N25 Little Island Pedestrian and Cyclist Bridge
Environmental Impact Assessment Report

Appendix 3.2

Options Selection Report / Structures Options Report

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1. Introduction

1.1 Scope of Report

Cork County Council (CCC), the National Transport Authority (NTA) and Arup have identified the benefits associated with the provision of a new pedestrian and cycle bridge to enhance sustainable transport and active transport within the Eastgate Business Park and the surrounding area. The proposed bridge will cross the N25 and connect the Little Island Train Station, the Glounthaune Road and future greenway to the Eastgate Business Park in Little Island, Cork. The objective of the proposed bridge is to provide efficient pedestrian and cycle connectivity between the Little Island Train Station and the Eastgate Business Park and to promote sustainable transport modes while minimising impacts on the surrounding area and environment.

The report builds on work carried out by Arup as part of the Little Island Sustainable Transport Interventions (LISTI) project where the benefits of a new pedestrian and cycle bridge were identified as part of the design interventions recommended on the existing public road network and East Gate Business Park. Arup were appointed by CCC in 2020 to undertake a preliminary feasibility report for this crossing. Subsequent to this, Arup were appointed in 2022 to progress the bridge design through Phases 2 and 3 of the NTA Project Appraisal Guidelines (PAG's) to include options assessment, preliminary design, and progression of the scheme through statutory planning.

This report encompasses the requirements of the Department of Transport (DOT) Common Appraisal Framework (CAF) in undertaking a Multi Criteria Appraisal (MCA) of Bridge options as per the requirements of the NTA Project Approval Guidelines for Phase 2 Concept Development and Options Selection. This report forms the basis of the NTA Phase 2 Options Selection Report (OSR).

Following the guidelines established in TII document DN-STR-03001 – Technical Acceptance of Structures, this document also presents the Structural Options Report for the Little Island/N25 Pedestrian and Cycle bridge.

1.2 Project Background

The Little Island Sustainable Transport Interventions Project (LISTI) Design Options Assessment Report provides the basis for the identification of the need for the proposed pedestrian and cycle bridge and the possible locations. The benefits of a new pedestrian and cycle bridge were identified as part of the design interventions recommended on the existing public road network and East Gate Business Park. These recommendations were to deliver enhanced access for public transport and pedestrians/cyclists to and within Little Island and between Little Island and the Little Island Railway Station.

Previous work was also undertaken in relation to the feasibility of a new bridge proposal adjacent to the existing R623 N25 overbridge completed by RPS Consultant Engineers (RPS) referred to as "Little Island Pedestrian / Cycle Bridge - High Level Feasibility Study" - December 2016. As part of that proposal, pedestrian steps and elevators were proposed to achieve the level difference with no allowance for ramps. Therefore the bridge would not accommodate cyclists unless cyclists dismounted and utilised the proposed elevators or stairs.

Arup were appointed in 2020 to undertake a feasibility report for the N25 Little Island Pedestrian and Cycle Bridge which is appended to this Report. This report found that bridge crossings were feasible and recommended a high-level preferred alignment option. The report also highlighted several feasible structural types and span options including a single span over the Irish Rail track and the N25 and a 2-span arrangement with a support between the railway and the N25. The feasibility report recommended the project should proceed to the next stage of defining the preferred structural option and completing preliminary design.

Further to the Feasibility Report a Bridge Alignment and Width Options Assessment was carried out to review the recommended bridge alignment in more detail and assess it against alternatives. This report also reviewed the Irish and international best practice regarding bridge width requirements and has been appended to this report for reference.

1.3 Multi criteria assessment scoring overview

A multi criteria assessment (MCA) has been carried out to compare and assess structural options for the main spans and the approach ramps. This is consistent with the requirements of the Department of Transport (DOT) Common Appraisal Framework (CAF) as required by the National Transport Authority Project Approval Guidelines.

Criteria to be assessed are taken from the requirements of the CAF qualitative appraisal criteria and Transport Infrastructure Ireland Structural Options Report (SOR) STA-1a model requirements given in DN-STR-03001.

The criteria have been assessed based on a scoring hierarchy from 1 to 5. An untenable solution, one which is unfeasible or detrimental to the progression of the project, scores a 1. While a characteristic which aligns with the core criteria of the brief and has a highly beneficial impact on the project receives a scoring of 5. An equal weighting has been given to all criteria.

1.3.1 Department of Transport Common Appraisal Framework Qualitative Appraisal Criteria

This project is proposed to be funded through the National Transport Authority (NTA) and as such is subject to the NTA Project Approval Guidelines. Phase 2, as outlined in the guidelines, comprises Concept Development and Option Selection. The purpose of this phase is to:

"…develop the project concept through the options selection, including appraisal of the alternatives and options, and selection of the Preferred Option."

Part of Phase 2 is the Options Selection Report required for projects in Band 2 (0.5million to 10million). As the requirements of this report broadly aligns with the TII Structure Options Report this report is intended to function also as the Structure Options Report.

The requirements of the Option Selection Report require that optioneering process to consider the realistic alternatives which may involve different modes, routes or alignments, alternative designs, or substitute approaches that could also deliver the core project objectives. In the case of this project, the earlier Feasibility Report and LISTI report have identified the requirements for a new pedestrian and cycling crossing joining Little Island Station and the Eastgate Business Park area. The first phase of the optioneering process as documented in the Alignment and Width Options Assessment Report (Appended) proposed a preferred bridge alignment based on a multi criteria assessment, see Section 3. As a result, this report will focus primarily on the options assessment of the crossing structural form *'alternative designs'*.

The NTA Project Approval Guidelines require the Sponsoring Agent (CCC) to consider the Department of Transport (DOT) Common Appraisal Framework in assessing options. See appraisal in accordance with the Qualitative guidance outlined in Section 4.3 of the DOT Common Appraisal Framework in the following sections.

The project scope also lays out the requirement for a multi criteria assessment of the options. In accordance with the DOT common appraisal framework a simple appraisal is required.

Table 1.1: Overview of Appraisal Thresholds and Scale of Appraisal Required

Estimated Project Cost	Scale of Appraisal Required
Less than €10m	Simple Appraisal incorporating elements of a preliminary and detailed appraisal

Figure 1.1: Department of Transport Common Appraisal Framework scale of appraisal

A comparative cost calculation is completed in Section 6 of this report. Further to this, a qualitative multi criteria analysis is carried out to the Project Appraisal Criteria.

Table 4.3: Project Appraisal Criteria

Economy	The impacts of a transport investment on economic growth and competitiveness are assessed under the economic impact and economic efficiency criteria.
Safety	Safety is concerned with the impact of the investment on the number of transport related accidents.
Integration	Integration considers the extent to which the project being evaluated promotes integration of transport networks and is compatible with Government policies, including national spatial and planning policy.
Environment	Environment embraces a range of impacts, such as emissions to air, noise, and ecological and architectural impacts.
Accessibility and Social Inclusion	Accessibility and social inclusion embraces the notion that some priority should be given to benefits that accrue to those suffering from social deprivation, geographic isolation and mobility and sensory deprivation.
Physical Activity (where applicable)	This relates to the health benefits derived from using different transport modes

Figure 1.2: Department of Transport Common Appraisal Framework Project Appraisal Criteria

Previous reports have identified the need for a bridge crossing in this location and the scope of this report is to develop this further to recommend a preferred bridge alignment and structural form. Therefore, an assessment of the 'do nothing' approach has not been completed as part of this report.

1.3.2 Transport Infrastructure Ireland Structural Options Report appraisal criteria

The following are the model criteria given by TII in DN-STR-03001 for the assessment of structural options. Many of these criteria are common with the DOT CAF criteria.

- Technical Evaluation
- Economic Evaluation
- Aesthetic Evaluation
- Evaluation of Durability and Maintenance Requirements
- Hydraulic Considerations (where applicable)
- Environmental Considerations
- Health & Safety Considerations
- Construction and Buildability
- Ground Conditions

2. Site and Location

The proposed bridge will cross the N25 and the Cork to Middleton/Cobh train line approximately 10km to the East of Cork City centre, see Figure 2.1. The high-level preferred bridge alignment as identified by the Arup feasibility report is shown in Figure 3.2

The N25 in this location is approximately 50m wide. To the North of this the Irish Rail land is approx. 30m wide with a CCC owned parkland and woodland to the north.

To the south of the N25 there is an existing woodland and the Radisson Blu hotel. The southern woodland is partly owned by the Radisson Blu and partly by a private landowner, see Figure 2.2.

A crossing in this location will provide a high-quality pedestrian and cycle link between little island station, the proposed Middleton to Cork greenway and the wider environs with Eastgate Business Park and the wider little Island area. For further details on the crossing location selected refer to the Arup Feasibility Report and the bridge Alignment and Width Options Assessment Report.

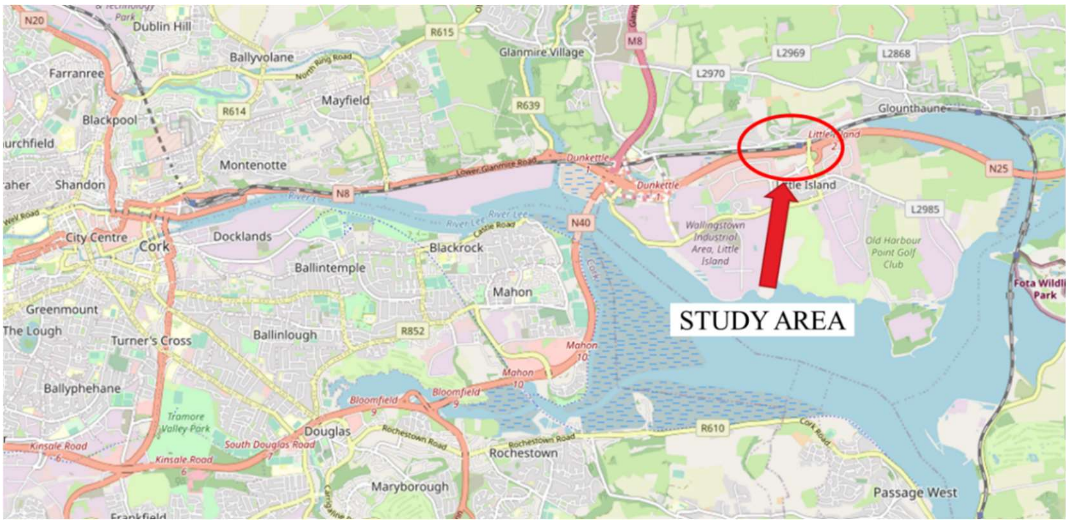

Figure 2.1: General location of proposed bridge crossing @OpenStreetMap contributors

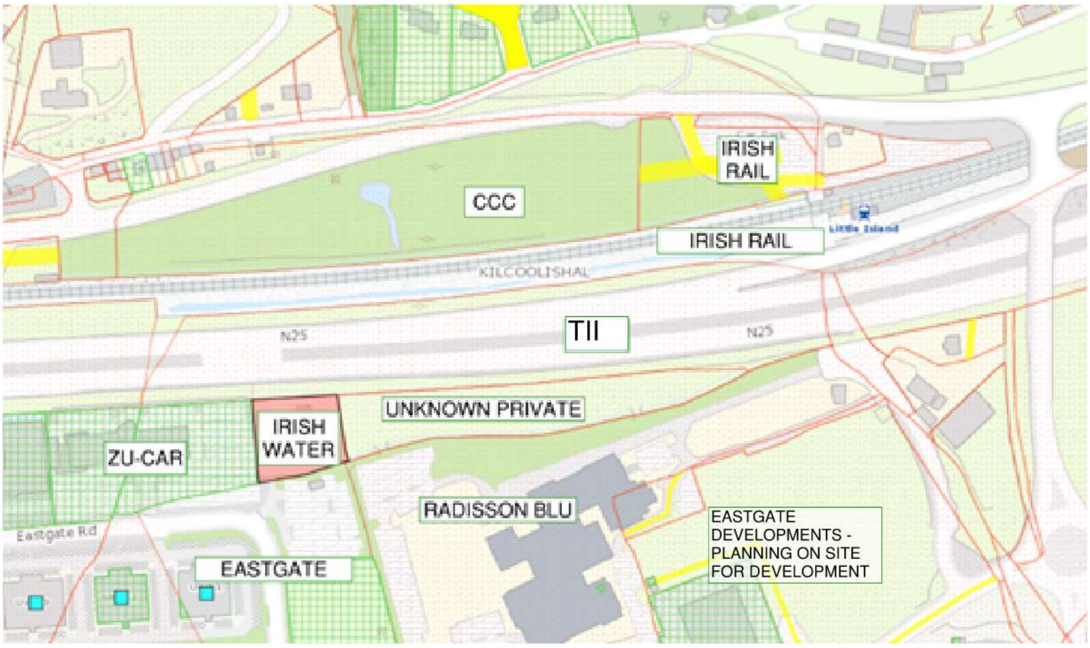

Figure 2.2: Details of Landowner/occupiers at bridge location (from land registry)

3. Alignment

The first phase of the options assessment is to determine the preferred alignment and has been documented in the Arup Feasibility Report which recommended alignment Option 2 as the preferred option, see Figure 3.1.

The alignment options were assessed further during this stage of design in the Alignment and Width Options Assessment Report LIPD-ARUP-ZZ-XX-RP-CB-001 (Appended) with more detailed topographical information available and following initial discussions regarding clearance envelopes with Transport Infrastructure Ireland (TII) and Irish Rail.

Based on the assessments carried out in these reports Alignment Option 2 (Figure 3.2) has been taken forward as the preferred alignment option for consideration of bridge structural options. The primary distinguishing factors which lead to the selection of alignment option 2 are summarised below.

- This option presents the most direct route of options considered along the primary desire line from Little Island Train Station to Eastgate Business Park.
- The southern tie in of this option services the largest working population as per the Little Island Sustainable Transport Improvements Planning Report. This option also services the Radisson Blu hotel directly through the intermediate landing near the existing carpark area
- This option is placed at the bottom of the east bound off ramp to minimise the vertical elevation of the bridge whilst achieving the required clearances to the N25. This has an impact on minimising the length of ramping and overall environmental impact on the area.
- This option minimises disruption to existing developments, for example the Irish Water building to the south of the N25. It also allows for tie in on the north and south which do not cross other roads, minimising the overall ramp length.
- This option can tie in with proposed LISTI works in the Eastgate business park without disrupting current proposals.
- Provides sufficient distance east of the existing TII VMS Gantries to ensure adequate recognition time of the existing portal gantry signage on the westbound approach.

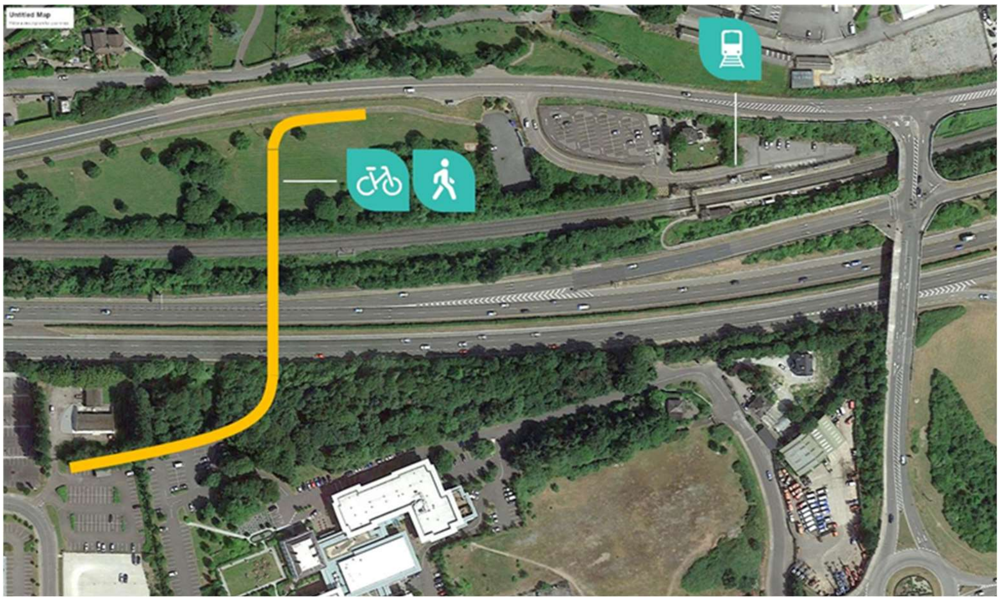

Figure 3.1: Preferred high level alignment recommended by from feasibility study

Figure 3.2: Preferred alignment, see alignment and width technical note appended

4. Description of the Structure and Options Considered

4.1 Constraints Identified

The key constraints contributing to the assessment of bridge options and the selection of the emerging preferred option are highlighted below. Constraints associated with the preferred alignment (route selection) have been considered in detail in both the Arup Feasibility Report (appended) and the Alignment and Width Options Assessment Report (appended). For further information on the constraints leading to the preferred alignment refer to these documents.

4.1.1 Geometric constraints

Irish Rail have advised a clearance from the structure's soffit to the rail of 5.3m minimum is required.

TII require a clearance from highway level to the structure's soffit of 5.7m minimum. In accordance with DN-GEO-03036 Cross Sections and Headroom.

There is a new portal gantry to the west of the proposed bridge location in the westbound lane. TII have advised that they require a minimum 200m site line to be maintained to this in a westbound direction. The preferred bridge alignment has taken account of this, see the Alignment and Width Options Assessment (appended) for more information.

TII STR-03005 recommends a maximum gradient of the structure of 1 in 20 (5%). TII-STR-03005 Section 6.1 notes landings are not required for structures with gradient flatter than 1 in 20. DMRB CD353 Section 5.11 (below) which has been updated more recently clarifies that for gradients of 1 in 22 no intermediate landings are required. As the overall structural length for a 1 in 20 gradient including landings is very similar to that of a 1 in 22 gradient with no landings it is proposed that the design proceeds based on a maximum 1 in 22 gradient (4.5%).

Landings and horizontal alignment on ramps

5.11 Intermediate horizontal landings shall be provided as follows:

1) for gradients shallower than 1 in 22: intermediate landings are not required;
2) for a gradient between 1 in 20 and 1 in 22: at equal vertical rise intervals of not more than 2.5 metres; and,
3) for gradients steeper than 1 in 20: at vertical rise intervals of not more than 0.65 metres.

4.1.2 Parapet/guarding constraints

Irish Rail standard CCE-TMS-410 Civil Engineering Structures Design Standard Section 5.3.6, requires a 1.8m high parapet over the rail. Irish rail has advised that this should consist of a 1.2m high solid infill section with 0.6m mesh infill above to allow for the potential of future overhead electrical on this line.

TII require a 1.4m high cycle parapet to be provided for the span(s) crossing the N25, in accordance with DN-STR-03005 Design Criteria for Footbridges. It is proposed that this parapet requirement be implemented on the approach ramp elevated sections also.

4.1.3 Existing Services

During the Feasibility Report stage utility companies were contacted in relation to the location of assets within the feasibility study area. The results are summarised in the table below.

Table 4.1: Location of assets

Utility Provider	Asset
Virgin Media	No services present
BT	Cable duct running from train station, along off ramp to Little Island and across existing bridge and into Eastgate Business Park
Gas Networks Ireland	600mm 19 bar transmission pipeline crosses through park under N25 to Eastgate Business Park 180mm 4 bar PE distribution pipe crosses the N25 between the train station and Eastgate Business Park
Aurora	Duct running parallel to the railway on area in between the railway and N25 road.
Electricity Supply Board	Buried and overhead services in vicinity 10kV overhead cable crosses through the park on the northern side of the N25, spans over the N25 before going underground and distributed through the Eastgate Business Park.
Irish Water/CCC (Foul and Water)	Gravity Foul main crosses the N25 through the park to a pumping station within the Eastgate Business Park 750mm Asbestos watermain running East-West across the existing park and then under the N25 to the Eastgate Business Park
E-net	Duct running through median of N25 road and into Eastgate Business Park
Eir	Several buried 50-100mm ducts Ducts cross under N25 road between the train station and Eastgate Business Park

During this stage of the works a GPR survey of the northern park area was conducted. The primary reason for this was to determine the location of the gas pipeline, water main and foul main crossing the park. Irish Rail land and the N25 was not surveyed at this point. It is recommended that local surveys be caried out during detailed design along the bridge alignment to determine the requirement for any diversions that may be required .

4.1.4 Environmental Constraints

A detailed study of Environmental constraints has been included in section 6.2 of the Arup Feasibility Report. This constraints study was considered in the recommendation of the preferred bridge alignment in the Feasibility Report and further in the Alignment and Bridge Width Options Assessment Report in selecting the preferred alignment option.

Further to this an Environmental Impact Assessment and Appropriate Assessment screening will take place of the emerging preferred structural option and alignment. Some key items to be considered in this study are

- Impacts to migratory and non-migratory birds flight paths.
- Potential hydrological linkages to nearby protected sites.
- Impacts to southern wooded area and wooded area surrounding Irish Rail track.
- Impacts to Northern Park area where ramped connections to bridge crossing are required.
- Impacts of flooding to bridge construction and detailing

For further details of environmental constraints refer to Feasibility Report.

4.1.5 Flooding

The website flooodinfo.ie provides flood maps which show a medium probability of coastal flooding in the northern park area and the lower areas surrounding the Irish Rail track at the location of the preferred alignment. Consideration shall be given to this is the options assessment and preliminary design of the preferred option. Consideration shall also be given to the mix of embankment vs elevated structure in areas at risk of flooding to minimise the maintenance liability for components in this area. Further consideration will be given to flood risk in the Environmental Impact Assessment.

Figure 4.1: Screenshot from floodinfo.ie showing extent of potential coastal flooding at location of proposed alignment

4.1.6 Aesthetics

Aesthetics, visual and user experience of the bridge has been identified by Cork County Council as a key factor to be considered. Some primary considerations of the optioneering process regarding aesthetics are given below:

- The main span of the structure crossing the N25 will be a signature piece of the overall structure that will be viewed by users of the N25 and from the surrounding area. An emphasis on high aesthetic quality is considered for this signature span to encourage members of the public to use the structure and resulting in increased active travel in the area.
- The aesthetic and feel of the structure for bridge users from deck level should be consistent across the entire crossing, where possible, regardless of different structural types used.
- Users of the northern amenity park area, Little Island train station, the Cork City to Middleton greenway and the adjacent highway will be able to view the northern approach ramp. Consideration needs to be given to the high aesthetic integrity of this section and integration of the approach ramp within the amenity park itself.
- The soffit of the structure over the railway line is not as visible to users of the public due to screening with the trees and lack of access for the public can be considered of lower priority for Aesthetic purposes. Similarly, the soffit of the section through the southern wooded area will not be visible to the public.

4.1.7 N25 and Irish Rail Boundary

Both Irish Rail and TII require physical setbacks from edge of railway and edge of roadway to foundations/substructures. This foundation free zone is 4.5m from the edge of track and the edge of the road respectively. No abutment/pier is allowed in the central median of the N25 in accordance with TII DN-STR-03005. This will dictate feasible span arrangements.

4.1.8 Constructability

The proposed bridge site has several physical constraints that will affect constructability. Section 12 of this report discusses feasible construction methodologies in more detail. Some key constraints are as follows:

- Works within N25, night and weekend working during road and lane closures will be required.
- Clearance under adjacent bridges for transporting prefabricated structures to site.
- Exclusion zones surrounding the railway line for construction works.
- Staging zones available for onsite fabrication.
- Access and clearance of wooded area to south of N25 for construction works.

On selection of the preferred structural option a more detailed constructability assessment will be carried out in the next preliminary design phase of the project.

4.1.9 Planning Considerations

Section 50(1)(a) of the Roads Act, 1993 (as amended) specifies the classes of development which require an EIA.

50.—(1) (*a*) A road authority shall prepare a statement of the likely effects on the environment (hereinafter referred to as an "environmental impact statement") of any proposed road development consisting of—

(i) the construction of a motorway,

(ii) the construction of a busway,

(iii) any prescribed type of proposed road development consisting of the construction of a proposed public road or the improvement of an existing public road.

Article 8 of the Roads Regulations 1994 (Road development prescribed for the purposes of Section 50(1)(a) of the Roads Act, 1993 (as amended) specifies the classes of development which require an EIA, including:

'The construction of a new bridge or tunnel which would be 100 metres or more in length'

Additionally, Section 50(1)(c) of the Roads Act, 1993 (as amended) specifies the following:

'Where a road authority considers that any proposed road development (other than development to which paragraph (a) applies) …. would be likely to have significant effects on the environment…'

Due to the total length of this bridge crossing at over 100m and the location of the proposed southern approach ramp in a currently wooded area an EAIR is required. Due to the proximity of the

Therefore, under the assumption that a Natura Impact Statement (NIS) and Environmental Impact Assessment (EIA) are screened in, based on the above, it will be required to submit planning to An Bord Pleanála (ABP) under Sections 175 and 177AE of the planning regulations.

4.2 Description of Bridge Options

The following section provides structural options for the N25 and Irish Rail spans. For approach ramp options see Section 4.3.

4.2.1 Option 1 – Single span steel through truss

Structural Option 1 consists of a single span steel through truss structure crossing both the N25 and the Irish Rail line in a single span. The structure, shown in Figure 4.2, is an arched Howe truss structure. The span of this structure will be approximately 82m. The steel structure would be of painted steel construction. Weathering steel is not suitable as the location is close to the ocean. Figure 4.3 gives an indicative example of a similar structure while Figure 4.4 gives an indicative example of a similar structure with a higher aesthetic quality.

Foundations for this option will be set back from the highway on the south and to the north of the Irish Rail track. Foundations are anticipated to be of reinforced concrete piled construction.

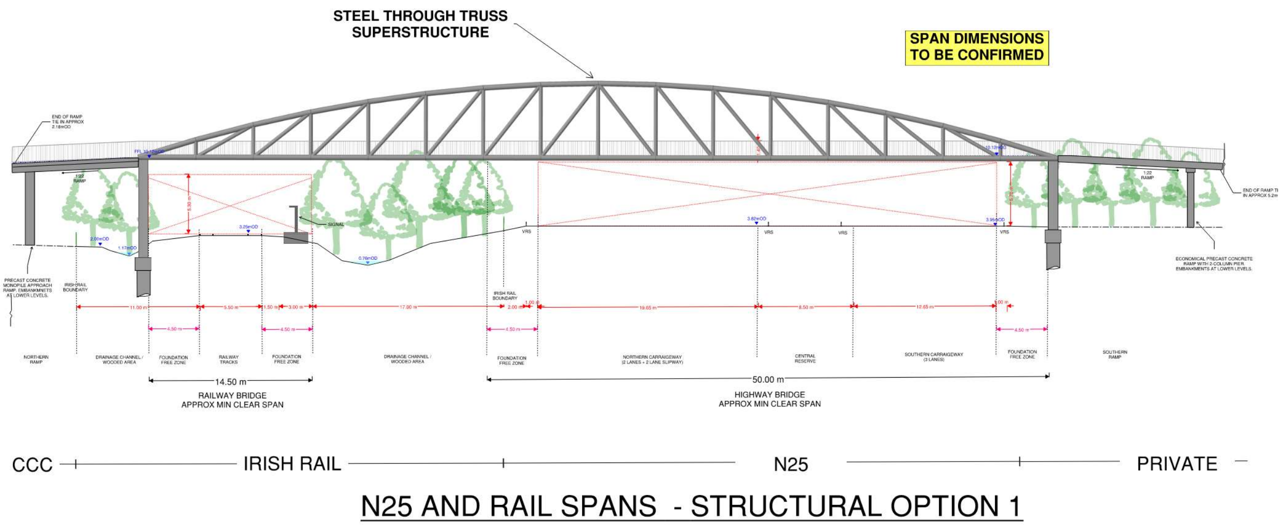

Figure 4.2: Structural option 3 indicative elevation with N25 span, Irish Rail span and start of approach ramps

Figure 4.3: Example of through truss pedestrian and cycle bridge

Figure 4.4: Example of through truss pedestrian and cycle bridge of higher aesthetic (note weathering steel not expected applicable for this project, architectural option would be painted steel)

4.2.2 Option 2 - Two span steel through truss

Structural option 2 consists of a 2-span steel through truss structure crossing the N25 and the Irish Rail line in separate spans. The structures shown in Figure 4.5 are arched Howe truss structures. The spans of these structures will be approximately 50m (N25) and 30m (Irish Rail). The steel structures would be of painted steel construction. Weathering steel is not suitable as the location is close to the ocean. Figure 4.6 and Figure 4.7 give an indicative example of a similar structures.

Foundations for this option will be set back from the highway on both sides and to the north of Irish Rail track. Foundations are anticipated to be of reinforced concrete piled construction.

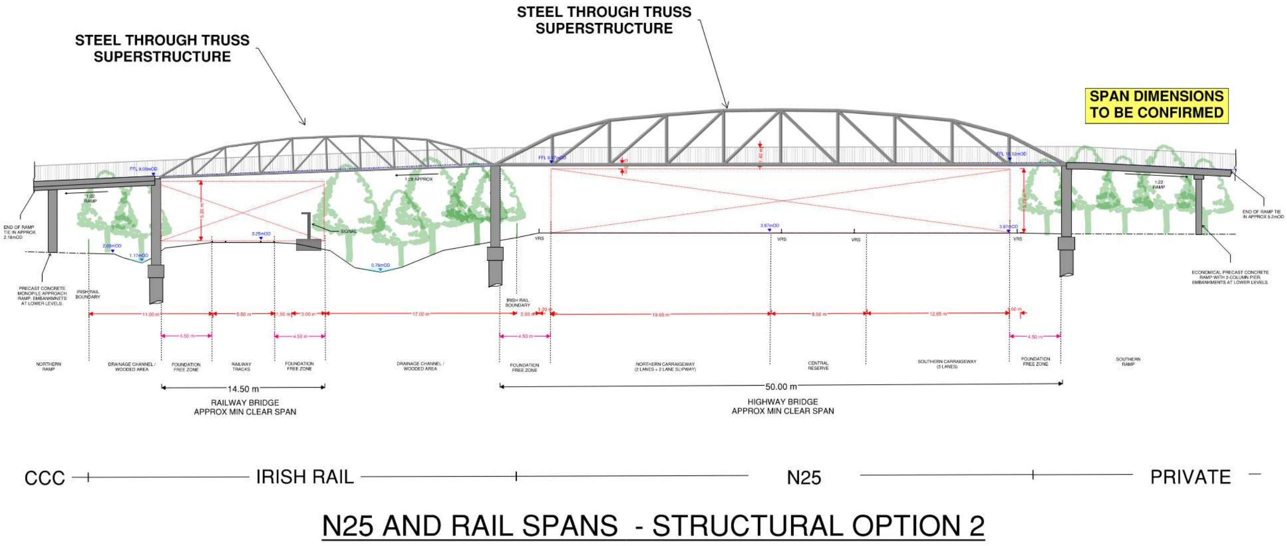

Figure 4.5: Structural option 2 indicative elevation with N25 span, Irish Rail span and start of approach ramps

Figure 4.6: Example of multiple span through truss footbridge structure

Figure 4.7: Example of shorter span steel through truss over road

4.2.3 Option 3 – Steel network arch N25 span with reinforced concrete portal frame over rail.

Structural option 3 consists of a single span steel network arch structure over the N25 and a 2-span precast segmental portal frame structure over the Irish Rail track and adjacent land to the south. Both a steel deck and a concrete deck can be considered for this option should it be selected. A steel deck would be more lightweight however a concrete deck would help to maintain the aesthetic link to the Irish Rail span and would reduce maintenance requirements. The spans of these structures will be approximately 50m (N25) and 2x15m (Irish Rail). The steel structures would be of painted steel construction. Weathering steel is not suitable as the location is close to the ocean. Figure 4.9 and Figure 4.10 give an indicative example of a similar structures.

Foundations for the N25 structure will be set back from the highway on both sides and are expected to be of reinforced concrete piled construction. Foundations for the portal frame structures are proposed to be within the Irish Rail land as shown in Figure 4.8. Foundations for the portal frame structure are yet to be defined but may be shallow foundations or reinforced concrete piled foundations.

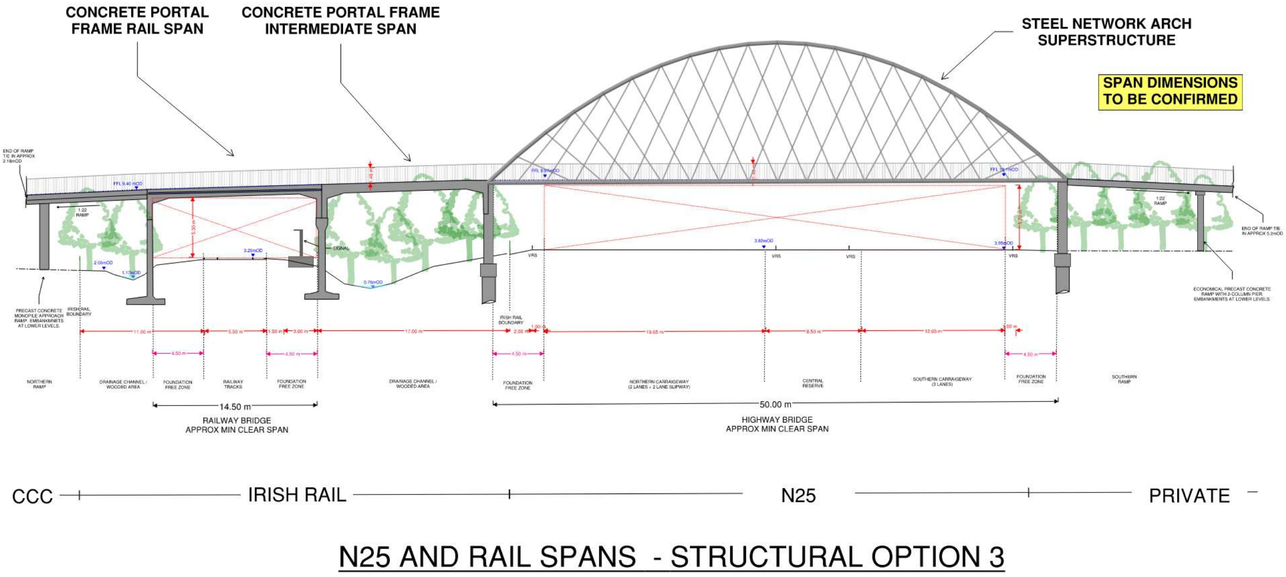

Figure 4.8: Structural option 3 indicative elevation with N25 span, Irish Rail span and start of approach ramps

Figure 4.9: Example of steel network arch pedestrian and cycle bridge with concrete deck

Figure 4.10: Example of segmental precast reinforced concrete porta frame structure over rail

4.3 Approach ramps

Due to the requirements for adequate clearance over the N25 and the Irish rail track and the required gradient for approach ramps, ramp structures for this crossing will be significant. A ramp gradient of 1 in 22 is proposed. This leads to ramped approaches to reach existing ground level of approximately 160m to the north and 130m to the south, in addition to lengths of at grade walkways/cycleways to tie in to end points of the crossing at Little Island station and the Eastgate Business Park.

Ramp structures are likely to consist of a combination of elevated structure, embankments, landscaping and at grade sections. The following sections outline feasible structural forms selected for consideration. It is proposed that the ramped structures are considered independently to the main crossings of the N25 and Irish Rail track as the considerations and constraints differ.

The elevated section of the ramp approach on the north will be prominent feature and visible from the underside by users of the Northern Park area, the adjacent road, and the new greenway. Therefore, the aesthetic quality of this structure from deck level and from below should be considered strongly. By comparison, the southern elevated ramp section will travel through a heavily wooded area that is not accessible by the public currently. For this structure, the importance is more so on the user experience from the deck and not from the underside. This gives opportunities for a more economic structure to be used in this section.

It is proposed for the north approach ramp that the lower ramp section is to be an embankment to a height above ground level of approximately 2m. This is consistent with recommendations in TII-STR-03005 to avoid confined crawl spaces under elevated structures.

The southern ramp section between the Radisson blue car park and the N25 bridge tie in is proposed as elevated structure due to the fall off in level to the north and east of the Radisson car park. A retained embankment is also proposed on the west side tie in to the Radisson car park. See section 4.3.3.

4.3.1 Elevated Ramp Structure Option 1: Steel Elevated Ramp

This option considers the use of a painted steel elevated ramp structure. Weathering steel was not considered due to the structure's proximity to the ocean. Steelwork can easily achieve the required span lengths for the approach ramps in a relatively lightweight form. This has advantages for construction and lifting of components. Steelwork sections can also come prefabricated with parapets included prior to being lifted into place and require less on-site construction works generally.

As there are no specific headroom requirements under the elevated ramp sections the main structural elements can be placed under the deck allowing for a more open parapet/edge of the structure for the user in comparison to a truss. For this reason, two structural forms are considered for this option.

A spine beam structure with single piers for the northern elevated ramp section and a more economical edge beam design with 2 column piers and crossheads for the southern ramp sections. See Figure 4.11 for indicative cross sections of both structural forms. Both options would allow for a consistent deck aesthetic for the user.

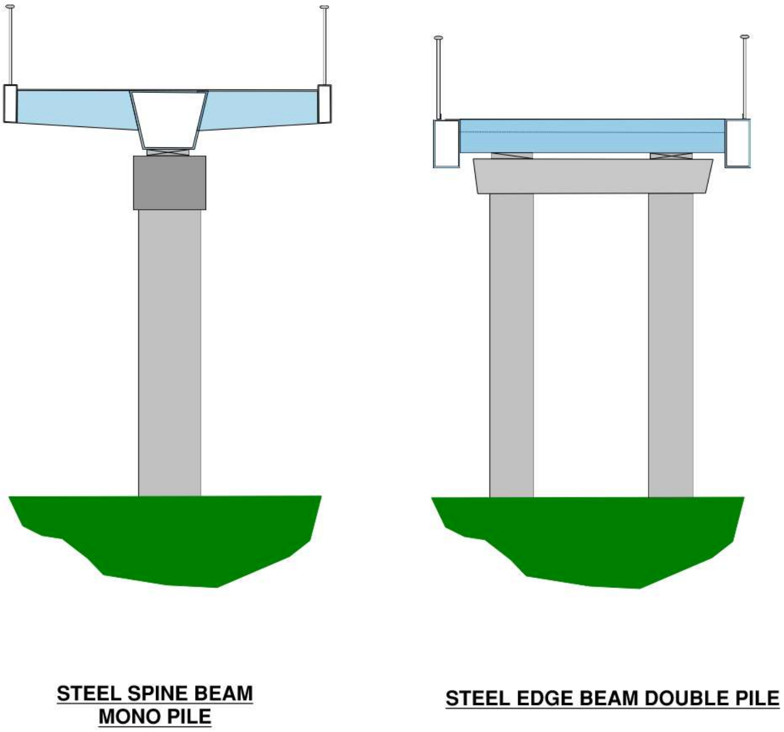

Figure 4.11: Indicative Cross sections of Steel Elevated Ramp Structural Forms

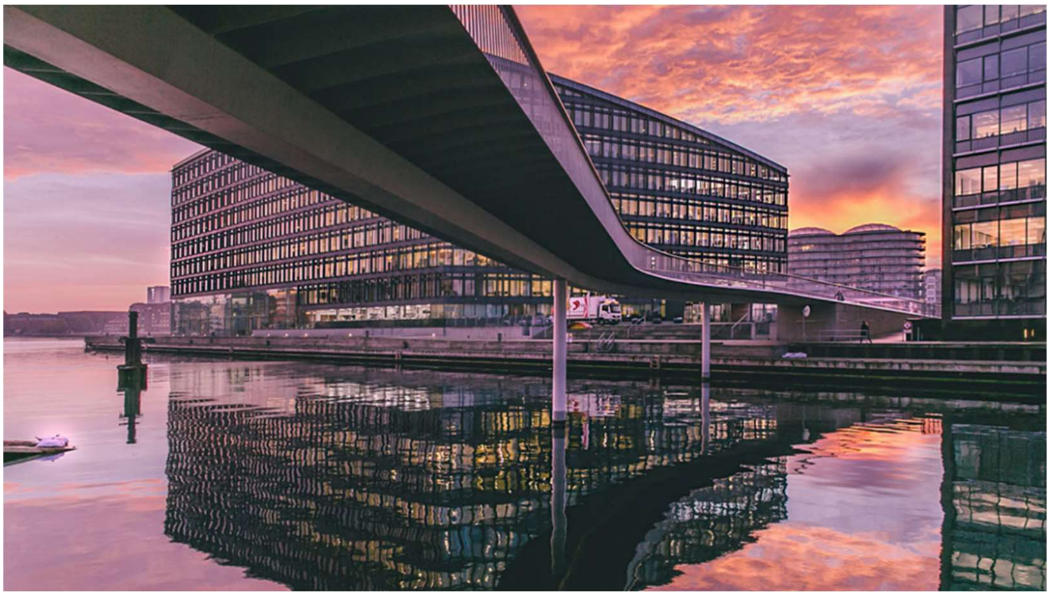

Figure 4.12: Example of steel elevated ramp/cycleway structure with spine beam and monopiles/columns

Figure 4.13: Steel edge beam bridge

4.3.2 Elevated Ramp Structure Option 2: Precast Prestressed Concrete

This option considers the use of a precast prestressed concrete spans. Precast concrete systems are widely available in Ireland and can easily reach the spans required. They are also extremely durable once constructed and with very low or no major maintenance required over their required design life of 120 years.

As there are no specific headroom requirements under the elevated ramp sections the main structural elements can be placed under the deck allowing for a more open parapet/edge of the structure for the user. For this reason, two structural forms are considered for this option. A bespoke concrete structure with single piers for the northern elevated ramp section and a more economical precast prestressed bridge beam bridge design with 2 column piers and crossheads for the southern ramp sections.

Precast bridge beams such as MY bridge beams are available in single beams with spans of 15m-25m leading to flexibility in design and construction. Once placed on the southern ramp structure works on the in-situ deck section are possible from the deck. Where access is easier in the northern park area a more bespoke architectural design is possible. Major strides have also been made in concrete mixes which allow for lower carbon forms of concrete to be used which can reduce the overall carbon footprint of the structure.

See Figure 4.14 for indicative cross sections of both structural forms. Both options would allow for a consistent deck aesthetic for the user.

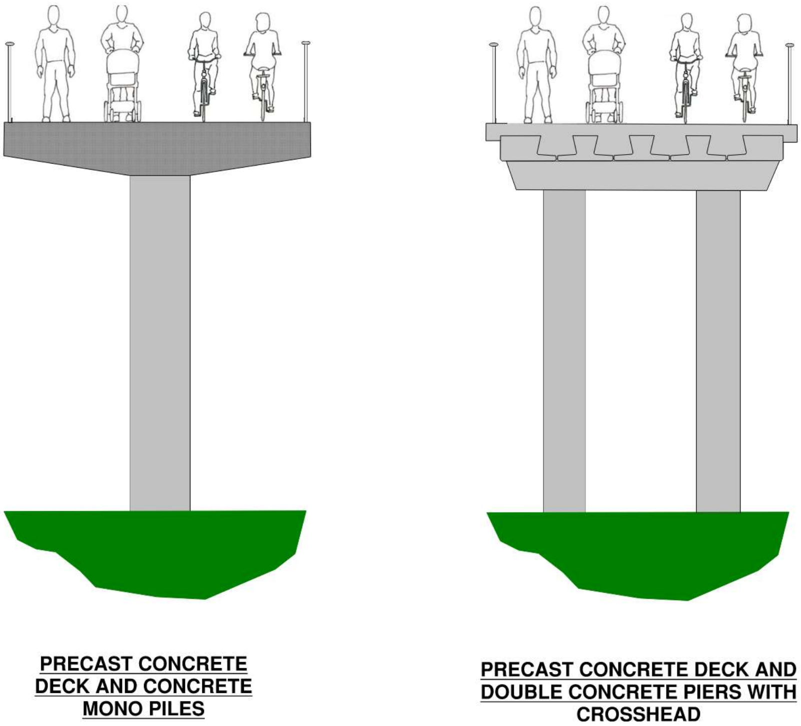

Figure 4.14: Indicative cross section for reinforced concrete structural forms for elevated ramp structure

Figure 4.15: Example of reinforced concrete elevated ramp structure with monopiles/columns (northern approach ramp)

Figure 4.16: Economical precast prestressed concrete bridge beam option for approach ramp elevated structure (southern approach ramp)

4.3.3 Embankments and Landscaping

Embankments and landscaping will be common to all ramp approach options for lower sections. This form of ramp is generally less expensive and intensive to construct than an equivalent elevated structure. They are also generally more robust and lower maintenance than an elevated structure.

Figure 4.17 gives an example of a landscaping proposal used to blend an approach ramp for the Blackrock Greenway in Cork into the surrounding landscape. Proposals similar to this will be developed further during preliminary design for the tie in point of the ramp on the northern approach.

On the southern side of the crossing, it is proposed that the ramp would tie into the carpark directly North of the Radisson Blu Hotel. (Figure 3.1). There are steep drop-offs in level on the north and east of this carpark and therefore a piled elevated structure is proposed to be used to connect to the bridge on the south side in lieu of embankments and landscaping. A section of embankment/retaining wall will be required however between this carpark and the lower carpark to the West for the crossing to tie in to the wider LISTI works in Eastgate Business Park. A segmental reinforced soil retaining structure such as that shown in Figure 4.17 is proposed here to minimise land take from the carparks. This is common to all options for main crossing structural type and elevated ramp structure structural form.

Figure 4.17: Example of landscaped ramp (left) and soil reinforcement retaining wall (right)

Figure 4.18: Vegetated green wall retaining solution, prior to vegetation growth

Figure 4.19: Vegetated green wall retaining solution, following vegetation growth

5. Technical Evaluation

5.1 Technical Challenges

The following is an evaluation of the technical considerations for each of the three options considered.

5.1.1 Option 1 – Single Span Steel Through Truss

A through truss pedestrian and cycle bridge is a relatively simple and efficient structural form and has been widely used throughout Ireland for similar applications. A number of contractors and fabricators would be familiar with the construction and design challenges associated with this type of structure. As the longest spanning and heaviest single span of the options challenges exist around craneage and steelwork erection of the steelwork superstructure.

This option reduces the number of piers which will reduce the land take and vegetation clearance. The main span bridge abutments would however be larger than other options.

Due to the single span nature of this structure, and the requirement for a higher clearance over the N25 relative to the Irish Rail track, this option would sit higher at the northern side of the Irish Rail track than other options. This would lead to an increased length of northern approach ramp relative to other options.

The design of such a bridge is relatively straightforward. The analysis is completed using standard modelling techniques such as grillage modelling, the results of which are also relatively simple to assess. The longer span nature of this structure and the relatively lightweight structural form can lead to vibrations in the structure which may be perceptible to users. Whilst this is not a safety concern this will need to be considered at design stage to ensure the structure is suitable stiff to meet the code requirements with regards to vibrations.

5.1.2 Option 2 - Two Span Steel Through Truss

A two-span steel through truss structure is a relatively simple and efficient structural form and has been widely used throughout Ireland for similar applications. A number of contractors and fabricators would be familiar with the construction and design challenges associated with this type of structure. Steelwork erection of this option would be much simpler than Option 1 with reduced span lengths and weights for craneage. Additionally, the height of the structure would be lower making it easier for delivery by road.

This option adds an additional support between the N25 and Irish Rail line relative to Option 1 requiring increased land access and works under lane closures and traffic management. Abutments are expected to be smaller than Option 1, however. The down slope for this option on the north side can commence at the end of the N25 span, therefore reducing the overall length required for the northern approach ramp.

The design of such a bridge is similarly to option 1 relatively straightforward. The analysis is completed using standard modelling techniques such as grillage modelling, the results of which are also relatively simple to assess. The smaller span length has the advantage of simplifying calculations regarding vibrations perceptible to bridge users.

5.1.3 Option 3 – Steel Network Arch & RC Precast Portal Frames

In Option 3, an RC precast segmental portal frame structure, over the Irish Rail line, is proposed and are straightforward structures that are widely used in this and similar applications. This type of structure is generally fabricated and erected by specialist precast producers with well-developed systems. The design risk of this type of structure is therefore relatively low and technical risk sits more on the construction side. The construction methodology for this type of system however is well developed and would also be considered low.

A steel network arch span is proposed over the N25. This is an efficient structural form of a tied arch bridge where inclined ‘hangers’ cross each other at least twice. This is not a new form of construction and has been widely used, including recently on similar pedestrian and cycle bridges in Ireland and in Europe. A well-designed network arch structure should be lighter than through truss structures of a similar span, although the height of the span is typically higher than a through truss structure to gain structural efficiency.

Similar to Option 1 the lightweight nature of this structure will require careful assessment of vibrations in the structure to meet code requirements for user comfort.

The design of a network arch bridge will be completed using standard modelling techniques such as grillage modelling with the use of parametric modelling helping to optimise the arch shape and number/spacing of cables. The design and detailing of this structure is expected to be more complicated than Options 1 and 2, however it would be expected that a competent consultant with experience in bridge design should be able to complete the design to a high standard.

5.1.4 Ramp Option 1: Steel Ramp Elevated Structure

While the same aesthetic appearance from the top of deck is proposed for both north and south elevated approach ramp structures, it is proposed that the north and south elevated approach ramp structures have different construction due to the accessibility and visual requirements of the underside of the deck. The north approach elevated ramp section would be constructed from a more architectural spine beam option (or similar structure) sitting on monopile type foundations while the southern sections are proposed to be of a simpler edge beam construction sitting on 2 pile piers with reinforced concrete crossheads.

It is expected that the technical design of the southern approach elevated ramp would be relatively straightforward using standard modelling and design approaches. The northern elevated sections would also use standard approaches however it is expected that the design detailing of this section would be more challenging.

Steel structures are generally more lightweight than concrete and allow the possibility of longer spans and less foundations. They also allow for prefabrication and modular construction to increase quality and limit programme risks on site.

5.1.5 Ramp option 2: Concrete Ramp Elevated Structure

Similar to ramp Option 1, from the top of deck it is proposed the aesthetic appearance on the northern and southern elevated approach ramp sections will be the same. The structural form will vary however, to provide a more architectural structure through the northern park area where it is more visible.

For the northern park, a prestressed/post tensioned concrete deck is proposed sitting on single monopile type piers. It is expected that there will be challenges associated with the design and detailing of this type of structure and the design consultant would need to have suitable experience in the design and detailing of reinforced concrete bridge structures.

The proposed design of the southern elevated ramp structures in this option is a straightforward commonly used design of prestressed bridge beams with an in-situ concrete deck. Limited formwork is required for this form of construction as the bridge beams act as permanent formwork. This type of design is well developed by several precast concrete suppliers and is expected to be a simpler design than the northern approach. Substructures are proposed to be 2 pile piers with a reinforced concrete crossbeam.

Prefabricated concrete structures allow for modular construction which increases overall build quality and reduces risks on site.

5.2 Summary of Technical Evaluation Main Bridge Crossing

All options are technically feasible. Option 1 presents a risk for construction from a technical perspective due to increased span, weight and rail/road possessions for span erection. Option 2 is the most preferrable option from a technical perspective due to the simplified construction process and the reduced northern ramp length relative to Option 1. Option 3, similar to Option 2 would have a simplified design however transportation to site, construction and erection would have added technical challenges due to the height of the arch.

Table 5.1: Technical Evaluation – Main Span Structure

Criterion	Option 1 Single span steel through truss	Option 2 Two span steel through truss	Option 3 Steel network arch & RC precast portal frame
Technical Merit	2	4	3

5.3 Summary of Technical Evaluation Elevated Ramp Structure

From a technical perspective both these options are technically feasible and widely used. For the northern park area there are potential technical challenges associated with the design and construction of more architectural monopile supported structures, however these challenges are expected to be similar for both options. For the southern approach ramp more economical steelwork or concrete structures on 2 pile piers with crossheads are technically straightforward and would be considered to have similar technical construction challenges. Therefore, both options have the same score.

Table 5.2: Technical Evaluation – Ramp Structure

Criterion	Option 1: Steel Elevated Ramp Structure	Option 2: Precast Prestressed Concrete Elevated Ramp Structure
Technical Merit	3	3

6. Economic Evaluation (Economy)

The economic evaluation is based on the comparative cost estimate as required by the NTA project appraisal guidelines at this stage, by comparing approximate costs for the construction of each bridge and ramp option. These costs are calculated based on estimated rates per square meter of deck area. The rates vary depending on the type of bridge structure proposed, influenced by span arrangements, materials, construction methodology and maintenance aspects. A more detailed cost estimate of the preferred option will be completed at the next stage. See appendices for detailed breakdown of the comparative cost estimate.

It should be noted that the below estimated costs are higher than those contained in the feasibility report cost estimate. The key reasons for this are inflation in the construction market since the feasibility report was completed and an increase in the proposed bridge width.

The SCSI (Society of Chartered Surveyor) publish a tender price index twice a year. According to this latest report there has been an increase in construction costs of 22% since the feasibility report for this project was completed (second half of 2020 to first half of 2022). The increase in costs for the second half of 2022 is not yet available. It is expected that there would be an inflationary cost increase as a result over and above what was estimated in the Feasibility Report.

As per the Alignment and Bridge Width Options Assessment (appended) the recommended bridge effective width (between parapets) is 5m. With allowance for parapet fixings and the structure the overall bridge width is expected to be approximately 6m. This is an increase of 20% on the structural width considered in the feasibility report and would be expected to increase the overall construction cost also.

The combined expected increase based on the above inflation estimate and the increase in bridge width is 1.46 (1.22 x 1.2). The maximum estimated construction cost from the Feasibility Report was € 5.225 million. Factored by 1.46 it would be expected an equivalent estimate would now be approximately € 7.65 million.

6.1 Estimated Bridge Costs

The comparative costs for each bridge are summarised in Table 6.1 below. These costs include the cost of ramps. Both ramp options are assumed to be of a similar cost and are not distinguished between steel and concrete options.

Table 6.1: Comparative cost estimate – bridges

Option	Estimated construction cost	Estimated construction cost + 30%	Estimated construction cost + 30%
Option 1: Single span steel truss.	€ 7.504 Million	€ 5.253 Million	€ 9.756 Million
Option 2: Two span steel through truss.	€ 6.956 Million	€ 4.869 Million	€ 9.043 Million
Option 3: Steel network arch & RC precast portal frames.	€ 7.723 Million	€ 5.406 Million	€ 10.040 Million

6.2 Summary of Economic Evaluation Main Bridge Crossing

The table below summarises the scores assigned to each bridge option based on the above economic evaluation.

Table 6.2: Economic Evaluation – Main Span Structure

Criterion	Option 1 Single span steel through truss	Option 2 Two span steel through truss	Option 3 Steel network arch & RC precast portal frame
Economic Merit	3	4	3

6.3 Summary of Economic Evaluation Elevated Ramp Structure

The table below summarises the scores assigned to each ramp option based on the above economic evaluation. Both options are considered to be of a similar cost and have both been awarded the same assessment score on this basis.

Table 6.3: Technical Evaluation – Ramp Structure

Criterion	Option 1: Steel Elevated Ramp Structure	Option 2: Precast Prestressed Concrete Elevated Ramp Structure
Economic Merit	3	3

7. Aesthetic Evaluation

Whilst the key focus of this structure is to provide an effective crossing of the Irish Rail line and N25 to connect Little Island train station and the Eastgate Business Park, the aesthetic appearance was identified as a key factor in placemaking and to encourage the use of the crossing, promoting sustainable transport modes in the surrounding area.

This is consistent with the guidance given in TII DN-STR-03005 03 Cl.3.20 to provide a structure that should be aesthetically pleasing, enhance the environment and encourage people to use the bridge.

7.1 Compositional Strategy

DMRB CD 351 The design and appearance of highway structures (formerly BA41/98) gives guidance on the design approach to consider bridge aesthetics.

It recommends that evaluation should consider all aspects that affect the aesthetic quality of the completed structure, its position in the landscape and its impact on social, cultural and heritage sensitivities within the community.

The aesthetic influence on the design is therefore largely focused on material choice, span arrangement and structural form. The choice of bridge components for different sections is also set based on a combination of economy, constructability, environmental, long-term durability and maintenance requirements.

It is proposed that the user experience from the deck will retain a similar level of high-quality aesthetic throughout the crossing. From the underside, a high emphasis has been placed on the aesthetic design of the northern approach ramp and the main N25 span as these will be visible from surrounding areas. In comparison, the aesthetics of the southern approach ramp and the Irish Rail span soffits, which will be largely shielded from view by trees and vegetation, are not seen as being as critical.

One of the key elements in encouraging use of this structure will be the main span crossing the N25. This span will be viewed by users of the N25 on exiting and entering Cork City and has the potential to be a landmark signature structure that both encourages active travel modes on the bridge itself but also promotes active travel modes in the wider area.

7.2 Concept Development

Several engagement sessions with CCC, at early stages of the optioneering process, identified suitable structural forms and assessed examples of similar structures. The presented structural options and examples in Section 4.2 of this report are the outcome of these discussions. Further development of the preferred option will take place at the next stage. Further development of the aesthetic of the tie ins to the north and south and landscaping surrounding the structure will also be considered in further detail at the next stage.

7.3 Summary of Aesthetic Evaluation Main Bridge Crossing

The table below summarises the scores assigned to each bridge option based on the above aesthetic evaluation. Structural Option 3 is deemed to be the most preferred option. The use of slim cable elements and a high arched profile is considered to provide a landmark structure for entering and exiting Cork City and is considered to have the highest likelihood of encouraging increased use of the crossing. The concrete portal frame over the Irish rail track is proposed to be screened by trees and vegetation and is considered to be aesthetically neutral as a result.

Structural Option 1 is considered to be the next most preferable option as it is an impressive long span structure and could be formed from an architectural truss. The long span nature of this structure is however slightly lost in the section that is screened by the trees between the Irish Rail line and N25.

Structural Option 2 is considered the least preferable superstructure option in terms of aesthetics. The span over the N25 is shorter than Option 1 and the structural form is more utilitarian and less striking than structural Option 3.

Table 7.1: Aesthetic Evaluation – Main Span Structure

Criterion	Option 1 Single span steel through truss	Option 2 Two span steel through truss	Option 3 Steel network arch & RC precast portal frame
Aesthetic Merit	3	2	5

7.4 Summary of Aesthetic Evaluation Elevated Ramp Structure

The aesthetics of the approach ramp elevated structures are considered neutral for both options as there is no major distinguishing factors between them as structural span lengths and forms will be similar for either option.

Table 7.2: Aesthetic Evaluation – Ramp Structure

Criterion	Steel Elevated Ramp Structure	Precast Prestressed Concrete Elevated Ramp Structure
Aesthetic Merit	3	3

8. Durability and Maintenance Requirements

Bridge structures in Ireland are designed and detailed to Eurocode Standards and TII specifications, which require a 120-year design life.

The durability and maintenance requirements of bridges is particularly important due to the long design life and outdoor environments bridges structures are exposed to. This is particularly relevant for structures close to marine environments, where the increased quantity of chlorides due to coastal waters present an additional corrosion risk.

The location of the proposed crossing in this case also passes through several heavily vegetated areas. The moist environment, lack of direct sunlight, and falling vegetation can also lead to increased maintenance requirements and accelerated corrosion of some forms of construction. This has been considered in the development of structural options for this structure.

Minimising maintenance requirements was considered as a key driver in developing the structural options and will be considered further in the next stages of design for the chosen option. Key considerations in the next stage will be to minimise the use of bridge bearings which have a shorter design life, provide appropriate paint systems to protect the structure where appropriate and to select materials and details which reduce maintenance liabilities.

When properly detailed, concrete elements are more favourable to steel due to the lower levels of maintenance required to achieve the designated design life. Concrete structures however are not always possible to achieve for a given span and structural depth.

For example, based on the preferred alignment structures options for the N25 span are all steel options with the main bridge structure above the deck level. This has allowed for the minimising of the structural depth. This is turn has helped to minimise the ramp lengths with consideration of the required gradients and the clearance envelopes required over the N25.

8.1 Construction Materials

8.1.1 Concrete Bridges

Concrete is an alkaline material which acts to protect steel from corrosion in reinforced concrete structures. Therefore, these structures are durable and require little maintenance over their lifetime if they have been properly detailed and constructed to a high standard in accordance with construction best practice.

Particular care should be taken in the design of prestressed concrete structures. In prestressed bridges, the prestressing tendons are under high stress and, subsequently will corrode more rapidly than ordinary steel reinforcement. However, it should be noted that compliance with current standards ensure that the 120-year design life of a structure can be achieved.

8.1.2 Steel Bridges

Structures comprising steel are subject to corrosion. Routine maintenance such as protective coat painting is required to ensure the steel structure remains in a satisfactory condition over its lifetime. Typically, a steel structure requires protective coating to be reapplied every 20 to 25 years.

Weathering steel is a material which is not painted but is formulated to develop an oxide patina which protects it from further corrosion. This is a suitable material for many highway structures as it retains the benefits of steelwork in terms of the longer span and lightweight structure abilities whilst not requiring as much maintenance as painted steel structures. In this case however, due to the proximity of the proposed structure to Cork Harbour weathering steel would not be suitable and has not been considered.

Stainless steel has a much higher resistance than painted mild steel to corrosion. The use of stainless steel for parapet components will be considered in the next stages of design but is not considered appropriate for the main structural elements due to the typically higher cost and lower strength.

8.1.3 Cables

Cables can consist of an assortment of steel strands or wires in varying arrangements. The strands and wires are produced from high strength steel and are typically subject to high stresses and, therefore have the potential to corrode more rapidly than ordinary steel reinforcement. However, a series of measures are provided to protect the steel in cables from corroding. It is therefore possible that the cables may not need replacement over the life of the structure.

In some cases, it is also possible for steel rods to be used in place of cables to act as tension members. These rods can be formed of stainless-steel material which is not subject to corrosion to the same extent and could be specified to achieve a 120-year design life without maintenance.

8.1.4 Expansion Joints and Bearings

The least durable components of the options considered above are the joints and bearings, which are required to accommodate the movement of the structure. These components are difficult to seal effectively to prevent the ingress of water and other corrosive materials. Where feasible, bearings and joints are removed by making the superstructure integral with the substructure. However, this approach has its limits. Particularly for multiple span structures.

Bearings can however be detailed to provide a life of approx. 40 years or more and allowances are made in the design of the superstructure and substructure for bearing replacement as part of a maintenance strategy.

Steelwork spans for this structure will have bearings minimised where possible which is consistent with TII and Irish Rail guidance.

8.2 Summary of Durability & Maintenance Evaluation

8.2.1 Option 1 – Single Span Steel Through Truss

This option consists of a steelwork superstructure crossing both the N25 and Irish Rail line. The volume of steelwork on this option is the largest of all options and will require maintenance in the form of cleaning and repainting at intervals of 20-25 years across its design life.

Access for maintenance of this structure will likely require temporary rail track and road closures. Bearings will be required for this option which will require temporary jacking of the structure to replace bearings at the end of their design life which will require both rail track and road closures during the works.

For main superstructure options this is considered the least preferable in terms of durability and maintenance.

8.2.2 Option 2 - Two Span Steel Through Truss

This option consists of two steelwork superstructures crossing both the N25 and Irish Rail line. These spans will require maintenance in the form of cleaning and repainting at intervals of 20-25 years across their design life.

Access for maintenance of this structure will likely require temporary rail track and road closures. Bearings will be required for this option which will require temporary jacking of the structure to replace bearings at the end of their design life during temporary rail track and road closures during the works.

This option is considered slightly more preferable to structural Option 1 in terms of durability and maintenance due to a smaller overall volume of steelwork requiring maintenance and the ability to potential construct the span over the rail line without bearings due to the reduce span length

8.2.3 Option 3 – Steel network arch & RC precast portal frames

This option consists of concrete portal frame structures over the Irish Rail track. This is a low maintenance option. No maintenance of the concrete structure would be required over the course of the design life with the exception of cleaning and periodic bridge inspection works.

A single span steel network arch structure is proposed for this option over the N25. Tension cables/bars in this structure are expected to require little maintenance over their design life if stainless steel elements are chosen. Main steelwork for this span will require repainting at intervals throughout the design life which may take place during temporary road closures. With this option the possibility of using a concrete deck can be assessed which will minimise the maintenance required of the deck but will increase the overall volume of steelwork required to support the concrete deck relative to a lighter steelwork deck. Bearings will be required for this option which will require temporary jacking of the structure to replace bearings at the end of their design life which will require road closures during the works.

This option is considered the most preferable main spans option in terms of durability and maintenance due to the significantly reduced maintenance requirement over the rail line.

8.2.4 Ramp Option 1: Steel Ramp Elevated Structure

This option consists of steel superstructures which may be preferable in terms of ease of construction and span lengths available but will require ongoing maintenance and repainting over their design life. For the southern approach ramp the environment is expected to be moist with falling vegetation which may accelerate the rate of corrosion for steel spans.

Access for the southern approach ramp for maintenance and repainting will also be difficult as vegetation grows back after the ramp has been constructed. Based on recent experience, maintenance of structures in similar locations have required regulatory approval in order to mitigate against environmental damage.

This option is considered less preferable in terms of durability and maintenance.

8.2.5 Ramp Option 2: Concrete Ramp Elevated Structure

This option consists of reinforced concrete superstructures and substructures. For the southern ramp area precast segmental bridge beam construction with infill concrete deck is proposed. This option does not require bridge bearings. For the northern park area, a monopile substructure with a concrete deck is proposed due to the ability of users to view the soffit from the below park.

Both these options, if detailed correctly will need minimal ongoing maintenance to the structure with the exception of cleaning of the structure and deck. This option will require maintenance to the surfacing although this is common with other options and can be completed from the deck level.

This option is considered the most preferable elevated ramp option in terms of maintenance and durability.

8.2.6 Landscaping/Embankments and Retaining Walls

Lower sections of ramps will be of embankments and landscaping as well as some sections of retaining walls. Low maintenance systems are proposed for these elements and they are common to both structural forms for elevated ramp structures. They are therefore considered neutral for the assessment of ramp options below.

8.3 Summary of Durability and Maintenance Evaluation Main Bridge Crossing

Table 8.1: Durability and Maintenance Evaluation – Main Span Structure

Criterion	Option 1 Single span steel through truss	Option 2 Two span steel through truss	Option 3 Steel network arch & RC precast portal frame
Technical Merit	2	3	4

8.4 Summary of Durability and Maintenance Evaluation Elevated Ramp Structure

Table 8.2: Durability and Maintenence Evaluation – Ramp Structure

Criterion	Option 1: Steel Elevated Ramp Structure	Option 2: Precast Prestressed Concrete Elevated Ramp Structure
Durability and Maintenance Merit	2	5

9. Hydraulic Considerations

9.1 Overview

All options for ramps and main structures span over ditches and waterways/streams that have been identified. No options have been identified to interfere with these streams at this stage. Further assessment of the preferred option will be made during the Environmental Impact Assessment and Flood Risk Assessment however for now, there is not deemed to be any distinction between options from a hydraulic perspective. The scoring below reflects this. The required bridge drainage via connection to a drainage network or direct outfall to adjacent streams and ditches will be reviewed further during the Environmental Impact Assessment.

9.2 Summary of Hydraulic Evaluation Main Bridge Structure

The table below summarises the scores assigned to each bridge option based on the above hydraulic evaluation.

Table 9.1: Hydraulic Evaluation – Main Span Structure

Criterion	Option 1 Single span steel through truss	Option 2 Two span steel through truss	Option 3 Steel network arch & RC precast portal frame
Hydraulic Merit	4	4	4

9.3 Summary of Hydraulic Evaluation Elevated Ramp Structure

Table 9.2: Hydraulic Evaluation – Ramp Structure

Criterion	Option 1: Steel Elevated Ramp Structure	Option 2: Precast Prestressed Concrete Elevated Ramp Structure
Hydraulic Merit	4	4

10. Environmental Considerations (Environment)

10.1 Environmental Risks

Several environmental risks have been identified over the course of the feasibility and optioneering study. Key environmental risks are discussed briefly below. It is not considered that there are significant difference between structural options in relation to environmental risks. There have been no environmental risks identified at this point that would preclude the use of any of the proposed structural options for the main spans or the approach ramps. As part of the environmental screening process environmental risks pertinent to the preferred option will be identified in more detail and mitigated accordingly during the next stage of design.

Potential Hydraulic linkages to Cork Harbour SPA

Streams and ditches have been identified either side of the N25 in early investigations. When setting the locations of potential abutments for the structural options these water bodies have been avoided. The potential linkages of these water bodies to the Cork Harbour SPA will be considered in the Environmental Impact Assessment and appropriate mitigations made for the chosen structural option.

Risk of bird strike

A risk of bird strike has been identified for structures crossing the N25, in particular due to the structure for all options being above the deck level. It should be noted that there are currently large gantries crossing the N25 at close proximity where this issue has not been identified. As part of the Environmental Impact Assessment the requirement for winter bird surveys and bird collision impact assessments will be investigated.

Embodied Carbon and sustainability

Due to the scale of the proposed crossing an amount of embodied carbon will be generated by all options. It is not considered that there are significant distinguishing factors between steel and concrete construction in this regard. Concrete with a higher proportion of admixtures to reduce carbon can be considered. While structural steel is currently more easily recycled, it is generally not produced as close to site as the equivalent concrete product meaning transport emissions are likely larger. For all options it is considered that the promotion of sustainable transport will help to mitigate the embodied carbon generated over the service life of the structure.

Vegetation and biodiversity

From an environmental perspective all options pose a similar level of risk.

Overall, and in light of the above considerations, it is concluded at this point that structural options score neutral with regard to environmental risks.

10.2 Summary of Environmental Evaluation Structure

The table below summarises the scores assigned to each bridge option based on the above environmental evaluation.

Table 10.1: Environmental Evaluation – Main span structure

Criterion	Option 1 Single span steel through truss	Option 2 Two span steel through truss	Option 3 Steel network arch & RC precast portal frame
Environmental Merit	3	3	3

10.3 Summary of Environmental Evaluation Elevated Ramp Structure

The table below summarises the scores assigned to each ramp option based on the above environmental evaluation.

Table 10.2: Environmental Evaluation – Ramp structure

Criterion	Option 1: Steel Elevated Ramp Structure	Option 2: Precast Prestressed Concrete Elevated Ramp Structure
Environmental Merit	3	3

11. Health and Safety Considerations

This section considers the health and safety risks associated with the construction and maintenance during service of the different bridge options. The safety aspects for the end user are considered negligible between the different bridge options considered.

11.1 Safety during Construction

A detailed discussion of constructability is contained for each option in Section 12 of this report. All options can be constructed and appropriate measures can be taken for all options to maintain safety during construction of foundations and abutments.

The proposed indicative construction methodology for all options allows for the erection of spans over the N25 and Irish Rail tracks in short construction windows. As a result, there are no major distinguishing factors for safety during construction between the options.

11.2 Safety during Maintenance

As considered previously, maintenance requirements for concrete structures are considered lower than steel elements and, as a result, lowers the associated risks.

Any bridge option with steel elements requires extra maintenance introducing additional risks to maintenance operatives and members of the public during the working life of the structure. Structures with cables also include additional risks working at height inspecting cables however this risk can be minimised by the use of stainless-steel elements which require lower maintenance.

However, best practice maintenance methods will ensure the highest safety standards for all options during maintenance works.

Due to the use of durable cable elements in the N25 span structure and a concrete structure over the Irish Rail line and the associated need for less maintenance Option 3 scores higher than Option 2. Option 2 scores higher than Option 1 also due to the reduced height of structure helping to make the structure more easily maintainable. Maintenance can also take place on the N25 span without impacting the Irish Rail span and vice versa.

11.3 Summary of Health and Safety Evaluation Main Bridge Structure

The table below summarises the scores assigned to each bridge option based on the above health & safety evaluation.

Table 11.1: Health & Safety Evaluation

Criterion	Option 1 Single span steel through truss	Option 2 Two span steel through truss	Option 3 Steel network arch & RC precast portal frame
Health & Safety Merit	2	3	4

11.4 Summary of Health and Safety Evaluation Elevated Ramp Structure

The table below summarises the scores assigned to each bridge option based on the above health & safety evaluation. Option 1 scores slightly lower due to the increased need for maintenance and the inherent safety risks of working at height during maintenance operations.

Table 11.2: Environmental Evaluation – Ramp structure

Criterion	Option 1: Steel Elevated Ramp Structure	Option 2: Precast Prestressed Concrete Elevated Ramp Structure
Health & Safety Merit	3	4

12. Construction and buildability

The below sections give a high-level indication of feasible construction methodologies for different options. A more detailed possible construction sequence for the preferred option will be developed during the preliminary design stage.

12.1 Foundation/Substructure Construction Sequence

Indicative construction sequences for main bridge foundations/substructures are given below:

Adjacent N25

- Offline site clearance, using overnight lane closures if required.
- Piling of foundations adjacent to N25 during night and/or weekend lane closures or using traffic management.
- Fixing of reinforcement and temporary works for abutments using traffic management.
- Pouring of concrete for abutments during lane closures.

Adjacent Irish rail track

- Offline site clearance, using overnight track closures if required.
- Piling works using rigs staying outside the Irish Rail exclusion zone during night closures of the rail line.
- Fixing of reinforcement and temporary works for abutments using traffic management.
- Pouring of concrete for abutments outside the Irish Rail exclusion zone.

12.2 Structural Option 1

Indicative steelwork erection sequence for the main superstructure for Option 1 is as follows:

- Bridge spans assembled off site and driven on N25 using trailer or self-propelled modular transporters (SPMTs), overall trailer + structure height to be less than 5.7m to clear under bridges and gantry's on N25.
- Tandem crane lift for main span over N25 using mobile cranes.

This option is the largest single structural option with an estimated steelwork tonnage of 150 tonnes. Required cranes will need to be reviewed in detail at the next stage should this be selected as the preferred option.

12.3 Structural Option 2

Indicative steelwork erection sequence for the main superstructure for Option 2 spans is as follows:

- Bridge spans assembled off site and driven on N25 using trailer or SPMTs, overall trailer + structure height to be less than 5.7m to clear bridges and gantry's on N25
- Tandem crane lift for main span over N25 using mobile cranes.
- Single crane lift from centre of Irish Rail span, note crane will need reach of approx. 30m.

The bridge superstructures steelwork tonnage is estimated at approximately 30 tonnes for the Irish Rail Span and 60 tonnes for the N25 span.

12.4 Structural Option 3

Indicative steelwork erection sequence for the main N25 superstructure for Option 3 is as follows:

- Bridge fabricated off site in northern park area.
- Bridge superstructure lifted onto 6m wide northern approach ramp and Irish Rail spans. Weight distributed through SPMT groups.
- Bridge launched from ramp with nose picked up over N25 with SPMTs and temporary works steel frame. Temporary works steelwork bracing required to arch.
- Median barriers to be removed during launch and reinstated.

The bridge superstructure steelwork tonnage is estimated at approximately 55-60 tonnes.

For the Irish Rail span a precast concrete segmental portal frame structure is proposed. These structures are designed to be erected in short windows of time using standardised processes and have been used over multiple rail lines, in particular in the UK. It is anticipated that the portal frame foundations and structure would be constructed over a single or multiple weekend track closure.

12.5 Elevated Ramp Structures

The likely construction sequence for both steel and concrete elevated ramp structural options will be largely similar. See indicative sequence below.

- Tree clearance along proposed southern ramp alignment to Radisson Blu carpark.
- Construction of temporary piling surfaces and crane pads on north and south.
- Construction of piles/piers and reinforced concrete pilecaps/crossheads.
- Construction of temporary crane pads adjacent to ramp positions.
- Erection of steelwork/precast concrete beams.
- Construction of in-situ deck sections for concrete option.

- Completion/installation of parapets, drainage, lighting and surfacing from deck level.

The construction of northern embankments and the southern retaining wall can take place in parallel with the above works. They are not expected to require any significant non-standard construction works and working space is easily accessible.

13. Ground Conditions

The following assessment of the geology of the site and ground conditions has been inferred from available information. No assurance is given to its accuracy and will be assessed further in the next stage of preliminary design following completion of the geotechnical investigation.

Northern Area:

Existing ground investigation data in this area extends to 7.5m below ground level. The ground conditions encountered typically consisted of soft and or loose alluvial/estuarine deposits to 1.5- 2.0m, underlain by cohesive alluvial/estuarine material to at least 7.5m BGL.

N25:

Existing ground investigation data in this area extends to 24m below ground level and was carried out after construction of the road. The ground conditions encountered were typically made ground (presumed to be cohesive engineered embankment fill) to 2.3m BGL underlain by a granular layer 0.4m thick presumed to be a crushed rock engineered fill. Underlying this made ground was approximately 5.5 – 6.0m of soft grey organic CLAY/SILT, underlain by approximately 9.5m of medium dense to very dense sandy GRAVEL. The final stratum encountered was a stiff sandy gravelly CLAY. Thickness of this stratum was not proven.

Southern Area:

Existing ground investigation data in this area extends to 19.5m below ground level. The ground conditions encountered typically consisted of cohesive made ground to a max depth of 2m BGL, underlain by approximately 4m of sandy gravelly CLAY/SILT with shell inclusions, organic lenses. The final stratum encountered was clayey sandy GRAVEL, becoming gravelly CLAY with depth. Thickness of this stratum was not proven.

14. Consultation with Relevant Authorities

Consultation during the optioneering stage has taken place with the following authorities

- Cork County Council.
- Transport Infrastructure Ireland.
- Irish Rail.

Consultation during the next stage of the project, preliminary design will take place with the above authorities and stakeholders and the following:

- National Transport Association.

- Irish Water.
- Utility Providers - ESB, Irish Water, Gas Networks Ireland, Eir.
- Radisson Blu Hotel owners/management.
- Private landowners.
- Eastgate Business Park owners/management.

15. Additional Department of Transport Common Appraisal Framework Qualitative Appraisal Criteria

15.1 Economy

See Section 6 of this report for a comparative cost estimate of different options.

15.2 Environment

See Section 10 of this report.

15.3 Integration

The proposed bridge structure will provide transport and modal integration on the north with the Little Island train station, local bus services and the Middleton to Cork City greenway which runs on the past the Little Island train station on the Glounthaune Road. On the southern side the proposed bridge will integrate with the Eastgate Business Park, the Radisson Blu hotel, and the wider Little Island Area. Transport integration on the southern tie in will be provided with connections to improved bus services provided within the Eastgate Business Park as part of the LISTI project.

The need for this integration and the north south connection over the Irish Rail line and the N25 has been identified by the previous Little Island Sustainable Transport Strategy improvements study. Section 7 of the Cork Metropolitan Area Transport Strategy has also identified the need for a connection from the Middleton-Dunkettle Interurban Cycle Route to Little Island which this bridge crossing will function as. The scheme also aligns with the Cork Cycle Network Plan (CCNP).

This crossing will provide greater walkability for the area and reduced walking and cycling times between Little Island train station and Eastgate promoting the use of sustainable transport modes.

All bridge options in this report provide the same level of integration with regard to land use integration, transport integration and modal integration. Therefore, there is no scoring allocated in the multi criteria assessment to differentiate between options presented.

15.4 Safety

See section 11 of this report.

15.5 Accessibility and Social Inclusion

The proposed scheme is inherently beneficial in terms of accessibility and social inclusion. With regards to social inclusion the scheme provides a major integration link which allows for safe transport by public transport, walking and cycling which is beneficial to more vulnerable and lower income groups.

Regarding accessibility, key constraints in the bridge alignment and ramp length have been to provide ramps of gradients which are suitable for use by people with disabilities in accordance with the latest TII and UK DMRS standards. Consideration has also been given in the Alignment and Width Options Assessment to the required widths for cycling, pedestrians, and wheelchair users.

Considerations have been given to SUSTRANs, TII standards, UK Local Transport Notes, the Inclusive mobility standard and other relevant standards as outlined in the appended report. In addition, visual segregation between the footway and cycleways have been proposed as well as a 2-way cycleway to improve the bridges accessibility for all users.

15.6 Physical activity

The main aim of this scheme is to provide an improved means of connection for pedestrians and cyclists between Little Island Train Station and Eastgate Business Park. All options presented in this report will meet this functional requirement and will encourage users to engage in physical activity as a means of transport. A key element in promoting and encouraging greater use is bridge aesthetics. A bridge with a high aesthetic value can be considered to be more likely to attract users. This has been considered in the multi criteria assessment under 'Aesthetics' in section 7 of this report.

15.7 Other Government Policy Integration

The need for investment in enhanced sustainable transport infrastructure generally is supported by European, national, regional and local public policy objectives. Transport access that encourages active travel and sustainable transport is important to reach sustainability goals. In addition, an improved pedestrian and cycle access to and through the Eastgate Business Park site is well established in policy as presented below:

- National Planning Framework (Government of Ireland, 2018);
- National Development Plan (Government of Ireland, 2021);
- National Investment Framework for Transport in Ireland (Department of Transport, 2021);
- UN Convention for the Rights of People with Disabilities (UNCRPD) (Government of Ireland, 2019);
- Climate Action Plan (Government of Ireland, 2021);
- Design Manual for Urban Roads and Streets (Government of Ireland, 2019);
- Cork County Development Plan 2014-2020.

15.8 Non-quantifiable economic impacts

Improved sustainable transport access to the Eastgate Business Park and linking the Little Island Train Station, Eastgate Business Park and Cork to Middleton Greenway with high quality active travel connections will lead to better geographic integration of the area. Active travel linkages that support sustainable mobility will protect against further local segregation and enable economic growth without encouraging increased car use. The improvement of connections to transport interchanges on the site provide for a greater local and regional connectivity through public transport options.

16. Conclusion

16.1 Comparison of Main Span Bridge Options

Table 16.1 below summarises the scorings for multi criteria assessment. The evaluation covers the main crossings over the Irish Rail line and the N25.

Table 16.1: Multi Criteria Assessment Scoring of Bridge Options

Assessment Criteria	Bridge Options		
	Option 1 Single span steel truss	Option 2 Two span steel truss	Option 3 Steel network arch & RC precast portal frames
Technical	2	4	3
Economic	3	4	3
Aesthetic	3	2	5
Durability and maintenance evaluation	2	3	4
Hydraulic	4	4	4
Environmental	3	3	3
Safety	2	3	4
Overall	19	23	26

16.2 Preferred Bridge Option – N25 and Irish Rail Spans

Based on the scoring matrix provided in Table 16.1, Structural Option 3 emerges as the preferred structural option for this bridge. See Figure 16.1 and Figure 16.2 for indicative details. This option consists of a steel network arch structure with a concrete deck over the N25, segmental precast concrete portal frame structures over the Irish rail land and reinforced concrete elevated structures forming the approach ramps. Lower sections of the approach ramps will be formed of at grade walkways and embankments/landscaping. The exact mixture of elevated structure and embankment is to be developed further at the preliminary design stage.

It is anticipated that foundations will be of piled construction with portal frame foundations potentially on shallow foundations. This will be confirmed in the preliminary design phase.

The bridge deck will have an effective width of 5m, as outlined in the Alignment and Width Options Assessment. The structural width will be approximately 6m to allow for parapets and fixings. Bridge approach ramps will have a maximum gradient of 1 in 22 as discussed in this report.

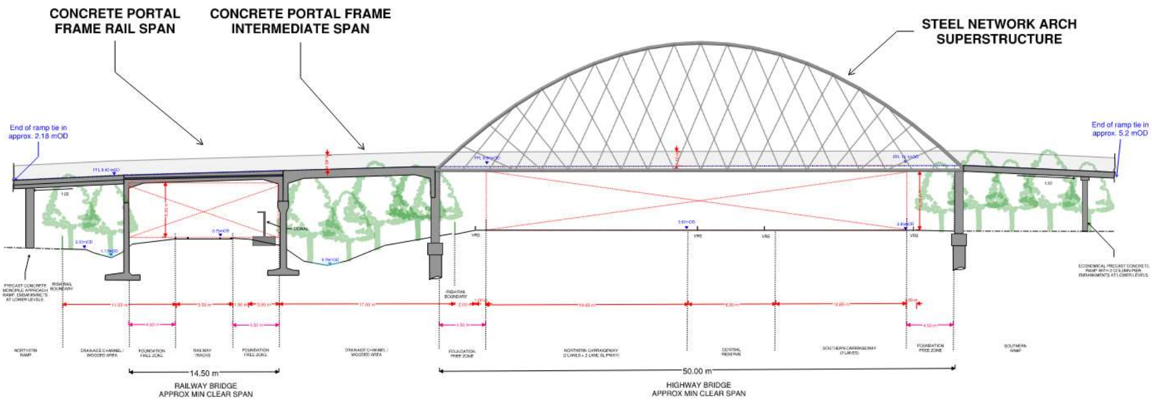

Figure 16.1: Indicative elevation of preferred option showing Irish Rail and N25 spans and beginning of approach ramps

Figure 16.2 shows the updated preferred alignment. Further to the Alignment and Width Options Assessment, detailed topographical survey information has led to the design developing on the southern approach. Northern and southern tie ins for the preferred design will continue to be developed in Phase 3, preliminary design.

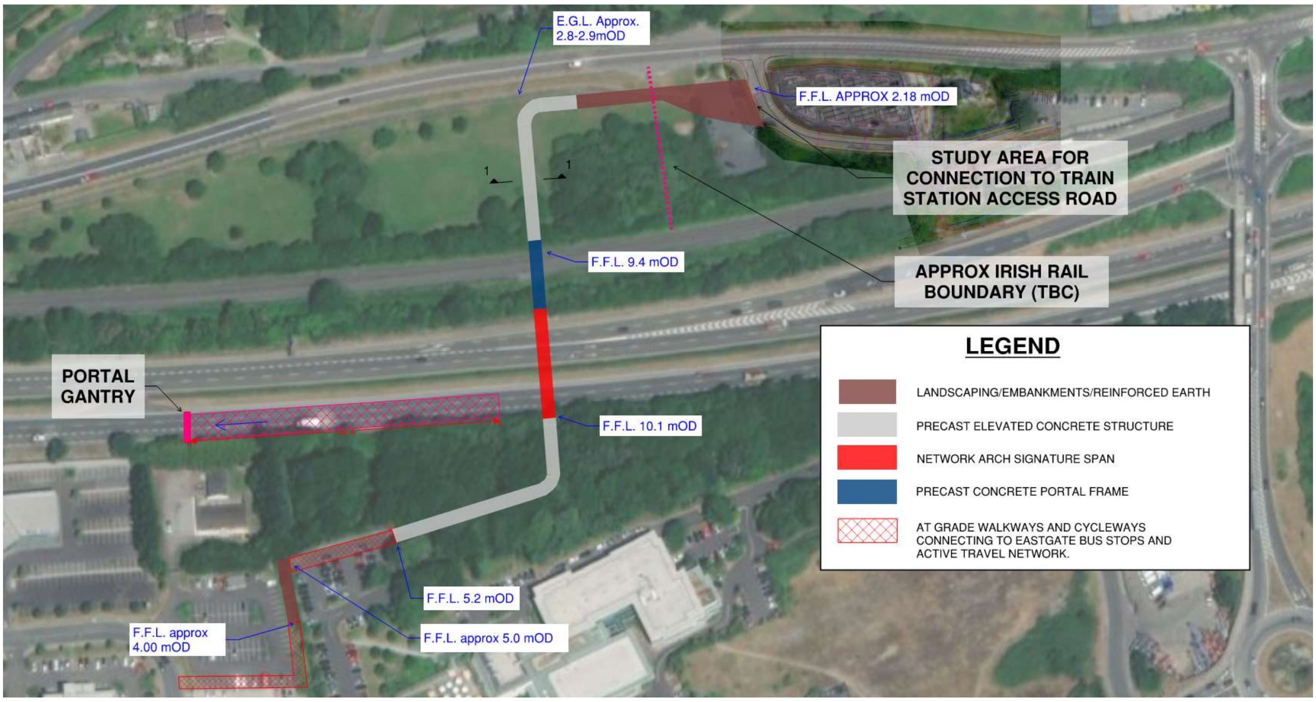

Figure 16.2: Indicative plan of preferred option with structure types

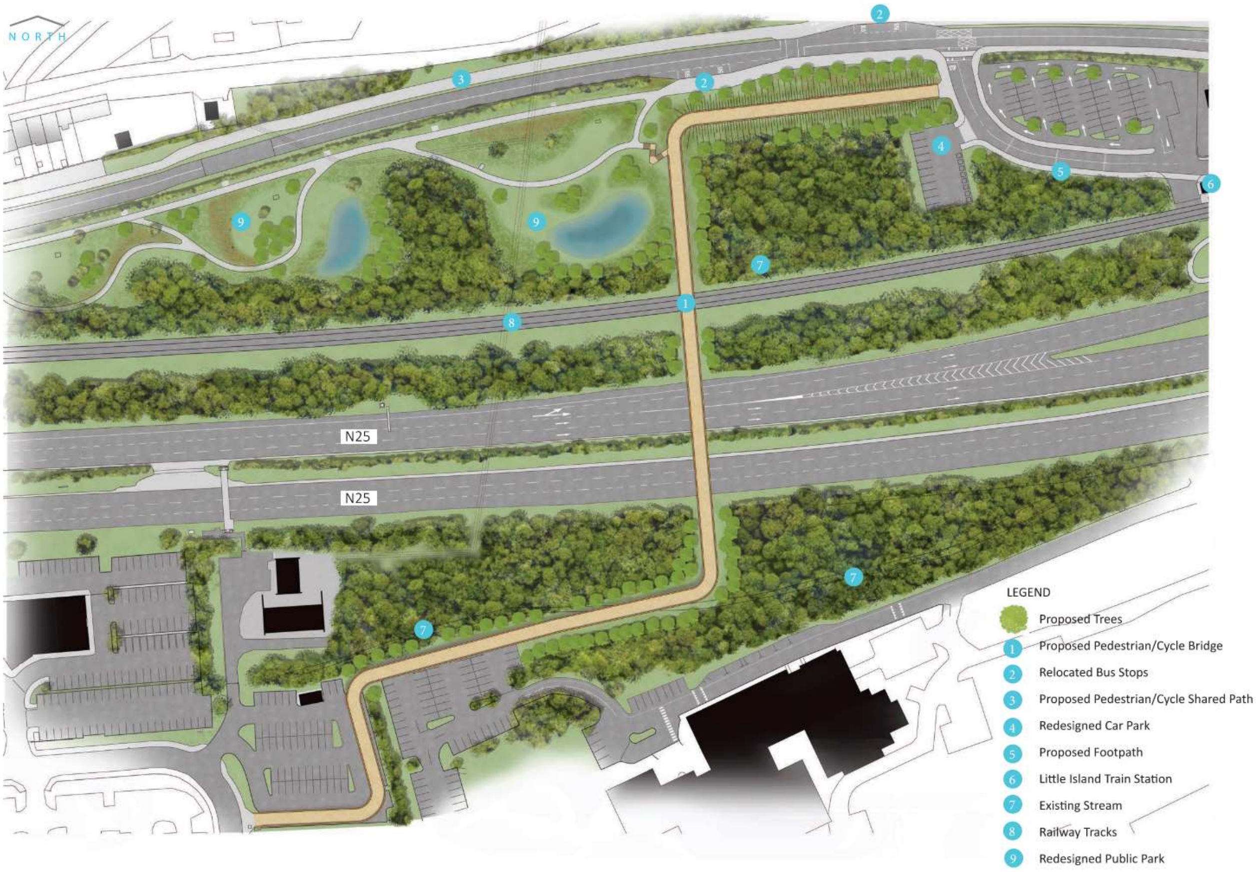

Figure 16.3: Landscape architecture sketch of preferred option

The proposed N25 span structural form will consist of a steel network arch structure with a reinforced concrete deck to ensure a consistent design aesthetic is maintained with the reinforced concrete decks provided on the approach ramps and Irish Rail span.

A reinforced concrete deck will also allow for a reduced maintenance liability on the main span for repainting over the lifetime of the structure. Indicative cross sections of the N25 span are provided in Figure 16.5.

Figure 16.4: Example of network arch structure with concrete deck

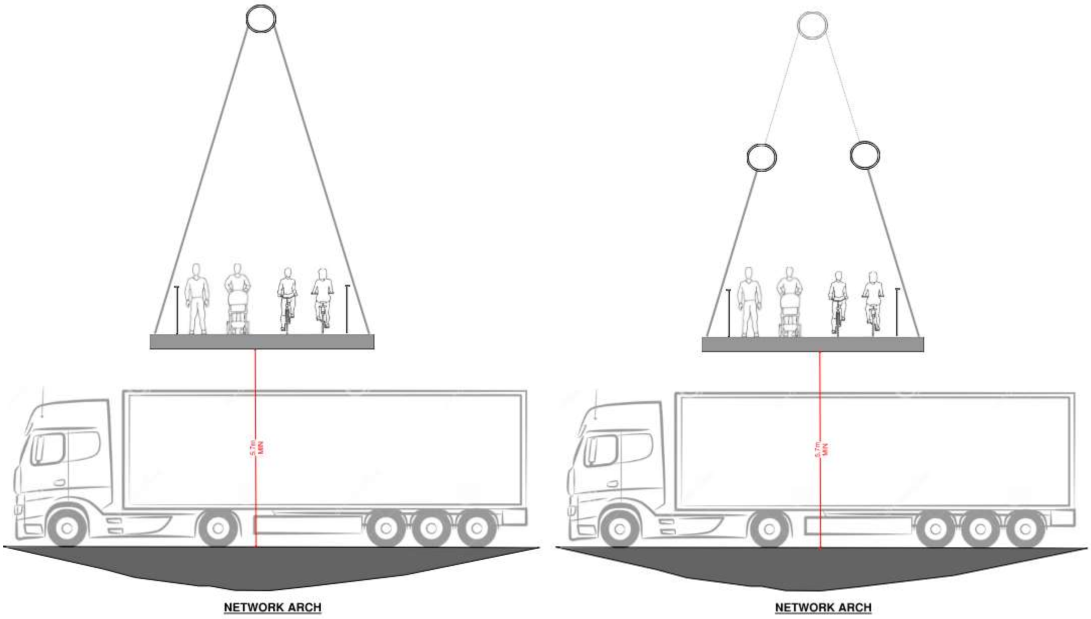

Figure 16.5: Indicative cross sections through network arch N25 span

16.3 Comparison of ramp options

The below table summarises the scorings for multi criteria assessment. The evaluation covers the elevated approach ramp structures.

Table 16.2: Multi Criteria Assessment Scoring of Bridge Options

Assessment Criteria	Ramp Options	
	Option 1 Elevated Steel ramp structures	Option 2 Elevated concrete ramp structure
Technical	3	3
Economic	3	3

Assessment Criteria	Ramp Options	
	Option 1 Elevated Steel ramp structures	Option 2 Elevated concrete ramp structure
Aesthetic	3	3
Durability and maintenance evaluation	2	5
Hydraulic	4	4
Environmental	3	3
Safety	3	4
Overall	19	25

16.4 Preferred approach ramp options

Based on the above scoring mechanism, for the elevated sections of both approach ramps concrete structures have been proposed. These have been proposed primarily to provide economical, low maintenance and durable structures given the location of the approach ramps close to the ocean and within a moist and vegetated wooded environment.

Figure 16.6 provides indicative cross sections of elevated ramp structures. For the northern approach ramp a concrete deck with a monopile/column is proposed to provide a higher aesthetic finish for users of the park below. As members of the public are not anticipated to use the southern wood, for the southern approach ramp (right) a precast prestressed concrete beam structure with in-situ reinforced concrete infill, sitting on 2 pile piers will be used as more economical structure that will retain a similar design aesthetic for the user from the deck.

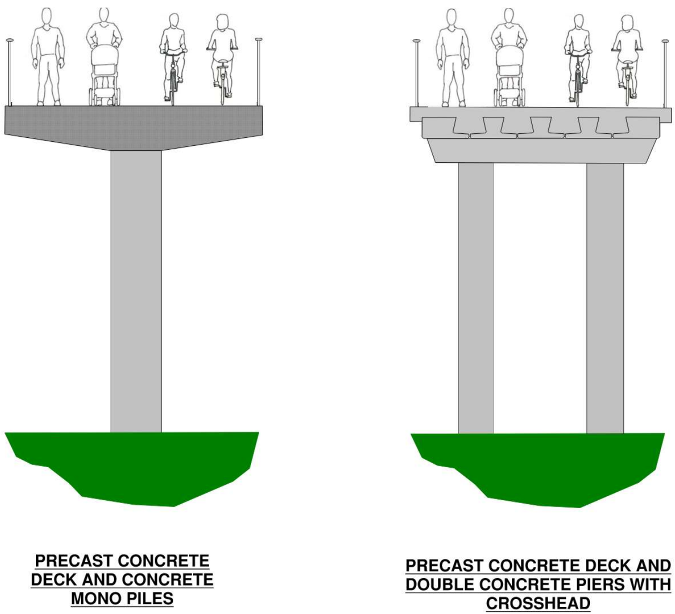

Figure 16.6: Indicative cross sections of elevated ramp structures

Indicative embankment types have been provided in Figure 16.7. Embankments and landscaping are to be used in lower sections of the approach ramps. Tie in details will be developed further in the preliminary design phase.

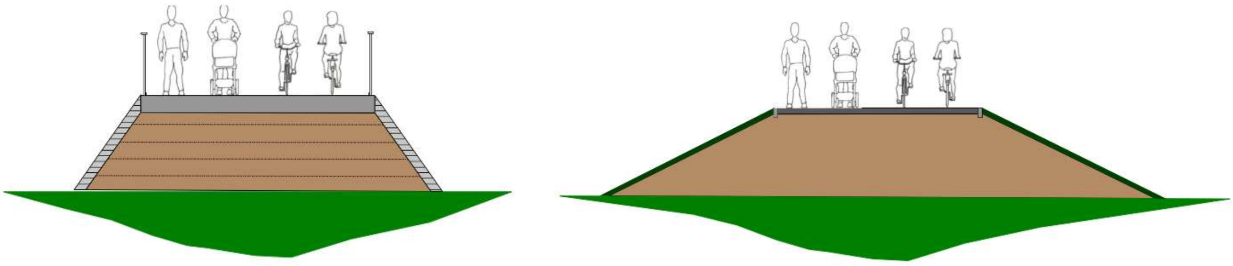

Figure 16.7: Indicative embankment types

16.5 Parapet options

For the N25 span and the approach ramps and steps several parapet types are possible. 1.4m high parapets will be required on these spans. The parapet type to be used will be confirmed at the next phase in consultation with CCC, TII and Irish Rail. Two types of parapets under consideration (outside of Irish Rail span) are post and rail with steel wire mesh infill (Figure 16.8) & vertical post infill at closely spaced centres (Figure 16.9).

For the Irish Rail span, as discussed in this report, a 1.8m high parapet is required, with the first 1.2m having solid infill and the top 0.6m having mesh infill. Achieving a consistent user experience and aesthetic treatment between the main span and Irish Rail span is important. Details of how the bridge parapets transition between each span will be developed in more detail at the next phase in consultation with Irish Rail.

Figure 16.8: Parapet type with vertical post and rail and steel mesh infill

Figure 16.9: Parapet type with vertical parapet infill

16.6 Parapet over Irish Rail

For the span over the Irish Rail track it is proposed that the same parapet height and type that is used elsewhere on the crossing will be used. Using a consistent and open parapet across the structure with adequate levels of lighting will greatly improve the aesthetic experience for the user and help to make the bridge a safe and inviting crossing option. This in turn will encourage greater use and an increased modal shift to sustainable active travel modes.

It is acknowledged that Irish Rail overbridges typically require 1.8m high parapets with the bottom 1.2m having solid infill and the top 0.6m having mesh infill. To mitigate against the reduced height of parapet and ‘open’ type infill it is proposed that an ancillary solid inclined underbridge protection screen will be used to shield users from the rail and potential future overhead electrical lines. The shield will also serve as a catch for rubbish and debris. A kicker plate will also be provided along the base of the parapet to prevent debris being kicked off the bridge.

The design approach of this underbridge screening shield is in keeping with international best practice and has been used recently on similar pedestrian and cycle bridges in the Netherlands and Denmark. Danish standards are less onerous and only require a parapet height of 1.2m where a screen is also use. It is proposed for this structure a parapet height is maintained at 1.4m height to meet TII cycle parapet requirements. See below images illustrating requirement from Danish Standard BaneDanmark BN1-105 and also an example of a recently completed bridge in Odense, Denmark showing the under-bridge screens.

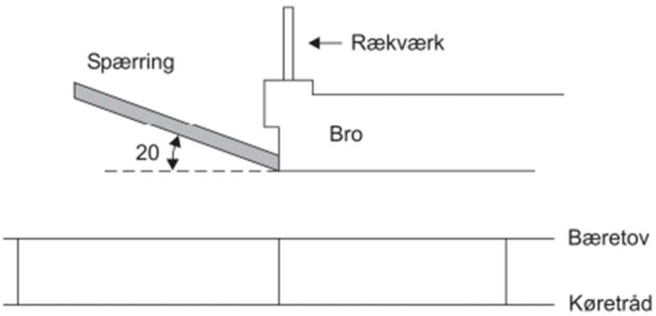

Figure 10 Requirement for inclined under bridge screen in Danisg Standard BaneDanmark BN1-105

Figure 11 Example of under bridge screening on new pedestrian and cycle bridge in Odense, Denmark with 1.2m high parapets with vertical bar infill

16.7 Security

A number of items will be considered during the development of the preliminary design for the preferred option. A key objective of the design will be to promote use and help to ensure the crossing feels safe to use and avoids anti-social behaviour here possible by design. The following will be considered

- Adequate lighting to ensure feeling of safety for users.
- High Aesthetic design to encourage footfall.
- CCTV cameras to enhance user safety and prevent anti-social behaviour.
- Adequate bins to prevent littering.
- Avoidance of concealed areas, in particular in the northern amenity park, with areas concealed from view of the existing roadway to prevent anti-social behaviour.
- High quality vandal proof parapets.
- Open parapet design to avoid bridge feeling 'locked in'.
- Kick plates on the N25 span to avoid falling debris onto the road below.
- Anti-graffiti paint to allow ease of cleaning and maintenance.

Appendix A

Alignment and Bridge Width Options Assessment Report

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1. Introduction

1.1 Background and overview

Cork County Council (CCC) and the National Transport Authority (CCC) are proposing a new pedestrian and cycle crossing linking Little Island train station with Eastgate business Park and the wider Little Island environs. The proposed bridge will cross the N25 and the Cork to Middleton/Cobh train line approximately 10km to the East of Cork City centre, see Figure 1.1. Arup were appointed by CCC in 2020 to undertake a feasibility report on this crossing and have now been appointed to progress the bridge design through Phases 2 and 3 (NTA PAG's), options assessment, preliminary design and statutory planning. This technical note forms the basis of the bridge alignment (route selection) evaluation and bridge usable width assessment.

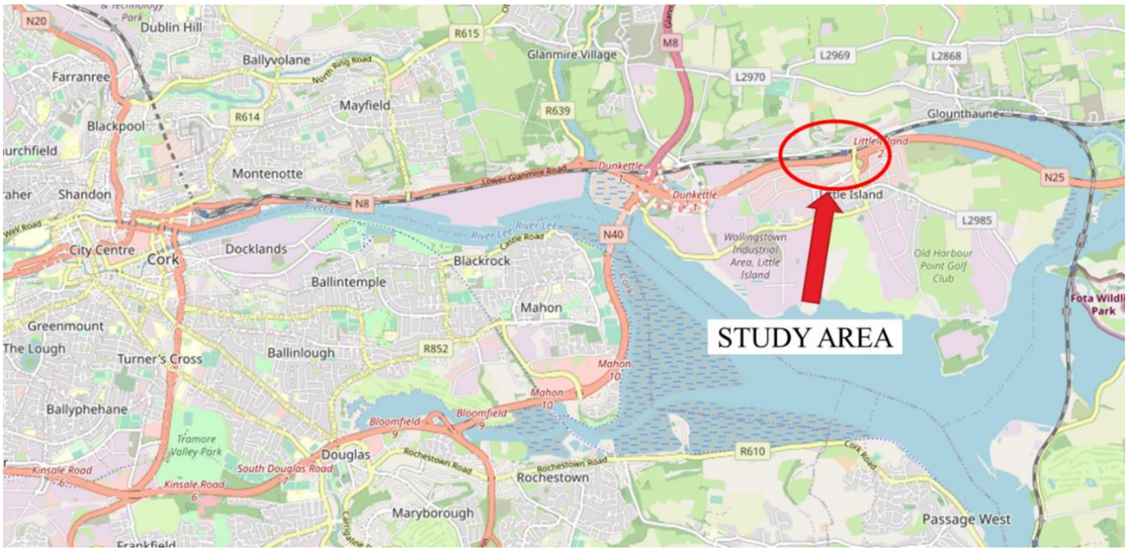

Figure 1.1: Location of proposed bridge crossing @OpenStreetMap contributors

Prior to the Arup feasibility report the requirement for a new pedestrian and cycle bridge in Little Island Co. Cork was identified as part of the Little Island Sustainable Transport Interventions Project (LISTI). The aim of the bridge is to provide efficient pedestrian and cycle connectivity between the Little Island Train Station and the Eastgate Business Park as well as Little Island as a whole and to promote sustainable transport modes while minimising impacts on the surrounding area and environment. The proposed bridge will provide safe access to the Eastgate business park and Little Island from the Little Island train station and from the planned Cork to Middleton greenway.

At present, the route for those travelling from the Little Island Train Station to the Eastgate Business Park is via the existing An Crompan Bridge to the east. The existing bridge has a single footpath on the western side and no cycle lanes, thus providing substandard active travel infrastructure. The location of the bridge, east of the Eastgate business park, also means that users travel a considerable additional distance between Eastgate business park and Little Island train station which discourages user travel to Eastgate by a combination of train and active travel means.

The Arup feasibility report highlighted several potential alignment options within the study area, given in Figure 1.2. This technical note is informed by this feasibility study and further develops alignment options for consideration with a view to determining the emerging preferred crossing alignment.

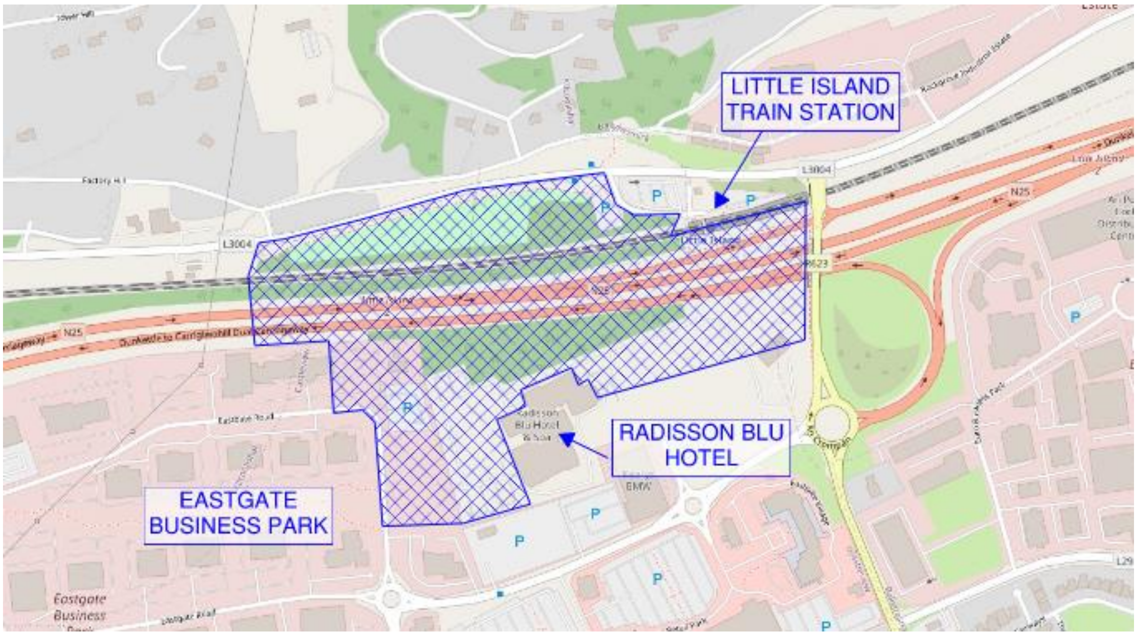

Figure 1.2: Crossing alignment study area @OpenStreetMap contributors

1.2 Scope of Technical note

The purpose of this note is to present the relevant information and constraints to recommend the emerging preferred bridge and approach ramp alignment for the proposed N25 Little Island Pedestrian and Cycle bridge.

This note also aims to specify the appropriate bridge width to be used in further optioneering and design. In this note, the bridge width refers to the internal/user width of the bridge. The overall bridge structural width will be dependent on the structural form selected and will be wider than the usable width.

The bridge width recommendation will be determined using relevant Irish codes and standards and taking guidance from current international best practice, to help ensure the bridge is future proofed for potential increased pedestrian and cycle traffic.

Additionally, this note will consider the requirements for pedestrian/cyclist segregation on the proposed bridge and approach ramps and provide a recommendation to be taken forward based on codes, standards and best practice.

The bridge structural form will not be evaluated in this note. This note will be appended to the Structural Options Report and will form the basis of the justification for preferred bridge/ramp alignment and width.

2. Alignment

2.1 Background

As part of the LISTI project, an initial examination of 4 potential bridge landing locations were identified and examined across the N25 into Little Island. The 2021 Arup feasibility report narrowed down the feasible alignment to 3 high level options in the preliminary options assessment.

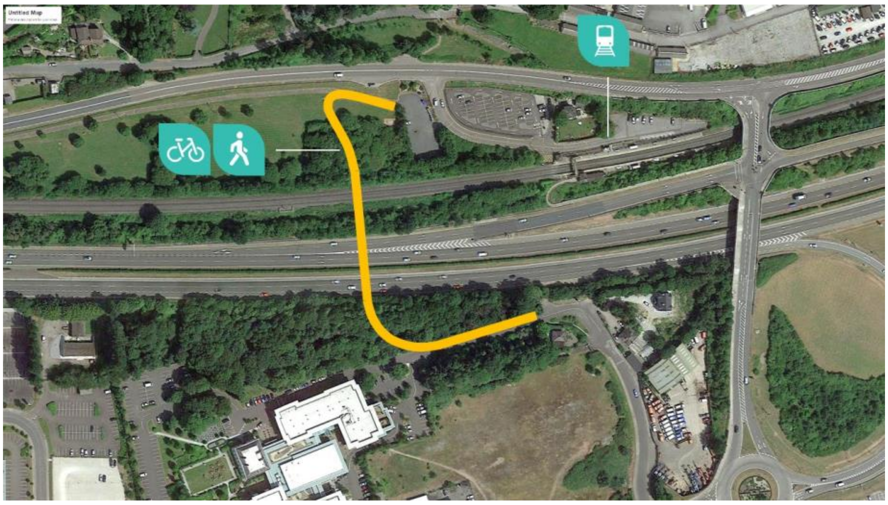

Figure 2.1: Feasibility study alignment option 1

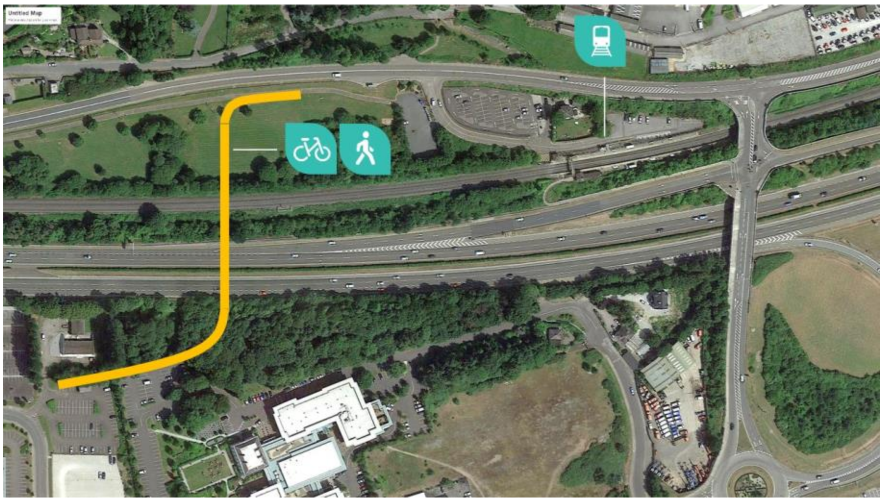

Figure 2.2: Feasibility study alignment option 2

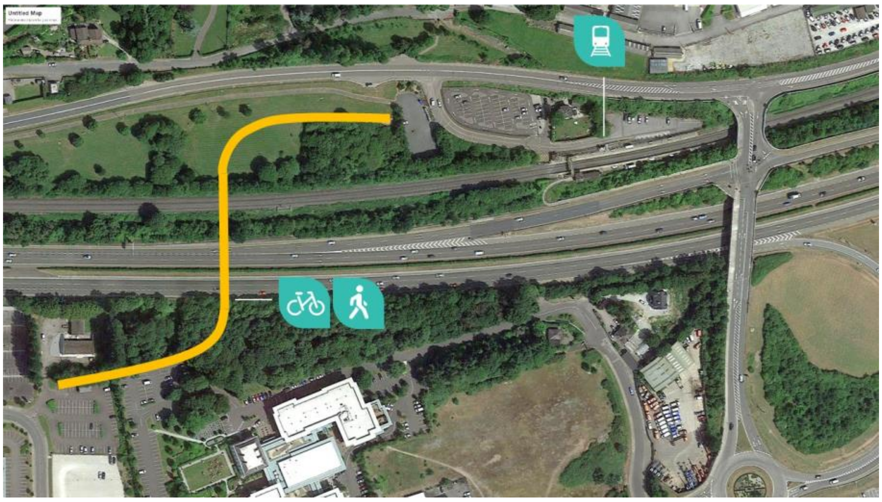

Figure 2.3: Feasibility study alignment option 3

The above alignment options were analysed against site constraints as part of the preliminary options assessment. Topographical survey information was not available at this time however and as a result a further alignment evaluation with more detailed information is given in this report. As alignment options 2 and 3 from the feasibility report are very similar and ramp location will be largely dependent on topography and ramp length they have been combined in this study as option 2 for consideration.

2.2 Alignment Options for Assessment

With the information gathered during the feasibility phase of this project as well as the information obtained at the current phase of the project, the following 3 bridge alignment options have been brought forward for consideration.

An alternative crossing option to the west of the study area has now been considered. This option is deemed to be worthy of consideration due to its southern ramp location away from the wooded areas south of the N25. This is given in this note as alignment Option 3. See Figure 2.4 for indicative alignment options to be further reviewed in this note.

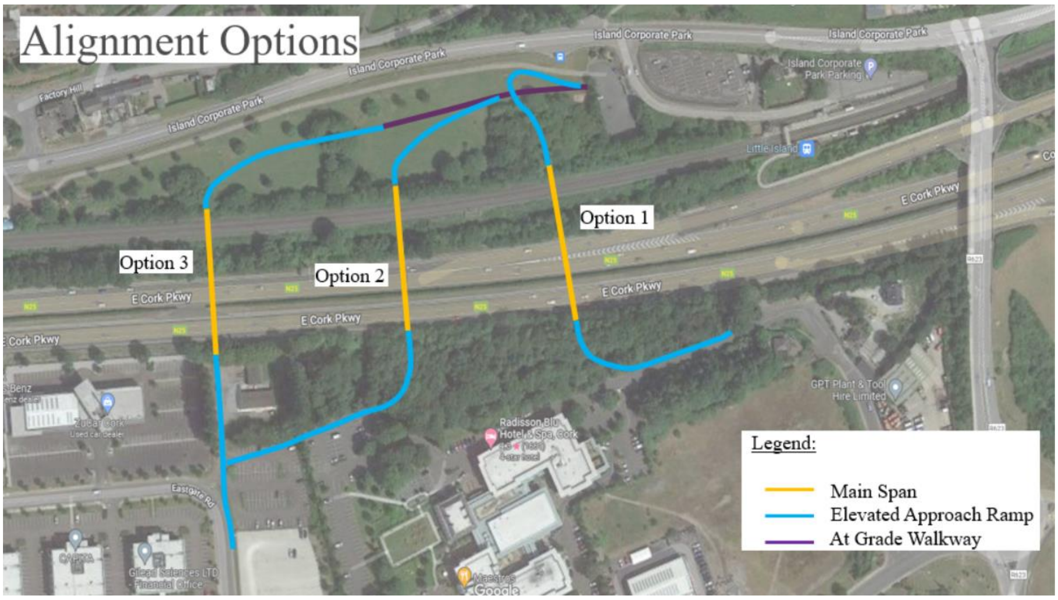

Figure 2.4: Options assessment bridge alignment options

2.3 Alignment Constraints

2.3.1 Vertical alignment

The vertical alignment of the structure over the N25 and Irish rail land is set by the required clearance envelopes of Transport Infrastructure Ireland and Irish Rail (IÉ). From discussions with both these stakeholders TII require 5.7m vertical clearance to the bridge soffit over the highway and IÉ require 5.3m vertical clearance to the bridge soffit above top of track level. These constraints and the required structural depth below finished footway level dictate the top of approach ramp levels on the north and south approaches.

For the purposes of this report a vertical clearance of 5.7m to internal Eastgate business park roads will also be deemed necessary to allow access for service and delivery vehicles.

TII DN-STR-03005 Design Criteria for Footbridges requires a maximum slope on approach ramps of 1:20 (5%) which dictates the minimum ramp length. DMRB CD353 Section 5.11 (below) which has been updated more recently clarifies that for gradients of 1 in 22 no intermediate landings are required. As the overall structural length for a 1 in 20 gradient including landings is very similar to that of a 1 in 22 gradient with no landings it is proposed that the design proceeds based on a maximum 1 in 22 gradient (4.5%).

2.3.2 Topography

A topographical survey specific to this project has not yet been completed however the design team have obtained a LIDAR survey of the Irish Rail land and track (IÉ), topographical information for roads in the Eastgate business park (Arup) and topographical information for the N25 Dunkettle scheme (TII). Inputs from these surveys has allowed for an estimate of ramp lengths and tie in points to be made for the alignment evaluation. Further development of the emerging preferred alignment option will be made when full topographical information is available.

2.3.3 Catchment and desire lines

A key constraint of the alignment evaluation is to promote the use of active travel modes between the Little Island train station area and the Eastgate Business Park. Long detours which deter users from using the railway station or the proposed structures are undesirable.

Developing an alignment which caters well for key catchments and increases the potential for modal shift to active and sustainable transport modes is critical. Also, choosing an alignment which integrates well with other sustainable transport hubs at the little Island Train station and planned facilities being provided under the Little Island Sustainable Transport Improvements is essential.

The main centre of employment on the south side to be targeted is considered the Eastgate Business Park which contains the majority of existing and planned employment in the Little Island area which has been identified by the Little Island Sustainable Transport Improvements planning report. On the north side the main integration hub to connect to is the Little Island train station area.

Irish Rail are currently designing upgrades to the pedestrian bridge at the Little Island train station and there is a link from the south platform of the station to the An Crompan bridge. It is acknowledged that this link will continue to be used by some pedestrians accessing the East side of Little Island. As a result, a connection with a similar southern end point to the east side of little Island is not considered to be as effective in creating modal shift as a connection to the Eastgate area.

Mapping

2.3.4 Environmental constraints (Statutory consents)

Article 8 of the Roads Regulations 1994 (Road development prescribed for the purposes of Section 50(1)(a) of the Roads Act, 1993 (as amended) specifies the classes of development which require an EIA, including:

'The construction of a new bridge or tunnel which would be 100 metres or more in length'

In addition, Section 50(1)(c) of the Roads Act, 1993 (as amended) specifies the following:

'Where a road authority considers that any proposed road development (other than development to which paragraph (a) applies) ….would be likely to have significant effects on the environment…'

For all alignment options the overall length will be more than 100m and an EIAR will be required, therefore it is difficult to compare alignment options based on this constraint. It may be possible that some options will have greater environmental impact than others however it is not possible to quantify this until EIA screening has taken place.

As outlined in the feasibility report the study area is not in a Natura 2000 site, however there are two sites in the vicinity. An appropriate Assessment (AA) screening assessment ill take place following the selection of a bridge alignment to determine the likely impact on a Natura 2000 site and to determine if a Natura Impact Statement is required.

2.3.5 Road/rail signage and gantries

To the West of the study area there are two new sign gantries over the N25. A cantilever gantry on the North and a portal gantry on the south. Further to initial discussions with TII a site line of absolute minimum 200m, but preferably 250m will be required to both gantries and signs. The proposed bridge structure cannot obscure this site line. See Figure 2.5, which gives an indicative set back required from both gantries. This offset will need to be confirmed and agreed with TII once road levels are confirmed by the topographical survey. If a bridge is too close to the gantry TII will likely require this gantry to be moved which will require the reconstruction of foundations etc. During the next stage of this project, preliminary design, the preferred alignment option will be reviewed further to ensure adequate recognition time for signs and legibility is not obscured in accordance with EN 12966.

At an early engagement meeting IÉ identified a signal box approximately at the location of alignment option 2 on the southern side. IÉ has verbally confirmed that this should not pose a constraint to the bridge alignment as it is located at a lower level and on the outside of the curve. The preferred alignment will need to be agreed with IÉ.

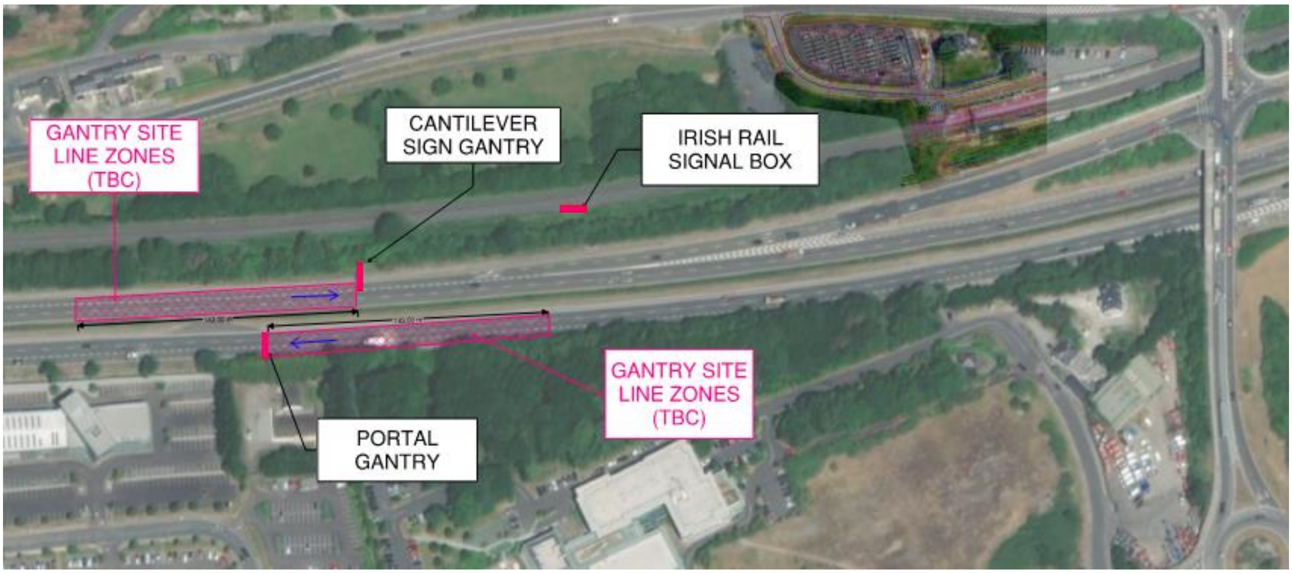

Figure 2.5: N25 Gantries Locations and site line zones & Irish Rail signal location

2.3.6 Landowners and stakeholders

Figure 2.6 provides info of the landowners/stakeholders to be considered in the evaluation of different alignment options. Details of private landowners are to be confirmed and appropriate consultation made by CCC following a selection of the emerging preferred alignment option. Efforts have been made in setting alignments to minimise clashes with existing and proposed developments.

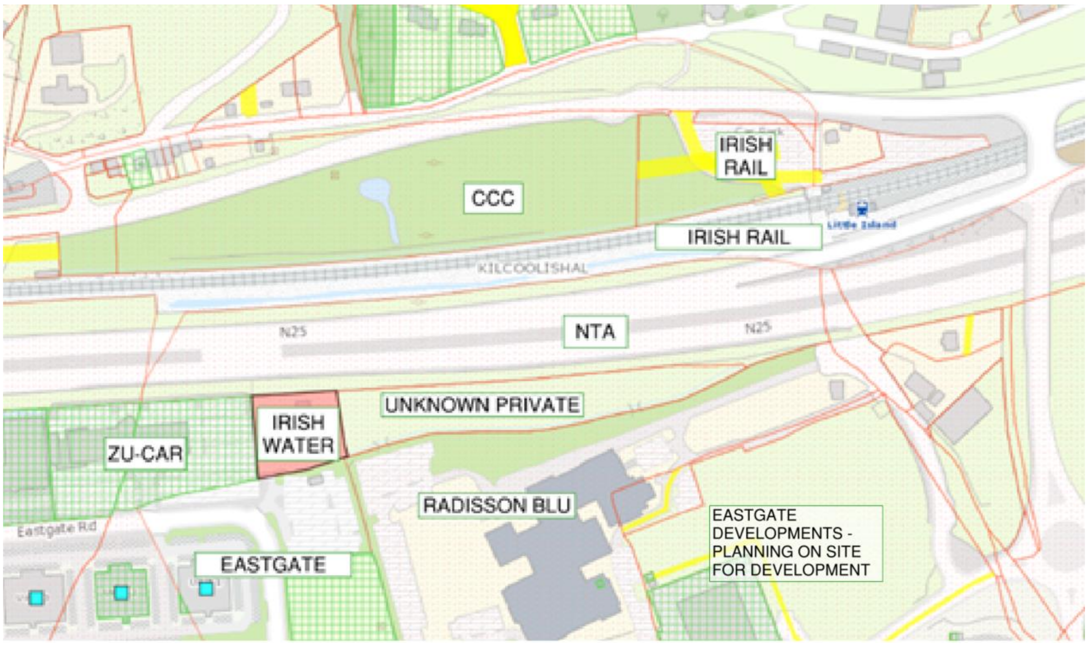

Figure 2.6: Landowner/occupiers from land registry

2.3.7 Cost and buildability

Relative costs of construction and buildability will be considered as part of the evaluation of alignment options by consideration of bridge and ramp lengths. A comparative cost assessment of bridge options will be completed as part of the Options Selection Report.

2.3.8 Services and utilities

Figure 2.7 gives indicative location of services and utilities in the study area as identified by the 2021 feasibility report. This image also shows indicative relative level differences on site based on a site walkover to be confirmed by the topographical survey. This level information as well as topographical information obtained from stakeholders is considered in the alignment options evaluation.

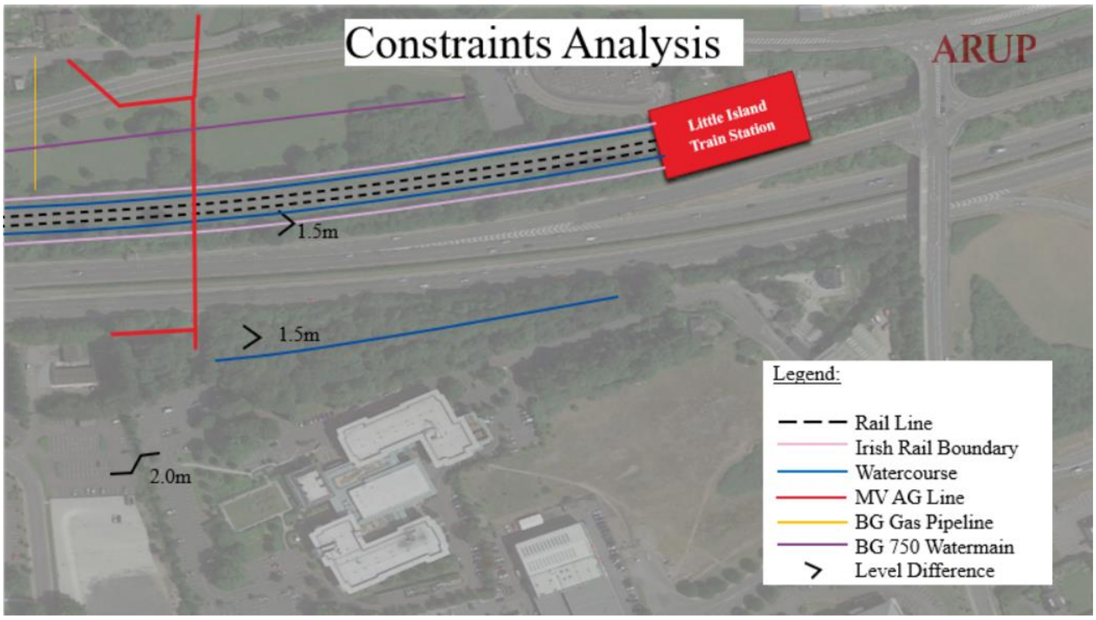

Figure 2.7: Indicative services and level constraints

2.4 Alignment Option 1

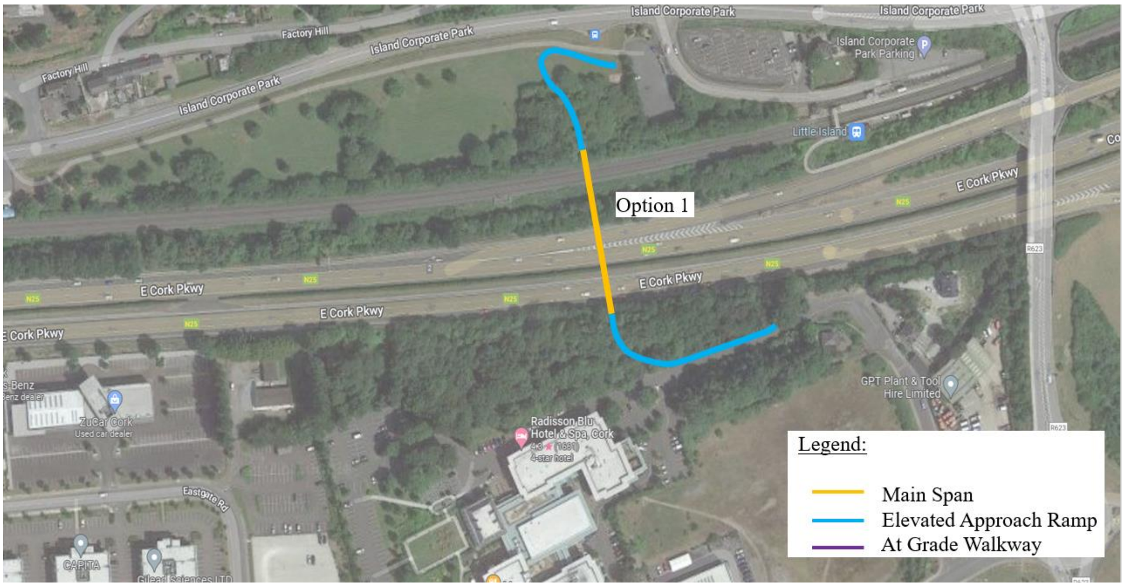

Figure 2.8: Bridge Alignment Option 1

Alignment Option 1 aims at keeping the proposed bridge as close as possible to the Little Island train station and existing An Crompan Bridge. The key considerations of this option have been outlined below.

The overall structure length is approximately 380m subject to review of ground levels when topographical survey is available.

Advantages:

- Shortest distance from the Little Island Train Station.
- Provides possibility for multi modal interchange at northern landing (rail, bus, cycling and pedestrian).

Disadvantages:

- Highest crossing over N25 due to raised off ramps leading to longer approach ramps than other options.

- Landing point not towards East gate business park, poor pedestrian, and cycle catchment, and tie in to Eastgate Business Park from south. Some pedestrians may continue using An Crompan Bridge.
- Length of northern ramp required does not distinguish crossing location greatly from option 2. Due to proposed location of crossing, there may be difficulty achieving length required for northern habitat.
- Tree felling and site clearance required for north and south ramps. Potential habitat disturbance.
- More difficult to construct and maintain southern ramp within wooded area.
- Sharp bend in northern ramp not preferred for cyclists.

Further to the feasibility assessment review of this option and further assessment at this stage, this option is not deemed to meet the basis requirements of encouraging active travel between Little Island train station and Eastgate Business Park and environs, as it is deemed to be off the desire line and would not provide a significantly different route to that already available via An Crompan Bridge.

Additionally, following review of the currently available topographical survey information and consultation with TII and IÉ it is clear that, to achieve a sufficient ramp length on the northern approach, the main crossing location would be very similar to that of alignment option 2. In this case there would not be an obvious advantage in terms of cost, buildability, statutory consents or desire lines for proceeding with Alignment Option 1 over alignment option 2. Therefore, Alignment Option 1 will not be considered further.

2.5 Alignment Option 2

Figure 2.9: Bridge Alignment Option 2

Alignment Option 2 main crossing moves further to the east from the Little Island train station however, the landing point of the bridge is towards the hub of the Eastgate Business park. Due to the required length of ramps the northern approach ramp still lands close to the Little Island train station. Key considerations of this option are outlined below.

The overall structure length is approximately 350m subject to review of ground levels when topographical survey is available.

Advantages:

- Landing points link Little Island Train Station to the business park providing a better desire line.
- Has been positioned so as not to affect gantry sight lines i.e., does not require gantries to be moved.
- Shorter sections of straight ramps may aid in slowing cyclist speeds.

- Shortest overall structure length. Lower structure relative to Option 1 over N25, avoids rising section of N25 off ramp. Can potentially utilise higher length of cheaper embankment on southern approach.
- Least interference with internal Eastgate Business Park roads and infrastructure. Instead uses currently unused wooded area for southern approach.
- Not expected to require gantries to be moved (TBC with TII).
- Provides possibility for multi modal interchange at northern landing (rail, bus, cycling and pedestrian);

Disadvantages:

- Tree felling and site clearance required for south ramp required. Potential habitat disturbance.
- More difficult to construct and maintain southern ramp within wooded area.
- Secondary approach ramp/embankment required between Radisson Blu carpark and Eastgate.
- Utility diversions may be necessary.

2.6 Alignment Option 3

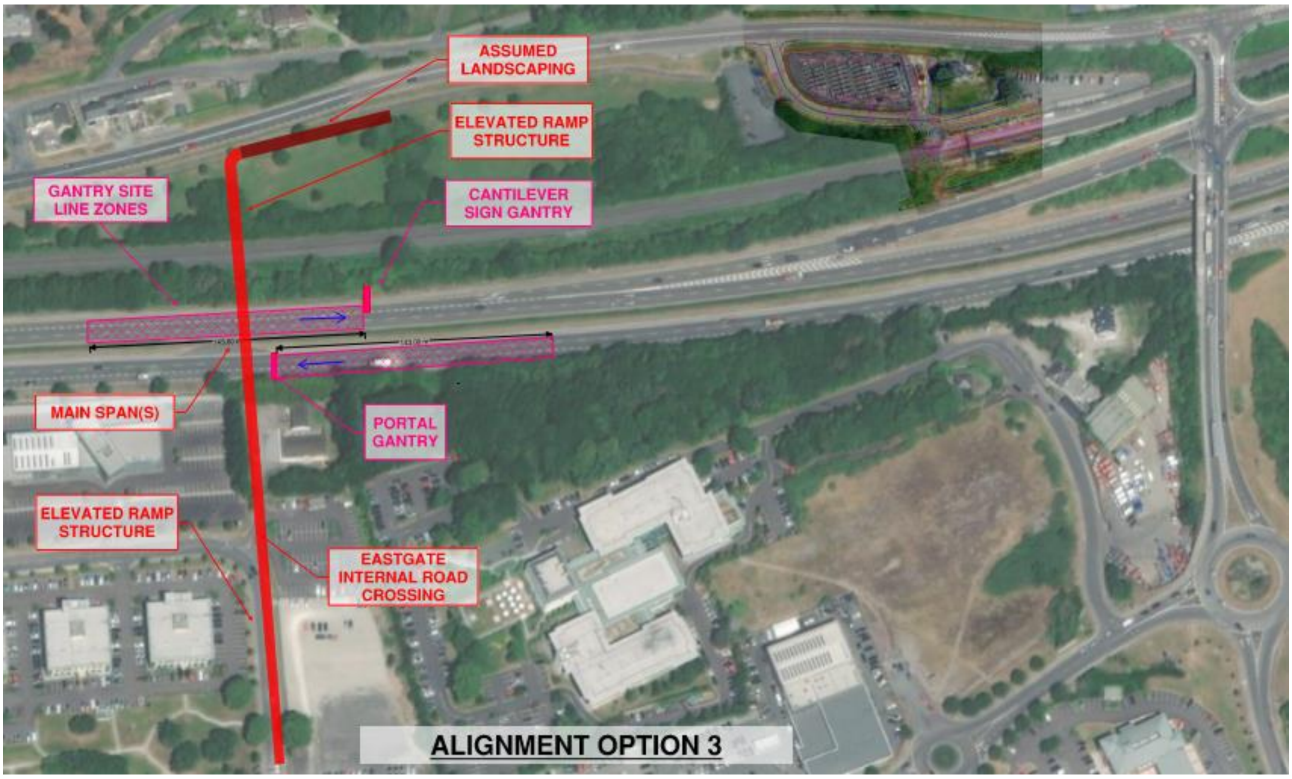

Figure 2.10: Bridge Alignment Option 3

Alignment option 3 is the furthest west of the options from the Little Island train station however, the landing point of the bridge is towards the hub of the east gate business park. Key considerations of this option are outlined below.

The overall structure length is approximately 390m, subject to review of ground levels when topographical survey is available.

Advantages:

- Minimises tree felling and potential habitat disturbance.
- Access for construction will be easier.
- Lower structure relative to option 1 over N25 as avoids rising section of N25 off ramp.

Disadvantages:

- Long straight southern ramp due to internal road crossing. Large amount of Eastgate land taken up along existing internal road, footway and cycle tracks which would require additional CPO;
- Landing points connect Eastgate business park to Little Island train station however base of northern ramp is approx. 170 m from the station car park. This leads to poorer connectivity.
- Located within gantry sight lines, will likely need to relocate the cantilever gantry.
- Northern abutment and ramp close to existing Bord Gais gas line. May need to provide utility diversion.
- Bridge elevation obscured on east approach by portal gantry, will affect aesthetics of the bridge regardless of bridge structural form.
- Southern ramp crossing Irish water premises which is currently in operation.
- Straight ramps sections encourage faster cycling speeds.

2.7 Alignment Options Evaluation

A multi-criterion assessment is carried out to establish a preferred alignment. The criteria have been assessed based on a scoring hierarchy from 1 to 5. An untenable solution, one which is unfeasible or detrimental to the progression of the project, scores a 1. While a characteristic which aligns with the core criteria of the brief and has a highly beneficial impact on the project receives a scoring of 5. An equal weighting has been given to all criteria.

Table 2.1: Preferred bridge alignment assessment

Criteria	Alignment options			Comment
	Option 1	Option 2	Option 3	
Economy	3	4	2	The longer structural length of Alignment Option 3, additional CPO and realigning of internal roads in Eastgate is expected to result in a higher cost in comparison to Alignment Option 2.
Integration/ Desire Lines	1	5	4	The distance between the Little Island Train station and Alignment Option 3 is seen as less desirable than that of Alignment Option 2. Option 2 can tie into a high-quality travel interchange at Little Island Train station. Alignment Option 2 ties provides a route into Eastgate with less diversions for some users from the Northern part of the park.
Statutory Requirements	–	–	–	Both Alignment Options will require an EIAR and it is likely both options will require a Natura Impact Statement. Therefore both options are neutral.
Third Party Engagement. Landowners	–	–	–	It is likely that both options will require significant third-party engagement and therefore, no option is preferred here.
Impact on existing development	2	4	3	Option 2 will take up land of existing landowners however this land is currently car parks and vegetated areas. Option 3 would interfere with the currently planned LISTI improvements in
Impact on services and utilities	3	4	2	Alignment Option 3 will require the relocation of the cantilever gantry on the N25. Additionally, Alignment Option 3 is closer to existing services on the northern approach.
User Safety	2	4	2	The straight ramp on Alignment Option 3 could increase the number of accidents/incidents on the bridge as cyclist are potentially encouraged to travel at higher speeds in comparison to the curved ramps of Alignment Option 2.
Total	11	21	13	

2.8 Recommendation

Based on the evaluation above of alignment options presented in this technical note, we recommend **Alignment Option 2** be taken forward as the preferred alignment option.

3. Bridge Width and Segregation

3.1 Bridge width

3.1.1 Overview

The usable deck width of the bridge should comply with all relevant Irish codes and standards and is informed by current international best practice. Given the design life of this type of structure at 120 years, the width should also be sufficient for future use and potential growth in user numbers. The bridge width is defined as the internal usable space between parapets in this note and does not look at overall bridge width.

3.1.2 Transport Infrastructure Ireland Standards

Transport Infrastructure Ireland (TII) DN-STR-03005 Design Criteria for Footbridges is largely based on the UK Design Manuel for Roads and Bridges (DMRB) BD29/04. Clause 12.3 defines the minimum bridge width for pedestrian and cycle bridges to be between 2m and 3.9m dependent on the level of segregation, which can be seen to be outdated. BD29/04 has been withdrawn and updated. TII DN-STR-03005 requires the current update of the UK Local Transport Note 2/86 be considered.

12.3 Where the crossing is part of a pedestrian and cycle route, specific provision shall be made in accordance with the guidance on shared use by cyclists and pedestrians contained in Local Transport Note 2/86 (Ref. 10) or any current update of that document. In Scotland, reference shall be made to 'Cycling by Design' (Ref. 13).

12.4 The minimum widths for a footpath (or footway) and a cycle track on a bridge and ramps shall be:

	Pedestrian Path	**Cycle Path**	**Total Width**
When segregated by kerb not less than 50mm high	1.75m	1.75m	3.5m
When segregated by railings not less than 900mm high	1.95m	1.95m	3.9m
When segregated by a white line, colour contrast or surface texture	1.5m	1.5m	3.0m
Unsegregated	-	-	2.0m

Figure 3.1: TII DN-STR-03005 Minimum Width Requirements

3.1.3 UK Local Transport Notes

The Local Transport Note 2/86 as referred to in TII DN-STR-03005 has been replaced with LTN 1/20: Cycle Infrastructure Design. LTN 1/20 gives guidance on cycle lane width requirements and directs the user to the 'Inclusive Mobility' document for footway width.

See excerpt from LTN 1/20 below with 2-way cycle track width requirements, Figure 3.2. Absolute minimum and desirable widths are defined based on peak hour cycle flow. Widths should be considered as effective widths with additional widths required dependant on the edge constraint type to maintain effective width, Figure 3.3. The Cork Cycle Network Plan 2017 section 4.5 presents a cycling proposed cycling mode share for AM trips in Little Island of 5% by 2025. Whilst modelling for future cycle numbers over a proposed crossing has not taken place, we recommend it would be prudent to allow for the absolute minimum effective cycle width for 300-1000 users per hour of 2.5m.

Table 5-2: Cycle lane and track widths

Cycle Route Type	Direction	Peak hour cycle flow (either one way or two-way depending on cycle route type)	Desirable minimum width* (m)	Absolute minimum at constraints (m)
Protected space for cycling (including light segregation, stepped cycle track, kerbed cycle track)	1 way	<200	2.0	1.5
		200-800	2.2	2.0
		>800	2.5	2.0
	2 way	<300	3.0	2.0
		>300-1000	3.0	2.5
		>1000	4.0	3.0
Cycle lane	1 way	All – cyclists able to use carriageway to overtake	2.0	1.5

*based on a saturation flow of 1 cyclist per second per metre of space. For user comfort a lower density is generally desirable.

Figure 3.2: LTN 1/20 Cycle Lane effective width requirements

Additional width for edge constraints will be required depending on the method of segregation. Additional 0.5m width should be provided adjacent to the cycle parapet and varying additional width of between 0m and 0.25m dependant on the method of segregation. Minimum cycle track width should be between 3m and 3.25m dependant on method of segregation.

Table 5-3: Additional width at fixed objects

Type of edge constraint	Additional width required to maintain effective width of cycle track (mm)
Flush or near-flush surface including low and splayed kerbs up to 60mm high	No additional width needed
Kerbs 61mm to 150mm high	200
Vertical feature from 151mm to 600 mm high	250
Vertical feature above 600 mm high	500

Figure 3.3: LTN 1/20 Cycle additional width requirements for edge constraint.

The UK Inclusive Mobility document section 3.1 recommends a minimum clear width of **2m** for footways which allows two wheelchairs to pass each other comfortably. As per the guidance of LTN 1/20 and 'Inclusive Mobility' a total bridge usable minimum bridge width of between **5m and 5.25m** is recommended to be adopted depending on method of segregation.

3.1.4 National Cycle Manuel

The Irish Cycling Manual section 1.5.2 gives guidance on required cycleway width. The Width Calculator figure is reproduced below. From this figure the width requirements applicable for this crossing would be

A=0m (no kerb to footway, just painted line)
B=1.75m (minimum for basic 2 way)
C=0.5m (Outside edge parapet allowance)
D=0.25m+0.25m=0.5m (Additional allowance for uphill cycling + sharp bends)
A+B+C+D = 2.75m min.

This requirement is less onerous than the requirement for 3m cycleway width given by LTN 1/20.

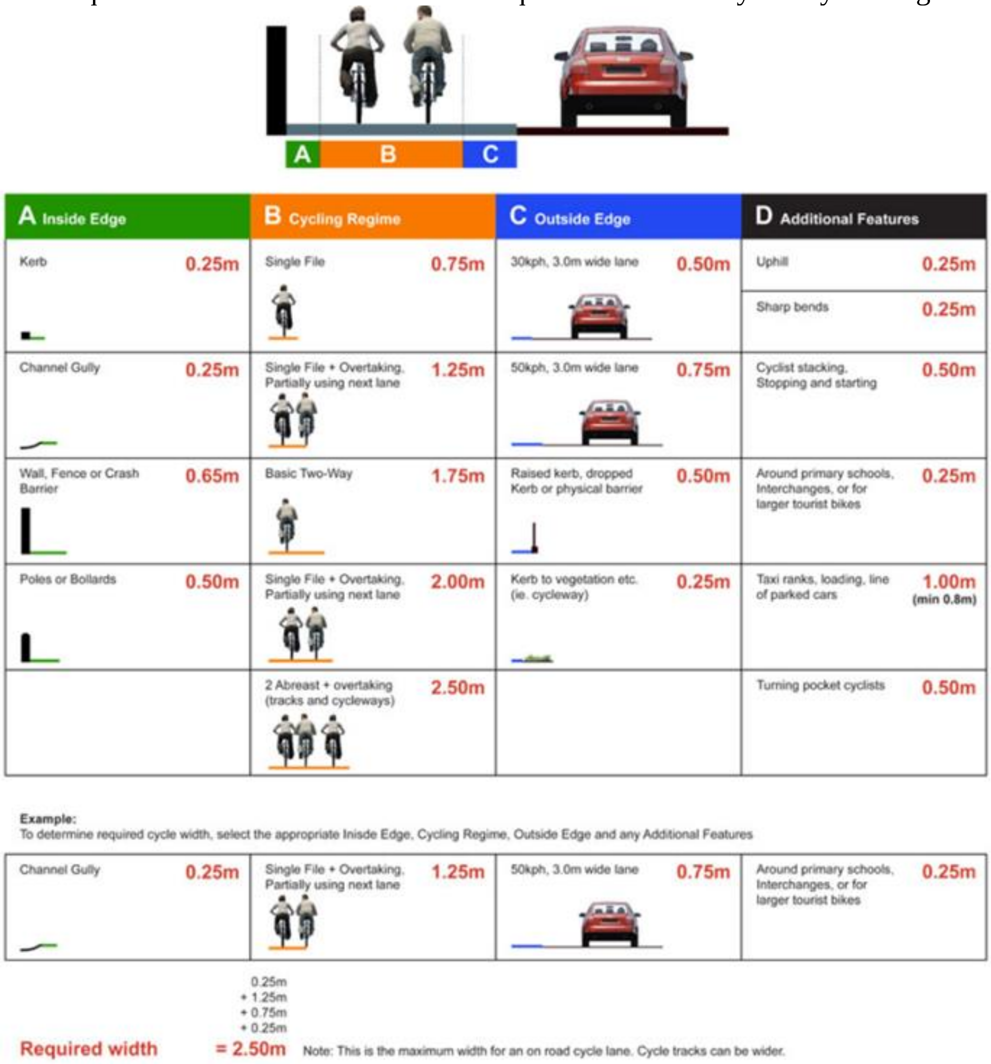

Figure 3.4: National Cycle Manual Width Calculator

3.1.5 UK DMRB Standards

TD29/04 has been superseded in the UK by DMRB CD 353 Design Criteria for Footbridges, this document gives minimum widths for shared bridges. The minimum usable bridge width for shared cycle and pedestrian use are given below. LTN documents are no longer referenced in CD353.

11.7 The minimum clear usable widths for the footway and cycle path on shared use bridges and ramps shall be in accordance with Table 11.7.

Table 11.7 Minimum bridge widths for shared use

	Footway	Cycle path	Total
When segregated by a kerb not less than 50mm high	2.0 m	2.7 m	4.7 m
When segregated by a physical barrier not less than 900mm high	2.0 m	3.0 m	5.0 m
When segregated by a white line and/or contrasting surface colours or textures	1.5 m	2.5 m	4.0 m
Unsegregated	-	-	3.5 m

Figure 3.5: DMRB CD 353 Bridge minimum width requirements

3.1.6 Dutch Standards

Although not strictly relevant in Ireland, Dutch standards have been considered as an example of available best practice.

The ‘Dutch Design Manual for Bicycle and Pedestrian Bridges’ gives minimum footway and cycleway widths. The minimum allowable width for a 2-way footway is 1.8m while the minimum allowable width for a two way cycleway is 2.575m (inclusive of safety margins, 1 vertical barrier and 1 side painted strip). This would give an overall bridge width of 4.375m.

3.2 Segregation

3.2.1 Overview

This bridge is intended to be used by pedestrians, cyclists, and other non-motorised users. The decision on whether to segregate bridge users will influence safe cycle speeds and the promotion of cycle use. Relevant codes and standards as well as international best practice will be considered in the recommendation of segregation type, if any.

3.2.2 Relevant standards

TII

TII DN-STR-03005 does not give any guidance on segregation on the bridge structure but instead states that segregation should be determined locally.

UK DRMB

UK DMRB CD353 Design Criteria for footbridges states that *segregation shall be consistent over the full length of the footbridge and its approaches*, however it does not provide guidance on the decision to segregate or not segregate. Instead, clause 11.6 states the following.

11.6 Where the bridge is part of a pedestrian and cycle route, specific provision shall be made in accordance with any guidance on shared use by cyclists and pedestrians provided by the Overseeing Organisation.

National Cycle Manual

Section 1.9.4 of the National Cycle Manual deals with requirements on how whether to provide segregation between cyclists and pedestrians. It states that on longer bridges where cyclists are likely to build up higher speed’s segregation is recommended. See excerpt below. The proposed crossing can be deemed a long bridge and therefore segregation is appropriate in accordance with the National Cycle Manual.

Non-traffic short flat bridges are suitable for shared use with pedestrian priority. However, longer bridges where cyclists are likely to build up higher speeds, should segregate both modes.

Dutch Standards

The Dutch Design Manual for Bicycle and Pedestrian Bridges recommends the use of separation in high density traffic flow situations stating *“it is advisable to separate footpath and cycleway in such cases by creating a physical or visual separation”*

SUSTRANS

SUSTRANs section 4.1 provides an in-depth discussion on the requirements for separation and allows for it to be considered on an individual project level. Section 4.1.2 states the following, however.

4.1.2

In general, where there is known to be, or anticipated to be, high levels of usage by any particular user group, it is desirable to provide separation. Where there are likely to be issues with people riding bikes at speed, separation is desirable.

This may be relevant where there are long straight alignments or downhill gradients along a route. Designers should consider the following when deciding whether to install a shared or separated path.

This would indicate that separation would likely be advisable for the proposed structure.

Inclusive Mobility UK

UK Inclusive Mobility document section 3.1 states "*Where a cycle track runs alongside a footway or a footpath best practice is to physically…".*

Ultimately there is no explicit guidance currently in Ireland on the requirement for segregation and the decision sits with the overseeing authority. Recent sub-urban bridges completed in Ireland have however included visual segregation, such as the new Garry castle Footbridge crossing the N6 in Athlone.

3.2.3 Buildability and complexity

Design of a bridging structure including a physical segregation in the form of a raised kerb or vertical central barrier has the potential to increase structural complexity and potentially add load due to non-structural makeup due of the level difference. Physical segregation with attachments to the structure may also add to the maintenance liability of the structure and could potentially add to the construction and ongoing maintenance cost.

Judgement of the potential benefits of physical segregation should be balanced against this. Visual segregation by comparison would not require any additional structure or physical barriers but can instead be achieved with differing surfacing colours and/or textures.

3.2.4 Conclusion

It is recommended that the cycle traffic be segregated from pedestrian/wheelchair traffic on the proposed bridge. As a minimum we would recommend that this segregation is in the form of painted lines and different surface textures/colours. Physical segregation would necessitate a larger and more complex structure and at this time is not recommended unless deemed necessary by CCC.

3.3 Recommendation

In summary, we would recommend that a bridge with a usable width of 5m be taken forward in the development of structural options. Usable width comprises a 3m 2-way cycleway and a 2m footway segregated via a painted strip or differing surface textures and colours.

4. Conclusions

The purpose of this note is to determine the recommended bridge alignment option along with the recommended internal bridge width requirements.

Three bridge alignment options were considered in this technical note. Bridge Alignment Option 1 was discounted as it did not satisfy the basic requirements of the project. Whilst it is a feasible option, it is located off the desire line for users and is considered to fail in enhancing connectivity between the little island train station and the east gate business park.

A multi-criterion assessment was carried out to determine the preferred bridge alignment between Option 2 and Option 3. From this assessment, bridge Alignment Option 2 has emerged as the preferred option.

In addition to this, the required internal usable bridge width was assessed using both Irish and International design standards. Based on this assessment a footway width of 2m and a cycleway of 3m, totalling an overall internal bridge width of 5m is recommended for this project.

A segregated footway/cycleway is also recommended using visual segregation in the form of a painted strip and/or different surface colours and textures.

Appendix B

Comparative Cost Estimate

Project: N25 Little Island Pedestrian and Cycle Bridge
Titile: Options Selection Report/Structural Options Report - Comparative Cost Estimate
Created by: Timothy O Sullivan Glynn
Checked by: John O Riordon
Date: 15/09/2022

1.1 Structural option 1: N25 and Irish Rail spans	Length [m]	Width [m]	Area [m2]	Rate [€/m2]	Deck total [€]	No. foundations	Rate [€/foundation]	Foundation total [€]	Overall total [€]
Irish rail span + N25 combined span	82	6	492	€ 3,800.00	€ 1,869,600.00	2	€ 160,000.00	€ 320,000.00	€ 2,189,600.00

1.2 Structural option 2: N25 and Irish Rail spans	Length [m]	Width [m]	Area [m2]	Rate [€/m2]	Deck total [€]	No. foundations	Rate [€/foundation]	Foundation total [€]	Overall total [€]
Irish rail span	32	6	192	€ 3,000.00	€ 576,000.00	1	€ 130,000.00	€ 130,000.00	€ 706,000.00
N25 span	50	6	300	€ 2,700.00	€ 810,000.00	2	€ 130,000.00	€ 260,000.00	€ 1,070,000.00

1.3 Structural option 3: N25 and Irish Rail spans	Length [m]	Width [m]	Area [m2]	Rate [€/m2]	Deck total [€]	No. foundations	Rate [€/foundation]	Foundation total [€]	Overall total [€]
Irish rail span	32	6	192	€ 2,600.00	€ 499,200.00	2	€ 50,000.00	€ 100,000.00	€ 599,200.00
N25 span	50	6	300	€ 5,300.00	€ 1,590,000.00	2	€ 130,000.00	€ 260,000.00	€ 1,850,000.00

1.4 Steel elevated ramp structures	Length [m]	Width [m]	Area [m2]	Rate [€/m2]	Deck total [€]	No. foundations	Rate [€/foundation]	Foundation total [€]	Overall total [€]
North elevated ramp	82	6	492	€ 3,500.00	€ 1,722,000.00	4	€ 50,000.00	€ 200,000.00	€ 1,922,000.00
South elevated ramp	110	6	660	€ 2,500.00	€ 1,650,000.00	5	€ 50,000.00	€ 250,000.00	€ 1,900,000.00

1.5 Reinforced concrete elevated ramp structures (all options)	Length [m]	Width [m]	Area [m2]	Rate [€/m2]	Deck total [€]	No. foundations	Rate [€/foundation]	Foundation total [€]	Overall total [€]
North elevated ramp	82	6	492	€ 3,500.00	€ 1,722,000.00	4	€ 50,000.00	€ 200,000.00	€ 1,922,000.00
South elevated ramp	110	6	660	€ 2,500.00	€ 1,650,000.00	5	€ 50,000.00	€ 250,000.00	€ 1,900,000.00

1.6 Northern embankments	Length [m]	Top width [m]	Average height [m]	Average base width [r	Volume [m3]	Rate [€/m3]	Embankment total [€]
North embankment	78	5	1.2	9.8	693	€ 55.00	€ 38,095.20

1.7 Southern retaining walls	Length [m]	Top width [m]	Average height [m]	Volume [m3]	Rate [€/m2]	Retaining wall total [€]
Southern retaining wall ramp	22	0.5	5	55	€ 200.00	€ 22,000.00

1.8 Walkway/cycleway (at grade and on embankments)	Length [m]	Width [m]	Area [m2]	Rate [€/m2]	Walkway total [€]
North (to elevated structure)	78	5	390	€ 140.00	€ 54,600.00
South (to elevated structure)	161	5	805	€ 190.00	€ 152,950.00
					€ 207,550.00

1.9 Other (prelims included seperately in section 2)	Length of structure [m	Rate [€/m]	Total	
Lighting (Public lighting to embankments, retaining wall and at grade walkway)	239	€ 280.00	€ 66,920.00	
Lighting (Bridge & elevated ramp structures - LED strip lighting type)	274	€ 900.00	€ 246,600.00	
General Site Clearance (Incl Tree removal up to girth of 300mm @1.5m above G.L.)	4	€ 10,000.00	€ 40,000.00	*Unit In hectares*
Bins - City of Cork black litter bin	10	€ 1,666.25	€ 16,662.50	
Benches	6	€ 1,666.25	€ 9,997.50	
Bike Storage - Cork City Council bicycle parking stands - type B stainless steel	6	€ 322.06	€ 1,932.36	
Bollards	20	€ 300.00	€ 6,000.00	
CCTV Cameras	3	€ 953.53	€ 2,860.58	
Allowance for Road markings/signs etc	1	€ 30,000.00	€ 30,000.00	
		Total	**€ 420,972.93**	

2.1 Summary tables - breakdown of componants

	Irish Rail span(s)	**N25 span**	**North elevated ramps**	**South elevated ramps**	**North embankment**	**South retaining wall**	**Walkway/cycleway paving**	**Other**	**Prelims @12%**
Structural option 1	*Combined span*	€ 2,189,600.00	€ 1,922,000.00	€ 1,900,000.00	€ 38,095.20	€ 22,000.00	€ 207,550.00	€ 420,972.93	€ 804,026.18
Structural option 2	€ 706,000.00	€ 1,070,000.00	€ 1,922,000.00	€ 1,900,000.00	€ 38,095.20	€ 22,000.00	€ 207,550.00	€ 420,972.93	€ 669,674.18
Structural option 3	€ 599,200.00	€ 1,850,000.00	€ 1,922,000.00	€ 1,900,000.00	€ 38,095.20	€ 22,000.00	€ 207,550.00	€ 420,972.93	€ 763,274.18

2.1 Summary tables - totals

	Total	**Total -30%**	**Total +30%**
Structural option 1	€ 7,504,244	€ 5,252,971	€ 9,755,518
Structural option 2	€ 6,956,292	€ 4,869,405	€ 9,043,180
Structural option 3	€ 7,723,092	€ 5,406,165	€ 10,040,020

<u>Exclusions:</u>

The following items are specifcally excluded from the cost estimate

Legal costs

Site surveys, scans and investigations

Operating costs (Planned and preventative maintenance)

VAT

Finance Costs

Design team fees

All other costs not specifically mentioned above

Landscaping and upgrades to the Northern park have not been allowed for at this point

Landscaping and upgrades to station area have not been allowed for at this point