Appendix A.7.2

BD02 Standard Underbridges

A.7.2

Galway County Council **N6 Galway City Transport Project** Standard Underbridges

GCOB-4.04-020-003

Issue 4 | 23 October 2017

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 233985

Ove Arup & Partners Ireland Ltd

Arup Corporate House City East Business Park Ballybrit Galway H91 K5YD Ireland www.arup.com

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1 Introduction

1.1 Design Brief given to the authors, including dates

This report has been produced by Arup, who have been appointed by Galway County Council to provide multi-disciplinary engineering consultancy for the N6 Galway City Transport Project. Galway County Council, Galway City Council, Transport Infrastructure Ireland (formerly known as the National Roads Authority) and the National Transport Authority are collaborating in developing a solution to the existing transportation issues in Galway City and its environs. The solution will include a smart mobility component, public transport component and a road component. The road component of the solution is known as N6 Galway City Ring Road (GCRR).

1.2 Background information covering the origins for the need for the structure

The standard underbridges are required as part of the proposed N6 Galway City Ring Road to preserve national regional and local routes impacted by route of the mainline.

1.3 Previous studies and their recommendations

Previous studies and documents relevant to this Outline Structures Report are listed below.

- Galway County Council. Project Brief. Phase 1, Scheme Concept and Feasibility Studies (REF/14/11222, 2 May 2015).
- Galway County Council. Project Brief. Phase 2, Route Selection (REF/14/11222, 6 November 2015).
- GCOB-4.04-009 Route Selection Report, Issue 1, 16/03/2016
- Galway Transport Strategy, An Integrated Transport Management Programme for Galway City and environs, Technical Report, September 2016

2 Site and function

2.1 Site location

The proposed standard underbridges are located at chainages stated in Table 1 below, along the N6 mainline.

Name of Structure	Chainage
S06/01 - Rahoon Road Underbridge	06+335
S07/01 - Letteragh Road Underbridge	07+290
S07/02 - N59 Link Road Underbridge	07+570
S08/02 - N59 Moycullen Road Underbridge	08+540
S09/01 - Menlo Castle Boithrin Underbridge	09+730
S10/02 - Seanbothar Underbridge	10+520
S12/01 - N84 Headford Road Underbridge	12+150
S13/02 - N17 Tuam Road Underbridge	13+975
S15/01 - Briarhill Business Park Underbridge	15+725
S15/02 – R339 Monivea Road Underbridge	15+880

2.2 Function of the structure and obstacles crossed

The standard underbridges are required to carry the mainline over local, regional and national roads due to the proposed N6 mainline.

2.3 Choice of location

The constraints of alignment design require that some local, regional and national routes will be separated. In such instances, structures are located so as to retain local, regional and national roads and to provide a safe, secure and appropriate level of access to severed lands.

2.4 Site description and topography

Name of	Site description and Topography		Archaeology at Structure	Ecology at Structure	
Structure	N6 Mainline	Road under	Structure		
S06/01 - Rahoon Road Underbridge	Mainline on embankment.	Local road at grade or shallow cut,	Site of cultural heritage listed in Chapter 13 of the EIS as CH29 - Site of vernacular structures marked on 1841 first edition map. No longer extant See EIS Appendix 13.X BH1 – Thatched cottage located in Mincloon	10m Otter Habitat within 65m of the structure Underbridge to provide bat passage, MU13	
S07/01 - Letteragh Road Underbridge	Mainline on embankment.	Local road at grade or shallow cut,	Area of Archaeological Potential listed in Chapter 13 of the EIS as AAP6 – Small Stream Site of cultural heritage listed in Chapter 13 of the EIS as CH34 - Site of vernacular structures marked on 1841 first edition map. No longer extant	10m Otter Habitat at the structure location Underbridge to provide bat passage, MU19	
S07/02 - N59 Link Road Underbridge	Mainline on embankment.	Link road in cutting.	Area of Archaeological Potential listed in Chapter 13 of the EIS as AAP7 – Small Stream Site of cultural heritage listed in Chapter 13 as CH37- Well-constructed cairns from stone clearance A townland boundary listed in Chapter 13 of the EIS as TB17 – Stone wall	An Ecological Constraint of Local (High) Importance listed in Chapter 8 of the EIS as EC25 is impacted by the structure S07/02. The habitat is a dry-humid acid grassland and a wet grassland under Fossit Code GS3/ GS4	
S08/02 - N59 Moycullen Road Underbridge	Mainline on embankment.	N59 at grade.	A townland boundary listed in Chapter 13 of the EIS as TB20 - Boundary between Dangan Upper and Dangan Lower along the current N59	10m Otter Habitat within 65m of the structure	

Table 2 Site description and topography.

Name of Structure	Site description and Topography		Archaeology at	Ecology at Structure	
Structure	N6 Mainline	Road under	Structure		
S09/01 - Menlo Castle Boithrin Underbridge	Mainline on embankment.	Local road at grade or shallow cut.	Site of cultural heritage listed in Chapter 13 as CH46- Possible circular enclosure identified during AP analysis and marked as a possible feature of the 1895-1900 mapping. A designated landscape listed in Chapter 13 as DL8 - Menlo Castle Demesne	An Ecological Constraint of Local (High) Importance listed in Chapter 8 of the EIS is impacted by the structure S09/01. The habitat contains scrub, hedgereows, dense braken, dry calcareous and natural grassland, exposed calcareous grass and building/ artificial surfaces under Fossit Codes WL1, WS1, HD1, GS1, ER2 and BL3	
				bat and badger passage, MU33	
S10/02 - Seanbothar Underbridge	Mainline on embankment.	Local road at grade or shallow cut	Site of cultural heritage listed in Chapter 13 as CH51 - Possible boulder of archaeological potential	An Ecological Constraint of Local (Low) Importance listed in Chapter 8 of the EIS as EC36 is impacted by the structure S10/02. The habitat is improved agricultural grassland and dry calcareous & natural grassland under Fossit Codes GA1 and GS1. Annex Habitat *8240 Limestone pavement is located within 20m of the structure but will not be directly impacted by the construction or operation of this structure. Underbridge to provide bat passage, MU37	
S12/01 - N84 Headford Road Underbridge	Mainline on embankment.	N84 road at grade or shallow cut	A townland boundary listed in Chapter 13 of the EIS as TB25 - Stone wall and hedgerow Ballindooley/ Castlegar	An Ecological Constraint of Local (High) Importance listed in Chapter 8 of the EIS as EC37 is within 5m of the structure S12/01. The habitat contains scrub and dry calcareous and natural grassland under Fossit Codes WS1 and GS1.	

Name of	Site description and Topography		Archaeology at Structure	Ecology at Structure	
Structure	N6 Mainline Road under		Structure		
S13/02 - N17 Tuam road Underbridge	Mainline on embankment.	N17 road at grade or	A townland boundary listed in Chapter 13 of the EIS as TB26 – Tuam Road A townland boundary listed in Chapter 13 of the EIS as TB27 - An Caisleán Gearr/ Cappanabornia Site of cultural heritage listed in Chapter 13 as CH55 - Site of vernacular structures marked on 1895-1900 map. No longer extant	- None	
S15/01 - Briarhill Business Park Underbridge	Mainline on embankment.	Local road at grade or shallow cut	- None	- None	
S15/02 R339 Underbridge	Mainline on embankment.	R339 road at grade.	Site of cultural heritage listed in Chapter 13 as CH58 - Site of vernacular structures, including a school, marked on the 1841 and 1895-1900 mapping. No longer extant. A townland boundary listed in Chapter 13 of the EIS as TB32 - Doughiska/Coolagh/ Breanloughaun	- None	

2.5 Vertical and horizontal alignments

	N6 M	ainline	Underbridges		
Name of Structure	VerticalHorizontalAlignmentAlignment		Vertical Alignment	Horizontal Alignment	
S06/01 - Rahoon Road Underbridge	Crest Curve K=120	R=1996	Sag Curve K=9	Straight	
S07/01 - Letteragh Road Underbridge	Crest Curve K=120	R=2100	1% Gradient	Straight	
S07/02 - N59 Link Road Underbridge	Crest Curve R=120	Straight	2% Gradient	Straight	
S08/02 - N59 Moycullen Road Underbridge	4% Gradient	Horizontal Transition Straight to R=1440	Sag Curve K=70 connecting to K=20	R=700	
S09/01 - Menlo Castle Boithrin Underbridge	Sag Curve K=120	R=2000	Sag Curve K=10	R=720 Straight	
S10/02 - Seanbothar Underbridge	Crest Curve K=100	R=1440	Sag Curve K=5	Straight R=1020	
S12/01 - N84 Headford Road Underbridge	0.75% Gradient	Horizontal Transition R720 to R2040	Crest Curve K=30	R=720	
S13/02 - N17 Tuam road Underbridge	Sag Curve K=55	R=2040	Sag Curve K=65	R=1440	
S15/01 - Briarhill Business Park Underbridge	Crest Curve K=117.6	R=2040	Sag Curve K=6.5	Straight	
S15/02 R339 Underbridge	Crest Curve K=117.6	R=2040 Transition	0.7% Gradient	Straight	

Table 3	Vertical and horizonta	l alignments.
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2.6 Cross sectional dimensions on the alignments

The proposed cross section of the road under the underbridge structures is given in Table 4 below.

Name of Structure	Carriageway Width (m)	Raised Verge Width (m) - Left [1]	Raised Verge Width](m) - Right [1]	
S06/01 - Rahoon Road Underbridge	6.0	1.8	1.8	
S07/01 - Letteragh Road Underbridge	6.0	2.8	2.8	
S07/02 - N59 Link Road Underbridge	17.0	2.5min	2.5min	
S08/02 - N59 Moycullen Road Underbridge	9.0min	1.8min	1.8min	
S09/01 - Menlo Castle Boithrin Underbridge	6.0	1.8	1.8	
S10/02 - Seanbothar Underbridge	6.0	1.8	1.8	
S12/01 - N84 Headford Road Underbridge	14.0	2.0min	2.0min	
S13/02 - N17 Tuam road Underbridge	Tuam road 17.25min		1.5min	
S15/01 - Briarhill Business Park Underbridge	6.0	2.0	2.0	
S15/02 R339 Underbridge	16.0min	2.0	2.0	

Table 4 Dimensions below bridge deck.

[1] When considered in the direction of increasing chainage.

The proposed cross section on the bridge deck of the underbridge structures is given in Table 5 below.

Name of Structure	Carriageway Width [5] (m)	Verge [2] Width (m) - Left [3]	Verge [2] Width (m) - Right [3]	Parapet width (m) [Left]	Parapet width (m) [Right]
S06/01 - Rahoon Road Underbridge [1]	21.6	3.0	3.0	n/a	n/a
S07/01 - Letteragh Road Underbridge [1]	Varies 45.5min [6]	3.0	3.0	n/a	n/a
S07/02 - N59 Link Road North Underbridge	21.6	0.6	0.6	0.5	0.5
S08/02 – N59 Moycullen Road Underbridge	Varies 22.7min	Varies 0.6min	Varies 0.6min	1.2[4]	1.2[4]
S09/01 – Menlo Castle Boithrin Underbridge [1]	21.6	3.0	3.0	n/a	n/a
S10/02 – Seanbothar Underbridge [1]	Varies 22.9min	Varies 3.0min	Varies 3.0min	n/a	n/a
S12/01 - N84 Headford Road Underbridge	Varies 26.5min	Varies 0.6min	Varies 4.0min	0.5	0.5
S13/02 - N17 Tuam road Underbridge	Varies 22.5min	Varies 0.6min	Varies 0.6min	0.5	0.5
S15/01 - Briarhill Business Park Underbridge	Varies 22.3 min	Varies 0.6min	Varies 0.6min	0.5	0.5
S15/02 R339 Underbridge	Varies 28.0min	Varies 0.6min	Varies 0.6min	0.5	0.5

Table 5 Dimensions on bridge deck (all dimensions measured perpendicular to the mainline).

[1] Buried structure. The mainline cross section including the full verge is carried across the structure.

[2] At non-buried structures a raised verge is provided. The width of the verge includes any additional requirements due to sightline visibility.

[3] When considered in the direction of increasing chainage.

[4] Extra width of 700mm provided at parapet to accommodate proposed noise barrier.

[5] Carriageway width measures from outer edge of hardshoulders (includes central reserve)

[6] Dimension includes slip roads at this location.

2.7 Existing underground and overground services

All the utility providers have been consulted during the preliminary design process. The existing services in the vicinity of the proposed structures are outlines in Table 6 below.

Name of Structure	Existing Services
	250mm Watermain
S06/01 - Rahoon Road Underbridge	ESB 38kV Underground
	Underground Eir
	250mm Watermain
	300mm Watermain
S07/01 Letters - Deed Us deskeider	Underground Eir
S07/01 - Letteragh Road Underbridge	Virgin Media ducts
	ESB LV Underground
	UPC
S07/02 - N59 Link Road North Underbridge	None
	Eir
S08/02 - N59 Moycullen Road Underbridge	ESB MV Overhead
	SSE
S09/01 - Menlo Castle Boithrin Underbridge	None
S10/02 - Seanbothar Underbridge	None
	Trunk Sewer
S12/01 N94 Hardfand Daad Hudarhadaa	Eir
S12/01 - N84 Headford Road Underbridge	100mm Watermain
	50mm Watermain
	Eir
	E-Net
S13/02 - N17 Tuam road Underbridge	750mm Trunk Sewer
	10" Watermain
	500mm Watermain
S15/01 - Briarhill Business Park	Eir
Underbridge	E-Net
	ESB MV/LV Underground
S15/02 R339 Underbridge	Eir
	E-Net
	ESB MV/LV Underground
	200mm Watermain

Table 6Existing Services

2.8 Geotechnical summary

Name of Structure	Depth from e.g.l.[1] to groundwater level (m)		Average depth from e.g.l. to rockhead level (m)	Ground Conditions	Preliminary Karst Risk	
	Maximum	Minimum	Average			
S06/01 - Rahoon Road Underbridge	est. 1.0	est. 2.0	est. 1.5	1.1	Gravelly clay Weathered Rock V/strong s/w GRANITE	n/a
S07/01 - Letteragh Road Underbridge	est. 3.0	est. 4.0	est. 3.5	2.5	Peat Gravelly clay Weathered Rock V/strong s/w GRANITE	n/a
S07/02 - N59 Link Road North Underbridge	est. 0.0	est. 0.0	est. 0.0	5.7	Soft sandy gravelly CLAY Firm very sandy gravelly CLAY Gravelly CLAY Weathered Rock V/strong s/w GRANITE	n/a
S08/02 - N59 Moycullen Road Underbridge	est. 3.0	est 5.0	est. 4.0	4.1	Firm sandy gravelly CLAY M/dense clayey gravelly SAND Weathered Rock V/strong s/w GRANITE	n/a
S09/01 - Menlo Castle Boithrin Underbridge	10.61	13.89	12.25	1.9	Soft sandy gravelly CLAY Weathered Rock M/strong non intact LIMESTONE V/strong s/w LIMESTONE	Medium
S10/02 - Seanbothar Underbridge	3.50	5.93	4.715	2.7	Soft to firm sandy gravelly CLAY Firm to stiff sandy gravelly CLAY M/strong s/w LIMESTONE	Medium
S12/01 - N84 Headford Road Underbridge	0.00	2.34	1.17	3.8	Made Ground Gravelly CLAY Weathered Rock V/strong s/w fractured LIMESTONE	High
S13/02 - N17 Tuam road Underbridge	est. 20.0	est. 16.00	est. 18.00	-	Soft sandy gravelly CLAY Firm to Stiff sandy gravelly CLAY Stiff to v/stiff sandy gravelly CLAY Dense clayey SAND Weathered Rock Non intact LIMESTONE	Low
S15/01 - Briarhill Business Park Underbridge	est. 3.0	est. 2.0	est.2.5	8.2	Made Ground Gravelly CLAY / Infilled LIMESTONE Karstified LIMESTONE Fresh LIMESTONE	High

Name of Structure	Depth from e.g (m)	Depth from e.g.l.[1] to groundwater level (m)		Average depth from e.g.l. to rockhead level (m)	Ground Conditions	Preliminary Karst Risk
	Maximum	Minimum	Average			
S15/02 Monivea Road R339 Underbridge	est. 3.5	est 2.5	est.2.0	6	Made Ground Firm slightly granular SILT/CLAY Weathered Rock Fresh Strong LIMESTONE	High

[1] e.g.l = existing ground level

2.9 Hydrology and hydraulic summary

The groundwater levels are listed in the previous section of this document, see Table 7.

There is an existing stream in the vicinity of S07/01 at the Letteragh Road. The stream currently is in a culvert at the crossing point. This stream will be realigned to the west of the proposed structure and approvals will be sought from OPW to both realign the stream and culvert it at the new crossing location.

There is an existing stream located to the west of structure S08/02 at the Moycullen Road. The stream has already been culverted through Ard na Locha and crosses beneath the N59 and discharges to a stream located in the Aughnacurra residential development. This stream will be maintained along its existing alignment adjacent to the structure.

2.10 Archaeology summary

The archaeology summary is provided in Table 2 above.

2.11 Environmental summary

The environmental (ecology) summary is provided in Table 2 above.

2.12 Sustainability

Typically concrete is selected as the primary structural material for the underbridges. Concrete has a high durability performance and requires little maintenance during the design life (120yrs), where the product is appropriately specified and executed. Portland cement replacements such as ground granulated blast-furnace slag (GGBS) will be used where appropriate.

All of the underbridges are of integral construction. This form of construction minimises the inspection and maintenance requirements compared to non-integral forms of construction.

All structures can be readily demolished at the end of the service life of the bridge, and much of the structural materials (concrete, steel etc.) can be recycled and reused.

3 Structure and aesthetics

3.1 Structural Options Considered

The structural options considered depend on the configuration at each bridge location. Typically, single span integral bridges of concrete construction are the preferred option. Where this arrangement is not feasible, then non-integral and/or steel composite materials are adopted.

A summary of the recommended structure options are provided below.

3.2 General description of recommended structures

There are ten underbridges identified in the preliminary design, which will carry the proposed N6 over local, regional and national roads. All underbridges are single span. Three main types of underbridges are proposed:

Underbridge Type 1: Buried reinforced concrete box structure

At locations where the span is less than 14.5m and the road being crossed is a local road, then a buried box structure is adopted. The box is made from pre-cast concrete units which are placed together to form a buried box construction. The typical elevation of this form of underbridge type is given in Figure 1 and Drawing GCOB-1700-D-GEN-001.

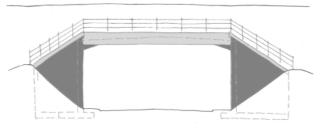


Figure 1 Underbridge Type 1

Underbridge Type 2: Bridge deck with reinforced earth wall abutment

For spans greater than 14.5m, and where vertical abutment walls are considered appropriate, then a bridge deck with reinforced earth wall abutments is adopted, referred to as Type 2. Depending on the span and skew of the bridge deck, various sub-types are specified, as given below:

• **Type 2A**: The deck consists of pre-cast concrete beams which is made integral with abutment bankseats which are supported directly on reinforced earth walls, which form the abutment construction. The skew of the bridge deck is less than 30 degrees and the clear span between abutment bankseats is less than 18m. The typical elevation of this form of underbridge type is given in Figure 2 and Drawing GCOB-1700-D-GEN-002.

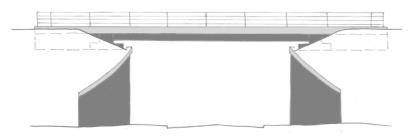


Figure 2 Underbridge Type 2A

• **Type 2B**: The deck consists of pre-cast concrete beams which is made integral with skeletal abutments constructed within the reinforced earth wall system. The skew of the bridge deck is less than 30 degrees and the clear span between abutment bankseats is greater than 18m. The typical elevation of this form of underbridge type is given in Figure 3 and Drawing GCOB-1700-D-GEN-003.

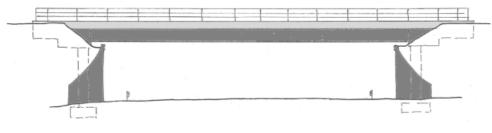


Figure 3 Underbridge Type 2B

Underbridge Type 3: Concrete deck with side slopes (1:1.5)

In the situation where a more open arrangement is preferred and the width of the road being crossed is not significant (less than 12m typically), then a single span bridge with side slopes is adopted. To reduce the overall span of the bridge, side slopes with an inclination of 1.5 horizontal to 1.0 vertical is adopted.

The deck consists of precast beams and an in-situ deck slab, made integral with bankseat abutments. The typical elevation of this form of underbridge type is given in Figure 4 and Drawing GCOB-1700-D-GEN-004.

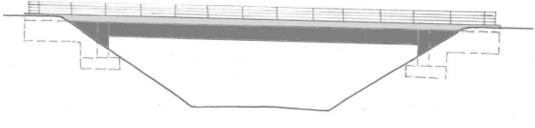


Figure 4 Underbridge Type 3

3.3 Aesthetic considerations

A consistent approach is used where possible for the structural form and finishes for underbridges along the length of the scheme to provide "a family of structures".

3.4 Proposals for the recommended structure of family of structures

3.4.1 Proposed Category

All underbridges have a category classification of 2.

3.4.2 Approaches including run-on arrangements

The approach embankments will be constructed using a compacted acceptable material with Clause 6N material behind end walls.

3.4.3 Type 1

Span arrangements

Table 8Span arrangements for Type 1.

Name of Structure	Span arrangement	Clear span (m)	Length of structure (m)
S06/01 - Rahoon Road Underbridge	1 Span	12.5	52.0
S07/01 - Letteragh Road Underbridge	1 Span	12.5	71.0
S09/01 - Menlo Castle Boithrin Underbridge	1 Span	10	37.0
S10/02 - Seanbothar Underbridge	1 Span	9.8	49.0

Approaches including run-on arrangements

The approach embankments will be constructed using a compacted acceptable material with Clause 6N material behind end walls.

Substructure

Portal frame with precast reinforced concrete elements.

Foundation type

Refer to Table 13 for the proposed foundation information.

Superstructure

Portal frame with precast reinforced concrete elements.

Articulation arrangements, joints and bearings

Portal frame with precast concrete elements, joints on each side of the wall.

Parapet

At all buried structures, a safety barrier with containment level of at least N2 will be provided on both verges of the mainline over the structure. Pedestrian protection will be provided at headwalls and wingwalls in accordance with TII DN-STR-03011 (NRA BD 52).

Inspection and maintenance

The structures are fully integral and therefore have no movement joints or bearings and hence minimal maintenance requirements are expected. Access to the bridge soffit will be from the local road below and will require local diversions and a mobile elevated work platform for access purposes. Waterproofing systems, joints, parapets etc shall be designed for Working Life Category 2 (replaceable structural parts, up to 50 years design working life).

All other elements of the structure shall be designed for Working Life Category 5 (\geq 120 years design working life).

3.4.4 Type 2

Span arrangements

Table 9 Span arrangements for Type 2 underbridges.

Name of Structure	Span arrangement	Span (m)	Structure skew (deg)	Deck Width
S07/02 - Letteragh Road underbridge	1 Span (Type2B)	27.0	6	23.8
S12/01 - N84 Headford Road Underbridge	1 Span (Type2B)	23.4	4	32.9
S13/02 - N17 Tuam road Underbridge	1 Span (Type2B)	32.6	30	45.4
S15/01 - Briarhill Business Park Underbridge	1 Span (Type2A)	15.5	8	25.1
S15/02 - Monivea Road R339 Underbridge	1 Span (Type2B)	26.6	6	31.6

Substructure

For Type 2A structures the abutments will be high level bankseats founded on a reinforced earthwall system. For Type 2B structures the abutments will be skeleton abutments located within the reinforced earth wall system. The columns supporting the bridge will be independent from the reinforced earth by means of a void provided by a sleeving system.

Foundation type

Refer to Table 13 for the proposed foundation information.

Superstructure

For all structures, the superstructure will consists of pre-cast prestressed concrete beams with an in-situ concrete deck slab.

Articulation arrangements, joints and bearings

For Type 2A bridges the superstructure will be fully integral with bankseat abutments.

For Type 2B structures the superstructure will be fully integral with skeleton abutments.

Parapet

Parapet type will be typically 1250mm high H2-W4, with mesh infill. Where a noise barrier is provided, e.g. S08/02, a W2 working width is envisaged. The approach and departure safety barrier and transitions will be H2 containment.

Inspection and maintenance

Type 2A and 2B structures are fully integral and therefore have no movement joints or bearings and hence minimal maintenance requirements are expected. Access to the bridge soffit will be from the local road below and will require local diversions and a mobile elevated work platform for access purposes.

Waterproofing systems, joints, parapets etc shall be designed for Working Life Category 2 (replaceable structural parts, up to 50 years design working life).

All other elements of the structure shall be designed for Working Life Category 5 (\geq 120 years design working life).

3.4.5 Type 3

Span arrangements

Table 10 Span arrangements for Type 3.

.Name of Structure	Span arrangement (m)	Span (m)	Structure skew (deg)	Deck Width (m)
S08/02 - N59 Moycullen Road Underbridge	1 Span	32.5	30	27.5

Approaches including run-on arrangements

The approach embankments will be constructed using a compacted acceptable material with Clause 6N material behind end walls.

Substructure

The abutments will be in-situ reinforced concrete walls of intermediate height.

Foundation type

Refer to Table 13 for the proposed foundation information.

Superstructure

The superstructure comprises precast prestressed concrete beams with an in-situ reinforced concrete deck slab.

Articulation arrangements, joints and bearings

The superstructure will be fully integral with the bankseat abutments. No bearings or expansion joints are proposed.

Parapet

Parapet type will be 1250mm high H2-W4, with mesh infill. The approach and departure safety barrier and transitions will be H2 containment.

Parapet type will be 1000mm high H2-W4 in accordance with TII DN-STR-03011 (NRA BD 52).

Inspection and maintenance

The structures are fully integral and therefore have no movement joints or bearings and hence minimal maintenance requirements are expected. Access to the bridge soffit will be from the local road below and will require local diversions and a mobile elevated work platform for access purposes.

Waterproofing systems, joints, parapets etc shall be designed for Working Life Category 2 (replaceable structural parts, up to 50 years design working life).

All other elements of the structure shall be designed for Working Life Category 5 (\geq 120 years design working life).

4 Safety

4.1 Traffic management during construction including land for temporary diversions

Detailed traffic management proposals will be developed at detail design stage by the appointed Contractor in consultation with their Designers and the consent for the diversions and or road closures will be sought from the appropriate local authority.

4.2 Safety during construction

The Designer will take account of the General Principles of Prevention, as specified in the Schedule 3 of the Safety, Health and Welfare at Work Act 2005, liaise with the Project Supervisor appointed by the Client for the Design Process and the Project Supervisor appointed for the Construction Stage and carry out all other duties as required by Clause 15 of the Safety, Health and Welfare at Work (Construction) Regulations 2013 (S.I. No. 291 of 2013).

The Project Supervisor for the Design Process will comply with all the requirements outlined in Clauses 11, 12, 13 & 14 of the Safety, Health and Welfare at Work (Construction) Regulations 2013 (S.I. No. 291 of 2013).

4.3 Safety in use

Parapets and safety barriers will be provided across the length of the structure and on the approach to, and departure from, the structure.

Where applicable, pedestrian protection will be provided at the top of headwalls and wingwalls in accordance with TII DN-STR-03011 (NRA BD 52).

4.4 Lighting

Lighting is proposed at the underbridge structures in the vicinity of grade separated junctions.

5 Cost

5.1 Budget Estimate in current year, including whole life cost

Name of structure	Structure Cost Excl. VAT (Million euro)
S06/01 - Rahoon Road Underbridge	0.8
S07/01 - Letteragh Road Underbridge	1.1
S07/02 - N59 Link Road North Underbridge	1.0
S08/02 - N59 Moycullen Road Underbridge	1.2
S09/01 - Menlo Castle Boithrin Underbridge	0.4
S10/02 - Seanbothar Underbridge	0.6
S12/01 - N84 Headford Road Underbridge	1.1
S13/02 - N17 Tuam road Underbridge (Mainline & EB Diverge)	1.9
S15/01 - Briarhill Business Park Underbridge	0.6
S15/02 – Monivea Road R339 Underbridge	1.2

The cost estimate values given in Table 11are based on a cost rate per square metre of structure area given in Table 12 below. A range of -10% to +15% is considered to be applicable to the budget cost for this stage of the design.

Table 12Basis of cost estimate

Structure Type	Rate (Euro/m2)
Buried reinforced concrete portal frame	1000
Prestressed beam deck underbridge	1300

6 Design Assessment Criteria

6.1 Normal Loading

Permanent Actions in accordance with IS EN 1991-1-1:2002 and the associated National Annex.

The structure will be designed for Load Models LM1 and LM2 in accordance with IS EN 1991-2:2003 and the associated National Annex.

6.2 Abnormal Loading

Load Model 3 up to and including SV196 (where applicable) will be considered in accordance with IS EN 1991-2:2003 and the associated National Annex.

6.3 Footway live loading

Where applicable, a footway loading shall be in accordance with Clause 5.3.2.1 of IS EN 1991-2:2003. A nominal $q_{fk} = 5kN/m2$ will be adopted.

6.4 **Provision for exceptional abnormal loads**

No exceptional abnormal loads are proposed.

6.5 Any special loading not covered above

Not applicable.

6.6 Heavy or high load route requirements and arrangements being made to preserve route

Not applicable.

6.7 Minimum headroom provided

The minimum headroom clearance for underbridge structures will be 5.3m in accordance with TII DN-GEO-03036 (NRA TD 27).

6.8 Authorities consulted and any special conditions required

Consultation with relevant authorities is on-going. The following groups have been contacted as part of the scheme:

Transport Infrastructure Ireland (TII)

Galway County Council (GCoC)

- Galway City Council (GCiC)
- Land and home owners

7 Ground Conditions

7.1 Description of the ground conditions and compatibility with proposed foundations

Table 13 Ground Conditions

Name of Structure	Foundation Type	Soil / Rock at Formation Level	Safe Bearing Pressure (kN/m ²)	Formation depth above (+)/ below (-) egl (m)	Depth to Rockhead egl (m)
S06/01 - Rahoon Road Underbridge	Pad	Weathered Rock	300	-0.6	1.1
S07/01 - Letteragh Road Underbridge	Pad	Weathered Rock	305	-2.3	2.5
S07/02 - N59 Link Road North Underbridge	Pad	Soil	190	-1.1	5.7
S08/02 - N59 Moycullen Road Underbridge	Pad	Soil	190	3.6	4.1
S09/01 - Menlo Castle Boithrin Underbridge	Pad	Weathered Rock	300	-0.3	1.9
S10/02 - Seanbothar Underbridge	Pad	Soil	195	-0.6	2.7
S12/01 - N84 Headford Road Underbridge	Pad / Piles[1]	Soil	300	-1.2	3.8
S13/02 - N17 Tuam road Underbridge	Piles	Soil	190	-1.1	-
S15/01 - Briarhill Business Park Underbridge	Pad / Piles[1]	Soil / Weathered Rock	190	-1.9	8.2
S15/02 R339 Underbridge	Pad / Piles[1]	Soil / Weathered Rock	190	-1.0	6.0

[1] due to the high potential for karst features at the structure location, piled foundations may be necessary. Additional ground investigation is recommended at this location to further assess this risk.

8 Drawings and Documents

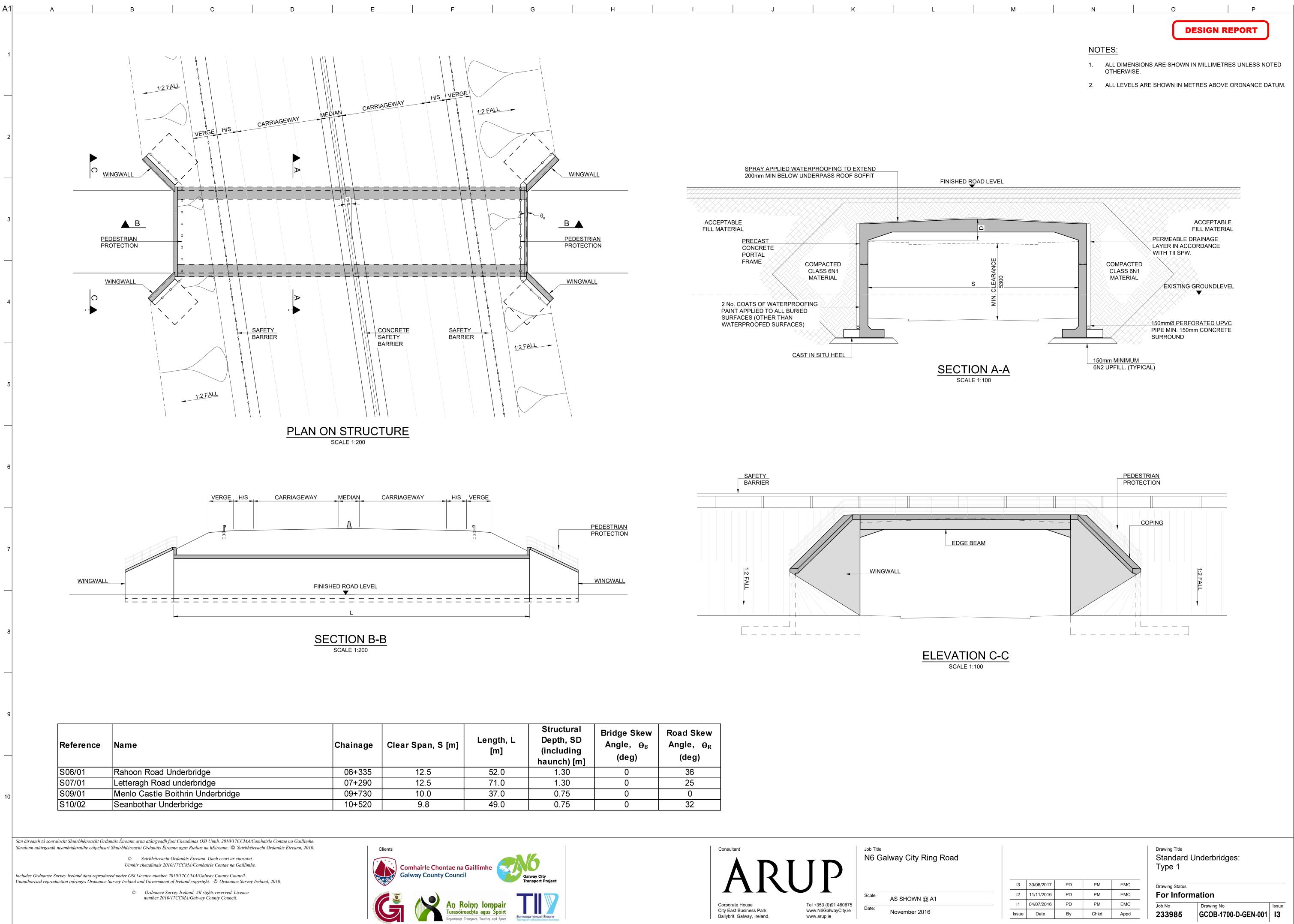
8.1 List of all documents accompanying the submission

Table 14 Drawings

Name of Structure	Drawing Number
Standard Underbridges – Type 1	GCOB-1700-D-GEN-001
Standard Underbridges – Type 2A	GCOB-1700-D-GEN-002
Standard Underbridges – Type 2B	GCOB-1700-D-GEN-003
Standard Underbridge – Type 3	GCOB-1700-D-GEN-004

Appendix A

Drawings

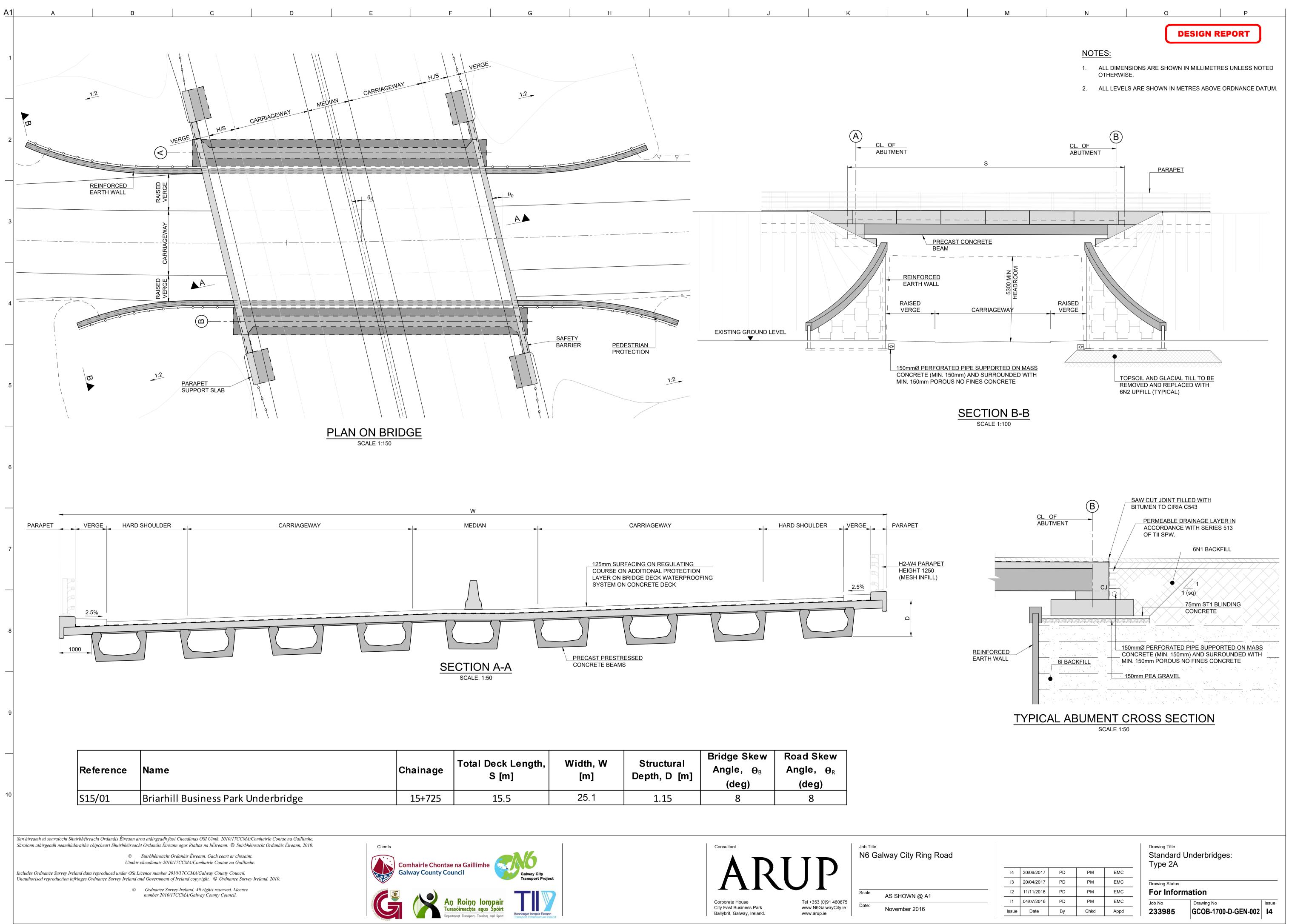


Do not scale

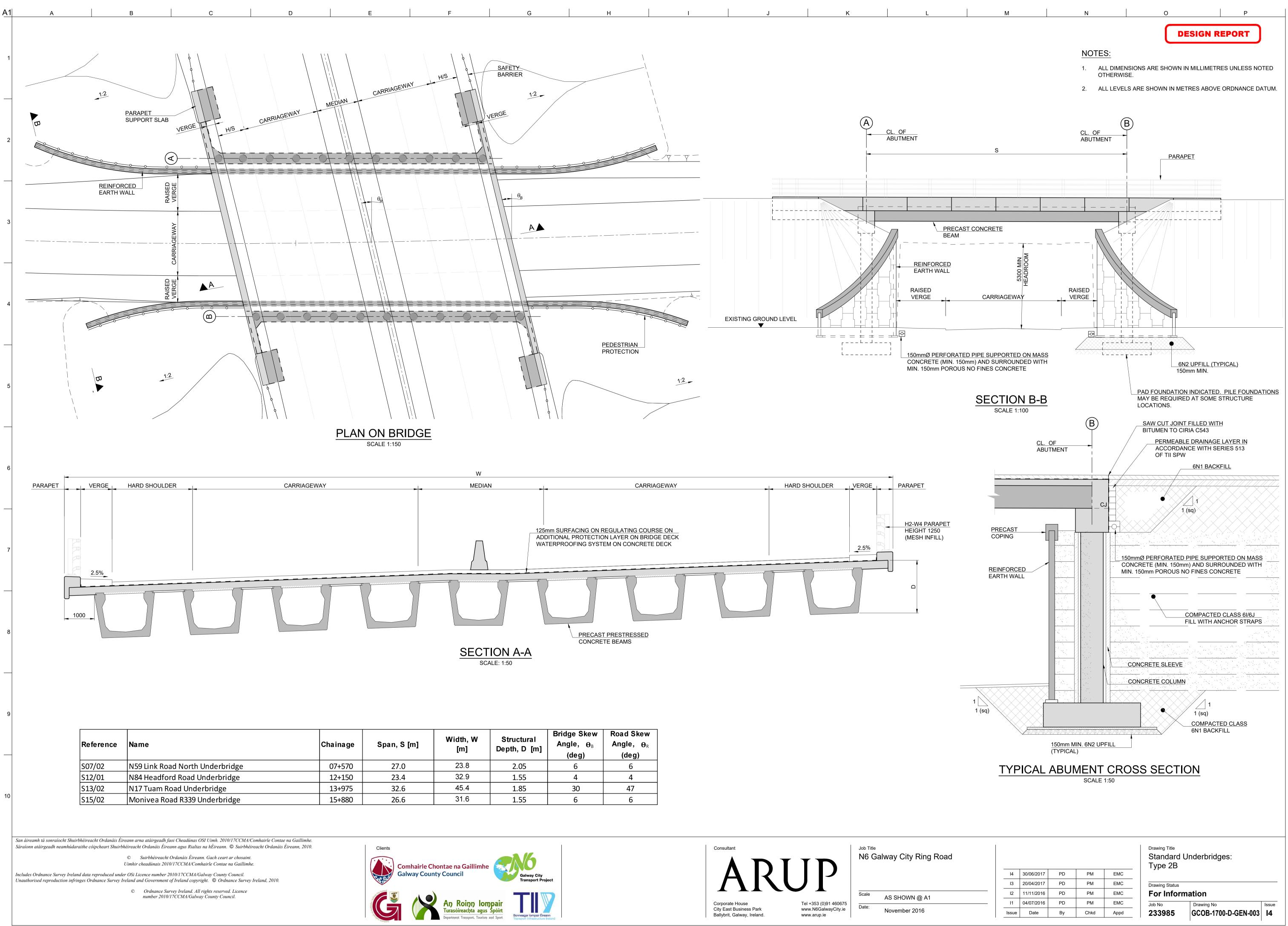
ength, L [m]	Structural Depth, SD (including haunch) [m]	Bridge Skew Angle, θ _B (deg)	Road Skew Angle, Ə _R (deg)
52.0	1.30	0	36
71.0	1.30	0	25
37.0	0.75	0	0
49.0	0.75	0	32



© Arup



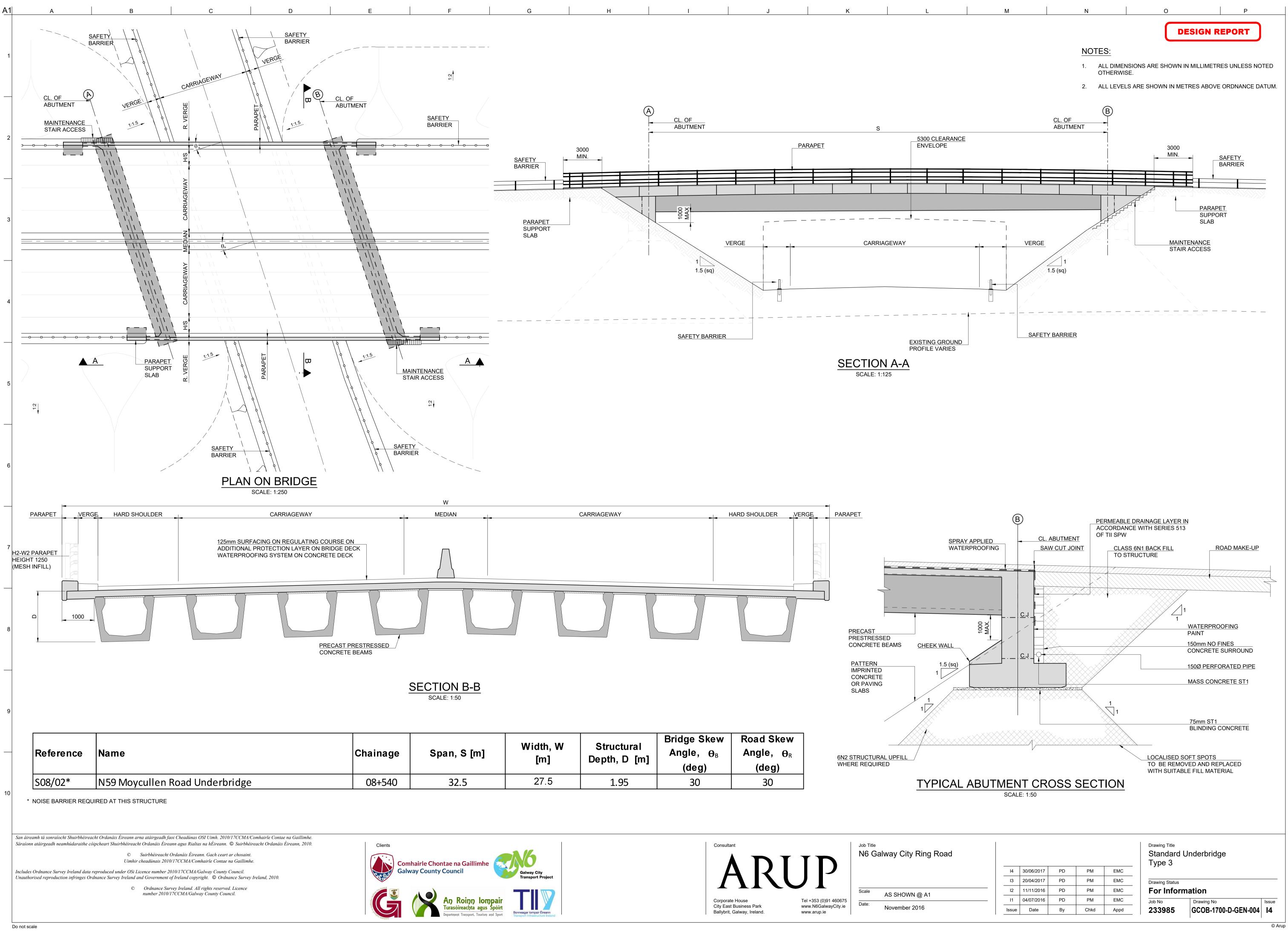
Deck Length, S [m]	Width, W [m]	Structural Depth, D [m]	Bridge Skew Angle, θ _Β (deg)	Road Skew Angle, θ _R (deg)
15.5	25.1	1.15	8	8



Do not scale

Structural Depth, D [m]	Bridge Skew Angle, θ _Β (deg)	Road Skew Angle, Θ _R (deg)
2.05	6	6
1.55	4	4
1.85	30	47
1.55	6	6

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Appendix B

Extract from ground investigation data



REPORT NUMBER

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	NTRAC			-	Project - Pha		_					BOREHO SHEET	DLE NO.	BH3/12 Sheet 1 o	
	-ordin Ound L	ATES .EVEL (m	525,90 725,92 AOD)	9.63 E 3.39 N 53.99	B		E LE DIAM LE DEPT		nm)	Dando 30 2.20		DATE CO DATE CO		CED 22/01/20 ⁴ ED 22/01/20 ⁴	
	ENT GINEER		ay County ⊃	Council			IMER REI RATIO (%					BORED E PROCES		WC JL	
					I			<i>.</i>	_		San	nples			
Depth (m)			Desc	cription			Legend	Elevation	Depth (m)	Ref. Number	Sample Type	· · · · · · · · · · · · · · · · · · ·	Recovery	Field Test Results	Standpipe Details
0	Very s	oft black g	ravelly pea	ty CLAY		-		52.69	1.30	AA43880 AA43881	D B	0.50 0.50-0.95		N = 2 (2, 2, 1, 0, 1, 0))
2	Very s	oft light bro	own grey v	ery sandy (gravelly CLAY	/ -	<u>* · · · · ·</u>		2.10	AA43882 AA43883	D B	1.50 1.50-1.95		N = 5 (0, 0, 0, 0, 1, 4	i)
. 2	Obstru	iction					<u> </u>	51.89 51.79	2.10						
		Borehole	at 2.20 m												
3 4 5 6 7 7 8															
HA	ARD STR	RATA BOF	RING/CHIS	ELLING						1		I	WA	TER STRIKE I	DETAILS
Fror	m (m) -	Го (m)	Time Co	omments			Wate			Sealed	Rise		me C	omments	
	2.1	2.2	(h) 0(Strike 1.30 1.90	1.	epth 30 90	At No	<u>To</u> 1.1(20	Seepage Moderate	
			AU C						Hole	Casing	De	pth to	_		RUGRESS
	Date	TION DET	AILS	RZ Base	Туре		Dat	e	Depth	Depth	W	pth to vater	Commen	ts	
RE	MARKS	Borehole	backfilled	upon comp	bletion			[B - Bulk D LB - Large	e Bulk Disturbed	ł		Sample P - Und	isturbed Piston Sample	er
									Env - Env	ironmental Sam	ple (Jar + \	/ial + Tub)	W - Wa	ter Sample	



REPORT NUMBER

Je	33[<u>ــ</u>															030	0
CON	TRA	СТ	N	6 Ga	Iway City	Transpo	ort Pr	oject -	Phase 3					DRILLHO	LE NO		3/13R	
CO-ORDINATES 526,078.57 E 726,036.12 N														SHEET			et 1 of 2	
726,036.12 N GROUND LEVEL (mOD) 58.65									RIG TYPE FLUSH			Casagra Air/Mist	inde	DATE DRI DATE LOO)3/2016)3/2016	
ENGINEER ARUP (INCLINATION CORE DIA		m)	-90 80		DRILLED LOGGED			SL . O'She	а
Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracti Spac Log (mr	ing ງ າ)	Non-intact Zone	Legend			Descrip	tion			Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0									SYMMETI as clayey	RIX DRILL gravel	NG: No re	covery, ob	serve	d by driller				
1 1	.10								SYMMETI as weathe	RIX DRILL	NG: No re	covery, ob	serve	d by driller) 57.95) 57.55	\otimes	
		100	96	96			600		mottled, p	ng, thickly to orphyritic, i cally slight	medium to	coarse-gra	browr ained,	nish purple GRANITE	,			
2 2	.10							╡┿╵╴ ┥┿╵╴ ┫┿╵╴	medium s Apertures	20° to locall paced, rou are tight to	gh to locall	y smooth,	plana	r.			0 0	
3 3	.10	100	97	97					smearing.								0 0	
		100	98	98			1070										o o o o	
4	.10	100	100	100			830		•								0 0 0 0	
5 5	.10																0 0 0 0	
6 6	.10	100	100	100			890 0004		-									
		100	100	100													0 0 0 0	
7	.10	100	100	100														
8	.10	100	100	100			570											
9 9	.10	100	100	100													0 0 0 0	
		100	100	100														
	AR	_									0	October 1		/		TER S	TRIKE	DETAILS
lole	cas	ed 0	0.00-1	1.10n	n.					Water Strike	Casing Depth	Sealed At	Ris		n) C	ommen No wate		recorde
															CP			DETAI
NST	ALL	ATIC	ON D	ETAI	LS					Date	Hole	Casing		epth to Vater C	ommen			
	ate				RZ Top	RZ Base	e	Тур			Depth	Depth		valer		-		
22-0)3-1	6	9.0	0	6.00	10.10		50mn	n SP									



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COI	NTR/	АСТ	N	l6 Ga	lway City	r Transp	ort Pr	oject -	Phase 3				DRIL SHE		NO		3/13R	
GROUND LEVEL (mOD) 58.65 FL									RIG TYPE FLUSH			Casagraı Air/Mist	DAT	e drill E logg		21/0	et 2 of 3/2016 3/2016	6
	ENT	ER		Balwa RUP	y County	Counci		1	INCLINATI		m)	-90 80		LED BY GED BY			SL O'She	ea
Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Frac Spa Lc (m 0 ²⁵⁽	cing og m)	Non-intact Zone	Legend			Descrip	tion			Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10	10.10							+	Endo	of Borehole	e at 10.10 n	n			10.10	48.55	0 0	
11																		
13																		
14																		
15																		
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17																		
18																		
19																		
_		_		l 1.10r	n					Water	Casing	Sealed	Rise	Time			_	DETAILS
101	e ca			1. TUP						Strike	Depth	At	To	(min)	N		r strike	e recorde
	ΤΑΙΙ			DETA	LS					Date	Hole	Casing	Depth to Water	⁰ Corr	GRO		VATER	R DETAII
N>		רא <u>-</u>								2010	Depth	Depth	vvater			-		



REPORT NUMBER

	NTRAC			y Transport Pro	-					{	BOREHO SHEET	LE NO.	BH3/10 Sheet 1	
	ORDIN	ATES .EVEL (m	726,63	54.60 E 35.82 N 58.47		Pe Ole Diam Ole Dept		nm)	Dando 30).50	1	DATE CO DATE CO		ED 29/01/20	
	ient Gineer	Galv ARU	way County JP	y Council		MMER RE					BORED E		WC JL	
					I	,	Í	_		Sam				
Depth (m)			Des	scription		Legend	Elevation	Depth (m)	Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
- 0	PEAT					<u>\\/</u> \\/	58.17	0.30						
Ē			EL- and CC	BBLE-sized fra	igments of		57.97	0.50	_					
Ē	Granite				/									
- 1			e at 0.50 m											
Ē														
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H	ARD STR		RING/CHI	SELLING								WA		DETAILS
		o (m)	Time	Comments		Wate			Sealed	Rise		ne c	omments	
).4	0.5	(h) 0.5			<u>Strik</u> 0,30		epth 30	At No	<u>To</u> 0.20	(m) 2	in)	Seepage	
i i														
							,					GRO		PROGRESS
INS	STALLA	TION DE	TAILS			Dat		Hole Depth	Casing Depth	Dep W	oth to cater	comment	s	
	Date	Tip Dep	th RZ Top	RZ Base	Туре	_								
	MARKS	1.5hr ge completi	tting rig an ion. Boreho	d tools off BH le	ocation. Borehole or rotary follow-o	e backfilleo n coring.	d upon	Samp	le Legend Disturbed (tub)	ł			disturbed 100mm Diame	eter
					,	.5		B - Bulk D LB - Large Env - Envi	isturbed Bulk Disturbed ironmental Sam	i ple (Jar + V	ïal + Tub)	Sample P - Undi W - Wat	sturbed Piston Sample er Sample	



REPORT NUMBER

CONT	RAC	I F N	l6 Ga	lway City Transpo	ort Pr	oject -	Phase 3					LHOLE	NO		3/16R	
	JND L	ATES EVEL	-	526,764.74 E 726,611.40 N D) 61.66 y County Council			RIG TYPE FLUSH INCLINATION (1	dea)		Casagran Air/Mist -90	de DAT	ET E DRILLI E LOGGI LED BY	ED	23/0 24/0	et 1 of 3/2016 3/2016 SSL	6
							CORE DIAMET		ו)	-90 80		GED BY			. O'Sh∉	ea
Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 ²⁵⁰ 500	Non-intact Zone	Legend			Descripti				Depth (m)	Elevation	Standpipe Details	SPT (N Value)
1							SYMMETRIX I as clayey grav	el		-	-		1.50	60.16		
2 2.5	50						SYMMETRIX I as weathered Very strong, th	rock iickly to	thinly band	led, dark b	rownish p	urple		59.16		
3.5	10	86	64				mottled, porph fresh to locally Dips are 20° to medium space	slightly locally d, roug	weathered 80°. Disco h to locally	d. ontinuities a smooth, p	are widely lanar.	to				
4.5	10	35	35				Apertures are smearing. 2.50-5.80m - S clay-smeared, weakening.	Slightly	o locally m	oderately	weathered	-				
5.8	62	16	0													
	10	93	73													
8.5	10	97	97	L												
) 10.0	10	99	99		1150								<u>10.0</u> 0	51.66	0 0 0 0 0 0 0 0	
EMA	RKS	0.00-	1.10r	n.			W	orehole 'ater trike	at 10.00 m Casing Depth	Sealed At	Rise To	Time (min)	WA ⁻ Co	TER S	ts er strike	DETAILS
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REPORT NUMBER

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	NTRAC		-	City Transpor	rt Project - P							BOREHO SHEET	OLE NO.	BH3/17 Sheet 1 c	
	-ordin Ound		527 726 m AOD)	,023.54 E ,804.98 N 65.54			'e Ole diam Ole dept	•	nm)	Dando 30 2.80		DATE CO DATE CO		CED 14/03/20 TED 14/03/20	
	ENT GINEER		alway Cou RUP	nty Council			MMER RE (RATIO (%					BORED E PROCES		WC / JL	
					1		Ì	ľ	_		San	nples			
Depth (m)			D	escription			Legend	Elevation	Depth (m)	Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
- 0	Soft to mediu	o firm dai ım cobble	rk brown s e content	andy gravelly	y CLAY with	na				AA48880	В	0.50			
- 1	Firm li mediu	ight brow Im cobble	n very sa e and bou	ndy gravelly (Ider content	CLAY with a	a		64.64	0.90	AA48881	В	1.00-1.45		N = 21 (3, 4, 4, 5, 7, 5	5)
- 2										AA48882	В	2.00-2.45		N = 15 (2, 8, 4, 3, 3, 5	5)
- 3	End o	f Boreho	le at 2.80	m				62.74	2.80	_					
- 4															
-															
- 5															
- 6															
- 7															
8															
9															
		RATA B		HISELLING			Wate	ar L Co	sing	Sealed	Rise	_ ∣_т.		ATER STRIKE I	DETAILS
Fror	m (m)	To (m)	Time (h)	Comments			Strik		ising epth	At	To		me nin) C	Comments	
2	2.7	2.8	0.5				2.70		.70	No	2.4(0 2	20	Seepage	
													GR	OUNDWATER P	PROGRESS
INS	TALLA	TION DI	ETAILS				Dat	te	Hole	Casing	De	pth to ater	Commer	nts	
	Date			op RZ Base	е Тур)e			Depth	Depth					
INS REI	MARKS		s getting p off positio	lant and equion.	ipment to be	orehole lo	ocation. 1h	r	B - Bulk D LB - Larg	Disturbed (tub) Disturbed e Bulk Disturbed vironmental Sam	ł	vial + Tub)	Sampl P - Un	Indisturbed 100mm Diamet e disturbed Piston Sample ater Sample	ter



REPORT NUMBER

CON	ITR/	СТ	N	6 Ga	Iway City 7	Franspo	ort Pro	oject -	Phase 3						NO		3/17R	
CO-ORDINATES 527,021.46 E 726,804.57 N GROUND LEVEL (mOD) 65.33 CLIENT Galway County Council ENGINEER ARUP									RIG TYPE FLUSH			Casagrar Air/Mist	DA	eet Te drill Te logg		10/0	et 1 of 3/2016 3/2016 3/2016	;
LIE	INT		G	alwa	-				INCLINATION CORE DIA		m)	-90 80		ILLED BY GGED BY			SL . O'She	a
	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fractu Spaci Log (mm 0 ²⁵⁰	ng J I)	Non-intact Zone	Legend			Descrip	tion			Depth (m)	Elevation	Standpipe Details	SPT (N Value)
1									SYMMETI as clayey	RIX DRILL gravel	ING: No red	covery, obs	erved by	driller			•`\\`\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	
3									SYMMETI as gravelly		ING: No rea	covery, obs	erved by	driller	2.70	62.63		
Ę	5.70								as weathe	red rock	ING: No rec	-	-			60.33 59.63	0 0	
;	6.70	100	26	0				- + - - + - - + - - + - - + -	porphyritic locally slig Dips are 2 closely sp	, medium t htly weath 0° to locall aced, roug	to coarse-g ered. ly 70°. Disc h to locally	rained, GR ontinuities smooth, pl	ANITE, fi are medi anar. Ape	resh to um to ertures			0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
	3.20	100	88	68	L		<u>(, ;) (</u>		are tight to	o partly ope	en, very thir	n brown cla	y smearir	ng.			0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	
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	_		.00-5	5.20n	n.					Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Co	ommen lo wate	ts er strike	e recorde
151	FALI	ATIC	DN D	ETAI	LS					Date	Hole	Casing	Depth Wate	to Com	GRO		VATER	DETAII
D	Date 03-1	Т		epth	RZ Top F 3.00	RZ Base 10.20	e e	Typ 50mm	e I SP		Depth	Depth	vvate					



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	NTR/			l6 Ga	Ilway City Transp 527,021.46 E	ort Pr	oject -	Phase 3				SHE			Shee	3/17R et 2 of	2
				(mOl	726,804.57 N	2		RIG TYPE			Casagrar		e drille E logge			3/2016 3/2016	
CLI			G		y County Counci			FLUSH INCLINATI CORE DIA		m)	Air/Mist -90 80	DRIL	LED BY GED BY		IG	SL O'She	
(E	(m)																
Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm)	Non-intact Zone	Legend			Descrip	tion			Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10	10.20	100	92	92			++	End o	of Borehole	e at 10.20 n	n		•	10.20	55.13	°∐°	
11																	
13																	
14																	
15																	
16																	
17																	
18																	
19																	
	MAR	_		1 5.20r	n		-		Water	Casing	Sealed	Rise	Time				DETAIL
1010	e cas			J.∠Ur					Strike	Depth	At	To	(min)	N		r strike	e record
NS	τΔι ι	ΔΤΙ		DETA	II S				Date	Hole	Casing	Depth to Water	Com	GRC ments		VATER	R DETAI
[Date	Г	Tip D	epth	RZ Top RZ Bas		Ту	pe	Dale	Depth	Depth	Water					
11-	03-1	6	10.2	20	3.00 10.20		50mn	n SP									



REPORT NUMBER

_	\bigcirc													
				-	Project - Phase 3				Dando 30		Boreho Sheet	LE NO.	BH3/23 Sheet 1 of 1	
	-ordina Ound Le	EVEL (m A	527,770 727,345 (OD)		BORE	HOLE DIAM	•	ım)	3.70		DATE CC DATE CC		CED05/02/2016ED05/02/2016	
		Galwa ARUP	y County	Council	_						BORED E		WC	
ENC	GINEER	ARUP			ENER	GY RATIO (%) 				PROCES: nples	SED BY	JL	1
Depth (m)			Desc	ription		Legend	Elevation	Depth (m)	Ref. Number	Sample Type		Recovery	Field Test Results	Standpipe Details
- 1	Firm da medium	rk brown s a cobble ar	andy grav nd boulder	relly CLAY	with a low to		24.48	2.30	AA32640 AA32641	В	1.00-1.45		N = 15 (2, 3, 3, 3, 4, 5) N = 15 (3, 3, 2, 3, 4, 6)	
		dense lig ow to medi Borehole a		ilightly clay and bould	ey gravelly SANE der content		23.08	3.70	AA32643	В	3.00-3.45		N = 16 (3, 4, 3, 4, 4, 5)	
4														
		ATA BOR	ime			Wate	er Ca	sing	Sealed	Ris	e Tir	ne	TER STRIKE DET	AILS
, —		5 (m)	(h) Co).75	omments		Strik	e De	pth 70	At No	3.20) (m	in) Ca 0	Slow)GRF99
INC	TAILAT					Da		Hole	Casing	De	pth to c	Comment		JILLOO
	Date	Tip Depth	RZ Top		Туре			Depth	Depth	Ŵ	/ater			
		0.5hr mov and tracke boulders to	d dumper	from bore	ting access to plo hole including rep	t. 0.5hr mov lacement of	ing rig	B - Bulk D LB - Larg	Disturbed (tub) Disturbed e Bulk Disturbed vironmental Sam	i	Vial + Tub)	Sample P - Undi	disturbed 100mm Diameter sturbed Piston Sample er Sample	



REPORT NUMBER

U	33	<u> </u>													•	000	0
	ITR/	ACT	N	6 Ga	lway City Trans	port Pr	oject -	Phase 3				1	ORILLHOLE	E NO	BH	3/23R	
20-1			LES		527,773.63 E							<u>-</u>	HEET		She	et 1 of 2	2
727,346.05 N											Casagrar		DATE DRILL			2/2016	
		D LE		-	-			RIG TYPE FLUSH			Air/Mist	-		2/2016			
	ENT INE	-P		ialwa RUP	y County Coun	cil				m)	-90		DRILLED B			SL	
		=ĸ	A	RUP				CORE DIA		m)	80		LOGGED B			. O'She	a
<u>۳</u>	Core Run Depth (m)	. 0	. 0													s	
Dept	bept	T.C.R.%	S.C.R.%	.Q.D.%	Fracture Spacing	Zone										Deta	(ən
ole E	un D	T.C	S.C	R.O	Log	act 2				Descrip	tion			Ê	LC LC	ipe [Val
Downhole Depth (m)	re R				(mm)	00 Non-intact Zone	Legend							Depth (m)	Elevation	Standpipe Details	SPT (N Value)
8	ပိ				0 ²⁵⁰ ę	00 2	Leć							De	Ele	Ste	SP
0							6	as clavev	RIX DRILL gravelly co	ING: No re	covery, obs	served	by driller				
								ac clayey	g. 4 tony 00	20100							
1																	
2																	
							$\begin{bmatrix} - \\ - \\ - \\ - \\ - \\ - \\ - \\ - \\ - \\ - $							2.80	24.13		
3							<u>.</u>	SYMMET	RIX DRILL	ING: No re	covery, obs asional cob	served	by driller				
										., 0000							
								SYMMET		ING: No rea	covery, obs	served	by driller	3.70	23.23	ŏ1ŏ1	
4	4.20							as greenis	sh grey we	athered roc	k		•	4.20	22.73		
							{+ + +	Very stron areen/are	ig to strong v/white mo	, thickly to ttled, porph	thinly band yritic, medi	led, lig ium to	nt			• =•	
		100	04				+++++++++++++++++++++++++++++++++++++++	coarse-gra weathered	ained, GRA	NITE, fres	h to locally	mode	ately			• •	
5		100	31	14			}+++				ontinuities	arewi	helv to				
ļ	5.70					λ ·	1+	medium s	paced, rou	gh to locall	y smooth, p	olanar.	-			。⊟。	
					È.		ŧ++ ↓+	smearing.	•		n, very thin		•				
6						-	╡┽╵╴ ╡┿╷╴	4.20-5.30	m - Modera	ately weath	ered, slight	weake	ening.				
		100	95	91			<u></u> +++										
,							$\{+,+\}$										
7 7	7.20						$\frac{1}{1}^{+}$]								\mathbb{K}	
						660											
8		100	100	93			1+ ⁺ +										
							╡ <u></u> ┿ ╡ _┿ ┆										
8	8.70					650											
9							$\frac{1}{1}$										
		100	100	100			+++										
						1100											
	IAR			1			1 - +								TER S		DETAILS
lole	e cas	sed 0	.00-4	4.20r	n.				Water Strike	Casing Depth	Sealed At	Rise To	Time (min)		ommen	its	
														N	lo wate	er strike	recorde
														GR		NATER	DETAI
NS	TALI	ATIO	ON D	ETA	LS				Date	Hole Depth	Casing Depth	Dep W	oth to cor	nment			
	Date				RZ Top RZ Ba		Typ 50mm										
24-	02-1	0	5.5		3.50 5.70	,	50mn	105									



REPORT NUMBER

	යප	ւ∕															I	890	3
COI	NTR/	ACT	N	l6 Ga	lway Cit	y Transp	oort Pr	oject -	Phase 3					DRIL Shee		NO		3/23R et 2 of 2	
		DINA			727,34	73.63 E 46.05 N			RIG TYPE			Casagra	ande	DATE	= I E DRILLI E LOGGI		24/0	2/2016 2/2016	;
CLI	ENT		G		-	26.93 y Counci			FLUSH)	Air/Mist -90		DRIL	LED BY		IG	SL	
	SINE	ER	A	RUP					CORE DIA	METER (m	m)	80		LOG	GED BY		D.	O'She	a
	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Spa L (n	cture acing .og nm) ^{50 50}	- 6 Non-intact Zone	Legend			Descrip	tion				Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10	10.20							++	End o	of Borehole	e at 10.20 r	n				10.20	16.73	~~~~	
11																			
13																			
14																			
15																			
16																			
17																			
18																			
19									D										
	MAR															WA	FER ST	RIKE	DETAILS
Hole	e cas	sed C).00-4	4.20r	n.					Water Strike	Casing Depth	Sealed At		Rise To	Time (min)	_	mmen o wate		e recorde
												Occi				GRO	DUNDV	VATER	DETAIL
	TALI Date			ETA		RZ Bas	م	Ту	ne	Date	Hole Depth	Casin Depth	y I h	Depth to Water	Com	ment	S		
	-02-1		5.5		3.50	5.70	20	50mn	00	4	1	1							



REPORT NUMBER

		/												
	NTRAC				Project - Phase 3					:	BOREH SHEET	OLE NO.	BH3/26 Sheet 1 of 1	
	-ORDIN OUND	ATES	528,81 727,92 AOD)	5.44 E 2.07 N 14.67		Pe Ole diam Ole dept		ım)	Dando 30 0.40				CED 01/02/2016 ED 01/02/2016	
	ENT GINEER		ay County	Council		MMER REI Y RATIO (%					BORED	BY SSED BY	WC JL	
							-/				nples			
Depth (m)			Desc	ription		Legend	Elevation	Depth (m)	Ref. Number	Sample Type	-	Recovery	Field Test Results	Standpipe Details
- 0	mediu	m boulder o	andy grav	elly CLAY \	with a low to		14.27	0.40	_					
	Obstru End o	uction f Borehole a	at 0.40 m											
- 9												1		
HA	RD ST	RATA BOR		ELLING									TER STRIKE DE	TAILS
Fror	n (m)	To (m)	Time (h)	omments		Wate Strike		sing Septh	Sealed At	Rise To		Fime min) C	omments	
	.4	0.4	0.5					Put		10	(No water strike	
2								Hole	Casing	De	pth to			JUKESS
	TALLA Date	TION DET	AILS RZ Top	RZ Base	Туре	Dat		Depth	Depth	Ŵ	pth to /ater	Commen	IS	
IGSL BH LUG 1893.GPJ IGSL.GUI 12/9/16	MARKS	0.75hr ga backfilled coring.	ining acces upon com	ss to field a pletion. Bo	nd moving to BH lo rehole scheduled fo	ccation. Bor or rotary foll	rehole low-on	I B - Bulk Di	e Legenc Disturbed (tub) sturbed Bulk Disturbed ronmental Sam		/ial + Tub)	Sample P - Und	disturbed 100mm Diameter isturbed Piston Sample ter Sample	



REPORT NUMBER

:ONT				6 Ga	lway City Transp 528,816.97 E	ort Pro	oject -	Phase 3			SHEET			Shee	3/26R et 1 of	2
			/EL ((mOE	727,920.32 N D) 14.42			RIG TYPE FLUSH		Comacchi Air/Mist		DRILLEI LOGGEI			2/2016 2/2016	
LIEN NGIN		R		alway RUP	y County Council		1	INCLINATION (deg) CORE DIAMETER (mm)	i	-90 80	DRILL LOGG				SL O'She	ea
	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm) 0 ²⁵⁰ 500	Non-intact Zone	Legend		Descripti	on			Depth (m)	Elevation	Standpipe Details	SPT (N Value)
								SYMMETRIX DRILLING as made ground consis	sting of sh	ell & auger	material	C).40	14.02		
								SYMMETRIX DRILLING		·	·		.40	13.02		
1.9	90	100	82	26				Medium strong to very blueish dark grey, fine fossiliferous, localized locally moderately wea	grained, L chert and thered.	IMESTON stylolites),	E (locally slightly to					
		100	100	84				Dips are horizontal to lo medium to closely space to occasionally undulos locally clay/gravel filled	ced, rough se. Apertu	to locally res are tigh	smooth, pla nt to wide,	e nar				
3.	50 70 1	100	100	100			<mark>┃ </mark>									
	1	100	94	81												
5.		100	100	78												
6.2		100	100	100		550										
6.6	60		100													
8.2	20	100	98	84												
8.9	90	100	97	77												
9.	10 1	100 67	100 47	100 47				9.30-9.83m - Clay/grav rounded.	el-filled fra	acture - sor	me gravel is	5				
EMA	.00 ARK					<u> </u>							WAT	ER ST	RIKE	DETAIL
ole	case	ed 0.	.00-1	.40m	n.				Casing Depth	Sealed At		Time (min)		mment o wate		e record
													GRC	DUNDV	VATEF	R DETAI
IST/	ALL/	ΑΤΙΟ	ם אמ	ΕΤΑΙ	LS			Date	Hole Depth	Casing	Depth to Water	Comm	oonto			



REPORT NUMBER

	ଟ୍ର	Ŀ/															1	896	3
CO	-ORI		TES		528,8 727,9	16.97	E N	rt Pro	oject -	Phase 3			Comacc	DAT	LHOLE N ET E DRILLE E LOGGE	D	Shee 15/0	3/26R et 2 of 2/2016 2/2016	2
CLI	ENT GINE				y Coun		1.42 Incil			FLUSH INCLINATIO CORE DIAI		m)	Air/Mist -90 80	DRIL	LED BY		IG	SL O'She	
Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Sp (I	acture acing Log mm)		Non-intact Zone	Legend			Descrip	ition			Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10							4			10.40-10.6	60m - Clay	/gravel-fille	d fracture		1	0.70	3.72		
-11										End o	of Borehol	e at 10.70 r	n			00	0.12		
12																			
13																			
14																			
15																			
16																			
17																			
18																			
19																			
	MAR e.ca).00-′	1.40n	n.						Water	Casing	Sealed	Rise	Time				DETAILS
. 101						7					Strike	Depth	At	To	(min)	N		r strike	e recorde
INS	TAL	LATI	ON D	ETAI	LS						Date	Hole	Casing	Depth t Water	0 Comr			VATER	R DETAIL
	Date				RZ Top	RZE	Base)	Ту	pe	25-02-16	Depth 10.70	Depth 1.40	6.80				10 mins a	after end of



REPORT NUMBER

/	\square														
	NTRAC			City Transpo	ort Project - F							BOREHO SHEET	LE NO.	BH3/29 Sheet 1 of 1	
	-ordin Ound		529 728 m AOD)	,489.29 E ,334.05 N 13.73			Pe ole diam ole dept	•	חm)	Dando 30 2.70		DATE CO DATE CO		CED 01/02/2016 TED 01/02/2016	
	ENT GINEER		alway Cou RUP	inty Council			MMER RE					BORED B		WC / JL	
								-1				nples	01		
Depth (m)			Ľ	Description			Legend	Elevation	Depth (m)	Ref. Number	Sample Type	· · · · · · · · · · · · · · · · · · ·	Recovery	– Field Test Results	Standpipe Details
0	to me	dium col	ble and b	andy gravell oulder conte	ent			12.93	0.80						
1	Firm t mediu	o stiff lig Im cobbl	ht brown e and low	silty sandy gr to medium b	ravelly CLAY boulder conte	Y with a ent				AA43890	В	1.00			
2										AA43891	В	1.50-1.95		N = 32 (4, 7, 7, 8, 8, 9)	
-3		uction	ole at 2.70	m				11.03	2.70	AA43892	в	2.50-2.70		N = 50/105 mm (8, 11, 16, 34)	
- 4															
HA	ARD ST	RATA B		HISELLING										ATER STRIKE DET	TAILS
Fror	m (m)	To (m)	Time (h)	Comments	3		Wate Strike		sing epth	Sealed At	Ris To			Comments	
2	2.6	2.7	0.5											No water strike	
													GRO	OUNDWATER PRO	GRESS
INS	TALLA	TION D	ETAILS				Dat	e	Hole Depth	Casing Depth	De	pth to /ater C	commer	nts	
	Date	Tip De	pth RZ 1	op RZ Bas	se Tyr	be			- 0001						
REI	MARKS	Reinst (0.75h	ating field r). Boreho	ction pit exca upon comple le backfilled	etion (0.5hr)	. Move ge	ear to BH3/	/26	B - Bulk D LB - Large	e Bulk Disturbed	d	\/ial + Tub\	Sample P - Uno	ndisturbed 100mm Diameter e disturbed Piston Sample ater Sample	
		for rota	ary follow-	on coring.	~				I EUA - EUA	ironmental Sam	ihin (ngi, +	vidi T I UD)	vv - vV2	ator oumpro	



REPORT NUMBER

ାପଃ	SL													1	030	5
ONTI	RAC	T	N6 Ga	Iway City Transpo	ort Pro	oject -	Phase 3					LLHOLE	NO		3/29R	
O-OF	RDIN	ATES	;	529,489.29 E								ET E DRILLI	FD		et 1 of 2/2016	
ROU	IND I	EVFI	_ (mOl	728,334.05 N D) 13.73			RIG TYPE			Comacc	hio	E LOGGI			2/2016 2/2016	
LIEN			•	y County Council			FLUSH INCLINATIO	ON (deg)		Air/Mist -90	DRI	LLED BY	,	IG	SL	
NGIN	IEER		ARUP	-			CORE DIA		m)	80	LOG	GED BY	,	D.	O'She	ea
			_												s	
)epth		S.C.R.%	R.Q.D.%	Fracture Spacing	Zone										Detail	(ən
		s s	R.Q	Log (mm)	tact 2				Descrip	tion			(m)	и	ipe [I Valı
Core Run Depth (m)					Non-intact Zone	Legend							Depth (m)	Elevation	Standpipe Details	SPT (N Value)
	5			0 250 500	ž	ٿ محم		י יייסס עוב				مايزالم	ă	Ē	St	ن ا
'							as made g	round con	ING: No red sisting of s	covery, ob hell & aug	served by o er material	ariller				
2.8	30/					XXX	SYMMET	י וופח צוצ	ING: No red		served by	drillor	2.70	11.03 10.93		
							∖as rock			-		/	ر <u>د.</u> 00			
	10	0 97	90			╞┼┰	blueish da	irk grey, fir	ry strong, the grained,	LIMESTO	NE (locally					
							fossiliferou slightly we	us, localize athered.	ed chert and	a stylolites)), tresh to lo	ocally				
4.1	40	0 93	67			╞╌┼	Dips are h	orizontal to	o locally ver	rtical. Disc	ontinuities	are				
4.8	10	0 73	33		4		undulose t	to locally p	ed, rough to lanar. Aper	tures are t	ight to					
						╞┼╾	slight iron-	y open, wi oxide staiı	th very thin ning.	prown cla	y smearing	,				
	10	0 85	83		900	Ē]									
							1									
6.3	30				<u> </u>	╞╍╧										
		0 63	48		/ 											
6.9	90				<u> </u>	╞┶┯	End o	of Borehole	e at 6.90 m				6.90	6.83		
				_												
EMA	RKS												WA	TER ST	RIKE	 DETAIL:
ole c	ased	1 0.00	-2.80r	n.				Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Co	mmen	ts	
													N	lo wate	r strike	e record
ICT 4			DF7 4					Dett	Hole	Casing	Depth t	0 0-			VATEF	R DETAI
Dat			DETA Depth	RZ Top RZ Bas	e	Тур	De	Date 12-02-16	Depth 6.90	2.80			level m	-	10 mins	after end of
									0.00	2.00	5.70	drilling			2	



REPORT NUMBER

1														
	NTRACT			-	Project - Phase 3						BOREH SHEET	OLE NC	D. BH3/30 Sheet 1 of 1	
	-ORDINAT OUND LE\		531,04 728,50 40D)	1.18 E 9.06 N 23.76		Pe Ole diam Ole dept		nm)	Hand Dug 0.50		DATE C DATE C		NCED 23/02/2016 TED 23/02/2016	
	ent Gineer	Galwa ARUP	ay County	Council		MMER RE Y RATIO ('				I	BORED PROCE		JD S Y JL	
_							Í			San	nples			
Depth (m)			Desc	cription		Legend	Elevation	Depth (m)	Ref. Number	Sample Type	1	Recovery	Field Test Results	Standpipe Details
- 0 - 1 - 1 - 2 - 3 - 3 - 4 	concrete,	ayey SAI red bric asbestos	ND with o k, ceramic s (MADE 0	ccasional fr	agments of er, roof slate and		23.61	0.15	- AA39968 AA39969 AA39970	BENVENV	0.15-0.5	0		
- 9	r,												-	
HA		TA BOR	ING/CHIS	ELLING						1		v		TAILS
	n (m) To		Time	omments		Wate			Sealed	Ris		ïme	Comments	
			(h) C			Strik	le De	epth	At	Tc) (1	1111)	No water strike	
IN CO	TAL					-	to	Hole	Casing	De	pth to			JUKESS
	TALLATIC Date T		AILS RZ Top	RZ Base	Туре	Da	te	Depth	Depth	Ň	pth to /ater	Comme	ents	
RE	MARKS H	and dug resence	pit at loca of possible	ation of BH3 e asbestos	3/30. Pit terminated roofing fragments.	l at 0.50m (due to	B - Bulk D	le Legence Disturbed (tub) Disturbed e Bulk Disturbed ironmental Sam	4	Vial + Tuh)	Sam P - U	Undisturbed 100mm Diameter ple Indisturbed Piston Sample Water Sample	
L														



REPORT NUMBER

	- 1	N6 Ga	lway City Transpo	ort Pr	oject -	Phase 2								B 110		
					•	111026 3					DRILLH		10		/30R	
	TES		531,041.18 E								SHEET				et 1 of	
		(m0)	728,509.06 N			RIG TYPE			Casag		DATE D				2/2016 2/2016	
IND L IT		-				FLUSH)N (dea)		Air/Mis -90	t						
IEER								m)	-90 80					-	-	ea
T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm)	intact Zone-ו	lend			Descrip	otion				oth (m)	vation	ndpipe Details	SPT (N Value)
; >			0 250 500	Nor	Leg								Dep	Ele	Sta	SPT
						SYMMETR as made gi	IX DRILLI	NG: No re sisting of c	covery, o concrete o	bserve clay an	ed by drill d wire		1.60	22.16		
									covery, c	bserve	ed by drill	er				
						SYMMETR		NG: No re	coverv. o	bserve	ed by drill	or		1 1		
70					5	as weather	ed rock						2.70	21.06		
83 30	32	0				and cobble	s of limes	tone		anguia	a gravel	:	3.30	20.46		
80 0	0	0			<u> </u>	No recover	y - driller i	notes clay	band			3	3.80	19.96		
) 85	52				grained, LI	MESTON	E (locally fo	ossilifero	us, loca	k grey, fir alized ch	ne				
67	54	51				Dips are 20 medium sp Apertures a smearing.)° to locall aced, roug are tight to	y 40°. Disc gh to locall partly ope	continuitie ly smooth en, very th	es are v n, plana	ar.					
70	-															
10(93	89				- - - -										
00						7.22-7.75m	n - Clay-fill	ed fracture	9							
	56	56				1										
00						End o	f Borehole	e at 8.00 m				3	3.00	15.76		
													1			
RKS	0.00	4.00					Motor	Cooina	Social				WAT	TER ST	RIKE	DETAIL
ased	0.00-	4.20r	n.				Water Strike	Casing Depth	Sealed At				N	o wate	r strike	
	10N I	DETA	ILS				Date	Hole			epth to	Comr			AIER	DETAI
te				e	Ту	be		Depth	Dept		vvaler					
	EER %2':0:1 0 0 0 0 0 0 0 0 0 0 0 0 0	EER A	EER ARUP %::::::::::::::::::::::::::::::::::::	EER ARUP See 2 See 2 See 3 See 2 See 3 See 3 See 3	EER ARUP	EER ARUP 3% % % Fracture 90 100 90 0 0 0 0 83 32 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 56 56 0 0 0 0 0 0 0 0 100 56 56 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	EER ARUP CORE DIAN 3 3 3 3 Fracture CORE DIAN 9 0 0 0 250 500 9 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 100 85 52 9 9 9 100 56 56 9 9 9 100 56 56 9 9 9 100 56 56 9 9 9 100 56 56 9 9	EER ARUP CORE DIAMETER (m	EER ARUP CORE DIAMETER (mm) 38 38 36 57 38 32 67 57 67 10 9 250 50 50 100 56 52 52 52 100 56 56 51 52 100 56 56 56 7.22-7.75m - Clay-filled fracture 4.57-5.01m - Clay-filled frac	EER ARUP CORE DIAMETER (mm) 80 St St St St Fracture Spacing Long (mm) B St Description D 20 500 500 Description Description D 20 500 500 Description SYMMETRIX DRILLING: No recovery, c as made ground consisting of concrete of as gravelly cobbly clay D 0 0 0 0 O SYMMETRIX DRILLING: No recovery, c as weathered rock - recovered as and cobbles of limestone D 0 0 0 O O O D 0 0 0 O O O D 0 0 0 O O O D 0 0 0 O O O D 0 0 0 O O O D 0 0 0 O O O O D 0 0 0 O O O O O O D 0 0 0 0 <	EER ARUP CORE DIAMETER (mm) 80 30 State State Description 30 State State Description 31 State State Description 32 0 State State State 33 32 0 State State State 40 0 0 0 State State State 67 54 51 State State State State State 67 54 51 State State </td <td>EER ARUP CORE DIAMETER (mm) 80 LOGGE So So So So So Description Description So So</td> <td>EER ARUP CORE DIAMETER (mm) 80 LOGGED BY SS SS</td> <td>EER ARUP CORE DAMETER (mm) 80 LOGGED BY 3 25 35 35 5 100<td>EER ARUP CORE DIAMETER (mm) 80 LOGGED BY D.</td><td>EER ARUP CORE DIAMETER (mm) 80 LOGGED BY D. OSh 8 8 9</td></td>	EER ARUP CORE DIAMETER (mm) 80 LOGGE So So So So So Description Description So So	EER ARUP CORE DIAMETER (mm) 80 LOGGED BY SS SS	EER ARUP CORE DAMETER (mm) 80 LOGGED BY 3 25 35 35 5 100 <td>EER ARUP CORE DIAMETER (mm) 80 LOGGED BY D.</td> <td>EER ARUP CORE DIAMETER (mm) 80 LOGGED BY D. OSh 8 8 9</td>	EER ARUP CORE DIAMETER (mm) 80 LOGGED BY D.	EER ARUP CORE DIAMETER (mm) 80 LOGGED BY D. OSh 8 8 9



REPORT NUMBER

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:01	NTRACT	N6 Galway City Transport Proje	ct - Phase 3						Boreholi Sheet	e no.	BH3/35 CI Sheet 1 of 1	Ρ
	ORDINATI	ES 532,852.21 E 728,223.09 N EL (m AOD) 17.70		Pe Ole diami Ole dept	•	ım))ando 30 .90	00			ED 29/03/2016	
	ENT GINEER	Galway County Council ARUP	MMER REI Y RATIO (%					BORED BY PROCESSI		WC JL		
_						(r		San	nples			a
nepin (m)		Description		Legend	Elevation	Depth (m)	Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standnine
5	Soft dark	brown sandy gravelly CLAY		<u></u>	17.40	0.30						
	Firm becc silty CLAY	ming stiff light brown sandy grave ⁄ with a medium cobble and bould	er content				AA1	в	0.50		N = 10	
1				P			AA2	В	1.00-1.45		(1, 2, 2, 2, 3, 3)	
2							AA3	В	2.00-2.45		N = 19 (2, 2, 3, 4, 6, 6)	
3							AA4	В	3.00-3.45		N = 37 (5, 7, 4, 8, 11, 14)	
4							AA5	В	4.00-4.45		N = 26 (3, 3, 5, 7, 6, 8)	
5							AA6	В	5.00-5.45		N = 39 (6, 7, 7, 9, 11, 12)	
5	Stiff to ver with a me	y stiff dark brown sandy gravelly s dium cobble and boulder content	silty CLAY		11.80	5.90	AA7	В	6.50-6.95		N = 45 (8, 5, 9, 11, 12, 13)	
3		je brown sandy gravelly CLAY			<u>9.40</u> 9.20	<u>8.30</u> 8.50	AA8	В	8.00-8.45		N = 31 (4, 6, 7, 11, 7, 6)	
9	medium c	grey brown sandy gravelly silty CL obble and boulder content rehole at 8.90 m	AY with a		8.80	8.90						
				Wate	r Co	sing S	Sealed	Ris	e Tim	2	TER STRIKE DET	AIL
rom 6. 8.	n (m) To (.3 6.1 .8 8.1	(h) Comments 5 0.5		Strike		pth	At	To			omments No water strike	
										GRO	UNDWATER PRO	GR
NS'	TALLATIO	N DETAILS		Dat		Hole	Casing	De	pth to ater Co	mment		
		p Depth RZ Top RZ Base	Туре			Depth	Depth					
EN	IARKS 1.4 cle	5hrs getting plant and equipment t eaning down road after exiting field	o borehole loo 1.	cation. 0.5h	r	Sample D - Small D B - Bulk Dis	e Legend Disturbed (tub) sturbed Bulk Disturbed	1		Sample P - Undis	tisturbed 100mm Diameter sturbed Piston Sample er Sample	



REPORT NUMBER

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:01	NTR/	ACT	N	l6 Ga	lway City	/ Transp	ort Pr	oject -	Phase 3				I	ORILLHOI	ENO	BH	3/35R	
:0-	ORE	DINA	TES		532,85	0.77 E							- F				et 1 of	
				(mOl	728,22				RIG TYPE			Knebel		DATE DRI			2/2016	
				-	y County				FLUSH INCLINATI	ON (dea)		Air/Mist -90	-	ORILLED			Peter	
	SINE	ER		RUP	.,				CORE DIA		m)	80		OGGED			. O'She	
	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Spa Lo (m	cture icing og im) 0 500	Non-intact Zone	Legend			Descrip	tion			Depth (m)	Elevation	Standpipe Details	SPT (N Value)
) 1 2 3									as TOPSC SYMMETH as silty sat	DIL. RIX DRILL ndy gravel	ING: No re ING: No re ly cobbly cl	covery, ob ay	oserved	by driller	0.50	17.02		N = 50/10 mm (11, 14, 1 33) N = 50/10 (25, 50)
5								× © O O O o o	as silty cla	iyey sand v	ING: No re with cobble ING: No re with many b	s and bou	Iders	-	5.30 6.80			N - 50/0 r
8								0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0			Λ							N = 50/10 (25, 50) (25, 50) N = 50/40 (15, 10, 5
	/AR	-		24.00						Water	Casing	Sealed	Rise	e Tim				DETAILS
IOle	e ca:	sed C	0.00-2	21.60	Jm.					Vater Strike 4.30 18.50	Casing Depth 4.30 18.50	At 4.40 N/S	15.5	(mi	n) C(C) N	ommen Seepag Modera	le te	DETAI
15.	τΔι ι			ETA	IIS					Date	Hole	Casing	g Dep	oth to co	GR		WATEF	
	Date				RZ Top	RZ Bas	e	Ту	ре	Dale	Depth	Depth	n ₩	ater	Juniell	10		
	02-1		18.0		10.50	19.50		50mn				1	1					



REPORT NUMBER

	33 	ட/															I	090	55
COI	NTR	ACT	N	l6 Ga	lway City	/ Transpo	ort Pr	oject -	Phase 3					DRILLI		NO		3/35R	
:0-	ORE	DINA	TES		532,85 728,22	0.77 E								SHEET		D		et 2 of 2/2016	
GR	DUN	D LE	VEL	(mOl		17.52			RIG TYPE			Knebel Air/Mis		DATE I	LOGGE	D	24/0	2/2016	6
	ent Sine			alwa RUP	y County	/ Council			INCLINATI		m)	-90 80		DRILLI				Peter	
											,	00							
Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	.Q.D.%			Zone											Details	(ən
nole [Run D	T.C	S.C	N. N.	L	og 🗍	ntact 2	g			Descrip	otion				(m)	ion	pipe [N Val
Down	Core I						Von-ir	-egen								Jepth	Elevat	Stand	SPT (N Value)
10	-				<u>[</u>	<u></u>		0	SYMMET	RIX DRILL	ING: No re	covery, o	bserve	d by dril	ller	-	н		
								O	as silty cla	ayey sand	with many b	oulders	(contini	ued)				0	
11								I C	Ø									o 0	N 50/05 m
								iΩ'.	0									o 0	N = 50/85 m (16, 9, 36, 1-
					Spacing (nm) P 250 (mm) SYMMETRIX DRILLING: No recovery, observed by driller as silty clayey sand with many boulders (continued) 14.50 3.02 0 Symmetric classes Symmetric classes Symmetric classes 14.50 3.02 0 0 Symmetric classes Symmetric classes Symmetric classes Symmetric classes 14.50 3.02 0 0 Symmetric classes Symmetric classes Symmetric classes Symmetric classes Symmetric classes 14.50 3.02 0	o 0													
12								1											
								Ľ. Ľ.	0										N = 50/15 m (9, 16, 50)
13									d										
								0	¢										
14								0.	Q										N = 50/10 m
								1								14.50	3.02	• =•	(25, 50)
								H	SYMMETI as weathe	RIX DRILL ered rock	ING: No re	covery, o	bserve	d by dril	ller			•	
15								E	-									•	
									-									° = °	N = 50/15 m (25, 50)
16								H	-									°	
								E	-										
17									-										N = 50/50 m
								H	-										(21, 4, 50)
									-										
18																		o c o	
																		0	N = 50/95 m (16, 9, 42, 8
19								<u>⊢</u>										0	
																		×.	
REM	/AR	KS						H								W۵٦	ER ST		
	_).00-2	21.60)m.					Water Strike	Casing Depth	Sealed At	Ri		Time (min)			_	
										4.30 18.50	4.30 18.50	4.40 N/S	15.		5	S	eepag odera	e te	
															-				
										_	Hole	Casir		enth to	6			VATE	R DETAILS
	TAL Date			epth	ILS RZ Top	RZ Bas	е	Ту	pe	Date	Depth	Dept		epth to Vater	Com	ment	5		
	02-1		18.0		10.50	19.50		50mn											



REPORT NUMBER

CONTRACT Nik Galway City Transport Project - Phase 3 DRILLHOLE NO SHEET BH3/35R SHEET CO-ORDINATES 532,253,08 N 522,253,08 N CROUND LEVEL (mOD) 17.52 Rig TYPE FLUSH Knebel AirMist NICLINATION (deg) Sheet 3 of AirMist CO-ORDINATES 532,253,08 N 522,253,08 N TE DILLED 7.52 Rig TYPE FLUSH Knebel AirMist DRILLHOLE NO DATE LOGGED DRILLED DI 240022016 Core DIAMETER Galway County Council Log Get 2 Transport Core DIAMETER (mm) 80 DRILLED DI DATE LOGGED DRILLED DI 240022016 Gil		000	•															Ŀ/	යිදු	\sqrt{n}
CO-ORDINATES 532,280,77 E T28,22598 N RGOUND LEVEL (mOD) 17.52 CROUND LEVEL (mOD) 17.52 RG TYPE FLUSH Knebel AirMist Date DRILLED 2 AirMist DATE DRILLED 2 DRILLED BY 23022016 CROUND LEVEL (mOD) 17.52 COR DAMETER (num) 80 DRILLED BY S. Pater (LIG) CRUP COR DAMETER (num) 80 Description IIII CORPORED 23022016 CRUP COR DAMETER (num) 80 Description IIII CORPORED 90 CRUP SYMMETRIX DRILLING: No recovery, observed by driller as weathered rock (continued) 3.38 20 20.90 3.38 21 21.60 SYMMETRIX DRILLING: No recovery, observed by driller as rock. 20.90 23 23 15 Very strong (where competant), medium to think) bedded, builter to costing spaced (noigh to baby spaced (noigh to bab) spaced (noigh to baby spaced (noigh to bab) spaced (noigh to babb) spacer) 24 7				NO	LHOLE	DRIL					Phase 3	oject -	ort Pro	y Transpo	alway City	6 Ga	N	ACT	NTR	CO
CLIENT Galway County Council INCLINATION (deg) -00 RILLED BY S. Peleric Uig did did did did did did did did did d	6	2/2016	23/02		E DRILL	DAT								25.98 N	728,22	(mOE				
20 SYMMETRIX DRILLING: No recovery, observed by driller as weathered rock (continued) 20.90 -3.38 21 21.60 SYMMETRIX DRILLING: No recovery, observed by driller as rock 21.60 22 33 23 15 23 33 23 15 23 23.10 Very strong (where competent), medium to thinly bedded, thuelsh dark grey, fine grained, LIMESTONE, locally fossillerous, localized thert and stylotices, lightly to locally highly weathered contributing to coreloss. 23 7 7 7 24 7 7 7 24 7 7 7 24 7 7 7 24 7 7 7 24 7 7 7 24 7 7 7 24 7 7 7 24 7 7 7 24 7 7 7 24 7 7 7 25 26.00 10 20.00 26 26.00 10 24.60 27 7 7 7 28 29.00 10 24.60 29 20.00 10 24.60 29 20.00 <							1151	-90	1)		INCLINATI			y Council		alwa	G		ENT	CLI
21 20.90 -3.38 21 20.90 -3.38 21 5 YMMETRIX DRILLING: No recovery, observed by driller as rock 20.90 -3.38 22 33 23 15 21.60 -4.08 22 33 23 15 Dips are horizontal to locally doi/leas, slightly to locally highly weathered contributing to coreloss. Dips are horizontal to locally speed, rough to locally spoid. 24.60 23 7 7 7 7 7 24 7 7 7 7 7 24 7 7 7 7 7 24 7 7 7 7 7 24 7 7 7 7 7 24 7 7 7 7 7 24.60 7 7 7 7 7 25 1 1 1 1 1 1 26 1 1 1 1 1 1 1 26 7 7 7 7 7	SPT (N Value)	Standpipe Details	Elevation	Depth (m)								Legend	Non-intact Zone	acing og nm)	Spa Lo (m	R.Q.D.%	S.C.R.%	T.C.R.%	Core Run Depth (m)	
21 SYMMETRIX DRILLING: No recovery, observed by driller as rock 21.60 4.08 22 33 23 15 Very strong (where competent), medium to thinly bedded, fossillerous, localized chern and stylolites), slightly to locally highly wathered contributing to coreloss, slightly to locally highly wathered contributing to corelosality smooth, planar medium to closely spaced, rough to locally 45°. Discontinuities are medium to closely spaced, rough to locally smooth, planar to cocasionally undulose. Apertures are wide, locally clay-filled. 20.02.3.00m - No recovery, possible clay-filled fracture 23.10-24.50m - No recovery, possible clay-filled fracture 23.10-24.50m - No recovery, possible clay-filled fracture 23.10-24.50m - No recovery, possible clay-filled fracture 24.60 -7.08 24 24.60 -7.08 End of Borehole at 24.60 m -7.08	N = 50/10 (25, 50		-3.38	20.90		rved by c	, obse	covery,	NG: No ree ontinued)	RIX DRILLI ered rock <i>(c</i>	SYMMET as weathe									20
22 33 23 15 33 23 15 123 23.10 15 123 23.10 15 123 23.10 15 124 7 7 124 7 7 124 7 7 124 24.60 -7.08 124 24.60 -7.08 124 24.60 -7.08 124 24.60 -7.08 124 24.60 -7.08 124 24.60 -7.08 125 1 1 126 1 1 24.60 -7.08 25 1 1 26 1 1 27 1 1 28 1 1 29 1 1 29 1 1 29 1 1 29 1 1 29 1 1 29 1 1 29					driller	·		-			as rock								21.60	
22 23.10 medium to closely spaced, rough to locally smooth, planar to occasionally undulose. Apertures are wide, locally clay-filled. 24 7 7 7 24 24.60 23.10-24.50m - No recovery, possible clay-filled fracture 23 24.60 24.60 24 24.60 24.60 25 24.60 24.60 26 24.60 24.60 27 24.60 24.60 28 28 24.60 28 28 24.60 29 29 24.60 20 20.02.10m 20.02.200m 29 20.02.200m 24.60 m 29 20.02.200m 24.60 m 29 20.02.200m 24.60 m 29 20.02.200m 20.02.200m 20.02.200m 24.60 m 24.60 m 29 20.02.200m 20.000m 20.02.200m 20.000m 20.000m 20.02.200m 20.000m 20.000m 20.02.200m 20.000m 20.000m 20.02.200m 20.000m 20.000m <td< td=""><td></td><td></td><td></td><td></td><td></td><td>E (locally slightly to loss.</td><td>STONE ites), s o core</td><td>LIMES⁻ d stylolit uting to</td><td>e grained, I chert and ed contrib</td><td>ark grey, fin us, localize hly weathe</td><td>blueish da fossilifero locally hig</td><td></td><td></td><td></td><td></td><td>15</td><td>23</td><td>33</td><td></td><td>22</td></td<>						E (locally slightly to loss.	STONE ites), s o core	LIMES ⁻ d stylolit uting to	e grained, I chert and ed contrib	ark grey, fin us, localize hly weathe	blueish da fossilifero locally hig					15	23	33		22
24 7					ure	smooth, p e, locally illed fract	cally s re wide clay-fi	h to loc ures are ossible o	aced, roug ose. Apert covery, po	o closely sp onally undul 00m - No re	medium to to occasio clay-filled 22.00-23.								23.10	23
End of Borehole at 24.60 m			7.00	24.60		illed fract	clay-fi	ossible (covery, po	50m - No re	23.10-24.					7	7		04.00	
27 28 28 29 29 Water Casing Sagled Pise Time		.~/~	7.00	-1.00				n	at 24.60 r	of Borehole	End								24.00	
28 29 Water Casing Spaled Pise Time																				26
29 Water Casing Spaled Pise Time																				27
REMARKS WATER STRIKE																				28
Vater Casing Sealed Rise Time																				29
Water Casing Sealed Rise Time	DETAILS	RIKE	ER ST	WAT		-	_						_					KS	MAR	REI
StrikeDepthAtToInneComments4.304.304.40Seepage18.5018.50N/S15.505Moderate		s e	mment eepag	Co S	(min)	То	D	At 4.40	Depth 4.30	Strike 4.30					Dm.	21.60).00-2	sed C	e ca	Hol
INSTALLATION DETAILS Date Depth Depth Water Comments		/ATER			0 000	Depth to				Data						ET ^ 1		AT14	T ^ ! !	
Date Tip Depth RZ Top RZ Base Type 24-02-16 18.00 10.50 19.50 50mm SP			,			Water			Depth	Dale					RZ Top	epth	Fip De	٦	Date	



REPORT NUMBER

1															
	ONTRAC				-	oject - Phase 3						BOREH SHEET		BH3/3 Sheet 1	
)-ordin Round I		727	,249.34 E ,540.83 N 45.2	1		PE IOLE DIAN IOLE DEP1	•	nm)	Dando 30).40		DATE C DATE C		NCED 09/02/20	
	IENT IGINEER		alway Cou RUP	inty Cound	cil		MMER RE					BORED PROCES		WC Y JL	
Depth (m)			Γ	Descriptior	1		Legend	Elevation	Depth (m)	Ref. Number	Sample Type	Depth (m)	Recovery	 Field Test Results	Standpipe Details
- 0	Soft lig	ght brow	n sandy g	ravelly CL	AY		<u> </u>	44.87	0.40						
2 2 3 4 5 6 7 8			Possible F le at 0.40	Rockhead m											
9															
H	ARD STI	RATA B	ORING/C	HISELLIN	G										DETAILS
Fro		To (m)	Time (h)	Comme			Wate Strik		asing epth	Sealed At	Ris Tc		ime	Comments	
36.901 12/3/16	0.4	0.4	0.5											No water strike	
	STALLA	יח אסוד					Da	ite	Hole	Casing	De	pth to /ater	GF Comme		PROGRESS
	Date			op RZ B	ase	Туре			Depth	Depth	N	/ater		A 163	
	MARKS	1hr mo after w		cation with	h tracke	d dumper. 0.5h	r reinstating	g field	B - Bulk D	L Disturbed (tub) isturbed Bulk Disturbed ronmental Sam		Vial + Tub)	Sam P - U	Undisturbed 100mm Diarr ple ndisturbed Piston Sample Vater Sample	



REPORT NUMBER

	3L/														030	
CONTR	RACT	N	6 Ga	Iway City Transp	ort Pr	oject -	Phase 3					DRILLHOLE	NO		3/38R	
CO-OR		TES		534,249.34 E							F	SHEET			et 1 of 2	
			(m. C-	727,540.83 N			RIG TYPE			Casagra		DATE DRILL			2/2016 2/2016	
GROUN			•) 45.27 y County Council				N (doc)		Air/Mist -90	-	DRILLED B			SL	
			RUP		·		INCLINATIO		n)	-90 80		LOGGED B			. O'She	a
Ê Ê																
Downhole Depth (m) Core Run Depth (m)	%	%.	%.(Fracture	ne										itails	
e De Del	.C.R.%	S.C.R.%	t.Q.D.%	Spacing	ct Zo				Descript	ion				-	e De	/alue
Rur	 	S	Я	(mm)	Non-intact Zone	pu€							Depth (m)	Elevation	Standpipe Details	SPT (N Value)
Dow Core				0 250 500	Non	Legend							Depi	Elev	Stan	SPT
0				<u>,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,</u>		0	SYMMETR		NG: No rec	overy, obs	served	l by driller				
							as clayey g	ravel								
													1.00	44.27		
1 1.20	U					╞╧╤	SYMMETR as weather	ed rock		-		/	<u> 1.20</u>	44.07		
						┢┰┾	Very strong grained, LI	MESTONE	E (locally fo	ssiliferous	, local	grey, fine ized chert				
2	87	64	42				and stylolite	es), fresh t	o slightly w	eathered.					¥//\\¥//\¥//\\¥//\.	
						╞┼┰	Dips are 20 to medium									
2.70	U					<u> </u>	Apertures a smearing.								<u> </u>	
3						Ē	1.20-1.66m 3.23-3.41m	- Modera	tely weather	ered, slight	t weak	ening.			0 0	
	100	93	88			╞┯╧	3.∠3-3.41M	- wodera	tery weathe	reu, siigh	t weak	ening.			0 0	
4 4.20	0														0 0	
4.20	~ <u> </u>					Ē									0 0	
						╞╧┯	•								0 0	
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5.70	0														0 0 0 0	
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REMAR	_		· · · · ·		600.000	0000000		Mate	Casila	O a a la la		- T		TER S		DETAILS
lole ca	ased C	0.00-2	2.70n	ι.				Water Strike	Casing Depth	Sealed At	Ris Tc		Co	ommen	ts	
													N	lo wate	er strike	recorde
										Casia			GR	OUND	WATER	DETAI
NSTAI	LLATI	ON D	ETAI	LS				Date	Hole Depth	Casing		pth to ater Con	nment	S		
Date			14.00	RZ Top RZ Bas		Ty										



REPORT NUMBER

	991 	5/																
CON				6 Ga	lway City	Transpo	ort Pro	oject -	Phase 3				DRILLI SHEET		NO		3/38R et 2 of	
GRO				(mOl	534,249 727,540 D)	9.34 E 0.83 N 45.27			RIG TYPE FLUSH			Casagran Air/Mist	de DATE				2/2016 2/2016	
CLIE ENGI		ER		alwa RUP	y County	Council			INCLINATI	ON (deg) METER (mn		-90 80	DRILL LOGG				SL O'She	ea
Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Frac Spac Lo (mr 0 ²⁵⁰	cing vg m)	Non-intact Zone	Legend			Descriptio	on			Depth (m)	Elevation	Standpipe Details	SPT (N Value)
- 10 1(0.30								End	of Borehole	at 10.30 m			1	10.30	34.97	0 0 0	
- 11																		
- 12																		
- 14																		
- 15																		
- 17																		
18		ľ																
REM		Ke l													14/ 4 7		DIVE	
Hole	_	_	0.00-2	2.70r	n.		-			Water		Sealed	Rise	Time		mment		DETAILS
REM Hole INST D 18-C										Strike	Depth	At	То	<u>(min)</u>	N	o wate	r strike	
INST	TALI		ON D	ETA	ILS					Date	Hole	Casing	Depth to Water	Comr			VATER	RDETAILS
D 18-(TALLATION DETAILS Date Tip Depth RZ Top RZ Base Type 02-16 8.30 2.80 10.30 50mm SP										Depth	Depth	vvalei					



REPORT NUMBER

	NTRACT	N6 Galway City Transport Pro							BOREHO SHEET	ole no.	BH3/39 Sheet 1 of 1	
	-ordinat ound le'	ES 534,360.45 E 727,402.19 N VEL (m AOD) 41.88	RIG TYPE BOREHOI BOREHOI	LE DIAM		ım)	0ando 300			OMMEN OMPLET	CED 10/02/2016 TED 10/02/2016	
	ENT GINEER	Galway County Council ARUP	SPT HAM ENERGY				1			BY SSED BY	WC JL	1
Depth (m)		Description		Legend	Elevation	Depth (m)	Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
- 0	Driller re GROUN	ports GRAVEL hardstanding (MA	DE		41.48	0.40						
		ion - Possible Rockhead orehole at 0.40 m										
				Wate	er Ca	sing S	Sealed	Rise	т	ime	TER STRIKE DET	AILS
		(m) (h) Comments .4 0.5		Strik	e De	epth	At	To		nin)	omments	
											No water strike	
						Hole	Casing	De	pth to			GRESS
		DN DETAILS	Туре	Dat		Depth	Depth	∣ Ŵ	pth to ater	Commen	IS	
REI	MARKS 0	.50hr moving rig and tracked durr	nper to BH3/39		I	B - Bulk Di LB - Large	e Legend Disturbed (tub) sturbed Bulk Disturbed ronmental Samp	1 10 (10r ±)	(ia) + Tub)	Sample	disturbed 100mm Diameter isturbed Piston Sample ter Sample	
							ontai oamp					



REPORT NUMBER

\sqrt{n}	යි	5													•	090	•
COI	NTR	АСТ	N	6 Ga	lway City Transp	ort Pro	oject -	Phase 3						NO		3/39R	
		DINA D LE	res Vel ((mOI	534,360.45 E 727,402.19 N D) 41.88	5		RIG TYPE FLUSH			Casagrar Air/Mist	da	et E drille E logge		16/0	et 1 of 2/2016 2/2016	3
	ENT GINE			alwa RUP	y County Council			INCLINATIO		n)	-90 80		LED BY GED BY			SL O'She	ea
Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm)	Non-intact Zone	Legend			Descript	ion			Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0								SYMMETF as made g	round con	sisting of cl	ayey grave	1		0.40	41.48		
	1.10							SYMMETF as weathe		NG: No rec	overy, obs	erved by d		1 10	40.78		
1	1.10							Very stron grained, L	MESTONE	E (locally fo	ssiliferous,	dark grey, localized	fine	1.10	40.78		
2		100	96	76		/		and stylolit Dips are h				dium to clo	selv				
	2.60							spaced, ro undulose.	ough to loca	ally smooth	, planar to	occasional	ly .				
3						530											
4	4.10					560											
		100	100	97		820											
5	5.30	100	100	51													
	0.00					620											
6		100	100	100													
	6.80					560											
7																	
		100	100	100		1130											
8	8.20																
		100	100	100		559.9999	99999999										
9		.00	.00	.00		840											
	9.70	100	100	80													
	MAR e cas		0.00-1	l.20n	n.	-			Water Strike	Casing Depth	Sealed At	Rise To	Time (min)		mment		DETAIL
									ounce	Берш		10	(11111)	N	o wate	r strike	e record
											Cooinc	Denth		GRO	DUNDV	VATEF	R DETAII
	TALI Date		ON D		LS RZ Top RZ Bas		Тур		Date	Hole Depth	Casing Depth	Depth to Water	' Com	ment	S		



REPORT NUMBER

Spart (N value)
2016 2016 - 'Shea
'Shea
Standpipe Details SPT (N Value)
trike record
TER DETAI



REPORT NUMBER

	1	_													
		TRAC				Project - Phase 3			-			BOREHC SHEET	DLE NO.	BH3/40 Sheet 1 of 1	
		ORDIN/	ATES EVEL (m	534,43 727,29 AOD)			PE Ole dian Ole dep1	•	nm)	Hand Dug).80		DATE CO DATE CO		CED11/02/2016ED11/02/2016	
				vay County	Council							BORED B		AC	
E	NGI	NEER	ARU	Р		ENERG	Y RATIO (%) 				PROCES	SED BY	/ JL	1
Donth (m)				Dese	cription		Legend	Elevation	Depth (m)	Ref. Number	Sample Type	Depth (m)	Recovery	Field Test Results	Standpipe Details
- (TOPS	DIL (MAD	E GROUN	D)			42.30	0.05	AA49469		0.15-0.50			
		GROU Firm da low to limesto Firm bi	ND) ark grey s medium c ne. rown sligh	lightly sand obble conte	ly slightly g ent. Cobble lightly grav	AVEL (MADE ravelly SILT with a s are of elly silty CLAY t. Cobbles and		42.20 41.85 41.55	0.15	AA49470		0.50-0.80			
	2	boulde Obstru rockhe	rs are ano ction - La ad	gular of lime	estone.	sible weathered									
	5														
	5														
	7														
	HAR		RATA BO	RING/CHIS	ELLING									ATER STRIKE DET	AILS
	om	(m) 1	ō (m)	Time (h)	omments		Wate Strik		sing s epth	Sealed At	Rise To		me nin) C	comments	
														No water strike	
2								to	Hole	Casing	De	oth to		DUNDWATER PRO	GRESS
10303.6F		ate	TION DET	AILS	RZ Base	Туре	Da	te	Depth	Depth	Ŵ	oth to cater c	Commer	nts	
IGSL BH LOG 18963.GPJ IGSL.GDT 12/5/16	EM	ARKS	Hand du	g pit at loca	ation of BH3	3/40			B - Bulk D LB - Large	e Legend Disturbed (tub) isturbed Bulk Disturbed ronmental Sam	i	/ial + Tub)	Sample P - Uno	ndisturbed 100mm Diameter a sisturbed Piston Sample ater Sample	



REPORT NUMBER

	GS NTR/	/	N	6 Ga	lway City	Transp	ort Pr	oject -	Phase 3					LLHOLE	NO		3/40R	
GRO		DINAT	VEL	-	534,439 727,299 D) y County	5.41 N 42.35			RIG TYPE FLUSH			Knebel Air/Mist	DAT	ET E DRILLI E LOGG	ED	29/0 29/0	et 1 of 2 2/2016 2/2016 2/2016	
		ER		alwa RUP		Counci	1		INCLINATIO		m)	-90 80		GED BY			. Peters . O'She	
Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Frac Spac Lo (mi 0 ²⁵⁰	cing og m)	Non-intact Zone	Legend			Descrip				Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0									as peaty T	OPSOIL. RIX DRILL e weathere	ING: No rec ING: No rec ed rock - rec	covery, obs	erved by o	driller	0.40	41.95		
3										g, thick to IMESTON	ING: No rec thinly bedde E (locally fo to slightly w	ed, blueish ssiliferous,	dark grey	, fine	<u>2.60</u> 2.80	39.75 39.55		
4 4.30									medium s	paced, rou	ly 40°. Disc gh to locall <u>y</u> partly ope	y smooth, p	lanar.				0 0 0 0 0 0	
	5.90	100	100	95			810		5.19-5.21r	n - Clay-fil	led fracture						0 0 0 0 0 0	
7	7.40	100	100	100			800										0 0 0 0 0 0	
8		100	100	100								_					0 0 0 0	
9	9.00	100	100	100			85 0 770				\bigwedge							
		_	.00-2	2 800	n					Water	Casing	Sealed	Rise	Time			_	DETAILS
	e cas	seu U	.UU-2	2.0UN						Strike	Depth	At	To	(min)	N		er strike	e recorde
															GR			DETAIL
NG.	ייאד	ΔΤΙ	ON D	ET VI	19					Date	Hole Depth	Casing Depth	Depth t Water	0 000	ment			



REPORT NUMBER

	ଟ୍ର	Ŀ/					-										1	890	3
	ORE			l6 Ga	534,43	y Transp 39.24 E 95.41 N	oort Pr	oject -	Phase 3			Kratst		BHEE		ED	Shee 29/0	3/40R et 2 of 2/2016	2
CLII	DUN ENT BINE		G	(mOl Jalwa RUP	D)	42.3 y Counci			RIG TYPE FLUSH INCLINATI CORE DIAI		m)	Knebel Air/Mist -90 80		DRIL	E LOGGI LED BY GED BY	,	S.	2/2016 Peters O'She	sen
												00					D.	U SH	a
Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Spa L (n	cture acing og nm) ^{50 50}	- 8 Non-intact Zone	Legend			Descrip	tion				Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10	10.10								End	of Borehole	e at 10.10 r	n				10.10	32.25	0 0	
11	12																		
13																			
14																			
15																			
16																			
17																			
18						_													
19									D										
	/IAR	_														WAT	FER ST	RIKE	DETAILS
Hole	e ca	sed C).00-2	2.80r	n.					Water Strike	Casing Depth	Sealed At		Rise To	Time (min)		mmen o wate		e recorde
																GRO	DUNDV	VATER	
	TALI	LATIO		ETA	LS					Date	Hole	Casin	g [Depth to Water	Com	ment			/
NS						RZ Bas		Ту			Depth	Depth	<u>ר</u>	vvaler					



Project												Ι	DRILLH	OLE	No
1	N6 Gal	way City	y Outer B	ypass									RC 1	110	4
Job No			Date 29-	-11-06	6	Ground Level (m))	Co-Ordina					RC	1104	•
			30-	-11-06		9.39		E 13	1,197.5	5 N 228,	895.3	_			_
Contrac												SI	heet	1 of 3	
	IDL											1		01 0	1.2
RU		TAILS (SPT)			Denth		ST	TRATA	ODIDI					20	nent II
Depth Date	(SUR)	(SPT) Fracture	Red'cd Level	Legend	Depth (Thick-			DES	CRIPT	ION	Tax Part Care			Geology	strur ackfi
0.00	RQD	Spacing			ness)	Discontinuities 0.00 - 2.00		Deta	200 L.	en hole dril	Main ling - no re	cover	v	5	Instrument/
0.00									-				<i>.</i>		
	0				-										
	(-)	NA			-(2.00)										
					Ē										
					Ē										
2.00			7.39	X OX	- 2.00	2.00 - 17.00			Gro	ey slightly s	andy grave	elly		_	
	30 (-)			Ox of	Ê				SII	T/CLAY viestone cob	vith some a	issorte	ed s		
	-			DY V						cotone coo	ores and be	under			
3.00				\$ *0*0× %											
	20 (-)			×Ox x											
1.00	-			()×.	F										
4.00	67	(50/150)		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$											
4.50	(-)			∞,× c	È										
				× × × ×	F										
	25			\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$	Ē										
	(-)			€ ° ° ° × ° × ° × ° × ° × ° × ° × ° × ° × ° ×	E										
6.00				××¢											
6.00		(A.E)		×°× €	Ē										
	21			ex at	Ē										
	21 (-)			× c ×	F										
	-				Ê										
7.50)			~×o	È										
				2 °0 × 2	È										
	21			UX.	-										
	(-)			O×.	E										
9.00				°× °€ ≈ × °¢	-										
		(45)		O. ox	F										8.8
	26 (-)			×O× ×	E (15.00)										83
-	-			Q×°*	F										
10.00	_	lling Pro	ogress and	1.00	1	rvations			Rotary	Flush		[CENE	DAI	
Date	Ti			Casing h I		e Dia Wate	r	From	То	Туре	Returns		GENE REMA		
	11		Dept	n 1	na n	nm Strike S	standing			- JPC		19m	m standpip lled to 19.	_	
												insta polv	dled to 19. drill used t	70m.2	gls of st
												drilli	ing.		
2000															
All dim	ensions etres e 1:62.5	in Client	Galway (County	Counci	il	Method/ Plant Us	Count	ty Trac	tor	Bit H Design	Q	Logged I	By EAT	



Project DRILLHOLE N6 Galway City Outer Bypass												E No		
1	N6 Gal	way Cit	y Outer B	ypass								D	C 110	4
Job No			Date 29-	-11-06		Ground Level (m)	Co-Ordinates				R	5 110	4
			30-	-11-06		9.39		E 131,	197.5	N 228,	895.3			
Contrac												Sheet	2 of	3
	DL													
RU		TAILS				1	S	FRATA					- 2	Instrument/ Backfill
Depth Date	TCR (SCR)	(SPT) Fracture		Legend	Deptl (Thick-			DESCI	RIPTI	ON			Geology	strun tekfi
Date	RQD	Spacing			ness)	Discontinuities		Detail	Grev	slightly s	Main andy gravell	V	<u> </u>	B
11.50	100 (-)	(50/150		× Q* Q* Q* Q* Q* A					SILT	/CLAY w	vith some assoles and boul	sorted		
13.00	44 (-) -			≫×Q [×] , ⊗×Q [×] , ⊗ ∞ °O × Q [×] ⊗										
	100 (-)	NA		\$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$		13.20 - 13.20 b brown slightly	ecoming o gravelly.	orange						
14.50	100 (-)			0×0×0×0×0×0×0×0×0×0×0×0×0×0×0×0×0×0×0×										
17.00	100 (-) -		-7.61	× Q × Q × Q × Q × Q × Q	17.0	0								
17.30	(86)		-7.0	ΓŢ.Τ	=	17.00 - 20.00 N			Stro	ng slightly	weathered g	grey thinly	y	
18.50	0 100 (77) 49	3			(3.00)	dipping 38 to 4 irregular, rougl silt smear. 17.60 to 18.2n undulating, loc with greyish br 17.80 to 18.0m	n, with ora n: Joint: su ally irregu own silt, o	ange brown abvertical, alar, rough, open.	sligh	itly sandy	LIMESTON	IE.		
1P TEMPLATE.GU1 09/	100 (71) 60	5	-10.6		20.0	rock. 18.75 to 18.95 undulating, loc with greyish br silt, wide.	ally irregu	ılar, rough,					T	
20.00		lling Pro	araca an	d Wate	r Obse			Ro	otary F	lush		GF	ENERA	<u> </u>
Date	-		pth Den	Casing	Co	re Dia Wate	standing	From	To	Туре	Returns		MARK	
Date Date			Dep		Dia	mm Strike S					i I	9mm star nstalled to	ndpipe pie o 19.70m. ised to ass	zometer 2gls of
All dim	ensions etres e 1:62.5	in Client	Galway	County	Cound	cil	Method/ Plant Us		Tracto	or	Bit HQ Design) Log	ged By EA	Т
□ Scale	e 1:62.5	_					1						Dit	•



Project			vay City Outer Bypass DRILI													
	N6 Gal	way Cit		ypass									RC	110	4	
Job No			Date 29-	-11-06	G	Ground Level (m	1)	Co-Ordina					NO	110-		
Contrac	tor		30-	-11-06		9.39		E 13	51,197.	5 N 228,	895.3	SI	neet	3		
	DL												icci	of 3	3	
_		TAILS					S	ΓRATA							nt/	
Depth	TCD	(SPT)	Red'cd	Legend (Th	Depth				SCRIP	TION				Geology	Instrument/ Backfill	
Date	(SCR) RQD	Fractur Spacin	e Red'cd g Level	Legend (1h nes	s)	Discontinuities	1	Det			Main			Geo	Instr Bacl	
				Ē					Bl	H terminated struction.	1 at 20.0m	bgl on	RE's			
				Ē												
				Ē												
Date	_	1	ogress and	d Water C Casing	Core	Dia Wat	er		-	/ Flush	Returns		GEN REM	ARKS		
	11	Illing Progress and Water Observations Rotary Flush GENE me Depth Casing Dia Core Dia Mater From To Type Returns REMA Image: Depth Depth Depth Dia Mm Strike Standing From To Type Returns 19mm standpign installed to 19. polydrill used to 19. polydri												pe piez .70m.2	ometer gls of	
All dim me Scale	ensions etres 1:62.5	in Clien	Client Galway County Council Method/ County Tractor Bit HQ Design											By EAT		



Project	N6 Galway City Outer Bypass													OLE	No
	N6 Gal	lway City		ypass									MW	01	
Job No			Date 06-	10-06		Ground Level (m	1)	Co-Ordinate						01	
Contrac			09-	10-06		16.14		E 128	,703.9	N 227,	927.7	CL	heet		
	DL											SI	leet	1 of 2	
		FAILC					C'							_	ť
	TCR	TAILS (SPT)			Dept	h	2	TRATA DESC	CRIPT	ION				gy	umen fill
Depth Date	(SCR) RQD	Fracture Spacing	Red'cd Level	Legend	(Thick- ness)	Discontinuities	e	DESC		IOIN	Main			Geology	nstru Backi
0.00	0	NA	15.64		(0.50) 0.5	0.00 0.50			St	en hole dril	ling - no re	cover	у.		Instrument/
	100 (57)	1				0.50 - 13.80 C medium space spaced, dippin	d to 7.6m, g 30 to 32	then widely	fine	to coarse	esh grey th grained slig with some	htly s	andv		
1.40	50 100	10				undulating, loc with a little gro	cally irregu	ılar, smooth,							
2.90	(98) 53	6													
	100 (99) 96	3			· · · · · · · · · · · · · · · · · · ·										
4.40	100	2													
6.00	(94) 88	4				5.15 to 5.42m: planar, locally rough, with a l silt, open.	irregular,	stepped,							
	100 (98) 83	1			- - - - - - - - - - - - - - - - - - -	n									
7.60		3													
	100 (96) 95	1			1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1										
9.20	100	3			+ 										
	Dri	illing Pro	gress and			ervations		R	otary	Flush			GENE		
Date	Ti	me De	pth Dept	Casing h I	Dia Co	mm Strike	er Standing	From	То	Туре	Returns		REMA		_
9.20 Date All dim												50mi 13.80	m standpir Om.	e insta	illed to
All dim Scale	ensions etres e 1:62.5	in Client	Galway (County	/ Coun	cil	Method Plant U	County Sed	y Tract	tor	Bit H Design	Q	Logged I	By EAT	



Project													Ι	DRILLH	IOLE	No
	N6 Gal	lway City	y Outer B	ypass										6/1\0	/ 01	
Job No			Date 06	-10-06		Grour	nd Level (Co-Ordin						101	
0			09	-10-06			16.14	1	E 12	28,703.9	9 N 227,	927.7			-	
Contrac	DL												SI	heet	2 of 2	!
		TAILO							TDATA						1	
		TAILS (SPT)		T	Dept	h		5	TRATA	SCRIPT	TION				gy	Instrument/ Backfill
Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	(Thick- ness)	-	continuiti	es	Det			Main			Geology	nstru Backf
	(96) 95	optioning			-	1010	continuiti			Ve	ry strong fr	esh grey thi	ckly	bedded	0	
		1								LI	e to coarse MESTONE	with some	htly s shelly	sandy y debris.		
10.80		· ·								(00	ontinued)					
	100				Ę											
	(99) 98	1			Ē											
			_													
12.20																
		0			Ę											
	100 (99)		_		Ē	1										
	98	0														
13.80		0	2,34		- 13.8	0										
	BH terminated at 13.8m										d at 13.8m b	ogl on	n RE's			
	Instruction.															
					Ē											
					Ē											
					-											
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				_	F									_		
	-		ogress and				ons w.	ater		Rotary		D		GENE REMA		
Date	Ti	me De	pth Dept	Casing th [Dia	ore Dia mm	Strike	ater Standing	From	То	Туре	Returns	50		-	lled
													13.80	m standpi 0m.	je insta	ined to
Date All dimm Scale	ensions etres	in Client	Galway (County	Cound	cil		Method Plant U		ity Trac	tor	Bit Ho Design	Q	Logged	By	v
Scale	etres 1:62.5							Plant U	200			Design			EAI	

