Appendix J.2
Preliminary Design Report

ST02 - Chapelizod Hill

Road Bridge Widening

ST02 Chapelizod Hill Road Underbridge Widening Preliminary Design Report

Lucan to City Centre Core Bus Corridor
BCIDA-ACM-STR_ZZ-0006_XX_00-RP-CB-0013

Client – National Transport Authority
Stage – Stage 2

Project Reference: BusConnects Package A
Project Number: 60599126
BCIDA–ACM-STR_ZZ–0006_XX_00–RP–CB–0013

Date (23rd February 2022)

Preliminary Design Report – Consultation

STA-1b

Categories 1, 2 & 3

Scheme

Name and Location BusConnects – CBC 06 Lucan to City Centre

Structures(s)

Name and nature of the Structure(s) ST02 Chapelizod Hill Road Underbridge Widening

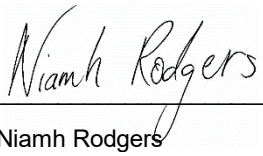
Preliminary Design Report

Reference BCIDA–ACM-STR_ZZ–0006_XX_00–RP–CB–0013

Revision L01

Date 23 / 02 / 2022

Submitted by

Signed 

Name Niamh Rodgers

Position Regional Director (Team Leader)

Organisation AECOM

Date 23 / 02 / 2022

National Transport Authority confirmation of consultation:

Signed: -

Name: -

Position: -

Date: -

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1. Introduction

1.1 Brief

The BusConnects Dublin – Core Bus Corridor (CBC) Infrastructure Works (herein after called the CBC Infrastructure Works) involves the development of continuous bus priority infrastructure and improved pedestrian and cycling facilities on twelve radial core bus corridor schemes in the Greater Dublin Area.

The National Transport Authority (NTA) have appointed AECOM in a joint venture with Mott MacDonald to undertake the design of the infrastructure works for Package A of the BusConnects Programme. Package A includes the following three CBC schemes:

Clongriffin to City Centre CBC;

Lucan to City Centre CBC; and

Tallaght/Clondalkin to City Centre CBC.

Each scheme contains several bridge structures with various structural forms. As part of the scope AECOM have agreed to take all structures through the *Technical Acceptance of Road Structures on Motorways and Other National Roads* procedure as outlined in DN-STR-03001.

This Preliminary Design Report (PDR) will focus on ST02, Chapelizod Hill Road Underbridge Widening, which carries the Chapelizod Bypass over Chapelizod Hill Road. This scheme will facilitate the addition of footpaths and bus lanes on the Chapelizod Bypass. The PDR is a deliverable at Phase 4 of the Technical Acceptance process.

1.2 Background information

BusConnects plans to transform Dublin's bus and cycle network, with an aim of increasing the attractiveness of public transport and cycling encouraging a modal shift from private car. The scheme consists of 16 radial Core Bus Corridor's (CBC), which will be supplemented at a later stage with a network of orbital corridors. Overall, the scheme will provide 230kms of continuous bus priority lanes and 200kms of cycle tracks/lanes throughout Dublin.

This CBC commences at Junction 3 on the N4. The CBC progresses east following the N4 to Junction 7 on the M50 where it continues via the R148 along the Palmerstown Bypass, Chapelizod Bypass, Con Colbart Road and St. John's Road West until tying in with the bus infrastructure along the Quays at the Frank Sherwin bridge beside Heuston Station.

As part of the Lucan to City Centre CBC, the existing Chapelizod Bypass needs to be widened to accommodate new bus lanes and footpaths. As part of these works the existing Chapelizod Hill Road Underbridge will need to be widened to accommodate a new bus lane and footpath along the Chapelizod Bypass.

1.3 Previous studies and their recommendations

The following table is a list of documents and previous studies for the development of the proposed bridge widening:

Date	Document Reference	Report Title	Author
Jan 2022	BCIDA-ACM-STR_ZZ-0006_XX_00-RP-CB-0011	ST02 Chapelizod Hill Road Underbridge Widening Structures Options Report	AECOM
2020	RPT-16_080-004	Lucan to City Centre Core Bus Corridor Options Study – Feasibility Report	AECOM
2020	BCIDA-ACM-PMG_PD-0006_XX_00-RP-ZZ-0001	CBC06 Preferred Route Options Report	AECOM

Table 1-1 Previous Studies

The Structures Options Report (SOR) assessed three different bridge widening options for the Chapelizod Hill Road Underbridge Widening. The report assessed each option based on a Multi Criteria Assessment (MCA) and recommended that Option 1 (Portal Frame adjacent to the existing bridge) should be taken forward to preliminary design as the emerging preferred bridge widening option.

2. Site & Function

2.1 Site location

The existing Chapelizod Hill Road Underbridge carries six lanes of traffic on the Chapelizod Bypass over Chapelizod Hill Road. The ITM co-ordinates of the existing bridge are 709998.000E, 734244.000N.

© 2021 Goggle Maps

Figure 2-1 Location Plan

2.2 Function of the structure and obstacles crossed

The widening will carry a new eastbound bus lane and footpath on the Chapelizod Bypass spanning Chapelizod Hill Road.

2.3 Choice of location

The location of the widening has been determined based on the position of the existing Chapelizod Hill Road Underbridge and the widths of the new bus lane, footpath and parapets/verges required to accommodate the desired Busconnects cross sections along the Chapelizod Bypass.

2.4 Site description and topography

The surrounding area consists primarily of residential, educational and commercial properties. The bridge is located to the south west of Chapelizod Village in a well-developed area with a number of busy roads, commercial units, educational facilities and other infrastructure. The bridge carries the R148 Chapelizod Bypass which is a highly trafficked road connecting the M50 and N4 to Dublin City Centre.

Residential housing estates are located at all corners of the site with the exception of the north-west corner at CDETB Ballyfermot Training Centre. The bypass and existing underbridge are separated from the Chapelizod Court and Knockmaree housing estates by relatively large mature trees and vegetation. These existing trees will serve to screen the proposed widening of the bridge on the north eastern side from the residential areas.

There are numerous commercial and educational facilities in the surrounding area including CDETB Ballyfermot Training Centre, St Dominics School and Chestnut Daycare. Similar to the existing residential areas, the existing commercial and educational facilities are separated from the Chapelizod Bypass by large areas of mature trees and vegetation.

2.5 Vertical and horizontal alignment

The vertical alignment of the bridge widening will be determined based on the existing vertical clearance of Chapelizod Hill Road Underbridge. The design will seek to retain and maximise the existing vertical clearances of the structure. The minimum vertical clearance on the eastern side of the existing bridge is 5.2m, which the proposed widening will be aligned with. However, the minimum vertical clearance of 2.8m on the western side of the existing bridge will remain unchanged.

The horizontal alignment of the bridge will be designed to span Chapelizod Hill Road at a skew of 0°. The pedestrian footpath and bus lanes will tie-in to the existing levels on the Chapelizod Bypass.

2.6 Cross sectional dimensions on the alignments

The proposed cross-section of the Chapelizod Bypass over the bridge is provided below:

Section	Width (m)
Footpath	2.00
Eastbound Bus Lane	3.30
Verge	0.60
Parapet	0.55
Verge	1.25
Eastbound Bus Lane	3.48
Eastbound Carriageway	3.28
Eastbound Carriageway	3.28
Central Reserve	3.95
Westbound Carriageway	3.21
Westbound Carriageway	3.23
Westbound Bus Lane	3.25
Verge	1.25
Total	**32.63**

Table 2-1 Chapelizod Bypass Proposed Cross-Section

2.7 Existing underground and overground services

A number of existing services have been recorded in the area surrounding the bridge widening. The following table summarises the service providers and their utilities. An existing services drawing can be found in the Appendix B of the report.

Service Provider	Services	Location
EIR	EIR Duct	West Verge on Chapelizod Hill Road
ESB	MV UG ESB LINE Existing Duct	Northbound Verge on the Chapelizod Bypass
DCC	Foul Water Drain	East Verge on Chapelizod Hill Road
	Storm Water Drain	Central Reserve on the Chapelizod Bypass
	Existing Water Network	East Verge on Chapelizod Hill Road
Virgin Media	Existing Virgin Media Network	West Verge on Chapelizod Hill Road
Gas Networks Ireland	Existing Gas Network	West Verge on Chapelizod Hill Road

Table 2-2 – Existing Utilities

2.8 Geotechnical summary

A Preliminary Sources Study Report (PSSR) for the BusConnects Lucan to City Centre CBC was prepared in accordance with Managing Geotechnical Risk DN-ERW-03083 (October 2019), Section 6.1, specifically Appendix C. It addressed the geological, geotechnical, geomorphological, hydrogeological and geo-environmental aspects of the BusConnects CBC.

The preliminary investigation comprised of two boreholes R6-CP10 and R6-CP11 located on the north westerly side of existing the bridge along the Chapelizod bypass carried out in October 2020. A trial pit was also carried out to identify the foundations of the existing underpass. The locations are shown in the figure below.

R6-CP10 encountered made ground from surface terminating in concrete at depth of 4.10 m (21.35 m OD). The borehole comprised of the following:

Depth Below Ground Level (m)	Material Description
0.0-0.3m	BITMAC
0.3-1.0	Black slightly sandy angular fine to coarse gravel of limestone
1.0-3.0	Firm becoming stiff brown slightly sandy slightly gravelly clay
3.0-4.0	Very stiff brown sandy gravelly clay
4.0-4.1	Concrete

Table 2-3 R6-CP10 Summary

R6-CP11 encountered made ground from surface terminating in possibly made ground at a depth of 4.12 m (20.93 m OD). The borehole comprised of the following:

Depth Below Ground Level (m)	Material Description
0.0-0.3m	BITMAC
0.3-1.1	Black sandy angular fine to coarse gravel of limestone
1.1-3.0	Firm becoming stiff brown slightly sandy slightly gravelly clay
3.0-4.2	Very stiff brown sandy gravelly clay

Table 2-4 R6-CP11 Summary

2.9 Hydrology and hydraulic summary

The River Liffey is located approximately 160m to the northeast of the Chapelizod Bypass and proposed bridge widening. There are no other major rivers, waterways or distributary streams in the immediate surrounding area of the bridge, and it is expected that the River Liffey is situated a sufficient distance from the bridge to avoid works

within the flood plain. The potential flooding impacts caused due to the construction of a new bridge should not be ignored and the flooding history of the surrounding location will be investigated.

A review of the OPW flood mapping (www.floodinfo.ie) shows that there are no historical events pertaining to flooding in the areas surrounding the bridge. Review of the flood mapping in the area should be revisited at detailed design stage to identify any updates to the flood record.

2.10 Archaeological summary

No sites of major archaeological importance were identified at the proposed bridge widening location during the EIA stage of the project.

2.11 Environmental summary

The scheme wide EIAR prepared as part of the preliminary design did not identify any particular major environmental impacts associated with the construction of the bridge widening. The main findings of the EIAR relating to the bridge widening are as follows:

Removal of trees required, which make a positive contribution to the separating of the Chapelizod Bypass from the surrounding residential area. The works do not directly impact the residential area but do affect views to and from the properties. Appropriate planting and screening of the proposed works should be provided for as part of the overall scheme. There is the potential for construction activities, to result in adverse noise impacts at properties in Chapelizod, this will need to be mitigated as part of the design

3. Structure & Aesthetics

3.1 General description of recommended structure or family of structures and design working life

The proposed bridge widening will be an independent precast concrete portal frame. The widening will be located parallel to the eastbound carriageway of the existing Chapelizod Hill Road Underbridge. The portal frame will be designed to accommodate a width of 6.4m composed of a 0.5m parapet, 2m footpath, 3.3m bus lane/bus stop and 0.6m raised verge. The portal frame will span 9.75m to match the existing bridge with a skew of 0°. The superstructure will be formed by a precast reinforced concrete portal frame supported on substructure pilecaps/abutments. The pilecaps will provide a connection to the bored concrete pile foundations which will transfer loading directly to the substrate. Piled foundations have been progressed to match the structural form of the Chapelizod Hill Road Retaining Wall No.1. A 20mm joint will be provided between the existing and proposed structures to ensure the two structures remain independent and differential movement between the two can be accommodated.

A new raised traffic island will be created between the existing and proposed structure. The raised island will be formed by the 0.6m raised verge on the proposed structure plus the 0.55m parapet edge beam and 1.25m raised verge on the existing structure. Trief kerbs will be installed to both side of the raised verges to prevent vehicles mounting the raised island.

The design working life of widening will be a minimum of 120 years as defined in the TII publication, DN-STR-03012 - Design for Durability. Maintainable elements and components listed below are subject to greater wear and will require replacement within the design life. Careful design and detailing combined with thorough routine inspections, quality control and supervision on site will help achieve the minimum expected design life listed below:

Component	Years
Parapets	50
Drainage Systems	50
Expansion Joints	50
Deck Waterproofing	50

Table 3-1 Minimum Design Life for Structural Elements

3.2 Aesthetic considerations

The appearance of the bridge has been designed to tie in seamlessly with the existing Chapelizod Hill Road Underbridge. The proposed bridge should not detract from the surrounding environment. The choice of concrete finish and shape of the bridge elements will have a negligible impact on costs but can offer significant improvements to the visual aesthetics. The bridge will utilise precast reinforced concrete portal frames in the design of the bridge widening. The advantage of concrete is that it can be cast using bespoke exterior formwork to have a wide range of patterned finishes. Consistency of form is an important aesthetic consideration and depends on materials, proportion, colour and details specified. The chosen concrete finish will tie-in with the existing bridge. Additionally, the form liners can produce concrete surfaces which avoid streaking. Surfaces with closely spaced vertical ribs or grooves can encourage channelling of rainwater or seepage. The quality of formed concrete finish can range from U1 to U5 and F1 to F5 as is detailed in CC-SPW-01700 with F5 being the highest quality finish. The portal frame concrete elements will be fabricated off site and can provide a higher quality of concrete finish in accordance with CC-SPW-01700.

The bridge aesthetics will be considered in depth during detailed design with the CIRIA C543 Bridge Detailing Guide used to determine a number of aesthetic requirements thus ensuring consistency across the bridge.

3.3 Proposals for the recommended structure or family of structures

3.3.1 Proposed Category

The bridge will be a Category 1 structure as the main span is greater than 5m and less than 10m, with a skew less than 25° in accordance with TII publication DN-STR-03001 Technical Acceptance of Road Structures on Motorways and Other National Roads. Category 1 structures require a check by another Engineer within the same Design Team.

3.3.2 Span Arrangements

The proposed bridge will be a single span portal frame spanning Chapelizod Hill Road. The span of the bridge will be approximately 9.75m in length and will span parallel to the Chapelizod Bypass carriageways.

3.3.3 Minimum headroom provided

The vertical alignment of the bridge will be determined based on the existing vertical clearance of Chapelizod Hill Road Underbridge. The design will seek to retain and maximise the existing vertical clearances of the structure. The bridge widening is located on the eastern side of the existing bridge and as such will assume a minimum vertical clearance requirement of 5.2m to match existing. No changes will be made to the vertical clearance of the existing Chapelizod Hill Road Underbridge, therefore, the minimum vertical clearance of 2.8m on the western side of the existing bridge will remain unchanged.

3.3.4 Approaches including run-on arrangements

The bridge will be required to tie-in to the existing and proposed infrastructure along the Chapelizod Bypass. The proposed bridge will need to run directly adjacent to the existing bridge. All approaches will be designed in accordance with the DMRBand be provided with a maximum 1-in-20 gradient from finished deck level.

3.3.5 Foundation type

The bridge frame will consist of a precast reinforced concrete portal frame sitting on a substructure pile cap supported on bored concrete pile foundations. The piled foundations will consist of 7 rock socketed bored piles. The length and diameter of the piles will be confirmed during the detailed design stage and are dependent on the soil stratum and predicted bearing pressures at the support locations.

3.3.6 Substructure

The substructure will be formed of a reinforced concrete pile cap connecting each of the bored concrete piles. The pile cap will be formed insitu and provide a suitable supported to the portal frame superstructure.

3.3.7 Superstructure

The superstructure will consist of an independent precast concrete portal frame. The frame will be located parallel to the eastbound carriageway of the existing bridge. The portal frame will have a width of 6.4m accommodating a 2m wide footpath, 3.3m wide bus lane and all necessary parapets and kerbs. The internal span length will be 9.75m and the bridge will have a skew of 0°, crossing perpendicular to Chapelizod Hill Road.

3.3.8 Articulation arrangements, joints and bearings

The bridge will be a portal frame structure designed with a pinned connection between the superstructure and substructure. No bearings will be required at these pinned connections.

A compressible filler joint will be required between the existing bridge and the proposed portal frame allowing for any differential movements between the two structures

3.3.9 Vehicle Restraint System (VRS)

The parapet of the existing bridge will be removed, and a new parapet will be installed between the two structures. The parapets will be designed with a minimum containment level of H2 based on the requirements of DN-REQ-03034 - The Design of Road Restraint Systems (Vehicle and Pedestrian) for Roads and Bridges. This is the minimum requirement for all structures on the national road network. The parapet shall also have an impact severity level of B and a working width not exceeding W4. The minimum height of the pedestrian parapet shall be 1.25m above the top of the surfacing with a 550mm fence on top with a mesh infill to prevent antisocial behaviour and users sitting on the parapet while waiting for an oncoming bus.

3.3.10 Drainage

Drainage of the bridge superstructure will be accommodated in the existing road drainage network. The significant longitudinal gradient from west to east along the Chapelizod Bypass avoids the needs for longitudinal drainage systems along the bridge deck and limits the risk of standing water and ice.

Substructure back of wall drainage systems will be provided at bottom of pilecap level to both abutments. This drainage system will consist of a 150mm diameter perforated pipe with a 150 PEA gravel surround in accordance with DN-STR-03012. The back of wall drainage will outfall to the existing road drainage network along Chapelizod Hill Road.

3.3.11 Durability

The bridge will be designed in accordance with the TII publication DN-STR-03012 - Design for Durability with a minimum design life of 120 years. The design life for replaceable parts such as waterproofing systems and surfacing will be 50 years in accordance with DN-STR-03012. The design working life of the bridge will be working life category 5 while replaceable parts will be working life category 2 in accordance with GE-POL-01008.

All buried concrete surfaces will be treated with two coats of epoxy resin waterproofing in accordance with DN-STR-03012 – Design for Durability and CC-SPW-02000 Specification for Road Works Series 2000 – Waterproofing for Concrete Structures.

All exposed concrete surfaces will receive a hydrophobic pore lining impregnation in accordance with DN-STR-03012 – Design for Durability and CC-SPW-02000 Specification for Road Works Series 2000 – Waterproofing for Concrete Structures.

3.3.12 Sustainability

The use of cement replacement products, such as Ground Granulated Blast Slag (GGBS) will be maximised in the foundation design, reducing the environmental impacts of concrete production. The replacement levels will be in accordance with the levels specified within IS EN 206:2013.

3.3.13 Inspection and maintenance

Inspections of the Chapelizod Hill Road Underbridge will be required regularly throughout its service life. The inspections will be carried out in line with the TII EIRSPAN Bridge Management System. The EIRSPAN system was introduced in 2001 to provide an integrated management system for the bridges in Ireland. The system coordinates activities such as inspection, repairs and maintenance work to ensure optimal management of the bridge stock.

The EIRSPAN system recommends the following intervals for inspections:

- General Inspection to be undertaken every year; and
- Principal Inspection to be undertaken at least every 6 years.

The above recommendations are the maximum recommended intervals and are dependent on the condition of the bridge and levels of deterioration since the previous inspection. If high levels of deterioration are identified the inspection interval should be decreased as required.

Inspection and maintenance to the top deck, parapet systems, road safety barriers and expansion joints will be carried out from road level on the Chapelizod Bypass. Inspection of the superstructures and deck soffits will be carried out from Chapelizod Hill Road using a mobile elevated work platform (MEWP). Traffic Management and

lane closures maybe required during inspection. Inspection and maintenance of the bridge substructure elements can also be carried out from Chapelizod Hill Road.

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4. Safety

4.1 Traffic management during construction including land for temporary diversions

The bridge widening is to be constructed parallel to the Chapelizod Bypass carriageways at Chapelizod Hill Road Underbridge. Chapelizod Bypass is a highly trafficked road; therefore, the construction sequence should avoid construction within the existing carriageways where possible and reduce the need for traffic management measures on the bypass. During any required lane closures suitable traffic management in accordance with Chapter 8 of the Traffic Signs Manual will need to be installed. This traffic management should consider the traffic flows and where possible minimise any negative effects.

Consideration will need to be given to the safe traffic movements for both members of the public and construction workers particularly at site entrances and along both the Chapelizod Bypass and Chapelizod Hill Road. This will be especially important during the transporting of large precast elements. Precast concrete components will be utilised in the portal frame design, to maximise the construction time off site and reduce the requirement for fabrication activity on site adding efficiency and enhancing quality for the construction process. The transportation of the precast frame and associated materials to the site will likely utilise the existing motorway and national road network. Erection of the superstructure will be carried out by a crane positioned on the Chapelizod Hill Road carriageway. During the superstructure erection all carriageways will be closed with traffic management required to divert traffic.

4.2 Safety during construction

As part of the design development, a Designer's Risk Assessment (DRA) has been prepared in accordance with the Safety, Health and Welfare at Work (Construction) Regulations 2013 and the amendments of 2019, 2020 and 2021. The DRA shall be viewed as a working document to be developed further as the design develops. The DRA includes all risks identified and the resulting mitigation measures or alterations incorporated within the design, where no mitigation is possible the DRA will be used to communicate the risks to the Contractor and site personnel.

Where possible, the hierarchy of risk control will be implemented within the design and construction, with the Designer and Contractor aiming to control all risks through elimination. Where this is not possible, reduction, isolation or mitigation controls will be incorporated to ensure safety during construction.

The following list of particular risks has been identified for the bridge widening:

- Consideration should be given to the potential risks to pedestrians travelling along Chapelizod Hill Road during construction. Safe work areas should be established, and re-routing of pedestrians should be arranged to avoid/minimise conflicts between pedestrians and construction vehicles;
- Working in an urban environment should be considered. The number of traffic movements to and from site should be minimised to avoid increase in the traffic congestion in the area;
- The risk of working near live services such as electrical supplies and drainage networks should be assessed. A health and safety plan should be prepared to determine the correct procedure in the event of contact with live services;
- Consideration should be given to the safety of traffic and potential collision with the structure due to an errant vehicle. Sufficient vehicle restraint systems should be put in place to prevent impact with the structure and in addition allowance for the working widths of the barrier and potential vehicle intrusion should be considered. Finally, positioning of the structure needs to consider the sightlines of the oncoming traffic to avoid an increased risk of impact;
- The existing Chapelizod Hill Road bridge should be kept clear and operable as much as possible during construction, however, it is likely that it will need to be closed for short periods during construction. Allowance should be made for pedestrians to safely use the bridge.
- Consideration should be given to the amount and safety of road crossings for pedestrians.

4.3 Safety in use

Safety of the end user will be considered as part of the Designer's Risk Assessment. A routine inspection will be carried out at least once a year or after any significant event in line with the recommendations contained within the EIRSPAN Bridge Management System, as defined by TII. The routine inspection will take account of any defects and establish whether the bridge requires a Principal Inspection to be carried out or if routine maintenance consisting of simple remedial works is sufficient to maintain the safety of the day-to-day pedestrian and vehicular traffic on the bridge. A Principal Inspection can only be carried out by an approved Principal Inspection Team Leader according to the TII Bridge Management Section. The Principal Inspection shall record all findings from the bridge on the EIRSPAN database for future reference.

The bridge widening incorporates a longitudinal fall across the deck to mitigate the slip hazard due to standing water and ice on the deck surface. The approaches will have a maximum constant gradient of 1-in-20 in line with DMURS recommendations.

The parapets will be designed with a minimum containment level of H2 based on the requirements of DN-REQ-03034 - The Design of Road Restraint Systems (Vehicle and Pedestrian) for Roads and Bridges. This is the minimum requirement for all structures on the national road network. The parapet shall also have an impact severity level of B and a working width not exceeding W4. The minimum height of the pedestrian parapet shall be 1.25m above the top of the surfacing with a 550mm fence on top with a mesh infill to prevent antisocial behaviour and users sitting on the parapet while waiting for an oncoming bus.

4.4 Lighting

No public lighting is to be installed as part of the bridge widening design. The existing lighting within the Chapelizod Hill Road Underbridge will be utilised to provide suitable lighting levels across the bridge. Where required at detailed design the existing lighting units may be upgraded to provide increased lighting levels.

5. Cost

5.1 Budget Estimate in current year

The construction costs provided below have been based on quantities calculated from the preliminary bridge design. Elements associated with bridge and ramps such as earthworks, piling, concrete, reinforcement, and waterproofing have been included. Rates have been based on AECOM's internal cost database or based on Spon's Civil Engineering and Highway Works Price Book 2022 as required. It should be noted that costs are indicative only and may vary depending on the detailed design and the Contractor's methodology.

Allowances have been made for preliminaries, consultancy fees and contingency. A budget of 20% of the construction cost has been provided for preliminaries to cover traffic management, PSCS, temporary accommodation etc. The contingency is 10% of the construction cost and will cover minor elements such as drainage, fencing, landscaping works and any unforeseen unknowns. Finally, an allowance of 10% of the construction cost has been provided for professional fees to deliver the bridge from detailed design to handover. These fees will include detailed design, CAT I checks, construction supervision and handover.

The rates used to calculate the amounts presented in the below table are all exclusive of VAT. No allowance has been made for land acquisition within the costs provided below. The cost of land acquisition will be covered under the construction costs for the entire BusConnects CBC06 Lucan to City Centre route.

Series	Amount (€)
CC-SPW-00600 – Earthworks	27,803.00
CC-SPW-01600 – Piling	98,308.45
CC-SPW-01700 – Structural Concrete	89,498.70
CC-SPW-02000 – Waterproofing of Structures	13,853.00
Construction Cost	**229,463.15**
Preliminaries (20% of Construction Cost)	45,892.63
Contingency (10% of Construction Cost)	22,946.31
Professional Fee (10% of Construction Cost)	22,946.31
Total Cost	**321,248.41**

Table 5-1 Budget Estimate in the current year

6. Design Assessment Criteria

6.1 Actions

6.1.1 Permanent Actions

Permanent actions and material densities will be applied in accordance with IS EN 1991-1-1 and the Irish National Annex. Material/partial factors will be as detailed in IS EN 1990 and the Irish National Annex. The accepted densities for principal construction materials are as follows:

Table 6-1 Material Densities for Design

Material	Density
Reinforced Concrete	25 kN/m^3
6N/6P backfill to structures	21 kN/m^3

6.1.2 Snow, Wind and Thermal Actions

Snow loads are not deemed a critical load case and will not be considered in accordance with the National Annex to IS EN 1991-1-3.

Wind loading will be considered in accordance with IS EN 1991-1-4 and the Irish National Annex. Wind loads will be taken to act simultaneously with other loads in accordance with the NA to IS EN 1990. Wind loads will not be considered in combination with thermal loading in accordance with clause A2.2.2 (6) of the NA to IS EN 1990.

Thermal loading will be considered in accordance with IS EN 1991-1-5 and the Irish National Annex. The combination of thermal and wind loading will not be considered for the bridge in accordance with the National Annex to IS EN 1990.

6.1.3 Actions relating to normal traffic

The bridge widening will be designed for vehicle loading associated with LM1 and LM2 live Loading in accordance with IS EN 1991-2.

6.1.4 Actions relating to abnormal traffic

The bridge widening will be designed to resist the surcharge loading due to the abnormal load effects of Load Model 3, specifically SV80, SV100 and SV196, as detailed in IS EN 1991-2.

6.1.5 Footway or footbridge live loading

Actions on the bridge widening due to LM4 footway loading will be considered in accordance with IS EN 1991-2 and the Irish National Annex.

6.1.6 Provision for exceptional abnormal loads

Not applicable.

6.1.7 Accidental actions

Accidental actions on the bridge due to accidental impact with the superstructure will be considered in accordance with IS EN 1991-1-7 and the Irish National Annex.

6.1.8 Actions during construction

Actions arising during construction will be considered in accordance with IS EN 1991-1-6 and the Irish National Annex.

6.1.9 Any special loading not covered above

Not applicable.

6.2 Authorities consulted and any special conditions required

The following authorities have been consulted as part of the development of the scheme:

- Dublin City Council
- National Transport Authority

6.3 Proposed departures from standards

No departures from standards are envisaged for the design and construction of the bridge.

6.4 Proposed methods of dealing with aspects not covered by Standards

Not applicable.

7. Ground Conditions

7.1 Geotechnical Classification

Considering the guidance in IS EN 1997-1, it is considered that Geotechnical Category 2 is currently the most appropriate for the proposed retaining walls.

Geotechnical Category 2 is for conventional types of structure and foundations with no exceptional risk or difficult loading conditions. This includes spread footing, raft foundations, piled foundations, walls or other structures retaining or supporting water, excavations, bridge piers and abutments, embankments and earthworks, ground anchors and other systems and tunnels in hard, non-fractured rock and not subjected to special water tightness or other requirements.

7.2 Description of the ground conditions and compatibility with proposed foundation design

Preliminary geotechnical analysis of the foundation options found that provided the bored concrete pile foundation elements are adequately sized during the detailed design phase, the piled elements could achieve Serviceability Limit State settlements of less than 25 mm. This is based on an assumption that the piles will be rock socketed to bedrock. As no bedrock was identified as part of the October 2020 Ground Investigation a further Ground Investigation should be carried out in advance of detailed design stage to identify the depths to bedrock. Where bedrock is not encountered the piles may be designed based on the skin friction only.

8. Drawings and Documents

8.1 List of all documents accompanying the submission

The following table lists the drawings accompanying this submission. The drawings are contained within Appendix B:

Drawing Number	Revision	Drawing Title
BCIDA-ACM-STR_GA-0006_BR_06-DR-CB-0101	L02.1	Lucan to City Centre Core Bus Corridor Scheme ST02 – Chapelizod Hill Road Bridge General Arrangement

Table 8-1 Chapelizod Hill Road Underbridge Widening Drawing List

Appendix A – Photographs

Figure A1 East Elevation of the Existing Chapelizod Hill Road Underbridge

Figure A2 Existing Chapelizod Hill Road Underbridge Soffit

Figure A3 South Wingwall of the Existing Chapelizod Hill Road Underbridge

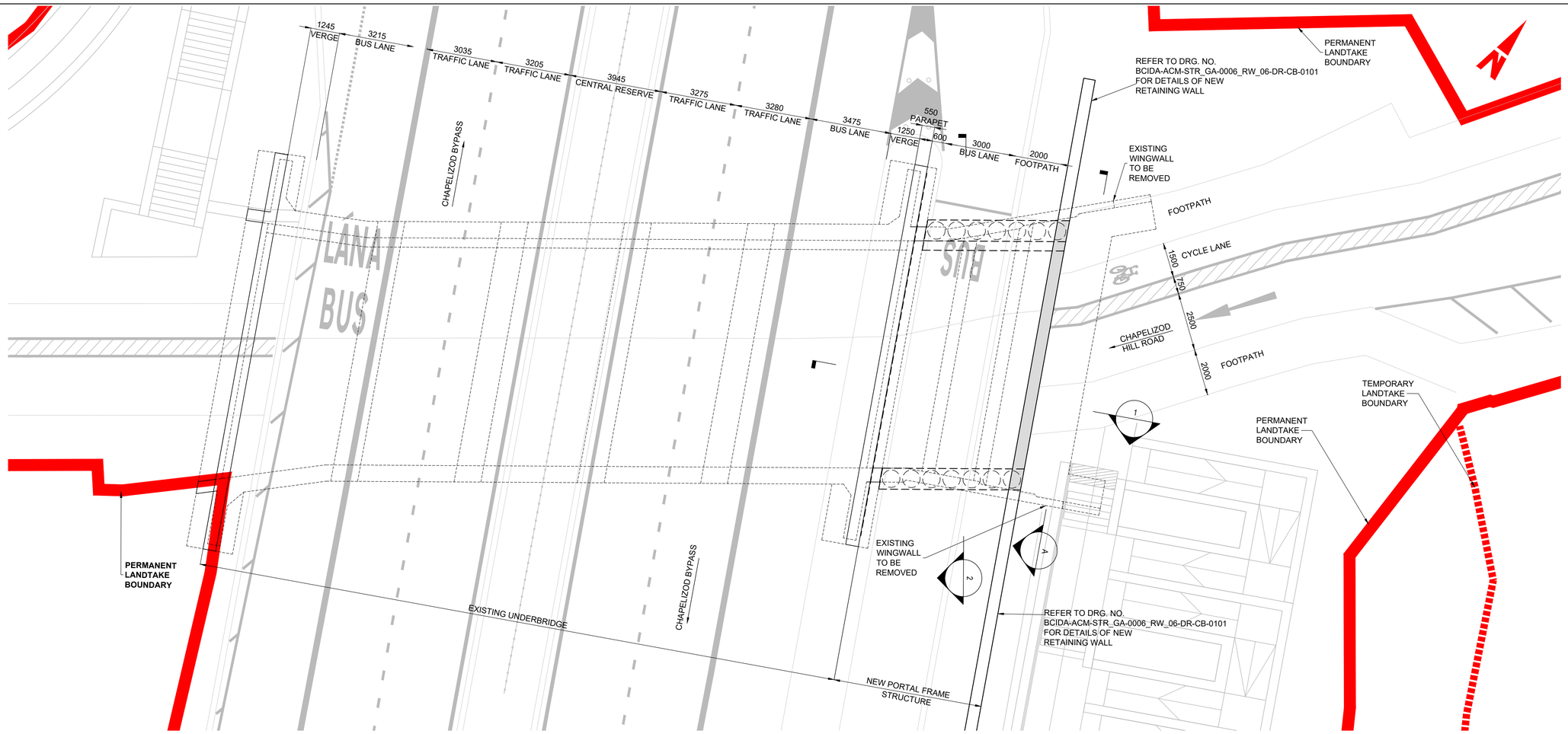
Figure A4 North Wingwall of the Existing Chapelizod Hill Road Underbridge

Figure A5 The Existing Chapelizod Bypass Eastbound Carriageways

Figure A6 Existing Chapelizod Hill Road Underbridge Abutments

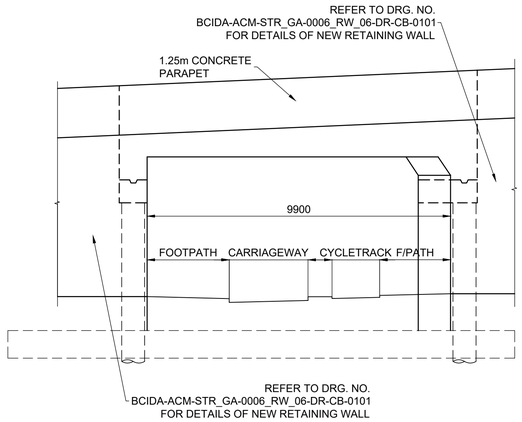
Figure A7 Existing Chapelizod Hill Road Underbridge Box Structure

Appendix B - Drawings



PLAN

1:100 @ A1
1:200 @ A3



PROPOSED ELEVATION A-A

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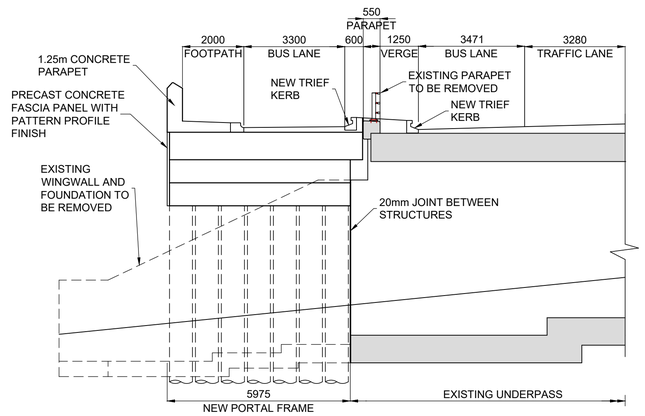
1:200 @ A3



SECTION 1-1

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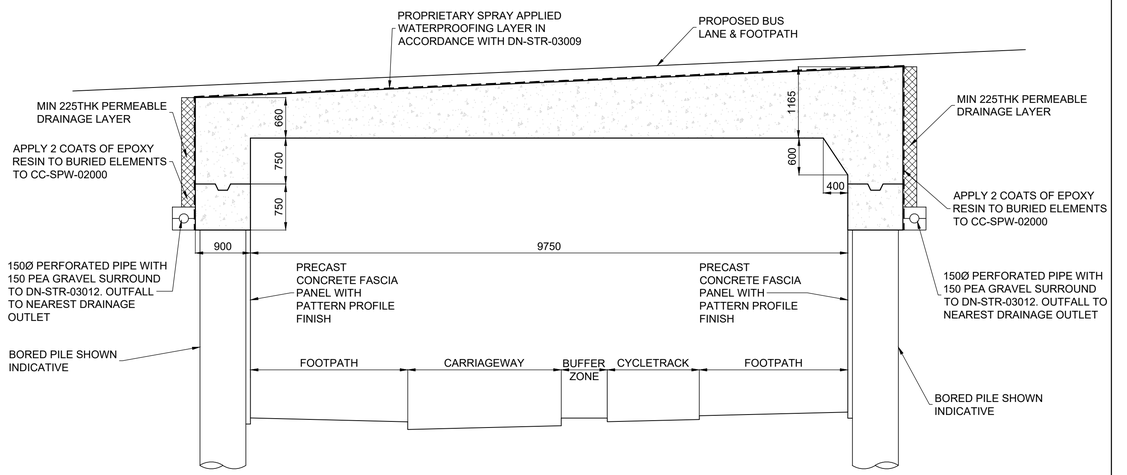

SECTION 2-2

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1:100 @ A3

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Project Ireland 2040
Building Ireland's Future

Rev	Date	Drn	Chk'd	App'd	Description
L02.1	19/01/21	---	---	---	
L01	11/12/20	DH	AD	JS	STAGE B1 - PEER REVIEW

W.I.P.

Client: NTA — Údarás Náisiúnta Iompair, National Transport Authority

Engineering Designer: AECOM / MOTT MACDONALD

Date	Scale	Drawn	Checked	Approved
19/01/21	AS SHOWN @ A1 AS SHOWN @ A3	---	---	---

Project Code	Originator Code	QMS Code
BCIDA	ACM	

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

Drawing Title: CBC06
LUCAN TO CITY CENTRE
ST02 - CHAPELIZOD HILL ROAD BRIDGE
GENERAL ARRANGEMENT

Drawing File Name	Sheet Number	Status	Rev
BCIDA-ACM-STR_GA-0006_BR_06-DR-CB-0101	1 of 1		L02.1

DO NOT SCALE USE FIGURED DIMENSIONS ONLY

Appendix C - Designers Risk Assessment

BUSCONNECTS – Lucan to City Centre Route 0006
CBC006-ST02 Chapelizod Hill Road Bridge Widening
Designers Risk Assessment

Project Number:	60599126	**Revision**						
Client:	National Transport Authority	**Rev**	01	02	03	04	05	06	07
Designer:	AECOM	**Date**	05/03/21						
Contractor:	Not applicable	**Client**	✓						
Prepared by:	Rionach Murphy	**Designer**	✓						
Checked by:	Arthur Costello	**Main Contractor**	-						
Approved by:	Niamh Rodgers	**Sub-Contractors**	-						
		Other	-						

Ref.	Feature, element, process or work activity	Constraints and significant hazards identified	Risk Rating before Intervention	Designers interventions to eliminate or reduce hazards	Significant residual hazards remaining	Residual Risk Rating	Information to be provided to enable project partners to manage hazards
1	Access and egress to the site area	Access and egress to the central supports is via Chapelizod Hill Road.	High	Traffic management to be implemented to ensure that safe access and egress is achieved		Low	The contractor is to ensure that suitable traffic management is implemented on site which includes appropriately designed and identified access points for site vehicles.
2	Site security	Unauthorised access by members of the public to the works areas	High	Suitable hoarding/fencing to be erected to prevent unauthorised access to the works areas		Low	Contractor to ensure that fencing is erected and maintained throughout the construction works.
3	Construction of bridge widening	Danger of improper lifting of prefabricated beams, formwork and reinforcement.	High	Consideration of method of construction has been made during detailed design. Elements have been sized such that they can be easily fabricated and transported to site.	Appropriate location for crane to be determined prior to lifting operations. A suitable set down area for steel structure to be determined prior to lifting into place	Medium	Contractor to be made aware that they are responsible for ensuring suitable locations are prepared for positioning of plant and crane outriggers etc. during lifting operations.
4	Placement of beams and concrete pour	Temporary stability prior to concrete deck widening and integral connection being formed	High	Bridge Beams are designed to account for temporary case during lifting and construction.	Additional measures may be required to ensure bridge is adequately restrained prior to establishment of integral connection.	Medium	Contractor to be made aware of need to satisfy themselves that bridge is adequately restrained in temporary condition.

Ref.	Feature, element, process or work activity	Constraints and significant hazards identified	Risk Rating before Intervention	Designers interventions to eliminate or reduce hazards	Significant residual hazards remaining	Residual Risk Rating	Information to be provided to enable project partners to manage hazards
5	Substances hazardous to health	Risk of chemical exposure from construction materials such as waterproofing and silane	High	Project Specific Specifications have been prepared to identify a number of likely substances to be used in the construction which are hazardous to health		Medium	Contractor to refer to project specification for further information. All substances to be applied in line with manufacturers recommendations
6	Structural Instability	Instability of structural elements of existing bridge during construction	High	Designs for construction stage loading thus reducing the requirements for temporary works.		Medium	Where required temporary works will be provided on site to ensure structural stability during construction. All temporary works required are to be designed by a temporary works designer.
7	Plant movements	Insufficient ground bearing pressure for site works.	Medium	Ground investigations have been carried out to determine if there are potential risks of low ground bearing pressures and to identify the presence of swamp/marshy conditions.		Low	Appropriate hoarding to be provided around site to separate works from areas of adverse ground conditions.
8	Working at Height	Erecting formwork, placing reinforcement and concrete above a waterway. Risk of fall of plant, materials and people.	High	Simple concrete shapes have been used in the design. The length and of reinforcing bars have been minimised where possible.		Medium	Contractor to ensure appropriate guard rails and netting provided to the structure to prevent falling objects. Contractor to ensure suitable fall restraint systems/harnesses to be used when working at height.
9	Manual handling	Injury to staff, possible back injury and/or crushing toes, caused by manual handling, lifting tools and equipment, moving materials, and/or hand digging.	High	Consideration of method of construction has been made during detailed design. Elements have been sized such that they can be easily fabricated and transported.	Appropriate location for hoist equipment to be determined.	Low	Contractor to develop method statements and ensure manual handling training is undertaken prior to manual handling activities. Only trained personnel to use tools. Only use the appropriate tool for each activity. Specialised equipment or mechanical hoist equipment to be used where appropriate.
10	Power tools	Risk of clothing becoming entangled in moving parts; possibility of eye injuries from dust or other airborne fragments, when using power tools. Also, risk of wrist and/or hand injuries, due to power tools jamming or binding. Hand/Arm Vibration Syndrome (HAVS) from over use of power tools.	High	Consideration has been made during the design to maximise the use of prefabricated components to reduce the requirements for power tools.		Low	The contractor is to ensure safe systems of work are in place and followed at all times. Protective PPE including eye protection and safety footwear (laced) provided and all staff must have received manual handling training. Inspect all tools before use for damage/wear, do not use if damaged. Hydraulic tools to be

							used in accordance with manufacturer's procedures and safety procedures and serviced to the manufacturer's specification.
11	Repetitive tasks	Long term risk, due to repetitive use of vibratory equipment (compaction tools, breakers etc.), of vibration white finger, carpel tunnel syndrome, permanent and painful numbness and tingling in the hands and arms, due to the use of vibratory equipment.	High	Consideration of method of construction has been made during detailed design to ensure that utilisation of larger equipment can be maximised for compaction of earthworks.		Medium	Operators to minimise the time spent during shift operating vibratory tools. Select power tools with the lowest vibration level. All operators to undergo regular HAVS assessments.
12	Anti-Social Behaviour	Risk to the site from anti-social behaviour and vandalism to contractors equipment and site materials.	Medium	A site compound has been established at the location for this structure. With only beaconed vehicles allowed entry.		Low	The Contractor must secure the site during and outside of working hours. They must advise all workers on the risk of confrontation with members of the public and how to deal with the situation.
13	Rising Ground Water	Risk of flooding to the site	High	Where possible excavations have been limited to above water strikes identified on the ground investigation. Water strike information has been provided on drawings to aid site team	Risk of rising water levels	Medium	Contractor to be made aware of the risk of rising water table and flooding. Temporary dewatering and pumping requirements to be determined by the Contractor as required.