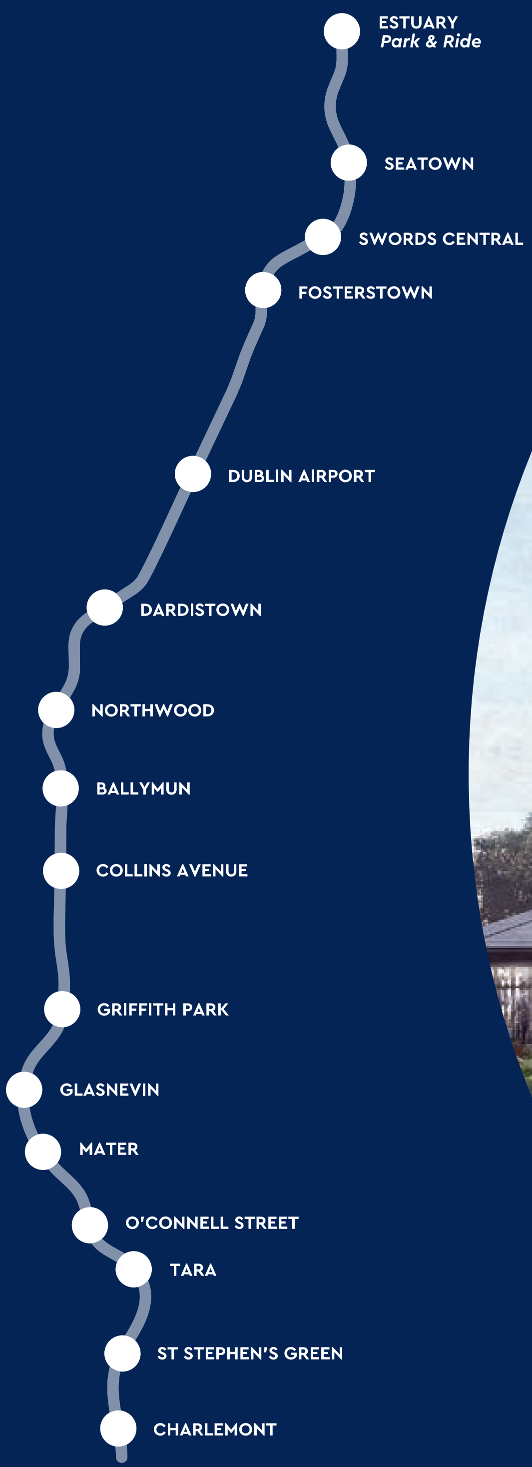

6 Metrolink Operations and Maintenance

Contents

List of Abbreviations

Acronym	Meaning
ACID	Access control and intrusion detection
AM	Ante meridiem, meaning before midday or colloquially in the morning
ATC	Automatic Train Control
ATO	Automatic Train Operation
ATP	Automatic Train Protection
ATS	Automatic Train Supervision
ATVM	Automatic ticket vending machine
ATWP	Automatic Train Washing Plant
BOH	Back of House
CBTC	Communications-based train control
CCTV	Closed Circuit Television
DANP	Dublin Airport North Portal
DASP	Dublin Airport South Portal
DCC	Dublin City Council
DTTAS	Department of Transport, Tourism and Sport
ECS	Environmental Control Sub-System (part of SCADA)
EIAR	Environmental Impact Assessment Report
EMS	Electro-mechanical Sub-System (part of SCADA)
EHP	Emergency help point
ERM	Eastern Region Model
ETB	Ethernet train network
EU	European Union
FCC	Fingal County Council
FOH	Front of House
GDA	Greater Dublin Area
GDPR	General Data Protection Regulation
GOA	Grade of Automation
HV	High Voltage
HVAC	Heating, Ventilation and Air Conditioning
km	Kilometre
km/h	Kilometre per hour
kV	Kilovolt
LED	Light emitting diode
m	Metre
mm	Millimetre
MVA	Megavolt-Amperes
NDA	National Disability Authority
NDP	National Development Plan
NPF	National Planning Framework
NTA	National Transport Authority
OCC	Operational Control Centre

Acronym	Meaning
OCR	Overhead Conductor Rail
OCS	Overhead Contact System
OTE	Over-track exhaust systems
P&R	Park and Ride
PAVA	Public Address and Voice Alarm
PCS	Power Supply Sub-System (part of SCADA)
PHP	Passenger help points
PIS	Passenger information systems
PM	Post meridiem, meaning after midday or colloquially in the afternoon
pphpd	Passengers Per Hour Per Direction
PSDs	Platform Screen Doors
SCADA	Supervisory Control and Data Acquisition
SoS	'Save our souls' – this refers to wall mounted distress stations to call for help
SWDR	Swords Western Distributor Road
TBM	Tunnel Boring Machine
TGD	Technical Guidance Document
TII	Transport Infrastructure Ireland
UPS	Uninterruptible power supply
Wi-Fi	Wireless fidelity

6. MetroLink Operations and Maintenance

6.1 Introduction

This Chapter provides an overview of the Operational Phase activities of MetroLink (hereafter referred to as the proposed Project). It describes the operational philosophy, operational system and how common elements of the proposed Project will work. It also provides a description of maintenance activities and outlines how the proposed Project will interface with existing and future transport services.

This Chapter has been informed by the design developed for the proposed Project, by way of collaborative engagement with the design team, assessment and workshops with the project designers and Environmental Impact Assessment Report (EIAR) specialists.

Outputs from stakeholder engagement have also informed the design and operational phase activities of the proposed Project. Further information on stakeholder engagement can be found in Chapter 8 (Consultation) of this EIAR.

Input from EIAR specialists during the design development of the proposed Project has also been critical in terms of ensuring that the design and proposed operational phase activities result in minimal environmental effects.

This Chapter has been prepared alongside, and should be read in conjunction with, the following chapters and their Appendices of this EIAR:

- Chapter 4 (Description of the MetroLink Project) which provides a detailed description of the infrastructure elements of the proposed Project; and
- Chapter 5 (MetroLink Construction Phase) which provides a detailed description of the proposed construction phase of the proposed Project.

Figures which are referenced in the text are provided in Volume 4 (Figures) and appendices referenced in the text are provided in Volume 5 (Appendices) of this EIAR.

Diagram 6.1 and Table 6.1 provide an overview of the principal infrastructural elements of the proposed Project and their geographical extent and location.

The MetroLink Project (hereafter referred to as the proposed Project) is being developed in Dublin in accordance with the National Planning Framework (NPF) and National Development Plan 2021-2030 (NDP) (Department of Public Expenditure and Reform, 2021) and as such is a key element of Project Ireland 2040. The proposed Project will comprise a high-capacity, high-frequency, modern and efficient metro railway between Estuary Station and the Park and Ride (P&R) Facility, north of Swords via Dublin Airport to Charlemont Station which lies south of Dublin City Centre. The proposed Project will be approximately 18.8km in length.

Diagram 6.1: Infographic Overview of Principal Locations along the Proposed Alignment

Table 6.1: Overview of the Key Elements of the proposed Project

Project Elements	Outline Description
Permanent Project Elements	
Tunnels	It is proposed to construct two geographically separate, single-bore tunnels, using a Tunnel Boring Machine (TBM). Each section of tunnel will have a 8.5m inside diameter and will contain both northbound and southbound rail lines within the same tunnel. These tunnels will be located as follows: The Airport Tunnel: running south from Dublin Airport North Portal (DANP) under Dublin Airport and surfacing south of the airport at Dublin Airport South Portal (DASP) and will be approximately 2.3km in length; and The City Tunnel: running for 9.4 km from Northwood Portal and terminating underground south of Charlemont Station.
Cut Sections	The northern section of the alignment is characterised by a shallow excavated alignment whereby the alignment runs below the existing ground level. Part of the cut sections are open at the top, with fences along the alignment for safety and security. While other sections are 'cut and cover', whereby the alignment is covered.
Tunnel Portals	The openings at the end of the tunnel are referred to as portals. They are concrete and steel structures designed to provide the commencement or termination of a tunneled section of route and provide a transition to adjacent lengths of the route which may be in retained structures or at the surface. There are three proposed portals, which are: ▪ DANP; ▪ DASP; and ▪ Northwood Portal. There will be no portal at the southern end of the proposed Project, as the southern termination and turnback would be underground.
Stations	There are three types of stations: surface stations, retained cut stations and underground stations: ▪ Estuary Station will be built at surface level, known as a 'surface station'; ▪ Seatown, Swords Central, Fosterstown Stations and the proposed Dardistown Station will be in retained cutting, known as 'retained cut stations'; and ▪ Dublin Airport Station and all 10 stations along the City Tunnel will be 'underground stations'.
Intervention Shaft	An intervention shaft will be required at Albert College Park to provide adequate emergency egress from the City Tunnel and to support tunnel ventilation. Following the European Standard for safety in railway tunnels TSI 1303/2014: Technical Specification for Interoperability relating to 'safety in railway tunnels' of the rail system of the European Union, it has been recommended that the maximum spacing between emergency exits is 1,000m. As the distance between Collins Avenue and Griffith Park is 1,494m, this intervention shaft is proposed to safely support evacuation/emergency service access in the event of an incident. This shaft will also function to provide ventilation to the tunnel. The shaft will require two 23m long connection tunnels extending from the shaft, connecting to the main tunnel. At other locations, emergency access will be incorporated into the stations and portals or intervention tunnels will be utilised at locations where there is no available space for a shaft to be constructed and located where required (see below).
Intervention Tunnels	In addition to the two main 'running' tunnels, there are three shorter, smaller diameter tunnels. These are the evacuation and ventilation tunnels (known as Intervention Tunnels): ▪ Airport Intervention Tunnels: parallel to the Airport Tunnel, there will also be two smaller diameter tunnels; on the west side, an evacuation tunnel running northwards from DASP for about 315m, and on the east side, a ventilation tunnel connected to the main tunnel and extending about 600m from DASP underneath Dublin Airport Lands. In the event of an incident in the main tunnel, the evacuation tunnel will enable passengers to walk out to a safe location outside the Dublin Airport Lands.

Project Elements	Outline Description
	▪ Charlemont Intervention Tunnel: The City Tunnel will extend 360m south of Charlemont Station. A parallel evacuation and ventilation tunnel is required from the end of the City Tunnel back to Charlemont Station to support emergency evacuation of maintenance staff and ventilation for this section of tunnel.
Park and Ride Facility	The proposed Park and Ride Facility next to Estuary Station will include provision for up to 3,000 parking spaces.
Broadmeadow and Ward River Viaduct	A 260m long viaduct is proposed between Estuary and Seatown Stations, to cross the Broadmeadow and Ward Rivers and their floodplains.
Proposed Grid Connections	Grid connections will be provided via cable routes with the addition of new 110kV substations at DANP and Dardistown. (Approval for the proposed grid connections to be applied for separately but are assessed in the EIAR).
Dardistown Depot	A maintenance depot will be located at Dardistown. It will include: ▪ Vehicle stabling; ▪ Maintenance workshops and pits; ▪ Automatic vehicle wash facilities; ▪ A test track; ▪ Sanding system for rolling stock; ▪ The Operations Control Centre for the proposed Project; ▪ A substation; ▪ A mast; and ▪ Other staff facilities and a carpark.
Operations Control Centre	The main Operations Control Centre (OCC) will be located at Dardistown Depot and a back-up OCC will be provided at Estuary.
M50 Viaduct	A 100m long viaduct to carry the proposed Project across the M50 between the Dardistown Depot and Northwood Station.
Temporary Project Elements	
Construction Compounds	There will be 34 Construction Compounds including 20 main Construction Compounds, 14 Satellite Construction Compounds required during the Construction Phase of the proposed Project. The main Construction Compounds will be located at each of the proposed station locations, the portal locations and the Dardistown Depot Location (also covering the Dardistown Station) with satellite compounds located at other locations along the alignment. Outside of the Construction Compounds there will be works areas and sites associated with the construction of all elements of the proposed Project, including an easement strip along the surface sections.
Logistics Sites	The main logistics sites will be located at Estuary, near Pinnock Hill east of the R132 Swords Bypass and north of Saint Margaret's Road at the Northwood Compound. (These areas are included within the 14 Satellite Construction Compounds).
Tunnel Boring Machine Launch Site	There will be two main tunnel boring machine (TBM) launch sites. One will be located at DASP which will serve the TBM boring the Airport Tunnel and the second will be located at the Northwood Construction Compound which will serve the TBM boring the City Tunnel.

This Chapter describes the principal elements of the proposed Project during the Operational Phase which are discussed in this Chapter in the following order:

- **Section 6.2:** Provides an overview of the operational philosophy and key considerations of the proposed Project;

- **Section 6.3:** Provides an overview of the operational principles of the proposed Project;
- **Section 6.4:** Outlines the key operational parameters of the proposed Project;
- **Section 6.5:** Describes the railway systems that ensures that the proposed Project will operate effectively on a day-to-day basis, covering communications-based train control and the rolling stock;
- **Section 6.6:** Describes the line wide operations systems covering the Operational Control Centre (OCC), power usage, communications systems, heating, ventilation and air conditioning (HVAC) systems, safety, security and emergency processes and lighting;
- **Section 6.7:** Covers mainline maintenance and cleaning;
- **Section 6.8:** Describes the station operation;
- **Section 6.9:** Dardistown Depot operation;
- **Section 6.10:** Park & Ride Facility operation;
- **Section 6.11:** Provides an overview of staffing requirements and key roles and responsibilities; and
- **Sections 6.12 and 6.13:** Provide a glossary of technical terms and a list of references.

6.2 Operational Philosophy and Key Considerations

The philosophy for the operations phase is to provide a sustainable, safe, efficient, integrated and accessible public transport service between Swords, Dublin Airport and Dublin City Centre. This is achieved through the design of the proposed Project, its construction, and the operational and maintenance activities of the railway service itself.

Diagram 6.2 shows an overview of key considerations for the proposed Project during the Operational Phase. The operational strategy sets out the overall framework to transport the predicted numbers of passengers in comfort between their starting point and their destination. Various operational systems will be implemented to run the fully automated train service, all controlled from the Operations Control Centre (OCC) to be located at Dardistown Depot, which will also be the centre for the majority of over-night stabling and maintenance of the trains. There will also be various front of house (FOH) features for the travelling passengers as well as back of house (BOH) activities for staff to manage and maintain facilities at the stations.

Diagram 6.2: Summary of Key Considerations during the Operational Phase of the Proposed Project

6.3 Operational Considerations

The operational design of the proposed Project has progressed based on the following:

- Be integrated with other rail and bus public transport networks in the Greater Dublin Area (GDA);
- Operate to the highest safety standards;
- Be accessible to all users (universal design approach);
- Provide a frequent service which meets demand;
- Provide a safe and friendly environment for its customers;
- Be clean and well maintained;

- Achieve high standards of lighting and signage;
- Provide effective customer support; and
- Operate in a sustainable and environmentally manner.

Specific design requirements for the Operational Phase included;

- To serve the predicted passenger requirements up to 2065 based on the passenger demand modelling;
- To provide an attractive, safe, sustainable, accessible service to promote modal shift from road traffic to the railway;
- For safety reasons, the signalling system will ensure that in each ventilation section there is no more than one commercial train (with passengers) per direction to meet Fire Safety requirements, if required; and
- Taking advantage of the benefits of an automatic system, provide a service that can adapt to changing demand throughout the day operating under different scenarios as required.

6.4 Key Operational Parameters

As introduced in Chapter 4 (Description of the MetroLink Project), the proposed Project is designed to be a fully automated system, segregated from other transport systems and surrounding land uses. The main operational parameters for the system are summarised below.

- **Line Speed:** The operational design speed is 80 km/h but restrictions will be required at certain locations due to geometric restrictions. The dwell time at each station will be between 20 seconds and 40 seconds.
- **Grade of Automation (GOA):** There are five GOAs from GOA0 to GOA4 as described in Section 4.12.5 Chapter 4 (Description of the MetroLink Project). The trains will be fully automated (GOA4). This means that the starting and stopping of trains, the operation of train doors, and handling of emergencies will all be fully automated and not require staff on board to drive the trains, although staff will be present for other activities such as checking tickets, assisting passengers and for security. This provides a more efficient service than non-automated trains resulting in less maintenance, wear-and tear, noise and vibration, and a more efficient system. A similar level of automation has been provided in Barcelona Metro Line 9 in Spain, Turin Metro Line 1 in Italy, and Santiago Metro Lines L3 and L6 in Chile.
- **Capacity:** The proposed Project is designed to carry up to 20,000 Passengers Per Hour Per Direction (pphpd) at peak hours.
- **Headway:** The headway (the time between trains) varies depending on the service pattern. The operational headway is 100 seconds in the morning peak on weekdays for the single loop 'Estuary – Charlemont'.The maximum operational headway will be 7 minutes 30 seconds for the 'Dublin Airport - Charlemont' section of the line in the early morning on Saturdays and on Sunday mornings and evenings. A less frequent 15 minute headway is predicted for the 'Estuary - Dublin Airport' section of the line on Saturdays in the early morning and on Sundays in the early morning to morning peak and late evening. It should be noted that should MetroLink be extended in the future and/or should demand exceed predicted demand, the system has been designed to operate up to a maximum frequency of one train every 90s.
- **Stabling and Train Service Entry:** Most trains will be stabled overnight at the Dardistown Depot. However, up to five trains could be stabled just south of Charlemont in the tunnel, ready for the start of service. Trains will enter into service directly from Charlemont or will travel empty from the Depot to start into service from Estuary. As Estuary is a surface station, it is not intended to stable trains there overnight for security reasons.
- **Service Pattern:** Trains are expected to run between 05:30 and 00:30 for 365 days per year, with more trains added into service at peak times. The operator will be able to implement dynamic service management to match demand, which is a key tool in providing appropriate capacity. The currently proposed operational strategy does not include for 24-hour services, but late night or overnight services may run on an occasional basis to facilitate night-time travel during busy holiday periods or special events.

The proposed Project has been developed based on a scenario to operate the long loop during peak hours and alternate long and short loops during inter-peak hours.

- A long loop will cover the full route from Charlemont to Estuary; and
- A short loop will cover Charlemont to Dublin Airport.

During the peak hours, the same level of service would be provided to all the stations, but during the inter-peak period half the trains will complete the long loop and half the short loop, resulting in double the number of trains between Charlemont and Dublin Airport than between Dublin Airport and Estuary.

It should be noted that during the Operational Phase, operators may decide to operate using different operational scenarios. However, for the purposes of this assessment the analysis undertaken has been based on the worst case scenario where maximum headway is achieved for all stations on a single loop (Refer to Diagram 6.3).

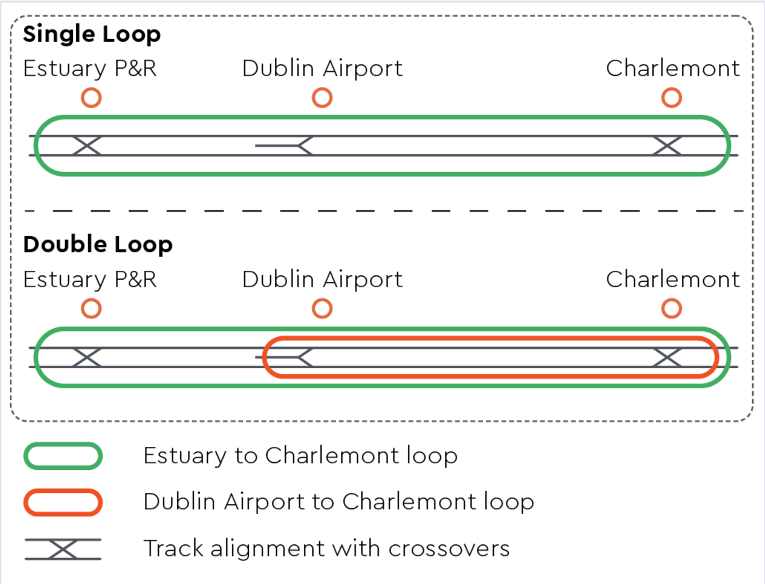

Diagram 6.3 Schematic of the Single Loop and Double Loop Services Patterns

- **Comfort:** Each train will carry up to 500 passengers (assuming four passengers/m^2) with seating provided for at least 100 passengers assuming seating provision is equal to or greater than 20% of passengers.
- **Schedule Perturbations:** Should services be disrupted, for example due to delays closing doors or to a broken-down train, it will be possible to keep disruption to a minimum by using track cross-overs and varied routing so that other trains can by-pass the affected train.
- **Universal Design Approach:** The overarching principle of universal design aims to make the proposed Project accessible for everyone to use, regardless of their age, gender, physical capabilities or cultural background. Design measures considered the following seven principles:

- **Equitable Use** – The proposed Project has been designed for use by people with diverse abilities, by providing the same means of use for all passengers without segregating or stigmatising any of them.
- **Flexibility in Use** – The design accommodates a wide range of individual preferences and abilities, providing choice in the methods of use and adaptability to the passenger's pace of travel.
- **Simple and Intuitive Use** – The layout of the facilities is easy to understand, regardless of the passenger's experience, knowledge, language skills, or current concentration level.
- **Perceptible Information** – Information is communicated effectively to the passenger, regardless of ambient conditions or the passenger's sensory abilities. Information will be provided in different modes (pictorial, verbal, and tactile).
- **Tolerance for Error** – The design minimises hazards and the adverse consequences of accidental or unintended actions by providing warnings of hazards.

- **Low Physical Effort** – The design can be used efficiently and comfortably and with minimal fatigue.
- **Size and Space for Approach and Use** – Appropriate size and space is provided for approach, reach, manipulation and use regardless of the passenger's body size, posture, or mobility. The design provides a clear line of sight to important elements for any seated or standing passenger.

- **Customer Service:** The proposed Project offers a rapid, comfortable rail service designed around passengers. Services include parking at the Estuary P&R and a mix of intermodal connections (walking, cycling, bus, taxi, Irish Rail, Luas, and DART) at stations along the route. There will be an automatic fare collection system compatible with an integrated ticketing scheme with other public transport offerings in the Greater Dublin Area (GDA). This will include the purchase of tickets at automatic ticket vending machines (ATVM), smart card validators and means to top up smart cards, gate-free access to the station platforms, portable control devices for staff to check fares and links with the OCC and banking facilities for central collection of fares. Circulation through the stations will be guided by wayfaring, announcements via Public Address and Voice Alarm (PAVA) and Public Information Systems (PIS). Passengers can seek assistance via passenger help points (PHP) at stations.
- **Security:** Secure boundary treatments are required along the surface section of the metro line to deter unauthorised entrance and vehicle restraint barriers to avoid road vehicles driving off roadways onto sections of rail in retained cut or ramming station entrances. Secure gated entrances for trains, road vehicles and pedestrians will be installed at Dardistown Depot. The stations will be open during operating hours, but the entrances will be closed at night outside operating hours. The safety of passengers has been considered in design features, such as the clear wayfinding, lighting design, the full height platform screen doors (PSD) and good line of sight in the urban realm areas. Passengers can call for help using PHPs at the stations which connect with an operator at the OCC. Operational staff will be able to monitor the stations, Estuary P&R, tunnels and the Dardistown depot via closed-circuit television (CCTV) and a single Access Control and Intrusion Detection (ACID) system from the OCC. Staff will be deployed from the OCC to help passengers when required.
- **Emergency Incident Management:** Safety features have been incorporated into the design of the stations and the tunnels to minimise the risk of fire and facilitate evacuation for staff and passengers, including passengers with restricted mobility. These features include the choice of fire-retardant materials and fire walls within the structures, intervention shafts at the stations via emergency stairs and at Albert Park no more than 1km apart, short intervention tunnels at the southern end of the Airport Tunnel and between the end of the City Tunnel and Charlemont Station, and emergency lifts for the use of the Dublin Fire Brigade. Active systems include fire detection, emergency lighting, signage, smoke exhaust, forced ventilation, CCTV, firefighting water supply and fire suppression systems, PAVA and PIS at the stations and on-board trains, and disconnection of trains from the overhead line. The rolling stock will incorporate safety features, such as evacuation via emergency doors from both ends of the train, use of fire-retardant materials in the body of the train and soft furnishings, door unlocking devices, and CCTV. Operational staff will be trained in emergency evacuation protocols.

6.4.1 Passenger Demand

The operation strategy of the proposed Project is driven by the forecasted passenger demand. The peak passenger demand profiles are important for the layout and design of the stations, ensuring safe and comfortable movements of all users between the entrances and the station platforms, the service frequency, and the rolling stock. The assumptions, methods and outputs of the passenger demand modelling are provided in Chapter 9 (Traffic & Transport) and associated appendices.

Passenger demand modelling has been used to predict the numbers of passengers boarding and alighting at each station, and the resulting passenger load on the proposed Project, for the years 2035 (the predicted opening year for the proposed Project), 2050 (design year taken to be 15 years after opening) and 2065 (forecast year taken to be 30 years after opening).

For the Forecast Year (2065), the peak demand for the proposed Project is during the AM peak with just over 15,000 passengers moving southbound and over 8,000 passengers moving northbound (Refer to Diagram 6.4 and Diagram 6.5).

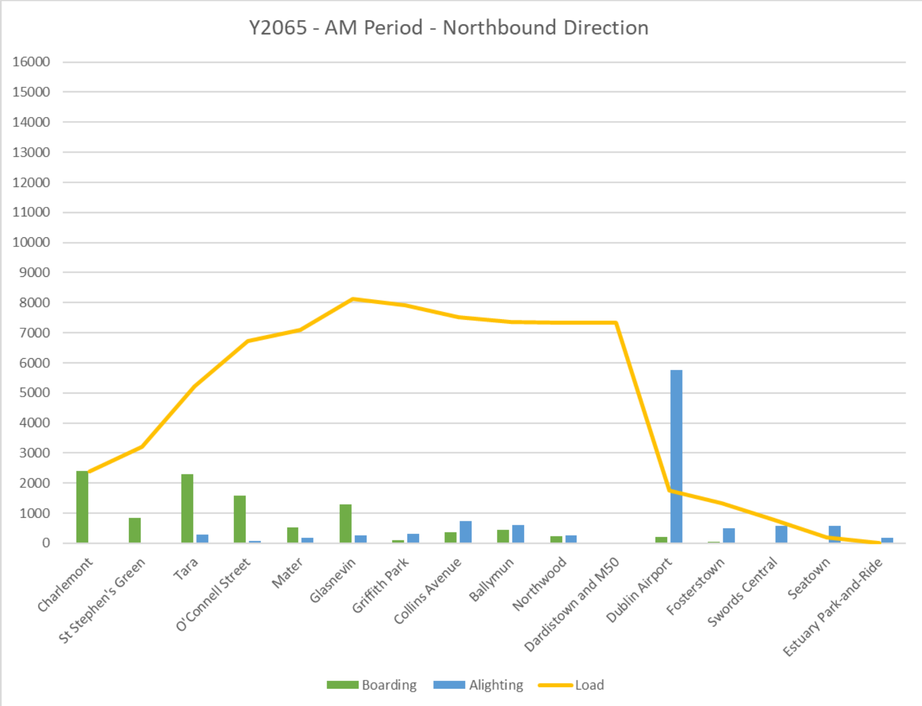

Diagram 6.4 Predicted Northbound Passengers during AM Peak for 2065

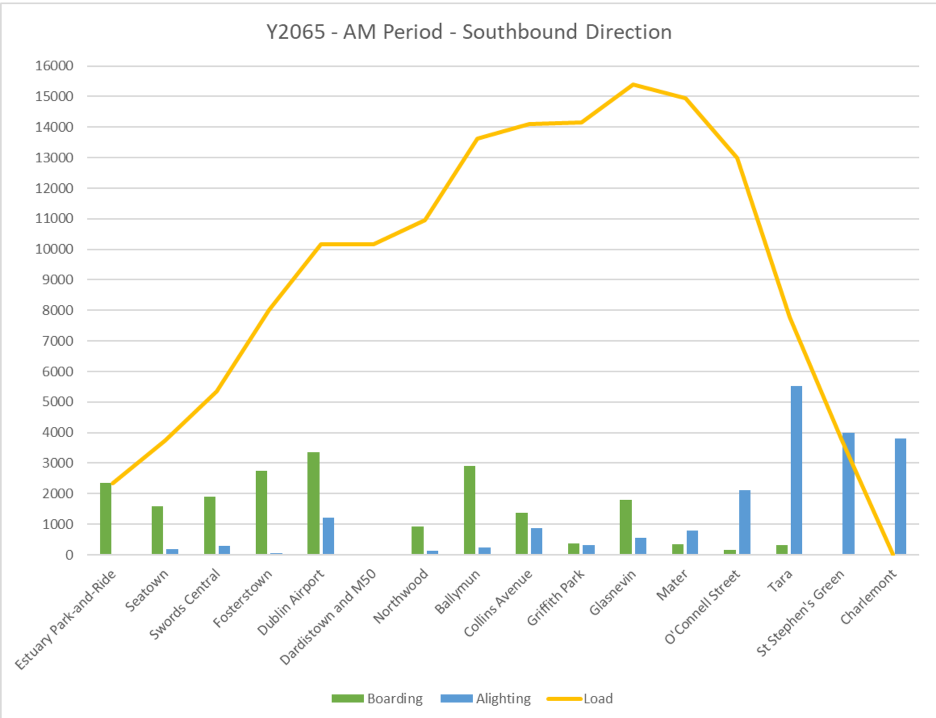

Diagram 6.5 Predicted Southbound Passengers during AM Peak for 2065

Previous passenger modelling identified that passenger numbers may peak at over 18,000 passengers for the AM peak southbound. On the basis of the modelling prepared for the proposed Project and allowing for future growth in capacity beyond the projection year, the proposed Project was designed to accommodate 20,000 pphpd.

6.4.2 Fleet Size

Based on the identified passenger requirement for the proposed Project as discussed above, the proposed Project fleet will comprise 40 trains for the Forecast Year (2065) and could be expanded should the proposed Project be extended further south of Charlemont.

6.4.3 Service Pattern

Demand will vary through the day and week, with different service levels provided to meet varying demand. It is anticipated that services will operate between 05:30 and 00:30, every day.

During peak hours all trains will run the whole line, that is the single loop from Estuary to Charlemont and back to Estuary.

As discussed in Section 6.4, due to the significant difference in passenger demand north of Dublin Airport, a double-loop system may be in operation combining a long loop and a short loop as follows:

- Long Loop - Estuary to Charlemont; and
- Short Loop - Dublin Airport to Charlemont.

During off-peak periods a double loop service will be provided. In this second case, the first train completes the entire loop from Estuary to Charlemont and back to Estuary, and the second follows the shorter loop, between Dublin Airport Station and Charlemont Station, resulting in a greater frequency of trains between the airport and Charlemont.

In the case of the double loop, the stations between Dublin Airport Station and Charlemont Station will have twice the train frequency as those between Estuary Station and Dublin Airport Station. This flexibility in the service pattern allows for the more efficient operation of the system with trains running more frequently where and when demand is greatest The service operational headway (amount of time between train arrivals at a stop) on weekdays, Saturdays and Sundays are presented in Table 6.2, Table 6.3 and Table 6.4.

Table 6.2: Service Operational Headway to Meet Demand - Monday to Friday

	Single Loop Strategy	Double Loop Strategy	
Timetable	**Operational Headway (seconds)**	**Operational Headway Dublin Airport – Charlemont (seconds)**	**Operational Headway Estuary – Dublin Airport (seconds)**
05:30 - 07:00 (Opening)	-	200	400
07:00 - 10:00 (AM)	100	-	-
10:00 - 16:00 (Lunchtime and School Run)	-	130	260
16:00 - 20:00 (PM)	120	-	-
20:00 - 22:00 (PM)	-	225	450
22:00 - 00:30 (Closing)	-	300	600

For Saturdays, Sundays and Public Holidays the frequency of service required are less than those for weekdays. The headways proposed for the weekend are outlined in Table 6.3 and Table 6.4.

Table 6.3: Service Operational Headway to Meet Demand - Saturday

Times of the Day	Operational Headway (minutes, seconds) Dublin Airport – Charlemont	Operational Headway (minutes) Estuary – Dublin Airport
05:30-09:30	7 mins 30 sec	15 mins
09:30-23:00	4 mins 30 sec	9 mins

23:00-00:30	5 mins	10 mins

Table 6.4: Service Operational Headway to Meet Demand - Sunday and Public Holidays

Times of the Day	Operational Headway (minutes, seconds) Dublin Airport – Charlemont	Operational Headway (minutes) Estuary – Dublin Airport
05:30-10:00	7 mins 30 sec	15 mins
10:00-22:00	5 mins	10 mins
22:00-00:30	7 mins 30 sec	15 mins

As can be seen from the tables above, the proposed Project service will run with highest frequency on weekdays during the peak periods, with an operational headway of 100 seconds during the AM peak and an operational headway of 120 seconds during the PM peak. During off peak periods, the operational headway between Dublin Airport and Charlemont is predicted to be 130 seconds, and double that between Estuary and Dublin Airport.

Service frequency is reduced on weekends and public holidays to reflect lower demand during these periods.

There will be occasions when a 'degraded' service is offered, for example due to a broken-down train resulting in a less frequent service. The nature of the degraded service will depend on the problem and passenger demand.

6.5 Railway Systems

This section of the Chapter describes the railway systems that ensure that the proposed Project will operate effectively on a day-to-day basis. It covers:

- Communications-based train control; and
- The rolling stock.

This section should be read in conjunction with the EIAR Chapter 4 (Description of the MetroLink Project) which describes the physical infrastructure required to implement these systems.

6.5.1 Communications-Based Train Control

The signalling system proposed for MetroLink to meet the requirements of GOA4 operation will be a Communications-Based Train Control (CBTC) system. The purpose of the CBTC system is to ensure safe, reliable, and cost-effective automatic train operation for the complete service. The CBTC system proposed comprises central, trackside and onboard equipment with dedicated software to provide all the functions for Automatic Train Protection (ATP) and Automatic Train Operation (ATO) (which together form the Automatic Train Control (ATC)), and Automatic Train Supervision (ATS).

- ATS acts as the interface between the operator and the CBTC system, managing the train service according to specific criteria. It provides the overall supervision and control for the train service, including status information for the central operator located at the OCC.
- ATP is a safety system which provides the primary level of protection for passengers, personnel and equipment against operational hazards.
- ATO operates the trains during transit between stations following the instructions provided by the ATS and as restricted by the ATP. The ATO performs the operations that would otherwise be performed by the train driver.
- ATC supervises the trains within the CBTC territory and manages the 'movement authorities' sent to the trains. The CBTC territory comprises the whole of the alignment between Estuary and Charlemont, the tracks to the Depot and some movements within the depot. It does not include tracks within the depot where the trains are driven manually and in the maintenance workshops.

CBTC provides the following features:

- Precise and accurate of the location of each train;
- Continuous, high capacity, bi-directional data communication between each train and wayside equipment; and
- On board and wayside processors performing vital functions.

The CBTC and its supporting communications network is a highly reliable, fully duplicated system with redundancy built in, so that failure in one part of the system is replaced by another part of the system, so that operational failures are extremely unlikely.

The CBTC interfaces with other systems, including the PSDs, communications systems and Supervisory Control and Data Acquisition (SCADA).

6.5.1.1 Moving Block Principle

CBTC uses a moving block principle whereby a safe distance is maintained between trains as the software on each train continuously calculates the zone over which the train can move based on real time operating speeds, braking curves, and real-time locations of the trains on the track. During the peak hours, trains run as close to each other as safely as possible (the minimum operational headway), achieving the maximum transport capacity.

The authorised movement of a train moves progressively along the track as the train continues on its journey, taking into consideration factors such as the weather conditions, speed limit of the track, the position of all other trains, the position and direction of travel of the train itself to which the authorised movement limits applies, train routing, the maximum distance allowed for an authorised movement. In addition, in the tunnel sections, restrict train movements by allowing one train in each direction between two ventilated zones. In most cases, the ventilated zones comprise the section between stations, except where the distance is greater than 1000m, where intervention and ventilation shafts have been provided.

The trains can be operated in different modes, e.g. a train in readiness for operation, a train on the mainline with or without passengers under normal operating mode and emergency mode, and, in different parts of Dardistown Depot, including automatic movements through the automatic train washing machine and in manual mode in the maintenance workshop and in testing stations. The management mode will govern subsystems such as Heating Ventilation and Air Conditioning (HVAC), lighting, communications, and passenger information.

6.5.1.2 Supervisory Control and Data Acquisition

SCADA comprises hardware and software to collect, analyse and visualise data collected from electro-mechanical equipment to aid remote control and management. SCADA brings together all the signals (alarms and status messages) needed for the operation of the trains, stations and the depot; displays these signals graphically on computer screens, and provides alarms and tables for the OCC operators and maintenance operators.

The control of SCADA will normally be carried out by operatives at the OCC (or back up OCC) during both normal operations and emergencies. However, in the event of a loss of communication between a station and the OCC, if authorised by OCC or if instructed by the Dublin Fire Brigade control of SCADA can be handed over to the station incident room.

The SCADA architecture is based on three sub-systems.

- Environmental Control Sub-System (ECS) - the SCADA ECS monitors and controls the sub-systems involved in safety. This includes ventilation and smoke extraction in the underground stations and tunnels during normal operating conditions and emergencies and the environmental conditions in the battery rooms. The ECS will interface with sub-systems monitored by the electro-mechanical sub-system (see below), to apply the right procedure to evacuate a station. These include the fire alarm panel, gaseous extinguishing equipment, station ventilation, stairwell pressurisation system, fire-fighting system, lighting, escalators and lifts, fire pumps and public announcement system.

- Power Supply Sub-System (PCS) - the SCADA PCS will control, supervise and monitor equipment required to supply electricity to power the trains and service the stations and depot, including the high voltage system, low voltage system, and substations. All traction power distribution equipment shall be controlled from the OCC where the SCADA operator will be able to supervise the state of traction power anywhere on the line and at the depot, transmit orders to traction equipment, and reconfigure the line, for example, through circuit breaker controls. The SCADA operator will be able to cut power to different parts of the line. The SCADA PCS will collect data on energy consumption and provide data for monitoring and optimising energy use.
- Electro-mechanical Sub-System (EMS) - the SCADA EMS will be able to monitor and control a wide range of electro-mechanical equipment, such as HVAC systems, escalators and lifts, pumps for wastewater and drainage water, fire pumps, station entry doors, PSDs, fire detection and fire extinguishing systems, and the compressed air system and the diesel generator at Dardistown Depot. The SCADA SMS will also collect data for use in maintenance operations.

SCADA will interface with other systems such as CCTV, traction power control, power supply to CBTC equipment, train position communication, tunnel lighting, pumps systems, fire detection and extinguishing and smoke exhaust.

6.5.2 Rolling Stock

6.5.2.1 Description

This section of the Chapter provides a general description of key features of the proposed rolling stock. Diagram 6.6 and Diagram 6.7 illustrate the indicative appearance of the rolling stock from the front and side views.

Diagram 6.6 Indicative View of the Train from the Front

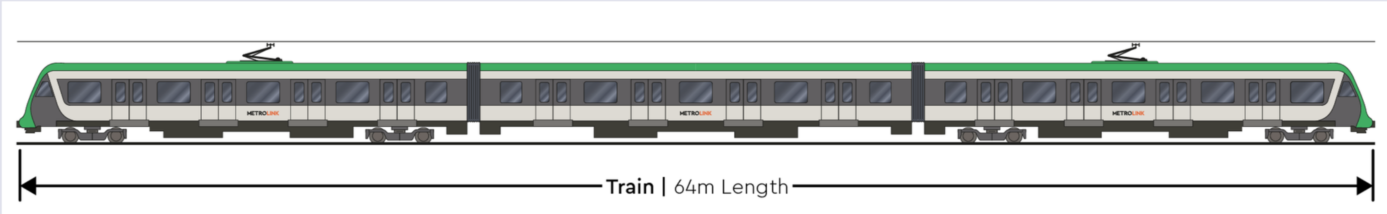

Diagram 6.7 Indicative View of the Train from the Side

The rolling stock to be used in the proposed Project will be electrically powered, high floor trains, which like heavy rail trains, require higher platforms to get onto and off the trains. The platform height and train floors will be at the same level to provide step free access onto and off the trains.

Each train will have three or four cars with an estimated maximum capacity for up to 500 passengers with room for approximately four people per square metre and seating for at least 100 passengers assuming ≥20% seating. The trains will be 64m long, slightly shorter than the 65m platform length, and 2.65m wide for a 1,435mm track gauge. Subject to the final specification for the rolling stock, the trains are expected to have twelve double doors on each side of the train. There are likely to be two pantographs on the roof of each train, one towards each end of the train, which will be in contact with the catenary system that supplies the electrical power to the train.

The interior of the carriages will be free of obstacles that could lead to falls or injuries of passengers. Handles will be positioned along the carriageway for standing passengers to hold onto. The train windows will be designed to provide maximum visibility for standing and seated passengers. The train floors will meet requirements to provide heat resistance and thermal insulation as well as good noise and vibration insulation. The lighting of the train will ensure luminosity in all areas of the train during normal operations and emergencies. The HVAC system will control the air renewal, temperature and the humidity on the trains. The system will be capable of renewing the air inside the train during a fire to exhaust the smoke and stop this process should toxic smoke be detected on the outside of the rolling stock. The materials used in the body of the train and furnishings will comply with fire resistant requirements. The fire resistance standard for the rolling stock and traction system will ensure that the trains will keep moving for at least four minutes at an average speed of 80 km/h, which is sufficient to arrive at the next station. Further discussion of emergency situations is provided below in Section 6.6.5 on evacuation from the train.

The trains will be fully automated (GOA4) and controlled from the OCC as described above in Section 6.4. Further discussion of the Grades of Automation (GOA) is provided in the EIAR Chapter 4 (Description of the MetroLink Project).

For GOA4 trains, the starting and stopping of trains, operation of train doors, and handling of emergencies are fully automated. The trains do not require a driver, although the driving mode can be changed from automatic to manual so that the trains could be driven manually, for example within Dardistown Depot. Operational staff will be available on the trains and at the stations to assist passengers. Further information on staffing is provided in Section 6.11.

6.5.2.2 On-Board Systems

The rolling stock will be equipped with a range of on-board systems to meet the safety and operational requirements of the line. These are classified into three groups: on-board systems required for signalling (CBTC), command and control, and fire and safety. Some of these systems are part of the line-wide systems and are discussed further in Section 6.7. A separate section on security and safety is provided in Section 6.6.5.

6.5.2.2.1 On-board Systems Required for Signalling (CBTC)

The CBTC is described above in Section 6.7.1 and information on the installations required on the train, along the wayside and at the OCC is provided in Chapter 4 (Description of the MetroLink Project). The on-board equipment required to operate the CBTC include the computer, odometer (to measure the train's movement along the track), a doppler (to measure speed and distances), a beacons reader to pick up signals from beacons placed trackside, and bi-directional radio devices via Wi-Fi to communicate with track-side equipment. The systems will allow automated trains to meet the service pattern and to function correctly in an emergency.

6.5.2.2.2 On-board Systems Required for Command and Control

Command and control systems will be connected by diverse radio networks depending on their function and bandwidth.

A radio communication system will provide bi-directional communications between the train, wayside equipment and the OCC. This network will have a relatively high band width compared with the small band width of the operational radio system described below, which will allow the transmission of large volumes of data while the train is in service. The ethernet train network (ETB) on board the train will connect the emergency communication system, the PAVA, PIS and CCTV with the radio communication system and two radio communication system antennae on the roof of the train. The radio communication area will be extended to the Dardistown Depot and data may be downloaded and uploaded when the train is in the stabling area, such as high-quality real-time CCTV imagery and maintenance data from on-board devices.

An operational radio system for the bi-directional communication between the train and staff for voice and data communications will be provided. Two radio antennae will be installed on the top of each train, both connected to one on-board radio device. The OCC operator will be able to send predefined data messages to individual trains or several trains in an area, send text data messages and start a distress call. When the train is operated in manual mode this system will allow the driver to talk with the OCC, the maintenance team and other train drivers independent from the radio communication system. For example, the operational radio system would be used to communicate between drivers in two trains and the OCC during shunting manoeuvres. In the event of failure of the radio communication system, low quality CCTV, emergency communications systems, and communications from the PAVA can be transmitted via this system.

Wi-Fi will be available for passengers via access points installed along the train and wayside. This system will not cause any interference with the other radio systems on-board the train.

A recording unit will be installed on the train to record operational data which would be evaluated as part of any accident investigation.

Further information on linewide communication systems is provided in Section 6.6.3.

6.5.2.2.3 On-board Systems Required for Fire and Safety

The trains will be equipped with a fire detection system, including an auto-test function to detect any failure in the system and communicate that to the OCC, incorporating very early smoke detection equipment to detect a fire before it has time to get hold. This system will be able to identify the location of the fire along the train.

The trains will be equipped with smoke exhaust systems to maintain air quality as far as possible in the event of a fire. Each carriage will have at least two extraction points, one at each end. The smoke exhaust system can be activated within the carriage by the fire detection system or remotely from the OCC.

The trains will be equipped with emergency panels for use by passengers. These panels will incorporate an emergency alarm (a button or handle) and an emergency intercom. When triggered, the on-board emergency alarm will notify the OCC and will allow the train to reach the next platform in order to prevent unattended evacuation between stations. If the train cannot reach the next platform or is already at a standstill, the system will immobilise the train. The alarm will also activate the adjacent emergency intercoms between the train and the OCC operator. The emergency panel will be placed at a level accessible to people with disabilities (motor, visual, hearing and sensory).

Each door will be equipped with a door unlocking device, which when unlocked will also activate the emergency intercoms. A separate emergency door release will allow the emergency services to access the train from the outside.

The trains will be equipped with manual fire extinguishers for different types of fires, accompanied with an explanative poster. The passenger area will be equipped with a water mist system to suppress fires, connected with an on-board water tank sized to operate for no less than 10 minutes.

On-board PAVA and PIS will convey messages to passengers. Subject to data protection impact assessment and compliance with the General Data Protection Regulation (GDPR), on-board CCTV will be in operation and will record and can be monitored from the OCC in real time.

The trains will be equipped with emergency lighting to provide minimum levels of illuminance in the event of a power failure and signage on what to do in the event of an emergency.

The train will also be fitted with derailment detectors, obstacle deflection equipment, and an emergency braking system to protect the trains against derailment.

6.5.2.3 Interaction between the Train Doors and Platform Screen Doors

Passenger train doors will interact with PSDs to enable safe and efficient transfer of passengers. The train doors and PSDs will open when a train arrives at its berthing position in the station and the train has stopped in the expected position. If this is not the case, the train doors and PSDs will remain closed due to an inadequate berthing position. Consequently, the PSDs and the train doors will open only when they are fully aligned and they will open and close synchronously. The train will not be able to move as long as the doors are open. When the dwell time has elapsed, the doors will close automatically.

If the PSDs are open while the train is approaching, the train will be stopped before the platform. If the train is too close to the platform, or already within the platform area, the emergency brakes will come on. If the train doors are not indicated as closed by the system on board the train, for example due to a defective door, the traffic controller at OCC can by-pass the command on board to close the doors.

The provision of PSDs along the edge of the platforms at all stations is essential for a metro with GOA4 and a short operational headway. The benefits include:

- Preventing people from accidentally or intentionally falling onto the tracks;
- Preventing or reducing wind felt by passengers in the underground stations caused by the piston effect, which could in certain circumstances cause people to lose their balance;
- Reducing the risk of accidents, especially from out-of-service trains passing through stations at high speeds;
- Improving climate control within underground stations (heating, ventilation, and air conditioning are more effective when the station is physically isolated from the tunnel);
- Improving security, restricting access to unauthorised personnel along the tracks and tunnel;
- Lowering operational costs by eliminating the need for drivers or conductors when used in conjunction with GOA4;
- Preventing litter build up on the track, which can be a fire risk; and
- Improving the sound quality of platform announcements because the background noise from the tunnels and trains that are entering or exiting is reduced.

6.5.2.4 Evacuation of Trains

Front and rear doors on trains will allow passengers to evacuate from either end onto the rail line in an emergency, as shown in Diagram 6.8. The front and rear evacuation doors will have an unfolding ramp that will allow the passengers, including people with reduced mobility, to leave the train safely during an emergency.

Diagram 6.8: Typical Ramp for Vehicle Evacuation

For safety reasons the doors will only be opened from inside the carriage and will have a system to ensure that the mechanism is closed and locked under normal operating conditions. If the closure check is lost or unblocked an alarm signal will be sent and the train will stop. A highly reliable and easy mechanism will be provided to open the door and unfold the ramp so that a passenger can activate the system in an emergency situation without any assistance. The ramp will be provided with a non-slippery floor to prevent falls during evacuations and when opened will provide a stable walkway down to track level. The slab track will be designed and installed to form an even walking surface without trip hazards. Further information on track design is provided in the EIAR Chapter 4 (Description of the MetroLink Project) and Section 6.6.5 of this document describes the evacuation procedures including protocols to halt trains on the affected section.

Front and rear doors are easier to exit in the tunnels, cut and cover, and retained cut sections compared with emergency doors along the side of the trains where access may be obstructed following an incident. It would also be easier for passengers to walk along the slab track than the narrow sidewalks alongside. People with reduced mobility can also evacuate more easily from the front and back of the train with the help of other passengers and the slab track will be passable for people in wheelchairs.

Side evacuation will also be possible by releasing emergency door handles, but this type of evacuation does not include ramps or steps so can be difficult for some passengers to exit the train. This form of access may also be used by the emergency services to rescue people inside the train after the evacuation of other passengers.

6.6 Linewide Operations Systems

This section of the Chapter describes the linewide operations covering:

- The Operational Control Centre;
- Power usage;
- Communications systems;
- Heating, ventilation and air conditioning systems;
- Safety, security and emergency processes; and
- Lighting.

This section should be read in conjunction with the EIAR Chapter 4 (Description of the MetroLink Project) which describes the physical infrastructure required.

6.6.1 Operational Control Centre (OCC) / Backup OCC

The OCC will be the central communications and operational hub for the management of the proposed Project, located in the administrative building at the Dardistown Depot. The OCC will control and monitor all train services, station operations, maintenance activities on the main line and in the depot, and passenger safety and security. The OCC will direct staff at each station to manage local incidents.

In the event of a problem or issue with the main OCC system, a back-up OCC at Estuary Station will be available until the main OCC is restored to full operation. At Estuary, the backup OCC will be incorporated into the same building housing the traction substation and the room housing the utility connections.

The central command and control system directed from the OCC cover:

- Voice and data communications
  - Transmission networks
  - Centralised time synchronisation subsystem
  - Telephone
  - Operational radio system
- Security in stations, tunnels and depot
  - CCTV in stations and tunnels including evacuation shafts and depot
  - Access control and intrusion detection (ACID) along the entire transit system
  - PSDs in stations
- Provision of information to passengers in the stations and on-board the trains
  - PAVA
  - PIS
- Remote control, monitoring and management
  - SCADA
  - OCC

The OCC will be equipped with the hardware, furnishings and software required, including technical equipment (servers, computers, video screens, keyboards, etc), computing, a video wall based on screen modules managed by a dedicated controller, a dedicated fire protection system, HVAC equipment for the rooms housing the electrical installation and switchboards, equipment for the ACID system, and furniture for the operators. The OCC will be operational 24 hours a day, 365 days of the year. Indicative staffing levels and roles and responsibilities are discussed in Section 6.11.

6.6.2 Power Usage

The key features of the power supply system and efficiency measures are described in Chapter 4 (Description of the MetroLink Project). The power supply system will be required to provide power to operate the rolling stock and all elements of infrastructure that form part of the proposed Project system such as station lighting, ventilation and back of house services. Traction power refers to the force that drives the trains forward which for MetroLink is provided by electricity.

Power for the system will be provided by way of two distinct High Voltage (HV) 110kV connections to the system, one at Dardistown adjacent to the depot and a second at the site of the DANP. It is estimated that the total proposed Project power system will be required to be rated at minimum of 51 megavolt-amperes (MVA) to supply sufficient power to all the proposed Project systems.

The power is transmitted to the trains via the catenary system in a safe and efficient way. Two catenary systems are proposed:

- **OCS – Overhead Contact System:** the OCS is formed by a contact wire and messenger/catenary wire suspended from poles on both sides of the railway line. The wires are auto tensioned that allow spans of up to 55m between the poles. The OCS will be installed in open route sections where visual impact is a concern; and
- **OCR – Overhead Conductor Rail:** OCR is formed by a rigid aluminium bar and contact wire. It does not require mechanical tension and allows spans of between 10 to 12m between the supports. OCR will be generally used in tunnels, cut and cover, parts of the retained cut sections and in Dardistown Depot.

Further details on the power systems and catenary system are provided in the EIAR Chapter 4 (Description of the MetroLink Project).

6.6.3 Communication Systems

The systems used to communicate with passengers will meet universal design principles. Passenger information will be available in a variety of forms (both audio and visual) to cater for passengers with different needs.

Communications between all systems on the proposed Project will be provided by a diverse fibre optic network. This allows for communication between the OCC and all the communications system in the stations (e.g. CCTV, PAVA, and PIS), on the trains, and lineside, including signalling access points.

Radio and Wi-Fi systems are provided for track to train communication, including operational voice, signalling, passenger to OCC and public mobile operators. Provision has also been made for the operation of the emergency services radio system through the underground sections.

The key elements of the integrated communication system are described briefly below.

Operational systems for normal mode and emergencies (see also Section 6.5.2.2 regarding on board systems):

- Operational Radio System - This system is designed to allow communications among MetroLink staff in all areas along the line and on board the trains for communication between the OCC and personnel. This system will be independent of the separate systems used for the current TETRA radiocommunication system used for the Luas line and by the emergency services;
- Emergency Services Radio - MetroLink will provide dedicated coverage of TETRA in the stations, tunnels, retained cut and cut and cover sections. The TETRA system used by the emergency services will provide coverage along the at grade sections of the railway without any additional installations by MetroLink;
- Telephone system - This system includes the PHPs and EHPs at the station for members of the public and staff; telephones at the stations at various locations such as near the track, in the technical rooms, in the station incident room, near the traction substations, and in underground stations at the muster room and emergency access areas; at Dardistown Depot; lineside emergency telephones at key locations such as the tunnel portals, by switches, at train turnback positions, and by emergency exits; and administration telephones at the OCC and backup OCC. The telephone system will be integrated with the operational radio system to allow for redundancy, the central clock system to obtain an accurate time reference, and CCTV to record users of the PHPs and EHPs. There will also be external lines for OCC operators to contact the emergency services;
- An onboard Wi-Fi system for operational purposes; and
- SCADA system.

Passenger focussed communication systems:

- CCTV - CCTV will be installed at the Estuary P&R, all the stations, Dardistown depot, along cut and cover sections over 61m long, at trackway accesses, emergency exits, at the tunnel portals, throughout the tunnels and on the trains. The CCTV will provide general security and surveillance of all the public areas and monitor passengers' movements in specific areas such as in and around stairs, lift interiors, doorways, escalators, emergency help points (EHP) and ATVMs. The CCTV posts at the cut and cover sections, tunnel portals and within the tunnels are to detect intrusion, provide a visual aid to detect fire and monitor the evacuation of passengers from trains, and support the emergency services. CCTV will also be installed on the trains to monitor passenger behaviours, observe lost property, check on well-being of passengers and ensure that no one is on the train at the end of the service. Enhanced lighting will be provided at locations where continuous surveillance with CCTV is required for safety and security reasons. The CCTV will be monitored from the OCC and videos stored for later viewing, with a duplicate system at the backup OCC. Only authorised personnel will be able to access CCTV records. To maintain evidential integrity in case the recordings are used in a court of law, all recorded images will include a robust embedded invisible watermark of information. The CCTV will be integrated with other systems, notably the telephone system and ACID;
- PIS - PIS provides a broadcast text-based information system to the travelling public. This system will link PIS displays throughout the network and with the OCC. At the stations PIS will provide real-time information visible from the platform on the train services, such as the waiting time for the next train, the destination of the incoming train, stations served or any incidents affecting the service. Messages and safety information will also be displayed. On board the trains, PIS will provide information on the service in real-time, as well as other information such as safety messages. PIS will interface with the PAVA system so that announcements are converted to text and displayed and with the Master Clock System to show the time accurately. PIS will also be monitored through an interface with SCADA;
- PAVA - PAVA will facilitate the broadcast of operational, security or emergency messages to passengers at stations, staff in the depot, and people on board the trains. Under normal operating conditions, the pre-recorded messages are announced automatically. When required, messages can be made by an operator at the OCC, at the station incident room, or on a train by a member of staff. The PAVA system is interfaced with the Data Communication Network System and the Central Clock System;
- Wi-Fi - radio hardware to provide passengers with access to Wi-Fi will be provided in the stations and on trains. The system will be supported by wayside antennae communicating with onboard antennae installed in the trains. The trains will also be equipped with Wi-Fi access points fixed to the roof of carriages;
- Passenger Help Points and Emergency Help Points - PHPs and EHPs will be located in public areas for use by passengers to communicate with the OCC through the MetroLink telephone system. This system will be linked with the CCTV system so that operators at the OCC can view the scene; and
- Public mobile network (including underground service) - this will be provided via TETRA (Terrestrial Trunked Radio).

The control, communications, SCADA and signalling systems will be monitored and managed by the OCC.

6.6.4 Heating, Ventilation and Air Conditioning Systems

6.6.4.1 Normal Operation for Passenger and Staff Comfort

During the Operational Phase, the Heating, Ventilation and Air Conditioning (HVAC) system will be provided within the stations and on the trains as discussed in Section 6.5.2 to ensure comfort and fresh air for passengers and staff and prevent over-heating of sensitive equipment.

The surface station at Estuary and the stations in retained cut are open to the weather, so HVAC systems will not be provided to the public areas. HVAC systems will be limited to the BOH rooms housing sensitive electronic equipment.

In the underground stations, HVAC systems will be provided to achieve an acceptable level of thermal comfort through ventilation in the public areas. These areas will not be heated or cooled, because the temperatures underground tend to be relatively stable, with slight variations between summer and winter. Ventilation will also be provided in the BOH rooms such as the station work areas, the telecom rooms and technical rooms. Fresh air will be provided through ventilation which will be filtered. Air conditioning will be provided in rooms used by staff and emergency services (the offices, station incident room, and muster room for the Dublin Fire Brigade) and in rooms housing sensitive equipment (uninterruptible power supply (UPS), battery room, variable speed rooms, telecom room and signalling room). In addition, the HVAC system will include hygro-thermal requirements (moisture and heat) for sensitive telecom equipment.

The air inlets and outlets at surface level shall be sufficiently low so that they do not present a risk to people or surroundings and the position of the inlets and outlets will be such as to prevent recirculation of air or intake of polluted air. Should there be a need to remove heat from the upper levels of the station, which can occur in some peak summer months, the ventilation system can exhaust the hot air. The noise emanating from the ventilation system will also be limited to acceptable values through design.

The tunnel ventilation system will use the train piston effect to extract heat and renew the air in the tunnel. This approach has the benefit of reducing energy consumption. The signalling system will manage train movements so that there is no more than one train per ventilated section.

The tunnel ventilation elements comprise the ventilation shafts, Over-Track Exhaust (OTE) systems and tunnel jet fans. The ventilation shafts are provided at both ends of the underground stations. In addition, there are two intermediate ventilation shafts, one in the Airport Tunnel between Dublin Airport and Dardistown stations exiting by the DASP and a second between Collins Avenue and Griffith Park stations exiting at Albert Park. Each shaft contains three reversible axial fans, one of them on stand-by, which can inject air in or extract air out of the tunnel. The fans will be fitted with silencers to attenuate operational noise. The fans in the ventilation shafts are also used for the OTE systems in the tunnels.

The OTEs are placed over the trackway zone where the trains stop in the station. This position enables the efficient extraction of heat produced by the train.

Jet fans are located inside the tunnels suspended from the roof and spaced equally between the north and southbound tracks. The jet fans are designed to help ventilate shafts, drive air horizontally along the tunnels, and provide ventilation in enclosed sections not equipped with ventilation shafts, such as the cut and cover sections in the northern part of the line.

Temperature sensors in the tunnels and at the underground stations will provide the necessary information to activate the tunnel ventilation system. Anemometers will monitor air flow speeds and in normal operating conditions will adjust the fans if required and in the case of a tunnel fire will confirm achievement of the required air speed in tunnels. Opacimeters will measure the opacity (clarity) of the air and be used as smoke detectors when CCTV is not operative.

Ventilation will control the difference in temperature between the underground sections and the open air. This control will be based on real-time temperature measurements along the enclosed parts of the track and measures at street level near each station. The system will operate in three modes: operation mode with normal train service when the piston effect contributes to heat removal; congestion operation mode when a train is stationary in the tunnel and the piston effect disappears and mechanical ventilation may need to be increased to prevent temperature rise, and maintenance operation mode when there are no trains operating.

6.6.4.2 Emergency Situation

In the event of a fire, the ventilation system will be capable of exhausting the smoke without affecting adjacent station platforms or the following tunnel sections. The tunnel emergency exits and the firefighting accesses to tunnels will be over-pressurised to create safe paths for evacuation of passengers and entry of the emergency services.

Should a fire break out on a stationary train in the station, the ventilation and OTE systems will exhaust smoke from above the train and from the platform.

It is unlikely for a fire to occur on a stationary train in the tunnel, and the aim would be to move the train to the next station. However, if this happens, the ventilation system will draw the smoke in one direction and evacuation should proceed in the opposite direction.

The HVAC will be controlled and monitored by the SCADA system at the OCC, as different information from sensors along the line and from the signalling system are essential to select the appropriate strategy, both during normal operations and in an emergency.

6.6.5 Safety, Security and Emergency Evacuation Processes

6.6.5.1 Introduction

The proposed Project is complex with multiple locations, rolling stock to be operated and maintained, complex operating protocols and a sizeable workforce interacting with very large numbers of passengers in a large urban area. Safety is a key factor that has informed the project design from the earliest stages e.g. through designing a safe and comfortable environment for passengers, considering evacuation from the trains, stations and tunnel in the event of an incident, and designing the CBTC systems to manage the operation of the service safety. During the operation of the proposed Project safety will be maintained in line with a Safety Strategy comprising a set of actions, systems and procedures aimed at minimising risks to the safety of passengers and the workforce, having regard to the European Regulations on Safety in Railway Tunnels (SRT-TSI, Regulation (EU) 1303/2014).

6.6.5.2 Safety and Security Staffing

The staff working at the OCC will be responsible for supervising the service, train management, power supply, customer support and security. Further details on the roles and responsibility of the OCC staff are provided in Section 6.11. In the event of an incident, they will be able to direct the response through controlling aspects of the train service (such as opening and closing trains doors, and controlling lifts and escalators), monitor events through CCTV in the stations and on the trains, respond to fire detection systems and anti-intrusion alarms, direct staff working at the stations and present on the trains to mobilise to the incident site, and liaise with the emergency services.

At each station there will be a station incident room, which will be unattended during normal operation. The station incident room can be staffed locally to operate and control station systems, including associated sections of tunnel, without connection to the OCC during any emergencies or incidents.

6.6.5.3 Emergency Evacuation from Surface Stations

For the purposes of the Fire Strategy, the surface stations comprise Estuary station which is at grade and the stations along the R132 in retained cut (Seatown, Swords Central, Fosterstown and Dardistown), as they are all open to the atmosphere.

Estuary station is fully open so passengers can evacuate away from the train and station from both platforms without hindrance.

The stations in retained cut are on two levels, the street level which functions as the main access to the station and the lower level generally at about -6.5m below ground where the northbound and southbound platforms will be located between retained walls. Each station is covered by a canopy. The entrance at the northern end and platform levels are connected by two sets of stairs and two lifts with 12 passenger capacity, except for Fosterstown station which has escalators and lifts but not stairs, reflecting the higher passenger forecasts. At the southern end of each station there will also be emergency stairs from each platform to the street level and an outdoor assembly point. This design provides for two alternative exits on both platforms with the distance between the evacuation point and egress being less than 100m. The width and capacity on the stairs are designed to help clear the platform in 4 minutes or less and clear the station in 6 minutes. The BOH rooms are located under the northern entrance to facilitate evacuation of staff close to the main entrance. Depending on the circumstances, the escalators at Fosterstown station may be kept operational or stopped either locally at the station or centrally at the OCC.

The structure of the stations and the materials used in the interior wall and ceiling finishes will comply with all applicable standards on fire resistance, the use of non-combustible materials and the minimal fire rating for different parts of the structure to contain the fire. Smoke inhalation is a lower risk given the open nature of the stations and natural ventilation compared with the underground stations. The architecture of the stations is described in Chapter 4 (Description of the MetroLink Project).

The Dublin Fire Brigade could use either the main public stairs or the emergency stairs at the southern end of the platform to access the station. Each station will include a station incident room where the emergency control panels will be located for operation during an incident.

The protocol for the evacuation of the surface stations includes:

- Release of security-controlled doors to facilitate evacuation from the station e.g. unlocking accesses and the doors to the technical rooms in the BOH;
- Escalators operating in the opposite direction to the egress will be smooth stopped;
- The PAVA system will broadcast pre-recorded messages to guide the evacuation and ask passengers to keep calm;
- Any equipment which can interfere audibly or visually with the alarm will be deactivated;
- All lights will be forced upwards;
- All emergency lighting will be activated to provide maximum visibility for evacuation; and
- MetroLink operational personnel will be moved to the affected station to guide and supervise the evacuation.

If the incident is due to a fire in the station, then additional automatic procedures are:

- Immediate notification to the emergency services;
- Activating visual and audible alarms; and
- Activation of the gas extinguishing system if the fire starts in a technical room equipped with this feature.

6.6.5.4 Emergency Evacuation from the Underground Stations

The underground stations will lie at a similar depth and largely follow a similar layout with some variations due to their geographical location and position along the alignment such as the position of the entrance, pop-up features for ventilation grilles and lift shafts. Further information on the architectural and engineering design are provided in Chapter 4 (Description of the MetroLink Project). The majority of the underground stations will have three levels accessible to the public – the concourse level, mezzanine, and the platform levels. Northwood will have two levels, due to its shallower depth, and Glasnevin will have five levels as this station will connect with new stations on the Irish Rail Western and the South-Western commuter lines. Under-platform and under-track levels are reserved for utility and communication services only.

In most cases passenger circulation is based on a single access route along the longitudinal axis of the station box. The exceptions are Northwood, Glasnevin, Tara and Charlemont which have two entrances due to their urban location and anticipated pedestrian footfall.

The street and concourse levels are typically connected by a bank of two escalators and one set of stairs, with a second bank of escalators and stairs on the same longitudinal axis between the concourse and mezzanine.

The number and location of escape routes have been designed to evacuate the station platforms in 4 minutes and full evacuation of the station in 6 minutes to a point of safety. There are three evacuation routes from both platforms, via the escalators and the stairs to the mezzanine and the emergency stairs platform-mezzanine-concourse-street. From the mezzanine pedestrians can take the escalators and stairs to the concourse level where there is a place of safety (as the design guarantees the area is free from smoke affecting passengers), and onto the escalators and stairs to the entrance. The Dublin Fire Brigade will have two dedicated intervention lifts between the street and the platform, and one between the concourse and the platform, plus a protected stairway. The intervention lifts will also provide access to the under-platform areas. The lifts will be large enough to take a stretcher and attendants.

The emergency exits consist of automatic openings at street level, provided with an electric or hydraulic opening system, as well as manual opening. The top of the hatches will be covered in pavement sets to match the surrounding streetscape. Smoke exhaust grilles will be installed as far as possible away from the location of emergency exits or intervention shafts. Inlet air grilles will be installed at a height of 3.5m above the ground level to ensure that clean, unpolluted air is drawn into the ventilation system. Typical images and further details of the design for each section are provided in the EIAR Chapter 4 (Description of the MetroLink Project).

The facilities available to the Dublin Fire Brigade will include the station incident room, a storage room and a mustering room located at the concourse level and a mustering room located at the platform level next to the lift and emergency stairs.

A station fire could be identified in multiple ways, for example from fire detectors used in the stations, a passenger activating a push button, an OCC operator detecting a fire on CCTV or a passenger reporting a fire by station emergency phones or intercoms. Both the fire detectors and the activation of a push button alarm link to the OCC and the SCADA system will request confirmation to launch an evacuation. If an evacuation is required for causes other than a fire, the OCC operator will need to activate the evacuation scenario manually.

The evacuation protocol will be similar to that described above for surface stations, with the following additional actions:

- The sprinkler system will be activated in the area where the fire has been detected;
- Normal HVAC operation will be stopped except in the technical rooms;
- The emergency smoke exhaust system inside the station will be activated; and
- The over-pressure system in the emergency stairs will be activated to keep them smoke-free.

Incidents will be managed from the OCC, with all incident-related information and a meeting and incident room made available for use by the Dublin Fire Brigade and other emergency services. If the emergency only affects one station and train movement along the system is not affected, the emergency services could decide to go directly to the affected station where they can use the local station incident room where the main information from SCADA will be mirrored, and all station systems can be controlled.

As for the surface stations, the construction structure of the underground stations, materials and finishes will comply with all applicable standards on fire resistance, the use of non-combustible materials and the minimal fire rating for different parts of the structure to contain the fire.

6.6.5.5 Emergency Evacuation from the Railway Line

In the surface sections of the railway, there could be up to four trains running simultaneously between two stations, resulting in the potential need to evacuate up to four train loads of passengers. In the tunnels, the operational procedures will ensure that there will be a maximum of two trains in each ventilated section, one facing each direction (i.e. that is either between two stations or a station and a ventilation shaft such as the DASP or Albert Park Intervention Shaft), so the maximum number of occupants that need to be evacuated would be two train loads.

The evacuation time for incidents that occur along the railway line will depend on the length of the section and the position of the train. In the unlikely event that a train stops on the track and has to be evacuated, passengers will leave the trains via the front and/or rear doors, with ramps leading to the track slab as described in Section 6.5.2.4. Passengers will then move towards the nearest intervention shaft or station. The affected section of track will be declared unsafe to the signalling system so that other trains will avoid entering the section.

The equipment along the track is required to operate the line and provide for the safety of passengers. Much of this equipment is made of metal and plastics which are non-toxic and flame retardant. Examples include the catenary system, the rails wiring and trays, lighting, jet fans in the tunnels, CCTVs and small sensors. The structures along the alignment including those in the tunnel sections have been designed to be passable by evacuating passengers.

Intervention points are provided at least every 1,000m along the alignment of the bored tunnel to provide ventilation, safe egress for passengers from the tunnel to the surface in an emergency, and access for the emergency services to the tunnel. Most of the intervention points are integrated within the station layouts and incorporate the following elements:

- Stairs which are designed as two-way stairs sized for 28 persons/m/min;
- Firefighters' lifts for equipment and personnel and for the evacuation of people with reduced mobility;
- A specific area for people with reduced mobility to assemble for access to the fire lift;
- A ventilation system to maintain clean air in the shaft; and
- A room for electrical equipment.

Evacuation from the stations is described above in Section 6.6.5.3 and 6.6.5.4. At the intervention shafts and tunnels, the exits will be via emergency doors leading to the stairs and lifts. Further information on the stations and intervention shafts and tunnels is provided in the EIAR Chapter 4 (Description of the MetroLink Project).

In the event of a fire within a tunnel section, it will be necessary to activate ventilation systems in the two adjacent stations:

- Forced ventilation will blow smoke in the opposite direction to the evacuation of passengers;
- Passengers will alight from the train and continue along the track to an emergency exit; and
- Along the track there is only equipment necessary to ensure the operation of the line and safety of passengers.

6.6.5.6 Fire Service Access and Facilities

A Fire Safety Strategy summarised below for the proposed Project has been developed in liaison with Dublin Fire Brigade. The Fire Safety Strategy includes:

- Safety features at stations to minimise the risk of fire;
- Safety lineside features within tunnels and other sections such as, but not limited to ventilation, CCTV, signage, lighting, firefighting water supply systems;
- Proposed emergency evacuation protocols to be adopted for emergency events along the railway line and at stations;
- Station specific information including drawings and evacuation calculations;
- Safety systems and features to be adopted as part of the formal tender requirements for rolling stock; and
- Fire safety information relating to the depot at Dardistown and the park and ride at Estuary.

Access to the tunnels for fire fighters will be at the underground stations or at the exit of the intervention shafts/tunnels at the DASP and Albert Park Intervention Tunnel.

All underground stations and intervention shafts/tunnels will have firefighting lifts with a lobby and protected stair shafts for firefighters to enter the tunnel and for the evacuation of passengers.

All stations will be provided with wet fire mains, fire water tank and pumps. At surface stations, the wet fire mains with outlets will be provided on both platforms together with a fire water tank and fire pumping room on one side of the platform. All underground stations will be provided with wet fire mains with outlets in the intervention and evacuation shafts, and the concourse, mezzanine, platform and under-platform levels. A water supply will be available within the tunnel for firefighters to access, fed from water tanks located within each station.

Some of the main electrical rooms within the stations will be protected with a stand-alone automatic gas extinguishing system, including the medium voltage substation (transformer room), the main switchboard room (low voltage), the signalling room, telecommunications room and the traction power substations (the latter at Estuary, Fosterstown, Dardistown future, Collins, Glasnevin, Tara and Charlemont stations).

Portable fire extinguishers will be placed in the BOH at surface stations and in public areas in the underground stations. Their removal from cabinets will trigger the fire alarms.

The underground stations will be fitted with automatic sprinklers which will be provided in some of the BOH rooms, namely the station operation room, administrative areas, resting rooms, dressing rooms, storage / cleaning / rubbish stores and mechanical rooms. Fire hose reels will be located close to the station exits on both platforms and their use will send an alarm signal to the fire alarm control panel.

Automatic suppression systems will be incorporated inside escalators based on a water mist system, activated by heat detectors that will send an alarm to the main fire alarm control panel. There will also be a manual activation button to the top and bottom of each escalator. A fire water tank will be installed in the under-platform level and connected to the sprinkler system, wet fire mains, hose reels and tunnel standpipes.

Further information on the location of fire service accesses and facilities is provided in the EIA Chapter 4 (Description of the MetroLink Project).

6.6.5.7 Emergency Signage

Emergency signage will be as follows:

- Signs to identify the emergency exits;
- Signs to identify equipment to be used by emergency services; and
- Directional evacuation signs.

Signs will be designed according to best practice for visually impaired users.

The lighting system on the PSDs will convey a message to passengers not to enter the train if a technical failure has been detected or in a scenario where the station has to be evacuated.

Audible communications systems will also be used, namely the PAVA.

6.6.5.8 Other Incidents

Other incidents in addition to fire have been considered in the design and operation of the proposed Project.

- **Hostile Vehicle Attacks -** The entrances to all stations have been designed to include Hostile Vehicle Mitigation Bollards which will stop any vehicle entering the stations;
- **Loss of Vital Signalling -** The CBTC is a highly reliable system, but in the unlikely event of a failure, if the train stops along the track a managed evacuation may be instigated or the train may continue to the next station before stopping. If the PSDs fail to open automatically, they can be opened manually;
- **Loss of Communications -** This may involve the loss of on-board CCTV, loss of PAVA or PIS (screens and displays) and loss of dynamic evacuation signage. If the train is running normally when the loss of communications occurs, it will continue to the next station, the passengers disembarked and the train taken to the depot for repair. In an emergency situation, the train may continue to the next station and the PSDs will be opened automatically so that passengers can

disembark. If the train stops between stations, the section will be declared unsafe to the signalling system, other trains will avoid entering this section, those already in it will be moved away, the doors will be unlocked once it is clear no other trains are passing and the passengers can evacuate;

- **Mute Train -** In the event of a train losing all communications, if it is in a station it will be held there and if it is moving the emergency brakes will be applied. The section of track will be declared unsafe to the signalling system so that other trains will avoid entering it and staff will be sent to the train to check whether the emergency handle has been opened automatically or manually to effect evacuation;
- **Loss of Power -** The power system is designed with several levels of redundancy, with several substations, a ring network, standby transformers, batteries and UPS for the most critical elements. Equipment failure will be corrected as quickly as possible with the action taken dependent on the nature of the failure. Critical on-board and lineside systems needed to ensure evacuation will be powered for at least 90 minutes through back-up supplies. This includes emergency lighting, PSDs, the PAVA system, CCTV, dynamic signage, doors unlocking and opening, emergency communication, and on-board smoke exhaust. The only exception is the ventilation in the tunnels which will be ensured through equipment redundancy;
- **Floods -** In the event of extreme rainfall and floods, the SCADA system will report alarms based on level sensors installed within the drainage system and excessive operation of drainage pumps, which would alert OCC operators. Staff may be sent to specific locations to observe the flood risk. The PIS and PAVA systems in the stations and on-board trains will alert passengers about delays to services should the service need to be halted;
- **Aids During Evacuation along the Trackway -** The design of the train and slab track allows for the evacuation for people in wheelchairs reaching the bottom of the intervention shafts and stations from where they should be evacuated via the emergency lifts. PIS and PAVA systems will provide audible communications to passengers on trains and in the stations. Emergency panels on trains will include Braille text. Visual systems such as displays and LED strips will inform passengers on how to evacuate in the station and on trains. In the tunnels, the CCTV will allow OCC operators to monitor evacuation. Tunnel ventilation will ensure a smoke-free path for more than an hour which should be sufficient time to mobilise assistance for people who are struggling; and
- **Vandalism or Anti-Social Behaviour on the Trains or within the Stations -** MetroLink has been designed as an open system for passengers, so that people can walk through the station and onto the platforms without obstruction. The PSDs will stop people accessing the track from the stations. A security fence will be installed along the whole of the above ground sections of the railway and at the tunnel portals. One of the outcomes of the architectural and urban realm design is to discourage anti-social behaviour, for example through the attractive setting, use of public lighting, open sight-lines, and avoidance of areas where individuals and groups of people can hide. Vandalism and anti-social behaviour on the trains and within the stations will be observed through CCTV and if required staff sent to manage the situation. The ACID system will also identify intruders trying to enter locations where unauthorised access is prohibited. It will also cover the platform doors to the track (surface and retained cut stations) and to the tunnel (underground stations); entrances to technical rooms, the station incident rooms, and stations (outside operational hours); access to the mainline tracks; entrances to facilities at Dardistown depot (test racks, workshops, garages, OCC, technical rooms, storage areas, offices, and emergency doors); the back-up OCC: electricity sub-stations; tunnel portals; shafts and ventilation shafts and emergency doors. ACID will be integrated with the telephone system, CCTV, SCADA, Fire Alarm System and the Central Clock System.

Subject to a Data Protection Impact Assessment and compliance with the General Data Protection Regulation, there will be a single CCTV system and a single ACID system serving all stations, tunnels, substations, and depot, and managed from Dardistown Depot.

6.6.6 Lighting

6.6.6.1 Public Lighting

Public lighting will be installed on the new roads, at parking areas and at the stations. Luminaires will be mounted on 8m to 12m columns for roads and parking areas, with the height reducing according to area and traffic flow i.e. a residential road will have an 8m column, but a busy dual carriage way interchange will have 12m columns. The plaza and station access areas will have luminaires mounted on 6m to 9m high columns for the pedestrian only areas and 8m-10m high columns for the bus stop and drop off areas.

All lights proposed for the proposed Project utilize LED (light emitting diode) light sources and will have dimmable drivers as future proofing. The lighting design minimises light spill beyond the roads and pedestrian areas wherever possible and uses luminaires with zero upward light in compliance with the Guidance Note 01/21 'The Reduction of obtrusive light' (Institute of Lighting Professionals, 2021) which can be downloaded free of charge from the internet. This is particularly key with the lighting near Dublin Airport due to the requirements to ensure street and amenity lighting does not obscure or get confused with airfield guidance lighting.

Areas to be planted with trees and/or other variable obstructions to lighting have been designed to account for future tree growth and seasonal changes.

Further information on lighting is presented in Chapter 4 (Description of the MetroLink Project).

6.6.6.2 Lighting Along the Track

Along the alignment there will be emergency lighting to provide minimal lighting for evacuation and reinforcement lighting for maintenance.

The emergency lighting along the tunnels will be placed at 1m height so that it is not obstructed by smoke. The lighting will consist of an LED strip or equivalent situated along both sides of the tunnel. This form of lighting will continue along the retained cut sections, providing the height of the side walls allow it. In the open-air sections two LED luminaires angled to face opposite directions up and down the line will be placed on the catenary posts located every 50m at a height of 5m. In intervention shafts the LED luminaires will be located every 12m in the ceiling while on the emergency stairs, each flight will be illuminated by a pair of LED luminaires in the ceiling above.

Reinforcement lighting will be required, sufficient for common maintenance tasks. Luminaires will be staggered every 20m at 4.5m height along both sides of the tunnel and in the deeper retained-cut sections. In the shallower sections of retained cut and open-air sections, luminaires will be placed on 5m high posts every 50m providing a minimum level of 20 lux illumination. In the intervention shafts, luminaires will be placed in the ceiling 12m apart and alternate with the emergency luminaires. There will be one LED luminaire over every flight of emergency stairs in addition to the emergency luminaires.

During normal operation, reinforcement and emergency lighting will be turned off, except for the luminaires linked to continuous surveillance cameras. During emergency operations, the incident emergency and reinforcement lighting will be connected in accordance with the corresponding emergency protocol. During maintenance, emergency and reinforcement lighting will be connected in the relevant sections to illuminate the work areas. The emergency and reinforcement lighting will be connected to remote terminal units in the adjacent stations and controlled from the OCC and adjacent stations if necessary. There will also be switches along the line for manual activation.

6.6.6.3 Lighting Within the Stations

At Estuary and the stations in retained cut, natural lighting will be provided by central glazing along the canopy and via the sides, which will be open at Estuary and protected by glass panelling at the retained cut stations to prevent anyone falling onto the station below. Direct lighting will be provided in the soffits above the platform and plaza area and also be integrated into the handrails and skirting.

Natural lighting will be provided to the mezzanine level in the underground stations via skylights where possible. Artificial lighting will be provided by LED lighting with a mix of direct lighting from the ceilings, uplighting of walls and ceilings, and lighting integrated with handrails.

High efficiency LED lighting will generally be used, except where LED strips may be used for some architectural features. The lighting would be switched on only when it is needed to provide the necessary lighting to complement the natural lighting. The lighting in public areas will be controlled by the building management system and lighting in the BOH areas will be controlled by passive infrared sensors. Some of the normal lighting fixtures in the public areas and corridors will also be used for emergency lighting. The lighting system within the offices will be wired from the emergency circuits.

6.7 Mainline Maintenance and Cleaning

The provision of the metro service to an acceptable quality and level of safety requires the maintenance of the assets to meet the following objectives:

- Availability - ensure that the facilities, equipment and assets in general are kept in optimum conditions to avoid unplanned downtime that can have an impact on service quality;
- Reliability - to guarantee that the installation or equipment works correctly over a given period;
- Life of the equipment - To reduce wear and tear on equipment and facilities and assets, thus prolonging their life; and
- Cost reduction - to avoid losses and unforeseen expenses due to corrective maintenance tasks following unscheduled downtime, which is in general more costly than scheduled and preventative maintenance.

Maintenance will be managed and resourced from Dardistown Depot. A detailed maintenance plan will be developed for the whole project by the operator, in accordance with the regulations and good industry practice, to encompass all the railway assets including the rolling stock, track, tunnel sections, stations, landscaping and boundaries. Whilst the trains will be maintained at the depot (see Section 6.9), many maintenance activities will take place along the mainline where they relate to track, signals, drainage and other trackside equipment. Maintenance may also be undertaken in the section of the City Tunnel south of Charlemont station. Table 6.5 summarises the assets to be maintained.

Table 6.5: MetroLink Assets that will Require Maintenance

Types of Assets to be Maintained	Components
Facilities related to passenger comfort	PAVA Real time information displays Ticketing and validation Air conditioning Lighting Escalators and lifts Comfort ventilation in stations
System components related to train circulation	Uninterruptible power supply systems (UPS) Track, switches and crossings Signalling in centralised and distributed equipment Switch motors Medium voltage distribution Electrical energy transformation Catenary system Platform Screen Doors OCC and Backup OCC Pumping wells for tunnel drainage
System components related to the safety of users and operator staff	Video surveillance systems Anti-intrusion system Fire protection system Signage Access doors to stations

Types of Assets to be Maintained	Components
	Emergency ventilators
Installations related to communications	Telephone equipment Intercom Data transmission Wi-Fi Fibre optics Radiocommunications
Installations related to civil works	Buildings (plumbing, electrical systems, gazing, security/locking systems, painting, signage, etc.) Tunnels, including all infrastructure contained within Portals Intervention shafts Access roads associated with MetroLink Drainage, including culverts Viaducts and bridges Tracks External Drainage Nets
Appearance and upkeep	Landscaping (replacement of shrubs, pruning, grass cutting, clearing ditches, removal of green waste)

Three types of maintenance will be developed – preventive maintenance, corrective maintenance and predictive maintenance. Preventive maintenance involves activities undertaken at regular intervals, which may be monthly, quarterly, annually, or periods of multiple years, which are specified in the Maintenance Plan. Corrective action or repair is required following an inspection, breakdown, or other circumstances that adversely affect the normal operation of the system. Corrective actions would be performed as a priority to maintain the train service. Predictive maintenance is based on a set of techniques to assess the behaviour of the equipment to optimise preventive maintenance and reduce the need for corrective maintenance. The asset management system will also consider the expected life of different categories of assets and plan for their eventual replacement.

Preventive maintenance work for the track consists of scheduled checks and visual inspections or, if necessary, track monitoring. Periodic inspection and maintenance shall be developed to detect displacements of the track bed structure. Among other requirements, the maintenance plan shall consider the quality standards of the rails and track components and include the preventive and corrective actions defined on the quality standards of the track.

The tunnels must be permanently clear of construction and station waste, sand and dust, sludge from leaks and other sources and litter. The tunnels will be cleaned regularly using specialised cleaning / washing vehicles equipped with water sprinklers to flush the tunnel ceiling, walls and ground, and suction heads to vacuum particulates. Exits must be kept clear of rubbish during normal operation for safety reasons. Preventive and periodic inspections shall be performed on the tunnel structure.

The following maintenance activities will be undertaken to ensure efficient and reliable services:

- On-going condition-monitoring of assets;
- Inspection and maintenance of electrical and mechanical equipment;
- Rail re-profiling and other heavy-duty operations using the dedicated rail-mounted, diesel-powered rail maintenance vehicles;
- Preventative maintenance for other equipment including 'maintenance by replacement' whereby components are exchanged and serviced offline in a depot or factory;
- Planned periodic refurbishment and replacement of assets; and
- General housekeeping, cleaning including all public areas, pest control and weed control.

In order to minimise impacts on services maintenance schedules will cover both day and night with certain activities possible only at night when services have ceased, including rail line maintenance. Weekend maintenance will be undertaken in cases where more extensive maintenance work is required, that could not be achieved over a night-time period.

Further discussion of staffing for maintenance operations is presented in Section 6.11. It is likely that while some aspects of maintenance will be undertaken by the operator, other aspects may be subcontracted out.

6.8 Station Operation

This section describes how the stations will operate, both in terms of how passengers use the stations and the activities undertaken by the station staff. The following subsections discuss:

- Interchange with other transport modes at the stations – by walking, cycling, using public transport and by car;
- A description of design features to allow Access for All;
- Passenger movement and wayfinding through the stations;
- Fare collection; and
- Back of house (BOH) operations of staff.

Each station has been designed to ensure a high-quality environment for passenger use by:

- Providing clearly identifiable entrances to 'MetroLink stations' at surface level;
- Providing easy wayfinding throughout the station regardless of type;
- Using natural daylight, with skylights where possible for the stations in retained cut and the underground stations;
- Providing clear indication of changes between concourse, mezzanine and platform levels for stairs, escalators and lifts;
- Providing a safe and open environment;
- Providing a clear distinction between public and restricted areas; and
- Providing accessibility for all (Universal Design).

6.8.1 Interchange with Other Transport Modes

The proposed Project has been designed to ensure maximum interchange with other modes of transport, specifically more sustainable modes of transport such as walking, cycling and public transport. Refer to Table 6.6 for details of interchange opportunities with other modes of transport and further details on the access to the Estuary P&R in Section 6.10.

Table 6.6: Access to Stations

Station	Pedestrian Access	Bicycle Access	Public Transport	Other Vehicular Access
Estuary Station	Access to the Park and Ride from the north via a new section of the Swords Western Distributor Road with footpaths on both sides and a signalised junction with the R132. Access to the Station via the signalised junction on the R132 with	Access to the Park and Ride from the north via a new section of Swords Western Distributor Road with cycle lanes on both sides and a signalised junction with the R132. Access to the Station via the signalised junction on the R132 with Ennis Lane onto the	Bus services will access a Bus Interchange within the site. Six bus stops will be provided adjacent to the station. The principal access will be from the south via the R132 and Ennis Lane Junction and onto the new perimeter road. This route will have	Access to the Station and Park and Ride via new section of Swords Western Distributor Road which will have a junction with the R132. In addition, a junction is proposed on the R132 with Ennis Lane. Taxi Rank and/or Drop Off Facilities

Station	Pedestrian Access	Bicycle Access	Public Transport	Other Vehicular Access
	Ennis Lane onto the perimeter road with footpaths on either side. In addition, appropriate pedestrian facilities will be provided at the junctions along the R132 to allow good pedestrian permeability from east of the R132. Access from the west via a new underpass beneath the railway to the station.	perimeter road with footpaths on either side. In addition, appropriate cycling facilities will be provided at the junctions along the R132 to allow good bicycle permeability from east of the R132. Access from the west via a new underpass beneath the railway to the bicycle store and station.	priority over traffic existing off the Swords Western Distributor Road onto the perimeter road.	will be provided at this station. A second exit off the Swords Western Distributor Road onto Ennis Lane will lead to a Drop Off point on Ennis Lane on the west side of the station.
Seatown Station	Existing footbridge crossing the R132 will be removed. Access to the station for pedestrians will be facilitated by an at grade pedestrian crossing over the R132.	Access to the station will be facilitated by an at grade cycle crossing over the R132.	Adjacent Bus Stop serving station.	No Facilities.
Swords Central Station	Access to the station for pedestrians from the west of the R132 i.e Swords and the Pavilions Shopping Centre will be facilitated by an at grade pedestrian crossing over the R132.	Access to the station for cyclists from the west of the R132 i.e Swords and the Pavilions Shopping Centre will be facilitated by an at grade cycle crossing over the R132 and toucan cross at the station.	Adjacent Bus Stop serving station.	No Facilities.
Fosterstown Station	Access to the station for pedestrians from Fosterstown will be facilitated by an at grade pedestrian crossing over the R132. In addition, a new walkway is proposed on the east side of the R132 to allow access to the adjacent retail park.	Access to the station will be facilitated by an at grade cycle crossing over the R132 and toucan crossing at the station.	New Bus Stops on Bus Connects corridor will be provided adjacent to station.	Drop Off facilities will be provided at this station.
Dublin Airport Station	Appropriate pedestrian connectivity is provided to	Bike parking is provided and links to the existing cycle	The Dublin Airport station design includes new coach parking off a public	No Facilities Interchange with existing airport Taxi

Station	Pedestrian Access	Bicycle Access	Public Transport	Other Vehicular Access
	Terminal 1 and Terminal 2 buildings from the Metrolink station by means of pedestrian crossing and path.	network around the airport road.	plaza facilitating passenger interchange between bus, metro and Dublin airport. The design includes 16 bus bays at 45 degrees and 4 parallel bus bays to maximise the capacity. The bus bays are connected with proposed roads which tie-in to the existing road network along the existing bus bays in front of the T1 terminal.	Rank and / or Drop Off Facilities.
Dardistown Station	Not a public station and as a result there will be no public access arrangements.	Not a public station and as a result there will be no public access arrangements.	No facilities.	A maintenance access road will be provided to facilitate routine maintenance of the station and surroundings.
Northwood Station	Pedestrian access provided via station entrances on both sides of the R108 with enhanced pedestrian access to the station location.	Cycle access provided by way of enhanced cycle access to the station location.	Location of Proposed Bus Connects stop located adjacent to station to allow for integration.	Drop Off Facilities will be provided at this proposed station.
Ballymun Station	Enhanced pedestrian crossing of the R108 to provide greater pedestrian capacity.	Enhanced crossing of the R108 to provide enhanced cycle access.	Location of Proposed Bus Connects stop located adjacent to station to allow for integration.	Existing Taxi Rank on Sillogue Road located adjacent to station to allow for integration.
Collins Avenue Station	Vehicular access to church at north end of station extinguished to provide cycle parking and safe pedestrian access to the station. Increased public space on Albert College Court while keeping access to church from this road.	Cycle parking will be provided and cycle lane provided along Ballymun Road by Bus Connects.	Location of Proposed Bus Connects stop located adjacent to station to allow for integration.	No Facilities
Griffith Park Station	Station entrance at the existing	Cycle lanes are being provided	Location of Proposed Bus	No Facilities.

Station	Pedestrian Access	Bicycle Access	Public Transport	Other Vehicular Access
	entrance gates to Whitehall College with an increased public space to ensure safe access and egress.	along Mobhi Road to access station, to tie in with Bus Connects cycle lane proposals.	Connects stop located adjacent to station to allow for integration.	
Glasnevin Station	Pedestrian access will be provided via Phibsborough Road.	Cycle lanes are being provided along Phibsborough Road to access station, to tie in with Bus Connects cycle lane proposals.	Adjacent Bus Stops and Irish Rail station Interchange with MetroLink station.	Disability Drop Off Facilities will be provided at this station.
Mater Station	Realignment of existing kerbs to facilitate a tie in with existing footpaths. In addition, a reduction in the width of Eccles Street to provide an enhanced public space at the station entrance.	Cycle access via existing cycle lanes.	Adjacent Bus Stop serving station.	No Facilities
O'Connell Street Station	Access to the station to be provided via an entrance on the west side of the footpath on the west side of O'Connell Street. Additional pedestrian entrance at south west corner of station to Moore Lane and proposed retail development.	Tie in with existing bicycle lanes surrounding the station.	Adjacent Bus Stops and Luas Stop at station.	No Facilities
Tara Station	Realignment of existing kerbs to facilitate a tie in with existing footpaths. In addition, a reduction in the width of Townsend Street and Poolbeg Street to provide an enhanced public space at the station entrance.	Two-way cycle lane between George's Quay and station plaza will provide safe access to bike parking.	Adjacent Bus Stops and DART station Interchange with MetroLink station.	No Facilities
St. Stephen's Green Station	Enhanced public space at the entrance to the station with enhanced pedestrian road	Tie in with existing bicycle lanes surrounding the station.	Adjacent Bus Stops and nearby Luas Stop to station.	No Facilities

Station	Pedestrian Access	Bicycle Access	Public Transport	Other Vehicular Access
	crossings on St Stephen's Green East and St Stephen's Green North			
Charlemont Station	Access to the station for pedestrians will be enhanced by an at grade pedestrian crossing on Grand Parade	Bike parking is provided and links to the existing cycle network around the station.	Adjacent Bus Stops and Luas stop Interchange with MetroLink station.	No Facilities.

6.8.1.1 Walking

Each of the proposed stations has been designed to provide a high-quality environment at the station approach to ensure easy access from the existing pedestrian footpath network surrounding the station. The Transport for London Pedestrian Comfort Guidance for London (Transport for London 2010) (available on the internet free of charge) was used as a reference during the design development process to guide the design of access to each station to ensure that pedestrian footpaths and road crossings are appropriate to the volume and type of users accessing the stations. Table 6.6 outlines the pedestrian access available at each of the proposed station locations. Figures 9.42 and 9.43 in the EIAR illustrates walking catchment areas around the stations.

6.8.1.2 Bicycle Access and Parking

One of the key design requirements for the proposed Project was the provision of bicycle access and bicycle parking facilities at and near each station (with the except of O'Connell Street Station where there is insufficient space) to facilitate passengers who wish to cycle to/from the proposed Project stations. Information on the bicycle parking arrangements at each of the proposed stations is provided in Chapter 4 (Description of the MetroLink Project) on the approach to the design. Figure 9.7 in the EIAR shows the stations in relation to existing and proposed cyclepaths.

An analysis was undertaken to determine the potential demand for cycle access and parking for the Opening Year of the proposed Project (2035) and the available space for the provision of cycle parking at each station. The requirement for cycle access and parking at each station was designed having regard to the requirements of the following:

- Dublin City Development Plan 2016-2022 (Dublin City Council 2016);
- Draft Dublin City Development Plan 2022-2028 (Dublin City Council, 2021);
- Fingal Development Plan 2017-2023 (Fingal County Council, 2017);
- Draft Fingal Development Plan 2023-2029 (Fingal County Council, 2022);
- National Cycle Manual (NTA 2011);
- Dublin City Centre Cycle Parking Strategy (DCC et al. 2015); and
- Bicycle Parking Manual (The Danish Cycle Federation 2008).

The requirement for bicycle parking at each station was calculated based on a combination of calculation methodologies in order to account for the variability of station types and their contributing catchment. The calculations entailed a combination of a fixed calculation approach and a variable calculation approach.

- *Fixed -* This calculation approach applied a flat percentage rate to all stations e.g. the National Cycle Manual suggests that a rate 2.5% is applied to the number of daily (Metrolink) boarders subject to a minimum of 10 bicycle spaces, or the DCC approach requires a minimum of seven spaces per the number of trains at the two-hour AM peak period, which must be a minimum of 100 spaces; or

- *Variable -* This approach applies a bespoke percentage range to each station based on the demographic spread relevant to each location e.g. the Danish Cycling Federation suggests that bicycle parking is provided for '10-30% of train passenger numbers per day', or '10% of passenger numbers in the morning rush hour (06:00 to 09:00) at bus stops and terminals'.

Once the optimum number of bicycle parking spaces was determined, an analysis was undertaken to define the available space for bicycle provision.

Due to space constraints in the vicinity of stations in the DCC area, it has not been possible to provide 100% of bicycle parking required at every station. However, the maximum number of bicycle parking has been provided at each station taking cognisance of available space.

DCC supports the proposed cycle provision at each of the proposed station locations and has determined that as part of a wider cycling strategy, supplementary bicycle provision and cycle parking will be provided at locations in close proximity to the proposed station locations.

Within the Fingal County Council (FCC) area, cycle parking provision will be accommodated at the proposed stations and the proposed level of bicycle parking provision has been agreed with FCC. For Seatown, Swords Central and Fosterstown stations semi-enclosed cycle parking is provided which entail roofed structures with glass or solid walls. Bicycle parking provision determined for each station within the DCC and FCC areas is outlined in Chapter 4 (Description of the MetroLink Project).

6.8.1.3 Public Transport

The locations of stations have been considered in relation to public transport, in particular connectivity with Dublin Airport; with Irish Rail, the Luas and DART lines; existing bus stops; and future bus stops to be provided as part of BusConnects. The proximity of public transport services to the new stations is shown in Figure 9.5 in the EIAR.

The main interchanges with rail services are Glasnevin station (Irish Rail), O'Connell Street (Luas), Tara Station (DART) and Charlemont (Luas). St Stephen's Green Station is located close to stops on the Luas green line.

6.8.1.4 Taxi Ranks and Drop Offs

A review of the demand for each station recommended the provision of taxi ranks and/or drop off facilities at a number of locations along the route to ensure compliance with the requirements of the Transport Strategy for the Greater Dublin Area 2016 – 2035 (NTA 2016) which states the requirement to 'Provide, outside of Dublin City Centre, drop-off facilities and taxi ranks at key train stations and Luas stops'.

Table 6.6 outlines the proposed drop off facilities and taxi ranks for each proposed station location. Further information is provided in the EIAR Chapter 4 (Description of the MetroLink Project).

6.8.1.5 Welfare Facilities for Passengers

Toilet facilities for passengers will be available at the main interchange stations.

6.8.2 Access for All

The proposed Project has been designed on the principle of Access for All. The design has been developed to meet all legislative requirements relevant to accessibility including the Disability Act 2005 and in turn the Sectoral Plan for Accessible Transport under the Disability Act 2005 (DTTAS 2012). The design will also comply with Part M to the Second Schedule of the Building Regulations.

The proposed Project will include the following features:

- The floor of the train will be at same level as the platform;
- There will be a very narrow gap between the train and the platform;
- Wheelchair users will be able to access each train;
- The interior is designed to ensure maximum visibility of grab rails and other features;
- Audio-visual information is provided on board and at platforms;
- All platforms incorporate ramps or lifts for access purposes;
- All platforms feature help points, which incorporate induction loops for people with hearing impairments;
- Changes in level, platform edges and crossing points are highlighted using tactile paving;
- Audio and Braille guides are available as well as a tactile map of the system;
- Ticket vending machines are equipped with audio support options as well as a user selectable high contrast interface; and
- The smartcard validation system incorporates audio and visual function indicators.

The provision of PSDs along the edge of the platforms further improves safety by preventing falls onto the tracks.

Ticket machines will be accessible at all stations with at least one machine with controls set lower for wheelchair users, where the supporting plinth will not project in front of the face of the machine in a way that prevents its convenient use and there will be a clear space in front of the machine to facilitate wheelchair users.

The internal dimensions of each lift have been designed to accommodate wheelchair users and provide a clear unobstructed space for manoeuvring in front of every entrance door to the lift.

Suitably sized landings will be provided at the top and bottom of access ramps to stations. The minimum unobstructed width between handrails will be not less than 1.2m and the shallowest possible gradient will be provided.

Good lighting is essential for everyone and has been carefully considered. It enables people to move safely and independently around a building and the external environment. Good lighting aids the perception of space, colour, and texture. It facilitates identification and reading of signs and instructions. It also makes lip-reading and visual communication easier.

The desired acoustic qualities for each area of the stations and buildings have been considered from the earliest design stage.

Visual contrast between surfaces is a common theme in the selection of surface finishes and benefits all building users as it promotes visual clarity; orientation; the perception of space; and the identification of surfaces, features, and potential obstacles. Whenever possible this principle has been considered to promote visual clarity.

6.8.3 Passenger Movement and Wayfinding

6.8.3.1 Access to Stations

Passenger forecasts (refer to Section 6.4.1) together with Access for All design guidelines have been used to design the size and layout of the public areas used by passengers, including the entrances; the escalators, lifts and stairs; and the platforms.

The approaches to the station entrances are positioned to provide convenient access with minimal changes in level. Design features to facilitate safe access to the station entrance include signalised crossings, 'raised tables' within the roadway to reduce traffic speed at pedestrian crossings and dropped kerbs on pavements on both sides of the crossing to remove a trip hazard and aid wheelchair users and people with wheeled luggage. Tactile paving surfaces will warn pedestrians with visual difficulties of the absence of a kerb and guide them in the direction of the crossing.

The pedestrian routes to the station will be logical and clear to understand. They will have a generous clear width, which will be sufficiently wide to allow adequate space for wheelchair users and be free of obstacles. Wheelchair ramps will provide an alternative to avoid steps.

The P&R Facility provides parking for 3,000 vehicles. Access to Estuary Station is via a pedestrian bridge and lifts or stairs to the platforms as described further in Section 6.10. The drop off points for taxis and private vehicles and the bicycle parking will be provided as close as possible to the principal station entrances. Taxi ranks have been orientated so that passengers can alight and board on the nearside of the taxi. In the city centre, access via private car is reduced to encourage walking, cycling and use of public transport (bus and rail connections).

The station entrances have been designed to provide a focal point for passengers arriving, acting as a beacon to guide passengers to the station entrance. While providing a common architectural style, there are variations in the entrance designs, which are illustrated in Chapter 4 (Description of the MetroLink Project).

At the surface station and the stations in retained cut, the canopy structure lying along and above the length of the platform will be visible to passengers arriving from various directions.

For the underground stations, the smaller canopied entrance and passenger lift will be located close together and similarly form focal points place marking the station entrance. The entrances have been designed without door or gates (while the stations are operational) with a clear landing space under the canopies for weather protection. Floor finishes will be firm and slip-resistant.

6.8.3.2 Wayfinding within the Stations

MetroLink stations will not be gated and will not feature turnstiles or accessible gates/doors. All of the public areas are deemed to be a 'Paid Area' in that people have either bought a ticket at one of the ATVMs or purchased a valid smart card. The absence of any gateways adds to the fluidity of movement through the station.

All passengers will be able to pass easily though the station entrance and via stairs, escalators or lifts and walkways to the platforms. These features have been designed sufficiently wide to be accessible for wheelchair users as well as accommodate other design parameters such as emergency evacuation.

Travel distances between the entrance and the platforms have been minimised, with clear circulation routes that are easy to follow. Fixed and variable signage throughout the station will enable route finding and will be clear, consistent, and unambiguous. Messages and directions will be concise and use familiar words, symbols, and language.

Changes of level have been minimised and lifts and escalators provided for people with reduced mobility. The corridors used by passengers have been designed to have a clear width of more than 2,000mm, while the areas not accessed by the public and only for staff use have a minimum corridor of 1,400mm. The overall layout has been designed to be as logical and direct as possible and to keep the main routes clear from potential obstructions.

Safety design features for flights of stairs include handrails, flights of stairs comprising no more than 12 steps, comfortable turning spaces on landings, each step edge visually highlighted and hazard warning surfaces at the bottom of stairs.

Passenger lifts will be located as close as possible to the stairs and escalators and will be clearly signposted. This design aims to provide safe, independent and dignified evacuation for people with mobility difficulties. The lifts are sized to carry either 13 or 33 passengers depending on lift size. Additional specifications for the lift design include features such as tactile floor numbers, the position of the lift controls for easy reach and signalling and illumination levels. Passenger lifts will provide access to all levels within the station and to both the northbound and southbound platforms from street level. In the event of a lift failure, staff at the OCC or within the station will be warned by an alarm, and a staff member will be directed to the station to get the lift moving.

For the underground stations, escalators will be the main form of access for most people between the ground level and the mezzanine, concourse and platform levels. One flight of escalators will also be installed at Fosterstown. The direction of travel of the escalators will be clearly signed. The footway at the top and bottom of the escalators will contrast visually with a change in floor finish to warn people of the start and finish points. The level moving section at the top of an escalator should be at least 2,000mm long and at the bottom should be at least 1,600mm long. Emergency stop controls at the top and bottom of the escalators will be visible and accessible to all users.

6.8.3.3 Platform Level

Once on the platform, passengers will find the automatic PSDs fitted along its entire length from floor to ceiling, separating passengers from the moving train, the rails and the tunnel. The trains will come to a halt within the station, with the train doors aligned with the PSDs. Both the train doors and PSDs will open and close together automatically thereby ensuring safe access for passengers on and off the train and prohibiting access onto the railway line. The back edge of the platform will be marked with blister surfacing, which will help visually impaired people to orientate themselves correctly with the direction of the PSD.

Outside operational hours, the stations will be closed. At Estuary the PSDs will prevent access onto the railway line. At the stations in retained cut, the entrance will be gated and there will be no access via the lifts. Similarly, the entrances to the underground stations will be gated with grilles incorporated into the canopies which will be lowered and locked at the end of the operational day and opened in the morning. The public lifts will not be available for use. Unauthorised access outside normal operating hours will be monitored via CCTV and ACID.

6.8.4 Fare Collection

Passengers will be able to purchase tickets from ATVMs, located in prominent positions in the stations, with the number provided enough to meet the peak passenger requirements. Specifications for the ATVMs have not been prepared at present, but they will be designed to accept cards or cash. There are no proposals for manned desks for ticket sales. Smart (Leap) Card validators will also be available at all stations.

An automatic fare collection system will be in place, which will require a communications system to link the ATVMs, smart card validators, handheld ticket validators carried by MetroLink staff on the trains, and connection to the banking system in order to collect fares and top up smart cards. The intention is also to integrate this system with existing and future fare collection systems on other public transport systems in the GDA to facilitate purchasing tickets across different modes of public transport.

6.8.5 Back of House (BOH) Operations

Several BOH and staff facilities will be available at each station including staff offices, telecommunications rooms, technical areas, storage rooms, toilets and corridors. These zones will be ventilated by means of dedicated heat recovery fan units located in dedicated mechanical rooms. The largest BOH facilities are reserved for the mechanical installations and electrical facilities. Further information on the BOH facilities is provided in the EIAR Chapter 4 (Description of the MetroLink Project).

6.9 Dardistown Depot Operation

The Dardistown Depot has been designed to maintain the total number of trains required in the opening year and the predicted future growth of train units as demand increases for the proposed Project up to 2065. Other projects such as potential future expansion to the south-east or south-west, have not been taken into account in the design of Dardistown Depot.

This section summarises the main activities that will take place at Dardistown Depot. Further information on the general arrangements for the depot, architectural design and landscaping are provided in the EIAR Chapter 4 (Description of the MetroLink Project). Section 6.11 of this Chapter describes the staffing arrangements, including staffing at Dardistown Depot.

6.9.1 Train Stabling

A fully enclosed train stabling building will shelter trains when out of service and to keep them secure. The rail approaches to this building will subdivide to create 15 parallel tracks within the building designed to stable the fleet of 40 trains. The trains will operate in automatic mode and access the building via automatic bi-folding doors. Platforms will be provided along the entire length of the stabling lanes for ease of access to the trains by cleaning and maintenance staff. The interior cleaning of the trains will also take place in here.

Indoor stabling provides advantages operationally over outdoor options including:

- Train availability with minimum preparation even in inclement weather conditions such as snow and ice;
- Lower light emissions;
- Can be used as a location to clean and do minor repairs;
- Passenger-friendly temperatures easier to achieve for immediate operation;
- Better protection of trains from the elements; and
- Better security.

6.9.2 Rolling Stock Maintenance

Preventive and corrective maintenance of the trains will take place in the main Maintenance Workshop. Trains will enter the building in manual mode through automatic bi-folding doors. There will be nine maintenance tracks in the workshop, including four tracks with pit lanes, two tracks with jack lifts and one track for painting and minor repairs. Other equipment at the workshop includes a wheel measurement device, wheel lathe, cranes, mobile lifting devices, lifelines connected to the ceiling for workers on the train roofs, and facilities for washing the exterior and interior of trains. The workshop will also house stores and temporary storage of solid waste arising out of maintenance activities. Further details are provided in Chapter 4 (Description of the MetroLink Project).

Preventive maintenance comprises a cycle of maintenance related to the annual mileage of the trains and will include inspections, wheel lathing, engine greasing and oil changes. Each activity may take between one day to a week, undertaken multiple times a year for the train fleet. In addition, each train will undergo a complete overhaul every 600,000km to 800,000km (which would occur about every five to six years per train assuming that the trains run 120,000km to 140,000km/year) taking two months to complete.

Corrective maintenance will take place when needed, due to incidents or breakdowns arising during the regular use of the trains or as identified through inspections or faults. Unscheduled maintenance activities may also occur due to changes in design or functionality.

6.9.3 Permanent Way Maintenance

This building will provide workshop and storage areas for wayside installations (that is equipment installed along the rail corridor), maintenance, and offices and welfare facilities for staff. The facilities will include:

- Workshops and storage with an overhead crane;
- Auxiliary maintenance trains;
- Diesel fuelling for rail maintenance vehicles; and
- Outdoor storage yard for large size pieces of supplies.

This building will also house diesel powered rail maintenance vehicles.

6.9.4 Train Washing

The exterior of the trains will be washed in an enclosed automatic train washing plant (ATWP) located close to the entrance in the south-west of the depot. Trains will manoeuvre through the ATWP in automatic mode. The ATWP will comprise an open-ended building to allow trains to pass through and be washed, as illustrated in Diagram 6.9 below.

Diagram 6.9: Typical Automatic Train Washing Plant

A complete wash cycle can be done without blocking access in or out of the depot. The plant is designed to wash the exterior of the train, both ends, and the underframe. The trains can be washed on one of two cycles, a normal wash cycle with the train running through the plant at 3km/h or a thorough wash cycle taking about 8.5 minutes when the train is stationary within the plant. The whole fleet would be washed daily. The layout also includes road access to the train washing plant for servicing, maintenance, delivery of washing agents and sludge removal.

Wastewater from the washing plant will be treated and up to 80% recycled on site to reduce water usage. The remaining wastewater will be treated in the industrial wastewater plant on site in the north-east corner and the treated wastewater discharged to the public sewer.

6.9.5 Train Inspection, Sand Bay and Manual Train Washing

An inspection bay with a series of pits under rail lines will be used for visual inspections and basic maintenance such as lubrication and sand-box filling, in a building located near the entrance and the ATWP.

A system to fill sand boxes on the trains will include a sand silo for on-site storage connected via pipes to the sand filling station. Filling nozzles will be used to pump the sand into the train sand boxes. Dust and sand spillage will be avoided by measures such as ensuring that the diameter of the filling nozzles fits the inner diameter of the train's sand inlet points and automatic cessation of sand filling. Sand boxes are incorporated on most trains to improve the train braking system, whereby sand can be dropped onto the rails in front of the wheels during wet and slippery conditions. Sand dropping onto the slab track in the surface section would be entrained by rainwater and be carried in the central drain between the tracks to an outfall location and caught in oil interceptor and silt traps prior to discharge to surface waters. The traps would be inspected and cleared periodically, with the sludges disposed of to a licensed waste disposal site. The use of the sand box should not be necessary in the tunnel sections as the internal environments are protected from the weather.

The manual train washing area will be equipped to facilitate cleaning of the outside of the trains when the automatic train washing plant is not operational and cleaning the interior of the trains. The trains will be stationary during these cleaning operations.

6.9.6 Train Testing

An 800m long test track will be used for testing of rolling stock and systems (such as brake and driving tests). It will also be used for the commissioning of the new rolling stock and trials and testing of trains after maintenance and overhaul.

6.9.7 OCC and Other Staff Facilities

The OCC is located at the depot within the main administration building. Other staff facilities available at the depot site include administrative offices for staff managing the workshop and testing activities associated with the depot, locker rooms and welfare facilities including bathrooms, showers and toilets, about 140 car parking spaces and cycle parking. These facilities will be for the use of OCC and workshop staff.

6.9.8 Security Arrangements

Access to the depot will be secured through the approved site entrances to maintain site security. The main road access is located at the north side of the depot and there is an emergency road access in the south-west corner. A gate house will be provided at the main access to monitor the entire site and it will be equipped with video monitors, computer, and telephone. There will also be turnstiles for pedestrian access. Strong sliding roll gates will secure the site when the entrance is not staffed.

The train entrance at the south-west corner of the depot will be controlled by a high security type automated depot access gate, with a Safety Integrity Level rated controller. This gate shall be interfaced with the Metrolink signalling system to open automatically in advance of an approaching train and automatically close behind it.

A security fence about 1,960m long will be installed around the perimeter of the depot. An internal steel fence will also be installed to separate certain areas of operation that have to be segregated due to functionality and security.

The OCC safety staff will provide 24 hours a day coverage, 365 days a year for the entire operation of the proposed Project.

6.9.9 Safety Arrangements

The design of the buildings at Dardistown Depot includes measures to effect safe evacuation in the event of an incident. This includes the provision of two escape routes in almost every part of the buildings and measures to restrict fire spread such as the choice of materials in the building structure, ceilings, walls and floors; fire doors; fire retardant furniture and fittings; and compartmentation of the buildings.

Firefighting equipment and monitoring systems will include fire extinguishers, an automatic sprinkler system, hose reels and connections, fire hydrants, water supply for firefighting, an automatic gas extinguishing system, emergency ventilation system, automatic fire detection and fire alarm systems, emergency escape lighting, PAVA and CCTV.

Dublin Fire Brigade will have access to the OCC meeting and incident room.

6.10 Park & Ride Facility Operation

Passengers arriving at the northern end of the proposed Project can park at the proposed P&R facility next to Estuary Station, from where they will be able to use the proposed Project to access other locations further south along the alignment of the proposed Project.

Drivers may approach via the M1 exiting at Junction 4 onto the R132, and then either turn off onto the Swords Western Distributor Road (SWDR) (the first 700m of which will be constructed as part of the proposed Project) to enter the P&R to the north or continue along the R132 to a new junction into the

P&R further south. Drivers may also approach from the south along the R132. The access off the SWDR will be the main access to the P&R. Drivers continue onto a one-way perimeter road around the P&R building to an entrance of their choice. The new junction between the R132 and the SWDR and the two new junctions onto the perimeter road around the P&R will be signalised.

A section of Ennis Lane will be permanently closed as it conflicts with the proposed Project alignment and the southern entrance to the P&R. The severance will be mitigated by constructing a priority junction off the SWDR to the north-west of the P&R.

The existing Ennis Lane junction with the R132 will be replaced with the proposed fully signalised junction into the P&R, incorporating pedestrian crossing facilities. This junction is intended as the main point of entry for buses, taxis and drop offs to the station. Vehicles entering via this entrance will have priority over vehicles already on the perimeter road, giving public transport vehicles in particular, priority on approach to Estuary Station.

The proposed one-way perimeter road will consist of two lanes in a clockwise direction and provide three entrance and three exit opportunities to the P&R building as well as access to bus stands, drop off point and taxi rank facilities.

Six bus stands will be provided in front of the station to cater for both local bus services and longer distance coach travel and the existing bus stops on the R132 just north of Ennis Lane will be improved.

Segregated cyclist and pedestrian accesses will be provided between the perimeter road and the proposed Project alignment, with pedestrian crossings and cyclist priority measures at both signalised junctions on the R132. The segregated cycle path leads directly to the proposed cycle parking facilities designed for 254 spaces. A pedestrian underpass will be provided where the alignment crosses the existing Ennis Lane to maintain walking routes between Ennis Lane to the west of the alignment and Balheary Industrial Park to the south.

Before the entrance to the building, the parking management system will provide drivers with information on parking occupancy. It will help the driver decide which entrance to use and indicate the state and number of free places in each zone. Based on the information provided, the driver will be able to choose a free parking place from the very moment of entering the building.

Once the driver has chosen their desired entrance from the perimeter road, they will enter the P&R at ground floor level. Upon entering, passengers have the choice of parking at ground floor level or parking at an upper level by proceeding up a ramp. Once inside the building, a one-way circulatory system will be in place to minimise the risk of collisions, except for short sections, for example accessing the ramp to drive to the next floor. This type of system reduces the risk of collisions and the amount of effort required by customers using the facility. Clear road markings will be provided to ensure drivers are aware of the required direction of travel.

Drivers will not require a ticket to gain access to the facility (i.e. there will be no barrier at the entrance) and passengers will be able to purchase tickets for parking and the metro at the facility. This is a similar arrangement to the Luas P&R.

The P&R has been designed to provide 3,000 car parking spaces, of which:

- 694 will have electric vehicle charging facilities, located in preferential spots, based on a provision of at least 23% of capacity;
- 208 will be wheelchair accessible spaces, located close to the lifts, based on a provision of at least 6% of capacity;
- 2,139 will be standard-sized parking spaces; and
- 10 will be for staff parking.

The disabled parking spaces will be clearly sign-posted. The size of the proposed 208 disabled parking spaces is compliant with the Disability Act 2005, Building for Everyone A Universal Design Approach (National Disability Authority, NDA 2012), BS8300-1:2018 Design of an accessible and inclusive built environment (BSI 2018) and Technical Guidance Document (TGD) part M Access and Use (Government of Ireland 2010). The number of spaces exceeds the guide of 6% of total parking spaces. The allocated space will be a minimum of 2.4 x 5m, plus a 1.2m marked access zone to the rear and the side for access. These spaces will be located with easy access to lifts which in turn provide access to the footbridge on Level 2 to the Estuary Station platforms.

Once parked, stairs and lifts are evenly distributed throughout the building to transport customers between levels. Clear signage will be provided to guide customers to their nearest lift and to the metro station. Pedestrian walkways will be clearly delineated throughout the building to improve pedestrian safety.

The parking management system will also be equipped with a car finder solution whereby a visitor will be able to use the simple touch screen interface to type in their licence plate number and see a map showing where their car is parked. The car finder solution will be integrated to a web browser and mobile applications.

All parts of the P&R will be sufficiently lit for safe pedestrian and vehicle circulation and to help reduce vandalism and crime. Other features include an automatic fire alarm system, CCTV with colour, day / night cameras with control panels and monitors in the security control room, an access control system and an intruder alarm system. The telecommunications system will cover IT and phones for staff and intercom systems provided throughout the building, wall mounted SoS stations, and lift intercoms for communications between customers and staff.

For the purposes of the design, it is assumed that the Estuary P&R will be staffed by ten operatives. They will be provided with rooms for the manager's office, a kitchen/break room, a security room, a control room, cleaner stores and bathrooms/toilets. There will be no welfare facilities for members of the public.

6.11 Staffing

6.11.1 Staffing Levels

The numbers of staff required to operate MetroLink have been estimated in order to design the facilities required at Dardistown Deport including the OCC, at the stations, Estuary P&R, and other installations. This section provides an indication of the likely size of the workforce. However, the actual workforce will be determined some years into the future by the operator of the proposed Project, who has not been appointed at this stage.

6.11.2 Dardistown Depot and OCC

Most operational staff will be based at Dardistown Depot, working in the various workshops and administration buildings. Some staff will travel out to various locations along the proposed Project to undertake tasks such as maintenance, respond to incidents, or ride the trains to check passengers' tickets as required.

The depot will operate 24 hours a day, in order to allow for rolling stock movements within the proposed commercial timetable and for the maintenance of the wayside and trains outside these hours.

The depot workforce will be able to access to Dardistown Depot via the Dardistown station and walk along an underpass and controlled entrance into the Depot which comes out to the back of the administration buildings and workshops. The workforce will also be able to arrive via the main entrance and park within the Depot. These arrangements are described in the EIAR Chapter 4 (Description of the MetroLink Project).

The total workforce required to operate and maintain the proposed Project is estimated to be approximately 300. Table 6.7 illustrates the workforce based at Dardistown Depot, comprising some 270 operation and maintenance staff and 22 administration staff. A further ten staff are assumed to work at the Estuary P&R. These numbers are indicative only.

Table 6.7: Indicative Staffing Levels for MetroLink

Staff Categories	Indicative Staffing Levels
Operation and Maintenance Management	**1**
Operations:	**117**
Chief Operation Officer	1
Line Manager (*)	5
Line Technician	10
OCC Manager	6
OCC Technician	21
Roaming System Operators (*)	74
Maintenance:	**120**
Chief Maintenance Officer	1
CCM Manager	1
CCM Technician	2
Documentation, Safety and Quality assurance	1
Maintenance of the Rolling Stock	**66**
Rolling Stock Maintenance Officer	1
Rolling Stock Maintenance Manager	2
Rolling Stock Maintenance Supervisor	4
Rolling Stock Maintenance Technician	59
Maintenance of the Installations	**49**
Installations Maintenance Officer	1
Signalling and PSD Maintenance Manager	1
Signalling and PSD Technician	9
Communication, Control and OCC Maintenance Manager	1
Communication, Control and OCC Maintenance Technician	7
Power and Electromechanical Facilities Maintenance Manager	1
Power and Electromechanical Facilities Maintenance Technician	7
Track Maintenance Manager	1
Track Maintenance Supervisor	3
Track Maintenance Technician	7
Catenary Maintenance Manager	1
Catenary Maintenance Supervisor	3
Catenary Maintenance Technician	7
Train Cleaning	**25**
Manager Responsible	1
Work Force (Automatic Train Washing Plant)	4
Work Force (Interior Train Cleaners)	20
General Store	**3**
Manager Responsible	1
Storage Personnel	2
Safety	**1**
Chief Safety Officer	1
Planning, Assignment and Logistics of the Service	**3**

Staff Categories	Indicative Staffing Levels
Chief Planning, Assignment and Logistics of the Service Officer	1
Planning Technician	1
Assignment Technician	1
Total Operation and Maintenance	**270**
Line Director	1
Line Director Deputy	1
Assistant	1
HR Coordinator	1
Economy, Finance & Accounting Manager	1
Accounting Assistant	1
Purchasing Assistant	1
Logistic Assistant	1
Notice & Billboard	1
Training Coordinator	1
Quality & Environment Manager	1
Health & Safety Manager	2
Safety & Security Manager	1
Administration office team	8
Total Administration	**22**
(*) Staff who do not work at Dardistown Depot	

Staffing at the OCC will cover five categories: supervision, traffic management, power supply, customer support and security. Depending on the workload, the day of the week, and the hour, these positions will be attended by a team of between three and five people. All five functions will be covered during the commercial service on weekdays. At weekends and outside commercial service on weekdays, the reduced number of trains in operation will allow power supply functions being performed by the Traffic Operator. Customer support will only be provided during the commercial service. The main responsibilities for the five functions are summarised in Table 6.8 below.

Table 6.8 Roles and Responsibilities of Staff Working in the OCC

Position	Responsibilities
Supervision	▪ Organising and supervising the development of the service, from start to end, performing the necessary modifications in the operation and identifying any incidents. ▪ Establish actuation criteria for the management of the service operation, in normal operation conditions as well as in degraded situations. ▪ Plan and supervise all the aspects related to the crowd management along the line, due to high influx events or unexpected situations. ▪ Manage and coordinate the emergency plans in the event of incidents and process all the actions required during and following the incident (including reporting technical information about the incident evolution, evolution report, etc), acting as the link with the emergency services. ▪ Assure the service delivery under degraded modes (provisional services, etc). ▪ Annalise the information obtained from incidents (actions performed, response time, etc.), with the objective to improve the response quality. ▪ Coordinate and activate all physical and human resources, internal and external, required for the resolution of incidents (both at daytime and night-time). ▪ Ensure the operability of the technical equipment at the OCC.
Traffic Management	▪ Ensure the track is free of any works before the start of the service.

Position	Responsibilities
	▪ Supervise the automatic assignment of trains into the service and the automatic start-up of trains and take action if needed. ▪ Supervise and control the movement of trains in the automated section of the depot and the test track through the Centralised Traffic Control and the CCTV systems. ▪ Manage train circulation in both normal operation and degraded mode. ▪ If instructed by the OCC Supervisor, establish alternative services. ▪ Inform the station staff about problems detected on trains or with the platform screen doors. ▪ In the event of an emergency, control the opening of the platform screen doors and the movement of trains between stations. ▪ Take action in the event of incidents, according to the established protocols. ▪ Coordinate the station staff and maintenance staff in the event of an incident, in order to resolve it as soon as possible. ▪ Assist the station staff in resolving incidents and the withdrawal of a train which is incapacitated if necessary. ▪ Collect data on incidents and prepare the corresponding reports. ▪ Control the status of any element that is involved in train circulation, such as switches and platform screen doors. ▪ Collect diagnostics information on the running trains. ▪ Manage the removal of trains from service into the workshop, cleaning, etc. ▪ Control and manage the permanent way work and the circulation of work trains. ▪ Authorise staff to access the tracks or tunnels, adopting the necessary safety measures.
Power Supply	▪ Control and operate all the elements of the substations, the medium and low voltage distribution, and the traction power distribution. Perform all the necessary tasks for their correct functioning. ▪ Energise (and de-energise) the OCS at the start (and end) of the service. ▪ Operate all the facilities (ventilation systems, pumping stations, escalators, lifts, lighting, etc). ▪ Coordinate the maintenance tasks related to their responsibilities (communication with maintenance staff, identification of alarms that might be triggered, etc) in order to minimise impact on the operation and facilitate maintenance works. Prepare the necessary reports, documents and records. ▪ Inform the maintenance staff about incidents detected in the facilities. ▪ Support the Traffic Management position if needed, especially in degraded mode. ▪ Authorize staff to access the facilities (for example substations), adopting the necessary safety measures.
Customer Support	▪ Through the CCTV, control the operation of stations and the conditions of facilities and premises. ▪ Attend the customers' requests made through the help points and resolved the problems to direct the issues to other staff to resolve (for example station staff). ▪ Manage accidents suffered by customers, activating if needed the Emergency Services response. ▪ Manage the cleaning of stations. ▪ Manage the lost property. ▪ Inform the customers through the PAVA system about incidents or degraded situations. ▪ Control and management of the ticket vending machines and the automatic ticket cancellation machines. ▪ Management of incidents, control and operations of the communication systems, PAVA, public information displays, etc. ▪ Coordinate the maintenance tasks related to their responsibilities (communication with maintenance staff, identification of alarms that might be triggered, etc) in order to minimise impacts on the operation and facilitate the maintenance works. Prepare the necessary reports, documents and records. ▪ Inform of incidents relating to customers. ▪ Perform the functions of the Security position if needed.
Security	▪ Supervise the opening and closure of stations to commercial service and take action if needed.

Position	Responsibilities
	▪ Control through the CCTV system the operation of stations, centralising all the registered incidents (vandalism, public security, etc.). ▪ Assist the staff at stations in the resolution of incidents. ▪ Manage the information from fire detection systems and anti-intrusion alarms, monitoring the incident and take appropriate action according to the established procedures. ▪ Control access of maintenance staff not employed by MetroLink on the MetroLink premises. ▪ Manage incidents, control and operations of escalators, lifts, fire protection system, station doors, etc. ▪ Coordinate the maintenance tasks related to their responsibilities (communication with maintenance staff, identification of alarms that might be triggered, etc.) in order to minimise impact on the operation and facilitate the maintenance works. Prepare the necessary reports, documents and records. ▪ Manage any public safety incident, mobilising internal and external resources. By delegation of the OCC Supervisor, link with the emergency services. ▪ Perform the functions of the Customer Support position if needed.

The supervisors will only undertake supervisory tasks, but the OCC operators are likely to be trained to cover any of the positions in traffic management, power supply, customer support and security.

6.11.3 Station Staffing

While the supervision, control and surveillance of the stations will largely be carried out from the OCC, some tasks will be performed within the stations themselves. Staff directed to the stations would be able to supervise and operate various systems from the station control room such as, the operation of escalators and lifts, lighting, PSDs, ticket vending machines, video surveillance, attend to help points, make announcements over the public address system, and fire detection and firefighting. Station staff may be required to sort out incidents, for example, rescuing passengers from lifts and restarting the lifts and opening and closing the PSDs.

6.11.4 Estuary P&R

It is assumed that ten staff would operate and maintain the Estuary P&R, comprising three office staff, five security and two maintenance staff. Allowance has been made in the design for a manager's office, a control room, security room, a break room and bathrooms, stores, a cleaner's room and a data centre, plus ten car parking spaces.

6.11.5 Management of the Soft Estate

The operator will employ staff, or a landscaping contractor, to maintain the 'soft estate' that is the landscaping areas around the Estuary P&R, the green corridor along the R132 and the alignment, and the plantings around the stations.

6.12 Glossary

Term	Meaning
Alignment	Alignment refers to the three-dimensional (3D) route of the railway, considering both the horizontal and vertical alignment.
Automatic Platform Screen Doors	Automatic platform screen doors are used primarily for passenger safety to avoid the risk of passengers falling in front of a train. The platform screen doors are paired with the train doors so that both sets of doors are aligned and open and close together. The automatic platform screen doors are full height between the platform and the station ceiling.
Back of House	Areas accessible just to employees required for the operation and maintenance of the service.
Fully Automated	Starting and stopping, operation of doors is all fully automated process without any on-train staff.
High Floor Train	A high floor train refers to a type of train where the floor of the carriage is typically 760 to 1370mm (30 to 54 inches) above the top of rails.
Intervention Shaft	A shaft to provide emergency access between the railway tunnel and an exit at ground level.
Intervention Tunnel	A tunnel parallel to the railway tunnel to provide emergency access/egress.
MetroLink	The name of the Proposed Project for the metro for which a Railway Order is being sought.
Overhead Conductor Rail	A rigid aluminium contact bar incorporating a contact wire to carry the current to power trains in the tunnelled sections
Overhead Contact System	A system to connect the trains with the source of electrical power consisting of a single contact wire and a single catenary wire supported from a support structure.
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 MetroLink 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.
Proposed Project	The MetroLink project.
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.
Rolling Stock	In the rail transport industry rolling stock refers to trains, including both powered and unpowered trains.

6.13 References

6.13.1 Documents

ARUP (2018). New Metro North Alignment Options Study – Concept Engineering Design Report.

British Standard Institution (BSI) (2018). BS8300-1:2018 Design of an accessible and inclusive built environment.

Department of Transport (2020). Common Appraisal Framework for Transport Projects and Programmes

Department of Transport, Tourism and Sport (DTTAS) (2012) Sectoral Plan for Accessible Transport under the Disability Act 2005.

Dublin City Council (DCC) (2016). Dublin City Development Plan 2016-2022

Dublin City Council (DCC) (2021). Draft 2022-2028 Dublin City Development Plan.

Dublin City Council (DCC), National Transport Authority (NTA), Halcrow Barry (2015). Dublin City Centre Cycle Parking Strategy

Fingal City Council (FCC) (2017). Fingal Development Plan 2017-2023

Government of Ireland (2010). Technical Guidance Document (TGD) part M Access and Use.

Government of Ireland (2018). National Planning Framework (NPF) – Project Ireland 2040.

Government of Ireland (2021). National Development Plan 2021 – 2030

Institute of Lighting Professionals (2021). The Guidance Note 01/21 'The Reduction of obtrusive light'

National Disability Authority (NDA) (2012). Centre For Excellence in Universal Design: Building for Everyone A Universal Design Approach.

National Transport Authority (NTA) (2011). National Cycle Manual

National Transport Authority (NTA) (2016). Transport Strategy for the Greater Dublin Area 2016 - 2035

National Transport Authority (NTA) (2018). National Household Travel Survey 2017

The Danish Cycle Federation (2008). Bicycle Parking Manual.

Transport for London (2010). Pedestrian Comfort Guidance for London

6.13.2 Regulations

Commission Regulation (EU) No 1303/2014 of 18 November 2014 concerning the technical specification for interoperability relating to 'safety in railway tunnels' of the rail system of the European Union Text with EEA relevance

Disability Act 2005

EIA Directive and the Transport (Railway Infrastructure) Act 2001 (as amended).

Part M of the Building Regulations