

# DART+ Depot Project Report

## Appendix D – Mainline Options Selection Report

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**DART+ Depot**

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## Executive Summary

This report aims to present the process followed to assess the options within the section of new twin tracking between Maynooth and the Depot West of Kilcock. To bring the double track and the electrification to the Depot, and across Kilcock, several constrained sections have been assessed, and all the available options to provide the necessary elements as part of the scheme have been studied to land on the preferred option.

Among the various elements under consideration, the electrification and double-tracking at Jackson's Bridge, identified as the most critical point in this railway section, have been assessed through a multi-criteria analysis (mca), as the existing structure does not provide sufficient vertical clearance. For this new process, an optioneering exercise has been carried out for Jackson's Bridge, based on a systematic examination of alternative design solutions and products to better address the major challenges of the DART+ programme. This analysis considers the impact of each design solution or product, the project's cost, maintenance, environmental footprint and safety, considering the quantifiable and non-quantifiable impacts of each option and allowing to make a recommendation on which is the preferred option. The mca process provides a valuable tool in prioritising schemes for investment and supporting decision making.

A separated report with the analysis of the preferred option for the construction of the platforms for the new DART Kilcock Station has been produced (see Appendix E).

# 1 Introduction

## 1.1 Purpose of This Report

This report presents the early project design work undertaken to determine the preferred option for all the elements as part of the double-tracking and electrification from Maynooth to the Depot West of Kilcock.

This Option Selection Report reflects consideration of the information obtained from surveys and investigations, further design development, engagement with the relevant stakeholders, and evaluation of the design options for Jackson's Bridge following the multi-criteria analysis process.

Bringing the DART service to the Depot West of Kilcock provides for enhancement of existing railway infrastructure over the 8 km length of the railway between the overbridge (OBG21) west of Maynooth Station and the end of the double track west of the Depot entrance. This enhancement entails the installation of a second track, and the electrical and signalling technology needed for the operation of the line. A number of discrete elements of the scheme extend beyond the boundary of the existing railway such as the proposed diversion south of Jackson's Bridge, several electrical buildings located along the line, and the intervention on the plaza in front of Kilcock Station. Alternatives in respect of many of the linear elements of electrical, signalling and telecommunications works vary little from an environmental perspective and, as a consequence, the options assessment for such elements is largely a technical matter rather than an issue of environmental impact.

While presenting a description of the end-to-end preferred option, this OSR has been drafted with a focus on Jackson's Bridge options, given that this is the one element for which significantly alternative options manifest, options which are markedly different from one another, and which have varied impact on the local environment. This notwithstanding, justification on the location for other elements, such as the substation and other minor electrical buildings along the route, the new car park and bike parking on the station, and the construction compounds, is covered in this report.

## 1.2 Report Structure

This Mainline Options Selection Report is structured to bring the reader through the key design elements and the associated options assessment process for Jackson's Bridge, and presents the summary and recommendation, under the main design elements.

The Report is structured as follows:

- Chapter 1: Introduction
- Chapter 2: DART+ Depot
- Chapter 3: Description of the end-to-end Preferred Option
- Chapter 4: Jackson's Bridge
- Chapter 5: New Kilcock Substation
- Chapter 6: Kilcock Station
- Chapter 7: Construction Compounds

## 1.3 Abbreviations and Reference Documents

The following table documents the list of abbreviations that may be found in this report and the explanation of their meaning:

**Table 1. Abbreviations**

Abbreviation	Meaning
CAF	Common Appraisal Framework for Transport Project and Programmes
CCE	Chief Civil Engineer

cwh	Contact wire Height
CWR	Continuous Welded Rail
DART	Dublin Area Rapid Transport (IÉ's Electrified Network)
DMRB	Transport Infrastructure Ireland Design Manual of Roads and Bridges
DMU	Diesel Multiple Unit
EIAR	Environmental Impact Assessment Report
EMU	Electric Multiple Unit
ESB	Electricity Supply Board
FRS	Functional Requirements Specifications
GDA	Great Dublin Area
GSWR	Great Southern and West Railway
IAMS	Infrastructure Asset Management System
IÉ	Iarnród Éireann/Irish Rail
Jct	Junction
Km	Kilometres
Km/h	Kilometres per hour
m	Metres
m/s	Metres per second
mm	Millimetres
mca	Multi-Criteria Analysis
MDC	Multi-Disciplinary Consultant (IDOM, for DART+ West)
MGWR	Midland Great Western Railway
mph	Miles per hour
NIAH	National Inventory of Architectural Heritage
NNTR	Notified National Technical Rule
NTA	National Transport Authority
OB	Over Bridge
OCR	Overhead Conductor Rail
OHLE	Overhead Line Equipment
OPW	Office of Public Works
OSR	Option Selection Report
PS	Protected Structure
PSR	Permanent Speed Restrictions
P&C	Points and Crossings
RO	Railway Order
RPS	Record of Protected Structures
s	Seconds
SET	Signalling, Electrification, and Telecommunications
TOR	Top of Rail
TMS	Technical Management Standard
UB	Under Bridge

The following table documents a list of the reference documents used that may be found in this report and the explanation of them.

**Table 2. Reference Documents**

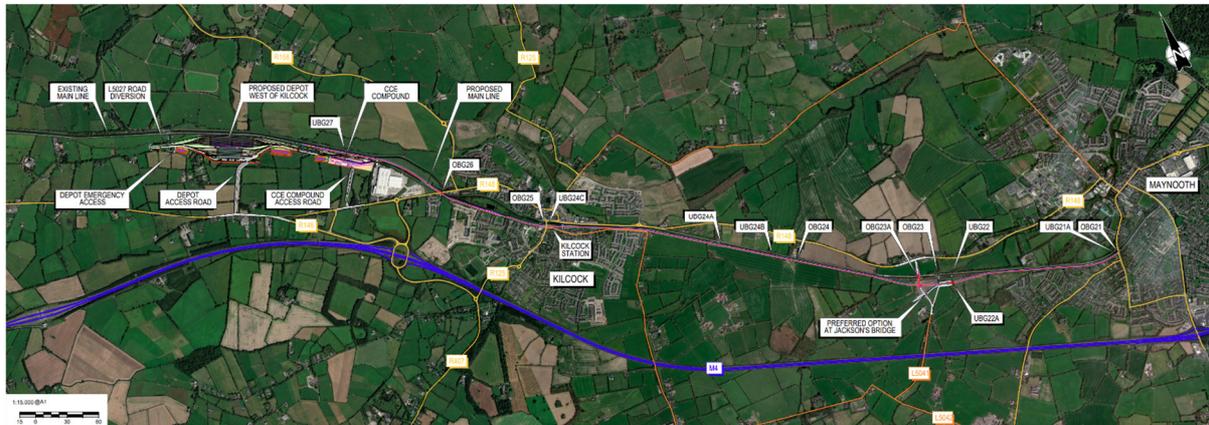
Document	Description
MAY-MDC-RGN-ROUT-RP-Y-0001	OHLE Clearance Option Selection Report
MAY-MDC-ENV-ROUT-RP-D-0001	Flood risk assessment Stages 1&2
MAY-MDC-ELE-ROUT-RP-E-0002	OHLE Early Clearance Assessment Report
MAY-MDC-ELE-ROUT-RP-E-0001	Options Study Electricity Report
MAY-MDC-GEN-DEPM-RP-Y-0004	Depot Strategy Study Report
MAY-MDC-GEN-ROUT-ME-Y-0001	Stage 2 mca Methodology Briefing Memo
COMMON APPRAISAL FRAMEWORK FOR TRANSPORT PROJECTS AND PROGRAMMES	Common Appraisal Framework for Transport Projects and Programmes and explains the steps to be used in the appraisal of transport projects and programmes for which the Department of Transport, Tourism and Sport or its agencies are Sanctioning Authorities.
MAY-MDC-TRK-ROUT-RP-C-0002	Permanent Way Preliminary Options Selection Report
MAY-MDC-TRK-ROUT-RP-C-0003	Permanent Way Cross Section Report
I-ETR-4101	Maintenance Parameters for 1500 Vdc OHLE
CME-TMS-327	Vehicle Gauging
I-PWY-1101	Requirements for Track and Structures Clearances
Overbridges Maynooth Route	List of Overbridges in the Maynooth Line
DE Electrification Assessment Report	DART+ – Rail Electrification Assessment
3210 Maynooth Pack2 Topo 2D ITM Rev01	Maynooth Topo Survey Package 2 – July / Sept 2011
3210 Maynooth Pack2 Topo 3D ITM Rev01	Maynooth Topo Survey Package 2 – July / Sept 2011
3210 Maynooth Pack4 Topo 2D ITM Rev1	Maynooth Topo Survey Package 4 – July / Sept 2011
3210 Maynooth Pack4 Topo 3D ITM Rev1	Maynooth Topo Survey Package 4 – July / Sept 2011
3418 T1 M50 2D	Package 1 M50 Area 12/08/2011
3418 T1 M50 3D	Package 1 M50 Area 12/08/2011
3418 T2 2D	Package 1 19/08/2011
3418 T2 3D	Package 1 19/08/2011
3422 T1 2D	Package 5 Maynooth to Kilcock 18/08/2011
3422 T1 3D	Package 5 Maynooth to Kilcock 18/08/2011
110704 Maynooth Railway Elev and Sec	Maynooth Railway 23/09/2011
Maynooth Line Package 3 final	Maynooth Package 3

## 2 The DART+ Depot Project

DART+ Depot, part of the DART+ West project, will introduce electrified high-capacity trains at increased frequency for the section between Maynooth Station and Kilcock Station. The new trains will have higher passenger carrying capabilities and their frequency will increase following some phasing up to 6 trains per hour per direction in the line. This will be achieved through modernisation of the track infrastructure (signalling, and electrification) and the construction of a second track.

The double-track will be extended West up to the connection to the new Depot.

The following Figure provides the overall area part of the project.



**Figure 1. Proposed DART+ Depot project area**

The overall scope of the DART+ Depot project includes the following key elements of infrastructural work:

- Provision of a new train maintenance and stabling depot;
- Twin-tracking from OBG21 towards the west, through Kilcock Station and up to the connection to the Depot;
- Electrification through the installation of overhead line equipment over the tracks to provide power to the new fleet for the projected capacity increase;
- Signalling and telecommunications to support the project capacity increase;
- Modifications to the existing Kilcock Station with the construction of a second platform and its subsequent accessible access, the increase of the car park spaces, and the inclusion of a new bike parking facility;
- Roadworks associated with the modifications and new elements in the route;
- The construction of a new substation to provide power to the overhead line equipment;
- The use of land for temporary construction / storage compounds; and
- All the necessary ancillary elements to facilitate the service, including crossovers, a new siding west of Kilcock, and several new systems buildings (for telecommunication, signalling and low voltage supply) along the route.

By providing a sustainable, electrified, faster, reliable and user-friendly rail system that will increase train frequencies and customer carrying capacity, the DART+ Depot facilitates compact sustainable development in the GDA and supports Government's climate change objectives.

## 3 Description of the end-to-end Preferred Option

### 3.1 Introduction

Chapters 3 to 8 of this document set out a description of the Preferred Option for DART+ Depot from Maynooth to Kilcock progressing from east to west.

A significant characteristic of the proposed DART+ West is that much of the associated works can be implemented on the existing railway infrastructure and within CIE property. Where it is necessary to carry out works outside the operational railway and in third party lands, the locations are discrete and localised.

## 3.2 General Linear Works

A number of elements of the works are general linear works required along the full length of the project to enable the electrification of the line and the double-tracking of the existing network:

- Overhead Line Equipment (OHLE) will be required to provide electrical power to the network's new electrified train fleet. This will be the same proposed for all the other projects part of the DART+ Programme;
- Signalling upgrades and additional signalling infrastructure will be required to the upgraded infrastructure to allow the trains to run at a higher frequency. Signalling infrastructure will include the associated low voltage power supply and telecommunications;
- Ancillary equipment cabins associated with electrical, signalling and telecommunications infrastructure;
- Improving boundary walls and fencing to ensure public safety is necessary due to the electrification of the line. This will require increasing the height of the parapets in one bridge and some other minor interventions and consideration in the design to provide the necessary protection and physical segregation between public areas and the railway corridor;
- Alterations to railway tracks, including minor realignment and track lowering will be required at locations to ensure sufficient space for the overhead electrical lines;
- Utility diversions are required to accommodate new and upgraded infrastructure;
- Vegetation management and other ancillary works are also anticipated along the length of the project.

### 3.2.1 Overhead Electrification Equipment

The new DART trains will be electrically powered using 1500V direct current from overhead wires and associated support wires. The appearance will be similar to that used on the existing DART as shown in the Figure 2. Sample DART OHLE Equipment below.



**Figure 2. Sample DART OHLE Equipment**

There are typically four longitudinal wires for each track. In order to carry the wires, structural steel supports are necessary.

A typical steel mast support has been selected and is illustrated in Figure 3. Masts will typically rise to between 6.0m and 8.5m above rail level. It is anticipated they will be located at spacings of between 40m and 60m along the railway.

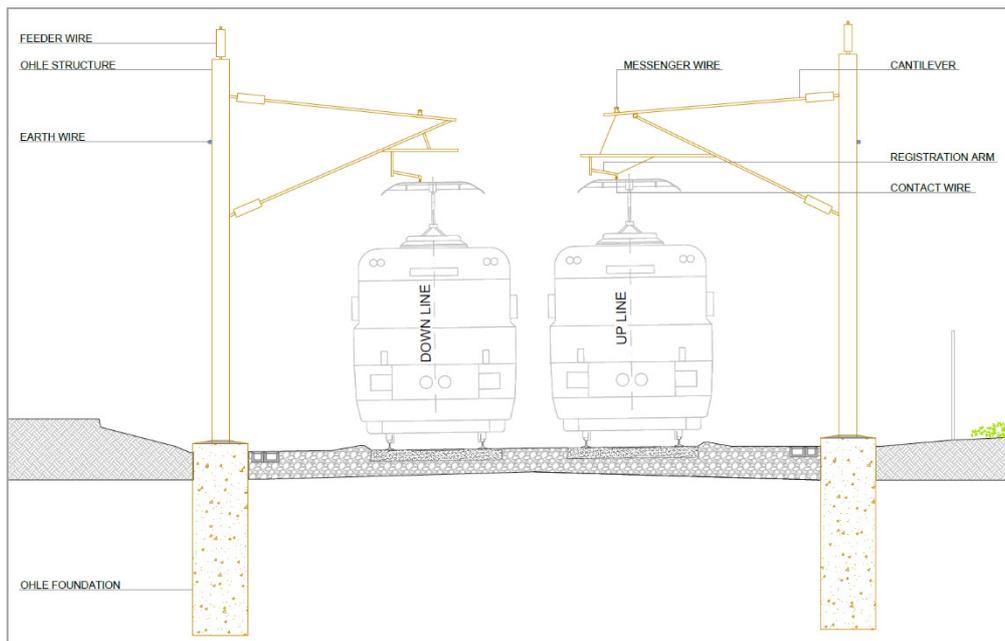


Figure 3. Single Track Cantilever layout

### 3.2.2 Signalling Upgrades and Associated Furniture

The existing railway incorporates signalling infrastructure along its length in the form of underground cables, track level sensors and switches, and visible signals on posts or gantries which communicate instruction to the train drivers along the route. As part of DART+ Depot it is intended to replace the existing signalling system with modern technology which will serve the more frequent train service. The proposed signalling system will incorporate similar components to those already in use. Sample posts and gantries and signal boxes are shown in the figures below.



Figure 4. Sample of Signalling Infrastructure

Portal gantries will only be used in the station or in areas with more than two tracks such as in the siding or the Depot yard.

Telecommunications for a rail project are critical to ensure all train movements are managed and regulated in a safe manner. This is an absolute project requirement to ensure the safety to all passengers using rail services and governed by strict legislation, guidelines and standards. The telecommunications provide a link between the remote signalman, the lineside signal / communications infrastructure and the train driver.

The telecommunications infrastructure includes underground cabling, lineside telecom location cases similar to the sample shown in the figure above and localised building infrastructure. The telecommunications system also controls station infrastructure, such as cameras, telephones, loudspeakers, public information displays for trains, etc. The details of the telecommunications buildings are described in the section below.

### 3.2.3 Ancillary Equipment Cabins

There are a number of equipment cabins which are required to support the signalling, electrical and telecommunication infrastructure. These will be located within existing Iarnród Éireann land where possible, and will be also placed in the station and where similar cabins are currently evident.

The various cabins required along the works are:

- Signalling Equipment Buildings (SEB's);
- Principal Supply Points (PSP's);
- Telecommunication Equipment Rooms (TER's)



Figure 5. Sample Cabins

The cabins are typically fenced off as they need to be secure. A sample set of cabins is shown in Figure 5. Sample Cabins. The sites of equipment cabins are indicated on the Scheme Drawings contained in Appendix A.

### 3.2.4 Interventions in Bridge Parapets and Fences

With the installation of electrified lines, it is necessary to ensure that any public space has the necessary distance to the electrical equipment. This results in the need to raise the parapets of the existing Bailey's Bridge (OBG24) to 1.8m height and provide a standard compliant fence along the whole route to remove the risk of the public coming into contact with the electrification equipment.

### 3.2.5 Trackwork

It is proposed to alter the existing track alignment to facilitate the necessary space for the second track and to ensure there is sufficient space to fit the electrical infrastructure along the route. The alterations typically include modification of the horizontal alignment, lowering sections of the railway and altering the associated drainage and utilities equivalently. They are shown in plan on the Scheme Drawings contained in Appendix A.

### 3.2.6 Utilities Diversion

Existing utilities such as watermains, electricity cables, telecommunications cables and gas mains, both underground and above ground will require temporary and permanent diversion to accommodate the scheme. This will typically involve the relocation of the existing services along new routes to make space for the new infrastructure.

### 3.3 Particular Components Across the Project

In addition to the general linear works discussed above, there are a number of components or treatments which are specific of particular locations within the project boundaries. These elements are:

- Intervention around Jackson's Bridge (OBG23) to provide sufficient clearance for the electrification equipment. This required the study of a number of options which were then the purpose of a specific multi-criteria analysis, as developed in section 4 below.
- Construction of an electrical substation, as presented in section 5 below.
- Interventions at Kilcock Station to accommodate the second track and increase of the number of car park spaces and bike parking in the plaza in front of the station access, as developed in section 6 below.
- Reconstruction of Allen Bridge (OBG26) to provide enough horizontal and vertical clearance for the double-track and the overhead line equipment, as presented in section 7 below.
- Provision of temporary land use for the location of the construction compounds needed during the construction phase of the project, as summarise in section 8 below.

## 4 Jackson's Bridge (OBG23)

### 4.1 Background

In the Early OHLE Clearance Assessment Report (predecessor of the MAY-MDC-RGN-ROUT-RP-Y-0001 and this document) developed as part of the DART+ West project, all the overbridges on the Maynooth line were analysed, looking for and identifying potential challenging bridges that would not allow a standard OHLE solution or that might represent a challenge for the DART+ Programme. During that process, several structures were classified as challenging structures, including Jackson's Bridge (OBG23), object of this section. All those structures were then subject to a multi-criteria analysis (mca) to determine the best solution, included in the MAY-MDC-RGN-ROUT-RP-Y-0001 OHLE Clearance Options Selection Report (predecessor of this document).

The options considered for Jackson's Bridge (OBG23) during that analysis have been revisited for the purpose of the current exercise, and the impacts reassessed incorporating further information acquired in the locality.

### 4.2 Geographical and historical area

This section 4 examines the potential solutions for delivering twin-tracking and electrification through the section of railway beneath Jackson's Bridge (OBG23), where a single track currently passes under the centre-span structure and where vertical-clearance constraints necessitated a detailed optioneering exercise..

Jackson's Bridge (OBG23) is located on the Maynooth to Sligo line at 16 miles 1055 yards mileage, between Maynooth Station and the future DART Depot, in the Lyreen river valley in an area that is susceptible to flooding. The Lyreen River crosses under the railway line and the Royal Canal through a culvert (named UBG22 in this report).



**Figure 6. Jackson's Bridge (OBG23) and Lyreen historic river flooding area**

Jackson's Bridge (OBG23) is a five-arch cut-stone bridge over the canal, railway line and stream, dated 1793.

Kildare CC Protected Structure (RPS no. B05-36) is of considerable social and historical significance representing a component of the canal and railway network development in Ireland in the late-18th and mid-19th centuries.



**Figure 7. Jackson's Bridge (OBG23): Royal Canal span at north, railway span at centre and stream span at the south**

It carries the local road L5401 and is a two-lane bridge 7.41m wide. In addition there is a footpath and an access to a nearby property, which means that any road closure would have an impact on mobility.

Also, any works to the railway bridge, whether raising or rebuilding the arch or merely raising the parapet level, will have implications for the character and setting of the canal bridge and the five-arched bridge as a whole and must be treated with great care and with the agreement of Kildare County Council and all IÉ departments.

The arch of the canal bridge is a shallow segmental arch with a low ratio of rise to span. The arch ring is parallel, and the voussoirs are of hammer-dressed limestone. The abutments of the canal bridge are constructed in limestone ashlar. The barrel of the arch is formed with small, squared limestone rubble. The parapet and spandrels are of squared limestone rubble.



**Figure 8. Eastern face of canal bridge**

The railway bridge carries the road over the railway in a single elliptical arch. The arch ring is parallel and is comprised of chamfered dressed limestone voussoirs with tooled margins. Above the arch ring is a projecting string course of dressed limestone. The arch is flanked on either side by projecting piers or pilasters of limestone ashlar. The spandrels and parapets are of limestone ashlar. The string course and the ashlar masonry continue to the south of the southern pilaster into the southern two arches, while to the north the string course and ashlar do not run beyond the pilaster into the canal bridge.



Figure 9. Western face of the railway bridge (OBG23)

Table 3. OBG23 overbridge information

OB	Description	Type of Structure	Use	PS
OBG23	Jackson's Bridge	Arch Bridge	Cars/Cycles/pedestrians	Yes
			No vehicle weight limits	

### 4.3 Options Analysis Objectives

All the elements considered in the DART+ Programme must be designed to ensure safety and provide the least intrusive and most cost-effective capacity enhancement in conjunction with Permanent Way, Track, Structures and SET development.

**The two primary objectives of this section are:**

- to present the multidisciplinary mca process that has been developed, considering OHLE, Permanent Way and Structures, and
- to determine the preferred solution raising from this mca.

To achieve these main objectives, the MDC has undertaken an optioneering exercise based on a systematic examination of the performance of alternative design solutions and products better to meet the major challenges for the DART+ programme. This exercise takes into account the impact of each solution or product, on the project's cost, maintenance, environmental footprint and safety.

**As a secondary objective**, this optioneering exercise provides and defines (to a concept design stage) all the elements to be assessed and cost to inform the mca process, namely:

- Track design
- Earthworks
- Drainage
- Structures (bridges or retaining walls)
- OHLE design
- Recovery
- Road diversions

- Trackside signage
- Protection or diversion of utilities.

The solutions provided in this section are designed to provide a safe and reliable operation by giving all the OHLE live parts enough distance from other infrastructure, so that flashover is prevented.

As an outcome of this analysis, the MDC is facilitating that the optimum design is developed, helping IÉ to make a fully informed decision before it is moved forward to further design stages.

#### 4.4 Multi-criteria Analysis Matrix Criteria

It is proposed to use a multi-criteria analysis (mca) mechanism to identify the preferred option of all the alternatives to provide an electrified double-track through Jackson's Bridge. The mca will consider the following principal criteria aligned with the Transport Appraisal framework Guidelines:

- Transport User Benefits & Other Economic Impacts
- Accessibility Impacts
- Social Impacts
- Land Use Impacts
- Safety
- Climate Change Impacts
- Local Environmental Impacts

**Table 3** below sets out the criteria, sub-criteria and proposed comparators for the assessment.

**Table 4. Proposed mca Criteria**

TAF Criteria	Sub-Criterion	Opt 1	Opt 2	Opt n	Proposed Data Source for Appraisal
Transport User Benefits & Other Economic Impacts	Alignment with Customer Requirements Specification				Train operation functionality
	Transport Costs and Operational Characteristics				Capital Cost Estimates, Operational Cost Estimates, Operations
Accessibility Impacts	Impacts on existing accessibility				Assessment of access impact to services and jobs
Social Impacts	Social Impacts				Review of socially disadvantaged geographical areas (HP deprivation index) within 1km of site locations. Scores better if in deprived region.
Land Use Impacts	Change in Quality of Public Realm Existing Transport Network and Service Impact:				Extent of alignment with the road network and the local area Impact on Local Road Network
	Zoned Land, Land Use Planning and Spatial Planning				Policy Review: Impact on land use strategies and regional and local plans. Assessment of support for land use factors local land use and planning.
Safety	Collisions & Related Impacts				Operational Configuration of the Site
	Other Safety Impacts				Assessment of Alignment Integration with local urban infrastructure
Climate Change Impacts	Climate Action Impact				Updating of train emissions profile in TUBA
	Climate Adaption Impact				Turnbacks and Crossovers: Flood risk, sites with soil stability issues, wind exposure. Train journeys (additional train running)
	Biodiversity				Environmental constraints assessment of options

TAF Criteria	Sub-Criterion	Opt 1	Opt 2	Opt n	Proposed Data Source for Appraisal
Local Impacts	Environmental				Water Resources & Soil Quality Flood Risk, Hydrogeology, Soils
					Landscape & Visual Quality Environmental constraints assessment of options
					Cultural & Heritage Environmental constraints assessment of options
					Noise & Vibration Estimated number of sensitive receptors (residential properties, community facilities etc) likely to be affected by transport related noise with the project within 50m, 100m, 200m and 300m bands.
					Air Quality Estimated number of sensitive receptors (residential properties, community facilities etc) likely to be affected by transport related noise with the project within 50m, 100m, 200m and 300m bands.

The table above identifies the principal criteria and sub-criteria proposed for use in the assessment. In addition, the proposed source data for comparison of options is included in the right-hand column of the table. Each comparator is described in more detail in Section 4 of this report.

The following mechanism is proposed for assessing options under the above criteria:

- The impact, positive or negative, is assessed on a numeric scale;
- The consolidated impact of a given criterion will have a rating between 1 and 7;
- Where all impacts are to one end of the scale i.e. all positive or all negative, the available range of ratings extends between the median score and the extremes i.e. 1 to 4 or 4 to 7;
- The outcomes for each sub-criteria are consolidated into criteria;
- At each stage of consolidation an averaging mechanism is utilised.

The assessment is proposed to be on an unweighted basis to allow the influence and effectiveness of the comparators to be monitored. A ranked, coloured and numeric scale is envisaged as set out in the graphic below. The assessment will be made on a spreadsheet.

The **Figure** below illustrates the Impact rating, number scale and colour scale.

The following MCA scoring scale example can be used to sift a longlist of options, or to assess scheme impacts at detailed appraisal stage:

7 - Highly Positive Impact	
6 - Positive Impact	
5 - Slight Positive Impact	
4 - Neutral Impact	
3 - Slight Negative Impact	
2 - Negative Impact	
1 - Highly Negative Impact	

Scores should be assigned to options based on their respective impacts on addressing identified issues or opportunities, meeting SMART objectives and probability of impacts occurring. The table below sets out some guidance for assigning scores for impacts and options:

7 - Highly Positive Impact	The option is likely to significantly improve conditions in the relevant criteria.
6 - Positive Impact	The option is likely to improve conditions in the relevant criteria.
5 - Slight Positive Impact	The option is likely to somewhat improve conditions in the relevant criteria.
4 - Neutral Impact	The option will result in no changes to conditions in the relevant criteria.
3 - Slight Negative Impact	The option is likely to somewhat worsen conditions in the relevant criteria.
2 - Negative Impact	The option is likely to worsen conditions in the relevant criteria.
1 - Highly Negative Impact	The option is likely to significantly worsen conditions in the relevant criteria.

Figure 10. Mca Scoring and Colour Scale

## 4.5 Jackson's Bridge (OBG23) Constraints

The main requirements and restraints found for the proposed solutions to obtain an enhanced OHLE clearance are:

### 4.5.1 OHLE Clearance

The worst clearance from TOR to soffit at track axis (survey data undertaken from October 2020) is 4.27m.

This clearance does not allow installing any OHLE solution and is also not compliant with I-PWY-1101 Requirements for Track and Structures Clearances in where states for the Truncated GSWR Minimum Construction Gauge a minimum requires a height of 4343 mm over rail level, subject to allowances for curvature and cant. It also a challenging structure due to the arch shape of the bridge and the lateral clearance with the pantograph.

For those reasons, the track will either require lowering or some other alternative civil engineering solution.

The clearance of this structure represents a challenge for the single and the double track and the OHLE because of the arch barrel.



Figure 11. OBG23 view from Maynooth. Single-track section



Figure 12. OBG23 OHLE Clearance challenge

#### 4.5.2 Operational analysis

Jackson's Bridge (OBG23) is located west of Maynooth in a section of track that will serve the entire new fleet of the DART+ Programme running through this section to access the new Depot West of Kilcock (5km West of the bridge).

The project must provide a second track and electrify both the existing single track and the new second track from Maynooth to the new Depot.

The construction methodology of each option and its impact on the operation of the railway has been analysed:

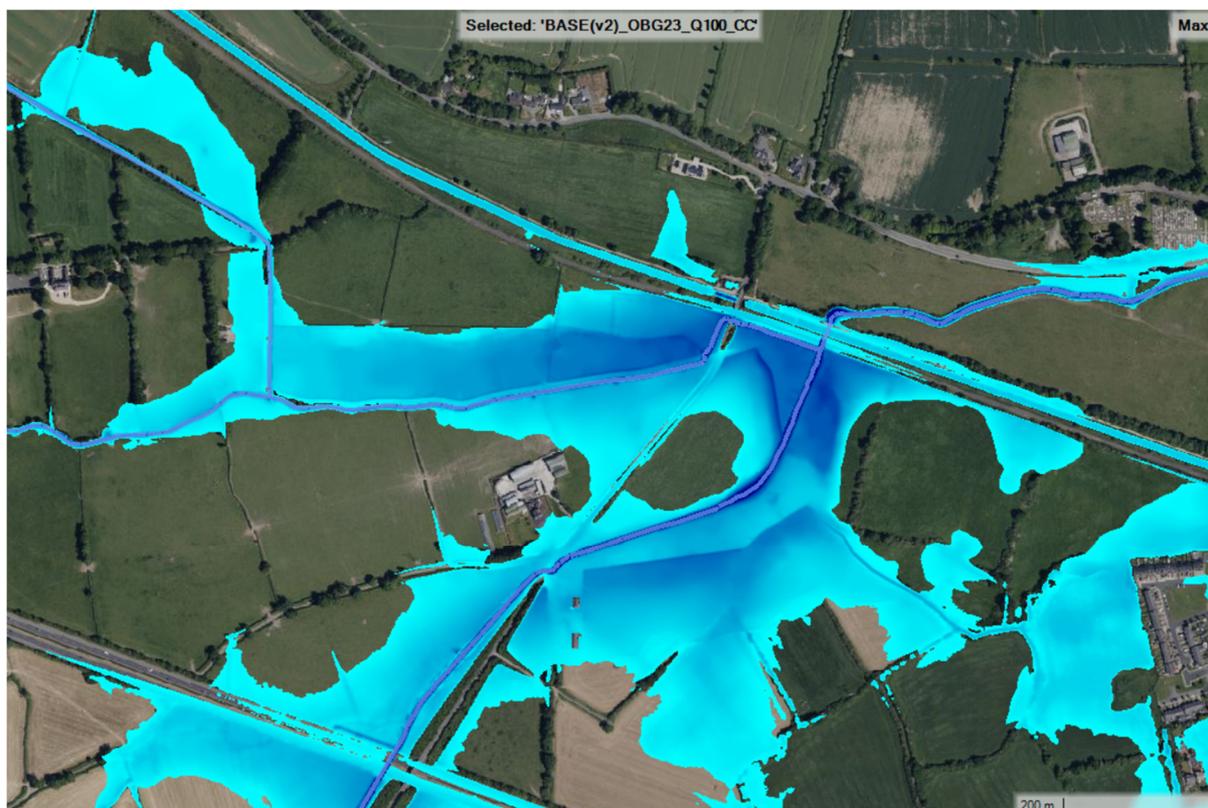
- Flood protection structures required for the online options significantly affect railway operations. Removal of the existing track is necessary, and due to the length and complexity of the works, these activities cannot be carried out within short possession windows (i.e., night-time or weekend possessions). Track-lowering options require removal of the existing track and ballast, excavation works, and installation of new track. These activities will require weekend possessions or longer-duration possessions to be completed safely and efficiently.

The Maynooth to Sligo line has an operational speed of 120 Km/h. The Jackson's Bridge section does not present any PSR (Permanent Speed Restriction).

The options evaluated avoid introducing any speed limitations.

### 4.5.3 Flood risk

The Stage 1 & 2 Site Specific Flood Risk Assessment report discusses flood risk at OBG23. Sources of available flood information have been reviewed including IAMS and OPW flood mapping. The outcomes of this desktop assessment indicate that the area in the vicinity of OBG23 has a significant history of flooding. This catchment was analysed as part of the OPW Eastern CFRAM Study. An extract of the flood mapping produced as part of this assessment showing the 10%, 1% & 0.1% AEP flood extents (current climate scenario) are shown in Figure 13 below. It appears that the railway line is at risk of overtopping in a 1% AEP fluvial flood event by approximately 150mm. Flooding of the line has occurred in the past, most notably in 2017.



**Figure 13. OBG23; Lyreen River 1 in 100-year event flood extents**

The findings of the Stage 2 assessment indicate that a detailed site-specific flood risk assessment (Stage 3 in accordance with DEHLG/OPW Guidelines 2009) is necessary to quantitatively assess flood risk and to determine appropriate flood risk management measures to limit upstream/downstream

impacts resulting from the proposed options and provide an appropriate standard of protection to the railway line. This required the development of a detailed 1D/2D hydraulic model. Due to the current lack of detailed topographic data of the full network of watercourses and culverts within the subject area at the moment of assessing the options, a preliminary 2D hydraulic model was prepared to inform this interim options assessment. The driving hydraulic constraint is the siphon under the railway and canal which conveys the Lyreen River under these infrastructures. This backs up flood water into the fields upstream and in extreme events overtops the railway and then into the canal.

The interim model was developed based on terrain created by integrating ground survey data as river /tributaries channels cross sections and structures ground survey with a LiDAR dataset. Additional data sources included the OPW terrain raster and channel cross sections, alongside supplementary information from the CFRAM Study. The model was validated using historic flood extents as well as flood levels and extents derived as part of the Eastern CFRAM Study. The hydraulic model and its outputs should be regarded as preliminary pending the detailed assessment to be undertaken upon receipt of detailed topographical survey data. The preliminary hydraulic analysis indicates that the 0.1%AEP flood level (plus a suitable climate change factor) at OBG23 is predicted to be 60.57 mOD. With the inclusion of an appropriate freeboard (to account for modelling uncertainties) of 500 mm, the flood level required to meet the 0.1%AEP standard of protection at OBG23 is 61.07 mOD and the proposed minimum track level (where no protection is implemented) is 61.27 mOD (to avoid the rail-water contact).

#### 4.5.4 EMU and infrastructure requirements regarding flood protection

The electrification of the line supports the introduction of EMU's to replace the current DMU's. These units require a higher standard of protection against flooding that cannot exceed the level of the sleepers. For that reason, it has been considered that the rail level must always be above the 61.27 mOD, 200 mm above the flooding protection level. This approach has been applied to the transition of the revised track alignment with the existing track tie in.

Note that at mid-range and high-end future scenarios, the potential effects of climate change increase rainfall by about 20% and 30% respectively, which increases the future flood risk.

At this stretch, the minimum track level is located under Jackson's Bridge at 59.76 m, 1.30 m below the flood protection rail elevation required for EMU's.

For the area where the groundwater table is higher than the track or there is any risk of flotation caused by groundwater and it is not feasible to raise the track level, a reinforced concrete U-section retaining wall solution is required along this track area to protect the track from groundwater. A drainage system is also required in the tracks for this solution.

#### 4.5.5 Protected structures

Jackson's Bridge (OBG23) is a protected structure and is included in the record of protected structures for Kildare County Council along with the adjacent canal lock. The description is "Jackson's Bridge (and Lock)".

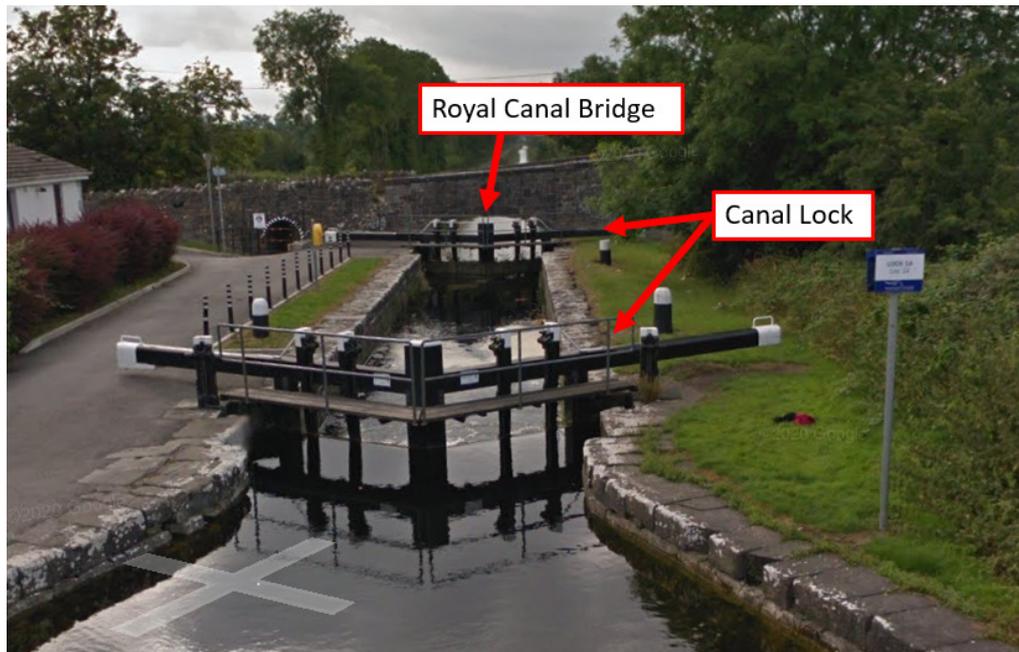


Figure 14. Royal Canal Bridge and Canal Lock. Source: Google Maps

The National Inventory of Architectural Heritage has included the bridge and lock; they have been assigned a regional significance for their architectural, historical, social and technical interest. The bridge (over the Royal Canal) dated from 1793 and the canal lock from 1795.

Jackson's Bridge (OBG23) is comprised of five arches. The original bridge had a single arch, carrying the road over the Royal Canal. In the 1840s the bridge was extended to take the road over the Midland Great Western Railway line and as the embankment leading to the bridge was to cross a watercourse two further arches were built to bring water through and to provide an accommodation arch for access between fields. A further arch was added at the northern end to allow those using the canal towpath to cross beneath the road.

#### 4.6 OBG23 Options Description

Considering the constraints explained in the previous sections, 6 options have been studied:

- Option 1. Double online track. Vertical track lowering and track protection
- Option 2. Double online track. Bridge deck reconstruction and track protection
- Option 3. Double offline track and L5041 road diversion
- Option 4. Double offline track without impacting the L5041
- Option 5. Double online track. Jackson's Bridge railway bridge deck removal and L5041 diversion

All options start at CH 91+020, about 900 m east of Jackson's Bridge, and end at CH 92+580 for online options and at 92+600 for offline options, a point located about 660 m west of Jackson's Bridge.

Online alternatives (1, 2 and 5) have a length of 1,560 m, while offline alternatives (3, 4a and 4b) have a length of 1,580 m (due to bypassing Jackson's bridge).

## 4.6.1 Option 1 Double online track. Vertical track lowering and track protection

### 4.6.1.1 Description

Option 1 follows the current railway corridor (online option) passing under Jackson's Bridge (OBG23).



Figure 15. Option 1 Online layout

This Option requires a 720 mm vertical track lowering at Jackson's Bridge to allow the new double-track pass with enough OHLE clearance under Jackson's Bridge.

It also requires a horizontal realignment of the existing track to allow enough space for the new track.

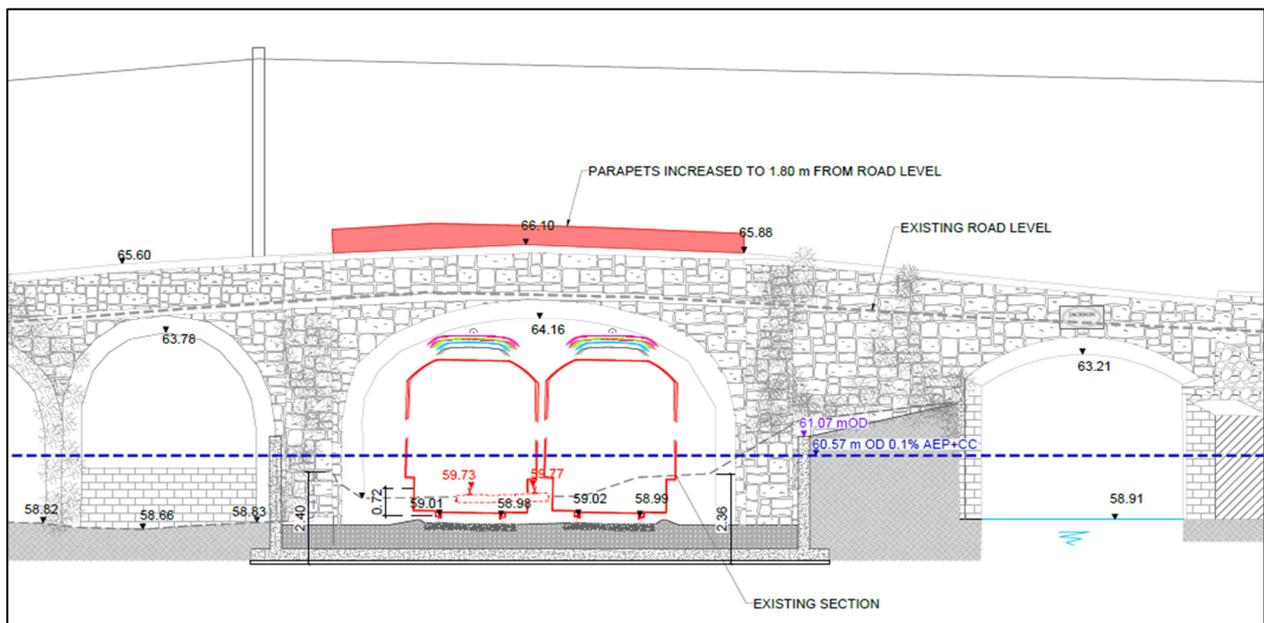


Figure 16. Option 1 Cross-section under Jackson's bridge

At Jackson's Bridge, the tracks reach their lowest level at 58.98 mOD below the 60.57 mOD flood level at 0.1% AEP +CC.

To prevent flooding of the tracks, major civil engineering works are required, involving the construction of a bottom slab and side retaining walls. The walls are designed at a height of 61.07 mOD, leaving a freeboard of 50 cm with respect to the flood level of 0.1% AEP +CC.

These flood containment structures are planned for a length of 980 m (CH 91+300 to 92+280) where the tracks level is below the flood level.

#### 4.6.1.2 Earthworks

In Option 1, due to the lowering of the track, the main earthworks involve excavation. The excavation and embankment volumes for this option are shown below:

**Table 5. Option 1 earthworks summary table**

	Cut (m <sup>3</sup> )	Fill (m <sup>3</sup> )
Railway	24,719	133

#### 4.6.1.3 Operational analysis

This option complies with the project requirement to duplicate and electrify the double track from Maynooth to the new Depot.

The construction methodology of this option presents operational disadvantages, the construction of these structures will require the existing track to be removed, necessitating a lengthy execution period during which rail service will be interrupted (estimated between 10 – 12 months).

Finally, the implementation of flood defences is seen as a potential residual risk of service disruption in case of failure.

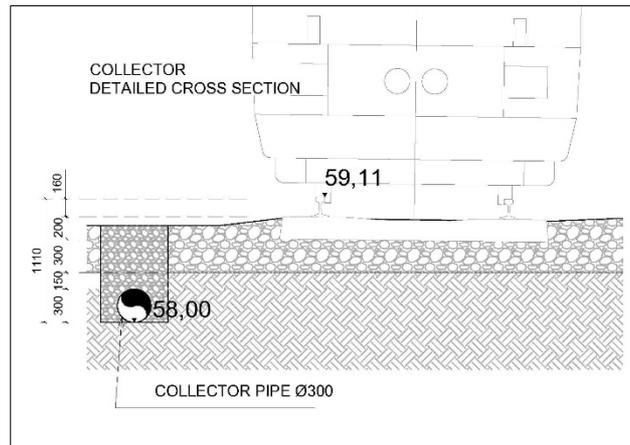
#### 4.6.1.4 Flood risk and drainage

These containment structures prevent water from flowing onto the railway and then cascading into the Royal Canal east of Lock 14 during extreme flooding events, as is currently the case. This barrier effect exacerbates flooding upstream of the Lyreen River siphon and can create additional overflow to the canal elsewhere. Downstream impacts are complicated because the canal also has the potential to overtop its banks and flood property to the west of Maynooth and at Maynooth Harbour

Flood defence walls/embankments are required to achieve the design standard of protection. Preliminary flood compensatory storage volumes necessary for this option are estimated to be 200,000 m<sup>3</sup> located upstream of UBG22, and are still not sufficient because compensatory storage is an ineffective mitigation measure where the natural flood relief of overtopping the railway is removed. A residual risk of flood waters overtopping the necessary flood defences causing rapid inundation of the railway line remains.

In the absence of providing compensatory storage, the introduction of flood defence walls/embankments will increase the rate of discharge through UBG22 by approximately 4% in the design event of 1% AEP. This will not have a significant impact on flood risk downstream of UBG22, the extent of which will be determined through detailed hydraulic and hydrological analysis, following receipt of the necessary topographical survey data.

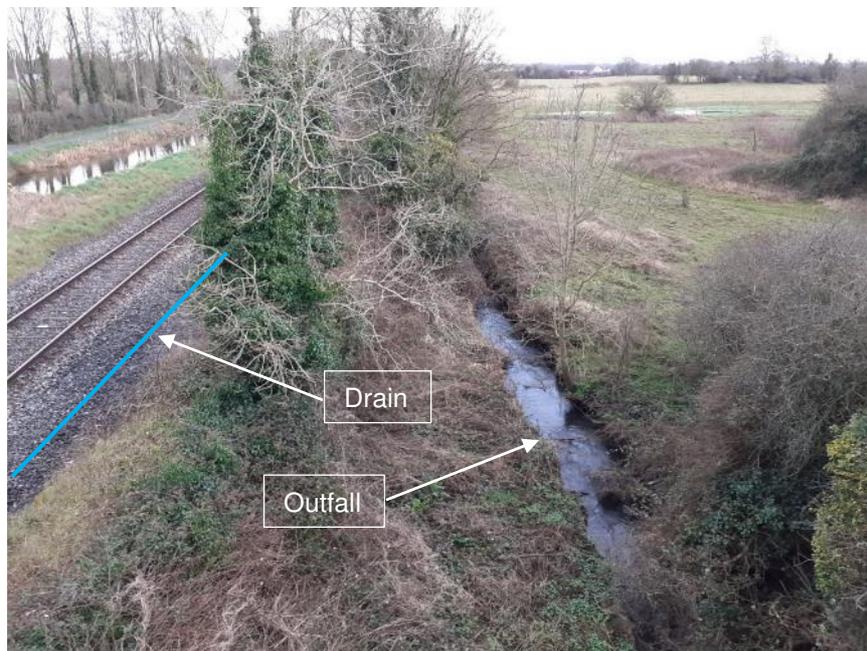
Due to hydraulic constraints, track lowering introduces the requirement for a pumped drainage system. Surface and Groundwater quality impacts are comparable with other options.



**Figure 17. Option 1 – Lineside drainage**

It is also necessary to consider that the Up Line also needs drainage at this low point. In this case, it is not possible to find an outfall point without crossing the track. It would be necessary to accommodate the subgrade layer with the desirable transverse slope so water can be collected directly by the drain mentioned above located on the Down Line.

With these considerations, a gravity drainage system cannot be used without worsening the flooding issues. A pumped drainage system is required, and it has been considered and costed.



**Figure 18. Option 1 Drainage outfall**

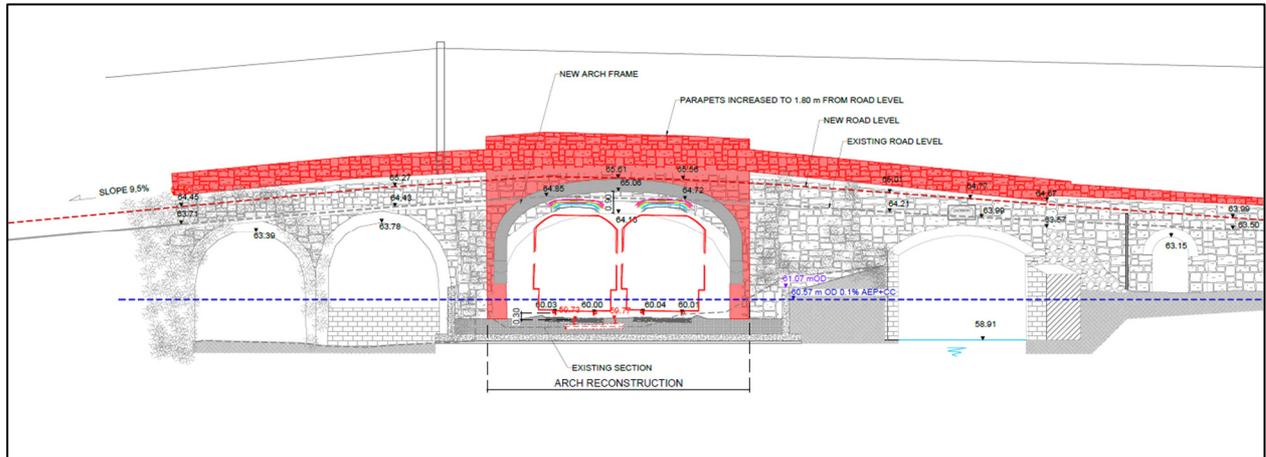
#### 4.6.1.5 Jackson's bridge protected structure

This option does not have a direct impact on the RPS Jackson's Bridge.

Even so, this solution requires a track lowering of 720 mm for one track meaning a total excavation ~1380 mm is required, which may mean hitting the structures foundations. If not, it is still possible that due to the vibration from works, the structure may be impacted adversely.



With these two conditions, it has been established that the maximum height to which the track under Jackson's Bridge can be raised is 60.0 mOD, which is below 60.57 mOD flood level at 0.1% AEP +CC.



**Figure 20. Option 2 Cross-section under Jackson's bridge**

As the previous option, to mitigate flood risk, construction of a bottom slab and side retaining walls are required. The walls are designed at a height of 61.07 mOD, leaving a freeboard of 50 cm with respect to the flood level of 0.1% AEP +CC.

In that case, these flood containment structures are planned for a length of 830 m (CH 91+300 to 92+130) where the tracks level is below the flood level.

**4.6.2.2 Earthworks**

In Option 2, due to the lowering of the track, the main earthworks involve excavation. The excavation and embankment volumes for this option are shown below:

**Table 6. Option 2 earthworks summary table**

	Cut (m <sup>3</sup> )	Fill (m <sup>3</sup> )
Railway	13,197	343

**4.6.2.3 Operational analysis**

This option complies with the project requirement to duplicate and electrify the double track from Maynooth to the new Depot.

The construction methodology of this option presents operational disadvantages, the construction of these structures will require the existing track to be removed, necessitating a lengthy execution period during which rail service will be interrupted (estimated between 10 – 12 months).

Finally, the implementation of flood defences is seen as a potential residual risk of service disruption in case of failure.

The bridge reconstruction will impact in the L5041 road that will be closed during the reconstruction works (estimated between 4 – 6 months).

**4.6.2.4 Flood risk and drainage**

These containment structures prevent water from flowing into the Royal Canal east of Lock 14 during extreme flooding events, as is currently the case. This barrier effect exacerbates flooding both upstream of the Lyreen River siphon and downstream.

Flood defence walls/embankments are required to achieve the design standard of protection. Preliminary flood compensatory storage volumes necessary for this option are estimated to be 200,000 m<sup>3</sup> located upstream of UBG22. A residual risk of flood waters overtopping the necessary flood defences causing rapid inundation of the railway line remains.

In the absence of providing compensatory storage, the introduction of flood defence walls/embankments will increase the rate of discharge through UBG22 by approximately 4% in the design event of 1% AEP. This will not have a significant impact on flood risk downstream of UBG22, the extent of which will be determined through detailed hydraulic and hydrological analysis, following receipt of the necessary topographical survey data.

Option 2 increases the track level by 300m to a minimum of 60.00mOD. This allows a gravity fed track drainage system.

#### 4.6.2.5 Jackson's bridge protected structure

This option has a direct impact on Jackson's Bridge (OBG23), a protected structure with recognised historical value. As a result, particular care would be required during any bridge-deck reconstruction works. In addition, the presence of four adjacent arch bridges means that any intervention on OBG23 could also affect them and would therefore need to be managed sensitively.

The proposed structural alteration has an impact on the adjacent arch bridges due to the raising of the bridge deck of the bridge. Lightweight concrete is proposed as the road backfill to the new increase the road elevation of the bridge. The existing road backfill will also be removed and replaced with lightweight concrete. This will reduce the existing dead load on the arch and the abutments as well as keep the additional new dead loading to a minimum.

Lightweight concrete has a density of 14,4 kN/m<sup>3</sup> to 18,40 kN/m<sup>3</sup> compared to normal weight concrete with a density of 24 kN/m<sup>3</sup>. The concrete mixture is made with lightweight coarse aggregate.

It is necessary to carry out a load test on the bridge to monitor any movement of the structure to ensure the safety of the design.

Furthermore, the need for strengthening of the adjacent arch barrels should be studied in the further stages of the project to ensure the safety of the structure.

As explained in Section 4.7.3.1, the construction of the OBG23 central arch rise will require the closure of the L5041 road for a period of approximately 4 to 6 months to facilitate preparatory works, excavation on both sides of the arch, and associated activities. All of these works are considered feasible during night-time hours without interrupting rail operations. However, during the final phase involving the installation of the prefabricated arch units, a night-time railway closure alone is deemed insufficient. A full weekend closure of the rail service will be required to complete this stage safely and effectively.

#### 4.6.2.6 OHLE clearance

The bridge lifting studied and proposed allows to achieve an OHLE solution (with fitted catenary or reduced dropper free running solution) with 4400 mm cwh. This cwh below 4700 mm requires a Risk Assessment and IE approval.

To achieve a 4700 mm cwh, it would require an additional 300 mm track lowering that compromises other relevant issues constraints making this option not feasible and or practical to study.

#### 4.6.2.7 Utilities

The proposed option does not impact relevant utilities.

- The proposed track levels under ESB 220 kV lines meets the required clearance to the electric line.

### 4.6.3 Option 3. Double offline track and L5041 road diversion

#### 4.6.3.1 Description

Option 3 proposes a new double-track alignment offline of the current railway corridor, avoiding passing under the Jackson's Bridge and the clearances issues.

The new railway line crosses the L5041 road south of Jackson's Bridge. The elevation of the tracks at this crossing point is 62.62 mOD, while the elevation of the road at this point is 60.0 mOD. This difference in elevation does not allow the road to cross either below or above the new railway line, which is why it is necessary to divert the L5041 road to the west to cross via a bridge over the new railway line and the Royal Canal.

The junction of the L5041 road with the R148 road, once it has crossed the Royal Canal, is planned to include a T-junction. To facilitate this, it is necessary to locally divert the R148 road in an area where it currently has an S-shaped alignment that limits the speed to 60 km/h.

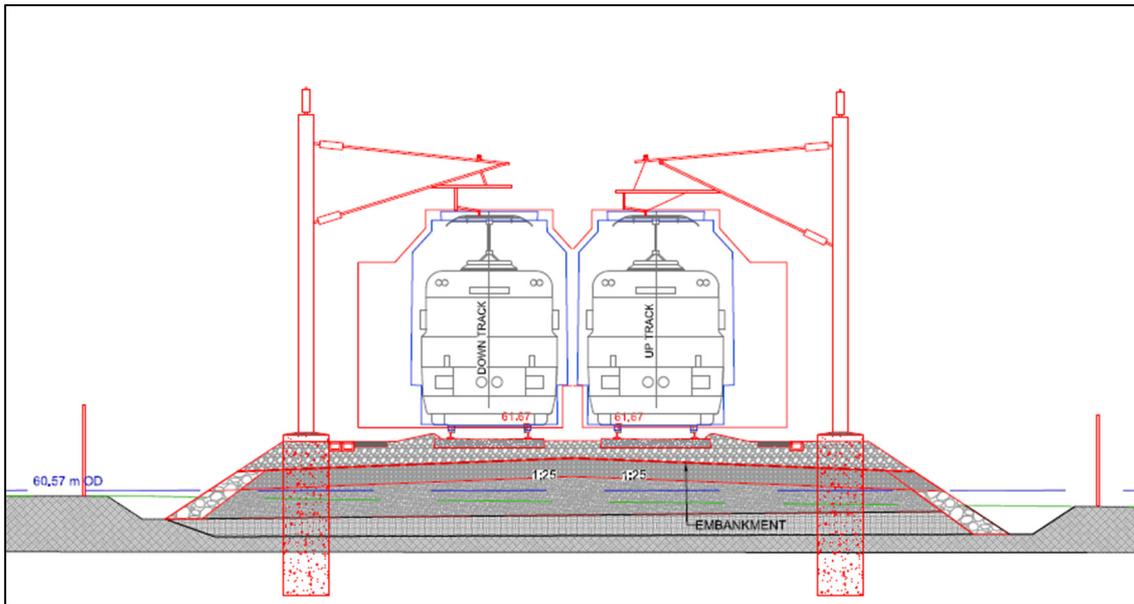
This proposal to divert the L5041 road and its intersection with the R148 has been submitted to and agreed upon with KCC in line with the future MOOR requirements.



**Figure 21. Option 3 Offline layout and L5041 road diversion**

This option avoids a direct negative impact to RPS Jackson's Bridge.

The new tracks run through the flood zone of the Lyreen River on an embankment. The minimum track level is designed at the 61.27 mOD, 20 cm above the 0.1% AEP +CC+500 mm freeboard to ensure that flooding does not reach the rail level.



**Figure 22. Option 3 Cross-section**

Two main underpass structures are designed to allow the waters of the Lyreen River and Ballycaghan stream to pass through.

The construction methodology does not present operational disadvantages. The main construction works are done offline, with a minimum impact in the line operational at the side connections with the current line.

#### 4.6.3.2 Earthworks

In Option 3, requires the greatest amount of earthworks, mainly due to the diversion of the L5041 road.

The excavation and embankment volumes for this option are shown below:

**Table 7. Option 3 earthworks summary table**

	Cut (m <sup>3</sup> )	Fill (m <sup>3</sup> )
Railway	5,668	22,769
Road diversion	1,321	81,265
<b>Total</b>	<b>6,989</b>	<b>105,656</b>

#### 4.6.3.3 Operational analysis

Option 3 comply with the project requirement to duplicate and electrify the double track from Maynooth to the new Depot.

The construction methodology does not present operational disadvantages. The main construction works are done offline, with a minimum impact in the line operational at the side connections with the current line.

#### 4.6.3.4 Flood risk and drainage

The option 3 comprises the offline track that crosses the Lyreen River with a bridge of 32m span, and being overpassed by the proposed high-embankment diversion of the road L5041. The Ballycaghan stream will be culverted under it, and the downstream path will be realigned and diverted into the Lyreen, avoiding the OBG23 current structure.

The previous modelling assessments have demonstrated that allowing Ballycaghan to have a new structure under the track, together with the existing consecutive ones, will only make the situation worse in the vicinity of these new infrastructure and further upstream. The realignment of Ballycaghan was decided after hydraulic model results showed significant improvements with its incorporation to the post develop arrangement.

Upstream of the diverted road crossing, slight backwater occurs that could easily be managed for the 1% AEP event, by providing storage areas at the track-road corner on the left floodplain of Ballycaghan. However, the 0.1% event would require a larger CSAs and an increase of crossing size and the channel section to improve conveyance.

**4.6.3.5 Jackson’s bridge protected structure**

Construction of two new offline tracks avoids any negative impact caused to RPS Jackson’s Bridge.

There is a potential negative visual impact due to the presence of the embankment, which is less than options 4a and 4b.

**4.6.3.6 OHLE clearance**

Option 3 allows to install an enhanced free running open route OHLE with 4700 mm cwh for both tracks.

**4.6.3.7 Utilities**

Option 3 proposed offline tracks elevations under ESB 220 kV lines does not allow for the required ESB clearance.

The ESB maximum track elevation under the 220 kV lines asked by ESB is **59.40 m**, while the track level proposed (to achieve the flood track protection level) is **61.30 m**.

The proposed solution is to increase the height of the ESB HV power poles.

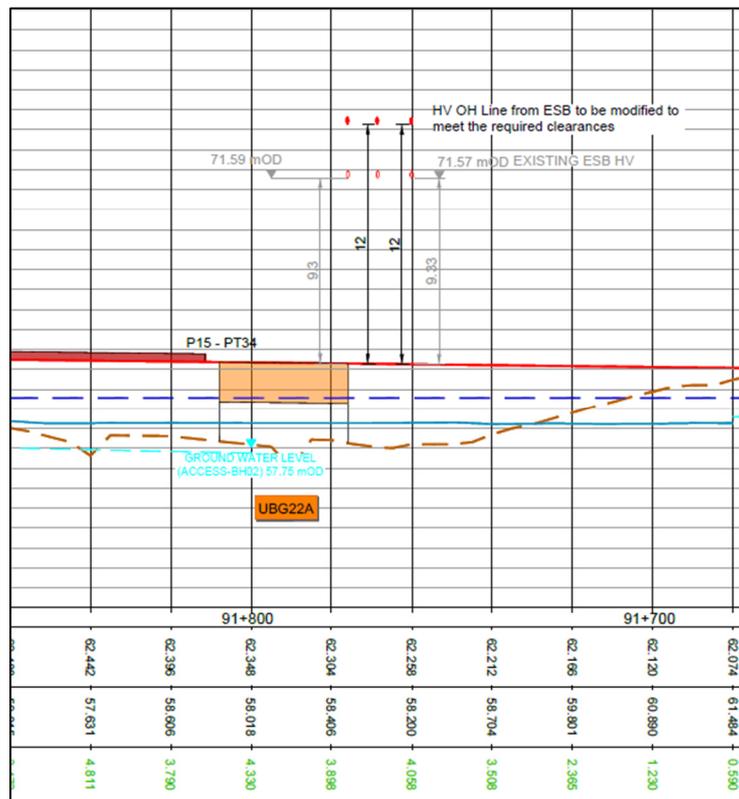


Figure 23. Option 3 220 kV ESB line to heighten

#### 4.6.4 Option 4 Double offline track without impacting the L5041

##### 4.6.4.1 Description

This option proposes the similar layout than Option 3 but modifies the vertical alignment, raising the level of the tracks so that the L5041 road can pass under the new railway line and the diversion of this road proposed in Option 3 is not necessary.

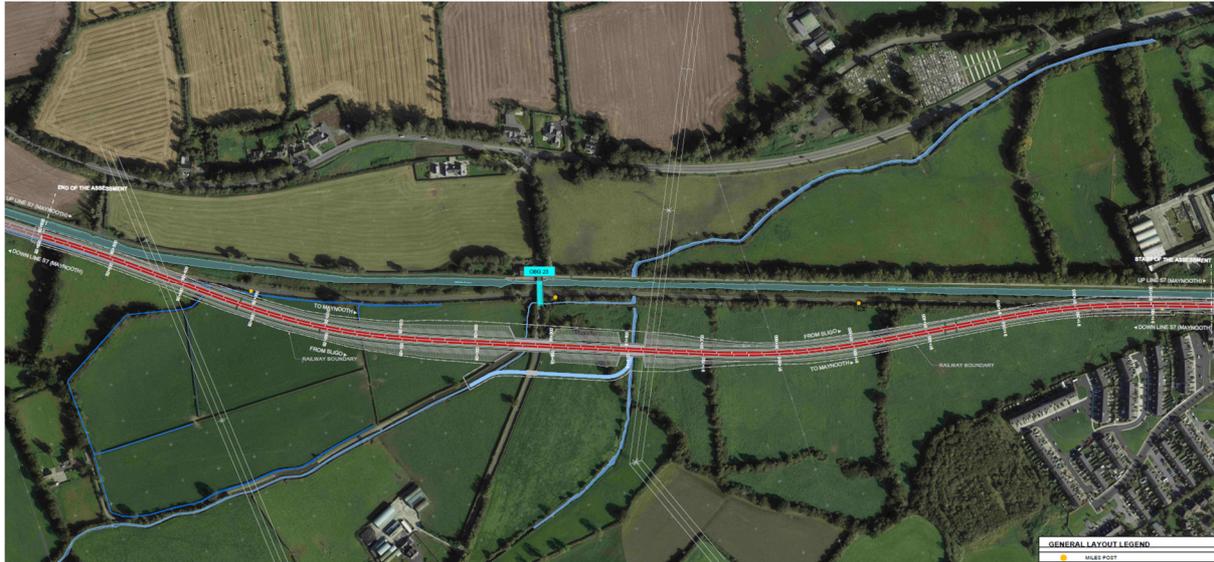


Figure 24. Option 4 Offline layout

In order to achieve sufficient clearance for the road crossing under the railway, it is necessary to raise the track level to 67.30 mOD, approximately 4.60 m higher than in Option 3.

The current elevation of the L5041 road, which is approximately 60.0 mOD at the junction under the railway, remains unchanged.

Option 4b proposes that the new railway line pass through the Lyreen River flood area via an embankment and two main underpass UBG22A (30 m span) and UBG22B (46 m span).

To improve the flooding problem in this area, it is proposed to divert the Ballycaghan stream towards the Lyreen river. This will require a new under bridge beneath the L5041 road.

In addition, the connection between a local road and the L5041 affected by the new railway line will have to be diverted.

##### 4.6.4.2 Earthworks

In Option 4, the main earthworks involve embankments for the construction of the railway.

The excavation and embankment volumes for this option are shown below:

Table 8. Option 4b earthworks summary table

	Cut (m <sup>3</sup> )	Fill (m <sup>3</sup> )
Railway	2,224	99,875

##### 4.6.4.3 Operational analysis

Option 4 comply with the project requirement to duplicate and electrify the double track from Maynooth to the new Depot.

The construction methodology does not present operational disadvantages. The main construction works are done offline, with a minimum impact in the line operational at the side connections with the current line.

#### 4.6.4.4 Flood risk and drainage

The only infrastructure that interferes with the current Lyreen flood flows is the proposed offline track, raised on a high embankment that provides enough clearance to the existing L5041 road avoiding the need to divert it.

While the increase in Lyreen upstream water levels are well mitigated with a 32m span even after the track and its embankments in place, the impact on the Ballycaghan would require an opening to accommodate the existing road and a stream diversion as in Option 3. The track opening would provide relief to high waters during extreme flood events, but the primary conveyance mechanism on the Ballycaghan stream would be that of the new ditch realignment that routes directly into Lyreen.

Upstream levels are manageable even for the 0.1% event.

#### 4.6.4.5 Jackson's bridge protected structure

Construction of two new offline tracks avoids any negative impact caused to RPS Jackson's Bridge.

It has a potentially indirect negative visual impact due to the presence of the embankment at a higher elevation than Jackson's Bridge.

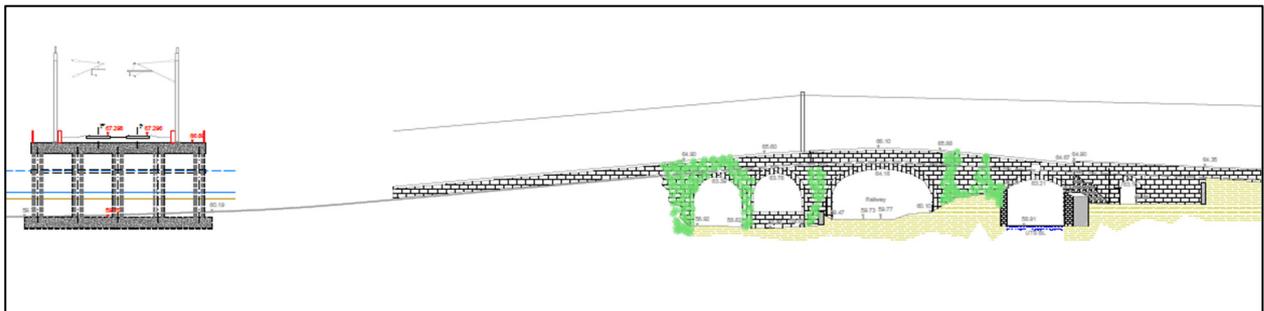


Figure 25. Option 4b Cross-section along Jackson's bridge and UBG22 underbridge

#### 4.6.4.6 OHLE clearance

Option 4 allows to install an enhanced free running open route OHLE with 4700 mm cwh for both tracks.

#### 4.6.4.7 Utilities

Option 4 proposed offline tracks elevations under ESB 220 kV lines does not allow for the required ESB clearance.

The ESB maximum track elevation under the 220 kV lines asked by ESB is **59.40 m**, while the track level proposed (to achieve the flood track protection level) is **66.25 m**.

The proposed solution (raising the poles is unfeasible, so rerouting the line would be necessary) must be studied and agreed upon with ESB.





#### 4.6.5.2 Earthworks

In Option 5, the main earthworks involve embankments for the L5041 road diversion.

The excavation and embankment volumes for this option are shown below:

**Table 9. Option 4 earthworks summary table**

	Cut (m <sup>3</sup> )	Fill (m <sup>3</sup> )
Railway	5,031	20,192
Road diversion	1,708	72,350
<b>Total</b>	<b>6,739</b>	<b>92,542</b>

#### 4.6.5.3 Operational analysis

Option 5 complies with the project requirement to duplicate and electrify the double track from Maynooth to the new Depot.

The construction methodology of this option presents operational disadvantages, the construction of the structures will require the existing track to be removed, necessitating a lengthy execution period during which rail service will be interrupted.

#### 4.6.5.4 Flood risk and drainage

As a result of preserving the overflow mechanism over the railway when the Lyreen siphon exceeds its capacity there is no hydraulic impact on the floodplains upstream of the siphon. The flood mechanism of cascading flow from the railway to the canal and then back into the Lyreen is maintained. No mitigation measures are required, except for ensuring the bottom slab of the structure taking the railway above the flood flows does not restrict this mechanism. The ability to remove floating debris that could deposit within this overflow would also dictate the soffit level.

To avoid backwater upstream of Ballycaghan road crossing, similar solution to option 3 needs to be implemented, with an adequate structure opening under the road.

#### 4.6.5.5 Jackson's bridge protected structure

This option has a direct impact on Jackson's bridge (OBG23), which is a protected structure with historical value.

This option affects the Jackson railway bridge, where the central arch over the railway is demolished and a new bridge is designed to the west for the L5041 to pass over (a similar diversion to that presented in Option 3).

The diversion of the L5041 road has a potential indirect negative visual impact due to the construction of a new bridge near and parallel to Jackson's Bridge, in addition to the embankments created by the road.

#### 4.6.5.6 OHLE clearance

Option 5 allows to install an enhanced free running open route OHLE with 4700 mm cwh for both tracks.

#### 4.6.5.7 Utilities

Option 5 proposed online tracks elevations under ESB 220 kV lines does not allow for the required ESB clearance (12 m vertical clearance from the cables to the TOR).

The proposed solution is to increase the height of the ESB HV power poles.

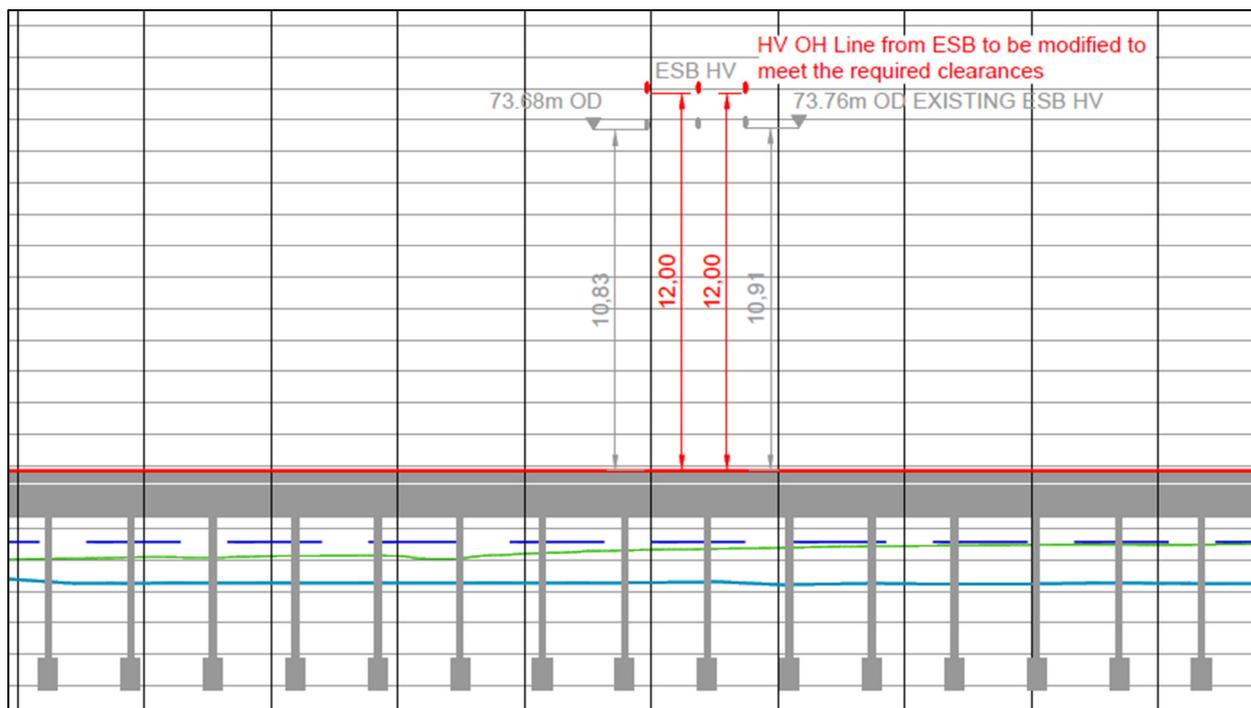


Figure 29. Option 5 220 kV ESB line to heighten

## 4.7 Options assessment

### 4.7.1 Introduction

This section presents the outcome of the first stage of the option selection process. It concludes on a proposed shortlist of options for further design development prior to the second stage of assessment. The methodology for each of the TAF criteria is outlined in Chapter 4 'Multi-Criteria Analysis and Comparators' of this report.

### 4.7.2 Transport user benefits and other economic impacts

#### 4.7.2.1 Alignment with customer requirements specification

All five options meet the requirements for servicing the new depot located west of Kilcock: a new electrified double track.

The geometric parameters of the tracks in all five options comply with IE specifications and regulations and allow the line to be operated at its commercial speed of 120 km/h.

All options are designed to avoid disruption to rail services during episodes of extreme flooding in the Lyreen River area, which represents a clear improvement on the current situation. However, in Options 1 and 2, the implementation of flood defences is also seen as a potential residual risk of disruption to service, which has reduced its positive impact on the current situation.

#### Option 1: Double online track. Vertical track lowering and track protection

Because this option meets the requirements for servicing the new depot and provides protection against flooding events—while acknowledging a potential residual risk should the flood defences fail—it receives a score of **5** on the TAF impact scoring scale, reflecting a *Slightly Positive Impact* on the customer requirement specifications.

**Option 2: Double online track. Bridge deck reconstruction and track protection**

Because this option meets the requirements for serving the new depot and provides protection against flooding events—while acknowledging a potential residual risk should the flood defences fail—it receives a score of **5** on the TAF impact scoring scale, reflecting a *Slightly Positive Impact* on the customer requirement specifications.

**Option 3: Double offline track (new alignment) and L5041 road diversion**

Because this option meets the requirements for serving the new depot and provides protection against flooding events, it receives a score of **7** on the TAF impact scoring scale, indicating a *Highly Positive Impact* on the customer requirement specifications.

**Option 4: Double offline track (new alignment). Embankment**

Because this option meets the requirements for serving the new depot and provides protection against flooding events, it receives a score of **7** on the TAF impact scoring scale, indicating a *Highly Positive Impact* on the customer requirement specifications.

**Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge**

Because this option meets the requirements for serving the new depot and provides protection against flooding events, it receives a score of **7** on the TAF impact scoring scale, indicating a *Highly Positive Impact* on the customer requirement specifications.

## 4.7.2.1.1 Summary Assessment

**Table 10. Alignment with customer requirements specification mca Assessment**

Option	TAF Impact Scoring
Option 1: Double online track. Vertical track lowering and track protection	5 – Slightly Positive Impact
Option 2: Double online track. Bridge deck reconstruction and track protection	5 – Slightly Positive Impact
Option 3: Double offline track (new alignment) and L5041 road diversion	7 – Highly Positive Impact
Option 4: Double offline track (new alignment). Embankment	7 – Highly Positive Impact
Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge	7 – Highly Positive Impact

**4.7.2.2 Transport Costs and Operational Characteristics**

Capital and operational cost estimates were prepared for each option. The capital costs associated with the construction are significantly higher than the operational cost differences and they consequently have greater impact.

Costs in this report are presented on the basis of percentage relative to the least expensive option.

**Option 1. Double online track. Vertical track lowering and track protection.**

Option 1 is the least expensive construction cost option.

This is because, although it has important structures to prevent flooding, it does not require land-take, the diversion of the L5041 road and does not impact relevant services (ESB 220 kV line).

#### **Option 2. Double online track. Bridge deck reconstruction and track protection**

Option 2 is 10 % more expensive than the lowest option (Option 1)

This is because of the OBG23 railway arch reconstruction.

#### **Option 3. Double offline track (new alignment) and L5041 road diversion**

Option 3 is 26 % more expensive than the lowest option (Option 1)

This is because, although it doesn't need the structures to prevent flooding, it does require land-take, the L5041 road diversion and impact on the ESB 220 kV line.

#### **Option 4: Double offline track (new alignment). Embankment**

Option 4 is 16 % more expensive than the lowest option (Option 1)

This is because of the higher mainline track cost, the land-take required and an estimated higher cost on the ESB 220 kV line diversion.

#### **Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge**

Option 5 is 26 % more expensive than the lowest option (Option 1)

This is because it needs structures to allow water flow to the Royal Canal and also the L5041 road diversion.

#### 4.7.2.2.1 Summary Assessment

**Table 11. Transport Costs and Operational Characteristics mca Assessment**

Option	TAF Impact Scoring
Option 1: Double online track. Vertical track lowering and track protection	3 – Slightly Negative Impact
Option 2: Double online track. Bridge deck reconstruction and track protection	3 – Slightly Negative Impact
Option 3: Double offline track (new alignment) and L5041 road diversion	2 – Negative Impact
Option 4: Double offline track (new alignment). Embankment	2 – Negative Impact
Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge	1 – Highly Negative Impact

#### 4.7.2.3 Change of Land Value

All options perform equivalently under change of Land Value. All options are rated Neutral Impact as a consequence.

## 4.7.2.3.1 Summary Assessment

Table 12. Change of Land Value mca Assessment

Option	TAF Impact Scoring
Option 1: Double online track. Vertical track lowering and track protection	4 – Neutral Impact
Option 2: Double online track. Bridge deck reconstruction and track protection	4 – Neutral Impact
Option 3: Double offline track (new alignment) and L5041 road diversion	4 – Neutral Impact
Option 4: Double offline track (new alignment). Embankment	4 – Neutral Impact
Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge	4 – Neutral Impact

## 4.7.2.4 Site Security

All options perform equivalently under site security. All options are rated Neutral Impact as a consequence.

## 4.7.2.4.1 Summary Assessment

Table 13. Site Security mca Assessment

Option	TAF Impact Scoring
Option 1: Double online track. Vertical track lowering and track protection	4 – Neutral Impact
Option 2: Double online track. Bridge deck reconstruction and track protection	4 – Neutral Impact
Option 3: Double offline track (new alignment) and L5041 road diversion	4 – Neutral Impact
Option 4: Double offline track (new alignment). Embankment	4 – Neutral Impact
Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge	4 – Neutral Impact

#### 4.7.2.5 Transport User Benefits and Other Economic Impacts Summary Assessment

Table 14. Transport User Benefits mca Assessment

Parameter	TAF Impact Scoring on Transport user benefits and other economic impacts			
	Alignment with Customer Requirements Specification	Transport Costs and Operational Characteristics	Change of Land Value	Site Security
Option 1: Double online track. Vertical track lowering and track protection	5 – Slightly Positive Impact	3 – Slightly Negative Impact	4 – Neutral Impact	4 – Neutral Impact
Option 2: Double online track. Bridge deck reconstruction and track protection	5 – Slightly Positive Impact	3 – Slightly Negative Impact	4 – Neutral Impact	4 – Neutral Impact
Option 3: Double offline track (new alignment) and L5041 road diversion	7 – Highly Positive Impact	2 – Negative Impact	4 – Neutral Impact	4 – Neutral Impact
Option 4: Double offline track (new alignment). Embankment	7 – Highly Positive Impact	2 – Negative Impact	4 – Neutral Impact	4 – Neutral Impact
Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge	7 – Highly Positive Impact	1 – Highly Negative Impact	4 – Neutral Impact	4 – Neutral Impact

### 4.7.3 Accessibility impacts

#### 4.7.3.1 Impacts on existing accessibility

This section provides the appraisal of the five options for Jackson's Bridge to identify and positive or negative impact on the accessibility of the households to the key services such as education, healthcare, or employment opportunities, during the construction phase and after the construction phase.

The main households potentially impacted in this area are:

- Private house next to Lock 14 Royal Canal
- Royal Canal (Lock 14 and greenway)
- Ballycurraghan
- Gheel Autism Services Maintenance (Ballycurraghan)
- Millfarm

The key services are located at:

- Maynooth (2.5 Km from Jackson's bridge to Maynooth centre)
- Kilcock (4 Km from Jackson's bridge to Maynooth centre)

#### During Construction:

Option 1: do not impact on OBG23. For that reason, the impact has been considered neutral

Option 2: impacts on OBG23. During the bridge deck reconstruction, the L5041 is shut down at his pass on Jackson's bridge (4-6 months)

- Access of Ballycurraghan and Millfarm properties or access to Gheel Autism Services Maintenance need to be diverted: L5041 south direction till L5042. From L5042:

- Maynooth direction: take L5042 eastern direction towards R408 and Maynooth. This would mean a diversion of 5 Km in length and about 10 minutes by car instead of the 2.7 km and 9 minutes of the normal way through Jackson's bridge.
- Kilcock direction: take L5042 western direction (Branganstown) till Connaugh St (Kilcock). This would mean a diversion of 6.4 Km in length and about 10 minutes by car instead of the 4.5 km and 7 minutes of the normal way through Jackson's bridge.
- Access of Private house, Royal Canal and greenway. As usual by R148.

For that reason, a slightly negative impact has been considered.

**Option 3: no impact on OBG23.** During the construction works, traffic management must allow the construction of the new road diversion and the access to the nearby areas. For that reason, the impact has been considered neutral.

**Option 4: no impact on OBG23.** During the construction works, traffic management must allow the construction of the new structure, allowing the pass on the L5041 and Jackson's bridge. For that reason, the impact has been considered neutral.

**Option 5: no impact on OBG23.** During the construction works, traffic management must allow the construction of the new road diversion and the access to the nearby areas. For that reason, the impact has been considered neutral.

After construction:

Regarding after construction phase, it has been considered the current Jackson's bridge accessibility for bikes and pedestrians. Current bridge is very narrow, without side walkways and with gradient steeper than 9%.

- The options (1, 4) maintain Jackson's bridge as it is right now, so the impact has been considered neutral.
- Option 2 that increase the length of current road slope (above 9%), so the impact has been considered slightly negative
- Option 3 provides a new road access, with sidewalks for bikes and pedestrians and with accessible slope, and it also provides a bikes and pedestrian way passing under UBG22A and connecting with Jackson's bridge. The impact has been considered significantly positive (even when it's probably the more negative during construction)
- Option 5 provides a new road access, with sidewalks for bikes and pedestrians and with accessible slope, so the impact has been considered significantly positive
- Summary Assessment

After balancing the construction phase and after construction phase, the impacts on existing accessibility impacts are:

**Table 15. Impacts on Existing Accessibility mca Stage 1 Assessment**

Option	TAF Impact Scoring
Option 1: Double online track. Vertical track lowering and track protection	4 – Neutral Impact
Option 2: Double online track. Bridge deck reconstruction and track protection	3 – Slightly Negative Impact
Option 3: Double offline track (new alignment) and L5041 road diversion	6 – Positive Impact

Option	TAF Impact Scoring
Option 4: Double offline track (new alignment). Embankment	4 – Neutral Impact
Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge	6 – Positive Impact

#### 4.7.3.2 Impacts on Freight Access

Access for freight-to-freight facilities is not likely to be impacted by any of the options, and are therefore all scored as '4' on the TAF Impact scoring scale as they'll have 'Neutral Impact' on freight access.

##### 4.7.3.2.1 Summary Assessment

**Table 16. Impact on freight access mca Stage 1 Assessment table**

Option	TAF Impact Scoring
Option 1: Double online track. Vertical track lowering and track protection	4 – Neutral Impact
Option 2: Double online track. Bridge deck reconstruction and track protection	4 – Neutral Impact
Option 3: Double offline track (new alignment) and L5041 road diversion	4 – Neutral Impact
Option 4: Double offline track (new alignment). Embankment	4 – Neutral Impact
Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge	4 – Neutral Impact

#### 4.7.3.3 Accessibility Impacts Summary Assessment

**Table 17. Accessibility Impacts mca Stage 1 Assessment table**

Option	TAF Impact Scoring on Accessibility Impacts	
	Existing Accessibility	Freight Access
Option 1: Double online track. Vertical track lowering and track protection	4 – Neutral Impact	4 – Neutral Impact
Option 2: Double online track. Bridge deck reconstruction and track protection	3 – Slightly Negative Impact	4 – Neutral Impact
Option 3: Double offline track (new alignment) and L5041 road diversion	3 – Slightly Negative Impact	4 – Neutral Impact
Option 4: Double offline track (new alignment). Embankment	4 – Neutral Impact	4 – Neutral Impact
Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge	6 – Positive Impact	4 – Neutral Impact

#### 4.7.4 Social Impacts

Under the social impacts criteria, TAF looks to assess the potential impacts of the projects on accessibility of deprived groups, transport users with different mobility needs and gender impacts.

The Haase and Pratschke (HP) deprivation index measures the relative affluence or disadvantage of a particular geographical area. The index is based on census data, using 10 key indicators such as the proportion of skilled professionals, education levels, employment levels, age dependency, and lone parent rate found in an area. HP deprivation scores of 'Marginally Below Average', 'Disadvantaged', 'Very Disadvantaged', and 'Extremely Disadvantaged' represent socially disadvantaged geographical areas. The potential social impacts with regards to job opportunities on socially disadvantaged geographical areas (HP deprivation index) at Electoral Division (EDs) within 1km of the proposed Jackson's Bridge option locations were considered.

##### 4.7.4.1 Options Appraisal

###### **Option 1. Double online track. Vertical track lowering and track protection.**

This option is located within Electoral Division(s) (ED) of Affluent HP deprivation index. EDs within 1 km of the proposed option are mix of affluence. Due to the nature of the proposed works, there will be no social impacts at this location.

The implementation of twin tracking at this location will enable the extension of the DART+ Programme by delivering the proposed DART+ service to Kilcock Station. This will result in improvement for all socially deprived areas across the network. All options perform equally in this respect.

Taking into consideration the temporary social impacts during construction phase and the long-term improvements to the DART+ service to Kilcock Station during operation phase, this option was given a TAF impact score of '6-Positive'.

###### **Option 2. Double online track. Bridge deck reconstruction and track protection**

This option is located within Electoral Division(s) (ED) of Affluent HP deprivation index. EDs within 1 km of the proposed option are mix of affluence. Due to the nature of the proposed works, there will be no social impacts at the location of the proposed works.

The implementation of twin tracking at this location will enable the extension of the DART+ Programme by delivering the proposed DART+ service to Kilcock Station. This will result in improvement for all socially deprived areas across the network. All options perform equally in this respect.

Taking into consideration the temporary social impacts during construction phase and the long-term improvements to the DART+ service to Kilcock Station during operation phase, this option was given a TAF impact score of '6-Positive'.

###### **Option 3. Double offline track (new alignment) and L5041 road diversion**

This option is located within Electoral Division(s) (ED) of Affluent HP deprivation index. EDs within 1 km of the proposed option are mix of affluence. Due to the nature of the proposed works, there will be no social impacts at the location of the proposed works.

The implementation of twin tracking at this location will enable the extension of the DART+ Programme by delivering the proposed DART+ service to Kilcock Station. This will result in improvement for all socially deprived areas across the network. All options perform equally in this respect.

Taking into consideration the temporary social impacts during construction phase and the long-term improvements to the DART+ service to Kilcock Station during operation phase, this option was given a TAF impact score of '6-Positive'.

#### Option 4: Double offline track (new alignment). Embankment

This option is located within Electoral Division(s) (ED) of Affluent HP deprivation index. EDs within 1 km of the proposed option are mix of affluence. Due to the nature of the proposed works, there will be no social impacts at the location of the proposed works.

The implementation of twin tracking at this location will enable the extension of the DART+ Programme by delivering the proposed DART+ service to Kilcock Station. This will result in improvement for all socially deprived areas across the network. All options perform equally in this respect.

Taking into consideration the temporary social impacts during construction phase and the long-term improvements to the DART+ service to Kilcock Station during operation phase, this option was given a TAF impact score of '6-Positive'.

#### Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge

This option is located within Electoral Division(s) (ED) of Affluent HP deprivation index. EDs within 1 km of the proposed option are mix of affluence. Due to the nature of the proposed works, there will be no social impacts at the location of the proposed works.

The implementation of twin tracking at this location will enable the extension of the DART+ Programme by delivering the proposed DART+ service to Kilcock Station. This will result in improvement for all socially deprived areas across the network. All options perform equally in this respect.

Taking into consideration the temporary social impacts during construction phase and the long-term improvements to the DART+ service to Kilcock Station during operation phase, this option was given a TAF impact score of '6-Positive'.

#### 4.7.4.1.1 Summary Assessment

**Table 18. Social Impacts mca Assessment**

Option	TAF Impact Scoring
Option 1: Double online track. Vertical track lowering and track protection	6 – Positive Impact
Option 2: Double online track. Bridge deck reconstruction and track protection	6 – Positive Impact
Option 3: Double offline track (new alignment) and L5041 road diversion	6 – Positive Impact
Option 4: Double offline track (new alignment). Embankment	6 – Positive Impact
Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge	6 – Positive Impact

### 4.7.5 Land Use Impacts

#### 4.7.5.1 Change in Quality of Public Realm

This section provides the appraisal of the five options for Jackson's Bridge to identify and change in quality of public realm. Under TAF, public realm is identified as areas containing streets, footpaths, parks, squares, bridges and public buildings and facilities. The proposed options are outside of the urban areas of Kilcock and Maynooth. There are no changes to the quality of public realm areas, as such all options have been given a score of 4 – Neutral.

## 4.7.5.1.1 Summary Assessment

Table 19. Change in Quality of Public Realm mca Assessment

Option	TAF Impact Scoring
<b>Option 1: Double online track. Vertical track lowering and track protection</b>	4 - Neutral
<b>Option 2: Double online track. Bridge deck reconstruction and track protection</b>	4 - Neutral
<b>Option 3: Double offline track (new alignment) and L5041 road diversion</b>	4 - Neutral
<b>Option 4: Double offline track (new alignment). Embankment</b>	4 - Neutral
<b>Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge</b>	4 - Neutral

## 4.7.5.2 Existing Transport Network and Service Impact

**Option 1. Double online track. Vertical track lowering and track protection.**

Option 1 requires the reconstruction of the flood protection structures causing a prolonged closure of the railway line (estimated between 10 – 12 months).

For this reason, this option receives a score of '1' on the TAF impact scoring scale, as it will have a 'Highly Negative Impact' on the accessibility.

**Option 2. Double online track. Bridge deck reconstruction and track protection**

Option 2 requires the reconstruction of the flood protection structures causing a prolonged closure of the railway line (estimated between 10 – 12 months). Also, it requires the OBG23 bridge deck reconstruction that will require (estimated between 4 – 6 months).

Due to the reconstruction of the Jackson's Bridge railway arch, the L5041 road must remain closed for an extended period.

For this reason, this option receives a score of '1' on the TAF impact scoring scale, as it will have a 'Highly Negative Impact' on the existing transport network accessibility.

**Option 3. Double offline track (new alignment) and L5041 road diversion**

Option 3 does not directly impact the railway service, which may only be temporarily and briefly impacted at the final links of the railway diversion with the current track.

The L5041 and R148 roads may also have partials and brief impacts due to the connections of the L5041 road diversion with these roads.

For this reason, this option receives a score of '3' on the TAF impact scoring scale, as it will have a 'Slightly Negative Impact' on the accessibility.

**Option 4: Double offline track (new alignment). Embankment**

Option 4 does not directly impact the railway service, which may only be temporarily and briefly impacted at the final links of the railway diversion with the current track.

The L5041 road may also have a brief impact due to the structure construction to allow the road underpass.

For this reason, this option receives a score of '3' on the TAF impact scoring scale, as it will have a 'Slightly Negative Impact' on the accessibility.

#### **Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge**

Option 5 requires the construction of a structure on the railway corridor causing a prolonged closure of the railway line

Also, it requires the demolition of Jackson's bridge and the construction of a new bridge in the same layout, causing a prolonged closure of the L5041 in this section (14-18 months). As explained in "4.7.3.1 Impacts on existing accessibility", alternative routes are feasible.

For this reason, this option receives a score of '1' on the TAF impact scoring scale, as it will have a 'Highly Negative Impact' on the accessibility.

#### 4.7.5.2.1 Summary Assessment

**Table 20. Existing Transport Network and Service Impact mca Assessment**

Option	TAF Impact Scoring
<b>Option 1: Double online track. Vertical track lowering and track protection</b>	1 – Highly Negative Impact
<b>Option 2: Double online track. Bridge deck reconstruction and track protection</b>	1 – Highly Negative Impact
<b>Option 3: Double offline track (new alignment) and L5041 road diversion</b>	3 – Slightly Negative Impact
<b>Option 4: Double offline track (new alignment). Embankment</b>	3 – Slightly Negative Impact
<b>Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge</b>	1 – Highly Negative Impact

#### 4.7.5.3 Material Assets: Property

This section deals with options selection in relation to Material Assets –Property. The options assessment will inform the mca of options for Jackson's Bridge.

The options assessment of Material Assets: Property separately considers the impact on agricultural property and non-agricultural property. The options impact category and mca score for Material Assets: Property is a cumulative assessment of the impact under Agricultural Property and Non-agricultural Property.

##### 4.7.5.3.1 Methodology

#### **Agricultural Property**

The options assessment comprises an assessment of option and the potential impact on agriculture and agricultural property. This will involve assigning a value rating and an impact rating to each option based on the criteria in Table 21.

Table 21. Options assessment

Basis	Criteria	Rating
Value criteria	Description of option alignment, online / offline, land cover, existing land use, presence of farmyards / farmhouses, presence of key agricultural constraints.	High, Medium, Low or Very Low
Impact criteria	Impacts on land, access to lands, farmhouses, farmyards and key agricultural constraints including highlighting significant impacts.	High, Medium, Low or Very Low
Significance of impact	Significance category and mca score based on the combination of both the value and impact ratings. based.	

The qualitative assessment consists of an evaluation of landcover on individual agricultural properties for each option. This assessment will consider improved grassland as an indicator of productive agricultural lands other than other landcover categories of forestry / woodland and rough grassland / scrub / peat. Key agricultural constraints on an option can be an indicator of high-quality agricultural lands, high intensity production and / or the sensitivity of agricultural activities depending on the type of constraint.

Equine constraints typically involve moderate to intensive activities considered sensitive to construction and operational activities associated with the development. Dairy constraints typically involve intensive agricultural production on high quality lands and are sensitive to the land-take and land severance impacts. Pig and Poultry farms are typically highly intensive farming enterprises within a farmyard setting and may be considered sensitive to direct impacts. Tillage constraints typically indicate high quality lands and may be considered sensitive to land-take. Agribusinesses typically are locations of local employment within the sector and may be considered sensitive to the direct impacts.

The quantitative assessment will consider total land-take required for each option and agricultural receptors within the corridor such as farmhouses, farmyards and other agricultural constraints.

The value rating in Table 22 is based on the qualitative and quantitative assessment of individual agricultural properties under the following criteria:

- Landcover (improved grassland / arable lands, rough grassland, forestry / woodland, peat / scrub).
- Farmhouses / farmyards / farm facilities present.
- Key Agricultural constraints.

The value rating will consider the criteria as presented in Table 22.

Table 22. Value rating criteria

Rating	Criteria
High	Land use – Livestock and / or tillage enterprises on good quality improved grassland / arable land with little or no forestry / peat / scrub present. Farmhouses and farm buildings / facilities present. Key constraints – Sensitive farm enterprises present (i.e., dairy, equine, poultry, pigs, horticulture, agribusiness, education).
Medium	Land use – Livestock and / or tillage enterprises on medium to good quality lands or with low levels of forestry / peat / scrub present. Farmhouses and farm buildings / facilities present. Key agricultural constraints – Sensitive farm enterprises may be present.
Low	Land use – Livestock farm enterprises on medium quality lands or with levels of forestry / peat / scrub present. Agricultural lands may be zoned for, or planning permission exists, for non-agricultural purposes.

Rating	Criteria
	Low level of farmhouses and farm buildings / facilities present. Key constraints – Sensitive farm enterprises may be present.
Very low	Land use – Extensively managed livestock farm enterprises on poor to medium quality lands or with significant levels of forestry / peat / scrub present. Agricultural lands may be zoned for, or planning permission exists, for non-agricultural purposes. Low level of farmhouses and farm buildings / facilities present. Key constraints – No sensitive farm enterprises present.

The impact rating assessment is based on the qualitative and quantitative assessment of the options under the following:

- Land-take.
- Likely land severance on farm holdings.
- Impact on farmhouses.
- Impact on farm buildings and facilities.
- Impact on key agricultural constraints.

The impact rating will consider the criteria as presented in Table 23.

**Table 23. Impact rating criteria**

Rating	Criteria
High	Land-take – Predominantly offline (on private agricultural lands). Significant land-take and land severance impacts on agricultural properties. Significant direct impacts on farmhouses and farm buildings / facilities. Significant impacts on key constraints present.
Medium	Land-take – Predominantly offline (on private agricultural lands). Land-take and land severance impacts on agricultural properties. Direct impacts on farmhouses and farm buildings / facilities. Impacts on key constraints present.
Low	Land-take – Online (on public road / public lands) / offline (on private agricultural lands). Land-take and land severance impacts on agricultural properties. Impacts are not significant on farmhouses and farm buildings / facilities. Impacts are not significant on key constraints present.
Very low	Land-take – Online (on public road / public lands) / offline (on private agricultural lands). Land-take and land severance impacts on agricultural properties. No direct impacts on farmhouses and farm buildings / facilities present. No direct impacts on key constraints present.

All options are located on agricultural farm holdings and options effects will involve direct and indirect impacts.

Direct impacts on agricultural property may include land-take, farm division and impacts on access to remaining lands. The impact of land-take involves a reduction in agricultural lands, fragmentation of retained lands and may include direct impacts on farm buildings / or farmyard facilities used in the operation of the farm enterprise.

Indirect impacts on agricultural property can affect the operation of the agricultural enterprise. Such impacts include noise, air, visual and lighting impacts arising from the construction and operation of the proposed options. Indirect impacts on farm enterprises have also been considered as part of the assessment e.g., the presence and proximity of equine farms.

The significance of impact increases with the degree of impact(s) associated with a proposed option. A higher significance is associated with farm enterprises considered of significance or sensitive to direct and indirect impacts. Such farm enterprises include agricultural property used for educational or research purposes, dairy farm enterprises or equine farm enterprises where operational activities involve a high level of interaction with horses.

The mca impact category for options is determined from the value rating combined with the impact rating from the matrix table in Table 24. There are four impact categories relevant to the assessment of the impact on agriculture that comprise of 'neutral', 'slight negative', 'negative' and 'highly negative'. These categories are taken from the seven-point scale in TII PAG guidance.

**Table 24. Mca Impact category and score**

Value Rating	Impact Rating			
	High	Medium	Low	Very low
High	Highly negative impact Score 1	Negative impact Score 2	Slight negative impact Score 3	Slight negative impact Score 3
Medium	Negative impact Score 2	Negative impact Score 2	Slight negative impact Score 3	Neutral impact Score 4
Low	Slight negative impact Score 3	Slight negative impact Score 3	Slight negative impact Score 3	Neutral impact Score 4
Very low	Slight negative impact Score 3	Slight negative impact Score 3	Neutral impact Score 4	Neutral impact Score 4

### Non-Agricultural Property

The options assessment comprises an assessment of Jackson's Bridge options and the potential option impact on non-agricultural property. This will involve assigning a value rating and an impact rating to each option based on the criteria in Table 25.

**Table 25. Options assessment**

Rating	Criteria	Rating
Value criteria	Type and quantity of non-agricultural property.	High, Medium, Low or Very Low
Impact criteria	Impacts on property, on residential, commercial, community and development property, on property curtilage, on property entrance / access. Identify significant impacts.	High, Medium, Low or Very Low
Significance of impact	Significance category and mca score based on the combination of both the value and impact ratings. based.	

The value rating in Table 26 is based on the qualitative and quantitative assessment of the option corridor with regards to the following non-agricultural property:

- Residential property.

- Commercial property.
- Community property – Public park, open space or lands that are used for public amenities and services; and
- Development land – Lands zoned for development and sites with planning permission.

The methodology for the options assessment comprises of a qualitative and quantitative appraisal of the options and the impact on non-agricultural property in Table 26.

**Table 26. Value rating criteria**

Rating	Qualitative Criteria
High	Non-agricultural property – Residential, commercial, community and development property with zoning for development and planning permission is present.
Medium	Non-agricultural property – Residential, commercial, community and development property with zoning for development or planning permission is present.
Low	Non-agricultural property – Residential, commercial, community and development property with zoning for development or planning permission is present.
Very low	Non-agricultural property – Absent within the option.

The qualitative assessment consists of an evaluation of non-agricultural property types along the route option corridor. The quantitative assessment considers the level of non-agricultural property types.

The impact rating in Table 27 is based on the qualitative and quantitative assessment of the potential option alignment under the following criteria:

- Land-take.
- Impact on dwelling houses / commercial / community buildings.
- Impact on entrance and access to property.
- Impact on property curtilage / property boundary.

The impact rating will consider the qualitative and quantitative criteria as presented in Table 27 for the option alignment.

**Table 27. Impact rating criteria**

Rating	Qualitative Criteria
High	Land-take and property impacts – on residential, commercial, community and development property with zoning for development and planning permission. Significant direct impacts involving property acquisition or a substantial area of curtilage / lands.
Medium	Impacts on residential, commercial, community and development property with zoning for development or planning permission. Direct impacts involving acquisition of areas of property curtilage / lands.
Low	Impacts on residential, commercial, community and development property with zoning for development or planning permission. Impacts on non-agricultural lands without planning permission. Direct impacts involving acquisition of areas of property curtilage / lands.
Very low	There is no impact on non-agricultural property or direct impact involves acquisition of areas of public road only.

The impact assessment considers the combined effects of land-take, direct impacts to properties and impacts on property access. The assessment of the option impact is based on the effect of the proposed option land-take boundary on non-agricultural property present.

A direct impact on residential, community or commercial property may be a significant negative impact on the property. On residential property, land-take may result in loss of property curtilage involving direct impacts to the dwelling / property entrance / access / property boundary and loss of garden area / mature planting. On commercial property, a loss of property curtilage may result in direct impacts to buildings / property entrance / property boundary and loss of staff parking / customer parking / commercial yard area. On community property, land-take may result in a direct impact on community building / property entrance / property boundary and loss of amenity area, mature planting and public parking.

The option assessment has allowed for mitigation of the loss of property access involving the replacement of property entrances and access on a like-for-like basis. These will be considered on an individual basis, and final mitigation will inform the assessment of the non-agricultural impact on individual properties.

The mca impact category for the options is determined from the value rating combined with the impact rating from the matrix table in Table 28. There are four impact categories relevant to the assessment of the impact on non-agricultural property that comprise of 'neutral impact', 'slight negative impact', 'negative impact' and 'highly negative impact'. These categories are taken from the seven-point scale in TAF (2024).

**Table 28. Mca Impact category and score**

Value Rating	Impact Rating			
	High	Medium	Low	Very low
High	Highly negative impact Score 1	Negative impact Score 2	Slight negative impact Score 3	Slight negative impact Score 3
Medium	Highly negative impact Score 1	Negative impact Score 2	Slight negative impact Score 3	Slight negative impact Score 3
Low	Negative impact Score 2	Negative impact Score 2	Slight negative impact Score 3	Slight negative impact Score 3
Very low	Neutral impact Score 4	Neutral impact Score 4	Neutral impact Score 4	Neutral impact Score 4

The assessment of impact on non-agricultural property has assumed, unless stated otherwise, that the following will apply to the route options in each section:

- The option will be predominantly offline on agricultural lands.
- The impact on non-agricultural property mainly comprises of land-take on property curtilage, impact on property boundaries or impacts on existing property entrances.

#### 4.7.5.3.2 Options Appraisal

##### **Option 1. Double online track. Vertical track lowering and track protection.**

Option 1 follows the current railway corridor (online option) passing under Jackson's Bridge (OBG23). The option will not involve permanent land-take of agricultural lands. It is likely that agricultural land will be required on a temporary basis along the southern boundary to facilitate construction. There is no impact on non-agricultural property.

Land cover along the corridor is comprised of moderate to good quality improved grassland. Land use is grassland for livestock grazing / fodder production. There are three agricultural properties with lands along the boundary of this option of which farmhouses and farmyards are present on one property. Agricultural land use is livestock based involving one beef farm enterprise and two farms with land leased for livestock grazing.

There are no significant or greater impacts on agricultural properties. There is no permanent land-take of agricultural lands. There are no direct impacts or impacts on existing access to farmhouses. There may be minor impacts on these three properties due to temporary land-take of agricultural lands during the construction phase.

Option 1 has an impact score of 4 based on a value rating of Medium and an Impact rating of Very Low. This impact score is associated with a Neutral impact level for property.

### **Option 2. Double online track. Bridge deck reconstruction and track protection**

Option 2 follows the current railway corridor (online option) passing under Jackson's Bridge (OBG23). The option will not involve permanent land-take of agricultural lands. It is likely that agricultural land will be required on a temporary basis along the southern boundary to facilitate construction. There is no impact on non-agricultural property.

Land cover along the corridor is comprised of moderate to good quality improved grassland. Land use is grassland for livestock grazing / fodder production. There are three agricultural properties with lands along the boundary of this option of which farmhouses and farmyards are present on one property. Agricultural land use is livestock based involving one beef farm enterprise and two farms with land leased for livestock grazing.

There are no significant or greater impacts on agricultural properties as a result of the proposed option. There is no permanent land-take of agricultural lands. There are no direct impacts or impacts on existing access to farmhouses. There may be minor impacts on these three properties due to temporary land-take of agricultural lands during the construction phase.

Option 2 has an impact score of 4 based on a value rating of Medium and an Impact rating of Very Low. This impact score is associated with a Neutral impact level for property.

### **Option 3. Double offline track (new alignment). L5041 road diversion**

Option 3 will involve a new double-track alignment offline and to the west of Jackson's Bridge. The L5041 road will be realigned to a bridge crossing of the rail line and Royal Canal and a T-junction with the R148. The option will involve permanent land-take of approximately 12.0ha agricultural lands. There is no impact on non-agricultural property.

Land cover along the corridor is comprised of moderate to good quality improved grassland. Land use is grassland and arable for livestock grazing / fodder production and tillage crop production. There are three agricultural properties with agricultural lands on this option of which farmhouses and farmyards are present on one property. Agricultural land use is livestock based involving one beef farm enterprise and two farms with lands leased for livestock grazing. There are no significant or greater impacts on agricultural properties. There are no direct impacts or impacts on existing access to farmhouses. Farm division of lands will occur on one property. Mitigation of access to divided and retained lands will be required on two properties. There will be minor to moderate impacts on the four agricultural properties due to permanent land-take and impacts on access.

Option 3 has an impact score of 2 based on a value rating of Medium and an Impact rating of Medium. This impact score is associated with a Negative impact level for property.

**Option 4: Double offline track (new alignment) - Embankment**

Option 4 will involve a new double-track alignment offline and to the south of Jackson's Bridge. The vertical alignment of the tracks will be raised on an embankment to allow the L5041 to be kept open and pass under the new railway line. The option will involve permanent land-take of approximately 9.0ha agricultural lands. There is no impact on non-agricultural property.

Land cover along the corridor is comprised of moderate to good quality improved grassland. Land use is grassland for livestock grazing / fodder production. There are three agricultural properties with agricultural lands on this option of which farmhouses and farmyards are present on one property. Agricultural land use is both livestock based involving one beef farm enterprise and two farms with lands leased for livestock grazing.

There are no significant or greater impacts on agricultural properties. There are no direct impacts or impacts on existing access to farmhouses. Mitigation of access to retained lands on one property will be required. There will be minor to moderate impacts on the three agricultural properties due to permanent land-take.

Option 4 has an impact score of 3 based on a value rating of Medium and an Impact rating of Low. This impact score is associated with a Slight Negative impact level for agricultural property.

**Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge**

Option 5 will involve a double-track alignment (online) through Jackson's Bridge. The vertical alignment of the tracks will be raised resulting in the removal and reconstruction of Jackson's Bridge. The option will involve permanent land-take of approximately 6.5ha agricultural lands. There is no impact on non-agricultural property. Land cover along the corridor is comprised of good quality improved grassland. Land use is grassland for livestock grazing / fodder production. There are three properties with agricultural lands on this option of which farmhouses and farmyards are present on one property. Agricultural land use is livestock based involving one beef farm enterprise and two farms with lands leased for livestock grazing.

There are no significant or greater impacts on agricultural properties. There are no direct impacts or impacts on existing access to farmhouses. Farm division of lands will occur on one property. Mitigation of access to retained lands may be required. There will be minor to moderate impacts on the agricultural properties due to permanent land-take and impacts on access.

Option 5 has an impact score of 3 based on a value rating of Medium and an Impact rating of Low. This impact score is associated with a Slight Negative impact level for property.

## 4.7.5.3.3 Summary Assessment

**Table 29. Material Assets: Property Impact mca Assessment**

Option	TAF Impact Scoring
<b>Option 1: Double online track. Vertical track lowering and track protection</b>	4 – Neutral Impact
<b>Option 2: Double online track. Bridge deck reconstruction and track protection</b>	4 – Neutral Impact
<b>Option 3: Double offline track (new alignment) and L5041 road diversion</b>	2 – Negative Impact
<b>Option 4: Double offline track (new alignment). Embankment</b>	3 – Slightly Negative Impact
<b>Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge</b>	3 – Slightly Negative Impact

#### 4.7.5.4 Built Services (Utilities)

##### **Option 1. Double online track. Vertical track lowering and track protection.**

Option 1 does not impact relevant utilities. The proposed track levels under ESB 220 kV lines meets the required clearance to the electric line.

For this reason, this option receives a score of '4' on the TAF impact scoring scale, as it will have a 'Neutral Impact' on built services.

##### **Option 2. Double online track. Bridge deck reconstruction and track protection**

Option 2 does not impact relevant utilities. It impacts an overhead power line that passes through Jackson's Bridge.

The proposed track levels under ESB 220 kV lines meets the required clearance to the electric line.

For this reason, this option receives a score of '3' on the TAF impact scoring scale, as it will have a 'Slightly Negative Impact' on built services.

##### **Option 3. Double offline track (new alignment) and L5041 road diversion**

Option 3 proposed offline tracks elevations under ESB 220 kV lines does not allow for the required ESB clearance. It requires the poles to increase in height.

The L5041 road diversion impacts on a MD electric line.

For this reason, this option receives a score of '2' on the TAF impact scoring scale, as it will have a 'Negative Impact' on built services.

##### **Option 4: Double offline track (new alignment). Embankment**

Option 4 proposed offline tracks elevations under ESB 220 kV lines does not allow for the required ESB clearance. It requires the poles to increase in height or rerouting the line.

It requires 4 m extra line elevation than Option 3. The proposed solution for rerouting the line must be studied and agreed upon with ESB.

For this reason, this option receives a score of '1' on the TAF impact scoring scale, as it will have a 'Highly Negative Impact' on built services.

##### **Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge**

Option 5 proposed online tracks elevations under ESB 220 kV lines does not allow for the required ESB clearance. It requires the poles to increase in height.

The L5041 road diversion impacts on a MD electric line. Option 5 impacts an overhead power line that passes through Jackson's Bridge.

For this reason, this option receives a score of '2' on the TAF impact scoring scale, as it will have a 'Negative Impact' on built services.

## 4.7.5.4.1 Summary Assessment

Table 30. Built Services (Utilities) Impact mca Assessment

Option	TAF Impact Scoring
<b>Option 1: Double online track. Vertical track lowering and track protection</b>	4 – Neutral Impact
<b>Option 2: Double online track. Bridge deck reconstruction and track protection</b>	3 – Slightly Negative Impact
<b>Option 3: Double offline track (new alignment) and L5041 road diversion</b>	2 – Negative Impact
<b>Option 4: Double offline track (new alignment). Embankment</b>	1 – Highly Negative Impact
<b>Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge</b>	2 – Negative Impact

## 4.7.5.5 Soils and Geology (incl. Waste)

This section provides the outcome of the site selection process under the heading of soils and geology (including waste). The appraisal involves undertaking an impact assessment of proposed options for the Jackson's Bridge.

## 4.7.5.5.1 Methodology

**Desk study**

A desktop assessment was carried out for the proposed options to establish baseline conditions using Geological maps, Geological Survey of Ireland (GSI), Historic Maps from the Ordnance Survey of Ireland, Google Earth, Environmental Protection Agency (EPA) maps to identify and assess any likely landfill sites or waste facilities within the study area, and historical investigation reports.

The proposed Jackson's Bridge options are primarily located within agricultural land, characterized by relatively flat, low-lying terrain with ground elevations ranging from +55 mOD to +70 mOD. According to the GSI database, the dominant soil type is Till derived from Limestone (TLs) with localised Alluvium along the River Lyreen. Bedrock outcrop is present locally southwest of Jackson's Bridge. The planned construction is going to take place on the existing railway alignment for Options 1, 2 and 5.

The bedrock geology consists solely of the Lucan Formation (LU, dark limestone and shale (Calp)). This formation is defined as a sedimentary rock consists mainly of dark grey to black fine-grained, occasionally cherty, micritic limestones and typically ranges from 300 m to 800 m in thickness. Tober Colleen Formation comprising of calcareous shale, limestone conglomerate is present at around 1 km southeast of the bridge. The vicinity of Jackson's Bridge encountered structural features namely a fault in the east, strike and dip of bedding in the south.

The proposed options do not encounter any significant geological constraints namely karst formation, geological heritage features, economic geology concerns related to quarries or mines, and landslides. According to the EPA, there are no waste facilities, industrial facilities, Special Areas of Conservation (SAC) and Special Protection Areas (SPA) present nearby the proposed options. Based on GSI Geologic Heritage Sites database, the closest heritage site is Louisa Bridge Cold Spring (GSI Site Code: KE016, IGH Theme: IGH16) which is approximately 7.7 km away from the proposed option.

There might be risk of hydrocarbon contamination (diesel and lubricating oils) on or near the tracks due to diesel operated trains in all the proposed options. However, site-specific contamination data are not available at this stage.

#### *Historical Ground Investigations (GIs)*

The ground investigation available in close proximity to Jackson's Bridge shows that the ground profile on the southwest of Jackson's Bridge has around 0.2m to 1m of soft clay and deeper soft clay of up to 2 m depth on the northeast side of the Jackson's Bridge. The soft clay is followed by firm to stiff clay over medium strong to strong limestone. The groundwater level based on the borehole logs ranges between 54 mOD to 59.5 mOD which is lower than the proposed flood level of 60.57 mOD at 0.1% AEP +CC.

There are two interpreted geophysical survey profiles available near the Jackson's Bridge GEO-156 (located southeast of the bridge) and GEO-046 (adjacent to Jackson's Bridge in the east direction). The ground profiles show soft to firm silt/clay (~ 1 mBGL deep) over firm to stiff silty gravelly clay (~ 1.8 to 5.0 mBGL deep) overlying weathered muddy limestone layer (~ 2 to 5.8 mBGL deep).

#### Multi Criteria Assessment (mca)

Upon review of the site conditions and project requirements, a Multi Criteria Assessment (mca) matrix has been prepared (in accordance with the TII publication DN-03083 Managing Geotechnical Risk) with the prime objective of providing a Transport Appraisal Framework (TAF) scoring of Soils and Geology (including Waste) risks for each of the proposed options. The same TAF 7-point scale was used but the scale is adjusted from 1 to 4 rather than 1 to 7 based on respective baseline environments of the proposed options. These scores denote the impact of each option to its existing environment, when compared to its own baseline scenario. A slight change was made to Table 31 below regarding "EW Volume Balance" as per the provided project information.

**Table 31. Soils and Geology mca Criteria**

TAF 7-point Scale		Soft Ground	EW Volume Balance	Impacts on Slopes/ Earthworks / Structures Foundations	Landslide	Karst	Contaminated Soils	Quarry / Mine Resources	Geologic Heritage Sites
Impact Level	Score								
Neutral	4	Not present / insignificant impact	Minimal EW required, flat slope on good foundation soils	Little or no effects on adjacent lands or structure foundations	Not present / insignificant impact	Not present / insignificant impact	Not present / insignificant impact	Not present / insignificant impact	Not present / insignificant impact
Slightly Negative	3	<10% of the site area	EW total fill:bulk cut ratio 50% to 100% and 100% to 150% / overall import and disposal volumes	Some slopes near boundaries or minor works near foundations	Site <500 m from recorded or suspected slope instability	Site impacts turloughs, springs and wells	Site impacts areas of local dumping <1000 m <sup>3</sup> and <500 m from possible area of contamination	Site <500 m from existing quarry	Potential disturbance to feature from construction
Negative	2	10% to 50% of the site area	EW total fill: bulk cut ratio 100% to 150% and 150% to 200% / overall import and disposal volumes	Large slopes or retention structures near boundaries, or strengthening structures foundations	Site <100 m from recorded or suspected slope instability	Site impacts minor sinkhole depressions <5m diameter and/or <100m distant	Site <500 m from known area of contamination	Site <100 m from existing quarry or restricts future resources	Partial removal of feature
Highly Negative	1	>50% of the site area	EW total fill: bulk cut ratio >150% or >200 / overall import and disposal volumes	Retention requiring anchors or other wayleaves on adjacent properties, demolition or condemning adjacent structures	Site impacts areas of recorded or suspected slope instability	Site impacts major sinkhole depressions >5m diameter or caves	Site impacts known landfill or area of contamination	Site impacts access or operations of existing quarry	Full removal of feature

#### 4.7.5.5.2 Options Appraisal

##### **Option 1. Double online track. Vertical track lowering and track protection.**

This option involves lowering the existing track by approximately 720 mm to provide sufficient clearance for overhead line equipment (OHLE) and horizontal realignment of the track to accommodate double track. To protect against flooding, reinforced concrete U-section retaining walls are proposed on both sides of the track between Ch. 91+300 to 92+280. The bridge parapets will be raised by approximately 220 mm to maintain adequate clearance and safety.

The main challenge in this option is that the deep excavation required for track lowering, including removal of ballast and sub-base layers, may affect the bearing strata or foundations of Jackson's Bridge and any buried utilities. There is a risk of lateral ground movement and loss of support beneath the bridge footings during excavation, particularly if groundwater ingress occurs. Although the assessment does not indicate direct impact on Jackson's Bridge or Canal Lock, there may be indirect negative impact due to presence of overhead line equipment and excavation-induced vibrations and noise.

To manage these risks, a detailed geophysical and structural investigation is recommended to identify the bridge foundation levels with vibration and settlement monitoring carried out during construction. Effective groundwater control might be required to prevent base heave and ensure safe working conditions during excavation.

The length of the retaining walls is also significant (around 980 m), and it might impose additional lateral pressure on the subgrade soils. The wall stability and bearing capacity of the founding material must be verified through detailed ground investigation. The retaining walls may also influence the behaviour of Jackson's Bridge and nearby canal structures. The proposed development may encounter Made Ground and soft soils, which are expected to be replaced.

The main earthworks involve excavation with cut volume of approximately 24,719 m<sup>3</sup> and limited fill volume of 133 m<sup>3</sup>. Excavated materials, subjected to suitability testing, could be reused on other parts of the railway alignment or at the depot site, which still has import requirements. Potential contamination may occur from diesel or lubricating oils on or near the tracks due to diesel operated trains. Overall, the geotechnical risks for this option are primarily related to excavation stability, groundwater control, and interaction with existing structures.

Based on this, Option 1 is assigned a TAF Impact Score of 3 – 'Slightly Negative' Impact.

##### **Option 2. Double online track. Bridge deck reconstruction and track protection**

Option 2 proposes demolition and reconstruction of the existing Jackson's Bridge arch to minimise the impact of floodplains. The work also includes construction of a flood defence walls/embankments between Ch. 91+300 to 92+130. This option requires removal of the existing tracks and the maximum track level achievable under Jackson's Bridge is 60.0 mOD, which is still below the flood level of 60.57 mOD. The existing road backfill is to be removed and is proposed to be replaced with lightweight concrete.

This option directly impacts the protected Jackson's Bridge as full arch demolition and reconstruction may also have a negative impact on the other part of bridges. The bridge deck reconstruction introduces new load paths and requires careful assessment of stiffness, settlement and load transfer responses, as there is increase in road level to ensure safety. Strengthening of adjacent arch barrels may be needed to prevent distortion or cracking. The differential settlement and bearing capacity checks of the foundations are advised due to such alterations, with the introduction of new vertical and lateral loads on existing ground from flood defence walls, increased road levels, overhead power lines, etc.

Subsurface conditions are expected to include Made Ground or soft soils that may not be adequate and will require replacement or improvement. The proximity to the river and high groundwater levels may cause seepage and instability, requiring proper dewatering or temporary support systems. The overhead powerlines also increase construction complexity.

The earthworks mainly involve excavation with cut volume of approximately 13,197 m<sup>3</sup> and limited fill volume of 343 m<sup>3</sup>. Excavated material can be reused on other parts of the railway alignment. Potential contamination may occur from diesel or lubricating oils on or near the tracks due to diesel operated trains.

Based on this, Option 2 is assigned a TAF Impact Score of 3 – ‘Slightly Negative’ Impact.

### **Option 3. Double offline track (new alignment) and L5041 road diversion**

This option avoids direct impact on Jackson’s Bridge and other adjacent structures but introduces new challenges due to the railway alignment’s location within a flood zone of the Lyreen river, especially where the ground is locally underlain by soft soils. The soft, saturated deposits are likely to have low shear strength, posing significant settlement and stability risks for embankments, underpass, and foundations. Flooding may pose a risk during construction, particularly for erosion of exposed soils or foundations. The proposed L5041 road would be founded on firm to stiff clay with localised areas of soft clay requiring compaction or minor ground improvement.

Based on the historical GI, the soft soil depth in the vicinity of the proposed railway alignment varies between approximately 0.20m to 1.5m, which may require localised ground replacement or improvement. According to the historical GI, the areas near the proposed L5041 road would follow firm to stiff clay with slight traces of soft clay. Adequate drainage design will also be necessary to manage water ingress and prevent softening of foundation materials.

Earthworks are anticipated to consist primarily of embankments for the railway and road diversion, with approximately 6,989 m<sup>3</sup> of cut and 105,656 m<sup>3</sup> of fill. Subject to identification of a suitable source with confirmation of appropriate sampling and testing, borrow material could be used. This imported fill material should have adequate strength, compaction and permeability characteristics, as well as being inert. The proposed alignment traverses predominantly in agricultural land with low contamination risk. The main challenges for this option are foundation settlement, extensive earthworks, soft floodplain soils, and high groundwater conditions rather than heritage impacts.

Based on this, Option 3 is assigned a TAF Impact Score of 2 – ‘Negative’ Impact. The text above provides details on this scoring and how the different factors are involved.

### **Option 4: Double offline track (new alignment) - Embankment**

Option 4 proposes a new double track alignment to the south of Jackson’s Bridge, with the new railway line traversing the Lyreen River flood zone on a raised embankment. The proposal includes two major underpasses (UBG22A of 30 m span and UBG22B of 46 m span) and a new under bridge for the Ballycaghan stream diversion towards the Lyreen River.

Flooding conditions particularly between Ch. 91+300 to 91+940 pose additional challenges for construction sequencing and temporary works. Proper drainage and erosion control measures might be needed around the embankment toes and underpass structures. This option introduces considerable loading on soft soil, likely to induce settlement, or lateral spreading if not adequately mitigated. Long term differential settlement across the embankment could affect track geometry and serviceability. If soft soil is encountered, it may require replacement, or ground improvement like geosynthetic reinforcement.

The total earthworks for this option comprise approximately 2,224 m<sup>3</sup> of cut and 99,875 m<sup>3</sup> of fill. Given the large fill volumes, identifying a suitable borrow source is critical to ensure material quality and minimize waste generation. The fill should be well-graded, low-plasticity material compacted in layers to achieve stability and minimize post-construction settlement. The embankment is located within agricultural floodplain areas suggesting negligible contamination risk.

Although this option avoids direct impact on Jackson's Bridge, the scale of embankment construction within flood-prone soft ground introduces considerable geotechnical risk. Based on this, Option 4 is assigned a TAF Impact Score of 2 – 'Negative' Impact.

#### **Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge**

Option 5 follows the existing railway corridor and involves the demolition of central arch of the Jackson's Bridge (OBG23) to enable the rail level to be raised by approximately 3m. A slab structure supported by piles is proposed between Ch. 91+700 to 91+960 to allow floodwater to pass beneath the tracks towards the Royal Canal. The scheme also includes westward diversion and raising of the L5041 road on embankment, new bridge to cross the raised railway, Royal Canal and greenway, realignment of R148 road locally and a box culvert to divert the Ballycaghan Stream.

The proposed work utilises the existing railway formation, which generally provides a firm and compacted foundation. This is supported by historic ground investigation along the track showing ballast over made ground over firm to stiff clay or medium dense sand. However, localized soft deposits or made ground may still be encountered and would require shallow soil replacement or improvement. According to the historical GI, the areas near the proposed L5041 road would follow firm to stiff clay with slight traces of soft clay. The pile supported slab structure will impose vertical and lateral loads on the underlying soil, necessitating further ground investigation to understand the bearing capacity and depth to competent strata. The excavations for pile caps, culvert foundations and drainage structures may encounter shallow groundwater, requiring dewatering and careful control of water ingress.

The proposed earthworks involve significant embankment construction associated with raised rail track and L5041 road diversion, with approximately 6,739 m<sup>3</sup> of cut and 92,542 m<sup>3</sup> of fill. A suitable borrow source will be needed to supply good quality fill material and help minimize waste generation. Careful material selection, compaction control, and use of geosynthetic reinforcement will be essential to achieve embankment stability and long-term performance. The existing railway corridor may contain localized contamination from diesel or lubricating oil spills associated with diesel operated trains.

Based on this, Option 5 is assigned a TAF Impact Score of 2 – 'Negative' Impact.

#### 4.7.5.5.3 Summary Assessment

##### Average TAF Impact Scoring for All Options

The average TAF scoring of options is presented in table below. It should be noted that as the scores are not weighted, the average score at the end of this assessment will be indicative only and does not represent the final TAF impact scoring of the proposed sites in terms of Soils and Geology (including Waste) as given in the following subsection. The geotechnical data at this stage is limited for the assessment. It can be concluded that some factors are more important than others in helping to differentiate between site location options. In other words, 'Landslide', 'Karst', 'Quarry/Mine Resources' are less important than the other criteria, as they are not specific to the options.

As discussed at the beginning of this subsection, no quarry/mine resources could be associated with the proposed options. According to GSI Landslide Susceptibility and Groundwater Karst databases, the options are located in sites classified as having low landslide susceptibility and no karst features (e.g., caves) were found within footprints. Therefore, a TAF Impact Score of 4 – 'Neutral Impact' is assigned to 'Landslide', 'Karst', 'Quarry / Mine Resources' and 'Geologic Heritage Sites' factors as summarized in Table 33.

The main factor causing impact for the options is the earthworks volume balance, alteration to Jackson's Bridge, possibility of soft soil and increase in water table due to floodplain areas, flood protection walls.

Table 32. Average TAF scoring – Option-by-option mca for Soils and Geology (including Waste) factors

Site Location Option #	TAF Scoring by Factor								TAF Average Scoring*	TAF Impact Scoring Description
	Soft Ground	EW Volume Balance	Impacts on Slopes/ Earthworks Structures Foundations	Landslide	Karst	Contaminated Soils	Quarry / Mine Resources	Geologic Heritage Sites		
Option 1	3	3	3	4	4	3	4	4	3.0	Slightly Negative
Option 2	3	3	2	4	4	3	4	4	2.75	Slightly Negative
Option 3	2	1	2	4	4	4	4	4	2.25	Negative
Option 4a	2	1	2	4	4	4	4	4	2.25	Negative
Option 4b	2	1	2	4	4	4	4	4	2.25	Negative
Option 5	3	1	1	4	4	3	4	4	2	Negative

\*: Calculated by discounting Landslide, Karst, Quarry / Mine Resources and Geologic Heritage Sites factors.

Table 33. Soils and Geology (incl. Waste) Impact mca Assessment

Option	TAF Impact Scoring
Option 1: Double online track. Vertical track lowering and track protection	3 – Slightly Negative
Option 2: Double online track. Bridge deck reconstruction and track protection	3 – Slightly Negative
Option 3: Double offline track (new alignment) and L5041 road diversion	2 – Negative
Option 4: Double offline track (new alignment). Embankment	2 – Negative
Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge	2 – Negative

#### 4.7.5.6 Planning Applications

This section provides the appraisal of 6 alternative solutions to Jackson's Bridge in terms of existing planning applications.

##### 4.7.5.6.1 Methodology

The following methodology has been applied to the options<sup>1</sup>.

- A defined research radius of 100m has been applied around each identified site.
- All planning applications within this radius have been reviewed and assessed.
- The assessment is based on publicly available data sourced from:
  - The National Planning Application Database (NPAD)
  - Local Authority planning application records

<sup>1</sup> This methodology applies to all options considered in this report.

- An Bord Pleanála (ABP) GIS data, where available (*manual search and mapping may be required where GIS data is unavailable*)

Planning applications were filtered, with the following cases excluded from further analysis:

- Expired permissions, unless an appeal was lodged.
- Consented extension of duration (EOD) permissions, where applicable.
- Invalidated or withdrawn applications.
- One-off housing developments and dwelling extensions

4.7.5.6.2 Options Appraisal

**Option 1. Double online track. Vertical track lowering and track protection.**

Planning applications within 100m of the site boundary have been considered, following the methodology outlined above. These are mapped below, with the details included in the Table following.



Figure 30. Planning History Map (Options 1 and 2)

Table 34. Planning History (Option 1 and 2)

P.A. Ref	Description	P.A. Grant Date
<b>ACP 314232</b>	Dart + West Railway Order	Make Railway Order with Conditions 18/07/2024
<b>2560111</b>	solar carports over the existing surface car park and associated infrastructure at Maynooth University	Grant 13/05/2025

<b>2560877</b>	195 no. apartments, a childcare facility and café/commercial unit	FI Requested 25/09/25
<b>21370 ABP-313264-22</b>	a mixed residential and commercial development including office; 183 no. and ancillary/commercial development.  (Note Cond. 2 of ACP approval permitted 169 no. residential units only)	Grant with conditions 12/02/24

The Railway Order Application made for the Dart + West project passes through the site. This application, ACP reference 314232, was permitted on 18<sup>th</sup> July 2024, however the Order omitted permission for all works west of bridge OBG21 west of Maynooth Station:

3. *The western end of the proposed development shall terminate at bridge OBG21 (Chainage 90+200), west of Maynooth Station. All components of the proposed development beyond this point shall not be developed in accordance with the submitted Railway Order application drawings and details, including:*

- *the depot and associated infrastructure,*
- *the flood compensatory storage areas,*
- *the proposed depot access road from the L5041 and its associated bridge crossing and links to the R148, and*
- *the diversion of the railway line in the vicinity of Jackson's Bridge.*

*Alternative/updated proposals for a depot and any associated support infrastructure shall be subject to further Railway Order approval(s).*

*Reason: In the interest of flood prevention.*

The Board's Decision includes a Detailed Explanatory Note why this Modification to the RO was applied.

In summary, the Board felt they had insufficient information available to them and not sufficient *'technical and policy support in the current application documentation'* to consider the proposals for this site against the Justification Test Criteria (See Box 5.1 in Figure below) of the *Planning System and Flood Risk Management Guidelines for Planning Authorities (2009)*.

**Box 5.1 Justification Test for development management  
(to be submitted by the applicant)**

When considering proposals for development, which may be vulnerable to flooding, and that would generally be inappropriate as set out in Table 3.2, the following criteria must be satisfied:

1. The subject lands have been zoned or otherwise designated for the particular use or form of development in an operative development plan, which has been adopted or varied taking account of these Guidelines.
2. The proposal has been subject to an appropriate flood risk assessment that demonstrates:
  - (i) The development proposed will not increase flood risk elsewhere and, if practicable, will reduce overall flood risk;
  - (ii) The development proposal includes measures to minimise flood risk to people, property, the economy and the environment as far as reasonably possible;
  - (iii) The development proposed includes measures to ensure that residual risks to the area and/or development can be managed to an acceptable level as regards the adequacy of existing flood protection measures or the design, implementation and funding of any future flood risk management measures and provisions for emergency services access; and
  - (iv) The development proposed addresses the above in a manner that is also compatible with the achievement of wider planning objectives in relation to development of good urban design and vibrant and active streetscapes.

The acceptability or otherwise of levels of residual risk should be made with consideration of the type and foreseen use of the development and the local development context.

Note: See section 5.27 in relation to major development on zoned lands where sequential approach has not been applied in the operative development plan.

Refer to section 5.28 in relation to minor and infill developments.

Regardless of the Option chosen for the works at and in the vicinity of Jackson's Bridge, the matters raised in this Explanatory Note will need to be addressed as part of a future application including:

- Consideration of Alternatives to expand to 'within and across the overall railway network' - this is underway in this mca analysis.
- A site specific flood risk assessment including revised justification test and mitigation measures as appropriate.
- Peer review of the final proposed flood management measures.

There are no other planning applications within the site boundary or significant applications within the study area relevant to the proposed development.

**Option 2. Double online track. Bridge deck reconstruction and track protection**

Option 2 is located at the same site as Option 1. Therefore, the findings and commentary under Option 1 above are applicable here.

### Option 3. Double offline track (new alignment) and L5041 road diversion

Planning applications within 100m of the site boundary have been considered, following the methodology outlined above. These are mapped below, with the details included in the Table following.

The Railway Order Application made for the Dart + West project passes through the site. This application, ACP reference 314232, was permitted on 18<sup>th</sup> July 2024, however the Order omitted permission for all works west of bridge OBG21 west of Maynooth Station.

Refer to further details under Option 1 above.

There are no other planning applications within the site boundary or significant applications within the study area relevant to the proposed development.



Figure 31. Planning History (Option 3)

Table 35. Planning History (Option 3)

P.A. Ref	Description	P.A. Grant Date
<b>ACP 314232</b>	Dart + West Railway Order	Make Railway Order with Conditions 18/07/2024
<b>2560111</b>	solar carports over the existing surface car park and associated infrastructure at Maynooth University	Grant 13/05/2025

P.A. Ref	Description	P.A. Grant Date
2560877	195 no. apartments, a childcare facility and café/commercial unit	FI Requested 25/09/25
21370 ABP-313264-22	a mixed residential and commercial development including office; 183 no. and ancillary/commercial development.  (Note Cond. 2 of ACP approval permitted 169 no. residential units only)	Grant with conditions 12/02/24
20/480	New walkway, extension to the existing multi-purpose all weather training pitch and new 3m wide tarmac surface "driving strips" on the existing permeable surface car parking area	Granted 29/03/2021
20/1053	for construction of 2 No. GAA grass playing pitches to the east of the exiting Pitch 1	Granted 28/05/2021
23/999	the construction of a building incl. a Multi-Sport Hall, changing rooms etc.	Granted 19/08/2024

Table 36. Planning History (Options 4a and 4b)

P.A. Ref	Description	P.A. Grant Date
ACP 314232	Dart + West Railway Order	Make Railway Order with Conditions 18/07/2024
2560877	195 no. apartments, a childcare facility and café/commercial unit	FI Requested 25/09/25
21370 ABP-313264-22	a mixed residential and commercial development including office; 183 no. and ancillary/commercial development including concierge, gym, café, creche, tenant amenity and commercial floorspace.  (Note Cond. 2 of ACP approval permitted 169 no. residential units only)	Grant with conditions 12/02/24
2560111	solar carports over the existing surface car park and associated infrastructure at Maynooth University	Grant 13/05/2025

**Option 4: Double offline track (new alignment). Embankment**

Option 4 is located at a site with the relevant planning history for both sites being the same. Refer to Figure below and Table above.

Therefore, the findings and commentary under Option 4a above are also applicable here.



Figure 32. Planning History (Option 4)

**Option 5: Double online track. Jackson’s Bridge deck removal and new L5041 bridge**

Planning applications within 100m of the site boundary have been considered, following the methodology outlined above. These are mapped below, with the details included in the Table following.

The Railway Order Application made for the Dart + West project passes through the site. This application, ACP reference 314232, was permitted on 18<sup>th</sup> July 2024, however the Order omitted permission for all works west of bridge OBG21 west of Maynooth Station. This includes smaller parcels of lands north of the rail line shown within Option 5 below.

Refer to further details under Option 1 above.

There are no other planning applications within the site boundary or significant applications within the study area relevant to the proposed development



Figure 33. Planning History (Option 5)

P.A. Ref	Description	P.A. Grant Date
ACP 314232	Dart + West Railway Order	Make Railway Order with Conditions 18/07/2024

#### 4.7.5.6.3 Summary Assessment

The 2024 Dart + West Railway Order Decision under ACP Ref. 314232 and the omission of works west of bridge OBG21, which includes all the options being considered, is the most relevant application for all the identified options.

The Explanatory Notes attached to the Decision from An Coimisiún Pleanála (Appendix 12), outlined the reasons for this omission, explaining that there was insufficient information available to the Board to enable them to make a determination of the proposed development in accordance with the *Planning System and Flood Risk Management Guidelines for Planning Authorities (2009)*.

Due consideration to this decision and guidance will inform the assessments required in the preparation of a new railway order application for the proposed works. Based upon the planning history, a negative TAF rating is applied.

Table 37. Planning Applications Impact mca Assessment

Option	TAF Impact Scoring
Option 1: Double online track. Vertical track lowering and track protection	-3- Slightly Negative
Option 2: Double online track. Bridge deck reconstruction and track protection	3- Slightly Negative
Option 3: Double offline track (new alignment) and L5041 road diversion	3- Slightly Negative
Option 4: Double offline track (new alignment). Embankment	3- Slightly Negative
Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge	3- Slightly Negative

#### 4.7.5.7 Zoned Land, Land Use Planning and Spatial Planning

This section provides the appraisal of alternative options for Jackson's Bridge in terms of zoned land, land use planning and spatial planning, under the DART + programme.

##### 4.7.5.7.1 Methodology

##### Policy Context

The policy context below applies to all options at Jackson's Bridge.

The **Kildare County Development Plan (CDP) 2023-2029** includes a number of policies and objectives which supports the development of rail infrastructure in the county, as set out below.

**Objective TM O1:** "Support the NTA Draft Transport Strategy for the Greater Dublin Area (2022-2042) and facilitate and secure the implementation of projects identified within the Strategy."

**Objective TM O10:** "Facilitate and secure the delivery/implementation of the public transport projects that relate to County Kildare as identified within the Integrated Implementation Plan (2019-2024), (or any superseding document), including the DART+ programme (Including DART+ West and DART+ South West), BusConnects and the light rail investments. The DART+ projects present an opportunity to improve journey time, reliability, and train frequency."

**Objective TM O13:** "Promote and facilitate the implementation of public transport projects (bus and rail) and encourage transport providers and other agencies (e.g. NTA, developers etc.) to improve public transport (bus and rail) and to have regard to and support recently implemented and/or planned routes under NTA's Bus Connects and proposed / planned routes under NTA's Connecting Ireland Rural Mobility Plan; Including: 1. Kilcock, Maynooth and Leixlip into Dublin; 2. Celbridge into Dublin; 3. Maynooth to Naas; 4. Leixlip to Naas; 5. Celbridge to Naas; 6. Naas to Caragh. in addition to a range of rural transport routes. Such developments shall be subject to AA screening and where applicable, Stage 2 AA."

**Policy TM P3:** *“Promote the sustainable development of the county by supporting and guiding national agencies in delivering major improvements to the public transport network and to encourage a shift from car-based travel to public transport that is accessible for all, regardless of age, physical mobility, or social disadvantage.”*

**Objective TM O50:** *“Facilitate and support the extension of the DART+ line to Kilcock, the extension of the DART+ Southwest line to Naas/Sallins (and promote a future extension to Newbridge and Kildare Town in the next DART + programme / GDA Transport Strategy Review) and the extension of the LUAS network, in co-operation with Irish Rail, the Department of Transport and the National Transport Authority.”*

#### 4.7.5.7.2 Options Appraisal

The works proposed at Jackson’s bridge will facilitate the extension of the Dart + West line to Kilcock. This aligns with local and regional objectives, developing and expanding on sustainable travel connections within the County and to the Greater Dublin Area.

This upgrade to the rail services will also promote Transport-orientated development at settlements along the rail line including Maynooth and Kilcock, supporting housing delivery along existing and planned transport corridors, reducing sprawl and lowering dependence on cars. The development will also promote and facilitate more compact, sustainable communities in line with national policy.

This will have a *highly positive impact* (i.e. TAF rating 7 – ‘likely to significantly improve conditions in the relevant criteria’) on achieving strategic land use planning proposals at all levels.

#### **Option 1. Double online track. Vertical track lowering and track protection.**

##### Land Use Zoning

These lands are not zoned. This is not unusual given the site comprises of the existing rail line.

The adjoining lands are zoned in the *Maynooth and Environs Joint Local Area Plan 2025-2031*, including Strategic Reserve (SR2) and agriculture to the south and New residential to the north adjoining the Canal.

The SR(2) lands to the south of the rail line are within the *Long Term Strategic and Sustainable Development Site*. Section 11.2.3 of the JLAP describes the purpose as being ‘to provide a level of clarity as to the future development of the town as well as to safeguard these lands to ensure the orderly and sequential expansion of the town in the period beyond the life of the Joint Plan.’

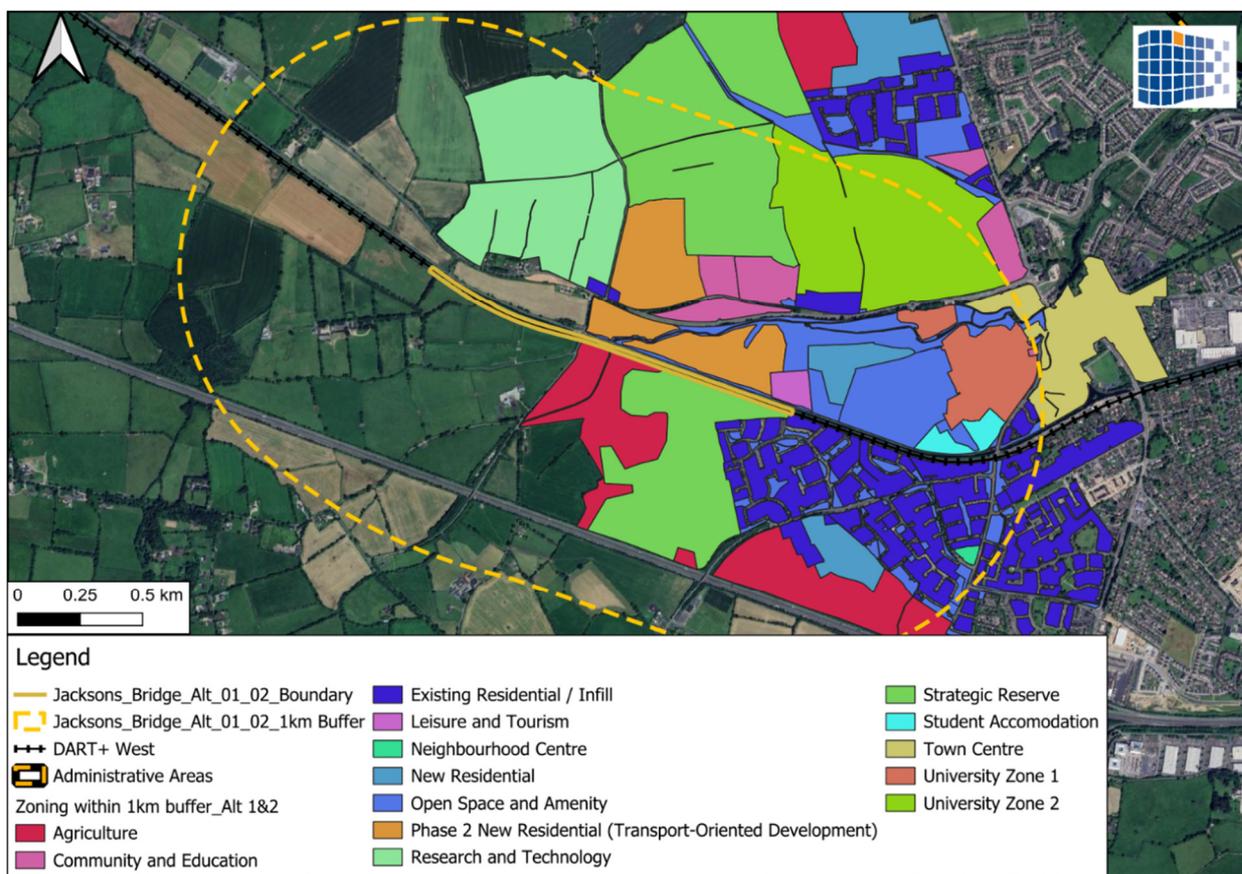
Section 11.2.3.1 of the JLAP describes the SR(2) lands and further outlines the purpose of its zoning:-

*“The lands within Maynooth West zoned as ‘SR(2): Strategic Reserve’ are located to the south of the Royal Canal and railway line comprise some 30.8 hectares of land which abuts the built-up area of the town at its southwestern edge. The area has a flat topography and is agricultural in nature, defined by a network of fields and hedgerow boundaries. A portion of the lands are subject to flood risk and there is a **high level of uncertainty regarding aspects relating to the delivery of key transport infrastructure in the area, specifically including the following projects:***

- **The finalisation of the DART+ West Railway project**
- **The finalisation and agreement of the route of Section 1B of the Maynooth Outer Orbital Route (MOOR), as per Measure RD 1 (see Table 7.5 and Map 7.4)**

- The M4 Maynooth to Leixlip Project and the potential location of a new junction, as per Measure RD 2B (see Table 7.5 and Map 7.4)
- The agreement of a location for the new Maynooth West Train Station and Park and Ride Facility, as per Parking Measure PK 14 (see Table 7.6 and Map 7.5)

**It is considered that the projects listed above, either individually or in combination, will have a significant impact on the potential of development on the lands within Maynooth West south of the rail line. Consequently, the ‘SR(2): Strategic Reserve’ zoning designation seeks to protect the lands from inappropriate and vulnerable uses, and facilitate key infrastructure projects to support Maynooth West as a Transport-Oriented Development, subject to site specific flood risk assessments and mitigation measures to address inter alia flood displacement.”**



**Figure 34. Land Use Zoning (Options 1 + 2)**

Site-specific policy objectives

The is one site-specific objective applicable to this site, with the Maynooth Outer Orbital Road (MOOR) crossing the site. The MOOR route is provided for under **Objective MATO 4.4** of the Maynooth JLAP:

*Support the phased delivery of the Maynooth Outer Orbital Road (MOOR), subject to planning and environmental considerations.*

The route of the MOOR is supported by the Regional Spatial and Economic Strategy 2019–2031 (RSES) and by the respective county development plans of Kildare County Council and Meath County Council.

Jackson’s bridge (and Lock) is a Protected Structure, listed in the Council’s Record of Protected Structures (RPS NO. B05-36). Refer to the Cultural Heritage Section for further details on this Protected Structure.

One scenic viewpoint is also listed on Jackson's Bridge – RC8. Views to and from the bridge are protected in the CDP.

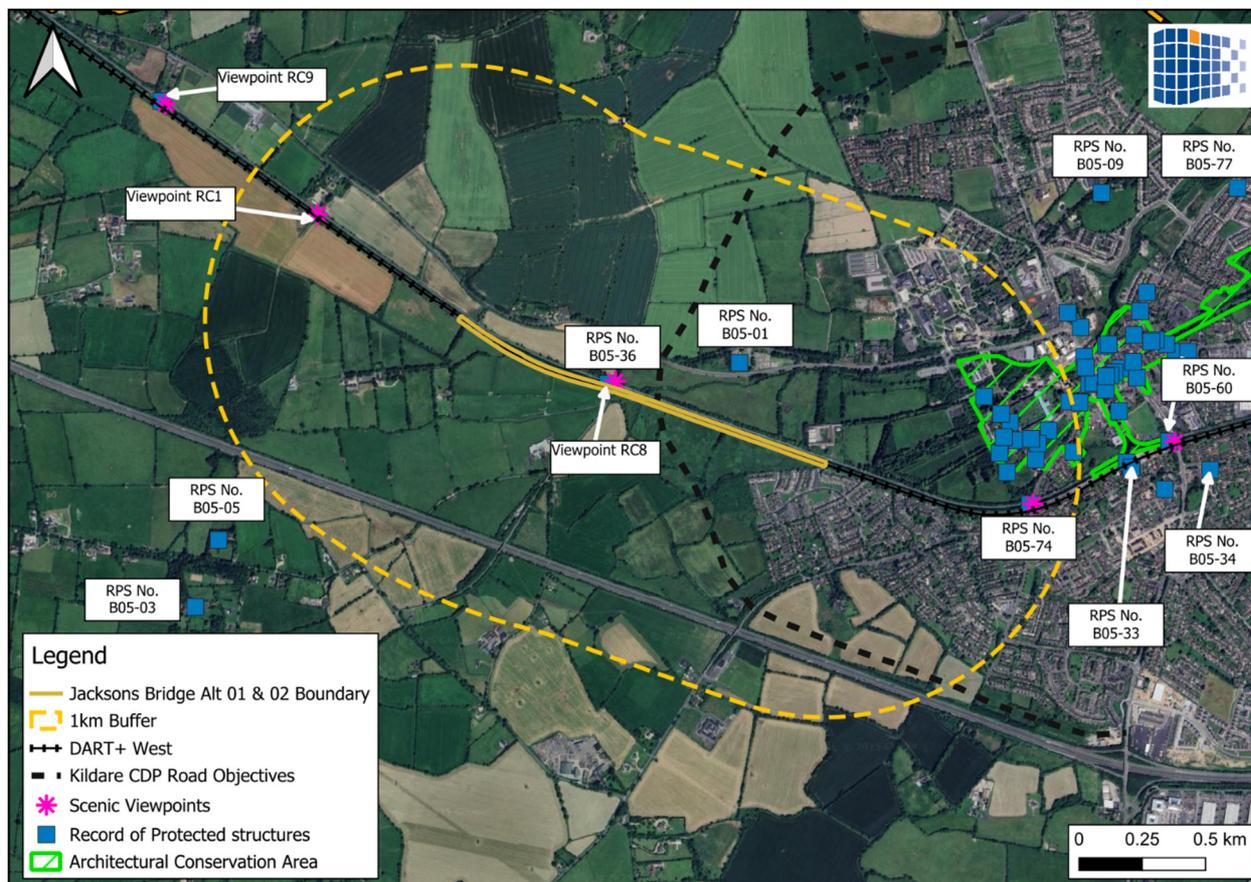


Figure 35. Specific Objectives (Options 1 + 2)

### Assessment

The redevelopment of Jackson's Bridge by lowering the existing track and including track protection measures, as per Option 1, will have a significant effect on the existing bridge, a protected structure, both culturally and visually. The effect of this impact on the TAF ratings is accounted for under the Cultural Heritage assessment below.

The route of the potential MOOR crossing the existing train line. It also traverses the site. However, due to the nature of the works proposed in lowering the track line, it is not envisaged that there any significant effects on future delivery of this orbital route which would not have previously been considered by the Local Authority when identifying the route crossing the existing rail line.

On the basis that the works proposed at Jackson's bridge are part of wider proposals to bring Dart + west to Maynooth and Kilcock, the works described will have a positive impact on achieving strategic land use planning proposals including national and regional goals for sustainable transport, new housing and transport orientated development for Maynooth and Kilcock.

No change to the TAF rating outlined in the policy context section (i.e. 7 – highly positive impact) is proposed.

### **Option 2. Double online track. Bridge deck reconstruction and track protection**

#### Land use Zoning and Site-specific policy objectives

Option 2 is located at the same site as Option 1. Therefore, the findings and commentary under Option 1 above are applicable here.

Refer to Figures above for zoning and relevant objectives.

#### Assessment

Option 2 is located at the same site as Option 1. Therefore, the findings and commentary under Option 1 above are applicable here.

No change to the TAF rating outlined in the policy context section (i.e. 7 – highly positive impact) is proposed.

### **Option 3. Double offline track (new alignment). L5041 road diversion**

#### Land use Zoning

Option 3 lies within County Kildare, outside of the boundary of the Maynooth JLAP. These lands are not zoned under the Kildare County Development Plan (CDP) 2023-2029. Such lands are deemed to be 'primarily agriculture' but other uses may be considered on their merits.

The adjoining lands are zoned in the *Maynooth and Environs Joint Local Area Plan 2025-2031*, including Strategic Reserve (SR2) and agriculture to the south and New residential to the north adjoining the Canal.

The SR(2) lands to the south of the rail line are within the *Long Term Strategic and Sustainable Development Site*. Section 11.2.3 of the JLAP describes the purpose as being 'to provide a level of clarity as to the future development of the town as well as to safeguard these lands to ensure the orderly and sequential expansion of the town in the period beyond the life of the Joint Plan.'

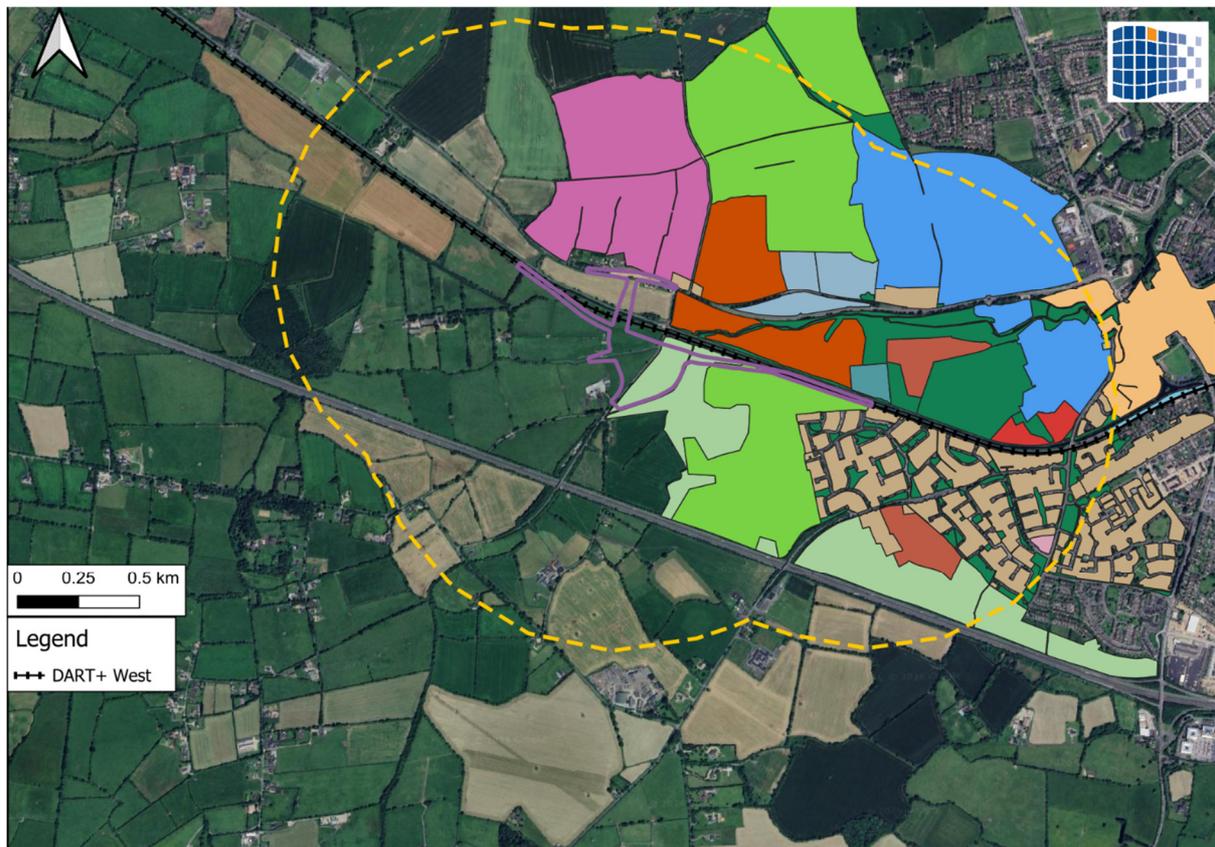
Section 11.2.3.1 of the JLAP describes the SR(2) lands and further outlines the purpose of its zoning:-

*"The lands within Maynooth West zoned as 'SR(2): Strategic Reserve' are located to the south of the Royal Canal and railway line comprise some 30.8 hectares of land which abuts the built-up area of the town at its southwestern edge. The area has a flat topography and is agricultural in nature, defined by a network of fields and hedgerow boundaries. A portion of the lands are subject to flood risk and there is a **high level of uncertainty regarding aspects relating to the delivery of key transport infrastructure in the area, specifically including the following projects:***

- **The finalisation of the DART+ West Railway project**
- *The finalisation and agreement of the route of Section 1B of the Maynooth Outer Orbital Route (MOOR), as per Measure RD 1 (see Table 7.5 and Map 7.4)*
- *The M4 Maynooth to Leixlip Project and the potential location of a new junction, as per Measure RD 2B (see Table 7.5 and Map 7.4)*
- *The agreement of a location for the new Maynooth West Train Station and Park and Ride Facility, as per Parking Measure PK 14 (see Table 7.6 and Map 7.5)*

***It is considered that the projects listed above, either individually or in combination, will have a significant impact on the potential of development on the lands within Maynooth West south of the rail line. Consequently, the 'SR(2): Strategic Reserve' zoning designation seeks to protect the lands from inappropriate and vulnerable uses, and facilitate key infrastructure projects to support Maynooth West as a Transport-Oriented***

*Development, subject to site specific flood risk assessments and mitigation measures to address inter alia flood displacement.”*



**Figure 36. Land Use Zoning (Option 3)**

#### Site-specific policy objectives

There is one site-specific objective applicable to this site, with the Maynooth Outer Orbital Road (MOOR) crossing the site. The MOOR route is provided for under **Objective MATO 4.4** of the Maynooth JLAP:-

*Support the phased delivery of the Maynooth Outer Orbital Road (MOOR), subject to planning and environmental considerations.*

The route of the MOOR is supported by the Regional Spatial and Economic Strategy 2019–2031 (RSES) and by the respective county development plans of Kildare County Council and Meath County Council.

Within the vicinity of the sites, there is one protected structure and one scenic viewpoint – Jackson’s Bridge, comprising of bridges and locks on the Canal. The effect of the proposed development on cultural heritage assets and its impact on the TAF ratings is accounted for under the Cultural Heritage assessment below.

See Figure below.

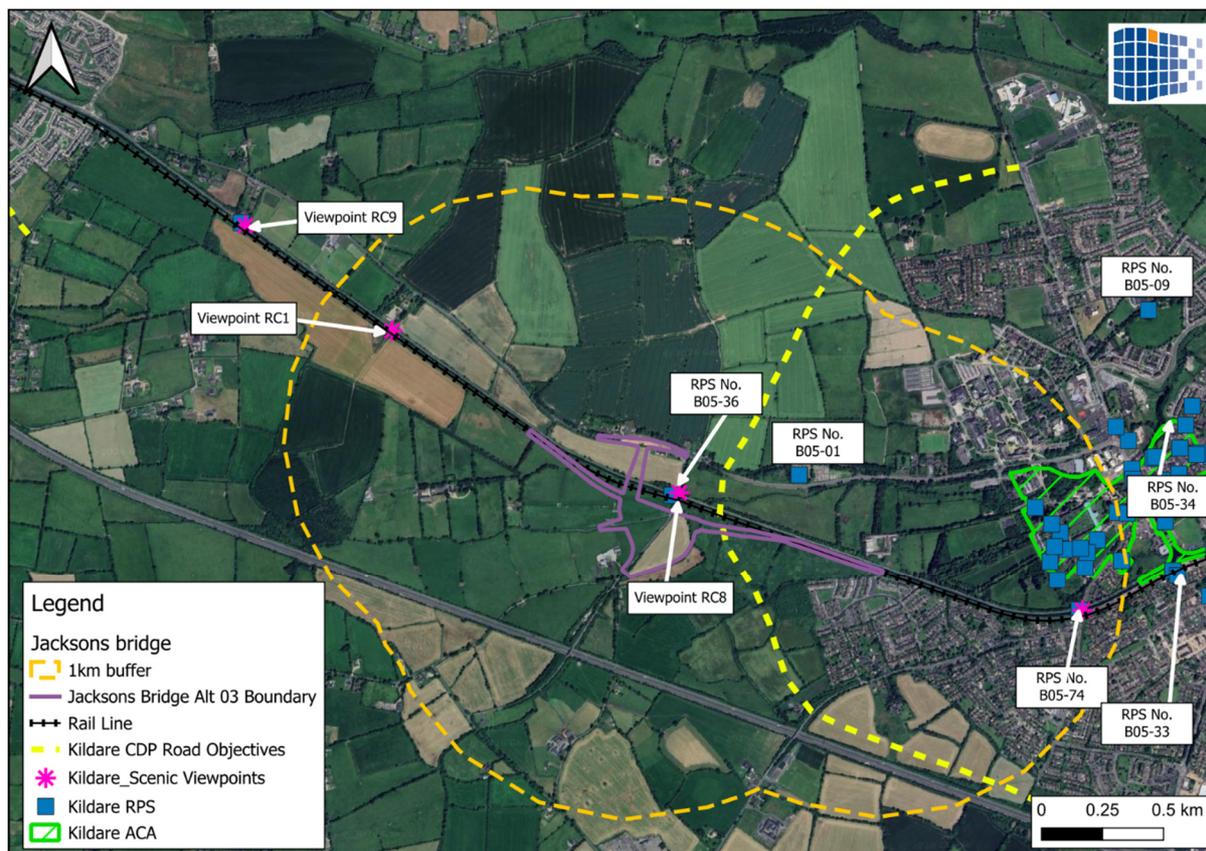


Figure 37. Specific Objectives (Option 3)

### Assessment

To facilitate the proposed design, including the realignment of the rail line and the L5041 road diversion, the site extends into unzoned agricultural land. The route of the MOOR is indicated in the CDP to cross the existing train line. It also traverses the site and the new track alignment. However in identifying this objective, the Council would have considered the existing rail line and presumably a bridge crossing of the rail and Grand Canal – they would not have considered the option now presented encompassing 2 separate crossings for the Canal and revised rail alignment. The MOOR route is still subject to design, route selection options etc.

On the basis that the works proposed in Option 3 are part of wider proposals to bring Dart + west to Maynooth and Kilcock, the works described will have a positive impact on achieving strategic land use planning proposals including national and regional goals for sustainable transport, new housing and transport orientated development for Maynooth and Kilcock.

The TAF rating outlined in the policy context section (i.e. 7 – highly positive impact) is downgraded to 5 – Slightly Positive having regard to the development on unzoned lands (deemed primarily agriculture) and potential impacts on an the MOOR roads objective in the JLAP – while this could be considered negative, the improvements to the rail line and facilitating the DART+ Programme have a highly positive impact in improving sustainable travel.

### Option 4: Double offline track (new alignment). Embankment

#### Land use Zoning

Part of the proposed site lies within County Kildare, outside of the boundary of the Maynooth JLAP. These lands are not zoned under the Kildare County Development Plan (CDP) 2023-2029 and are deemed to be 'primarily agriculture' but other uses may be considered on their merits.

Land use zoning policy for the eastern portion lies within the JLAP and is zoned as *I – Agriculture* and *SR(2) - Strategic Reserve*.

Refer to Figure below.

The zoning objectives for these lands are as follows:

- “*I – Agriculture*” - “*To retain and protect agricultural uses.*”
- “*SR - Strategic Reserve*” - “*To protect the integrity of the lands to provide for the future strategic expansion of the town and ensure that any development that would prejudice the future orderly expansion of the town will be resisted.*”

...  
***SR(2) To protect the integrity of lands to the south of the railway line and canal corridor from inappropriate and vulnerable uses, and facilitate key infrastructure projects (i.e. MOOR, Dart + West, Maynooth West Train Station, Park and Ride at Maynooth West Train Station and M4 Maynooth to Leixlip Project) subject to site specific flood risk assessments and implementation of mitigation measures to address issues including flood displacement.***”

It is noted that lands zoned as *SR(2)* are not included in the land use class zoning matrix in the JLAP, with applications being considered on their merits against its zoning objective. “*Utility Structures*” are Open for Consideration on “*I - Agriculture*” lands.

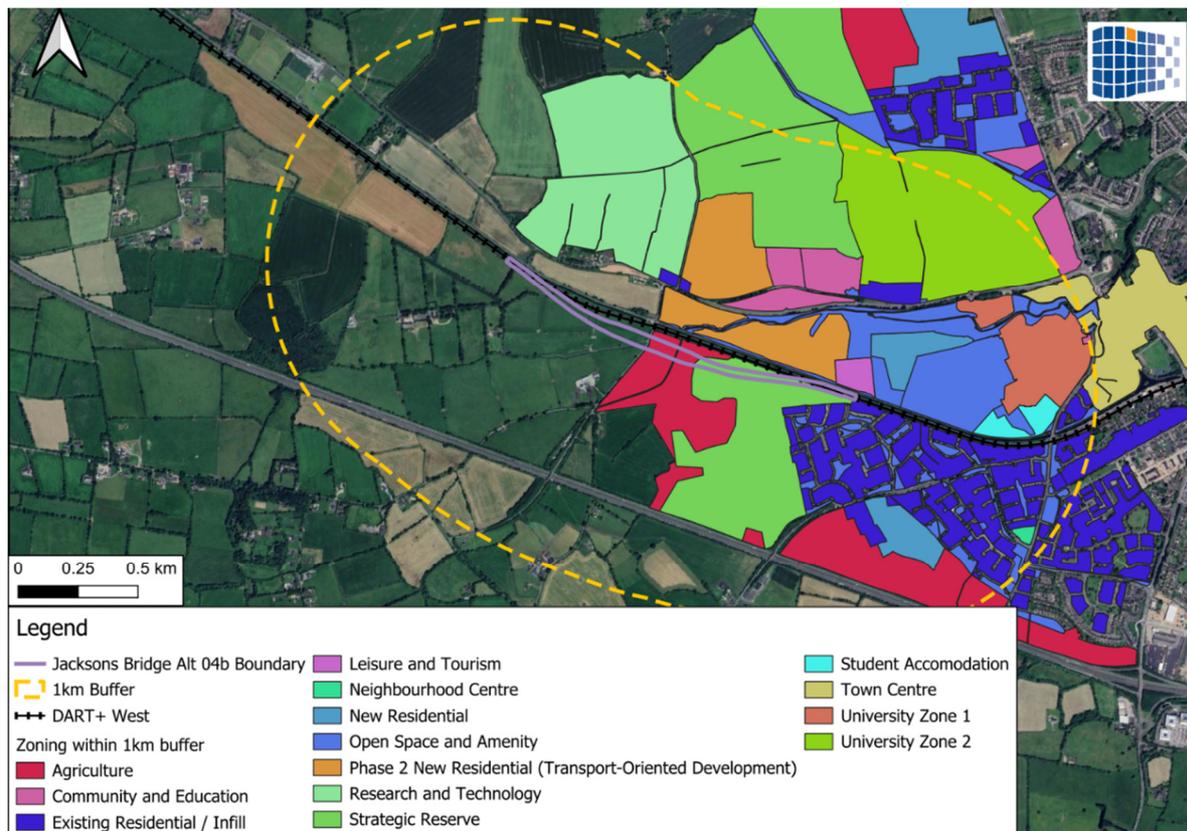


Figure 38. Land Use Zoning (Option 4)

Site-specific policy objectives

The is one site-specific objective applicable to this site, with the Maynooth Outer Orbital Road (MOOR) crossing the site. The MOOR route is provided for under **Objective MATO 4.4** of the Maynooth JLAP:

*Support the phased delivery of the Maynooth Outer Orbital Road (MOOR), subject to planning and environmental considerations.*

The route of the MOOR is supported by the Regional Spatial and Economic Strategy 2019–2031 (RSES) and by the respective county development plans of Kildare County Council and Meath County Council.

Within the vicinity of the sites, there are a number of protected structures and scenic viewpoints, comprising of bridges and locks on the Canal. The effect of the proposed development on cultural heritage assets and its impact on the TAF ratings is accounted for under the Cultural Heritage assessment below.

See Figure below.

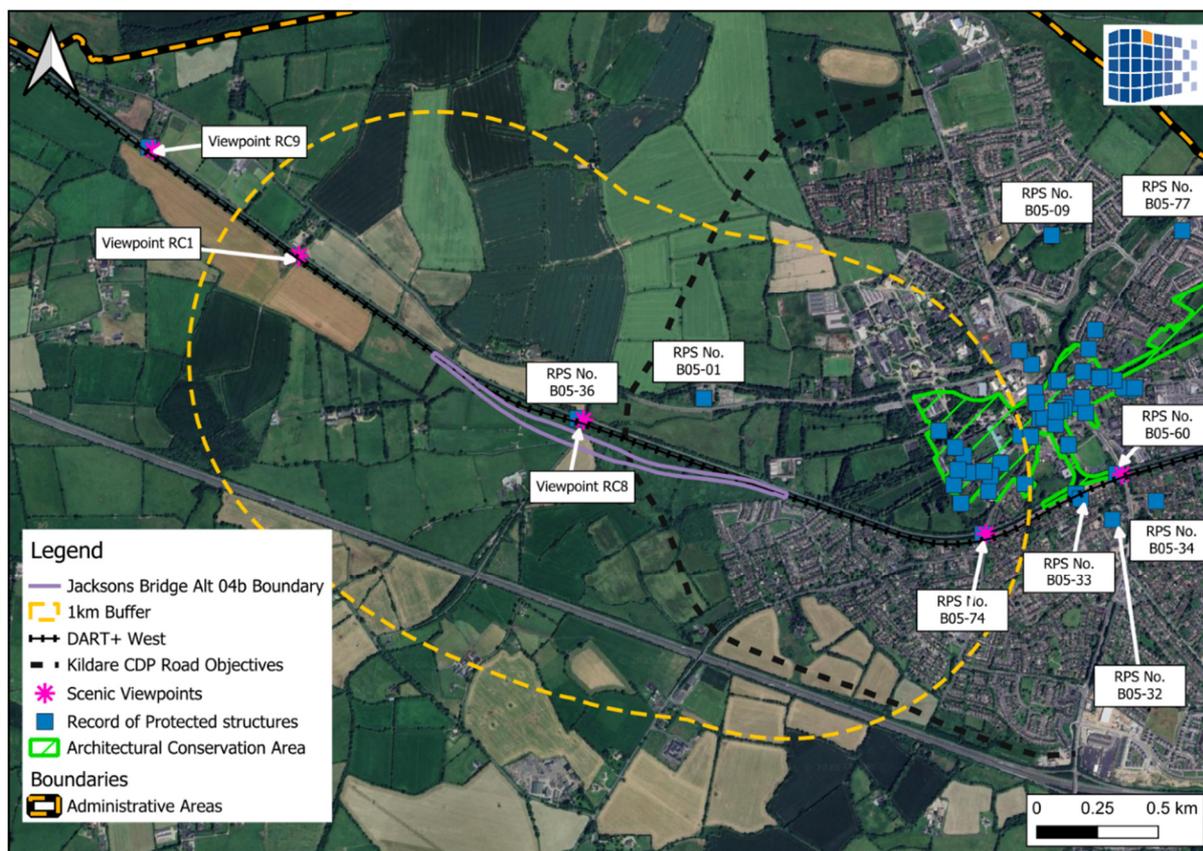


Figure 39. Specific Objectives (Option 4)

## Assessment

This site extends into unzoned agricultural land. Work is also proposed within the Maynooth JLAP boundary on agricultural zoned lands, and SR2 lands reserved to ‘facilitate key infrastructure projects’ including DART+ West and the MOOR.

The route of the potential MOOR crosses the new track alignment line. The Local Authority would not have envisaged that the alignment of the rail tracks would have increased when identifying the route crossing the existing rail line. This increase allows for the L5041 to continue with its current traffic under the railway and avoids any works to Jackson’s Bridge (a protected structure). However, it is accepted that this option would require the MOOR to raise over the railway, requiring a high embankment. While no design is available for the MOOR route at the time of writing, or for any embankments and viaducts over this option, it is likely that any such proposals would have a visual effect on the area and on the protected structure / scenic views from Jackson’s Bridge.

On the basis that the works proposed are part of wider proposals to bring DART+ west to Maynooth and Kilcock, the works described will have a positive impact on achieving strategic land use planning proposals including national and regional goals for sustainable transport, new housing and transport orientated development for Maynooth and Kilcock. Setting the impacts on the future MOOR aside, the TAF rating for this option, outlined in the policy context section (i.e. 7 – highly positive impact) is downgraded to 6 – Positive impact having regard to development on unzoned lands (deemed primarily agriculture) and agricultural zoned lands within the settlement boundary of Maynooth.

However, the effects of this option may have a significant negative impact on the proposed MOOR. It is noted that at this time, the MOOR is not a planned or permitted project but an objective of the JLAP, supported in the CDP for Meath and Kildare, as well as the RSES, Applying the precautionary approach, and including the impacts on the MOOR, if it proceeds at the mapped location, the final TAF rating for this option is 1- Highly Negative Impact.

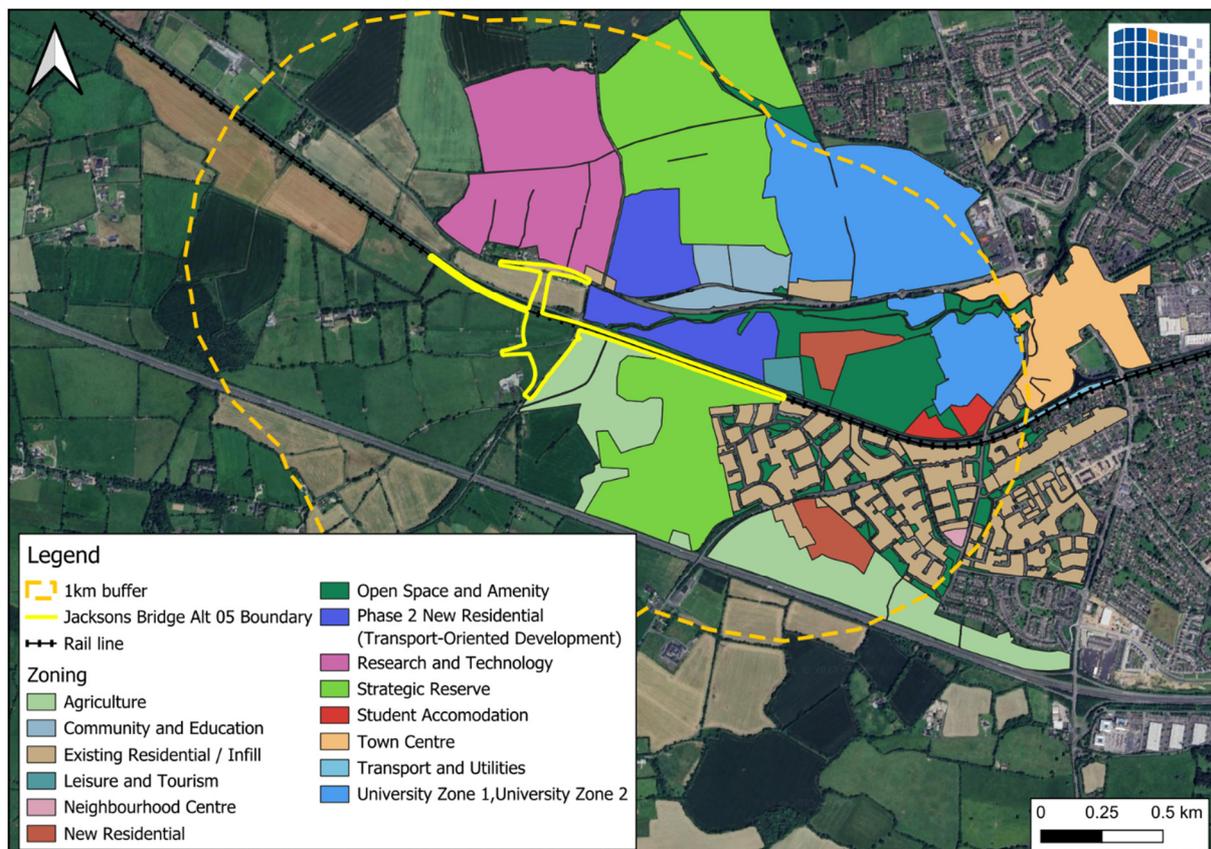
**Option 5: Double online track. Jackson’s Bridge demolition and new L5041 bridge**

Land use Zoning

This site is located within County Kildare, outside the settlement boundary for Maynooth JLAP. These are un-zoned lands in the Kildare CDP and are deemed to be ‘primarily agriculture’. Other uses are noted as being considered on their merits.

Lands along the track lines are unzoned.

Refer to Figure below.



**Figure 40. Land Use Zoning (Option 5)**

Site-specific policy objectives

The following site-specific objectives are applicable to this site

Objective MATO 4.4 – Maynooth Outer Orbital Ring Road: The Maynooth Outer Orbital Road (MOOR) crossing the site. The MOOR route is provided for under **Objective MATO 4.4** of the Maynooth JLAP:

*Support the phased delivery of the Maynooth Outer Orbital Road (MOOR), subject to planning and environmental considerations.*

The route of the MOOR is supported by the Regional Spatial and Economic Strategy 2019–2031 (RSES) and by the respective county development plans of Kildare County Council and Meath County Council.

Jackson’s Bridge, located within the site, is identified as a Protected Structure (RPS B05-36) and a scenic viewpoint (RC8) in the County Development Plan. The effect of the proposed development on cultural heritage assets and its impact on the TAF ratings is accounted for under the Cultural Heritage assessment below.

See Figure below.

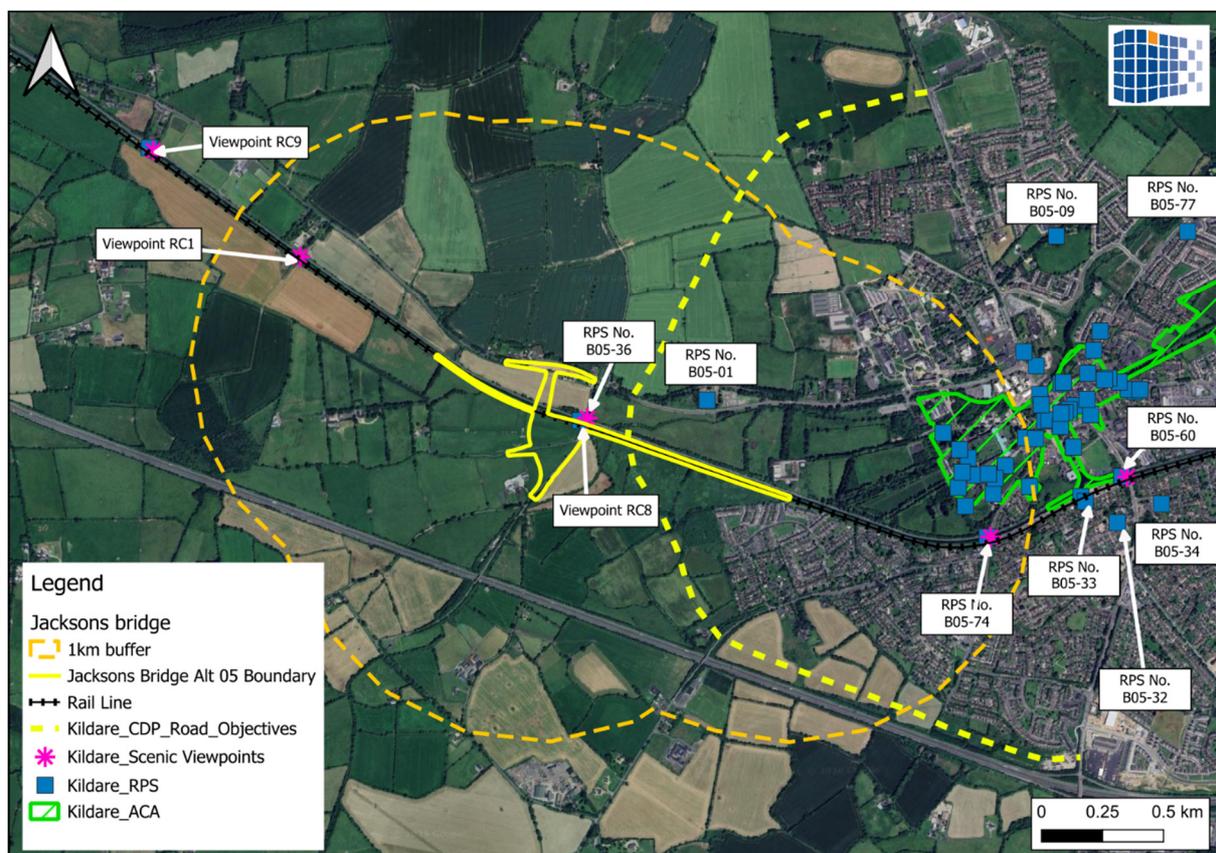


Figure 41. Specific Objectives (Option 5)

## Assessment

This site extends into unzoned lands outside the Maynooth JLAP boundary. Development on unzoned land is deemed primarily agricultural in the CDP but consideration will be given to other development on its merits.

The route of the potential MOOR crosses the new track alignment line. However, it is not envisaged that there are any significant effects on the future delivery of this orbital route which would not have previously been considered by the Local Authority when identifying the route crossing the existing rail line.

On the basis that the works proposed are part of wider proposals to bring DART+ West to Maynooth and Kilcock, the works described will have a positive impact on achieving strategic land use planning

proposals including national and regional goals for sustainable transport, new housing and transport orientated development for Maynooth and Kilcock, as well as facilitating transport orientated development on the Cp2 zoned lands adjoining.

The TAF rating outlined in the policy context section (i.e. 7 – highly positive impact) is downgraded to 6 – Positive having regard to development on unzoned lands (deemed primarily agriculture) outside the settlement boundary of Maynooth.

#### 4.7.5.7.3 Summary Assessment

**Table 38. Zoned Land, Land Use Planning and Spatial Planning Impact mca Assessment**

Option	TAF Impact Scoring
<b>Option 1: Double online track. Vertical track lowering and track protection</b>	7 – Highly Positive
<b>Option 2: Double online track. Bridge deck reconstruction and track protection</b>	7 – Highly Positive
<b>Option 3: Double offline track (new alignment) and L5041 road diversion</b>	5 – Slightly Positive
<b>Option 4: Double offline track (new alignment). Embankment</b>	1 – Highly Negative Impact
<b>Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge</b>	6 – Positive

#### 4.7.5.8 Land Use Impacts Summary Assessment

Table 39. Land Use Impacts mca Assessment table

Parameter	TAF Impact Scoring on Land Use						
	Change in Quality of Public Realm	Existing Transport Network and Service Impact	Material Assets: Properties	Built Services (Utilities)	Soils and Geology (inc. Waste)	Planning Applications	Zoned Land, Land Use Planning and Spatial Planning
<b>Option 1: Double online track. Vertical track lowering and track protection.</b>	4 – Neutral Impact	1 – Highly Negative Impact	4 – Neutral Impact	4 – Neutral Impact	3 – Slightly Negative Impact	4 – Neutral Impact	7 – Highly Positive Impact
<b>Option 2: Double online track. Bridge deck reconstruction and track protection</b>	4 – Neutral Impact	1 – Highly Negative Impact	4 – Neutral Impact	3 – Slightly Negative Impact	3 – Slightly Negative Impact	4 – Neutral Impact	7 – Highly Positive Impact
<b>Option 3: Double offline track (new alignment) – and L5041 road diversion</b>	4 – Neutral Impact	3 – Slightly Negative Impact	2 – Negative Impact	2 – Negative Impact	2 – Negative Impact	4 – Neutral Impact	5 – Slightly Positive
<b>Option 4: Double offline track (new alignment). Embankment</b>	4 – Neutral Impact	3 – Slightly Negative Impact	3 – Slightly Negative Impact	1 – Highly Negative Impact	2 – Negative Impact	4 – Neutral Impact	1 – Highly Negative Impact
<b>Option 5: Double online track. Jackson’s Bridge demolition and new L5041 bridge</b>	4 – Neutral Impact	1 – Highly Negative Impact	3 – Slightly Negative Impact	2 – Negative Impact	2 – Negative Impact	4 – Neutral Impact	7 – Highly Positive Impact

### 4.7.6 Safety impacts

#### 4.7.6.1 Collisions & Related impacts

This section evaluates the positive or negative impact of the options in relation to potential situations that could lead to collisions or impacts. In this case, in the section under study, the OBG23 is a structure with a potential impact risk. Actions that eliminate this potential impact risk point are considered positive, while those that reduce the current lateral clearance are considered negative.

#### Option 1. Double online track. Vertical track lowering and track protection.

The current track has a lateral clearance to the bridge abutment of 2.78 m, but to allow the passage of the second track, the current track must be moved towards the abutment, reducing this lateral clearance to 1.98 m. The new track is 1.96 m from the opposite abutment of the bridge.

A risk assessment must be carried out and implementation of mitigation measures to be adopted.

Due to this option reduces the actual lateral clearance, increasing the potential risk of collision this option receives a score of ‘2’ on the TAF impact scoring scale, as it will have a ‘Negative Impact’ on the collision and related impacts.

#### Option 2. Double online track. Bridge deck reconstruction and track protection

Option 2, similar to Option 1, introduces a new track through the current OBG23, reducing the current lateral clearance.

A risk assessment must be carried out and implementation of mitigation measures to be adopted.

Due to this option reduces the actual lateral clearance, increasing the potential risk of collision this option receives a score of '2' on the TAF impact scoring scale, as it will have a 'Negative Impact' on the collision and related impacts.

### **Option 3. Double offline track (new alignment) and L5041 road diversion**

Option 3, is an offline solution that avoid going through the OBG23, eliminating the potential risk of collision.

Due to this option eliminates the potential risk of collision receives a score of '6' on the TAF impact scoring scale, as it will have a 'Positive Impact' on the collision and related impacts.

### **Option 4: Double offline track (new alignment). Embankment**

Option 4, is an offline solution that avoid going through the OBG23, eliminating the potential risk of collision.

Due to this option eliminates the potential risk of collision receives a score of '6' on the TAF impact scoring scale, as it will have a 'Positive Impact' on the collision and related impacts.

### **Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge**

Option 5, is an online solution that demolish the central arch over the railway.

The current track has a lateral clearance to the bridge abutment of 2.78 m, but to allow the passage of the second track, the current track must be moved towards the abutment, reducing this lateral clearance to 2.45 m. The new track is 2.39 m from the opposite abutment of the bridge.

A risk assessment must be carried out and implementation of mitigation measures to be adopted.

Due to this option reduces the actual lateral clearance, increasing the potential risk of collision this option receives a score of '2' on the TAF impact scoring scale, as it will have a 'Negative Impact' on the collision and related impacts.

#### 4.7.6.1.1 Summary Assessment

**Table 40. Collisions and Related Impacts mca Assessment**

Option	TAF Impact Scoring
<b>Option 1: Double online track. Vertical track lowering and track protection</b>	2 – Negative Impact
<b>Option 2: Double online track. Bridge deck reconstruction and track protection</b>	2 – Negative Impact
<b>Option 3: Double offline track (new alignment) and L5041 road diversion</b>	6 – Positive Impact
<b>Option 4: Double offline track (new alignment). Embankment</b>	6 – Positive Impact
<b>Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge</b>	2 – Negative Impact

#### 4.7.6.2 Other safety impacts

In this section, the offline options have been considered positively, as they eliminate the railway passing under the road, a situation with risk of anti-social behaviour impacting the trains.

Also the reduction of the current lateral clearance at OBG23 because the second track (currently 2.78 m, that will be reduced to 1.98 m and 1.96 in the opposite abutment of the bridge) is seen as a negative impact in maintenance personal safety.

##### **Option 1. Double online track. Vertical track lowering and track protection.**

Option 1 maintains the current railway pass under OBG23 a situation with risk of anti-social behaviour impacting the trains.

Option 1 reduces the current lateral clearance because of new double track, with a reduced pass for maintenance staff.

For this reason, this option receives a score of '3' on the TAF impact scoring scale, as it will have a 'Slightly Negative Impact' on built services.

##### **Option 2. Double online track. Bridge deck reconstruction and track protection**

Option 2 maintains the current railway pass under OBG23 a situation with risk of anti-social behaviour impacting the trains.

Option 2 reduces the current lateral clearance because of new double track, with a reduced pass for maintenance staff.

For this reason, this option receives a score of '3' on the TAF impact scoring scale, as it will have a 'Slightly Negative Impact' on built services.

##### **Option 3. Double offline track (new alignment) and L5041 road diversion**

Option 3 removes the current railway pass under OBG23 a situation with risk of anti-social behaviour impacting the trains.

Option 3 provides a safe passage for maintenance staff.

For this reason, this option receives a score of '6' on the TAF impact scoring scale, as it will have a 'Positive Impact' on built services.

##### **Option 4: Double offline track (new alignment). Embankment**

Option 4 removes the current railway pass under OBG23 a situation with risk of anti-social behaviour impacting the trains.

Option 4 provides a safe passage for maintenance staff.

For this reason, this option receives a score of '6' on the TAF impact scoring scale, as it will have a 'Positive Impact' on built services.

##### **Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge**

Option 5 maintains the possibility of anti-social behaviour impacting the trains.

For this reason, this option receives a score of '4' on the TAF impact scoring scale, as it will have a 'Neutral Impact' on built services.

## 4.7.6.2.1 Summary Assessment

Table 41. Other Safety Impacts mca Assessment

Option	TAF Impact Scoring
Option 1: Double online track. Vertical track lowering and track protection	3 – Slightly Negative Impact
Option 2: Double online track. Bridge deck reconstruction and track protection	3 – Slightly Negative Impact
Option 3: Double offline track (new alignment) and L5041 road diversion	6 - Positive Impact
Option 4: Double offline track (new alignment). Embankment	6 - Positive Impact
Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge	4 - Neutral Impact

## 4.7.6.3 Safety Impacts Summary Assessment

Table 42. Safety Impacts mca Assessment

Option	TAF Impact Scoring on Safety Impacts	
	Collisions and related Impacts	Other safety Impacts
Option 1: Double online track. Vertical track lowering and track protection	2 – Negative Impact	3 – Slightly Negative Impact
Option 2: Double online track. Bridge deck reconstruction and track protection	2 – Negative Impact	3 – Slightly Negative Impact
Option 3: Double offline track (new alignment) and L5041 road diversion	6 – Positive Impact	6 - Positive Impact
Option 4: Double offline track (new alignment). Embankment	6 – Positive Impact	6 - Positive Impact
Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge	2 – Negative Impact	4 - Neutral Impact

## 4.7.7 Climate Change Impacts

This section describes the climate assessment of the route options selection at Jackson's Bridge. The specific objectives of the climate assessment at this stage are to:

- Determine the existing climate baseline with reference to Ireland's current Greenhouse Gas (GHG) emissions;
- Predict GHG emissions as a result of the station options;

- Assess the vulnerability or adaptation potential of the proposed station options due to potential future climate change.

The climate assessment is split into two aspects: the Climate Action Impact (i.e. the impact of the project on climate change) and the Climate Change Risk Assessment (i.e. the impact of climate change on the project).

#### 4.7.7.1 Methodology

This assessment has been prepared based on the following TII Climate guidance:

- PE-ENV-01104: Climate Guidance for National Roads, Light Rail and Rural Cycleways (Offline & Greenways) – Overarching Technical Document (TII 2022a);
- PE-ENV-01105: Climate Assessment of Proposed National Roads – Standard (TII 2022b); and
- GE-ENV-01106: TII Carbon Assessment Tool for Road and Light Rail Projects and User Guidance Document (TII 2025).

The climate assessment is split into two aspects: the Climate Action Impact (i.e. the impact of the project on climate change) and the Climate Change Risk Assessment (i.e. the impact of climate change on the project).

##### 4.7.7.1.1 Climate Action Impact

The primary aspects of the assessment relate to the greenhouse gas (GHG) emissions by quantifying carbon sources. This assessment is qualitative as quantitative data for each of the options is not available at this stage. Key sources of emissions have been described for each option, based on experience of similar schemes, and the differences in likely embodied carbon across the options assessed.

Preference of route options is based on the qualitatively assessed lowest lifecycle GHG emissions. Consideration is also given to options which have higher potential for mitigation during further design.

**Table 43. Greenhouse Gas Assessment Scoring Scale**

Score		Description
Major or highly positive	7	Based on professional judgement the option would result in a potentially significantly positive improvement, providing a GHG reduction overall and positively contributing to Ireland's net zero trajectory. Mitigation measures are in place well beyond policy requirements.
Moderately positive	6	Based on professional judgement it is anticipated that the option would not result in a potentially significant positive improvement. However, the option has the potential to provide a moderate GHG reduction and will align with Ireland's net zero trajectory. Some mitigation measures are in place.
Minor or slightly positive	5	Based on professional judgement it is anticipated that the option would not result in a potentially significant positive improvement. However, the option has the potential to provide a small GHG reduction and will align with Ireland's net zero trajectory. Some mitigation measures are in place.
Not significant or neutral	4	Based on professional judgement it is anticipated that the option will align with Ireland's net zero trajectory. No mitigation measures are in place.

Score		Description
Minor or slightly negative	3	Based on professional judgement it is anticipated that the option has mitigation measures in place way beyond policy requirements, but it is likely that the project will produce some carbon emissions and fall short of Ireland's net zero trajectory.
Moderately negative	2	Based on professional judgement it is anticipated that the option has some mitigation measures in place, but it is likely that the project will produce carbon emissions and fall short of Ireland's net zero trajectory.
Major or highly negative	1	Based on professional judgement it is anticipated that the option has no mitigation measures in place, and it is likely that the project will produce carbon emissions and fall short of Ireland's net zero trajectory. Mitigation would be required for an option to progress.

#### 4.7.7.1.2 Climate Change Adaptation

In addition to the greenhouse gas assessment, a screening climate change risk assessment has been conducted to consider the risk of future climate change impacts on the project receptors (i.e. drainage, road surfaces, utilities etc). Potential risks to these sensitive infrastructure receptors due to climate change include:

- Flooding (coastal, pluvial, fluvial) – including sea level rise and storm surge;
- Extreme heat (including wildfires and drought)– including extreme heat events and increasing temperatures overtime;
- Extreme cold – including frost and snow;
- Extreme wind;
- Lightning and hail;
- Landslides; and
- Fog.

The climate screening risk assessment comprises a sensitivity analysis which evaluates the project's vulnerability to climate change. This is completed by combining a sensitivity and exposure analysis. The sensitivity analysis first identifies the climate hazards relevant to the specific project type irrespective of its location (e.g., sea level rise will affect seaport projects regardless of specific location). TII (TII 2022a) describes the following as potential sensitive receptors; drainage, structures, earthworks, geotechnical, utilities, landscaping, signs, light posts and fences and buildings. These can be considered the on-site assets for road projects.

Sensitivity ratings are classed as:

- High Sensitivity: The climate hazard may have a significant impact on assets and processes, inputs, outputs and transport links. This is a sensitivity score of 3;
- Medium Sensitivity: The climate hazard may have a slight impact on assets and processes, inputs, outputs and transport links. This is a sensitivity score of 2; and
- Low Sensitivity: The climate hazard has no (or insignificant) impact. This is a sensitivity score of 1.

The exposure analysis identifies the climate hazards relevant to the planned project location irrespective of the project type, e.g., flooding could be a risk if the project location is next to a river in a floodplain. Exposure can be considered as high, medium or low:

- High exposure: It is almost certain or likely this climate hazard will occur at the project location i.e. might arise once to several times per year. This is an exposure score of 3;
- Medium exposure: It is possible this climate hazard will occur at the project location i.e. might arise a number of times in a decade. This is an exposure score of 2; and

- Low exposure: It is unlikely or rare this climate hazard will occur at the project location i.e. might arise a number of times in a generation or in a lifetime. This is an exposure score of 1.

Once sensitivity and exposure are categorised, the vulnerability is calculated by multiplying the sensitivity and exposure, as shown in Table 44. The mca scoring scale is detailed in Table 45.

The Climate Change Risk Assessment results will inform the comparative ranking in combination with the GHGA, while considering possible mitigation measures. Since the options are geographically close, the climate vulnerability is primarily distinguished by differences in flood risk and soil stability issues.

Given the location of all proposed options coastal erosion and flood risk are not a potential hazard.

**Table 44. Screening Assessment: Vulnerability Analysis**

Sensitivity	Exposure		
	High (3)	Medium (2)	Low (1)
High (3)	9 - High	6 - High	3 - Medium
Medium (2)	6 - High	4 - Medium	2 - Low
Low (1)	3 - Medium	2 - Low	2 - Low

**Table 45. Climate Change Risk Assessment mca Scoring Scale**

Score		Description
Major or highly positive	7	Based on the vulnerability assessment undertaken for the project, the option has only low vulnerabilities to climate change risk across all climate hazards.
Moderately positive	6	Based on the vulnerability assessment undertaken for the project, the option has primarily low vulnerability to climate change risk, with medium vulnerability for one climate hazard.
Minor or slightly positive	5	Based on the vulnerability assessment undertaken for the project, the option has primarily low vulnerability to climate change risk, with medium vulnerability across up to three climate hazards.
Not significant or neutral	4	Based on the vulnerability assessment undertaken for the project, the option has only low and medium vulnerabilities to climate change risk across all hazards.
Minor or slightly negative	3	Based on the vulnerability assessment undertaken for the project, the option has high vulnerability to climate change risk for one climate hazard.
Moderately negative	2	Based on the vulnerability assessment undertaken for the project, the option has high vulnerability to climate change risk across more than one climate hazard.
Major or highly negative	1	Based on the vulnerability assessment undertaken for the project, the option has high vulnerability to climate change risk across three or more climate hazards.

#### 4.7.7.1.3 Existing Environment

##### 4.7.7.1.3.1 Climate Action

PE-ENV-01105 (TII 2022b) states that a baseline climate scenario should identify, consistent with the study area for the proposed development, GHG emissions without the proposed development for both the current and future baseline.

Given the circumstances of Ireland's declaration of a climate and biodiversity emergency in May 2019, and the November 2019 European Parliament approval of a resolution declaring a climate and environment emergency in Europe, in conjunction with Ireland's current failure to meet its EU binding targets under the GHG Regulation, beneficially or adverse changes in GHG emissions are of more significance than previously viewed prior to these declarations. Thus, the baseline climatic environment should be considered a highly sensitive environment for the assessment of impacts.

Data published in July 2025 (EPA 2025), indicates that Ireland exceeded, without the use of flexibilities, its 2024 annual limit set under EU's Effort Sharing Decision (ESD) (EU 2018/842) by 1.03 Mt CO<sub>2e</sub>. However, the 2024 emissions represent the second consecutive year in which Ireland's emission were below (-4.2%) 1990 levels. ETS (Emissions Trading Scheme) emissions decreased (-7.4%) and ESR (Effort Sharing Regulation) emissions decreased (-0.5%). Ireland's target is an emission reduction of 626 kt of CO<sub>2e</sub> by 2030 on an average baseline of 2016 to 2018.

The EPA estimate that 2024 total national GHG emissions, excluding land use, land-use change and forestry (LULUCF), have decreased by 2.0% on 2023 levels to 53.75 Mt CO<sub>2e</sub>, with a 0.7 Mt CO<sub>2e</sub> (-8.9%) reduction in electricity industries alone. This was driven by a 39.6% share of energy from renewables in 2024 and the complete phase-out of peat for electricity generation. Manufacturing combustion and industrial processes decreased by 4.6% to 6.0 Mt CO<sub>2e</sub> in 2024 due to declines in fossil fuel usage. The sector with the highest emissions in 2024 was agriculture at 38% of the total, followed by transport at 21.7%. For 2024, total national emissions (including LULUCF) were 57.65 Mt CO<sub>2e</sub> (EPA 2025)(Table 46).

The current estimates of national greenhouse gas emissions (including LULUCF) in 2024 are 12.0% below 2018, well off the National Climate ambition of a 51% reduction by 2030. The data indicate that from 2021- 2024 Ireland has used 82.5% of the 295 Mt CO<sub>2e</sub> Carbon Budget for the five-year period 2021-2025. This leaves 17.5% of the budget available for 2025, requiring a substantial 10.3% annual emissions reduction for 2025 to stay within budget.

**Table 46. Trends in total national GHG emissions 2022–2024.**

Sector <sup>Note 1</sup>	2022 (Mt CO <sub>2e</sub> )	2023 (Mt CO <sub>2e</sub> )	2024 (Mt CO <sub>2e</sub> )	Total Budget (Mt CO <sub>2e</sub> ) (2021-2025)	% Budget 2021-2025 Used	Annual Change 2023 to 2024
Electricity	9.69	7.57	6.95	40	85.25%	-8.19%
Transport	11.76	11.8	11.65	54	85.74%	-1.27%
Buildings (Residential)	5.75	5.35	5.61	29	81.31%	4.86%
Buildings (Commercial and Public)	1.45	1.39	1.49	7	82.43%	7.19%
Industry	6.62	6.31	6.01	30	86.77%	-4.75%
Agriculture	21.78	20.72	20.41	106	80.05%	-1.50%

Sector <sup>Note 1</sup>	2022 (Mt CO <sub>2</sub> e)	2023 (Mt CO <sub>2</sub> e)	2024 (Mt CO <sub>2</sub> e)	Total Budget (Mt CO <sub>2</sub> e) (2021-2025)	% Budget 2021-2025 Used	Annual Change 2023 to 2024
Other <sup>Note 2</sup>	1.93	1.81	1.63	9	80.33%	-9.94%
LULUCF	3.98	3.89	3.89	–	–	0
Total including LULUCF	62.99	58.83	57.64	295	82.81%	-2.04%

<sup>Note 1</sup> Reproduced from latest emissions data on the EPA website (EPA 2025).

<sup>Note 2</sup> Other includes Petroleum refining, F-Gases and Waste (emissions from solid waste disposal on land, solid waste treatment (composting and anaerobic digestion), wastewater treatment, waste incineration and open burning of waste).

In relation to carbon budgets, the Climate Action and Low Carbon Development Act 2015 (No. 46 of 2015) (as amended) states “A carbon budget, consistent with furthering the achievement of the national climate objective, shall be proposed by the Climate Change Advisory Council, finalised by the Minister and approved by the Government for the period of 5 years commencing on the 1 January 2021 and ending on 31 December 2025 and for each subsequent period of 5 years (in this Act referred to as a ‘budget period’)”.

The carbon budget is to be produced for 3 sequential budget periods, as shown in Table 47. 2030 Sectoral Emissions Ceilings. The carbon budget can be revised where new obligations are imposed under the law of the European Union or international agreements or where there are significant developments in scientific knowledge in relation to climate change. In relation to the sectoral emissions ceiling, the Minister for the Environment, Climate and Communications (the Minister for the Environment) shall prepare and submit to government the maximum amount of GHG emissions that are permitted in different sectors of the economy during a budget period and different ceilings may apply to different sectors.

The sectoral emission ceilings for 2030 were published in Climate Action Plan 2025 (CAP25) (DECC, 2025) and are shown in Table 48. Electricity has a 75% reduction requirement and a 2030 emission ceiling of 3 Mt CO<sub>2</sub>e (carbon dioxide equivalent), while the transport sector requires a 50% reduction and has a 2030 emissions ceiling of 6 Mt CO<sub>2</sub>e. The industry sector requires a 35% reduction and has a 2030 emissions ceiling of 4 Mt CO<sub>2</sub>e.

**Table 47. 2030 Sectoral Emissions Ceilings**

Sector	Baseline (Mt CO <sub>2</sub> e)	Carbon Budgets (Mt CO <sub>2</sub> e)		2030 Emissions (Mt CO <sub>2</sub> e)	Indicative Emissions % Reduction in Final Year of 2025- 2030 Period (Compared to 2018)
	2018	2021-2025	2026-2030		
Electricity	10	40	20	3	75
Transport	12	54	37	6	50
Built Environment - Residential	7	29	23	4	40
Built Environment - Commercial	2	7	5	1	45

Sector	Baseline (Mt CO <sub>2</sub> e)	Carbon Budgets (Mt CO <sub>2</sub> e)		2030 Emissions (Mt CO <sub>2</sub> e)	Indicative Emissions % Reduction in Final Year of 2025- 2030 Period (Compared to 2018)
	2018	2021-2025	2026-2030		
Industry	7	30	24	4	35
Agriculture	23	106	96	17.25	25
Other (F-gases, waste, petroleum refining)	2	9	8	1	50
Land Use, Land-use Change and Forestry (LULUCF)	5	Reflecting the continued volatility for LULUCF baseline emissions to 2030 and beyond, CAP24 puts in place ambitious activity targets for the sector reflecting an EU-type approach.			
Total	68				
Unallocated Savings	-	-	26	-5.25	-
Legally Binding Carbon Budgets and 2030 Emission Reduction Targets	-	295	200	-	51

The future baseline, with respect to the GHGA, can also be considered in relation to the future climate targets which the assessment results will be compared against. In line with TII (TII 2022b) and IEMA Guidance (IEMA, 2022) the future baseline is a trajectory towards net zero by 2050, *“whether it [the project] contributes to reducing GHG emissions relative to a comparable baseline consistent with a trajectory towards net zero by 2050”*.

The future baseline will be determined by Ireland meeting its targets set out in the CAP25, and future CAPs, alongside binding 2030 EU targets.

#### 4.7.7.1.3.2 Climate Change Adaptation

Met Éireann’s 2024 *Climate Statement* (Met Éireann 2025) states 2024’s average shaded air temperature in Ireland is provisionally 10.72 °C, which is 1.17°C above the 1961-1990 long-term average, or 0.55°C above the most recent 1991-2020 long-term average. This is the 4<sup>th</sup> warmest year on record with 2023 breaking previous records. Seven of the top ten warmest years have occurred since 2005. Record high sea surface temperatures (SST) were recorded in 2022, and in 2024 continued at or near record high levels. 2024 was overall drier than average; however, there were many instances of heavy or intense rainfall which led to flooding events. This trend is predicted to continue with climate change with an increase in both dry periods and heavy rainfall events.

The TRANSLATE research report (Met Éireann 2024) finds that night-time temperatures will warm more than day-time temperatures, with temperatures increases across all seasons but the highest in the summer, with an increase of 0.5°C to 3.5°C. Autumn is projected to have the highest increase in average minimum temperatures, with an increase of 1.1°C to 4.4°C. The variance is dependent on the scenario that is being reviewed. While these temperatures are projected across all of Ireland, they increase most in the east of the country compared to the west. With respect to rainfall, increases of 4% to 38% are projected. However, this will not be spread across the year as, during summer months, there are projected decreases in rainfall beyond the 2°C warming scenario.

The projections were echoed by the *Updated High-Resolution Climate Projections for Ireland Research Report: 471* (EPA, 2024) which was in broad agreement with previous research. The future autumn and winter months are projected to be up to 10% wetter, while summer is projected to be up to 8% drier.

#### 4.7.7.2 Climate Action Impact

This assessment is semi-qualitative as detailed quantitative data for each of the bridge options is not available at this stage. Key sources of emissions have been described for each bridge option, based on experience of similar schemes, and the differences in likely embodied carbon across the options assessed.

##### Option 1. Double online track. Vertical track lowering and track protection.

Assessment of this option considers the following activities which would generate or avoid GHG emissions:

- **Demolition** – this option would require removal of the existing track, resulting in GHG emissions associated with demolition.
- **Excavation** – this option requires lowering of the track, resulting in GHG emissions associated with excavation and excavated material waste disposal, as well as fill material. This option requires the most amount of excavation but the least amount of fill material, resulting in approx. 261 tCO<sub>2e</sub>.
- **Construction** – this option would require construction of 980 m of flood containment structures (bottom slab and retaining walls), resulting in GHG emissions associated with materials required for this construction.
- **Road traffic** – construction works for this option would impact operation of rail services, resulting in GHG emissions associated with additional vehicle kilometres from traffic rerouting.

All bridge options have been assigned a score of 4 – Not significant or neutral as there will be GHG emissions associated with them, however all options facilitate the drive to encourage modal shift to public travel and are in line with CAP25. There is the potential to improve this rating to a positive impact through the implementation of mitigation measures such as using low carbon intensive construction materials, reuse of site materials or increased planting to provide carbon sink opportunities for example.

There are no significant adverse impacts induced by the operational phase. The score is not significant or neutral. Under the Transport Appraisal Framework (TAF) Climate Change Scorecard the impact is also considered neutral.

##### Option 2. Double online track. Bridge deck reconstruction and track protection

Assessment of this option considers the following activities which would generate or avoid GHG emissions:

- **Demolition** – this option would require removal of the existing track, resulting in GHG emissions associated with demolition.
- **Excavation** – this option requires lowering of the track, resulting in GHG emissions associated with excavation and excavated material waste disposal, as well as fill material. This option would result in approx. 139 tCO<sub>2e</sub>.
- **Construction** – this option would require construction of 980 m of flood containment structures (bottom slab and retaining walls), resulting in GHG emissions associated with materials required for this construction.
- **Road traffic** – construction works for this option would impact operation of rail services, resulting in GHG emissions associated with additional vehicle kilometres from traffic rerouting.

All bridge options have been assigned a score of 4 – Not significant or neutral (see Table 49) as there will be GHG emissions associated with them, however all options facilitate the drive to encourage modal shift to public travel and are in line with CAP25. There is the potential to improve this rating to a positive impact through the implementation of mitigation measures such as using low carbon intensive construction materials, reuse of site materials or increased planting to provide carbon sink opportunities for example.

There are no significant adverse impacts induced by the operational phase. The score is not significant or neutral. Under the Transport Appraisal Framework (TAF) Climate Change Scorecard the impact is also considered neutral.

### Option 3. Double offline track (new alignment) L5041 road diversion

Assessment of this option considers the following activities which would generate or avoid GHG emissions:

- **Demolition** – this option would require diversion of the L5041 and the R148, resulting in GHG emissions associated with removal of road surface.
- **Excavation** – this option requires embankments for the construction of the track and diversion of the L5041, resulting in GHG emissions associated with excavation and excavated material waste disposal, as well as fill material. This option would result in approx. 75 tCO<sub>2e</sub>.
- **Construction** – this option would require construction of two underpass structures, a new bridge over the new railway line and the Royal Canal, new junction of L5041 with the R148, realignment of the L5041 and the R148 and the two new offline tracks themselves, resulting in GHG emissions associated with materials required for this construction.
- **Road traffic** – construction works for this option would have no significant impact operation of rail services, therefore not resulting in any additional GHG emissions associated with additional vehicle kilometres from traffic rerouting.

All bridge options have been assigned a score of 4 – Not significant or neutral as there will be GHG emissions associated with them, however all options facilitate the drive to encourage modal shift to public travel and are in line with CAP25. There is the potential to improve this rating to a positive impact through the implementation of mitigation measures such as using low carbon intensive construction materials, reuse of site materials or increased planting to provide carbon sink opportunities for example.

There are no significant adverse impacts induced by the operational phase. The score is not significant or neutral. Under the Transport Appraisal Framework (TAF) Climate Change Scorecard the impact is also considered neutral.

### Option 4: Double offline track (new alignment). Embankment

Assessment of this option considers the following activities which would generate or avoid GHG emissions:

- **Demolition** – this option would require diversion of the connection between a local road and the L5041, resulting in GHG emissions associated with removal of road surface.
- **Excavation** – this option requires embankments for the construction of the track and diversion of the Ballycaghan stream, resulting in GHG emissions associated with excavation and excavated material waste disposal, as well as fill material. This option would result in approx. 24 tCO<sub>2e</sub>.
- **Construction** – this option would require construction of two underpass structures, a new bridge beneath the L5041 for the Ballycaghan stream diversion, and the two new offline

tracks themselves, resulting in GHG emissions associated with materials required for this construction.

- **Road traffic** – construction works for this option would have no significant impact operation of rail services, therefore not resulting in any additional GHG emissions associated with additional vehicle kilometres from traffic rerouting.

All bridge options have been assigned a score of 4 – Not significant or neutral (see Table 49) as there will be GHG emissions associated with them, however all options facilitate the drive to encourage modal shift to public travel and are in line with CAP25. There is the potential to improve this rating to a positive impact through the implementation of mitigation measures such as using low carbon intensive construction materials, reuse of site materials or increased planting to provide carbon sink opportunities for example.

There are no significant adverse impacts induced by the operational phase. The score is not significant or neutral. Under the Transport Appraisal Framework (TAF) Climate Change Scorecard the impact is also considered neutral.

#### **Option 5: Double online track. Jackson's Bridge railway bridge deck removal and L5041 diversion**

Assessment of this option considers the following activities which would generate or avoid GHG emissions:

- **Demolition** – this option would require full demolition of Jackson's Bridge and removal of the existing track, resulting in GHG emissions associated with demolition.
- **Excavation** – this option requires diversion of the L5041 road and excavation of the area required for the slab track superstructure, resulting in GHG emissions associated with excavation and excavated material waste disposal, as well as fill material. This option requires the most amount of fill material, resulting in approx. 72 tCO<sub>2e</sub>.
- **Construction** – this option would require reconstruction of Jackson's Bridge, construction of the slab track superstructure, embankment, new junction of L5041 with the R148, and realignment of the L5041 and the R148, resulting in GHG emissions associated with materials required for this construction.
- **Road traffic** – construction works for this option would impact operation of rail services, resulting in GHG emissions associated with additional vehicle kilometres from traffic rerouting.

All bridge options have been assigned a score of 4 – Not significant or neutral (see Table 49) as there will be GHG emissions associated with them, however all options facilitate the drive to encourage modal shift to public travel and are in line with CAP25. There is the potential to improve this rating to a positive impact through the implementation of mitigation measures such as using low carbon intensive construction materials, reuse of site materials or increased planting to provide carbon sink opportunities for example.

There are no significant adverse impacts induced by the operational phase. The score is not significant or neutral. Under the Transport Appraisal Framework (TAF) Climate Change Scorecard the impact is also considered neutral.

#### **4.7.7.2.1 Summary Assessment**

All options facilitate the drive to encourage modal shift to public travel by supporting the DART network in growing from its current 50km in length to over 150km. Modal shift away from private car use to public transport, particularly those powered by renewable energy such as the proposed DART network, is encouraged. This is in line with CAP25 (DECC, 2025).

*Option 4: Double offline track (new alignment). Embankment* is the most preferred as it will likely result in the lowest GHG emissions of the bridge options. *Option 3: Double offline track (new alignment) and L5041 road diversion* is the least preferred option as it will likely result in the highest GHG emissions of the bridge options. However, there is the potential to reduce GHG emissions from all options through the implementation of mitigation measures such as using low carbon intensive construction materials, reuse of site materials or increased planting to provide carbon sink opportunities for example.

**Table 48. Climate Action Impacts mca Assessment**

Option	Assessment Summary	TII Impact Rating	TAF Impact Scoring
<b>Option 1: Double online track. Vertical track lowering and track protection</b>	All options facilitate the drive to encourage modal shift to public travel and are in line with CAP25.	Not significant or neutral (4)	4 – Neutral Impact
<b>Option 2: Double online track. Bridge deck reconstruction and track protection</b>	All options facilitate the drive to encourage modal shift to public travel and are in line with CAP25.	Not significant or neutral (4)	4 – Neutral Impact
<b>Option 3: Double offline track (new alignment) and L5041 road diversion</b>	All options facilitate the drive to encourage modal shift to public travel and are in line with CAP25.	Not significant or neutral (4)	4 – Neutral Impact
<b>Option 4: Double offline track (new alignment). Embankment</b>	All options facilitate the drive to encourage modal shift to public travel and are in line with CAP25.	Not significant or neutral (4)	4 – Neutral Impact
<b>Option 5: Double online track (Jackson’s railway bridge deck removal and L5041 diversion)</b>	All options facilitate the drive to encourage modal shift to public travel and are in line with CAP25.	Not significant or neutral (4)	4 – Neutral Impact

#### 4.7.7.3 Climate Adaptation Impacts

When assessing adaptation to climate hazards, the resilience to extreme temperatures, wind, drought, and wildfire are considered to be stable across all options, given the limited geographic area. Flood risk, soil stability/landslide and potential have the greatest likelihood of changing across options and require adaptation of the design to mitigate risks. Therefore, during the below appraisal, these are the climate hazards that have been discussed to differentiate between options.

#### **Option 1. Double online track. Vertical track lowering and track protection.**

With regard to flood risk, the Stage 1 & 2 Site Specific Flood Risk Assessment report indicates that the area in the vicinity of OBG23 has a significant history of flooding and that the railway line is at risk of overtopping in the 10% AEP fluvial flood event.

However, using available information, to build resilience and mitigate the potential for flood risk, this option proposes preliminary flood compensatory storage volumes of approx. 100,000 m<sup>3</sup> located upstream of UBG22. A residual risk of flood waters overtopping the necessary flood defences causing rapid inundation of the railway line remains, therefore it is also proposed to use flood containment structures (bottom slab and side retaining walls) and a pumped drainage system to prevent flooding of the tracks.

Stormwater requirements will increase with climate change as more intense rainfall events occur over concentrated time periods. The projections account for climate change in RCP4.5, or an additional 20% for climate change. The design ensures that flood risk from fluvial sources can be managed adequately by the above measures. Stormwater requirements will increase with climate change with more intense rainfall events occurring over concentrated time periods. There is some residual risk in RCP8.5 in 2100. This may result in a requirement for further mitigation in detailed design or operational phase to ensure resilience, should climate projections indicate that the most likely future scenario aligns with RCP8.5.

The boundary for this option, including trackworks, is within areas of low susceptibility to landslide. Future climate change drought/flood cycles have the potential to increase the potential for landslides and, therefore, the risk associated with landslides. However, given the low risk the exposure likelihood remains low. This additional risk will apply to all areas of potential landslide susceptibility.

The flood risks are mitigated for RCP4.5 however there are some residual risks in RCP8.5. The TII score is *minor or slightly negative (3)*, based on the TII mca criteria definition “*the option has high vulnerability to climate change risk for one climate hazard*” (see Table 50) Based on consultation with the project hydrologist, the equivalent TAF score is considered *highly negative (1)*. It is noted that the fluvial system is heavily reliant on the siphon under the railway. Its capacity is limited and sensitive to flow increases and blockage. Therefore, the adaptability of this option is low, as the only means of managing the risk is to increase the height of the retaining wall.

### **Option 2. Double online track. Bridge deck reconstruction and track protection**

With regard to flood risk, the Stage 1 & 2 Site Specific Flood Risk Assessment report indicates that the area in the vicinity of OBG23 has a significant history of flooding and that the railway line is at risk of overtopping in the 10% AEP fluvial flood event.

However, using available information, to build resilience and mitigate the potential for flood risk, this option proposes preliminary flood compensatory storage volumes of approx. 100,000 m<sup>3</sup> located upstream of UBG22. A residual risk of flood waters overtopping the necessary flood defences causing rapid inundation of the railway line remains, therefore it is also proposed to use flood containment structures (bottom slab and side retaining walls) and a gravity fed drainage system to prevent flooding of the tracks.

Stormwater requirements will increase with climate change as more intense rainfall events occur over concentrated time periods. The projections account for climate change in RCP4.5, or an additional 20% for climate change. The design ensures that flood risk from fluvial sources can be managed adequately by the above measures. Stormwater requirements will increase with climate change with more intense rainfall events occurring over concentrated time periods. There is some residual risk in RCP8.5 in 2100. This may result in a requirement for further mitigation in detailed design or operational phase to ensure resilience, should climate projections indicate that the most likely future scenario aligns with RCP8.5.

The boundary for this option, including trackworks, is within areas of low susceptibility to landslide. Future climate change drought/flood cycles have the potential to increase the potential for landslides and, therefore, the risk associated with landslides. However, given the low risk the exposure likelihood remains low. This additional risk will apply to all areas of potential landslide susceptibility.

The flood risks are mitigated for RCP4.5 however there are some residual risks in RCP8.5. The TII score is *minor or slightly negative (3)*, based on the TII mca criteria definition “*the option has high vulnerability to climate change risk for one climate hazard*” (see Table 50) Based on consultation with the project hydrologist, the equivalent TAF score is considered *highly negative (1)*. It is noted that the drainage system is heavily reliant on the siphon under the railway. Its capacity is limited and sensitive to flow increases and blockage. Therefore, the adaptability of this option is low, as the only means of managing the risk is to increase the height of the retaining wall.

### **Option 3. Double offline track (new alignment). L5041 road diversion**

With regard to flood risk, the Stage 1 & 2 Site Specific Flood Risk Assessment report indicates that the area in the vicinity of OBG23 has a significant history of flooding and that the railway line is at risk of overtopping in the 10% AEP fluvial flood event.

This option proposes a new double-track alignment offline of the current railway corridor, avoiding passing under the Jackson's Bridge and the significant flood compensation areas required, in Options 1 and 2. Two flood compensation areas will be required, located alongside the L5041 south of the existing Jackson's Bridge and to the west of the new L5041 road crossing of the Ballycaghan stream. The new tracks run through the flood zone of the Lyreen River on an embankment. The minimum track level is designed at the 61.27 mOD, 20 cm above the 0.1% AEP +CC+500 mm freeboard to ensure that flooding does not reach the rail level.

Stormwater requirements will increase with climate change as more intense rainfall events occur over concentrated time periods. The projections account for climate change in RCP4.5, or an additional 20% for climate change. The design ensures that flood risk from fluvial sources can be managed adequately by the above measures. Stormwater requirements will increase with climate change with more intense rainfall events occurring over concentrated time periods. There is some residual risk in RCP8.5 in 2100. This may result in a requirement for further mitigation in detailed design or operational phase to ensure resilience, should climate projections indicate that the most likely future scenario aligns with RCP8.5. The flood risks are mitigated for RCP4.5 however there are some residual risks in RCP8.5.

The boundary for this option, including trackworks, is within areas of low susceptibility to landslide. Future climate change drought/flood cycles have the potential to increase the potential for landslides and, therefore, the risk associated with landslides. However, given the low risk the exposure likelihood remains low. This additional risk will apply to all areas of potential landslide susceptibility.

The flood risks are mitigated for RCP4.5 however there are some residual risks in RCP8.5. The TII score is *minor or slightly negative (3)*, based on the TII mca criteria definition "*the option has high vulnerability to climate change risk for one climate hazard*" (see Table 50). Based on consultation with the project hydrologist, the equivalent TAF score is considered *slightly negative (3)*.

#### **Option 4: Double offline track (new alignment). Embankment**

With regard to flood risk, the Stage 1 & 2 Site Specific Flood Risk Assessment report indicates that the area in the vicinity of OBG23 has a significant history of flooding and that the railway line is at risk of overtopping in the 10% AEP fluvial flood event.

This option proposes that the new railway line pass through the Lyreen River flood area. To improve the flooding problem in this area, it is proposed to divert the Ballycaghan stream towards the Lyreen river (requiring a new under bridge beneath the L5041 road).

Stormwater requirements will increase with climate change as more intense rainfall events occur over concentrated time periods. The projections account for climate change in RCP4.5, or an additional 20% for climate change. The design ensures that flood risk from fluvial sources can be managed adequately by the above measures. Stormwater requirements will increase with climate change with more intense rainfall events occurring over concentrated time periods. There is some residual risk in RCP8.5 in 2100. This may result in a requirement for further mitigation in detailed design or operational phase to ensure resilience, should climate projections indicate that the most likely future scenario aligns with RCP8.5. The flood risks are mitigated for RCP4.5 however there are some residual risks in RCP8.5.

The boundary for this option, including trackworks, is within areas of low susceptibility to landslide. Future climate change drought/flood cycles have the potential to increase the potential for landslides and, therefore, the risk associated with landslides. However, given the low risk the exposure likelihood remains low. This additional risk will apply to all areas of potential landslide susceptibility.

The flood risks are mitigated for RCP4.5 however there are some residual risks in RCP8.5. The TII score is *minor or slightly negative (3)*, based on the TII mca criteria definition “*the option has high vulnerability to climate change risk for one climate hazard*” (see Table 50). Based on consultation with the project hydrologist, the equivalent TAF score is considered *slightly negative (3)*.

#### **Option 5: Double online track. Jackson’s Bridge railway bridge deck removal and L5041 diversion**

With regard to flood risk, the Stage 1 & 2 Site Specific Flood Risk Assessment report indicates that the area in the vicinity of OBG23 has a significant history of flooding and that the railway line is at risk of overtopping in the 10% AEP fluvial flood event.

This option is similar to Options 1 and 2 in its alignment, however it proposes from Ch 91+300 to Ch 91+960 (40 m past Jackson’s Bridge), a slab supported by piles is designed to allow water to pass under the tracks towards the Royal Canal.

Stormwater requirements will increase with climate change as more intense rainfall events occur over concentrated time periods. The projections account for climate change in RCP4.5, or an additional 20% for climate change. The design ensures that flood risk from fluvial sources can be managed adequately by the above measures. Stormwater requirements will increase with climate change with more intense rainfall events occurring over concentrated time periods. There is some residual risk in RCP8.5 in 2100. This may result in a requirement for further mitigation in detailed design or operational phase to ensure resilience, should climate projections indicate that the most likely future scenario aligns with RCP8.5. The flood risks are mitigated for RCP4.5 however there are some residual risks in RCP8.5.

The boundary for this option, including trackworks, is within areas of low susceptibility to landslide. Future climate change drought/flood cycles have the potential to increase the potential for landslides and, therefore, the risk associated with landslides. However, given the low risk the exposure likelihood remains low. This additional risk will apply to all areas of potential landslide susceptibility.

The flood risks are mitigated for RCP4.5 however there are some residual risks in RCP8.5. The TII score is *minor or slightly negative (3)*, based on the TII mca criteria definition “*the option has high vulnerability to climate change risk for one climate hazard*” (see Table 50). Based on consultation with the project hydrologist, the equivalent TAF score is considered *slightly negative (3)*.

#### **4.7.7.3.1 Summary Assessment**

Options 4 and 5 are preferred in terms of their climate change hazard adaptability. These options either by alignment or by river design reduce the vulnerability of design to fluvial flood risk to a low level, whereas Options 1 and 2 are reliant on either pumped or gravity fed drainage systems, the siphon of which is sensitive to flow increase and blockages. Note all bridge options require some level of flood risk mitigation in the form of compensation storage areas. All bridge options have similar low vulnerability all other climate change hazards. Maintenance will be conducted along the rail track to ensure the risk to the additional areas of electrification due to uncontrolled wildfire are mitigated and the asset is protected. Such mitigation measures will be required across the DART+ network.

**Table 49. Climate Adaptation Impacts mca Assessment**

Parameter	Assessment Summary	TII Impact Rating	TAF Impact Scoring
<b>Option 1: Double online track. Vertical track lowering and track protection</b>	High vulnerability to fluvial flooding and requires the most mitigation. Heavily reliant of a drainage system siphon which is sensitive to flow increase and blockages. Low vulnerability to other climate change hazards.	Slightly negative (3)	1 – Highly Negative Impact

Parameter	Assessment Summary	TII Impact Rating	TAF Impact Scoring
<b>Option 2: Double online track. Bridge deck reconstruction and track protection</b>	High vulnerability to fluvial flooding and requires the most mitigation. Heavily reliant of a drainage system siphon which is sensitive to flow increase and blockages. Low vulnerability to other climate change hazards.	Slightly negative (3)	1 – Highly Negative Impact
<b>Option 3: Double offline track (new alignment) and L5041 road diversion</b>	Vulnerability to fluvial flooding is low, due to the minimum track level designed at 61.27 mOD, 20 cm above the 0.1% AEP +CC+500 mm freeboard to ensure that flooding does not reach the rail level. Low vulnerability to other climate change hazards.	Slightly negative (3)	3 – Slightly Negative Impact
<b>Option 4: Double offline track (new alignment). Embankment</b>	Vulnerability to fluvial flooding is low, due diversion of the Ballycaghan stream towards the Lyreen river, away from the alignment of the new railway tracks. Low vulnerability to other climate change hazards.	Slightly negative (3)	3 – Slightly Negative Impact
<b>Option 5: Double online track (Jackson's railway bridge deck removal and L5041 diversion)</b>	Vulnerability to fluvial flooding is low, due to a slab supported by piles is designed to allow water to pass under the tracks towards the Royal Canal. Low vulnerability to other climate change hazards.	Slightly negative (3)	3 – Slightly Negative Impact

#### 4.7.7.4 Climate Change Impacts Summary Assessment

Table 50. Climate Change Impacts mca Assessment

Option	TAF Impact Scoring on Climate	
	Climate Action Impacts	Climate Adaptation Impacts
<b>Option 1: Double online track. Vertical track lowering and track protection</b>	4 – Neutral Impact	1 – Highly Negative Impact
<b>Option 2: Double online track. Bridge deck reconstruction and track protection</b>	4 – Neutral Impact	1 – Highly Negative Impact
<b>Option 3: Double offline track (new alignment) and L5041 road diversion</b>	4 – Neutral Impact	3 – Slightly Negative Impact
<b>Option 4: Double offline track (new alignment). Embankment</b>	4 – Neutral Impact	3 – Slightly Negative Impact

Option	TAF Impact Scoring on Climate	
	Climate Action Impacts	Climate Impacts Adaptation
<b>Option 5: Double online track (Jackson's railway bridge deck removal and L5041 diversion)</b>	4 – Neutral Impact	3 – Slightly Negative Impact

## 4.7.8 Local Environment Impacts

### 4.7.8.1 Biodiversity

This section provides the appraisal of the options at Jackson's Bridge, under the DART+ programme under biodiversity.

#### 4.7.8.1.1 Methodology

The resources consulted as part of the desk study include the following:

- Environmental Protection Agency – water bodies and water quality ([www.epa.ie](http://www.epa.ie)).
- Perrin, P.M., Daly, O.H., (2010) A provisional inventory of ancient and long-established woodland in Ireland. Irish Wildlife Manuals, No. 46. National Parks and Wildlife Service, Department of the Environment, Heritage and Local Government, Dublin, Ireland.
- The National Parks and Wildlife Service (NPWS) online database, consulted for designated sites of nature conservation interest in the study area.
- Review of Ordnance Survey maps and orthophotography.

### Study Area

The study area for the desk study to inform the option selection was defined as:

- The entire area within each option and a 1km buffer to identify designated sites and semi natural habitats.
- All watercourses within the options, downstream and including estuaries and coastal waterbodies to identify designated sites and ecologically valuable watercourse that were hydrologically connected to each option.

### Criteria

The criteria related to Biodiversity against which the options were assessed as follows:

- The presence of European or other internationally designated sites within, hydrologically or functionally connected to each site.
- The presence of Nationally designated sites within, hydrologically or functionally connected to each site.
- The presence of habitats capable of supporting the Qualifying Interests of European sites within, hydrologically or functionally connected to each site.
- The presence of natural or semi-natural habitats within, hydrologically or functionally connected to each site.
- The presence of natural or semi-natural habitats capable of supporting rare and protected species within, hydrologically or functionally connected to each site.

#### 4.7.8.1.2 Options Appraisal

##### **Option 1. Double online track. Vertical track lowering and track protection.**

This option requires construction within 15m of the Royal Canal pNHA for approx. 1.5 km along the existing track. There is potential for water quality impacts, construction disturbance and hedgerow/scrub

removal from along the existing track. The overall impact is assigned a TAF Impact score of '3- Slightly Negative'.

#### **Option 2. Double online track. Bridge deck reconstruction and track protection**

This option requires construction within 15m of the Royal Canal pNHA for approx. 1.5 km along the existing track. There is potential for water quality impacts, construction disturbance and hedgerow/scrub removal from along the existing track. The overall impact is assigned a TAF Impact score of '3- Slightly Negative'.

#### **Option 3. Double offline track (new alignment) and L5041 road diversion**

This option has a large construction footprint to accommodate the offline railway line and a new road and road overbridge. The construction of the new road overbridge will require work over the Royal Canal pNHA. New crossings of the Lyreen River and Ballycaghan Stream for the railway line will also be required, and a section of the Gragadder will be diverted. Approximately 900 m of hedgerow habitat will be lost within the footprint. The overall impact is assigned a TAF Impact score of '2- Negative'.

#### **Option 4: Double offline track (new alignment). Embankment**

The majority of the footprint verges away from the Royal Canal pNHA. New crossings of the Lyreen and Gragadder river will be required, and the Ballycaghan Stream will also be diverted. The railway line will travel over L5041 on an embankment. This option will result in the loss of c.280 m of hedgerow habitat within the footprint. The overall impact is assigned a TAF Impact score of '2- Negative'.

#### **Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge**

This option will involve the demolition of Jackson's Bridge and the construction of a new bridge meeting the required vertical clearance. The L5041 and Ballycaghan Road will be reconstructed in the same footprint but on embankments to accommodate the new bridge. The construction of the new overbridge will require works over the Royal Canal pNHA. The Ballycaghan Stream will be diverted locally, which is 3.5 km upstream of the Rye Water/Carton SAC. The overall impact is assigned a TAF Impact score of '2- Negative'.

#### 4.7.8.1.3 Summary Assessment

**Table 51. Biodiversity Impacts mca Assessment**

Option	TAF Impact Scoring
Option 1: Double online track. Vertical track lowering and track protection	3 – Slightly Negative Impact
Option 2: Double online track. Bridge deck reconstruction and track protection	3 – Slightly Negative Impact
Option 3: Double offline track (new alignment) and L5041 road diversion	2 –Negative Impact
Option 4: Double offline track (new alignment). Embankment	2 –Negative Impact
Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge	2 –Negative Impact

#### 4.7.8.2 Water Resources

The assessment of water-related constraints for the proposed development involved a comprehensive desk study and preliminary hydraulic modelling. This included gathering information on surface and groundwater bodies, water quality, protected areas, and geological features. Key data sources were Ordnance Survey maps, EPA water quality databases and geological and environmental data from various national resources.

The assessments in this section were carried out in accordance with:

- Department of Transport's Transport Appraisal Framework (TAF, 2023): Appraisal Guidelines for Capital Investments in Transport. Module 7- Detailed Guidance on Appraisal Techniques;
- Transport Infrastructure Ireland's (TII) Project Appraisal Guidelines for National Roads Unit 7.0 – Multi Criteria Analysis (PE-PAG-02031) (PAGs; TII, 2024); and
- National Roads Authority (NRA) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (NRA, 2008).

#### Option 1. Double online track. Vertical track lowering and track protection.

##### Hydrology (including flood risk)

Increasing the head of water at the siphon as a result of preventing the overflow of flood waters onto the railway/canal has the impact of increasing flood levels upstream. An increase in flood depth and extent is found upstream, impacting on agricultural lands and the road network and critically residential areas to the east and one isolated property on Ballycaghan stream. Compensation areas are only partially effective as the impact is as a result changing the conveyance and not storage in the system. There is also resulting feedback into increased spilling into the upper canal pound, which will pass over the lock. There are impacts that cannot be mitigated. The overall impact is considered to be '1-Highly Negative'.

Management of surface water drainage will need positive measures, such as pumps in order to be able to discharge above the flood levels adjacent to the track. As a result of the track lowering, these pumps would be utilised frequently

##### Vulnerable Aquifers

The impact of option 1 on groundwater has been assessed by considering the underlying aquifers, soils and groundwater using publicly available information obtained from EPA and GSI Maps.

Option 1 is underlain by a Locally Important Aquifer- Bedrock which is Moderately Productive only in Local Zones and there are no gravel aquifers or karst features nearby. Approximately 11% of the option is underlain by Alluvium, with the remaining 89% being underlain by Till derived from limestones. The subsoil permeability is low.

This option is underlain by the Dublin groundwater body, the WFD risk status of which is under review. Approximately 78% of this option is underlain by groundwater of Moderate vulnerability, approximately 10% by groundwater of High vulnerability and approximately 12% by groundwater of Extreme vulnerability. The average groundwater recharge rate is in the range of 51-100mm/yr.

The eastern end of the option comes within the accuracy range of borehole 2923SWW104 accurate to 1km with a yield class of 'poor'. There are no Public Water Supply Source Protection Areas or Group Water Scheme Zones of Contribution in the vicinity. The option is located directly parallel to the Royal Canal which is designated as a proposed Natural Heritage Area (pNHA) due to the diversity of species it supports; no GWDTE have been identified. The option crosses the Lyreen River approximately 3km upstream of the Rye Water Valley/Carton SAC over the existing bridge. *Petrifying springs with tufa formation (Cratoneurion)* [7220] is listed as a qualifying interest of this SAC and is a GWDTE.

Option 1 is online and the majority of the groundwater underlying this option is of Moderate vulnerability; however, this option requires a significant amount of excavation (24,719 Cu.M). Due to the volume and depth of ground affected, there will be a moderate magnitude of impact on the bedrock aquifer of medium importance and on groundwater flow. The overall impact on groundwater flow and quality is considered to be Slightly Negative.

### **Option 2. Double online track. Bridge deck reconstruction and track protection**

#### Hydrology (including flood risk)

Increasing the head of water at the siphon as a result of preventing the overflow of flood waters onto the railway/canal has the impact of increasing flood levels upstream. An increase in flood depth and extent is found upstream, impacting on agricultural lands and the road network and critically residential areas to the east and one isolated property on Ballycaghan stream. Compensation areas are only partially effective as the impact is as a result changing the conveyance and not storage in the system. There is also resulting feedback into increased spilling into the upper canal pound, which will pass over the lock. There are impacts that cannot be mitigated. The overall impact is considered to be '1-Highly Negative'.

Management of surface water drainage will need positive measures, such as pumps in order to be able to discharge above the flood levels adjacent to the track.

#### Vulnerable Aquifers

The impact of option 2 on groundwater has been assessed by considering the underlying aquifers, soils and groundwater using publicly available information obtained from EPA and GSI Maps.

Option 2 is underlain by a Locally Important Aquifer- Bedrock which is Moderately Productive only in Local Zones and there are no gravel aquifers or karst features nearby. Approximately 11% of the option is underlain by Alluvium, with the remaining 89% being underlain by Till derived from limestones. The subsoil permeability is low.

This option is underlain by the Dublin groundwater body, the WFD risk status of which is under review. Approximately 78% of this option is underlain by groundwater of Moderate vulnerability, approximately 10% by groundwater of High vulnerability and approximately 12% by groundwater of Extreme vulnerability. The average groundwater recharge rate is in the range of 51-100mm/yr.

The eastern end of the option comes within the accuracy range of borehole 2923SWW104 accurate to 1km with a yield class of 'poor'. There are no Public Water Supply Source Protection Areas or Group Water Scheme Zones of Contribution in the vicinity. Option 2 is located directly parallel to the Royal Canal which is designated as a proposed Natural Heritage Area (pNHA) due to the diversity of species it supports; no GWDTE have been identified. The option crosses the Lyreen River approximately 3km upstream of the Rye Water Valley/Cartron SAC over the existing bridge. *Petrifying springs with tufa formation (Cratoneurion)* [7220] is listed as a qualifying interest of this SAC and is a GWDTE.

As option 2 is online and the majority of the groundwater underlying this option is of Moderate vulnerability and as there is minimal cut, there will be an imperceptible magnitude of impact on groundwater vulnerability (of medium importance). The overall impact on groundwater flow and quality is considered to be Neutral.

### **Option 3. Double offline track (new alignment) and L5041 road diversion**

#### Hydrology (including flood risk)

The hydraulic performance at the siphon is maintained, and the impacts are as a result of the loss of floodplain with the track embankment and/or loss of conveyance routes as a result of the crossings of the Lyreen and Ballycaghan Stream by railway and diversion road. Increased bridge openings help to

reduce the afflux, and a new route for the Ballycaghan stream to the Lyreen is needed to remove any impacts in more local storms. Increased levels in the canal are noted and an increase in flood risk downstream is noted. This can be resolved by use of compensation areas and removing overflow routes to the canal. The compensation storage areas will need to be distributed across both the Ballcaghan and Lyreen floodplains. These are effective in the 1% AEP event in mitigating all impacts but sustained nominal residual water level rises are noted.

The Lyreen\_020 WFD river waterbody comprises stretches of the Lyreen River and its tributaries such as the Ballycaghan Stream. The proposed offline railway crosses the Lyreen River once and the Ballycaghan Stream once over clear span structures. The Ballycaghan Stream is also proposed to be diverted for a short stretch through a culvert under the new road.

The Lyreen\_020 waterbody is "Poor" Status and "At Risk" of not meeting WFD objectives. Agriculture and septic tanks on poorly draining lands are significant pressures in addition to diffuse urban sources. The Lyreen River and Ballycaghan Stream appear to drain a significant section of the M4 (untreated and unattenuated). South of the M4 the Lyreen has been subject to drainage works with associated hydromorphological pressures.

The Rye Water Valley/Carnton SAC is located approx. 3km downstream of the Lyreen\_020 from the proposed crossings, although the SAC is solely designated for groundwater dependent tufa spring, and whorl snail species. As such there is no source-pathway receptor linkage between any polluting surface-water generated by the development and the groundwater dependent features within the SAC.

As the watercourses are crossed by clear span bridges and the length of Ballycaghan Stream being culverted is short, this option will have a negligible effect on the Lyreen\_020's significant pressures and will not prevent the attainment of Good Status. Therefore, this option will have a neutral impact on river water quality.

#### Vulnerable Aquifers

Option 3 is underlain by a Locally Important Aquifer- Bedrock which is Moderately Productive only in Local Zones and there are no gravel aquifers or karst features nearby. Approximately 19% of the option is underlain by Alluvium, with the remaining 81% being underlain by Till derived from limestones. The subsoil permeability is low.

This option is underlain by the Dublin groundwater body, the WFD risk status of which is under review. Approximately 35% of this option is underlain by groundwater of Moderate vulnerability, approximately 29% by groundwater of High vulnerability and approximately 36% by groundwater of Extreme vulnerability. The average groundwater recharge rate is in the range of 51-100mm/yr.

The eastern end of the option comes within the accuracy range of borehole 2923SWW104 accurate to 1km with a yield class of 'poor'. There are no Public Water Supply Source Protection Areas or Group Water Scheme Zones of Contribution in the vicinity. Option 3 crosses the Royal Canal which is designated as a proposed Natural Heritage Area (pNHA) due to the diversity of species it supports; no GWDTE have been identified. Railway grading works will be within 2.5km of the Rye Water Valley/Carnton SAC. *Petrifying springs with tufa formation (Cratoneurion)* [7220] is listed as a qualifying interest of this SAC and is a GWDTE.

Option 3 involves the construction of three new bridges and significant earthworks, although it is mostly fill to raise the local roads and to elevate the offline railway alignment above the design flood level. This will lead to a moderate magnitude of impact on the bedrock aquifer of medium importance associated with the bridge foundations. This option will likely have an imperceptible magnitude of impact on Rye Water Valley/Carnton SAC (of extremely high importance) due to the distance of the works from the SAC. Therefore, the overall impact on groundwater flow and quality is considered to be Slightly Negative.

**Option 4: Double offline track (new alignment). Embankment**Hydrology (including flood risk)

The hydraulic performance at the siphon is maintained, with overtopping of the old route of the railway maintained. The impacts are as a result of the loss of floodplain with the track embankment and/or loss of conveyance routes as a result of the crossings of the Lyreen and Ballycaghan Stream by railway and diversion road. Increased bridge openings help to reduce the afflux, and a new route for the Ballycaghan stream to the Lyreen is needed to remove any impacts in more local storms. These impacts can be resolved by use of compensation areas and removing secondary overflow routes to the canal. Scored as Negative impact as the cause of the impacts is complex and therefore the success of the mitigation measures is harder to predict. A residual impact is likely, but will be contained to agricultural lands. Openings through embankment are optimised to reduce afflux.

This option impacts the Ballycaghan Stream and Lyreen River. The WFD status of both waterbodies is Poor.

The overall impact is considered to be '2 - Negative'.

Vulnerable Aquifers

The impact of option 4 on groundwater has been assessed by considering the underlying aquifers, soils and groundwater using publicly available information obtained from EPA and GSI Maps.

Option 4 is underlain by a Locally Important Aquifer- Bedrock which is Moderately Productive only in Local Zones and there are no gravel aquifers or karst features nearby. Approximately 22% of the option is underlain by Alluvium, with the remaining 78% being underlain by Till derived from limestones. The subsoil permeability is low.

This option is underlain by the Dublin groundwater body, the WFD risk status of which is under review.

Approximately 59% of this option is underlain by groundwater of Moderate vulnerability, approximately 8% by groundwater of High vulnerability and approximately 33% by groundwater of Extreme vulnerability. The average groundwater recharge rate is in the range of 51-100mm/yr.

The eastern end of the option comes within the accuracy range of borehole 2923SWW104 accurate to 1km with a yield class of 'poor'. There are no Public Water Supply Source Protection Areas or Group Water Scheme Zones of Contribution in the vicinity. The option is located near the Royal Canal which is designated as a proposed Natural Heritage Area (pNHA) due to the diversity of species it supports; no GWDTE have been identified. The option crosses the Lyreen River approximately 3km upstream of the Rye Water Valley/Carton SAC over a proposed bridge. Petrifying springs with tufa formation (Cratoneurion) [7220] is listed as a qualifying interest of this SAC and is a GWDTE.

Although option 4 requires minimal excavation (2224 Cu.M), there will be a slight magnitude of impact on the bedrock aquifer of medium importance associated with the bridge foundations. This option will have an imperceptible magnitude of impact on Rye Water Valley/Carton SAC (of extremely high importance). The overall impact on groundwater flow and quality is considered to be Slightly Negative.

**Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge**Hydrology (including flood risk)

The hydraulic performance at the siphon is maintained by raising the on-line track above the flood overtopping level. The impacts are as a result of the loss of floodplain with the road approach embankment. The flood overtopping route is maintained under the elevated track and there is limited impact upstream.

The Lyreen\_020 WFD river waterbody comprises stretches of the Lyreen River and its tributaries such as the Ballycaghan Stream. This option raises the railway along its existing alignment and includes a pile-supported slab superstructure which conveys the railway for approx. 260m adjacent to the Lyreen River and Ballycaghan Stream to allow river water to overflow towards the Royal Canal. The Ballycaghan Stream is also proposed to be diverted for a short stretch through a culvert under the new road.

The Lyreen\_020 waterbody is "Poor" Status and "At Risk" of not meeting WFD objectives. Agriculture and septic tanks on poorly draining lands are significant pressures in addition to diffuse urban sources. The Lyreen River and Ballycaghan Stream appear to drain a significant section of the M4 (untreated and unattenuated). South of the M4 the Lyreen has been subject to drainage works with associated hydromorphological pressures.

The Rye Water Valley/Carnton SAC is located approx. 3km downstream of the Lyreen\_020 from the proposed crossings, although the SAC is solely designated for groundwater dependent tufa spring, and whorl snail species. As such there is no source-pathway receptor linkage between any polluting surface-water generated by the development and the groundwater dependent features within the SAC. As the watercourses are crossed by clear span structures and the length of Ballycaghan Stream being culverted is short, this option will have a negligible effect on the Lyreen\_020's significant pressures and will not prevent the attainment of Good Status. Therefore, this option will have a neutral impact on river water quality.

#### Vulnerable Aquifers

Option 5 is underlain by a Locally Important Aquifer- Bedrock which is Moderately Productive only in Local Zones and there are no gravel aquifers or karst features nearby. Approximately 22% of the option is underlain by Alluvium, with the remaining 78% being underlain by Till derived from limestones. The subsoil permeability is low.

This option is underlain by the Dublin groundwater body, the WFD risk status of which is under review. Approximately 43% of this option is underlain by groundwater of Moderate vulnerability, approximately 18% by groundwater of High vulnerability and approximately 39% by groundwater of Extreme vulnerability. The average groundwater recharge rate is in the range of 51-100mm/yr.

The eastern end of the option comes within the accuracy range of borehole 2923SWW104 accurate to 1km with a yield class of 'poor'. There are no Public Water Supply Source Protection Areas or Group Water Scheme Zones of Contribution in the vicinity. The option is located directly parallel to, and crosses, the Royal Canal which is designated as a proposed Natural Heritage Area (pNHA) due to the diversity of species it supports; no GWDTE have been identified. Railway grading works will be within 2.5km of the Rye Water Valley/Carnton SAC. *Petrifying springs with tufa formation (Cratoneurion)* [7220] is listed as a qualifying interest of this SAC and is a GWDTE.

Option 5 involves extensive earthworks, although it is mostly fill to raise the local roads and the railway at either end of the slab, therefore there will be a moderate magnitude of impact on the bedrock aquifer of medium importance associated with the road bridge foundations and slab piles. This option will have an imperceptible magnitude of impact on Rye Water Valley/Carnton SAC (of extremely high importance) due to the distance of the works from the SAC. The overall impact on groundwater flow and quality is considered to be Slightly Negative.

## 4.7.8.2.1 Summary Assessment

Table 52. Water Resources Impacts mca Assessment table

Option	TAF Impact overall Scoring for Hydrology (including Flood Risk)	TAF Impact overall Scoring for Hydrogeology	Overall Impact score under Water Resources
Option 1: Double online track. Vertical track lowering and track protection	1 – Highly Negative	3 – Slightly Negative Impact	1 – Highly Negative
Option 2: Double online track. Bridge deck reconstruction and track protection	1 – Highly Negative	4 – Neutral Impact	1 – Highly Negative
Option 3: Double offline track (new alignment) and L5041 road diversion	2 – Negative Impact	3 – Slightly Negative Impact	2 – Negative Impact
Option 4: Double offline track (new alignment). Embankment	2 – Negative Impact	3 – Slightly Negative Impact	2 – Negative Impact
Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge	3 – Slightly Negative	3 – Slightly Negative	3 – Slightly Negative

## 4.7.8.3 Landscape and Visual Quality

This section provides the appraisal of the landscape and visual impact of 6 alternative options, developed under the DART + programme, to address constraints associated with Jackson's Bridge, which carries the L5041 local road over the railway and the adjoining Royal Canal adjacent to Lock 14 between Maynooth and Kilcock.

Jackson's Bridge and associated lock are listed as a protected structure (No. B05-36) in the Record of Proposed Structures (Appendix 6 Kildare County Development Plan 2023-2029). The bridge and 14<sup>th</sup> lock are also recorded on the National Inventory of Architectural Heritage (National Built Heritage Service) under No. 11900505.

## 4.7.8.3.1 Description of Existing Environment

Between Maynooth and Kilcock, the railway corridor runs in a southeast to northwest alignment immediately south of and parallel to the Royal Canal. Jackson's Bridge carries the L5041 local road, which runs 160m south from the R148 Kilcock Road, over the adjoining canal and railway as well as over the pedestrian canal-side towpath and the channel of the Lyreen River (refer to Figure 39).

The surrounding landscape is low-lying agricultural pasture with treelines and hedgerows, some of which are managed as low field boundaries. Dieback is common in ash trees within the field boundaries. The canal and railway are set within a linear corridor enhanced by strong hedgerows on either side and the bridge rises in a prominent hump-back to cross the railway and canal (refer to Figures 40, 41 & 42). Some low-lying areas, especially southwest of the railway corridor are subject to flooding.

A residential property, 'Lock House' is located adjacent to the 14<sup>th</sup> lock and bridge. Further residential properties are located along the R148 Kilcock Road c.160m plus north of the bridge, and off the L5041 over 300m south of the bridge.



Figure 42. View of Jackson's Bridge from Royal Canal with railway to left.



Figure 43. Railway, Royal Canal and 14th Lock northwest of Jackson's Bridge.



Figure 44. Railway and Royal Canal corridor southeast of Jackson's Bridge.



**Figure 45. View northeast towards Jackson's Bridge over the railway.**

In relation to the Royal Canal, the Kildare County Development Plan 2023-2029 notes at Section 13.4.6, that:

*“The canal corridors and their adjacent lands have been landscaped and enhanced along the sections where the canals flow through urban areas and with the development of Greenways and Blueways. Canal locks are distinctive features of these water corridors. The smooth terrain, generally gentle landform and low canal bank grassland that characterise the canal corridors allow vistas over long distances without disruption, where the canal flows in a straight-line direction. Consequently, development can have a disproportionate visual impact along the water corridor, and it can prove difficult for the existing topography to visually absorb development. The occurrence of natural vegetation, coniferous and mixed plantations adjacent to the water corridors can have shielding and absorbing qualities in landscape terms, by providing natural visual barriers.*

*Canal corridors are potentially vulnerable linear landscape features, as they are often highly distinctive in the context of the general landscape. In some cases, landscape sensitivities may be localised or site-specific.”*

As a corridor, the Royal Canal is a key component of Kildare's Green Infrastructure Strategy providing vital linkages in the network and also includes the long-distance Royal Canal Greenway.

Views for protection in Table 13.7 (Views to and from Bridges) in the Kildare County Development Plan 2023-2029 includes Jackson's Bridge under No. RC8. It is an objective (LR 032) of the Development Plan to:

*“Avoid any development that could disrupt the vistas or have a disproportionate impact on the landscape character of the area, particularly upland views, river views, canal views, views across the Curragh, views of historical or cultural significance (including buildings and townscapes), views of natural beauty and specifically those views listed in Tables 13.5 – 13.7 of this plan.”*

#### 4.7.8.3.2 Options Appraisal

Five options are proposed, and the potential landscape and visual impact of each option is set out in the following sections.

##### **Option 1. Double online track. Vertical track lowering and track protection.**

Option 1 retains the location of the existing railway, local road and Jackson's Bridge with a lowering of the track to achieve clearance with the following key interventions:

- Excavation and lowering by c.960mm at Jackson's Bridge, of c.1,000m of the existing track;
- Minor horizontal re-alignment of the tracks at Jackson's Bridge;

- Provision of a bottom slab (under the lowered tracks) and side retaining walls to prevent flooding of the tracks;
- Provision of dual tracking and associated overhead electrical catenary through the full corridor;
- Raising of the bridge parapet over the railway arch to 1,800mm above road level.

Impact on the wider landscape is minimal and temporary. Provision of overhead electrical catenary will have a slight negative impact on the canal corridor. Subject to the use of sensitive finishes, raising part of the parapet of the bridge over the railway will only have a slight negative impact on the appearance of Jackson's Bridge and for views of the railway / canal corridor from the bridge.

The potential impact of Option 1 on Jackson's Bridge, the Royal Canal, the 14<sup>th</sup> Lock, the adjoining residential property and for views to and from the Bridge is slight adverse during construction; and slight neutral thereafter.

### **Option 2. Double online track. Bridge deck reconstruction and track protection**

Option 2 retains the location of the existing railway and local road, however, with a raising of the track and the associated railway arch of Jackson's Bridge to achieve clearance with the following key interventions:

- Demolition of the railway arch of Jackson's Bridge and reconstruction so as to raise the arch and road level over the railway by c.900mm;
- Raising of the road level on both sides on approach to the bridge and raising of the parapet of the bridge to match existing height – but to 1,800mm above road level in crossing the railway;
- Raising by c.200mm at Jackson's Bridge, of c.800m of the existing track;
- Minor horizontal re-alignment of the tracks at Jackson's Bridge;
- Provision of a bottom slab (under the lowered tracks) and side retaining walls to prevent flooding of the tracks;
- Provision of dual tracking and associated overhead electrical catenary through the full corridor;

Impact on the wider landscape is minimal and temporary. Demolition of the railway arch and bridge reconstruction and road raising works will have a significant temporary and short-term negative impact on Jackson's Bridge, the 14<sup>th</sup> Lock, and adjoining residential property and on the local canal corridor.

Provision of overhead electrical catenary will have a slight negative impact on the canal corridor. Subject to the use of sensitive finishes, raising part of the parapet of the bridge over the railway will have a moderate negative impact on the appearance of Jackson's Bridge and for views from the canal corridor from the adjoining residential property.

The potential impact of Option 2 on Jackson's Bridge, the Royal Canal, the 14<sup>th</sup> Lock, the adjoining residential property and for views to and from the bridge is significant adverse during construction; and moderate adverse to neutral thereafter.

### **Option 3. Double offline track (new alignment) and L5041 road diversion**

Option 3 proposes a new double-track slightly elevated alignment offline and south of the current railway corridor, avoiding Jackson's Bridge with the following key interventions:

- Provision of 1,600m long section of re-aligned new railway offline to the south of the existing corridor. The railway will be elevated on low embankment with a bridging structure over the channel of the Lyreen River and the Ballycaghan Stream;
- Severance of the existing L5041 local road south of the existing railway and provision of a new alignment of a c.550m long section of the L5041 local road from a new junction off a c.400m realigned section of the R148 Road, all c.200m west of the existing L5041 local road.
- The realigned L5401 local road rises on embankment up to 10m high as it crosses the canal and railway via a new c.80m long bridge. The new realigned road ties back down via embankments to the existing L5041 local road south of the railway corridor.

- A section of the Ballycaghan Stream is re-aligned and culverted under the realigned L5041 local road and passes under the railway at its existing location;
- Jackson's Bridge is retained without direct impact to provide access to lands located between the existing and new offline railway corridors;
- Provision of dual tracking and associated overhead electrical catenary through the full offline corridor and retained online railway corridor.

The works will result in a significant impact on the wider landscape west and south of Jackson's Bridge. Construction of the elevated link road and new bridge over the canal and existing railway, and the construction of the elevated offline section of railway will necessitate removal of sections of treelines and hedgerows, including those on the canal corridor, and will have a significant short and medium-term negative impact on the local area, including the local canal corridor. Provision of overhead electrical catenary will have a slight negative impact on the canal corridor.

The potential impact of Option 3 on the Royal Canal, the Royal Canal Greenway, and the local landscape is significant adverse during construction and moderate / significant adverse thereafter.

#### **Option 4: Double offline track (new alignment). Embankment**

Option 4 proposes a new double-track elevated alignment offline and south of the current railway corridor, avoiding Jackson's Bridge with the following key interventions:

- Provision of 1,600m long section of re-aligned new railway offline elevated over the L5041 local road to the south of the existing corridor, with two bridging structures (30m & 46m) over the Lyreen River and the L5041 local road and adjoining Ballycaghan Stream;
- The alignment of the existing L5041 local road south of the existing railway is maintained via an underbridge of the new elevated offline railway;
- Local realignment of the Ballycaghan Stream and the junction between the Ballycurraghan local road and L5041 local road;
- Jackson's Bridge is retained without direct impact as part of the existing L5041 local road;
- Provision of dual tracking and associated overhead electrical catenary through the full elevated offline corridor and retained online railway corridor.

The works will result in a significant impact on the landscape south of Jackson's Bridge. Construction of the elevated offline railway and viaduct will necessitate removal of sections of treelines and hedgerows, including those on the canal corridor, and will have a significant short and medium-term negative impact on the local area, including the local canal corridor and the residential farm property along the L5041 south of the new railway alignment. Provision of overhead electrical catenary will have a slight negative impact on the canal corridor.

The potential impact of Option 4 on the Royal Canal, the Royal Canal Greenway and the local landscape is significant adverse during construction and slight / moderate adverse thereafter.

#### **Option 5: Double online track. Jackson's Bridge railway bridge deck removal and L5041 diversion**

Option 5 proposes an online double-tracking removing Jackson's Bridge over the canal and railway with the following key interventions:

- Removal of Jackson's Bridge which allows for the railway to be elevated as it passes through the structure;
- Provision of a realignment of c.430m of the L5041 local road alongside and east of the existing local road with a new c.42m long bridge over the canal and railway on or close to the location of the existing Jackson's Bridge. The new realigned road, which will rise onto embankment in excess of 10m high as it crosses the canal and railway, ties back down via embankments to the Ballycurraghan local road and the existing L5041 south of the railway corridor. A section of

the Ballycaghan Stream is re-aligned and culverted under the realigned local road and associated embankment;

- The section of the existing L5401 north of the canal will be retained for access to the Royal Canal Greenway, the 14<sup>th</sup> Lock and the adjoining residential property. The realigned L5401 will require a c.8m high retaining structure alongside the retained section of L5401, where it approaches the canal / new bridge;
- Provision of dual tracking and associated overhead electrical catenary through the full online corridor of the railway.

The works will result in a significant impact on Jackson's Bridge and the local landscape with the removal of the bridge structure. Construction of the elevated realigned local road and new bridge will necessitate removal of a significant tree-line along the east of the local road north of the canal, sections of hedgerows, and will have a very significant short and medium-term negative impact on the local area, including the local canal corridor, the setting of the 14<sup>th</sup> Lock and adjoining residential property and the residential farm property along the L5041 south of the railway. While the section of the existing L5401 local road north of the canal will be retained, the adjoining western edge of the realigned L5401 will be supported by means of a retaining structure of up to 8m in height. Provision of overhead electrical catenary will have a slight negative impact on the canal corridor.

The potential impact of Option 5 on the Royal Canal and 14<sup>th</sup> Lock, the Royal Canal Greenway and the residential property adjacent to the lock is very significant adverse during construction and significant adverse thereafter.

#### 4.7.8.3.3 Summary Assessment

**Table 53. Landscape and Visual Quality Impacts mca Assessment**

Option	TAF Impact Scoring
Option 1: Double online track. Vertical track lowering and track protection	4 – Neutral Impact
Option 2: Double online track. Bridge deck reconstruction and track protection	3 – Slightly Negative Impact
Option 3: Double offline track (new alignment) and L5041 road diversion	1 – Highly Negative Impact
Option 4: Double offline track (new alignment). Embankment	2 – Negative Impact
Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge	1 – Highly Negative Impact

#### 4.7.8.4 Cultural Heritage

This section provides the appraisal of the cultural heritage impact of 6 alternative options, under the DART + programme for provision of OHLE clearance at Jackson's Bridge.

##### 4.7.8.4.1 Methodology

A range of all available desktop sources of architectural and archaeological heritage information were consulted as part of the desk study to inform the assessment, including the following:

- The Historic Environment Viewer, National Inventory of Architectural Heritage (NIAH) and NIAH Garden Survey.

- Meath County Development Plan 2021-2027 (A06 Record of Protected Structures) (RPS and ACA).
- Kildare County Development Plan 2023-2029, The Record of Protected Structures (RPS and ACA).
- Record of Monuments and Places for Counties Dublin, Kildare, Meath;
- Sites and Monuments Record for Counties Dublin, Kildare, Meath;
- National Monuments in State Care Database;
- Preservation Orders List;
- Cartographic and aerial photographic sources;
- Excavations Bulletin (1970-2024)

The study area for this assessment consisted of the area within the proposed options, as well as the area extending 50m from the site locations. Structures of architectural, archaeological and cultural heritage significance close to that boundary but at a greater distance from the railway are included in the assessment. Measurements are taken from the proposed site location boundaries to the nearest point of a site or structure.

The quality and type of potential impacts can vary to include the following, as per TII's *Guidelines for Cultural Heritage Impact Assessment of TII National Road and Greenway Projects* (TII, 2024):

- Direct Effect – where a Cultural Heritage Receptor or its setting is physically located within the footprint of a project which would entail its removal in whole or in part. Direct effects can also be defined as those that are directly attributable to the proposed development.
- Indirect Effect – an effect that results indirectly from the proposed project, often occurring away from the development, or because of a sequence of interrelationships or a complex pathway.
- Positive Effect – a change which enhances or improves the quality of the Cultural Heritage Receptor.
- Negative Effect – a change which reduces the quality of the Cultural Heritage Receptor.

A five-level rating system was used to describe the importance of Cultural Heritage Receptors in accordance with the TII, 2024 Guidelines, as shown in Table 54.

**Table 54. Rating of Cultural Heritage Receptors**

Importance	Cultural Heritage Receptors
Very high	<ul style="list-style-type: none"> <li>• Designated Built Heritage Receptors rated as being of international importance, including associated historic gardens and designed landscapes.</li> <li>• Designated features of international intangible heritage value.</li> <li>• Designated historic landscapes of international value.</li> <li>• National Monuments.</li> <li>• Sites with Preservation Orders</li> <li>• Other designated Cultural Heritage Receptors of international importance.</li> <li>• World Heritage Properties (including the tentative list)</li> </ul>
High	<ul style="list-style-type: none"> <li>• Architectural Conservation Areas.</li> <li>• Historic landscapes (designated or undesignated) of outstanding interest and of demonstrable national value. These will be well-preserved historic landscapes exhibiting considerable coherence, time depth, or other critical factors.</li> <li>• Other designated or undesignated Cultural Heritage Receptors of demonstrable national importance.</li> <li>• Places or features of national intangible heritage value.</li> <li>• Protected Structures.</li> <li>• Recorded Monuments (or sites and monuments scheduled for inclusion on the RMP).</li> <li>• Undesignated receptors of high quality and importance.</li> </ul>
Medium	<ul style="list-style-type: none"> <li>• NIAH structures</li> <li>• Historic landscapes of regional value (designated or undesignated).</li> </ul>

Importance	Cultural Heritage Receptors
	<ul style="list-style-type: none"> <li>Other designated or undesignated receptors of regional Cultural Heritage importance.</li> <li>Places or features of regional intangible heritage value.</li> </ul>
Low	<ul style="list-style-type: none"> <li>Historic landscapes whose value is limited by poor preservation and/or poor survival of contextual associations.</li> <li>Other designated or undesignated Cultural Heritage Receptors of local importance.</li> <li>Places or features of local intangible heritage value.</li> <li>Receptors compromised by poor preservation of contextual associations with inherent, albeit limited, Cultural Heritage value.</li> <li>Undesignated historic buildings of modest quality in their fabric or historical association.</li> </ul>
Negligible	<ul style="list-style-type: none"> <li>Receptors/landscapes with very little surviving Cultural Heritage interest.</li> </ul>

The importance of cultural heritage receptors in combination with the type of impact on each was used to inform the cultural impact assessment for each proposed option.

#### 4.7.8.4.2 Options Appraisal

##### **Option 1. Double online track. Vertical track lowering and track protection.**

This option will not result in an impact on recorded monuments. This option will be primarily located within the footprint of the existing railway and as such there will be minimal potential for impacts on previously unrecorded archaeological sites that may be located within the area surrounding the railway.

The option will involve the lowering of the railway bed, which will see the retention of Jackson's Bridge, which is a protected structure. The option will require an increase in the parapet height of the railway bridge to a height of 1.8m. This will result in a direct, negative impact on the bridge structure, which is considered moderately negative.

##### **Option 2. Double online track. Bridge deck reconstruction and track protection**

This option will not result in an impact on recorded monuments. This option will be primarily located within the footprint of the existing railway and as such there will be minimal potential for impacts on previously unrecorded archaeological sites that may be located within the area surrounding the railway.

The option will involve the lowering of the railway bed but will require the dismantling and reconstruction of Jackson's Bridge, which is a protected structure. This applies to the arch crossing the railway rather than the adjacent arches. The parapet height of the overall bridge will also be increased in height. This will result in a direct, negative impact on the bridge structure, which is considered significantly negative.

##### **Option 3. Double offline track (new alignment). L5041 road diversion**

This option will not result in an impact on recorded monuments, but the option comprises a re-route of a railway through greenfield to the south of Jackson's Bridge and railway and a new access road crossing the proposed and existing railway, along with the canal. As such there is the potential for impacts on previously unrecorded archaeological sites that may be located within the footprint of the realigned railway and road.

The option will bypass Jackson's Bridge and as such will not directly impact the bridge or adjacent protected structures (canal locks). The new bridge further to the west has the potential to indirectly impact the setting of the bridge, locks and canal, although the impacts would not be significant.

##### **Option 4: Double offline track (new alignment). Embankment**

This option will not result in an impact on recorded monuments, but the option comprises a re-route of a railway through greenfield to the south. As such there is the potential for impacts on previously unrecorded archaeological sites that may be located within the footprint of the realigned railway.

The option will bypass Jackson's Bridge and as such will not directly impact the bridge. The option will see a section of the railway to the south of Jackson's Bridge elevated on an embankment, with the new railway line at a higher elevation to Jackson's Bridge. This has the potential to result in a significant indirect negative impact on the setting of the structure.

#### **Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge**

This option will not result in an impact on recorded monuments. This option will be primarily located within the footprint of the existing railway, a new road will be required to cross the railway, which is located in greenfield and has the potential to directly impact previously unrecorded archaeological sites that may be located within this area.

The option will involve the removal of the railway arch at Jackson's Bridge, although the remaining structure will be retained in-situ. This is a protected structure. This will result in a direct, negative impact on the bridge structure, which is considered significant.

The new bridge further to the west has the potential to indirectly impact the setting of the bridge, locks and canal, although the impacts would not be significant.

#### 4.7.8.4.3 Summary Assessment

**Table 55. Cultural Heritage Impacts mca Assessment**

Option	TAF Impact Scoring
Option 1: Double online track. Vertical track lowering and track protection	3 – Slightly Negative Impact
Option 2: Double online track. Bridge deck reconstruction and track protection	2 – Negative Impact
Option 3: Double offline track (new alignment) and L5041 road diversion	3 – Slightly Negative Impact
Option 4: Double offline track (new alignment). Embankment	2 – Negative Impact
Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge	2 – Negative Impact

#### 4.7.8.5 Noise and Vibration

This section describes the noise and vibration assessment of the options selection for the Jackson's Bridge (OBG23). The specific objectives of the noise and vibration assessment at this stage are to determine the existing noise environment, the most sensitive receptor locations in proximity to the proposed options, and the potential impacts as a result of the proposed options.

##### 4.7.8.5.1 Methodology

The specific objectives at this stage are to determine the presence and density of noise sensitive receptor locations in proximity to the proposed options and the potential noise impacts associated with the construction and operational phases of each.

All options have potential noise impacts during both the construction and operational phases. The assessment of potential noise impacts is based upon an assessment of the number of Noise Sensitive Locations (NSLs) in the vicinity of each option and its potential impact rating (PIR). An assessment of

specific operational noise levels from changes in operational rail or road traffic noise on the surrounding environment has also been undertaken.

#### 4.7.8.5.2 Potential Impact Rating

The prevailing noise environment is influenced by road traffic from the M4 to the south, the R146 Kilcock Road and intermittent passing rail along the operational rail line.

Property counts of NSLs have been conducted within 300m of each of the options locations and have been quantified within the following bands from the site boundary:

- 0m to 50m.
- 50m to 100m.
- 100m to 200m.
- 200m to 300m.

Counted NSLs include residential units, education buildings, medical buildings (including nursing homes), and amenity areas; although at this stage of the assessment no further distinction is made between these different types of NSLs. During the specific impact assessment for the emerging preferred bridge option, any variation in NSL type will be identified and considered as appropriate. Any variation in type of NSL, however, would not be expected to materially affect the noise impact assessment

An assessment of potential noise impact based upon the number of noise sensitive receptors within specified distance bands from each of the options under consideration has been undertaken. From the property counts a Potential Impact Rating (PIR) is calculated by weighting the property counts and summing the weighted value. A weighting factor of 4 is applied for the closest distance band (0 to 50m) down to 1 for the furthest distance band (200 to 300m). For the PIR assessment, the calculated weighted value within 300m from options boundary is then determined. The option with the lowest PIR has the lowest nominal potential impact.

The calculated PIR within each distance band and for the total 300m assessment boundary is presented in Table below. The number of NSLs counted within each distance band is provided in parenthesis.

**Table 56. Potential Impact Ratings (PIR)**

Options	Calculated PIR at each distance band				
	0-50m	50-100m	100m-200m	200m-300m	Total PIR
Jackson's Bridge Options 1 & 2	160 (40)	150 (50)	284 (142)	122 (122)	716
Jackson's Bridge Option 3	192 (48)	165 (55)	266 (133)	128 (128)	751
Jackson's Bridge Option 4	160 (40)	153 (51)	274 (137)	129 (129)	716
Jackson's Bridge Option 5	172 (43)	153 (51)	282 (41)	125 (125)	732

The PIR assessment has determined all options have comparable overall PIRs and have a very similar number of NSLs located within the closest distance bands of 0 – 50 and 50 – 100m where highest potential impacts will occur.

Options 3 and 5 have the highest PIR compared to the other options and also have the highest number of NSLs within 100m, however the difference is marginal between these and the other 3 options.

Options 4 has the lowest PIR and a marginally lower number of NSLs within 100m compared to the other options.

#### 4.7.8.5.3 Options Appraisal

##### **Option 1. Double online track. Vertical track lowering and track protection.**

The first option follows the current railway corridor (online option) passing under Jackson's Bridge (OBG23). This option requires a 720 mm vertical track lowering at Jackson's Bridge to allow the new double-track pass with enough OHLE clearance under Jackson's Bridge. It also requires a horizontal realignment of the existing track to allow enough space for the new track. During the construction phase the following activities are expected for this option.

- **Demolition** – No demolition is required for this option.
- **Rail works** – The proposed option requires the addition of a new track, track lowering, bottom slab and side retaining walls. Due to works on the live rail line these will necessitate night-time and / or weekend possessions.
- **Road works** – No road works required for this option.

The Potential Impact Rating for this option is 716, with 40 NSLs located within 50m. The majority of the NSLs within the 50m band are apartments within one building (33 No.) at Newtown Hall to the southeast.

During the construction phase, the potential noise impacts associated with this option relates to track lowering and the construction of a new parallel track. The closest affected properties at those within Newtown Hall / The Grove to the south-east of the red line boundary (RLB) where track works will take place, one residential property immediately north of Jackson's Bridge in proximity to rail lowering and widening works. The works will require night-time and weekend possessions which will result in associated construction noise impacts.

There are no expected significant operational noise impacts due to the small horizontal change in alignment closer to properties at Newtown hall / The Grove. A noise barrier will form the boundary of the westbound track edge between approximately 91+500 and OBG21 to the east to reduce operational rail noise levels as per the DART West EIAR, particularly for technical rail movements. The specific design and length of the barrier will be determined during Phase 3 should this option progress. With mitigation in place, operational noise levels will be not significant to slight and long term.

The overall impact is determined to be negative given the short-term significant construction impacts with potential for night-time disturbance but the long term low operational noise impacts.

##### **Option 2. Double online track. Bridge deck reconstruction and track protection**

Option 2 follows the current railway corridor (online option) passing under Jackson's Bridge (OBG23), but in this case the aim is to raise the level of the track to minimise the impact on the floodplain. This option includes the demolition and rebuilding the arch of Jackson's Bridge, over which the railway passes. During the construction phase the following activities are expected for this option.

- **Demolition** – the arch of Jackson's Bridge would require demolition to accommodate the double track arrangement proposed as part of this option
- **Rail works** – The proposed option requires track removal, raising of the track level and the addition of a new track. Due to works on the live rail line these will necessitate night-time and / or weekend possessions.
- **Road works** – No road works required for this option; however the bridge reconstruction will impact in the L5041 road that will be closed during the reconstruction work. Traffic diversions will therefore be in place.

The Potential impact rating is 716, with 40 NSLs located within 50m. The majority of the NSLs within the 50m band are apartments within one building (33 No.) at Newtown Hall to the southeast.

During the construction phase, the potential impact associated with this option relates to track raising, the construction of a new track and bridge alterations. The closest affected properties at those within Newtown Hall / The Grove to the south-east of the RLB where track works will take place, one residential property immediately north of Jackson's Bridge in proximity to the bridge demolition works and track works. The works will require night-time and weekend possessions and associated construction noise impacts.

There are no expected significant operational noise impacts due to the small horizontal change in alignment closer to properties at Newtown hall / The Grove. A noise barrier will form the boundary of the westbound track edge between approximately 91+500 and OBG21 to the east to reduce operational rail noise levels as per the DART West EIAR, particularly for technical rail movements. The specific design and length of the barrier will be determined during Phase 3 should this option progress. With mitigation in place, operational noise levels will be not significant to slight and long term.

The overall impact is determined to be negative given the short-term significant construction impacts with potential for night-time disturbance but the long term low operational noise impacts.

### **Option 3. Double offline track (new alignment) and L5041 road diversion**

Option 3 proposes a new double-track alignment offline of the current railway corridor, avoiding pass under the Jackson's Bridge and the clearances issues. The new railway line crosses the L5041 road south of Jackson's Bridge. During the construction phase the following activities are expected for this option. The new railway line crosses the L5041 road south of Jackson's Bridge. The elevation of the tracks at this crossing point is 62.62 mOD, while the elevation of the road at this point is 60.0 mOD. This difference in elevation does not allow the road to cross either below or above the new railway line, which is why it is necessary to divert the L5041 road to the west to cross via a bridge over the new railway line and the Royal Canal.

- **Demolition** – no demolition is required as this option.
- **Rail works** – This option requires construction of an offline track on embankment, a new bridge over the new railway line and the Royal Canal, realignment of the L5041 and tie in point to the R148. The works are unlikely to require night-time and weekend possessions, however there may be a short possession during works on the new rail crossing.
- **Road works** – Road works required for this option include realignment of the L5041 and the R148 tie in.

The Potential impact rating is 751, with 48 NSLs located within 50m. The majority of the NSLs within the 50m band are apartments within one building (33 No.) at Newtown Hall to the southeast which is least affected by this option.

During the construction phase, the potential impacts associated with this option relates to the new track alignment to the south of the existing rail line and road works for the diverted L5041 Road to tie into the Kilcock Road. The closest affected properties at those within Newtown Hall / The Grove to the south-east of the RLB where construction of the new track works will take place, one residential property immediately north of Jackson's Bridge and properties along Kilcock Road in proximity to the realigned road and new T-junction. There may be a requirement for a short night-time possession to construct the new rail overbridge, which is positioned approximately 130m from the closest NSLs hence the overall potential significance of construction effects at residential properties is lower compared to other options.

During the operational phase, there will be an insignificant change in in rail noise at residential properties in proximity to the realigned offline track due to its distance from the properties. A noise barrier will form the boundary of the westbound track edge to the east to reduce operational rail noise

levels as per the DART West EIAR, hence operational noise levels will not be significant. There is potential for increased road traffic noise at NSL in proximity to the realigned L5041 and the new T-Junction with the Kilcock Road. Depending on the final vertical alignment and road traffic flows, there may be a requirement for noise mitigation.

The overall impact is determined to be slightly negative given the given the less significant construction noise impacts compared to Options 1, 2 and 5 and the long term slight negative operational noise impacts.

#### **Option 4: Double offline track (new alignment). Embankment**

Option 4 proposes a similar to Option 3 but modifies the vertical alignment, raising the level of the tracks so that the L5041 road can pass under the new railway line and the diversion of this road proposed in Option 3 is not necessary.

Option 4 proposes that the new railway line pass through the Lyreen River flood area via an embankment and two main underpass UBG22A (30 m span) and UBG22B (46 m span).

During the construction phase the following activities are expected for this option.

- **Demolition** – no demolition is required for this option
- **Rail works** – This option requires construction of an embankment for the realigned track and construction of an underpass structure. The works are unlikely to require night-time and weekend possessions and will require standard working hours.
- **Road works** – No significant road works are required for this option.

The Potential impact rating is 716, with 40 NSLs located within 50m. The majority of the NSLs within the 50m band are apartments within one building (33 No.) at Newtown Hall to the southeast which is least affected by this option.

During the construction phase, the potential impact associated with this option relates to the new track alignment to the south of the existing rail line. The closest affected properties at those within Newtown Hall / The Grove to the south-east of the RLB where construction of the new track works will take place, and one residential property immediately north of Jackson's Bridge. It is unlikely that any of the proposed activities will require night-time works which will reduce the overall potential significance of construction effects at residential properties.

During the operational phase, there will be an increase in rail noise at residential properties in proximity to the realigned offline track on viaduct. Due to the distance between the track and the small increase in vertical alignment passing the residential properties to the southeast (<2.5m above ground) the expected change in rail noise levels is not significant. A noise barrier will form the boundary of the westbound track edge between approximately 91+500 and OBG21 to the east to reduce operational rail noise levels as per the DART West EIAR, hence operational noise levels will be reduced to slight and long term.

The overall impact is determined to be slightly negative given the given the less significant construction noise impacts compared to Options 1, 2 and 5 and the long term low operational noise impacts.

#### **Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge**

This option is similar to Options 1 and 2 in its alignment of the rail line, but involves removing the existing Jacksons bridge deck and a new bridge is constructed to the west for the L5041 to pass over (a similar diversion to that presented in Option 3).

During the construction phase the following activities are expected for this option

- **Demolition** – the arch of Jackson's Bridge will be removed

- **Rail works** – The proposed option requires the addition of a new track, track raising on piles, bottom slab and side retaining walls. Due to works on the live rail line these will necessitate night-time and / or weekend possessions.
- **Road works** – Realignment of the L5041 across a new bridge will be required and a T-Junction tie in to the Kilcock Road.

The Potential impact rating is 758, with 51 NSLs located within 50m. The majority of the NSLs within the 50m band are apartments within one building (33 No.) at Newtown Hall to the southeast which is least affected by this option and NSLs at the tie in of the L5041 with the Kilcock Road along the realigned road section.

During the construction phase, the potential noise impacts associated with this option relates to track works and the construction of a new parallel track. The closest affected properties at those within Newtown Hall / The Grove to the south-east of the red line boundary (RLB) where track works will take place, one residential property immediately north of Jackson's Bridge in proximity to rail works, the bridge deck demolition works and the L5041 road realignment works. The rail works will require night-time and weekend possessions which will result in associated construction noise impacts.

There are no expected significant rail operational noise impacts due to the electrification of the fleet and the small horizontal alignment closer to these properties at Newtown Hall / The Grove. There is potential for road traffic noise levels at the Jackson's Bridge property to be altered due to the vertical alignment, but the overall change is expected to be minor. There is potential for increased road traffic noise at NSL in proximity to the realigned L5041 and the new T-Junction with the Kilcock Road. Depending on the final vertical alignment and road traffic flows, there may be a requirement for noise mitigation.

The overall impact is determined to be negative given the short-term significant construction impacts with potential for night-time disturbance but the long term low operational noise impacts.

#### 4.7.8.5.4 Summary Assessment

**Table 57. Noise and Vibration Impacts mca Assessment**

Option	TAF Impact Scoring
Option 1: Double online track. Vertical track lowering and track protection	2 – Negative Impact
Option 2: Double online track. Bridge deck reconstruction and track protection	2 – Negative Impact
Option 3: Double offline track (new alignment) and L5041 road diversion	3 – Slightly Negative Impact
Option 4: Double offline track (new alignment). Embankment	3 – Slightly Negative Impact
Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge	2 – Negative Impact

#### 4.7.8.6 Air Quality

This section describes the air quality assessment of the options selection for the Jackson's Bridge (OBG23) Options. The specific objectives of the air quality assessment at this stage are to determine the existing ambient air quality, the most sensitive receptor locations in proximity to the proposed

options, and the predicted air quality impact as a result of the proposed options. All options assist with the clean air strategy and working towards achieving Directive (EU) 2024/2881 by providing alternatives to private car use.

This chapter was completed by Tanmay Gojamgunde. Tanmay is an environmental consultant in the Air Quality & Climate section of AWN Consulting, a Trinity Consultants Company. He holds a MSc in Air Pollution Management and Control from the University of Birmingham and has also completed BTech in Environmental Engineering. As part of the MSc, he worked on 'The Impact of bus-fleet electrification on air quality in Birmingham' utilising advanced dispersion modelling tools and emission inventory toolkit. Prior to joining AWN, Tanmay contributed to several key environmental projects in India, including Delhi's first air quality monitoring program (R ASMAN), air quality and traffic planning assessments with IIT Kanpur, and an Environmental Impact Assessment Report (EIAR) for an industrial district in Kanpur. He also specialises in conducting air dispersion modelling assessments of emissions, emission inventories, R programming and extends to broader aspects of environmental engineering.

#### 4.7.8.6.1 Methodology

This assessment has been prepared based on the following TII Air Quality guidance:

- PE-ENV-01106: Air Quality Assessment of Specified Infrastructure Projects; (TII 2022a); and
- PE-ENV-01107: Air Quality Assessment Standard for Proposed National Roads (TII 2022b).

The primary aspects of the assessment relate to the existing ambient air quality, proximity of sensitive locations and a review of the overall significance of potential changes in air quality.

The objective at this stage of the Jackson's Bridge (OBG23) options selection process is to indicate whether there are likely to be significant air quality impacts associated with the proposed options. The evaluation methodology assesses the number of residential properties within 50m of the options. Traffic data obtained for the Opening Year and Design Year have been used in the model as per the TII guidelines (2022a, 2022b). A comparison of the proposed routes can be carried out based on a calculation of the Index of the Overall Change in Exposure by human receptors to nitrogen oxides (NO<sub>x</sub>) and particulate matter (PM<sub>10</sub> and PM<sub>2.5</sub>) resulting from each individual route. The calculation of the Index of Overall Change in Exposure allows a comparison of the overall air quality impact on people from each route option to be carried out. The Index is based on identifying the number of sensitive receptor locations (e.g. residential properties, schools) within 50m of the carriageway of all road links that would experience a significant change in traffic for each of the routes and be classified as "affected". The change in emissions is influenced by changes in traffic flow, composition and speed. The analysis is carried out using the methodology of TII (2022a, 2022b) and using TII Road Emissions Model (REM) (GE-ENV-01107) (TII 2024).

The TII guidance (TII, 2022a) states that the following scoping criteria shall be used to determine whether a road link is classified as "affected":

- Road alignment will change by 5 m or more; or
- Annual average daily traffic (AADT) flows will change by 1,000 or more; or
- Heavy duty vehicle (HDV) (vehicles greater than 3.5 tonnes, including buses and coaches) flows will change by 200 AADT or more; or
- Daily average speed change by 10 kph or more; or
- Peak hour speed will change by 20 kph or more.

In addition to assessing the impact to people as a result of air quality, the impact to sensitive ecosystems must also be assessed as per the TII guidelines (TII 2022a, 2022b). The EC Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (the "Habitats Directive") requires an Appropriate Assessment to be carried out where there is likely to be a

significant impact upon a European protected site. TII requires the Air Quality Specialist to liaise with an ecologist on schemes where there is a European protected site within 2km of the options. However, as the potential impact of a scheme is limited to local level, detailed consideration need only be given to roads where there is a significant change to traffic flows (>5%) and the designated site lies within 200m of the road centre line. Where these two requirements are fulfilled, the assessment at the options selection stage involves a calculation of nitrogen oxides (NO<sub>x</sub>) and ammonia (NH<sub>3</sub>) concentrations, and acid deposition and nitrogen deposition rates using the methodology set out in TII Guidance document PE-ENV-01106 (TII 2022a).

The nature of the Proposed Development is to support the DART network as it grows from its current 50km in length to over 150km. Therefore, impacts due to road traffic in the operational phase are scoped out as there is no potential for significant impact on human or ecological receptors due to changes in pollutant concentrations as per the significance criteria in TII PE-ENV-01106.

The study area will have associated rail transport emissions. However, the trains associated with the railway track will be electric rather than fuelled by a combustion engine. Therefore, the rail stock will not have the potential for significant localised impacts. Impacts due to rail traffic in the operational phase are scoped out as there is no potential for significant impact on human or ecological receptors due to changes in pollutant concentrations as per the significance criteria in TII PE-ENV-01106. There are no potentially significant sources of combustion emissions from any of the options.

The most significant potential construction phase impacts relate to construction dust. Transport Infrastructure Ireland (TII) recommends the use of the IAQM guidance (2024) in the TII guidance document Air Quality Assessment of Specified Infrastructure Projects – PE-ENV-01106 (TII, 2022a). The proposed options are considered to have the potential for magnitudes of dust emissions in accordance with IAQM (IAQM 2024) Guidance for the demolition, earthworks, construction and trackout activities during the construction phase.

The potential for impact prior to mitigation is assessed by combining the magnitude of potential emissions with the sensitivity of the area.

The Institute of Air Quality Management in the UK (IAQM) guidance document '*Guidance on the Assessment of Dust from Demolition and Construction*' (2024) outlines mitigation measures and to determine the level of site-specific mitigation required. Construction dust related impacts can be mitigated with best practice mitigation measures and are temporary in nature.

There is no potential for significant effects due to operational dust emissions from any of the options.

The comparative evaluation of options was assisted by scoring of impacts to sensitive receptors using the Stage 2 Project Appraisal Matrix as per the Project Appraisal Guidelines for National Roads Unit 7.0 - Multi Criteria Analysis (TII 2016) and (TII 2022b). A qualitative assessment was undertaken of each option, with the quantitative assessment being scoped out due to lack of significant changes in traffic. Each impact is scored based on the seven-point scale, as detailed in Table 58.

**Table 58. Seven-Point Scale from AQ overarching guidance (TII 2022a)**

Seven Point Scale	Stage 2: Local Air Quality (quantitative)	Stage 2: Index of Overall Change in Exposure (quantitative)
7 – Major or highly positive	Overall significant positive air quality effects are predicted at either human health receptors or sensitive designated habitats.	Negative index value

Seven Point Scale	Stage 2: Local Air Quality (quantitative)	Stage 2: Index of Overall Change in Exposure (quantitative)
6 – Moderately positive	Overall significant positive air quality effects are not predicted at either human health receptors or sensitive designated habitats. However, the option has a higher potential for significant positive effects e.g. moderate impacts at individual receptors.	Negative index value
5 – Minor or slightly positive	Overall significant air quality effects are not predicted at either human health receptors or sensitive designated habitats. Only positive effects that are at worst slight at individual locations are predicted.	Negative index value
4 – Not significant or neutral	Overall significant air quality effects are not predicted at either human health receptors or sensitive designated habitats. Only effects that are Neutral at individual locations are predicted.	Low positive or negative index value (less than 100 for NO <sub>x</sub> and PM <sub>10</sub> )
3 – Minor or slightly negative	Overall significant air quality effects are not predicted at either human health receptors or sensitive designated habitats. Only negative effects that are at worst slight at individual locations are predicted.	Positive index value
2 – Moderately negative	Overall significant air quality effects are not predicted at either human health receptors or sensitive designated habitats. However, the option has a higher risk of significant effects e.g. moderate impacts at individual receptors.	Positive index value
1 – Major or highly negative	Overall significant adverse air quality effects are predicted at either human health receptors or sensitive designated habitats. This would be a showstopper, and mitigation would be required for a scheme/option to progress.	Positive index value

#### 4.7.8.6.2 Existing Environment

##### Sensitive Receptors

The TII guidance (2022a) defines sensitive receptor locations as residential housing, schools, hospitals, places of worship, sports centres and shopping areas, i.e. locations where members of the public are likely to be regularly present. Private residential properties make up the majority of the sensitive receptors in the study area.

In addition to assessing the impact to people as a result of air quality, the impact to sensitive ecosystems must also be assessed as per the TII guidelines (2022a, 2022b). The TII PE-ENV-01106 guidance (2022a) states that sensitive designated ecological sites within 2km of the study area should be identified. However, impacts are localised to ecological sites within 200m of the options or 50m of the source in the case of construction dust emissions (IAQM, 2024). The following designed areas of sensitive ecology are within 2km of the study area:

- Royal Canal pNHA (Site Code : 002103)

## Air Pollution Sources

As part of the implementation of the Air Quality Standards Regulations 2022 (S.I. No. 739 of 2022), as amended, four air quality zones have been defined in Ireland for air quality management and assessment purposes (EPA, 2024). Dublin is defined as Zone A and Cork as Zone B. Zone C is composed of 23 towns with a population of greater than 15,000. The remainder of the country, which represents rural Ireland but also includes all towns with a population of less than 15,000, is defined as Zone D. In terms of air monitoring, the study area is categorised as Zone D (rural areas and towns with a population of less than 15,000).

Air quality monitoring programs have been undertaken throughout Ireland in recent years by the EPA and Local Authorities. The most recent EPA annual report on air quality monitoring undertaken throughout Ireland is entitled "Air Quality in Ireland 2024" (EPA, 2025). The TII PE-ENV-01106 guidelines (2022a) state that the local air quality assessment should focus on NO<sub>2</sub>, PM<sub>10</sub> and PM<sub>2.5</sub> as these are the pollutants of greatest concern with respect to road traffic conditions. A review of data from representative Zone D locations in Ireland was used to provide an indication of the prevailing air quality conditions within the study area. It was found that all locations were below the current EU limit values.

### 4.7.8.6.3 Options

#### Option 1. Double online track. Vertical track lowering and track protection.

The first option follows the current railway corridor (online option) passing under Jackson's Bridge (OBG23). This option requires a 720 mm vertical track lowering at Jackson's Bridge to allow the new double-track pass with enough OHLE clearance under Jackson's Bridge. It also requires a horizontal realignment of the existing track to allow enough space for the new track. This option is situated in close proximity to the Royal Canal pNHA (Site Code: 002103).

During the construction phase the following activities are expected for this option – a magnitude of potential dust emissions has been identified for each activity as per the IAQM guidance (IAQM, 2024):

- **Demolition** – No demolition is required for this option.
- **Excavation** – The proposed option requires earthworks (Cut-24,719 m<sup>3</sup>, Fill-133 m<sup>3</sup>) resulting in dust emissions associated with excavation. The magnitude of potential dust emissions associated with excavation is considered medium.
- **Construction** – To prevent flooding of the tracks, the construction of a bottom slab and side retaining walls is required resulting in dust emissions associated with construction. The magnitude of potential dust emissions associated with construction is considered medium.
- **Road traffic/trackout** – The excavation and retaining wall works would prevent railway service during these activities, resulting in emissions due to additional vehicle kilometres from private car use to replace normal train trips. The magnitude of potential dust emissions is associated with road traffic/trackout is considered medium.

This option would require the construction of a bottom slab and side retaining walls, resulting in resulting in dust emissions associated with construction. However, the construction phase impacts related to construction dust can be mitigated with best practice, in accordance with IAQM Guidance (IAQM 2024). Impacts of this are limited to the construction phase and, as a result of construction dust, can be mitigated.

Without mitigation, Option 1 has a high sensitivity of dust soiling effects, low sensitivity to human health effects and high sensitivity to ecological effects. This is based on the number of sensitive receptors within specific distance bands (0-250m) from the redline boundary within which dust generating activities may occur. However, with mitigation, in line with IAQM Guidance (IAQM 2024), these impacts are considered **not significant**.

There is no potential for significant dust generation during the operational phase. There are no significant adverse impacts induced by the operational phase.

Operational stage impacts due to road, rail traffic and combustion emissions associated with Option 1 have been scoped out as a source of potential significant impact.

- There are 40 no. of high sensitivity receptors within 50m of the proposed Option 1.
- There are no projected changes in traffic associated with Option 1.
- On nearby road links which have the potential to be affected due to rerouting of traffic are below the scoping criteria detailed in Section 7.8.6.1.
- There are no projected speed changes associated with this option.

Therefore, the potential for impact is considered **not significant** and is scoped out.

Overall, no significant air quality effects are not predicted at either human health receptors or sensitive designated habitats. This aligns with the TII score of *Negative and Not Significant (4)*, as per Table 58. The equivalent score under the Transport Appraisal Framework (TAF) Air Quality Scorecard for each option is considered *Neutral*.

All options facilitate the drive to encourage modal shift to public travel by supporting the DART network as it grows from its current 50km in length to over 150km. This assists with the clean air strategy and working towards achieving Directive (EU) 2024/2881 by providing alternatives to private car use.

### **Option 2. Double online track. Bridge deck reconstruction and track protection**

Option 2 follows the current railway corridor (online option) passing under Jackson's Bridge (OBG23), but in this case the aim is to raise the level of the track to minimise the impact on the floodplain. This option includes the demolition and rebuilding the arch of Jackson's Bridge, over which the railway passes. This option is situated in close proximity to the Royal Canal pNHA (Site Code: 002103). However, Option 2 requires the least amount of earthworks as a part of the proposed works.

During the construction phase the following activities are expected for this option – a magnitude of potential dust emissions has been identified for each activity as per the IAQM guidance (IAQM, 2024):

- **Demolition** – the arch of Jackson's Bridge would require demolition to accommodate the double track arrangement proposed as part of this option, resulting in dust emissions associated with demolition. The magnitude of potential dust emissions associated with demolition is considered medium as worst-case.
- **Excavation** – this option requires the least amount of earthworks (Cut-13,197m<sup>3</sup>, Fill-343m<sup>3</sup>) resulting in dust emissions associated with excavation. The magnitude of potential dust emissions associated with excavation is considered medium.
- **Construction** – along with the reconstruction of Jackson's bridge arch this option also requires the construction of a bottom slab and side retaining walls resulting in dust emissions associated with construction. The magnitude of potential dust emissions associated with construction is considered medium.
- **Road traffic/trackout** – the construction works, and excavation activities would prevent railway service as well as bridge reconstruction will impact in the L5041 road that will be closed during the reconstruction works, resulting in emissions due to additional vehicle kilometres from private car use to replace normal train trips. The magnitude of potential dust emissions associated with road traffic/trackout is considered medium.

This option would require the construction of a bottom slab and side retaining walls, resulting in resulting in dust emissions associated with reconstruction. However, the construction phase impacts related to construction dust can be mitigated with best practice, in accordance with IAQM Guidance (IAQM 2024).

This option will require the least amount of additional construction compared to other options. Impacts of this are limited to the construction phase and, as a result of construction dust, can be mitigated.

Without mitigation, Option 2 has a high sensitivity of dust soiling effects, low sensitivity to human health effects and high sensitivity to ecological effects. This is based on the number of sensitive receptors within specific distance bands (0-250m) from the redline boundary within which dust generating activities may occur. However, with mitigation, in line with IAQM Guidance (IAQM 2024), these impacts are considered **not significant**.

There is no potential for significant dust generation during the operational phase. There are no significant adverse impacts induced by the operational phase.

Operational stage impacts due to road, rail traffic and combustion emissions associated with Option 1 have been scoped out as a source of potential significant impact.

- There are 40 no. of high sensitivity receptors within 50m of the proposed Option 2.
- There are no projected changes in traffic associated with Option 2.
- On nearby road links which have the potential to be affected due to rerouting of traffic are below the scoping criteria detailed in Section 7.8.6.1.
- There are no projected speed changes associated with this option.

Therefore, the potential for impact is considered **not significant** and is scoped out.

Overall, no significant air quality effects are not predicted at either human health receptors or sensitive designated habitats. This aligns with the TII score of *Negative and Not Significant (4)*, as per Table 58. The equivalent score under the Transport Appraisal Framework (TAF) Air Quality Scorecard for each option is considered *Neutral*.

All options facilitate the drive to encourage modal shift to public travel by supporting the DART network as it grows from its current 50km in length to over 150km. This assists with the clean air strategy and working towards achieving Directive (EU) 2024/2881 by providing alternatives to private car use.

### Option 3. Double offline track (new alignment) -and L5041 road diversion

Option 3 proposes a new double-track alignment offline of the current railway corridor, avoiding pass under the Jackson's Bridge and the clearances issues. The new railway line crosses the L5041 road south of Jackson's Bridge. This option is situated in close proximity to the Royal Canal pNHA (Site Code: 002103). This option brings the track alignment closer to the nearby high sensitivity human receptors.

During the construction phase the following activities are expected for this option – a magnitude of potential dust emissions has been identified for each activity as per the IAQM guidance (IAQM, 2024):

- **Demolition** – no demolition is required as this option involves the vertical track lowering at Jackson's Bridge to allow the new double-track pass under Jackson's Bridge.
- **Excavation** – this option requires embankments for the construction of the track and diversion of the L5041 which involves earthworks (Cut-17,482m<sup>3</sup>, Fill-183,796m<sup>3</sup>) resulting in dust emissions associated with excavation. The magnitude of potential dust emissions associated with excavation is considered medium.
- **Construction** – this option would require construction of two underpass structures, a new bridge over the new railway line and the Royal Canal, new junction of L5041 with the R148, realignment of the L5041 and the R148 and the two new offline tracks themselves, resulting in dust emissions associated with construction. The magnitude of potential dust emissions associated with construction is considered medium.

- **Road traffic/trackout** – the main construction works are done offline, with a minimum impact in the line operational at the side connections with the current line. No significant additional vehicle kilometres from private car use to replace normal train trips are expected in this option, rail services can be maintained during the construction and earthworks activities for this option. The magnitude of potential dust emissions associated with trackout is considered medium.

Construction of new double-track alignment, two main underpass structures and related activities, result in dust emissions associated with reconstruction. However, the construction phase impacts related to construction dust can be mitigated with best practice, in accordance with IAQM Guidance (IAQM 2024). Impacts of this are limited to the construction phase and, as a result of construction dust, can be mitigated.

Without mitigation, Option 3 has a high sensitivity of dust soiling effects, low sensitivity to human health effects and high sensitivity to ecological effects. This is based on the number of sensitive receptors within specific distance bands (0-250m) from the redline boundary within which dust generating activities may occur. However, with mitigation, in line with IAQM Guidance (IAQM 2024), these impacts are considered **not significant**.

There is no potential for significant dust generation during the operational phase. There are no significant adverse impacts induced by the operational phase.

Operational stage impacts due to road, rail traffic and combustion emissions associated with Option 3 have been scoped out as a source of potential significant impact.

- There are 42 no. of high sensitivity receptors within 50m of the proposed Option 3.
- There are no projected changes in traffic associated with Option 3.
- On nearby road links which have the potential to be affected due to rerouting of traffic are below the scoping criteria detailed in Section 7.8.6.1.
- There are no projected speed changes associated with this option.

Therefore, the potential for impact is considered **not significant** and is scoped out.

Overall, no significant air quality effects are not predicted at either human health receptors or sensitive designated habitats. This aligns with the TII score of *Negative* and *Not Significant (4)*, as per Table 58. The equivalent score under the Transport Appraisal Framework (TAF) Air Quality Scorecard for each option is considered *Neutral*.

All options facilitate the drive to encourage modal shift to public travel by supporting the DART network as it grows from its current 50km in length to over 150km. This assists with the clean air strategy and working towards achieving Directive (EU) 2024/2881 by providing alternatives to private car use.

#### **Option 4: Double offline track (new alignment). Embankment**

Option 4 proposes the same layout as Option 3 but modifies the vertical alignment, raising the level of the tracks so that the L5041 road can pass under the new railway line and the diversion of this road proposed in Option 3 is not necessary. Option 4b proposes that the new railway line pass through the Lyreen River flood area via an embankment and two main underpass UBG22A (30 m span) and UBG22B (46 m span). This option is situated in close proximity to the Royal Canal pNHA (Site Code: 002103). This option brings the track alignment closer to the nearby high sensitivity human receptors.

During the construction phase the following activities are expected for this option – a magnitude of potential dust emissions has been identified for each activity as per the IAQM guidance (IAQM, 2024):

- **Demolition** – no demolition is required as this option involves the vertical track lowering at Jackson's Bridge to allow the new double-track pass under Jackson's Bridge.

- **Excavation** – this option requires embankments for the construction of the track and diversion of the Ballycaghan stream and involves earthworks (Cut-2,224m<sup>3</sup>, Fill-99,875m<sup>3</sup>) resulting in dust emissions associated with excavation. The magnitude of potential dust emissions associated with excavation is considered medium.
- **Construction** – this option would require construction of two underpass structures, a new bridge beneath the L5041 for the Ballycaghan stream diversion, and the two new offline tracks, resulting in dust emissions associated with construction. The magnitude of potential dust emissions associated with construction is considered medium.
- **Road traffic/trackout** – the main construction works are done offline, with a minimum impact in the line operational at the side connections with the current line. No significant additional vehicle kilometres from private car use to replace normal train trips are expected in this option, rail services can be maintained during the construction and earthworks activities for this option. The magnitude of potential dust emissions associated with trackout is considered medium.

This option would require construction of two underpass structures, a new bridge beneath the L5041 for the Ballycaghan stream diversion, and the two new offline tracks themselves, resulting in dust emissions associated with construction. However, the construction phase impacts related to construction dust can be mitigated with best practice, in accordance with IAQM Guidance (IAQM 2024). Impacts of this are limited to the construction phase and, as a result of construction dust, can be mitigated.

Without mitigation, Option 4b has a high sensitivity of dust soiling effects, low sensitivity to human health effects and high sensitivity to ecological effects. This is based on the number of sensitive receptors within specific distance bands (0-250m) from the redline boundary within which dust generating activities may occur. However, with mitigation, in line with IAQM Guidance (IAQM 2024), these impacts are considered **not significant**.

There is no potential for significant dust generation during the operational phase. There are no significant adverse impacts induced by the operational phase.

Operational stage impacts due to road, rail traffic and combustion emissions associated with Option 4b have been scoped out as a source of potential significant impact.

- There are 39 no. of high sensitivity receptors within 50m of the proposed Option 4b.
- There are no projected changes in traffic associated with Option 4b.
- On nearby road links which have the potential to be affected due to rerouting of traffic are below the scoping criteria detailed in Section 4.7.8.6.1.
- There are no projected speed changes associated with this option.

Therefore, the potential for impact is considered **not significant** and is scoped out.

Overall, no significant air quality effects are not predicted at either human health receptors or sensitive designated habitats. This aligns with the TII score of *Negative* and *Not Significant (4)*, as per Table 58. The equivalent score under the Transport Appraisal Framework (TAF) Air Quality Scorecard for each option is considered *Neutral*.

All options facilitate the drive to encourage modal shift to public travel by supporting the DART network as it grows from its current 50km in length to over 150km. This assists with the clean air strategy and working towards achieving Directive (EU) 2024/2881 by providing alternatives to private car use.

#### **Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge**

This option is similar to Options 1 and 2 in its alignment, however it proposes from Ch 91+300 to Ch 91+960 (40 m past Jackson's Bridge), a slab supported by piles is designed to allow water to pass

under the tracks towards the Royal Canal and the railway arch will be removed to allow the railway run. This option is situated in close proximity to the Royal Canal pNHA (Site Code: 002103). However, Option 5 requires the greatest amount of earthworks as compared to other options. This option brings the track alignment closest to the nearby high sensitivity human receptors.

During the construction phase the following activities are expected for this option – a magnitude of potential dust emissions has been identified for each activity as per the IAQM guidance (IAQM, 2024):

- **Demolition** – Jackson’s Bridge will be fully demolished and the bridge deck removed as part of this option, resulting in dust emissions associated with demolition. The magnitude of potential dust emissions associated with demolition is considered medium as worst-case.
- **Excavation** – the proposed option 5 requires the greatest amount of earthworks resulting in dust emissions associated with excavation. The magnitude of potential dust emissions associated with excavation is considered medium.
- **Construction** – this option would require reconstruction of Jackson’s Bridge, construction of the slab track superstructure, embankment, new junction of L5041 with the R148, and realignment of the L5041 and the R148, resulting in dust emissions associated with construction. The magnitude of potential dust emissions is associated with construction is considered medium.
- **Road traffic/trackout** – the construction works, and excavation activities would prevent railway service as well as the diversion of the L5041 road will be impacted during works, resulting in emissions due to additional vehicle kilometres from private car use to replace normal train trips. The magnitude of potential dust emissions associated with road traffic/trackout is considered medium.

This option would require construction of the slab track superstructure, a new roundabout and realignment of the L5041 and the R148, resulting in dust emissions associated with construction. However, the construction phase impacts related to construction dust can be mitigated with best practice, in accordance with IAQM Guidance (IAQM 2024). This option will require the additional construction compared to other options. Impacts of this are limited to the construction phase and, as a result of construction dust, can be mitigated.

Without mitigation, Option 5 has a high sensitivity of dust soiling effects, low sensitivity to human health effects and high sensitivity to ecological effects. This is based on the number of sensitive receptors within specific distance bands (0-250m) from the redline boundary within which dust generating activities may occur. However, with mitigation, in line with IAQM Guidance (IAQM 2024), these impacts are considered **not significant**.

There is no potential for significant dust generation during the operational phase. There are no significant adverse impacts induced by the operational phase.

Operational stage impacts due to road, rail traffic and combustion emissions associated with Option 5 have been scoped out as a source of potential significant impact.

- There are 51 no. of high sensitivity receptors within 50m of the proposed Option 5.
- There are no projected changes in traffic associated with Option 5.
- On nearby road links which have the potential to be affected due to rerouting of traffic are below the scoping criteria detailed in Section 4.7.8.6.1.
- There are no projected speed changes associated with this option.

Therefore, the potential for impact is considered **not significant** and is scoped out.

Overall, no significant air quality effects are not predicted at either human health receptors or sensitive designated habitats. This aligns with the TII score of *Negative and Not Significant (4)*, as per Table 58. The equivalent score under the Transport Appraisal Framework (TAF) Air Quality Scorecard for each option is considered *Neutral*.

All options facilitate the drive to encourage modal shift to public travel by supporting the DART network as it grows from its current 50km in length to over 150km. This assists with the clean air strategy and working towards achieving Directive (EU) 2024/2881 by providing alternatives to private car use.

#### 4.7.8.6.4 Summary Assessment

All options have the same rating due to the lack of potential for significant operational phase impacts. Ranking is based on minor differences in the potential for construction and operational phase dust impacts. However, these impacts can be mitigated and, therefore, do not affect the assessment score. Overall, no significant air quality effects are not predicted at either human health receptors or sensitive designated habitats. This aligns with the TII score of *Negative and Not Significant (4)*, as per Table 59 Seven-Point Scale from AQ overarching guidance (TII 2022a). The equivalent score under the Transport Appraisal Framework (TAF) Air Quality Scorecard for each option is considered *Neutral*.

*Option 2: Double online track. Bridge deck reconstruction and track protection* is the most preferred as it will likely result in the lowest dust emissions of the bridge options. *Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge* is the least preferred option as it will likely result in the highest dust emissions of the bridge options. However, *the impacts related to dust emissions can be mitigated with best practice, in accordance with IAQM Guidance (IAQM 2024)*.

**Table 59. Air Quality Impacts mca Assessment**

Option	Assessment Summary	TII Impact Rating	TAF Impact Scoring
Option 1: Double online track. Vertical track lowering and track protection	With dust mitigation there is no potential for significant effect on air quality.	Not significant or neutral (4)	4 – Neutral Impact
Option 2: Double online track. Bridge deck reconstruction and track protection	With dust mitigation there is no potential for significant effect on air quality.	Not significant or neutral (4)	4 – Neutral Impact
Option 3: Double offline track (new alignment) and L5041 road diversion	With dust mitigation there is no potential for significant effect on air quality.	Not significant or neutral (4)	4 – Neutral Impact
Option 4: Double offline track (new alignment). Embankment	With dust mitigation there is no potential for significant effect on air quality.	Not significant or neutral (4)	4 – Neutral Impact
Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge	With dust mitigation there is no potential for significant effect on air quality.	Not significant or neutral (4)	4 – Neutral Impact

#### 4.7.8.7 Electromagnetic Compatibility

This section provides the appraisal of the five Jackson's Bridge options, under the DART + programme under electromagnetic compatibility.

#### 4.7.8.7.1 Methodology

This assessment looks to examine the electromagnetic compatibility Impact.

The proposed Project will be required to comply with the requirements of the European Directive on Electromagnetic Compatibility (2014/30/EU), and European Standards EN 50121 (Parts 1-5), which address railway Electromagnetic Compatibility (EMC). In addition, all electrical and electronic products placed on the market or taken into service in the European Union must comply with all applicable directives which include the above EMC Directive, the Low Voltage Directive (2014/35/EU) and the Radio Equipment Directive (2014/53/EU). These directives have been transposed into Irish law under the following statutory instruments).

- S.I. No. 145/2016 - European Communities (Electromagnetic Compatibility) Regulations 2016
- S.I. No. 248/2017 - European Union (Radio Equipment) Regulations 2017
- S.I. No. 345/2016 - European Union (Low Voltage Electrical Equipment) Regulations 2016

It is proposed to assess the proposed Project's required compliance in accordance with the above directives and standards in addition to guidelines on limiting exposures to electromagnetic fields as published by the International Commission on Non-Ionising Radiation Protection (ICNIRP) and the EU EMF Recommendation (1999/519/EC) when addressing human health effects.

The Electromagnetic Compatibility Directive (2014/30/EU) and the Radio Equipment Directive (2014/53/EU) do not cover emissions from DC and near DC fields which are also an interference risk to particularly sensitive equipment such as Scanning Electron Microscopes (SEMs) and Magnetic Resonance Imaging (MRI) equipment. Nonetheless an assessment of this type of Electromagnetic Interference (EMI) is included in the scope of the investigation.

Impacts from stray currents arising from the operation of the system will also be mitigated as per European Standard EN 50122-2.

#### 4.7.8.7.2 Options Appraisal

The biggest EMI contributor for the bridge, whichever option is chosen, will be the DC, Quasi-DC and AC harmonic fields associated with the electrification systems for the lines. In addition to this AC fields associated, and RF fields associated with ancillary equipment such as lighting, ticketing, CCTV etc. All bridge options are proposed to be within a rural environment such that any potentially impacts from EMI are evaluated equally regardless of which of the option chosen. The main reason for this is that all the systems and subsystems are required to conform to the applicable European Directives with respect to electromagnetic compatibility and radio equipment.

The baseline environment is a rural one and from an EMI perspective there are very few receptors that have the potential to be impacted from the selection of any of the options aside from transient equipment (tractors, cars etc.) which are not known to be susceptible to the type of electromagnetic radiation generated by this project.

##### **Option 1. Double online track. Vertical track lowering and track protection.**

There are no positive nor negative impacts from an EMI perspective with Option 1. It is assessed as Neutral.

##### **Option 2. Double online track. Bridge deck reconstruction and track protection**

There are no positive nor negative impacts from an EMI perspective with Option 2. It is assessed as Neutral.

##### **Option 3. Double offline track (new alignment) and L5041 road diversion**

There are no positive nor negative impacts from an EMI perspective with Option 3. It is assessed as Neutral.

**Option 4: Double offline track (new alignment). Embankment**

There are no positive nor negative impacts from an EMI perspective with Option 4. It is assessed as Neutral.

**Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge**

There are no positive nor negative impacts from an EMI perspective with Option 5. It is assessed as Neutral.

## 4.7.8.7.3 Summary Assessment

**Table 60. Electromagnetic Compatibility Impacts mca Assessment**

Option	TAF Impact Scoring on Electromagnetic Compatibility
<b>Option 1: Double online track. Vertical track lowering and track protection</b>	4 – Neutral Impact
<b>Option 2: Double online track. Bridge deck reconstruction and track protection</b>	4 – Neutral Impact
<b>Option 3: Double offline track (new alignment) and L5041 road diversion</b>	4 – Neutral Impact
<b>Option 4: Double offline track (new alignment). Embankment</b>	4 – Neutral Impact
<b>Option 5: Double online track. Jackson's Bridge demolition and new L5041 bridge</b>	4 – Neutral Impact

## 4.7.8.8 Local Environment Summary Assessment

**Table 61. Local Environmental Impacts mca Stage 1 Assessment table**

Option	TAF Impact Scoring on Local Environment						
	Biodiversity	Water Resources	Landscape and Visual Quality	Cultural and Heritage	Noise and Vibration	Air Quality	Electro-magnetic Compatibility
Option 1: Double online track. Vertical track lowering and track protection.	3 – Slightly Negative Impact	1 – Highly Negative Impact	4 – Neutral Impact	3 – Slightly Negative Impact	2 – Negative Impact	4 – Neutral Impact	4 – Neutral Impact
Option 2: Double online track. Bridge deck reconstruction and track protection	3 – Slightly Negative Impact	1 – Highly Negative Impact	3 – Slightly Negative Impact	2 – Negative Impact	2 – Negative Impact	4 – Neutral Impact	4 – Neutral Impact
Option 3: Double offline track (new alignment) and L5041 road diversion)	2 – Negative Impact	2 – Negative Impact	1 – Highly Negative Impact	3 – Slightly Negative Impact	3 – Slightly Negative Impact	4 – Neutral Impact	4 – Neutral Impact

Option	TAF Impact Scoring on Local Environment						
	Biodiversity	Water Resources	Landscape and Visual Quality	Cultural and Heritage	Noise and Vibration	Air Quality	Electro-magnetic Compatibility
Option 4: Double offline track (new alignment). Embankment	2 – Negative Impact	2 – Negative Impact	2 – Negative Impact	2 – Negative Impact	3 – Slightly Negative Impact	4 – Neutral Impact	4 – Neutral Impact
Option 5: Double online track. New L5041 bridge	2 – Negative Impact	3 – Slightly Negative Impact	1 – Highly Negative Impact	1 – Highly Negative Impact	2 – Negative Impact	4 – Neutral Impact	4 – Neutral Impact

#### 4.7.9 Multi-criteria Analysis Summary

The matrix with the details of the multi-criteria analysis of all the options is included in Annex B. A summary table of the assessment is presented in Table 62 below.

**Table 62. Jackson’s Bridge mca Stage 1 summary**

		Option 1	Option 2	Option 3	Option 4	Option 5
1	Transport User Benefits and Other Economic Impacts	4 – Neutral Impact				
2	Accessibility Impacts	4 – Neutral Impact				
3	Social Impacts	4 – Neutral Impact				
4	Land Use Impacts	4 – Neutral Impact	3 – Slightly Negative Impact	3 – Slightly Negative Impact	2 – Negative Impact	3 – Slightly Negative Impact
5	Safety Impacts	3 – Slightly Negative Impact	3 – Slightly Negative Impact	5 – Slightly Positive Impact	5 – Slightly Positive Impact	3 – Slightly Negative Impact
6	Climate Change Impacts	3 – Slightly Negative Impact	3 – Slightly Negative Impact	4 – Neutral Impact	4 – Neutral Impact	4 – Neutral Impact
7	Local Environment Impacts	3 – Slightly Negative Impact				

## 4.8 Conclusions

From the results of the multi-criteria analysis, it becomes evident that option 3 is the one that rates better, hence that the project proposes as preferred option for this location.

Moreover, the alignment for the road diversion presented as part of the scheme has been presented and agreed upon with Kildare County Council.

## 5 New Kilcock Substation

The “*DART-DEP-006-RP-IDOM-EE-0001 Traction Power Modelling -New Depot Location*” report determined the requirement for one electrical substation in Kilcock for the electrical supply of the new electrification from the end of the DART+ West (as approved) to the access to the new Depot west of Kilcock.

This section presents the justification of the preferred location for the new substation needed as part of the scheme.

The following factor has been taken into account when identifying potential locations for this facility:

- Maximum distance of 6.7 Km from Maynooth Substation (as per above mentioned traction power report)

To determine the preferred location, two potential options were analysed.

The drawings with the layout of both alternatives are included in the Annex C.

### 5.1 Alternative 1. West of Kilcock Station

The Alternative 1 is located west of Kilcock Station, in the area between the Royal Canal and the railway. This area is adjacent to the new siding for Kilcock Station.

The distance between this location and Maynooth substation is 6.5 Km, within the maximum distance requirements, but close to its maximum limit.

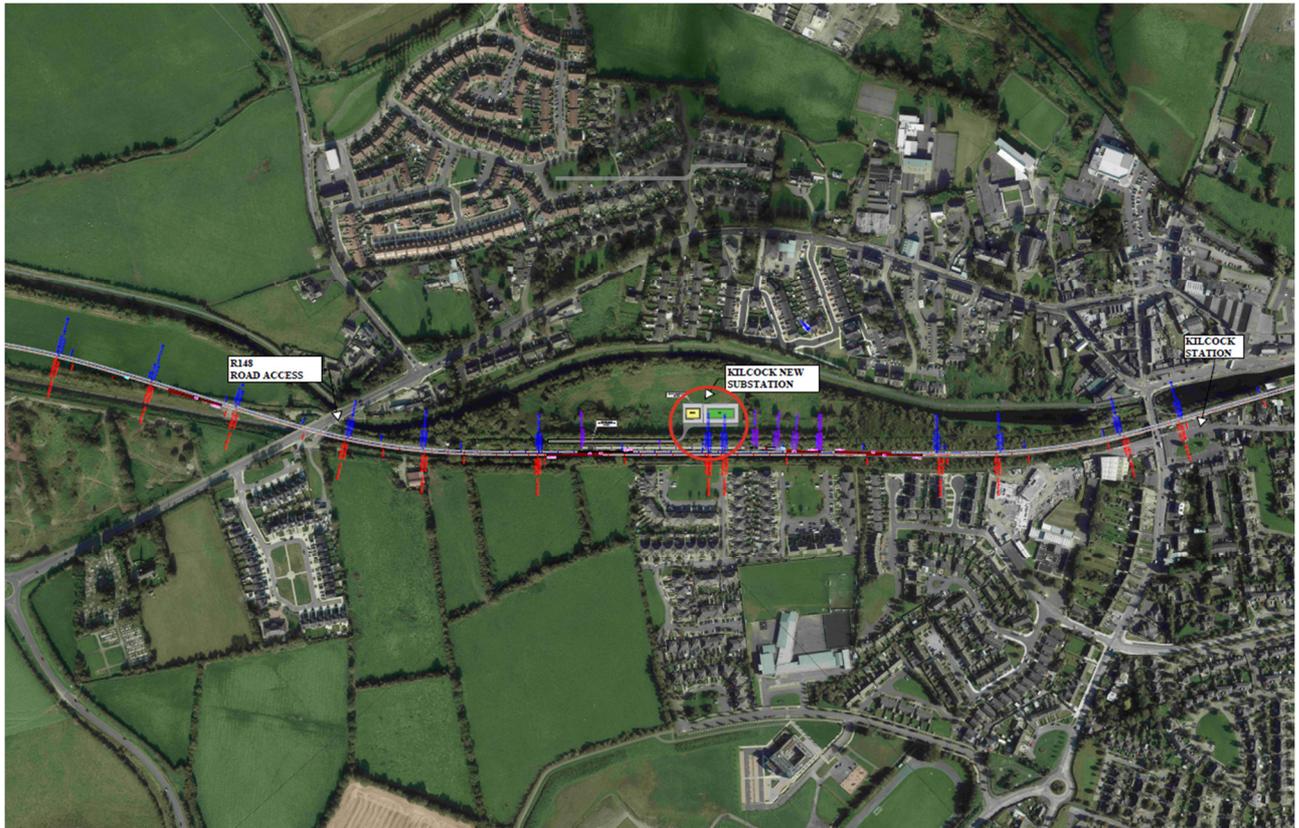


Figure 46. Kilcock Substation Option 1 Layout

Access to the substation is from Allen Bridge (OBG26) located on the R148 road, via an existing road that will need to be upgraded and widened to 5 metres in width.

### 5.2 Alternative 2. East of Kilcock (Branganstown)

The Alternative 2 is located East of Kilcock, in the Branganstown townland. The ESB and substation buildings are positioned parallel to the tracks.

The distance between this location and Maynooth substation is 4,8 Km, within the maximum distance requirements.

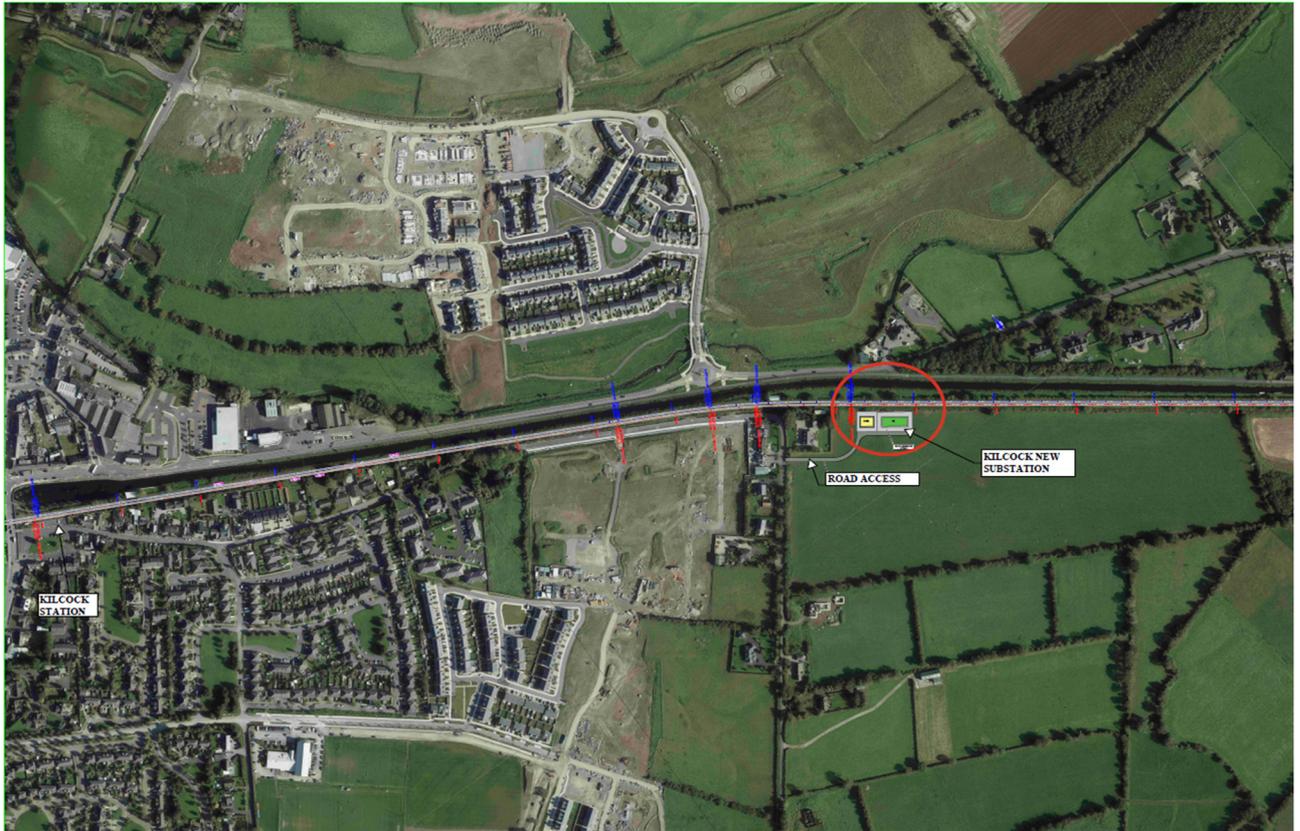


Figure 47. Kilcock Substation Option 2 Layout

Access to the substation is from Brangastown Rd, in an expanding residential area. Note the presence of a recorded monument close to the substation and access road.

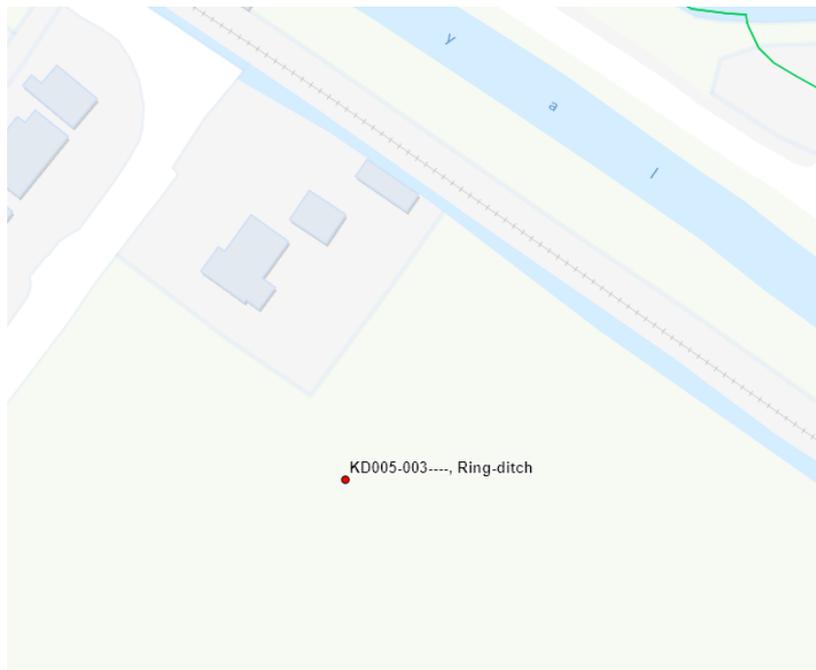


Figure 48. Kilcock Substation Option 2 recorded monument

### 5.3 Preferred Option

The Alternative 1 has comparative advantages over the Alternative 2.

#### *Accessibility Impact:*

The impact on accessibility is expected to be greater during the construction phase of the substation than during the operational phase, when access to the substation will be limited to maintenance and inspection work.

Alternative 1 has a lower impact on accessibility as it is located in an area far from residential properties, with a service road from the R148 (Shaw's Bridge) that does not disturb the urban environment.

In contrast, Alternative 2 is accessed from Branganstown Street, near a residential property in a recently developed area.

#### *Zoned land, land use planning and spatial planning:*

Alternative 1 is partially located on existing IE lands: The lands are zoned F2 open space and amenity. Despite this, utility structures are listed as open for consideration in the analysis. There is also an objective to provide a pedestrian / cycle path through the lands.

Alternative 2 is located in zoned lands under the Kildare County Development Plan (CDP) 2023-2029. Such lands are deemed to be 'primarily agriculture' but other uses may be considered on their merits. The site is adjoining the Grand Canal proposed NHA and a recorded monument.

#### *Biodiversity:*

Alternative 1 is in a more natural area between the railway line and the canal. This alternative does not impact in the Royal Canal pNHA.

Alternative 2 is in a field but closer to the canal. This alternative does not impact in the Royal Canal pNHA.

#### *Cultural Heritage:*

MH Planning noted presence of a recorded monument near Alternative 2.

#### *Noise and vibration:*

Alternative 2 is close to a residential property and a newly developed residential area.

In light of all the points above, alternative 1 is considered the best option for the new substation give that:

- It is located far from any residential property, unlike alternative 1.
- It is partially located on existing IE lands, zoned F2 open space and amenity with utility structures listed as open for consideration.
- It does not impact the Royal Canal pNHA.
- Does not have any recorded monument nearby, unlike alternative 2.
- Its construction will have minor impact on residential properties than the alternative, unlike alternative 2.

## 6 Kilcock Station

The proposed works to the existing Kilcock Station entail twin tracking, the construction of a new northern platform to serve the additional track, and the relocation of the existing station's platform east of Shaw's Bridge (OBG25). The existing southern platform will be relocated approximately 120 metres towards the east.

The preferred station platforms' location was selected following an optioneering process and a multi-criteria analysis carried out in line with the Transport Appraisal Framework Guidelines. Details of this

assessment are included in Appendix E of the Project Report, “Kilcock Station Options Selection Report”.

The current station entrance will be retained, and the track alignment will be adjusted under Shaw’s Bridge to facilitate the twin-tracking without impacting the bridge. The platforms will be up to 3 metres wide. The Preferred Option will include a pedestrian access bridge which will be erected above the tracks. The bridge will include lifts to provide access for all with various mobility needs.



**Figure 49. New footbridge at Kilcock Station to provide access to the new northern platform**

The southern platform of the proposed station will connect directly with the access point to the car park to minimise walking distance for passengers. To facilitate the construction of the new platforms to the east, the existing Kilcock Canoe Polo Club will be impacted, requiring further consideration as part of the ongoing design process.

New crossovers, west and east of the station platforms, will be necessary to allow the movement of trains in all necessary configurations, as Kilcock Station will serve as a terminus station once the project is implemented. A new siding, approximately 450 metres to the west will be provided to allow the necessary turn-back movements.

It is also proposed to provide additional car and bicycle parking at Kilcock Station, as shown in **¡Error! No se encuentra el origen de la referencia.** and **¡Error! No se encuentra el origen de la referencia.** below.

Discussion with the Heritage Office of Kildare County Council is on going to relocate the Market Cross placed on the Fair Green to facilitate the scheme proposal.

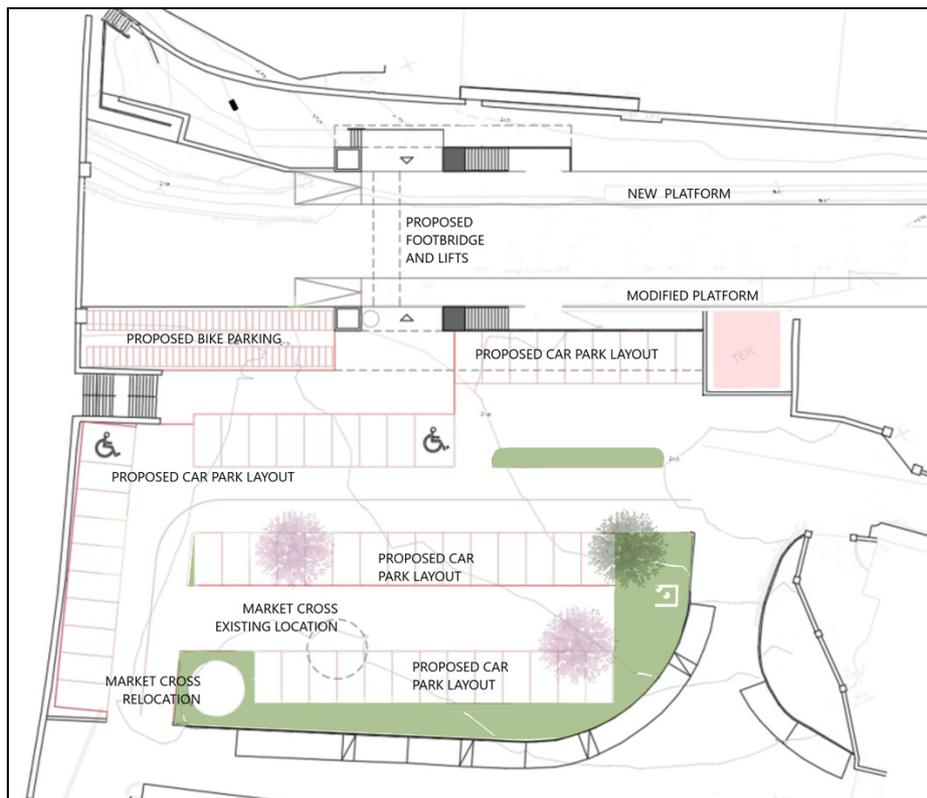


Figure 50. Plan scheme of the Proposed Footbridge and lifts and the Car Park layout at Kilcock Station



Figure 51. Additional car park spaces at Kilcock Station

## 7 Allen Bridge (OBG26) reconstruction

The alignment in the vicinity of Allen Bridge (OBG 26) West of Kilcock has been adjusted to locate the second track and the overhead line equipment. Given the existing narrow section, it was not possible to maintain the existing abutments, forcing the project to demolish the existing structure (which consist of two adjacent structures, and construct a new one.

The constraints East and West of the bridge, together with the limited OHLE clearance existing today, resulted in a sole solution, that which limits the track lowering (and associated earthworks), the height of the needed walls, the width of the new structure, and the acquisition of lands on the western side of the bridge. No optioneering was done, because there was no other option than the one proposed.

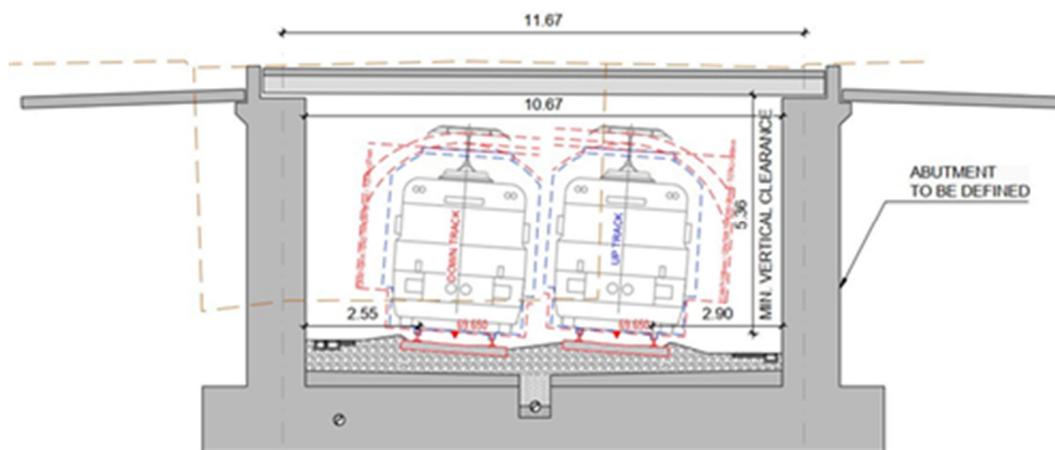


Figure 52. Cross section for the new OBG26

The construction methodology will be such that will allow the traffic to be maintained on the road (R148) for the whole duration of the works. Discussion with Kilcare County Council on this matter will continue as the design evolves.

## 8 Construction Compounds

A number of temporary compounds are required along the length of the project. These are generally located adjacent to the site of the individual infrastructure elements being constructed, such as the station, the works around Jackson's Bridge, the substation, and other minor interventions. For these locations, the least disruptive options have been selected.

Alongside the localised compounds, two multi-disciplinary sites have been identified to serve the linear works along the section of track between Maynooth and the entrance to the depot. The location of these two sites is based on key requirements: direct access to the track, proximity to suitable road access, and sufficient distance from residential areas. Due to the limited number of viable alternatives and the evident suitability of both locations for operational and environmental reasons, a formal multi-criteria analysis was not deemed necessary.

Their locations are summarised in the table below, and shown on the Scheme Drawings in Appendix A. The Construction methodology will determine the exact dimensions and sufficiency of these locations as the design evolves.

Table 63. Proposed Temporary Construction Compound Locations

Function	Locations
Multi-disciplinary (for linear works, Permanent Way and Systems)	Labaghbryan East, and Boycetown townlands
Station	Kilcock Station
SET	Branganstown townland and at Kilcock Station
Roads and Structures	Labaghbryan East, Treadstown, and Boycetown townlands
Substation	Kilcock
Depot	Boycetown townland

The compounds for the Station, the SET buildings, the road diversion, and the substation are located in close proximity of the elements they serve to.

The two multi-disciplinary compounds that are to be used for the linear works are located at both ends of the scheme to provide an efficient access to the line and limit the need for unproductive track possessions, and locations where the impact on properties is limited.

## ANNEX A. JACKSON'S BRIDGE DRAWINGS

Document	Description	Sheets
DART-DEP-005-DR-IDOM-CE-0001	Alternative 1 Layout (railway)	1
DART-DEP-005-DR-IDOM-CE-0002	Alternative 1 Longitudinal Profile (railway)	2
DART-DEP-005-DR-IDOM-CE-0003	Alternative 1 Cross Sections (railway)	1
DART-DEP-005-DR-IDOM-CE-0020	Alternative 2 Layout (railway)	1
DART-DEP-005-DR-IDOM-CE-0021	Alternative 2 Longitudinal Profile (railway)	2
DART-DEP-005-DR-IDOM-CE-0022	Alternative 2 Cross Sections (railway)	1
DART-DEP-005-DR-IDOM-CE-0030	Alternative 3 Layout (railway and L5041 road diversion)	1
DART-DEP-005-DR-IDOM-CE-0031	Alternative 3 Longitudinal Profile (railway and L5041 road diversion)	4
DART-DEP-005-DR-IDOM-CE-0032	Alternative 3 Cross Sections (railway and L5041 road diversion)	2
DART-DEP-005-DR-IDOM-CE-0040	Alternative 4 Layout (railway)	1
DART-DEP-005-DR-IDOM-CE-0041	Alternative 4 Longitudinal Profile (railway)	2
DART-DEP-005-DR-IDOM-CE-0042	Alternative 4 Cross Sections (railway)	1
DART-DEP-005-DR-IDOM-CE-0050	Alternative 5 Layout (railway and L5041 road diversion)	1
DART-DEP-005-DR-IDOM-CE-0051	Alternative 5 Longitudinal Profile (railway and L5041 road diversion)	4
DART-DEP-005-DR-IDOM-CE-0052	Alternative 5 Cross Sections (railway and L5041 road diversion)	2

## **ANNEX B. JACKSON'S BRIDGE MULTI-CRITERIA ANALYSIS MATRIX**

The following Matrix shows the detailed assessment for every sub-criteria as part of the multi-criteria analysis for the alternatives considered for Jackson's Bridge.

## ANNEX C. NEW KILCOCK SUBSTATION DRAWINGS

Document	Description	Sheets
DART-DEP-005-DR-IDOM-CE-0400	Alternative 1 Layout	1
DART-DEP-005-DR-IDOM-CE-0500	Alternative 2 Layout	1