Appendix J1

Preliminary Design Report – Structure K01A & K01B – Footbridges at Robert Emmett Bridge on the Grand Canal

Preliminary Design Report – Consultation STA-1b

Categories 1, 2 & 3

Scheme

Name and Location: Busconnects Infrastructure Delivery – Project D

Structure(s)

Name and nature of the Structure(s): Kimmage 01A & 01B Footbridges

Preliminary Design Report

Reference	BCIDD-ROT-STR-ZZ_0011-XX-00-RP-CB-0013
Revision	L02
Date	Jun-2022

Submitted by

Signed:	
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Organisation:	Roughan & O'Donovan – TYPSA Consulting Engineers
Date:	27-06-2022

Structures Section confirmation of consultation:

Signed: ______________________________

Name: ______________________________

Position: ______________________________

Date: ______________________________

BUSCONNECTS INFRASTRUCTURE DELIVERY – PROJECT D

PRELIMINARY DESIGN REPORT – KIMMAGE 01A & 01B

TABLE OF CONTENTS

1. INTRODUCTION

1.1 Brief

Roughan & O'Donovan-TYPSA have prepared this report for the National Transportation Authority (NTA) for the design of the Kimmage 01A & 01B bridges as part of the Busconnects Infrastructure Delivery – Project D.

1.2 Background Information

The proposed scheme for Kimmage to City Centre aims to provide enhanced walking, cycling and bus infrastructure, which will enable and deliver efficient, safe and integrated sustainable transport movement to this corridor.

Priority for buses is provided along the entire route consisting primarily of dedicated bus lanes in both directions, with alternative measures proposed at particularly constrained locations along the scheme. Cycle tracks and footpaths will also be provided separated from the bus lanes. At constrained points, it is necessary to build new structures or widen the existing ones to provide adequate space for the new road layout.

This document relates to the Preliminary Design Report in respect of the Kimmage 01A & 01B bridges in accordance with DN-STR-03001 (April 2019). A location drawing of this structure within the scheme is provided in the Appendices, as well as a general arrangement drawing of the proposed bridges.

This structure is being proposed to provide a new crossing for cyclists and pedestrian over the Grand Canal.

Photographs of the structure taken during a site visit are included in Appendix 1.

1.3 Previous Studies

Reports prepared and published for this structure to date include:

- BCIDD-ROT-STR-ZZ_0011-XX_00-RP-CB-0011 – Structures Options Report: Kimmage 01A & 01B
- BCID-ROT-ERW-GI_0011-RP-CR-0001 – Geotechnical Interpretive Report: Kimmage Corridors

2. SITE & FUNCTION

2.1 Site Location

The Kimmage 01A & 01B bridges are located over the Grand Canal at Harold's Cross Road. The proposed structures run parallel to and are independent of the existing Robert Emmet arch bridge. The site location plan is included in Appendix 2.

2.2 Function of the Structure

The objective of the new bridges is to increase the width of the existing carriageway to accommodate the proposed cycle lane and footpaths. This allows unimpeded passage of the cycle lane and footpaths at the intersection between Harold's Cross Road and Clanbrassil Street Upper. Proposed lanes for buses and the eastern cycle lane, as well as traffic lanes, will be on the existing Robert Emmet Bridge.

2.3 Choice of Location

The location of the structure was chosen to facilitate the proposed Kimmage to city centre corridor taking into account the layout and roadway requirements in terms of space for proposed lanes, footpaths, maximum slopes, etc.

2.4 Site Description and Topography

The site of the proposed structure is located in an urban area, close to Dublin's city centre. Consequently, there are existing buildings and infrastructure in the direct vicinity of the new structure.

The level of the existing carriageway at the centreline of the bridges is:

- At 01A bridge: 24.00m and 23.50m at the north and south abutments, respectively.
- At 01B bridge: 23.50m at both abutments.

2.5 Vertical and Horizontal Alignments

Horizontal and vertical road alignments at the bridge location are described below. The proposed general arrangement drawings can be seen in Appendix 2.

Horizontal Alignment

The proposed bridge follows the horizontal alignment of the existing Robert Emmet arch bridge.

Vertical Alignment

The proposed vertical road alignment at the location of the bridges follows the alignment of the existing road on the arch bridge to maintain the vertical clearance over the Grand Canal.

2.6 Cross-Sectional Dimensions on the Alignments

The proposed mainline cross section at the structure location is shown in Table 2.1 and Table 2.2.

Table 2.1: Kimmage 01A Cross-Section

Parameter	Value
Railing	0.50 m
Footpath	2.00 m
Cycle track	3.00 m
Railing	0.50 m
Out-to-Out Width	**6.00 m**

Table 2.2: Kimmage 01B Cross-Section

Parameter	Value
Railing	0.50 m
Footpath	2.50 m
Railing	0.50 m
Out-to-Out Width	**3.50 m**

2.7 Existing Underground and Overground Services

A list of the existing services located in close proximity to the Kimmage 01A & 01B bridges is outlined below.

Low and Medium Voltage Electricity Lines

ESB low voltage underground lines are present at the structure's location. These may need to be diverted following discussions with ESB.

High Voltage Electricity Lines

Desktop services tracking to date indicate low and medium voltage underground lines in the vicinity of the structure which may need to be diverted following discussions with the ESB. There appear to be no high voltage lines, however, these will need to be verified by the Contractor on site.

Telecommunications

Desktop services tracking to date indicate some telecommunication cables in the vicinity of the structure which may need to be diverted following discussions with the provider. Exact locations will need to be verified by the Contractor on site.

Water Supply

Desktop services tracking to date indicate water mains at the structures location which may need to be diverted following discussions with Irish Water. Exact locations will need to be verified by the Contractor on site.

Gas Networks

Desktop services tracking to date indicate gas mains at the structures location which may need to be diverted following discussions with Gas Networks Ireland. Exact locations will need to be verified by the Contractor on site.

2.8 Geotechnical Summary

The existing site investigation information for the area has been taken from the Geological Survey of Ireland (GSi) website and the British Geological Survey (BGS) website, including the Quaternary and Bedrock Geology of Dublin and Depth of Bedrock digital maps.

At the date of this report there is a GI contract available that aims to assess the geology of the site and determine the ground properties and conditions to enable the design of Bus Connects Core Bus Corridors.

2.9 Hydrology and Hydraulic Summary

The bridge is crossing a watercourse. It will have minimal effect on the hydrology of the area as the structural depth of the proposed bridges are smaller than the adjacent Robert Emmet bridge. Therefore, there is no reduction of the canal section due to the construction of the proposed bridges. The design has been developed in agreement with Waterways Ireland.

2.10 Archaeological Summary

An Environmental Impact Assessment Report (EIAR) is currently being prepared that considers archaeological impacts along the mainline alignment.

2.11 Environmental Summary

An Environmental Impact Assessment Report (EIAR) is currently being prepared and it considered the mainline alignment at the structure location and its impact on the environment and local communities. All likely significant environmental effects are assessed, and mitigation is proposed as necessary in the Environmental Impact Assessment Report.

3. STRUCTURE & AESTHETICS

3.1 General Description of Recommended Structure

The Kimmage 01A & 01B bridges shall be a 3-span steel beam bridges, integrally connected to their substructure. Both bridges incorporate intermediate supports.

3.2 Aesthetic Considerations

The bridge form fulfils the client's requirement to provide a "light and transparent structure" of visual interest, to reduce the visual impact on the existing Robert Emmet arch bridge.

The width of the bridges meets the intention to design two independent footpaths and a cycle lane. The level of the existing carriageway has been kept. The light bridges with glass parapet intend to preserve the overall aesthetic to the area while providing continuity to the cycle lane and footpath to Harold's Cross Road.

The glass parapets will require aesthetic approval from the Employer's Representative to ensure an appropriate solution is employed in construction.

3.3 Proposals for the Recommended Structure

3.3.1 Proposed Category

The proposed bridges are Category 2 structures.

3.3.2 Span Arrangements

The Kimmage 01A & 01B are a 3-span steel beam bridges of 23.0m and 24.0m length from c/c bearings respectively. The spans of Kimmage 01A are 3.70m – 12.90m – 6.40m. And the spans of Kimmage 01B are 5.40m – 12.90m – 5.70m.

3.3.3 Minimum Headroom Provided

The vertical headroom requirement is to maintain existing vertical clearance as the Robert Emmet Bridge. This vertical headroom is 3.20m approx. above mean water level.

3.3.4 Approaches (incl. Run-on Arrangements)

The approaches are tied into existing footpaths, which will need fill up to the back of the end abutments after piling and capping beam construction and reinstatement of the footpath pavement.

Kimmage 01A requires widening of Clanbrassil Street Upper to accommodate the proposed road layout at the northern approach. Therefore, it will be required to construct a new retaining wall (named Kimmage 03 – treated in a separate Preliminary Design Report – BCIDD_ROT_STR_ZZ_0011_XX_00_RP_CB_0015) in that area for this purpose.

3.3.5 Foundation Type

The substructure comprises of embedded foundations, formed by bored in-situ reinforced concrete piles and in-situ reinforced concrete pile caps, where the steel structure will be supported.

3.3.6 Substructure

North abutment of Kimmage 01A will consist of an in-situ reinforced concrete wall or bank-seat supported by the embedded foundation.

For south abutment of Kimmage 01A and both abutments of Kimmage 01B, the superstructure will be supported directly on to the pile cap.

The bridges shall have intermediate Y-shape steel columns founded on reinforced concrete piled foundations. Intermediate columns intend to reduce the main span length to reduce the structural depth of the solution and ensure the vertical clearance is maintained below the proposed bridges.

Geometry and dimensions of these intermediate supports are as described on the drawings included in Appendix 2.

3.3.7 Superstructure

The superstructure will consist of two main longitudinal steel beams (square hollow sections), with longitudinal and transverse steel beams to support a perforated metal deck with slip resistance.

3.3.8 Articulation Arrangements (Joints and Bearings)

The structure will be designed to be fully integral with the substructure and foundations. There will be no requirement for any articulation of the structure. Longitudinal forces acting on the frame due to temperature strains and service loads will be resisted through soil-structure interaction and flexure of the frame.

3.3.9 Vehicle Restraint System

The parapets proposed consists of glass panels mounted on a steel frame. All parapets will comply with TII DN-STR-03034 (historical ref. NRA TD19) and EN 1317. The parapet proposed for this footbridge is a pedestrian parapet, where a cycleway is adjacent to the parapet. The parapets are solid, thus they will not have footholds.

3.3.10 Drainage

A perforated metal deck is used for the deck of these bridges over the Grand Canal, thus no drainage system is necessary.

Gullies will also provide at Kimmage 01A to collect surface water on the northern approach.

3.3.11 Durability

The proposed structure will be designed to achieve the required 120 years design life.

In addition, the specification of suitable materials will enhance durability and reduce the maintenance liability. The following measures are proposed:

- Durable concrete to be provided in accordance with TII DN-STR-03012 (formerly BD 57);
- Exposed concrete to be surface impregnated and buried concrete surfaces to be waterproofed in accordance with the TII Specification for Road Works;
- Exposed formed concrete surfaces to be F4 / F3;
- Contract Documents should make allowance for impregnation and coating of steel beams to prevent corrosion.

3.3.12 Sustainability

Life cycle sustainability assessment (LCSA) has been considered for the detailed design of the proposed bridge to enable a cost-effective and sustainable solution since the construction until the end of service life, with a minimal impact on the surrounding environment.

The proposed structures are an integral 3-span steel beam bridges which are considered a sustainable solution for the following reasons:

- Due to the lightness of steel structures, they transmit lower loads to the foundations, which means smaller abutments and consequently a lower environmental impact on the Grand Canal's banks.
- At the end of the structure's service life, the fact that it is made of steel means that it can be 100% recycled, whereas concrete structures need to be taken to a landfill site.
- Local cement and aggregates are used in the production of concrete.
- It avoids the requirement for bearings (replaceable element) due to its integral nature.

It is proposed to adopt 50% ground granulated blast furnace slag (GGBS) as cement replacement in the mix design for all in-situ concrete which reduces CO2 emissions.

3.3.13 Inspection and Maintenance

The inspection of bridges shall be carried out in accordance with TII procedures by suitably qualified personnel who shall be responsible for providing the relevant equipment and establishing traffic management appropriate to the type of inspection being carried out.

Inspection of most parts of the bridge can be done from finish deck level. Inspection of the soffit of the steel structures shall be carried out from the towpath and the Grand Canal.

Superstructure

Structural steelwork will require regular inspection and maintenance, with major maintenance (paint system) required every 20 years.

Substructures

The substructures consist of in situ reinforced concrete, which should not incur any substantial maintenance costs.

Parapets

The parapets consist of glass panels, which should incur in minimum maintenance requirements.

4. SAFETY

4.1 Traffic Management during Construction

Total and/or partial closures of the Grand Canal navigation will be required during construction.

Traffic management will be required at Harold’s Cross Road and Clanbrassil Street Upper during construction.

4.2 Safety during Construction

The Designer will comply with the General Principles of Prevention (of accidents) as specified in the First Schedule of the Safety, Health and Welfare at Work (General Application) Regulation and liaise with the Project Supervisor for the Design Stage (PSDP) appointed by the Client and the Project Supervisor appointed for the Construction Stage as required by the “Safety, Health and Welfare at Work (Construction) Regulations, 2013”.

4.3 Safety in Use

Bridge parapets will be designed for pedestrian and cyclist loading in accordance with IS EN1317, the headroom and cross section will be designed in accordance with TII DN-GEO- 03036 (historical ref. TD 27).

4.4 Lighting

The proposed structures’ deck will require to be lit. The lighting system shall be incorporated in the bridges’ parapets. Lighting will be provided in accordance with BS-5489-1.

5. COST

5.1 Budget Estimate in Current Year (incl. Whole Life Cost)

The estimated cost for the construction of the bridges is 1,200,000€.

Basis of Cost Estimate

The cost estimate has been produced on the following basis:

- Figures are given in Euro and are based on 2019 rates (excluding VAT) – TII Schedule of Rates 2019 (CC-GMP-00054);
- Excludes land acquisition and rights of way;
- Excludes preliminaries;
- The Construction Cost Estimate does not include for fees associated with the following:
  - Additional SI and Topo;
  - Environmental Assessment;
  - Detailed Design and Checking;
  - Contract Administration;
  - Site Supervision during Construction.

6. DESIGN ASSESSMENT CRITERIA

6.1 Actions

The structure will be designed in accordance with IS EN 1991 Eurocode 1: Actions on Structures and, in particular, Part 1-1: General Actions, Part 1-3: Snow Loads, Part 1-4 Wind Loads, Part 1- 5 Thermal Actions, Part 1-6 Execution, Part 1-7 Accidental Actions and IS EN 1991 Part 2 Traffic Loads on Bridges as amended by the relevant Irish National Annexes.

6.1.1 Permanent Actions

The following nominal densities will be adopted:

- Reinforced concrete 25 kN/m^3
- Structural steelwork 77 kN/m^3
- Pavement 23 kN/m^3
- Backfill to structures 20 kN/m^3

6.1.2 Snow, Wind and Thermal Actions

Snow action may be ignored due to the geographical location as outlined in IS EN 1990:2002 + NA:2010. Thermal actions Approach 2 will be used in accordance with clause NA.2.3 of the Irish National Annex to IS EN 1991-1-5. Wind load will be assessed in accordance with IS EN 1991-1-4:2005 and the associated National Annex.

6.1.3 Actions relating to Normal Traffic

None.

6.1.4 Actions relating to Abnormal Traffic

None.

6.1.5 Footway Live Loading

The structure will be designed for footway loading in accordance with IS EN 1991-2 load model LM4 (crowd loading). This consists of a uniformly distributed load (q_{fk}) of 5kN/m² and a concentrated load (Q_{fwk}) of 20kN as defined in section 5 of IS EN 1991-2 and the Irish National Annex.

6.1.6 Provision for Exceptional Abnormal Loads

None.

6.1.7 Accidental Actions Accidental actions will be considered in accordance with I.S. EN 1991-1-7.

Accidental actions will be considered in accordance with I.S. EN 1991-1-7.
Accidental presence of vehicles on the bridge in accordance with IS EN 1991-2.

6.1.8 Actions during Construction

The design shall take account of any adverse loading during construction as outlined in IS EN 1991-1-6 and its National Annex.

6.1.9 Any Special Loading Not Covered Above

None.

6.2 Authorities Consulted

The following is a list of Authorities to be consulted as part of the scheme:

- Local Authorities – Dublin City Council;
- ESB;
- Gas Networks Ireland;
- Irish Water;
- Waterways Ireland.

6.3 Proposed Departures from Standards

There are no existing departures applied for at this stage of the design process.

6.4 Proposed Methods of Dealing with Aspects not Covered by Standards

Agreed departures to be incorporated into the design – however at this stage no departures have been applied for.

7. GROUND CONDITIONS

7.1 Geotechnical Classification

The existing site investigation information for the area has been taken from the Geological Survey of Ireland (GSi) website and the British Geological Survey (BGS) website, including the Quaternary and Bedrock Geology of Dublin and Depth of Bedrock digital maps.

A GI contract has recently been completed which aims to assess the geology of the site and determine the ground properties and conditions to enable the design of Bus Connects Core Bus Corridors. The GI includes boreholes, trial pits, dynamic probes, standpipes/piezometer installation and monitoring, in-situ testing, geotechnical and environmental laboratory testing and preparation of a factual report, all in accordance with the “Specification and Related Documents for Ground Investigation in Ireland”.

7.2 Description of the Ground Conditions and Compatibility with Proposed Foundation Design

The following table shows the expected depth to bedrock, based on the data from the Desktop Review, as well as the depth of the encountered bedrock in the GI undertaken. Note that some of the boreholes were terminated at a shorter length, before encountering the bedrock strata.

Table 7.1: Encountered bedrock in the vicinity of Kimmage 01A & 01B

Borehole Ref.	Depth to Encountered Bedrock	Depth to N SPT Values of Refusal
R11-CP01	5-10 m	8.0 m
R11-WS02	5-10 m	4.0 m
R11-CP03	5-10 m	3.0 m
R11-WS03	5-10 m	2.5 m

Additional information regarding the geological profile and location of the boreholes can be found on the Geotechnical Interpretation Report, document No. BCID-ROT-ERW_GI-0011-RP-CR-0001. An extract of the Geotechnical Interpretation Report is included in Appendix 3.

Based on the current site investigation information provided, it is proposed to use piled foundations to support the bridge abutments.

8. DRAWINGS & DOCUMENTS

8.1 List of All Documents Accompanying the Submission

Appendix 1 – Photographs:

(4No. of photos)

Appendix 2 – Site Location and Drawings

- BCIDD-ROT-STR_KP-0011_XX_00-DR-SS-0001 – Kimmage to City Centre Core Bus Scheme – Bridges and Retaining Structures – Key Plan
- BCIDD-ROT-STR_ZZ-0011_XX_00-DR-SS-0001 – Kimmage 01A. General Arrangement
- BCIDD-ROT-STR_ZZ-0011_XX_00-DR-SS-0002 – Kimmage 01A. Sections
- BCIDD-ROT-STR_ZZ-0011_XX_00-DR-SS-0003 – Kimmage 01B. General Arrangement
- BCIDD-ROT-STR_ZZ-0011_XX_00-DR-SS-0004 – Kimmage 01B. Sections

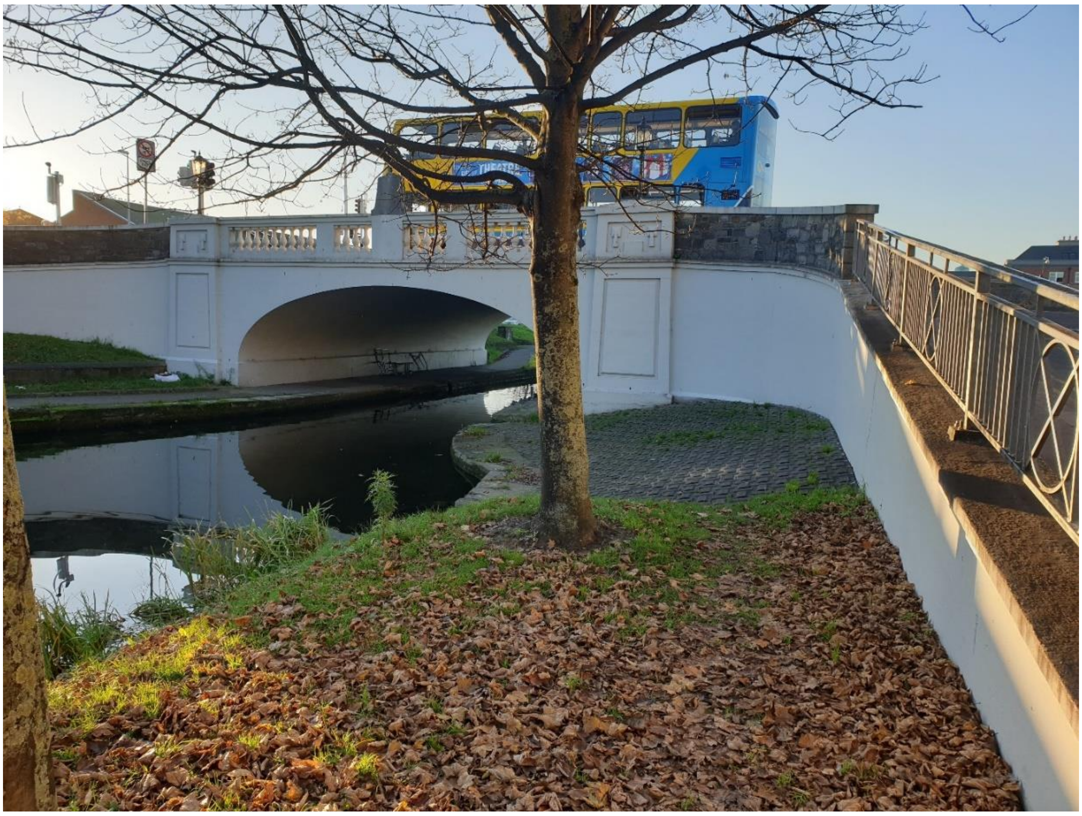
Appendix 3 – Relevant Extracts from Ground Investigation Report

(6No. of pages)

Appendix 4 – Other Relevant Documentation/Reports

(Not Used)

APPENDIX 1
PHOTOGRAPHS



Existing Robert Emmet Bridge – looking from the East side where Kimmage 01B will be located

Grand Canal Banks at Kimmage 01 location

Existing Robert Emmet Bridge – looking from the West side where Kimmage 01A will be located

Footpath and parapet of Robert Emmet bridge

APPENDIX 2
DRAWINGS

Project Ireland 2040
Building Ireland's Future

Rev	Date	Drn	Chk'd	App'd	Description
L01	02/07/2021	JGE	EFD	SMG	ISSUE FOR APPROVAL
L02	26/11/2021	JVG	EFD	SMG	ISSUE FOR PHASE 3: PRELIMINARY DESIGN

Client: NTA Údarás Náisiúnta Iompair National Transport Authority

Engineering Designer: ROD ROUGHAN & O'DONOVAN TYPSA

Programme Title: **BUSCONNECTS DUBLIN CORE BUS CORRIDORS INFRASTRUCTURE WORKS**

Drawing Title: CBC 11 KIMMAGE TO CITY CENTRE CORE BUS CORRIDOR SCHEME BRIDGES & RETAINING STRUCTURES KEY PLAN

Date	Scale	Drawn	Checked	Approved
26/11/2021	1:10000 @ A1 1:20000 @ A3	JVG	EFD	SMG

Project Code	Originator Code	QMS Code	Drawing File Name	Sheet Number	Status	Rev
BCIDD	NTA		BCIDD-ROT-STR_KP-0011_XX_00-DR-SS-0001	01 of 01	A	L02

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4. ALL BURIED SURFACES TO BE WATERPROOFED IN ACCORDANCE WITH THE TII SPECIFICATION FOR ROAD WORKS.
5. FOUNDATION DETAILS SUBJECT TO CONFIRMATION OR RECEIPT OF G.I.
6. SAFETY BARRIER IN ACCORDANCE WITH DN-REG-03034
7. STRUCTURAL STEEL ELEMENTS:
   - STEEL S355
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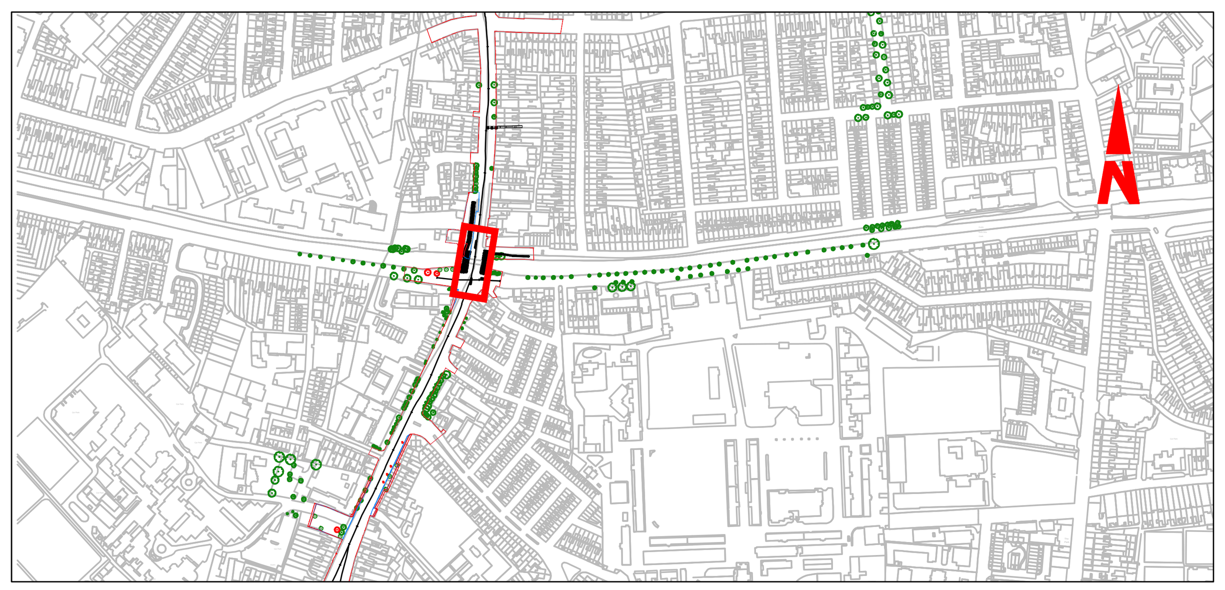

KEY PLAN

Project Ireland 2040
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Rev	Date	Drn	Chk'd	App'd	Description
L01	16/04/2021	JGE	EFD	SMG	PEER REVIEW STAGE B
L02	02/07/2021	JGE	EFD	SMG	ISSUE FOR APPROVAL
L03	26/11/2021	JVG	EFD	SMG	ISSUE FOR PHASE 3: PRELIMINARY DESIGN

Client: NTA Údarás Náisiúnta Iompair National Transport Authority

Engineering Designer: ROD ROUGHAN & O'DONOVAN, TYPSA

Date	26/11/2021
Scale	1:100 @ A1; 1:200 @ A3
Drawn	JVG
Checked	EFD
Approved	SMG
Project Code	BCIDD
Originator Code	ROT
QMS Code	

Programme Title: BUSCONNECTS DUBLIN CORE BUS CORRIDORS INFRASTRUCTURE WORKS

Drawing Title: CBC11 KIMMAGE TO CITY CENTRE CORE BUS CORRIDOR SCHEME STRUCTURES KIMMAGE 01A. GENERAL ARRANGEMENT

Drawing File Name	Sheet Number	Status	Rev
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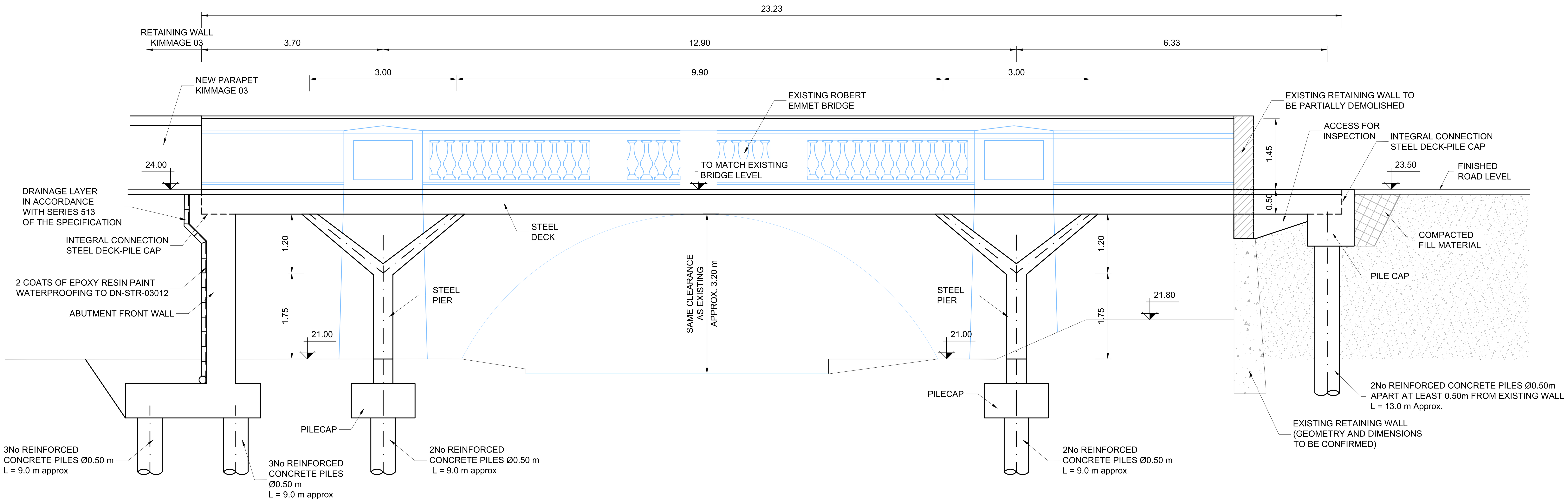

SECTION A-A. LONGITUDINAL SECTION
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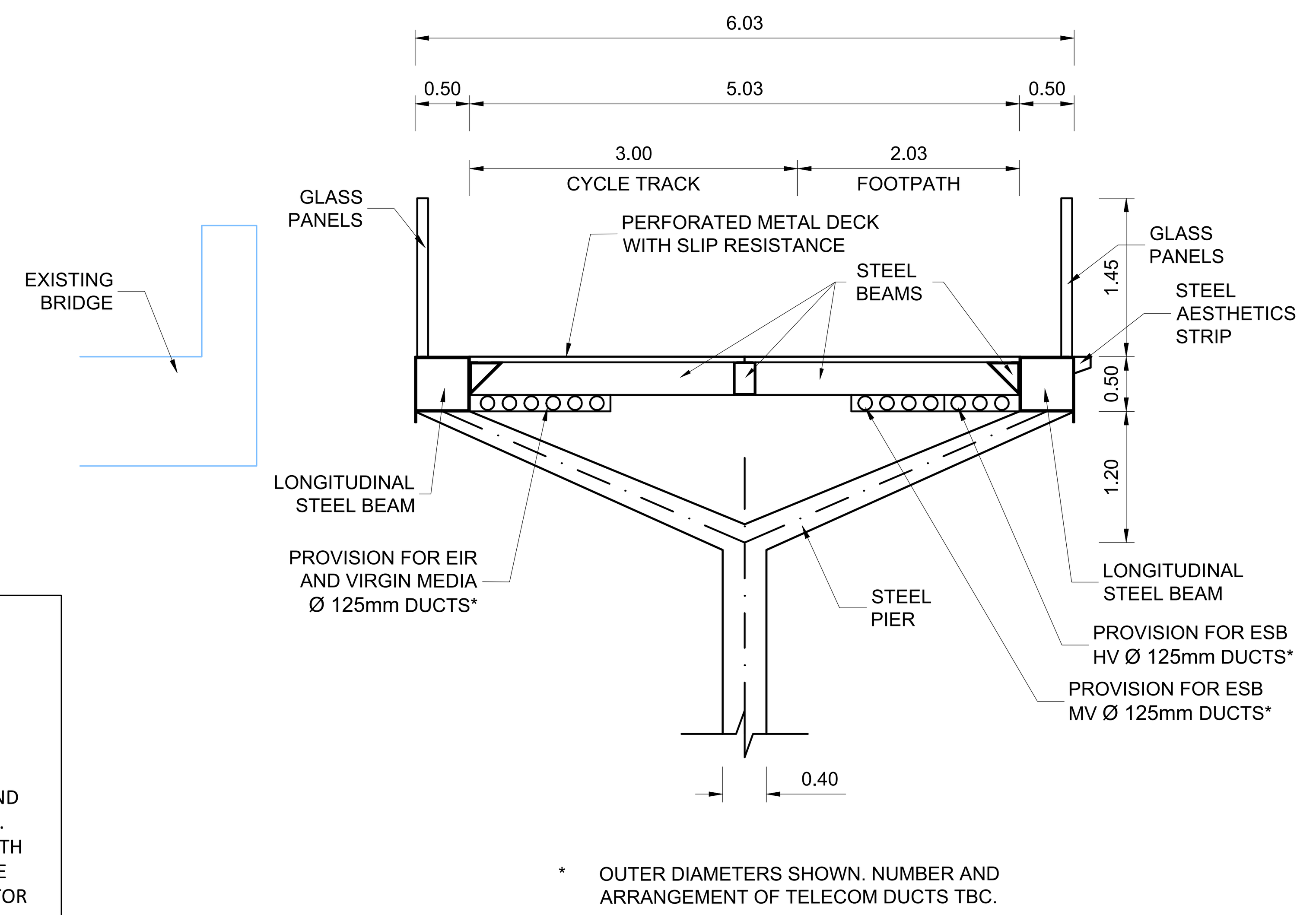

SECTION B-B. TYPICAL CROSS SECTION
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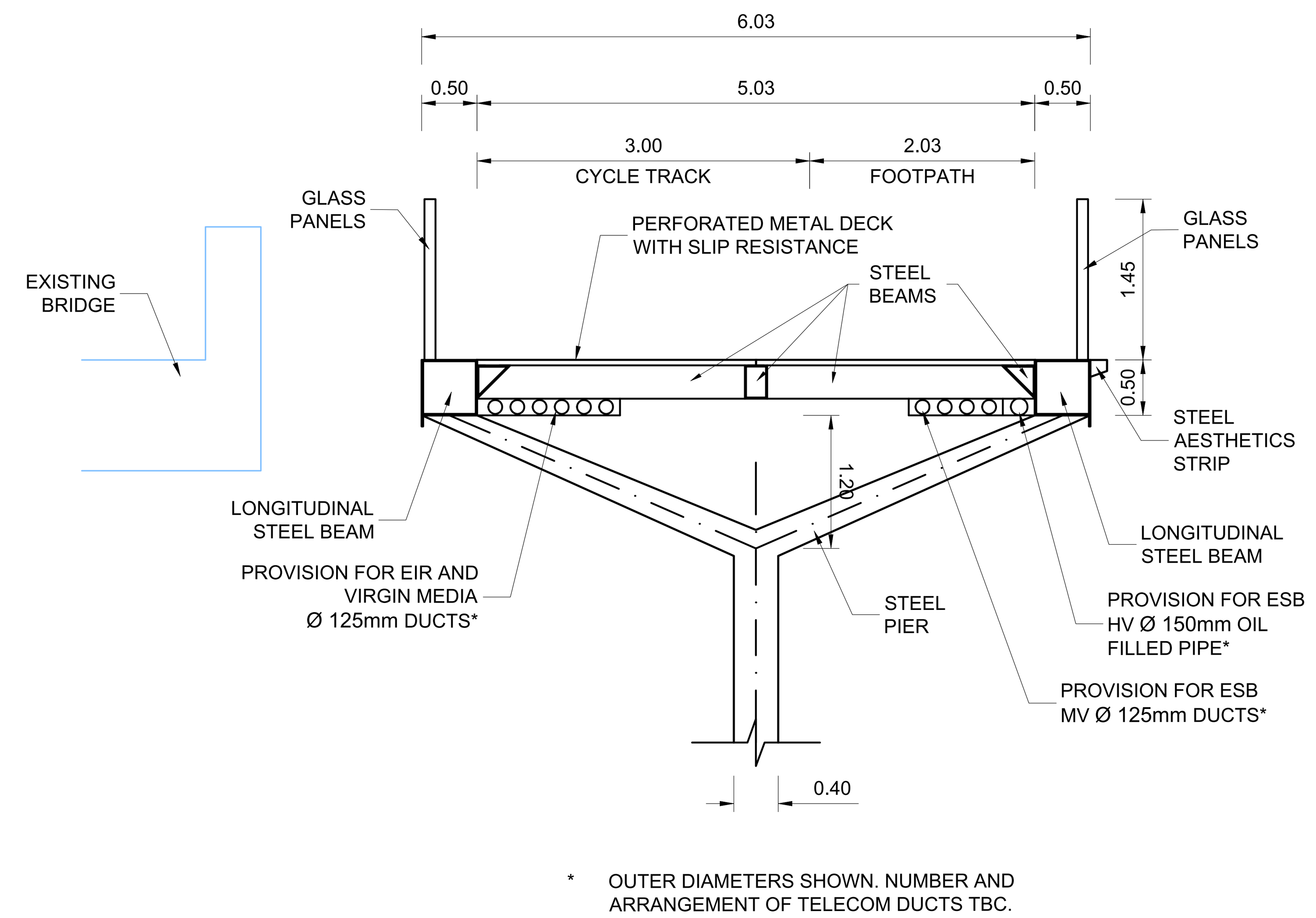

SECTION B-B. TYPICAL CROSS SECTION (SHOWING A SECOND OPTION FOR THE ESB CABLES)
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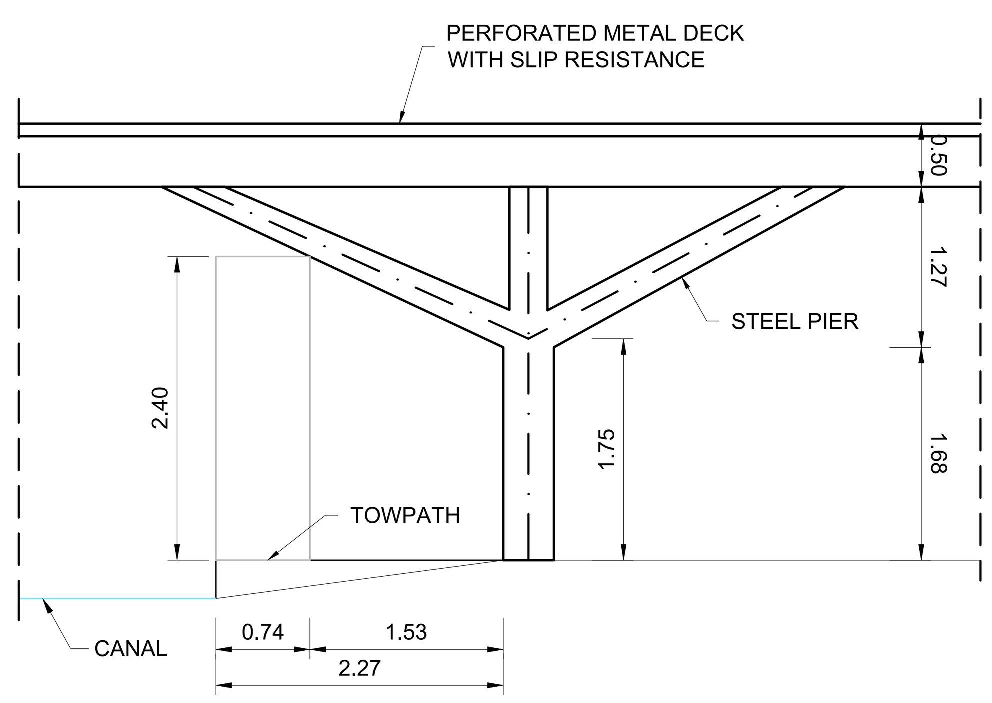

SECTION C-C. SHOWING TOWPATH CLEARANCES
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Rev	Date	Drn	Chk'd	App'd	Description
L01	16/04/2021	JGE	EFD	SMG	PEER REVIEW STAGE B
L02	02/07/21	JGE	EFD	SMG	ISSUE FOR APPROVAL
L03	26/11/2021	JVG	EFD	SMG	ISSUE FOR PHASE 3: PRELIMINARY DESIGN

Client
NTA
Údarás Náisiúnta Iompair
National Transport Authority

Engineering Designer
ROD
ROUGHAN & O'DONOVAN
TYPSA

Programme Title
BUSCONNECTS DUBLIN
CORE BUS CORRIDORS INFRASTRUCTURE WORKS

Drawing Title
CBC11
KIMMAGE TO CITY CENTRE CORE BUS CORRIDOR SCHEME
STRUCTURES
KIMMAGE 01A. SECTIONS

Date	Scale	Drawn	Checked	Approved
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GENERAL PLAN
SCALE 1:100

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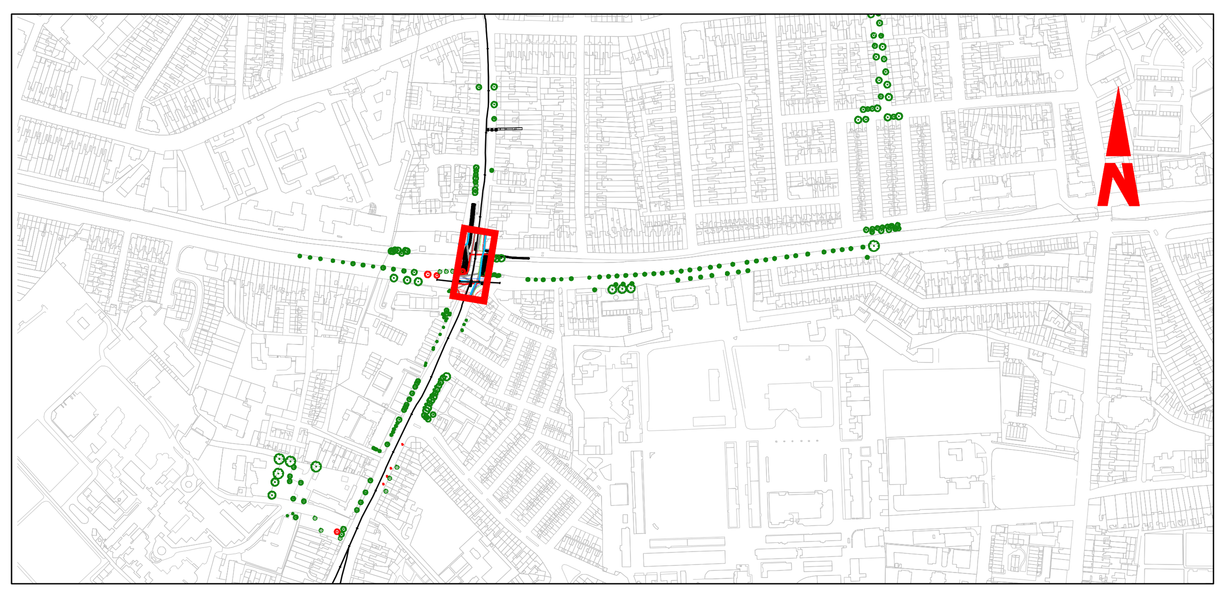

KEY PLAN

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Project Ireland 2040
Building Ireland's Future

Rev	Date	Drn	Chk'd	App'd	Description
L01	16/04/2021	JGE	EFD	SMG	PEER REVIEW STAGE B
L02	02/07/2021	JGE	EFD	SMG	ISSUE FOR APPROVAL
L03	26/11/2021	JVG	EFD	SMG	ISSUE FOR PHASE 3: PRELIMINARY DESIGN

Client: NTA Údarás Náisiúnta Iompair National Transport Authority

Engineering Designer: ROD ROUGHAN & O'DONOVAN TYPSA

Date	Scale	Drawn	Checked	Approved
26/11/2021	1:100 @ A1 1:200 @ A3	JVG	EFD	SMG

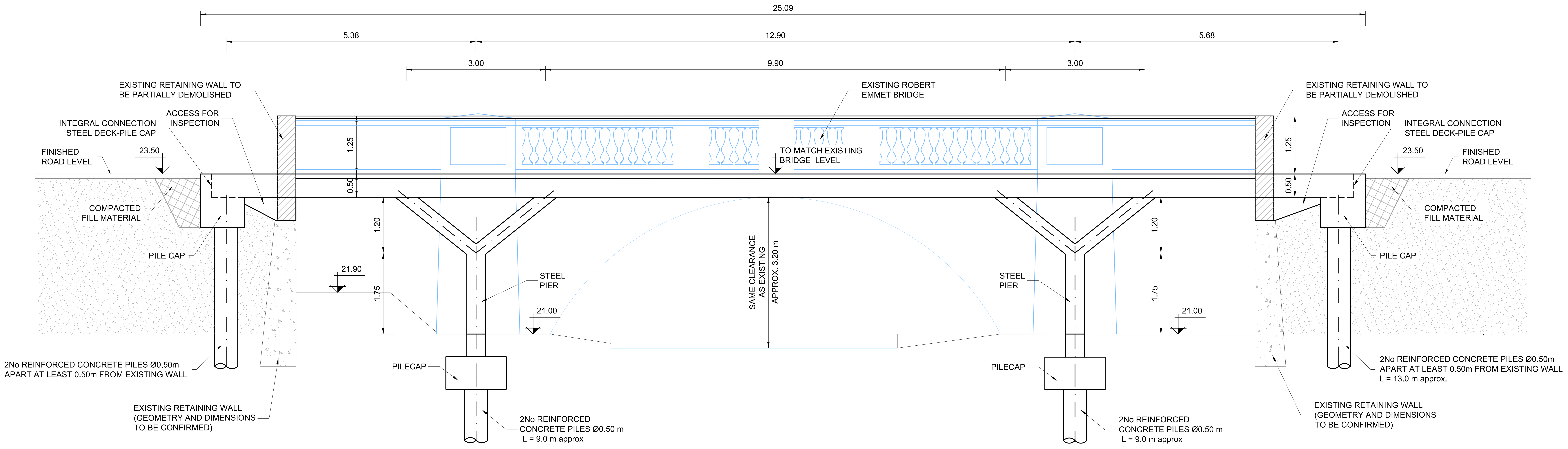
Project Code	Originator Code	QMS Code
BCIDD	ROT	

Programme Title
BUSCONNECTS DUBLIN
CORE BUS CORRIDORS INFRASTRUCTURE WORKS

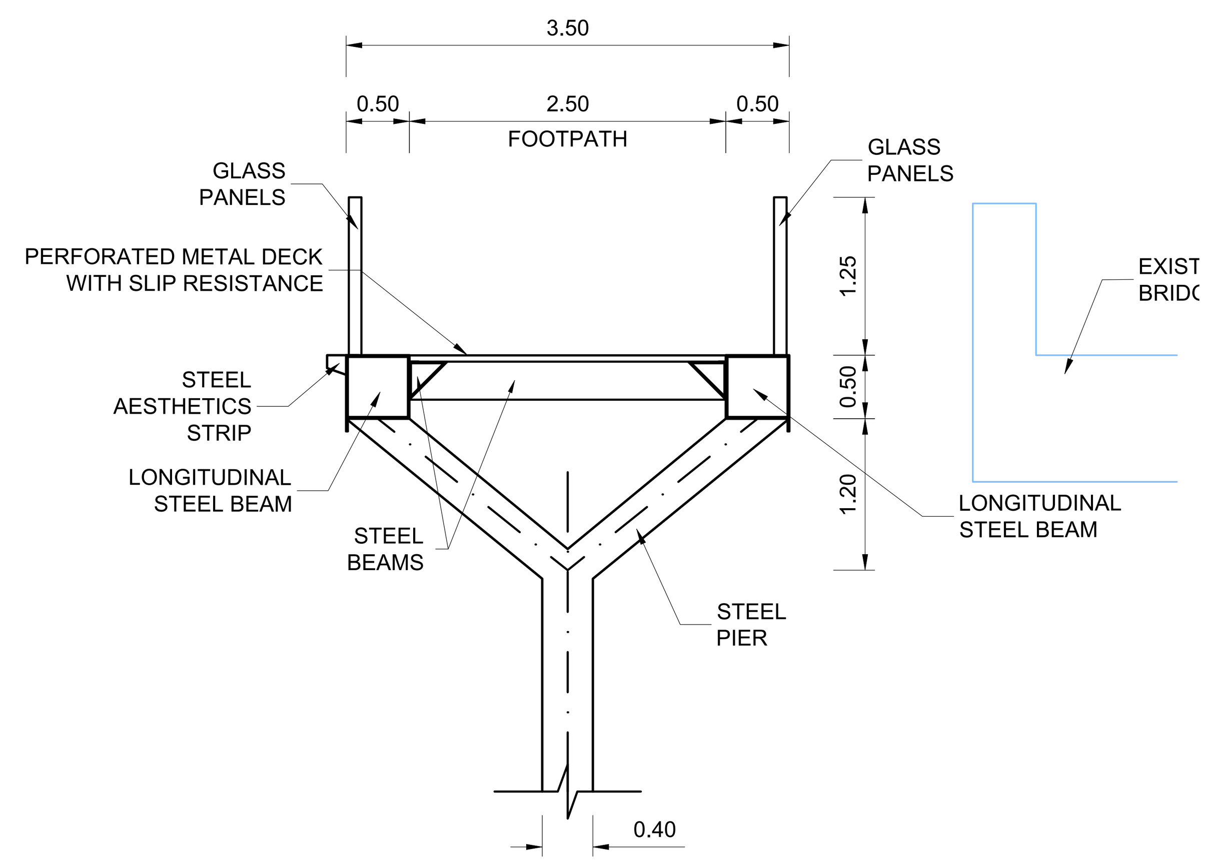
Drawing Title
CBC11
KIMMAGE TO CITY CENTRE CORE BUS CORRIDOR SCHEME
STRUCTURES
KIMMAGE 01B. GENERAL ARRANGEMENT

Drawing File Name	Sheet Number	Status	Rev
BCIDD-ROT-STR_ZZ-0011_XX_00-DR-SS-0003	01 of 02	A	L03

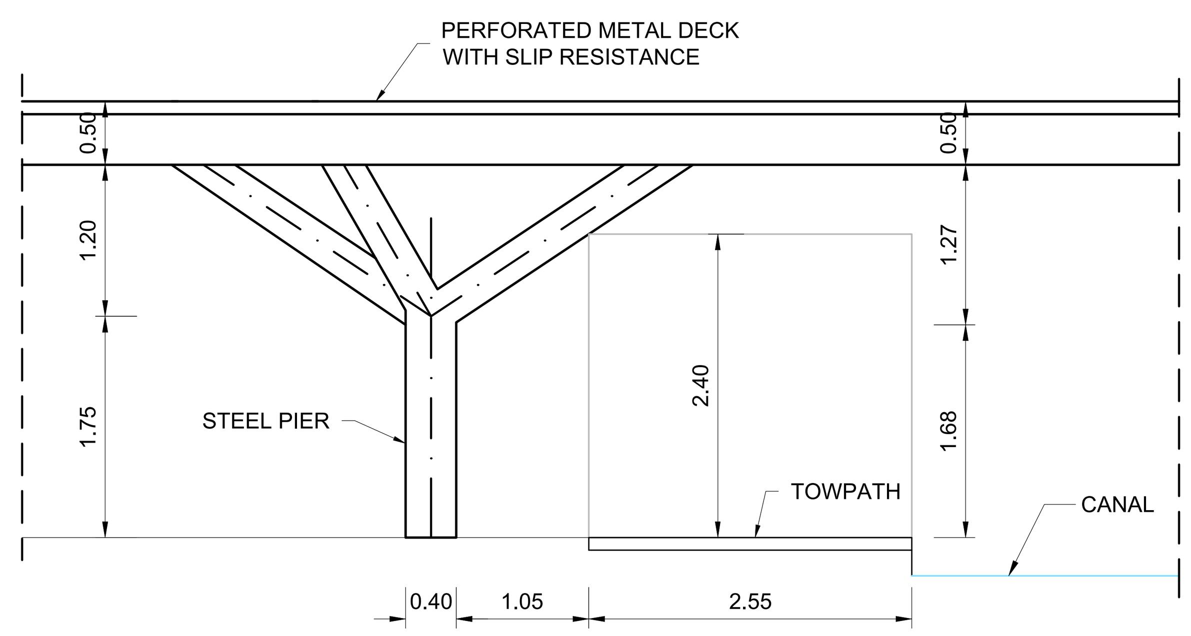
DO NOT SCALE USE FIGURED DIMENSIONS ONLY



SECTION A-A. LONGITUDINAL SECTION
SCALE 1:50



SECTION B-B. TYPICAL CROSS SECTION
SCALE 1:50



SECTION C-C. SHOWING TOWPATH CLEARANCES
SCALE 1:50

NOTES:

1. ALL DIMENSIONS ARE IN METRES UNLESS NOTED OTHERWISE.
2. THE GENERAL ARRANGEMENT IS INDICATIVELY ONLY.
3. PRIOR TO THE EXECUTION OF THE WORKS, THE CONTRACTOR MUST CHECK ON SITE THE GEOMETRY AND DIMENSIONS OF THE EXISTING STRUCTURAL ELEMENTS. SHOULD THE CONTRACTOR FIND ANY DISCREPANCY WITH THOSE INDICATED IN THE DRAWINGS, THEN IT SHALL BE COMMUNICATE IMMEDIATELY TO THE PROJECT DIRECTOR PRIOR COMMENCING CONSTRUCTION WORKS.
4. ALL BURIED SURFACES TO BE WATERPROOFED IN ACCORDANCE WITH THE TII SPECIFICATION FOR ROAD WORKS.
5. FOUNDATION DETAILS SUBJECT TO CONFIRMATION OR RECEIPT OF G.I.
6. SAFETY BARRIER IN ACCORDANCE WITH DN-REG-03034
7. STRUCTURAL STEEL ELEMENTS:
   - STEEL S355
8. SERVICES SHOWN INDICATIVELY ONLY. THE CONTRACTOR SHALL IDENTIFY THE SERVICES ON SITE PRIOR COMMENCING CONSTRUCTION WORKS.

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Project Ireland 2040
Building Ireland's Future

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L01	16/04/2021	JGE	EFD	SMG	PEER REVIEW STAGE B
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Date	26/11/2021
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Drawn	JVG
Checked	EFD
Approved	SMG
Project Code	BCIDD
Originator Code	ROT
QMS Code	

Programme Title: **BUSCONNECTS DUBLIN CORE BUS CORRIDORS INFRASTRUCTURE WORKS**

Drawing Title:
CBC11
KIMMAGE TO CITY CENTRE CORE BUS CORRIDOR SCHEME
STRUCTURES
KIMMAGE 01B. SECTIONS

Drawing File Name	Sheet Number	Status	Rev
BCIDD-ROT-STR_ZZ-0011_XX_00-DR-SS-0004	02 of 02	A	L03

DO NOT SCALE USE FIGURED DIMENSIONS ONLY

APPENDIX 3
RELEVANT EXTRACTS FROM GROUND INVESTIGATION REPORT

1. INTRODUCTION AND DESKTOP REVIEW

The existing site investigation information for the area has been taken from the Geological Survey of Ireland (GSi) website and the British Geological Survey (BGS) website, including the Quaternary and Bedrock Geology of Dublin and Depth of Bedrock digital maps.

The following selection of published papers has found to be of relevance to estimate the lithology and geotechnical properties:

- "Geotechnical properties of Dublin boulder clay". Authors: Long, Michael M and Menkiti, Christopher O. Sept 2007, Géotechnique 57 (7): 595-611. Published by the ICE.
- Ground Investigation Report of the National Pediatric Hospital Project, Dublin. Roughan & O'Donovan Consulting Engineers, January 2015.

1.1 Overview of geotechnical conditions along the Project.

Quaternary sediments cover up to 80% of the Dublin region. Quaternary thicknesses at the city area range from 5 to 20m. Maximum thicknesses are recorded along a Tertiary channel occurring on the north shore of the River Liffey valley, reaching 45m, and along a channel-like feature running along the south margin of the Dodder valley Quaternary sediments, with a thickness of 15 to 25 m.

The most commonly occurring Quaternary deposit in the area has been termed locally as the Dublin Boulder Clay. It is a glacial deposit derived from the Lower Carboniferous Limestone and it is classified by its two main members: the Black Boulder Clay (BkBC) and the Brown Boulder Clay (BrBC). The Brown Boulder Clay is less consolidated and since it overlies the Black Boulder Clay it has been interpreted as its weathered upper layer.

The Upper Brown Boulder Clay (UBrBC) is the outcome of the oxidation of the clay particles in the top 2m to 3m of the UBkBC, resulting in a change in colour from black to brown and a lower strength material. It is usually described as thick stiff to very stiff brown, slightly sandy clay, with rare silt / gravel lenses and some rootlets, particularly in the upper metre.

The Upper Black Dublin Boulder Clay (UBkBC) is a very stiff, dark grey, slightly sandy clay, with some gravel and cobbles. It is typically 4 m to 12 m thick.

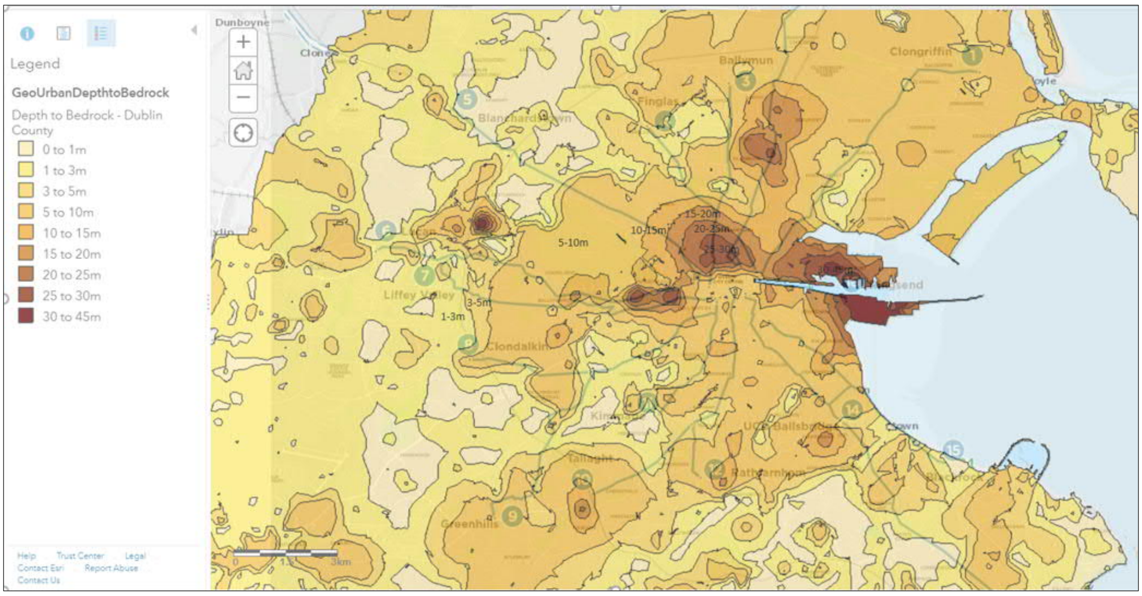
The Lower Brown Dublin Boulder Clay (LBrBC) exists as a 5 m to 9 m thick hard, brown, silty clay, with gravel, cobbles and boulders. It has previously been called the "sandy boulder clay" as it is similar to but siltier than the UBkBC above.

The Lower Black Dublin Boulder Clay (LBkBC) is a patchy layer of hard slightly sandy gravelly clay with an abundance of boulders. Its thickness does not exceed 4 m and is typically less than 2 m.

Note that not all four distinct formations of the Dublin Boulder Clay are always present. The upper two units though have been proven at all investigation sites across the city.

Bedrock close to the surface occurs mostly along the main riverbeds as well as the coastline and the higher ground areas of the Howth peninsula. The bedrock map of Ireland shows a wide variety of rock types which have originated at different periods of geological time. Underlaying the project area consists of Lower Carboniferous Limestone of the Lucan Formation (Calp), which is typically described as a dark grey to black fine grained limestone.

The following image from the Geological Survey Ireland website shows the expected depth to Bedrock.



Depth of Bedrock from the Geological Survey Ireland website

The water pressures correspond to hydrostatic conditions with a groundwater table about 2m below ground level.

- *Summary of Desktop Review.*

The following preliminary lithology and geotechnical properties has been assumed based on the Desktop Review:

Layer	Depth	Thickness	Undrained shear strength, cu (kPa)
Made ground / Urban / Alluvium	0 to 1 m	1	0
Upper Brown Boulder Clay, UBrBC	1 to 3 m	2	80
Upper Black Boulder Clay, UBkBC	3 to 10 m	7	200
Lower Brown Boulder Clay, LBrBC	10 to 18 m	8	400
Lower Black Boulder Clay, LBkBC	18 to 22 m	4	600
Bedrock	>22 m	N/A	>600

The expected depth to bedrock has been included in Section 2.

2. SUMMARY OF GROUND INVESTIGATION CONTRACT

At the date of this document, there are two GI contracts underway. Lot 1, which includes projects C and D, and Lot 2, which covers A and B projects.

Proposed ground investigation works aim to assess the geology of the site and determine the ground properties and conditions to enable the design of Bus Connects Core Bus Corridors. The GI provides for boreholes, trial pits, dynamic probes, standpipes/piezometer installation and monitoring, in-situ testing, geotechnical and environmental laboratory testing and preparation of a factual report, all in accordance with the “Specification and Related Documents for Ground Investigation in Ireland”.

At the Project D schemes (Ballymun/Finglas to City Centre, Kimmage to City Centre and Ringsend to City Centre), there are 21 proposed investigation points, consisting of Cable Percussion (CP) and Rotary Core (RC) boreholes as well as few windowless dynamic samples

(WS) in restricted space areas. The location of these points can be found in the form of drawings in the "*BusConnects Detailed Ground Investigation – Stage 1 – LOT 1*", February 2020.

In situ tests mainly include standard penetration tests. Laboratory tests mainly include particle size distribution, Atterberg limits, density and moisture content to identify soils and direct shear strength, triaxial CU or UU and uniaxial compression to determine the strength of the soil/rock.

For more details see the "BusConnects Detailed Ground Investigation – Stage 1 – LOT 1", February 2020.

For the Kimmage to City Centre Bus Corrido Scheme, the following investigation points have been proposed:

Borehole Ref.	Expected Depth to Bedrock	Borehole Depth (m) – Cable Percussion	Borehole Depth (m) – Rotary Core
R11-CP01	5-10m	10	2
R11-CP02	5-10m	15	2
R11-CP03	5-10m	15	2
R11-CP04	5-10m	15	2
R11-WS01	5-10m	10	
R11-WS02	5-10m	10	

3. SUMMARY OF FACTUAL GEOTECHNICAL REPORT

The following factual reports have been received as part of the Lot 1 GI:

Detailed Stage 1 Lot 1 Route 11. June 2021 Completed investigation points are as summarised below:

<table>
<tr><th>Structure</th><th>Borehole Ref.</th><th>Expected Depth to Bedrock</th><th>Borehole Depth (m) – Cable Percussion</th><th>Borehole Depth (m) – Rotary Core</th><th>Notes</th></tr>
<tr><td rowspan="2">Kimmage 01</td><td>R11-CP01</td><td>5-10m</td><td>8.7</td><td>6.5 to 12.5</td><td></td></tr>
<tr><td>R11-CP02</td><td>5-10m</td><td>3.9</td><td>-</td><td>Changed to WS02</td></tr>
<tr><td></td><td>R11-CP03</td><td>5-10m</td><td>6.3</td><td>-</td><td></td></tr>
<tr><td></td><td>R11-CP04</td><td>5-10m</td><td>2.9</td><td>-</td><td>Changed to WS03 (Drive-in Windowless Sampler)</td></tr>
<tr><td rowspan="2">Kimmage 01</td><td>R11-WS01</td><td>5-10m</td><td>3.6</td><td>-</td><td></td></tr>
<tr><td>R11-WS02</td><td>5-10m</td><td></td><td>-</td><td>Cancelled</td></tr>
</table>

The GI works undertaken comprise 2 No. Cable Percussion Boreholes to a maximum depth of 8.7m BGL, 3 No. Window Samples and 2 No. Rotary Core Boreholes to a maximum depth of 12.5m BGL; 14 SPT tests at 1 metre intervals alternating with disturbed samples and 9 GWL recordings.

10 disturbed samples were taken at each change of soil consistency or between SPT tests. Geotechnical testing consisting of 10 moisture content, 5 Atterberg limits, 1 Bulk Density and 7 Particle Size Distribution. Rock strength testing included 2 Unconfined Compressive Strength (UCS) testing.

Environmental & Chemical testing consisted of 9 Suite E samples and 2 PH and Organic matter content tests.

4. OVERVIEW OF SOIL CLASSIFICATION, AS APPLICABLE

4.1 Made Ground:

Made Ground deposits were encountered beneath the Topsoil/Surfacing and were present to depths of between 1.50m and 3.70m BGL.

These deposits were described generally as brown, dark brown, grey, dark grey or greyish brown sandy gravelly Clay with occasional cobbles or grey sandy subangular to subrounded fine to coarse Gravel with occasional cobbles and contained occasional fragments of ceramic, concrete, glass, metal, mortar, plastic, red brick and wood.

Soil classifies as CLAY of lower to intermediate plasticity, with a plasticity index ranging between 16% and 18%.

The Particle Size Distribution tests confirm percentages of sands and gravels of about 24% and 31% respectively.

PH and total organic carbon (TOC) were determined at R11-CP03 and C11-WS01 both at 1m depth. Organic matter content (OMC) was estimated from TOC. A PH average value of 8.1 was obtained.

TOC and OMC values at R11-WS01 were 1.8% w/w C and 3.1% w/w respectively. At R11-CP03, total organic carbon test showed high values (>6% w/w C).

Asbestos was detected at 1m depth at boreholes R11-CP03 and R11-CP04.

4.2 Cohesive deposits:

Cohesive deposits were encountered beneath the Made Ground or interbedded with Granular Deposits and were described typically as brown, grey, brownish grey or greyish brown sandy gravelly CLAY or as greyish brown or grey slightly sandy gravelly SILT. These deposits had rare, occasional, some or frequent cobble and boulder content.

The strength of the cohesive deposits typically increased with depth. In the majority of the exploratory holes, it was stiff below 3.0m BGL.

The geotechnical testing carried out on recovered soil samples generally classify the deposits as CLAY of low plasticity, with a plasticity index ranging between 12% and 16%.

The Particle Size Distribution tests confirm generally well-graded deposits with percentages of sands and gravels ranging between 25% and 28% and 27% and 34%, respectively.

4.3 Bedrock:

The rotary core boreholes recovered medium strong to strong thinly laminated to thickly bedded grey/dark grey fine-grained LIMESTONE locally interbedded with medium strong dark grey fine grained laminated MUDSTONE.

The depth to rock varies from 4.40m BGL to 8.90m BGL. The total core recovery is good, typically 100%. The SCR and RQD both are relatively poor but both show an increase with depth in each of the boreholes.

5. SUMMARY OF GROUND INVESTIGATION INTERPRETATIVE REPORT

For Kimmage to City Centre scheme, the following lithology and soil strength properties has been assumed based on the GI findings:

Layer	Depth (m)	SPT	Undrained shear strength, c_u (kPa)
Topsoil	0 to 0.5	-	-
Made Ground: Brown Clay (possibly UBrBC) / Grey Clay	0.5 to 3.5	6	40
Stiff Brown Boulder Clay (UBrBC)	3.5 to 4	50	325
Stiff Grey Boulder Clay / Very stiff dark Grey Boulder Clay (UBkBC)	4 to 9	30-50	250
Limestone	Top level between 5 and 10m	-	-

No soil strength tests have been performed on Route 11.

2 uniaxial compression tests (rock strength) undertaken within the Limestone have shown base resistant values between 31.3 and 49.5 MPa. This range of values have been sustained by 7 UCS tests, 13 point load tests and 3 Brazil tests done in Glasnevin project and 5 UCS tests done in Metrolink project, in which base resistant values range between 17 and 101 MPa, with an average value around 46 MPa.

6. HYDROGEOLOGY, AS APPLICABLE

Groundwater was noted during the investigation although the exploratory holes did not remain open for sufficiently long periods of time to establish the hydrogeological regime. However, standpipes were installed to allow the equilibrium groundwater level to be determined.

Groundwater levels recorded during the GI works are summarized below:

Date:	20/4/21	16/6/21
R11-CP01	1.44	1.94
R11-WS02	0.47	0.40
R11-CP03	2.74	2.67
R11-CP04	-	1.35
R11-WS01	0.68	0.61

7. GEOTECHNICAL INPUTS TO STRUCTURES

The following table shows the expected depth to bedrock, based on the data from the Desktop Review, as well as the depth of the encountered bedrock in the GI undertaken at Routes 3, 11 and 16.

Note that most of the boreholes were terminated at a shorter length, before encountering the bedrock strata. Therefore, the expected depth to bedrock could not be confirmed.

Structure	Permanent loads / Variable loads (KN)	Borehole Ref.	Expected Depth to Bedrock	Depth to encountered Bedrock	Depth to N_{SPT} values of Refusal	Piles estimated length (m)
Kimmage D=0.5m	TBC	R11-CP01	5-10m	9m	8m	-
		R11-WS02	5-10m	-	4m	-
		R11-CP03	5-10m	4.5m	3m	-
		R11-WS03	5-10m	-	2.5m	-
		R11-WS01	5-10m	-	3.5m	-

A preliminary number of the characteristic compressive resistance of piles has been obtained following the alternative procedure in accordance with the Eurocode 7 and the Irish National Annex. This procedure makes use of the ground parameters (such as the undrained shear strength, cu) to estimate the shaft and base compressive resistance of piles.

Cu values have been derived from SPT values obtained in each borehole following the SPT-Cu relationship proposed by Stroud and Butler (1975). Calcs can be found at Appendix 3.

For 0.5m diameter driven piles embedded in the Dublin boulder clay the estimated piles length that satisfies the ULS is as detailed in the table above.

APPENDIX 4
OTHER RELEVANT DOCUMENTATION/REPORTS

(Not used)