn leads to the platform concourse (located in the mined platform cavern) via three tiers of escalators and a passenger lift from which access is then provided via lifts and escalators down to the station platforms. Two access/egress intervention shafts and two dedicated Dublin Fire Brigade lifts are located along St. Stephen's Green East with a ventilation shaft with grilles also serving the southern end of the station. All are located outside of the St. Stephen's Green Park fence line. There are a further two ventilation grilles provided at the top of the main access shaft in the Plaza area to serve the northern end of the station. (Refer to Diagram 7.29)

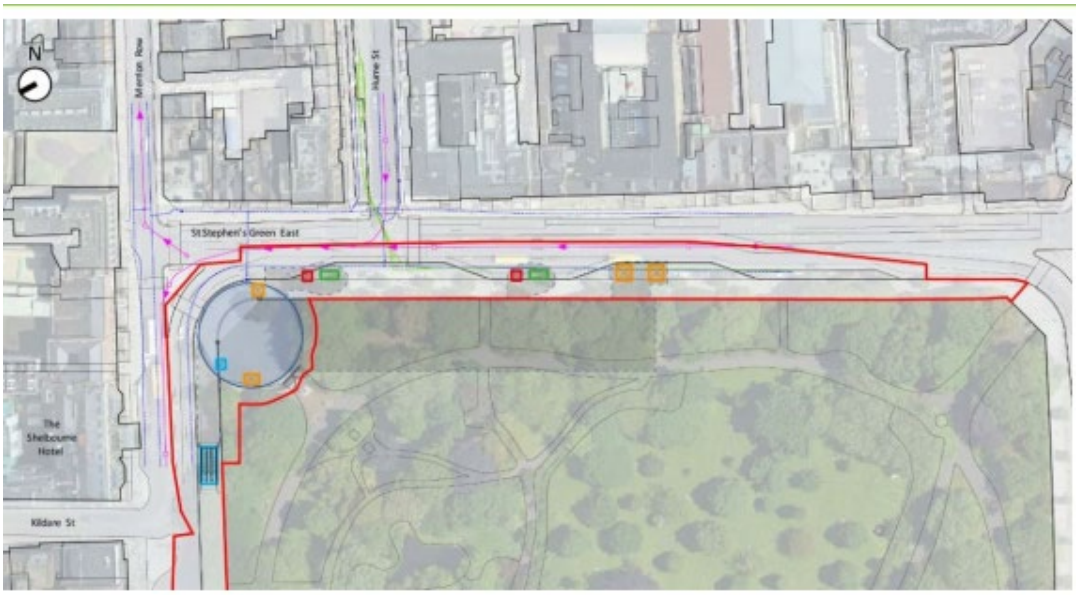


Diagram 7.29 Mined Option 1

Option 1a, Construction / Operation Shaft + Cavern (side platforms with platforms moved north): The same as Option 1 except that the platform cavern has been moved north so that the main access shaft is

located in the centre of the station platform, with only one emergency access/egress and dedicated Dublin Fire Brigade lift is now provided on St. Stephen's Green East. The ventilation shaft serving the south end of the platform also remains on St. Stephen's Green East. The other emergency access/egress and dedicated Dublin Fire Brigade lift is now provided in the main access shaft and a ventilation shaft for the northern end of the station is provided north of St. Stephen's Green North in a built-up area. (Refer to Diagram 7.30)

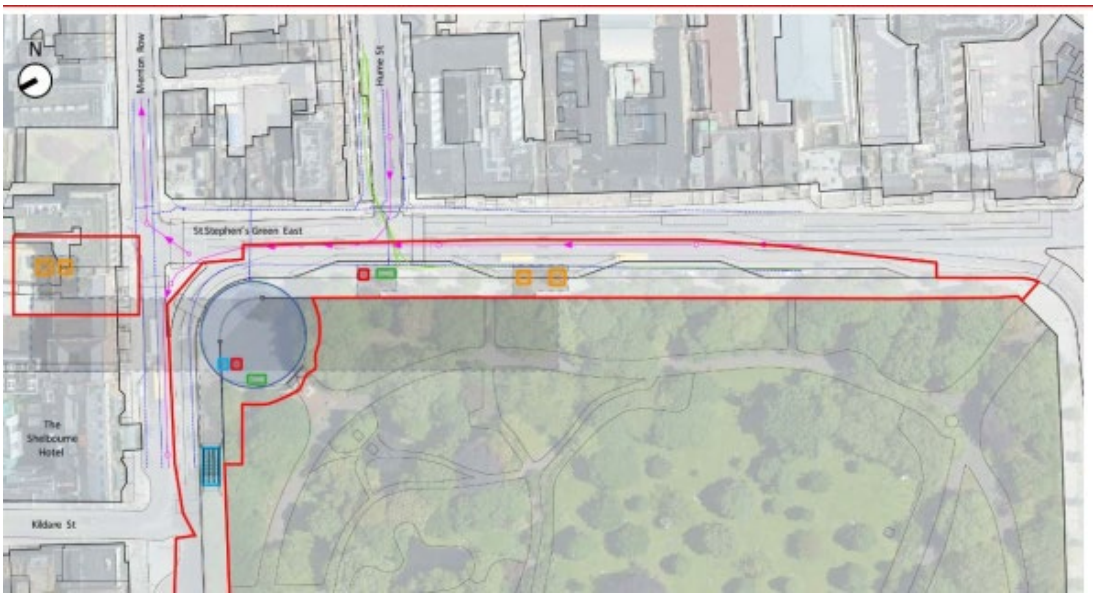


Diagram 7.30 Mined Option 1a

Option 2, Construction / Operation Shaft + Cavern (central platform with running tunnel transition caverns): The entrance to the station, route to platform concourse level and the provision of emergency access/egress intervention shafts, dedicated Dublin Fire Brigade lifts, and a ventilation shaft at the south end of the station along St. Stephen's Green East, with ventilation grilles positioned at the top of the main access shaft are the same as Option 1. With escalators and lifts leading from the platform concourse to an island platform which is located between the tracks. The use of an island platform would require an enlarged tunnel (165m and 178m long north and south of the station respectively) to be constructed to allow the track to align correctly to serve the island platform. (Refer to Diagram 7.31)

Diagram 7.31 Mined Option 2

Option 2a, Construction / Operation Shaft + Cavern (central platform, running tunnel transition cavern, and platform moved north): The same as Option 2 except that the platform cavern has been moved north so that the main access shaft is located in the centre of the station platform, a ventilation shaft, emergency access/egress and a dedicated Dublin Fire Brigade lift remains on St. Stephen's Green

East to serve the southern end of the station; and emergency access/egress and a dedicated Dublin Fire Brigade lift are now located on the north side of St. Stephen's Green North, with a ventilation shaft now provided in the built-up area north of St. Stephen's Green North to serve the northern end of the station. (Refer to Diagram 7.32)

Diagram 7.32 Mined Option 2a

Option 3, Cut and Cover Station Box + Platform Cavern (side platforms): The aim of this option was to place every piece of station surface infrastructure outside of the St. Stephen Green Park fence line. It comprises a narrow box located on St. Stephen's Green East that provides an entrance to the station in the St. Stephen's Green East footpath down to platform concourse level from which passengers then travel across via a single passageway connection to the station platform cavern concourse before descending to the platforms via lifts and escalators. Emergency access/egress, dedicated Dublin Fire Brigade lifts and station ventilation are all contained within St. Stephen's Green East outside of the Park's fence line, providing access and ventilation to the north and south ends of the station. (Refer to Diagram 7.33)

Diagram 7.33 Mined Option 3

Option 4, Two Construction / Operation Shafts + Cavern (side platforms): Option 4 was derived as a 'pure' mined option, with two station entrances located north and south of the station, one in the north-east entrance Plaza area of St. Stephen's Green Park, and one on land (currently built upon) bounded by Earlsfort Terrace and Lesson Street Lower. Access at these two entrances is via escalators and lifts that connect to passageways (mined tunnels) leading to the station platforms. Emergency access/egress, dedicated Dublin Fire Brigade access and station ventilation is provided via the two main access shafts for the north and south ends of the station. (Refer to Diagram 7.34)

Diagram 7.34 Mined Option 4

Stage 3 Preliminary Assessment

The preliminary analysis comprises a qualitative assessment of potential station locations based on a set of criteria:

- Meeting the project objectives,
- Environment: Minimising the potential for environmental impact;
- Engineering: Ensuring the proposal is constructable and
- Economy: Considering the cost, programme to completion and risk;

Diagram 7.35 outlines the outcome of the analysis. **Option 1** was considered to provide an acceptable and functional design solution with good constructability confidence. It does however also have considerable environmental impact during construction in terms of the need for 24-hour tunnel construction and the risk of generating noise and ground borne noise and vibration that has the potential to impact hotels and residents at this location. It was identified that this option should be taken forward to the Stage 4 analysis.

Option 1a – The moving of the platforms north generates greater risk and impact to overlying property and needs to be considered against any benefit resulting from having the opportunity to mine the platform cavern north and south simultaneously from the main construction shaft. It was identified that this option should not be taken forward to the Stage 4 analysis.

Option 2 - Island platform configuration is a significant departure from the Metrolink design concept and would be the only station on the alignment configured this way. Combined with the need for extensive mined cavern running tunnel transitions at the north and south of the station, this option is likely to have significant cost and programme implications with an increased construction risk profile. It was identified that this option should not be taken forward to the Stage 4 analysis.

Option 2a - This option presents the same disbenefits as Option 2, plus moving of the platforms north generates greater risk and impact to overlying property and outweighs any benefit resulting from having the opportunity to mine the platform cavern and running tunnel transitions north and south simultaneously from the main construction shaft. It was identified that this option should not be taken forward to the Stage 4 analysis.

Option 3 - Extremely constrained construction access (c.6m clear space between diaphragm walls) and the necessary sequential working to construct the box will import significant programme challenges and possibly place the Station on the critical path of the construction programme. It will also likely be the most expensive option and presents significant passenger experience/wayfinding challenges. It was identified however that this option should be more refined and taken forward to the Stage 4 analysis.

Option 4 - The architectural concept and passenger experience is considered to be poor and is a radical change from the overarching architectural vison for MetroLink. In addition, there is a need to acquire property to construct the southern access. The Station would however provide two entrances north and The Station would however provide two entrances north and south and the opportunity for over site development (OSD) at the southern entrance. It was identified that this option should not be taken forward to the Stage 4 analysis.

	Option 1	Option 1a	Option 2	Option 2a	Option 3	Option 4
Project Objectives						
Environment						
Engineering						
Economy						
Overall Ranking						

Diagram 7.35 Outcomes of Stage 3 Preliminary Analysis

Stage 4 Multi-criteria Analysis

Stage 4 involved taking the locations which remained following the Stage 3 Preliminary Assessment and subjecting them to a more detailed MCA comparative analysis to identify the preferred station location option. This evaluation also included an assessment of the performance of the current Design (Option 0) against the mined station options brought forward to Stage 4. Refer to Diagram 7.36 for details of the options considered for Stage 4.

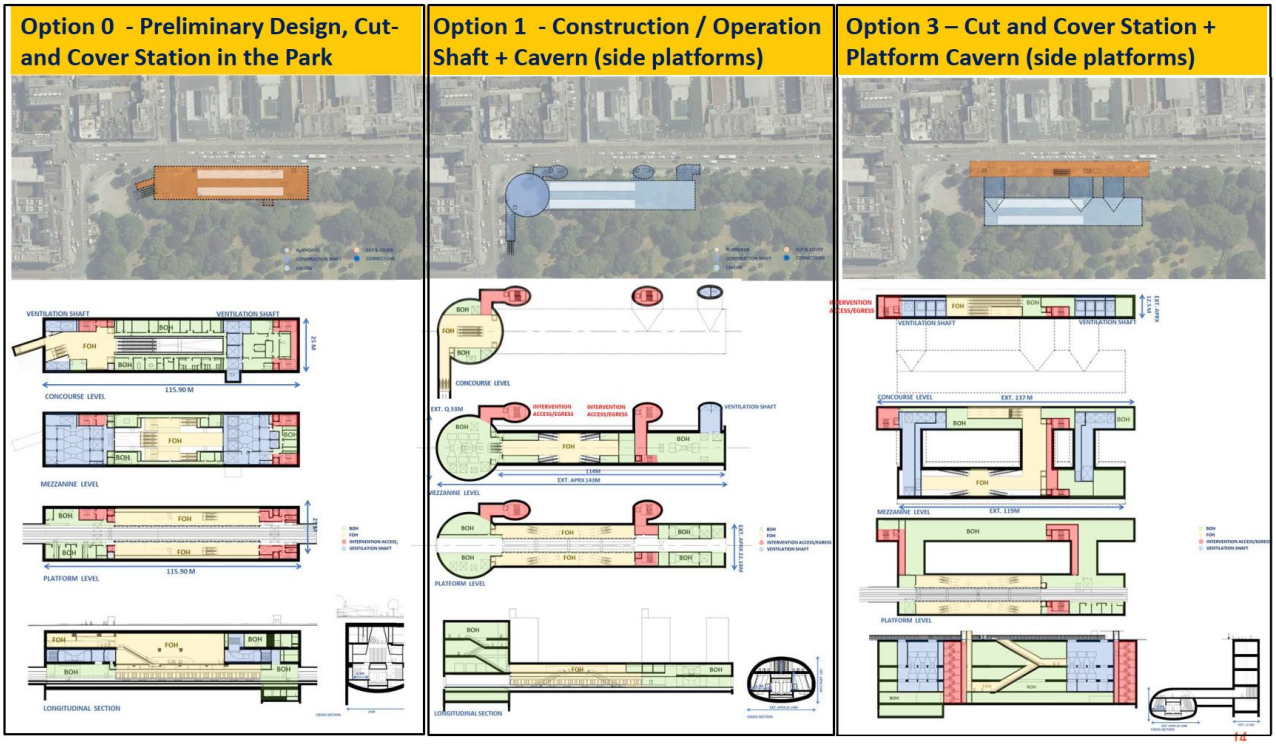


Diagram 7.36 St Stephen's Green Options 0,1 and 3

MCA analysis was undertaken to complete the Stage 4 MCA. The evaluation was also divided between construction and operation to provide further clarity in understanding the performance of the mined

options and the current Preliminary Design. Project Objectives, Environment, Engineering and Economy have a different number of sub criteria, thereby in effect introducing weighting:

- Project Objectives: 8 No. criteria
- Environment: 11 No. criteria
- Engineering: 6 No. criteria
- Economy: 3 No. criteria

Construction Phase Summary			
Criteria	Option 0	Option 1	Option 3
Project Objectives			
Environment			
Engineering			
Economy			

Diagram 7.37 Stage 4 MCA Construction Phase Results

Operational Phase Summary			
Criteria	Option 0	Option 1	Option 3
Project Objectives			
Environment			
Engineering			
Economy			

Diagram 7.38 Stage 4 MCA Operational Phase Analysis

Diagram 7.37 and Diagram 7.38 summarise the results of the Stage 4 MCA evaluation from which the following conclusions can be drawn:

As a result of ground borne noise and vibration limits constraining mined tunnel construction to 12-hour/dayshift working due to the potential night-time impacts on residents, including the Shelborne Hotel (Option 1) and Loretto College (Option 3), this generates a significant and unacceptable programme impact, increasing the programme for Option 1 by 2 years compared to Option 0 and Option 3 by approximately 4 years compared to the preliminary design.

The Project Objectives show that neither of the mined options (1 and 3) can provide a high-quality operational station that achieves the MetroLink architectural vision. In contrast, Option 0, the current Preliminary Design, provides for a high-quality station achieving the aforementioned very effectively, providing a predominance of horizontal straight routes for passengers, compared to the mined options that have an estimated 150% plus increase in walking times from surface to platform, accompanied by a significantly poorer passenger experience.

With regards to the Public Realm during construction, Option 0 significantly impacts St. Stephen's Green Park as well as the St. Stephen's Green East footpath, but it does maintain three traffic and two cycle lanes along St. Stephen's Green East. Option 1 impacts the Plaza area, reduces St. Stephen's Green East to two traffic lanes and a single cycle lane, and impacts St. Stephen's Green North footpath, and therefore both Option 0 and 1 are assessed to offer some disadvantages compared to Option 3, which impacts St. Stephen's Green East traffic the same as Option 1, requires construction within the St. Stephen's Green East footpath but does not infringe on St. Stephen's Green Park.

Option 0 requires significantly less permanent surface land take overall at 3050m^2, compared to Option 1 - 4050m^2 (+33%), and Option 3 - 5100m^2 (+67%). However, when considering the permanent land take

just within the St. Stephen's Green Park fence line, Option 0 performs the worst, although with only a small area (an estimated 196m^2) being required, versus 40m^2 for Option 1, and 0m^2 for Option 3.

Environmentally, Option 0 has been assessed to perform the worst of the three options, both during the construction and Operational Phases as a result of the station being partially located in St. Stephen's Green Park, scoring poorly with regards to 'Property Impact on SSG Park', 'Biodiversity', 'Landscape and Visual', 'Archaeology/Cultural Heritage', and 'Architectural Heritage'. This is in contrast to Option 3 where the station is located wholly outside of St. Stephen's Green Park, and Option 1 that has its construction shaft / permanent passenger vertical access located in the entrance Plaza of St. Stephen's Green.

However, Option 0 does present some advantages environmentally given it will maintain three traffic lanes and two cycle lanes during the construction (Options 1 and 3 are reduced to two traffic lanes and a single cycle lane), groundwater impacts are better controlled and minimised as a result of employing diaphragm wall construction rather than open face mining techniques, and the carbon footprint of the station is significantly less than Option 1 and Option 3. In the Operational Phase, being a shallower station with a better internal functional layout means less and shorter escalators, reduced power consumption and reduced ventilation requirements, as well as providing a much better environmentally integrated station entrance, compared to Options 1 and 3 which have entrances located in St. Stephen's Green North and East footpaths respectively where pedestrian congestion is likely.

Overall, Option 0 the current preliminary design option is the preferred option as it allows for a significantly reduced Construction Phase with all the impacts that will have when compared to the mined options. In addition, the preliminary design option offers a higher quality station both in terms of the architectural design and the passenger experience. Please refer to Appendix A7.5 St Stephen's Green – Mined Options Report for full details of the analysis undertaken.

7.7.10.10.4 St Stephen's Green Station Summary Options Assessment

Appendix A7.8 St Stephen's Green Station Options Assessment Summary outlines a re-analysis of all options considered for a station location at St Stephen's Green East. This assessment was undertaken in order to compare all options previously identified and assessed as discussed in Sections 7.7.10.10.1,7.7.10.10.3 and 7.7.10.10.2 and to provide an update on two further options that were developed during the design development process. A comparative analysis was undertaken of all 16 options developed having regard to the following:

- The potential impacts on St Stephen's Green Park including station footprint required within the park;
- The potential impacts on St Stephen's Green East roadway, public transport corridor and footpaths;
- The access to the station and useability for all passengers including those with mobility issues;
- The potential impacts on major utilities at St Stephen's Green East;
- The potential construction programme and associated costs to construct;
- The potential Construction Phase impacts on sensitive receptors surrounding the station and
- The achievement of an architectural vision for the St Stephen's Green Station having regard to the sensitivity of the surrounding environment.

The re-analysis confirmed that Station Location 5 (Option 0) was the preferred option for a station location on St Stephen's Green East for the following reasons:

(1) Station Location 5 can be constructed in 8.5 years which is the shortest construction period achievable for any of the options assessed;
(2) Station Location 5 presents a lower construction cost and more cost certainty when compared to options that would require an intervention shaft and/or the diversion of major utilities;
(3) The preferred station location would allow the critical transport corridor on St Stephen's Green east to remain operational during the full duration of the Construction Phase. This compares favourably to other options entirely within St Stephen's Green east which result in significant disruption to traffic, public transport and pedestrian movements over a number of years;

(4) The preferred station location can be designed to ensure a high quality environment for all passengers, with excellent way-finding including for those with mobility and visual impairment. This is not achievable for a number of options, particularly the mined station options where the passenger experience would be reduced due to design constraints caused by the construction methodology;
(5) The construction of the preferred station location will remove the construction site further from the population using buildings on St Stephen's Green East and St Stephen's Green North which include a number of hotels, a school and office buildings. This will have the benefit of reducing potential effects on these sensitive receptors during the Construction Phase such as those caused by noise and vibration and dust;
(6) The preferred station location will have an impact on approximately 5% of the area of St Stephen's Green during the Construction Phase, however once the station is constructed, with the reinstatement of all railings, monuments, street furniture and paving stones, only 0.21% of the park area will be directly impacted.

7.7.10.11 Charlemont

The EPR placed the proposed Charlemont Station underground to the south of the Grand Canal in an area where a new development has received approval (DCC Planning ref: 2373/17 & An Bord Pleanála appeal ref: 300873-18) and is progressing through construction. The public consultation on the EPR in 2018 identified several concerns regarding the location and impact on adjacent properties. Key among these were potential impacts on adjacent Dartmouth Terrace and Dartmouth Square West, potential impacts on the proposed office development proposals for the site and the impacts of the proposed Projects operation on the existing Luas Green Line as discussed in Section 7.7.7.

Design development in advance of the publication of the preferred route identified changes to the Charlemont station design. The tunnel section was lowered to ensure it passed safely beneath the Grand Canal and the 3.6m diameter, Grand Canal Drainage tunnel. The station's overall dimensions were altered to minimise construction impacts the lane to the rear of Dartmouth Square West properties and integrate with the 2 Grand Parade development (DCC Planning Ref 4755/19 and An Bord Pleanála Appeal Ref 4755/19) currently under construction. The revised station design also removed the need to acquire and demolish properties on Dartmouth Road and Northbrook Road

The station box layout has also been further developed to retain the ability to construct the full station box and internal fit-out in close proximity to the office development (currently in construction) overhead. The developer of the oversite development has carried out some advanced station box works on TII's behalf to ensure a station can be safely constructed at a later date. A multi-disciplinary analysis was undertaken to identify the preferred option for a station at Charlemont.

7.7.10.11.1 Environmental Assessment

An environmental assessment was undertaken to identify the preferred location for a station at Charlemont by comparing the potential impacts of the proposed EPR station location and design with the modified station box design that was further developed as described above. The environmental assessment was undertaken to identify the preferred station location having regard to all environmental topics, but the principle environmental issues are as follows:

- *Property:* The EPR option required the demolition of a number of residential properties on Dartmouth Road and Northbrook Road in addition to the railway embankment along Northbrook Avenue in close proximity to a number of residential properties. The PR option avoided these potential impacts. In addition, the PR option integrates the station box with foundations of the Carroll's Building redevelopment project, thereby reducing potential for impacts on the proposed future commercial property impacts. Furthermore, the station box footprint has been amended to avoid direct impacts on property on Dartmouth Square West and any permanent impacts on the laneway to the west of the Dartmouth Square West properties.
- *Noise & Vibration:* The PR option will have potential for groundborne noise and vibration impacts due to the advancement of the TBM through the station block and south towards termination

point. However, when compared to the EPR option there are reduced impacts arising due to the reduced requirement for demolition works

- *Air Quality:* Potential for air quality impacts due to dust and emissions during construction remain. Potential impacts due to construction work, excavations, soil movement, demolition in close proximity to residential and sensitive buildings would occur in the absence of sufficient mitigation measures.
- *Architectural Heritage:* The PR option has potential for indirect impacts on Dartmouth Architectural Conservation Area (ACA) with a number of buildings listed on the Record of Protected Structures (RPS) directly impacted during the Construction Phase. However, the station box has been designed to reduce the potential for direct impacts on these properties with no properties requiring demolition at this location. The PR option station is located behind Carroll's Buildings, a designated RPS on Grand Parade (a protected structure RPS Ref. 3280) but the PR design has been modified to integrate into the proposed design at this site, thereby reducing the potential for an impact on this site.

7.7.10.11.2 Overall Conclusions

The tunnel re-alignment at Charlemont has ensured that the strategically important sewer which is considered a critical piece of drainage infrastructure in Dublin City will be avoided. The design change results in a lowering of the rail level and a consequently deeper Charlemont Station. The station box size and placement has also been adjusted to:

- Avoid the need to demolish a number of residential buildings to the south of Dartmouth Road;
- Minimise the impact on the private gardens of houses along Dartmouth Square west and permanent impacts on the laneway at the rear of these properties;
- Minimise permanent impacts on Dartmouth Road to the south and to minimise impact on Grand Parade.

In light of the decision not to include a tie into and upgrade of the Luas Green Line to metro standard as part of the MetroLink Project, design development identified the need to provide a train turnback facility at immediately south of Charlemont Station.

To facilitate this and any potential future connection to the Green Line the tunnel was extended a further 360m south of the station. The required turn back facilitates will be housed within the tunnel bore. A intervention tunnel is also provided for emergency services use. Refer to Charlemont Shafts Options Report in Appendix A7.4 for further details.

7.7.10.11.3 Charlemont Connection to Charlemont Luas Stop

In order to ensure that there is an efficient connection between the proposed Charlemont Station and the existing Charlemont Luas stop an analysis of alternatives was undertaken to identify the preferred method of connection having regard to the following constraints:

- The different levels from the MetroLink Station (below ground) to the Luas stop (on an elevated embankment/bridge over the Grand canal);
- The Carroll's Building, a protected structure (RPS Ref.:3280);
- The Grand Canal;
- Grand Parade as an important transport route.

The alternatives analysis considered the following options for accessing the Luas Charlemont stop:

- Option 1: Stairs in front of Carroll's Building at South East of Luas Station & one new lift;
- Option 2: Pedestrian Crossing of Grand Parade, Deck along canal edge and stairs to Luas from platform;
- Option 3: Elevated Walkway in front of Carroll's Building & one new lift;
- Option 3a: Elevated Walkway in front of Carroll's Building at a lower level & one new lift;

Option 1 was the preferred Option as it reduced the potential for a setting impact on the Carroll's Building (when compared to Option 2);

7.7.11 Intervention Shaft/tunnel Locations

Intervention shafts and/or tunnels are required for ventilation during normal operation, and for evacuation in an emergency situation. In most locations, these facilities have been incorporated into the station designs, as the tunnel lengths between stations are sufficiently short (<1km) that this is appropriate. However, separate shafts or tunnels are required in the following locations:

- South of the Dublin airport station;
- Between Collins Avenue and Griffith Park stations; and
- At the southern termination of the tunnel, south of Charlemont station.

In terms of the identification of the required intervention shafts/tunnels at Dublin Airport, there were no alternative options considered because the choice of the intervention shafts was dictated by (a) Ensuring the shortest route possible for the shafts and (b) ensuring that the end point of the evacuation tunnels was located at a safe location outside of the Dublin Airport airfield. This meant that each shaft was provided as parallel tunnels to the main tunnel with the end points located at the tunnel portal locations. Refer to Figure 4.1 Overview of MetroLink Alignment.

A multi-disciplinary analysis was undertaken to identify the preferred option for intervention shafts/tunnels at the following locations:

- Between Collins Avenue and Griffith Park stations; and
- At the southern termination of the tunnel, south of Charlemont station.

7.7.11.1 Albert College Park Intervention Shaft

There is greater than 1000m between the proposed Collins Avenue and Griffith Park Stations and as a result, an intervention shaft is required between these two locations. The function of the intervention shaft is for intervention by emergency services, escape by passengers, and ventilation for smoke control during an incident and comfort in normal operations.

In determining the location for the tunnel intervention shaft at Albert College Park, possible locations for an intervention shaft within a 1000m radius of Collins Avenue Station and Griffith Park Stations were required. Figure 1 shows the area between Collins Avenue Station and Griffith Park Station. The maximum distance of 1000m has been drawn from both stations with the shaded area in red hatching showing where an intervention shaft should be located to ensure there is less than 1000m between the shaft and the emergency exits at both Collins Avenue and Griffith Park Station.

The location of an intervention shaft needs to be in close proximity to the alignment in order to avoid the requirement for an elongated intervention tunnel. Diagram 7.39 identifies the limited area within which it is possible to locate an intervention shaft at this location. The location assessment gave consideration to a number of factors including environmental impact, constructability, distance from the main tunnel and suitable road access. The intervention shaft should be no more than 1000m from either Collins Avenue or Griffith Park Stations. As a result, the intervention shaft must be situated either immediately north of Hampstead Avenue in the south-west corner of Albert College Park; or within the residential area immediately south of Hampstead Avenue;

Diagram 7.39 Potential Intervention Shaft Locations

7.7.11.1.1 Environmental Assessment

An environmental assessment was undertaken to identify the preferred location for an intervention shaft station at Charlemont. The environmental assessment was undertaken to identify the preferred station location having regard to all environmental topics, but the principle environmental considerations were as follows:

- ***Property:*** The location of an intervention shaft within Albert College Park avoids the requirement for a direct impact on private property and/or the demolition of any property;
- ***Population and Land Use:*** The location of the proposed intervention shaft in Albert College Park has potential to cause an impact on the amenity function of Albert College Park during the Construction Phase. However, the playing pitches and pathways will be reinstated following the Construction Phase;
- ***Landscape & Visual:*** The location of an intervention shaft within Albert College Park would result in an impact on the Landscape and Visual amenity during the Construction Phase. However, with replanting and landscaping the landscape and visual impacts could be mitigated following the Construction Phase.
- ***Biodiversity:*** The location of an intervention shaft within Albert College Park would result in an impact on the biodiversity during the Construction Phase. However, with replanting would mitigate any permanent impacts following the Construction Phase.

7.7.11.1.2 Overall Conclusions

The assessment of a suitable location for the required intervention shaft to minimise construction and operational impacts has resulted in this Intervention Shaft being placed in the south-west corner of Albert College Park for the following reasons:

- The Intervention shaft is no more than 1000m from either Collins Avenue or Griffith Park Stations;
- The intervention shaft is adjacent to the tunnel on the west side of the park in order to reduce the length of connecting tunnel;
- The park area is the only "open space" on the MetroLink route between the two stations and as a result the location of the intervention shaft here avoids the requirement for any demolitions; and
- The tunnel intervention shaft can be accessed easily by emergency vehicles and there is enough area for safely congregating passengers in an emergency.

The public consultation report for the Albert College Park Intervention Shaft can be reviewed in full on the www.metrolink.ie website.

7.7.11.2 Charlemont Turnback

In light of the decision not to include a tie into and upgrade of the Luas Green Line to metro standard as part of the MetroLink Project, design development identified the need to provide a train turnback facility at immediately south of Charlemont Station.

To facilitate this a further section of tunnel was required further south of the station. The required turn back facilitates will be housed within the tunnel bore. A new escape tunnel/intervention tunnel shaft is also provided for emergency services use.

Five different tunnel extension option types were considered, each having a number of different intervention shaft options as follows;

- Type A: Tunnel termination at turnback end and an Intervention Shaft to the surface constructed
- Type B: Tunnel termination just south of turnback (or at Turnback end) and a parallel tunnel (gallery) constructed back to Charlemont Station
- Type C: Tunnel termination south of turnback and an intervention shaft constructed
- Type D: Tunnel termination at station box with mined cavern for the turnback and parallel tunnel (gallery)

7.7.11.2.1 Type A: TBM buried at Turnback End and an Intervention Shaft to the surface constructed

Tunnel Extension A, identified five different intervention options as detailed in Diagram 7.40 which are as follows:

- Option 1: Distance from shaft to main tunnel 50 m;
- Option 2: Distance from shaft to main tunnel 2-5m;
- Option 3: Distance from shaft to main tunnel 13m;
- Option 4: Distance from shaft to main tunnel 110m; and
- Option 5: Distance from shaft to main tunnel 170m

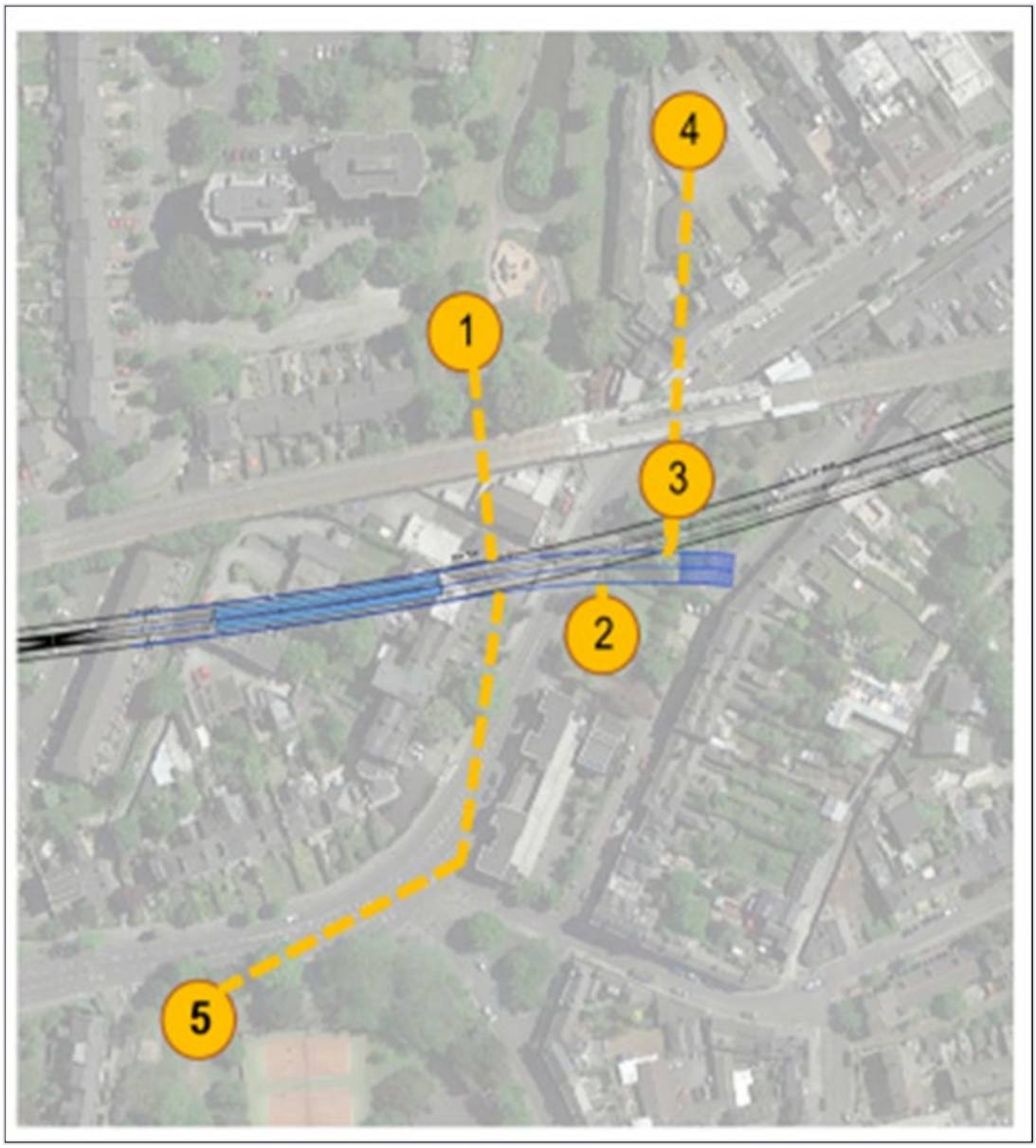


Diagram 7.40 Type A Shaft Options

7.7.11.2.2 Type B, C and D

For tunnel extensions types B,C and D, a number of different intervention options were identified as shown in Diagram 7.41 as follows:

- Option 6: The tunnel termination is at the end of the turnback, and an intervention shaft is proposed to the west side of Ranelagh Road close to the end of the turnback;
- Intervention Option 7 involves the construction of an evacuation tunnel which runs from the tunnel termination point back to the station box. The evacuation tunnel connects to the station box at mezzanine level to allow staff and emergency personnel to exit the incident via the station. This option has the advantage of not requiring the construction of an intervention shaft;
- Option 8 consists of a shorter mined cavern containing 4 parallel turnback tracks and a walled off escape route back to the station; and
- Option 9 and its sub options (A and B) is where the tunnel is extended south of the turnback section, and an intervention shaft provided at its termination.

Diagram 7.41 Options 6,7,8 and 9

An MCA was undertaken of all of the options, to determine the preferred option based on an analysis of Economy, safety, Integration, Engineering and Environment. Appendix A7.4 contains a detailed options assessment report.

7.7.11.2.3 Environmental Assessment

An environmental assessment was undertaken to identify the preferred location for an Intervention tunnel south of Charlemont. The environmental assessment was undertaken to identify the preferred option having regard to all environmental topics, but the principle environmental considerations were as follows:

- *Property:* Options with an intervention shaft (Options 1-6 and 9) would require an entrance/exit for the shaft to be constructed at ground level. There are limited available locations for the construction of these intervention shafts due to the urban nature of the area. Locations were identified that did not require the demolition of property, but there were potential impacts on private and public property at all locations due to the land take required for the entrance/exist infrastructure. The options with an intervention tunnel (Options 7 and 8) would not result in any direct impacts on property as they would allow for evacuation along the proposed tunnel back to Charlemont station and therefore would not require any additional land take at ground level.
- *Noise & Vibration:* All options would result in the generation of noise & vibration during the Construction Phase. Options 1-6 and 9, that require surface works in the vicinity of sensitive receptors would result in the most significant potential for noise impacts. Options 1 and 4 have an intervention shaft coming to the surface in noise sensitive locations such as in Ranelagh Park which is a designated quiet zone. It should be noted that the tunnel (gallery) options would also result in noise and vibration generation during the Construction Phase, but these impacts would result in groundborne noise, rather than airborne noise.
- *Waste and Resources:* The options with the longest length of tunnel will generate the highest quantity of spoil during the Construction Phase.
- *Landscape & Visual:* Options 1-6 and 9, that require the construction of entrance and exist locations at ground level will have a more significant impact on the landscape and visual amenity than the tunnelled (gallery) options that come back to the surface level within Charlemont station.
- *Biodiversity:* Options 1-6 and 9, that require the construction of entrance and exit locations at ground level will have a more significant impact on existing biodiversity as they will require the felling of trees. The tunnelled (gallery) options that come back to the surface level within Charlemont station will not require the removal of any vegetation beyond the extent of the existing Charlemont station.

Overall, the options 7 and 8 with an intervention tunnel (gallery) are preferred from an environmental perspective as they have much less potential for impacts at ground level when compared to those that require an intervention shaft (Options 1-6 and 9). Option 7 and 8 would have much less direct impact on property requiring no additional land to build beyond the extent of the station. The fact that options 7 and 8 have no impact at surface level means that there would be no impacts beyond the station

location, and that there would be no additional impacts on biodiversity or landscape. They would also have reduced airborne N&V during the Construction Phase but have potential for groundborne noise and vibration impacts during this period. Option 7 is preferred over Option 8 as it removes the requirement for the excavation of a large cavern underground, thereby further reducing the potential for groundborne noise and vibration impacts.

7.7.11.2.4 Overall Conclusions

Option 7 is recommended based on the analysis undertaken as it reduced potential environmental impacts when compared to other options as discussed above.

7.7.12 Relocation of the proposed 110kV Substation

During the Operational Phase, MetroLink will be powered by a 110kV HV power supply from ESB Networks (ESBN). For resilience reasons the ESBN 110kV HV power supply will be presented to two different MetroLink HV substations. This means that if one power supply fails, there will be a backup connection that will ensure that the system will continue to operate.

Each MetroLink HV substation will include a Customer Compound, adjoining the ESBN compound, for the HV substation customer (MetroLink) elements, including incoming HV switchgear, the MetroLink 110kV/20kV transformers, and an MV building.

The intention is that there would be one MetroLink HV substation located within the Dardistown depot complex. The second substation location was previously proposed at the Estuary site. However, consultation with Fingal County Council identified that it was considered that the provision of a substation at this location would not be in keeping with future development plans for the area. As a result, further analysis was undertaken to identify a preferred location for the 2nd 110kV substation. An alternative substation location was identified adjacent to the Dublin Airport North Portal and this location was analysed to identify if it was a feasible alternative to the proposed Estuary site.

7.7.12.1 Environmental Assessment

An environmental assessment was undertaken to identify the preferred location for an 110kV HV substation. The principle environmental considerations were as follows:

- *Landscape and Visual:* The provision of a 110kV substation to the north of the Estuary station site would result in a significant impact on the landscape and visual environment and would be a dominant feature in the landscape particularly when viewed from the north and west of the site, from where future development lands are to be located. At the site of Dublin Airport North Portal, the proposed substation site would be developed on a greenfield site zoned for future development associated with Dublin Airport. However, the proposed site will also impact on a designated green belt area (designated under the Fingal Development Plan 2017 -2023). There is potential for an impact on the landscape and visual amenity at the Dublin Airport site if not mitigated.
- *Infrastructure and Utilities:* The provision of a 110kV substation at Dublin Airport North Portal removes the requirement for an extended cable route from Belcamp ESBN substation which would progress along the R132 roadway from Cloughran roundabout (at junction of R132 and Stockhole lane) as far north as the proposed Estuary station. This has significant environmental benefits as potential impacts associated with the construction of this cable route are avoided.
- *Waste and Resources:* The provision of the proposed substation at Estuary would require a significantly longer cable route to be constructed when compared with the location adjacent to the Airport North Portal. The longer cable route would require additional materials and resources to construct when compared to the shorter connection.

7.7.12.2 Overall Conclusions

Following the evaluation of the alternative sites for the second MetroLink 110kV HV substation, the proposed location at the MetroLink North Portal, off Naul Road, north of Dublin Airport was chosen as the preferred option.

7.7.13 Grid Connection – Alternatives considered

In July 2018, TII/ESBN discussions were held regarding the nature of the HV grid connection to MetroLink. ESBN's initial approach was to provide a single 54MVA connection to MetroLink. However, responding to TII concerns about resilience of a single HV feed, a number of alternative options were discussed such as the following:

- 2 x 54MVA substations;
- 3 x 27MVA substations; and
- 2 x 40MVA (one north and one south) + 1 x 14MVA (centre area)).

It was eventually agreed that 2 x 54MVA HV connections, provided in a ring configuration, connecting to two MetroLink HV substations, offered the optimum solution as it ensures that there is a back-up grid connection should one connection fail.

Following this work ESBN undertook further analysis to identify the preferred HV grid connection routes to link existing substations to the proposed new substation locations (discussed above in Section 7.7.9). The analysis was undertaken in order to identify preferred cable route connections, having regard to identified constraints. The identified routes will require further confirmation based on substantial site investigation and further consultation. The Identified routes are:

- 110kV Forest Little to Belcamp;
- 110kV Newbury to Ballystruan; and
- 110kv Ballystruan to Forest Little.

In developing the preferred routes for the proposed grid connections, the following selection criteria were considered:

- Grid connection cable routes were selected within the public domain e.g., roadways, public parks etc. to avoid private property where possible. The routes were investigated (i.e., surveyed) to ensure that the required clearances from existing structures, or utility services could be maintained as far as was practically possible to do.
- Grid connection cable routes were chosen to avoid unnecessary crossings of major roads, and water ways, where possible and to minimise any road closures during construction that would result in traffic impacts.
- Grid connection cable routes were selected to minimise impact on the community.
- Grid connection cable routes were selected to avoid sudden changes in the alignment, both in horizontal and vertical plane.
- Grid connection cable routes should provide suitable locations for HV cable joint bays.
- The routes chosen had regard to the constructability of the cable routes.
- The grid connection cable routes were selected with aim to minimise the overall route length, to reduce the costs.
- The grid connection cable routes were selected to minimise conflict with future development, where these future developments were known, and where it was possible.
- Environmental constraints including the following:

- No. of Water Crossings;
- Potential for Flooding;
- Potential for Contaminated Land;
- Potential impacts on Cultural Heritage sites;
- Potential impacts on biodiversity including effects on designated areas such as NHA's and European sites (SAC's and SPA's);

- Potential risk of spreading Invasive Species; and
- Potential impacts from a landscape perspective.

- The future maintenance access was critical when identifying the grid connection cable route.
- Compliance with the current development plan was also taken into consideration.

7.7.13.1 110kV Forest Little to Belcamp;

Three route options were assessed for this route in order to identify a preferred route having regard to the above-mentioned criteria. (Refer to Diagram 7.42 for details of each of the routes assessed).

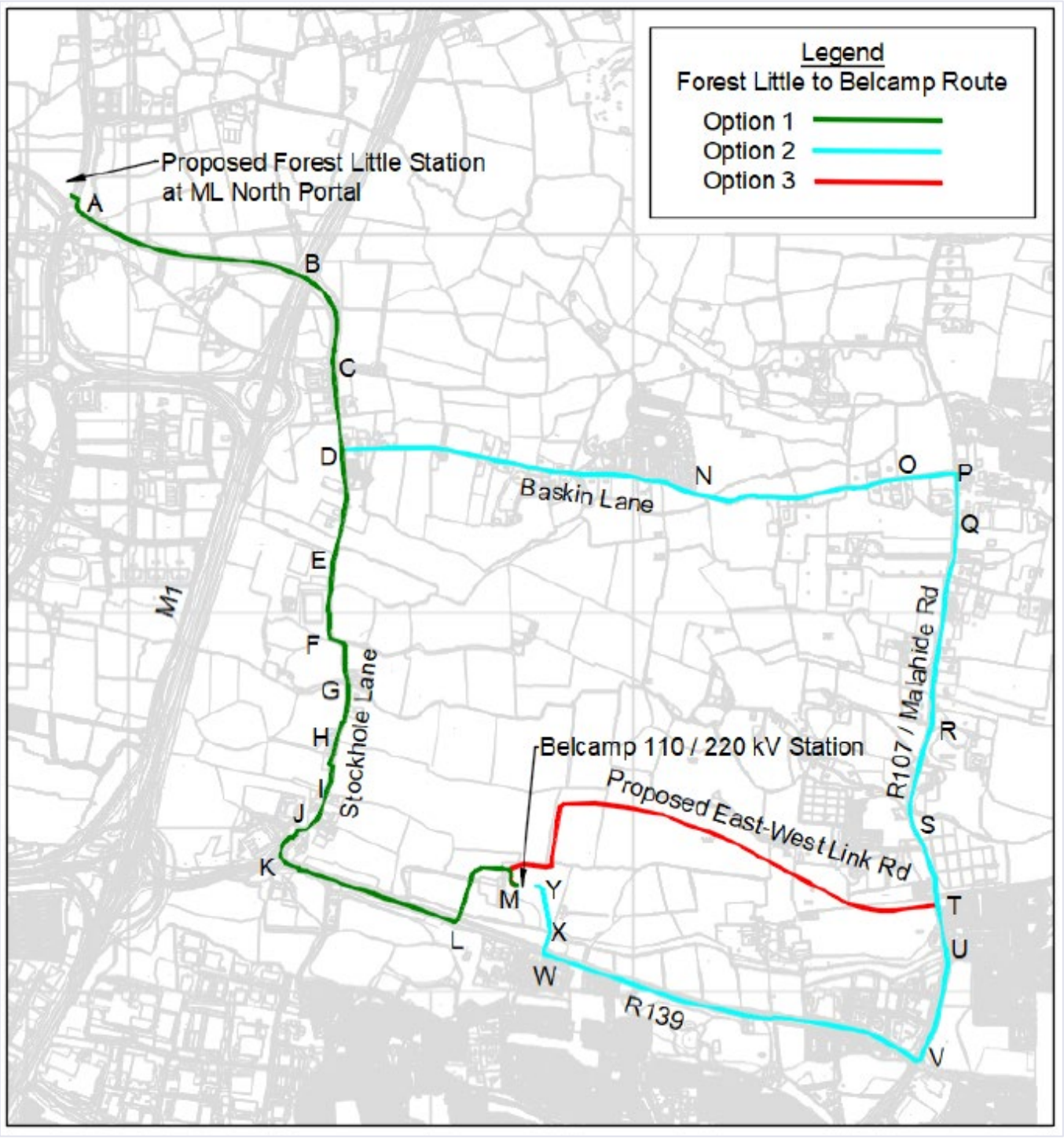


Diagram 7.42 Route Options for Forrest Little to Belcamp

Route option 2 was chosen as the preferred route for this cable route alignment for the following reasons:

- This route option avoids impacts on other major utilities when compared to other options, particularly along the constrained Stockhole Lane such as a 600mm watermain, 250mm gas main and an aviation fuel line;
- This route option minimises traffic impacts when compared to other options assessed during the Construction Phase of the proposed Project having particular regard to traffic on Stockhole Lane and at roundabouts at Cloghran roundabout and the roundabouts at the southern end of Stockhole Lane at the Clayton hotel;
- This route option avoids impacts on future road projects when compared to other options such as the proposed "East-West Link road";
- This route option minimises the number of watercourse crossings compared to option 3, however option 1 and 2 have an equal number of crossings; and
- This route option is entirely located within existing roads ensuring that the biodiversity, cultural heritage or landscape are not differentiating factors.

The preferred route option (option 2) progresses from the proposed Dublin Airport North Portal 110kV substation at Forest Little on the Naul Road, crossing the R132 and progressing in an easterly direction along Stockhole lane before crossing over the M1 motorway on the existing overbridge. The route then turns in a southerly direction down Stockhole Lane before turning left onto Baskin Lane. The route then continues along Baskin Lane to its junction with the Malahide Road before turning right onto Malahide Lane and continuing in a southerly direction before turning right at the Hilton Dublin Airport Hotel, progressing along the R139 roadway as far as Belcamp substation.

7.7.13.2 110kV Newbury to Ballystruan

The route will run from the existing Newbury 110kV station in Clonshaugh Business Park to the proposed Ballystruan Business Park at Dardistown. Two route options were assessed in order to identify a preferred route (refer to Diagram 7.43 for details of each of the routes assessed).

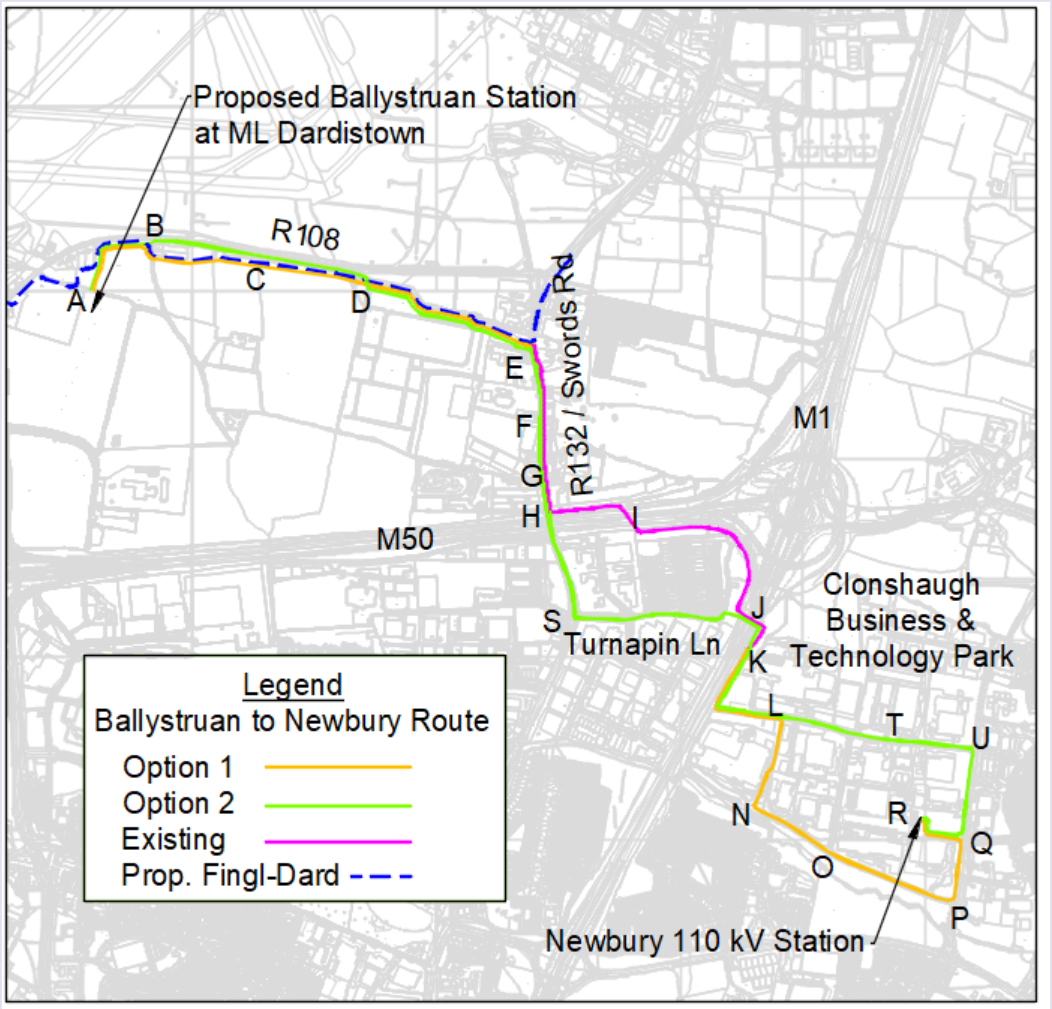


Diagram 7.43 route Options for Ballystruan to Newbury

For the Newbury – Ballystruan HV cable route, Option 1 and Option 2 are considered feasible. However, for the following reasons Option1 is the preferred route option:

- Option 1 will take less construction effort as there is significantly longer spare ducting available along this route;
- Option 2 route will require trenching and ducting works through the Airways Industrial Estate and along the Old Airport Road may be in conflict with the existing HV cables and services buried there;
- Option 1 is slightly longer than Option 2 at 5.1km (compared to 4.8km), but the Option 2 route will encounter more utility services than Option 1 route;
- The number of water crossings required for each option are similar, no flooding is expected along either route;
- No cultural heritage routes are expected along either Option 1 or 2 routes.
- Biodiversity (flora and fauna) and/or landscaping requirements do not seem to present particular issue along either HV cable route, although any trenching and ducting works through the industrial estates grass verges, or the like, will require reinstatement for both options.

Route option 1 is approx. 5.1km long as shown in Diagram 7.43. Starting at the proposed Ballystruan 110kV station at the proposed Metrolink Dardistown Depot site, the HV cable route initially runs through private property south of the R108, through the north perimeter of the two GAA pitches, and parallel to the proposed Finglas - Dardistown 110 kV circuit (construction due to progress in 2022), before entering agricultural land before crossing into the QuickPark carpark. The HV cable route subsequently joins the road R132/Swords Road before heading south in the existing spare ducts installed parallel to the existing 110 kV Dardistown - Kilmore cable. At the M50 motorway it turns east, running along the north side of

the motorway before crossing to the southside adjacent to the Turnapin Green/Turnapin Cottages area and then follows the slip road alignment to the south along the M1 before crossing the motorway into the Clonshaugh Business Park. The route then runs south, adjacent to the M1 before turning east and then south again adjacent to Kilmore Station, turning east along the road just north of the Santry River. At the main entrance road to Clonshaugh Business Park the circuit turns north before entering Newbury 110 kV station to the west.

7.7.13.3 110kV Ballystruan to Forest Little

The Ballystruan to Forest Little cable route will run from the proposed Ballystruan Substation at the proposed Metrolink Dardistown Depot to the proposed Forest Little Substation at DANP. Three route options were assessed for this route in order to identify a preferred route having regard to the above-mentioned criteria. (Refer to Diagram 7.44 for details of each of the routes assessed).

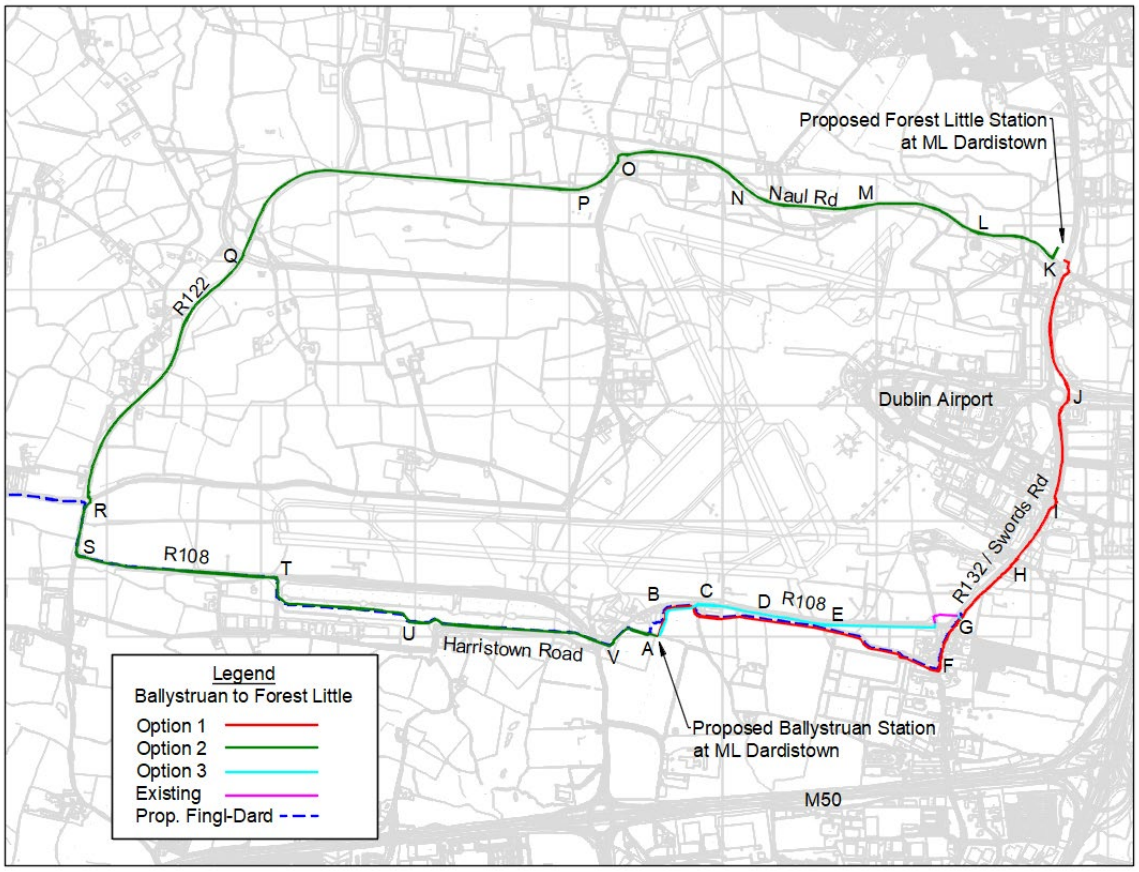


Diagram 7.44 Route Options for Ballystruan to Forest Little

The Ballystruan – Forest Little HV cable route, Option 1, Option 2, and Option 3 are primarily all designed for progression along the existing public roads and are all considered viable. However, as option 2 is longer than the other route options it would require more construction work. The Option 1 cable route is approximately 4km long, Option 2 is 9.8km long and Option 3 is 3.9km long. Nonetheless, Option 2 is considered the preferred option for the following reasons:

- HV Cable Maintenance Wayleave/Easement Requirements, Option 2 is expected to have advantage over the other two.
- Option 1 and Option 3 routes will encounter more utility services than Option 2 route.
- The Option 1 and Option 3 routes are expected to have greater general impact on the DAA and its tenants, including herewith two GAA clubs, than Option 2.
- In respect of the traffic flow, the Option 1 and Option 3 routes will have greater impact than Option 2 route. This is especially the case for the Airport roundabout, Cloghran roundabout and R108/R132 junction.

- There are water crossings required along all three HV cable routes.
- No flooding should be expected along any of the proposed HV cable routes.
- No cultural heritage sites are expected along any of the HV cable routes.
- Biodiversity (flora and fauna) and/or landscaping requirements do not seem to present particular issue along any of the HV cable route.

The Preferred Option 2 commences at the proposed Ballystruan Substation from where the route heads west through Ballymun Kickham's GAA onto the Harristown Road before crossing into the DAA Blue Carpark and through to the R108, continuing west before turning north onto the R122. The route follows the R122 north and eventually east around the perimeter of the airport. It continues east to join up with the Naul Road and into the proposed Forest Little station adjacent to the Cloghran roundabout.

7.7.14 Overall Conclusions

Based on the conclusions of the multi-disciplinary analysis outlined above, the Preferred Route was identified for the proposed cable routes. It should be noted however that ESBN will be making a separate application for approval for the proposed grid connection. As a result, in advance of submission of that application, there may be further alternatives assessments undertaken and presented as part of the EIAR prepared for that application.

7.8 Consideration of Alternatives for the Construction Phase

The construction of the proposed Project has potential to have short term effects when not mitigated sufficiently. In the development of the Construction Phase design for the proposed Project, alternative options have been developed and assessed to identify preferred options having regard to the potential environmental effects under the following headings:

- Tunnel Boring Machine (TBM) launch sites;
- Tunnel Boring Machine Hours of Operation;
- Location of Construction Compounds; and
- Construction of Stations.

It should be noted that it was not possible to consider alternatives to easement strips as the need and land take required for easement strips is driven by the access required to the alignment for maintenance and management purposes.

7.8.1 Tunnel Boring Machine (TBM launch sites)

As outlined in section 7.7.2 the adoption of a single bore tunnel has resulted in the TBM launch site being moved from the location proposed at the EPR stage (Griffith Park) to Northwood for the Preferred route. The adoption of this alternative option has significant environmental advantages over the EPR option as outlined in section 7.7.2.

7.8.2 Tunnel Boring Machine Hours of Operation

An analysis was undertaken as to whether the proposed TBMs to be used on the project should progress 24 hours per day and based on this analysis it was decided that 24 hours a day operation was the only feasible option for the following reasons;

- The construction programme for the tunnel would be extended by a minimum of 4 years if the TBM did not progress on the basis of 24 hours a day operation;
- There would be a significantly increased risk of settlement at locations where the TBM is stopped overnight due to lower face pressure during the non-progression of the machine.

While Chapter 14 of the EIAR has identified that there is potential for elevated groundborne noise levels during night time periods resulting in potential sleep disturbance for some for a number of days as the TBM passes closest to a property. However, a 4-year increase in construction duration would have much more significant impacts including the following:

- Extended duration of works with prolonged associated impacts in terms of noise & vibration, dust emissions;
- Prolonged requirement for traffic management measures to manage traffic congestion;
- Prolonged period of disruption whereby areas being used for construction works, compounds etc are used and not returned to the proposed end use; and
- Significant additional cost to the project.

7.8.3 Location of Construction Compounds

As described in Chapter 5 of this document there are a number of construction compounds required to allow for the construction of the proposed Project. Construction compounds have been located in proximity to the required working areas to ensure the maximum efficiency of the Construction Phase works and to minimise potential environmental effects. In the majority of cases, it is not possible to consider an alternative site for a construction compound as the sites are required to be at or adjacent to the construction works locations. The assessment of alternative construction compounds is presented in Table 7-19

Table 7-19 Consideration of Alternative Construction Compounds

Compound Name	Alternatives Assessed	Rationale	Environmental Assessment
North Section			
Start of Route (Estuary Station) to Seatown			
Estuary Station construction and logistics site	Western / Central / Eastern options	This site, the "Railhead site" is required to be adjacent to railway tracks to facilitate movement of materials and construction resources onto the rail alignment for construction of slab track, rail laying and installation of systems equipment. A site not directly adjacent to the MetroLink tracks would not be feasible. Alternative adjacent sites investigated for access suitability and sized according to construction needs. Final decision was driven by a full environmental appraisal of each site. The critical items that were considered were identifying a site that (a) minimises impacts on identified archaeology and architectural heritage (b) minimises impacts on Property, by considering the future development potential of the land (3) minimising the impact on nearby sensitive receptors and (3) minimising impacts on hedgerows in the area.	Preferred site location minimised the impacts on archaeology and features of architectural heritage and moved the site further from sensitive receptors as this could be a noisy site during the Construction Phase. The site boundary was revised to preserve hedgerows where possible and to minimise impacts on watercourses;
Estuary Court	None	MetroLink cut and cover section traverses the green area in front of Estuary Ct. Construction working space has to extend the construction boundary towards the Estuary Ct properties and hence the requirement for the southern triangle of grass by the properties. The northern triangle of grass is also proposed for construction purposes to provide storage space for plant and materials and additional working room of construct the cut and cover under the R132. The alternative would require siting the construction working area on the R132 road but there is no space to divert the road to accommodate this.	No environmental assessment of alternatives as this was the only feasible option

Compound Name	Alternatives Assessed	Rationale	Environmental Assessment
Seatown West	None	Available space adjacent to works area.	No environmental assessment of alternatives as this was the only feasible option
Fingallians footbridge site	None	Available space adjacent to works area.	Locations adjacent to works space, with no sensitive residential properties in close proximity. Only feasible option
Woodie's	None	Required for demolition of existing footbridge in this area - working space and materials storage space required by the footbridge ramp.	No environmental assessment of alternatives as this was the only feasible option
Seatown Station to Malahide Roundabout			
Seatown Station	None	Major construction works for station. Space restricted at northern end by R132 to the west and the Hertz building. Existing undeveloped land to the south provides sufficient space for main compound which will service construction works No other available space adjacent to the MetroLink corridor and station.	Available open space adjacent to R132 and commercial buildings. No residential properties adjacent. No environmental assessment of alternatives as this was the only feasible option
Mantua Park	None	Adjacent to works area	No environmental assessment of alternatives as this was the only feasible option
NDC	None	Available undeveloped land bounded by the R132 and commercial/industrial buildings. Avoids impact on R132 and any residential buildings	No environmental assessment of alternatives as this was the only feasible option
Chapel Lane	None	Required for footbridge demolition and removal of western foundations. No other feasible location.	Adjacent to some residential properties, but no other option.
Pavilion's Shopping Centre	None	Area of open space accessible for construction traffic	No environmental assessment of alternatives as this was the only feasible option
Malahide Roundabout to Pinnock Hill Roundabout			
Swords Central	None	Construction works associated with station construction and adjacent corridor works. Construction area has to be located immediately by the station, no other alternative.	Located in current undeveloped grassland area, compound size reduced at Landowner request to current minimum size required to manage works in this area. Only feasible option
Pinnock Hill Roundabout Satellite Site	None	Adjacent to works area	No environmental assessment of alternatives as this was the only feasible option

Compound Name	Alternatives Assessed	Rationale	Environmental Assessment
Pinnock Hill Roundabout to North Portal (North Section)			
Fosterstown Station	None	Construction works associated with station construction and adjacent corridor works. Construction area has to be located immediately by the station, no other alternative.	Adjacent to Airside retail park. No residential properties nearby. No environmental assessment of alternatives as this was the only feasible option
Nevinstown Lane	None	Adjacent to works area	No environmental assessment of alternatives as this was the only feasible option
Boland	None	Construction site centred on the cut and cover alignment southwest of the R132. Currently agricultural fields. No other alternative.	No environmental assessment of alternatives as this was the only feasible option
North Portal (North Section)		Sited on the MetroLink route to avoid use of land further away.	No environmental assessment of alternatives as this was the only feasible option
Central Section			
Dublin Airport North Portal	None	Site centred on major construction area at N Portal, also the receiving area for the TBM. No other appropriate location.	Site located in agricultural area/Green belt area and bounded by the Naul Road to the south. No nearby residential properties.
Dublin Airport Station	None	Site centred on the Airport underground station. Site utilises the existing car park area and avoids adjacent roads and buildings	No environmental assessment of alternatives as this was the only feasible option
Dublin Airport South Portal	None	Site centred on the alignment and the south portal structure. This is the TBM launch point for the airport tunnel and the compound is sized to service the TBM operations and the S portal and adjacent route construction.	Existing open grassland zoned for future development. Only feasible option
Dardistown Station and Depot	None	Compound encompasses the full extent of the proposed Dardistown depot.	Existing open grassland zoned for future development. No environmental assessment of alternatives as this was the only feasible option
Central Section Surface Works at M50 Viaduct	None	Site centred on the viaduct and viaduct approaches.	No environmental assessment of alternatives as this was the only feasible option
St Anne's South of M50 Viaduct	None	Adjacent to works area	No environmental assessment of alternatives as this was the only feasible option
South Section			
Northwood Station and	none	Site centred on the alignment and the tunnel portal structure. This is the TBM launch point	Site utilises available empty undeveloped land zoned for

Compound Name	Alternatives Assessed	Rationale	Environmental Assessment
Portal		for the City tunnel and the compound is sized to service the TBM operations, the Northwood portal and station and adjacent route construction.	future residential/commercial development. No residential properties in near vicinity. No environmental assessment of alternatives as this was the only feasible option
Northwood Logistics Yard	none	Additional available open undeveloped space away from Residential properties, required to provide logistic support to the station construction works through to the city	Site utilises available empty undeveloped land zoned for future residential/commercial development. No residential properties in near vicinity. No environmental assessment of alternatives as this was the only feasible option
Ballymun Station	none	Site centred on the station and utilised some of the current open space where the old shopping centre has been removed	No environmental assessment of alternatives as this was the only feasible option
Collins Avenue	none	Site necessarily centred on the station box location and limited in size to avoid surrounding buildings and roads.	No environmental assessment of alternatives as this was the only feasible option
Albert College Intervention Shaft	None	Site is centred on the construction works necessary together with some adjacent plant and materials storage space. Size restricted to limit impact on adjacent sports pitches	No environmental assessment of alternatives as this was the only feasible option
Griffith Park Station	None	Site necessarily centred on the station box location and limited in size to existing pitch area to maintain access to the Whitehall college.	No environmental assessment of alternatives as this was the only feasible option
Glasnevin Station	None	Site necessarily centred on the station box location and limited in size to minimise impact on surrounding buildings, roads, railway and canal.	No environmental assessment of alternatives as this was the only feasible option
Mater Station	None	Site necessarily centred on the station box location and limited in size to avoid surrounding buildings and roads.	No environmental assessment of alternatives as this was the only feasible option
O'Connell Street	None	Site necessarily centred on the station box location and limited in size to avoid surrounding buildings and roads.	No environmental assessment of alternatives as this was the only feasible option
Tara Station	None	Site necessarily centred on the station box location and limited in size to avoid surrounding buildings and roads.	No environmental assessment of alternatives as this was the only feasible option
St. Stephen's Green Station	None	Site necessarily centred on the station box location and limited in size to minimise impact on adjacent park, footpaths and roads	No environmental assessment of alternatives as this was the only feasible option
Charlemont	None	Site necessarily centred on the station box	No environmental

Compound Name	Alternatives Assessed	Rationale	Environmental Assessment
Station		location and limited in size to minimise impact on surrounding buildings and roads.	assessment of alternatives as this was the only feasible option

7.8.4 Construction of Stations

The majority of underground stations are located in areas where limestone rock is present. In order to construct the stations, it will be necessary to excavate large quantities of rock. Two method of excavation have been considered as follows;

- Mechanical excavation using Hydrofraise, road headers, pneumatic hammers and other plant; and
- Blasting with some mechanical excavation.

These methods of excavation are described in full in Chapter 5 MetroLink Construction Phase.

Blasting with some mechanical excavation was considered the preferred option because it is significantly quicker than options that use only mechanical excavation. Furthermore, mechanical excavation is not feasible on harder rock that is encountered at deeper levels required for the excavation of stations.

A number of different scenarios were appraised, and it was estimated that an excavation scenario based on blasting with some mechanical excavation would reduce the overall construction programme by up to 300 days when compared to a mechanical excavation only scenario. The increased duration associated with mechanical excavation would mean more significant environmental effects including the following.

- Extended duration of excavation activity resulting in a longer period of elevated noise & vibration levels and dust emissions;
- Prolonged requirement for traffic management measures to manage traffic congestion;
- Prolonged period of disruption whereby areas being used for construction works, compounds etc are used and not returned to the proposed end use; and
- Significant additional cost to the project.

As a result, the construction programme for the proposed Project has been based on a scenario where deep station excavations are undertaken by way of blasting and associated mechanical excavation. However, it is important to note that should softer rock be encountered, allowing mechanical excavation to progress quickly, this option may be used locally, so long as the project programme is maintained.

Diagram 7.45: Preferred Route

7.9 Conclusions

The design of the proposed Project has been developed since the commencement of the project based on an ongoing assessment of alternatives having regard to the relative potential impacts on the receiving environment of the options assessed.

On the basis of the assessment of alternatives, the proposed project has been developed and is described in detail in Chapters 4,5 and 6 of this document.

7.10 Glossary

Term	Meaning
Alignment	Alignment refers to the three-dimensional (3D) route of the railway, considering both the horizontal and vertical alignment.

Term	Meaning
Construction Compound	An area occupied temporarily for construction-related activities. The main construction compounds will act as strategic hubs for core project management activities (i.e., engineering, planning and construction delivery) and for office-based construction personnel. The main construction compounds will include offices and welfare facilities, workshops and stores, and storage and laydown areas for materials and equipment (e.g., aggregate, structural steel, and steel reinforcement).
Grade of Automation	The grade of automation refers to the degree to which aspects of the railway service are automated or controlled manually. Five GoA are recognised from GoA 0 (manual operation) to GoA 4 (maximum level of automation).
High Floor Train	A high floor train refers to a type of train where the floor of the carriage is typically XX mm (XX inches) above the rails.
Intervention Shaft	A tunnel to provide emergency access between the railway tunnel
Intervention Tunnel	A tunnel parallel to the railway tunnel to provide emergency access / egress
(Old) Metro North	Refers to the Metro North project that received a Railway Order on 2011 (Reference PL06F.NA0003)
Park & Ride Facility	A location usually sited out of the main urban areas comprising a large car park and connected with a mass transit system, in the case of the proposed Project an urban metro to attract potential travellers to drive and park at the facility and take the metro into the city centre and avoid driving into the city centre.
Retained Cut Station	A railway station constructed primarily below ground level with vertical retaining walls either side of the alignment to reinforce the walls and no roof or enclosure overhead.
Surface Station	A railway station designed at ground level
Underground Stations	A railway station located fully underground with a roof slab over the station to enclose it fully.
Rolling stock	in the rail transport industry refers to railway vehicles, including both powered and unpowered vehicle
Cut and Cover	the oldest method of tunnelling, which involves the digging of a trench, the construction of a tunnel, and then returning the surface to its original state
Retained cut	cutting which is constructed with additional structural support that allows a steeper overall slope gradient than would be naturally possible
Fully Automated	Starting and stopping, operation of doors is all fully automated process without any on-train staff.
Light Rail	form of passenger urban rail transit characterized by a combination of tram and metro features
MetroLink	Proposed project of Dublin metro line
Proposed Project	The MetroLink project.

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