DART+ Maynooth Line

Iarnród Éireann

Depot Options Selection Report

MAY-MDC-GEN-DEPM-RP-Y-0008

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Revision	Date	Description	Author	Checker	Reviewer	Approver
1.0	22/06/2020	First submission	Iban Mirones	Javier Duran	Cristina Chalé	Tom McKay

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Executive Summary

This document collects all the analysis performed to date, and its aim is to propose an emerging preferred option for the layout that will be developed in the following stage during the Reference Design. It contains a multicriteria analysis and conclusions given from the analysis carried out.

The alternatives proposed have been updated according to interfaces with other disciplines (permanent way, operation, SET…) and feedback received from IÉ or other stakeholders involved.

It is important to highlight that the strategies analysed in this document refer to two different areas: on the one hand the boundary of the West Maynooth Depot and on the other hand the whole DART network. This report only considers the first area at this stage because of the delay of the submission "Preferred Scheme with Proposed Sidings" report where the inputs required for the whole DART network analysis will be included.

1 Purpose

The purpose of this document is to depict several key features that will be weighted qualitatively and propose a preferred alternative.

The current design is based on the following documents:

- Design Review Report MAY-MDC-GEN-OTHE-RP-Y-0001
- Depot Requirements Report MAY-MDC-GEN-DEPM-RP-Y-0001
- Generation of Alternatives Report MAY-MDC-GEN-DEPM-RP-Y-0002
- Definition of Criteria & Assignment of Weightings Report MAY-MDC-GEN-DEPM-RP-Y-0003
- Depot Strategy Study MAY-MDC-GEN-DEPM-RP-Y-0004
- Monthly progress meetings MAY-MDC-GEN-DEPM-MI- (from 0001 to 0006)

SET design is in an optioneering stage where it is analysing together the issues related to the mainline and the depot, the last submittals are:

- Options Study Signalling Report: MAY-MDC-SIG-ROUT-RP-Y-0001.
- Options Study Electricity Report (includes OHLE, HV and LV): MAY-MDC-ELE-ROUT-RP-E-0001.
- Telecommunications Options Selection Report: MAY-MDC-TEL-OTHE-RP-Y-0001.

2 Abbreviations

The following abbreviations may be found in this report, and the explanation of their meaning is given below:

Table 1. Abbreviations

Abbreviation	Meaning
AVI	Automatic Vehicle Inspection
AWP	Automatic Washing Plant
BEMS	Building Energy Monitoring System
BEMU	Battery Electric Multiple Unit
BMS	Building Management System
CCTV	Closed Circuit Television
CET	Controlled Emission Toilets
CME	Chief Mechanical Engineer
CRS	Customer Requirement Specifications
CTC	Centralised Traffic Control
CWR	Continuous Welded Rail
DART	Dublin Area Rapid Transport (IÉ's Electrified Network)
DCC	Depot Control Centre
DMU	Diesel Multiple Unit
DPS	Depot Protection System
EMU	Electric Multiple Unit
ESB	Electricity Supply Board
ESBN	Electricity Supply Board Network
FLU	Full Length Unit
GDA	Great Dublin Area
GSM	Global System for Mobile communications (originally from the French: Groupe Spécial Mobile)
HF	Human Factors
HGV	Heavy Goods Vehicle
HLU	Half Length Unit
HM	Heavy Maintenance
IÉ	Iarnród Éireann/Irish Rail
IEC	International Electrotechnical Commission
ISO	International Standards Organizations
MDC	Multi-Disciplinary Consultant
NTA	National Transport Authority
OCR	Overhead Conductor Rail
OHLE	Overhead Line Equipment
O&M	Operation and maintenance
RFI	Request for Information
RS	Rolling Stock
SCADA	Supervisory Control And Data Acquisition
SET	Signalling, Electrical, Telecommunication

Abbreviation	Meaning
SoW	Scope of Works
TSS	Train Service Specification
UFC	Under Frame Cleaning
WTT	Working Timetable

3 Specific Analysis

The aim of this section is to highlight several specific analyses and interfaces with other disciplines and stakeholders carried out for the development of the depot design.

3.1 Utilities and surveys at the depot site

3.1.1 Survey existing services

Based on the Utility Services Survey, existing services near the Depot Layout have been identified, which will establish the base for the connection of Depot services. Each of the services connection is described in subsections below. Power substation is to be designed by SET team.

The next services have been identified in Depot surroundings:

- Watermain
- Communications
- Gas
- Storm Drainage
- Foul Drainage

Connection from Depot to these services would be as follows:

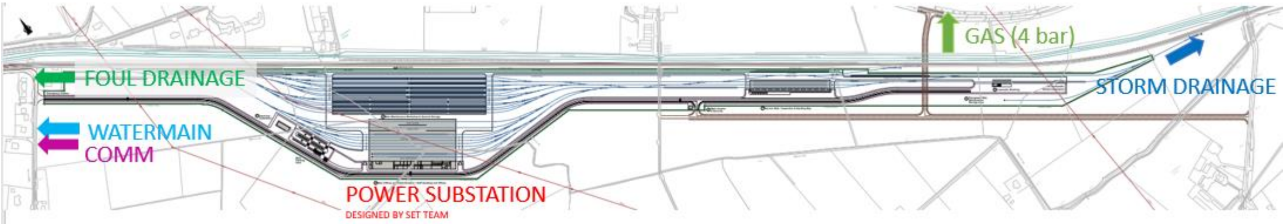


Figure 1: Existing Services in Depot surroundings

3.1.1.1 Gas Network

As shown in the figure above, the existing gas service is north of the Depot, at the other side of the channel. It would be possible to make the connection through the new OBG24, crossing this way the channel to reach the Depot.

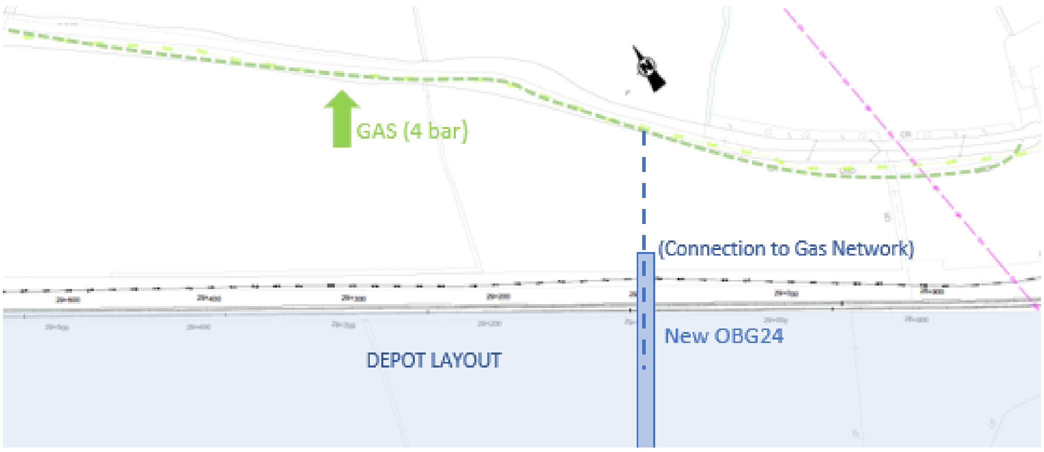


Figure 2: Connection to existing Gas Network

3.1.1.2 Water supply and communications

Connection to water supply network and to communications network would be at the West side of the Depot layout, as shown in figure below.

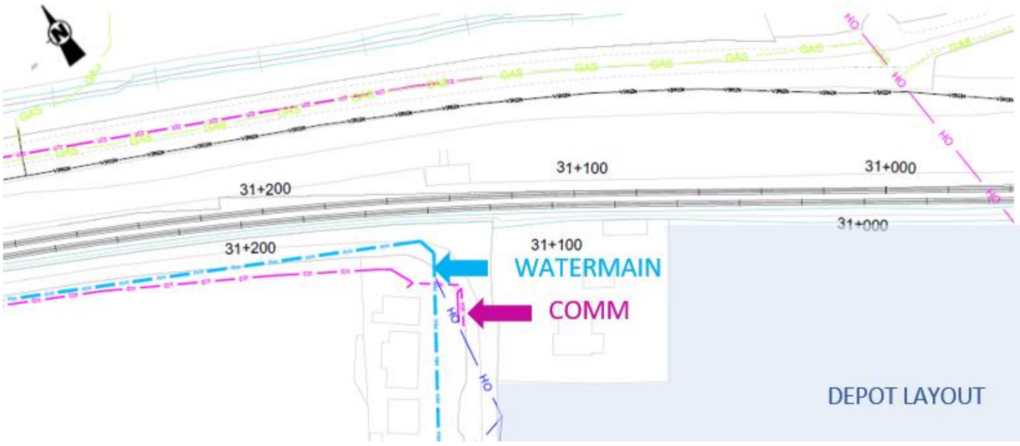


Figure 3: Connection to existing Watermain and Telecom network

3.1.1.3 Storm Drainage

For the storm water drainage, connection to existing network east to the depot layout would be possible. Drainage from the layout to this discharge point in east side would be optimal taking into account depot layout gradient, which decreases the level from west to east side. In long alternatives, west side level is +65.9 and decreases to +63.04 in the eastern side. In long alternatives, the level is +65.9 in west side +62.66 in eastern side.

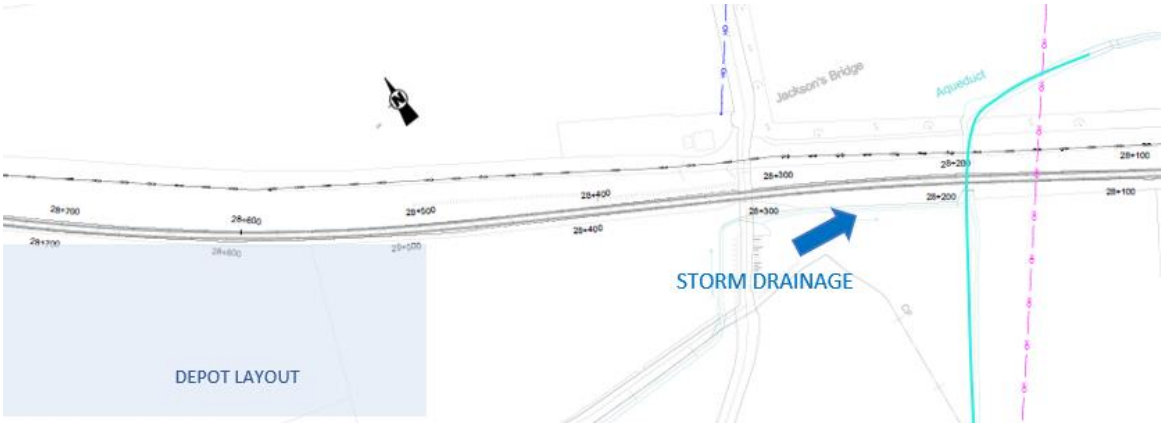


Figure 4: Connection of Storm Drainage network

3.1.1.4 Foul Drainage

Foul Drainage network in this area appears to be only on the other side of the Royal Canal, and also west side of the Depot in Kilcock. In houses next to the Depot, there appears to be no foul drainage network in the surveys reference.

Therefore, the most suitable connection would be to the Kilcock area, avoiding the crossing of the channel.

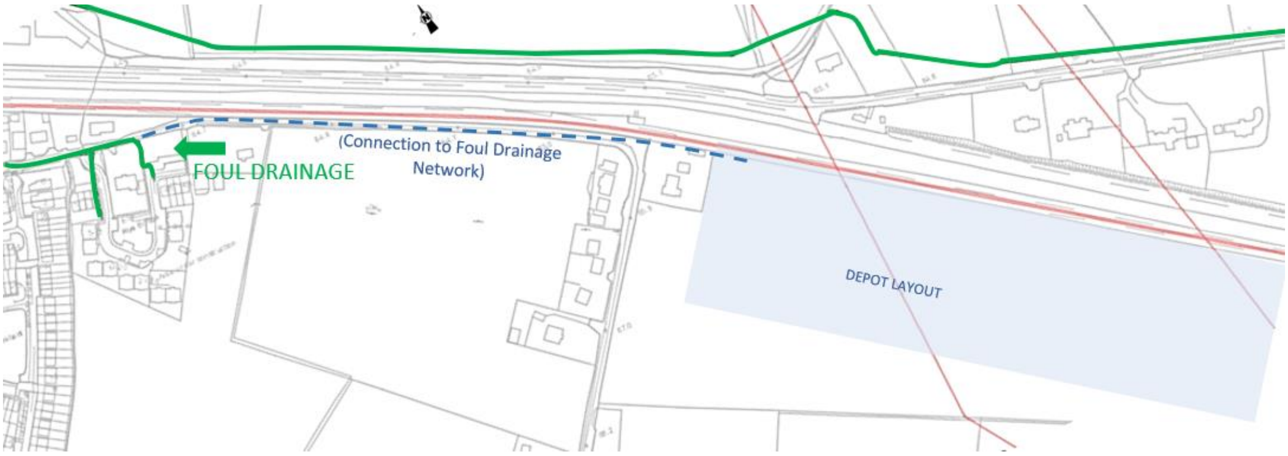


Figure 5: Connection to existing Foul Drainage Network

3.1.2 Overhead Power Lines

Based on the communications with ESB and the diversion proposal for 38 kv Lines, different diversion options have been provided by ESB, at least one for each depot layout alternative. In all of them, the main idea is to bury the 38 kV lines along the Depot Layout, installing two new interface mast South of the depot, and other two North of the depot, all being inside the depot boundary for ease of maintenance activities.

Therefore, the Depot layout will have to accommodate space for installing 4 masts of 12 m height. Also, the route of the buried cables has to avoid passing under depot buildings, and with bending radius of at least 6 m.

ESB has costed according to their standards the options included in the following subsections. The costings are at a high level. No matter which underground diversion is most suitable, costs do not include civil works to install the underground ducting, Horizontal Directional Drilling, other civil or ancillary works that may arise, nor the ducting, marked boards, warning tape, joint bays, etc. The material provision and civil works to install any pole, mast or other ESB structure will be done by ESB. These costs are included in the quotation for the entire diversion.

Once the preferred Depot Layout is agreed, the ESB diversion will have to be included in the planning application for ESB, including its interface mast details.

3.1.2.1 Both lines buried under Depot layout

For cables circuit, it can be single circuit cable or double circuit cable. This will depend on the preferred depot layout and the buildings arrangement. Both examples are shown in figures below:

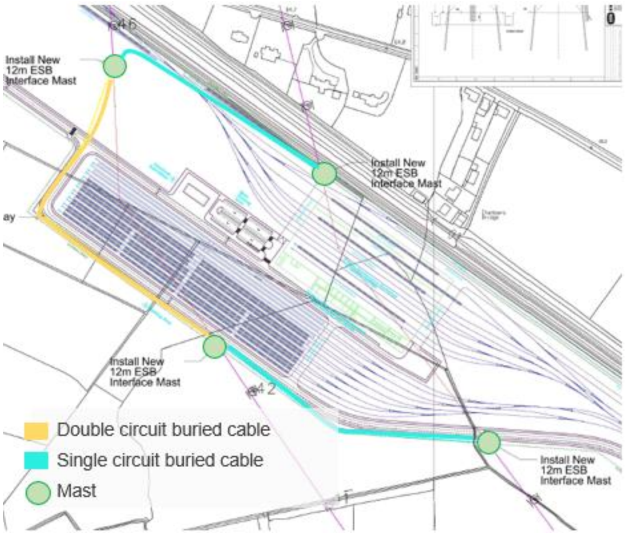


Figure 6: Cables route with double and single circuit ESB Costing €281k

Figure 7: Cables route with single circuit ESB Costing €119K

3.1.2.2 Both lines buried and passing the channel underground

Other possible option is having the two new masts in the lands North of the depot, on the other side of the canal. This would imply passing the canal underground. Therefore, this is the most expensive alternative however space for only two towers in the depot layout would be needed, instead of four.

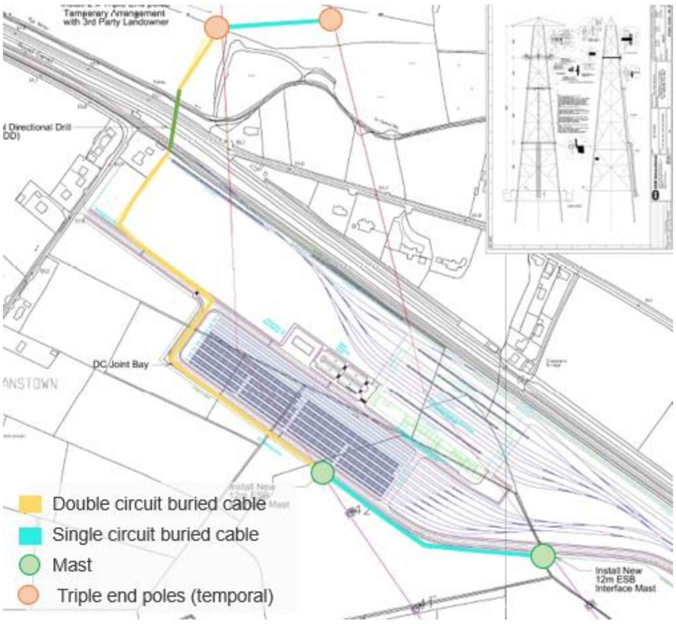


Figure 8: Cables route having two masts in Depot Layout ESB Costing €451k

3.1.2.3 Raising one line and burying the other one

In this case the preferred Depot layout has no buildings behind the 38 kV lines, line could have a raise alteration. This will have to be thoroughly checked, as if it goes over a location on personnel can access, it may come within close proximity to 38 kv lines with risk of electrocution. Therefore, this will not be the best solution with regards to health and safety.

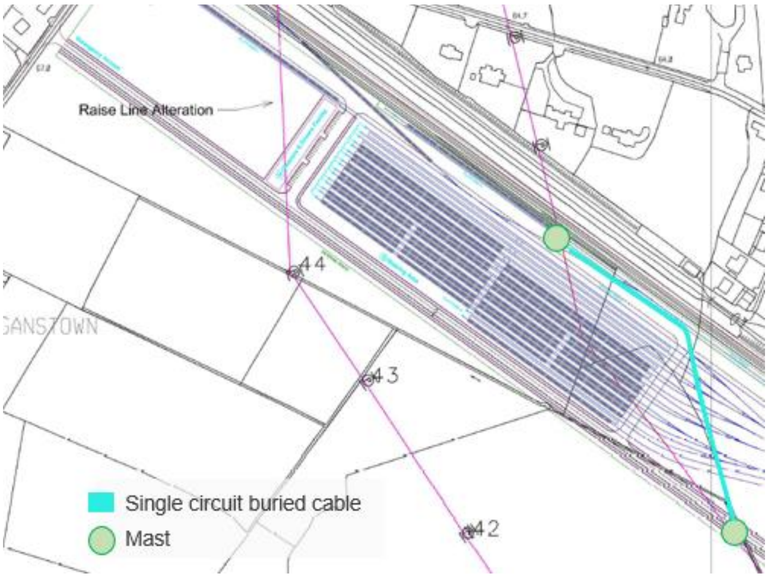


Figure 9: Raising one 38 kV line
ESB Costing €45k

3.1.3 Survey geotechnical study

The geological and geotechnical study throughout the depot area colonists of two phases:

- 1st phase: Desk study. Analysis of the published information.
- 2nd phase: Further ground investigation.

A desk study has been undertaken comprising an analysis of published information, with the purpose of providing a bibliographic collation of ground conditions in the Maynooth depot and surroundings. This information has been the basis to formulate further investigation work, targeting specific areas of potential geotechnical/geological risks, and therefore culminating in a cost-effective and targeted investigation as the next step.

The desk study indicated that the site is underlain by Quaternary Glacial Till deposits underlain by Calp Limestone. Some Quaternary Alluvium and Lacustrine deposits have been mapped according to available information, but only the Lacustrine has been noted after reviewing the historical geological site investigations. Made Ground is present at the beginning and end of the proposed route, associated with the development of Maynooth and Kilcock.

The ground investigation and mapping show a potential shallow Calp Limestone, between 1m to 6m depth, with uneven rockhead profile along the proposed route. According to the information consulted and recommendations by Irish Geological Survey, the possibility of karstification of the limestone cannot be discarded and undertaking a specific karst study for the proposed route should be considered.

The whole proposed route and the new Depot are underlain by a Locally Important aquifer, which is moderately productive only in local zones (LI).

The main geotechnical risks associated with the site are:

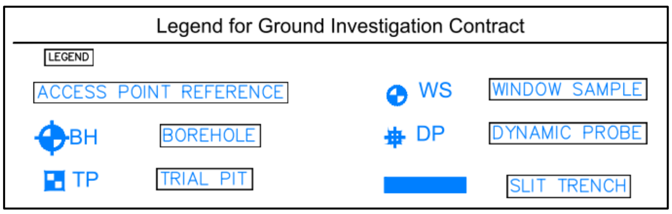
- Limited previous ground investigation data.
- Weak and compressible ground associated with Alluvium deposits, Lacustrine deposits and Made Ground Deposits.
- Unknown groundwater regime due to lack of investigation data and long-term groundwater monitoring.
- Potential high groundwater or surface water.
- Potential karstification present in Calp Limestone.
- Potential contamination of the existent aquifer during site operations.
- Potential obstructions during site operations due to the presence of boulders in Boulder Clay.

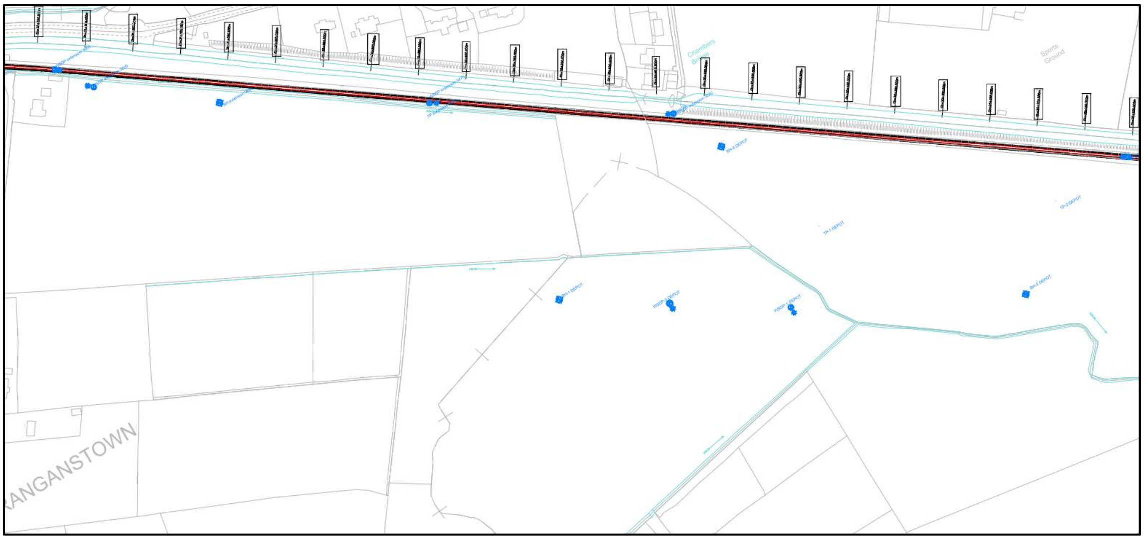
As further surveys, it is recommended to:

- Undertake ground investigation to classify the ground and to obtain appropriate samples for testing to provide a robust model for detailed design.
- Undertake a ground investigation to understand better the ground conditions at the site and the extent of the Quaternary deposits.
- Undertake ground investigation and monitoring to understand water levels.
- Undertake a ground investigation to understand better the extent of the Calp Limestone and degree of karstification.
- Liaise closely with Waterways Ireland to confirm requirements relating to construction close to the Royal Canal.

The scope of the works envisaged under the 2nd phase of further investigation is as follows:

Depot – Geotechnics surveys			
Hole ID	**Chainage/No.**	**Target/notes**	**hole type**
CP+RC-101DEPOT-SP	01	foundations	CP+RC-1
CP+RC-202DEPOT	02	sidings	CP+RC-2
CP+RC-303DEPOT	03	sidings	CP+RC-3
TP-101DEPOT	01	sidings	TP-1
TP-202DEPOT	02	sidings	TP-2
WS+DP01DEPOT	01	foundations	WS+DP
WS+DP02DEPOT	02	foundations	WS+DP
WS+DP3DEPOT	3	foundations	WS+DP
3 boreholes; 2 trial pits; 3 dynamic probing DPSH; Samples and laboratory tests/testing			





Finally an interpretive Ground Investigation Report will be prepared in accordance with IS EN1997-2, Section 6 as per S1.21.9 for the Depot site.

3.2 Planning information

3.2.1 Kildare County Development Plan

Kildare County Development Plan 2017-2023 has been checked in order to be in accordance with the requirements and provisions. It sets out an overall strategy for the proper planning and sustainable development of the functional area of County Kildare.

Some of the applicable issues, regarding Planning Chapter 17: Development Management Standards, and specifically the ones that affect industrial development, are the ones listed below.

3.2.1.1 Parking Space

The minimum size for a car parking space shall be 2.5 m x 5.0 m and circulation aisle 6 m side. Loading bays shall be a minimum of 3x6 m. 5% of parking spaces in non-residential developments should be set aside for disabled parking.

Non-residential developments shall provide facilities for the charging of battery operated cars at a rate of up to 10% of the total car parking spaces in order to meet the targets of the Governments Electric Transport Programme and in response to 'Climate Change the Government's National Policy Position on Climate Action and Low Carbon Development'.

Enterprise / Employment	
Industry / Manufacturing	1 per 33 sqm gross floor area
Warehousing	1 per 100sqm gross floor area
Office Town Centre	1 per 30 sqm gross floor area
Office Park	1 per 20 sqm gross floor area
	Where the floor area exceeds 1500 sqm, 1 space per 50 sq m

Figure 10: Parking space requirements according to Kildare County Development Plan

The gross floor area is the sum of all floorspace within the external walls of the buildings, excluding plant, tank rooms and car parking areas. The gross site area comprises all land within the curtilage of the site.

3.2.1.2 Cycle Parking

Cycle stands for use by visitors should be located to maximise convenience to the entrance of buildings, and positioned so as to ensure safety, security and supervision. The cycle parking standards set out in next table shall apply, and cycle parking provision should be in accordance with the National Cycle Manual, NTA (2011).

Enterprise / Employment	
Industry / Manufacturing	1 space per 100sqm gross floor area
Warehousing	1 space per 100sqm gross floor area
Office	1 space per 50 sqm gross floor area

Figure 11: Cycle Parking requirements according to Kildare County Development Plan

Along with cycle parking, sufficient shower and changing facilities should be made available in larger commercial developments/places of employment. Changing/drying areas, toilets and lockers should be provided in association with shower facilities.

3.2.1.3 Surface water/flooding

All applications for development shall include proposals for restricting the rate of surface water run-off in accordance with the recommendations of the Greater Dublin Strategic Drainage Study (GDSDS).

Developments shall incorporate **Sustainable urban Drainage Systems** (SuDS) as appropriate in accordance with the recommendations of the Greater Dublin Strategic Drainage Study (GDSDS)

Proposals to construct new and replacement culverts and bridges on watercourses shall be subject to the approval of the Office of Public Works, in accordance with Section 50 of the Arterial Drainage Act 1945 and the Planning System and Flood Risk Management Guidelines, DEHLG, (2009). These applications will be made to the Office of Public Works by the developer post receipt of planning permission. Approval shall be obtained prior to commencement of the works. The minimum permissible diameter of any culvert shall be **900 mm** with access to be provided for maintenance as appropriate.

All new developments shall be designed and constructed to meet the following minimum flood design standards:

- For urban areas – the 1% AEP storm event + a 20% allowance for climate change
- For rural areas - the 1% AEP storm event + a 20% allowance for climate change.

AEP = Annual Exceedance Probability represents the probability that a given rainfall total accumulated over a given duration will be exceeded in any one year.

3.2.1.4 Industry development

In relation to industrial development, in addition to the previous ones, the following should be also taken into consideration:

- Individual buildings should exhibit a high quality of modern architectural design and finish (including the use of colour)
- In the case of two or more industrial / warehouse units, a uniform design is required for boundary treatments, roof profiles and building lines
- Areas between the building and road boundary may include car parking spaces provided adequate screen planting is incorporated into the design proposal
- Adequate provision shall be made on the site for parking of vehicles, storage and stacking space. Storage and stacking areas shall be located to the rear of the building or, where such facilities are located at the side, provision for screening shall be made
- Any industrial or commercial development shall not be injurious to the residential amenity of adjoining properties;

- A landscaped buffer zone (minimum 5-10 metres) will be a requirement of planning permissions for any industrial / warehousing development where it adjoins another zoning or where it would impact on the amenities of adjoining land uses; and
- Proposals shall be submitted to incorporate Sustainable Drainage Systems (SuDS) in developments.

3.2.2 Security Fencing

The requirements for the provision of fencing on the Irish Rail Network are set out in CCE-TRK-SPN-037 Fencing Specification. This document states different typologies of fences, from which the Security Purpose Palisade Fencing is envisaged as the best option for the Depot.

Main characteristics of Security Purpose (SP) Fencing are listed below:

- The type of fencing shall be 2.4 m (the top of the fencing pales shall be 2.4 meters above ground level).
- Pales shall be 3.0 mm thick corrugated with a 'W' profile. The maximum spacing of pales, centre to centre, shall be 155 mm. The minimum face to view (width) shall be 70 mm.
- The maximum centre of posts shall be 2.75 meters. The posts shall be set in concrete in the ground to a minimum depth of 750 mm.
- A minimum of two number horizontal rails shall be installed.

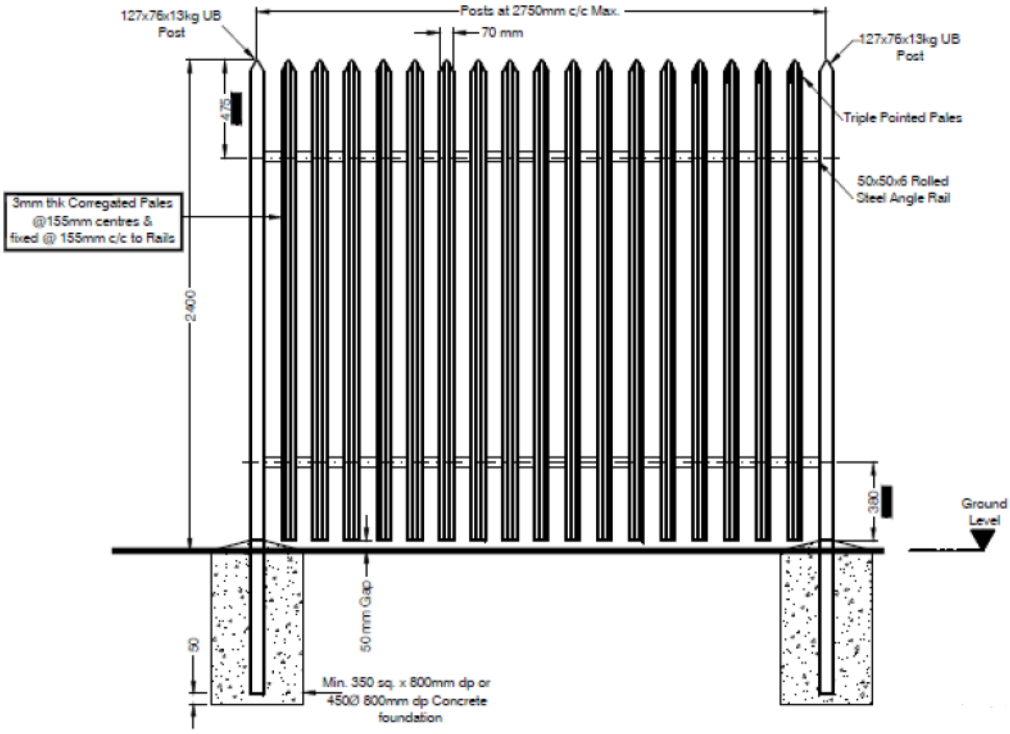


Figure 12: Security Purpose (SP) Fencing

3.3 Road Access

The road access to the depot site has been studied to determine a suitable route for depot staff for site access, delivery of stock or equipment and HVG travelling. Several routes have been proposed:

- 3 western accesses originating at Exit 8 of the M4
- 3 eastern accesses originating at Exit 7 of the M4

- 2 northern accesses that require the construction of a new bridge as shown in the Proposed DART Maintenance Depot provided by IÉ

In *Appendix 2* there are detailed pictures of the road access routes assessed for the depot. The proposed routes are:

Table 2. Proposed routes

Route Nº	Western accesses (Kilcock)
1	M4 (Exit 8) → R407 → R125→Courtown Park St → L5042(overpass) → Depot
2	M4 (Exit 8) → R407 → R125 → Connaught St → Depot
3	M4 (Exit 8) → R407 → R125 → Penwall Lodge → Ledwill Avenue → Depot
Route Nº	**Eastern Access (Maynooth)**
4	M4 (Exit 7) → R406 → L5037 → R408 → L5042 → L5042(overpass) → Depot site
5	M4 (Exit 7) → R406 → Meadowbrook Link RD → Beaufield Cl → Newton Rd → R408 → L5042 → L5041 → Depot
6	M4 (Exit 7) → R406 → Meadowbrook Link RD → Beaufield Cl → Newton Rd → Castledawson → Newton Hall → New Road → Depot
Route Nº	**New access by bridge**
7	Kilcock: M4 (Exit 8) → R148 → Church St →New Ln → R148 → Depot
8	Maynooth: M4 (Exit 7) → R406 → R148 → Depot

Routes number 7 and 8 require the construction of a new bridge which is related to the operation of the main line because of the singularity of OBG23 which has a clearance issue with the OHLE when doubling track. This is Jackson´s Bridge, and it is protected (Categories of Special Interest: Architectural Historical Social Technical). The bridge (over the Royal Canal) and the Royal Canal drop are dated from 1793.

In the "Speed Restrictions Report" (MAY-MDC-TRK-ROUT-RP-C-0001) four possible options are considered and the fourth one has been assessed as the most suitable. This option proposes a new track alignment out of the bridge, at least one new track is required to be placed out of the OBG23. The current track would be used for Intercity services. Whether the new alignment is for one or two tracks has to be assessed with the trains-Depot operation performance.

This option requires new OBs and UBs for the new track alignment and the road accesses. As a preliminary proposal to be confirmed, a cycle/footbridge over the alignment of the new tracks and connecting the L5041 and Jackson´s Bridge is deemed feasible. An outline of this option is shown in the figure below.

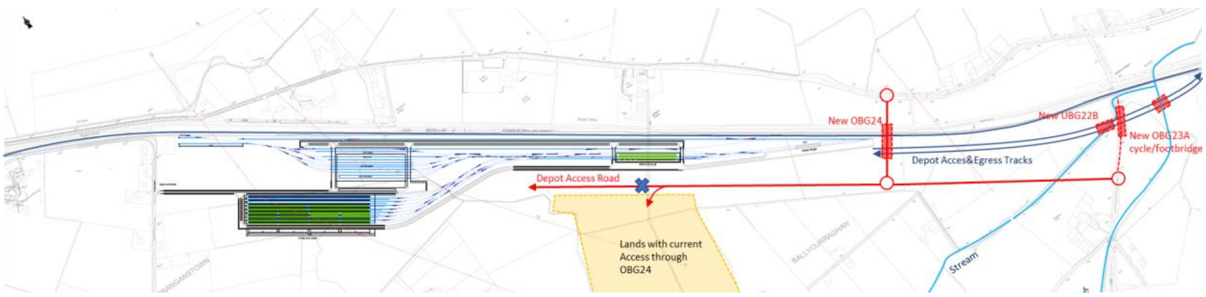


Figure 13: New OBG24 proposed scheme and depot road access

These routes have been analysed regarding the overall impact on the local community, suitability of route for HGVs and need of new infrastructures (road or bridge). The route features have been summarised in the following table:

Table 3. Route features

Route Nº	Length	Via residential road	Via new road	Via new bridge	Limiting Width and Street
1	4.5 Km	140 m	-	-	3.0 m (CourtownPark Rd)
2	3.1 Km	500 m	-	-	2.9 m (Connaught St)
3	2.8 Km	370 m	670 m	-	6.5 m (R125 Overpass)
4	9.5 Km	-	-	-	4.8 m (L5042 Overpass)
5	6.6 Km	-	-	-	4.8 m (L5042 Overpass)
6	4.3 Km	620m	850 m	-	-
7	5.3 Km	-	-	350 m	-
8	6.0 Km	-	-	350 m	-

Following, there is a map overview of the road access routes assessed for the depot.

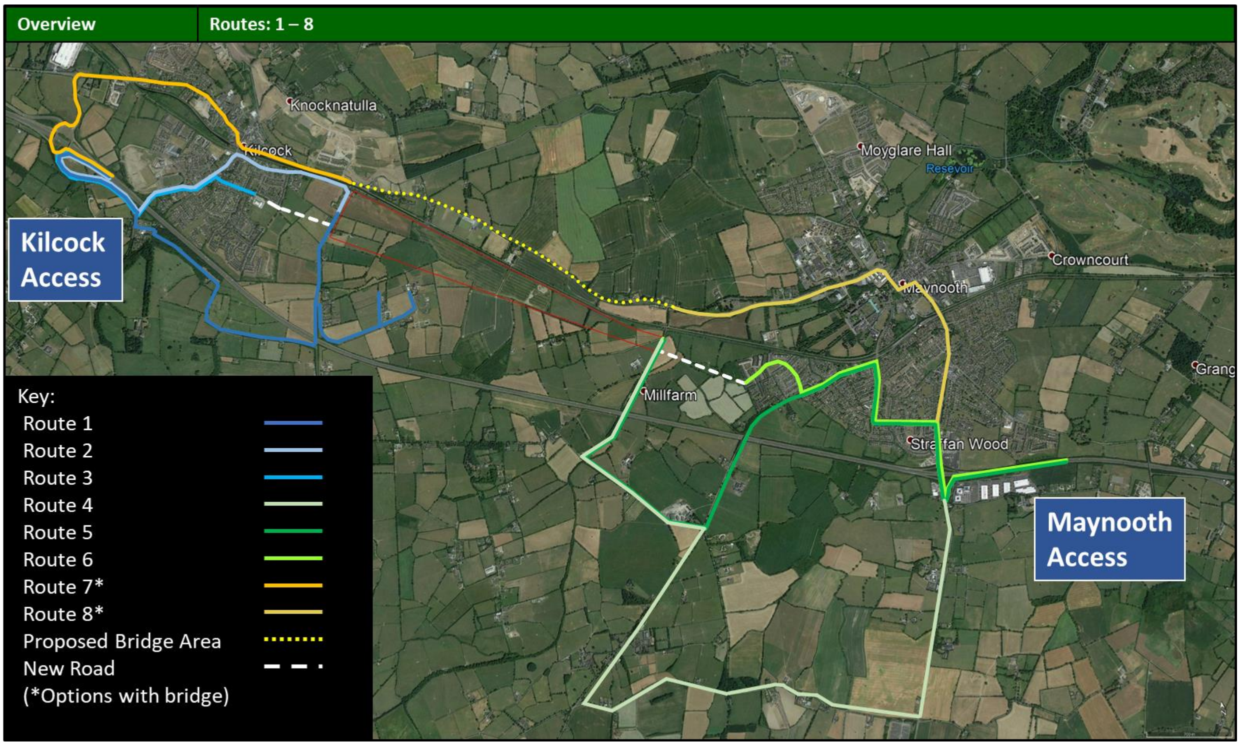


Figure 14: Road access routes

From the analysis carried out, the following conclusions are extracted:

- Routes 7 and 8 seem the best ones for the main connection. The new OBG24 enables a new connection to the R148 crossing the canal and the main line for the depot access and for the road network located south of the main line.

- Routes 1 and 2 seem suitable for a secondary/emergency connection. The routes from Kilcock go through residential area with narrow straight roads and new infrastructures are not necessary.
- Routes 4, 5 and 6 are discarded. The routes coming from Maynooth go through a heavy residential area with narrow meandering roads.

Alternatives from 1 to 6 show a main road connection to the R148 and another secondary connection to Connaught street in Kilcock.

In the section 10, there is MCA to assess the 4 most suitable routes to be considered in the analysis.

3.4 Depot facilities configuration

There are some facilities in the depot, which by its configuration within the depot yard, will foster better operation. This section highlights some of the issues in that regards:

3.4.1 AWP-AVI Scheme

The AWP and the AVI facilities are intended to be at the entrance of the depot. This is to ease the flows of those vehicles returning and scheduled for exterior washing or to go through the AVI facility. The arrangement of these facilities will be the same in all the layouts.

In the AWP the train is washed by brushes while it advances through the facility. It is intended to clean only the sides and eaves of the train with a cadence every two days, as stated in the IÉ requirements. The AWP location needs to provide a free space with the length of one FLU and its clearances at both ends of the facility.

It has been agreed with IÉ to consider the AVI as a facility of 20 m length in a stretch of track. The AVI information has been procured directly by IÉ.

The operation is intended to be the following:

- Intake from the main line and access to the facility for those trains that have scheduled washing/AVI.
- The train performs the activities going through the facility.
- Finally, the train heads to the service slab, or directly to stabling or workshop.

The facilities can be both on the same track or separated in parallel tracks, following there is a scheme of the layout of these facilities.

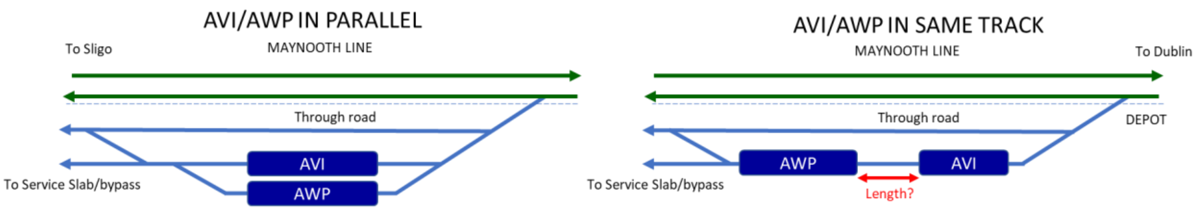


Figure 15: AWP-AVI Scheme

The points to consider at deciding which is the better option are the following:

1. If the facilities are in parallel, it will be necessary to provide more infrastructure, but the AVI facility will not be affected by the washing, besides, there is enough space in width.
2. If the facilities are in the same track, it will be necessary to assess an adequate space between facilities for the AWP not to affect the AVI sensors and lenses, that means more space in length.
3. This scheme is to be agreed with IÉ that so far has preferred both facilities in the same track.

Alternatives from 1 to 6 show these facilities in the same track but distance between them need to be assessed according to AVI specifications.

3.4.2 Test Track Scheme

Currently, the rolling stock tests in the DART network are performed in a section of the main line. This involves the need of undertaking the tests during the night when the services are finished, entailing safety problems.

The construction of the new depot offers the possibility of providing an exclusive test track within the complex, for train testing after maintenance, and test and commissioning of new vehicles.

The tests are to be carried out to try the different equipment of the train (bogies, brake pads, suspension, etc.). Consequently, those trains to have tests performed will be in the workshop.

The main features of the test track are the following:

- Test track will be straight and parallel to the main line.
- Test track will be protected from other tracks by a continuous protective fence.
- The length to perform the tests (achieving 60% of the max speed, considering braking time and safety distances) is around 1.1 Km.

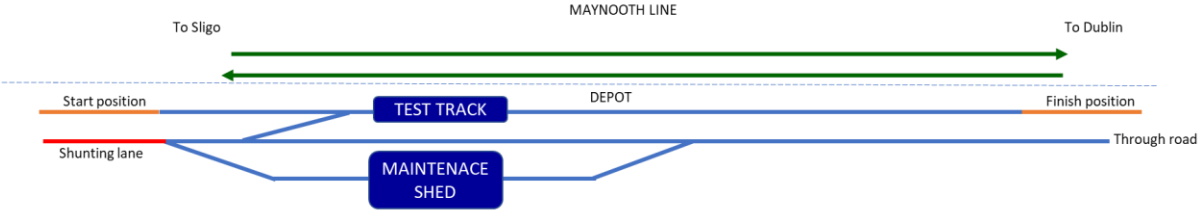


Figure 16: Test track scheme

The test track operation is intended to be the following:

- The train comes out from the maintenance shed up to the test track with a shunting movement.
- The train accesses to the test track and is placed in the start position.
- Performance of the tests and calibrations.
- The train finishes the tests and it heads to the stabling zone or the workshop with the shunting movement.

Alternatives from 1 to 6 show the test track as the scheme abovementioned.

3.4.3 Transition Platforms

The transition platforms will be the handover area between mainline and CME depot drivers. This will suppose a designated interface between mainline and depot operations as stated in the IÉ requirements.

Trains will be handed over from mainline driver to depot driver if they are requested to perform maintenance tasks (at the service slab or at the workshop shed).

Trains will head directly to the stabling yard, through the automatic washing plant and the AVI facility, or through the by-pass track if they are not required to undergo maintenance activities.

From the analysis carried out, two areas for transition platforms are considered in the depot. These areas have good connections for pedestrians and platforms to access the vehicle. Furthermore, there is a scheme with the location of the two transition platforms in the depot.

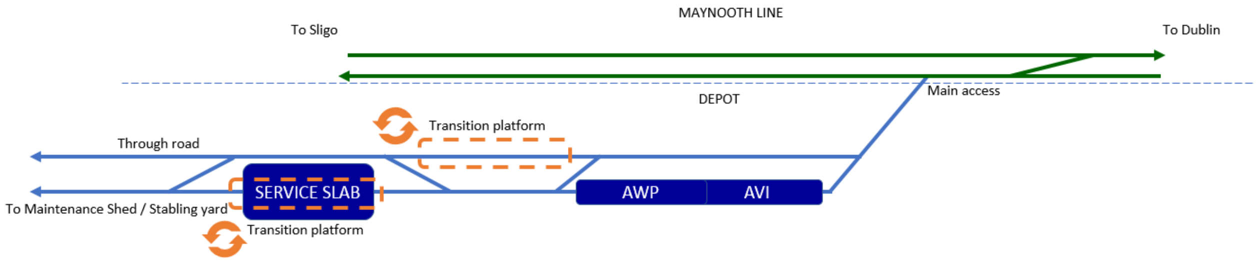


Figure 17: Transition platforms scheme

The two areas for the proposed transition platforms are:

- Section of the through road: for those trains that have to go directly to the workshop without stopping at the service slab. The train stops at this stretch of track, then the switch of drivers is made, and the depot driver heads the train to the workshop.
- Service slab: for those trains that are to be serviced (every second day). This activity is undertaken with the train stopped; hence, the switch of drivers can be done making the most of the time that the train is stopped. Later, the train can be headed to the workshop or the stabling yard by the depot drivers.

Alternatives from 1 to 6 show the transition platforms as the scheme abovementioned.

3.5 Main line connections and longitudinal profile

3.5.1 Railway connections

The general arrangement of the depot in all the alternatives results in a depot length at least of 2 km approximately. It is a terminus point in the western area of the line, and it is placed in the southern side of the main line. Consequently, the trains coming from Dublin access directly to the depot.

The location of these connections depends on the design of the main line in the vicinity of the OBG23 and they will be adjusted after that. Alignment between main line and Depot has to be coordinated taking into account the requirements from both sides. The points of connection between both infrastructures impact on the track configuration and facilities within the Depot. Additionally, a crossover will have to be included in the mainline so trains can enter and egress from the Depot in both directions of the mainline (in western and eastern access).

The connections with the main line in all the alternatives are the same:

- 1 main access from the east that gives direct access to the AWP/AVI or to the service slab, and the chance to bypass these facilities using a parallel track.
- 1 secondary access from the east to provide redundancy that gives direct connection to the through road.
- 1 access from the west to increase the resilience and to ease the egress/ingress to Kilcock, this access provides direct connection with the through road.

The access turnouts from the main line are P15/18 type.

The following figure shows the different train accesses that are common for all the alternatives analysed:

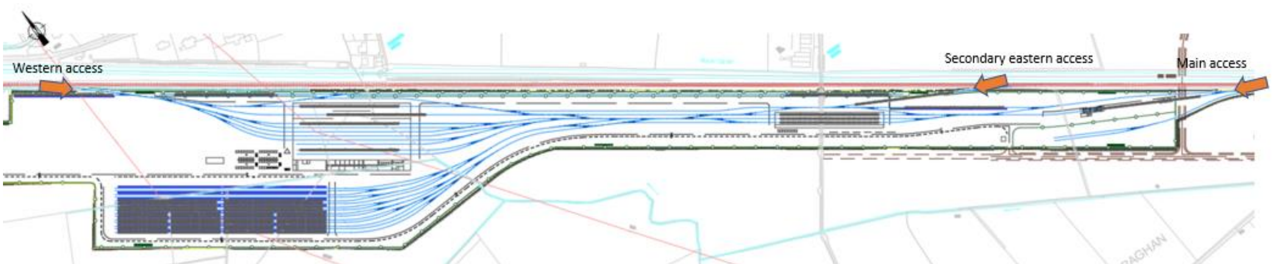


Figure 18: Rail access from main line (Alternative 1)

Alternatives from 1 to 6 show the main line connections as the scheme abovementioned.

3.5.2 Longitudinal profile

In order to undertake a preliminary assessment of depot level, gradient and earthworks required, two different longitudinal profiles of the bypass track have been developed (MAY-MDC-GEN-DEPM-DR-Y-007). From the depot layout alternatives, alternatives 1 and 2 are shorter than the others.

For all the alternatives, main line alignment and longitudinal profile will need to be considered, as there are three connections between main line and depot, which are Main access to the depot, secondary eastern access, and western access. The track alignment criteria considered to assess the vertical alignment is the following:

- Desired minimum vertical parabolic parameter: 1000 m
- Locations where there is a changing gradient less than 0,15%, vertical curves are not considered

- Max gradient 1% (0% is considered in stabling tracks, maintenance shed, service slab and washing plant).

Below is a features summary of the two longitudinal profiles developed highlighting the main points:

Longitudinal profile for alternatives 1 and 2

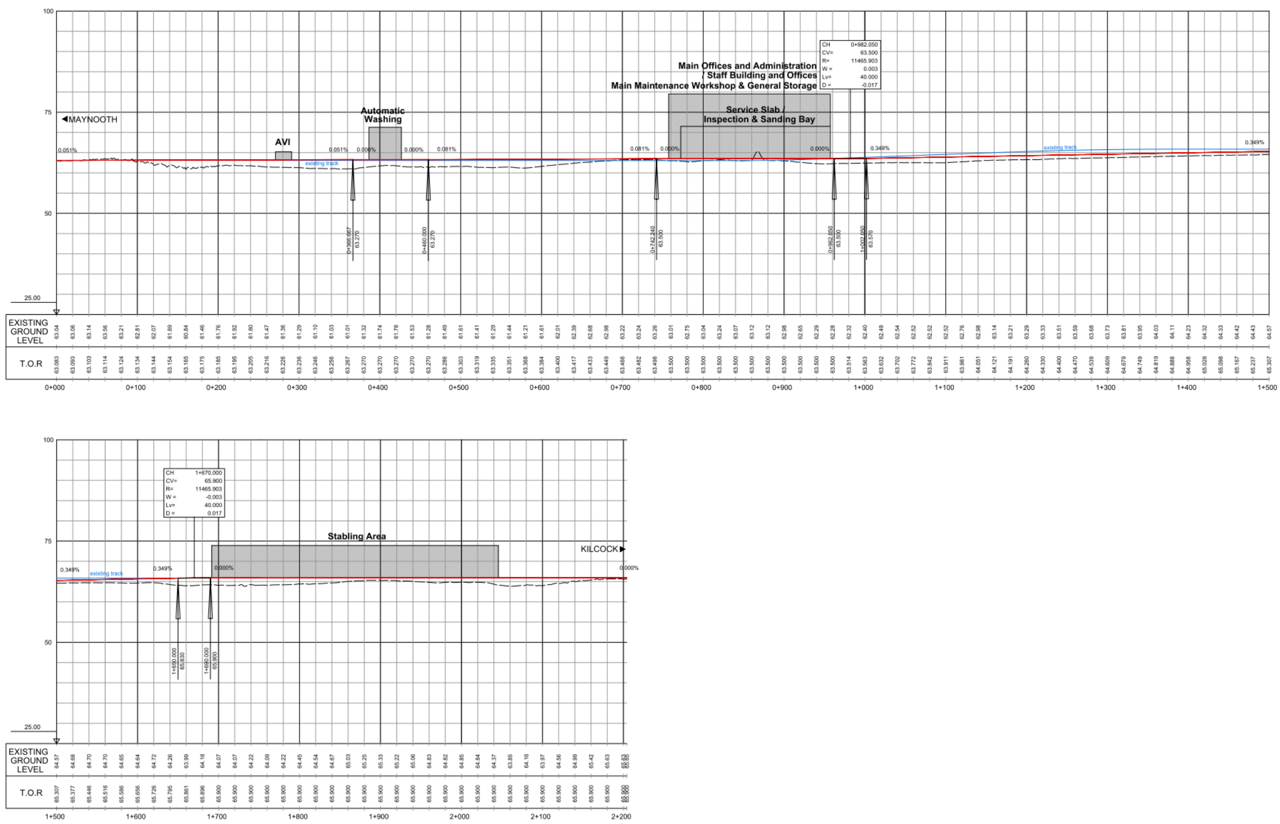


Figure 199: Longitudinal profile shorter options (Alternative 1 and 2)

Below are the main features in terms of vertical alignment of the shorter options:

- Maximum gradient: 0.349 % between servicing area and stabling
- Gradient in the main access / western access: 0.051% / 0.000% approx.
- AWP level: +63.27 m
- Main building level: +63.5 m
- Stabling area level: +65.9 m
- Maximum embankment section is around 2.50 m height
- Maximum cutting section is around 0.60 m in Alternative 2 and 1.50 in Alternative 1. In the localised point of the OBG 24 (0+870 approx.) is around 4.50 m.

Longitudinal profile for alternatives 3, 4, 5 and 6

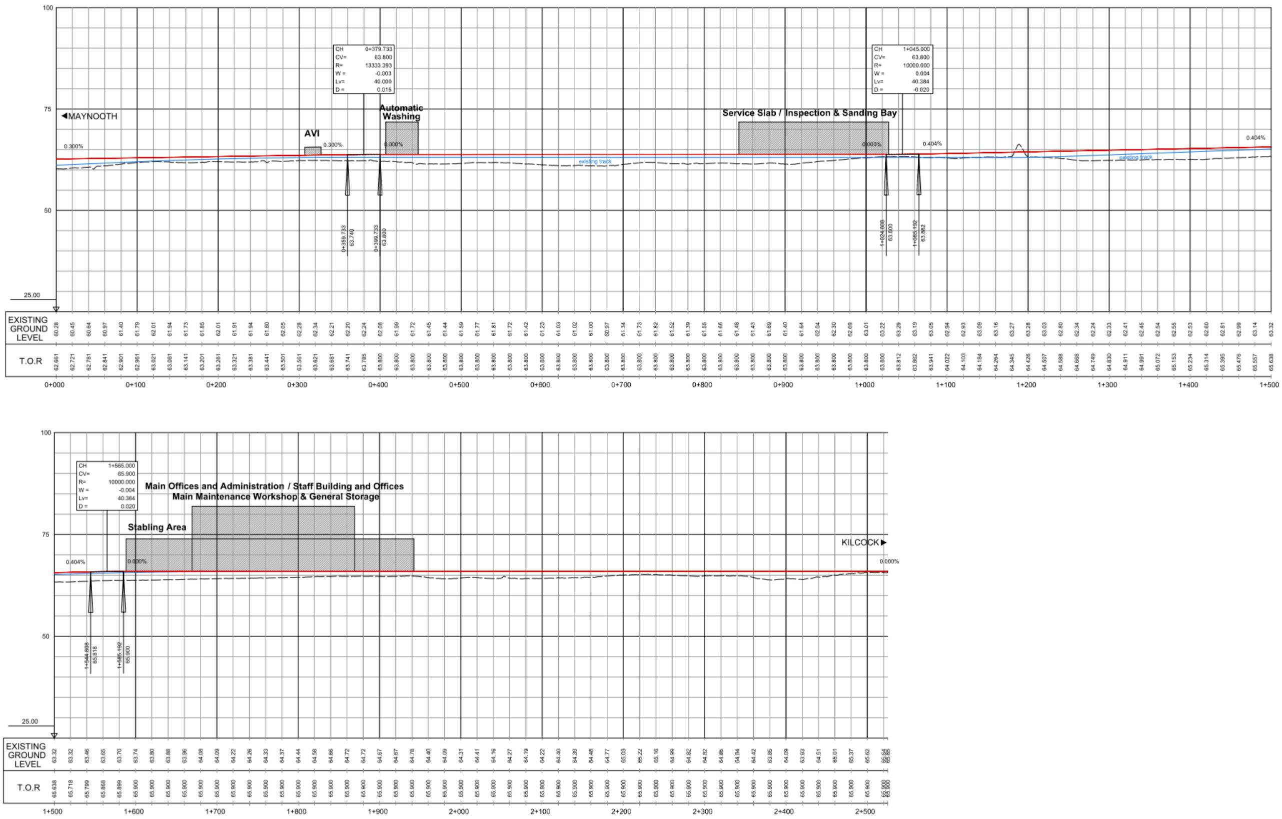


Figure 20: Longitudinal profile longer options (Alternative 3, 4, 5 and 6)

Below there are the main features in terms of vertical alignment of the longer options:

- Maximum gradient: 0.404 % between servicing area and main building
- Gradient in the main access / western access: 0.300% / 0.000% approx.
- AWP level: +63.80 m
- Main building and stabling area level: +65.90 m
- Maximum embankment section is between 3.00 and 3.30 m height
- Maximum cutting section is around 0.35 m in Alternative 4 and 1.55 in Alternative 6. In the local point of the OBG 24 (0+870 approx.) is between 2.78 and 3.77 m. In Alternatives 3 and 5 there is no cutting section apart from the OBG 24 zone.

The conclusions from the preliminary assessment of the longitudinal profiles are the following:

- Vertical gradients achieved are smooth (<1%), and besides stabling area, servicing area and maintenance shed have gradient 0%.
- Most of the complex is in an embankment section that supposes advantages for the drainage of the facilities, and the flood issues located in the eastern area around OBG23.

4 Depot facilities

4.1.1 Service slab

This facility is located after the automatic washing plant track, and before the access to the stabling yard. It is an enclosed building with roof and sidewalks containing three tracks. The number of tracks will be analysed in the siding and washing strategy. The length of the building is 185 m with a width of 26.2 m.

Between the roads, there are utilities such as water supply, electrical supply, fluid top up including windscreen wash and sanding system top-up (sand silo, sand filter and sand filling stations), as well as a proper wastewater management system for the CET toilets of the train.

A stretch of building is reserved for plant rooms, tanks, technical rooms, tools and equipment storage. The building will have road access for heavy trucks and forklifts and pedestrian access for the workers.

The dimensioning of the service slab is based on the following assumptions:

- The most restrictive activity is the CET discharge and the refilling, since the sanding will be performed every 12,500 km within the inspection PI1.
- Train ingress to depot every 10 min, timetable service to be confirmed and validated by OPS team.
- Activity carried out after depot ingress and washing cycle (off-peak and during the night), consequently both activities will be related and harmonised with the timetable service.
- CET discharge carried every second day, so 15 FLU of berthed fleet in Maynooth to be serviced daily.
- The duration of the CET discharge is quite dependant on the facility and the rolling stock. The process could last around 4-6 minutes for a single toilet tank, and besides there is an additional time of 1 minute for refilling clean water. At this stage, and with no further data is considered to be around 20-30 minutes.

In summary, 3 tracks in the service slab allow to perform the maintenance tasks along the ingress of the vehicles into the depot during the removal of the fleet in off peak hours to satisfy the maintenance requirements.

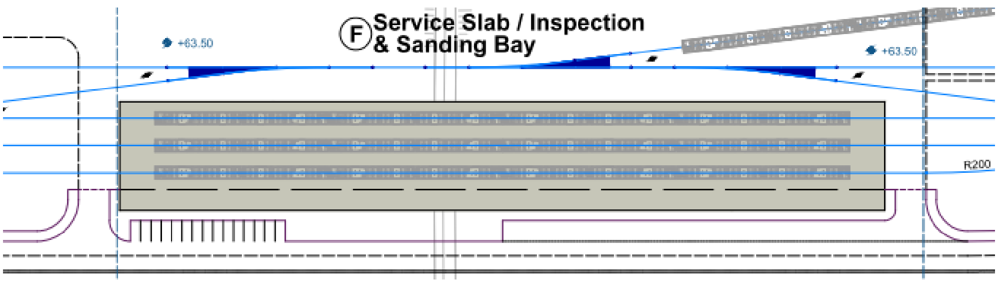


Figure 21: Service slab facility

4.1.2 Automatic Washing Plant

The AWP will be a drive-through type and it is located at the entrance of the depot after the AVI facility, which is on the same track, and before the access to the service slab, stabling yard and maintenance shed. The final number of tracks will be analysed in depth in the siding and washing strategy.

The washing will be unidirectional and capable of washing the sides and eaves of the vehicles. Washing speed will not exceed 5km/h, optimal considered as 3km/h.

The washing strategy for the DART flee will be based in different time windows: AM off-peak period, PM off-peak period and during the night.

According to our experience, approximately around a 30-70% of the fleet is removed from the main line to depot in the off-peak morning, having a period until the evening peak between 4-5 hours. Depending on the headway during the ingress to the depot, most of them could be washed directly, but if the AWP is occupied an arriving train has to be headed to the stabling and washed in another time frame.

The later period is the PM off-peak and the night, where the rest of trains can be washed. Following there is a general scheme of the different time slots described previously:

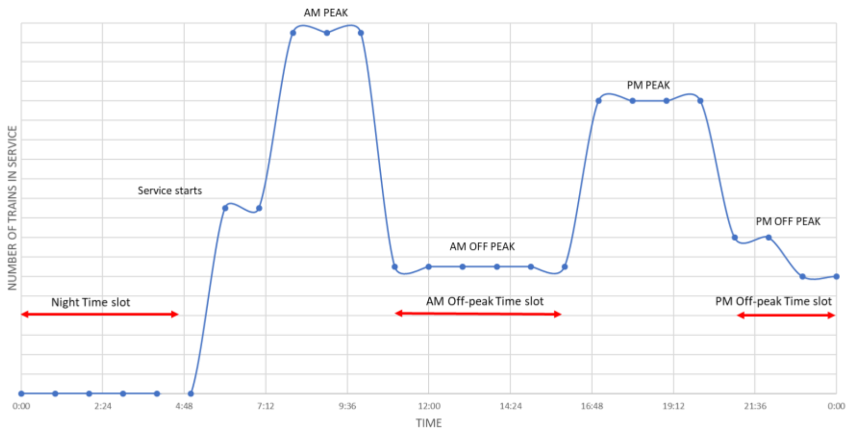


Figure 22: Example of general operation scheme with peak and off-peak time slots

The dimensioning of the washing plant is based on the following assumptions:

- Washing at 3 km/h, approximate duration of 3’22’’.
- Activity carried every second day: 50% or 15 FLU of those berthed in Maynooth to be washed daily.
- Activity carried out after depot ingress in off peak hours or during the night.

In summary, 30% of the fleet could be washed during the removal of the fleet in off peak hours and of the rest up to 50% could be washed at night from the stabling. Considering this initial estimation, the number of 1 AWP is enough to satisfy the maintenance requirements.

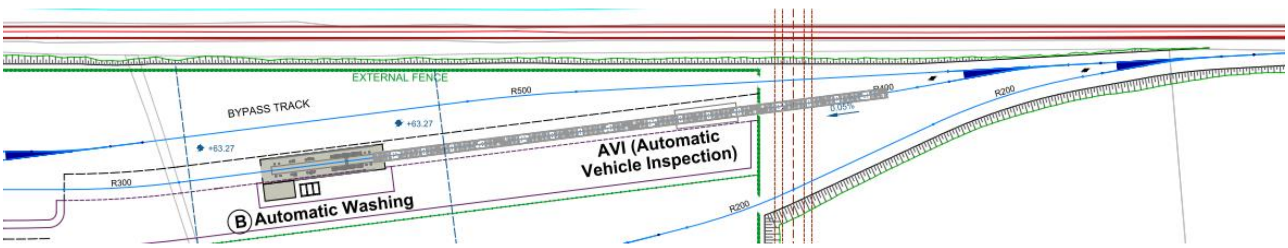


Figure 23: AWP/AVI facility

4.1.3 Automatic Vehicle Inspection

AVIS Specification 32109501/H01 Issue 1 provided by IÉ has been checked for inputs related to operation and location of the facility within the depot.

The AVI facility is placed on the same track that the AWP and at the entrance of the depot (requirement 2.2.) but the minimum distance between these facilities need to be assessed by equipment supplier to be sure that the washing process does not affect the performance of sensors and lenses of the AVI facility.

The AVI will be housed in a surrounding structure required to house the AVIS system. (requirement 2.4.) but the minimum distance to aerial electrical lines need to be assessed by equipment supplier to avoid any interference.

For the operation analysis is considered that the system shall only be active when a train is detected as approaching the system (requirement 2.15). It shall be bi-directional, capable or working up to speeds of 8 km/h, and able to be activated from both directions (requirements 2.16 and 2.17).

4.1.4 Stabling area

The fleet to be berthed at Maynooth depot is foreseen to be a 40% of the 600 EMU of the total DART fleet (240 EMU), it is highlighted that the final number will be validated by the operational analysis. The fleet will operate in 4 and 8 car formations. Therefore, 240 EMU will be 30 FLU or 60 HLU.

The 15 stabling tracks of the depot are designed to accommodate 2 FLU of 168 m each of them, enabling to berth 2 FLU, or 4 HLU, taking into consideration berthing distances between them. The stabling zone has central platforms to ease train access for both drivers and cleaner brigades. The distance between tracks is 4.10 and 6.6 m alternatively, thus providing a longitudinal access corridor every two trains. The length of the stabling zone is 375 m, with a width of 91 m.

Figure 24: Stabling area: alternative no 3

Only alternative 5, where the minimum clash with overhead powerlines is achieved, considers 10 longer tracks instead of 15.

4.1.5 Main Depot Building

The main building will be the largest and most complex facility of the Maynooth Depot. Administrative, operational and maintenance tasks will be carried out there. The main building will also contain the Depot Control Centre (DCC), from where the movement, control and security of vehicles within the Depot will be managed. Taking into account the organisation inside the building, studied in the MAY-MDC-GEN-DEPM-RP-Y-002 report, the distribution and sizing of the building was selected. Therefore, the Main Depot Building and Maintenance shed considered is 216 m long and 115 m wide.

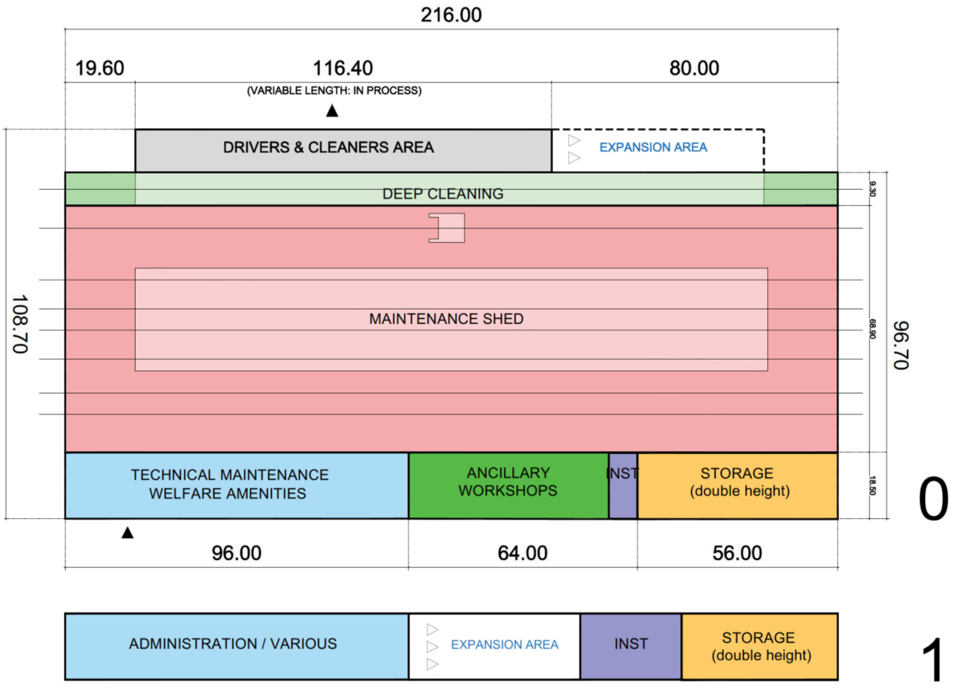


Figure 25: Main Building. Preliminary general dimensions

Below is a longitudinal section that aims to report on the preliminary heights of the building. As required by IE, the Contact Wire height shall be between 4.2 m and 5.7 m (nominal contact wire height in the mainline will be 4.7 m). Following this input, force beam cranes will run over the OHLE.

Since MEP facilities will be located above the beam crane (HVAC, electricity, fire, etc.) and considering 1.5 m height for structure and deck, this would result in around 11 m height of the building. This height could slightly increase with the addition of skylights or external HVAC equipment (pending of constructive design). As required, at each end of the building, will be at least an apron of 15 m of free area.

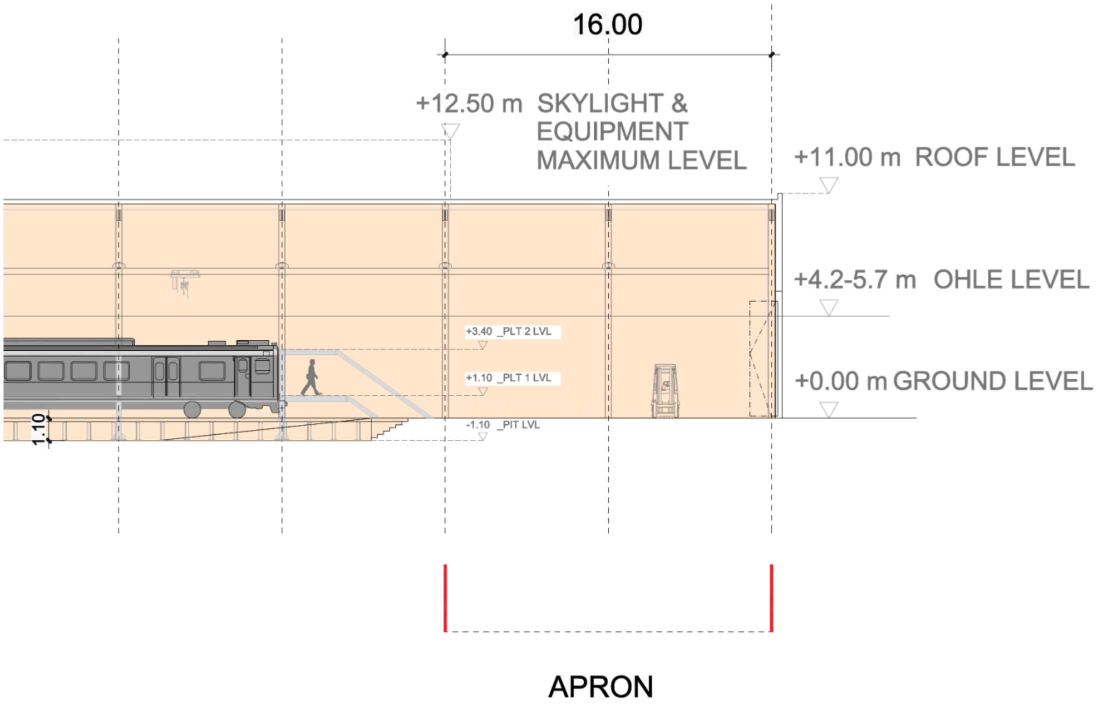


Figure 26: Main Building. Longitudinal section detail

4.1.5.1 Maintenance shed

The maintenance shed will allow performance of all the following activities:

- Heavy Maintenance: two tracks in-floor lifting system with overhead crane facilities. Both tracks are 6.00 m apart, allowing the passage of forklifts between them. There is a bogie track on the side.

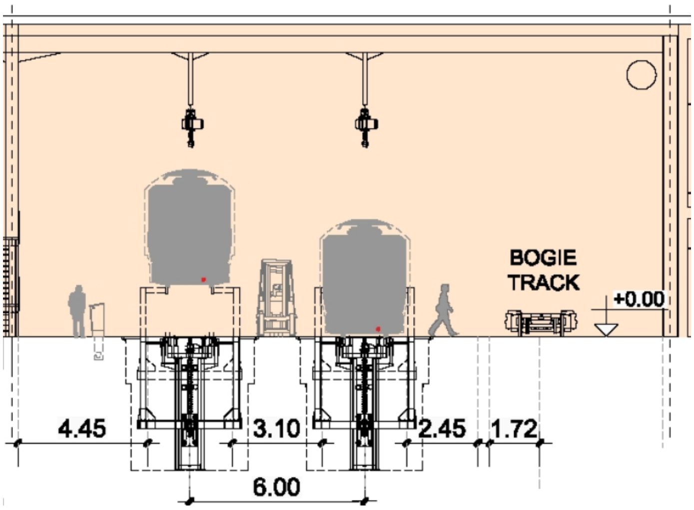


Figure 27: HM. Preliminary dimensions (to confirm)

- Light Maintenance: four tracks on pit, with lateral overhead platforms and overhead beam cranes as suggested by IR. Each track allows to accommodate a FLU or 2 HLU that are not coupled.

  The tracks are alternately 8 and 6 meters separated. There are stairs and also three ramps of low slope that allow to descend to the pit with wheelbarrows and forklifts. In the pit, under each track, a longitudinal trench of greater depth shall allow the lower inspection of the trains (frame, shock absorbers, etc.).

  Double-level side platforms are proposed, allowing access to both the train (passengers level) and the upper part of the train (roof level). It is proposed that these platforms will have the entire length of the train and will be located only on one of its sides. In this way, by having all the tracks the same equipment, maximum efficiency and flexibility is obtained. This design is very common in modern depots, as it offers installation and equipment for demanding performance. The final decision on the number and disposition of these will be left to IE.

  Below is a preliminary design where it is possible to appreciate the different elements described. The dimensions are approximate, the result of our previous. The final dimensions will be obtained from the combined conclusions of the Human Factors Integration Plan (HFIP) and the Lean Manufacturing Plan.

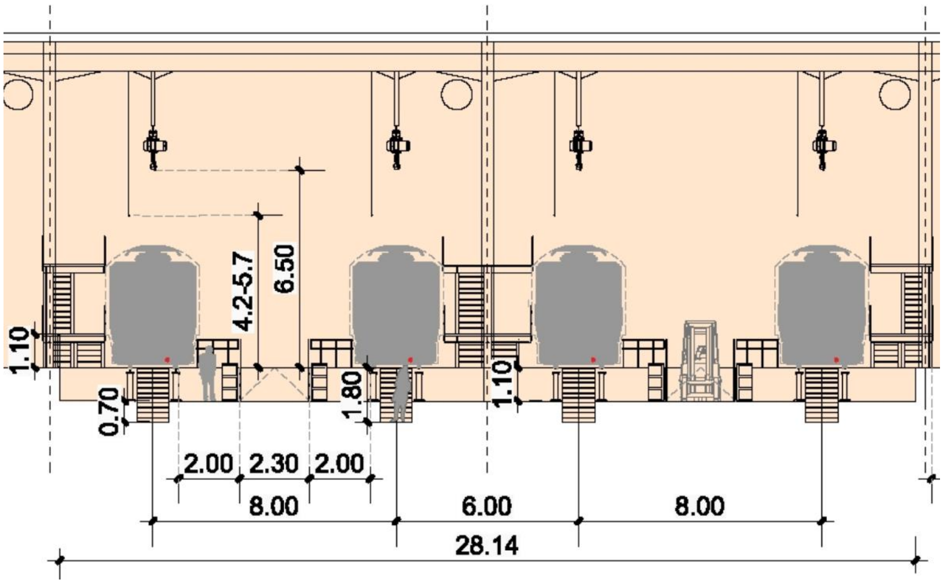


Figure 28: LM. Preliminary pit dimensions (to confirm)

- Ancillary workshops: As pointed out by IE, the auxiliary workshops will be organized within a single space that will contain them all. Preliminarily it is dimensioned with approx. 1000 m^2 (70x10.5 m)

  These workshops should be equipped with the necessary connections and supplies, such as: electricity, water, data, etc., as well as the required fire protection measures. Located adjacent to the main workshop, it will be composed of the following zones:

  - Mechanical workshop
  - Parts cleaning booth
  - Electromechanical workshop
  - Electrical/Electronic workshop
  - Battery loading workshop
  - Painting and polyester workshop

- Bogie delivery area: It will be track connected to heavy maintenance tracks; shunting vehicle will move train bogies between these areas.

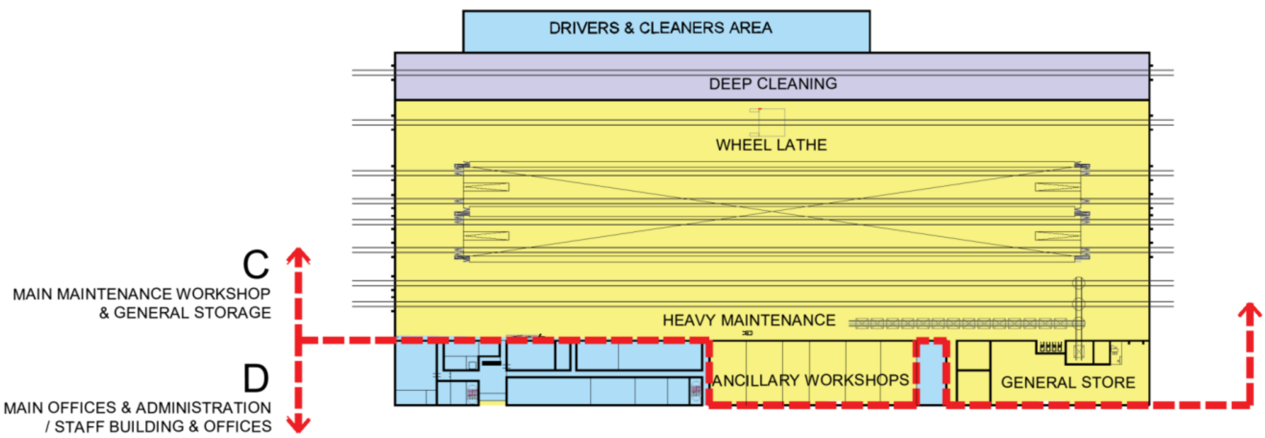


Figure 29: Maintenance shed zones

4.1.5.2 Office and Administrative Building

Located on one side of the building and distributed over two floors, spread over 3,330 m^2. It offers the following uses for administration, operations, as well as welfare services:

- Administrative area
- Depot Control Centre (DCC)
- Maintenance and Installations offices
- Training Area
- Toilets, Lockers & Showers
- Break rooms and Canteen

4.1.5.3 Storage

Included in the Main Depot building, it is located on one side of the building. The actions to be carried out in this facility is to store consumable and capital spares for the different EMU fleets.

The General Storage will have double height allowing trucks access to the interior, as well as the existence of high shelves.

Close to the warehouse, but already in the workshop, there will be a parking lot and forklift loading area. They will have to be located there since it is the storage and entry point of material to the building.

The facility contains (preliminary figures):

- Main Storage: 695 m^2
- Oil storage: 61 m^2
- Waste collection room (seven types of waste): 105m^2 -in process final surface-
- Tool hand out point

4.1.5.4 Deep Cleaning

The facility is located on the last track in the maintenance workshop. There is direct access from the Wheel Lathe area, but it will be segregated from the rest of the building. It will have the same length as the rest of the workshop.

Since minor bodywork and finishing repairs will be carried out there, a spare parts and tool store will need to be located nearby. In the absence of adjustments in the area, it preliminarily occupies an area of 2.016 m^2.

4.1.5.5 Tandem Underfloor Wheel Lathe

The Underfloor Wheel Lathe (UWL) will be integrated in a designated track within the Workshop, in a way that the process can be done without decoupling the vehicles. It will be located on one side of the Workshop, between the Light Maintenance and the Deep Cleaning. It has a length equal to the rest of the building, by covering an approximate area of 2,788 m^2.

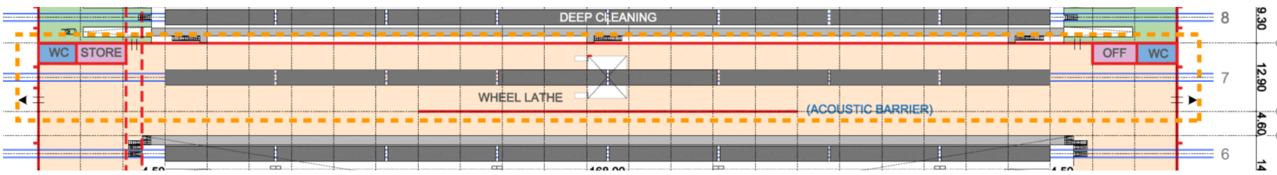


Figure 30: Wheel Lathe location and dimensions

It shall be equipped with a remote-control shunting vehicle that will enable the machine operator to move each bogie of the train into position for machining.

The vehicle shall not move during the re-profiling process.

The lathe shall have the capability to machine 2 wheelsets at a time without disassembling the bogie or the wheelsets. It shall be able to process simultaneously each wheel in the bogie with an individual wear profile.

The facility will primarily be designed for the EMU fleet, and it shall be capable of machining other vehicles in the IE fleet. For this, detailed technical information of the different chassis/wheelsets must be provided to adapt the fixing clamping solutions to the needs. The systems will be simple and easy to reduce cycle time, and ergonomic in all cases.

The lathe shall have a 1-car pit to allow underframe inspection following machining and for ride height adjustment.

The facility will be provided with a swarf treatment system, connected to the control panel.

4.1.5.6 Drivers and cleaners management area

With the chosen alternative 3, the operating building that will house the drivers and cleaners facilities shall be located inside the main building volume but facing the Stabling. In this way the workers will have direct access to the depots, facilitating also the management and displacement of equipment. In order to access this area without causing functional and safety conflicts, we propose that it be done through an **underpass** that would run under the main workshop.

The facility will contain:

- Not control necessary (it will be perform in the Min building lobby)
- Cleaners and Drivers offices
- Training room
- Toilets, showers and lockers
- Break room and Canteen
- Store cleaning equipment and products.
- Installations

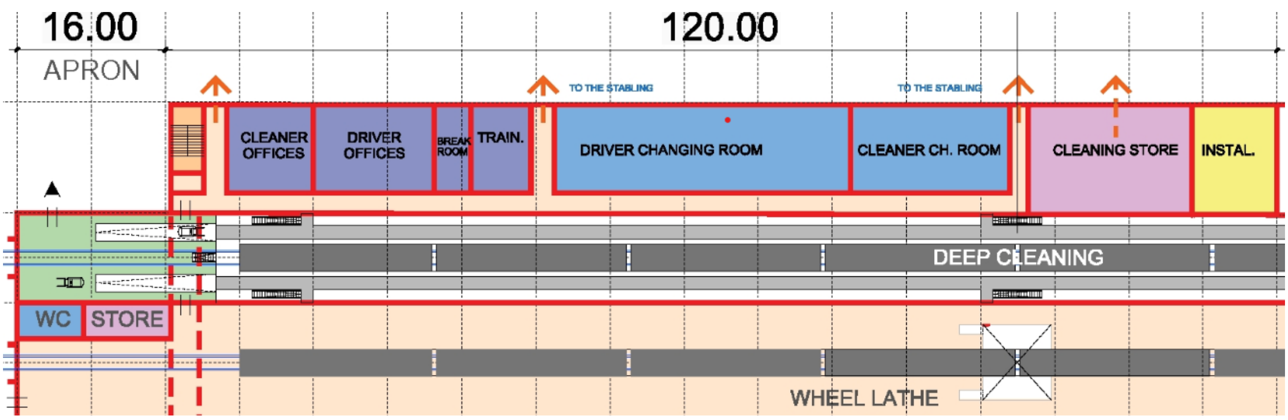


Figure 31: Operation building. Distribution and general dimensions

The building occupies approx. an area of 1,455 m^2, it could be extended if the program requires it. One of the issues that can change the size of the building is the number of staff that will use the building. Such personnel will essentially be the sum of drivers and cleaners, and sizing of the building is made considering the maximum final fleet in the Depot (600 vehicles).

In order to estimate the number of drivers, it is necessary to consider the number of trains that will be housed in the depot overnight:

- A fleet of approx. 300 vehicles, configured as 8 car units: 38 units (15 units on site each night)
- A full fleet of approx. 600 vehicles, configured as 8 cars units: 75 units (30 units on site each night)

Following the initial specification for mainline drivers received from IÉ, and based on Fairview comparison, there could be approx. 100 drivers based in this facility.

Once we estimate the number of workers, it is time to size the locker-rooms and to establish a male to female ratio. The IÉ organisation is committed to improving the gender balanced across all grades and functions.

According to previous experience in similar situations, and feedback from IÉ, we propose a ratio 70 % male - 30% female. In this way, following IE's suggestions, changing rooms will be separated by a single partition, to allow the resizing of the spaces (see image below).

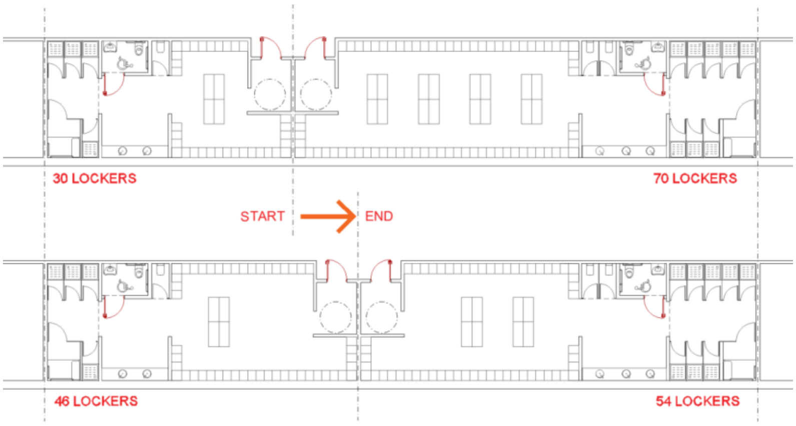


Figure 32: Locker rooms. Flexible design

Regarding cleaners we expect a similar procedure. In order to fix the staff, we would like to know IÉ current experience. According to our experience for the initial fleet (15 units), we estimate a team of 15 cleaners (including shifts/holidays/absenteeism), assuming that a team composed of 3 workers could perform this task for 4/5 vehicles during the night. For the final fleet (30 units) these values should be duplicated.

4.1.6 Test track

The Test track is parallel to the main line and linked to the workshops in the most directly way, it is protected from main tracks by a continuous protective fence. It will contain two platforms at the beginning and the end of the track. The length of the test track required in order to perform tests is around 1.5 km. Calculations are based on having the train running for 10 seconds at a 60% of the maximum speed in the test track. From the technical specifications for the rolling stock we extract the following data:

- Acceleration in service 0,92 m/s^2
- Deceleration in service 1 m/s^2
- Maximum speed of 110 km/h

The calculations are given for different stretches of track, considering the tests for a FLU:

- Start position clearance of 168 m (1 FLU)
- Acceleration of 183 m
- 60% Maximum speed for 10 seconds: 183 m
- Deceleration of 168 m
- Finish position clearance of 168 m (1 FLU)
- Safety margin of 168 m (1 FLU)
- Total: 1,038 m

4.1.7 Access Control Building

The access control building will be located by the depot entrance gate, to provide security control for the access/egress to the depot facilities. The access control room should be mostly glazed in order to facilitate monitoring of the site and entrance.

With 27.5 m^2, it has a checkpoint and rest program, toilet and installations room. In order to control people and vehicles, near to the Control Access will have a boom barrier, and a full height turnstile.

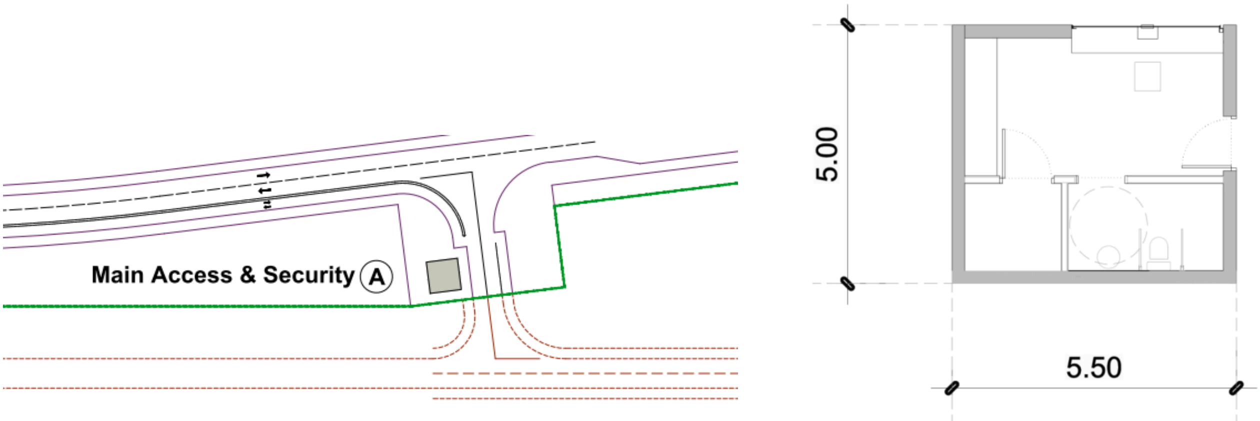


Figure 33: Access control building. Location and distribution

4.1.8 Electrical Substation

The electrical substation is intended to provide the buildings power and traction power supply within the site. The features of the facility are still being analysed by SET team, since there are no data available about the fleet and the design of the rest of the facilities is preliminary.

For a preliminary and conservative approach, a building of 10 m width and 30 m length is considered. A road access will be provided, as well as some parking area. In the figure below the substation scheme with its dimensions and access is shown.

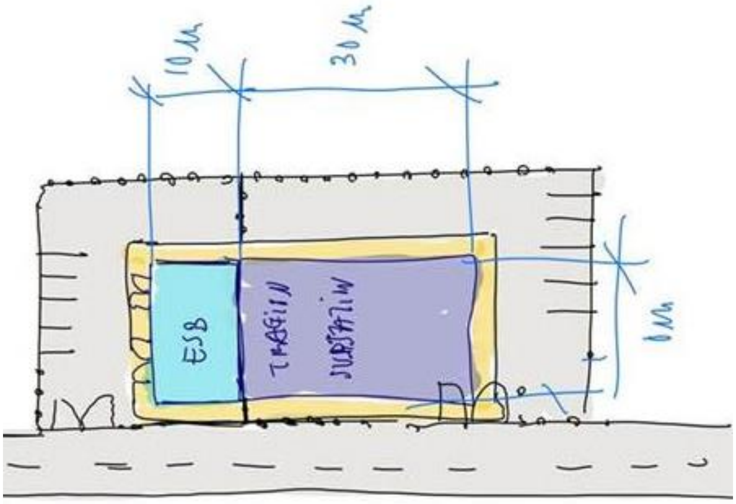


Figure 34: Substation scheme

4.1.9 Permanent way maintenance area

The permanent way and SET compound for maintenance area is being studied so far, it depends strongly on the O&M procurement. The requirements from IÉ are the following:

- Per-Way maintenance compound, OHLE maintenance compound and SET maintenance compound.
- Storage containers for tools and materials
- Storage area for materials such as ballast, rails, sleepers, replacement cantilevers, contact wire, sable, signals, point motors, etc.
- Space to assemble replacement turnout either with compound or somewhere else on site
- Staff facilities: canteen, lockers, toilets, etc.
- Common facilities: track access point with strails, suitable for RRVs, Storage area for RRVs (10 No.), road access suitable for artic-truck deliveries and staff parking for IÉ vehicles.

The features, square metres, and dimensioning of these zones is to be studied and agreed along with IÉ.

5 Generation of alternatives

This section discussed the analysis and the description of the different alternatives studied based on the following flow chart that depicts the logic sequence of the operations that rule the movement of the trains inside the depot.

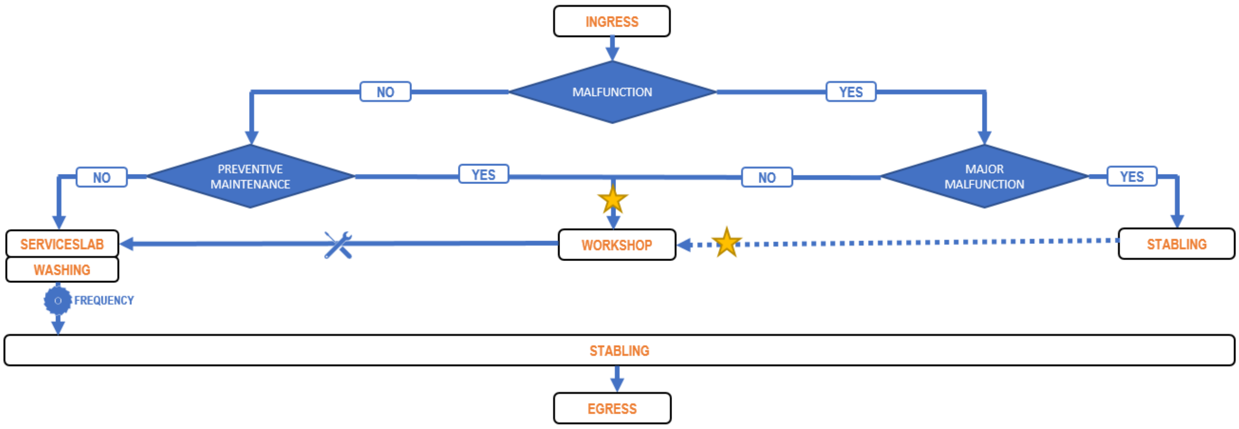


Figure 35: Flow chart

The sequence schematised above includes:

- After the end of the service, the drivers bring the vehicle to the depot.
- If the train has no malfunctions and should not be subjected to scheduled maintenance, it will be directly head toward the stabling yard.

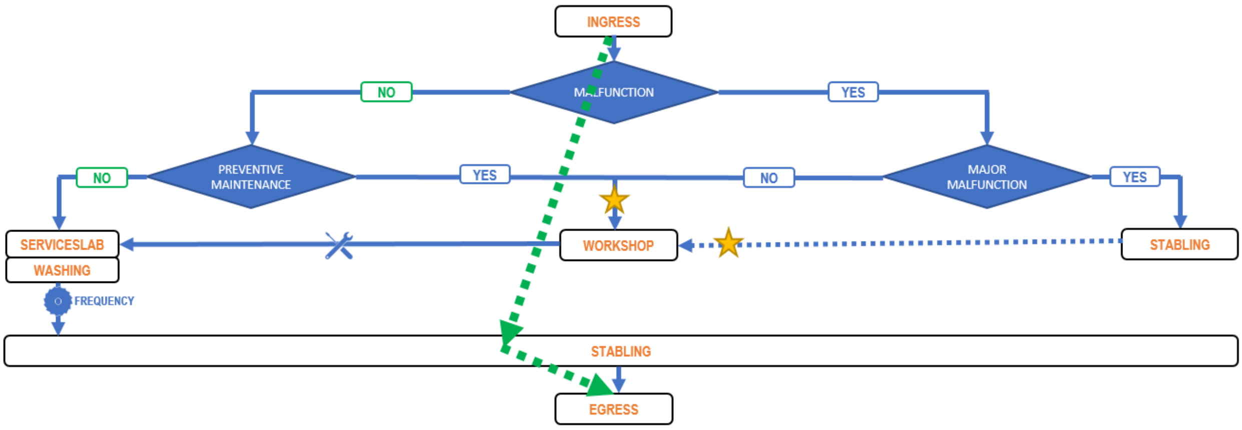


Figure 36: Mainline -> Stabling-> Mainline movement

- If the train has to be washed it will go through the AWP/AVI track at the entrance (by mainline drivers) and if it has to be replenished it will route to the service slabs where it will be handed over to the depot drivers. After these operations the train is berthed and available for operation.

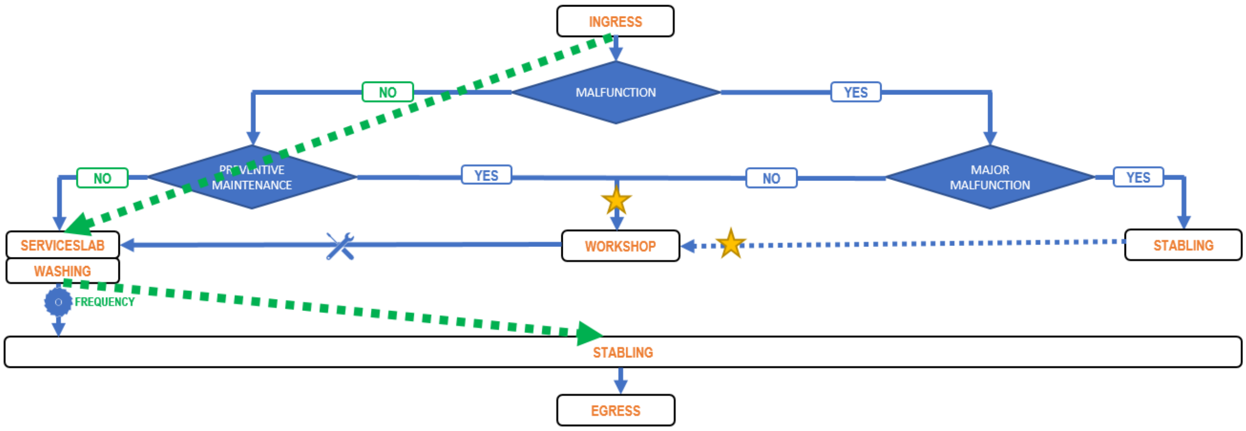


Figure 37: Mainline -> AWP/AVI/Service slab->Stabling movement

- If the AWP/AVI or service slabs are occupied during the ingress of a train that should perform these tasks it will be routed to the stabling yard and later, it will return to these facilities by depot drivers.

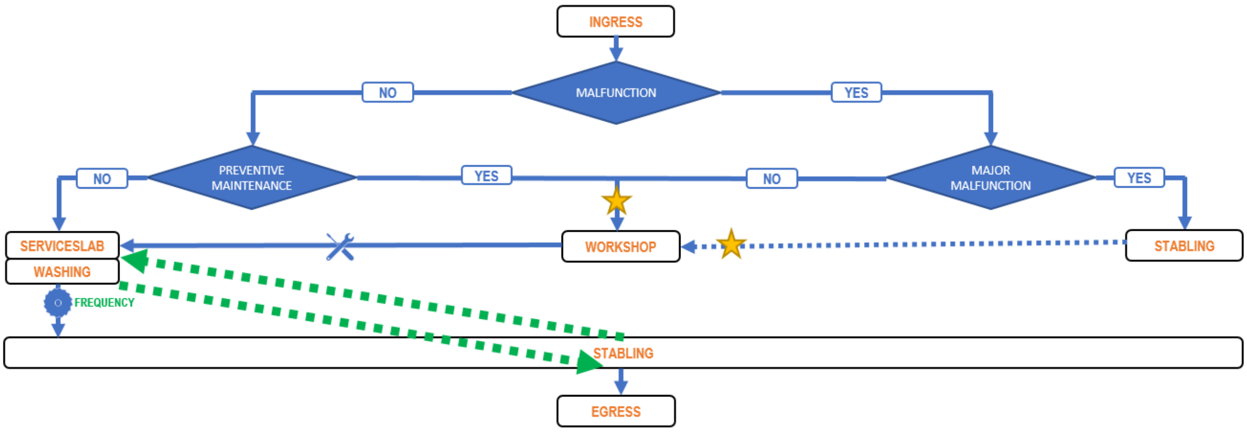


Figure 38: Stabling -> AWP/AVI/Service slab -> Stabling movement

- If the train is not broken but it should be subjected to scheduled maintenance, the train will be guided to the transition platform where it will be handed over to the depot drivers, later it will be routed to the workshop, if available, or in the stabling area, from which it will be taken as soon as the workshop is able to receive it. After the scheduled maintenance, the train will be taken from the workshop, washed and replenished, berthed and ready for operation.

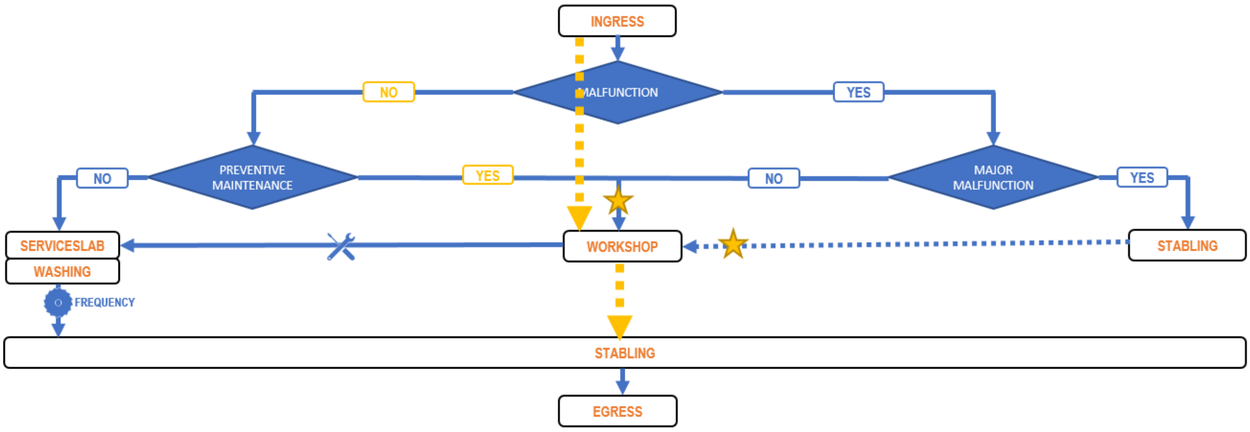


Figure 39: Mainline -> Workshop -> Stabling movement

- If malfunctions are noted on the train, it will be guided to the transition platform where it will be handed over to the depot drivers and later it will be routed to the workshop. Here the staff will see if the malfunctions are minor (repairable in 1/2 hour). In this case, the repair should be carried out immediately (corrective maintenance), but if a longer intervention time is foreseen, it must head to a stabling yard. Later, it will be taken to the workshop as soon as it will be able to receive it. After the repair of the breakdown, it will have to be taken from the workshop, washed and replenished, berthed and ready for the service.

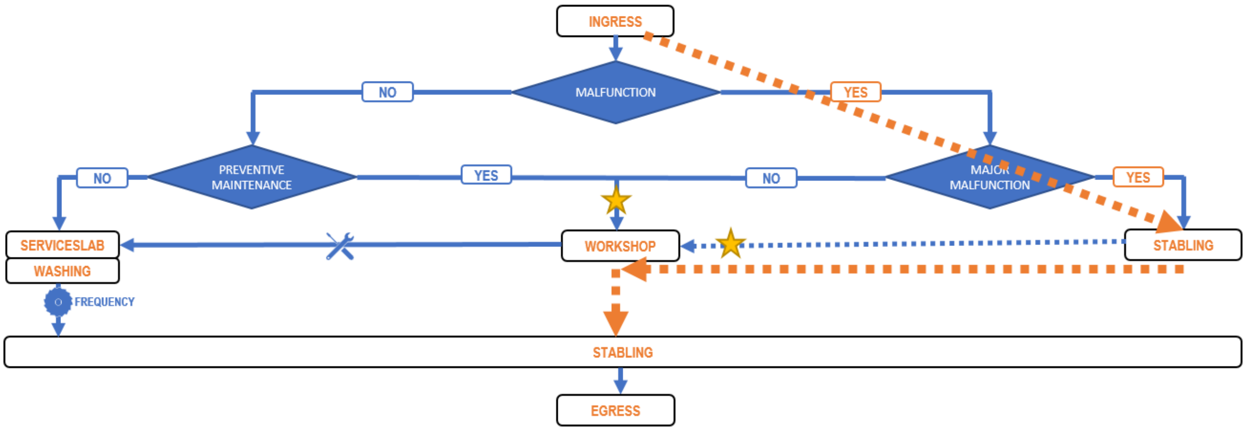


Figure 40: Mainline -> Stabling -> Workshop -> Stabling movement

- At the beginning of the service, mainline drivers will go to take delivery of the trains ordered in the stabling area and will come out by adjusting the departures depending on the deployment program.

From this point six alternatives are proposed, their general arrangements are depicted, and their main five train movements analysed.

5.1 Alternative 1

5.1.1 General arrangement

The configuration of the depot is a through type, with several two-ended tracks in the maintenance shed and single-ended tracks in the stabling yard. All the movements are enabled by using shunting tracks when necessary.

Following, it is shown an image of the layout:

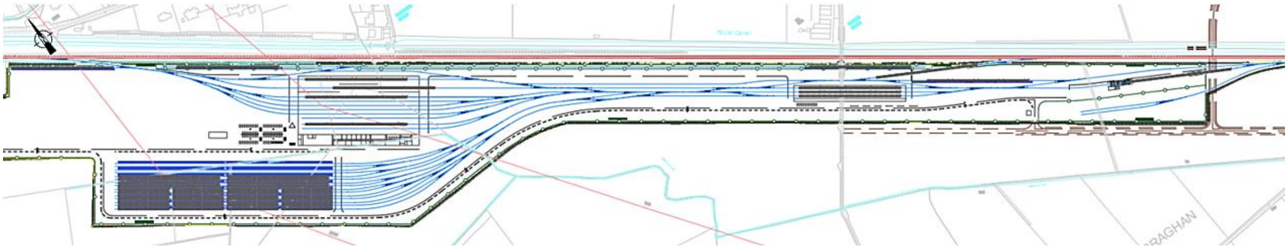


Figure 41: General layout of the Alternative 1

The total length of the depot along the main line is 2,252 m and the wider section measure is 268 m, at the stabling and workshop area. The land acquisition for the Alternative 1 layout is approximately 31,5 Ha. The unevenness between the main eastern access (+63.083m) and the western access (+65.90m) is around 2.8 m.

The general arrangement of the depot has the following features:

- The depot is parallel to the existing infrastructure making the most of the straight section of the main line.
- The stabling yard is adjacent to the maintenance shed and the main building. The stabling yard could be extended towards the west to increase the capacity of the depot by berthing three FLU per track instead of two FLU.
- The AVI, AWP and service slab are placed before the stabling and the maintenance shed and there is a track parallel to the AVI and AWP to bypass these facilities.
- The test track is parallel and adjacent to the main line.
- The through road is parallel and adjacent to the test track to bypass all the facilities.
- A shunting track is provided at the western end of the maintenance shed, to allow the change of track, or to bypass the main building by the through road or to head to the test track.
- The access to the workshop and to the stabling yard is direct from the main line. The flows between stabling and workshop have to be performed with reversing movements.
- The main road accesses to the depot have been described in the Section 3.3. Road access is provided to all the facilities listed above and the main carpark is nearby the main building.
- The main building of the depot will contain the offices, administration area, maintenance shed and storage.
- The permanent way area for maintenance and storage for fixed installations is at the main entrance of the depot. This facility comprehends a track for maintenance vehicles as well as storage.

- Staff is allowed to access to the depot by car, walking or by cycling from the road access. The staff flows within the depot are by the roads and the pedestrian footpath, connecting all the facilities: service slab, AWP and AVI with the maintenance shed and the stabling yard.

5.1.2 Train movements

Regarding the train movements, to allow all the movements from all the maintenance and stabling tracks, turnouts have been extensively used (59 P8/8 turnouts have been placed). This arrangement has the aim of providing redundancy and a more resilient design (if one track is blocked the train always could select another route for the same purpose).

Following there is a description of the main train movements in the depot:

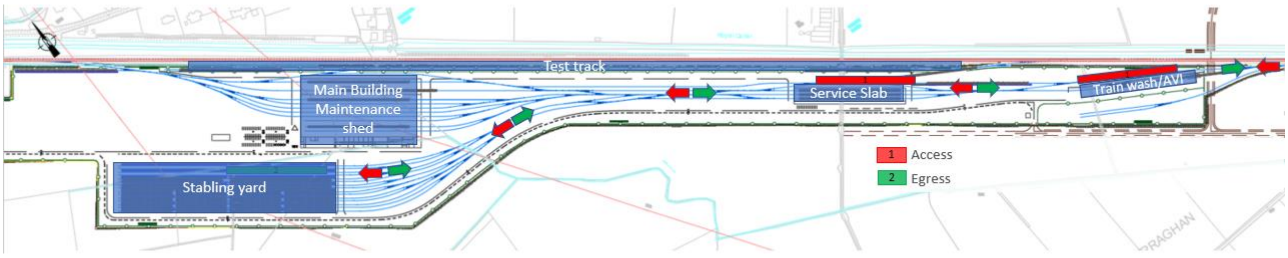


Figure 42: Movement 1: main line → stabling → main line (Alternative 1)

The deployment of the fleet berthed in the depot begins when the service starts, the trains are deployed according to the schedule. During the morning off-peak certain number of trains return to the depot and when the service is finished the removal of the rest of the fleet begins.

Within the complex, if the train does not need to perform the AWP/AVI or the service slab, the train will head to the through road and bypass these facilities going directly to the stabling yard where it will be berthed.

The egress movement to the main line from the stabling is the same, these operations are intended to be performed by the main line drivers.

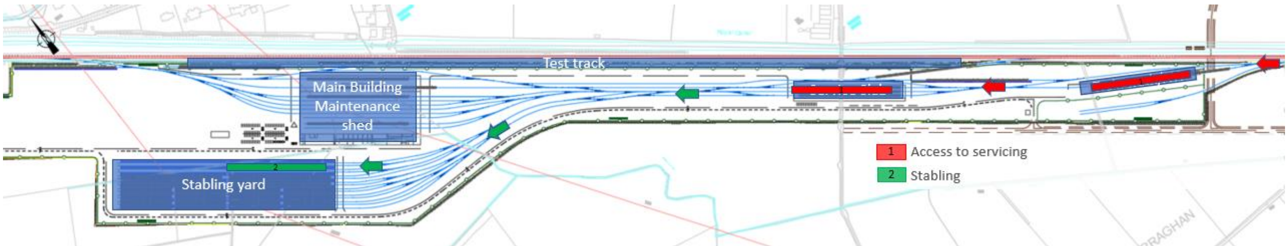


Figure 43: Movement 2: main line → service/washing → stabling (Alternative 1)

When the train has servicing and/or washing scheduled, instead of heading directly to the through road, the train accesses directly. Later, the train goes to the stabling yard to be berthed until the service starts the next day.

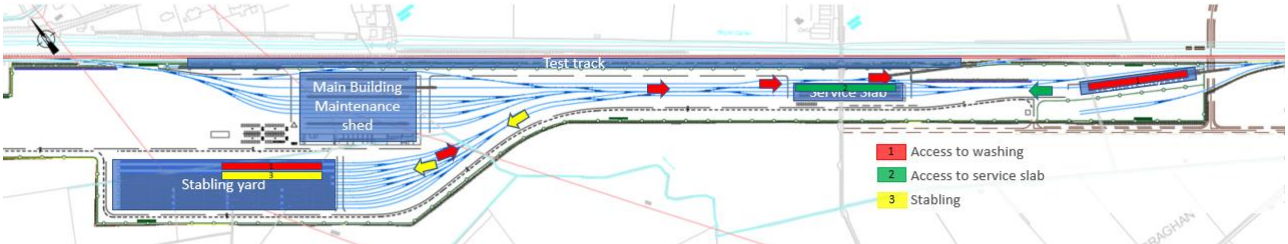


Figure 44: Movement 3: stabling → service/washing → stabling (Alternative 1)

Whenever the AWP or the service slab are occupied, those trains coming from the main line and scheduled for washing or servicing have to bypass these facilities and head to the stabling yard. Later, when these facilities are available, the train heads to them. Finally, they return directly again to the stabling yard.

The AWP is to be provided with clearances at both ends avoiding any block (all alternatives), especially in the access from the main line. This movement is to be performed by the CME depot drivers.

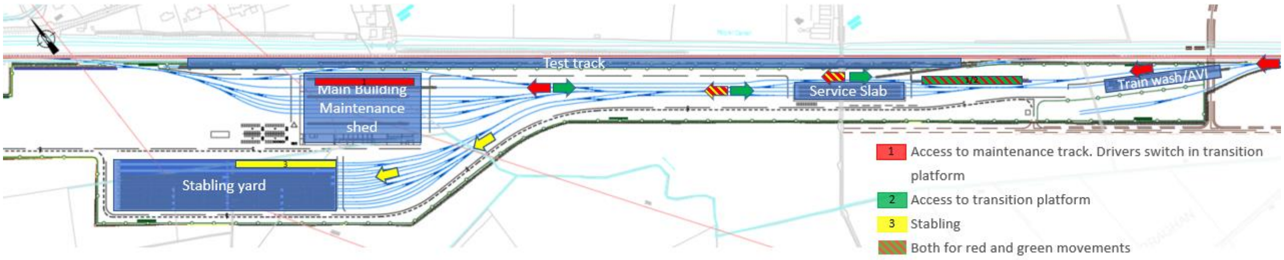


Figure 45: Movement 4: main line → workshop → stabling (Alternative 1)

There are two causes for those trains coming from the main line to go directly to the workshop: scheduled maintenance activities or a failure during the service and consequently a corrective maintenance activity to solve it.

Those trains coming from the main line have to perform the switch of drivers in the transition platform located in the through road. Then the train heads to the workshop shed and carry out the maintenance activity. Finally, when the maintenance is finished the train has to perform a shunting movement in the through road to go to the stabling yard and it is berthed until the service starts the next day. This movement is intended to be performed by the CME depot drivers.

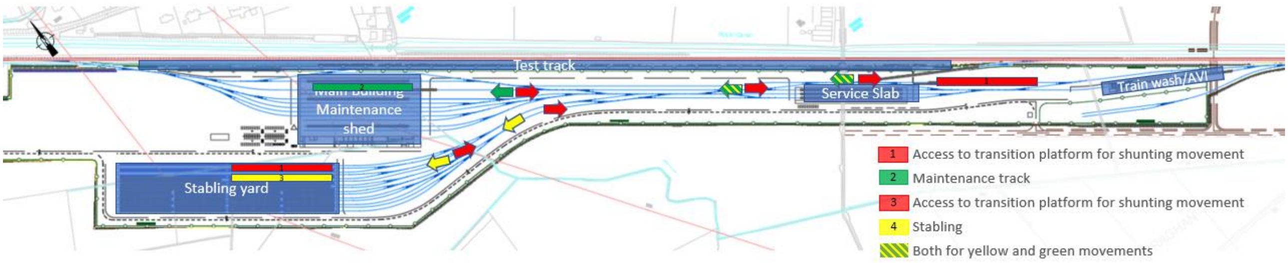


Figure 46: Movement 5: stabling → workshop → stabling (Alternative 1)

5.1.3 Staff and road flows

Apart from train movements, also staff and road flows inside the depot layout and between facilities has been analysed. For staff flows, distance and level crossings between workshop and stabling is considered, and for road flows, road access to facilities in the depot and level crossings with tracks is assessed.

Therefore, in Alternative 1, in the case of staff flows, workshop and stabling and adjacent to each other, and also close to the main parking area in the depot. No level crossings are needed for going from one to the other. Also, for road flows, the internal road connects all the facilities in the depot layout without level crossings.

Figure 47: Staff and road flows (Alternative 1)

5.2 Alternative 2

5.2.1 General arrangement

The configuration of the depot is a through type, with several two-ended tracks in the maintenance shed, and single-ended tracks in the stabling yard. The maintenance shed is opposite to the stabling yard, and all the movements are enabled by using shunting tracks when necessary. The following figure shows the layout:

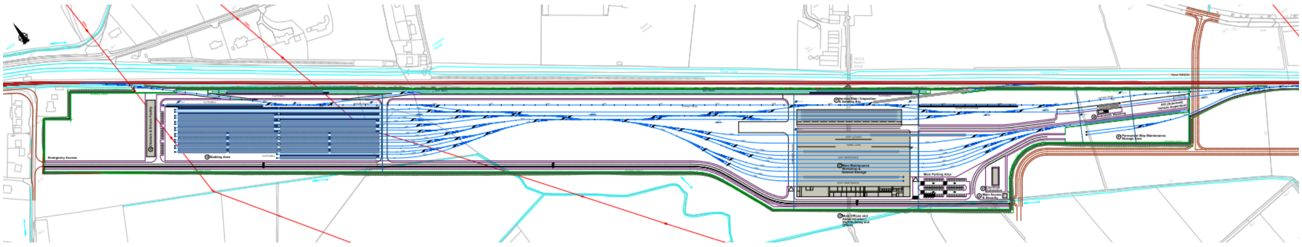


Figure 48: General layout of the Alternative 2

In this alternative, the total length of the depot along the main line is 2,252 m, and the wider section measure is 216 m, at the workshop and service slab area. The occupied plot for the Alternative 2 layout is 31.7 Ha. The unevenness between the main access (+63.083 m) and the western access (+65.90 m) is around 2.8 m.

The general arrangement of the depot has the following features:

- The depot is parallel to the existing infrastructure making the most of the straight section of the main line.
- The stabling yard is opposite to the maintenance shed easing the connection between the two areas without shunting movements.
- The stabling yard could be extended towards the west to increase the capacity of the depot by berthing three FLU per track instead of two FLU.
- The service slab is placed parallel to the maintenance shed and before the stabling.
- The AWP/AVI are placed before the service slab and the stabling and the maintenance shed. There is a track parallel to bypass these facilities.
- The test track is parallel and adjacent to the main line.
- The through road is parallel and adjacent to the test track to bypass all the facilities.
- A shunting track is provided at the eastern end of the maintenance shed, to allow the change of track, or to bypass the facility through other unoccupied maintenance track
- A shunting track is provided at the western end of the through road for giving access to the test track.
- The access to workshop from the main line is by a reverse movement in a shunting track adjacent to the stabling yard. The access to stabling yard is direct from mainline eastern connection.
- The main road accesses to the depot have been described in the section 3.3. Road access is provided to all the facilities listed above. The road access to service slab and AWP/AVI is to be by crossing the tracks. Carpark is nearby the main building.
- The permanent way area for maintenance and storage for fixed installations is at the entrance of the depot, parallel to the main line and directly connected from the main access.

- Staff are allowed to access the depot by car, walking or by cycling from the road access. The staff movements inside the depot are by the roads and the pedestrian footpath, connecting all the facilities: service slab, AWP and AVI, with the maintenance shed and the stabling yard.

5.2.2 Train movements

Regarding the train movements, to allow all the movements from all the maintenance and stabling tracks, turnouts have been extensively used (61 P8/8 turnouts have been placed). This arrangement has the aim of providing redundancy and a more resilient design.

Following there is a description of the main train movements in the depot:

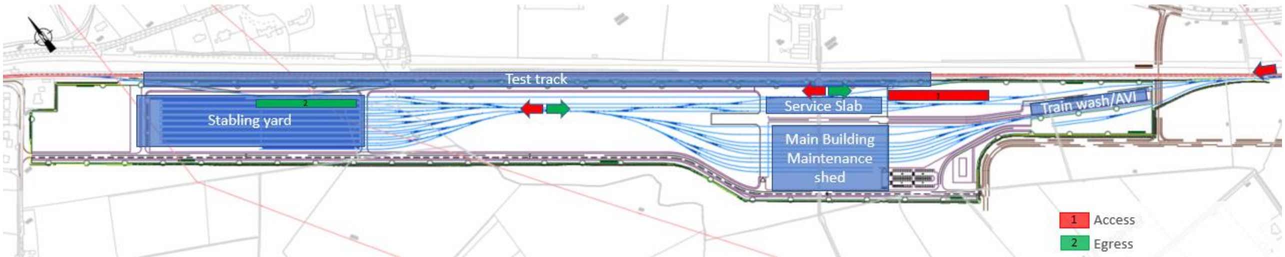


Figure 49: Movement 1: main line → stabling → main line (Alternative 2)

Within the complex, if the train does not need to perform the AWP/AVI or the service slab, the train heads to the through road and bypass these facilities. Finally, the train goes directly to the stabling yard where it will be berthed.

The egress movement to access the main line from the stabling is the same, these operations are intended to be performed by the main line drivers.

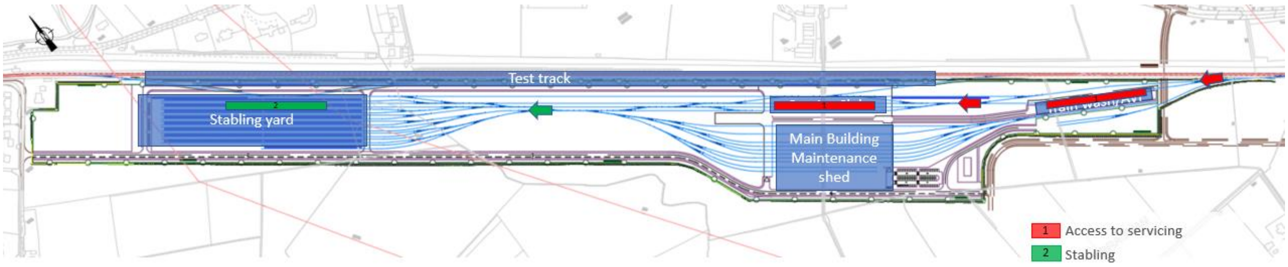


Figure 50: Movement 2: main line → service/washing → stabling (Alternative 2)

When the train has servicing and/or the AWP/AVI scheduled, instead of heading directly to the through road, the train accesses to the automatic washing plant. Then the vehicle heads to the service slab and performs the maintenance tasks. Finally, the train goes directly to the stabling yard to be berthed until the service starts the next day.

Figure 51: Movement 3: stabling → service/washing → stabling (Alternative 2)

Whenever AWP/AVI or the service slab are occupied, those trains coming from the main line and scheduled for washing or servicing have to bypass these facilities and head to the stabling yard to be berthed. Later, when these facilities are available, the train goes to them and finally they return again to the stabling yard.

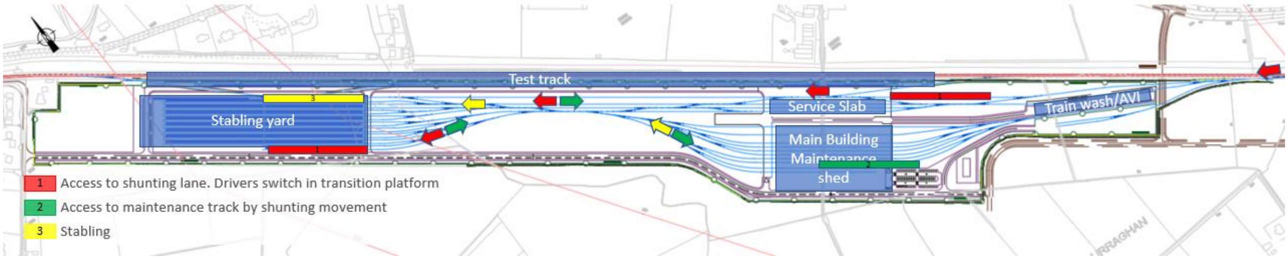


Figure 52: Movement 4: main line → workshop → stabling (Alternative 2)

The trains coming from the main line and going directly to the workshop, have to perform the switch of drivers in the transition platform located in the through road or in the shunting track close to the stabling. Then the train heads to the workshop and carry out the maintenance activity.

Finally, when the maintenance is finished the train has a direct connection to the stabling yard and the train is berthed until the service starts the next day.

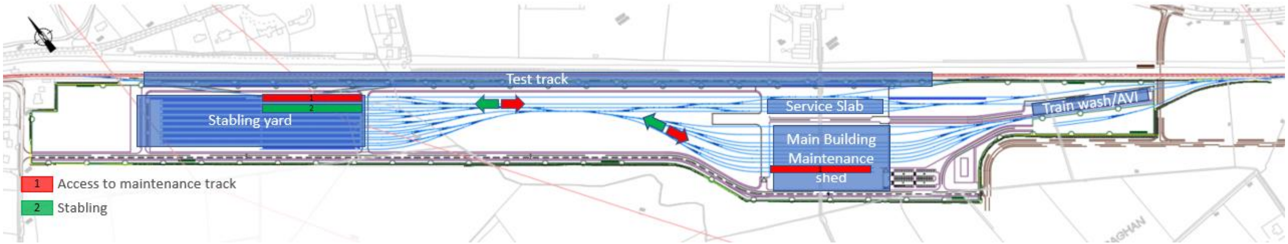


Figure 53: Movement 5: stabling → workshop → stabling (Alternative 2)

The berthed trains have direct access along the yard to the workshop without shunting movements needed. When the maintenance tasks are finished, the way back to the stabling yard is the same without any clash with the movements from/to the main line. This movement is intended to be performed by the CME depot drivers.

5.2.3 Staff and road flows

In Alternative 2, in the case of staff flows, workshop and stabling are distant (more than 0.5 km), but no level crossings are needed for going from one to the other. In the case of road flows, the internal road connects all the facilities in the depot layout but the service slab, that needs level crossings for accessing.

Figure 54: Staff and road flows (Alternative 2)

5.3 Alternative 3

5.3.1 General arrangement

The configuration of the depot is a through type, with several two-ended tracks in the maintenance shed, being all the tracks in the stabling yard two ended as well. All the movements are enabled by using shunting tracks when necessary. The access to the workshop and the stabling yard is direct from the main line. However, since the stabling yard is parallel to the maintenance shed, shunting movements will be necessary between both facilities. The following figure shows the layout:

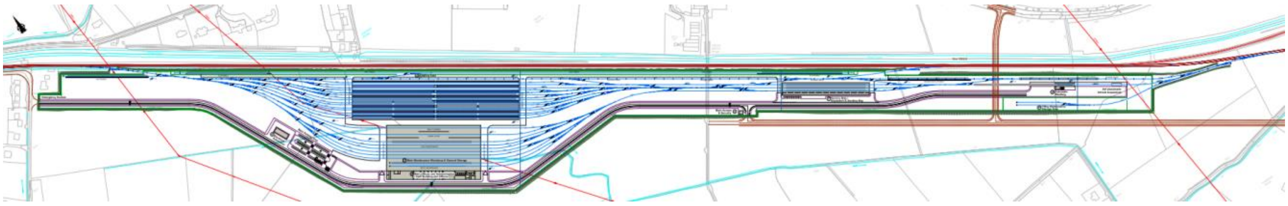


Figure 55: General layout of the Alternative 3

In this alternative, the total length of the depot along the mainline is 2,579 m, and the wider section measure is 256 m, at the workshop and stabling area. The occupied area is 30,7 Ha. The unevenness between the main access (+62.66 m) and western access (+65.90 m) is around 3.24 m.

The general arrangement of the depot has the following features:

- The depot is parallel to the existing infrastructure making the most of the straight section of the main line.
- The stabling yard is adjacent to the maintenance shed and the main building.
- The service slab and the AWP/AVI are placed before the stabling and the maintenance shed and there is a track parallel to the AVI and AWP to bypass these facilities.
- The test track is parallel and adjacent to the main line.
- The through road is parallel and adjacent to the test track to bypass all the facilities.
- A shunting track is provided towards the west at the end of the maintenance shed and the stabling yard. This allows the change of track and bypassing these facilities and it is used to access the test track using the through road.
- The accesses to the stabling yard and maintenance shed are direct from mainline connections. The flows between stabling and workshop have to be performed with reversing movements.
- The main road accesses to the depot have been described in the section 3.3. Road access is provided to all the facilities listed above but to the stabling area, to which is possible to access through the embedded tracks. Carpark is nearby the main building.
- The permanent way area for maintenance and storage for fixed installations is at the entrance of the depot, parallel to the main line and directly connected from the main access.
- Staff is allowed to access to the depot by car, walking or by cycling from the road access. The staff flows inside the depot are by the roads and the pedestrian footpath, connecting all the facilities: service slab, AWP and AVI, with the maintenance shed and the stabling yard.

5.3.2 Train movements

Regarding the train movements, to allow all the movements from all the maintenance and stabling tracks, turnouts have been extensively used (73 P8/8 turnouts are used).

Following there is a description of the main train movements in the depot:

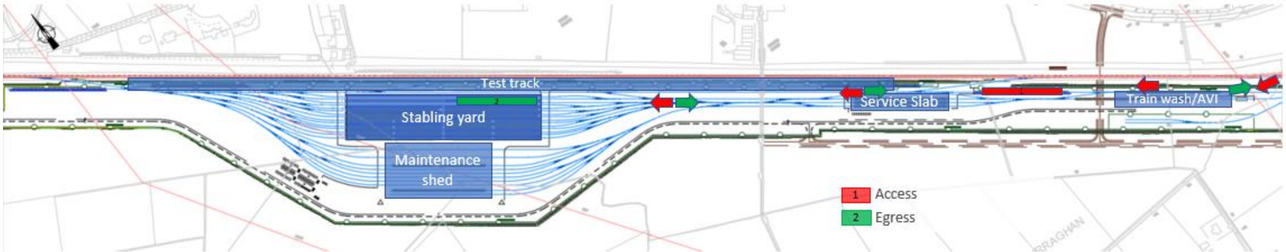


Figure 56: Movement 1: main line → stabling → main line (Alternative 3)

Within the complex, if the train does not need to perform the washing/AVI or the service slab, the train will head to the through road and bypass these facilities. Finally, the train will be guided directly to the stabling yard where it will be berthed.

The egress movement to access the main line from the stabling is the same, these operations are intended to be performed by the main line drivers.

Figure 57: Movement 2: main line → service/washing → stabling (Alternative 3)

When the train has servicing and/or washing scheduled, instead of heading directly to the through road, the train accesses to the AWP/AVI or to the service slab and performs the maintenance tasks. Finally, the train goes directly to the stabling yard to be berthed.

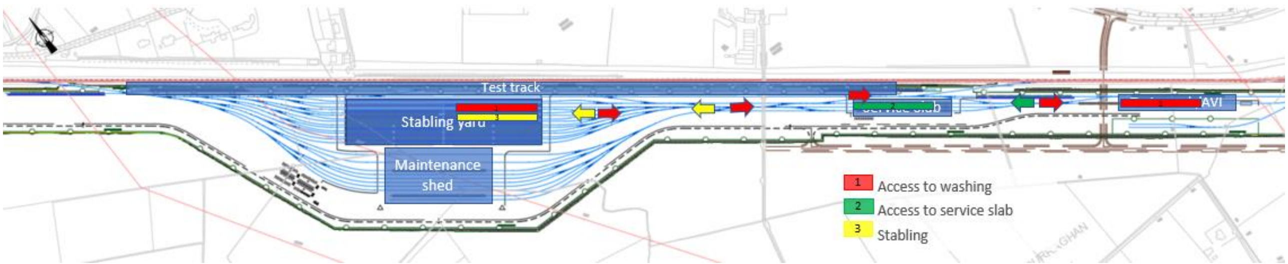


Figure 58: Movement 3: stabling → service/washing → stabling (Alternative 3)

Whenever the AWP/AVI or the service slab are occupied, those trains coming from the main line and scheduled for washing or servicing, have to bypass these facilities and head to the stabling yard to be berthed. Later, when these facilities are available, the train heads to the them and finally they return again to the stabling yard.

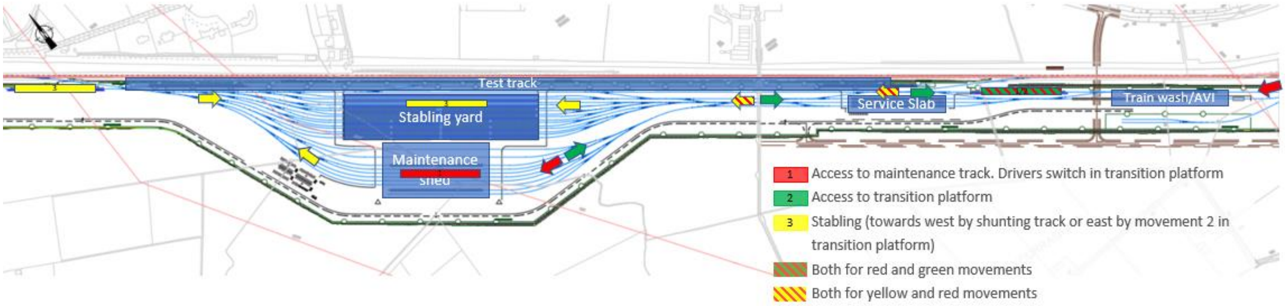


Figure 59: Movement 4: main line → workshop → stabling (Alternative 3)

Those trains coming from the main line and going directly to the workshop, have to perform the switch of drivers in the transition platform located in the through road, then the train heads directly to the workshop and carry out the maintenance activity.

Finally, when the maintenance tasks are finished the train has two possibilities to go to the stabling yard: performing a shunting movement towards west in the shunting lane at the end of the stabling yard, or perform it in the transition platform towards the east. The train will be berthed until the service starts the next day.

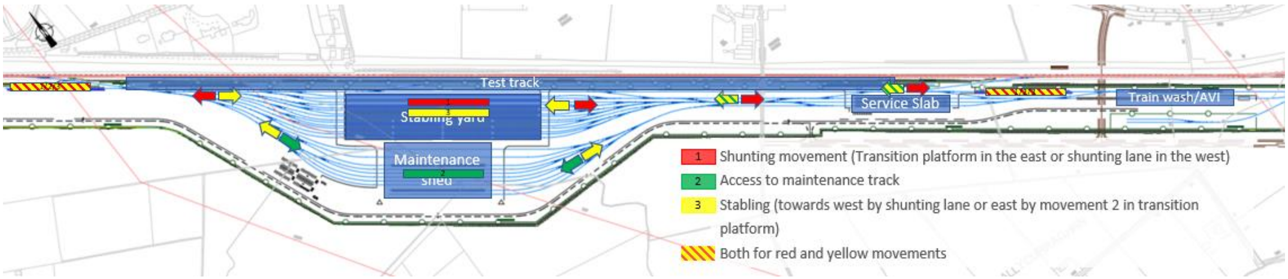


Figure 60: Movement 5: stabling → workshop → stabling (Alternative 3)

The berthed trains do not have direct access to the workshop since this is parallel to the stabling yard. Considering that the stabling yard and the maintenance shed are both two-ended, those trains coming from the stabling can perform the shunting movements to access the workshop towards the west in the shunting track provided at the end, or in the east in the transition platform.

It must be noted that heavy maintenance tracks are only accessible from the east since they could be single ended tracks. When the maintenance tasks are finished, the way back to the stabling yard is the same. This movement is intended to be performed by the CME depot drivers.

5.3.3 Staff and road flows

In Alternative 3, in the case of staff flows, workshop and stabling facilities are adjacent, also next to the main parking area, but level crossings are needed for going from one to the other. In the case of road flows, the internal road connects all the facilities in the depot layout but the stabling, that as mentioned before, needs level crossings for accessing.

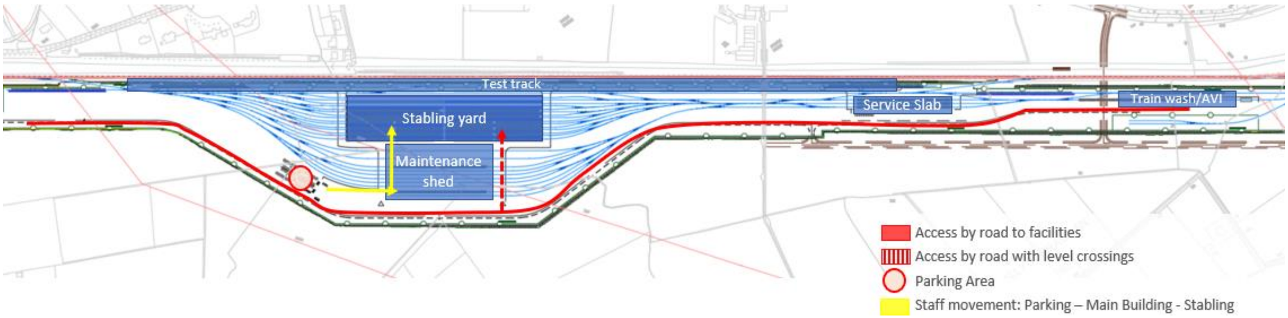


Figure 61: Staff and road flows (Alternative 3)

5.4 Alternative 4

5.4.1 General arrangement

The configuration of the depot is a through type, with several two-ended tracks in the maintenance shed, and single-ended tracks in the stabling yard. This alternative has all the facilities placed inline progressively, the accesses to the maintenance shed are direct from the three mainline connections and to the stabling yard are direct from the two eastern ones. The movements between the stabling yard and the workshop are direct as well. The following figure shows the layout:

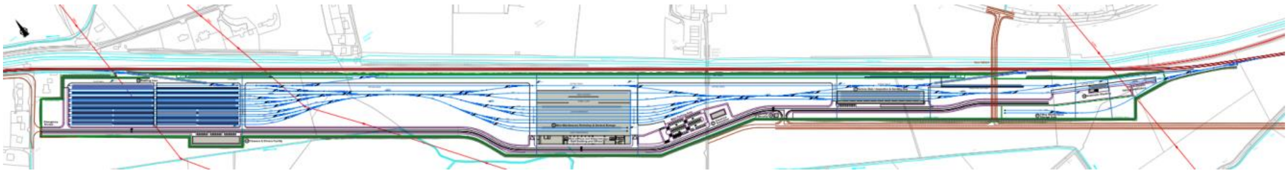


Figure 62: General layout of the Alternative 4

In this alternative, the total length of the depot along the mainline is 2,579 m, and the broader section measure is 175 m, at the workshop area. The occupied area is 30,0 Ha. The unevenness between the main access (+62.66 m) and western access (+65.90 m) is around 3.24 m.

The general arrangement of the depot has the following features:

- The depot is parallel to the existing infrastructure making the most of the straight section of the main line. Since this is one of the longest alternatives, the point access is near the Jackson's Bridge.
- The stabling yard has direct access from maintenance shed without shunting movements needed.
- The service slab and the washing facility are placed before the maintenance shed. There is a track parallel to bypass these facilities.
- The test track is parallel and adjacent to the main line.
- The through road is parallel and adjacent to the test track to bypass all the facilities.
- A shunting track is provided towards the west at the end of the stabling yard. This is necessary for giving access to the test track using the through road.
- The accesses to the stabling yard and maintenance shed are direct from mainline connections. The flows between stabling and workshop are direct as well.
- The main road accesses to the depot have been described in the section 3.3. Road access is provided to all the facilities listed above. Carpark is nearby the main building.
- The permanent way area for maintenance and storage for fixed installations is at the main entrance of the depot. This facility comprehends a track for maintenance vehicles as well as storage.
- Staff is allowed to access to the depot by car, walking or by cycling from the road access. The staff flows inside the depot are by the roads and the pedestrian footpath, connecting all the facilities: service slab, AWP and AVI, with the maintenance shed and the stabling yard.

5.4.2 Train movements

Regarding the train movements, to allow all the movements from all the maintenance and stabling tracks, turnouts have been extensively used (60 P8/8 turnouts have been used).

Following there is a description of the main train movements in the depot:

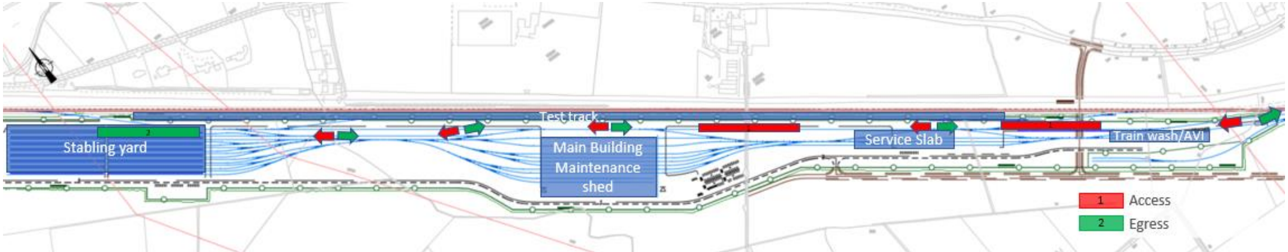


Figure 63: Movement 1: main line → stabling → main line (Alternative 4)

Within the complex, if the train does not need to perform the AWP/AVI or the service slab, the train will head to the through road and bypass these facilities. Finally, the train will be guided directly to the stabling yard where it will be berthed.

The egress movement to access the main line from the stabling is the same, these operations are intended to be performed by the main line drivers.

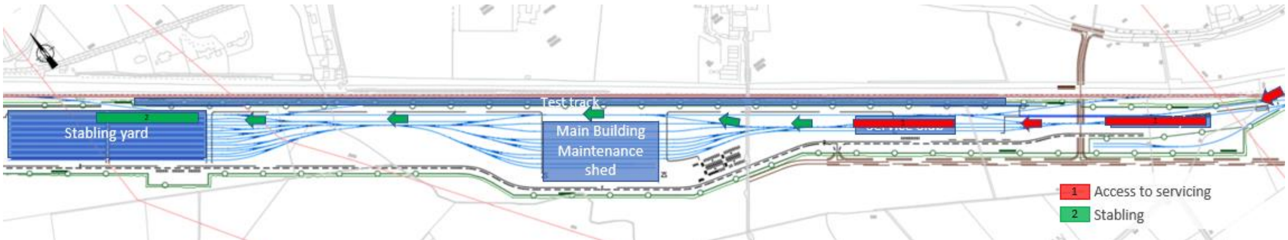


Figure 64: Movement 2: main line → service/washing → stabling (Alternative 4)

When the train has servicing and/or washing scheduled, instead of heading directly to the through road, the train accesses to the AWP or to the service slab and performs the maintenance tasks. Finally, the train goes directly to the stabling yard to be berthed until the service starts the next day.

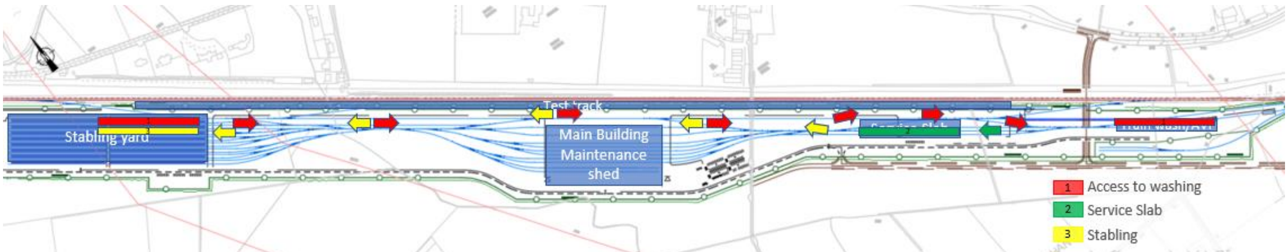


Figure 65: Movement 3: stabling → service/washing → stabling (Alternative 4)

Whenever the AWP/AVI or the service slab are occupied, those trains coming from the main line and scheduled for washing or servicing, have to bypass these facilities and head to the stabling yard to be berthed. Later, when these facilities are available, the train heads to the washing plant and performs the washing. Then the train goes to the service slab where its servicing shall be conducted, and finally heads again to the stabling yard. This movement is to be performed by the CME depot drivers.

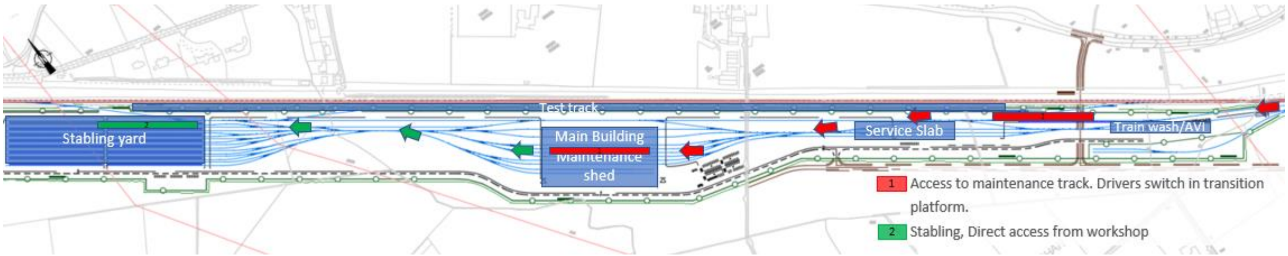


Figure 66: Movement 4: main line → workshop → stabling (Alternative 4)

Those trains coming from the main line and going directly to the workshop, have to perform the switch of drivers in the transition platform located in the through road. Then the train heads to the workshop and carry out the maintenance activity. Finally, when the maintenance is finished the train heads to the stabling directly without shunting movements.

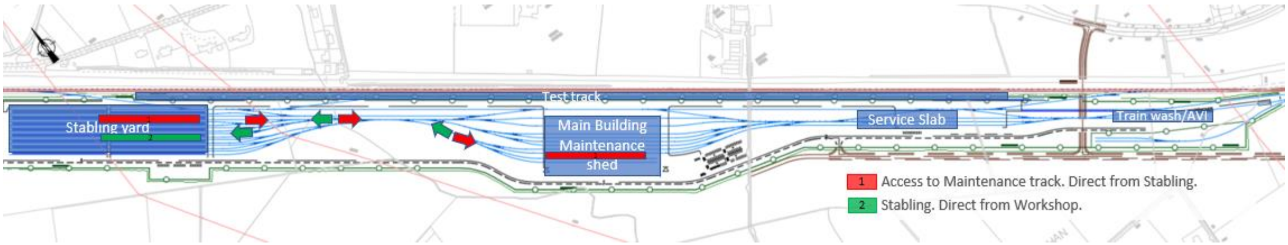


Figure 67: Movement 5: stabling → workshop → stabling (Alternative 4)

In order to head to the workshop shed, the trains have direct access from the stabling, without shunting needed. When the maintenance tasks are finished, the way back to the stabling yard is the same. This movement is intended to be performed by the CME depot drivers.

5.4.3 Staff and road flows

In Alternative 4, in the case of staff flows, workshop and stabling facilities are distant (more than 0.5 km), but no level crossings are needed for going from one to the other. In the case of road flows, the internal road connects all the facilities in the depot layout, without level crossings needed.

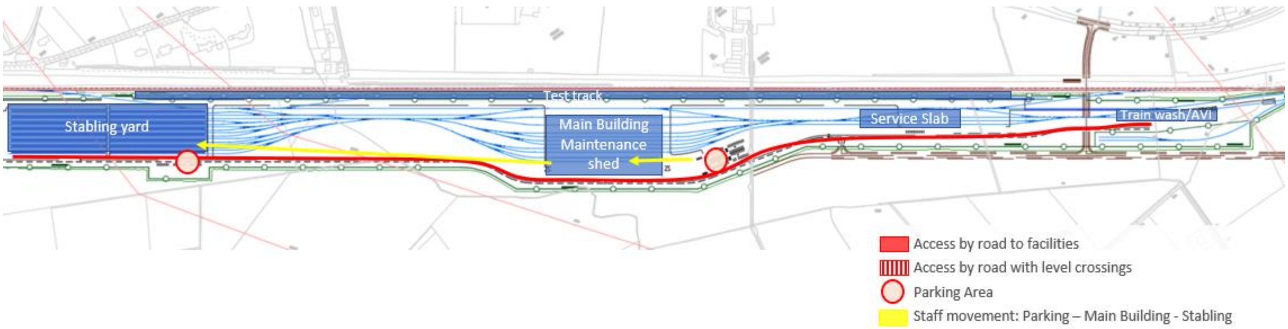


Figure 68: Staff and train flows (Alternative 4)

5.5 Alternative 5

5.5.1 General arrangement

The configuration of the depot is a through type that presents several two-ended tracks in the maintenance shed, as well as two-ended tracks in the main stabling yard. In this case, the stabling is divided into two different parts, so there is space for locating the main building avoiding electrical overhead lines. There is direct access to stabling and to workshop from main line connections. The connection between stabling and workshop is by reversing movements. The following figure shows the layout:

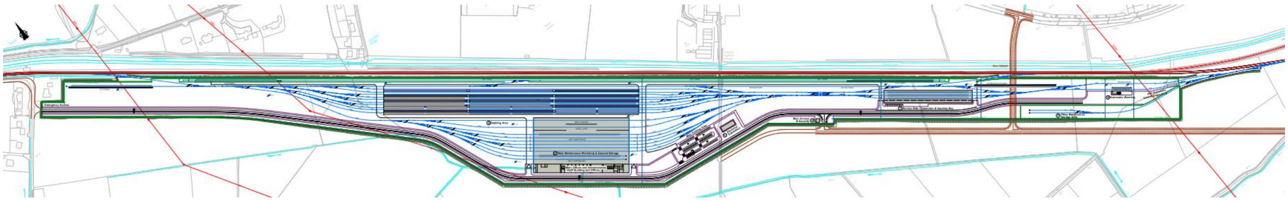


Figure 69: General layout of the Alternative 5

In this alternative, the total length of the depot along the mainline is 2,579 m, and the wider section measure is 225 m, at the workshop and stabling area. The occupied area is 28,9 Ha. The unevenness between the main access (+62.66 m) and western access (+65.90 m) is around 3.24 m.

The general arrangement of the depot has the following features:

- The depot is parallel to the existing infrastructure making the most of the straight section of the main line. This alternative comes up to avoid the overhead electrical lines on site.
- The stabling is adjacent to the maintenance shed and the main building.
- The service slab and the AWP/AVI are placed before the main stabling and the maintenance shed. There is a track parallel to the AVI and AWP to bypass these facilities.
- The test track runs parallel and adjacent to the main line.
- The through road is parallel and adjacent to the test track to bypass all the facilities.
- A shunting track is provided towards the west at the end of the maintenance shed and the stabling yard. This allows the change of track and bypassing these facilities. Moreover, is necessary for giving access to the test track using the through road.
- The access to the stabling yard and maintenance shed is direct from the mainline. The flows between stabling and workshop have to be performed with reversing movements.
- The main road accesses to the depot have been described in the section 3.3. Road access is provided to all the facilities listed above but to main stabling yard, to which is possible to access through the embedded tracks. Carpark is nearby the main building.
- The permanent way area for maintenance and storage for fixed installations is at the main entrance of the depot. This facility comprehends a track for maintenance vehicles as well as storage.
- Staff is allowed to access to the depot by car, walking or by cycling from the road access. The staff flows within the depot are by the roads and the pedestrian footpath, connecting all the facilities: service slab, AWP and AVI with the maintenance shed and the stabling yard.

5.5.2 Train movements

Regarding the train movements, to allow all the movements from all the maintenance and stabling tracks, turnouts have been extensively used as well as diamond crossings in some parts (61 P8/8 turnouts have been used). This arrangement has the aim of providing redundancy and a more resilient design.

Following there is a description of the main train movements in the depot:

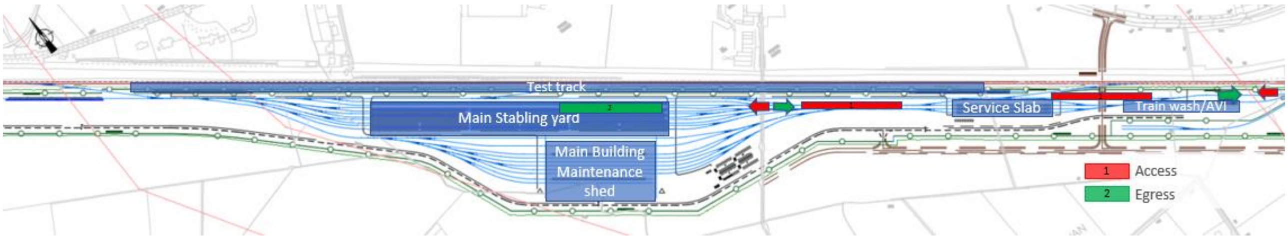


Figure 70: Movement 1: main line → stabling → main line (Alternative 5)

Within the complex, if the train does not need to perform the washing/AVI or the service slab, the train will head to the through road and bypass these facilities. Finally, the train will be guided directly to the stabling yard where it will be berthed.

The egress movement to access the main line from the stabling is the same, these operations are intended to be performed by the main line drivers.

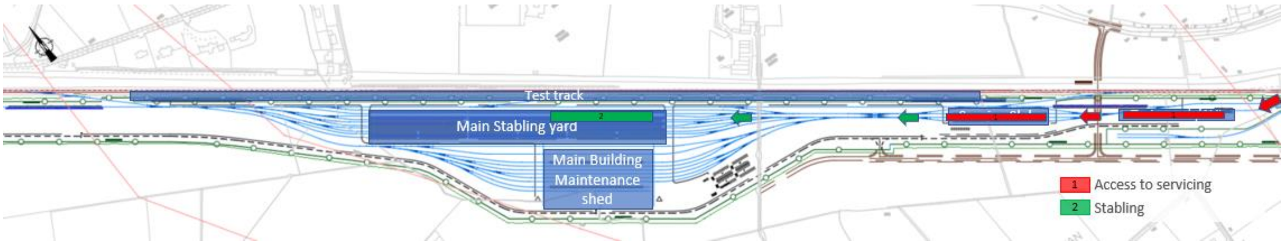


Figure 71: Movement 2: main line → service/washing → stabling (Alternative 5)

When the train has servicing and/or washing scheduled, instead of heading directly to the through road, the train accesses to the automatic washing plant. Then the vehicle heads to the service slab and performs the maintenance tasks. Finally, the train goes directly to the stabling yard to be berthed.

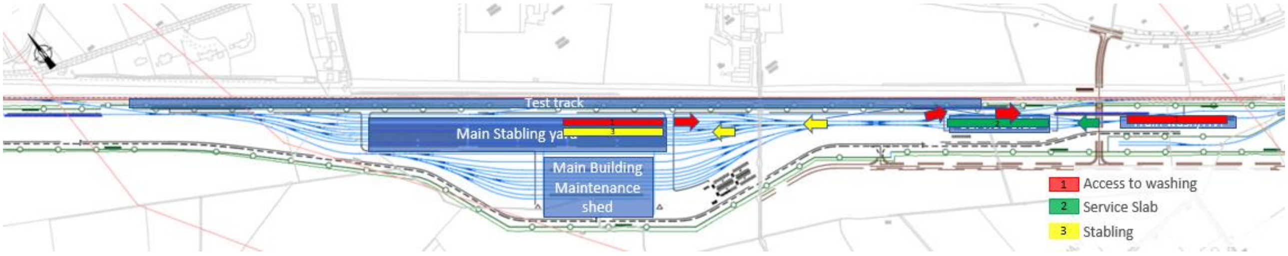


Figure 72: Movement 3: stabling → service/washing → stabling (Alternative 5)

Whenever the AWP/AVI or the service slab are occupied, those trains coming from the main line and scheduled for washing or servicing, have to bypass these facilities and head to the stabling yard to be berthed, as shown in Figure 70. Later, when these facilities are available, the train heads to the washing plant and performs the washing. Then the train goes to the service slab where its servicing shall be conducted, and finally heads again to the stabling yard. This movement is to be performed by the CME depot drivers.

Figure 73: Movement 4: main line → workshop → stabling (Alternative 5)

Those trains coming from the main line and going directly to the workshop, have to perform the switch of drivers in the transition platform located in the through road. Then the train heads to the workshop and carry out the maintenance activity. It must be noted that heavy maintenance tracks could be only accessible from the west since they could be single ended tracks, so it would be necessary to make a shunting movement in the east side if coming from the main access.

Finally, when the maintenance is finished there are two options for heading to the stabling by shunting movements: by the shunting lane in west side, or by the transition platform in the east side. Once in the stabling, the train will be berthed until the service starts the next day.

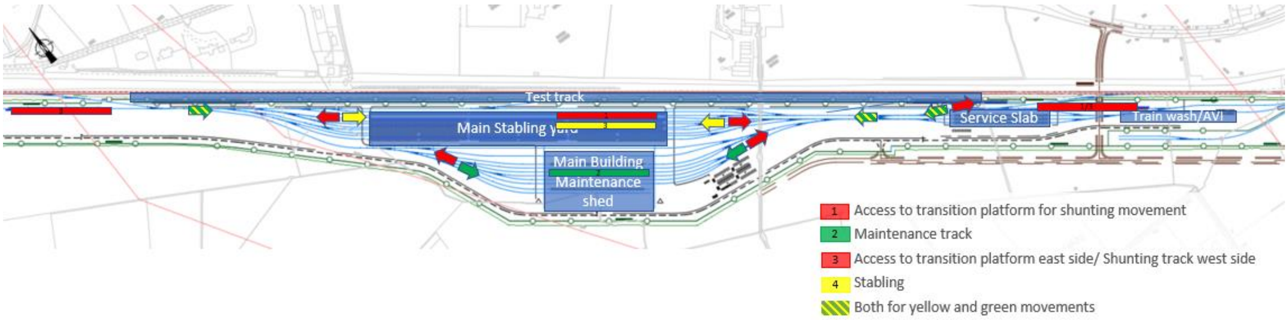


Figure 74: Movement 5: stabling → workshop → stabling (Alternative 5)

The trains are to carry out a shunting movement in order to head to the workshop from the stabling. There are also two possibilities: performing the shunting movement in the shunting lane in the west side, or in the transition platform in east side. It must be noted that heavy maintenance tracks are only accessible from the west since are single ended tracks. Once the maintenance tasks are finished, the way back to the stabling yard is the same. This movement is intended to be performed by the CME depot drivers.

5.5.3 Staff and road flows

In Alternative 5, in the case of staff flows, workshop and stabling facilities are adjacent, also next to the main parking area, but level crossings are needed for going from one to the other. In the case of road flows, the internal road connects all the facilities in the depot layout but the stabling, that as mentioned before, needs level crossings for accessing.

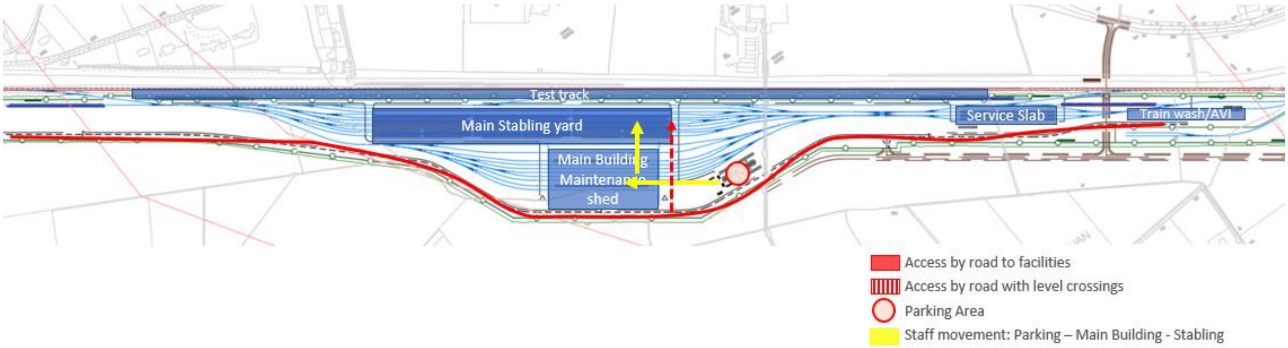


Figure 75: Staff and road flows (Alternative 5)

5.6 Alternative 6

The aim of this section is to assess the convenience of the reception roads facility in the depot, considering functional and operational issues. For this purpose, the Alternative 1 will be studied with the inclusion of three reception roads at the entrance of the depot, to compare it with the other alternatives that do not have reception roads.

The reception roads are the interface between the mainline and the depot, in this zone is performed the switch of drivers from the mainline to the depot drivers. Below, there is a description of the main advantages and disadvantages of reception roads.

Advantages:

- Drivers switch centralised
- Road access and staff facilities beside

Disadvantages:

- Increase of length
- Increase of occupation
- Increase of infrastructure
- From the operational point of view, reception roads have no more benefits than the transition platform. Furthermore, the handover in the reception road could cause difficulty to the vehicle flows, since all the trains are to stop at this facility to perform the drivers switch.

In the alternatives without reception roads the operational service starts from stabling tracks. The service ends in stabling tracks, service slab or in the transition platform included parallel to AWP/AVI track where units are handed over from mainline driver to depot driver (see section 3.4.3) without any extension of the length of the layout. Therefore, no specific operational need of these reception roads is foreseen, and the depot layout could be shortened, as shown in the Alternative 1.

However, with the inclusion of the reception roads in the layouts, the trains have to always stop in this facility for the ingress/egress train flows, and this will have an impact on the operation of the depot. The following figure shows the Alternative 6 including three reception roads at the east side of the depot.

Figure 76: General Layout of the Alternative 6

In the previous image, marked in yellow is the extra area required of around 3.7 Ha compared to Alternative 1, the rest of the layout being the same for both alternatives. Hence, the extra occupation in the plot of land is noticeable.

Considering the previous analysis, the inclusion or exclusion of reception roads is going to influence heavily the operation of the depot. Consequently, this issue should be agreed with IÉ before progressing the design.

More detailed images of the alternatives are shown below for the area where transition platforms/reception roads are proposed, so the space requirement and similar operation can be appreciated.

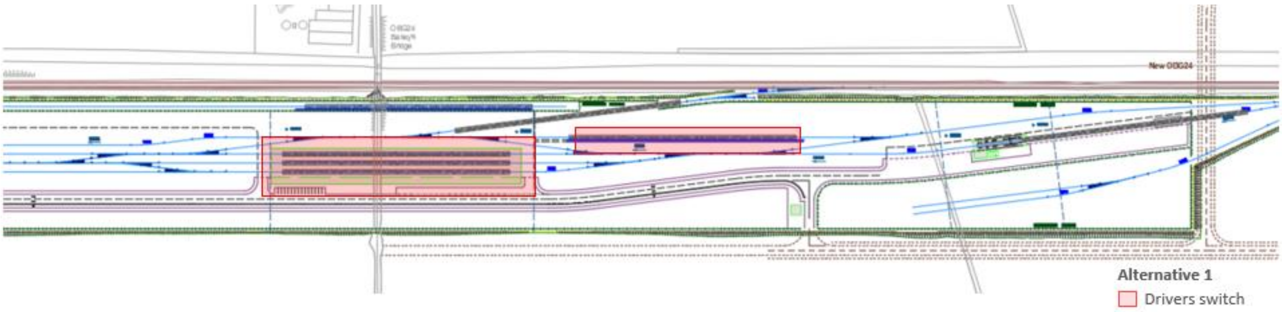


Figure 77: Drivers switch in Alternative 1

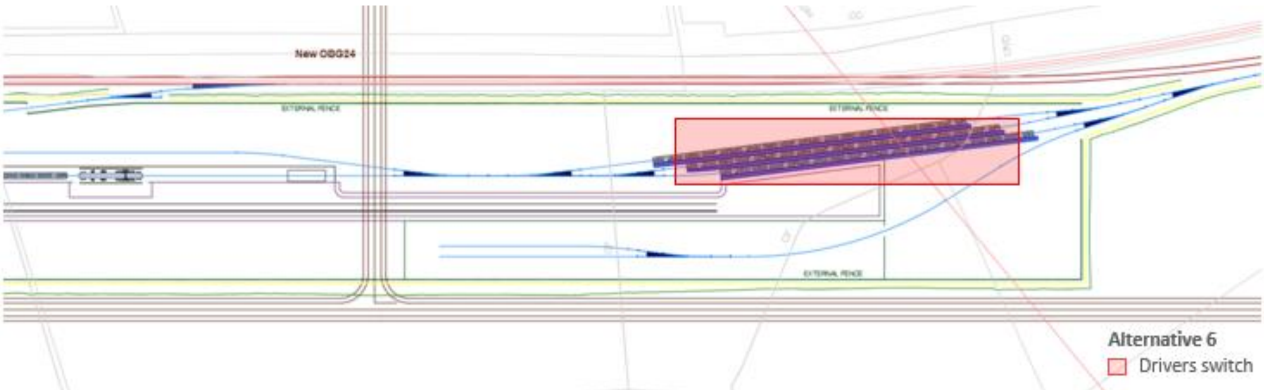


Figure 78: Drivers switch in Alternative 6

6 Maintenance strategy

This section will present a description of the maintenance strategy envisaged for the DART fleet in the whole DART network. It is important to note that at this stage the information of the new fleet has not been released. However, the aim of this section is to validate the number of maintenance tracks at the depot, as well as satisfy the O&M philosophy and requirements from IÉ, regardless of the new rolling stock, for which the manufacturer will provide a specific maintenance plan as stated in section 9.2 of the *DART Expansion Train Technical Specification*.

6.1 Grade of Maintenance

Considering the IÉ requirements in terms of rolling stock maintenance, the different maintenance tasks to carry out for the fleet are the following:

- Daily Maintenance:
  - Service slab activities
  - Internal cleaning
  - Exterior washing
- Preventive Maintenance:
  - Light maintenance activities
  - Heavy maintenance activities
  - Wheel lathe activities
- Corrective Maintenance and other Unscheduled activities
- Deep Cleaning activities
  - remove dirt from areas that AWP cannot access for example at body ends
  - remove graffiti or conduct a biological clean post animal strike or fatality
  - change vinyl on the units and small paint repairs
  - manually wash down train fronts and intermediate ends with power washers

6.1.1 Daily Maintenance

6.1.1.1 Internal cleaning

The internal cleaning of trains includes the train interior surfaces (box, floor, ceilings, information elements, monitor screens, seats, handles, doors, cabin and driving desk) and all the normally accessible elements. These activities are generally carried out during the night in the stabling yard while the vehicles are berthed in one of the stabling tracks once the service is ended for the day. It is proposed to have three different levels of cleaning that are to be performed dependent on the train condition.

The three different levels of cleaning are described as follows:

- Daily maintenance cleaning
  - Waste collection and floor sweeping.
  - Cleaning of windows and interior sides of trains with cloth.
  - Light seat cleaning.
  - Floor scrubbing with double bucket mop or scrubbing machine.
- Main cleaning
  - Waste collection and floor hoovering.
  - Cleaning of windows and interior sides of trains with brush.
  - Cleaning of exposed steelwork, seats and vehicle intermediate ends.
  - Thorough scrubbing of the floor with mechanical disc scrubber.

- In depth cleaning
    - Waste collection and floor hoovering.
    - Thorough cleaning of windows and interior sides of trains.
    - Cleaning of steelwork, seats, stain removal and total washing.
    - Cleaning of train intermediate ends exterior and interior.
    - Cleaning of ceilings, niches of fire extinguishers, alarm, etc.
    - Thorough scrubbing with mechanical disc scrubber.

6.1.1.2 Service slab activities

The service slab activities are the following:

- CET (Toilet Tank) Discharge and Water Fill (if fitted)
- Sanding system top-up
- Fluid top up including Windscreen wash
- Front and rear cleaning with long-handled brushes

These activities are to be carried out every second day, but the sanding is more dependent on the operation and the weather conditions during the seasons. According to the *DART Expansion Train Technical Specification*, the sandbox shall be designed with enough volume to last at least 72 hours between each replenishment, including during the autumn, when adhesion is reduced by leaf fall, and the sand filling will be no longer than 30 minutes.

Considering this issue, the most demanding activity will be the CET discharge of the train, which must be carried out every second day, and has a duration approximate of 20 minutes for two toilets per each FLU. The sanding is likely to last less than 30 minutes and to be carried out with more cadence than 3 days.

Fluid top-up is not considered a demanding activity in terms of time, it can be carried out at the same time as the previous ones.

The AWP only washes sides and eaves of the train, and because of that, additional cleaning of the front cab and rear of the train must be performed in the service slab. This activity will be carried out by an operator with a long-handled brush. The activity can be performed at the same time as the other ones.

The service slab strategy to dimension the facilities is outlined in section 7 of this document.

6.1.1.3 Exterior washing

The AWP will be a drive-through type and it is located at the entrance of the depot after the AVI facility, which is on the same track, and before the access to the service slab, stabling yard and maintenance shed. The washing will be unidirectional and capable of washing the sides and eaves of the vehicles. Washing speed will not exceed 5 km/h, considering optimal 3 km/h.

The trains will be washed every second day as a requirement from IÉ. The washing strategy for the DART fleet will be based on different time windows: AM off-peak period, PM off-peak period and during the night, but if possible, all the trains are washed during their removal from the mainline.

The washing strategy to dimension the facilities is outlined in Section 7 of this document.

6.1.2 Preventive Maintenance

The scheduled maintenance of the DART fleet is based on balanced distance exams. The preventive maintenance of the rolling stock is split into three types:

- Light maintenance: activities with more frequency than heavy maintenance activities, shorter duration, performed normally in tracks with platform and pit. These are mainly related to functional tests and visual inspections
- Heavy maintenance: activities carried out with less frequency than light maintenance activities, longer duration, performed in tracks with lifting jacks. Mainly related to heavy component changeout activities.

- Wheel lathe: activity carried out periodically. However, it is possible that an unusual (corrective) intervention must be performed due to undesirable conditions, such as flat spots.

The next activities are excluded from the scope of the new depot (as stated in the IÉ CRS):

- bogie or wheelset overhaul facilities planned for this site. Bogie overhauls will be carried out elsewhere.
- major component overhaul

6.1.2.1 Light maintenance activities

These activities are cyclic maintenance based on balanced distance exams. Most of the tasks are checking, visual inspections, measuring, verification and replacement. This maintenance will be done mostly in tracks on pit with overhead platforms.

The balanced distance exams are carried out within a schedule according to the mileage and the operation. Since the operation is normally fixed, the mileage could be expressed on a time basis as well. Considering the balanced distance approach, the duration of the exams will be the same.

The content of different Light Maintenance exams envisaged for the fleet is shown in the Appendix 1. It is important to note that are based on the existing grade of maintenance implemented in the 8500 fleet, hence the definitive content, cadence and duration of the exams will depend on the rolling stock supplier. This information was received through the RFI 150 requesting information related to depot activities. Basically, there are two types of exam:

- Periodical Inspection A: it will comprise the most basic exam for the fleet. It is performed every 30 days, and it is composed of basic tests, checks and visual inspections.
- Periodical Inspection C (C1 to C6): C exams will be split into different sections depending on the part of the train to be examined: there will be electrical, body and mechanical exams, all of them performed in every level of maintenance. The different C exams are performed every 30,000 km, that considering the current operation means a C exam every 60 days, and each of the C exams once a year. The inspections within the A exam are as well considered in the C exams.

6.1.2.2 Heavy maintenance activities

These activities are related to a heavy component change out that, in most cases, requires having the train lifted, especially to assembly and disassembly the bogies. Usually, these activities are carried out in the heavy maintenance track, but some of them can be carried out in the light maintenance tracks such as the air dryer change, HVAC change, or the changeout windscreen, depending on the availability of the tracks and the maintenance schedule. The capacity of the cranes installed in the light maintenance tracks shall be suitable to face these heavy maintenance activities.

Some of the activities considered are the following:

- Air dryer change
- Pantograph change
- Coupler change
- Compressor change
- HVAC system change
- Changeout windscreen
- Bogies and wheelset change
- Changes other underframe components

The duration and the cadence of these activities are quite dependent on the lifecycle of the elements as well as the rolling stock. The information regarding the different HM activities was received through the Fairview HM plan for 2020, in the RFI 150 requesting information related to depot activities. For this assessment is proposed to split the heavy maintenance exams into 6 levels, from HM1 to HM6, depending on their cadence: 2, 4, 5, 8, 10, and 12 years.

At this stage there is no available data of the new rolling stock, hence for the present study, the previous activities for the current 8500 fleet (the Fairview HM plan for 2020 in the RFI 150) are considered as a preliminary approach to heavy maintenance tasks in the new depot. The different Heavy Maintenance exams are shown in the Appendix 1.

6.1.2.2.1 Bogie strategy

The main activity in terms of heavy maintenance in the depot is foreseen to be the bogie change of the trains. The wheel reprofiling and wheel wear in normal operation reduces the lifecycle of the wheelsets and the bogies must be replaced with a certain cadence. This operation of bogie replacement will be carried out in the new depot in Maynooth, but the complete overhaul of the bogies will be carried out in Inchicore depot.

In terms of operation, there are several options to consider for the bogie strategy. One of the main options for the bogie replacement is envisaged to be performed as follows:

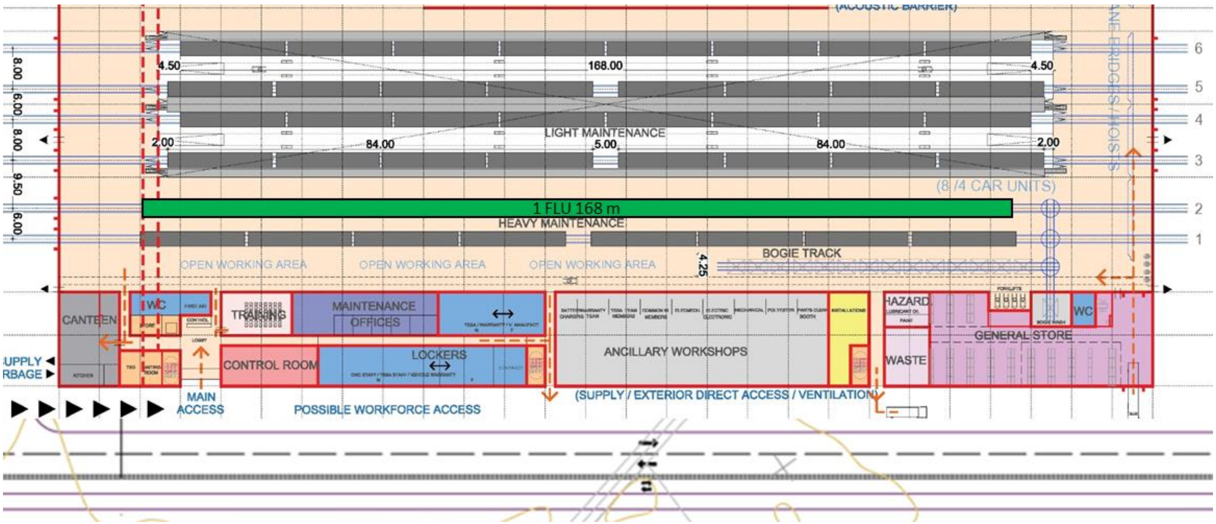


Figure 79: HM bogie strategy. FLU in HM track

Firstly, for the train access to the heavy maintenance track, considering that the HM track will not have OHLE the train must be powered by internal auxiliary batteries or moved using a shunting vehicle. The final solution will depend on the rolling stock supplier. Once the train has accomplished all the requirements of the safety procedures from the DPPS process the train can access the lifting track.

The bogie replacement process starts by lifting the vehicle with the bogies, then the operator can access the underframe to disconnect mechanically and electrically the bogie. Later, the bogie is disassembled from the carriage and placed on track. The bogie replacement will be for the complete vehicle (FLU or HLU) since all the bogies have run the same and have performed the same lathe activities.

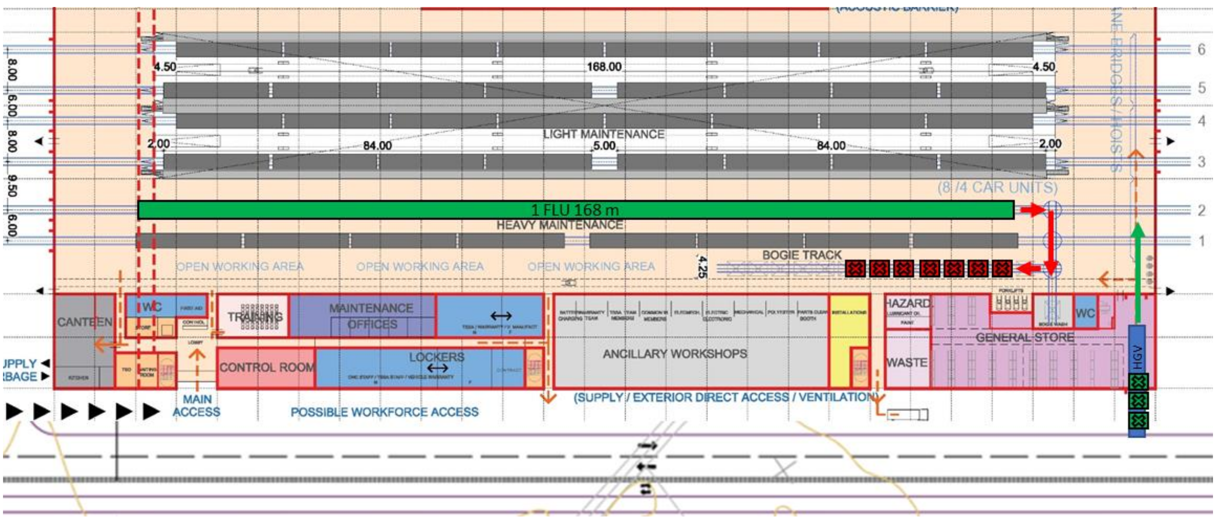


Figure 80: HM bogie strategy. FLU bogie to be overhauled moved to bogie storage track flow

Once the bogies are disassembled from the carriage, they can be placed in the parallel bogie storage track. The bogies are moved manually using the bogie turntables that connect the adjacent tracks. In parallel, the new bogies can access to the depot by means of a truck. The incoming trucks must be coordinated depending on the new bogie availability, to optimise the bogie delivery in the depot.

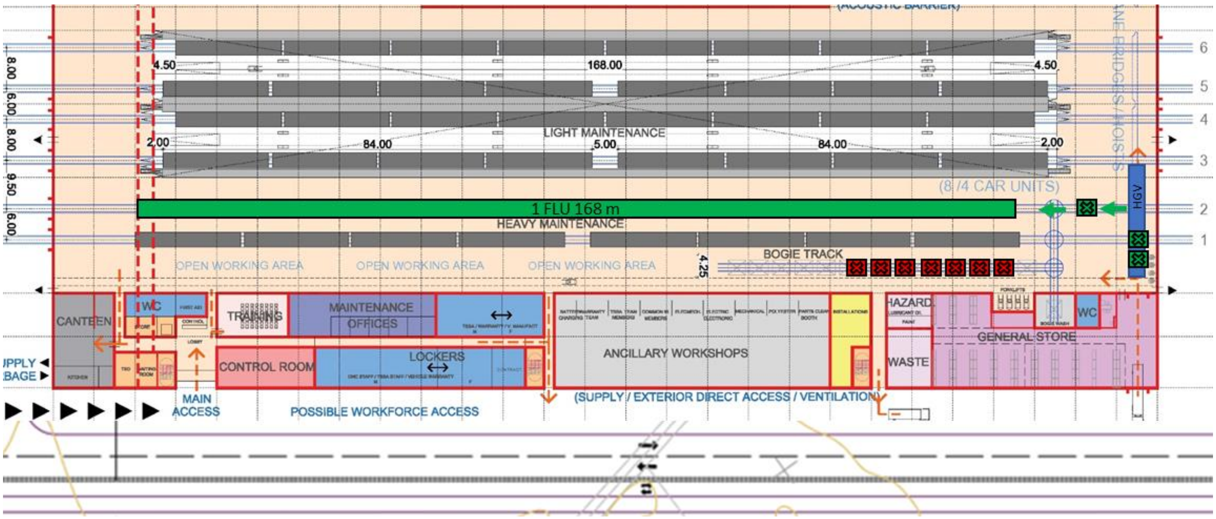


Figure 81: HM bogie strategy. Drop on rail new bogie flow

Once all the bogies from the unit are placed in the bogie storage track, the operation of placing the new bogies on rail could start. The truck is placed perpendicular to the heavy maintenance track, and the gantry crane takes the new bogies to place them in rail, on the same track where the train is lifted. Meanwhile, the workers place the bogies in their definitive position and perform the adjustments and inspections needed.

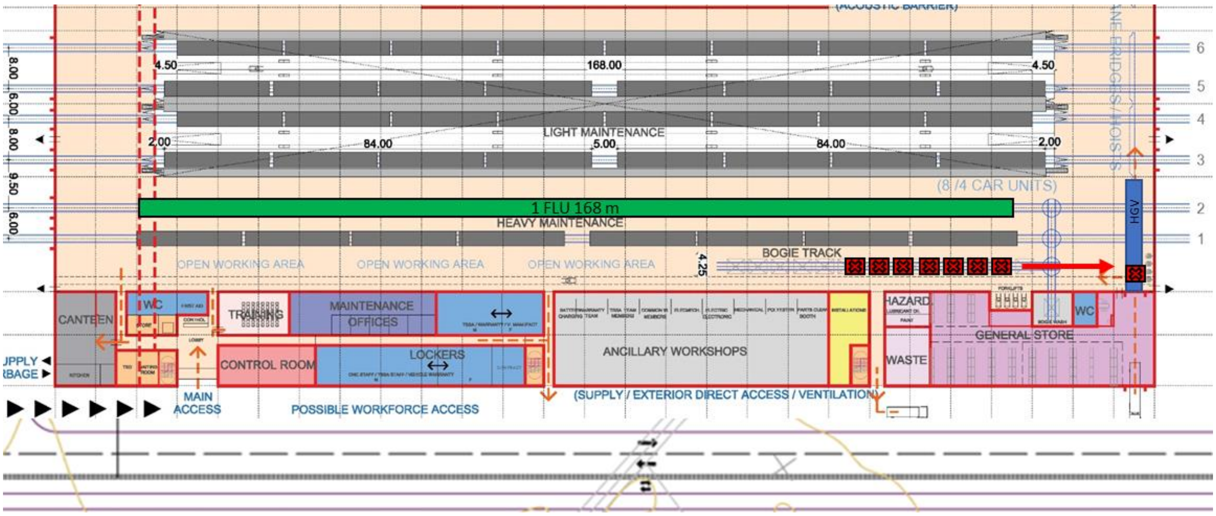


Figure 82: HM bogie strategy. FLU bogie to be overhauled carried on HGV

Normally, several HGV will be necessary to provide all the new bogies (depending on their capacity). Once all the bogies are placed in rail, the bogies to be overhauled are carried in the truck using the gantry crane of the heavy maintenance area.

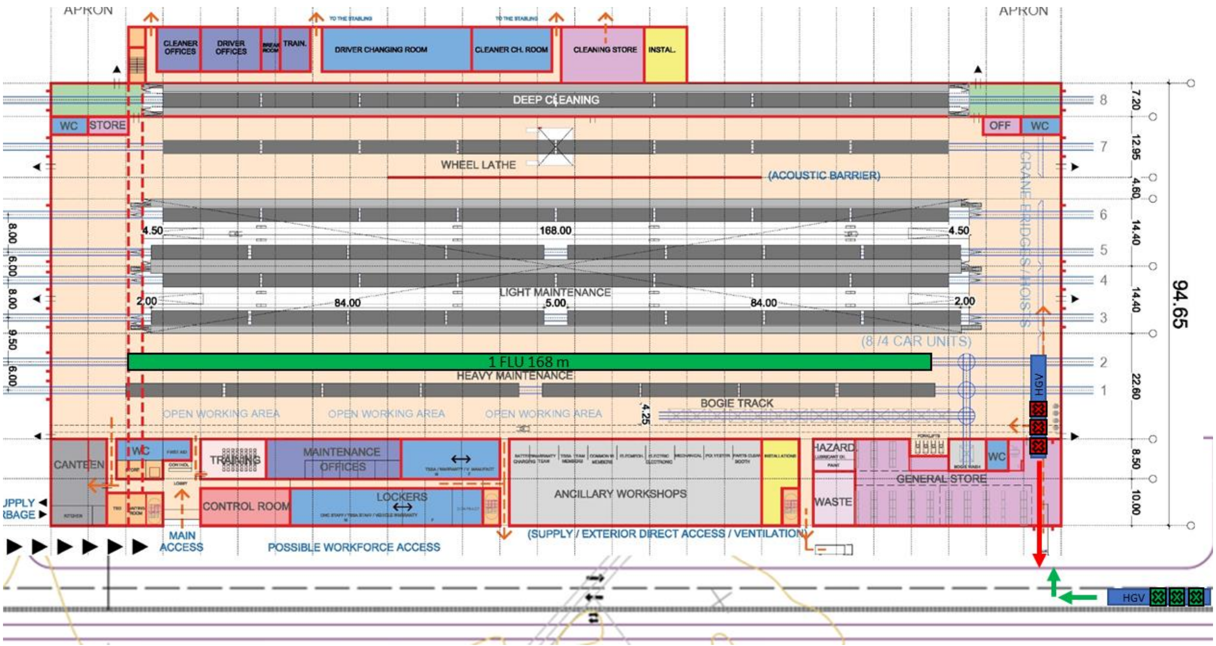


Figure 83: HM bogie strategy. HGV flows

When the operation of carrying the bogies in the truck is finished, the vehicle can head to the access to go to Inchicore, and if there is a proper timing, the next coming HGV will take new bogies to the lifting track when the truck is going out. When the process of placing the new bogies on the rail and take them to their position in the FLU unit is finished, the new bogies can be connected.

At this stage, the previously described alternative is the main foreseen for the main building layouts developed. Still, there are some options suitable to be considered and studied along with IÉ for the bogie strategy:

- Option 2 (bogie storage tracks in both ends of HM tracks): having parallel bogie storage tracks at both ends of the maintenance track, provides the most flexible and efficient operation. For instance, all the maintenance works in a FLU can be done by both sides instead of only one. Besides, when there are 2 HLU in the maintenance track, both can be maintained at the same time, performing the bogie replacement at each end. This could be enabled by arranging two gantry cranes for each of the stretches of track. One of the inconveniences of having two gantry cranes, is that these cannot run the entire length of the track or must be properly interlocked between them. In terms of operation, it should be study if an operation with HLU will be more frequent than the one with FLU, to assess properly the convenience of this solution.

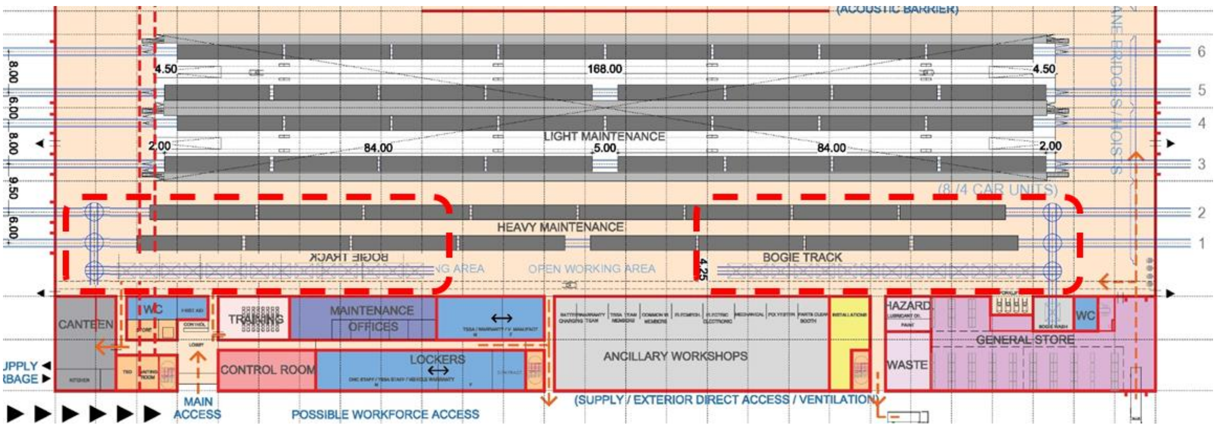


Figure 84: Option 2 Bogie strategy (bogie storage tracks in both ends of HM tracks)

- Option 3 (bogie storage tracks out of the maintenance shed): having the bogie storage track out of the maintenance shed enables to use this track as a delivery track. Moreover, the separation between zones and the spacing is bigger, but in the previous alternatives, the spaces were designed accordingly to allow forklift and staff flows. There are noticeable inconveniences: there is not a gantry crane outside (HGV must be equipped with auxiliary cranes), it will be necessary to cover the bogies (a new shed or individually) and the working distances are bigger.

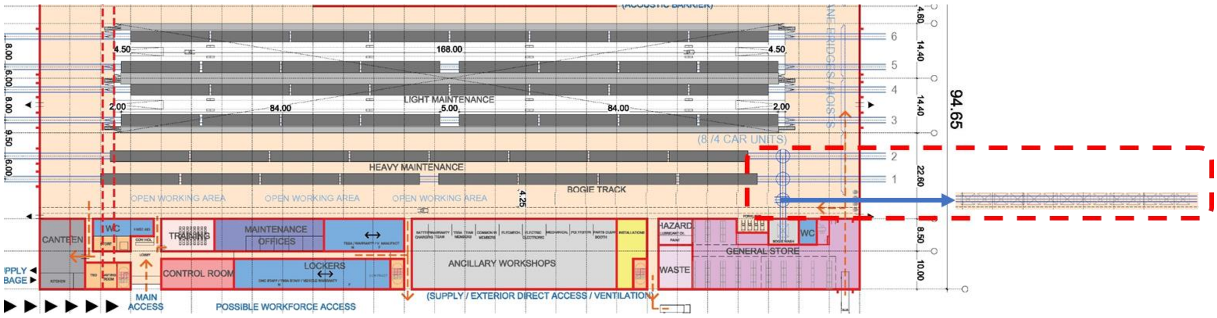


Figure 85: Option 3 Bogie strategy (bogie storage tracks out of the maintenance shed)

From the analysis of the bogie strategy highlighted previously it can be opened a debate to discuss which of the approaches fits better the IÉ requirements and philosophy of O&M. Nevertheless, the following issues must be clarified:

- Need of having all the new bogies stored and ready on site for each operation, since this should decrease duration of the activities. On the other hand, the bogie delivery can be carried out by the HGV when needed.
- The preference of having the bogie storage track out or inside the maintenance shed. Pros and cons have been highlighted previously.

The need of operating 2 HLU instead of 1 FLU in the HM track. This could foster the second option, along with two gantry cranes in the heavy maintenance track, providing the most flexible operation.

6.1.2.3 Wheel lathe strategy

The wheel lathe strategy for the DART fleet will consist of scheduled activities every certain mileage. Corrective wheel lathe activities shall be conducted as well, when the wheel measurement device of the AVI system detects a fault (such as flat spots). The operation of the wheel lathe is carried out within the maintenance shed by the lathe operators. The process will be the following:

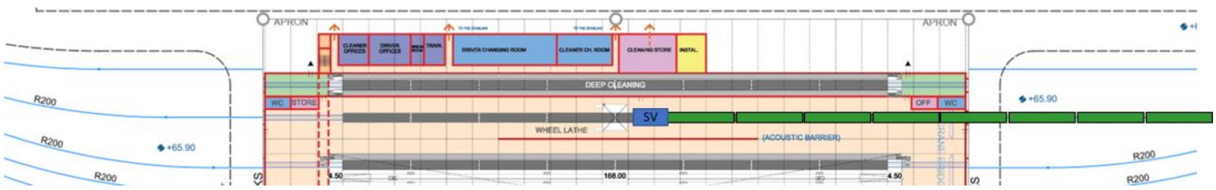


Figure 86: Wheel lathe train access

The first operation is the train access to the maintenance shed. Once the train has accomplished all the requirements of the safety procedures from the DPPS process the train can access the wheel lathe track. The OHLE must be properly interlocked with the wheel lathe. Then the shunting vehicle is sent to a fixed position within the maintenance shed and before the wheel lathe, and the operator connects the train to the shunting vehicle. Later the operator isolates the brakes and set up the machine for the activity.

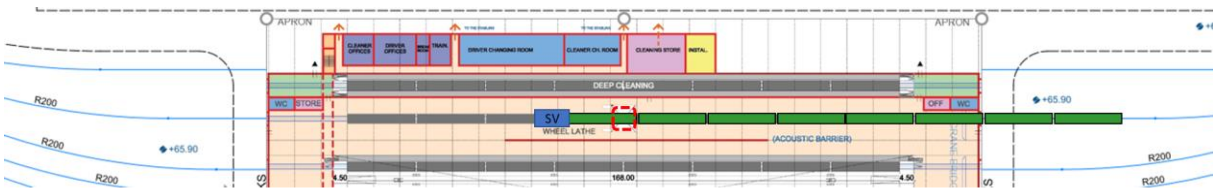


Figure 87: Wheel lathe train machining

Secondly, the lathe operator moves remotely the train using the shunting vehicle to place it above the lathe. The operation is composed of the following: positioning, loading and manual clamping of wheel set, measurement, reprofiling operation, intermediate measuring, reprofiling operation, visual inspection and clean, final measurement, manual unclamping and unloading. The duration will be dependent on the rolling stock, equipment supplier and operator´s ability.

Figure 88: Wheel lathe ride height adjustment

When all the bogies of the carriage are machined, in order to maintain a standard train floor height for interface with platforms at train stations, operation of height adjustment is conducted in the suspension. The operators insert packing shims of different measures (depending on the lathe process) between the suspension and the train body above the bogie. This operation is carried out by hand with portable jacking systems, in a dedicated zone after the wheel lathe area. Eventually, this operation will depend on the new rolling stock and its suspension system.

Later, the brakes are de-isolated, and it is performed a train weighing to check the balance of the train along with the post-machining examination. Occasionally, within a certain cadence to be studied depending on the data gathered from the machining process, the metal swarf must be emptied by forklifts and taken to bigger containers in the main waste yard.

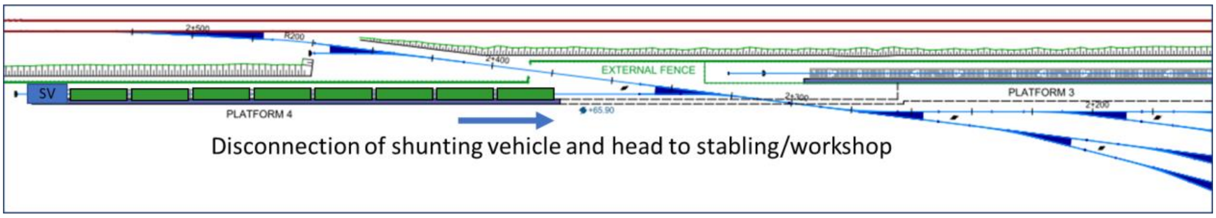


Figure 89: Disconnection of shunting vehicle and head to stabling/workshop

The final step is to disconnect the shunting vehicle which is foreseen to be a road/rail vehicle that will be easily disconnected in the shed. Later, the connection of the OHLE with the proper safety measures and take the train to the stabling or to another workshop track. To perform these movements, the train must head to the western shunting lane and make a reverse.

6.1.3 Corrective Maintenance and Unscheduled activities

This will comprise the unforeseen maintenance activities due to incidents or breakdowns arisen during the regular use of the units. In general, it could be performed in tracks on pit and lifting tracks.

The approach taken to provide reserve capacity and consider the corrective maintenance is to provide 1 LM and 1 HM track to perform these activities when needed.

If the maintenance tracks are free, some unscheduled activities (upgradings, changes of image, commissioning activities, etc.) can be performed. However, they must be combined and harmonised with the existing working shifts for preventive and corrective maintenance, that eventually are most important for the running operation of the DART network. The availability of the tracks for these activities can be increased at certain times when needed, by increasing the working shifts.

6.1.4 Deep cleaning activities

The deep cleaning facility is a multifunctional facility that enables to carry out several activities related to cleaning, changes of image, bodyworks, and so on. The main activities are:

- Washing and remove dirt from areas that AWP cannot access for example at body ends or underframe. In addition, manually wash down train fronts and intermediate ends with power washers

- Removal of graffiti as well as biological clean post animal strike or fatalities are activities that will need the use of chemicals and specialised products.
- Change vinyl on the units and small paint repairs

The last two bullets are mainly related to the corrective maintenance, consequently these activities are not scheduled. However, the washing activities in the deep cleaning facilities can be scheduled and incorporated to the washing strategy for the DART fleet or can be performed when needed.

6.1.5 Grade of maintenance summary

The summary of the activities and tasks to undertake periodically to satisfy the grade of maintenance required is shown in the following table:

Table 4. Grade of maintenance summary

Type of maintenance	N	Rolling Stock Maintenance Activities	Cadence (km; days)
1. Daily Maintenance	1.1	Service slab activities	Every 2 days
	1.2	Internal cleaning in stabling	Every day
	1.3	Exterior cleaning in washing plant	Every 2 days
2. Preventive Maintenance Proposal	2.1	Periodical inspection A	Every 30 days
	2.2	Periodical inspection C (C1 to C6)	Every 60 days (30,000 km)
	2.3	Heavy maintenance activity (HM1 to HM6)	From 2 to 12 years
	2.4	Wheel lathe	140,000 km
3. Corrective Maintenance	3.1	Activities when there is a failed or damaged component	Non scheduled
4. Deep Cleaning facility	4.1	Cleaning graffiti, animal fatality and small paint repairs.	Non scheduled
	4.2	Washing with power washers (underframe or other parts)	Non scheduled
5. Unscheduled Activities	5.1	Improvements or changes in train design.	Non scheduled

The following table shows the preventive LM activities foreseen for a train during a year:

Table 5. LM activities for a train during a year of operation

Exam	Month											
	1	2	3	4	5	6	7	8	9	10	11	12
A	Exam A		Exam A		Exam A		Exam A		Exam A		Exam A	
C1		Exam C										
C2				Exam C								
C3						Exam C						
C4								Exam C				
C5										Exam C		
C6												Exam C

6.2 Capacity of maintenance tracks

This section presents the calculations for the Maintenance Plan to justify the type and number of work-stands and maintenance tracks in the depot.

The main assumptions taken to assess the maintenance plan and the capacity of the tracks are:

- Fleet of 75 FLU to maintain (600 EMU)
- Depot operating days: 364 days a year

- Working shifts: 2 shifts per day for LM (day and night and 7 day a week operation), 1 shift per day for HM (day and 5 days a week operation), 1 shift per day for WL (day and 5 days a week operation).
- Duration of LM exams: 1.5 shifts (no data available for the new fleet)
- Duration of HM exams: no data available for the new fleet. Assumptions to be agreed with IÉ.
- Reserve of 10% of capacity in each maintenance track due to failures in infrastructure and equipment

Following there is a summary of the inspections to carry out yearly per train and fleet within a programmed maintenance.

Table 6. Programmed maintenance inspections for the fleet yearly

N	Activities	Cadence	Duration	Track	Inspection per train	Inspection per fleet
1	Periodical inspection A	30 days	1.5 shifts	LM track	6	450
2	Periodical Inspection C1-C6	60 days	1.5 shifts	LM track	6	450
3	Heavy maintenance: HM1 HM2 HM3 HM4 HM5 HM6	 2 years 4 years 5 years 8 years 10 years 12 years	***Note:*** more information regarding the heavy maintenance activities is necessary to assess the occupancy of the heavy maintenance tracks. With the preliminary assessment and the IÉ feedback, 2 HM roads are enough to satisfy the Grade of Maintenance proposed. Nevertheless, it is necessary to have duration, cadence and the proper assumptions to carry out the analysis			
4	Wheel lathe	140,000	3 shifts	Wheel lathe	0.71	53.57

Considering the proposed grade of maintenance highlighted previously and the assumptions, the number of inspections for the DART fleet can be assessed. The occupancy of the maintenance tracks is as follows:

Table 7. Maintenance track capacity

Activity	A	C1	C2	C3	C4	C5	C6	HM	WL	Days	Occupancy
Wheel lathe									161	161	66.69%
LM 1	655.2									655.2	90.00%
LM 2	19.8	112.5	112.5	112.5	112.5	112.5	72.9			655.2	90.00%
LM 3							39.6	189		39.6	5.44%
LM 4	Reserve for corrective and unscheduled maintenance										
HM 1	Heavy maintenance activities										
HM 2	Reserve for corrective and unscheduled maintenance										

The calculation gives the following conclusions:

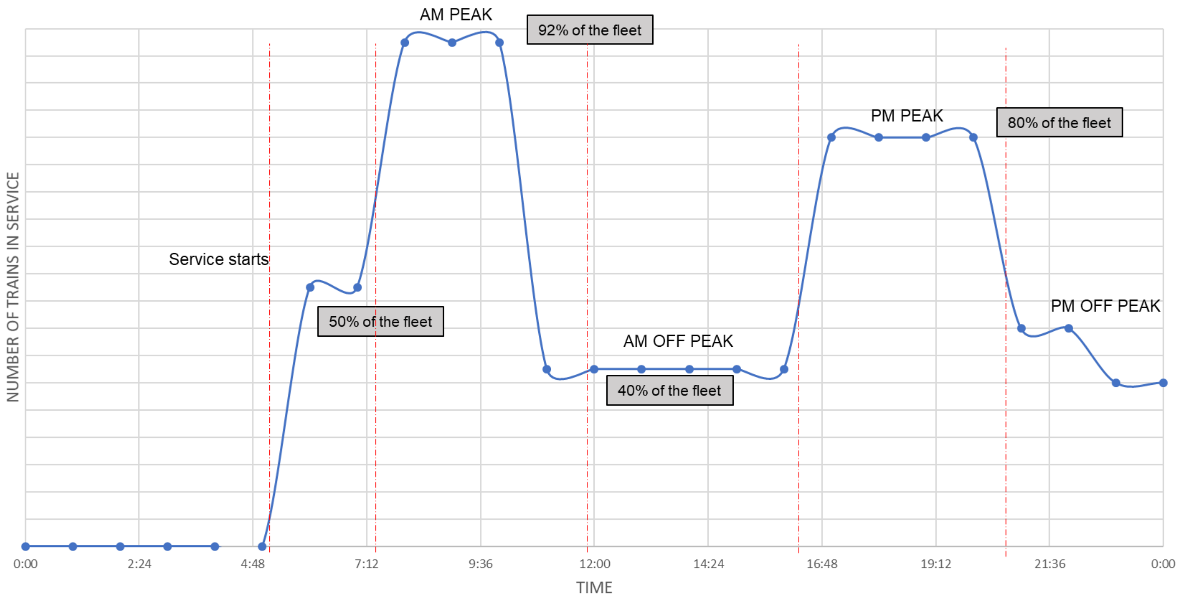
- For the programmed preventive maintenance will be necessary at least 3 LM and 1 HM track
- It is considered a reserve for corrective and unscheduled maintenance: 1 additional LM and HM tracks must be added. Maintenance tasks performed in HM tracks needs further coordination with the Inchicore depot.
- It is important to notice that doubling working shifts could increase the capacity of the workshop
- Consequently, the number of 4 LM, 2 HM roads, 1 deep cleaning track, and 1-wheel lathe is proposed at this stage to be considered for the new depot of Maynooth according to our experience and IÉ feedback.

6.3 Maintenance schedule

The maintenance of the DART fleet is dependent on the operational timetable service, that will feed to the maintenance teams with the available timeframes for the scheduled activities. The harmonisation with the operation is crucial since it has a noticeable impact on the availability of the trains.

Considering a total fleet of 600 EMUs to maintain, and the main target of achieving a 92% of availability, the running maintenance will be designed accordingly. In addition, the timeframes for maintenance and the duration of activities, as well as the operating days in the maintenance shed of the depot will be used to design the staff and the maintenance teams necessary in the depot.

Following there is a generic distribution of the fleet along the daily operation (to be validated by operational analysis), considering the number of trains in operation in the DART network:



Vehicle on service	0	38	69	30	60	34
Available for maintenance	75	37	6	45	15	41

The previous graph highlights several issues:

- An availability of 92% in the AM peak hour, which is the most demanding (69 FLU in operation), with no further available data on the operation.
- Always there are 6 trains available for maintenance (8% of the fleet)
- Consequently, the running maintenance can be scheduled accordingly with the scheduled activities and their duration.

7 Servicing and Washing strategy

Considering the IÉ requirements as regards to Daily maintenance, the trains will be washed every second day and must perform the servicing every second day also. This section aims to design the servicing and washing strategy for the whole DART fleet, considering the existing facilities, the timetable service, and the possible land for further facilities if needed. The analysis will be split into two parts: one focusing on the new EMU Depot in West Maynooth, and another one for the whole DART network, considering existing facilities and sidings.

7.1 Timeframes

The main input at designing the servicing and washing strategy for the DART fleet is the timetable service. The operational analysis feeds the study with the timeframes where a percentage of the fleet is not in service, and hence is available for washing. The servicing and washing strategy for the DART fleet will be based in different time windows: AM off-peak period, PM off-peak period and during the night.

In a generic operation, the scheduled service of trains will be approximately the following:

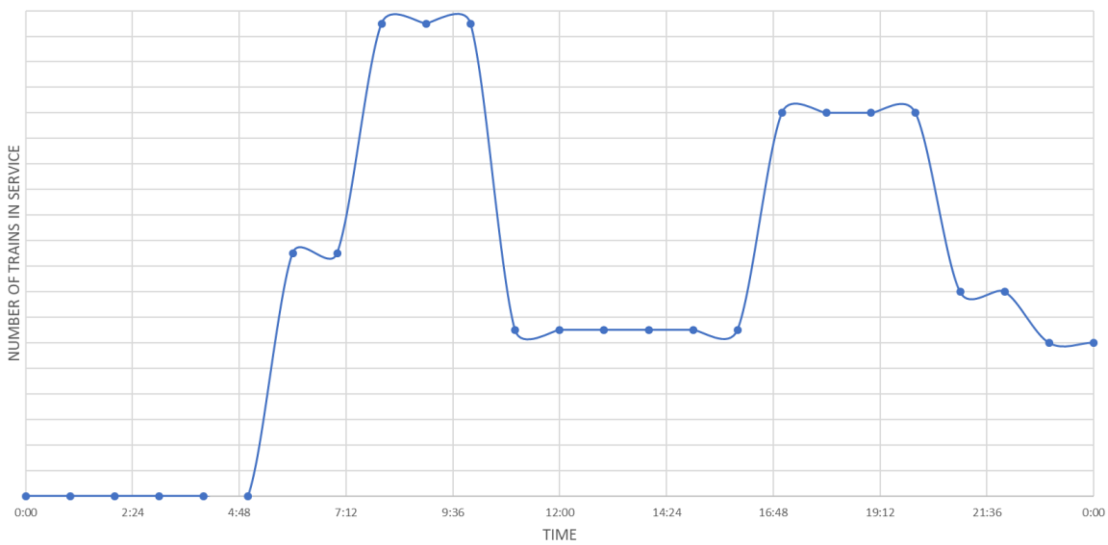


Figure 90: Generic operational scheme

The service starts at 6:00 AM, reaching the peak hour between 7:00-10:00 and later coming in an off-peak hour from 11:00 to 17:00 when around a 30-70% of the fleet could be removed from the main line (according to our experience), depending on the reduction of the frequency. Later the peak hour in the afternoon starts from 17:00 until 20:00, after this stretch of service starts the gradual removal of trains from the main line, until the end of the service at 00:00.

Usually, the peak hour in the morning is more demanding in terms of capacity than the peak hours in the afternoon, so more trains will be needed in this timeframe. The reduction of trains between the peak hours is a percentage to be analysed. Besides, during the off-peak hours it is performed a gradual removal of trains from the main line to the depot and sidings scheduled. Considering the previously exposed generic operation, the timeframes available for the washing are the following:

- AM Off-peak hour: this timeframe makes the most of the available time between peak hours for the servicing and washing of the trains. Considering the different facilities in the network, trains that are not in service, head to them and perform the washing.
- PM Off-peak hour: this timeframe starts with the removal of trains from the mainline to the sidings and the depot to be berthed until the service begins the next day. The trains head to the facilities and later to the stabling.

- Night-time: in case any train could not be serviced in the previous timeframes, for example, if the AWP was occupied and the train had to bypass it, and head to the stabling directly, during the night hours the operators could take the train to the AWP, perform the washing and come back to the stabling. This will not be frequent since the washing will be performed in inbound movements as much as possible taking advantage of the previous time slots.

From an operational point of view, the servicing and washing strategy is related to the headway and the returning cadence of the trains to the depot. At this stage, the timetable service of the DART network operation is not available, hence the analysis is based on likely and reliable assumptions, to be updated when the operational data is available. The main assumption is related to the operational timetable service. It is considered a generic timetable composed of trains coming every certain cadence for the study:

- The Depot servicing and washing strategy will be developed considering headways of 10 minutes in a first step, and headways of 5 minutes in a second step.
- The DART Network servicing and washing strategy will be developed when data about the operation, sidings and existing facilities are available. In this report, it will be included a functional analysis of the existing facilities in Drogheda and Fairview (section 7.3.1).

7.2 Depot servicing and washing strategy

The activities and the sequence of movements for the inbound trains and scheduled for servicing are the following:

Figure 91: Sequence of movements and servicing activities

Trains incoming head to the AVI to perform an automatic inspection at a maximum speed of 8km/h, later the train goes through the AWP at a maximum speed of 3 km/h. When the train finishes the washing can head to the service slab and carry out the servicing activities (section 6.1.1.2). Finally, the train is taken by a depot driver and headed to the stabling yard or the workshop for scheduled or corrective maintenance.

Besides, there is always the possibility to bypass these facilities using the bypass track that goes through the railway yard of the depot. The following image indicates the facilities considered in the analysis and their relative position within the complex:

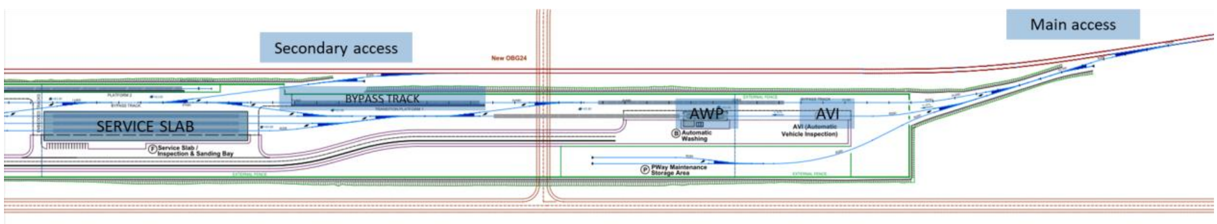


Figure 92: Servicing facilities

The document *Definition of criteria and assignment of weightings* (MAY-MDC-GEN-DEPM-RP-Y-0003) provided a brief description of the facilities.

The main inputs considered to carry out the analysis in the depot are:

- Fleet to be serviced daily: 15 FLU, 50% of those berthed in Maynooth (240 EMU)
- Maximum speed in the depot: 8 km/h
- AWP duration: approximate duration of 4’10’’
- Service Slab activities duration: approximate duration of 20 minutes
- Reduction of trains after the AM peak hour: 30-70% less of trains (to be validated by operation)
- Reduction of trains between peak hours: 10% less of trains needed (to be validated by operation)
- Headway of incoming trains: 10 minutes and 5 minutes (to be validated by operation)
- It will be considered always AWP + Servicing, being this situation the most restrictive, but of course the activities can be performed separately

Considering the previous data and the sequence of movements envisaged for the servicing in the depot, the analysis seeks to optimise as much as possible the servicing activities, to make the most of the timeframes available and have a more efficient operation.

When the first unit access to the depot, head to the AVI facility at 8km/h in the minute 02:18, and then reaches the AWP lowering the speed to 3 km/h in the minute 03:05. When the complete train passes through the washing plant (minute 07:15), the washing is completed and the train heads to the service slab at 8 km/h (min 10:23). The duration of the servicing is 20 minutes, later the train can go to the stabling yard or to the workshop. If the train head to the stabling yard will reach its position in the minute 35:58, depending on the stabling track.

Below is a time-lapse graph of the sequence of these movements.

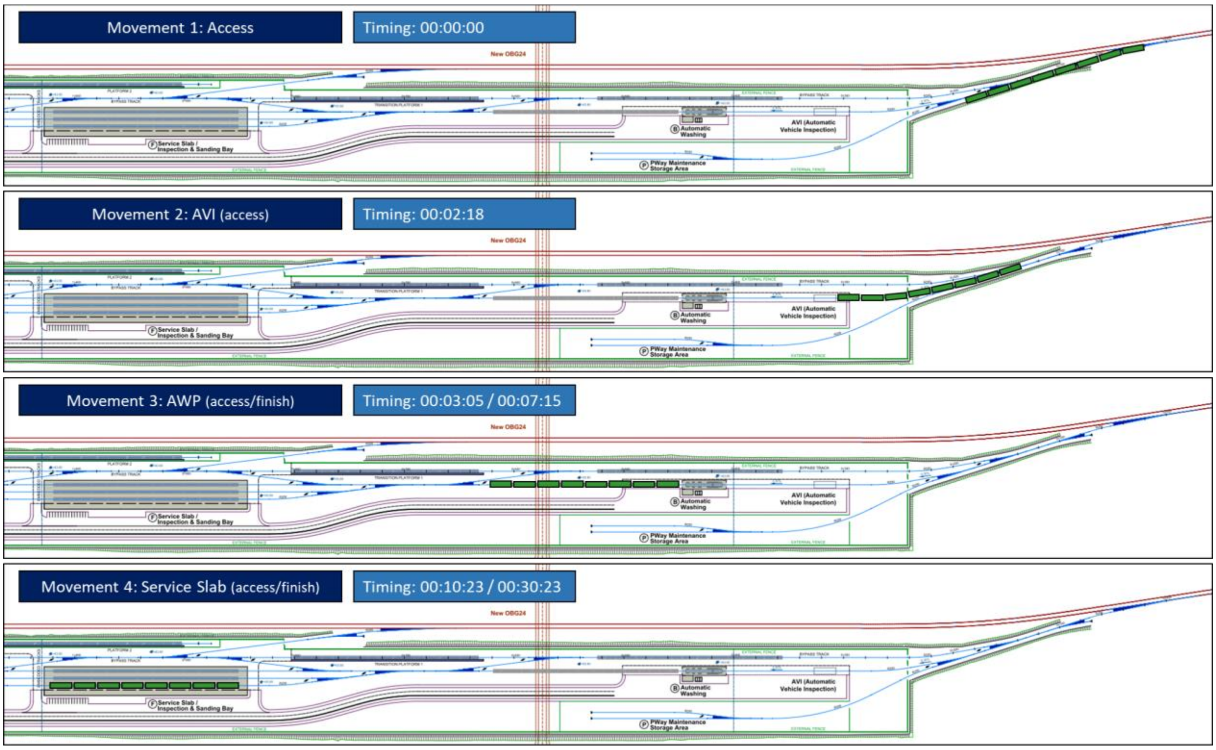


Figure 93: Depot servicing time-lapse images

The previous time-lapse highlights that the main entrance is primarily used for the inbound movements, so the secondary entrance could be used for those needed outbound movements without disturbing the incoming flows for the servicing.

Below there are two charts of the speed-profile and timetable of the operation described previously, one for the maximum speed of 8km/h and another one for 15 km/h. In the graphs it can be noted the speed reduction in the AWP and the time consumed in the service slab activities, as well as the access to the stabling yard:

Figure 94: Speed profile and timetable of the servicing operation (Max speed 8 km/h)

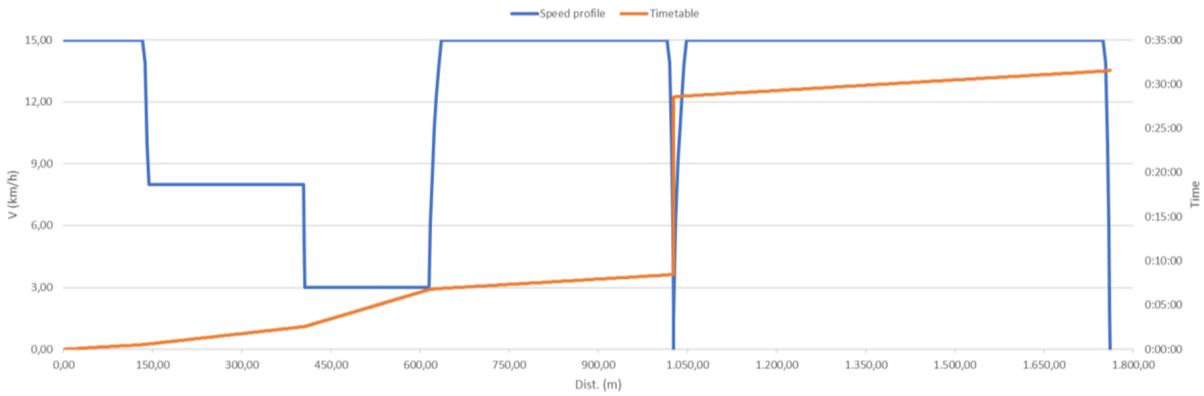


Figure 95: Speed profile and timetable of the servicing operation (Max speed 15 km/h)

From the previous graphs is extracted that the operation with a maximum speed of 8 km/h takes 35:58 minutes, and the servicing operation with 15 km/h takes 31:34 minutes. If the train takes the bypass track, the saved time is approximately 5 minutes (from 13 minutes to 7 minutes) The time savings and the analysis of the maximum speed within the depot will be studied in the Depot Functional Report, but for the present assessment the maximum speed considered is 8 km/h.

During the AM off-peak hour, it is removed a certain percentage of the fleet from the main line (around 30-70% of the fleet taken out from service). The trains start to head to the depot approximately at 10:00, depending on its position on the mainline they can reach the depot at a different time, but for the analysis it is considered that the trains reach the depot at 11:00, later the trains must start the service again at 17:00 approximately.

Considering that a certain number of units are serviced during the AM off-peak hour, if there are still units to be serviced to reaching the 50% of the fleet serviced daily, these units can be serviced during the PM off-peak hour when starts the removal of trains from the main line to the depot from 20:00 to 24:00, and all the units will be ready for the service the next day.

The analysis will be based in a 1-hour study with different returning cadence: 10 minutes and 5 minutes. Following there are two graphs, that shows the timeframe of 1-hour for servicing and the scheduled timing proposed with the headways considered:

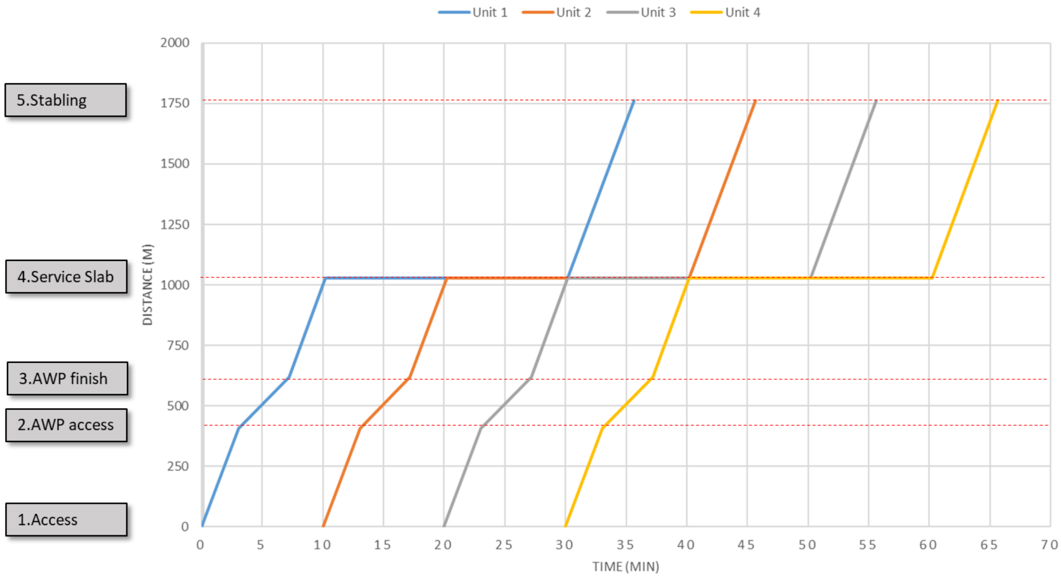


Figure 96: Timing of units accessing the depot during off-peak hour with 10 min of returning cadence

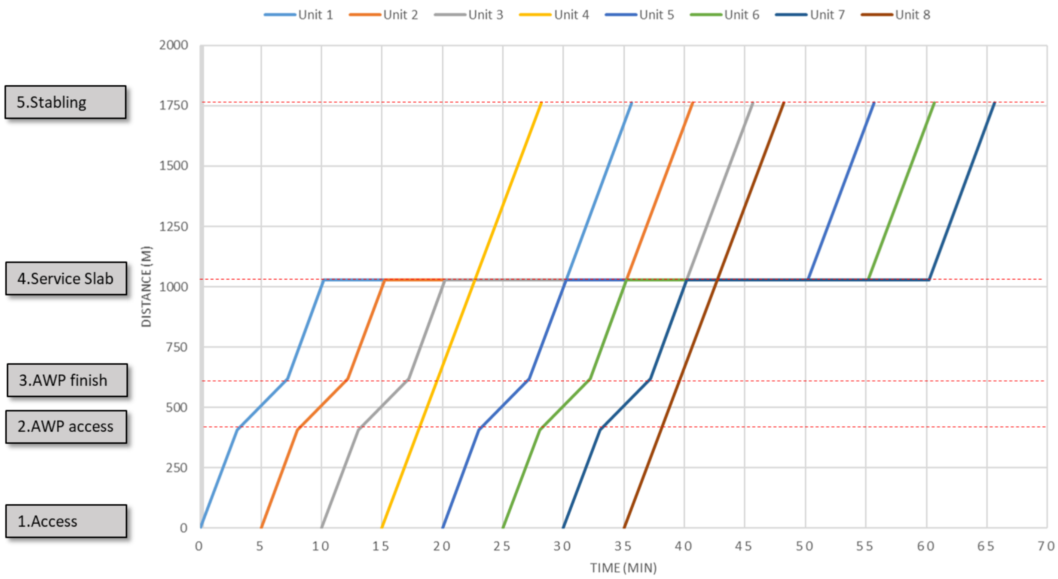


Figure 97: Timing of units accessing the depot during off-peak hour with 5 min of returning cadence

In the first case with the study of 10 min cadence of return, it can be appreciated that all the trains coming to the depot can perform the washing and the servicing without interferences.

Nevertheless, in the second case with the 5 min cadence of return, every fourth coming train must be headed directly to the stabling, since the service slab it is fully occupied. In Figure 97, it can be seen the unit 4 and unit 8, going directly to the stabling yard using the bypass track without stopping in any facility.

The operation of servicing can be scheduled in different ways: trying to service all the incoming trains, servicing one every two incoming trains, or in different combinations to meet the requirements of daily maintenance from IÉ.

These combinations will depend on the frequency and the number of incoming trains, being possible to service some of them with inbound movements from mainline to the depot, and for the other trains headed directly to the stabling yard, when possible within the off-peak hour, returning them to the servicing facilities to perform the activities.

The main conclusions from the Depot servicing and washing strategy are:

- The fleet berthed in the depot can perform the servicing and the washing effectively with the facilities proposed (1 AWP and 3 service slabs), every second day with both a headway of 10 min and 5 min.
- There is still room for servicing more trains during the daily operation and during the night, so the second washing plant on site would not be necessary.
- In the following deliverable, Depot Functional Report the routing analysis will be developed with more detail.

7.3 DART Network servicing and washing strategy

This section comprises the analysis of the servicing and washing strategy for the DART network. **The DART Network servicing and washing strategy will be developed when data about the operation, sidings and existing facilities are available.**

At this stage an analysis of the existing facilities has been carried out to be updated accordingly in further stages.

7.3.1 Existing facilities

7.3.1.1 Drogheda

In the current Depot of Drogheda, which nowadays serves Diesel vehicles, there are both washing plant (AWP) and two tracks for Service Slab. Therefore, both movements have been considered. There is direct connection from mainline to service slab, after which the train would have to head back and go to the AWP. Once it has performed the washing, train can go directly to the Stabling without shunting.

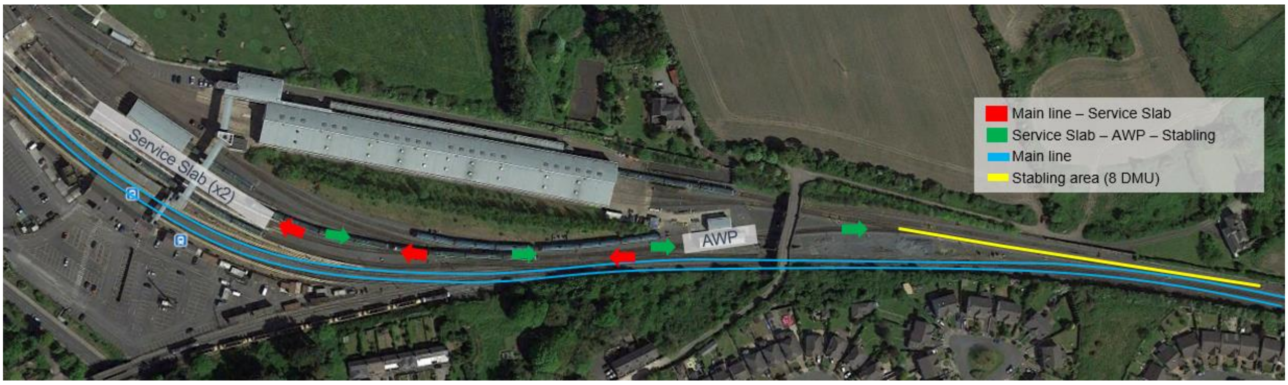


Figure 98: Main Line – Service Slab – AWP – Stabling

If once the train has been washed there is not space in the stabling area, which is limited, the train will have to head back through the same track, make a shunting movement and head to the Main line.

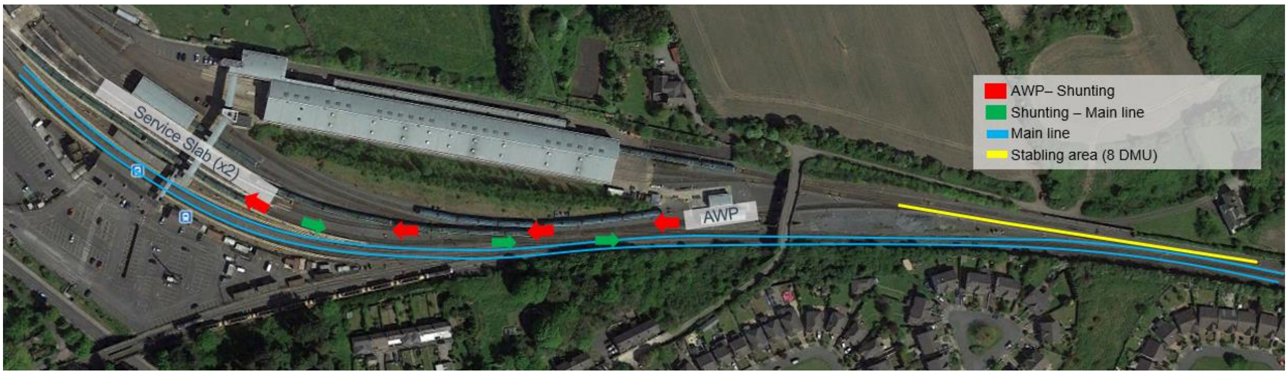


Figure 99: AWP – Shunting – Main line

Times for performing both activities has been calculated, based on the next assumptions:

- Speed in Depot: 8km/h
- Speed for washing: 3 km/h
- Duration of servicing: 20 min

Therefore, and considering the worst case in which there is no space for stabling and the train has to go back to the mainline, times would be:

- Entrance – Service slab: 2.92 min
- Service slab finishes: 22.92 min
- AWP Access: 25.25 min
- AWP finishes: 28.61
- Shunting: 31.46 min
- Mainline: 33.84 min

The whole movement, from the time the train enters the depot to the time it exits, takes 33.84 minutes. After analysing the movements, it seems the time is not the matter, but the track that connects the entrance, AWP and the servicing, as it is continuously occupied by train performing these movements, and there is no bypass track.

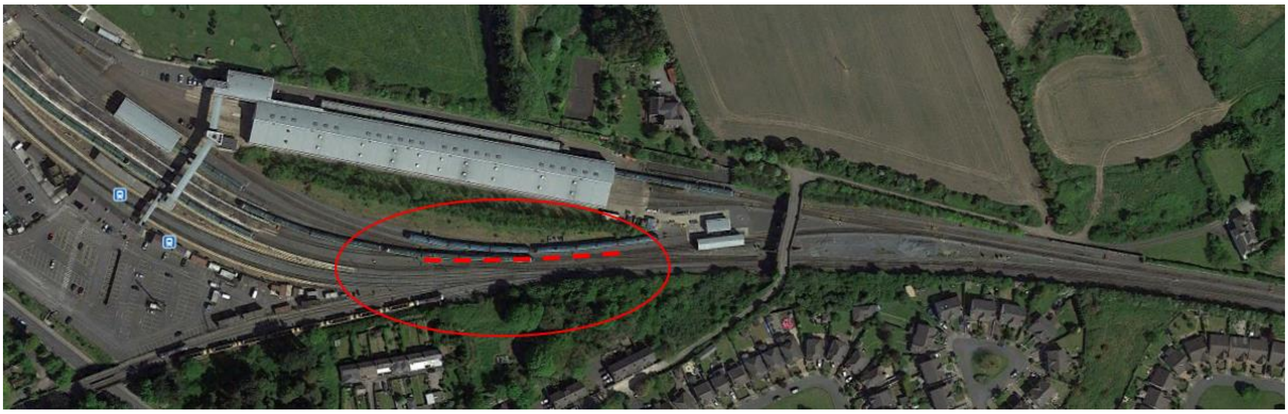


Figure 100: Bottleneck track for Depot Entrance, AWP and Servicing

Therefore, operations inside the depot for performing washing and servicing might be conditioned by this track, which is used for:

- Entrance to the Depot
- Going from the entrance to the Servicing
- Going from the servicing to the AWP
- When the train starts the washing, it is still occupying this track
- For going from the AWP to the shunting track

7.3.1.2 Fairview

The Fairview Depot is for Electric vehicles and it has no Service Slab, there is just the Washing Plant. The connection from mainline with the AWP is direct from the Mainline.

Once the washing has been performed, it can directly head to the mainline and afterwards to the stabling area at the other side of the mainline. West of the AWP, there is a bypass track that eases movements. It has enough length for a 8EMU train to stay there after washing without interfering with trains coming from washing and going to the Mainline.

Figure 101: Mainline – AWP – Stabling or Mainline

Assumptions for calculating times have been the same as in the case before:

- Speed in Depot: 8km/h
- Speed for washing: 3 km/h

Therefore, the time for washing and exiting the Depot would be:

- Entrance – AWP Access: 3.03 min
- AWP finishes: 6.39 min
- AWP-Mainline: 10.04 min

The whole movement, from the time the train enters the depot to the time it exits, it takes 10.04 minutes, and no bottleneck movements are envisaged in this operation.

8 Dimensioning of facilities

In order to size the building, the uses being considered are listed below:

GROUND FLOOR
ADMINISTRATION AREA
Main entrance / Lobby / Information + control
Maintenance offices
Depot Control Centre (DCC)
Training room
Toilets
Canteen
Dedicated break room
First aid
Toilets
Toilets, lockers and showers
- CME staff
- TSSSA staff
- Vehicle warranty
- Vehicle manufacturer staff
- Other contractors
Ancillary workshops
- Mechanical
- Parts cleaning booth
- Electromechanical
- Electrical and electronic
- Battery loading
- Painting and polyester
- Common for all IR teams
- Warranty team
- TSSSA team members
- Bogie wash
Installations
Office
- Diesel room
- Low & Medium voltage
Storage
- General Storage (double height)
- Lubricant / oil storage
- Paint storage
- Waste collection room
- Tool hand out point
Toilets
MAINTENANCE SHED (two ends)
LM (4 roads)
HM (2 roads + bogie track)
UFWL (1 road)
Forklift parking + charging area
DEEP CLEANING (two ends)
DC + Bodywork area
Cleaning storage
Office
Toilet
DRIVERS & CLEANERS AREA
Drivers offices (+ Union rooms?)
Cleaners offices (+ Union rooms)
Toilets, lockers and showers
- Mainline drivers
- Cleaning contractors
Cleaning storage
Installations

FIRST FLOOR
ADMINISTRATION AREA
Depot management
Support staff (+ union rooms?)
Dedicate break room
Toilets
INSTALLATIONS
HVAC area
Air compressor room
Sanitary hot water

Although in general the choice of **Alternative 3** maintains geometries and dimensions, compared to previous layouts, the drivers and cleaners' area is modified to adapt to the new configuration. It is proposed that this facility be located inside the main building volume but facing the Stabling.

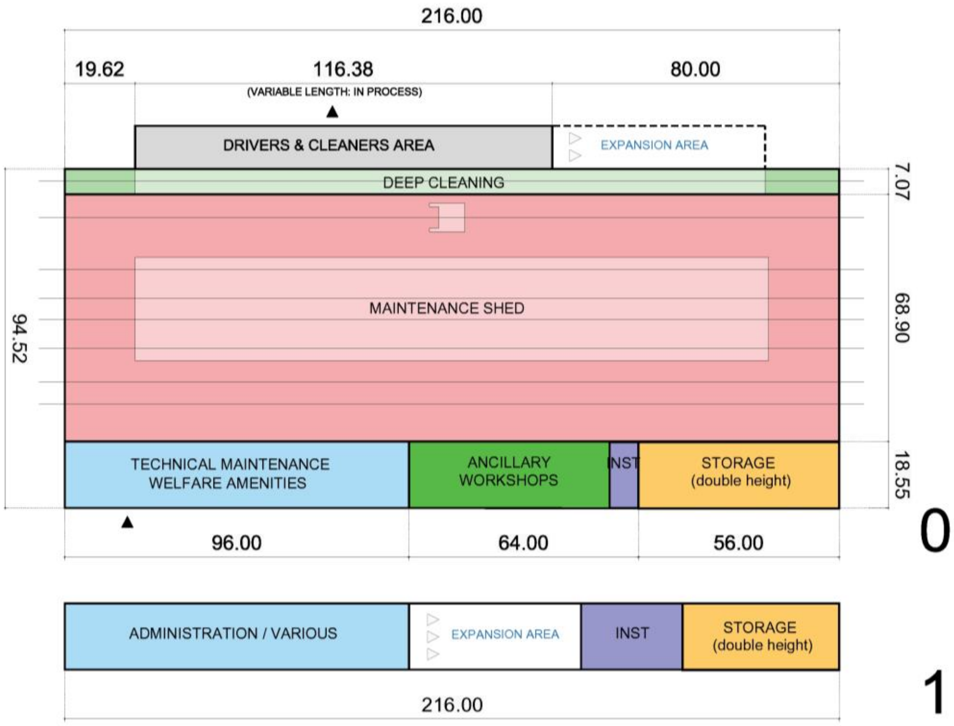


Figure 102. Main dimensions of the main building

In this way the workers will have direct access to the depots, facilitating also the management and displacement of equipment. In order to access this area without causing functional and safety conflicts, we propose that it be done through an **underpass** that would run under the main workshop. This underpass would be placed next to the revision pit (not below), in order to keep it as shallow as possible.

It would also be possible to cross the workshop aerially via a walkway, but we advise against this because of the complications it would entail: great height, interference with equipment (OHLE, crane beams, etc.) and installations (sprinklers, HVAC ducts, lighting, etc.) and the necessary fire protection.

Figure 103. Underground access to the operation area

With respect to previous layouts, the current advance includes several modifications:

- While the uses are maintained, the administration layout has been reversed (left-right) so that the main entrance is located near the employee parking lot and thus avoid long access routes.
- Segregate the driver and contractor cleaner's area and move it to the rear facade, next to the stabling (above-mentioned).

  Below is a cross section where it is identified in blue the tunnel through under the Shop that would communicate the access area of the Main Building, with the drivers and cleaners' area.

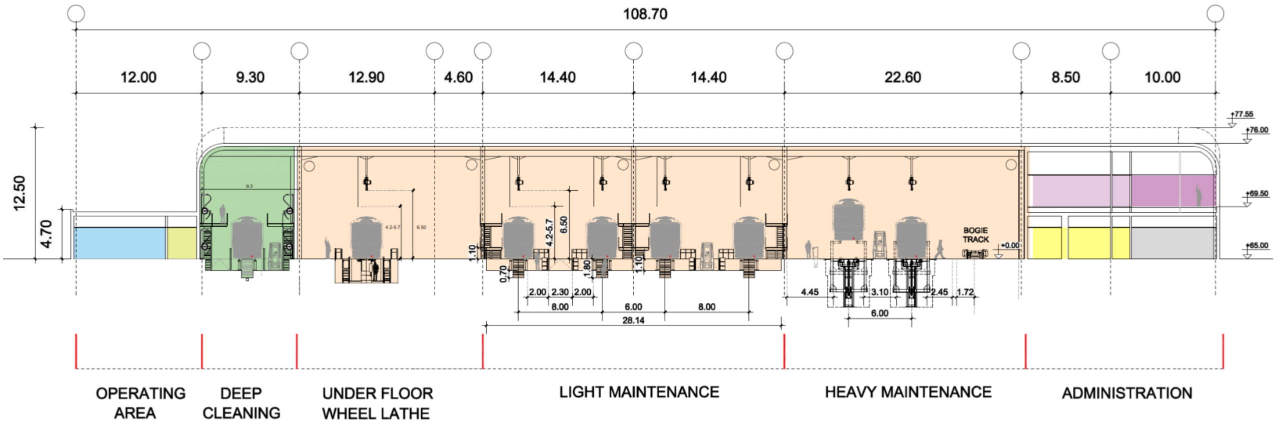


Figure 104. Main Building cross section

- The fact that the **drivers and cleaners**' program is not in the administrative module, makes it possible to locate the Training room, the maintenance offices and the control room (DCC) on the ground floor.
- Following IR guidelines, the installation rooms have been moved up to the first floor. In this way the **Ancillary workshops** will have access both from the Shop itself and from the outside of the building. Only the heaviest installations or those that require registration from the outside (electricity company access) will be maintained on the ground floor.

  In addition, Ancillary workshops area has been increased in order to include space for Warranty team and TSSA team members.

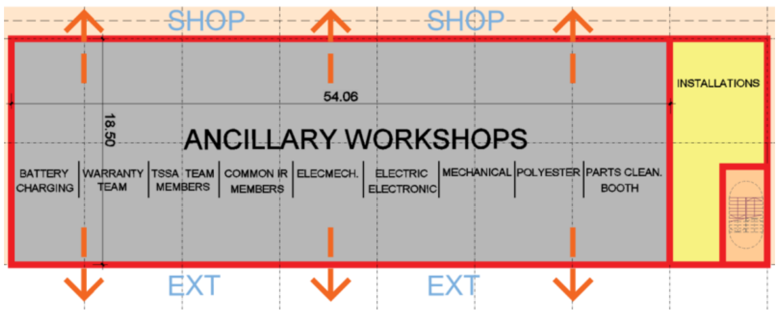


Figure 105. Ancillary workshops area

- The **changing rooms'** area has been increased to accommodate new worker profiles: TSSA, Vehicles Manufacturer Staff and Warranty team (sizing in process).
- The size of the **Waste Collection** room for the Main Building has been increased (approx. 105 m2). The definitive area will be established on the basis of the information about Waste streams received from IR (currently in process).

For reasons of proximity and cleanliness, we recommend a waste collection room within the Main Building, independent or complementary to another one that may exist in the yard.

As shown in figure 32, it would be helpful if there were more than one waste collection point distributed throughout along the stabling, thus avoiding long displacements to the cleaning teams

- **LM** has been readjusted to 4-roads.
- As suggested about Stoke Gifford Depot, it is implemented a **crane beam** that runs along centre line of vehicle and the **OHLE** is off set. Coverage in the rest of roads is pending to determine.

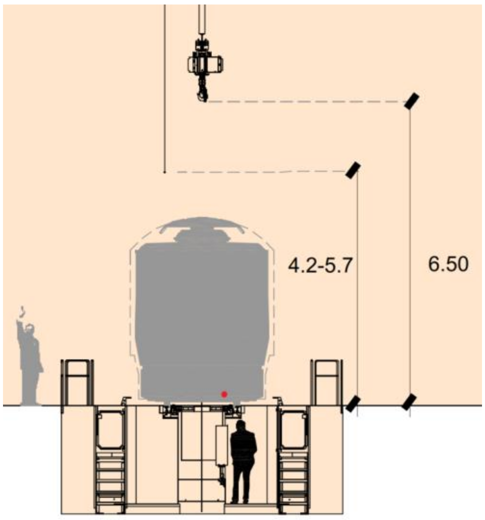


Figure 106. Crane beam & OHLE disposition

- The **Deep Cleaning** has been redesigned according to the basic criteria received from IR: pit of the same train length, fixed gantries with steps access, and also additional width for forklift access throughout.

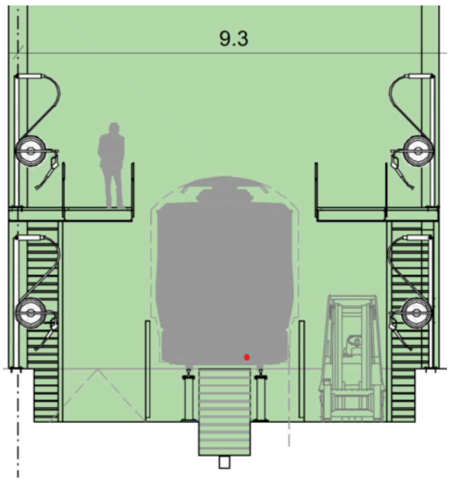


Figure 107. Deep Cleaning arrangement

- Inflatable doors will be considered in wheel lathe and in deep cleaning in order to minimise heat loss.

Below is a more detailed dimensional advance of the **Main Building layout**, incorporating the mentioned technical requirements and functional feedback.

Note: In the absence of additional specification on substantive issues such as Human Factors, Lean Process, bogie strategy, etc., the dimensions and surfaces are provisional, and subject to a process of continuous improvement.

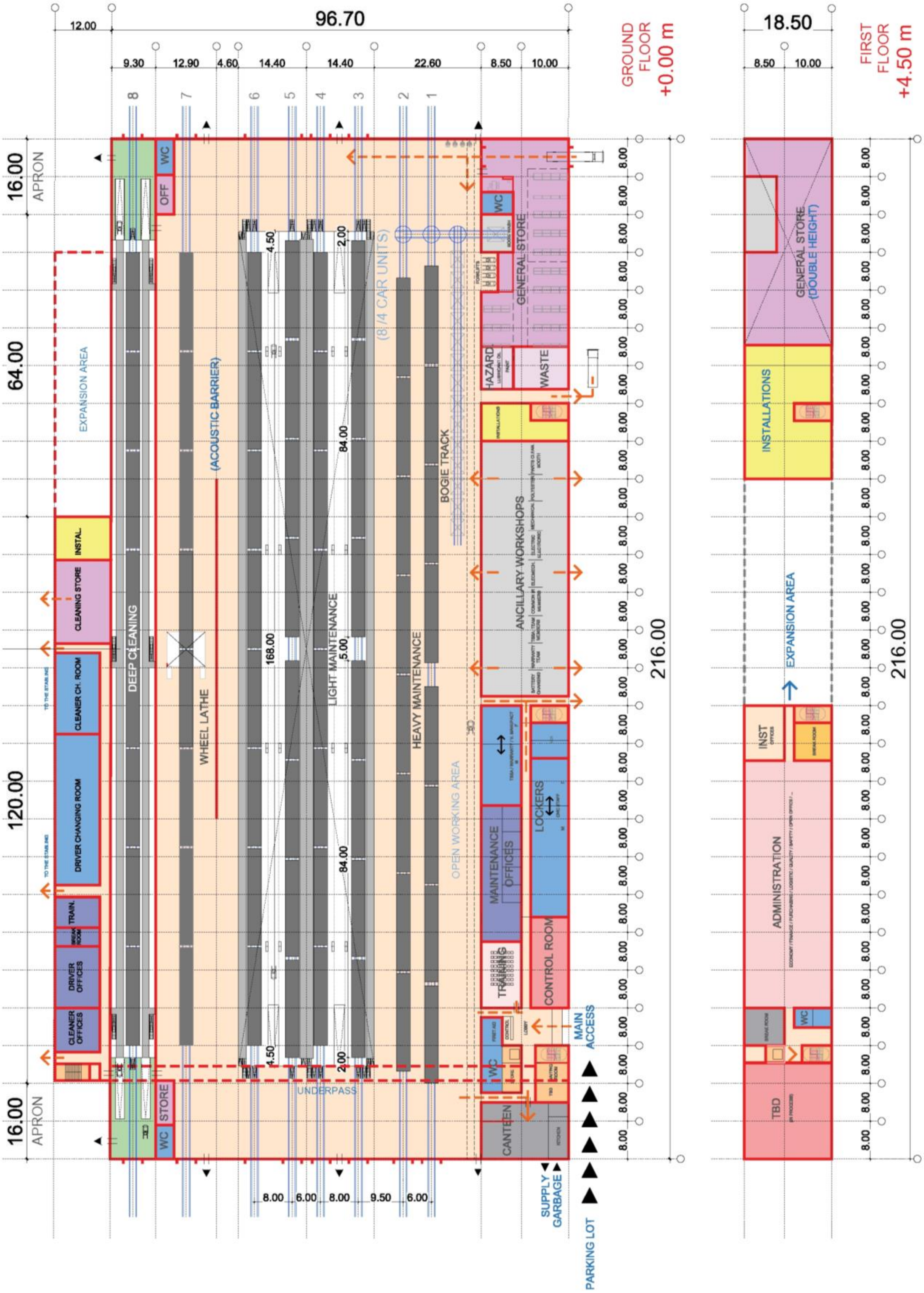


Figure 108. Main Building layout

9 Depot Multicriteria Analysis

The MCA main goal is to compare some key parameters for each alternative and to highlight the emerging preferred one. The MCA methodology is informed by Department of Transport Tourism and Sport (DTTAS), Common Appraisal Framework for Transport Project and Programmes March 2016 guidance document.

9.1 Overview of Assessment Approach

The assessment undertaken is of a comparative nature (options compared against each other). This is based on the Common Appraisal Framework (CAF) criteria and based on professional judgement in respect of the items to be qualitatively evaluated, and comprehensively assessed against the key relevant criteria in accordance with good industry practice.

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

The criteria list includes 6 main parameters (groups of criteria) from the Common Appraisal Framework (CAF). A number of criteria were developed under each of the six CAF parameters, informed by CAF/MCA guidance and the unique characteristics of the project. Sub-criteria for the quantitative and qualitative statements have been adapted relevant to the analysis.

Table 8. Parameters and criteria

Parameter	Criteria	Sub-Criteria
Economy	Construction cost	Assessment of cost of earthworks
	Construction cost and Long term Maintenance Costs	Assessment of cost of tracks
	Construction cost	Overhead power line conflicts. Assess impacts on existing utilities. Length and Number of poles within the plot
	Construction cost	Bridge new OBG24. Length of the bridge over the plot
	Traffic Functionality /economic benefit	Train flows mainline-Stabling connectivity.
	Traffic Functionality /economic benefit	Train flows Main line-AWP/Service slab-Stabling connectivity.
	Traffic Functionality /economic benefit	Train flows Stabling-AWP/Service slab connectivity.
	Traffic Functionality /economic benefit	Train flows Main line-Workshop
	Traffic Functionality /economic benefit	Train flows Stabling-Workshop connectivity.
	Traffic Functionality /economic benefit	Train flows Workshop-Test track connectivity.
	Traffic Functionality /economic benefit	Train flows AWP/Service slab connectivity.
Integration	Adaptability in the future	Considering adaptability potential for link more stabling tracks
	Adaptability in the future	Considering adaptability potential for link future facilities
	Land Use Integration	Impact on land use strategies and regional and local plans. Assessment of support for land use factors local land use and planning. Inclusion of project in relevant local and regional planning documents.

Parameter	Criteria	Sub-Criteria
	Geographical Integration	Impact on improvement of external links. Overall electrification scheme would be highly positive.
	Other Government Policy	Integration with Government Policy, Smarter Travel, Investment Programmes, rail safety, electrification etc
Environment	Noise and Vibration	Estimated number of people likely to be affected by transport
	Air Quality and Climate	Local air quality effects. Number of receptors within 50m.
	Landscape and Visual (including light)	Key landscape characteristics affected; Effects on listed/ key views; Impact on landscape character.
	Biodiversity (flora and fauna)	Potential compliance/conflict with biodiversity objectives; Indirect impacts on protected species, designated sites; Overall effect on nature conservation resource.
	Cultural, Archaeological and Architectural Heritage	Overall effect on cultural, archaeological and architecture heritage resource. Likely effects on RPS, National Monuments, SMRs, Conservation areas, etc. Number of designated sites/structures (by level of designation) directly impacted by scheme (landtake)
	Water Resources	Overall potential significant effects on water resource attributes likely to be affected during construction and operation.
	Agriculture and Non-Agricultural	Overall impact on land take & property. Number of properties to be impacted/acquired. Likely temporary or permanent severance effects, etc.
	Land occupation	Area needed for new railway infrastructure. Maximum length.
	Geology and Soils (including Waste)	Soils and Geology and likely impact on geological resources based on preliminary/likely construction details. Soil resources to be developed/removed. Existing information relating to potential to encounter contaminated land. High-level assessment based on the likely structures/ works required and the potential for ground contamination due to historic landfills, pits and quarries.
	Radiation and Stray Current	Overall likely impact on existing sources of electromagnetic radiation.
Accessibility & Social inclusion	Impact on the local residents	Proximity to residential areas
	Social Inclusion	Accessibility to employment
Safety	Security	Remote stabling yard are more vulnerable against vandalism
	Ease of supervision. Staff flows	Distance between workshop and service slab
	Ease of supervision. Staff flows	Distance and level crossings between workshop and stabling.
	Road flows	Assess road and level crossings with tracks

Parameter	Criteria	Sub-Criteria
Physical Activity	Connectivity to adjoining cycling facilities	Provision of cycle track or / and connectivity to adjoining cycling facilities.
	Permeability and local connectivity opportunity	Analysis of the connectivity to green areas/key attractions related to active mode

There are some common features that all the alternatives consider in the same way as:

- Redundancy and flexibility of access to main facilities.
- Main line connections and rail access.
- Road network connections and road access.
- Two ended tracks within workshop area

A comparative assessment is undertaken for each option, where in general, for each positively scored option there must be an opposing negatively scored option. For illustrative purposes, this five-point scale is colour coded as presented in Table 8 with advantageous options graded to 'dark green' and disadvantaged routes graded to 'dark brown'.

Table 9. Evaluation scale

Significant comparative advantage over other alternatives
Some comparative advantage over other alternatives
Comparable to other alternatives
Some comparative disadvantage over other alternatives
Significant comparative disadvantage over other alternatives

For each individual assessment the parameter and associated criteria and sub criteria were considered and options were compared against each other based on the five-point comparative scale, ranging from having 'significant advantages over other options' to having 'significant comparative disadvantages over other options.' Options that are comparable were assigned 'comparable across all other options'. Options were compared under each criteria, before those criteria are aggregated to give a summary score for each parameter. These scores were then compared to establish the relative ranking of the options.

9.2 Description of alternatives

This section shows a summary of the six alternatives studied and described in the previous documents MAY-MDC-GEN-DEPM-RP-Y-0002 and 0003, that are going to be analysed using a Multi-Criteria analysis. The proposed location is in the West of Maynooth in a broadly agricultural setting in rural areas outside the zoned boundaries of Maynooth and Kilcock, it runs parallel to the main line and on the other side of the Royal Canal.

Figure 109: Proposed location

The alternatives consist of different layouts of the tracks and facilities according to the assumed depot requirements, the following figures shown these alternatives that have been depicted in previous report:

Alternative 1:

- Stabling (one-ended tracks) and Main building are parallel in the West.
- Area: 328.947 m2
- Length along main line: 2,25 km
- Earthworks: 6.884 m3 cut / 387.989 m3 fill
- Tracks length: 16,6 km
- Turnouts: 62 units
- Carriageways + parking area: 34.718 m2

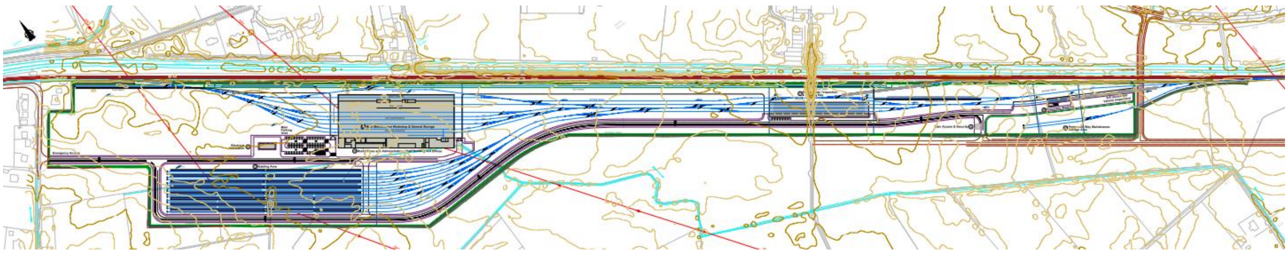


Figure 110: Alternative 1

Alternative 2:

- Stabling (one-ended tracks) in the West and Main building in the East.
- Area: 330.939 m2
- Length along main line: 2,25 km
- Earthworks: 1.729 m3 cut / 367.403 m3 fill

- Tracks length: 18,1 km
- Turnouts: 64 units
- Carriageways + parking area: 42.291 m2

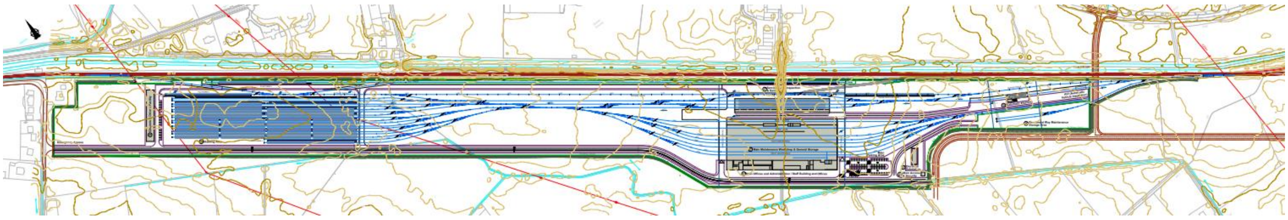


Figure 111: Alternative 2

Alternative 3:

- Stabling (two-ended tracks) and Main building are adjacent in the central area.
- Area: 326.389 m2
- Length along main line: 2,58 km
- Earthworks: 608 m3 cut / 587.518 m3 fill
- Tracks length: 18,7 km
- Turnouts: 76 units
- Carriageways + parking area: 33.686 m2

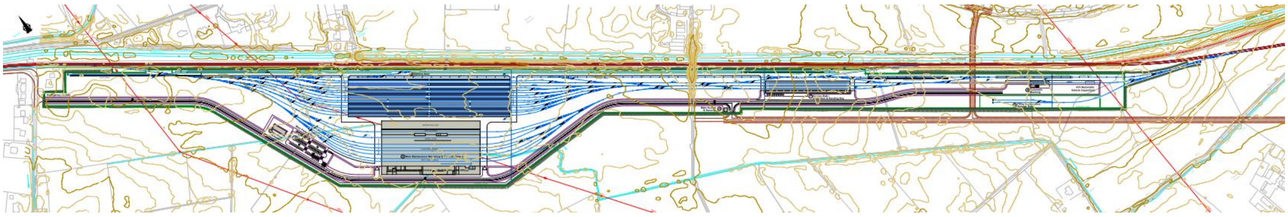


Figure 112: Alternative 3

Alternative 4:

- Stabling (one-ended tracks) in the West and Main building in the central area.
- Area: 316.704 m2
- Length along main line: 2,58 km
- Earthworks: 17.995 m3 cut / 446.659 m3 fill
- Tracks length: 17,0 km
- Turnouts: 63 units
- Carriageways + parking area: 32.257 m2

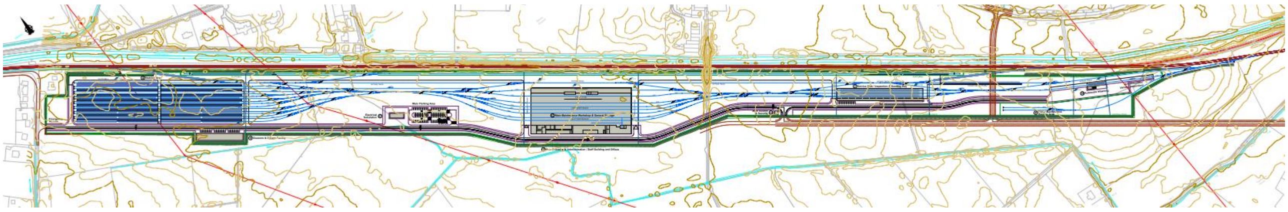


Figure 113: Alternative 4

Alternative 5:

- Stabling (two-ended tracks) and Main building are adjacent in the central area, avoiding as much as possible electrical power lines clash.
- Area: 309.829 m2
- Length along main line: 2,58 km
- Earthworks: 277 m3 cut / 624.746 m3 fill
- Tracks length: 17,4 km
- Turnouts: 64 units
- Carriageways + parking area: 33.887 m2

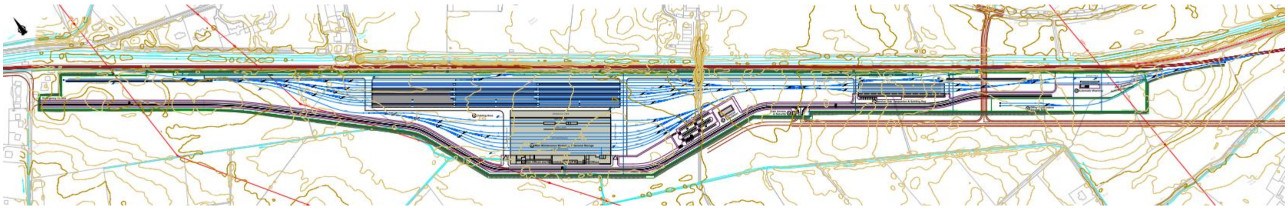


Figure 114: Alternative 5

Alternative 6:

- Stabling (one-ended tracks) and Main building are parallel in the West and reception area has been included close to the entrance.
- Area: 368.769 m2
- Length along main line: 2,58 km
- Earthworks: 6.637 m3 cut / 495.144 m3 fill
- Tracks length: 17,6 km
- Turnouts: 64 units
- Carriageways + parking area: 41.026 m2

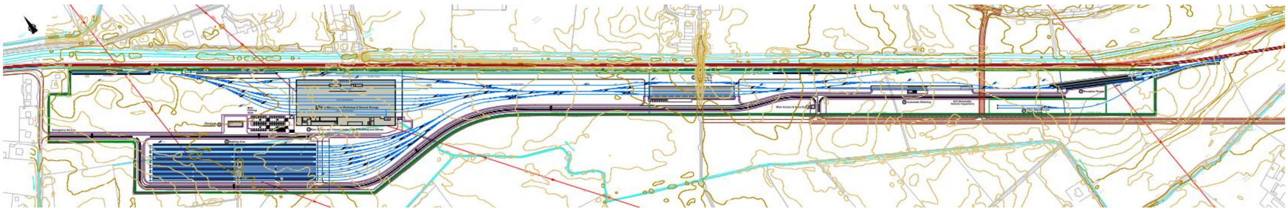


Figure 115: Alternative 6

9.3 Multicriteria Analysis

The following table includes all the parameters with their criteria for all alternatives:

DART Maynooth & City Centre Enhancements. MCA Criteria and parameters									
Depot Alternatives Assessment									
Nº	Parameter	Criteria	Sub-Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
1	Economy	Construction cost	Assessment of cost of earthworks	**Some comparative advantage over other options** Construction cost impact are lower. Cut 6.884 m3 Fill 387.989 m3	**Some comparative advantage over other options** Construction cost impact are lower. Cut 1.729 m3 Fill 367.403 m3	**Some comparative disadvantage over other options** Construction cost impact are higher. Cut 608 m3 Fill 587.518 m3	**Some comparative disadvantage over other options** Construction cost impact are higher. Cut 17.995 m3 Fill 446.659 m3	**Some comparative disadvantage over other options** Construction cost impact are higher. Cut 277 m3 Fill 624.746 m3	**Some comparative disadvantage over other options** Construction cost impact are higher. Cut 6.637 m3 Fill 495.144 m3
		Construction cost and Long term Maintenance Costs	Assessment of cost of tracks	**Some comparative advantage over other options** Track length 16,6 km Turnouts 62 units	**Some comparative disadvantage over other options** Track length 18,1 km Turnouts 64 units	**Some comparative disadvantage over other options** Track length 18,7 km Turnouts 76 units	**Some comparative advantage over other options** Track length 17 km Turnouts 63 units	**Some comparative advantage over other options** Track length 17,4 km Turnouts 64 units	**Some comparative advantage over other options** Track length 17,6 km Turnouts 64 units
		Construction cost	Overhead power line conflicts. Assess impacts on existing utilities. Length and Number of poles within the plot	**Significant comparative disadvantage over other options** 2 Overhead lines 38 KV above stabling and workshop. Diversion is required. 38 KV Length: 475 m + 428 m = 903 m 38 Kv poles: 8	**Some comparative disadvantage over other options** 1 Overhead line 38 KV above stabling. Diversion is required. 38 KV Length: 186 m + 371 m = 557 m 38 Kv poles: 6	**Some comparative disadvantage over other options** 1 Overhead line 38 KV above stabling and workshop. Diversion is required. 1 Overhead line 220 KV close to AVI facility. 220 kv length: 115 38 KV Length: 102 m + 610 m = 712 38 Kv poles: 6	**Significant comparative disadvantage over other options** 2 Overhead line 38 KV above stabling. Diversion is required. **1 Overhead line 220 KV close to AVI facility.** **220 kv length: 100** **38 KV Length: 175 m + 330 m= 505 m** **38 Kv poles: 5**	**Some comparative advantage over other options** 1 overhead line 38 KV above tracks and roads. 1 Overhead line 220 KV close to AVI facility. 220 kv length: 88 38 KV Length: 102 m + 270 m = 372 m 38 Kv poles: 4	**Significant comparative disadvantage over other options** 2 Overhead lines 38 KV above stabling and workshop. Diversion is required. 1 Overhead line 220 KV close to AVI facility. 220 kv length: 95 m 38 KV Length: 475 m + 428 m = 903 m 38 Kv poles: 8
		Construction cost	Bridge new OBG24. Length of the bridge over the plot	**Some comparative advantage over other options** 46 m	**Some comparative advantage over other options** 45 m	**Some comparative disadvantage over other options** 75 m	**Significant comparative disadvantage over other options** 94 m	**Some comparative disadvantage over other options** 84 m	**Significant comparative disadvantage over other options** 94 m
		Traffic Functionality /economic benefit	Train flows mainline-Stabling connectivity.	**Some comparative disadvantage over other options** Direct access up to the stabling from the 2 eastern connections to the mainline. Access from the western connection need a reversing in the shunting track.	**Some comparative disadvantage over other options** Direct access up to the stabling from the 2 eastern connections to the mainline. Access from the western connection need a reversing in the shunting track.	**Significant comparative advantage over other options** Direct access up to the stabling from the 3 connections to the mainline.	**Some comparative disadvantage over other options** Direct access up to the stabling from the 2 eastern connections to the mainline. Access from the western connection need a reversing in the shunting track.	**Some comparative disadvantage over other options** Direct access up to the stabling from the 3 connections to the mainline. Fleet berthed 3 in a row to reduce the width of the stabling area.	**Some comparative disadvantage over other options** Direct access up to the stabling from the 2 eastern connections to the mainline. Access from the western connection need a reversing in the shunting track.
		Traffic Functionality /economic benefit	Train flows Main line-AWP/Service slab-Stabling connectivity.	**Comparable to other options** Direct access from the primary connection to the mainline to the AWP and subsequently to the stabling. Access from the central connection to the AWP needs a reversing in the western shunting track. Access from the western connection to the AWP is direct by the through track.	**Comparable to other options** Direct access from the primary connection to the mainline to the AWP and subsequently to the stabling. Access from the central connection to the AWP needs a reversing in the western shunting track. Access from the western connection to the AWP is direct by the through track.	**Comparable to other options** Direct access from the primary connection to the mainline to the AWP and subsequently to the stabling. Access from the central connection to the AWP needs a reversing in the western shunting track. Access from the western connection to the AWP is direct by the through track.	**Comparable to other options** Direct access from the primary connection to the mainline to the AWP and subsequently to the stabling. Access from the central connection to the AWP needs a reversing in the western shunting track. Access from the western connection to the AWP is direct by the through track.	**Comparable to other options** Direct access from the primary connection to the mainline to the AWP and subsequently to the stabling. Access from the central connection to the AWP needs a reversing in the western shunting track. Access from the western connection to the AWP is direct by the through track.	**Comparable to other options** Direct access from the primary connection to the mainline to the AWP and subsequently to the stabling. Access from the central connection to the AWP needs a reversing in the western shunting track. Access from the western connection to the AWP is direct by the through track.
		Traffic Functionality /economic benefit	Train flows Stabling-AWP/Service slab connectivity.	**Some comparative advantage over other options** Direct access from stabling to AWP.	**Some comparative advantage over other options** Direct access from stabling to AWP.	**Some comparative advantage over other options** Direct access from stabling to AWP.	**Some comparative disadvantage over other options** Direct access from stabling to AWP. Facilities are more distant.	**Some comparative disadvantage over other options** Direct access from stabling to AWP. Facilities are more distant.	**Some comparative advantage over other options** Direct access from stabling to AWP.
		Traffic Functionality /economic benefit	Train flows Main line-Workshop	**Some comparative advantage over other options** Direct access from the three connections to the mainline up to the workshop.	**Some comparative disadvantage over other options** Direct access from the eastern and western connections to the mainline up to the workshop. Access from the central connection to the AWP needs a reversing in the western shunting track.	**Some comparative advantage over other options** Direct access from the three connections to the mainline up to the workshop.	**Some comparative advantage over other options** Direct access from the three connections to the mainline up to the workshop.	**Some comparative advantage over other options** Direct access from the three connections to the mainline up to the workshop.	**Some comparative advantage over other options** Direct access from the three connections to the mainline up to the workshop.
		Traffic Functionality /economic benefit	Train flows Stabling-Workshop connectivity.	**Some comparative disadvantage over other options** Access from stabling to workshop needs a reversing in the eastern shunting track.	**Some comparative advantage over other options** Direct access from stabling to workshop.	**Some comparative disadvantage over other options** Access from stabling to workshop needs a reversing in the eastern shunting track.	**Some comparative advantage over other options** Direct access from stabling to workshop.	**Some comparative disadvantage over other options** Access from the main stabling to workshop needs a reversing in the eastern shunting track.	**Some comparative disadvantage over other options** Access from stabling to workshop needs a reversing in the eastern shunting track.
		Traffic Functionality /economic benefit	Train flows Workshop-Test track connectivity.	**Some comparative advantage over other options** Access from workshop to test track needs a reversing in the western shunting track.	**Some comparative disadvantage over other options** Access from workshop to test track needs a reversing in the western shunting track. Facilities are more distant.	**Some comparative advantage over other options** Access from workshop to test track needs a reversing in the western shunting track.	**Some comparative disadvantage over other options** Access from workshop to test track needs a reversing in the western shunting track. Facilities are more distant.	**Some comparative advantage over other options** Access from workshop to test track needs a reversing in the western shunting track.	**Some comparative advantage over other options** Access from workshop to test track needs a reversing in the western shunting track.
		Traffic Functionality /economic benefit	Train flows AWP/Service slab connectivity.	**Some comparative disadvantage over other options** During the washing process the access to the tracks of the service slab is blocked, so trains should go through by-pass up to the stabling.	**Some comparative disadvantage over other options** During the washing process the access to the tracks of the service slab is blocked, so trains should go through by-pass up to the stabling.	**Some comparative advantage over other options** During the washing process the access to the track of the service slab is available.	**Some comparative disadvantage over other options** During the washing process the access to the tracks of the service slab is blocked, so trains should go through by-pass up to the stabling.	**Some comparative disadvantage over other options** During the washing process the access to the tracks of the service slab is blocked, so trains should go through by-pass up to the stabling.	**Some comparative disadvantage over other options** During the washing process the access to the tracks of the service slab is blocked, so trains should go through by-pass up to the stabling.

DART Maynooth & City Centre Enhancements. MCA Criteria and parameters									
Depot Alternatives Assessment									
Nº	**Parameter**	**Criteria**	**Sub-Criteria**	**Alternative 1**	**Alternative 2**	**Alternative 3**	**Alternative 4**	**Alternative 5**	**Alternative 6**
2	**Integration**	Adaptability in the future	Considering adaptability potential for link more stabling tracks	**Some comparative advantage over other options**	**Some comparative disadvantage over other options**	**Some comparative disadvantage over other options**	**Some comparative disadvantage over other options**	**Some comparative disadvantage over other options**	**Some comparative advantage over other options**
				Single ended stabling tracks could be extended to the West.	Stabling tracks should be added separated from the main stabling area.	Stabling tracks should be added separated from the main stabling area.	Stabling tracks should be added separated from the main stabling area.	Stabling tracks should be added separated from the main stabling area.	Single ended stabling tracks could be extended to the West.
		Adaptability in the future	Considering adaptability potential for link future facilities	**Some comparative disadvantage over other options**	**Some comparative disadvantage over other options**	**Some comparative advantage over other options**	**Some comparative advantage over other options**	**Some comparative advantage over other options**	**Some comparative advantage over other options**
				Short stretches in the lead tracks to link new facilities.	Short stretches in the lead tracks to link new facilities.	Longer stretches in the lead tracks to link new facilities.	Longer stretches in the lead tracks to link new facilities.	Longer stretches in the lead tracks to link new facilities.	Longer stretches in the lead tracks to link new facilities.
		Land Use Integration	Impact on land use strategies and regional and local plans. Assessment of support for land use factors local land use and planning. Inclusion of project in relevant local and regional planning documents.	**Comparable to other options**	**Comparable to other options**	**Comparable to other options**	**Comparable to other options**	**Comparable to other options**	**Comparable to other options**
				The Depot location is located on unzoned greenfield lands between the settlements of Kilcok and Maynooth. At a local level the option is consistent with the Kildare CDP 2017-2023 with, objective PTO 3 *'Support of the NTAs Greater Dublin Area Transport Strategy (2016-2035)'* and PTO 7: *'Promote and support the upgrading of the Maynooth rail line & the Kildare rail way, in accordance with Transport Strategy for the Great Dublin Area 2016-2035'*	The Depot location is located on unzoned greenfield lands between the settlements of Kilcok and Maynooth. At a local level the option is consistent with the Kildare CDP 2017-2023 with, objective PTO 3 *'Support of the NTAs Greater Dublin Area Transport Strategy (2016-2035)'* and PTO 7: *'Promote and support the upgrading of the Maynooth rail line & the Kildare rail way, in accordance with Transport Strategy for the Great Dublin Area 2016-2035'*	The Depot location is located on unzoned greenfield lands between the settlements of Kilcok and Maynooth. At a local level the option is consistent with the Kildare CDP 2017-2023 with, objective PTO 3 *'Support of the NTAs Greater Dublin Area Transport Strategy (2016-2035)'* and PTO 7: *'Promote and support the upgrading of the Maynooth rail line & the Kildare rail way, in accordance with Transport Strategy for the Great Dublin Area 2016-2035'*	The Depot location is located on unzoned greenfield lands between the settlements of Kilcok and Maynooth. At a local level the option is consistent with the Kildare CDP 2017-2023 with, objective PTO 3 *'Support of the NTAs Greater Dublin Area Transport Strategy (2016-2035)'* and PTO 7: *'Promote and support the upgrading of the Maynooth rail line & the Kildare rail way, in accordance with Transport Strategy for the Great Dublin Area 2016-2035'*	The Depot location is located on unzoned greenfield lands between the settlements of Kilcok and Maynooth. At a local level the option is consistent with the Kildare CDP 2017-2023 with, objective PTO 3 *'Support of the NTAs Greater Dublin Area Transport Strategy (2016-2035)'* and PTO 7: *'Promote and support the upgrading of the Maynooth rail line & the Kildare rail way, in accordance with Transport Strategy for the Great Dublin Area 2016-2035'*	The Depot location is located on unzoned greenfield lands between the settlements of Kilcok and Maynooth. At a local level the option is consistent with the Kildare CDP 2017-2023 with, objective PTO 3 *'Support of the NTAs Greater Dublin Area Transport Strategy (2016-2035)'* and PTO 7: *'Promote and support the upgrading of the Maynooth rail line & the Kildare rail way, in accordance with Transport Strategy for the Great Dublin Area 2016-2035'*
		Geographical Integration	Impact on improvement of external links. Overall electrification scheme would be highly positive.	**Comparable to other options**	**Comparable to other options**	**Comparable to other options**	**Comparable to other options**	**Comparable to other options**	**Comparable to other options**
				Comparable across all options	Comparable across all options	Comparable across all options	Comparable across all options	Comparable across all options	Comparable across all options
		Other Government Policy	Integration with Government Policy, Smarter Travel, Investment Programmes, rail safety, electrification etc	**Comparable to other options**	**Comparable to other options**	**Comparable to other options**	**Comparable to other options**	**Comparable to other options**	**Comparable to other options**
				Comparable across all options	Comparable across all options	Comparable across all options	Comparable across all options	Comparable across all options	Comparable across all options

DART Maynooth & City Centre Enhancements. MCA Criteria and parameters									
Depot Alternatives Assessment									
Nº	Parameter	Criteria	Sub-Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
3	**Environment**	Noise and Vibration	Estimated number of people likely to be affected by transport	**Comparable to other options** Options provide comparabile impacts on noise and vibration.	**Comparable to other options** Options provide comparabile impacts on noise and vibration.	**Comparable to other options** Options provide comparabile impacts on noise and vibration.	**Comparable to other options** Options provide comparabile impacts on noise and vibration.	**Comparable to other options** Options provide comparabile impacts on noise and vibration.	**Comparable to other options** Options provide comparabile impacts on noise and vibration.
		Air Quality and Climate	Local air quality effects. Number of receptors within 50m.	**Comparable to other options** Options provide comparable impacts on air and climate.	**Comparable to other options** Options provide comparable impacts on air and climate.	**Comparable to other options** Options provide comparable impacts on air and climate.	**Comparable to other options** Options provide comparable impacts on air and climate.	**Comparable to other options** Options provide comparable impacts on air and climate.	**Comparable to other options** Options provide comparable impacts on air and climate.
		Landscape and Visual (including light)	Key landscape characteristics affected; Effects on listed/ key views; Impact on landscape character.	**Comparable to other options** All Options are likely to have signficant **negative impact on landscape and visual amenity of the Royal Canal defined as an Area of High Amenity in the Kildare CDP.** The Kildare CDP has identified a number of Scenic Viewpoints along the Canal at this Location that are likely to be affected by the construction of proposed Depot buildings and new bridge structure (OB24) over the Royal Canal as well as operational impacts of trains parked along the Canal at the stablings which will change the landscape character of this area significnatly. The proposed development is does not support policies and objectives of the Kildare CDP relating to curtailing develpoment along the Canal and preserving this corridor (WV 1, WV 2 and WV 3).	**Comparable to other options** All Options are likely to have signficant **negative impact on landscape and visual amenity of the Royal Canal defined as an Area of High Amenity in the Kildare CDP.** The Kildare CDP has identified a number of Scenic Viewpoints along the Canal at this Location that are likely to be affected by the construction of proposed Depot buildings and new bridge structure (OB24) over the Royal Canal as well as operational impacts of trains parked along the Canal at the stablings which will change the landscape character of this area significnatly. The proposed development is does not support policies and objectives of the Kildare CDP relating to curtailing develpoment along the Canal and preserving this corridor (WV 1, WV 2 and WV 3).	**Comparable to other options** All Options are likely to have signficant **negative impact on landscape and visual amenity of the Royal Canal defined as an Area of High Amenity in the Kildare CDP.** The Kildare CDP has identified a number of Scenic Viewpoints along the Canal at this Location that are likely to be affected by the construction of proposed Depot buildings and new bridge structure (OB24) over the Royal Canal as well as operational impacts of trains parked along the Canal at the stablings which will change the landscape character of this area significnatly. The proposed development is does not support policies and objectives of the Kildare CDP relating to curtailing develpoment along the Canal and preserving this corridor (WV 1, WV 2 and WV 3).	**Comparable to other options** All Options are likely to have signficant **negative impact on landscape and visual amenity of the Royal Canal defined as an Area of High Amenity in the Kildare CDP.** The Kildare CDP has identified a number of Scenic Viewpoints along the Canal at this Location that are likely to be affected by the construction of proposed Depot buildings and new bridge structure (OB24) over the Royal Canal as well as operational impacts of trains parked along the Canal at the stablings which will change the landscape character of this area significnatly. The proposed development is does not support policies and objectives of the Kildare CDP relating to curtailing develpoment along the Canal and preserving this corridor (WV 1, WV 2 and WV 3).	**Comparable to other options** All Options are likely to have signficant **negative impact on landscape and visual amenity of the Royal Canal defined as an Area of High Amenity in the Kildare CDP.** The Kildare CDP has identified a number of Scenic Viewpoints along the Canal at this Location that are likely to be affected by the construction of proposed Depot buildings and new bridge structure (OB24) over the Royal Canal as well as operational impacts of trains parked along the Canal at the stablings which will change the landscape character of this area significnatly. The proposed development is does not support policies and objectives of the Kildare CDP relating to curtailing develpoment along the Canal and preserving this corridor (WV 1, WV 2 and WV 3).	**Comparable to other options** All Options are likely to have signficant **negative impact on landscape and visual amenity of the Royal Canal defined as an Area of High Amenity in the Kildare CDP.** The Kildare CDP has identified a number of Scenic Viewpoints along the Canal at this Location that are likely to be affected by the construction of proposed Depot buildings and new bridge structure (OB24) over the Royal Canal as well as operational impacts of trains parked along the Canal at the stablings which will change the landscape character of this area significnatly. The proposed development is does not support policies and objectives of the Kildare CDP relating to curtailing develpoment along the Canal and preserving this corridor (WV 1, WV 2 and WV 3).
		Biodiversity (flora and fauna)	Potential compliance/conflict with biodiversity objectives; Indirect impacts on protected species, designated sites; Overall effect on nature conservation resource.	**Comparable to other options** Similar Total Area to other alternatives Slightly less frontage onto the Royal Canal pNHA	**Comparable to other options** Similar Total Area to other alternatives Slightly less frontage onto the Royal Canal pNHA	**Comparable to other options** Similar Total Area to other alternatives Slightly less frontage onto the Royal Canal pNHA	**Comparable to other options** Similar Total Area to other alternatives Slightly less frontage onto the Royal Canal pNHA	**Comparable to other options** Similar Total Area to other alternatives Slightly less frontage onto the Royal Canal pNHA	**Comparable to other options** Similar Total Area to other alternatives Slightly less frontage onto the Royal Canal pNHA
		Cultural, Archaeological and Architectural Heritage	Overall effect on cultural, archaeological and architecture heritage resource. Likely effects on RPS, National Monuments, SMRs, Conservation areas, etc. Number of designated sites/structures (by level of designation) directly impacted by scheme (landtake)	**Comparable to other options** Potential for significant direct negative impacts on two recorded monuments (ring ditch and barrow) along with previously unrecorded archaeological sites. Potential for indirect negative impacts on Chamber's Bridge (RPS)	**Comparable to other options** Potential for significant direct negative impacts on two recorded monuments (ring ditch and barrow) along with previously unrecorded archaeological sites. Potential for indirect negative impacts on Chamber's Bridge (RPS)	**Comparable to other options** Potential for significant direct negative impacts on two recorded monuments (ring ditch and barrow) along with previously unrecorded archaeological sites. Potential for indirect negative impacts on Chamber's Bridge (RPS)	**Comparable to other options** Potential for significant direct negative impacts on two recorded monuments (ring ditch and barrow) along with previously unrecorded archaeological sites. Potential for indirect negative impacts on Chamber's Bridge (RPS)	**Comparable to other options** Potential for significant direct negative impacts on two recorded monuments (ring ditch and barrow) along with previously unrecorded archaeological sites. Potential for indirect negative impacts on Chamber's Bridge (RPS)	**Comparable to other options** Potential for significant direct negative impacts on two recorded monuments (ring ditch and barrow) along with previously unrecorded archaeological sites. Potential for indirect negative impacts on Chamber's Bridge (RPS)
		Water Resources	Overall potential significant effects on water resource attributes likely to be affected during construction and operation.	**Some comparative advantage over other options** culverting of a small watercourse. All options are directly adjacent to the Royal Canal on there northern boundary. The close proximity to the royal canal and the minor watercourse diversion poses risk to water quality during construction and operation phases. OPW flood mapping indicates that the area where the minor watercourse discharges to the Lyreen river is liable to flood. This appears to affect options 1& 2 the least. Majority of proposed option is within "Moderate" groundwater vulnerability and poses a limited threat to groundwater.	**Some comparative advantage over other options** All options will require the diversion of culverting of a small watercourse. All options are directly adjacent to the Royal Canal on there northern boundary. The close proximity to the royal canal and the minor watercourse diversion poses risk to water quality during construction and operation phases. OPW flood mapping indicates that the area where the minor watercourse discharges to the Lyreen river is liable to flood. This appears to affect options 1& 2 the least. Majority of proposed option is within "Moderate" groundwater vulnerability and poses a limited threat to groundwater.	**Some comparative disadvantage over other options** All options will require the diversion of culverting of a small watercourse. All options are directly adjacent to the Royal Canal on there northern boundary. The close proximity to the royal canal and the minor watercourse diversion poses risk to water quality during construction and operation phases. OPW flood mapping indicates that the area where the minor watercourse discharges to the Lyreen river is liable to flood. A portion of option 3 appears to be within the predicted flood extents. Majority of proposed option is within "Moderate" groundwater vulnerability and poses a limited threat to groundwater.	**Some comparative disadvantage over other options** All options will require the diversion of culverting of a small watercourse. All options are directly adjacent to the Royal Canal on there northern boundary. The close proximity to the royal canal and the minor watercourse diversion poses risk to water quality during construction and operation phases. OPW flood mapping indicates that the area where the minor watercourse discharges to the Lyreen river is liable to flood. A portion of option 4 appears to be within the predicted flood extents. Majority of proposed option is within "Moderate" groundwater vulnerability and poses a limited threat to groundwater.	**Some comparative disadvantage over other options** All options will require the diversion of culverting of a small watercourse. All options are directly adjacent to the Royal Canal on there northern boundary. The close proximity to the royal canal and the minor watercourse diversion poses risk to water quality during construction and operation phases. OPW flood mapping indicates that the area where the minor watercourse discharges to the Lyreen river is liable to flood. A portion of option 5 appears to be within the predicted flood extents. Majority of proposed option is within "Moderate" groundwater vulnerability and poses a limited threat to groundwater.	**Some comparative disadvantage over other options** All options will require the diversion of culverting of a small watercourse. All options are directly adjacent to the Royal Canal on there northern boundary. The close proximity to the royal canal and the minor watercourse diversion poses risk to water quality during construction and operation phases. OPW flood mapping indicates that the area where the minor watercourse discharges to the Lyreen river is liable to flood. A portion of option 6 appears to be within the predicted flood extents. Majority of proposed option is within "Moderate" groundwater vulnerability and poses a limited threat to groundwater.
		Agriculture and Non-Agricultural	Overall impact on land take & property. Number of properties to be impacted/acquired. Likely temporary or permanent severance effects, etc.	**Some comparative disadvantage over other options** Alternative 1 will involve land severance on 5 No. holdings with impacts on access on 1 No. farm holding. Apart from landtake which will be compensated it is not likely to impact on agribusiness. Alternative 1 will impact on agricultural lands of good quality with significant landtake and severance impacts on a number of properties.	**Some comparative advantage over other options** Alternative 2 will involve land severance on 5 No. holdings with impacts on access on 1 No. farm holding. Apart from landtake which will be compensated it is not likely to impact on agribusiness. Alternative 2 will impact on agricultural lands of good quality with significant landtake and severance impacts on a number of properties.	**Some comparative disadvantage over other options** Alternative 3 will involve land severance on 4 No. holdings with impacts on access on 1 No. farm holding. Apart from landtake which will be compensated it is not likely to impact on agribusiness. Alternative 3 will impact on agricultural lands of good quality with significant landtake and severance impacts on a number of properties.	**Some comparative advantage over other options** Alternative 4 will involve land severance on 4 No. holdings with impacts on access on 1 No. farm holding. Apart from landtake which will be compensated it is not likely to impact on agribusiness. Alternative 4 will impact on agricultural lands of good quality with significant landtake and severance impacts on a number of properties.	**Some comparative advantage over other options** Alternative 5 will involve land severance on 4 No. holdings with impacts on access on 1 No. farm holding.Apart from landtake which will be compensated it is not likely to impact on agribusiness. Alternative 5 will impact on agricultural lands of good quality with significant landtake and severance impacts on a number of properties.	**Some comparative disadvantage over other options** Alternative 6 will involve land severance on 4 No. holdings with impacts on access on 1 No. farm holding. Apart from landtake which will be compensated it is not likely to impact on agribusiness. Alternative 6 will impact on agricultural lands of good quality with significant landtake and severance impacts on a number of properties.
		Land occupation	Area needed for new railway infrastructure. Maximum length.	**Some comparative disadvantage over other options** Area 32,89 Has Length 2,25 km	**Some comparative disadvantage over other options** Area 33,09 Has Length 2,25 km	**Some comparative advantage over other options** Area 32,63 Has Length 2,58 km	**Some comparative advantage over other options** Area 31,67 Has Length 2,58 km	**Some comparative advantage over other options** Area 30,98 Has Length 2,58 km	**Significant comparative disadvantage over other options** Area 36,87 Length 2,58 m
		Geology and Soils (including Waste)	Soils and Geology and likely impact on geological resources based on preliminary/likely construction details. Soil resources to be developed/removed. Existing information relating to potential to encounter contaminated land. High-level assessment based on the likely structures/ works required and the potential for ground	**Comparable to other options** Potential for impact on soils & geology is mainly related to karstlacustrine or alluvial soils may be present. This would most likely require removal and replacement for construction but the majority of the site appears to be on glacial till, a soil which is generally acceptable for the required construction.	**Comparable to other options** Potential for impact on soils & geology is mainly related to karstlacustrine or alluvial soils may be present. This would most likely require removal and replacement for construction but the majority of the site appears to be on glacial till, a soil which is generally acceptable for the required construction.	**Comparable to other options** Potential for impact on soils & geology is mainly related to karstlacustrine or alluvial soils may be present. This would most likely require removal and replacement for construction but the majority of the site appears to be on glacial till, a soil which is generally acceptable for the required construction.	**Comparable to other options** Potential for impact on soils & geology is mainly related to karstlacustrine or alluvial soils may be present. This would most likely require removal and replacement for construction but the majority of the site appears to be on glacial till, a soil which is generally acceptable for the required construction.	**Comparable to other options** Potential for impact on soils & geology is mainly related to karstlacustrine or alluvial soils may be present. This would most likely require removal and replacement for construction but the majority of the site appears to be on glacial till, a soil which is generally acceptable for the required construction.	**Comparable to other options** Potential for impact on soils & geology is mainly related to karstlacustrine or alluvial soils may be present. This would most likely require removal and replacement for construction but the majority of the site appears to be on glacial till, a soil which is generally acceptable for the required construction.
		Radiation and Stray Current	Overall likely impact on existing sources of electromagnetic radiation.	**Comparable to other options** The main sources of EMI from the proposed development will be the traction supply system , MV ring, HV lines, substation and comms infrastructure. Assuming that routing of the cabling, the location of substations, hubs etc. along the line are not impacted by the selection of any of these options then all options are comparable from an EMI perspective.	**Comparable to other options** The main sources of EMI from the proposed development will be the traction supply system , MV ring, HV lines, substation and comms infrastructure. Assuming that routing of the cabling, the location of substations, hubs etc. along the line are not impacted by the selection of any of these options then all options are comparable from an EMI perspective.	**Comparable to other options** The main sources of EMI from the proposed development will be the traction supply system , MV ring, HV lines, substation and comms infrastructure. Assuming that routing of the cabling, the location of substations, hubs etc. along the line are not impacted by the selection of any of these options then all options are comparable from an EMI perspective.	**Comparable to other options** The main sources of EMI from the proposed development will be the traction supply system , MV ring, HV lines, substation and comms infrastructure. Assuming that routing of the cabling, the location of substations, hubs etc. along the line are not impacted by the selection of any of these options then all options are comparable from an EMI perspective.	**Comparable to other options** The main sources of EMI from the proposed development will be the traction supply system , MV ring, HV lines, substation and comms infrastructure. Assuming that routing of the cabling, the location of substations, hubs etc. along the line are not impacted by the selection of any of these options then all options are comparable from an EMI perspective.	**Comparable to other options** The main sources of EMI from the proposed development will be the traction supply system , MV ring, HV lines, substation and comms infrastructure. Assuming that routing of the cabling, the location of substations, hubs etc. along the line are not impacted by the selection of any of these options then all options are comparable from an EMI perspective.

DART Maynooth & City Centre Enhancements. MCA Criteria and parameters

Depot Alternatives Assessment

Nº	Parameter	Criteria	Sub-Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
4	**Accessibility & Social inclusion**	Impact on the local residents	Proximity to residential areas	**Some comparative disadvantage over other options** Main building and stabling are adjacent close to the western residential area	**Significant comparative disadvantage over other options** Main building and stabling are separated and stabling is close to the western residential area	**Some comparative advantage over other options** Main building and stabling are adjacent far from the western residential area	**Significant comparative disadvantage over other options** Main building and stabling are separated and stabling is close to the western residential area	**Some comparative advantage over other options** Main building and stabling are adjacent far from the western residential area	**Some comparative disadvantage over other options** Main building and stabling are adjacent close to the western residential area
		Social Inclusion	Accessibility to employment	**Comparable to other options** Same accessbility to employment	**Comparable to other options** Same accessbility to employment	**Comparable to other options** Same accessbility to employment	**Comparable to other options** Same accessbility to employment	**Comparable to other options** Same accessbility to employment	**Comparable to other options** Same accessbility to employment
5	**Safety**	Security	Remote stabling yard are more vulnerable against vandalism	**Some comparative advantage over other options** Stabling close to main building	**Some comparative disadvantage over other options** Remote stabling in the West	**Significant comparative advantage over other options** Stabling in front of main building	**Some comparative disadvantage over other options** Remote stabling in the West	**Significant comparative advantage over other options** Stabling in front of main building	**Some comparative advantage over other options** Stabling close to main building
		Ease of supervision. Staff flows	Distance between workshop and service slab	**Some comparative disadvantage over other options** Maintenance facilities are distant (more than 0.5 km).	**Some comparative advantage over other options** Maintenance facilities are adjacent.	**Some comparative disadvantage over other options** Maintenance facilities are distant (more than 0.5 km).	**Some comparative disadvantage over other options** Maintenance facilities are distant (more than 0.5 km).	**Some comparative disadvantage over other options** Maintenance facilities are distant (more than 0.5 km).	**Some comparative disadvantage over other options** Maintenance facilities are distant (more than 0.5 km).
		Ease of supervision. Staff flows	Distance and level crossings between workshop and stabling.	**Some comparative advantage over other options** Facilities are adjacent. No level crossings.	**Some comparative disadvantage over other options** Facilities are distant (more than 0.5 km). No level crossings.	**Some comparative advantage over other options** Facilities are adjacent. Crossing to be provided at different level.	**Some comparative disadvantage over other options** Facilities are distant (more than 0.5 km). No level crossings.	**Some comparative advantage over other options** Facilities are adjacent. Crossing to be provided at different level.	**Some comparative advantage over other options** Facilities are adjacent. No level crossings.
		Road flows	Assess road and level crossings with tracks	**Some comparative advantage over other options** Internal road connected to all facilities without level crossings.	**Some comparative disadvantage over other options** Access to service slab needs some level crossings.	**Some comparative disadvantage over other options** Access to stabling needs some level crossings.	**Some comparative advantage over other options** Internal road connected to all facilities without level crossings.	**Some comparative disadvantage over other options** Access to main stabling needs some level crossings.	**Some comparative advantage over other options** Internal road connected to all facilities without level crossings.
6	**Physical Activity**	Connectivity to adjoining cycling facilities	Provision of cycle track or / and connectivity to adjoining cycling facilities.	**Comparable to other options** Same possibility for connections	**Comparable to other options** Same possibility for connections	**Comparable to other options** Same possibility for connections	**Comparable to other options** Same possibility for connections	**Comparable to other options** Same possibility for connections	**Comparable to other options** Same possibility for connections
		Permeability and local connectivity opportunity	Analysis of the connectivity to green areas/key attractions related to active mode	**Comparable to other options** Same possibility for connections	**Comparable to other options** Same possibility for connections	**Comparable to other options** Same possibility for connections	**Comparable to other options** Same possibility for connections	**Comparable to other options** Same possibility for connections	**Comparable to other options** Same possibility for connections

9.4 Comparison of options

The summary of the results is shown in the table below.

Nº	Parameter	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
1	Economy	Some comparative advantage over other options	Some comparative disadvantage over other options	Some comparative advantage over other options	Some comparative disadvantage over other options	Some comparative disadvantage over other options	Some comparative disadvantage over other options
2	Integration	Some comparative advantage over other options	Some comparative disadvantage over other options	Some comparative advantage over other options	Some comparative advantage over other options	Some comparative advantage over other options	Some comparative advantage over other options
3	Environment	Some comparative disadvantage over other options	Some comparative advantage over other options	Some comparative disadvantage over other options	Some comparative advantage over other options	Some comparative advantage over other options	Significant comparative disadvantage over other options
4	Accessibility & Social inclusion	Some comparative disadvantage over other options	Significant comparative disadvantage over other options	Some comparative advantage over other options	Significant comparative disadvantage over other options	Some comparative advantage over other options	Some comparative disadvantage over other options
5	Safety	Some comparative advantage over other options	Some comparative disadvantage over other options	Some comparative advantage over other options	Some comparative disadvantage over other options	Some comparative advantage over other options	Some comparative advantage over other options
6	Physical Activity	Comparable to other options	Comparable to other options	Comparable to other options	Comparable to other options	Comparable to other options	Comparable to other options

In terms of Economy, there is included criteria for the construction cost associated to earthworks and tracks (because the facilities and buildings are similar to all alternatives) and to new overbridge for the road access and overhead power line diversion. Also, it is considers the traffic functionality and the benefits related to reduction in movement time.

Alternatives 1 and 3 have better results in the economical parameter, being alternative 3 that allow the most efficiency related to trains flows between the main facilities although it is required a higher cost for the construction and maintenance.

Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Construction cost	**Some comparative advantage over other options** Construction cost impact are lower. Cut 6.884 m3 Fill 387.989 m3	**Some comparative advantage over other options** Construction cost impact are lower. Cut 1.729 m3 Fill 367.403 m3	**Some comparative disadvantage over other options** Construction cost impact are higher. Cut 608 m3 Fill 587.518 m3	**Some comparative disadvantage over other options** Construction cost impact are higher. Cut 17.995 m3 Fill 446.659 m3	**Some comparative disadvantage over other options** Construction cost impact are higher. Cut 277 m3 Fill 624.746 m3	**Some comparative disadvantage over other options** Construction cost impact are higher. Cut 6.637 m3 Fill 495.144 m3
Construction cost and Long term Maintenance Costs	**Some comparative advantage over other options** Track length 16,6 km Turnouts 62 units	**Some comparative disadvantage over other options** Track length 18,1 km Turnouts 64 units	**Some comparative disadvantage over other options** Track length 18,7 km Turnouts 76 units	**Some comparative advantage over other options** Track length 17 km Turnouts 63 units	**Some comparative advantage over other options** Track length 17,4 km Turnouts 64 units	**Some comparative advantage over other options** Track length 17,6 km Turnouts 64 units
Construction cost	**Significant comparative disadvantage over other options** 2 Overhead lines 38 KV above stabling and workshop. Diversion is required. 38 KV Length: 475 m + 428 m = 903 m 38 Kv poles: 8	**Some comparative disadvantage over other options** 1 Overhead line 38 KV above stabling. Diversion is required. 38 KV Length: 186 m + 371 m = 557 m 38 Kv poles: 6	**Some comparative disadvantage over other options** 1 Overhead line 38 KV above stabling and workshop. Diversion is required. 1 Overhead line 220 KV close to AVI facility. 220 kv length: 115 38 KV Length: 102 m + 610 m = 712 38 Kv poles: 6	**Significant comparative disadvantage over other options** 2 Overhead line 38 KV above stabling. Diversion is required. **1 Overhead line 220 KV close to AVI facility.** **220 kv length: 100** **38 KV Length: 175 m + 330 m= 505 m** **38 Kv poles: 5**	**Some comparative advantage over other options** 1 overhead line 38 KV above tracks and roads. 1 Overhead line 220 KV close to AVI facility. 220 kv length: 88 38 KV Length: 102 m + 270 m = 372 m 38 Kv poles: 4	**Significant comparative disadvantage over other options** 2 Overhead lines 38 KV above stabling and workshop. Diversion is required. 1 Overhead line 220 KV close to AVI facility. 220 kv length: 95 m 38 KV Length: 475 m + 428 m = 903 m 38 Kv poles: 8
Construction cost	**Some comparative advantage over other options** 46 m	**Some comparative advantage over other options** 45 m	**Some comparative disadvantage over other options** 75 m	**Significant comparative disadvantage over other options** 94 m	**Some comparative disadvantage over other options** 84 m	**Significant comparative disadvantage over other options** 94 m
Traffic Functionality /economic benefit	**Some comparative disadvantage over other options** Direct access up to the stabling from the 2 eastern connections to the mainline. Access from the western connection need a reversing in the shunting track.	**Some comparative disadvantage over other options** Direct access up to the stabling from the 2 eastern connections to the mainline. Access from the western connection need a reversing in the shunting track.	**Significant comparative advantage over other options** Direct access up to the stabling from the 3 connections to the mainline.	**Some comparative disadvantage over other options** Direct access up to the stabling from the 2 eastern connections to the mainline. Access from the western connection need a reversing in the shunting track.	**Some comparative disadvantage over other options** Direct access up to the stabling from the 3 connections to the mainline. Fleet berthed 3 in a row to reduce the width of the stabling area.	**Some comparative disadvantage over other options** Direct access up to the stabling from the 2 eastern connections to the mainline. Access from the western connection need a reversing in the shunting track.
Traffic Functionality /economic benefit	**Comparable to other options** Direct access from the primary connection to the mainline to the AWP and subsequently to the stabling. Access from the central connection to the AWP needs a reversing in the western shunting track. Access from the western connection to the AWP is direct by the through track.	**Comparable to other options** Direct access from the primary connection to the mainline to the AWP and subsequently to the stabling. Access from the central connection to the AWP needs a reversing in the western shunting track. Access from the western connection to the AWP is direct by the through track.	**Comparable to other options** Direct access from the primary connection to the mainline to the AWP and subsequently to the stabling. Access from the central connection to the AWP needs a reversing in the western shunting track. Access from the western connection to the AWP is direct by the through track.	**Comparable to other options** Direct access from the primary connection to the mainline to the AWP and subsequently to the stabling. Access from the central connection to the AWP needs a reversing in the western shunting track. Access from the western connection to the AWP is direct by the through track.	**Comparable to other options** Direct access from the primary connection to the mainline to the AWP and subsequently to the stabling. Access from the central connection to the AWP needs a reversing in the western shunting track. Access from the western connection to the AWP is direct by the through track.	**Comparable to other options** Direct access from the primary connection to the mainline to the AWP and subsequently to the stabling. Access from the central connection to the AWP needs a reversing in the western shunting track. Access from the western connection to the AWP is direct by the through track.
Traffic Functionality /economic benefit	**Some comparative advantage over other options** Direct access from stabling to AWP.	**Some comparative advantage over other options** Direct access from stabling to AWP.	**Some comparative advantage over other options** Direct access from stabling to AWP.	**Some comparative disadvantage over other options** Direct access from stabling to AWP. Facilities are more distant.	**Some comparative disadvantage over other options** Direct access from stabling to AWP. Facilities are more distant.	**Some comparative advantage over other options** Direct access from stabling to AWP.
Traffic Functionality /economic benefit	**Some comparative advantage over other options** Direct access from the three connections to the mainline up to the workshop.	**Some comparative disadvantage over other options** Direct access from the eastern and western connections to the mainline up to the workshop. Access from the central connection to the AWP needs a reversing in the western shunting track.	**Some comparative advantage over other options** Direct access from the three connections to the mainline up to the workshop.	**Some comparative advantage over other options** Direct access from the three connections to the mainline up to the workshop.	**Some comparative advantage over other options** Direct access from the three connections to the mainline up to the workshop.	**Some comparative advantage over other options** Direct access from the three connections to the mainline up to the workshop.
Traffic Functionality /economic benefit	**Some comparative disadvantage over other options** Access from stabling to workshop needs a reversing in the eastern shunting track.	**Some comparative advantage over other options** Direct access from stabling to workshop.	**Some comparative disadvantage over other options** Access from stabling to workshop needs a reversing in the eastern shunting track.	**Some comparative advantage over other options** Direct access from stabling to workshop.	**Some comparative disadvantage over other options** Access from the main stabling to workshop needs a reversing in the eastern shunting track.	**Some comparative disadvantage over other options** Access from stabling to workshop needs a reversing in the eastern shunting track.
Traffic Functionality /economic benefit	**Some comparative advantage over other options** Access from workshop to test track needs a reversing in the western shunting track.	**Some comparative disadvantage over other options** Access from workshop to test track needs a reversing in the western shunting track. Facilities are more distant.	**Some comparative advantage over other options** Access from workshop to test track needs a reversing in the western shunting track.	**Some comparative disadvantage over other options** Access from workshop to test track needs a reversing in the western shunting track. Facilities are more distant.	**Some comparative advantage over other options** Access from workshop to test track needs a reversing in the western shunting track.	**Some comparative advantage over other options** Access from workshop to test track needs a reversing in the western shunting track.
Traffic Functionality /economic benefit	**Some comparative disadvantage over other options** During the washing process the access to the tracks of the service slab is blocked, so trains should go through by-pass up to the stabling.	**Some comparative disadvantage over other options** During the washing process the access to the tracks of the service slab is blocked, so trains should go through by-pass up to the stabling.	**Some comparative advantage over other options** During the washing process the access to the track of the service slab is available.	**Some comparative disadvantage over other options** During the washing process the access to the tracks of the service slab is blocked, so trains should go through by-pass up to the stabling.	**Some comparative disadvantage over other options** During the washing process the access to the tracks of the service slab is blocked, so trains should go through by-pass up to the stabling.	**Some comparative disadvantage over other options** During the washing process the access to the tracks of the service slab is blocked, so trains should go through by-pass up to the stabling.

For integration, it is assessed the adaptability in the future related to the extension of the stabling area or other facilities.

Alternative 6 is the top-rated because of the ease to link more stabling tracks in a one side stabling yard and to link future facilities to a longer alternative.

Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Adaptability in the future	**Some comparative advantage over other options** Single ended stabling tracks could be extended to the West.	**Some comparative disadvantage over other options** Stabling tracks should be added separated from the main stabling area.	**Some comparative disadvantage over other options** Stabling tracks should be added separated from the main stabling area.	**Some comparative disadvantage over other options** Stabling tracks should be added separated from the main stabling area.	**Some comparative disadvantage over other options** Stabling tracks should be added separated from the main stabling area.	**Some comparative advantage over other options** Single ended stabling tracks could be extended to the West.
Adaptability in the future	**Some comparative disadvantage over other options** Short stretches in the lead tracks to link new facilities.	**Some comparative disadvantage over other options** Short stretches in the lead tracks to link new facilities.	**Some comparative advantage over other options** Longer stretches in the lead tracks to link new facilities.	**Some comparative advantage over other options** Longer stretches in the lead tracks to link new facilities.	**Some comparative advantage over other options** Longer stretches in the lead tracks to link new facilities.	**Some comparative advantage over other options** Longer stretches in the lead tracks to link new facilities.
Land Use Integration	**Comparable to other options** The Depot location is located on unzoned greenfield lands between the settlements of Kilcock and Maynooth. At a local level the option is consistent with the Kildare CDP 2017-2023 with, objective PTO 3 *'Support of the NTAs Greater Dublin Area Transport Strategy (2016-2035)'* and PTO 7: *'Promote and support the upgrading of the Maynooth rail line & the Kildare rail way, in accordance with Transport Strategy for the Great Dublin Area 2016-2035'*	**Comparable to other options** The Depot location is located on unzoned greenfield lands between the settlements of Kilcock and Maynooth. At a local level the option is consistent with the Kildare CDP 2017-2023 with, objective PTO 3 *'Support of the NTAs Greater Dublin Area Transport Strategy (2016-2035)'* and PTO 7: *'Promote and support the upgrading of the Maynooth rail line & the Kildare rail way, in accordance with Transport Strategy for the Great Dublin Area 2016-2035'*	**Comparable to other options** The Depot location is located on unzoned greenfield lands between the settlements of Kilcock and Maynooth. At a local level the option is consistent with the Kildare CDP 2017-2023 with, objective PTO 3 *'Support of the NTAs Greater Dublin Area Transport Strategy (2016-2035)'* and PTO 7: *'Promote and support the upgrading of the Maynooth rail line & the Kildare rail way, in accordance with Transport Strategy for the Great Dublin Area 2016-2035'*	**Comparable to other options** The Depot location is located on unzoned greenfield lands between the settlements of Kilcock and Maynooth. At a local level the option is consistent with the Kildare CDP 2017-2023 with, objective PTO 3 *'Support of the NTAs Greater Dublin Area Transport Strategy (2016-2035)'* and PTO 7: *'Promote and support the upgrading of the Maynooth rail line & the Kildare rail way, in accordance with Transport Strategy for the Great Dublin Area 2016-2035'*	**Comparable to other options** The Depot location is located on unzoned greenfield lands between the settlements of Kilcock and Maynooth. At a local level the option is consistent with the Kildare CDP 2017-2023 with, objective PTO 3 *'Support of the NTAs Greater Dublin Area Transport Strategy (2016-2035)'* and PTO 7: *'Promote and support the upgrading of the Maynooth rail line & the Kildare rail way, in accordance with Transport Strategy for the Great Dublin Area 2016-2035'*	**Comparable to other options** The Depot location is located on unzoned greenfield lands between the settlements of Kilcock and Maynooth. At a local level the option is consistent with the Kildare CDP 2017-2023 with, objective PTO 3 *'Support of the NTAs Greater Dublin Area Transport Strategy (2016-2035)'* and PTO 7: *'Promote and support the upgrading of the Maynooth rail line & the Kildare rail way, in accordance with Transport Strategy for the Great Dublin Area 2016-2035'*
Geographical Integration	**Comparable to other options** Comparable across all options	**Comparable to other options** Comparable across all options	**Comparable to other options** Comparable across all options	**Comparable to other options** Comparable across all options	**Comparable to other options** Comparable across all options	**Comparable to other options** Comparable across all options
Other Government Policy	**Comparable to other options** Comparable across all options	**Comparable to other options** Comparable across all options	**Comparable to other options** Comparable across all options	**Comparable to other options** Comparable across all options	**Comparable to other options** Comparable across all options	**Comparable to other options** Comparable across all options

In the case of the environment parameter the land occupation is considered. Alternatives 2, 4 and 5 have higher evaluation as they require a smaller land occupation and agricultural impacts.

Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Noise and Vibration	**Comparable to other options** Options provide comparabile impacts on noise and vibration.	**Comparable to other options** Options provide comparabile impacts on noise and vibration.	**Comparable to other options** Options provide comparabile impacts on noise and vibration.	**Comparable to other options** Options provide comparabile impacts on noise and vibration.	**Comparable to other options** Options provide comparabile impacts on noise and vibration.	**Comparable to other options** Options provide comparabile impacts on noise and vibration.
Air Quality and Climate	**Comparable to other options** Options provide comparable impacts on air and climate.	**Comparable to other options** Options provide comparable impacts on air and climate.	**Comparable to other options** Options provide comparable impacts on air and climate.	**Comparable to other options** Options provide comparable impacts on air and climate.	**Comparable to other options** Options provide comparable impacts on air and climate.	**Comparable to other options** Options provide comparable impacts on air and climate.
Landscape and Visual (including light)	**Comparable to other options** All Options are likely to have signficant **negative impact on landscape and visual amenity of the Royal Canal defined as an Area of High Amenity in the Kildare CDP.** The Kildare CDP has identified a number of Scenic Viewpoints along the Canal at this Location that are likely to be affected by the construction of proposed Depot buildings and new bridge structure (OB24) over the Royal Canal as well as operational impacts of trains parked along the Canal at the stablings which will change the landscape character of this area significnatly. The proposed development is does not support policies and objectives of the Kildare CDP relating to curtailing develpoment along the Canal and preserving this corridor (WV 1, WV 2 and WV 3).	**Comparable to other options** All Options are likely to have signficant **negative impact on landscape and visual amenity of the Royal Canal defined as an Area of High Amenity in the Kildare CDP.** The Kildare CDP has identified a number of Scenic Viewpoints along the Canal at this Location that are likely to be affected by the construction of proposed Depot buildings and new bridge structure (OB24) over the Royal Canal as well as operational impacts of trains parked along the Canal at the stablings which will change the landscape character of this area significnatly. The proposed development is does not support policies and objectives of the Kildare CDP relating to curtailing develpoment along the Canal and preserving this corridor (WV 1, WV 2 and WV 3).	**Comparable to other options** All Options are likely to have signficant **negative impact on landscape and visual amenity of the Royal Canal defined as an Area of High Amenity in the Kildare CDP.** The Kildare CDP has identified a number of Scenic Viewpoints along the Canal at this Location that are likely to be affected by the construction of proposed Depot buildings and new bridge structure (OB24) over the Royal Canal as well as operational impacts of trains parked along the Canal at the stablings which will change the landscape character of this area significnatly. The proposed development is does not support policies and objectives of the Kildare CDP relating to curtailing develpoment along the Canal and preserving this corridor (WV 1, WV 2 and WV 3).	**Comparable to other options** All Options are likely to have signficant **negative impact on landscape and visual amenity of the Royal Canal defined as an Area of High Amenity in the Kildare CDP.** The Kildare CDP has identified a number of Scenic Viewpoints along the Canal at this Location that are likely to be affected by the construction of proposed Depot buildings and new bridge structure (OB24) over the Royal Canal as well as operational impacts of trains parked along the Canal at the stablings which will change the landscape character of this area significnatly. The proposed development is does not support policies and objectives of the Kildare CDP relating to curtailing develpoment along the Canal and preserving this corridor (WV 1, WV 2 and WV 3).	**Comparable to other options** All Options are likely to have signficant **negative impact on landscape and visual amenity of the Royal Canal defined as an Area of High Amenity in the Kildare CDP.** The Kildare CDP has identified a number of Scenic Viewpoints along the Canal at this Location that are likely to be affected by the construction of proposed Depot buildings and new bridge structure (OB24) over the Royal Canal as well as operational impacts of trains parked along the Canal at the stablings which will change the landscape character of this area significnatly. The proposed development is does not support policies and objectives of the Kildare CDP relating to curtailing develpoment along the Canal and preserving this corridor (WV 1, WV 2 and WV 3).	**Comparable to other options** All Options are likely to have signficant **negative impact on landscape and visual amenity of the Royal Canal defined as an Area of High Amenity in the Kildare CDP.** The Kildare CDP has identified a number of Scenic Viewpoints along the Canal at this Location that are likely to be affected by the construction of proposed Depot buildings and new bridge structure (OB24) over the Royal Canal as well as operational impacts of trains parked along the Canal at the stablings which will change the landscape character of this area significnatly. The proposed development is does not support policies and objectives of the Kildare CDP relating to curtailing develpoment along the Canal and preserving this corridor (WV 1, WV 2 and WV 3).
Biodiversity (flora and fauna)	**Comparable to other options** Similar Total Area to other alternatives Slightly less frontage onto the Royal Canal pNHA	**Comparable to other options** Similar Total Area to other alternatives Slightly less frontage onto the Royal Canal pNHA	**Comparable to other options** Similar Total Area to other alternatives Slightly less frontage onto the Royal Canal pNHA	**Comparable to other options** Similar Total Area to other alternatives Slightly less frontage onto the Royal Canal pNHA	**Comparable to other options** Similar Total Area to other alternatives Slightly less frontage onto the Royal Canal pNHA	**Comparable to other options** Similar Total Area to other alternatives Slightly less frontage onto the Royal Canal pNHA
Cultural, Archaeological and Architectural Heritage	**Comparable to other options** Potential for significant direct negative impacts on two recorded monuments (ring ditch and barrow) along with previously unrecorded archaeological sites. Potential for indirect negative impacts on Chamber's Bridge (RPS)	**Comparable to other options** Potential for significant direct negative impacts on two recorded monuments (ring ditch and barrow) along with previously unrecorded archaeological sites. Potential for indirect negative impacts on Chamber's Bridge (RPS)	**Comparable to other options** Potential for significant direct negative impacts on two recorded monuments (ring ditch and barrow) along with previously unrecorded archaeological sites. Potential for indirect negative impacts on Chamber's Bridge (RPS)	**Comparable to other options** Potential for significant direct negative impacts on two recorded monuments (ring ditch and barrow) along with previously unrecorded archaeological sites. Potential for indirect negative impacts on Chamber's Bridge (RPS)	**Comparable to other options** Potential for significant direct negative impacts on two recorded monuments (ring ditch and barrow) along with previously unrecorded archaeological sites. Potential for indirect negative impacts on Chamber's Bridge (RPS)	**Comparable to other options** Potential for significant direct negative impacts on two recorded monuments (ring ditch and barrow) along with previously unrecorded archaeological sites. Potential for indirect negative impacts on Chamber's Bridge (RPS)
Water Resources	**Some comparative advantage over other options** All options will require the diversion or culverting of a small watercourse. All options are directly adjacent to the Royal Canal on there northern boundary. The close proximity to the royal canal and the minor watercourse diversion poses risk to water quality during construction and operation phases. OPW flood mapping indicates that the area where the minor watercourse discharges to the Lyreen river is liable to flood. This appears to affect options 1& 2 the least. Majority of proposed option is within "Moderate" groundwater vulnerability and poses a limited threat to groundwater.	**Some comparative advantage over other options** All options will require the diversion or culverting of a small watercourse. All options are directly adjacent to the Royal Canal on there northern boundary. The close proximity to the royal canal and the minor watercourse diversion poses risk to water quality during construction and operation phases. OPW flood mapping indicates that the area where the minor watercourse discharges to the Lyreen river is liable to flood. This appears to affect options 1& 2 the least. Majority of proposed option is within "Moderate" groundwater vulnerability and poses a limited threat to groundwater.	**Some comparative disadvantage over other options** All options will require the diversion or culverting of a small watercourse. All options are directly adjacent to the Royal Canal on there northern boundary. The close proximity to the royal canal and the minor watercourse diversion poses risk to water quality during construction and operation phases. OPW flood mapping indicates that the area where the minor watercourse discharges to the Lyreen river is liable to flood. A portion of option 3 appears to be within the predicted flood extents. Majority of proposed option is within "Moderate" groundwater vulnerability and poses a limited threat to groundwater.	**Some comparative disadvantage over other options** All options will require the diversion or culverting of a small watercourse. All options are directly adjacent to the Royal Canal on there northern boundary. The close proximity to the royal canal and the minor watercourse diversion poses risk to water quality during construction and operation phases. OPW flood mapping indicates that the area where the minor watercourse discharges to the Lyreen river is liable to flood. A portion of option 4 appears to be within the predicted flood extents. Majority of proposed option is within "Moderate" groundwater vulnerability and poses a limited threat to groundwater.	**Some comparative disadvantage over other options** All options will require the diversion or culverting of a small watercourse. All options are directly adjacent to the Royal Canal on there northern boundary. The close proximity to the royal canal and the minor watercourse diversion poses risk to water quality during construction and operation phases. OPW flood mapping indicates that the area where the minor watercourse discharges to the Lyreen river is liable to flood. A portion of option 5 appears to be within the predicted flood extents. Majority of proposed option is within "Moderate" groundwater vulnerability and poses a limited threat to groundwater.	**Some comparative disadvantage over other options** All options will require the diversion or culverting of a small watercourse. All options are directly adjacent to the Royal Canal on there northern boundary. The close proximity to the royal canal and the minor watercourse diversion poses risk to water quality during construction and operation phases. OPW flood mapping indicates that the area where the minor watercourse discharges to the Lyreen river is liable to flood. A portion of option 6 appears to be within the predicted flood extents. Majority of proposed option is within "Moderate" groundwater vulnerability and poses a limited threat to groundwater.
Agriculture and Non-Agricultural	**Some comparative disadvantage over other options** Alternative 1 will involve land severance on 5 No. holdings with impacts on access on 1 No. farm holding. Apart from landtake which will be compensated it is not likely to impact on agribusiness. Alternative 1 will impact on agricultural lands of good quality with significant landtake and severance impacts on a number of properties.	**Some comparative advantage over other options** Alternative 2 will involve land severance on 5 No. holdings with impacts on access on 1 No. farm holding. Apart from landtake which will be compensated it is not likely to impact on agribusiness. Alternative 2 will impact on agricultural lands of good quality with significant landtake and severance impacts on a number of properties.	**Some comparative disadvantage over other options** Alternative 3 will involve land severance on 4 No. holdings with impacts on access on 1 No. farm holding. Apart from landtake which will be compensated it is not likely to impact on agribusiness. Alternative 3 will impact on agricultural lands of good quality with significant landtake and severance impacts on a number of properties.	**Some comparative advantage over other options** Alternative 4 will involve land severance on 4 No. holdings with impacts on access on 1 No. farm holding. Apart from landtake which will be compensated it is not likely to impact on agribusiness. Alternative 4 will impact on agricultural lands of good quality with significant landtake and severance impacts on a number of properties.	**Some comparative advantage over other options** Alternative 5 will involve land severance on 4 No. holdings with impacts on access on 1 No. farm holding.Apart from landtake which will be compensated it is not likely to impact on agribusiness. Alternative 5 will impact on agricultural lands of good quality with significant landtake and severance impacts on a number of properties.	**Some comparative disadvantage over other options** Alternative 6 will involve land severance on 4 No. holdings with impacts on access on 1 No. farm holding. Apart from landtake which will be compensated it is not likely to impact on agribusiness. Alternative 6 will impact on agricultural lands of good quality with significant landtake and severance impacts on a number of properties.
Land occupation	**Some comparative disadvantage over other options** Area 32,89 Has Length 2,25 km	**Some comparative disadvantage over other options** Area 33,09 Has Length 2,25 km	**Some comparative advantage over other options** Area 32,63 Has Length 2,58 km	**Some comparative advantage over other options** Area 31,67 Has Length 2,58 km	**Some comparative advantage over other options** Area 30,98 Has Length 2,58 km	**Significant comparative disadvantage over other options** Area 36,87 Length 2,58 m
Geology and Soils (including Waste)	**Comparable to other options** Potential for impact on soils & geology is mainly related to karstlacustrine or alluvial soils may be present. This would most likely require removal and replacement for construction but the majority of the site appears to be on glacial till, a soil which is generally acceptable for the required construction.	**Comparable to other options** Potential for impact on soils & geology is mainly related to karstlacustrine or alluvial soils may be present. This would most likely require removal and replacement for construction but the majority of the site appears to be on glacial till, a soil which is generally acceptable for the required construction.	**Comparable to other options** Potential for impact on soils & geology is mainly related to karstlacustrine or alluvial soils may be present. This would most likely require removal and replacement for construction but the majority of the site appears to be on glacial till, a soil which is generally acceptable for the required construction.	**Comparable to other options** Potential for impact on soils & geology is mainly related to karstlacustrine or alluvial soils may be present. This would most likely require removal and replacement for construction but the majority of the site appears to be on glacial till, a soil which is generally acceptable for the required construction.	**Comparable to other options** Potential for impact on soils & geology is mainly related to karstlacustrine or alluvial soils may be present. This would most likely require removal and replacement for construction but the majority of the site appears to be on glacial till, a soil which is generally acceptable for the required construction.	**Comparable to other options** Potential for impact on soils & geology is mainly related to karstlacustrine or alluvial soils may be present. This would most likely require removal and replacement for construction but the majority of the site appears to be on glacial till, a soil which is generally acceptable for the required construction.
Radiation and Stray Current	**Comparable to other options** The main sources of EMI from the proposed development will be the traction supply system , MV ring, HV lines, substation and comms infrastructure. Assuming that routing of the cabling, the location of substations, hubs etc. along the line are not impacted by the selection of any of these options then all options are comparable from an EMI perspective.	**Comparable to other options** The main sources of EMI from the proposed development will be the traction supply system , MV ring, HV lines, substation and comms infrastructure. Assuming that routing of the cabling, the location of substations, hubs etc. along the line are not impacted by the selection of any of these options then all options are comparable from an EMI perspective.	**Comparable to other options** The main sources of EMI from the proposed development will be the traction supply system , MV ring, HV lines, substation and comms infrastructure. Assuming that routing of the cabling, the location of substations, hubs etc. along the line are not impacted by the selection of any of these options then all options are comparable from an EMI perspective.	**Comparable to other options** The main sources of EMI from the proposed development will be the traction supply system , MV ring, HV lines, substation and comms infrastructure. Assuming that routing of the cabling, the location of substations, hubs etc. along the line are not impacted by the selection of any of these options then all options are comparable from an EMI perspective.	**Comparable to other options** The main sources of EMI from the proposed development will be the traction supply system , MV ring, HV lines, substation and comms infrastructure. Assuming that routing of the cabling, the location of substations, hubs etc. along the line are not impacted by the selection of any of these options then all options are comparable from an EMI perspective.	**Comparable to other options** The main sources of EMI from the proposed development will be the traction supply system , MV ring, HV lines, substation and comms infrastructure. Assuming that routing of the cabling, the location of substations, hubs etc. along the line are not impacted by the selection of any of these options then all options are comparable from an EMI perspective.

In terms of accessibility and social inclusion there is included criteria for the impact on the residents and the accessibility to employment, where alternatives 3 and 5 have less impact on the residents joining the main buildings in the central area.

Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Impact on the local residents	Some comparative disadvantage over other options	Significant comparative disadvantage over other options	Some comparative advantage over other options	Significant comparative disadvantage over other options	Some comparative advantage over other options	Some comparative disadvantage over other options
	Main building and stabling are adjacent close to the western residential area	Main building and stabling are separated and stabling is close to the western residential area	Main building and stabling are adjacent far from the western residential area	Main building and stabling are separated and stabling is close to the western residential area	Main building and stabling are adjacent far from the western residential area	Main building and stabling are adjacent close to the western residential area
Social Inclusion	Comparable to other options	Comparable to other options	Comparable to other options	Comparable to other options	Comparable to other options	Comparable to other options
	Same accessbility to employment	Same accessbility to employment	Same accessbility to employment	Same accessbility to employment	Same accessbility to employment	Same accessbility to employment

Safety includes the criteria related to security, ease of supervision and road flows avoiding any internal level crossing. Alternatives 1 and 6 have better evaluation avoiding any crossing with the track yard for road and staff flows.

Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Security	Some comparative advantage over other options	Some comparative disadvantage over other options	Significant comparative advantage over other options	Some comparative disadvantage over other options	Significant comparative advantage over other options	Some comparative advantage over other options
	Stabling close to main building	Remote stabling in the West	Stabling in front of main building	Remote stabling in the West	Stabling in front of main building	Stabling close to main building
Ease of supervision. Staff flows	Some comparative disadvantage over other options	Some comparative advantage over other options	Some comparative disadvantage over other options	Some comparative disadvantage over other options	Some comparative disadvantage over other options	Some comparative disadvantage over other options
	Maintenance facilities are distant (more than 0.5 km).	Maintenance facilities are adjacent.	Maintenance facilities are distant (more than 0.5 km).	Maintenance facilities are distant (more than 0.5 km).	Maintenance facilities are distant (more than 0.5 km).	Maintenance facilities are distant (more than 0.5 km).
Ease of supervision. Staff flows	Some comparative advantage over other options	Some comparative disadvantage over other options	Some comparative disadvantage over other options	Some comparative disadvantage over other options	Some comparative disadvantage over other options	Some comparative advantage over other options
	Facilities are adjacent. No level crossings.	Facilities are distant (more than 0.5 km). No level crossings.	Facilities are adjacent. Level crossings.	Facilities are distant (more than 0.5 km). No level crossings.	Facilities are adjacent. Level crossings.	Facilities are adjacent. No level crossings.
Road flows	Some comparative advantage over other options	Some comparative disadvantage over other options	Some comparative disadvantage over other options	Some comparative advantage over other options	Some comparative disadvantage over other options	Some comparative advantage over other options
	Internal road connected to all facilities without level crossings.	Access to service slab needs some level crossings.	Access to stabling needs some level crossings.	Internal road connected to all facilities without level crossings.	Access to main stabling needs some level crossings.	Internal road connected to all facilities without level crossings.

Finally, for physical activity it is considered the connectivity to adjoining cycling facilities and to green areas, and all the alternatives are comparable to other options.

Criteria	Alternative 1	Alternative 2	Alternative 3	Alternative 4	Alternative 5	Alternative 6
Connectivity to adjoining cycling facilities	Comparable to other options	Comparable to other options	Comparable to other options	Comparable to other options	Comparable to other options	Comparable to other options
	Same possibility for connections	Same possibility for connections	Same possibility for connections	Same possibility for connections	Same possibility for connections	Same possibility for connections
Permeability and local connectivity opportunity	Comparable to other options	Comparable to other options	Comparable to other options	Comparable to other options	Comparable to other options	Comparable to other options
	Same possibility for connections	Same possibility for connections	Same possibility for connections	Same possibility for connections	Same possibility for connections	Same possibility for connections

9.5 Summary

Alternative 3 has been selected as the Emerging Preferred Option and it will be taken forward in the reference design and presented to Public Consultation No. 1.

The main merits of this alternative are related to economy (providing the most functional layout although it supposes higher construction and long term cost), integration (considering adaptability for link futures facilities), accessibility & social inclusion and safety.

The demerits are related to environment where land occupation and agricultural impacts are higher.

The next steps are:

- Receive feedback from IÉ to the criteria proposed and to some issues that could be included if they impact on this assessment.

- Progress with permanent way design to coordinate the interfaces (connections, vertical and longitudinal alignment, drainage, flooding) between the main line and the depot.

- Analyse with operation design the impact on the depot of the number of trains in operation, timetable, locations and capacities of stabling tracks and assessment of non-passenger operation to/from depots.

10 Depot Road Access Multicriteria Analysis

The MCA main goal is to compare some key parameters for each alternative and to highlight the emerging preferred one. The MCA methodology is informed by Department of Transport Tourism and Sport (DTTAS), Common Appraisal Framework for Transport Project and Programmes March 2016 guidance document.

10.1 Overview of Assessment Approach

The overview assessment approach is similar to the section 8.

The criteria list includes 6 main parameters (groups of criteria) from the Common Appraisal Framework (CAF). A number of criteria were developed under each of the six CAF parameters, informed by CAF/MCA guidance and the unique characteristics of the project. Sub-criterion for the quantitative and qualitative statements have been adapted relevant to the analysis.

Table 10. Parameters and criteria

Parameter	Criteria	Sub-Criteria
Economy	Construction and Land Cost	Assessment of cost of construction of option, land costs, acquisition costs and temporary works
	Long Term Maintenance costs	Assessment of Long Term Maintenance
	Traffic Functionality /economic benefit	Benefits to vehicular traffic through reduction in journey time lengths and delays through removal of level crossings. Consideration of potentially longer routes for traffic.
Integration	Transport Integration	Impact on scope for and ease of interchange between modes. Impact on the operation of other transport services both during construction and in operation. New interchange nodes and facilities; Reduced walking and wait times associated with interchanges. Modal shift figures during construction and operations. Changes to journey times to transport nodes.
	Land Use Integration	Impact on land use strategies and regional and local plans. Assessment of support for land use factorslocal land use and planning. Inclusion of project in relevant local and regional planning documents.
Environment	Noise and Vibration	Estimated number of people likely to be affected by transport
	Air Quality and Climate	Local air quality effects. Number of receptors within 50m.
	Landscape and Visual (including light)	Key landscape characteristics affected; Effects on listed/ key views; Impact on landscape character.
	Biodiversity (flora and fauna)	Potential compliance/conflict with biodiversity objectives; Indirect impacts on protected species, designated sites; Overall effect on nature conservation resource.
	Cultural, Archaeological and Architectural Heritage	Overall effect on cultural, archaeological and architecture heritage resource. Likely effects on RPS, National Monuments, SMRs, Conservation areas, etc. Number of designated sites/structures (by level of designation) directly impacted by scheme (land take)
	Water Resources	Overall potential significant effects on water resource attributes likely to be affected during construction and operation.
	Agriculture and Non-Agricultural	Overall impact on land take & property. Number of properties to be impacted/acquired. Likely temporary or permanent severance effects, etc.

Parameter	Criteria	Sub-Criteria
	Geology and Soils (including Waste)	Soils and Geology and likely impact on geological resources based on preliminary/likely construction details. Soil resources to be developed/removed. Existing information relating to potential to encounter contaminated land. High-level assessment based on the likely structures/ works required and the potential for ground contamination due to historic landfills, pits and quarries.
	Radiation and Stray Current	Overall likely impact on existing sources of electromagnetic radiation.
Accessibility & Social Inclusion	Impact on neighbours	Potential impacts (positive / negative) on neighbours
Safety	Vehicular Traffic Safety	Quality of Access for these road users, lengths of diversions, removal of interface with rail and other modes of transport
	Pedestrian, Cyclist and Vulnerable Road user Safety	Quality of Access for these road users. removal of interfaces

10.2 Description of alternatives

The road network of the area is characterised by the following main features:

- The Royal Canal and the Maynooth line suppose a barrier
- The main road is the Motorway M4 to the south of the plot with interchanges in Maynooth and Kilcock.
- There is a regional road R148 to the north, beyond the Royal canal and the main line.
- The local roads are narrow in the surrounding area.
- There are overpasses with not enough width for two lanes over the main line.
- There are residential areas to the west (Kilcock) and to the east (Maynooth).

Figure 116: Existing road and overbridge OBG23

The road access to the depot site has been studied to determine a suitable route for depot staff for site access, delivery of stock or equipment and HVG travelling. Several routes have been proposed:

- 2 western accesses originating at Exit 8 of the M4 from Kilcock.
- 1 eastern access originating at Exit 7 of the M4 from Maynooth.
- 1 northern access linked to R148 that requires the construction of a new bridge.

Option 1 is an access from Kilcock interchange by the existing road network where a ring one direction could be provided because of the narrow width of these roads and so no new infrastructure is necessary, but a rearrangement of the direction of traffic.

Figure 117: Option 1.

Option 2 is an access from Kilcock interchange through a residential area where the final stretch up to the depot is a new road 670 m long (dotted line).

Figure 118: Option 2.

Option 3 is a road access from Maynooth interchange, this route goes through a large residential area with narrow meandering roads and the final stretch up to the depot is a new road 850 m long (dotted line).

Figure 119: Option 3.

Option 4 is a road access from road R148 (connecting traffic to Maynooth and Kilcock interchanges) that requires the construction of a new bridge, which is related to the operation of the mainline because of the singularity of OBG23, which has a clearance issue with the OHLE when doubling track. This is Jackson´s Bridge, and it is protected (Categories of Special Interest: Architectural Historical Social Technical). The bridge (over the Royal Canal) and the Royal Canal drop are dated from 1793. The new OBG24 enables a new connection to the R148 crossing the canal and the mainline for the depot access and for the road network located south of the mainline.

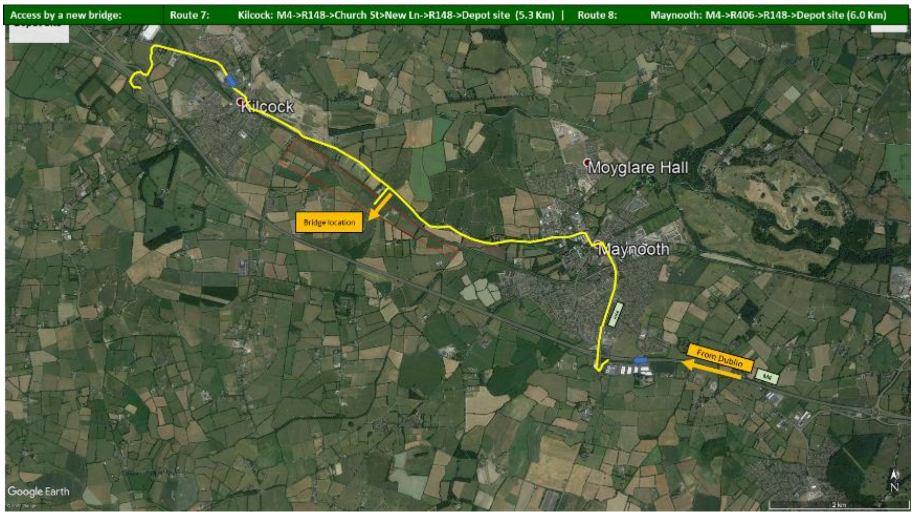


Figure 120: Option 4.

10.3 Multicriteria Analysis

The following table includes all the parameters with their criteria for all alternatives:

DART Maynooth & City Centre Enhancements. MCA Criteria and parameters							
Road Access Assessment							
Nº	**Parameter**	**Criteria**	**Sub-Criteria**	**Option 1**	**Option 2**	**Option 3**	**Option 4**
1	**Economy**	Construction and Land Cost	Assessment of cost of construction of option, land costs, acquisition costs and temporary works	**Some comparative advantage over other options**	**Some comparative disadvantage over other options**	**Some comparative disadvantage over other options**	**Some comparative advantage over other options**
				Existing roads, rearrange to one direction roads.	Required new stretch up to depot within residential areas.	Required new stretch up to depot within residential areas.	Required new bridge within greenfield site.
		Long Term Maintenance costs	Assessment of Long Term Maintenance	**Some comparative advantage over other options**	**Some comparative disadvantage over other options**	**Some comparative disadvantage over other options**	**Some comparative disadvantage over other options**
				Lower amounts of maintenance because this option is based on existing roads.	Maintenance and inspection of the new strecth is needed.	Maintenance and inspection of the new strecth is needed.	Higher amounts of maintenance and inspections are needed with the introduction of an overbridge.
		Traffic Functionality /economic benefit	Benefits to vehicular traffic through reduction in journey time lengths and delays through removal of level crossings. Consideration of potentially longer routes for traffic.	**Significant comparative disadvantage over other options**	**Some comparative disadvantage over other options**	**Some comparative disadvantage over other options**	**Some comparative advantage over other options**
				Longer journey time	Medium journey time	Medium journey time	North and South roadnetwork connection. Improvements in journey time
2	**Integration**	Transport Integration	Impact on scope for and ease of interchange between modes. Impact on the operation of other transport services both during construction and in operation. New interchange nodes and facilities; Reduced walking and wait times associated with interchanges. Modal shift figures during construction and operations. Changes to journey times to transport nodes.	**Some comparative disadvantage over other options**	**Some comparative disadvantage over other options**	**Some comparative disadvantage over other options**	**Some comparative advantage over other options**
				No impact on transport integration	No impact on transport integration	No impact on transport integration	Link for road networks at both sides of the main line.
		Land Use Integration	Impact on land use strategies and regional and local plans. Assessment of support for land use factorslocal land use and planning. Inclusion of project in relevant local and regional planning documents.	**Some comparative advantage over other options**	**Significant comparative advantage over other options**	**Some comparative disadvantage over other options**	**Some comparative advantage over other options**
				This option is supported in principle by the national and regional planning policy context. Kilcock LAP M*TO 2 To maximise the use of public transport infrastructure, walking and cycling To maximise the use of public transport infrastructure, walking and cycling and minimise car".* At local planning policy level,MTO 2 To maximise the use of public transport infrastructure, walking and cycling To maximise the use of public transport infrastructure, walking and cycling and minimise car". The Movement and Transport Objective MTO 24 of Kilcock LAP 2015-2021 aims *"to avoid severance within local catchments"* . The one direction traffic flow proposed as part of Option 1 has the potential to cause severance at local level by creating diversions in the area.	This option is supported in principle by the national and regional planning policy context. At local planning policy level, this option will support the Kilcock LAP Road Objective MTO 25 To *facilitate the future construction of the following roads and in the interim protect their routes from development:* (indiacted on Map 7: Transport Objectives Map (points E-F Indicative route) from *"Mollyware Street (Royal Meadows) to the Braganstown Road"*. This option will construct a new road at this location therefore supporting this develppment objective.	This option is supported in principle by the national and regional planning policy context. Kilcock LAP M*TO 2 To maximise the use of public transport infrastructure, walking and cycling To maximise the use of public transport infrastructure, walking and cycling and minimise car".* A section of the new road proposed as part of Option 3 is located within unzoned agricultural lands. Option 3 is likely to have an impact on agricultural land use and could affect future develppment patterns.	This option is supported in principle by the national and regional planning policy context. Kilcock LAP MTO 2 To maximise the use of public transport infrastructure, walking and cycling To maximise the use of public transport infrastructure, walking and cycling and minimise car".

DART Maynooth & City Centre Enhancements. MCA Criteria and parameters							
Road Access Assessment							
Nº	Parameter	Criteria	Sub-Criteria	Option 1	Option 2	Option 3	Option 4
		Noise and Vibration	Estimated number of people likely to be affected by transport	**Some comparative advantage over other options** High number of senstive receptors on this route. However, given the relatively small additional traffic volume on exisitng routes the overall noise and vibration impact will not be significant. Construction phase impacts will also be lower due to the use of existing road infrastructure.	**Some comparative disadvantage over other options** Large number of senstive receptors on this route. Furthermore the access route through a residential area would despite the low traffic volumes have the potential for a more significant noise impact. Construction phase impacts will also occur during the construction of the new access road which will lead to noise and vibration impacts.	**Some comparative disadvantage over other options** Large number of senstive receptors on this route. Furthermore the access route through a residential area would despite the low traffic volumes have the potential for a more significant noise impact. Construction phase impacts will also occur during the construction of the new access road which will lead to noise and vibration impacts.	**Some comparative disadvantage over other options** High number of senstive receptors on this route. However, given the relatively small additional traffic volume on exisitng routes the overall noise and vibration impact will not be significant. Construction phase impacts will also be lower due to the use of existing road infrastructure. Option 4 is considered to have lower potential for noise impacts than Options 2 or 3.
		Air Quality and Climate	Local air quality effects. Number of receptors within 50m.	**Some comparative advantage over other options** **Air**: High number of sensitive receptors on this route. However, impacts less than 1,000 AADT or 200 HGV per day and background air quality significantly below limit value. Therefore, no significant impacts on air qulaity. **Climate**: Preferable from a Climate Point of View due to lower construction materials required provided upgrades to roads were limited. Longer journey time noted in economy will likely result in higher emissions.	**Some comparative disadvantage over other options** **Air:** High number of sensitive receptors in a highly suburban area on this route. However, impacts less than 1,000 AADT or 200 HGV per day and background air quality significantly below limit value. Therefore, no significant impacts on air qulaity. . **Climate:** Required new road shorter than option 3 therefore option 2 preferable in comparison.	**Some comparative disadvantage over other options** **Air:** High number of sensitive receptors in a highly suburban area on this route. However, impacts less than 1,000 AADT or 200 HGV per day and background air quality significantly below limit value. Therefore, no significant impacts on air qulaity. **Climate:** Required new road longer than option 2 therefore less preferable in comparison.	**Some comparative disadvantage over other options** **Air** :Potential increased congestion in Maynooth and Kilcock towns which impacts vehicle emissions**.** High number of sensitive receptors in urban area on this route. However, impacts less than 1,000 AADT or 200 HGV per day and background air quality significantly below limit value. Therefore, no significant impacts on air qulaity. **Climate:** Required new bridge which will require significant embodied energy within constructing materials. Shorter journey time noted in economy will likely result in lower emissions if congestion not an issue.
		Landscape and Visual (including light)	Key landscape characteristics affected; Effects on listed/ key views; Impact on landscape character.	**Significant comparative advantage over other options** This Option assumes minimal physical intervention in existing environment and therefore, there are no likely significant impacts on existing landscape or visual characteristics. Likely Visual impacts to properties in the vicinity.	**Some comparative disadvantage over other options** This Option has the potential to impact on 'High' and 'Moderate' Value hedgerows identified in the Kilcock LAP within the Branganstown area, where a new road is proposed. Likely Visual impacts to properties in the vicinity.	**Some comparative disadvantage over other options** The proposed option is located within the 'Northern Lowlands' landscape character type as identified by the Kildare CDP. This landscape has low sensitivity, whereby it *"has the capacity to generally accommodate a wide range of uses"* . However, the proposed option will have an impact on landscape at local level by introducing road infrastructure into an agricultural setting. The alignment of the new road is likely to have a moderate visual impact on residential properties at Newtown Hall Estate, Maynooth which are located in close proximity to the development. A slight visual impact on 3 residential properties located along the L5041 is also likely.	**Significant comparative disadvantage over other options** The development of a bridge structure is likely to have significant landscape and visual impact on the Royal Canal, a pNHA defined as a Area of High Amenity in the KCDP. It will result in a new landscape feature likely to obstruct scenic views along the Canal. Additionally, this option is likely to have a significant visual impact on Jackson's Bridge (and lock), a protected structure and a listed view. (Kildare County Development Plan Scenic view "RC8 Jackson's Bridge Laraghbryan East" and "RC9 Chambers Bridge Maw" views to and from /on the Royal Canal.
		Biodiversity (flora and fauna)	Potential compliance/conflict with biodiversity objectives; Indirect impacts on protected species, designated sites; Overall effect on nature conservation resource.	**Some comparative advantage over other options** Route on existing roads but increasing in traffic over longer distance.	**Some comparative advantage over other options** New road required but increase in traffic over shorter distance.	**Some comparative advantage over other options** New road required but increase in traffic over shorter distance.	**Significant comparative disadvantage over other options** New bridge required over pNHA and land take on both sides of the pNHA.
3	Environment	Cultural, Archaeological and Architectural Heritage	Overall effect on cultural, archaeological and architecture heritage resource. Likely effects on RPS, National Monuments, SMRs, Conservation areas, etc. Number of designated sites/structures (by level of designation) directly impacted by scheme (land take)	**Significant comparative advantage over other options** No impact as existing road network is being utilised	**Some comparative disadvantage over other options** Potential for negative direct impacts on previously unrecorded archaeological sites where new road is required	**Some comparative disadvantage over other options** Potential for negative direct impacts on previously unrecorded archaeological sites where new road is required	**Some comparative disadvantage over other options** Potential for negative direct impacts on historic town of Maynooth (RMP), if road widening required, along with potential indiect impacts on Maynooth ACA. Potential for indiect impacts on Kilcock ACA
		Water Resources	Overall potential significant effects on water resource attributes likely to be affected during construction and operation.	**Significant comparative advantage over other options** Low risk to surface water if proper mitigation measures are followed during construction. No indicators of flood risk to the proposed route. Majority of route within Moderate groundwater vulnerability. limited threat to groundwater.	**Significant comparative advantage over other options** Low risk to surface water if proper mitigation measures are followed during construction. No indictors of flood risk to the proposed route. Majority of route within Moderate groundwater vulnerability. limited threat to groundwater.	**Some comparative disadvantage over other options** Requires new crossing of River Lyreen and tributary. Additional crossing may pose risk to water quality during construction and operation. Extensive Flooding within the vicinity of Maynooth. Proposed road within River Lyreen floodplain. New road and crossing is proposed within area of high to extreme groundwater vulnerability. Threat to groundwater.	**Some comparative disadvantage over other options** Requires new crossing of the Royal Canal. Additional crossing may pose risk to water quality during construction and operation. Extensive Flooding within the Vicinity of Maynooth and Kilcock. Proposed route in or directly adjacent to floodplain. Majority of route within Moderate groundwater vulnerability. limited threat to groundwater.
		Agriculture and Non-Agricultural	Overall impact on land take & property. Number of properties to be impacted/acquired. Likely temporary or permanent severance effects, etc.	**Significant comparative advantage over other options** Route 1a / 1b - Route opnion involves non-agricultural lands (public road) only. There are no direct impacts on agricultural or other non-agricultural property. Will not impact on access to property. Will not impact on agricultural & non-agricultural property.	**Significant comparative disadvantage over other options** Route 2 - Impact upon agricultural lands, non-agricultural (community / amenity) lands and public road. Existing adjoining land use consists of agricultural lands comprised of grassland used for livestock grazing and are subject to Planning for Residential Development (Ref. 2097). Non-agricultural property consists of Kilcock GAA Club and public road. Direct impacts on agricultural lands (subject to PP) include medium levels of landtake and severance. Direct impacts to non-agricultural property include landtake to community / amentiy property (Kilcock GAA).	**Some comparative disadvantage over other options** Route 3 - Impact upon agricultural lands and public road. Direct impacts on agricultural lands include low to medium level of landtake and severance. Route 3 will involve medium land severance on one property.	**Some comparative advantage over other options** Impact upon agricultural lands and public road. Direct impacts on agricultural lands include low level of landtake and severance. Route will involve a low level of land severance on one property.
		Geology and Soils (including Waste)	Soils and Geology and likely impact on geological resources based on preliminary/likely construction details. Soil resources to be developed/removed. Existing information relating to potential to encounter contaminated land. High-level assessment based on the likely structures/ works required and the potential for ground contamination due to historic landfills, pits and quarries.	**Some comparative advantage over other options** No signifncat mpacts of soils or geolog	**Some comparative advantage over other options** No signifncat mpacts of soils or geolog	**Some comparative disadvantage over other options** New road will require removal of soil resources	**Some comparative advantage over other options** New bridge structure requried. No signifncat impacts on soils or geology resources.
		Radiation and Stray Current	Overall likely impact on existing sources of electromagnetic radiation.	**Comparable to other options** The main sources of EMI from the proposed development will be the traction supply system , MV ring, HV lines, substation and comms infrastructure. Assuming that routing of the cabling, the location of substations, hubs etc. along the line are not impacted by the selection of any of these options then all options are comparable from an EMI perspective.	**Comparable to other options** The main sources of EMI from the proposed development will be the traction supply system , MV ring, HV lines, substation and comms infrastructure. Assuming that routing of the cabling, the location of substations, hubs etc. along the line are not impacted by the selection of any of these options then all options are comparable from an EMI perspective.	**Comparable to other options** The main sources of EMI from the proposed development will be the traction supply system , MV ring, HV lines, substation and comms infrastructure. Assuming that routing of the cabling, the location of substations, hubs etc. along the line are not impacted by the selection of any of these options then all options are comparable from an EMI perspective.	**Comparable to other options** The main sources of EMI from the proposed development will be the traction supply system , MV ring, HV lines, substation and comms infrastructure. Assuming that routing of the cabling, the location of substations, hubs etc. along the line are not impacted by the selection of any of these options then all options are comparable from an EMI perspective.

DART Maynooth & City Centre Enhancements. MCA Criteria and parameters							
Road Access Assessment							
Nº	Parameter	Criteria	Sub-Criteria	Option 1	Option 2	Option 3	Option 4
4	**Accessibility & Social Inclusion**	Impact on neighbours	Potential impacts (positive / negative) on neighbours	**Some comparative disadvantage over other options**	**Some comparative disadvantage over other options**	**Some comparative disadvantage over other options**	**Some comparative advantage over other options**
				Neighbours are affected by a higher traffic density on existing local roads	Neighbours are affected by a higher traffic density on existing residential roads	Neighbours are affected by a higher traffic density on existing residential roads	There are no increase on the traffic density on local roads, only in the regional R148. Neighbours have better connectivity over the mainline and the Royal Canal.
5	**Safety**	Vehicular Traffic Safety	Quality of Access for these road users, lengths of diversions, removal of interface with rail and other modes of transport	**Some comparative disadvantage over other options**	**Some comparative disadvantage over other options**	**Some comparative disadvantage over other options**	**Some comparative advantage over other options**
				Interface with residential traffic. Existing narrow road.	Interface with residential traffic	Interface with residential traffic	Direct access from regional road
		Pedestrian, Cyclist and Vulnerable Road user Safety	Quality of Access for these road users. removal of interfaces	**Some comparative disadvantage over other options**	**Some comparative disadvantage over other options**	**Some comparative disadvantage over other options**	**Some comparative advantage over other options**
				Interface with residential traffic. Existing narrow road.	Interface with residential traffic	Interface with residential traffic	Direct access from regional road
6	**Physical Activity**	Permeability and local connectivity opportunity	Journey Time and lengths of diversions for active modes and numbers affected. Analysis of the connectivity between level crossing and green areas/key attractions related to active mode	**Some comparative disadvantage over other options**	**Some comparative disadvantage over other options**	**Some comparative disadvantage over other options**	**Some comparative advantage over other options**
				No improvement on local connectivity	No improvement on local connectivity	No improvement on local connectivity	Increase local connectivity at both sides of mainline

10.4 Comparison of options

The summary of the results is shown in the table below.

Table 11. Summary

Nº	Parameter	Option 1	Option 2	Option 3	Option 4
1	Economy	Some comparative disadvantage over other options	Some comparative disadvantage over other options	Some comparative disadvantage over other options	Some comparative advantage over other options
2	Integration	Some comparative disadvantage over other options	Some comparative advantage over other options	Some comparative disadvantage over other options	Some comparative advantage over other options
3	Environment	Some comparative advantage over other options	Some comparative disadvantage over other options	Some comparative disadvantage over other options	Some comparative disadvantage over other options
4	Accessibility & Social inclusion	Some comparative disadvantage over other options	Some comparative disadvantage over other options	Some comparative disadvantage over other options	Some comparative advantage over other options
5	Safety	Some comparative disadvantage over other options	Some comparative disadvantage over other options	Some comparative disadvantage over other options	Some comparative advantage over other options
6	Physical Activity	Some comparative disadvantage over other options	Some comparative disadvantage over other options	Some comparative disadvantage over other options	Some comparative advantage over other options

In terms of Economy there is included criteria for the construction and long term cost and the traffic functionality and the benefits related to improvements in journey time.

Option 4 has better results in the economical parameter considering the huge impact in the improvements in the journey time although new overbridge OBG24 is required.

Parameter	Criteria	Option 1	Option 2	Option 3	Option 4
Economy	Construction and Land Cost	Some comparative advantage over other options Existing roads, rearrange to one direction roads.	Some comparative disadvantage over other options Required new stretch up to depot within residential areas.	Some comparative disadvantage over other options Required new stretch up to depot within residential areas.	Some comparative advantage over other options Required new bridge within greenfield site.
	Long Term Maintenance costs	Some comparative advantage over other options Lower amounts of maintenance because this option is based on existing roads.	Some comparative disadvantage over other options Maintenance and inspection of the new stretch is needed.	Some comparative disadvantage over other options Maintenance and inspection of the new stretch is needed.	Some comparative disadvantage over other options Higher amounts of maintenance and inspections are needed with the introduction of an overbridge.
	Traffic Functionality /economic benefit	Significant comparative disadvantage over other options Longer journey time	Some comparative disadvantage over other options Medium journey time	Some comparative disadvantage over other options Medium journey time	Some comparative advantage over other options North and South roadnetwork connection. Improvements in journey time

For integration, transport integration is assessed within the existing road network where the option 4 contains some clear advantages improving the links above the mainline and the Royal Canal and land use integration.

Parameter	Criteria	Option 1	Option 2	Option 3	Option 4
Integration	Transport Integration	**Some comparative disadvantage over other options** No impact on transport integration	**Some comparative disadvantage over other options** No impact on transport integration	**Some comparative disadvantage over other options** No impact on transport integration	**Some comparative advantage over other options** Link for road networks at both sides of the main line.
	Land Use Integration	**Some comparative advantage over other options** This option is supported in principle by the national and regional planning policy context. Kilcock LAP M*TO 2 To maximise the use of public transport infrastructure, walking and cycling To maximise the use of public transport infrastructure, walking and cycling and minimise car".* At local planning policy level,MTO 2 To maximise the use of public transport infrastructure, walking and cycling To maximise the use of public transport infrastructure, walking and cycling and minimise car". The Movement and Transport Objective MTO 24 of Kilcock LAP 2015-2021 aims *"to avoid severance within local catchments"* . The one direction traffic flow proposed as part of Option 1 has the potential to cause severance at local level by creating diversions in the area.	**Significant comparative advantage over other options** This option is supported in principle by the national and regional planning policy context. At local planning policy level, this option will support the Kilcock LAP Road Objective MTO 25 To f*acilitate the future construction of the following roads and in the interim protect their routes from development:* (indiacted on Map 7: Transport Objectives Map (points E-F Indicative route) from *"Mollyware Street (Royal Meadows) to the Braganstown Road".* This option will construct a new road at this location therefore supporting this develppment objective.	**Some comparative disadvantage over other options** This option is supported in principle by the national and regional planning policy context. Kilcock LAP M*TO 2 To maximise the use of public transport infrastructure, walking and cycling To maximise the use of public transport infrastructure, walking and cycling and minimise car".* A section of the new road proposed as part of Option 3 is located within unzoned agricultural lands. Option 3 is likely to have an impact on agricultural land use and could affect future develppment patterns.	**Some comparative advantage over other options** This option is supported in principle by the national and regional planning policy context. Kilcock LAP MTO 2 To maximise the use of public transport infrastructure, walking and cycling To maximise the use of public transport infrastructure, walking and cycling and minimise car".

In the case of the Environment, Option 1 has more clear advantages because it minimises the impacts related to new construction using the existing road network.

Parameter	Criteria	Option 1	Option 2	Option 3	Option 4
Environment	Noise and Vibration	**Some comparative advantage over other options** High number of senstive receptors on this route. However, given the relatively small additional traffic volume on exisitng routes the overall noise and vibration impact will not be significant. Construction phase impacts will also be lower due to the use of existing road infrastructure.	**Some comparative disadvantage over other options** Large number of senstive receptors on this route. Furthermore the access route through a residential area would despite the low traffic volumes have the potential for a more significant noise impact. Construction phase impacts will also occur during the construction of the new access road which will lead to noise and vibration impacts.	**Some comparative disadvantage over other options** Large number of senstive receptors on this route. Furthermore the access route through a residential area would despite the low traffic volumes have the potential for a more significant noise impact. Construction phase impacts will also occur during the construction of the new access road which will lead to noise and vibration impacts.	**Some comparative disadvantage over other options** High number of senstive receptors on this route. However, given the relatively small additional traffic volume on exisitng routes the overall noise and vibration impact will not be significant. Construction phase impacts will also be lower due to the use of existing road infrastructure. Option 4 is considered to have lower potential for noise impacts than Options 2 or 3.
	Air Quality and Climate	**Some comparative advantage over other options** **Air**: High number of sensitive receptors on this route. However, impacts less than 1,000 AADT or 200 HGV per day and background air quality significantly below limit value. Therefore, no significant impacts on air qulaity. **Climate**: Preferable from a Climate Point of View due to lower construction materials required provided upgrades to roads were limited. Longer journey time noted in economy will likely result in higher emissions.	**Some comparative disadvantage over other options** **Air:** High number of sensitive receptors in a highly suburban area on this route. However, impacts less than 1,000 AADT or 200 HGV per day and background air quality significantly below limit value. Therefore, no significant impacts on air qulaity. . **Climate:** Required new road shorter than option 3 therefore option 2 preferable in comparison.	**Some comparative disadvantage over other options** **Air:** High number of sensitive receptors in a highly suburban area on this route. However, impacts less than 1,000 AADT or 200 HGV per day and background air quality significantly below limit value. Therefore, no significant impacts on air qulaity. **Climate:** Required new road longer than option 2 therefore less preferable in comparison.	**Some comparative disadvantage over other options** **Air :**Potential increased congestion in Maynooth and Kilcock towns which impacts vehicle emissions**.** High number of sensitive receptors in urban area on this route. However, impacts less than 1,000 AADT or 200 HGV per day and background air quality significantly below limit value. Therefore, no significant impacts on air qulaity. **Climate:** Required new bridge which will require significant embodied energy within constructing materials. Shorter journey time noted in economy will likely result in lower emissions if congestion not an issue.
	Landscape and Visual (including light)	**Significant comparative advantage over other options** This Option assumes minimal physical intervention in existing environment and therefore, there are no likely significant impacts on existing landscape or visual characteristics. Likely Visual impacts to properties in the vicinity.	**Some comparative disadvantage over other options** This Option has the potential to impact on 'High' and 'Moderate' Value hedgerows identified in the Kilcock LAP within the Branganstown area, where a new road is proposed. Likely Visual impacts to properties in the vicinity.	**Some comparative disadvantage over other options** The proposed option is located within the 'Northern Lowlands' landscape character type as identified by the Kildare CDP. This landscape has low sensitivity, whereby it *"has the capacity to generally accommodate a wide range of uses"* . However, the proposed option will have an impact on landscape at local level by introducing road infrastructure into an agricultural setting. The alignment of the new road is likely to have a moderate visual impact on residential properties at Newtown Hall Estate, Maynooth which are located in close proximity to the development. A slight visual impact on 3 residential properties located along the L5041 is also likely.	**Significant comparative disadvantage over other options** The development of a bridge structure is likely to have significant landscape and visual impact on the Royal Canal, a pNHA defined as a Area of High Amenity in the KCDP. It will result in a new landscape feature likely to obstruct scenic views along the Canal. Additionally, this option is likely to have a significant visual impact on Jackson's Bridge (and lock), a protected structure and a listed view. (Kildare County Development Plan Scenic view "RC8 Jackson's Bridge Laraghbryan East" and "RC9 Chambers Bridge Maw" views to and from /on the Royal Canal.
	Biodiversity (flora and fauna)	**Some comparative advantage over other options** Route on existing roads but increasing in traffic over longer distance.	**Some comparative advantage over other options** New road required but increase in traffic over shorter distance.	**Some comparative advantage over other options** New road required but increase in traffic over shorter distance.	**Significant comparative disadvantage over other options** New bridge required over pNHA and land take on both sides of the pNHA.
	Cultural, Archaeological and Architectural Heritage	**Significant comparative advantage over other options** No impact as existing road network is being utilised	**Some comparative disadvantage over other options** Potential for negative direct impacts on previously unrecorded archaeological sites where new road is required	**Some comparative disadvantage over other options** Potential for negative direct impacts on previously unrecorded archaeological sites where new road is required	**Some comparative disadvantage over other options** Potential for negative direct impacts on historic town of Maynooth (RMP), if road widening required, along with potential indiect impacts on Maynooth ACA. Potential for indiect impacts on Kilcock ACA
	Water Resources	**Significant comparative advantage over other options** Low risk to surface water if proper mitigation measures are followed during construction. No indicators of flood risk to the proposed route. Majority of route within Moderate groundwater vulnerability. limited threat to groundwater.	**Significant comparative advantage over other options** Low risk to surface water if proper mitigation measures are followed during construction. No indictors of flood risk to the proposed route. Majority of route within Moderate groundwater vulnerability. limited threat to groundwater.	**Some comparative disadvantage over other options** Requires new crossing of River Lyreen and tributary. Additional crossing may pose risk to water quality during construction and operation. Extensive Flooding within the vicinity of Maynooth. Proposed road within River Lyreen floodplain. New road and crossing is proposed within area of high to extreme groundwater vulnerability. Threat to groundwater.	**Some comparative disadvantage over other options** Requires new crossing of the Royal Canal. Additional crossing may pose risk to water quality during construction and operation. Extensive Flooding within the Vicinity of Maynooth and Kilcock. Proposed route in or directly adjacent to floodplain. Majority of route within Moderate groundwater vulnerability. limited threat to groundwater.
	Agriculture and Non-Agricultural	**Significant comparative advantage over other options** Route 1a / 1b - Route opnion involves non-agricultural lands (public road) only. There are no direct impacts on agricultural or other non-agricultural property. Will not impact on access to property. Will not impact on agricultural & non-agricultural property.	**Significant comparative disadvantage over other options** Route 2 - Impact upon agricultural lands, non-agricultural (community / amenity) lands and public road. Existing adjoining land use consists of agricultural lands comprised of grassland used for livestock grazing and are subject to Planning for Residential Development (Ref. 2097). Non-agricultural property consists of Kilcock GAA Club and public road. Direct impacts on agricultural lands (subject to PP) include medium levels of landtake and severance. Direct impacts to non-agricultural property include landtake to community / amentiy property (Kilcock GAA).	**Some comparative disadvantage over other options** Route 3 - Impact upon agricultural lands and public road. Direct impacts on agricultural lands include low to medium level of landtake and severance. Route 3 will involve medium land severance on one property.	**Some comparative advantage over other options** Impact upon agricultural lands and public road. Direct impacts on agricultural lands include low level of landtake and severance. Route will involve a low level of land severance on one property.
	Geology and Soils (including Waste)	**Some comparative advantage over other options** No signifncat mpacts of soils or geolog	**Some comparative advantage over other options** No signifncat mpacts of soils or geolog	**Some comparative disadvantage over other options** New road will require removal of soil resources	**Some comparative advantage over other options** New bridge structure requried. No signifncat impacts on soils or geology resources.
	Radiation and Stray Current	**Comparable to other options** The main sources of EMI from the proposed development will be the traction supply system , MV ring, HV lines, substation and comms infrastructure. Assuming that routing of the cabling, the location of substations, hubs etc. along the line are not impacted by the selection of any of these options then all options are comparable from an EMI perspective.	**Comparable to other options** The main sources of EMI from the proposed development will be the traction supply system , MV ring, HV lines, substation and comms infrastructure. Assuming that routing of the cabling, the location of substations, hubs etc. along the line are not impacted by the selection of any of these options then all options are comparable from an EMI perspective.	**Comparable to other options** The main sources of EMI from the proposed development will be the traction supply system , MV ring, HV lines, substation and comms infrastructure. Assuming that routing of the cabling, the location of substations, hubs etc. along the line are not impacted by the selection of any of these options then all options are comparable from an EMI perspective.	**Comparable to other options** The main sources of EMI from the proposed development will be the traction supply system , MV ring, HV lines, substation and comms infrastructure. Assuming that routing of the cabling, the location of substations, hubs etc. along the line are not impacted by the selection of any of these options then all options are comparable from an EMI perspective.

In terms of accessibility and social inclusion option 4 has not effects on the traffic of the local roads surrounding the depot.

Parameter	Criteria	Option 1	Option 2	Option 3	Option 4
Accessibility & Social Inclusion	Impact on neighbours	Some comparative disadvantage over other options	Some comparative disadvantage over other options	Some comparative disadvantage over other options	Some comparative advantage over other options
		Neighbours are affected by a higher traffic density on existing local roads	Neighbours are affected by a higher traffic density on existing residential roads	Neighbours are affected by a higher traffic density on existing residential roads	There are no increase on the traffic density on local roads, only in the regional R148. Neighbours have better connectivity over the mainline and the Royal Canal.

For the safety option 4 .provides direct access from R148 increasing other traffic safety.

Parameter	Criteria	Option 1	Option 2	Option 3	Option 4
Safety	Vehicular Traffic Safety	Some comparative disadvantage over other options	Some comparative disadvantage over other options	Some comparative disadvantage over other options	Some comparative advantage over other options
		Interface with residential traffic. Existing narrow road.	Interface with residential traffic	Interface with residential traffic	Direct access from regional road
	Pedestrian, Cyclist and Vulnerable Road user Safety	Some comparative disadvantage over other options	Some comparative disadvantage over other options	Some comparative disadvantage over other options	Some comparative advantage over other options
		Interface with residential traffic. Existing narrow road.	Interface with residential traffic	Interface with residential traffic	Direct access from regional road

Finally, for physical activity it is considered the local connectivity where option 4 is again the best valued.

Parameter	Criteria	Option 1	Option 2	Option 3	Option 4
Physical Activity	Permeability and local connectivity opportunity	Some comparative disadvantage over other options	Some comparative disadvantage over other options	Some comparative disadvantage over other options	Some comparative advantage over other options
		No improvement on local connectivity	No improvement on local connectivity	No improvement on local connectivity	Increase local connectivity at both sides of mainline

10.5 Summary

Option 4 has been selected as the Emerging Preferred Option and it will be taken forward in the reference design and presented to Public Consultation No. 1.

The main merits of this alternative are related to economy (providing clear improvements in journey time), integration with the existing road network, accessibility & social inclusion, safety and physical activity.

The demerits are related to construction and long term maintenance costs and environment where excavations and works of the new bridge pose a higher potential risk to groundwater quality and soils but some mitigation measures could keep under control this issue.

11 APPENDIX 1. Content of the maintenance exams DART fleet

Following there are some tables showing the content of the different maintenance exams envisaged for the DART fleet based on the current 8500 fleet. This information was received by means of the RFI 150 regarding the depot activities.

Table 12. Summary of the content in the Periodical Exam A

ALL STAFF	MECHANICAL	ELECTRICAL
1. Air Horn Test 2. Sandbox Filling 3. Headlights and Tail lights function test 4. Passenger doors intermediate check 5. Drivers defect log book check 6. Emergency equipment	1. Air compressor check oil level 2. Windscreen Wiper, Washer Check and Bottle Fill 3. Brake Pads – Intermediate Check 4. Brake Test - Functional Test 5. Autocoupler - Manual Operation Check 6. Axle and Brake Disc - Visual Examine 7. Visual Assessment of Wheels 8. Underframe and Bogie Visual Exam	1. Pantograph – Intermediate Visual Inspection 2. Underframe and Bogies – Visual Electrical Examine

Table 13. Summary of the content in the Periodical Exam C1

C1 Body Exam	**CAB**	**SALOON**	**EXTERIOR**
	Drivers Defect Log Book – Check Windscreen Examine Cab Interior Inspection Driver’s Seat – Examination Cab Door – Examination Emergency Equipment - Check	PIS – Check Saloon Interior Equipment Check. Internal Doors – Examination Passenger Doors - Visual Exam	Vehicle Exterior - Examine
C1 Electrical Exam	**CAB**	**SALOON**	**EXTERIOR**
	Drivers Defect Log Book – Check Headlights and Tail lights - Function Test Lamp Test Radio Test Destination Indicators – Examine Emergency Equipment – ChecK PIS Function – Check CCTV System Checks Wheelslide Control Unit Test Cab Air Conditioning – Examination Drivers Desk -Examine	Saloon Lighting Functional Test Passenger Doors - Operation Check Passenger Doors - Functional Test	Isolation Switch – Examine Underframe and Bogies – Electrical Examine Electrical Cupboards - Examine
	BATTERIES	**PANTOGRAPH**	**COUPLER**
	Batteries - Examine	Pantograph - Visual Examination Pantograph - Examination	Auto Coupler - Examine Electrical Heads
C1 Mechanical Exam	**CAB**	**SALOON**	**EXTERIOR**
	Drivers Defect Log Book – Check Brake Test - Functional Test Air Horn – Test Windscreen Wiper, Washer Check and Bottle Fill		Underframe and Bogie Examine Air Compressor - Check Oil level Main Reservoirs drain and integrity check Brake Pads Examine Traction Motor – Examination Drive Gear - Check Oil level Drive Gear – Examine Drive Coupling – Examine Drive Coupling – Lubricate Axle and Brake Disc – Examine Visual Assessment of Wheels
	FLANGE LUBRICATION	**SANDING**	**COUPLER**
	Flange Lubricator – Top Up	Sandbox - Fill	Auto Coupler – Examine Auto Coupler - Gauge Check Semi-Permanent Coupler Inspection Auto Coupler - Check Alignment

Table 14. Summary of the content in the Periodical Exam C2

C1 Body Exam	**CAB**	**SALOON**	**EXTERIOR**
	Drivers Defect Log Book - Check Windscreen Examine Drivers Seat - Examination Second Man's Seat - Examination Cab Interior Inspection Cab Door - Examination Emergency Equipment - Check	Gangway - Examine Saloon Interior Equipment Check. Internal Doors - Examination Passenger Doors - Visual Exam Passenger Doors External Access - Function Test Passenger Doors closing force	Vehicle Exterior - Examine
C1 Electrical Exam	**CAB**	**SALOON**	**EXTERIOR**
	Drivers Defect Log Book - Check Cab Air Conditioning - Renew filters Cab Air Conditioning - Examine Headlights and Tail lights - Function Test Radio Test Lamp Test Destination Indicators - Examine Emergency Equipment - Check PIS Function - Check Master Controller - Examine Wheelslide Control Unit Test Drivers Desk -Examine	Saloon Lighting Functional Test Saloon Air Conditioning - Renew filters Saloon Air Conditioning - Examination Passenger Doors - Operation Check	Underframe and Bogies – Electrical Examine Dynamic Brake Resistors - Examine Auxiliary Power Unit Case - Examine Traction Invertor Case – Examine Filter Reactor Case – Examine
	BATTERIES	**PANTOGRAPH**	**COUPLER**
	Batteries - Examine	Pantograph - Visual Examination	Auto Coupler - Examine Electrical Heads
C1 Mechanical Exam	**CAB**	**SALOON**	**EXTERIOR**
	Drivers Defect Log Book - Check Brake Test - Functional Test Air Horn - Test Windscreen Wiper, Washer Check and Bottle Fill	Aux Compressor - Check Oil level	Underframe and Bogie Examine Air Compressor - Check Oil level Air Dryer Functional Check Main Reservoirs drain and integrity check Compressor Governor Check and Leakage Test Brake Pads Examine Traction Motor - Examination Drive Gear - Check Oil level Visual Assessment of Wheels Axle and Brake Disc - Examine
	FLANGE LUBRICATION	**SANDING**	**COUPLER**
	Flange Lubricator – Top Up	Sandbox - Fill	Auto Coupler - Examine

Table 15. Summary of the content in the Periodical Exam C3

C1 Body Exam	**CAB**	**SALOON**	**EXTERIOR**
	Drivers Defect Log Book - Check Windscreen Examine Cab Interior Inspection Driver's Seat - Examination Cab Door - Examination Emergency Equipment - Check	PIS - Check Saloon Interior Equipment Check. Internal Doors - Examination Passenger Doors - Visual Exam Passenger Doors - Obstacle Detection	Vehicle Exterior - Examine
C1 Electrical Exam	**CAB**	**SALOON**	**EXTERIOR**
	Drivers Defect Log Book - Check Headlights and Tail lights - Function Test Radio Test Lamp Test Destination Indicators - Examine Emergency Equipment - Check PIS Function - Check Wheelslide Control Unit Test CCTV System Checks CCTV Hard Drive Change Cab Air Conditioning - Examine Drivers Desk -Examine	Saloon Lighting Functional Test Train Energy Monitoring System (TEMS) - Examine	Underframe and Bogies – Electrical Examine Passenger Doors - Operation Check Electrical Cupboards - Examine
	BATTERIES	**PANTOGRAPH**	**COUPLER**
	Batteries - Examine	Pantograph - Visual Examination Pantograph - Examination	Auto Coupler - Examine Electrical Heads
C1 Mechanical Exam	**CAB**	**SALOON**	**EXTERIOR**
	Drivers Defect Log Book - Check Brake Test - Functional Test Air Horn - Test Windscreen Wiper, Washer Check and Bottle Fill		Underframe and Bogie Examine Air Compressor - Check Oil level Main Reservoirs drain and integrity check Air System Safety Valve - Clean Seat Brake Callipers – Inspection Brake Pads Examine Traction Motor - Examination Drive Gear - Check Oil level Axle and Brake Disc - Examine Visual Assessment of Wheels Wheel Diameter Gauging
	FLANGE LUBRICATION	**SANDING**	**COUPLER**
	Flange Lubricator – Top Up Flange Lubricator – Examine	Sandbox - Fill Sanding System - Integrity Check	Auto Coupler - Examine Auto Coupler - Gauge Check Semi-Permanent Coupler Inspection Auto Coupler - Check Alignment

Table 16. Summary of the content in the Periodical Exam C4

C1 Body Exam	**CAB**	**SALOON**	**EXTERIOR**
	Drivers Defect Log Book - Check Windscreen Examine Driver's Seat - Examination Second Man's Seat - Examination Cab Interior Inspection Cab Door - Examination Emergency Equipment - Check	Saloon Interior Equipment Check. Internal Doors - Examination Passenger Doors - Visual Exam	Vehicle Exterior - Examine
C1 Electrical Exam	**CAB**	**SALOON**	**EXTERIOR**
	Drivers Defect Log Book - Check Cab Air Conditioning - Examine Headlights and Tail lights - Function Test Radio Test Lamp Test Destination Indicators - Examine Emergency Equipment - Check PIS Function - Check Master Controller - Examine Wheelslide Control Unit Test Drivers Desk -Examine	Saloon Lighting Functional Test Passenger Doors - Operation Check	Underframe and Bogies – Electrical Examine Dynamic Brake Resistors - Examine Isolation Switch - Examine Auxiliary Power Unit Case - Examine Traction Invertor Case – Examine
	BATTERIES	**PANTOGRAPH**	**COUPLER**
	Batteries - Examine Batteries Topping Up	Pantograph - Visual Examination	Auto Coupler - Examine Electrical Heads
C1 Mechanical Exam	**CAB**	**SALOON**	**EXTERIOR**
	Drivers Defect Log Book - Check Brake Test - Functional Test Air Horn - Test Windscreen Wiper, Washer Check and Bottle Fill	Auxiliary Air Compressor – Check/Renew Air filters Auxiliary Compressor Oil Change Aux Compressor Safety Valve - Clean Seat	Air Compressor - Renew Filter Element Air Compressor - Clean Cooler Change Main Compressor Oil Air Dryer Functional Check Main Reservoirs drain and integrity check Brake Pads Examine Traction Motor – Examination Drive Gear - Check Oil level Drive Gear - Oil Sampling and Oil Change Drive Coupling - Examine Axle and Brake Disc - Examine Visual Assessment of Wheels Underframe and Bogie Exam
	FLANGE LUBRICATION	**SANDING**	**COUPLER**
	Flange Lubricator – Top Up	Sandbox - Fill	Auto Coupler - Examine

Table 17. Summary of the content in the Periodical Exam C5

C1 Body Exam	**CAB**	**SALOON**	**EXTERIOR**
	Drivers Defect Log Book - Check Windscreen Examine Drivers Seat - Examination Cab Interior Inspection Cab Door - Examination Emergency Equipment - Check	Gangway - Examine PIS - Check Saloon Interior Equipment Check. Internal Doors - Examination Passenger Doors - Visual Exam Passenger Doors External Access - Function Test Passenger Doors closing force – Measure	Vehicle Exterior - Examine
C1 Electrical Exam	**CAB**	**SALOON**	**EXTERIOR**
	Drivers Defect Log Book - Check Headlights and Tail lights - Function Test Radio Test Lamp Test Destination Indicators - Examine Emergency Equipment - Check PIS Function - Check Wheelslide Control Unit Test CCTV System Checks Cab Air Conditioning - Examine Drivers Desk -Examine	Saloon Lighting Functional Test Saloon Air Conditioning - Renew filters Saloon Air Conditioning - Examination	Underframe and Bogies – Electrical Examine Passenger Doors - Operation Check Filter Reactor Case – Examine Electrical Cupboards - Examine
	BATTERIES	**PANTOGRAPH**	**COUPLER**
	Batteries - Examine	Pantograph - Visual Examination Pantograph - Examination	Auto Coupler - Examine Electrical Heads
C1 Mechanical Exam	**CAB**	**SALOON**	**EXTERIOR**
	Drivers Defect Log Book - Check Brake Test - Functional Test Air Horn - Test Windscreen Wiper, Washer Check and Bottle Fill		Underframe and Bogie Examine Air Compressor - Check Oil level Main Reservoirs drain and integrity check Flexible Delivery Hose - Check Integrity and damage Compressor Governor Check and Leakage Test Brake Pads Examine LMRG Pressure Switch – Check Operation Traction Motor - Examination Drive Gear - Check Oil level Axle and Brake Disc - Examine Visual Assessment of Wheels
	FLANGE LUBRICATION	**SANDING**	**COUPLER**
	Flange Lubricator – Top Up	Sandbox - Fill	Auto Coupler - Examine Auto Coupler - Gauge Check Semi-Permanent Coupler Inspection Auto Coupler - Check Alignment

Table 18. Summary of the content in the Periodical Exam C6

Exam			
C1 Body Exam	**CAB**	**SALOON**	**EXTERIOR**
	Drivers Defect Log Book - Check Windscreen Examine Driver's Seat - Examination Cab Interior Inspection Second Man's Seat - Examination Cab Door - Examination Emergency Equipment - Check	Saloon Interior Equipment Check. Internal Doors - Examination Passenger Doors - Visual Exam Passenger Doors - Obstacle Detection	Vehicle Exterior - Examine
C1 Electrical Exam	**CAB**	**SALOON**	**EXTERIOR**
	Drivers Defect Log Book - Check Cab Air Conditioning - Examine Headlights and Tail lights - Function Test Radio Test Lamp Test Destination Indicators - Examine Emergency Equipment - Check PIS Function - Check Master Controller – Remove and Examine Wheelslide Control Unit Test Drivers Desk -Examine	Saloon Lighting Functional Test Passenger Doors - Operation Check	Underframe and Bogies – Electrical Examine Dynamic Brake Resistors - Examine Auxiliary Power Unit Case - Examine Traction Invertor Case – Examine
	BATTERIES	**PANTOGRAPH**	**COUPLER**
	Batteries - Examine	Pantograph - Visual Examination	Auto Coupler - Examine Electrical Heads
C1 Mechanical Exam	**CAB**	**SALOON**	**EXTERIOR**
	Drivers Defect Log Book - Check Brake Test - Functional Test Air Horn - Test Windscreen Wiper, Washer Check and Bottle Fill	Aux Compressor - Check Oil level	Underframe and Bogie Examine Air Compressor - Check Oil level Air Dryer Functional Check Main Reservoirs drain and integrity check Air Compressor Safety Valve – Clean Seat Brake Pads Examine Traction Motor - Examination Drive Gear - Check Oil level Axle and Brake Disc - Examine Visual Assessment of Wheels Wheel Diameter Gauging Flange Gauging Wheels- hollow Wear Gauging
	FLANGE LUBRICATION	**SANDING**	**COUPLER**
	Flange Lubricator – Top Up Flange Lubricator – Examine	Sandbox - Fill Sanding System - Integrity Check	Auto Coupler - Examine

Table 19. Summary of the Heavy maintenance activities and cadence for the 8500 fleet

	HM activities for the current 8500 fleet	Cadence
HM 1	85type - Electrical 2Yr Exam	2
	85type - Pneumatic 2 Year Purge Valve Exam	2
	85type - Reservoir HM 2 Year	2
HM2	8500 Wheel Change (cadence to be agreed) IDOM's assumption: 4 years	4
	8500/8520 - Bogie Overhaul (cadence to be agreed) IDOM's assumption: 4 years	4
	85type - 4 Year Heating Exam (8500/8510)	4
HM3	8500/8510 - Pantograph 5Yr	5
HM4	85type - Inter Coupler 8year Overhaul	6
	85type - Auto Coupler 8year Overhaul	6
	85type - HSCB 8 Year	6
	85type - L1/L2 Breakers 8 Year	6
HM5	85type - 8 Year Heating Exam HVAC (8520)	8
	85type - Electrical 8Yr Exam	8
	85type - Battery Overhaul 8 Year	8
	85type - Traction /SIV Battery 8 Year Exam	8
	85 Type - Pneumatic 8 Year Exam	8
	85type - Air Supply Module 8 Year	8
	85ytype - Body Exam 8 Year	8
HM6	85type - 10 year Pneumatic Exam	10
HM7	85type - Battery Door Exam 12 Year	12
	8500/8510 - Seat Cover Replacement 12 Year	12
	85 Type - Reservoir Testing (cadence to be agreed) IDOM's assumption: 4 years	12
	85 Type - Drivers seats NEW (cadence to be agreed) IDOM's assumption: 4 years	12

12 APPENDIX 2. Road access routes

Following, there is a map overview of the road access routes assessed for the depot as well as pictures of the different routes.

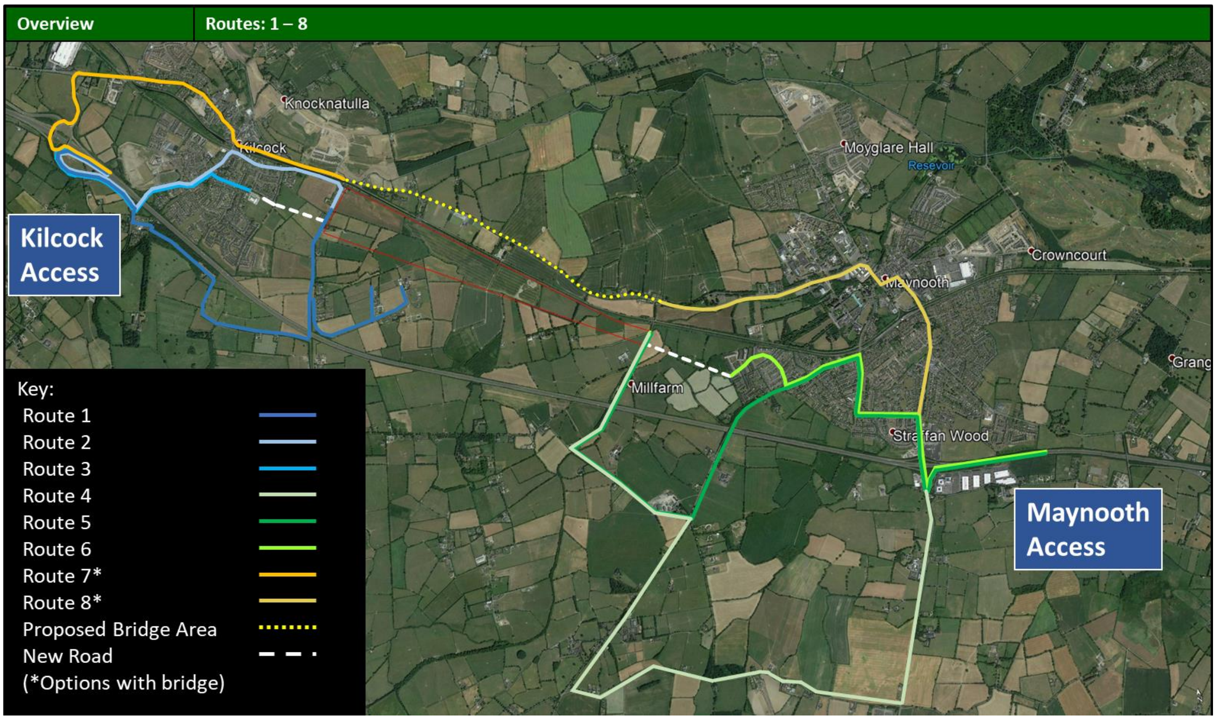


Figure 121: Road access routes

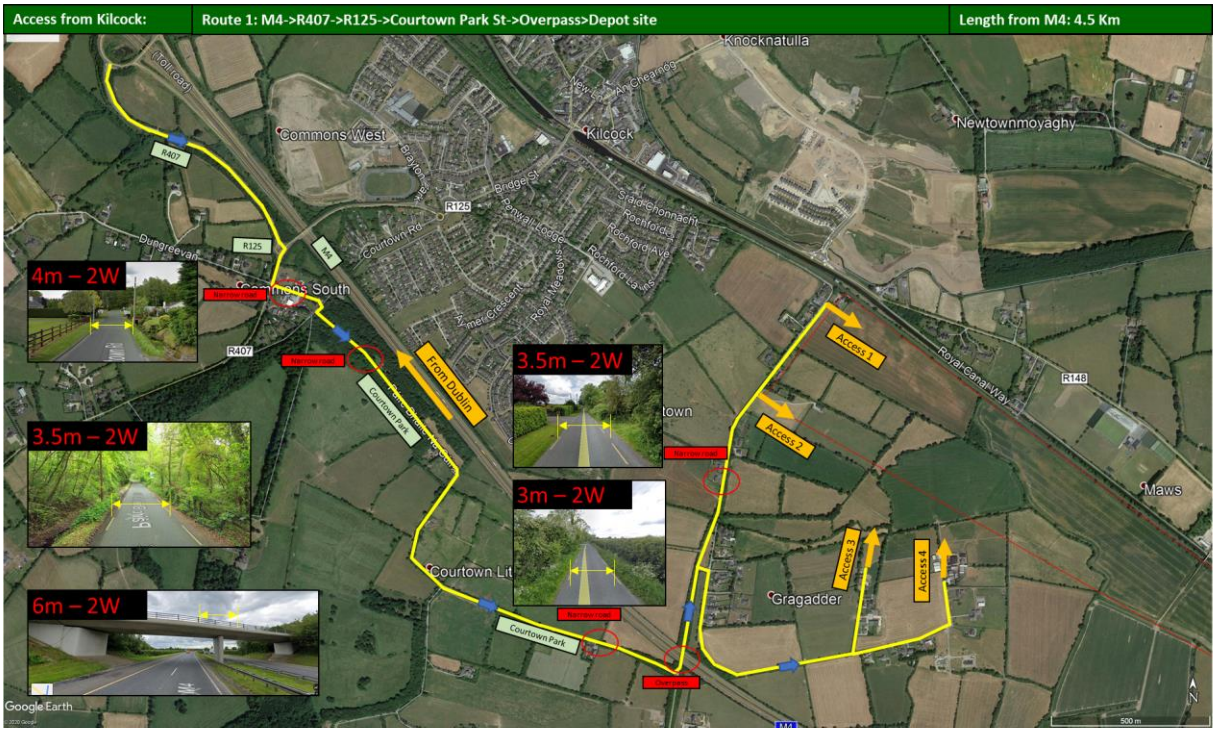


Figure 122: Route 1

Figure 123: Route 2

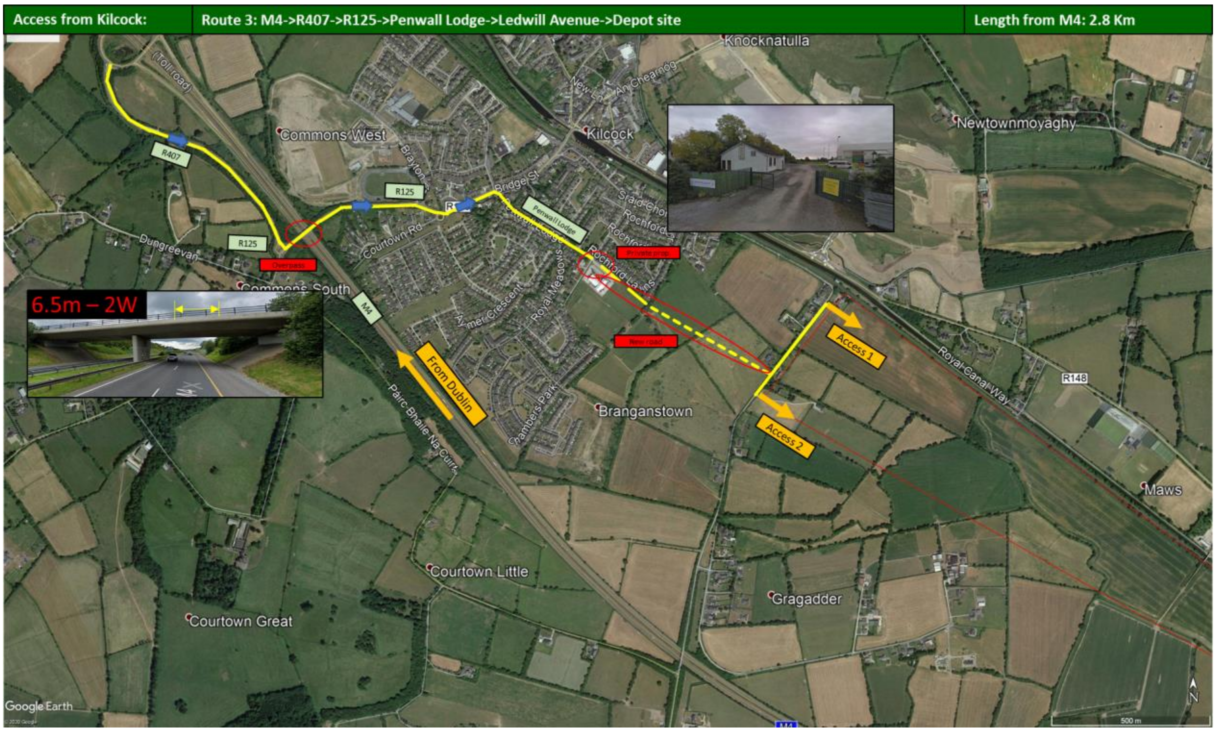


Figure 124: Route 3

Figure 125: Route 4

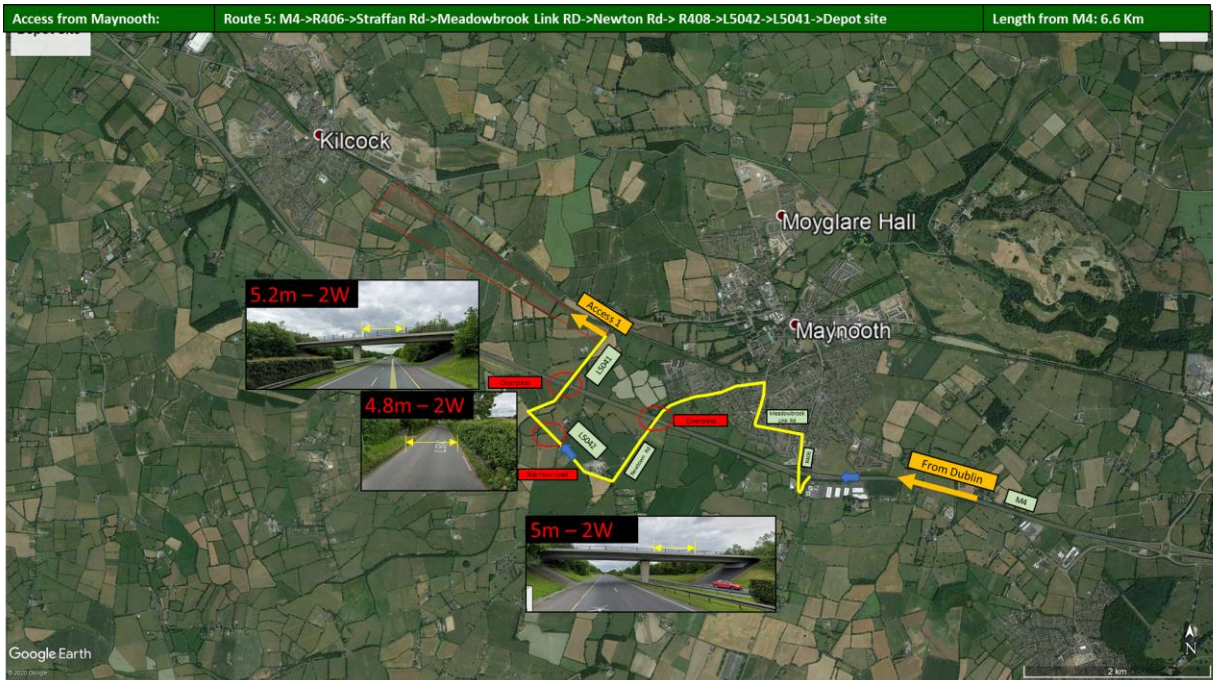


Figure 126: Route 5

Figure 127: Route 6

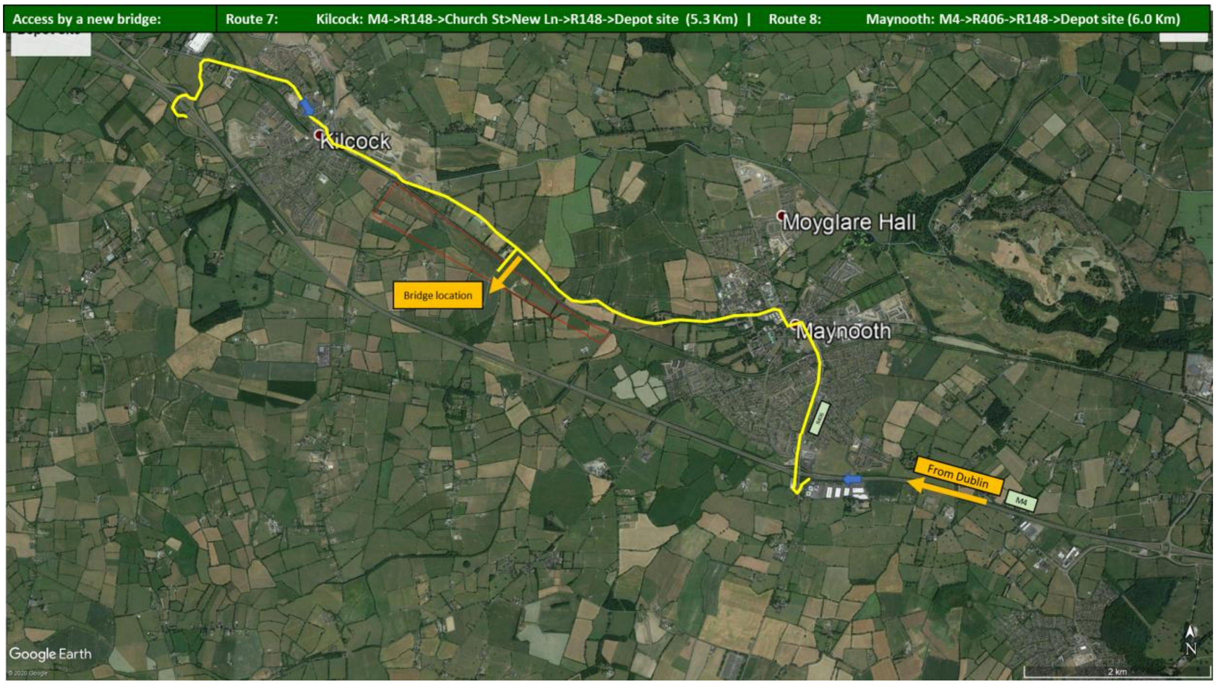


Figure 128: Route 7 and 8