

The background of the page is a vibrant red. It is decorated with several abstract geometric shapes: a large teal semi-circle in the top-left corner, a blue semi-circle in the top-right corner containing a white circle, a dark blue horizontal bar in the top-right corner, a teal semi-circle in the bottom-right corner, and a blue semi-circle in the bottom-left corner containing a white circle. There are also smaller white circles within some of these shapes.

**Appendix J.5**  
Preliminary Design Report –  
TII Retaining Walls



# Retaining Walls Preliminary Design Report

Lucan to City Centre Core Bus Corridor  
BCIDA-ACM-STR\_ZZ-0006\_XX\_00-RP-CB-0004

Client – National Transport Authority  
Stage – Stage 2

Project Reference: BusConnects Package A  
Project Number: 60599123  
BCIDA-ACM-STR\_ZZ-0006\_XX\_00-RP-CB-0004

Date (16<sup>th</sup> July 2021)

# 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) CBC06-RW02 N4 Retaining Wall; CBC06-RW05 Hermitage  
Medial Clinic Retaining Wall

#### Preliminary Design Report

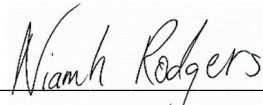
Reference BCIDA-ACM-STR\_ZZ-0006\_XX\_00-RP-CB-0004

Revision L01

Date 16 / 07 / 2021

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16 / 07 / 2021

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20-08-2021

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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 sixteen radial core corridors 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 four CBC routes:

Clongriffin to City Centre CBC;

Lucan to City Centre CBC;

Clondalkin to Drimnagh CBC; and

Tallaght to City Centre CBC.

Each route contains several structures with various structural forms. As part of the scope AECOM have agreed to take all structures which affect the Transport Infrastructure Ireland (TII) Road Network 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 a family of retaining wall structures located along the N4 National Road between Junction 1 M50 and Junction 3 Lucan. The retaining walls will be located within the TII road network and the Lucan to City Centre corridor of the BusConnects Programme. The PDR is a deliverable at Phase 4 of the Technical Acceptance process.

The family of structures refers to the following retaining walls:

CBC006-RW02 N4 Retaining Wall

CBC006-RW05 Hermitage Medical Clinic Retaining Wall

These retaining walls are required due to proposed changes to the existing road alignment creating additional cross-sectional width along the N4 to meet the project objectives of CBC Infrastructure Works.

## 1.2 Background information

Within BusConnects, there are 16 radial CBCs and plans for a number of orbital bus routes that will service the wider Dublin area to be developed. This CBC commences at Ballyowen Road Bridge 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 bus stops which service Liffey Valley Shopping Centre (LVSC) are being relocated west and lengthened to accommodate increased bus traffic. This relocation also helps to improve the weaving distances to and from the adjacent major junction between the N4, M50 and R148. As part of these works the existing carriageways/footpaths need to be widened and new retaining wall (N4 Retaining Wall) is required to retain the existing N4 fill embankment.

At the Junction 2 N4 eastbound diverge lane the existing carriageways are also to be widening to create a dedicated two way cycle track parallel to the existing carriageways, a new retaining wall is required to retain the widened carriageway layouts reducing the requirement to remove mature vegetation along the length of the wall.

## 1.3 Previous studies and their recommendations

The following table is a list of documents as part of previous studies for the development of the proposed retaining walls:

**Table 1.1 Previous Studies**

Date	Document Reference	Report Title	Author
May 2021	BCIDA-ACM-STR_ZZ-0006_XX_00-RP-CB-0003	Retaining Walls Structures Options Report	AECOM
2020	RPT-16_080-004 (DRAFT)	Lucan to City Centre Core Bus Corridor Options Study – Feasibility Report	AECOM
2020	BCIDA-ACM-PMG_PD-0006_XX_00-RP-ZZ-0001 (DRAFT)	CBC06 Preferred Route Options Report	AECOM

The Structures Options Report (SOR) assessed three different options for each retaining wall. The report assessed each option based on a Multi Criteria Assessment (MCA) and recommended that both retaining walls should be formed by gravity retaining structures. A signed STA-1a form has been received from TII confirming consultation for the SOR stage.

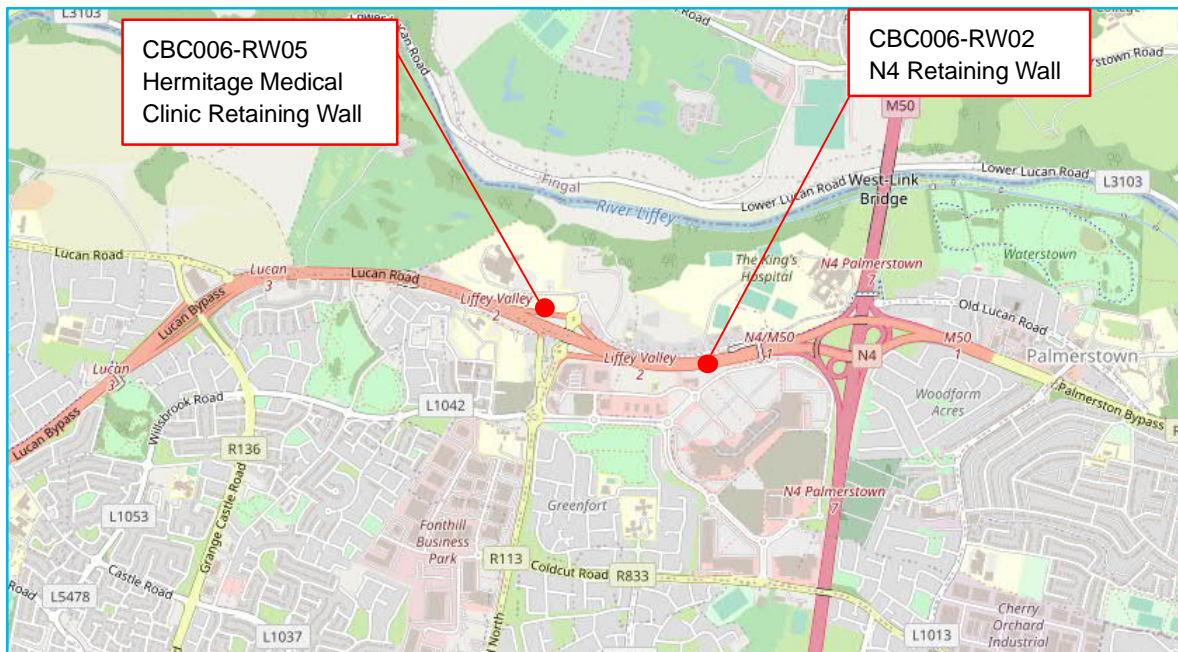
## 2. Site & Function

### 2.1 Site location

The retaining walls are located along the N4 between Junction 1 M50 and Junction 3 Lucan. The co-ordinates of the retaining walls are as follows:

CBC006-RW02 N4 Retaining Wall – 706939.072, 735124.708 (ITM)

CBC006-RW05 Hermitage Medical Clinic Retaining Wall – 705980.963, 735422.608 (ITM)



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Figure 2.1 Location Plan

### 2.2 Function of the structure and obstacles crossed

The N4 Retaining Wall is required to retain the existing embankment while providing sufficient space for a new bus stop along the N4. In addition, the wall will retain the existing embankment parallel to the proposed southern approach ramp to CBC06-ST01 N4 Pedestrian Bridge.

The Hermitage Medical Clinic Retaining is required to retain the widened carriageway layouts along the diverge lane. The retaining wall will help to minimise removal of mature vegetation along the length of the wall.

### 2.3 Choice of location

The N4 Retaining Wall will be located along the westbound carriageway of the N4 between Junction 1 and 2. The retaining wall will replace a portion of an existing boundary wall which currently forms the boundary between the N4, Liffey Valley Shopping Centre and the existing office building/carpark. The retaining wall will form the new boundary line between this existing infrastructure and will be required to tie in with the remaining section of the existing boundary wall.

The Hermitage Medical Clinic retaining wall will be located along the existing eastbound diverge lane of the N4 at Junction 2. The wall is required due to the proposal to widen the existing carriageways and provide a two-way cycle facility. Widening of the existing embankment with an earthworks solution at this location is not possible due to a requirement to minimise removal of existing mature trees under CBC Infrastructure Works. As such, a new retaining wall is required to retain the widened carriageway layouts.



## 2.4 Site description and topography

The areas surrounding the retaining walls are a busy urban environment with several existing structures, infrastructure and street furniture acting as constraints to the design, location and construction of the retaining walls.

The N4 Retaining Wall is located parallel to the N4 a busy primary traffic route with high traffic volumes which poses significant construction constraint. To the south of the retaining wall is an existing office building with associated carparking and boundary/retaining walls which are separated from the N4 by a steep earthwork’s embankment. Further east is Liffey Valley Shopping Centre and associated car parks.

The Hermitage Medical Clinic Retaining Wall is located parallel to the N4 Eastbound Junction 2 Diverge Lane. The area directly to the north of the wall is densely vegetated by mature trees which were planted on the side slopes of the existing N4 embankment. Hermitage Medical Clinic is located further north behind this vegetation.

## 2.5 Vertical and horizontal alignment

At the N4 Retaining Wall the existing N4 is on a maximum longitudinal fall of 5% from east to west at the wall location. The alignment is on a standard cross fall of 2.5% either side of the centre line.

For the Hermitage Medical Clinic Retaining Wall the alignment is on a maximum longitudinal fall of 5% from west to east at the wall location. The alignment is on a standard cross fall of 2.5% either side of the centre line of the N4.

## 2.6 Cross sectional dimensions on the alignments

The N4 cross section at the N4 Retaining Wall is as follows:

Section	Width (m)
Eastbound Bus Lane	3.21
Raised Island	1.47
Eastbound Carriageway	11.75
Central Reserve	4.79
Westbound Carriageway	11.23
Westbound Bus Lane	3.92
<b>Total</b>	<b>36.37</b>

Table 2.1 N4 Primary Road Cross-Section

The N4 Eastbound Junction 2 Diverge Carriageway cross section at the Hermitage Medical Clinic Retaining Wall is as follows:

Table 2.2 N4 Eastbound Junction 2 Diverge Carriageway Cross-Section

Section	Width (m)
Eastbound Carriageway	3.76
Ghost Island	1.42
Eastbound Bus Lane	3.45
Footpath	3.00
Two-way cycle track	3.90
<b>Total</b>	<b>15.53</b>

## 2.7 Existing underground and overground services

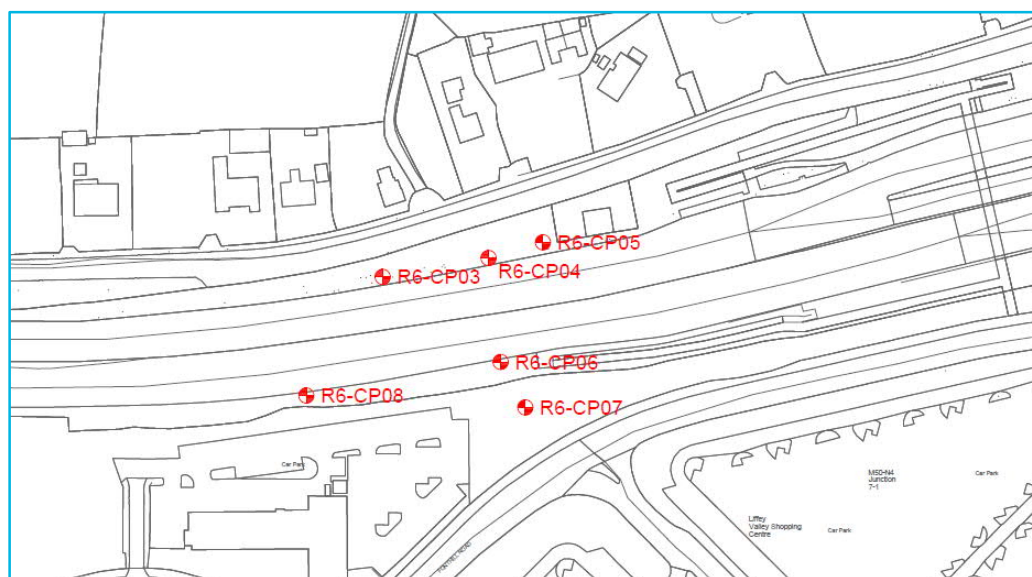
For the N4 Retaining Wall there are a large number of existing underground services along the verges of the N4 carriageway and along Fonthill Road. These services consist of stormwater and foul water drainage pipes, underground ESB low voltage, medium voltage & high voltage lines and EIR ducts. Overground services in the area consist of a low voltage ESB line along Old Lucan Road as well as lighting columns lining the verges of the N4 carriageways.

At the Hermitage Medical Clinic Retaining wall limited services were recorded with underground EIR ducting and surface water drainage present within the existing footpath.

## 2.8 Geotechnical summary

### 2.8.1 N4 Retaining Wall Ground Summary

Numerous boreholes were carried in proximity to the N4 Retaining Wall due to its proximity to the proposed CBC06-ST01 N4 Pedestrian Bridge. Two of the boreholes are located along the length of the proposed retaining wall namely R6-CP06 and R6-CP08. The approximate locations are shown in the figure below. The locations and exploratory techniques were adjusted in the field to allow for access.



**Figure 2.2 N4 Retaining Wall Borehole Locations**

R6-CP06 was put down to completion by light percussion boring techniques using a Dando Terrier dynamic sampling rig. The borehole was put down initially in 150mm diameter, reducing in diameter with depth as required, down to 50mm by use of the smallest sampler.

R6-CP08 was put down to completion in minimum 200mm diameter using Dando 2000 light cable percussion boring rig. The borehole was terminated on encountering virtual refusal on obstructions. Hand dug inspection pits were carried out between ground level and 1.20m depth to ensure the borehole was put down at locations clear of services or subsurface obstructions.

The borehole logs for R6-CP06 recorded topsoil for the first 0.1m overlaying 1.7m deep made ground of grey sandy angular to subangular fine to coarse gravel of mixed lithologies. Very stiff brown sandy gravelly clay with low cobble content was recorded for the remaining 0.8 after which point the borehole was terminated.

The borehole logs for R6-CP08 recorded made ground of soft brown sandy gravelly clay to 0.4m depth overlaying 0.7m of loose brown gravelly silty fine to coarse sand. The following 3.9m recorded stiff brown/greyish sandy gravelly clay. The gravels were subangular to surrounded fine to coarse material of mixed lithologies. The borehole was terminated at 4.2m at the presence of 0.2m thick grey sandy subangular coarse limestone gravel. Although not proven, possible bedrock was noted in the borehole logs with an SPT blow count of 50 being recorded.

The following sequence of ground conditions are expected to be present at the site in approximate stratigraphic order.

- Topsoil; overlying
- Made Ground; overlying
- Thin Sand and Gravel layers; overlying
- Glacial Till: overlying
- Limestone Bedrock.

Stratum	Typical Stratum Description	Depth at Top of Stratum (m bgl)	Level at Top of Stratum (m AOD)	Thickness Range (m)	Occurrence
<b>Topsoil</b>	Topsoil	0 – 0.1	51.51	0.1	R6-CP06
<b>Made Ground</b>	Grey Sandy Gravel and Clay	0.1 – 0.4	51.61 – 52.30	0.4 – 1.7	R6-CP06, R6-CP08
<b>Clay</b>	Very stiff brown sandy gravelly clay with low cobble content	0.4 – 1.8	49.81 – 51.90	0.8 – 3.6	R6-CP06, R6-CP08
<b>Gravel</b>	Grey Snady Silty Gravel of Limestone (possibly bedrock)	4.0	48.30	0.2	R6-CP08

Table 2.3 N4 Retaining Wall Ground Summary

## 2.8.2 Hermitage Medical Clinic Ground Summary

For the Hermitage Medical Clinic Retaining Wall one cable percussion borehole was carried out along the back of the existing footpath. The borehole was put down to completion in minimum 200mm diameter using Dando 2000 light cable percussion boring rigs. The borehole was terminated on encountering virtual refusal on obstructions.

Topsoil was recorded for the first 0.1m overlying made ground of soft brown sandy gravelly clay was recorded to a depth of 0.9m. The following 4.7m recorded firm brown slightly gravelly sandy silty clay. The gravels were subangular to surrounded fine to course material of mixed lithologies. The sand was recorded as fine to course. The borehole was terminated at 5.0m at the presence of 0.3m thick grey sandy angular coarse limestone gravel. Although not proven, possible bedrock was noted in the borehole logs with an SPT blow count of 50 being recorded.

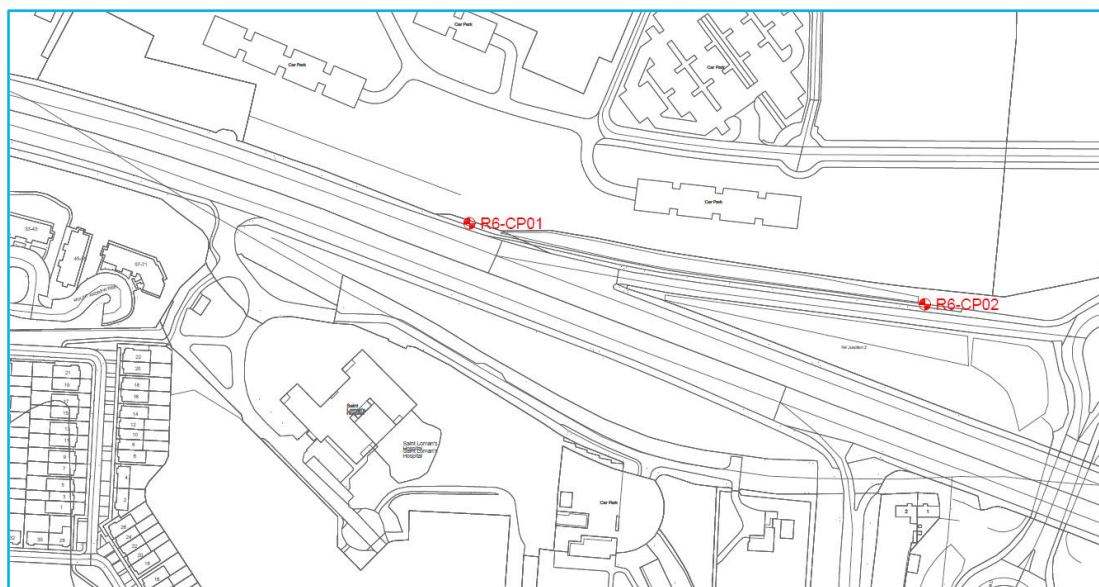


Figure 2.3 Hermitage Medical Clinic Retaining Wall Borehole Locations

The following sequence of ground conditions are expected to be present at the site in approximate stratigraphic order.

- Topsoil; overlying
- Made Ground; overlying
- Clay; overlying
- Gravel.

Stratum	Typical Stratum Description	Depth at Top of Stratum (m bgl)	Level at Top of Stratum (m AOD)	Thickness Range (m)	Occurrence
<b>Topsoil</b>	Topsoil	0 – 0.2	60.52 – 52.79	0.1 – 0.2	R6-CP01, R6-CP02
<b>Made Ground</b>	Soft brown sandy gravelly clay	0.1 – 1.0	60.42 – 52.09	0.5 – 0.9	R6-CP01, R6-CP02
<b>Clay</b>	Firm brown slightly gravelly sandy silty clay	1.0 – 4.0	59.62 – 52.09	1.2 – 3.0	R6-CP01, R6-CP02
<b>Clay</b>	Firm brown sandy gravelly clay	4.0	56.62 – 50.89	0.7	R6-CP01
<b>Gravel</b>	Course gravel of limestone (possibly bedrock)	4.7	55.92 – 55.62	0.3	R6-CP01

Table 2.4 Hermitage Medical Clinic Retaining Wall Ground Summary

## 2.9 Hydrology and hydraulic summary

The River Liffey forms the main hydraulic feature in the surrounding area. The River Liffey is located approximately 500m to the north of the retaining wall locations with no other major waterways or distributary stream in the immediate surrounding area.

A review of the OPW flood mapping ([www.floodinfo.ie](http://www.floodinfo.ie)) shows that there are no historical events pertaining to flooding at the retaining wall locations as of 16<sup>th</sup> July 2021. A review of CFRAMS model output for fluvial flooding for the present day shows that the retaining walls are located outside of the River Liffey's flood zone for the 0.1% Annual Exceedance Probability (AEP).

## 2.10 Archaeological summary

No sites of major archaeological importance were identified at the proposed retaining wall locations during the EIA stage of the project.

## 2.11 Environmental summary

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

N4 Retaining Wall - Removal of trees, which make a positive contribution to the setting of the historic buildings and structures on Old Lucan Road, will be required for the construction of the new bridge and retaining wall. The works do not directly impact the historic buildings and structures on Old Lucan Road but do affect views to and from the properties. Appropriate planting and screening of the bridge and retaining wall should be provided for as part of the overall scheme. In addition, reinstatement of the landscape at Liffey Valley Shopping Centre should be included to help integrate the proposed scheme into the surrounding environment. There is the potential for construction activities, to result in adverse noise impacts at properties on Old Lucan Road this will need to be mitigated as part of the design.

Hermitage Medical Clinic Retaining Wall – Removal of trees, which make a positive contribution to the environment will be required for the construction of this retaining, however it is noted that the retaining wall is being constructed to minimise removal of mature vegetation. There is the potential for construction activities, to result in adverse noise impacts at properties in the Fonthill area including the Hermitage Medical Clinic. 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

Both retaining walls propose the use of a gravity retaining wall solution. The walls would be formed using either an insitu concrete base and wall or a precast concrete solution. The geometry of the footing and wall will be dependent on a number of factors such as predicted loading and available working area. The walls will be designed to ensure a toe is provided to the front of the footing to move the centre of gravity further away from the point of overturning and reducing the quantity of materials required. This type of wall is generally considered to be economical for heights up to 3m. A boundary wall will be provided to the top of both retaining walls which shall tie into existing walls on site. These boundary walls will help to increase the self-weight of the wall while also preventing falls from height from the retained side.

The proposed retaining wall dimensions are as follows:

Parameter	Dimension
Retained Length	140m
Max Retained Height	2.6m
Min Retained Height	1.45m
Boundary Wall Height	1.8m
Wall Thickness	0.3m
Footing Length	2.2m
Footing Thickness	0.3m

**Table 3.1 N4 Retaining Wall Geometry**

Parameter	Dimension
Retained Length	83.0m
Max Retained Height	2.3m
Min Retained Height	1.5m
Boundary Wall Height	2.0m
Wall Thickness	0.4m
Footing Length	3.5m
Footing Thickness	0.4m

**Table 3.2 Hermitage Medical Clinic Retaining Wall Geometry**

The gravity wall will be designed to resist sliding, overturning and bearing forces. The horizontal forces to the rear of the wall due to soil loading and surcharging will be resisted through utilisation of friction between the footing and soil below. Overturning will be resisted by the combination of self-weight plus the vertical force of soil.

The design working life of the retaining walls 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 in the below table:

Component	Years
Expansion Joints	50
Drainage Systems	50

**Table 3.3 Minimum Design Life for Structural Elements**

## 3.2 Aesthetic considerations

The retaining wall designs have been developed to take account of the basic principles of aesthetics which respects the surrounding landscape, minimises the environmental intrusion and protects existing vegetation where possible.

The proposed finishes for each of the options will be critical to ensuring the environmental intrusion of the walls is limited. The quality of concrete finish will have a large effect on the aesthetics of a plain concrete finish. The finish can be specified in formed or unformed and range in quality from 1 to 5 with 5 being the highest quality finish achievable. Where the wall is visible by users an F4 or F5 finish shall be specified to ensure the aesthetics of the wall are not compromised.

A patterned profile concrete finish is recommended for all large areas of exposed concrete. The form liners produce concrete surfaces which avoid streaking. Surfaces with closely spaced vertical ribs or grooves have worked well in the past as the grooves encourage channelling of rainwater or seepage. Consistency of form is an important aesthetic consideration and will depend on materials, proportion, colour and details specified.

In all cases the proposed finishes will be required to match the finish of existing retaining/boundary walls on site. The table below indicates the required finish for each wall.

Retaining Wall	Finish Required
CBC06-RW02	Pattern Profile Concrete Finish
CBC06-RW05	Masonry Stonework Finish

**Table 3.4 Required Finishes**

## 3.3 Proposals for the recommended structure or family of structures

### 3.3.1 Proposed Category

Both retaining walls shall be Category 1 (retaining structures <1.5m and >5m) requiring a check by another Engineer within the same Design Team in accordance with TII publication DN-STR-03001 Technical Acceptance of Road Structures on Motorways and Other National Roads.

### 3.3.2 Span Arrangements

The retaining walls will be required to retaining the existing embankments for a length of 140m (N4 Retaining Wall) and 83m (Hermitage Medical Clinic Retaining Wall) respectively.

### 3.3.3 Minimum headroom provided

Not applicable – unrestricted headroom will be provided at both retaining walls.

### 3.3.4 Approaches including run-on arrangements

Both retaining walls will be required to tie in with existing boundary walls on approach to the structures. The N4 Retaining Wall will tie in with the existing pattern profile finished boundary wall between the N4 and Liffey Valley/office building boundary. For the Hermitage Medical Clinic Retaining Wall the wall will be required to tie in with the existing masonry clad boundary/retaining wall along the edge of the eastbound N4 carriageways from Junction 2 to Junction 3.

### 3.3.5 Foundation type

Both walls will be formed with a reinforced concrete spread foundation. These spread foundations will be supported on 6N structural upfill. The preliminary sizing of the retaining wall foundations shall be 2.2m (N4 Retaining Wall) and 3.5m (Hermitage Medical Clinic Retaining Wall) wide respectively. A preliminary foundation thickness of 0.3m (N4 Retaining Wall) and 0.4m (Hermitage Medical Clinic Retaining Wall) has also been assumed. The final foundation sizing will be confirmed during the detailed design stage and will be dependent on the soil parameters and predicted loading.

### 3.3.6 Substructure

Not applicable

### 3.3.7 Superstructure

The above ground superstructure will consist of a reinforced concrete wall integrally connected to the spread foundation. The height of the walls will vary depending on the required retaining height. The maximum height of the walls including boundary walls shall be 4.4m (N4 Retaining Wall) and 5.8m (Hermitage Medical Clinic Retaining Wall). The wall thicknesses shall vary between 0.35m (N4 Retaining Wall) and 0.4m (Hermitage Medical Clinic Retaining Wall) and finished in either a pattern profile finish (N4 Retaining Wall) or a masonry clad finish (Hermitage Medical Clinic Retaining Wall).

### 3.3.8 Articulation arrangements, joints, and bearings

Expansion joints shall be located along the length of both walls at maximum spacings of 10m centre to centre. The joints shall be formed with compressible filler board sealed with two-part polysulphide sealant.

### 3.3.9 Vehicle Restraint System

Both walls are located outside of the required clear zone from the N4 carriageways. As a result, no vehicle restraint system is required. A boundary wall shall be provided to the top of each retaining structure to prevent falls from height.

### 3.3.10 Drainage

A 225mm wide permeable drainage layer coupled with a perforated drainage pipe shall be provided to the rear of the gravity retaining wall to prevent the build-up of pore water pressure to the back of the wall. The drainage shall be a positive drainage system in accordance with DN-STR-03012. Future access for rodding and maintenance of the drainage system shall also be provided.

### 3.3.11 Durability

The retaining walls 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 expansion joints and drainage systems will be 50 years in accordance with DN-STR-03012. The design working life of the retaining walls 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 retaining wall design, reducing the environmental impacts of concrete production. The replacement levels will be in accordance with the levels specified within IS EN 206:2013.



At the end of the service life a large proportion of the concrete can be recycled and reused as hard core for road construction or as an aggregate material for other concrete structures.

### 3.3.13 Inspection and maintenance

Maintenance and inspection of the retaining walls will be required throughout their 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 and structures in Ireland. The system coordinates activities such as inspection, repairs and maintenance work to ensure optimal management of the bridge stock. As a minimum the following inspection regime should be implemented:

- Routine Inspection – every year;
- Principal Inspection - every six years.

Inspection of the front face of both walls will be carried out from footpath level along the edge of the N4 with inspection of the back face being carried out from the embankments to the rear of the walls. It is expected that no lane closures or traffic management will be required to facilitate inspection.

## 4. Safety

### 4.1 Traffic management during construction including land for temporary diversions

The retaining walls will be constructed parallel to the N4 carriageway, a highly trafficked primary road. The construction sequence will need to avoid construction within the carriageway where possible and reduce the need for traffic management measures on the N4. Lane closures however may be unavoidable particularly for the construction of the Hermitage Medical Clinic Retaining Wall where the existing carriageway is being widening on new fill. During all 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 N4 traffic flows and where possible minimise any negative effects.

### 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 and 2020. 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 retaining walls:

- The maximum retained height of the retaining walls varies from 2.3m to 2.6m. These retained heights may lead to a risk of burial under earth falls during temporary excavation. All temporary cut slopes should be constructed to suitable gradients to minimise the risk of earth falls or slide. If required temporary shoring should be considered to further limit the risk of slope failure.
- Construction works will need to be cognisant of work near live carriageways of the N4. The carriageways will need to remain operational during construction; however, it is anticipated that closure of bus lanes during construction will be required to provide a safe working zone.
- Working in a congested 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 potential risks to pedestrians and cyclists travelling along the N4 during construction. Safe work areas should be established, and re-routing of pedestrians and cyclists should be arranged to avoid/minimise conflicts between pedestrians, cyclists and construction vehicles;

### 4.3 Safety in use

Safety of the end user will be considered as part of the Designer's Risk Assessment. An Engineer 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 retaining wall requires a Principal Inspection to be carried out or if routine maintenance consisting of simple remedial works is sufficient to maintain the safety. 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 on the EIRSPAN database for future reference.

Boundary walls have been included to the top of each retaining wall to prevent falls from height in use. These boundary walls have a minimum height of 1.8m and shall be detailed with coping units which prevent climbing.

## 4.4 Lighting

No public lighting is proposed as part of the retaining wall design.

## 5. Cost

### 5.1 Budget Estimate in current year

The construction costs provided below have been based on quantities calculated from the preliminary retaining wall design. Elements associated with retaining walls such as earthworks, concrete and reinforcement 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 2021 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 retaining walls 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 below 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	127,080.90
CC-SPW-01700 – Structural Concrete	157,027.50
<b>Construction Cost</b>	<b>284,108.40</b>
Preliminaries (20% of Construction Cost)	56,821.80
Contingency (10% of Construction Cost)	28,410.90
Professional Fees (10% of Construction Cost)	28,410.90
<b>Total Cost</b>	<b>397,752.60</b>

Table 5.1 N4 Retaining Wall Budget Estimate in the current year

Series	Amount (€)
CC-SPW-00600 – Earthworks	123,119.00
CC-SPW-01700 – Structural Concrete	163,065.00
<b>Construction Cost</b>	<b>286,184.00</b>
Preliminaries (20% of Construction Cost)	57,236.80
Contingency (10% of Construction Cost)	28,618.40
Professional Fees (10% of Construction Cost)	28,618.40
<b>Total Cost</b>	<b>400,657.60</b>

Table 5.2 Hermitage Medical Clinic Retaining Wall 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 <sup>3</sup>
6N/6P backfill to structures	21 kN/m <sup>3</sup>

#### 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 in accordance with the National Annex to IS EN 1990.

#### 6.1.3 Actions relating to normal traffic

The retaining walls will be designed for surcharge loading associated with LM1 and LM2 live Loading in accordance with IS EN 1991-2.

#### 6.1.4 Actions relating to abnormal traffic

The retaining walls 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

Surcharge actions on the retaining walls 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

Not applicable. Both retaining walls are located outside of the clear zone of the carriageways so accidental impact loading will not be considered.

#### 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:

- South Dublin County Council
- Transport Infrastructure Ireland
- National Transport Authority
- Liffey Valley Shopping Centre

## **6.3 Proposed departures from standards**

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

## **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

#### 7.2.1 N4 Retaining Wall

Preliminary geotechnical analysis of the foundation options found that provided the foundations are adequately sized during the detailed design phase, spread foundations founded on the clay layers could achieve Serviceability Limit State settlements of less than 25 mm. All topsoil, made ground and soft clays should be removed and replaced with 6N structural fill. Spread foundations are being progressed as part of the preliminary design.

#### 7.2.2 Hermitage Medical Clinic

Preliminary geotechnical analysis of the foundation options found that provided the foundations are adequately sized during the detailed design phase, spread foundations founded on the firm brown slightly gravelly sandy silty clay could achieve Serviceability Limit State settlements of less than 25 mm. All topsoil and soft clays should be removed and replaced with 6N structural fill. Spread foundations are being progressed as part of the preliminary design.

## 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:

**Table 8.1 N4 Retaining Wall Drawing List**

Drawing Number	Revision	Drawing Title
BCIDA-ACM-STR_GA-0006_RW_03-DR-CB-0101	L03	RW02.06 N4 Retaining Wall General Arrangement

**Table 8.2 Hermitage Medical Clinic Retaining Wall Drawing List**

Drawing Number	Revision	Drawing Title
BCIDA-ACM-STR_GA-0006_RW_04-DR-CB-0101	L02	RW05.06 Hermitage Medical Clinic Retaining Wall General Arrangement



# Appendix A Photographs and Photomontages

## CBC006-RW02 N4 Retaining Wall

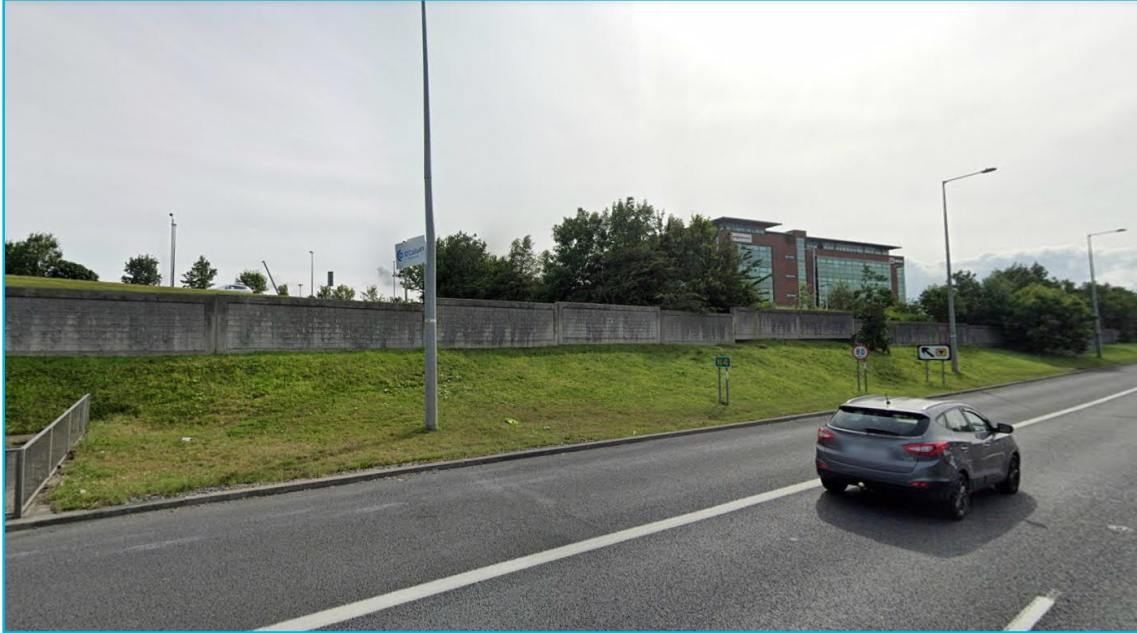


Photo 1 – Proposed retaining wall location looking South



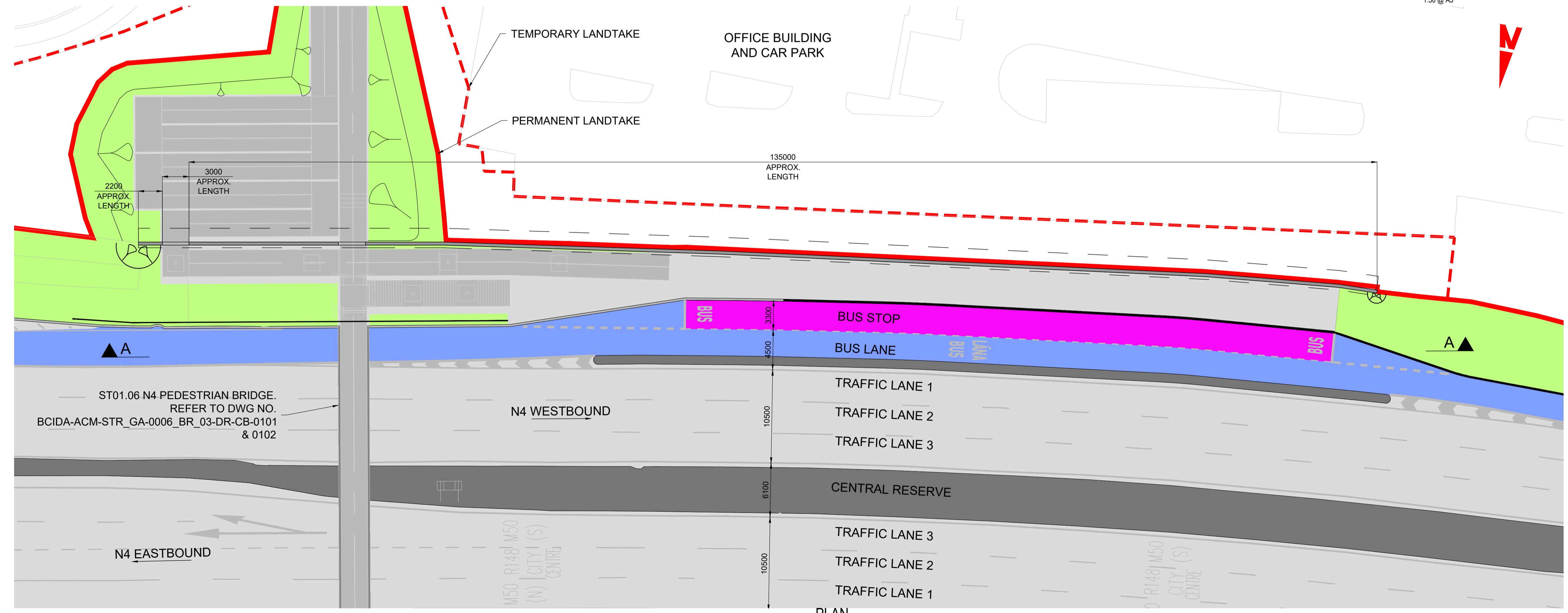
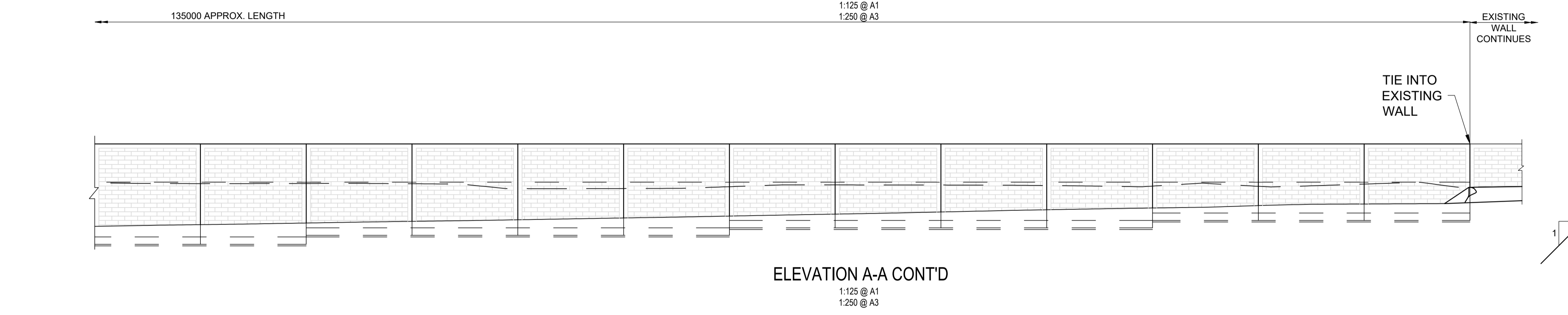
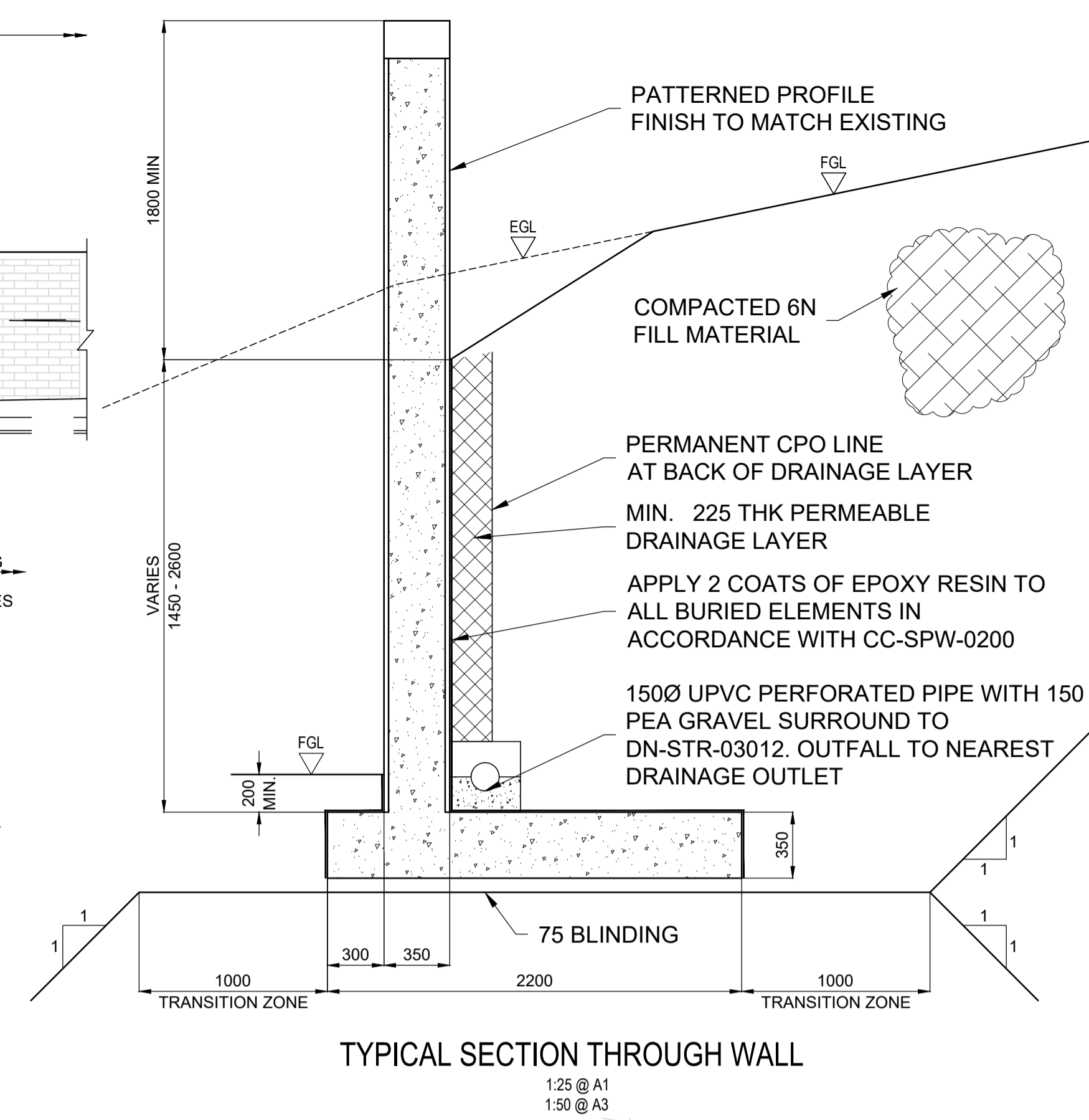
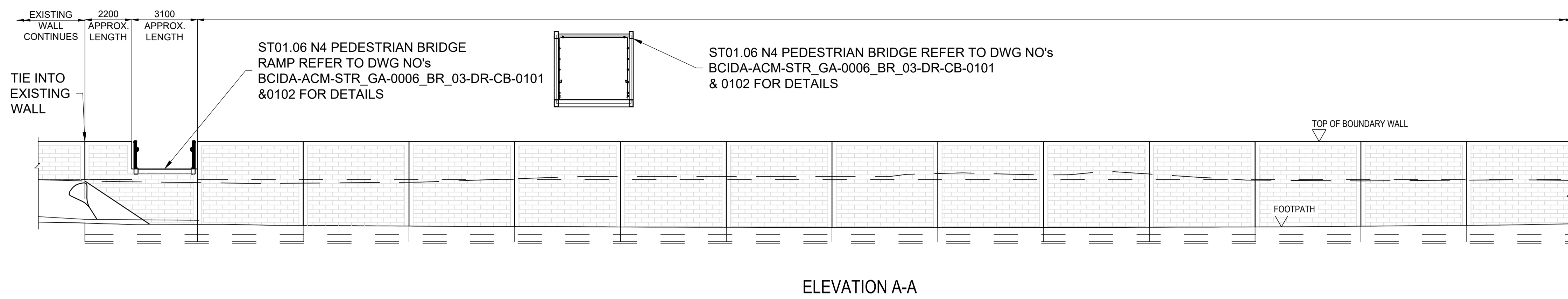
Photo 2 – Proposed retaining wall location looking North

## CBC006-RW05 Hermitage Medical Clinic Retaining Wall



Photo 3 – Proposed retaining wall location looking North East

# Appendix B Drawings



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Rev	Date	Drn	Chk'd	App'd	Description
L03	25/06/21	SH	CA	JS	ISSUED FOR APPROVAL
L02	22/04/21	DH	NR	JS	ISSUED FOR PEER REVIEW
L01	11/12/20	DH	AD	JS	STAGE B1 - PEER REVIEW

Client  
**NTA**  
Údarás Náisiúnta Iompair  
National Transport Authority

Engineering Designer  
**AECOM** **M** **MOTT MACDONALD**

Date: 25/06/21  
Scale: AS SHOWN @ A1 AS SHOWN @ A3

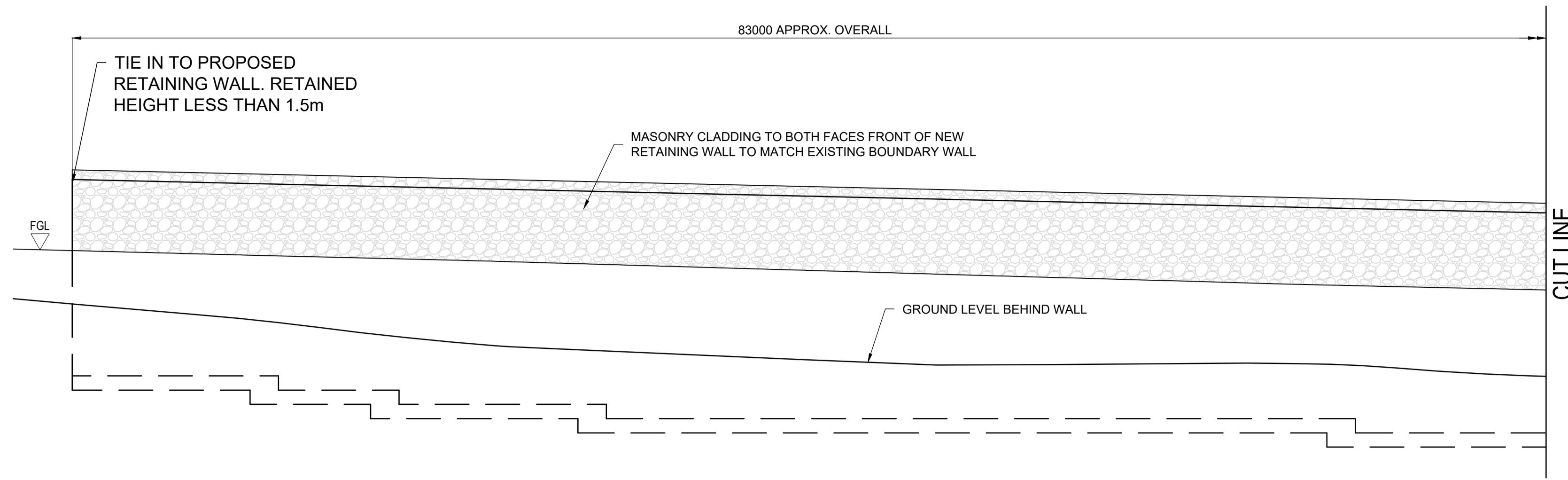
Drawn: S.HENDERSON  
Checked: C.ACTON  
Approved: J.SEYMOUR

Project Code: BCIDA  
Originator Code: ACM

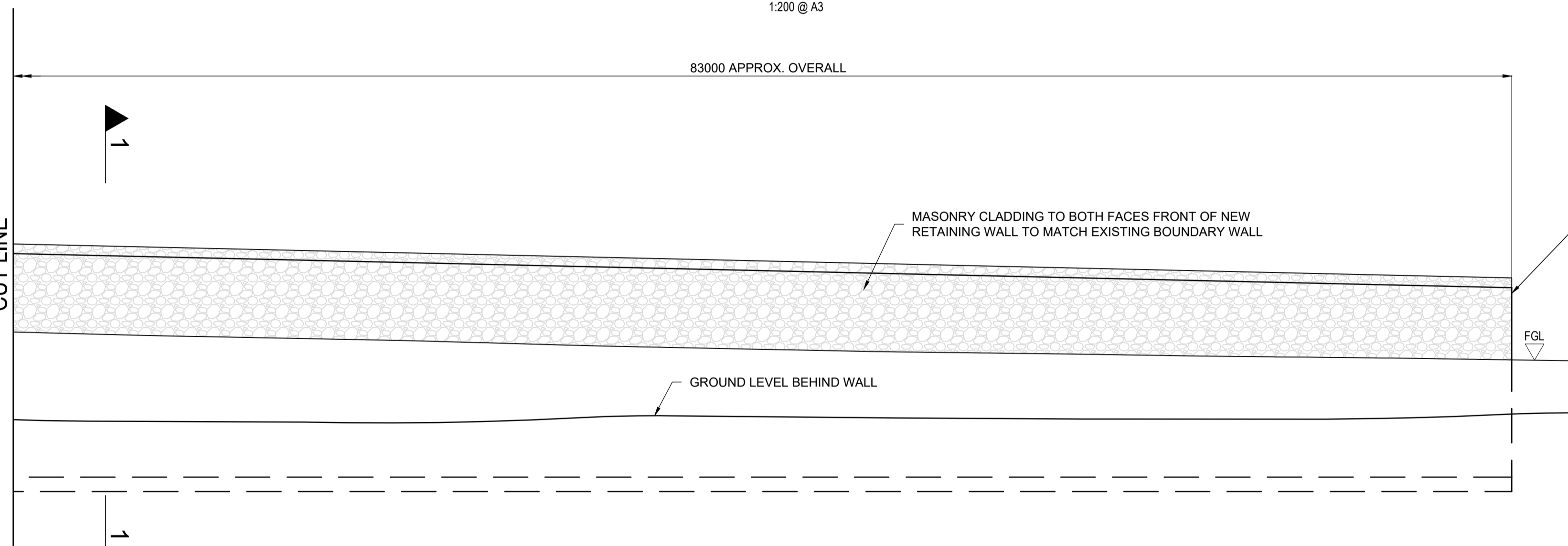
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Programme Title <b>BUSCONNECTS DUBLIN CORE BUS CORRIDORS INFRASTRUCTURE WORKS</b>			
Drawing Title LUCAN TO CITY CENTRE SCHEME RW02.06 N4 RETAINING WALL GENERAL ARRANGEMENT			
Drawing File Name BCIDA-ACM-STR_GA-0006_RW_03-DR-CB-0101	Sheet Number 1 of 1	Status S3	Rev L03

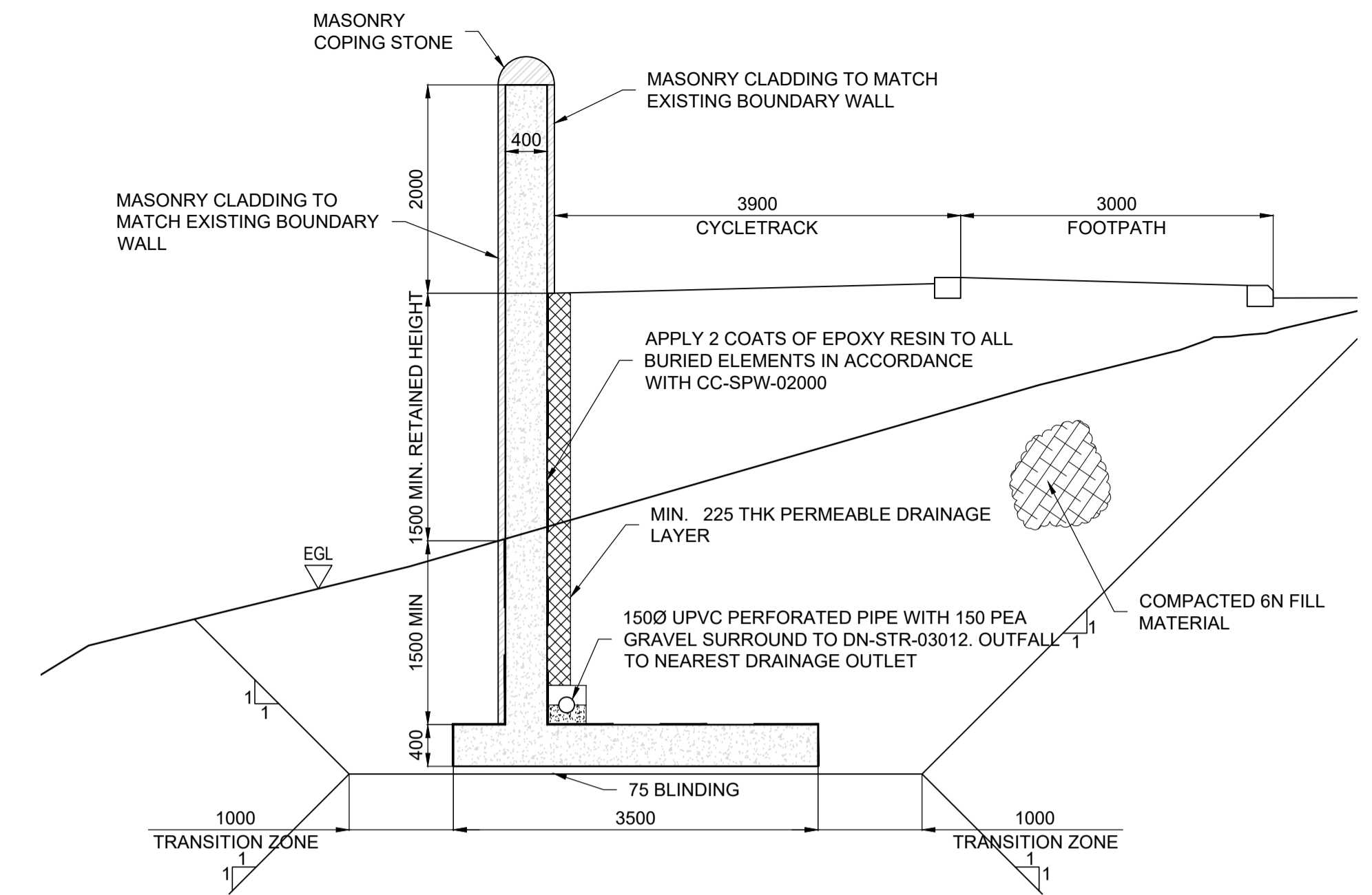
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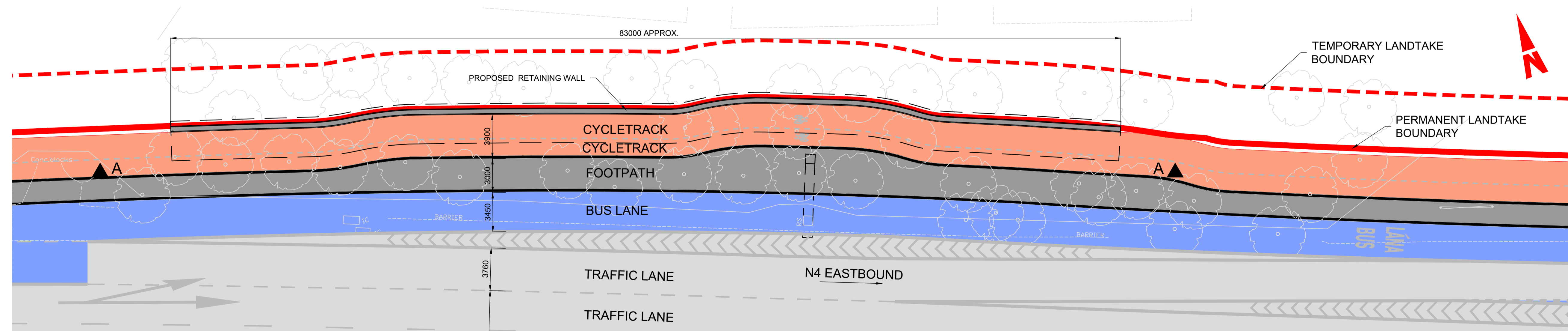
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PART DEVELOPED ELEVATION A-A  
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1:200 @ A3



SECTION 1-1  
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1:100 @ A1



PLAN  
1:200 @ A1  
1:400 @ A3

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L02	25/06/21	SH	CA	JS	ISSUED FOR APPROVAL
L01	22/04/21	DH	NR	JS	ISSUED FOR PEER REVIEW

Client  
**NTA**  
Údarás Náisiúnta Iompair  
National Transport Authority

Engineering Designer  
**AECOM** **M**  
**MOTT** **M**  
**MACDONALD**

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

Drawing Title  
LUCAN TO CITY CENTRE SCHEME  
RW05.06 HERMITAGE MEDICAL CLINIC RETAINING WALL  
GENERAL ARRANGEMENT

Drawing File Name  
BCIDA-ACM-STR\_GA-0006\_RW\_04-DR-CB-0101

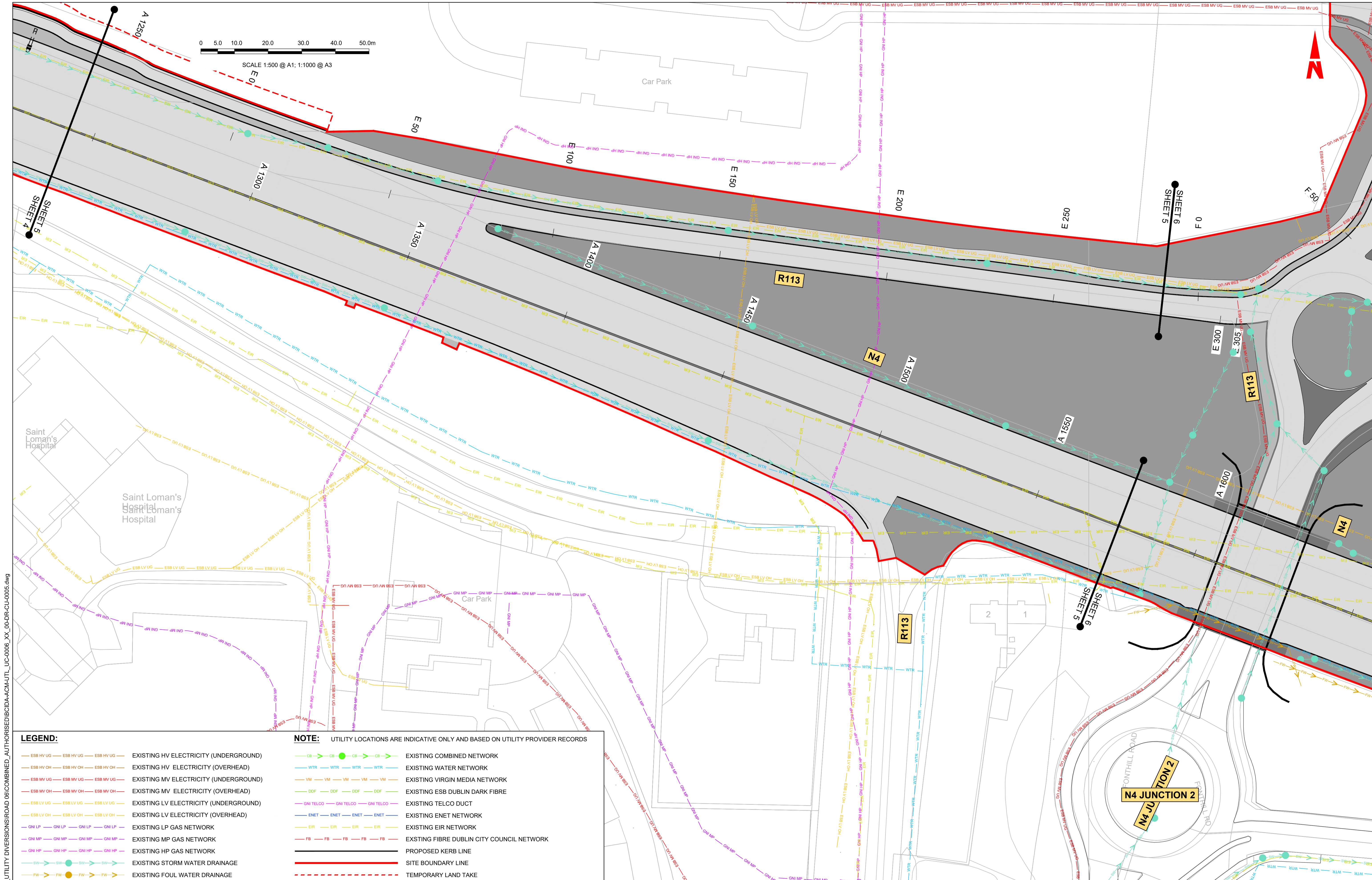
Sheet Number  
1 of 1

Status  
S3

Rev  
L02

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# Appendix C Utility Drawings



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**LEGEND:**

	EXISTING HV ELECTRICITY (UNDERGROUND)
	EXISTING HV ELECTRICITY (OVERHEAD)
	EXISTING MV ELECTRICITY (UNDERGROUND)
	EXISTING MV ELECTRICITY (OVERHEAD)
	EXISTING LV ELECTRICITY (UNDERGROUND)
	EXISTING LV ELECTRICITY (OVERHEAD)
	EXISTING LP GAS NETWORK
	EXISTING MP GAS NETWORK
	EXISTING HP GAS NETWORK
	EXISTING STORM WATER DRAINAGE
	EXISTING FOUL WATER DRAINAGE

**NOTE:** UTILITY LOCATIONS ARE INDICATIVE ONLY AND BASED ON UTILITY PROVIDER RECORDS

	EXISTING COMBINED NETWORK
	EXISTING WATER NETWORK
	EXISTING VIRGIN MEDIA NETWORK
	EXISTING ESB DUBLIN DARK FIBRE
	EXISTING TELCO DUCT
	EXISTING ENET NETWORK
	EXISTING EIR NETWORK
	EXISTING FIBRE DUBLIN CITY COUNCIL NETWORK
	PROPOSED KERB LINE
	SITE BOUNDARY LINE
	TEMPORARY LAND TAKE

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Building Ireland's Future

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L02	22/04/21	PZ	AD	JS	ISSUED FOR PEER REVIEW
L01	23/10/20	PZ	AD	JS	STAGE A - PEER REVIEW

**NTA**  
Údarás Náisiúnta Iompair  
National Transport Authority

**AECOM** **MOTT MACDONALD**

Engineering Designer

Date: 22/04/21  
Scale: 1:500 @ A1, 1:1000 @ A3  
Drawn: P.ZAJAC  
Checked: A.T.DALE  
Approved: J.SEYMOUR

<b>Programme Title</b> BUSCONNECTS DUBLIN CORE BUS CORRIDORS INFRASTRUCTURE WORKS			
<b>Drawing Title</b> CBC06 LUCAN TO CITY CENTRE COMBINED EXISTING UTILITIES RECORDS SHEET 05			
Drawing File Name BCIDA-ACM-UTL_UC-0006_XX_00-DR-CU-0005	Sheet Number 05 of 31	Status S3	Rev L02

W.I.P.

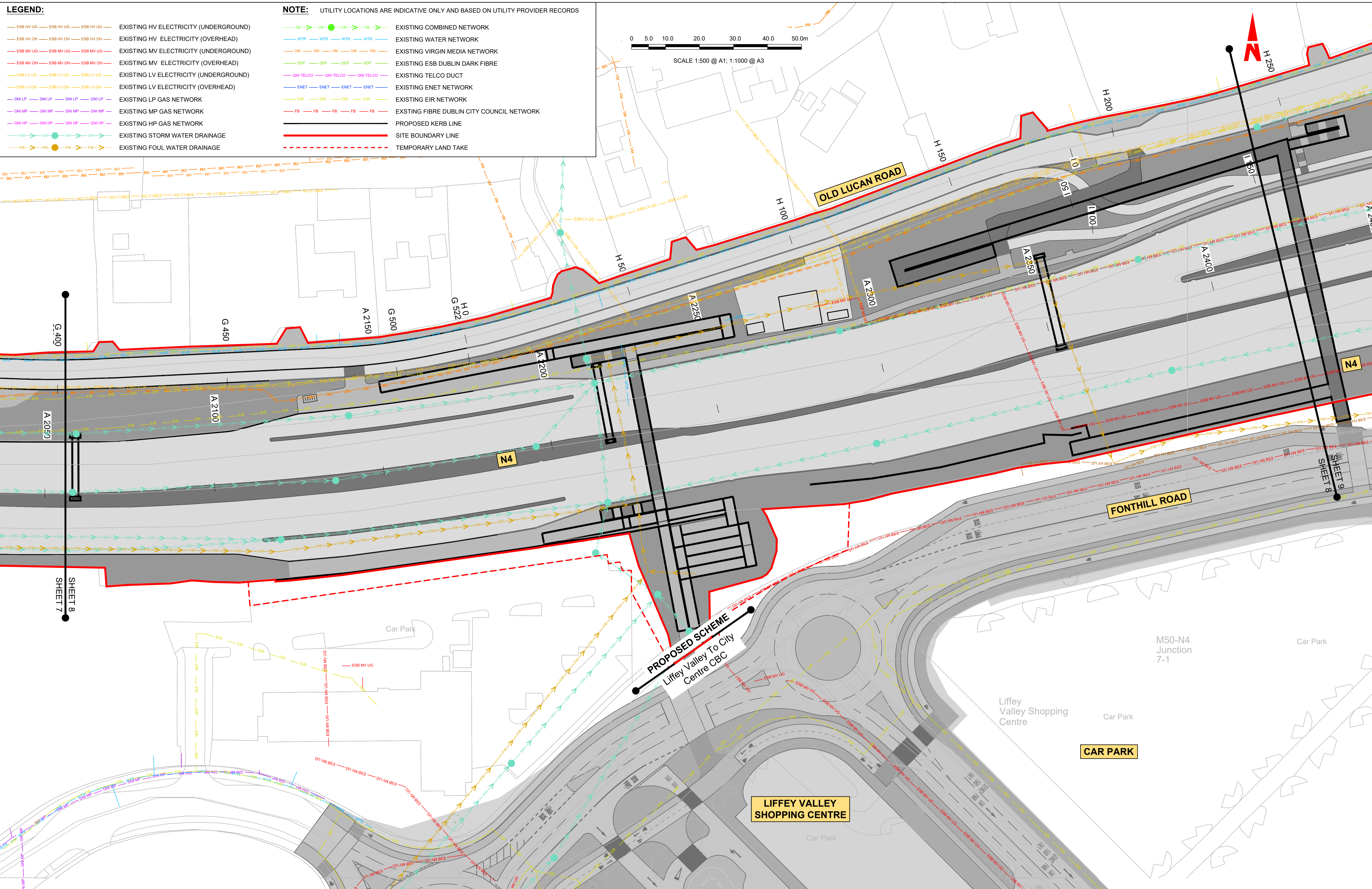
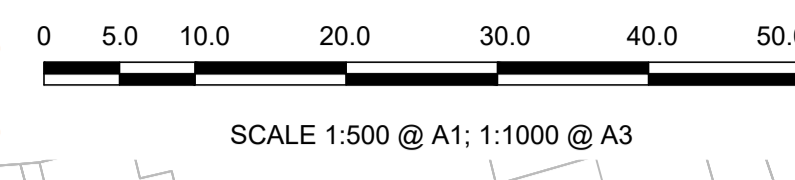
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**LEGEND:**

	EXISTING HV ELECTRICITY (UNDERGROUND)
	EXISTING HV ELECTRICITY (OVERHEAD)
	EXISTING MV ELECTRICITY (UNDERGROUND)
	EXISTING MV ELECTRICITY (OVERHEAD)
	EXISTING LV ELECTRICITY (UNDERGROUND)
	EXISTING LV ELECTRICITY (OVERHEAD)
	EXISTING LP GAS NETWORK
	EXISTING MP GAS NETWORK
	EXISTING HP GAS NETWORK
	EXISTING STORM WATER DRAINAGE
	EXISTING FOUL WATER DRAINAGE

**NOTE:** UTILITY LOCATIONS ARE INDICATIVE ONLY AND BASED ON UTILITY PROVIDER RECORDS

	EXISTING COMBINED NETWORK
	EXISTING WATER NETWORK
	EXISTING VIRGIN MEDIA NETWORK
	EXISTING ESB DUBLIN DARK FIBRE
	EXISTING TELCO DUCT
	EXISTING ENET NETWORK
	EXISTING EIR NETWORK
	EXISTING FIBRE DUBLIN CITY COUNCIL NETWORK
	PROPOSED KERB LINE
	SITE BOUNDARY LINE
	TEMPORARY LAND TAKE



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Rev	Date	Drn	Chk'd	App'd	Description
L02	22/04/21	PZ	AD	JS	ISSUED FOR PEER REVIEW
L01	23/10/20	PZ	AD	JS	STAGE A - PEER REVIEW

Client <b>NTA</b> Údarás Náisiúnta Iompair National Transport Authority		Engineering Designer <b>AECOM</b> <b>MOTT MACDONALD</b>	
Date 22/04/21	Scale 1:500 @ A1 1:1000 @ A3	Drawn P.ZAJAC	Checked A.T.DALE
Project Code BCIDA	Originator Code ACM	QMS Code	

Programme Title <b>BUSCONNECTS DUBLIN CORE BUS CORRIDORS INFRASTRUCTURE WORKS</b>			
Drawing Title CBC06 LUCAN TO CITY CENTRE COMBINED EXISTING UTILITIES RECORDS SHEET 08			
Drawing File Name BCIDA-ACM-UTL_UC-0006_XX_00-DR-CU-0008	Sheet Number 08 of 31	Status S3	Rev L02

W.I.P.

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# Appendix D Designers Risk Assessment

BUSCONNECTS – Lucan to City Centre Route 0006  
 CBC006-RW02 N4 Retaining Wall  
 Designers Risk Assessment



<b>Project Number:</b>	60599126	<b>Revision</b>							
<b>Client:</b>	National Transport Authority	<b>Rev</b>	01	02	03	04	05	06	07
<b>Designer:</b>	AECOM	<b>Date</b>	16/07/21						
<b>Contractor:</b>	Not Applicable	<b>Client</b>	✓						
<b>Prepared by:</b>	Rionach Murphy	<b>Designer</b>	✓						
<b>Checked by:</b>	Arthur Costello	<b>Main Contractor</b>	-						
<b>Approved by:</b>	Niamh Rodgers	<b>Sub-Contractors</b>	-						
		<b>Other</b>	-						

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	Live National Primary Road	Site is immediately adjacent to the N4. The road will be live during majority of construction.	High	Traffic management to be implemented to ensure that safe working strips are provided to work areas.	Live traffic with traffic management zones	Medium	Traffic Management controls to be implemented on site during construction works. Contractor is to ensure that appropriate PPE is worn at all times and that all staff are aware of the risks of working near a live road.
2	Access and egress to the site area	Access and egress to the central supports is via the N4.	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.
3	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.
4	Underground services	Potential for unknown and/or undocumented services in the vicinity of the proposed structure.	Medium	Desk top study of available utility information carried out and all known services in the vicinity of the proposed structure have been shown on detailed design drawings.		Low	Full CAT scan site survey to be carried out prior to construction commencing. Any services identified should be located by hand excavation, marked and protected or re-routed before commencement of works

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6	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
7	Slope/ground stability	Risk of embankment failure during construction	High	Embankments have been designed to ensure stability during temporary construction stages as well as the final construction. The depth of embankments has been limited where possible to reduce the risk of collapse.		Low	Stability of constructed embankments to be checked on a regular basis, surcharging with heavy plant to be avoided on embankments, if movement of heavy plant on embankments is required the embankment should be monitored.
8	Excavation adjacent to a live road	Excavations required to construct the wall run the risk of undermining and vibrating the foundations of the live road adjacent to the Wall	High				The contractor is to be aware of the risk of undermining the existing N4 road foundations. The contractor is to ensure that vibration levels from excavation are limited and that safe working limits are developed prior to works.
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.		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 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

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11	Night-time Working	Reduced visibility and fatigue caused by night time working poses the risk of slips, trips, falls and unsafe working practices being incorporated.	High	Site personnel should receive the required safety induction training. Appropriate signage should be erected to make site personnel aware of the potential hazards across the site.		Low	The contractor must ensure that all site personnel wear the required PPE at all times when on site. It is also the contractor's responsibility to ensure site personnel are not overworked and remain vigilant.
12	Demolition of structures	Demolition of existing retaining wall	High	Detailed demolition plan to be prepared prior to demolition. Lane closures and traffic management to be implemented during demolition.		Medium	Contractor is to develop a detailed method statement and risk assessment for all demolition works. Safe working limits are to be established and any damages that occur to the existing N4 road must be repaired.

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 CBC006-RW05 Hermitage Medical Clinic Retaining Wall  
 Designers Risk Assessment



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8	Excavation and adjacent to a live road	Excavations required to construct the wall run the risk of undermining and vibrating the foundations of the live road adjacent to the Wall	High				The contractor is to be aware of the risk of undermining the existing N4 road foundations. The contractor is to ensure that vibration levels from excavation are limited and that safe working limits are developed prior to works.
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12	Demolition of structures	Demolition of existing boundary wall	High	Detailed demolition plan to be prepared prior to demolition. Lane closures and traffic management to be implemented during demolition.		Medium	Contractor is to develop a detailed method statement and risk assessment for all demolition works. Safe working limits are to be established and any damages that occur to the existing N4 road must be repaired.

