



ANNEX 3.2

Technical Optioneering Report:
Electrification of the Northern Line
between Malahide and Drogheda

SECTION G

User worked level crossing south
of Donabate

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Appendices

A1 – Detailed MCA Table

Abbreviations

Abbreviation	Definition
AEP	Annual Exceedance Probability
CAF	Common assessment framework
CRR	Commission for railway regulations
EPA	Environmental Protection Agency
FRAM	Flood Risk Assessment and Management
GSI	Geological Survey of Ireland
MCA	Multi-criteria analysis
NIAH	National Inventory of Architectural Heritage
NPWS	National Parks & Wildlife Service
OHLE	Overhead line equipment
OLE	Overhead line electrification
OPW	Office of Public Works
pNHA	Proposed Natural Heritage Area
SAC	Special Area of Conservation
SPA	Special Protected Area
TSS	Train Service Specification
TSS	Traction Substation Study
WFD	Water Framework Directive

1 Introduction

The purpose of the report is to provide the technical input to the Preliminary Option Selection Report. This report provides the technical assessment of the user worked level crossing south of Donabate, from option selection through to the Draft Emerging Preferred Option, including the options considered and how a Draft Emerging Preferred Option was chosen.

The report includes:

- An introduction and description of the study;
- A summary of the option assessment approach undertaken;
- A description of the existing situation;
- The requirements;
- The relevant constraints;
- The option assessment containing:
 - Longlist of options;
 - Sifting of longlist of options;
 - Summary and details of the shortlisted options;
 - Multi-criteria analysis (MCA);
- The Draft Emerging Preferred Option.

1.1 Packages of work

The scope of work for DART+ Coastal North covers a wide range of interventions on the Northern Line needed in order to meet the Train Service Specification (TSS) requirements. To appropriately assess options against each other, the works have been split into separate work packages, as summarised within the separate Technical Annexes. Where appropriate, the Annexes have then been further split down into ‘sections’ which define the system which has been subject to the optioneering and design process.

This document is a Section of Annex 3.2 Technical Report for the Electrification of the Northern Line between Malahide and Drogheda. Please refer to Table 1-1 for a list of the different Sections which make up the electrification Annex.

This document contains an overview of the optioneering process for the user worked level crossing located close the Malahide Estuary south of Donabate. Intervention to the current crossing is considered due to an increase in the perceived risk from electrification of the railway line and greater frequency of trains.

Table 1-1: Sections within Annex 3.2: Electrification of the Northern Line between Malahide and Drogheda

Annex	Section	Title
3.2	A	OHLE system
	B	OHLE foundation solution
	C	OHLE foundation solution at underbridges
	D	Bridge parapet modifications
	E	OHLE Bridge Clearance works
	F	Traction Power Supply (will form part of Public Consultation 2)
	G	User worked level crossing south of Donabate
	H	Fencing and lineside safety

1.2 References

This report should be read in conjunction with the following related optioneering reports:

Table 1-2: List of key documents associated with this report

Annex	Title	Description
N/A	DART+ Coastal North Preliminary Option Selection Report	This is the main report which summarises the optioneering process and the different packages of proposed works on the DART+ Coastal North project.
N/A	DART+ Coastal North Preliminary Option Selection Report – Executive Summary	This report summarises the main Preliminary Option Selection Report.
1	Emerging Preferred Option Maps	Includes drawings for each Emerging Preferred Option, to support the Preliminary Option Selection Report.
2.1	Policy Context	This presents a detailed review of the European, National, Regional and Local policy context for the DART+ Programme and the DART+ Coastal North Project
2.2	Useful Links	Useful links to documents/websites relating to the DART+ Coastal North project.
3.1	Constraints Report	This report reviews the DART+ Coastal North constraints.
3.2	Technical Optioneering Report: Electrification of the Northern Line between Malahide and Drogheda.	The Technical Optioneering Report for the Electrification of the Northern Line between Malahide and Drogheda. The report is divided into a series of sections, as described in Table 1.
3.3	Technical Optioneering Report: Works around Drogheda MacBride Station	The Technical Optioneering Report for Works around Drogheda MacBride Station. The report addresses track and station modifications to allow for the increased number of DART services.
3.4	Technical Optioneering Report: Works around Malahide Station	The Technical Optioneering Report for Works around Malahide Station. The report addresses track modifications required to allow trains to be turned back clear of through running services.

Annex	Title	Description
3.5	Technical Optioneering Report: Works around Clongriffin Station	The Technical Optioneering Report for Works around Clongriffin Station. The report addresses track modifications required to allow trains to be turned back clear of through running services.
3.6	Technical Optioneering Report: Works around Howth Junction & Donaghmede Station	The Technical Optioneering Report for Works around Howth Junction & Donaghmede Station. The report addresses the addition of tracks to allow a higher frequency shuttle service.
3.7	Technical Optioneering Report: Howth Branch Level Crossings	The Technical Optioneering Report for the Howth Branch Level Crossings. The report addresses the impacts of all proposed increases in train frequency on existing level crossings on the Howth Branch.

1.3 Option Assessment Approach

The works proposed at Malahide have been assessed using the Department of Transport’s Common Appraisal Framework for Transport Projects and Programmes (CAF) as the options have the potential to be geographically different from each other and have a material difference on external parties or the environment. Further details can be found in the Option Selection Process section of the North Preliminary Option Selection Report.

2 Existing Situation

2.1 Overview

The level crossing is located south of Donabate, close to the Malahide Estuary. It is defined as a user worked crossing, connecting farmlands either side of the trainline. The level crossing's asset I.D is XB001.



Figure 2-1: Location of level crossing (XB001) in relation to Malahide and Donabate Station (Source: OSI aerial mapping)



Figure 2-2: Location of level crossing (XB001) (Source: OSI aerial mapping)



Figure 2-3: View looking south from level crossing, towards Malahide



Figure 2-4: View looking north from level crossing, towards Corballis Cottages



Figure 2-5: View looking southeast from level crossing, towards Malahide Estuary and agricultural land



Figure 2-6: East gate to crossing



Figure 2-7: West gate to crossing



Figure 2-8: Existing User Worked Crossing signage

2.2 Structures

There is one existing structure associated with the level crossing. This is a tidal outflow underbridge (reference UBB31) located north of the level crossing, as shown in Figure 2-9: UBB31 upstream, West elevation (source: Bridge Scour Inspection Survey Report, Murphy Surveys 2020).



Figure 2-9: UBB31 upstream, West elevation (source: Bridge Scour Inspection Survey Report, Murphy Surveys 2020)



Figure 2-10: UBB31 downstream, East elevation (source: Bridge Scour Inspection Survey Report, Murphy Surveys 2020)

2.3 Permanent Ways

The railway consists of two lines, the Up Main to Dublin and the Down Main to Drogheda. The line speed on both is 90Mph. It is currently un-electrified.

Signalling is controlled from North East CTC at Connolly

2.4 Ground Conditions

Historic mapping (1837) shows that the area was initially agricultural fields and indicates an embankment to cater for the Dublin-Drogheda railway line which was under construction.

Geological Survey Ireland (GSI) Quaternary sediment mapping indicates that the site is founded on an embankment over Irish sea till derived from Lower Palaeozoic sandstones and shales and estuarine silts and clays on both the eastern and western side of the site.

GSI mapping shows that the site is underlain by argillaceous bioclastic limestone, shale of the Malahide formation and the bedrock depth is in the range of 3 to 5m. There are no significant karst features identified near the site.

EPA (Environmental Protection Agency) river network mapping indicates that River Pill is located to the north of the site.

There is very limited historic ground investigations information available for this location which indicates the existing ground conditions at the site to comprise reclaimed land constituting of silts, glacial tills and gravels respectively.



Figure 2-11: Site Location (© OpenStreetMap)

2.5 Environmental

The existing level crossing links agricultural land on the eastern side of the railway line to approx. 5.5ha of grassland on the western side and is located at the northern end of Malahide Estuary.

The River Pill discharges to the estuary just north of the level crossing, running under the railway line. The Malahide Estuary is designated as both a Special Protection Area (SPA), Special Area of Conservation (SAC) and a proposed Natural Heritage Area (pNHA) in this area.

There is no significant development in the area, with the nearest development being approximately 500m away, including commercial and residential development.

A brief overview of the baseline environment, under key environmental criteria, is provided in the following sections.

2.5.1 Traffic and Transportation

Access to the site is provided through farmland towards the west of the rail line. The farmland is accessible via local roads. The nearest road link of regional importance is the R126 to the west, which links with Junction 4 on the M1.

A planned walkway and cycleway across Broadmeadow Estuary have been granted planning permission. The Broadmeadow Way forms part of the Fingal Coastal

Way, the NTA's Greater Dublin Area Cycle Network and East Coast Trail. It is funded by the NTA and Fingal County Council and construction is set to take place between 2022 and 2023. The route will run alongside the westside of the railway line, currently crossing the estuary and will include a 280 meters long bridge on the railway viaduct.

2.5.2 Landscape and visual impact

The rail line in this location runs on an embankment between farmland to the west and the estuary to the east. Sections of the rail line embankment are covered with areas of scrub planting. The level crossing provides access to a small area of farmland (circa 5 to 5.5ha.) that projects into the estuary east of the railway line. The level crossing is located in broadly flat, visually open lands adjacent to the estuary. The lands around the level crossing are zoned High Amenity and there is an objective to preserve views along Corballis Cottages Road east of the railway line (as noted on Sheet No. 7 of the Fingal County Council Development Plan).

2.5.3 Archaeological and cultural heritage

From an archaeological perspective, Malahide has been the focus for settlement activity for thousands of years, as evidenced by the Mesolithic and Neolithic flint scatters in the area. The village itself was based around a Viking landing point, which survived from the eighth century until the arrival of the Anglo-Normans. Malahide Castle (DU012:030) was built by Sir Richard Talbot, who was granted land here in 1176, and the castle remained in the family until the 1970s. The church (DU012:031) beside the castle is fifteenth or sixteenth century in date. The village continued as a fishing port and was also the site of several silk and poplin mills. The building of the Dublin to Drogheda railway viaduct in 1844 was largely responsible for the decline and eventual disappearance of the fishing fleet (Bennett 1991) at Malahide. The railway was also fundamental to the growth and development of Donabate and to the siting of St Ita's Hospital at Portrane. The railway infrastructure is an important aspect of the industrial past and contributes in a positive manner to the historic character of the coastal environment.

The railway runs through the Malahide and Rogerstown Estuaries on a viaduct (a protected structure (RPS No. 420 and 516) and resulted in the land being reclaimed from estuarial waters. The building of an embankment most likely led to a silting over of historic passes in the estuary. Rocque's map of Dublin (1756) shows the estuary's oyster beds, which were removed by the railway viaduct less than a hundred years later.

The earliest evidence of human activity in the form of two Bann flint flakes and a flint blade in Kilcrea townland (located to the west of the viaduct) dates to the late Mesolithic period (9000 BC-4000 BC) (NMI file no. (1967:182-184). Flint artefacts are evidence that the coast was exploited during prehistory. The process of change, alluvial deposition and coastal erosion can result in archaeological remains and the preservation of organic structures such as wood being buried under the silts and mud flats, masking features such as trackways, causeways, jetties and fishtraps as well as artefacts.

2.5.4 Architectural heritage

The lands to the south of Corballis Cottages were in open agricultural use, prior to the construction of the Dublin and Drogheda Railway which opened on 24 May 1844. The railway would eventually extend to link Dublin to Belfast with the completion of the Boyne crossing in 1855, merging to form the Great Northern Railway of Ireland (GNR(I)) in 1876, and operated by Iarnród Éireann since 1987. A level crossing had been established by 1907, to access the land on the east of the tracks as noted on the Ordnance Survey maps from this date. Following the construction of the railway, the area remained in agricultural use.

One protected structure was identified in the vicinity of the level crossing. This is the railway bridge over Corballis Cottages (FCC RPS 0502). The bridge is also included in the NIAH (NIAH 11336027) where it is rated of regional importance for reasons of architectural and technical interest.

No other features of built-heritage interest have been identified as part of the preliminary desk-based baseline review. The area is not included in an Architectural Conservation Area or a Conservation Area.

2.5.5 Noise and Vibration

The acoustic environment in the area of the level crossing will include noise from train passbys, as well as noise from agricultural activity from farmland to the west, and natural sounds (e.g. birds, wind, etc.) from the estuary to the east. Train passbys are expected to be the dominant noise source at the site, although intermittent. Freight trains are expected to have a higher level of noise than passenger trains.

Further information will become available once a site survey has been undertaken.

2.5.6 Air Quality and climate

Due to the rural location of the level crossing, the air quality in the area is considered to be very good.

2.5.7 Agricultural

The grassland to the east of the crossing is being used by folio DN6626 which is a beef farm located on the western side of the railway line. The land to the west of the railway line is medium quality and from examination of aerial photography on the Geohive¹ website from 2000, 2005, 2005-2012 and 2013 – 2018 this land has been used continuously for grassland.

2.5.8 Geology and Soils

As highlighted in Section 2.4, the expected ground conditions at the study area constitute reclaimed land of silts, glacial tills and gravels respectively.

¹ <http://map.geohive.ie/>

The Corine Land Cover 2018 categorises the land use in the area as coastal wetlands with intertidal flats.

2.5.9 Water resources

The site is within the Turvey_010 river sub basin which is in the Ballough Stream_SC_010 sub-catchment. The River Pill (Turvey_010) flows underneath the railway line 35m north of the crossing and discharges to Malahide Bay coastal waterbody (IE_EA_060_0000). No other surface water features have been identified at the site area.

Under the Water Framework Directive (WFD, 2000/60/EC) the “Ecological Status” of the Malahide Bay coastal water body is classified as Moderate for the 2013-2018 monitoring cycle and At Risk, indicating that the waterbody may not maintain or achieve that status on the next WFD cycle. The minimum objectives for a water body under the WFD are to achieve at least ‘Good’ status (or ‘Good potential’ for artificial/ highly modified water bodies), and no deterioration of existing status. The ecological status for the Turvey_010 river waterbody is unassigned.

The site is underlain by Dinantian Lower Impure Limestone which is part of the Malahide Formation. The aquifer is classified as a ‘Locally Important’ (LI) aquifer which is ‘Moderately Productive’ only in Local Zones. The groundwater vulnerability at the site is classified as low.

There are no high yielding water supply springs and wells i.e. public water supplies or group water scheme supplies within the site. No ‘Source Protection Zones’ associated with public or group groundwater supply schemes are located with the site.

The study area lies within the Swords groundwater body (IE_EA_G_011). The Swords groundwater body is currently at ‘Good’ WFD Status for the 2013-2018 monitoring cycle and currently ‘Not at Risk’ with regard to achieving its WFD objectives.

Historical flooding has been assessed by examining reports and maps from the Office of Public Work’s (OPW) National Flood Hazard mapping. There are no records of flood events within the site area. The risk of coastal flooding at Malahide Bay has been assessed and mapped by the OPW as part of the Fingal East Meath Flood Risk Assessment and Management (FRAM) study. According to the OPW predictive flood maps (floodinfo.ie), the site is located adjacent to areas at risk of tidal and fluvial flooding. The predicted level during the 0.5% Annual Exceedance Probability (AEP) event near the site is 3.18mOD, with the 1% AEP fluvial event flood level from River Pill at 1.25mOD.

2.5.10 Biodiversity

The works location is set adjacent to the estuarine environment of the Broadmeadow estuary, on the northern side of the estuary, south of Donabate.

The Broadmeadow estuary is designated as a Special Area of Conservation (SAC), a Special Protection Area (SPA) and a proposed Natural Heritage Area (pNHA), as

indicated in Figure 2-12: below. The land directly to the east of the railway line is also part of the Malahide Estuary SPA.

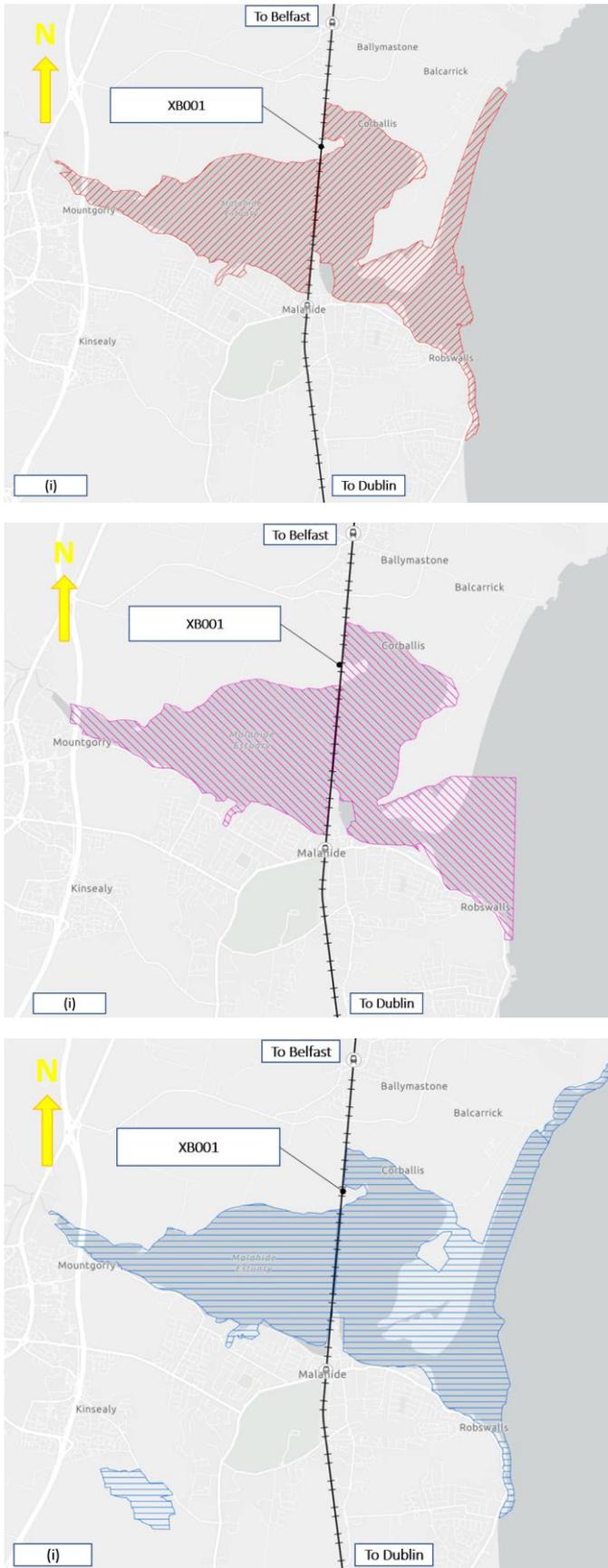


Figure 2-12: Malahide estuary extents of (i) SAC (ii) SPA and (iii) pNHA

2.6 Utilities

Utility records have been gathered from the utility providers in the area. The following utility companies have infrastructure within the area of interest:

- Eir;
- BT Ireland;
- Lineside cables running parallel along the length of the railway line.

All utility records should be considered indicative only and must be verified prior to any intrusive works occurring. There are no utility crossings in the area around the level crossing.



Figure 2-13: Location of utilities close to level crossing XB001

3 Requirements

The current requirement of the crossing is to provide the only means of access to a number of fields in the area. Access is required/used for the following:

- Farming
- Maintenance of drainage ditches
- Maintenance of coastal defences/causeway
- Vegetation management

With the project requirement to electrify the Northern Line from Malahide to Drogheda, mitigation solutions will need to be implemented to reduce the risk to traffic and users due to:

1. Increased train traffic – Train traffic is to increase by approximately 200%
2. Hazards related to electrification

3.1 Specific Requirements

There are no specific requirements relating to crossing opening times i.e. the availability to cross. However, farm machinery likely to use the crossing will potentially require longer to cross and could pose risks to train traffic unless strict procedures are followed for slow moving vehicles. Machine operators are required to follow the procedures regarding crossing, including assuring the safe clearance height.

3.2 Systems Infrastructure and Integration

As this is a level crossing to access farmland, the road traffic levels are sparse and amount to few or no crossings per day. During the hours of peak traffic, trains will pass the location on average every 3-4 minutes meaning that opportunities to use the level crossing that do not affect train traffic are limited.

The standard design for level crossings currently includes automatic barriers operated by the approaching train with CCTV (Closed circuit television) monitoring from the central traffic control located near Connolly station. Such crossing designs are specifically for public roads to protect both vehicular and pedestrian traffic but are carefully designed to minimise impact on the train service by ensuring that the barriers are down well before the arrival of the train to avoid having to reduce train speed on approach.

Even so, level crossings are not preferred in high rail traffic areas due to the increasing risk of conflict between the road traffic users and trains where there are short opening times and long waits in between.

3.3 Design Standards

The Commission for Rail Regulation (CRR) guidelines recommend, but do not require, closure due to electrification.

4 Constraints

Relevant constraints are listed within this section, under relevant headings.

4.1 Technical

The current constraints are as follows:

- Increased DART train frequency (Train Service Specification) as part of the DART+ programme
- Electrification - According to CRR guidelines, user worked crossings are not normally suitable for electrified areas;
- Currently limited signalling/monitoring capability installed at crossing;

4.1.1 Permanent Way and Track

No constraints have been identified. The area uses standard track units.

4.1.2 Geotechnical

Based on the desk study information retrieved from historic ground investigations along the railway line, there is the risk of contamination due to the presence of made ground as highlighted in nearby ground investigations and with respect to the historic and industrial use of the site as a railway. Subsequently, material excavated during the works may not be suitable for reuse on site and subject to testing may require disposal or recovery to a suitably licensed facility.

Moreover, there is the possibility of soft ground (alluvium deposit) associated with River Pill and its historic estuary to the north of the site.

A site-specific ground investigation is a prerequisite at the location of the proposed works to investigate the current ground and groundwater conditions. There is limited information on depth to bedrock, groundwater and geo-environmental from existing ground investigations.

4.1.3 Structures

This area currently accommodates a two-track railway. Any reconfiguration of the horizontal track alignment or increase in the number of tracks may require alternation to the structures in the area as described in the table below.

Table 4-1: Structure constraints along the site

Name	ID	Function	Constraint
UBB31 - Tidal Outflow	UBB31	Underbridge	Any alteration to the tracks at this location may require a modification to the bridge should additional width be required here.

4.1.4 Utilities

Existing utilities are a constraining factor to the project when considering the various design options. It is often cheaper, easier, and quicker for a project to change the design than to divert a utility. Existing utilities should be taken into consideration from an early stage in the project, and where possible worked around and only diverted where necessary.

Utility locations should be taken into consideration when constructing or designing bridges, underpasses, or automatic barrier crossings, as this may require utilities in the area to be diverted. Any construction work taking place in the vicinity of the level crossing must take the existing lineside and telecommunication cables into consideration. Appropriate arrangements must be made with Irish Rail, BT Ireland and Eir.

Currently the only known utilities in the vicinity are the telecommunication and signalling cables associated with the railway

4.1.5 Other Railway Facilities

No constraints have been identified.

4.1.6 Roads

No road constraints have been identified in the permanent scenario. During construction access to nearby residential and business areas must be maintained. Traffic diversions may be necessary.

4.2 Environmental

For an overview of the existing environmental constraints for DART+ Coastal North refer to Annex 3.1 Constraints Report.

Section 2.5 above describes the baseline environment for the various options being considered under this study pack. Building on this information, the key constraints associated with the options being considered, under the various environmental criteria, are summarised below.

4.2.1 Traffic and Transportation

The crossing is immediately beside the route of the proposed Broadmeadow Greenway. As such there is an increased risk of members of the public being in the vicinity of the crossing and trespassing/crossing the line. Furthermore, any interfaces will need to be considered, particularly during construction works.

4.2.2 Landscape and visual impact

The level crossing is in broadly flat, visually open lands adjacent to the estuary. The lands around the level crossing are zoned 'High Amenity' and there is an objective to preserve views along Corballis Cottages Road east of the rail line (Sheet No. 7 Fingal County Council Development Plan).

The planned Broadmeadow Way (see section 2.5.1 is another constraint that must be considered. The Broadmeadow Way forms part of the Fingal Coastal Way, the NTA's Greater Dublin Area Cycle Network and East Coast Trail. The route will run alongside the west side of the railway line currently crossing the estuary and will include a 280m long bridge to be placed on existing piers immediately west of the railway viaduct.

4.2.3 Archaeology and cultural heritage

While there are no archaeological monuments located in the vicinity of the proposed works for any of the options, the area is considered to be of archaeological potential. This is due to the potential to identify or record buried archaeological features, finds or deposits from within the estuarine silts upon which the railway infrastructure is built. This is evidenced from the finds of a flint blade and flint flakes in Kilcrea townland (NMI 1067:182-184).

4.2.4 Architectural heritage

One protected structure has been identified in the vicinity of the level crossing. This is the railway bridge over Corballis Cottages (FCC RPS 0502). The bridge is also included in the NIAH (NIAH 11336027) where it is rated of regional importance for reasons of architectural and technical interest.

No other features of built-heritage interest have been identified as part of the preliminary desk-based baseline review.

4.2.5 Noise and vibration

Noise and vibration constraints are nearby sensitive receptors. The nearest sensitive receptors are approximately 500m from the site and are unlikely to be affected by noise or vibration from level crossing works for most options. Construction and operational noise and vibration limits will have to be set at the nearby receptors for the options proposed.

4.2.6 Air quality and climate

The existing level crossing is located at the northern end of Malahide Estuary surrounded by agricultural land. No dwellings or other human sensitive receptors are located in proximity.

The River Pill discharges to the estuary just north of the level crossing, running under the railway line. The Malahide Estuary is designated as both a Special Protection Area (SPA), Special Area of Conservation (SAC) and a proposed Natural Heritage Area (pNHA) in this area. The Estuary is therefore considered sensitive in the context of potential dust emissions during any construction phase.

4.2.7 Agricultural

The agricultural constraints in this area are low-to-medium sensitivity based on the criteria in Table 4-2. There is a medium sensitivity beef farm (Folio DN6626) on the east side of the crossing and a tillage and vegetable growing enterprise just south of this. Tillage farms are generally medium sensitivity and while vegetable cropping is a higher value use of the land, and therefore potentially more sensitive from an agricultural perspective, the rotation of such high value crops is such that the land will be used for conventional cropping for the majority of cropping seasons and therefore is assessed as medium sensitivity. The grassland to the east of the railway line is low sensitivity due to restricted access and medium land quality.

Table 4-2: Farm Sensitivity²

Farm enterprise type	Intensity / Scale	Sensitivity
Stud farms, farm shops/open farms/agri tourism farms are generally high or very high sensitivity. Intensive horticulture (mushroom farms) is generally high or very high sensitivity. Intensive agriculture (pigs and poultry) is high sensitive.	High	Very High
	Medium	High
	Low	Medium
Dairy farms and equine enterprises.	High	High
	Medium	High
	Low	Medium
Non dairy grazing livestock enterprises (including beef, sheep and small non intensive equine) and grass cropping enterprise.	High	Medium
	Medium	Low
	Low	Very low
Tillage	High	Medium
	Medium	Low
	Low	Very low
Rough Grazing, Bog, Forestry, Woodland	Low	Low or Very low

4.2.8 Geology and soils

Based on the historic and industrial use of the site as a railway, there are likely to be some sources of contamination within the made ground throughout the study area.

² The sensitivity of typical Irish agricultural enterprises is based on the author's professional judgement

4.2.9 Water resources

The constraints to the development in terms of water resources include the Malahide Bay, River Pill, the underlying locally important aquifer, areas at medium to high risk of flooding and the protected water dependant ecological sites where changes to the water flow and quality could have a negative impact.

The site is at close proximity to the Malahide Bay SAC, SPA and pNHA. One of the objectives of the SAC relates to the flooding regime, and specifically the natural tidal regime. The pioneer saltmarsh community at the SAC requires regular tidal inundation. Changes to the hydrological regime as part of the proposals could therefore have a negative impact.

4.2.10 Biodiversity

The key ecological constraints in this area are the Malahide Estuary SAC, Malahide Estuary SPA and pNHA designation (located immediately adjacent to and overlapping with the works area) which are designated for marine habitats and overwintering birds. These designated areas are of international and national biodiversity importance. The reasons for designation are listed in Table 4-3 below.

Table 4-3: Qualifying interests (reasons for designation) of the Malahide Estuary SAC and SPA

Malahide Estuary SAC	Malahide Estuary SPA
<ul style="list-style-type: none"> ● 1140 Mudflats and sandflats not covered by seawater at low tide ● 1310 <i>Salicornia</i> and other annuals colonising mud and sand ● 1320 <i>Spartina</i> swards (<i>Spartinion maritima</i>) ● 1330 Atlantic salt meadows (<i>Glaucopuccinellietalia maritima</i>) ● 1410 Mediterranean salt meadows (<i>Juncetalia maritimi</i>) ● 2120 Shifting dunes along the shoreline with <i>Ammophila arenaria</i> (white dunes) ● 2130 Fixed coastal dunes with herbaceous vegetation (grey dunes) 	<ul style="list-style-type: none"> ● A005 Great Crested Grebe <i>Podiceps cristatus</i> ● A046 Brent Goose <i>Branta bernicla hrota</i> ● A048 Shelduck <i>Tadorna</i> ● A054 Pintail <i>Anas acuta</i> ● A067 Goldeneye <i>Bucephala clangula</i> ● A069 Red-breasted Merganser <i>Mergus serrator</i> ● A130 Oystercatcher <i>Haematopus ostralegus</i> ● A140 Golden Plover <i>Pluvialis apricaria</i> ● A141 Grey Plover <i>Pluvialis squatarola</i> ● A143 Knot <i>Calidris canutus</i> ● A149 Dunlin <i>Calidris alpina</i> ● A156 Black-tailed Godwit <i>Limosa</i> ● A157 Bar-tailed Godwit <i>Limosa lapponica</i> ● A162 Redshank <i>Tringa totanus</i> ● A999 Wetlands

Other potential ecological constraints include:

- The River Pill which drains to the Malahide estuary;
- Vegetation (scrub, hedgerows or treelines) which may provide foraging, nesting, and commuting corridors for fauna species (e.g. birds, bats, small mammals);
- Potential for the railway to support interesting flora species and habitats due to the calcareous nature of the ballast and their often relatively undisturbed nature;
- Potential for invasive species to occur along the railway line.

Also of note are Fingal County Council’s proposals for the Broadmeadow Greenway adjacent to the railway line. The environmental assessments for the Broadmeadow Greenway set out specific environmental and ecological mitigation and any works in this area should be cognisant of those plans and ensure there are no conflicts between the Irish Rail works and the Broadmeadow Greenway proposals (e.g. timings of works to avoid sensitive periods for species, or control of access by people to the adjacent designated sites).

4.3 Planning

XB001 is located within the administrative area of Fingal County Council. The Fingal Development Plan 2017-2023 sets out the Council’s proposed policies and objectives for the development of the County over the Plan period. The Development Plan seeks to develop and improve, in a sustainable manner, the social, economic, environmental and cultural assets of the County.

The Strategic Vision for the plan contains a number of sectoral policies, the following of which are relevant:

“Consolidate urban areas to provide a vibrant, attractive environment for living and working, facilitating efficient movement by sustainable modes of transport throughout the County.

Make better use of key resources such as land, water, energy, waste and transportation infrastructure.

Reduce climate change through settlement and travel patterns and reduced use of non-renewable resources.”

The Strategic Vision intends to deliver on the Main Aims of the Plan by, inter alia:

“Seek the development of a high quality public transport system throughout the County and linking to adjoining counties, including the development of the indicative route for New Metro North and Light Rail Corridor, improvements to railway infrastructure including the DART Expansion Programme, Quality Bus Corridors (QBCs) and Bus Rapid Transit (BRT) systems, together with enhanced facilities for walking and cycling.”

The following objectives in relation to transportation are also relevant:

“Objective MT01

Support National and Regional transport policies as they apply to Fingal. In particular, the Council supports the Government’s commitment to the proposed new Metro North and DART expansion included in Building on Recovery: Infrastructure and Capital Investment 2016-2021. The Council also supports the implementation of sustainable transport solutions.

Objective MT02

Support the recommendations of the National Transport Authority’s Transport Strategy for the Greater Dublin Area 2016-2035 to facilitate the future sustainable growth of Fingal.

Objective MT05

Integrate land use with transportation by allowing higher density development along higher capacity public transport corridors.

Objective MT30

Support Iarnród Éireann and the NTA in implementing the DART Expansion Programme, including the extension of the DART line to Balbriggan, the design and planning for the expansion of DART services to Maynooth, and the redesign of the DART Underground.”

5 Options

The following section runs through the optioneering process from the longlist of options through to the selection of the Draft Emerging Preferred Option.

The option selection process is described in the option selection process section of the Preliminary Option Selection Report.

5.1 Longlist of options

This section describes the options which have been considered for the level crossing. The discussion is limited to items which will have a bearing on the development or selection of an option. A more detailed technical description of the works is included for the shortlisted options.

The options which have been considered are summarised in Table 5-1 below.

Table 5-1: Longlist of options considered

Option	Description
Option 0	Do Nothing
Option 1	New automatic barrier crossing interlocked with signalling
Option 2	Close the crossing
Option 3	Close the crossing and provide new access from Corballis cottages along estuary side of railway
Option 4	Close the crossing and IÉ purchase the adjacent land to remove any third-party access
Option 5	Construct new overbridge
Option 6	Construct new underbridge

5.1.1 Option 0 – Do nothing

This option involves doing nothing to the level crossing, following electrification and service frequency increases to the railway line.

5.1.2 Option 1 – New automatic barrier crossing interlocked with signalling

This option involves installation of a new automatic barrier crossing interlocked with signalling. The current standardised design includes the installation of barriers which are dropped to close the crossing on the approach of trains, raised when the line is clear and are monitored by CCTV in accordance with CRR guidelines. Such designs are adapted specifically for public roads and less suited to level crossings such as this.

5.1.3 Option 2 - Close the crossing

This option involves closure of the crossing due to the increased perceived risk from electrification and service frequency increases. It proposes no further mitigation nor means of access to the land east of the railway.

5.1.4 Option 3 – Close the crossing and provide new access

This option involves provision of access to the agricultural land east of the crossing via a new access road from Corballis cottages, along the estuary side of the railway. The existing level crossing would be closed. The proposed route of this road is shown in Figure 5-1 below.

The works would likely require creation of a retaining structure along the length of the road, supporting this up from the estuary. Additionally, widening to the existing underbridge would likely be required.



Figure 5-1: Level crossing option 3 access road sketch (Source: OSI aerial mapping)

5.1.5 Option 4 - Close the crossing and IÉ purchase the adjacent land

This option involves purchase of the land east of the crossing such that third-party access requirements are removed. The existing level crossing would be closed. Consideration would need to be given as to the access method for maintenance

activities in the field/to the estuary shoreline. The option presents the opportunity to improve biodiversity/ecological value of the area of land in question.

5.1.6 Option 5 - Construct new overbridge

This option comprises removal of the level crossing and construction of a new overbridge to provide access to the adjacent farmland. A level difference of 6.6 m would be required, coming from 5.8 m clearance to rail level plus a structural depth of 0.8 m for the bridge. Considering a maximum 7% gradient, this would result in 95m long approach earthen ramps either side.

A two-span arrangement would be necessary to accommodate both the proposed Greenway and the railway, resulting in an overall length in excess of 25 m. The deck would be approximately 4 m wide between parapets. It is likely the bridge would be constructed of prestressed concrete girders sat upon reinforced soil wall embankments. The ground is likely to be soft, necessitating an amount of ground improvement for the embankment and bridge works.

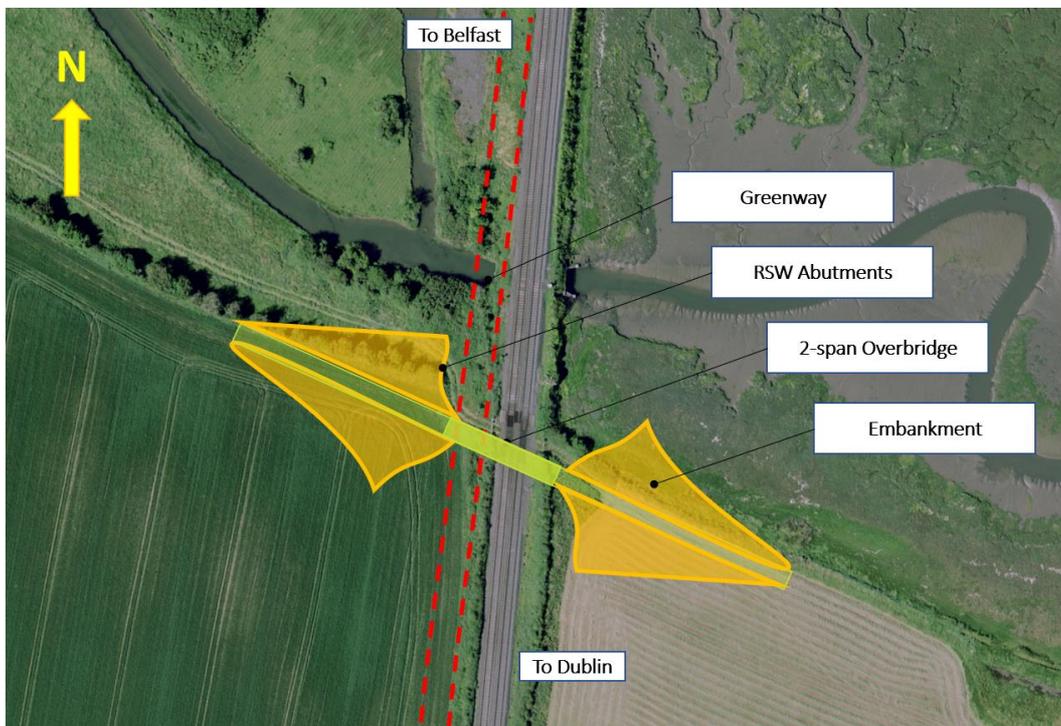


Figure 5-2: Level cross option 5 overbridge layout sketch (Source: OSI aerial mapping)

5.1.7 Option 6 - Construct new underbridge

This option comprises removal of the level crossing and construction of a new underpass to provide access to the adjacent farmland. A level difference of 3.5 m would be required, coming from 2.7 m clearance for vehicles in the underpass, plus 0.4 m of structural depth and 0.4 m of ballast. Considering a maximum 7% gradient, this would result in 50m long approach ramps either side.

The underpass would likely be formed from a precast reinforced concrete box culvert, with an overall length in excess of 25m to pass under both the proposed Greenway and railway. Wingwalls to the structure would likely be formed from reinforced concrete. The underpass would be approximately 4 m wide internally.

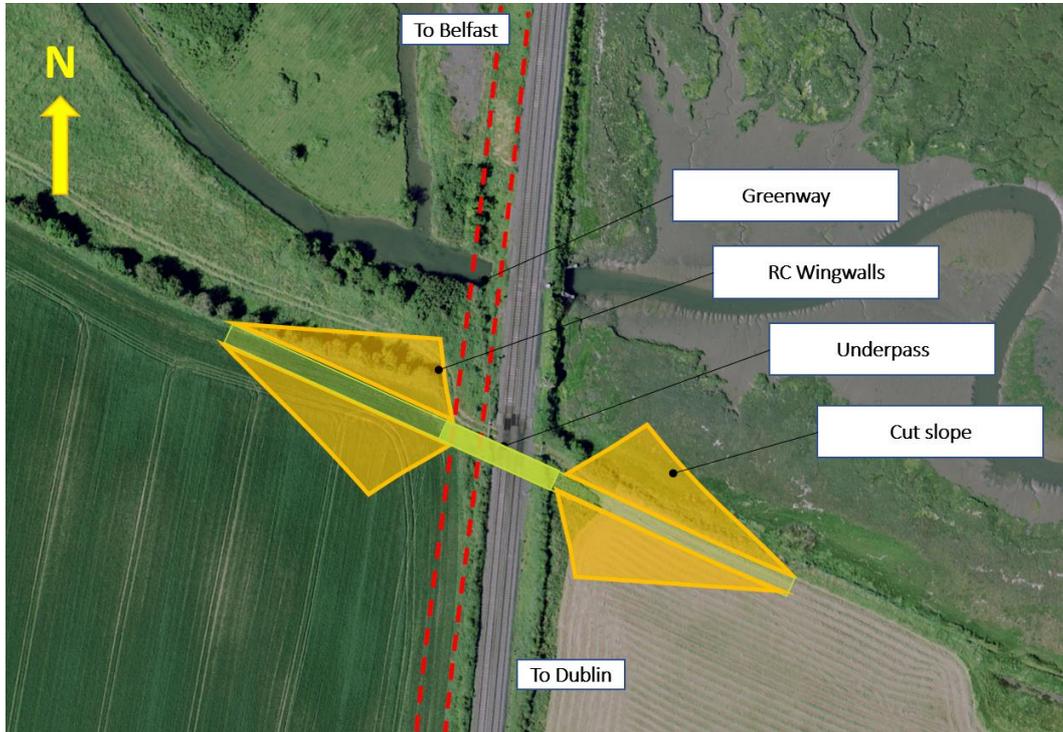


Figure 5-3: Level crossing option 6 underpass layout sketch (Source: OSI aerial mapping)

5.2 Sifting of longlist of options

This sifting process considers the project objectives and project requirements. Each option presented in section 5.1 will be assessed on its ability to meet the project objectives and requirements.

Assessment of the options is provided in Table 5-2 and Table 5-3 below.

Table 5-2: Assessment of longlist of options against project objectives and requirements (Options “do-nothing” 1 to 4)

Project objectives and requirements	Description	Option “do-nothing”		Option 1 - New automatic barrier crossing interlocked with signalling		Option 2 – Close the crossing		Option 3 – Close the crossing and provide new access from Corballis cottages along estuary side of railway		Option 4 – Close the crossing and IE purchase the adjacent land to remove any third-party access	
		Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale
Project objective	To deliver a higher frequency, higher capacity, reliable, electrified route to enable an increased DART service frequency between Drogheda and Central Dublin.	Fail	<ul style="list-style-type: none"> Does not meet objective Affects the reliability of services as there is not full separation of road/rail traffic CRR guidelines recommend closure 	Fail	<ul style="list-style-type: none"> Does not meet objective Affects the reliability of services as there is not full separation of road/rail traffic 	Pass	<ul style="list-style-type: none"> Enables delivery of objective 	Pass	<ul style="list-style-type: none"> Enables delivery of objective Full separation of road/rail traffic 	Pass	<ul style="list-style-type: none"> Enables delivery of objective Full separation of road/rail traffic
Project objective	To deliver solutions which improve the passenger experience where passenger infrastructure interventions are required to meet the Train Service Specification.	Pass	<ul style="list-style-type: none"> Potential for disruption to services due to level crossing 	Pass	<ul style="list-style-type: none"> Potential for disruption to services due to level crossing 	Pass	<ul style="list-style-type: none"> Separation of road and rail for improved service reliability 	Pass	<ul style="list-style-type: none"> Separation of road and rail for improved service reliability 	Pass	<ul style="list-style-type: none"> Separation of road and rail for improved service reliability
Project objective	To deliver a sustainable, low carbon and climate resilient design solution including making use of existing infrastructure where possible with targeted improvement works.	Pass	<ul style="list-style-type: none"> No impact from ‘do-nothing’ approach 	Pass	<ul style="list-style-type: none"> Embodied carbon of construction works Construction in environmentally sensitive area 	Pass	<ul style="list-style-type: none"> No impact from closure of level crossing 	Pass	<ul style="list-style-type: none"> Resilience considerations for construction on shoreline Embodied carbon of works Construction in environmentally sensitive area 	Pass	<ul style="list-style-type: none"> No impact from closure of level crossing Biodiversity gain potential on purchased land

Project objectives and requirements	Description	Option “do-nothing”		Option 1 - New automatic barrier crossing interlocked with signalling		Option 2 – Close the crossing		Option 3 – Close the crossing and provide new access from Corballis cottages along estuary side of railway		Option 4 – Close the crossing and IÉ purchase the adjacent land to remove any third-party access	
		Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale
Project objective	To identify cost-effective solutions from a capital, operations, and maintenance perspective.	Pass	<ul style="list-style-type: none"> No cost associated with do-nothing approach 	Pass	<ul style="list-style-type: none"> Installation cost Maintenance cost 	Pass	<ul style="list-style-type: none"> No cost associated with closure of level crossing 	Pass	<ul style="list-style-type: none"> Cost of access road Cost of retaining structure Maintenance cost of structure over/near water 	Pass	<ul style="list-style-type: none"> No cost associated with closure of level crossing Cost of land purchase Cost of maintenance of land and question over access
Project objective	To minimise adverse impacts on the natural and built environment associated with construction, operation and maintenance of the project	Pass	<ul style="list-style-type: none"> No adverse impact associated with ‘do-nothing’ approach Limited safe crossing periods for farming activity 	Pass	<ul style="list-style-type: none"> Impact of construction in environmentally sensitive area 	Pass	<ul style="list-style-type: none"> No adverse impact from closure of level crossing 	Pass	<ul style="list-style-type: none"> Impact of construction in environmentally sensitive area 	Pass	<ul style="list-style-type: none"> Potential for biodiversity gain on purchased land
Project objective	To minimise adverse impacts on existing rail services, road users and landowners associated with the construction, operation and maintenance of the project.	Pass	<ul style="list-style-type: none"> Increased risk to landowner/rail passengers from increased risk associated with level crossing Reduced opening times of crossing from service frequency increase Risk of delays to rail services 	Pass	<ul style="list-style-type: none"> Reduced opening times of crossing from service frequency increase Risk of delays to rail services Construction impact to rail services 	Fail	<ul style="list-style-type: none"> No access provided for landowner following closure of level crossing 	Pass	<ul style="list-style-type: none"> Construction impact to rail services Impact to road users 	Pass	<ul style="list-style-type: none"> Compulsory purchase of land

Project objectives and requirements	Description	Option “do-nothing”		Option 1 - New automatic barrier crossing interlocked with signalling		Option 2 – Close the crossing		Option 3 – Close the crossing and provide new access from Corballis cottages along estuary side of railway		Option 4 – Close the crossing and IÉ purchase the adjacent land to remove any third-party access	
		Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale
Project objective	To provide efficient and cost-effective integration of systems with the other DART routes	Pass	<ul style="list-style-type: none"> Disruption to services due to level crossing a potential risk 	Pass	<ul style="list-style-type: none"> Disruption to services due to level crossing a potential risk 	Pass	<ul style="list-style-type: none"> No impact on integration with other DART routes 	Pass	<ul style="list-style-type: none"> No impact on integration with other DART routes 	Pass	<ul style="list-style-type: none"> No impact on integration with other DART routes
Project requirement	To design in accordance with IÉ Standards and relevant national and EU standards and guidelines.	Pass	<ul style="list-style-type: none"> CRR guidelines recommend but do not mandate closure of the level crossing 	Pass	<ul style="list-style-type: none"> New level crossing could be designed in accordance with relevant standards and criteria 	Pass	<ul style="list-style-type: none"> Closure of crossing is in line with CRR recommendations 	Pass	<ul style="list-style-type: none"> Closure of crossing is in line with CRR recommendations 	Pass	<ul style="list-style-type: none"> Closure of crossing is in line with CRR recommendations
Project requirement	Designs shall comply with the Minimum Employer’s Functional Requirements and meet the Train Service Specification	Pass	<ul style="list-style-type: none"> Compliant 	Pass	<ul style="list-style-type: none"> Compliant 	Pass	<ul style="list-style-type: none"> Compliant 	Pass	<ul style="list-style-type: none"> Compliant 	Pass	<ul style="list-style-type: none"> Compliant

Project objectives and requirements	Description	Option “do-nothing”		Option 1 - New automatic barrier crossing interlocked with signalling		Option 2 – Close the crossing		Option 3 – Close the crossing and provide new access from Corballis cottages along estuary side of railway		Option 4 – Close the crossing and IÉ purchase the adjacent land to remove any third-party access	
		Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale
Project requirement	Electrification of the line from the end of the current electrified section at Malahide to Drogheda with 1500V DC overhead.	Pass	<ul style="list-style-type: none"> Does not prevent electrification of line 	Pass	<ul style="list-style-type: none"> Does not prevent electrification of line If constructed prior to electrification, future passive provision for clearances needs considering 	Pass	<ul style="list-style-type: none"> Does not prevent electrification of line 	Pass	<ul style="list-style-type: none"> Does not prevent electrification of line 	Pass	<ul style="list-style-type: none"> Does not prevent electrification of line
Project requirement	Provision of an appropriate number of substations to support electrification.	Pass	<ul style="list-style-type: none"> Does not affect number/location of substations 	Pass	<ul style="list-style-type: none"> Does not affect number/location of substations 	Pass	<ul style="list-style-type: none"> Does not affect number/location of substations 	Pass	<ul style="list-style-type: none"> Does not affect number/location of substations 	Pass	<ul style="list-style-type: none"> Does not affect number/location of substations
Project requirement	Undertake necessary infrastructure change to achieve the clearances required for electrification at bridges and structures.	Pass	<ul style="list-style-type: none"> No associated clearance issues with ‘do-nothing’ approach 	Pass	<ul style="list-style-type: none"> Clearances can be achieved but need considering in level crossing design 	Pass	<ul style="list-style-type: none"> No associated clearance issues with closing crossing 	Pass	<ul style="list-style-type: none"> No associated clearance issues with closing crossing Sufficient clearance and separation for access road must be provided 	Pass	<ul style="list-style-type: none"> No associated clearance issues with closing crossing

Project objectives and requirements	Description	Option “do-nothing”		Option 1 - New automatic barrier crossing interlocked with signalling		Option 2 – Close the crossing		Option 3 – Close the crossing and provide new access from Corballis cottages along estuary side of railway		Option 4 – Close the crossing and IÉ purchase the adjacent land to remove any third-party access	
		Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale	Pass/ fail	Rationale
Project requirement	Undertake safety improvements resulting from the introduction of 1500V DC Overhead.	Pass	<ul style="list-style-type: none"> CRR guidelines do not mandate closure Increased risk to crossing users 	Pass	<ul style="list-style-type: none"> Automated crossing improves safety but does not fully remove risk 	Pass	<ul style="list-style-type: none"> Closing crossing improves safety for landowners/members of public 	Pass	<ul style="list-style-type: none"> Provides safer method of access to land than current crossing Adequate anti-trespass measures need considering in conjunction with works 	Pass	<ul style="list-style-type: none"> Access to IÉ land for maintenance following crossing closure needs considering Closing crossing improves safety for landowners/members of public

Table 5-3: Assessment of longlist of options against project objectives and requirements (options 5 to 6)

Project objectives and requirements	Description	Option 5 – Construct new overbridge		Option 6 – Construct new underbridge	
		Pass/ fail	Rationale	Pass/ fail	Rationale
Project objective	To deliver a higher frequency, higher capacity, reliable, electrified route to enable increased DART service frequency between Drogheda and Central Dublin.	Pass	<ul style="list-style-type: none"> Enables delivery of objective Full separation of road/rail traffic 	Pass	<ul style="list-style-type: none"> Enables delivery of objective Full separation of road/rail traffic Bridge strike reliability risk
Project objective	To deliver solutions which improve the passenger experience where passenger infrastructure interventions are required to meet the Train Service Specification.	Pass	<ul style="list-style-type: none"> Separation of road and rail for improved service reliability 	Pass	<ul style="list-style-type: none"> Separation of road and rail for improved service reliability
Project objective	To deliver a sustainable, low carbon and climate resilient design solution including making use of existing infrastructure where possible with targeted improvement works.	Pass	<ul style="list-style-type: none"> Embodied carbon of new construction Construction in an environmentally sensitive area 	Pass	<ul style="list-style-type: none"> Embodied carbon of new construction Construction in an environmentally sensitive area
Project objective	To identify cost-effective solutions from a capital, operations, and maintenance perspective.	Pass	<ul style="list-style-type: none"> Cost of overbridge construction Cost of delays to services during construction Maintenance costs 	Pass	<ul style="list-style-type: none"> Cost of underpass construction Cost of delays to services during construction Maintenance costs

Project objectives and requirements	Description	Option 5 – Construct new overbridge		Option 6 – Construct new underbridge	
		Pass/ fail	Rationale	Pass/ fail	Rationale
Project objective	To minimise adverse impacts on the natural and built environment associated with construction, operation and maintenance of the project	Pass	<ul style="list-style-type: none"> Construction in environmentally sensitive area 	Pass	<ul style="list-style-type: none"> Construction in environmentally sensitive area
Project objective	To minimise adverse impacts on existing rail services, road users and landowners associated with the construction, operation and maintenance of the project.	Pass	<ul style="list-style-type: none"> Delays to existing services from construction works Disruption to landowner, loss of land for ramps 	Pass	<ul style="list-style-type: none"> Delays to existing services from construction works Disruption to landowner, loss of land for ramps
Project objective	To provide efficient and cost-effective integration of systems with the other DART routes	Pass	<ul style="list-style-type: none"> No impact on integration with other DART routes 	Pass	<ul style="list-style-type: none"> No impact on integration with other DART routes
Project requirement	To design in accordance with IÉ Standards and relevant national and EU standards and guidelines.	Pass	<ul style="list-style-type: none"> Closure of crossing is in line with CRR recommendations Overbridge design and clearances can be in accordance with relevant standards 	Pass	<ul style="list-style-type: none"> Closure of crossing is in line with CRR recommendations
Project requirement	Designs shall comply with the Minimum Employer's Functional Requirements and meet the Train Service Specification	Pass	<ul style="list-style-type: none"> Compliant 	Pass	<ul style="list-style-type: none"> Compliant
Project requirement	Electrification of the line from the end of the current electrified section at Malahide to Drogheda with 1500V DC overhead.	Pass	<ul style="list-style-type: none"> Does not prevent electrification of line If constructed prior to electrification, future passive provision for clearances needs considering 	Pass	<ul style="list-style-type: none"> Does not prevent electrification of line

Project objectives and requirements	Description	Option 5 – Construct new overbridge		Option 6 – Construct new underbridge	
		Pass/ fail	Rationale	Pass/ fail	Rationale
Project requirement	Provision of an appropriate number of substations to support electrification.	Pass	<ul style="list-style-type: none"> Does not affect number/location of substations 	Pass	<ul style="list-style-type: none"> Does not affect number/location of substations
Project requirement	Undertake necessary infrastructure change to achieve the clearances required for electrification at bridges and structures.	Pass	<ul style="list-style-type: none"> Clearance for overbridge structure can be achieved 	Pass	<ul style="list-style-type: none"> No electrification clearance issues from underpass
Project requirement	Undertake safety improvements resulting from the introduction of 1500V DC Overhead.	Pass	<ul style="list-style-type: none"> Improves safety of current level crossing Adequate anti-trespass measures need considering in conjunction with works 	Pass	<ul style="list-style-type: none"> Improves safety of current level crossing Adequate anti-trespass measures need considering in conjunction with works

5.3 Summary of Longlist Sifting

Table 5-4: Summary of longlist sifting

Option	Screening Result	Summary
“Do-Nothing”	FAIL	Does not meet project objective: a high-risk crossing considering the train frequency and line speed
Option 1	FAIL	Does not meet project objective – not appropriate for a user worked crossing to access farmland
Option 2	FAIL	Fails to consider third-party landowner by closing crossing and removing their access
Option 3	PASS	Met project objectives and requirements
Option 4	PASS	Met project objectives and requirements
Option 5	PASS	Met project objectives and requirements
Option 6	PASS	Met project objectives and requirements

5.4 Shortlisted options

The following sections describe the shortlisted options in further detail.

Note for all options some adjustments to the OHLE design will be necessary to accommodate infrastructural changes, however these are seen to be minor.

5.4.1 Option 3 - Close the crossing and provide new access description

This option will have no impact on the electrification works assuming that it does not constrain installation of new OHLE structures. It will likely require the widening of the tidal overflow bridge and the inclusion of a substantial length of retaining structure along the estuary side – approximately 460 m long . This will result in substantial structural and geotechnical interventions.

5.4.2 Option 4 - Close the crossing and IÉ purchase the adjacent land description

This option will have no impact on the electrification design, nor will it require modification of signalling systems or structural/geotechnical interventions.

5.4.3 Option 5 - Construct new overbridge description

This option will require construction of an overbridge with geometry and soffit height such that all electrical clearances can be achieved with standard OHLE geometry. It will, therefore, only affect the electrification design in locating OHLE structures longitudinally such that they do not clash with the new structure. It is assumed that the overbridge will be constructed prior to the electrification works.

The proposed 2-span overbridge bridge will be approximately 25m in length which includes spanning over the Broadmeadow Way and 4m wide between parapets. It will require approximately 95m long ramps at either edge of the bridge with a 7% gradient. Note an embankment will be built either side of this ramp construction. The level difference is around 6.6m: 5.8m rail clearance + 0.8m structural depth. Note this 5.8m clearance will be sufficient for the 25kv passive provision, if this is required.

5.4.4 Option 6 - Construct new underbridge

This option will require construction of a new underbridge prior to the electrification works. It will affect the OHLE design in terms of locating structures longitudinally along the track. The option will result in significant structural and geotechnical interventions.

The proposed underpass will be approximately 25m in length which includes passing the Broadmeadow Way with a 4m wide passage. It will require approximately 50m long ramps at either edge of the underpass with a 7% gradient. Note an embankment will be built either side of this ramp construction. The level difference is approximately 3.5m: 2.7m clearance + 0.4m ballast allowance.

The lowest road level will be approximately 1.4m OD, assuming a 2.7m vertical clearance height within the underpass. The potential for the road level of the underpass to be below water level will depend on the high tide levels and the ground water levels in the area (including potential fluctuations in water table levels).

High tide is at 2.52m OD Malin therefore there will times when the underpass will be below sea level. This will be reviewed and developed during preliminary design stage, should this option be chosen as the emerging preferred option.

5.5 Multi-criteria analysis

5.5.1 Methodology

For each individual entity an assessment has been made against the MCA criteria. Each option has been relatively compared against each other based on the five-point colour coded ranking scale as shown in Table 5-7.

5.5.2 MCA summary table

A multi-criteria analysis table is presented in this section. This has been developed to reflect the relative rankings for all sub-criteria for each of the options assessed and is presented as a summary of the key issues considered.

A more detailed table is provided in the appendix to this report with the full detailed rationale behind the scoring of each criteria and option.

Table 5-5: MCA Summary table

Criteria	Sub-Criteria	Option 3	Option 4	Option 5	Option 6
		Close the crossing and provide new access	Close the crossing and purchase the adjacent land	Construct new overbridge	Construct new underbridge
Economy	CAPEX	Orange	Green	Orange	Orange
	OPEX	Orange	Green	Light Green	Light Orange
	Train operations functionality/economic benefit	Yellow	Yellow	Yellow	Yellow
	Traffic functionality and associated economic activities and opportunities	Light Orange	Light Green	Light Orange	Light Orange
Safety	Employer's Safety	Yellow	Yellow	Yellow	Yellow
	Public safety	Light Orange	Light Green	Light Orange	Light Orange
Environment	Landscape and Visual Quality	Light Orange	Green	Orange	Light Green
	Biodiversity	Orange	Green	Orange	Orange
	Noise and Vibration	Orange	Green	Orange	Orange
	Water resources	Orange	Green	Orange	Orange
	Archaeology, Architectural and Cultural Heritage	Orange	Green	Orange	Orange
	Geology and Soils	Orange	Green	Orange	Orange
	Agricultural and non-agricultural	Yellow	Yellow	Yellow	Yellow
	Air Quality & Climate Change	Orange	Green	Orange	Orange
Accessibility & Social Inclusion	Accessibility	Yellow	Yellow	Yellow	Yellow
	Social Inclusion	Yellow	Yellow	Yellow	Yellow
Integration	Adaptability in the future	Yellow	Yellow	Yellow	Yellow
	Transport Integration	Yellow	Yellow	Yellow	Yellow
	Land Use Integration	Yellow	Yellow	Yellow	Yellow
	Government policy integration	Yellow	Yellow	Yellow	Yellow
	Geographical integration	Yellow	Yellow	Yellow	Yellow
Physical Activity	Walking / cycling opportunities	Yellow	Yellow	Yellow	Yellow

Table 5-6: Overall criteria MCA summary table

Criteria Summary	Option 3	Option 4	Option 5	Option 6
		Close the crossing and provide new access	Close the crossing and IÉ purchase the adjacent land	Construct new overbridge
Economy	Orange	Green	Light Green	Light Orange
Safety	Light Orange	Light Green	Light Orange	Light Orange
Environment	Orange	Green	Orange	Orange
Accessibility & Social Inclusion	Yellow	Yellow	Yellow	Yellow
Integration	Yellow	Yellow	Yellow	Yellow
Physical Activity	Yellow	Yellow	Yellow	Yellow

Table 5-7: Legend for MCA Summary Table

Significant comparative advantage over other options
Some comparative advantage over other options
Comparable to other options / neutral
Some comparative disadvantage over other options
Significant comparative disadvantage over other options

5.5.3 Economy

Economy has been divided into four sub-criteria which are considered below.

CAPEX

Option 4 has significant advantages over the other options as there is no construction and temporary works costs associated with this option. The only CAPEX costs incurred is the cost of purchasing the farmland to remove the requirement for any 3rd party access.

Options 3, 5 and 6 have significant disadvantages over Option 4 due to costs associated with construction of new structures. Option 3 requires a construction of a new access road and widening of UBB31, Option 5 is the construction of a new overbridge and Option 6 is the construction of a new underpass

OPEX

Option 4 has significant advantages over the other options due to minimal to no operational costs would be incurred with this option.

Option 3 has significant disadvantages due to the maintenance costs required for the access road and the retaining road.

Option 5 has some comparative advantages over Option 6. There is limited maintenance foreseen for the over bridge however the underpass will likely require greater maintenance, such as for drainage and retained earth.

Train operations functionality/economic benefit

All options are comparable as they all provide fully segregated farm and rail traffic. The options increase timetable resilience by removing the risk of delays due to farm traffic interference.

There is a possibility of road traffic impacting rail services through bridge strikes by oversized vehicles, which could decrease timetable resilience and negatively impact performance. However, this risk is low and does not affect the scoring.

Traffic functionality and associated economic activities and opportunities

Option 4 has some comparative advantages over the other options as there is no change or increase in construction traffic and operational traffic will likely be reduced. For Options 3, 5 and 6 there will be traffic associated with the construction works.

5.5.4 Safety

Safety has been divided into two sub-criteria which are considered below. It should be noted that all options are safe, but some will have the potential for greater residual risks to remain. This criterion considers relative advantages of each option on the criteria of safety.

Employer's Safety

All options are comparable as all options do not require IÉ staff on the track apart from existing track/formation maintenance.

Public Safety

Option 4 has significant advantages for public safety as public access to the track and to the land on the eastern side of the track has been eliminated. Option 3 does eliminate the access to the track however the public can still gain access to the land on the eastern side of the track by the new road. Option 5 and 6 both have risks associated with the new structure. Option 5 carries the risk of overpassing machinery to fall onto the track and option 6 has some disadvantages with the risk of bridge strike from farm machinery.

5.5.5 Environment

Section 2.5 sets out a description of the existing environment, under key environmental criteria, while section 4.2 considers the key environmental constraints associated with this study area. Below is a summary of the key findings of the MCA under the various environmental criteria, with an emphasis on differentiating aspects for the options considered.

Landscape and Visual Qualitative

Option 3 involves major construction to provide the access along the estuary (east) side of the existing rail line embankment. Post construction it is likely that the existing largely planted eastern embankment will be replaced by a structural wall along the new access. Option 3 has some comparative disadvantages over other options.

Option 4 will close the crossing and the adjacent land will be purchased to remove the requirement for third-party access. There will be relatively minor physical works of fencing off the level crossing and removing track crossing panels, as well as likely providing a gate access from the railway corridor to the east to allow for maintenance. The acquisition / severance of the land will likely result in a change of land use / land management which will change the visual character of the landscape. Nevertheless, option 4 has some comparative advantages over other options.

Option 5 involves provision of a new overbridge across the rail line. The structure is located in a high amenity landscape and will be visible from the protected views on Corballis Cottages Road. Option 5 has significant comparative disadvantages over other options.

Option 6 involves provision of a new underbridge beneath the rail line. While located in a high amenity landscape the structure will not be particularly visible from the wider landscape or protected views on Corballis Cottages Road. Option 6 has some comparative disadvantages over other options.

Biodiversity

Options 3, 5 and 6 have potential to significantly impact on the Malahide estuary internationally and nationally important designated sites, either directly or indirectly.

Option 3 would require significant works within the designated sites. It would also introduce people into an area currently inaccessible which may cause disturbance to overwintering birds. Although ranked the same as Options 5 and 6 (significant comparative disadvantage over other options), Option 3 is the least preferred option from a biodiversity perspective.

Options 5 and 6 would require works within the designated sites. Additional potential indirect impacts include construction related impacts (e.g. potential for water quality impacts or disturbance to birds). Although ranked the same (significant comparative disadvantage over other options), Option 5 may be less preferable than Option 6 from a biodiversity perspective due to the larger scale of works within the designated sites.

Determining the precise location of the Malahide Estuary SAC and SPA boundaries would be important for Options 3, 5 and 6 given that works for these options will come near and/or within these designated sites. This may take time and require consultation with the NPWS and even then, may prove difficult.

Option 4 offers significant comparative advantages over other options and is the preferred option from a biodiversity perspective. This option does not introduce any

direct/indirect impacts and provides opportunity for significant biodiversity benefit by managing the purchased lands for biodiversity.

There are several other potential ecological constraints for Options 5 and 6 but these are similar across the options and do not differentiate the preference between them. These include:

- Vegetation removal with potential for removal of habitat of value (scrub, hedgerows or treelines) and which may provide foraging, nesting, and commuting corridors for fauna species (e.g. birds, bats, small mammals).
- It is not known whether invasive species may occur in this works area. If present, there would be the risk of spreading these to the adjacent SAC and SPA which would be particularly sensitive receptors.

Noise and Vibration

Option 4 is, comparatively, the best option from a noise and vibration point of view as there are no noise or vibration impacts to the surrounding sensitive community.

Options 5 and 6 have the potential to impact the surrounding community during construction but will have less of an impact than Option 3, where construction will occur in close proximity to the residents on the Corballis Cottages Road. Construction for Options 5 and 6 will occur approximately 500 m away from the nearest residents, which means that the potential for negative impact is reduced compared to Option 3. However when compared to Option 4, Options 3, 5 and 6 are significant comparable disadvantages.

Water resources

The comparative differences across the options relate mainly to development adjacent to or within areas at flood risk from the River Pill or the Malahide Estuary, as well as development adjacent to and within the Malahide Estuary SAC/SPA and the impact this might have in terms of water pollution and changes to the hydrological regime.

Option 3 would require construction works on the edge of the estuary, in an environmentally sensitive area. A retaining structure is likely to be required along the length and the bridge over the River Pill would most likely need to be widened. These works have the potential to have an impact on the groundwater and surface water flow regimes as well as the water quality. Therefore, this option is considered to have significant comparative disadvantage over the other options in terms of water resources.

Option 4 does not propose any construction and would have no impact on the existing water resources in the area and is considered to have significant advantage over other options.

Option 5 would require works parallel to the River Pill and Malahide Estuary which are environmentally sensitive waterbodies. The construction of the ramps could have a negative impact on the waterbodies in terms of water pollution during construction and might cause changes to the groundwater and the surface water

flow regimes as well as the water quality and therefore is considered to have significant comparative disadvantage over the other options in terms of water resources.

Finally, option 6 would require works parallel to the River Pill and Malahide Estuary. The construction of the underpass could have a negative impact on the waterbodies in terms of water pollution during construction and has the potential to impact the groundwater and surface water flow regimes. The construction of the underpass will require considerably more excavation than the other options. This presents a greater impact to the groundwater flow regime and groundwater quality and their receiving waterbodies compared to the other options. This option is considered to have a significant comparative disadvantage over other options.

Archaeology, Architectural & cultural heritage

Option 3 involves the closing of the level crossing and the provision of a new access from Corballis Cottages along the estuary side of the railway. No archaeological monuments are located in proximity to the proposed works, however the area is of archaeological potential. Extensive works will be required with this option including earthmoving and excavation. This potential is borne out by the finds of a flint blade and flint flakes in Kicrea (1967:182-184).

Archaeological monitoring (11E0060) of works took place at a residential development to the west of the railway immediately before the railway overbridge and east-west trending road that extends to Corballis Cottages. As a result of this exercise no archaeological features or finds were identified. Option 3 also blocks the historic access and creates a new access road which will also impact on Kilcrea Bridge (NIAH 11336027 - Regional Importance). NOTE: the significance of impact on Kilcrea Bridge is likely to be Low.

Due to the extent of works required including excavation, option 3 has a significant comparative disadvantage over other options. As a mitigation measure, archaeological monitoring will be required during any earthmoving activities.

Option 5 involves localised excavation works to construct an overbridge. It would be a significant intervention into the landscape. Relative to the other proposed options, it would have a negative visual impact on the historic character of the surrounding landscape including the setting of the Malahide Viaduct - a Protected Structure (FCC RPS 0420), and Kilcrea Bridge (NIAH 11336027 - Regional Importance). Option 5 therefore also has a significant comparative disadvantage over other options.

Option 6 involves localised excavation works to construct an underbridge. It would also be a significant intervention into the landscape. Relative to Option 5 however, it would have less visual impact on the historic character of the surrounding landscape including the setting of the Malahide Viaduct - a Protected Structure (FCC RPS 0420), and Kilcrea Bridge (NIAH 11336027 - Regional Importance). As a mitigation measure, archaeological monitoring will be required during any construction works.

Option 4 will close the crossing and the adjacent land will be purchased to remove any third-party access. There are no physical works required and as such there is no opportunity to reveal below ground remains at this location. While this option blocks the historic access, it is considered that this will have a negligible impact on the architectural heritage value of the site. As a result, this option has a significant comparative advantage over other options.

Geology and Soils

The comparative differences across the four options relate mainly to construction related activities and the expected interaction with the underlying geology and soils as opposed to the operational considerations where there are no discernible differences.

The main construction impact relates to the earthworks required for the proposed option and the potential generation of earthworks material requiring recovery or disposal on or off the site.

Option 3 requires the provision for a new access along the estuary side of the railway which may result in the potential loss of topsoil. The access to be provided from Corballis Cottages along the estuary side of the railway may require the excavation and replacement of soft ground associated with the estuary to accommodate access (specification and type of access to be confirmed which will influence the earthworks volume required). Moreover, additional earthworks and interaction with the underlying soils and geology and existing railway ballast will be associated with construction of a new retaining wall (extending for approximately 500m) and widening of an existing underbridge. There is also the potential for encountering ground contamination associated with the current railway use and the subsequent construction and operational impacts to be considered as a result of the proposed works and their proximity to a designated site.

For Option 4, it is proposed that the crossing is closed and there will be no/minor works associated.

For both Options 5 and 6 respectively, the construction of a new overbridge and underbridge will require major earthworks and foundations, thereby increasing the risk for ground contamination. An additional disadvantage of option 6 is the proximity of the new underbridge with the estuary.

As such, from a geology and soils perspective, Options 3, 5 and 6 respectively are deemed to have a significant comparative disadvantage over Option 4.

Agricultural and Non-Agricultural

There are no significant comparative differences for agriculture between any of the options.

Air quality and Climate

All options are comparable from an air quality perspective as they each have good separation from the nearest human sensitive receptors.

All options are comparable from a climate perspective as they all increase timetable resilience by removing the risk of delays due to farm traffic interference.

However, Option 4 is preferable as it provides opportunity for carbon sequestration due to the purchased lands for biodiversity.

5.5.6 Accessibility and Social Inclusion

All options are comparable as there is not impact or improvement to accessibility and social inclusion. It will be necessary to ensure the safety of vulnerable population subsets using the cycleway, for example children and children or adults with physical or intellectual disabilities. This protection could, in principle, be provided by each of the options.

5.5.7 Integration

Integration is assessed using the five sub-criteria described below.

Adaptability in the future

All options are comparable as there is no improvement in terms of future internal transport links

Transport integration

All options are comparable as there is no impact on integration with other existing transport modes.

Land use integration

In all options the proposal complies with regional and local policies to improve public transport services including DART services, encouraging modal shift and allowing for increased density of development in certain areas. The development is contained within the existing ‘envelope’ of the railway line. There is no impact on existing land uses.

Government policy integration

All international, national, regional and local policies encourage improvements in relation to the efficiency of public transport. All the proposed options will facilitate this.

Geographical integration

All international, national, regional and local policies encourage improvements in relation to the efficiency of public transport. All the proposed options will facilitate this.

5.5.8 Physical Activity

All options are comparable. It is assumed that the Broadmeadow Way would be safely accommodated and then there is no temporary or long-term impact foreseen on walking or cycling opportunities.

5.6 Construction Considerations

Constructability considerations for the shortlisted options are as follows:

5.6.1 Option 3

It is assumed the retaining wall would be sheet piles, driven from the track during weekend possessions. At the same time bridge works would be undertaken. It is currently unknown what mitigation works are required to safeguard estuary features but assumed to be minimal.

Construction access is viable from the rail track and along the new road track once it has been sufficiently progressed. There will be disruption to the new cycleway, including probably short-term closures.

This option would also require a sizable construction compound to be installed temporarily during the works

5.6.2 Option 4

Any works required to close the crossing are expected to be minor and undertaken with no disruption to trains. Works will be either offline or during non-disruptive possessions.

5.6.3 Option 5

This option has significant civil engineering works, with challenges for construction access. It is assumed all plant, materials and labour would be delivered along the rail track in possessions but arrangements for road vehicles across farmland appears to be viable too (there being some farm tracks visible in Google imagery). Several weekend track possessions are anticipated to be needed, depending upon design.

There will be disruption to the new cycleway, including probably short-term closures.

This option would also require a sizable construction compound to be installed temporarily during the works

5.6.4 Option 6

Option 6 is similar to Option 5 from a construction perspective, but with the added risk of needing to lift and relay tracks. Significant civil engineering works are required, with challenging construction access. It is assumed all plant, materials and labour would be delivered along the rail track in possessions but arrangements for road vehicles across farmland appears to be viable too (there being some farm tracks visible in Google imagery). Several weekend track possessions are anticipated to be needed, depending upon design.

There will be disruption to the new cycleway, including probably short-term closures.

This option would also require a sizable construction compound to be installed temporarily during the works.

6 Summary and conclusions

6.1 Non-preferred options

Option 3 is not preferred due to:

- The large number of negative environmental impacts this option would result in.
- the construction costs of the access road and retaining wall on the west of the causeway would be significant.

Option 5 is not preferred due to:

- The large number of negative environmental impacts this option would result in.
- the construction costs of the overbridge would be significant.

Option 6 is not preferred due to:

- The large number of negative environmental impacts this option would result in.
- the construction costs of the underbridge would be significant.
- The long-term maintenance and management of water would be a significant challenge

6.2 Draft Emerging Preferred Option

Option 4 has been chosen as the Draft Emerging Preferred Option as it:

- Incurs minimal to no CAPEX and OPEX costs
- It's significant advantages over the other options on the environmental impacts, such as water resources, air quality and climate change.

6.3 Key Risks/Next Steps

The following risks have been identified:

- The purchasing process and appropriate valuation of the land needs to be assessed.
- Any ongoing obligations of being the landowner of this parcel of land need to be assessed.

A.1 Detailed MCA table

Comparison Criteria Legend	
Significant comparative advantage over other options	
Some comparative advantage over other options	
Comparable to other options / neutral	
Some comparative disadvantage over other options	
Significant comparative disadvantage over other options	

Economy											
Package of Work Description	Summary of requirements	Option Number	Description of Option	Capital Expenditure (CAPEX): Construction, land acquisition, temporary works		OPEX: Operational costs (IÉ or other entities), Technology advancements and future proofing / obsolescence		Train Operations Functionality/Economic Benefit		Traffic functionality and associated economic activities and opportunities	
				Quantitative appraisal of potential infrastructure costs of proposed options	Rationale	Qualitative appraisal of potential ongoing infrastructure maintenance costs of proposed options	Rationale	Qualitative appraisal of potential ongoing operational costs of proposed options	Rationale	Quantitative appraisal of potential wider benefits of proposed options	Rationale
				Estimate high level cost of construction of option Extent and type of 3rd party lands required permanently Extent and type of 3rd party lands required temporarily for temporary works during construction		Cost to maintain the infrastructure over the whole life. Effects of infrastructure maintenance to services. Provision of ways of undertaking routine inspections and maintenance activities while minimising the effect on service to customers.		Potential improvement or deterioration of the operational conditions of the line (reduction or increase of the risk of interruption of service) Increased DART service improving connectivity and economy (leading to increased competition in economy, increased output of firms, increased tax revenue).		Potential benefit to vehicular traffic flows in the vicinity of the works during construction and associated economic activities and opportunities in the vicinity Consideration of duration of traffic disruption and length of diversions To minimise the impacts on traffic and transportation during the construction and operational stages	
Electrification of Northern Line: XB001 Level Crossing	Electrification of the line from the end of the current electrified section at Malahide to Drogheda with 1500V DC overhead.	3	Close the crossing and provide new access from Corballis cottages along estuary side of railway		This option will likely require the widening of the tidal overflow bridge and the inclusion of a substantial length of wall along the estuary side. This will involve substantial structural and geotechnical solutions.		Maintenance required for the access road and retaining wall		Option 3 involves fully segregating road and rail traffic, increasing timetable resilience by removing the risk of delays due to road traffic interference.		Assume construction activities associated with constructing a new access off Corballis cottages will require a retaining structure and bridge widening.
		4	Close the crossing and IÉ purchase the adjacent land to remove any third party access		The only cost incurred for this option is the cost of purchasing the land.		Ongoing maintenance costs of the land purchased are expected to be low. Existing ditches will need to be maintained		Option 4 involves fully segregating road and rail traffic, increasing timetable resilience by removing the risk of delays due to road traffic interference.		No change or increase in construction traffic. Very small change in operational traffic for maintenance - operational traffic will probably reduce.
		5	Construct new overbridge		New overbridge and approach embankments required to span both the railway and the proposed greenway crossing. Significant civil engineering works, with challenge for construction access. Assumed all plant, materials and labour would be delivered along track in possessions but arrangements across farmland/tracks appear viable too. Several weekend possessions anticipated, depending upon design. Cycleway disrupted.		Limited maintenance costs for the bridge		Option 5 involves fully segregating road and rail traffic, increasing timetable resilience by removing the risk of delays due to road traffic interference.		Construction traffic for overbridge
		6	Construct new underbridge		New underbridge and approach embankments required to span both the railway and the proposed greenway crossing. Similar to Option 5 but with added risk of needing to lift and relay track. There are significant civil engineering works, with challenge for construction access. Assumed all plant, materials and labour would be delivered along track in possessions but arrangements across farmland/ tracks appear viable too. Several weekend possessions anticipated, depending upon design. Cycleway disrupted.		Maintenance required, such as drainage, linked with the underbridge		Option 6 involves fully segregating road and rail traffic, increasing timetable resilience by removing the risk of delays due to road traffic interference. There is a possibility of road traffic impacting rail services through bridge strikes by oversized vehicles, which could decrease timetable resilience and negatively impact performance. However this risk is low and does not affect the scoring		Construction traffic for underbridge

				Safety			
Package of Work Description	Summary of requirements	Option Number	Description of Option	Employer's Safety		Public safety	
				Qualitative appraisal on the safety impacts on IÉ or railway staff	Rationale	Qualitative appraisal on the safety impacts on the public (road/rail/cycle/pedestrian)	Rationale
				To reduce safety risks associated with construction, maintenance and operations. To reduce the potential for incidents or near-misses for IÉ/construction staff.		To reduce safety risks associated with passengers at platforms, public adjacent to the railway, and road, pedestrian and cycle users at level crossings. To reduce the potential for accidents for members of the public/passengers on railway infrastructure. To reduce the potential for conflict between rail and road users.	
Electrification of Northern Line: XB001 Level Crossing	Electrification of the line from the end of the current electrified section at Malahide to Drogheda with 1500V DC overhead.	3	Close the crossing and provide new access from Corballis cottages along estuary side of railway		No further need for IÉ staff on track apart from existing track/formation maintenance.		Public access to track is eliminated however public can still access the land on the eastern side of the track. Therefore risk is not fully removed to the public, unlike option 4.
		4	Close the crossing and IÉ purchase the adjacent land to remove any third party access		No further need for IÉ staff on track apart from existing track/formation maintenance.		Public access to track and to the land on eastern side is eliminated.
		5	Construct new overbridge		Maintenance of new infrastructure will require additional manpower on site and on track.		Risk of overpassing machinery to fall onto the tracks.
		6	Construct new underbridge		Maintenance of new infrastructure will require additional manpower on site and on track.		Risk of bridge strike from farm machinery.

				Environment															
Package of Work Description	Summary of requirements	Option Number	Description of Option	Landscape and Visual Quality		Biodiversity (Flora and Fauna)		Noise and Vibration		Water resources		Archaeology, Architectural and Cultural Heritage		Geology and Soils (includes Waste)		Agricultural and non-agricultural		Air Quality & Climate Change	
				Appraisal of landscape and visual impacts of options based on the sensitive viewpoints	Rationale	Qualitative appraisal on the impact on biodiversity	Rationale	Qualitative appraisal of the potential noise and vibration impact	Rationale	Qualitative appraisal on the potential impacts to surface, ground or coastal waters	Rationale	Qualitative appraisal of the potential impacts of proposed options on potential sub surface archaeology and impact on foundations and above ground elements of architectural heritage	Rationale	Qualitative appraisal of the potential impacts of the proposed options on waste and material resources including the reuse of site won materials.	Rationale	Qualitative appraisal of impacts on valued resources either from a human or natural origin with value arising for economic or cultural reasons. These assets can be existing utilities or non-renewable resources	Rationale	Qualitative appraisal of air quality and climate impacts both on the operational and construction phases	Rationale
				To avoid / minimise impact on designated amenities, landscapes, protected trees or views. To avoid / minimise visual impact on properties & amenities. To avoid / minimise removal of trees / hedgerows. To avoid / minimise impact from light pollution. To provide opportunities to enhance the local amenity and green infrastructure.		To ensure that the solution provided minimises the effects on biodiversity of the area and/or provides opportunities to enhance it.		To provide a solution which ensures minimum levels of noise and vibration		To minimise the impact or provide opportunities to enhance the quality of surface waters and associated floodplains, ground waters and coastal waters.		To minimise the impact on cultural heritage such as on below ground archaeological remains, historic buildings (individual and areas), and historic landscapes and parks.						To provide a solution which comprises a reduction in greenhouse gas emissions. To ensure that the chosen solution preserves or enhances the local air quality	
Electrification of Northern Line: XB001 Level Crossing	Electrification of the line from the end of the current electrified section at Malahide to Drogheda with 1500V DC overhead.	3	Close the crossing and provide new access from Corballis cottages along estuary side of railway		Works in context of objective to preserve views from Corballis Cottage Road. Moderate / Significant change in landscape / visual environment.		Would require significant works (including a new retaining structure) within the designated sites. It would also introduce people into an area currently inaccessible which may cause disturbance to overwintering birds. Although ranked the same as Options 5 and 6 this option is the least preferred option from a biodiversity perspective.		Construction noise would affect residents at Corballis cottages		Will require construction works on the edge of estuary, in an environmentally sensitive area. Retaining structure is likely to be required along the length. The bridge over the River Pili will most likely need to be widened. These works have the potential to have an impact on the groundwater and surface water flow regimes as well as the water quality		No archaeological monuments are located in proximity of the proposed works, however the area is of archaeological potential. Extensive works are required including earth moving and excavation to construct new access from Corballis cottages along the estuary side of the railway. This would require archaeological monitoring of the wetland / dryland interface potential. This potential is borne out by the finds of a flint blade and flint flakes in Kilcrea (1967:182-184). Monitoring (11E0060) of works took place at a residential development to the west of the railway immediately before the railway overbridge and east west road that extends to Corballis Cottages. No archaeological features or finds were identified. This option blocks the historic access, and creates a new access road which will also impact on Kilcrea Bridge (NIAH 11336027 - Regional Importance). NOTE: the significance of impact on Kilcrea Bridge is likely to be Low.		Construction related activities will have the main impact on soils and geology with the potential loss of topsoil through provision of access route. Access to be provided from Corballis Cottages along estuary side of railway may require the excavation and replacement of soft ground associated with the estuary to accommodate access route (specification and type of access to be confirmed which will influence the earthworks volume required. Additional earthworks and interaction with the underlying soils and geology and existing railway ballast will be associated with construction of a new retaining wall (extending for approximately 500m) and widening of existing underbridge. There is also the potential for encountering ground contamination associated with the current railway use and the subsequent construction and operational impacts to be considered as a result of the proposed works and their proximity to a designated site.		Improved independent access benefit balanced by increased land-take and permanent disturbance (additional travel time)		Construction works adjacent to estuary and cottages has the potential to generate dust impacts.
		4	Close the crossing and if purchase the adjacent land to remove any third party access		Likely to result in change in visual character of land use for acquired /severed lands.		Offers significant comparative advantages over other options and is the preferred option from a biodiversity perspective. This is because not only does it avoid introducing any new significant impacts, either direct or indirect, it also provides opportunity for a significant biodiversity benefit by managing the purchased lands for biodiversity.		No noise/vibration impacts		No change		No archaeological monuments are located in proximity to the proposed works. No works are required and there is no opportunity to reveal below ground remains at this location due to excavation. Blocks the historic access, though it is considered that this will have a negligible impact on the architectural heritage value of the site		Crossing closed & no/very minor works planned		Improved access balanced by increased land-take		No impact on air quality as no works likely to generate dust required. The purchase of land offers the opportunity for planting which can have a positive impact on climate through carbon sequestration depending on the species planted.
		5	Construct new overbridge		Visually intrusive new structure in sensitive landscape / visual environment.		Would require works within the designated sites. Additional potential indirect impacts include construction related impacts (e.g. potential for water quality impacts or disturbance to birds). Although ranked the same as Option 6 this option may be less preferable than Option 6 from a biodiversity perspective due to the larger scale of works within the designated sites.		Construction noise may affect receptors, but closest receptor is 500 m away		Construction of an overbridge over the crossing parallel to River Pili and Malahide Estuary which are environmentally sensitive waterbodies. The construction of the ramps could have a negative impact on the waterbodies in terms of water pollution during construction and might cause changes to the groundwater and the surface water flow regimes as well as the water quality		No archaeological monuments are located in proximity to the proposed works. Localised excavation and construction work required in proximity to NIAH 11226027 bridge. Archaeological monitoring will be required as works are being carried out in an area considered to be of potential as borne out by the finds of a flint blade and flint flakes in Kilcrea (1967:182-184). This option would be a significant intervention into the landscape. Relative to the other proposed options, it would have a negative visual impact on the historic character of the surrounding landscape including the setting of the Malahide Viaduct - a Protected Structure (FCC RPS 0420), and Kilcrea Bridge (NIAH 11336027 - Regional Importance)		Major earthworks and foundations associated with overbridge. Potential ground contamination		Improved access balanced by increased land-take		Construction works adjacent to estuary has the potential to generate dust impacts.
		6	Construct new underbridge		Limited visibility of new structure in sensitive landscape / visual environment.		Would require works within the designated sites. Additional potential indirect impacts include construction related impacts (e.g. potential for water quality impacts or disturbance to birds). Although ranked the same as Option 5 this option may be more preferable than Option 5 from a biodiversity perspective due to the lesser scale of works within the designated sites.		Construction noise may affect receptors, but closest receptor is 500 m away		The construction of the underpass will require considerably more excavation than the other options. This presents a greater impact to the groundwater flow regime and groundwater quality and their receiving surface waterbodies.		No archaeological monuments are located in proximity to the proposed works. Localised excavation and construction work required in proximity to NIAH 11226027 bridge. Archaeological monitoring will be required as works are being carried out in an area considered to be of potential as borne out by the finds of a flint blade and flint flakes in Kilcrea (1967:182-184). This option would also be a significant intervention into the landscape. Relative to the Option 5, it would have less visual impact on the historic character of the surrounding landscape including the setting of the Malahide Viaduct - a Protected Structure (FCC RPS 0420), and Kilcrea Bridge (NIAH 11336027 - Regional Importance)		Major earthworks and foundations associated with underbridge. Potential ground contamination. Proximity with estuary.		Improved access for livestock balanced by increased land-take and restriction of machinery access.		Construction works adjacent to estuary has the potential to generate dust impacts.

				Accessibility & Social Inclusion			
Package of Work Description	Summary of requirements	Option Number	Description of Option	Accessibility		Social Inclusion	
				Qualitative appraisal of capacity of options to facilitate the movement of people (either within, on to or across the rail system)	Rationale	Qualitative appraisal of capacity of options to provide ease of access for the mobility and visually impaired	Rationale
				To provide a solution which produces a positive impact on passenger and public experience.		To provide a solution which creates a positive impact towards vulnerable groups. To provide a solution which creates a positive impact to deprived geographic areas Improve accessibility to key facilities, such as employment, education, transport and healthcare to satisfy transport demand for all trip types	
Electrification of Northern Line: XB001 Level Crossing	Electrification of the line from the end of the current electrified section at Malahide to Drogheda with 1500V DC overhead.	3	Close the crossing and provide new access from Corballis cottages along estuary side of railway		No impact or improvement to accessibility.		No impact or improvement to social inclusion
		4	Close the crossing and if purchase the adjacent land to remove any third party access		No impact or improvement to accessibility.		No impact or improvement to social inclusion
		5	Construct new overbridge		No impact or improvement to accessibility.		No impact or improvement to social inclusion
		6	Construct new underbridge		No impact or improvement to accessibility.		No impact or improvement to social inclusion

Integration													
Package of Work Description	Summary of requirements	Option Number	Description of Option	Adaptability in the future		Transport Integration		Land use integration		Geographical Integration		Government policy Integration	
				Qualitative appraisal of capacity of options to cater for future projects or aspirations	Rationale	Qualitative appraisal of the options and their impact on integration with other transport modes	Rationale	Qualitative appraisal of the options and their impact on integration with land use policies	Rationale	Qualitative appraisal of the options and their impact on integration with geographical policies	Rationale	Qualitative appraisal of the options and their impact on integration with geographical and government policies	Rationale
				Ability to continue to function successfully despite future changes in circumstances		Scope for and ease of interchange between modes New interchange nodes and facilities Reduce walking and wait times associated with interchanges Integration with the cycle networks Modal shifts figures during construction and operations Changes to journey times to transport nodes Impact on the operation of the other transport services both during construction and in operation stage		Consistency with land use strategies, regional and local plans		Potential to impact on external links during construction Potential to impact on external links during operations Consideration for any community severance impacts		Integration with national and international plans and policies	
Electrification of Northern Line: XB001 Level Crossing	Electrification of the line from the end of the current electrified section at Malahide to Drogheda with 1500V DC overhead.	3	Close the crossing and provide new access from Corballis cottages along estuary side of railway		No improvement in terms of future internal transport links		No impact on integration with other existing transport modes as private car access is maintained.		The proposal complies with regional and local policies to improve public transport services including DART services, encouraging modal shift and allowing for increased density of development in certain areas. The development is contained within the existing "envelope" of the rail line. There is no impact on existing land uses.		All international, national, regional and local policies encourage improvements in relation to the efficiency of public transport. All the proposed options will facilitate this.		All international, national, regional and local policies encourage improvements in relation to the efficiency of public transport. All the proposed options will facilitate this.
		4	Close the crossing and if purchase the adjacent land to remove any third party access		No improvement in terms of future internal transport links		Requirements for private car access is removed.		The proposal complies with regional and local policies to improve public transport services including DART services, encouraging modal shift and allowing for increased density of development in certain areas. The development is contained within the existing "envelope" of the rail line. There is no impact on existing land uses.		All international, national, regional and local policies encourage improvements in relation to the efficiency of public transport. All the proposed options will facilitate this.		All international, national, regional and local policies encourage improvements in relation to the efficiency of public transport. All the proposed options will facilitate this.
		5	Construct new overbridge		No improvement in terms of future internal transport links		No impact on integration with other existing transport modes as private car access is maintained.		The proposal complies with regional and local policies to improve public transport services including DART services, encouraging modal shift and allowing for increased density of development in certain areas. The development is contained within the existing "envelope" of the rail line. There is no impact on existing land uses.		All international, national, regional and local policies encourage improvements in relation to the efficiency of public transport. All the proposed options will facilitate this.		All international, national, regional and local policies encourage improvements in relation to the efficiency of public transport. All the proposed options will facilitate this.
		6	Construct new underbridge		No improvement in terms of future internal transport links		No impact on integration with other existing transport modes as private car access is maintained.		The proposal complies with regional and local policies to improve public transport services including DART services, encouraging modal shift and allowing for increased density of development in certain areas. The development is contained within the existing "envelope" of the rail line. There is no impact on existing land uses.		All international, national, regional and local policies encourage improvements in relation to the efficiency of public transport. All the proposed options will facilitate this.		All international, national, regional and local policies encourage improvements in relation to the efficiency of public transport. All the proposed options will facilitate this.

				Physical Activity	
Package of Work Description	Summary of requirements	Option Number	Description of Option	Walking / cycling opportunities	
				Qualitative appraisal of the options and their impact to enable walking and cycling opportunities in a safer environment for the communities along the route	Rationale
				To enable walking and cycling opportunities in a safer environment in the communities along the route To create a healthy environment conducive to active travel Connectivity to adjoining cycling and pedestrian facilities Enhanced connectivity between key attractions/trip generators related to active modes Diversion, duration and impact on journey times and potential to create a negative modal shift (e.g. people opt to drive instead of walk or cycle)	
Electrification of Northern Line: XB001 Level Crossing	Electrification of the line from the end of the current electrified section at Malahide to Drogheda with 1500V DC overhead.	3	Close the crossing and provide new access from Corballis cottages along estuary side of railway		Level crossing is closed
		4	Close the crossing and if purchase the adjacent land to remove any third party access		Level crossing is closed
		5	Construct new overbridge		Level crossing is closed
		6	Construct new underbridge		Level crossing is closed