

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

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Job number 233985



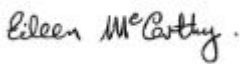







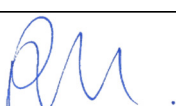

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1 Introduction

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.

Table 1 Standard underbridge mainline chainages.

Name of Structure	Chainage
S06/01 - Ragoon 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

Table 2 Site description and topography.

Name of Structure	Site description and Topography		Archaeology at Structure	Ecology at Structure
	N6 Mainline	Road under		
S06/01 - Ragoon 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 Minclon	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

Name of Structure	Site description and Topography		Archaeology at Structure	Ecology at Structure
	N6 Mainline	Road under		
S09/01 - Menlo Castle Boithrin Underbridge	Mainline on embankment.	Local road at grade or shallow cut.	<p>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.</p> <p>A designated landscape listed in Chapter 13 as DL8 - Menlo Castle Demesne</p>	<p>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</p> <p>Underbridge to provide bat and badger passage, MU33</p>
S10/02 - Seanbothar Underbridge	Mainline on embankment.	Local road at grade or shallow cut	<p>Site of cultural heritage listed in Chapter 13 as CH51 - Possible boulder of archaeological potential</p>	<p>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.</p> <p>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.</p> <p>Underbridge to provide bat passage, MU37</p>
S12/01 - N84 Headford Road Underbridge	Mainline on embankment.	N84 road at grade or shallow cut	<p>A townland boundary listed in Chapter 13 of the EIS as TB25 - Stone wall and hedgerow Ballindooley/ Castlegar</p>	<p>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.</p>

Name of Structure	Site description and Topography		Archaeology at Structure	Ecology at Structure
	N6 Mainline	Road under		
S13/02 - N17 Tuam road Underbridge	Mainline on embankment.	N17 road at grade or	<p>A townland boundary listed in Chapter 13 of the EIS as TB26 – Tuam Road</p> <p>A townland boundary listed in Chapter 13 of the EIS as TB27 - An Caisleán Gearr/ Cappanabornia</p> <p>Site of cultural heritage listed in Chapter 13 as CH55 - Site of vernacular structures marked on 1895-1900 map. No longer extant</p>	- 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.	<p>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.</p> <p>A townland boundary listed in Chapter 13 of the EIS as TB32 - Doughiska/Coolagh/ Breanloughaun</p>	- None

2.5 Vertical and horizontal alignments

Table 3 Vertical and horizontal alignments.

Name of Structure	N6 Mainline		Underbridges	
	Vertical Alignment	Horizontal Alignment	Vertical Alignment	Horizontal Alignment
S06/01 - Ragoon 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

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.

Table 4 Dimensions below bridge deck.

Name of Structure	Carriageway Width (m)	Raised Verge Width (m) - Left [1]	Raised Verge Width(m) - Right [1]
S06/01 - Ragoon 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	17.25min	4.0	1.5min
S15/01 - Briarhill Business Park Underbridge	6.0	2.0	2.0
S15/02 R339 Underbridge	16.0min	2.0	2.0

[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.

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

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 - Ragoon 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

[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 outlined in Table 6 below.

Table 6 Existing Services

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

2.8 Geotechnical summary

Table 7 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.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.

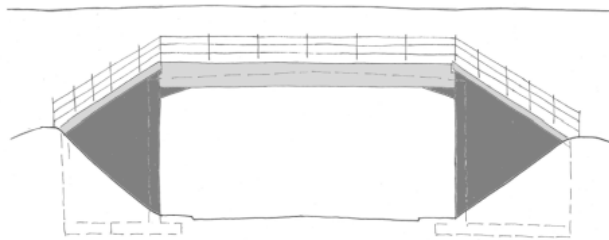


Figure 1 Underbridge Type 1

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.

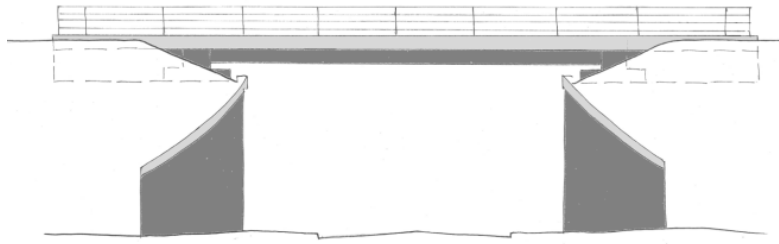


Figure 2 Underbridge Type 2A

- **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.

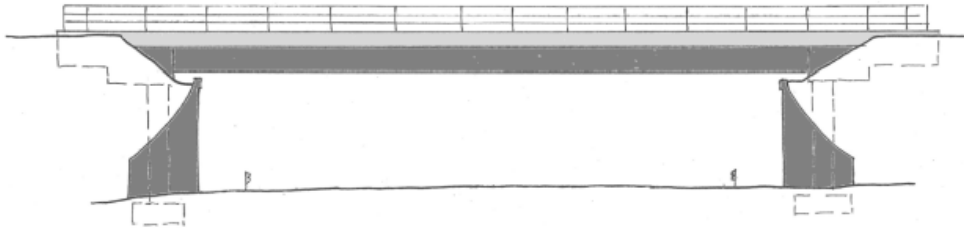


Figure 3 Underbridge Type 2B

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.

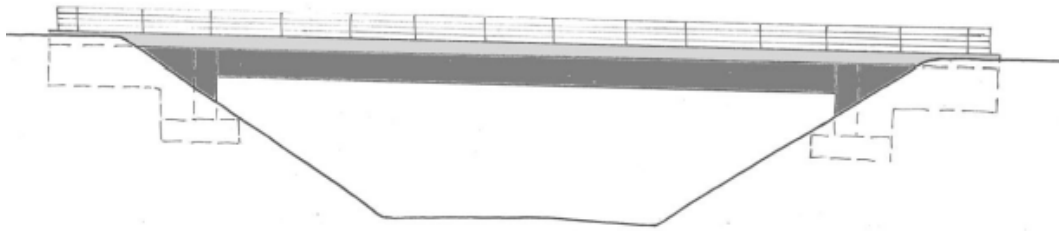


Figure 4 Underbridge Type 3

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 8 Span arrangements for Type 1.

Name of Structure	Span arrangement	Clear span (m)	Length of structure (m)
S06/01 - Ragoon 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 (≥ 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 consist 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 (≥ 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 (≥ 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

Table 11 Budget estimate

Name of structure	Structure Cost Excl. VAT (Million euro)
S06/01 - Ragoon 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 11 are 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 12 Basis 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 $q_{fk} = 5\text{kN/m}^2$ 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 - Ragoon 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

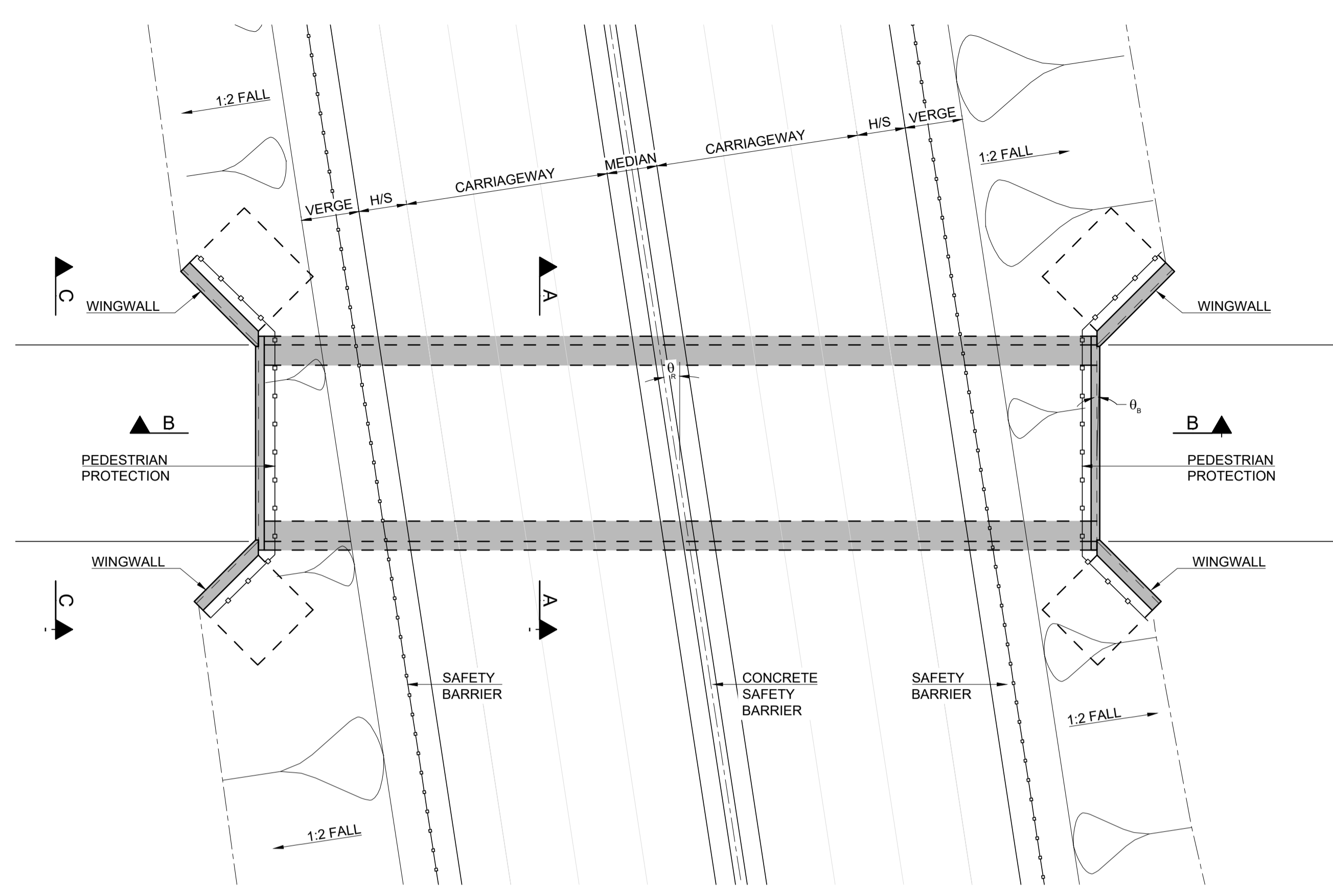
Table 14 Drawings

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

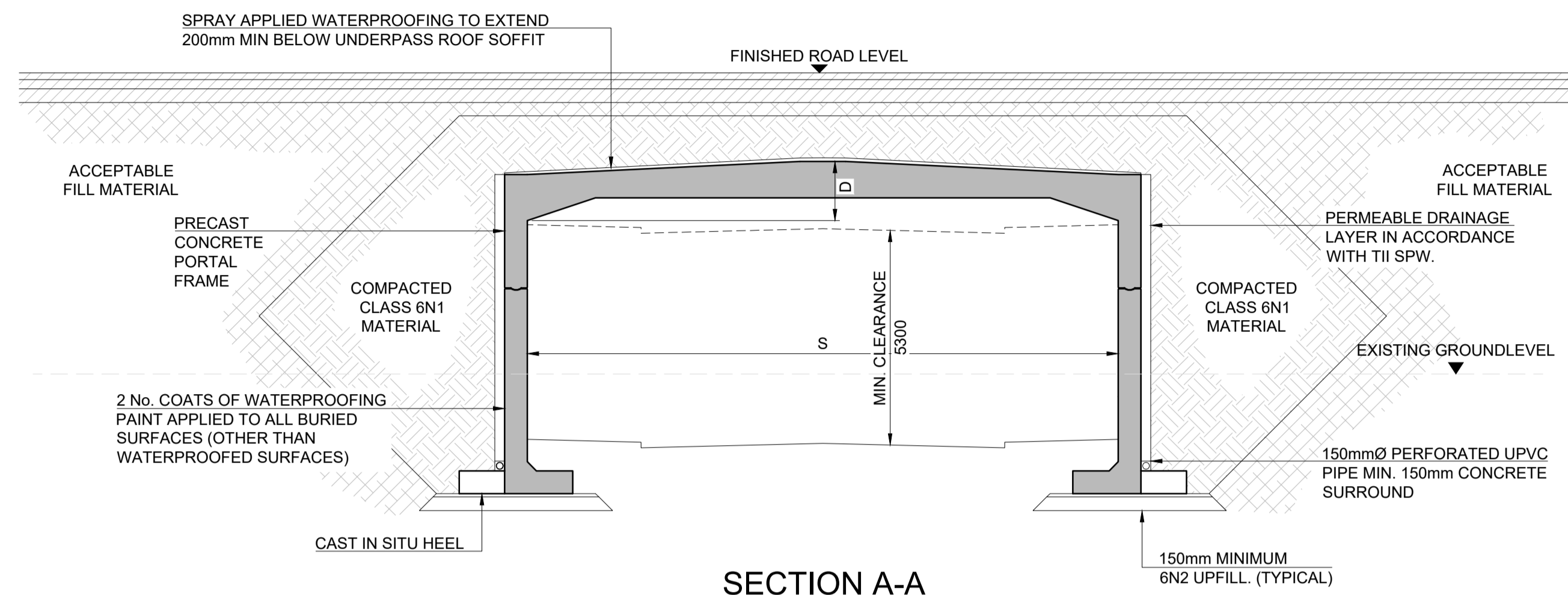
Appendix A

Drawings

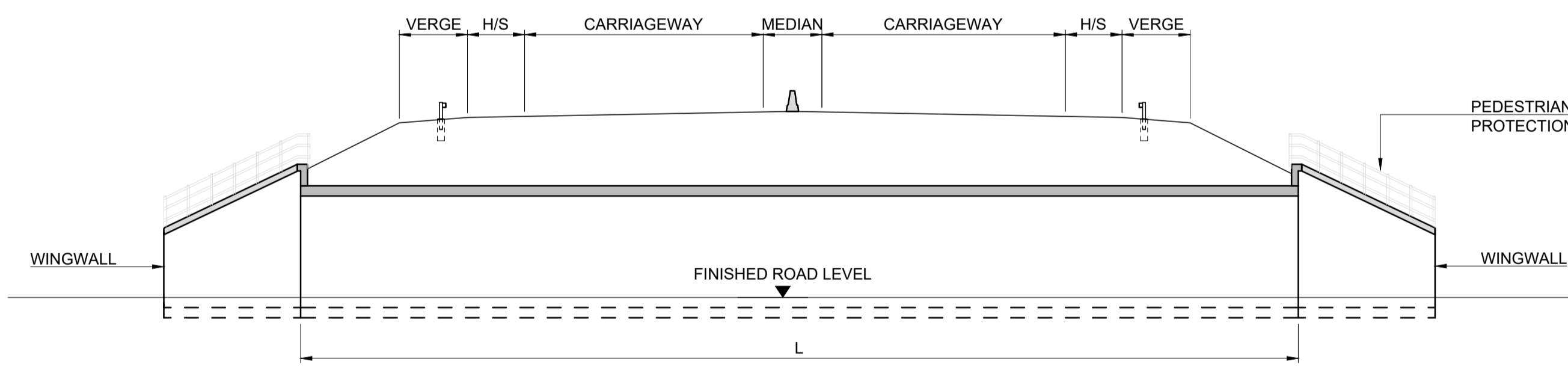
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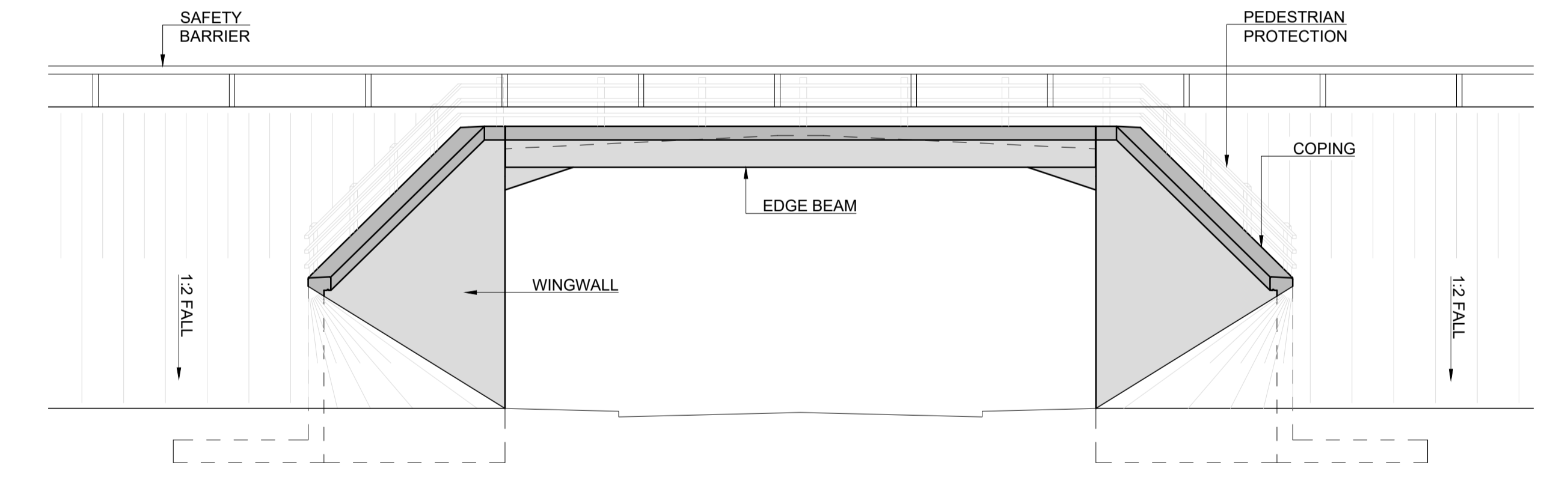
PLAN ON STRUCTURE
SCALE 1:200



SECTION A-A
SCALE 1:100



SECTION B-B
SCALE 1:200



ELEVATION C-C
SCALE 1:100

Reference	Name	Chainage	Clear Span, S [m]	Length, L [m]	Structural Depth, SD (including haunch) [m]	Bridge Skew Angle, θ_B (deg)	Road Skew Angle, θ_R (deg)
S06/01	Rahoon Road Underbridge	06+335	12.5	52.0	1.30	0	36
S07/01	Letteragh Road underbridge	07+290	12.5	71.0	1.30	0	25
S09/01	Menlo Castle Boithrin Underbridge	09+730	10.0	37.0	0.75	0	0
S10/02	Seanbothar Underbridge	10+520	9.8	49.0	0.75	0	32

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Date
November 2016

I3	30/06/2017	PD	PM	EMC
I2	11/11/2016	PD	PM	EMC
I1	04/07/2016	PD	PM	EMC
Issue	Date	By	Chkd	Appd

Drawing Title
Standard Underbridges: Type 1

Drawing Status

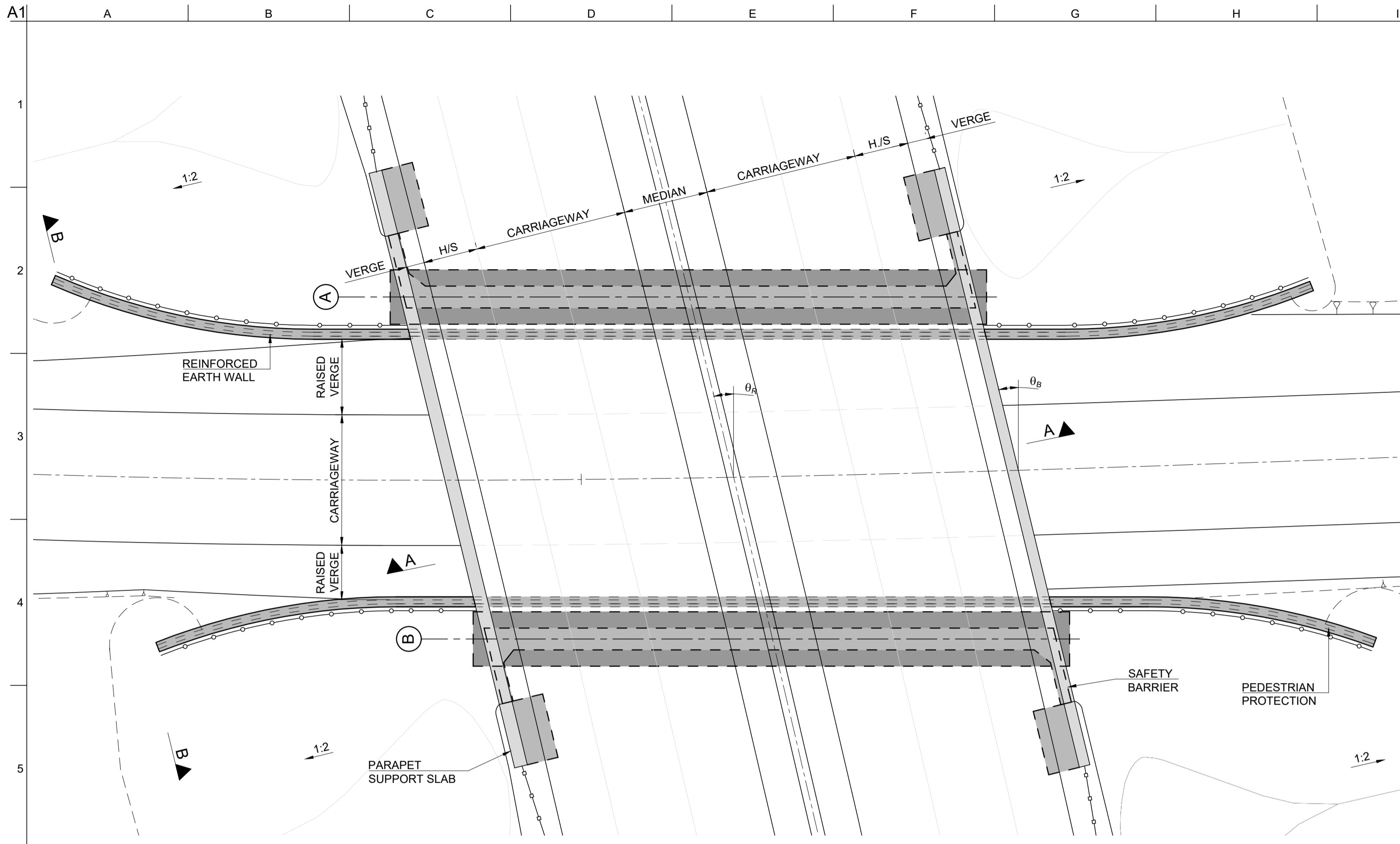
For Information

Job No
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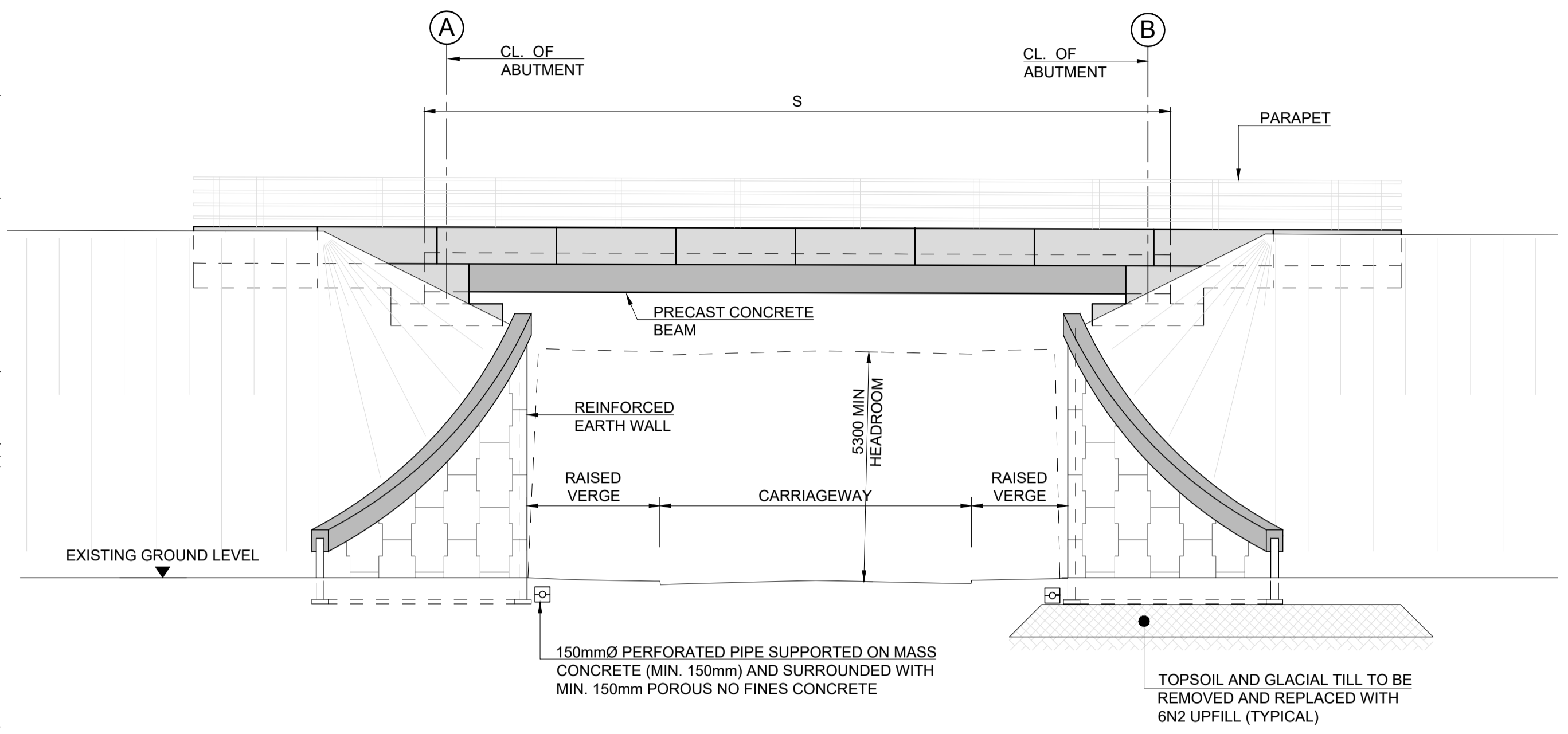
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Issue
13

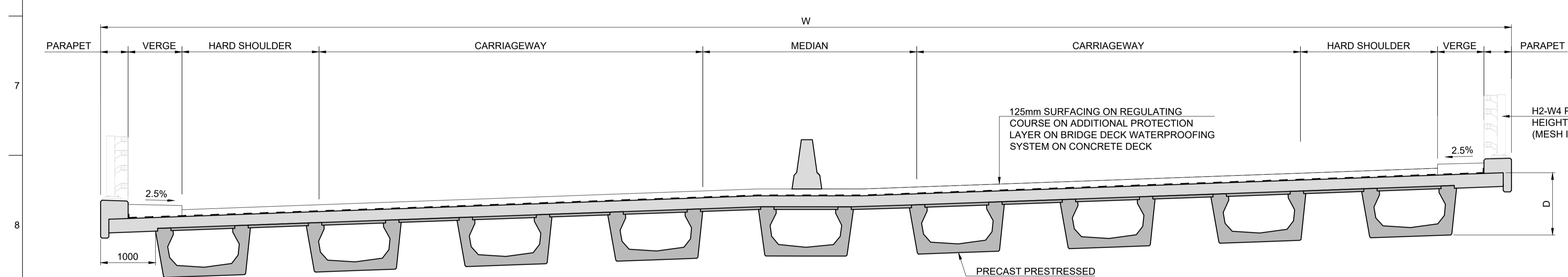
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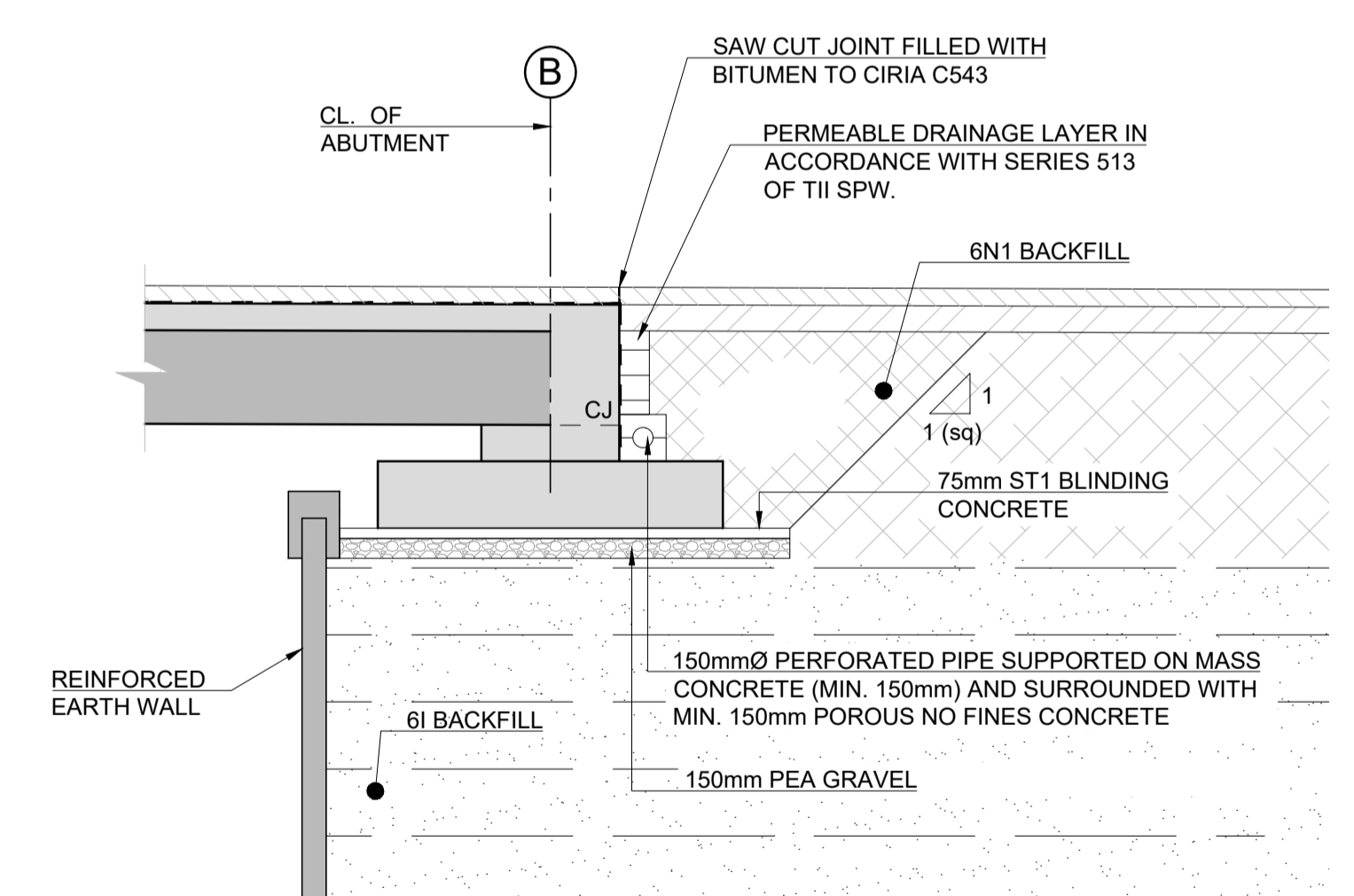
PLAN ON BRIDGE
SCALE 1:150



SECTION B-B
SCALE 1:100



SECTION A-A
SCALE 1:50



TYPICAL ABUTMENT CROSS SECTION
SCALE 1:50

Reference	Name	Chainage	Total Deck Length, S [m]	Width, W [m]	Structural Depth, D [m]	Bridge Skew Angle, θ_B (deg)	Road Skew Angle, θ_R (deg)
S15/01	Briarhill Business Park Underbridge	15+725	15.5	25.1	1.15	8	8

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Clients

Comhairle Chontae na Gaillimhe
Galway County Council

Galway City Transport Project

An Roinn Iompair Turasóireachta agus Spóirt
Department of Transport, Tourism and Sport

TII
Transport Infrastructure Ireland

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I3	20/04/2017	PD	PM	EMC
I2	11/11/2016	PD	PM	EMC
I1	04/07/2016	PD	PM	EMC

Drawing Title
Standard Underbridges:
Type 2A

Drawing Status

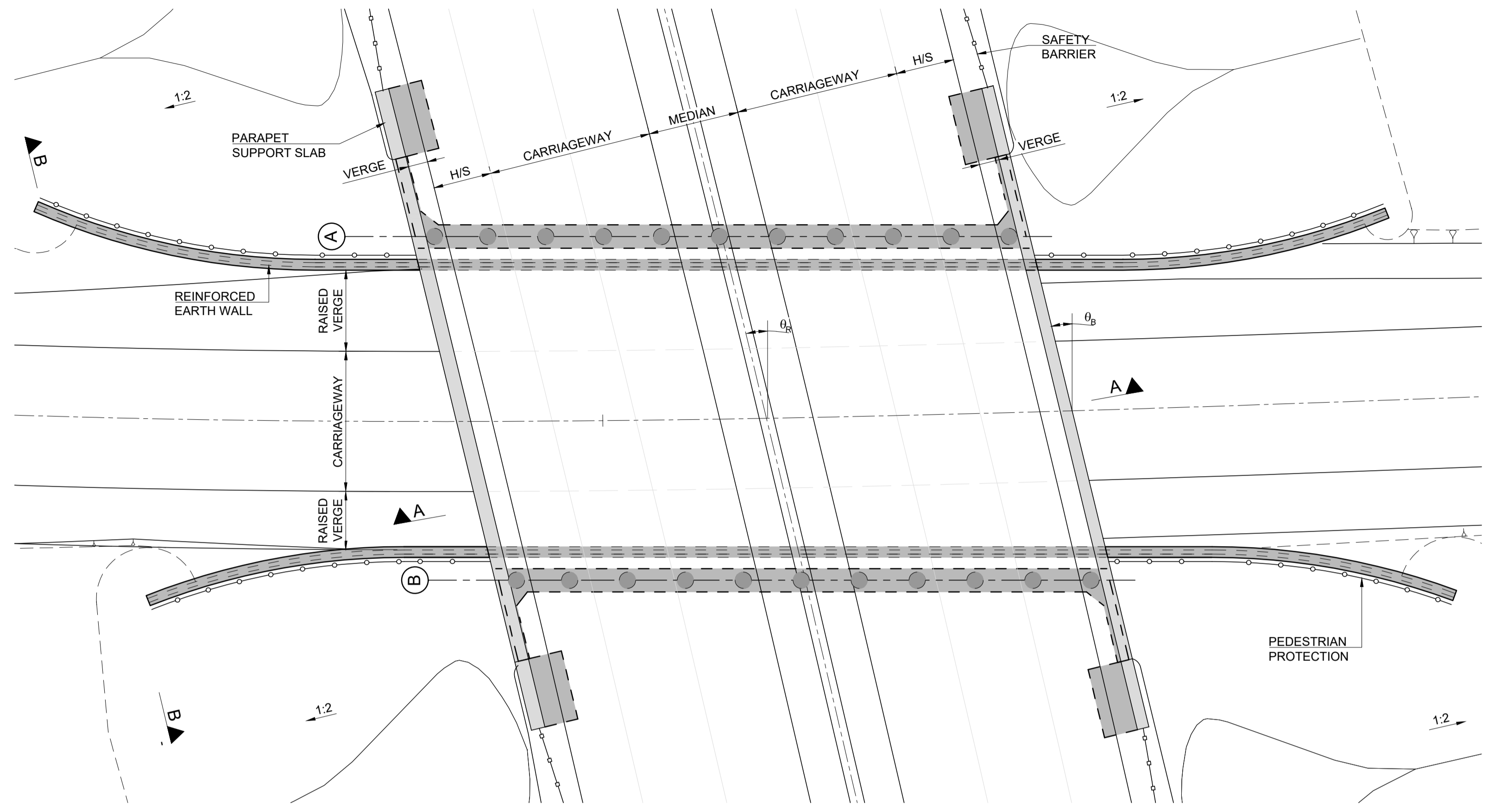
For Information

Job No
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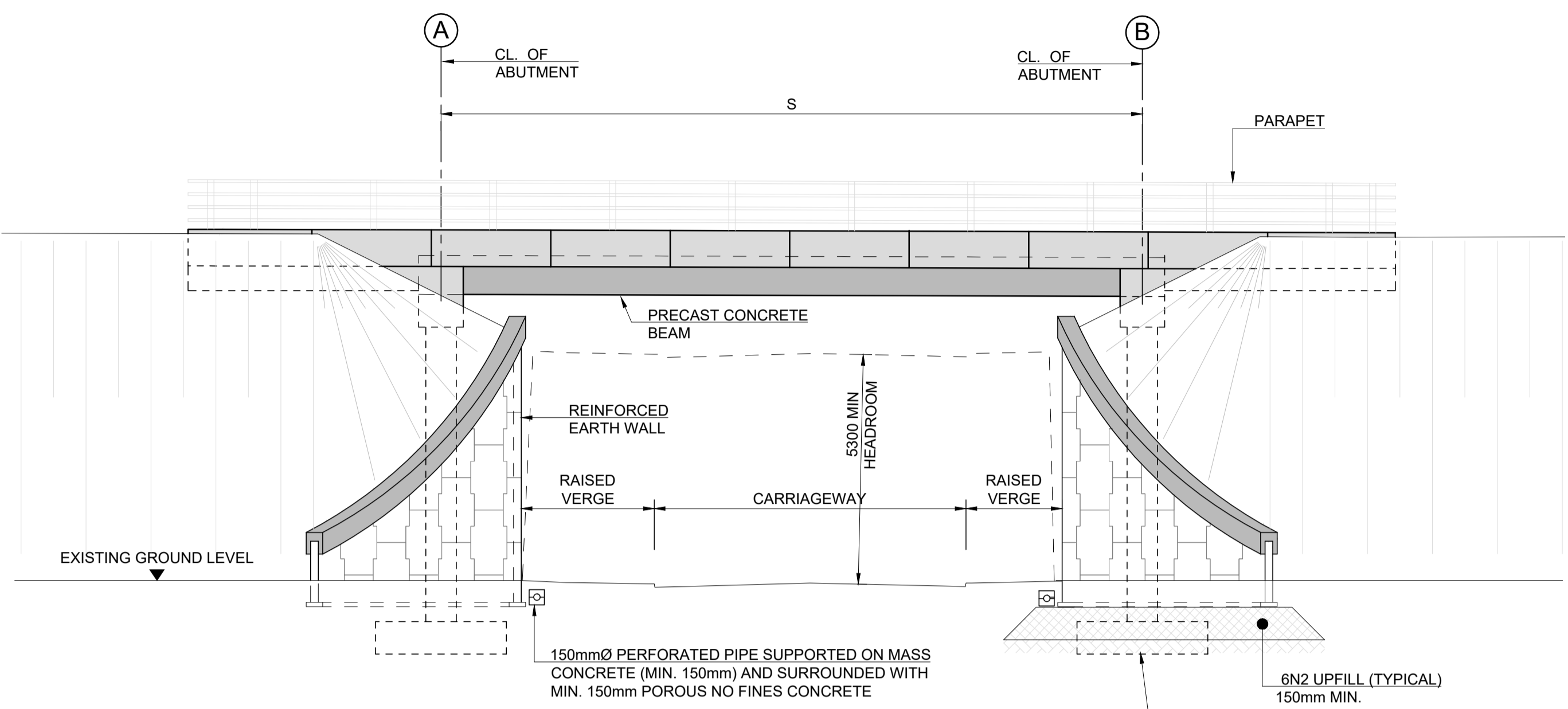
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Issue
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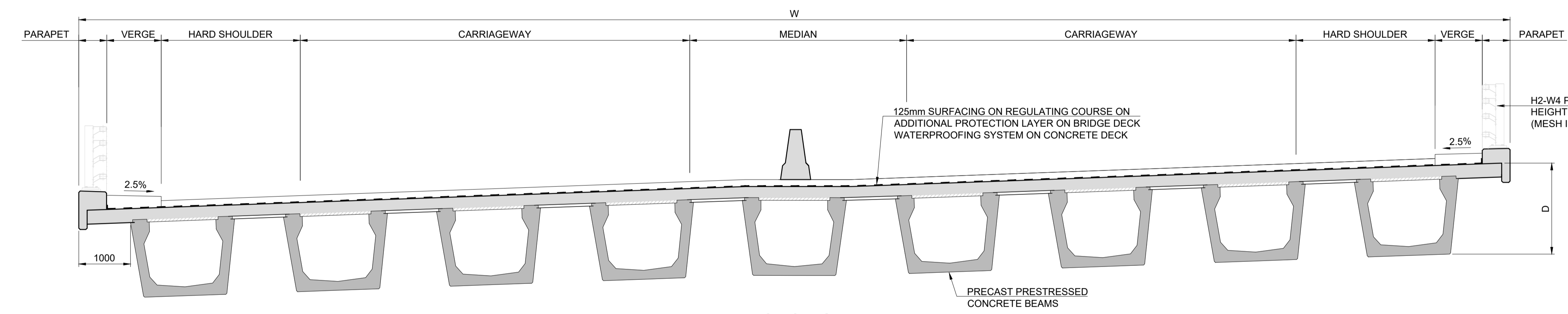
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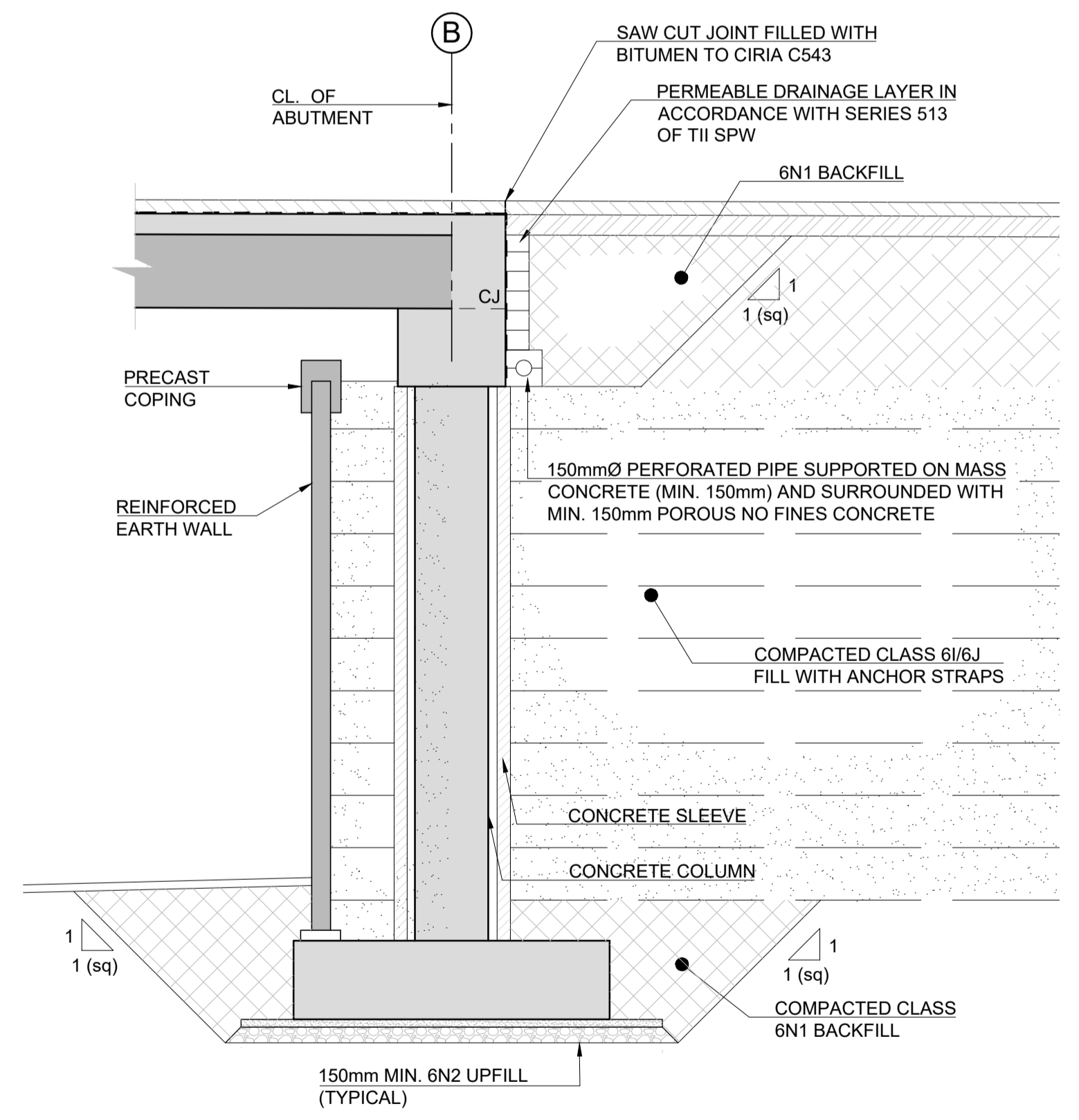
PLAN ON BRIDGE
SCALE 1:150



SECTION B-B
SCALE 1:100



SECTION A-A
SCALE 1:50



TYPICAL ABUTMENT CROSS SECTION
SCALE 1:50

Reference	Name	Chainage	Span, S [m]	Width, W [m]	Structural Depth, D [m]	Bridge Skew Angle, θ_B (deg)	Road Skew Angle, θ_R (deg)
S07/02	N59 Link Road North Underbridge	07+570	27.0	23.8	2.05	6	6
S12/01	N84 Headford Road Underbridge	12+150	23.4	32.9	1.55	4	4
S13/02	N17 Tuam Road Underbridge	13+975	32.6	45.4	1.85	30	47
S15/02	Monivea Road R339 Underbridge	15+880	26.6	31.6	1.55	6	6

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I3	20/04/2017	PD	PM	EMC
I2	11/11/2016	PD	PM	EMC
I1	04/07/2016	PD	PM	EMC

Drawing Title
**Standard Underbridges:
Type 2B**

Drawing Status

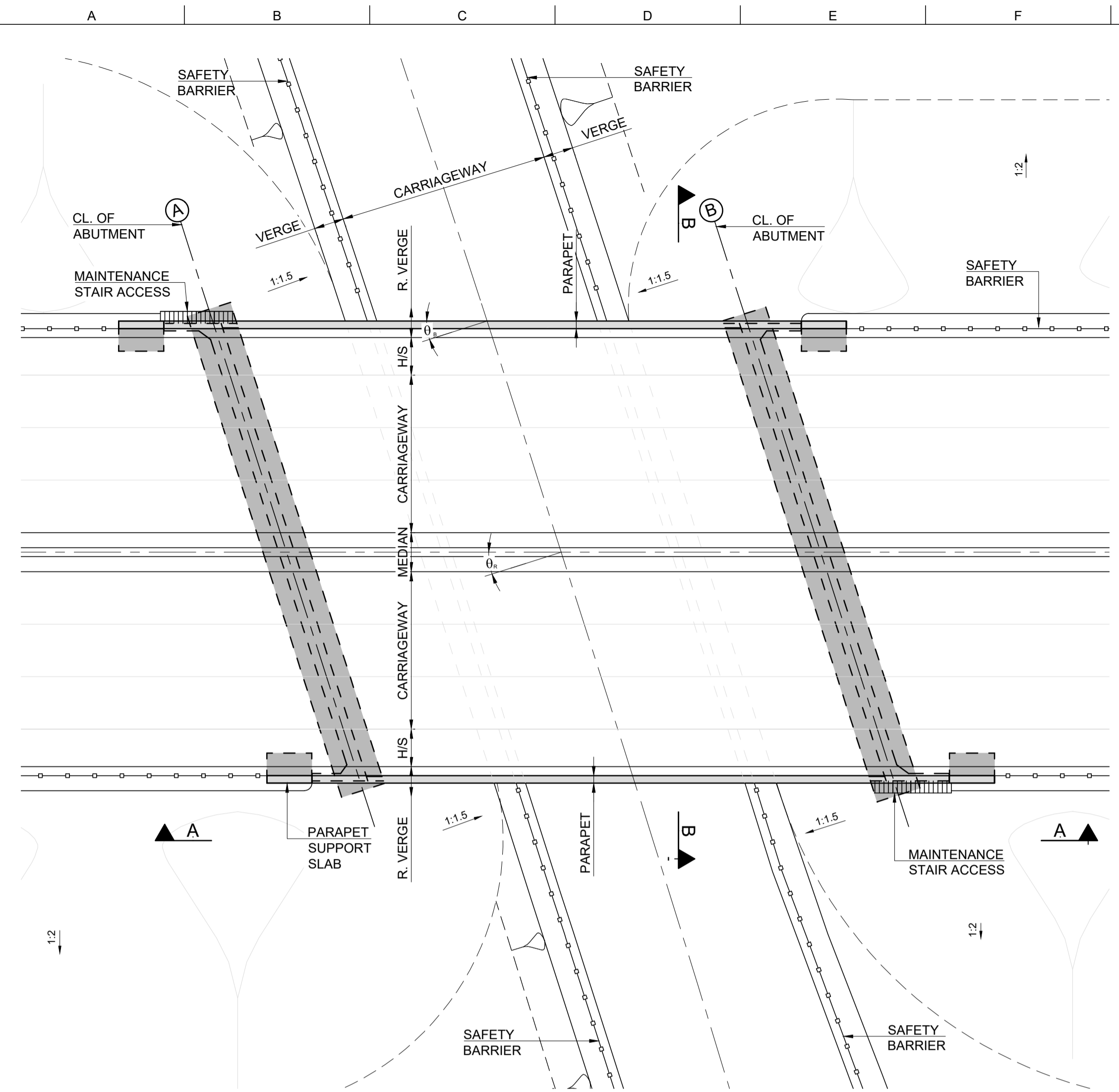
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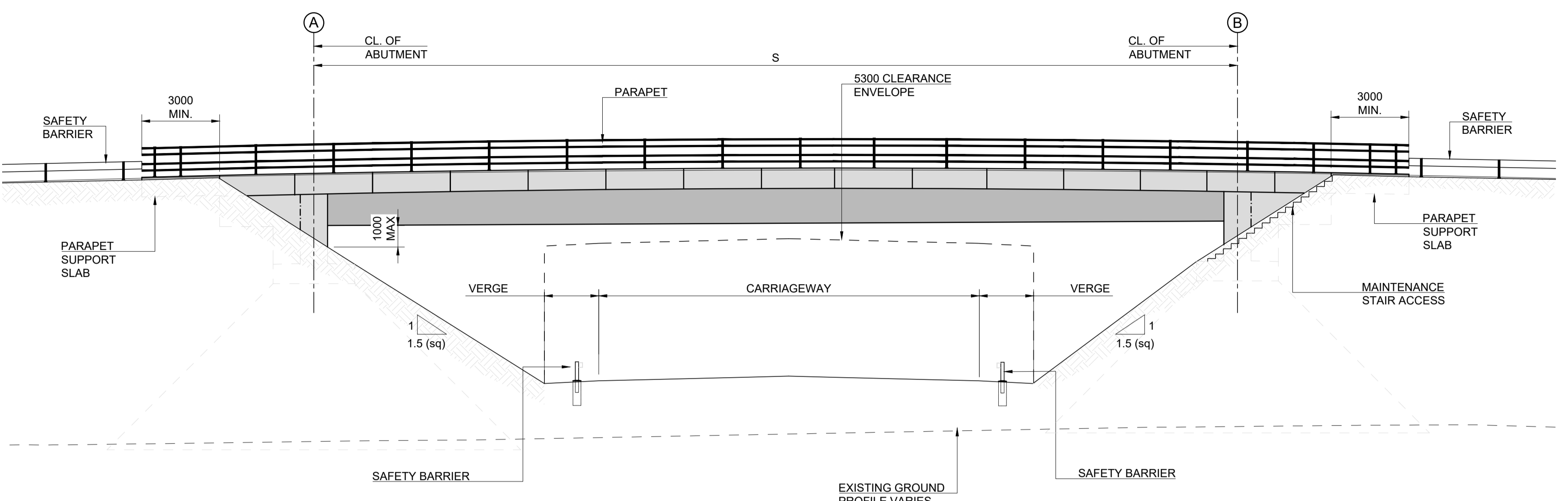
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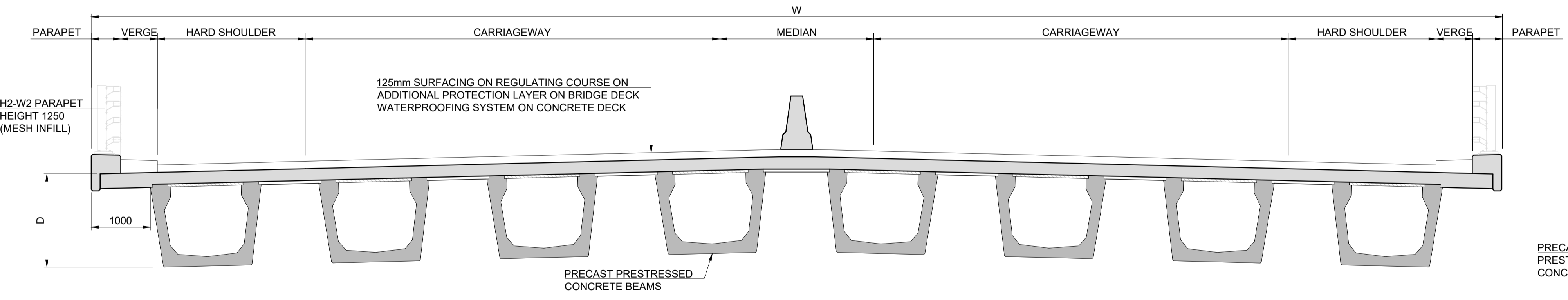
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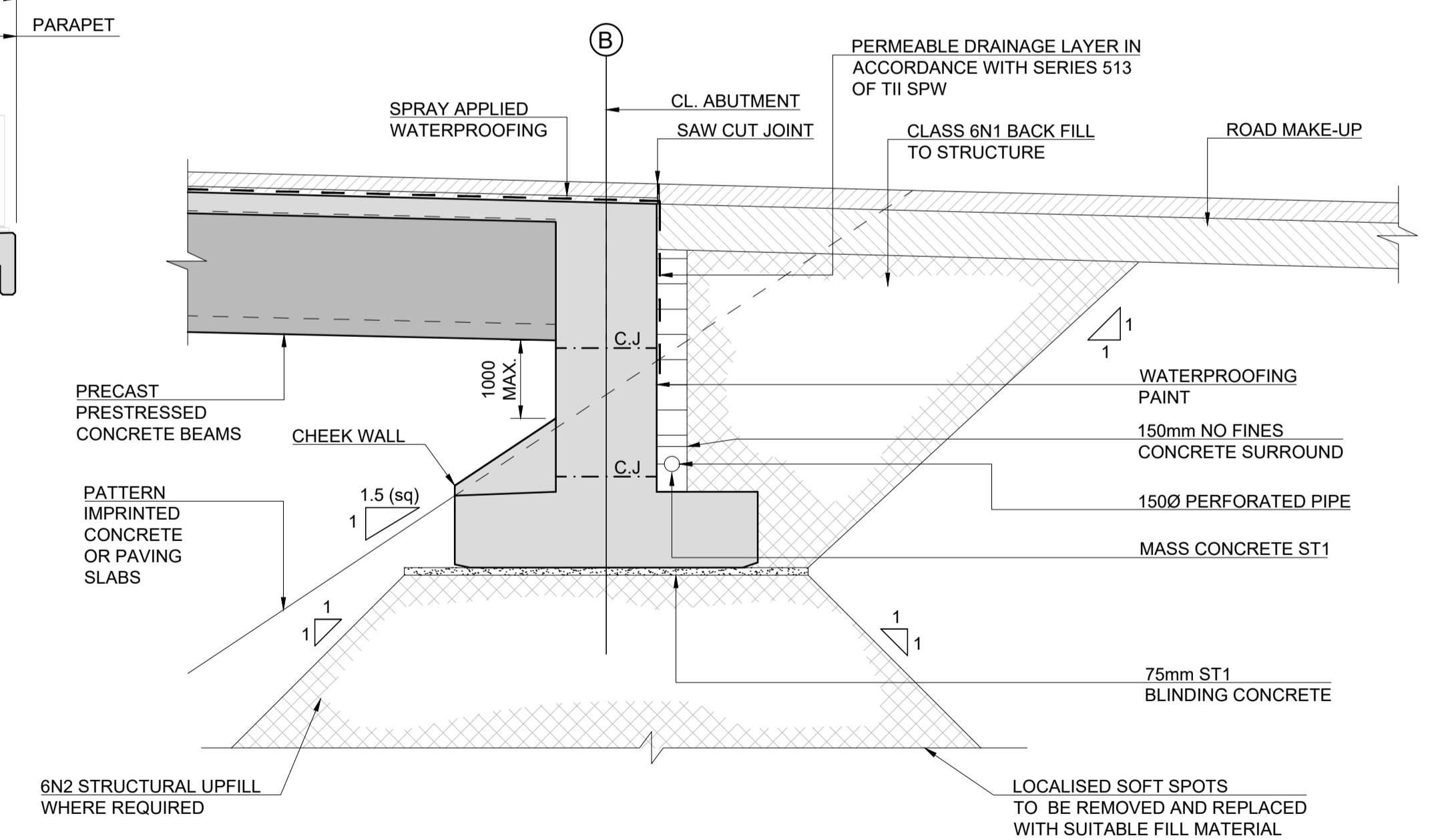
PLAN ON BRIDGE
SCALE: 1:250



SECTION A-A
SCALE: 1:125



SECTION B-B
SCALE: 1:50



TYPICAL ABUTMENT CROSS SECTION
SCALE: 1:50

Reference	Name	Chainage	Span, S [m]	Width, W [m]	Structural Depth, D [m]	Bridge Skew Angle, θ_B (deg)	Road Skew Angle, θ_R (deg)
S08/02*	N59 Moycullen Road Underbridge	08+540	32.5	27.5	1.95	30	30

* NOISE BARRIER REQUIRED AT THIS STRUCTURE

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Date
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I3	20/04/2017	PD	PM	EMC
I2	11/11/2016	PD	PM	EMC
I1	04/07/2016	PD	PM	EMC

Drawing Title
Standard Underbridge Type 3

Drawing Status

For Information

Job No
233985

Drawing No
GCOB-1700-D-GEN-004

Issue
14

Appendix B

Extract from ground investigation
data



GEOTECHNICAL BORING RECORD

REPORT NUMBER

18963

CONTRACT N6 Galway City Transport Project - Phase 3				BOREHOLE NO. BH3/12	
CO-ORDINATES 525,909.63 E 725,923.39 N		RIG TYPE Dando 3000		SHEET Sheet 1 of 1	
GROUND LEVEL (m AOD) 53.99		BOREHOLE DIAMETER (mm)		DATE COMMENCED 22/01/2016	
		BOREHOLE DEPTH (m) 2.20		DATE COMPLETED 22/01/2016	
CLIENT ENGINEER Galway County Council ARUP			SPT HAMMER REF. NO.		BORED BY WC
			ENERGY RATIO (%)		PROCESSED BY JL

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples				Field Test Results	Standpipe Details
					Ref. Number	Sample Type	Depth (m)	Recovery		
0	Very soft black gravelly peaty CLAY	[Symbol]			AA43880 AA43881	D B	0.50 0.50-0.95		N = 2 (2, 2, 1, 0, 1, 0)	
1	Very soft light brown grey very sandy gravelly CLAY	[Symbol]	52.69	1.30	AA43882 AA43883	D B	1.50 1.50-1.95		N = 5 (0, 0, 0, 0, 1, 4)	
2	Obstruction End of Borehole at 2.20 m	[Symbol]	51.89 51.79	2.10 2.20						
3										
4										
5										
6										
7										
8										
9										

HARD STRATA BORING/CHISELLING				WATER STRIKE DETAILS					
From (m)	To (m)	Time (h)	Comments	Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
2.1	2.2	1		1.30 1.90	1.30 1.90	No	1.10	20	Seepage Moderate

INSTALLATION DETAILS					GROUNDWATER PROGRESS				
Date	Tip Depth	RZ Top	RZ Base	Type	Date	Hole Depth	Casing Depth	Depth to Water	Comments

REMARKS Borehole backfilled upon completion

Sample Legend
 D - Small Disturbed (tub) Sample
 B - Bulk Disturbed
 LB - Large Bulk Disturbed
 Env - Environmental Sample (Jar + Vial + Tub)
 UT - Undisturbed 100mm Diameter Sample
 P - Undisturbed Piston Sample
 W - Water Sample

IGSL BH LOG - 18963.GPJ IGSL_GDT 12/5/16



GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER

18963

CONTRACT N6 Galway City Transport Project - Phase 3		DRILLHOLE NO BH3/13R
CO-ORDINATES 526,078.57 E 726,036.12 N		SHEET Sheet 1 of 2
GROUND LEVEL (mod) 58.65	RIG TYPE Casagrande	DATE DRILLED 21/03/2016
CLIENT Galway County Council	FLUSH Air/Mist	DATE LOGGED 22/03/2016
ENGINEER ARUP	INCLINATION (deg) -90	DRILLED BY IGSL
	CORE DIAMETER (mm) 80	LOGGED BY D. O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm)	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0								SYMMETRIX DRILLING: No recovery, observed by driller as clayey gravel	0.70	57.95		
1	1.10							SYMMETRIX DRILLING: No recovery, observed by driller as weathered rock	1.10	57.55		
2	2.10	100	96	96				Very strong, thickly to thinly banded, dark brownish purple mottled, porphyritic, medium to coarse-grained, GRANITE, fresh to locally slightly weathered.				
3	3.10	100	97	97				Dips are 20° to locally 80°. Discontinuities are widely to medium spaced, rough to locally smooth, planar. Apertures are tight to partly open, very thin brown clay smearing.				
4	4.10	100	98	98								
5	5.10	100	100	100								
6	6.10	100	100	100								
7	7.10	100	100	100								
8	8.10	100	100	100								
9	9.10	100	100	100								

REMARKS Hole cased 0.00-1.10m.					WATER STRIKE DETAILS					
					Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
										No water strike recorded
INSTALLATION DETAILS					GROUNDWATER DETAILS					
					Date	Hole Depth	Casing Depth	Depth to Water	Comments	
Date	Tip Depth	RZ Top	RZ Base	Type						
22-03-16	9.00	6.00	10.10	50mm SP						

IGSL RC FI 10M 18963.GPJ IGSL.GDT 24/6/16



GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER

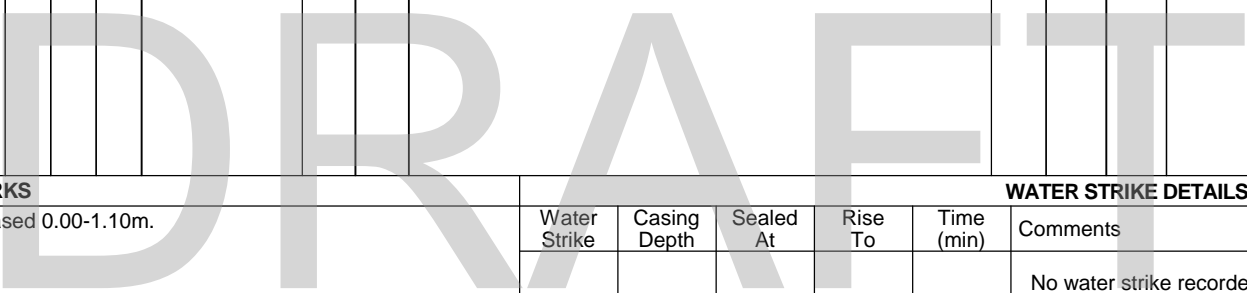
18963

CONTRACT N6 Galway City Transport Project - Phase 3		DRILLHOLE NO BH3/13R
CO-ORDINATES 526,078.57 E 726,036.12 N		SHEET Sheet 2 of 2
GROUND LEVEL (mOD) 58.65	RIG TYPE Casagrande	DATE DRILLED 21/03/2016
CLIENT Galway County Council	FLUSH Air/Mist	DATE LOGGED 22/03/2016
ENGINEER ARUP	INCLINATION (deg) -90	DRILLED BY IGSL
	CORE DIAMETER (mm) 80	LOGGED BY D. O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm)	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10.10	10.10				0 250 500			End of Borehole at 10.10 m	10.10	48.55		
11												
12												
13												
14												
15												
16												
17												
18												
19												

REMARKS Hole cased 0.00-1.10m.					WATER STRIKE DETAILS					
					Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
										No water strike recorded
INSTALLATION DETAILS					GROUNDWATER DETAILS					
					Date	Hole Depth	Casing Depth	Depth to Water	Comments	
Date	Tip Depth	RZ Top	RZ Base	Type						
22-03-16	9.00	6.00	10.10	50mm SP						

IGSL RC FI 10M 18963.GPJ IGSL.GDT 24/6/16





GEOTECHNICAL BORING RECORD

REPORT NUMBER

18963

CONTRACT N6 Galway City Transport Project - Phase 3				BOREHOLE NO. BH3/16	
CO-ORDINATES 526,754.60 E 726,635.82 N		RIG TYPE Dando 3000		SHEET Sheet 1 of 1	
GROUND LEVEL (m AOD) 58.47		BOREHOLE DIAMETER (mm)		DATE COMMENCED 29/01/2016	
		BOREHOLE DEPTH (m) 0.50		DATE COMPLETED 29/01/2016	
CLIENT ENGINEER Galway County Council ARUP			SPT HAMMER REF. NO.		BORED BY WC
			ENERGY RATIO (%)		PROCESSED BY JL

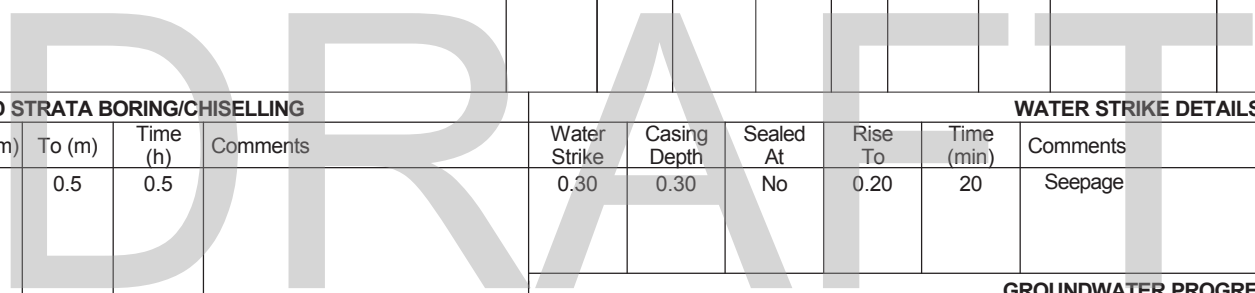
Depth (m)	Description	Legend	Elevation	Depth (m)	Samples				Field Test Results	Standpipe Details
					Ref. Number	Sample Type	Depth (m)	Recovery		
0	PEAT		58.17	0.30						
	Angular GRAVEL- and COBBLE-sized fragments of Granite		57.97	0.50						
1	Obstruction End of Borehole at 0.50 m									
2										
3										
4										
5										
6										
7										
8										
9										

HARD STRATA BORING/CHISELLING				WATER STRIKE DETAILS					
From (m)	To (m)	Time (h)	Comments	Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
0.4	0.5	0.5		0.30	0.30	No	0.20	20	Seepage

INSTALLATION DETAILS					Date	Hole Depth	Casing Depth	Depth to Water	Comments
Date	Tip Depth	RZ Top	RZ Base	Type					

REMARKS 1.5hr getting rig and tools off BH location. Borehole backfilled upon completion. Borehole scheduled for rotary follow-on coring.	Sample Legend D - Small Disturbed (tub) B - Bulk Disturbed LB - Large Bulk Disturbed Env - Environmental Sample (Jar + Vial + Tub) UT - Undisturbed 100mm Diameter Sample P - Undisturbed Piston Sample W - Water Sample
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IGSL BH LOG - 18963.GPJ IGSL_GDT_12/5/16





GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER

18963

CONTRACT N6 Galway City Transport Project - Phase 3		DRILLHOLE NO BH3/16R
CO-ORDINATES 526,764.74 E 726,611.40 N		SHEET Sheet 1 of 1
GROUND LEVEL (MOD) 61.66	RIG TYPE Casagrande	DATE DRILLED 23/03/2016
CLIENT Galway County Council	FLUSH Air/Mist	DATE LOGGED 24/03/2016
ENGINEER ARUP	INCLINATION (deg) -90	DRILLED BY IGSL
	CORE DIAMETER (mm) 80	LOGGED BY D. O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm)	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0								SYMMETRIX DRILLING: No recovery, observed by driller as clayey gravel				
1									1.50	60.16		
2								SYMMETRIX DRILLING: No recovery, observed by driller as weathered rock				
2.50									2.50	59.16		
3		100	86	64				Very strong, thickly to thinly banded, dark brownish purple mottled, porphyritic, medium to coarse-grained, GRANITE, fresh to locally slightly weathered.				
3.50								Dips are 20° to locally 80°. Discontinuities are widely to medium spaced, rough to locally smooth, planar. Apertures are tight to partly open, very thin brown clay smearing.				
4		100	35	35				2.50-5.80m - Slightly to locally moderately weathered, clay-smearing, penetrative iron-oxide staining, slight weakening.				
4.50												
5		62	16	0								
5.80												
6		100	93	73								
7												
7.00												
8		100	97	97								
8.50												
9		100	99	99								
10.00									10.00	51.66		

REMARKS End of Borehole at 10.00 m					WATER STRIKE DETAILS					
Hole cased 0.00-1.10m.					Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
										No water strike recorded
					GROUNDWATER DETAILS					
INSTALLATION DETAILS					Date	Hole Depth	Casing Depth	Depth to Water	Comments	
Date	Tip Depth	RZ Top	RZ Base	Type						
24-03-16	10.00	6.00	10.00	50mm SP						

IGSL RC Fl 10M 18963.GPJ IGSL.GDT 24/06/16



GEOTECHNICAL BORING RECORD

REPORT NUMBER

18963

CONTRACT N6 Galway City Transport Project - Phase 3				BOREHOLE NO. BH3/17	
CO-ORDINATES 527,023.54 E 726,804.98 N		RIG TYPE Dando 3000		SHEET Sheet 1 of 1	
GROUND LEVEL (m AOD) 65.54		BOREHOLE DIAMETER (mm)		DATE COMMENCED 14/03/2016	
		BOREHOLE DEPTH (m) 2.80		DATE COMPLETED 14/03/2016	
CLIENT ENGINEER Galway County Council ARUP			SPT HAMMER REF. NO.		BORED BY WC
			ENERGY RATIO (%)		PROCESSED BY JL

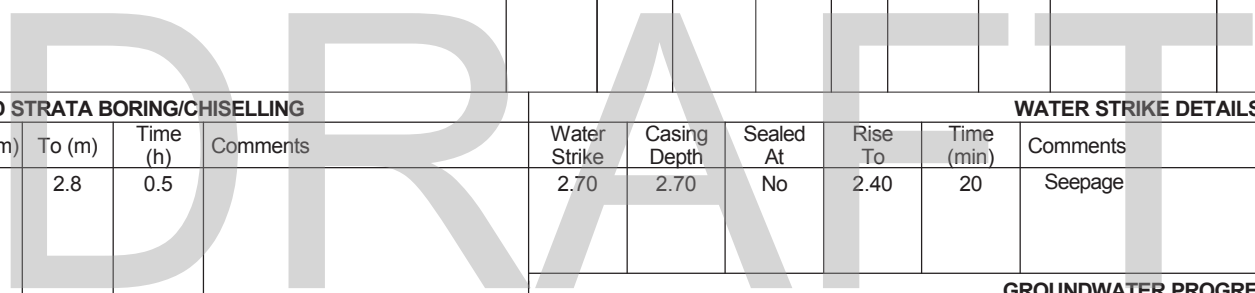
Depth (m)	Description	Legend	Elevation	Depth (m)	Samples				Field Test Results	Standpipe Details
					Ref. Number	Sample Type	Depth (m)	Recovery		
0	Soft to firm dark brown sandy gravelly CLAY with a medium cobble content		64.64	0.90	AA48880	B	0.50			
1	Firm light brown very sandy gravelly CLAY with a medium cobble and boulder content			1.00-1.45	AA48881	B		N = 21 (3, 4, 4, 5, 7, 5)		
2				2.00-2.45	AA48882	B		N = 15 (2, 8, 4, 3, 3, 5)		
3	End of Borehole at 2.80 m		62.74	2.80						
4										
5										
6										
7										
8										
9										

HARD STRATA BORING/CHISELLING				WATER STRIKE DETAILS					
From (m)	To (m)	Time (h)	Comments	Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
2.7	2.8	0.5		2.70	2.70	No	2.40	20	Seepage

INSTALLATION DETAILS					GROUNDWATER PROGRESS				
Date	Tip Depth	RZ Top	RZ Base	Type	Date	Hole Depth	Casing Depth	Depth to Water	Comments

REMARKS 1.75hrs getting plant and equipment to borehole location. 1hr getting off position.	Sample Legend D - Small Disturbed (tub) B - Bulk Disturbed LB - Large Bulk Disturbed Env - Environmental Sample (Jar + Vial + Tub) UT - Undisturbed 100mm Diameter Sample P - Undisturbed Piston Sample W - Water Sample
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IGSL BH LOG 18963.GPJ IGSL.GDT 12/5/16





GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER

18963

CONTRACT N6 Galway City Transport Project - Phase 3		DRILLHOLE NO BH3/17R
CO-ORDINATES 527,021.46 E 726,804.57 N		SHEET Sheet 1 of 2
GROUND LEVEL (MOD) 65.33	RIG TYPE Casagrande	DATE DRILLED 10/03/2016
CLIENT Galway County Council	FLUSH Air/Mist	DATE LOGGED 11/03/2016
ENGINEER ARUP	INCLINATION (deg) -90	DRILLED BY IGSL
	CORE DIAMETER (mm) 80	LOGGED BY D. O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm)	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0								SYMMETRIX DRILLING: No recovery, observed by driller as clayey gravel				
1												
2												
2.70								SYMMETRIX DRILLING: No recovery, observed by driller as gravelly clay	2.70	62.63		
3												
4												
5								SYMMETRIX DRILLING: No recovery, observed by driller as weathered rock	5.00	60.33		
5.70								Very strong, thickly to thinly banded, dark green mottled, porphyritic, medium to coarse-grained, GRANITE, fresh to locally slightly weathered.	5.70	59.63		
6	100	26	0					Dips are 20° to locally 70°. Discontinuities are medium to closely spaced, rough to locally smooth, planar. Apertures are tight to partly open, very thin brown clay smearing.				
6.70												
7	100	88	68									
8												
8.20												
9	100	100	91									
9.70												

REMARKS Hole cased 0.00-5.20m.					WATER STRIKE DETAILS				
					Water Strike	Casing Depth	Sealed At	Rise To	Time (min)
					No water strike recorded				
INSTALLATION DETAILS					GROUNDWATER DETAILS				
					Date	Hole Depth	Casing Depth	Depth to Water	Comments
Date	Tip Depth	RZ Top	RZ Base	Type					
11-03-16	10.20	3.00	10.20	50mm SP					

IGSL RC Fl 10M 18963.GPJ IGSL_GDT 24/6/16



GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER

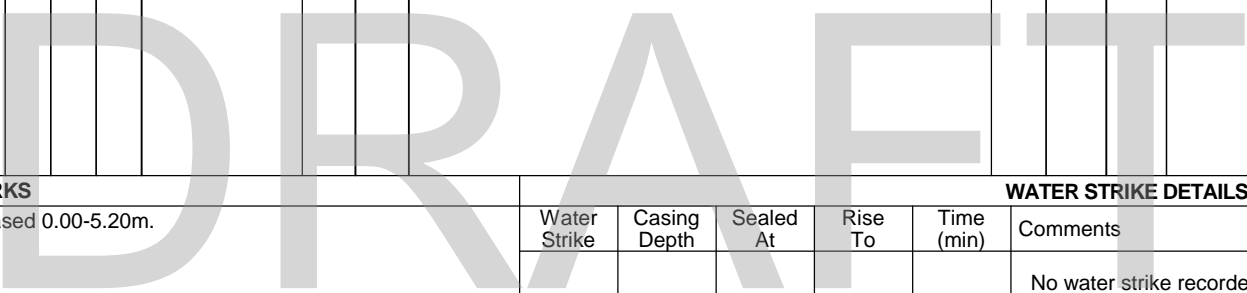
18963

CONTRACT N6 Galway City Transport Project - Phase 3		DRILLHOLE NO BH3/17R
CO-ORDINATES 527,021.46 E 726,804.57 N		SHEET Sheet 2 of 2
GROUND LEVEL (mOD) 65.33	RIG TYPE Casagrande	DATE DRILLED 10/03/2016
CLIENT Galway County Council	FLUSH Air/Mist	DATE LOGGED 11/03/2016
ENGINEER ARUP	INCLINATION (deg) -90	DRILLED BY IGSL
	CORE DIAMETER (mm) 80	LOGGED BY D. O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm)	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10	10.20	100	92	92			+	End of Borehole at 10.20 m	10.20	55.13	□	
11												
12												
13												
14												
15												
16												
17												
18												
19												

REMARKS Hole cased 0.00-5.20m.					WATER STRIKE DETAILS					
					Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
										No water strike recorded
INSTALLATION DETAILS					GROUNDWATER DETAILS					
					Date	Hole Depth	Casing Depth	Depth to Water	Comments	
Date	Tip Depth	RZ Top	RZ Base	Type						
11-03-16	10.20	3.00	10.20	50mm SP						

IGSL RC FI 10M 18963.GPJ IGSL.GDT 24/6/16





GEOTECHNICAL BORING RECORD

REPORT NUMBER

18963

CONTRACT N6 Galway City Transport Project - Phase 3				BOREHOLE NO. BH3/23	
CO-ORDINATES 527,770.91 E 727,345.14 N		RIG TYPE Dando 3000		SHEET Sheet 1 of 1	
GROUND LEVEL (m AOD) 26.78		BOREHOLE DIAMETER (mm)		DATE COMMENCED 05/02/2016	
		BOREHOLE DEPTH (m) 3.70		DATE COMPLETED 05/02/2016	
CLIENT ENGINEER Galway County Council ARUP			SPT HAMMER REF. NO.		BORED BY WC
			ENERGY RATIO (%)		PROCESSED BY JL

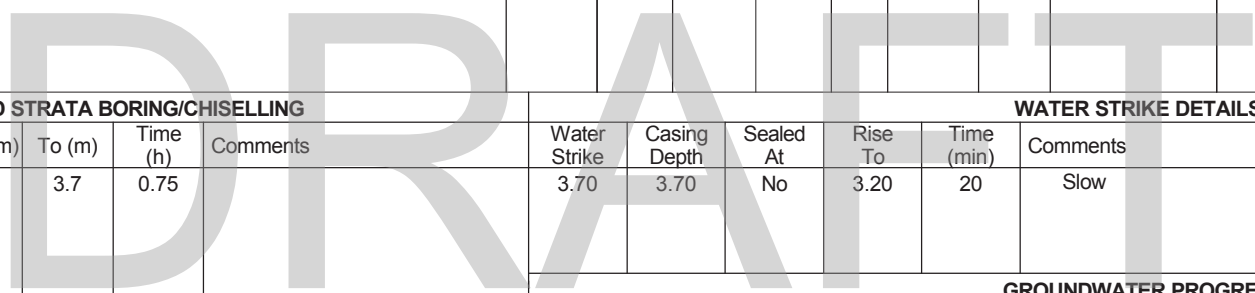
Depth (m)	Description	Legend	Elevation	Depth (m)	Samples				Field Test Results	Standpipe Details
					Ref. Number	Sample Type	Depth (m)	Recovery		
0	Firm dark brown sandy gravelly CLAY with a low to medium cobble and boulder content		24.48	2.30						
1					AA32640	B	1.00-1.45		N = 15 (2, 3, 3, 3, 4, 5)	
2					AA32641	B	2.00-2.45		N = 15 (3, 3, 2, 3, 4, 6)	
3	Medium dense light brown slightly clayey gravelly SAND with a low to medium cobble and boulder content		23.08	3.70						
3					AA32643	B	3.00-3.45		N = 16 (3, 4, 3, 4, 4, 5)	
4	End of Borehole at 3.70 m									

HARD STRATA BORING/CHISELLING				WATER STRIKE DETAILS					
From (m)	To (m)	Time (h)	Comments	Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
3.6	3.7	0.75		3.70	3.70	No	3.20	20	Slow

INSTALLATION DETAILS					Date	Hole Depth	Casing Depth	Depth to Water	Comments
Date	Tip Depth	RZ Top	RZ Base	Type					

REMARKS 0.5hr moving boulders obstructing access to plot. 0.5hr moving rig and tracked dumper from borehole including replacement of boulders to block entrance.	Sample Legend D - Small Disturbed (tub) B - Bulk Disturbed LB - Large Bulk Disturbed Env - Environmental Sample (Jar + Vial + Tub) UT - Undisturbed 100mm Diameter Sample P - Undisturbed Piston Sample W - Water Sample
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IGSL BH LOG 18963.GPJ IGSL.GDT 12/5/16





GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER

18963

CONTRACT N6 Galway City Transport Project - Phase 3		DRILLHOLE NO BH3/23R
CO-ORDINATES 527,773.63 E 727,346.05 N		SHEET Sheet 1 of 2
GROUND LEVEL (mOD) 26.93	RIG TYPE Casagrande	DATE DRILLED 24/02/2016
CLIENT Galway County Council	FLUSH Air/Mist	DATE LOGGED 24/02/2016
ENGINEER ARUP	INCLINATION (deg) -90	DRILLED BY IGSL
	CORE DIAMETER (mm) 80	LOGGED BY D. O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm)	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0								SYMMETRIX DRILLING: No recovery, observed by driller as clayey gravelly cobbles				
1												
2												
3								SYMMETRIX DRILLING: No recovery, observed by driller as sandy gravelly clay with occasional cobbles	2.80	24.13		
4								SYMMETRIX DRILLING: No recovery, observed by driller as greenish grey weathered rock	3.70	23.23		
4.20								SYMMETRIX DRILLING: No recovery, observed by driller as greenish grey weathered rock	4.20	22.73		
5		100	31	14				Very strong to strong, thickly to thinly banded, light green/grey/white mottled, porphyritic, medium to coarse-grained, GRANITE, fresh to locally moderately weathered.				
5.70								Dips are 20° to locally 80°. Discontinuities are widely to medium spaced, rough to locally smooth, planar. Apertures are tight to partly open, very thin brown clay smearing.				
6		100	95	91				4.20-5.30m - Moderately weathered, slight weakening.				
7												
7.20												
8		100	100	93								
8.70												
9		100	100	100								

REMARKS Hole cased 0.00-4.20m.					WATER STRIKE DETAILS				
					Water Strike	Casing Depth	Sealed At	Rise To	Time (min)
					No water strike recorded				
INSTALLATION DETAILS					GROUNDWATER DETAILS				
					Date	Hole Depth	Casing Depth	Depth to Water	Comments
Date	Tip Depth	RZ Top	RZ Base	Type					
24-02-16	5.50	3.50	5.70	50mm SP					

IGSL RC Fl 10M 18963.GPJ IGSL.GDT 24/06/16



GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER

18963

CONTRACT N6 Galway City Transport Project - Phase 3		DRILLHOLE NO BH3/23R
CO-ORDINATES 527,773.63 E 727,346.05 N		SHEET Sheet 2 of 2
GROUND LEVEL (mOD) 26.93	RIG TYPE Casagrande	DATE DRILLED 24/02/2016
CLIENT Galway County Council	FLUSH Air/Mist	DATE LOGGED 24/02/2016
ENGINEER ARUP	INCLINATION (deg) -90	DRILLED BY IGSL
	CORE DIAMETER (mm) 80	LOGGED BY D. O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm)	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10	10.20				0 250 500		+	End of Borehole at 10.20 m	10.20	16.73	///	
11												
12												
13												
14												
15												
16												
17												
18												
19												

REMARKS Hole cased 0.00-4.20m.					WATER STRIKE DETAILS					
					Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
										No water strike recorded
INSTALLATION DETAILS					GROUNDWATER DETAILS					
					Date	Hole Depth	Casing Depth	Depth to Water	Comments	
Date	Tip Depth	RZ Top	RZ Base	Type						
24-02-16	5.50	3.50	5.70	50mm SP						

IGSL RC FI 10M 18963.GPJ IGSL.GDT 24/06/16

DRAFT



GEOTECHNICAL BORING RECORD

REPORT NUMBER

18963

CONTRACT N6 Galway City Transport Project - Phase 3				BOREHOLE NO. BH3/26	
CO-ORDINATES 528,815.44 E 727,922.07 N		RIG TYPE Dando 3000		SHEET Sheet 1 of 1	
GROUND LEVEL (m AOD) 14.67		BOREHOLE DIAMETER (mm)		DATE COMMENCED 01/02/2016	
		BOREHOLE DEPTH (m) 0.40		DATE COMPLETED 01/02/2016	
CLIENT ENGINEER Galway County Council ARUP			SPT HAMMER REF. NO.		BORED BY WC
			ENERGY RATIO (%)		PROCESSED BY JL

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples				Field Test Results	Standpipe Details
					Ref. Number	Sample Type	Depth (m)	Recovery		
0	Soft dark brown sandy gravelly CLAY with a low to medium boulder content Obstruction End of Borehole at 0.40 m	D	14.27	0.40						
1										
2										
3										
4										
5										
6										
7										
8										
9										

HARD STRATA BORING/CHISELLING				WATER STRIKE DETAILS					
From (m)	To (m)	Time (h)	Comments	Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
0.4	0.4	0.5							No water strike

INSTALLATION DETAILS					Date	Hole Depth	Casing Depth	Depth to Water	Comments
Date	Tip Depth	RZ Top	RZ Base	Type					

REMARKS 0.75hr gaining access to field and moving to BH location. Borehole backfilled upon completion. Borehole scheduled for rotary follow-on coring.	Sample Legend D - Small Disturbed (tub) B - Bulk Disturbed LB - Large Bulk Disturbed Env - Environmental Sample (Jar + Vial + Tub) UT - Undisturbed 100mm Diameter Sample P - Undisturbed Piston Sample W - Water Sample
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IGSL BH LOG 18963.GPJ IGSL.GDT 12/5/16



GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER

18963

CONTRACT N6 Galway City Transport Project - Phase 3		DRILLHOLE NO BH3/26R
CO-ORDINATES 528,816.97 E 727,920.32 N		SHEET Sheet 1 of 2
GROUND LEVEL (MOD) 14.42	RIG TYPE Comacchio	DATE DRILLED 15/02/2016
CLIENT Galway County Council	FLUSH Air/Mist	DATE LOGGED 25/02/2016
ENGINEER ARUP	INCLINATION (deg) -90	DRILLED BY IGSL
	CORE DIAMETER (mm) 80	LOGGED BY D. O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm)	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0								SYMMETRIX DRILLING: No recovery, observed by driller as made ground consisting of shell & auger material	0.40	14.02		
1								SYMMETRIX DRILLING: No recovery, observed by driller as rock				
1.90		100	82	26				Medium strong to very strong, thick to thin bedded, blueish dark grey, fine grained, LIMESTONE (locally fossiliferous, localized chert and stylolites), slightly to locally moderately weathered.	1.40	13.02		
2								Dips are horizontal to locally vertical. Discontinuities are medium to closely spaced, rough to locally smooth, planar to occasionally undulose. Apertures are tight to wide, locally clay/gravel filled, locally calcite veined (10mm).				
3		100	100	84								
3.50												
3.70		100	100	100								
4												
5		100	94	81								
5.10												
6		100	100	78								
6.20												
6.60		100	100	100								
7												
8		100	98	84								
8.20												
9		100	97	77								
8.90												
9.10		100	100	100								
10.00								9.30-9.83m - Clay/gravel-filled fracture - some gravel is rounded.				

REMARKS Hole cased 0.00-1.40m.					WATER STRIKE DETAILS					
					Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
										No water strike recorded
INSTALLATION DETAILS					GROUNDWATER DETAILS					
					Date	Hole Depth	Casing Depth	Depth to Water	Comments	
Date	Tip Depth	RZ Top	RZ Base	Type						

IGSL RC Fl 10M 18963.GPJ IGSL.GDT 24/6/16



GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER

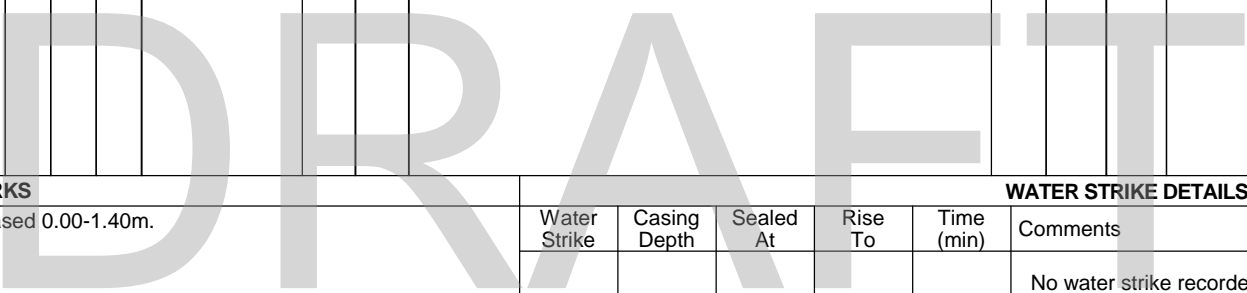
18963

CONTRACT N6 Galway City Transport Project - Phase 3		DRILLHOLE NO BH3/26R
CO-ORDINATES 528,816.97 E 727,920.32 N		SHEET Sheet 2 of 2
GROUND LEVEL (mOD) 14.42	RIG TYPE Comacchio	DATE DRILLED 15/02/2016
CLIENT Galway County Council	FLUSH Air/Mist	DATE LOGGED 25/02/2016
ENGINEER ARUP	INCLINATION (deg) -90	DRILLED BY IGSL
	CORE DIAMETER (mm) 80	LOGGED BY D. O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm)	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10								10.40-10.60m - Clay/gravel-filled fracture	10.70	3.72		
11								End of Borehole at 10.70 m				
12												
13												
14												
15												
16												
17												
18												
19												

REMARKS Hole cased 0.00-1.40m.					WATER STRIKE DETAILS					
					Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
										No water strike recorded
INSTALLATION DETAILS					GROUNDWATER DETAILS					
					Date	Hole Depth	Casing Depth	Depth to Water	Comments	
Date	Tip Depth	RZ Top	RZ Base	Type	25-02-16	10.70	1.40	6.80	Water level measured 10 mins after end of drilling	

IGSL RC Fl 10M 18963.GPJ IGSL.GDT 24/6/16





GEOTECHNICAL BORING RECORD

REPORT NUMBER

18963

CONTRACT N6 Galway City Transport Project - Phase 3				BOREHOLE NO. BH3/29	
CO-ORDINATES 529,489.29 E 728,334.05 N		RIG TYPE Dando 3000		SHEET Sheet 1 of 1	
GROUND LEVEL (m AOD) 13.73		BOREHOLE DIAMETER (mm)		DATE COMMENCED 01/02/2016	
		BOREHOLE DEPTH (m) 2.70		DATE COMPLETED 01/02/2016	
CLIENT ENGINEER Galway County Council ARUP			SPT HAMMER REF. NO.		BORED BY WC
			ENERGY RATIO (%)		PROCESSED BY JL

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples				Field Test Results	Standpipe Details
					Ref. Number	Sample Type	Depth (m)	Recovery		
0	Soft to firm light brown sandy gravelly CLAY with a low to medium cobble and boulder content		12.93	0.80						
1	Firm to stiff light brown silty sandy gravelly CLAY with a medium cobble and low to medium boulder content				AA43890	B	1.00		N = 32 (4, 7, 7, 8, 8, 9)	
					AA43891	B	1.50-1.95			
					AA43892	B	2.50-2.70			N = 50/105 mm (8, 11, 16, 34)
3	Obstruction End of Borehole at 2.70 m		11.03	2.70						
4										
5										
6										
7										
8										
9										

HARD STRATA BORING/CHISELLING				WATER STRIKE DETAILS					
From (m)	To (m)	Time (h)	Comments	Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
2.6	2.7	0.5							No water strike

INSTALLATION DETAILS					Date	Hole Depth	Casing Depth	Depth to Water	Comments
Date	Tip Depth	RZ Top	RZ Base	Type					

REMARKS Hand dug inspection pit excavated to commence hole (1.5hr). Reinstating field upon completion (0.5hr). Move gear to BH3/26 (0.75hr). Borehole backfilled upon completion. Borehole scheduled for rotary follow-on coring.

Sample Legend

- D - Small Disturbed (tub)
- B - Bulk Disturbed
- LB - Large Bulk Disturbed
- Env - Environmental Sample (Jar + Vial + Tub)

- UT - Undisturbed 100mm Diameter Sample
- P - Undisturbed Piston Sample
- W - Water Sample

IGSL BH LOG 18963.GPJ IGSL.GDT 12/5/16



GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER

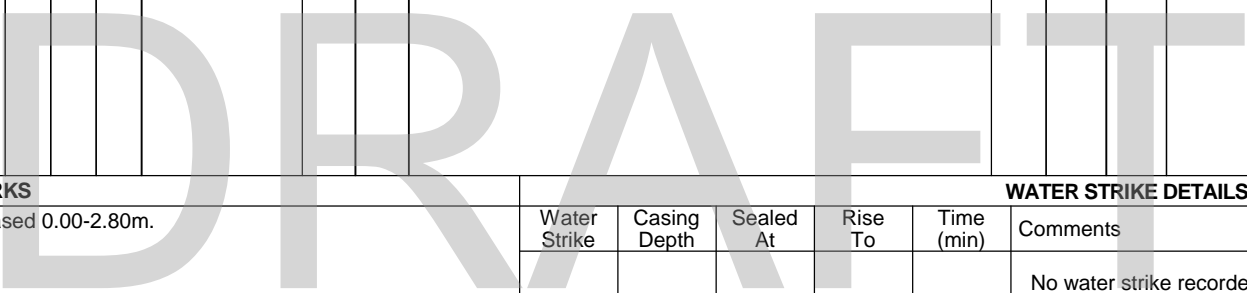
18963

CONTRACT N6 Galway City Transport Project - Phase 3		DRILLHOLE NO BH3/29R
CO-ORDINATES 529,489.29 E 728,334.05 N		SHEET Sheet 1 of 1
GROUND LEVEL (MOD) 13.73	RIG TYPE Comacchio	DATE DRILLED 11/02/2016
CLIENT Galway County Council	FLUSH Air/Mist	DATE LOGGED 12/02/2016
ENGINEER ARUP	INCLINATION (deg) -90	DRILLED BY IGSL
	CORE DIAMETER (mm) 80	LOGGED BY D. O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm)	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)	
0								SYMMETRIX DRILLING: No recovery, observed by driller as made ground consisting of shell & auger material					
2.80								SYMMETRIX DRILLING: No recovery, observed by driller as rock	2.70	11.03			
3		100	97	90				Medium strong to very strong, thick to thin bedded, blueish dark grey, fine grained, LIMESTONE (locally fossiliferous, localized chert and stylolites), fresh to locally slightly weathered.	2.80	10.93			
4.10								Dips are horizontal to locally vertical. Discontinuities are wide to closely spaced, rough to occasionally smooth, undulose to locally planar. Apertures are tight to moderately open, with very thin brown clay smearing, slight iron-oxide staining.					
4.40		100	93	67									
4.80		100	73	33									
5													
6.30													
6.90		100	63	48					6.90	6.83			
7								End of Borehole at 6.90 m					

REMARKS Hole cased 0.00-2.80m.					WATER STRIKE DETAILS					
					Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
										No water strike recorded
INSTALLATION DETAILS					GROUNDWATER DETAILS					
					Date	Hole Depth	Casing Depth	Depth to Water	Comments	
Date	Tip Depth	RZ Top	RZ Base	Type	12-02-16	6.90	2.80	3.70	Water level measured 10 mins after end of drilling	

IGSL RC Fl 10M 18963.GPJ IGSL.GDT 24/6/16





GEOTECHNICAL BORING RECORD

REPORT NUMBER

18963

CONTRACT N6 Galway City Transport Project - Phase 3				BOREHOLE NO. BH3/30	
CO-ORDINATES 531,041.18 E 728,509.06 N		RIG TYPE Hand Dug		SHEET Sheet 1 of 1	
GROUND LEVEL (m AOD) 23.76		BOREHOLE DIAMETER (mm)		DATE COMMENCED 23/02/2016	
		BOREHOLE DEPTH (m) 0.50		DATE COMPLETED 23/02/2016	
CLIENT ENGINEER Galway County Council ARUP		SPT HAMMER REF. NO.		BORED BY JD	
		ENERGY RATIO (%)		PROCESSED BY JL	

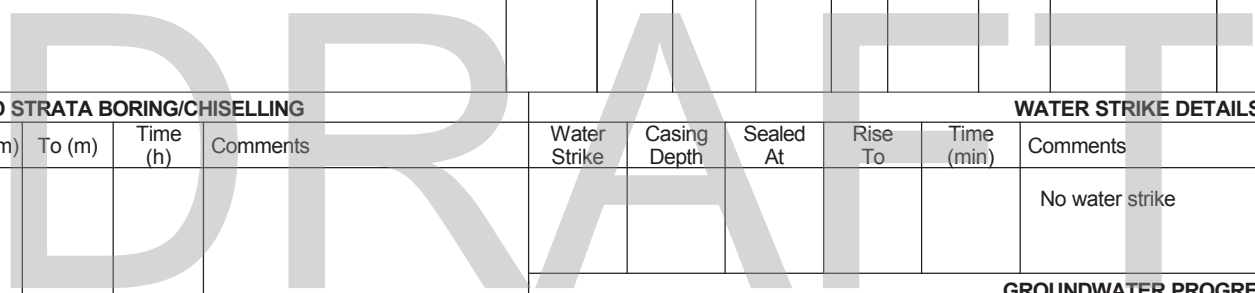
Depth (m)	Description	Legend	Elevation	Depth (m)	Samples				Field Test Results	Standpipe Details
					Ref. Number	Sample Type	Depth (m)	Recovery		
0	TOPSOIL (MADE GROUND)		23.61	0.15	AA39968	B	0.15-0.50			
	Brown clayey SAND with occasional fragments of concrete, red brick, ceramic pipe, timber, roof slate and possible asbestos (MADE GROUND)		23.26	0.50	AA39969 AA39970	ENV ENV	0.15-0.50 0.15-0.50			
1	End of Borehole at 0.50 m									
2										
3										
4										
5										
6										
7										
8										
9										

HARD STRATA BORING/CHISELLING				WATER STRIKE DETAILS					
From (m)	To (m)	Time (h)	Comments	Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
									No water strike

INSTALLATION DETAILS					GROUNDWATER PROGRESS				
Date	Tip Depth	RZ Top	RZ Base	Type	Date	Hole Depth	Casing Depth	Depth to Water	Comments

REMARKS Hand dug pit at location of BH3/30. Pit terminated at 0.50m due to presence of possible asbestos roofing fragments.	Sample Legend D - Small Disturbed (tub) B - Bulk Disturbed LB - Large Bulk Disturbed Env - Environmental Sample (Jar + Vial + Tub)	UT - Undisturbed 100mm Diameter Sample P - Undisturbed Piston Sample W - Water Sample
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IGSL BH LOG - 18963.GPJ IGSL_GDT_12/5/16





GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER

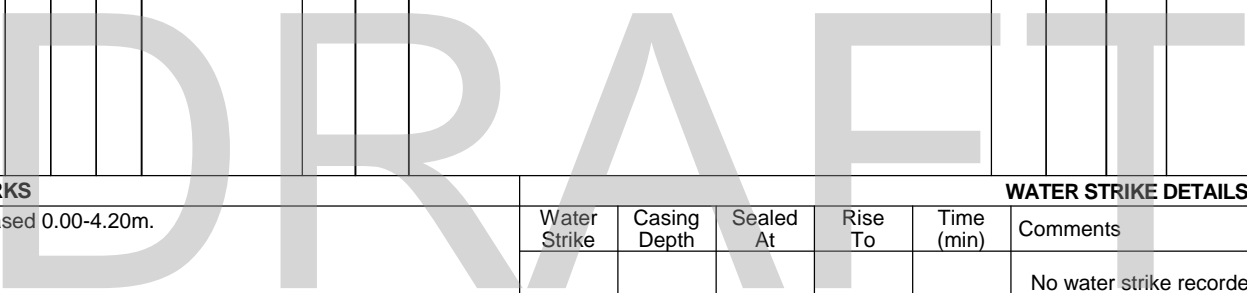
18963

CONTRACT N6 Galway City Transport Project - Phase 3		DRILLHOLE NO BH3/30R
CO-ORDINATES 531,041.18 E 728,509.06 N		SHEET Sheet 1 of 1
GROUND LEVEL (MOD) 23.76	RIG TYPE Casagrande	DATE DRILLED 29/02/2016
CLIENT Galway County Council	FLUSH Air/Mist	DATE LOGGED 29/02/2016
ENGINEER ARUP	INCLINATION (deg) -90	DRILLED BY IGSL
	CORE DIAMETER (mm) 80	LOGGED BY D. O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm)	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0								SYMMETRIX DRILLING: No recovery, observed by driller as made ground consisting of concrete clay and wire				
1									1.60	22.16		
2								SYMMETRIX DRILLING: No recovery, observed by driller as gravelly cobbly clay	2.40	21.36		
2.70								SYMMETRIX DRILLING: No recovery, observed by driller as weathered rock	2.70	21.06		
3		83	32	0				Possible weathered rock - recovered as angular gravel and cobbles of limestone	3.30	20.46		
3.30		0	0	0				No recovery - driller notes clay band	3.80	19.96		
3.80												
4		100	85	52				Very strong, thick to thinly bedded, blueish dark grey, fine grained, LIMESTONE (locally fossiliferous, localized chert and stylolites), fresh to slightly weathered.				
5		67	54	51				Dips are 20° to locally 40°. Discontinuities are widely to medium spaced, rough to locally smooth, planar. Apertures are tight to partly open, very thin brown clay smearing.				
5.70								4.16-4.40m - Clay-filled fracture 4.57-5.01m - Clay-filled fracture				
6		100	93	89								
7												
7.00		100	56	56				7.22-7.75m - Clay-filled fracture				
8									8.00	15.76		
8.00								End of Borehole at 8.00 m				
9												

REMARKS Hole cased 0.00-4.20m.					WATER STRIKE DETAILS					
					Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
										No water strike recorded
INSTALLATION DETAILS					GROUNDWATER DETAILS					
					Date	Hole Depth	Casing Depth	Depth to Water	Comments	
Date	Tip Depth	RZ Top	RZ Base	Type						

IGSL RC Fl 10M 18963.GPJ IGSL.GDT 24/6/16





GEOTECHNICAL BORING RECORD

REPORT NUMBER

18963

CONTRACT N6 Galway City Transport Project - Phase 3

BOREHOLE NO. BH3/35 CP

CO-ORDINATES 532,852.21 E
728,223.09 N
GROUND LEVEL (m AOD) 17.70

RIG TYPE Dando 3000
BOREHOLE DIAMETER (mm)
BOREHOLE DEPTH (m) 8.90

SHEET Sheet 1 of 1

DATE COMMENCED 29/03/2016
DATE COMPLETED 30/03/2016

CLIENT ENGINEER Galway County Council
ARUP

SPT HAMMER REF. NO.
ENERGY RATIO (%)

BORED BY WC
PROCESSED BY JL

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples				Field Test Results	Standpipe Details
					Ref. Number	Sample Type	Depth (m)	Recovery		
0	Soft dark brown sandy gravelly CLAY		17.40	0.30						
1	Firm becoming stiff light brown sandy gravelly slightly silty CLAY with a medium cobble and boulder content				AA1	B	0.50			
					AA2	B	1.00-1.45	N = 10 (1, 2, 2, 2, 3, 3)		
2					AA3	B	2.00-2.45	N = 19 (2, 2, 3, 4, 6, 6)		
3					AA4	B	3.00-3.45	N = 37 (5, 7, 4, 8, 11, 14)		
4					AA5	B	4.00-4.45	N = 26 (3, 3, 5, 7, 6, 8)		
5					AA6	B	5.00-5.45	N = 39 (6, 7, 7, 9, 11, 12)		
6	Stiff to very stiff dark brown sandy gravelly silty CLAY with a medium cobble and boulder content		11.80	5.90						
					AA7	B	6.50-6.95	N = 45 (8, 5, 9, 11, 12, 13)		
7										
8			9.40	8.30	AA8	B	8.00-8.45	N = 31 (4, 6, 7, 11, 7, 6)		
	Stiff orange brown sandy gravelly CLAY		9.20	8.50						
	Stiff dark grey brown sandy gravelly silty CLAY with a medium cobble and boulder content		8.80	8.90						
9	End of Borehole at 8.90 m									

HARD STRATA BORING/CHISELLING

WATER STRIKE DETAILS

From (m)	To (m)	Time (h)	Comments	Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
6.3	6.5	0.5							No water strike
8.8	8.9	0.75							

GROUNDWATER PROGRESS

INSTALLATION DETAILS

Date Hole Depth Casing Depth Depth to Water Comments

Date	Tip Depth	RZ Top	RZ Base	Type

REMARKS 1.5hrs getting plant and equipment to borehole location. 0.5hr cleaning down road after exiting field.

Sample Legend

- D - Small Disturbed (tub) Sample
- B - Bulk Disturbed
- LB - Large Bulk Disturbed
- Env - Environmental Sample (Jar + Vial + Tub)
- UT - Undisturbed 100mm Diameter Sample
- P - Undisturbed Piston Sample
- W - Water Sample

IGSL BH LOG 18963.GPJ IGSL_GDT 12/5/16



GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER

18963

CONTRACT N6 Galway City Transport Project - Phase 3

DRILLHOLE NO BH3/35R

SHEET Sheet 1 of 3

CO-ORDINATES 532,850.77 E
728,225.98 N

GROUND LEVEL (mOD) 17.52

RIG TYPE Knebel
FLUSH Air/Mist

DATE DRILLED 23/02/2016

DATE LOGGED 24/02/2016

CLIENT Galway County Council
ENGINEER ARUP

INCLINATION (deg) -90
CORE DIAMETER (mm) 80

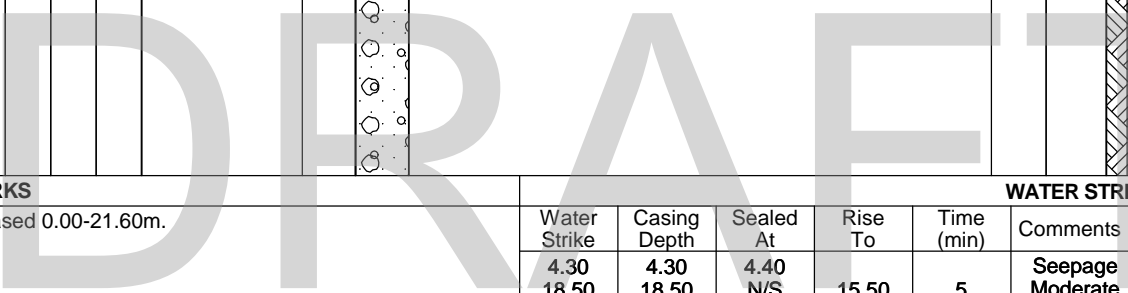
DRILLED BY S. Petersen

LOGGED BY D. O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm)	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0					0 250 500			SYMMETRIX DRILLING: No recovery, observed by driller as TOPSOIL.	0.50	17.02		
1								SYMMETRIX DRILLING: No recovery, observed by driller as silty sandy gravelly cobbly clay				
2								SYMMETRIX DRILLING: No recovery, observed by driller as silty clayey sand	2.40	15.12		N = 50/135 mm (11, 14, 17, 33)
3								SYMMETRIX DRILLING: No recovery, observed by driller as silty clayey sand with cobbles and boulders	5.30	12.22		N = 50/10 mm (25, 50)
4								SYMMETRIX DRILLING: No recovery, observed by driller as silty clayey sand with cobbles and boulders	6.80	10.72		N = 50/195 mm (5, 11, 20, 13, 17)
5								SYMMETRIX DRILLING: No recovery, observed by driller as silty clayey sand with many boulders				N = 50/0 mm (25, 50)
6												N = 50/10 mm (25, 50)
7												N = 50/10 mm (25, 50)
8												N = 50/40 mm (15, 10, 50)
9												N = 50/40 mm (15, 10, 50)

REMARKS					WATER STRIKE DETAILS					
Hole cased 0.00-21.60m.					Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					4.30 18.50	4.30 18.50	4.40 N/S	15.50	5	Seepage Moderate
INSTALLATION DETAILS					GROUNDWATER DETAILS					
Date	Tip Depth	RZ Top	RZ Base	Type	Date	Hole Depth	Casing Depth	Depth to Water	Comments	
24-02-16	18.00	10.50	19.50	50mm SP						

IGSL RC Fl 10M 18963.GPJ IGSL.GDT 24/02/16





GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER

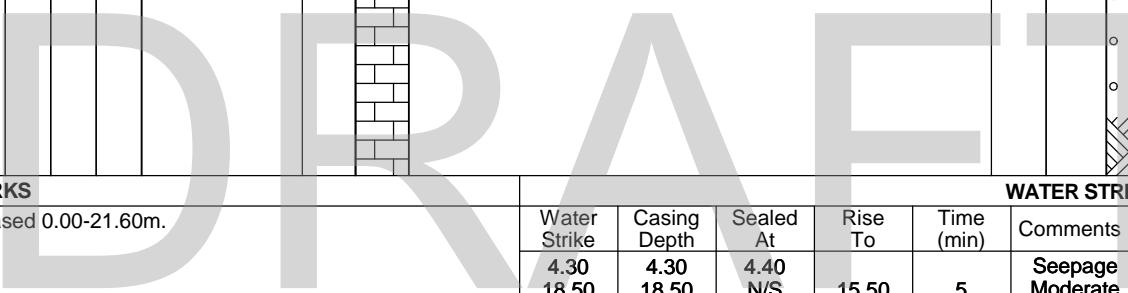
18963

CONTRACT N6 Galway City Transport Project - Phase 3		DRILLHOLE NO BH3/35R
CO-ORDINATES 532,850.77 E 728,225.98 N		SHEET Sheet 2 of 3
GROUND LEVEL (mOD) 17.52	RIG TYPE Knebel	DATE DRILLED 23/02/2016
CLIENT Galway County Council	FLUSH Air/Mist	DATE LOGGED 24/02/2016
ENGINEER ARUP	INCLINATION (deg) -90	DRILLED BY S. Petersen
	CORE DIAMETER (mm) 80	LOGGED BY D. O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm)	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10					0 250 500			SYMMETRIX DRILLING: No recovery, observed by driller as silty clayey sand with many boulders (<i>continued</i>)				
11												N = 50/85 mm (16, 9, 36, 14)
12												N = 50/15 mm (9, 16, 50)
13												N = 50/10 mm (25, 50)
14									14.50	3.02		N = 50/15 mm (25, 50)
15								SYMMETRIX DRILLING: No recovery, observed by driller as weathered rock				N = 50/15 mm (25, 50)
16												N = 50/50 mm (21, 4, 50)
17												N = 50/95 mm (16, 9, 42, 8)
18												
19												

REMARKS Hole cased 0.00-21.60m.					WATER STRIKE DETAILS					
					Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					4.30	4.30	4.40	15.50	5	Seepage Moderate
					18.50	18.50	N/S			
INSTALLATION DETAILS					GROUNDWATER DETAILS					
					Date	Hole Depth	Casing Depth	Depth to Water	Comments	
Date	Tip Depth	RZ Top	RZ Base	Type						
24-02-16	18.00	10.50	19.50	50mm SP						

IGSL RC Fl 10M 18963.GPJ IGSL.GDT 24/06/16





GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER

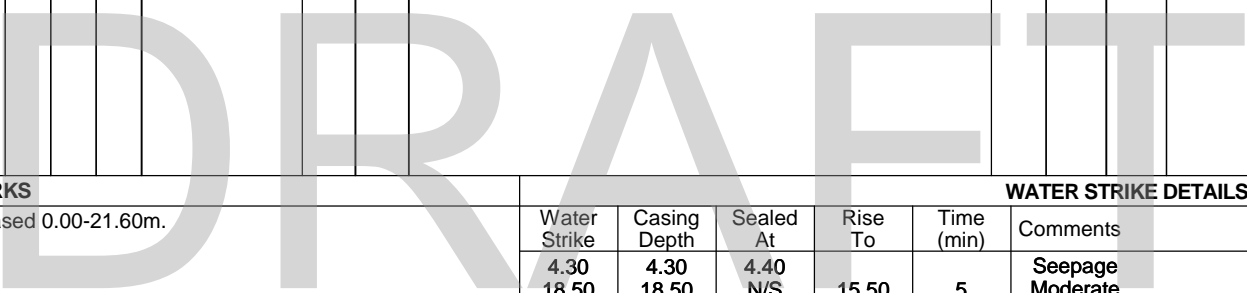
18963

CONTRACT N6 Galway City Transport Project - Phase 3		DRILLHOLE NO BH3/35R
CO-ORDINATES 532,850.77 E 728,225.98 N		SHEET Sheet 3 of 3
GROUND LEVEL (mod) 17.52	RIG TYPE Knebel	DATE DRILLED 23/02/2016
CLIENT Galway County Council	FLUSH Air/Mist	DATE LOGGED 24/02/2016
ENGINEER ARUP	INCLINATION (deg) -90	DRILLED BY S. Petersen
	CORE DIAMETER (mm) 80	LOGGED BY D. O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm)	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
20								SYMMETRIX DRILLING: No recovery, observed by driller as weathered rock (<i>continued</i>)				N = 50/10 mm (25, 50)
21								SYMMETRIX DRILLING: No recovery, observed by driller as rock	20.90	-3.38		
21.60									21.60	-4.08		
22		33	23	15				Very strong (where competent), medium to thinly bedded, blueish dark grey, fine grained, LIMESTONE (locally fossiliferous, localized chert and stylolites), slightly to locally highly weathered contributing to coreloss.				
23								Dips are horizontal to locally 45°. Discontinuities are medium to closely spaced, rough to locally smooth, planar to occasionally undulose. Apertures are wide, locally clay-filled.				
23.10								22.00-23.00m - No recovery, possible clay-filled fracture				
24		7	7	7				23.10-24.50m - No recovery, possible clay-filled fracture				
24.60								End of Borehole at 24.60 m	24.60	-7.08		
25												
26												
27												
28												
29												

REMARKS Hole cased 0.00-21.60m.					WATER STRIKE DETAILS					
					Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					4.30	4.30	4.40	15.50	5	Seepage Moderate
					18.50	18.50	N/S			
INSTALLATION DETAILS					GROUNDWATER DETAILS					
					Date	Hole Depth	Casing Depth	Depth to Water	Comments	
Date	Tip Depth	RZ Top	RZ Base	Type						
24-02-16	18.00	10.50	19.50	50mm SP						

IGSL RC Fl 10M 18963.GPJ IGSL.GDT 24/06/16





GEOTECHNICAL BORING RECORD

REPORT NUMBER

18963

CONTRACT N6 Galway City Transport Project - Phase 3				BOREHOLE NO. BH3/38	
CO-ORDINATES 534,249.34 E 727,540.83 N		RIG TYPE Dando 3000		SHEET Sheet 1 of 1	
GROUND LEVEL (m AOD) 45.27		BOREHOLE DIAMETER (mm)		DATE COMMENCED 09/02/2016	
		BOREHOLE DEPTH (m) 0.40		DATE COMPLETED 09/02/2016	
CLIENT ENGINEER Galway County Council ARUP			SPT HAMMER REF. NO.		BORED BY WC
			ENERGY RATIO (%)		PROCESSED BY JL

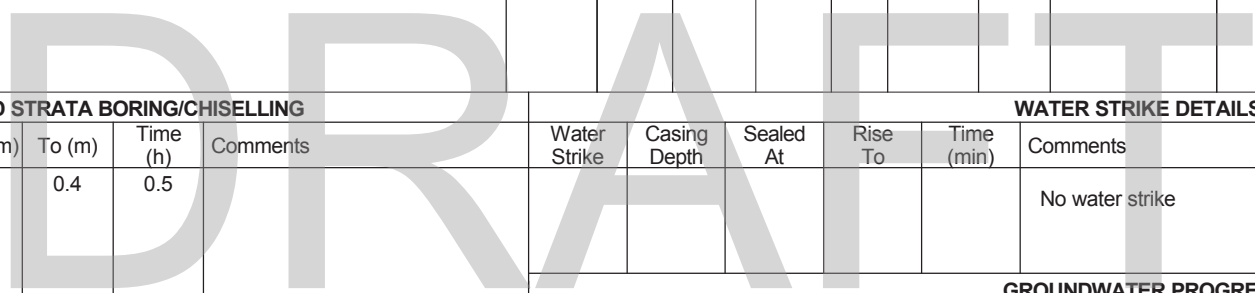
Depth (m)	Description	Legend	Elevation	Depth (m)	Samples				Field Test Results	Standpipe Details
					Ref. Number	Sample Type	Depth (m)	Recovery		
0	Soft light brown sandy gravelly CLAY		44.87	0.40						
0.40	Obstruction - Possible Rockhead End of Borehole at 0.40 m									
1										
2										
3										
4										
5										
6										
7										
8										
9										

HARD STRATA BORING/CHISELLING				WATER STRIKE DETAILS					
From (m)	To (m)	Time (h)	Comments	Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
0.4	0.4	0.5							No water strike

INSTALLATION DETAILS					Date	Hole Depth	Casing Depth	Depth to Water	Comments
Date	Tip Depth	RZ Top	RZ Base	Type					

REMARKS 1hr moving to location with tracked dumper. 0.5hr reinstating field after works.	Sample Legend D - Small Disturbed (tub) B - Bulk Disturbed LB - Large Bulk Disturbed Env - Environmental Sample (Jar + Vial + Tub)	UT - Undisturbed 100mm Diameter Sample P - Undisturbed Piston Sample W - Water Sample
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IGSL BH LOG - 18963.GPJ IGSL_GDT_12/5/16





GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER

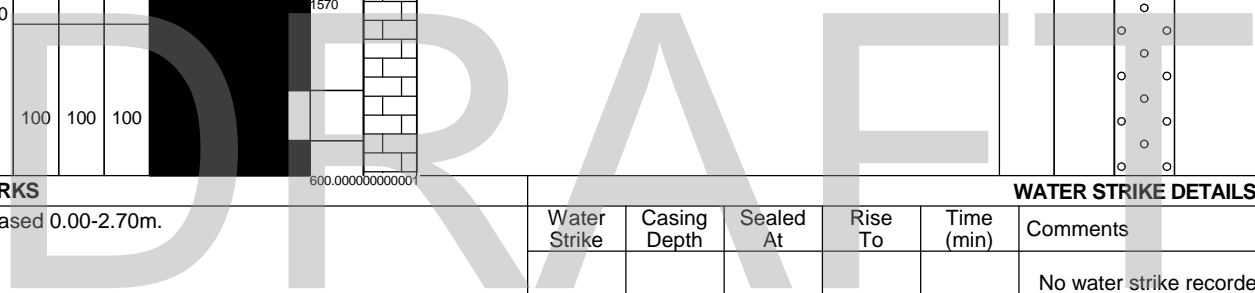
18963

CONTRACT N6 Galway City Transport Project - Phase 3		DRILLHOLE NO BH3/38R
CO-ORDINATES 534,249.34 E 727,540.83 N		SHEET Sheet 1 of 2
GROUND LEVEL (MOD) 45.27	RIG TYPE Casagrande	DATE DRILLED 17/02/2016
CLIENT Galway County Council	FLUSH Air/Mist	DATE LOGGED 18/02/2016
ENGINEER ARUP	INCLINATION (deg) -90	DRILLED BY IGSL
	CORE DIAMETER (mm) 80	LOGGED BY D. O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm)	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0								SYMMETRIX DRILLING: No recovery, observed by driller as clayey gravel	1.00	44.27		
1	1.20							SYMMETRIX DRILLING: No recovery, observed by driller as weathered rock	1.20	44.07		
2		87	64	42				Very strong, thick to thin bedded, blueish dark grey, fine grained, LIMESTONE (locally fossiliferous, localized chert and stylolites), fresh to slightly weathered.				
3								Dips are 20° to locally 40° & 80°. Discontinuities are widely to medium spaced, rough to locally smooth, planar. Apertures are tight to partly open, very thin brown clay smearing.				
4								1.20-1.66m - Moderately weathered, slight weakening.				
5								3.23-3.41m - Moderately weathered, slight weakening.				
6												
7												
8												
9												

REMARKS Hole cased 0.00-2.70m.					WATER STRIKE DETAILS					
					Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
					No water strike recorded					
INSTALLATION DETAILS					GROUNDWATER DETAILS					
					Date	Hole Depth	Casing Depth	Depth to Water	Comments	
Date	Tip Depth	RZ Top	RZ Base	Type						
18-02-16	8.30	2.80	10.30	50mm SP						

IGSL RC Fl 10M 18963.GPJ IGSL.GDT 24/6/16





GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER

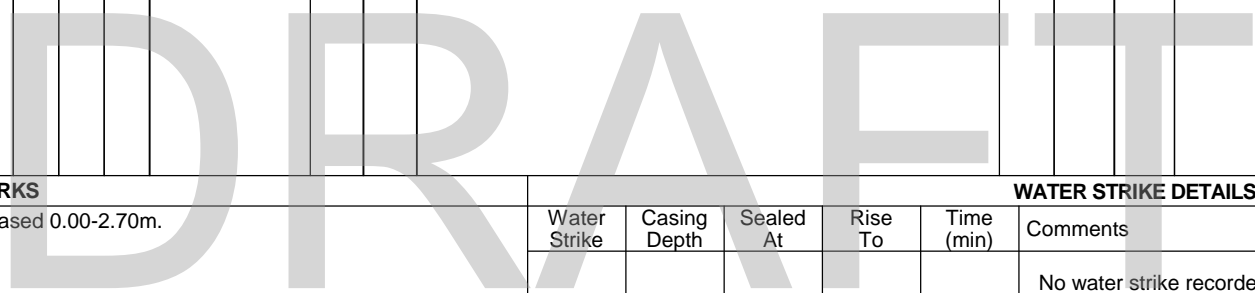
18963

CONTRACT N6 Galway City Transport Project - Phase 3		DRILLHOLE NO BH3/38R
CO-ORDINATES 534,249.34 E 727,540.83 N		SHEET Sheet 2 of 2
GROUND LEVEL (mOD) 45.27	RIG TYPE Casagrande	DATE DRILLED 17/02/2016
	FLUSH Air/Mist	DATE LOGGED 18/02/2016
CLIENT Galway County Council	INCLINATION (deg) -90	DRILLED BY IGSL
ENGINEER ARUP	CORE DIAMETER (mm) 80	LOGGED BY D. O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm)	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10	10.30							End of Borehole at 10.30 m	10.30	34.97	°	°
11												
12												
13												
14												
15												
16												
17												
18												
19												

REMARKS Hole cased 0.00-2.70m.					WATER STRIKE DETAILS					
					Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
										No water strike recorded
INSTALLATION DETAILS					GROUNDWATER DETAILS					
					Date	Hole Depth	Casing Depth	Depth to Water	Comments	
Date	Tip Depth	RZ Top	RZ Base	Type						
18-02-16	8.30	2.80	10.30	50mm SP						

IGSL RC Fl 10M 18963.GPJ IGSL.GDT 24/6/16





GEOTECHNICAL BORING RECORD

REPORT NUMBER

18963

CONTRACT N6 Galway City Transport Project - Phase 3

BOREHOLE NO. BH3/39

CO-ORDINATES 534,360.45 E
727,402.19 N
GROUND LEVEL (m AOD) 41.88

RIG TYPE Dando 3000
BOREHOLE DIAMETER (mm)
BOREHOLE DEPTH (m) 0.40

SHEET Sheet 1 of 1

DATE COMMENCED 10/02/2016
DATE COMPLETED 10/02/2016

CLIENT ENGINEER Galway County Council
ARUP

SPT HAMMER REF. NO.
ENERGY RATIO (%)

BORED BY WC
PROCESSED BY JL

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples				Field Test Results	Standpipe Details
					Ref. Number	Sample Type	Depth (m)	Recovery		
0	Driller reports GRAVEL hardstanding (MADE GROUND) Obstruction - Possible Rockhead End of Borehole at 0.40 m		41.48	0.40						
1										
2										
3										
4										
5										
6										
7										
8										
9										

DRAFT

HARD STRATA BORING/CHISELLING				WATER STRIKE DETAILS					
From (m)	To (m)	Time (h)	Comments	Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
0.4	0.4	0.5							No water strike

INSTALLATION DETAILS					Date	Hole Depth	Casing Depth	Depth to Water	Comments
Date	Tip Depth	RZ Top	RZ Base	Type					

REMARKS 0.50hr moving rig and tracked dumper to BH3/39	Sample Legend D - Small Disturbed (tub) B - Bulk Disturbed LB - Large Bulk Disturbed Env - Environmental Sample (Jar + Vial + Tub) UT - Undisturbed 100mm Diameter Sample P - Undisturbed Piston Sample W - Water Sample
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IGSL BH LOG 18963.GPJ IGSL.GDT 12/5/16



GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER

18963

CONTRACT N6 Galway City Transport Project - Phase 3		DRILLHOLE NO BH3/39R
CO-ORDINATES 534,360.45 E 727,402.19 N		SHEET Sheet 1 of 2
GROUND LEVEL (MOD) 41.88	RIG TYPE Casagrande	DATE DRILLED 16/02/2016
CLIENT Galway County Council	FLUSH Air/Mist	DATE LOGGED 17/02/2016
ENGINEER ARUP	INCLINATION (deg) -90	DRILLED BY IGSL
	CORE DIAMETER (mm) 80	LOGGED BY D. O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R. %	S.C.R. %	R.Q.D. %	Fracture Spacing Log (mm)	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
0								SYMMETRIX DRILLING: No recovery, observed by driller as made ground consisting of clayey gravel	0.40	41.48		
1.10								SYMMETRIX DRILLING: No recovery, observed by driller as weathered rock	1.10	40.78		
2	100	96	76					Very strong, thick to thinly bedded, blueish dark grey, fine grained, LIMESTONE (locally fossiliferous, localized chert and stylolites), fresh to slightly weathered.				
2.60								Dips are horizontal. Discontinuities are medium to closely spaced, rough to locally smooth, planar to occasionally undulose. Apertures are tight to wide, locally clay-filled.				
3	100	91	88									
4.10												
5	100	100	97									
5.30												
6	100	100	100									
6.80												
7	100	100	100									
8.20												
9	100	100	100									
9.70												
	100	100	80									

REMARKS Hole cased 0.00-1.20m.					WATER STRIKE DETAILS				
					Water Strike	Casing Depth	Sealed At	Rise To	Time (min)
					No water strike recorded				
INSTALLATION DETAILS					GROUNDWATER DETAILS				
					Date	Hole Depth	Casing Depth	Depth to Water	Comments
Date	Tip Depth	RZ Top	RZ Base	Type					

IGSL RC Fl 10M 18963.GPJ IGSL.GDT 24/6/16



GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER

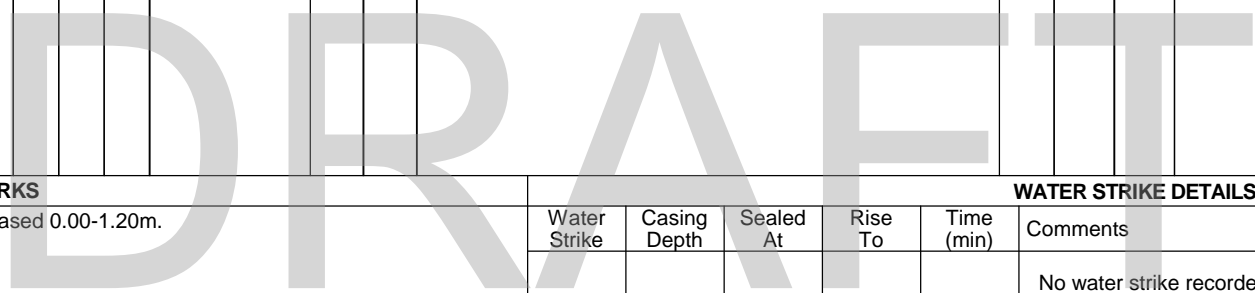
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CONTRACT N6 Galway City Transport Project - Phase 3		DRILLHOLE NO BH3/39R
CO-ORDINATES 534,360.45 E 727,402.19 N		SHEET Sheet 2 of 2
GROUND LEVEL (mOD) 41.88	RIG TYPE Casagrande	DATE DRILLED 16/02/2016
CLIENT Galway County Council	FLUSH Air/Mist	DATE LOGGED 17/02/2016
ENGINEER ARUP	INCLINATION (deg) -90	DRILLED BY IGSL
	CORE DIAMETER (mm) 80	LOGGED BY D. O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm)	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10.10	10.10				0 250 500			End of Borehole at 10.10 m	10.10	31.78		
11												
12												
13												
14												
15												
16												
17												
18												
19												

REMARKS Hole cased 0.00-1.20m.					WATER STRIKE DETAILS					
					Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
										No water strike recorded
INSTALLATION DETAILS					GROUNDWATER DETAILS					
					Date	Hole Depth	Casing Depth	Depth to Water	Comments	
Date	Tip Depth	RZ Top	RZ Base	Type						

IGSL RC Fl 10M 18963.GPJ IGSL.GDT 24/6/16





GEOTECHNICAL BORING RECORD

REPORT NUMBER

18963

CONTRACT N6 Galway City Transport Project - Phase 3				BOREHOLE NO. BH3/40	
CO-ORDINATES 534,439.24 E 727,295.41 N		RIG TYPE Hand Dug		SHEET Sheet 1 of 1	
GROUND LEVEL (m AOD) 42.35		BOREHOLE DIAMETER (mm)		DATE COMMENCED 11/02/2016	
		BOREHOLE DEPTH (m) 0.80		DATE COMPLETED 11/02/2016	
CLIENT ENGINEER Galway County Council ARUP			SPT HAMMER REF. NO.		BORED BY AC
			ENERGY RATIO (%)		PROCESSED BY JL

Depth (m)	Description	Legend	Elevation	Depth (m)	Samples				Field Test Results	Standpipe Details
					Ref. Number	Sample Type	Depth (m)	Recovery		
0	TOPSOIL (MADE GROUND)		42.30	0.05						
	Brown grey sandy fine to medium GRAVEL (MADE GROUND)		42.20	0.15	AA49469	B	0.15-0.50			
			41.85	0.50	AA49470	B	0.50-0.80			
	Firm dark grey slightly sandy slightly gravelly SILT with a low to medium cobble content. Cobbles are of limestone.		41.55	0.80						
1	Firm brown slightly sandy slightly gravelly silty CLAY with a high cobble and boulder content. Cobbles and boulders are angular of limestone.									
2	Obstruction - Large BOULDERS / Possible weathered rockhead End of Borehole at 0.80 m									
3										
4										
5										
6										
7										
8										
9										

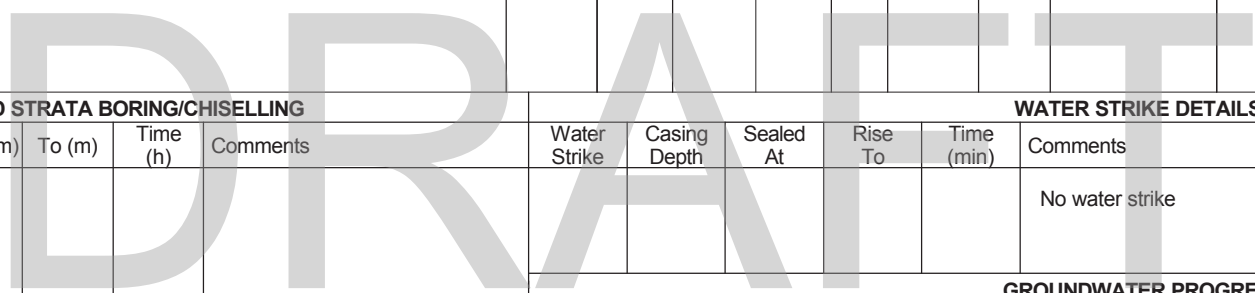
HARD STRATA BORING/CHISELLING				WATER STRIKE DETAILS					
From (m)	To (m)	Time (h)	Comments	Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
									No water strike

INSTALLATION DETAILS					GROUNDWATER PROGRESS				
Date	Tip Depth	RZ Top	RZ Base	Type	Date	Hole Depth	Casing Depth	Depth to Water	Comments

REMARKS Hand dug pit at location of BH3/40

Sample Legend
 D - Small Disturbed (tub) Sample
 B - Bulk Disturbed
 LB - Large Bulk Disturbed
 Env - Environmental Sample (Jar + Vial + Tub)
 UT - Undisturbed 100mm Diameter Sample
 P - Undisturbed Piston Sample
 W - Water Sample

IGSL BH LOG - 18963.GPJ IGSL_GDT_12/5/16



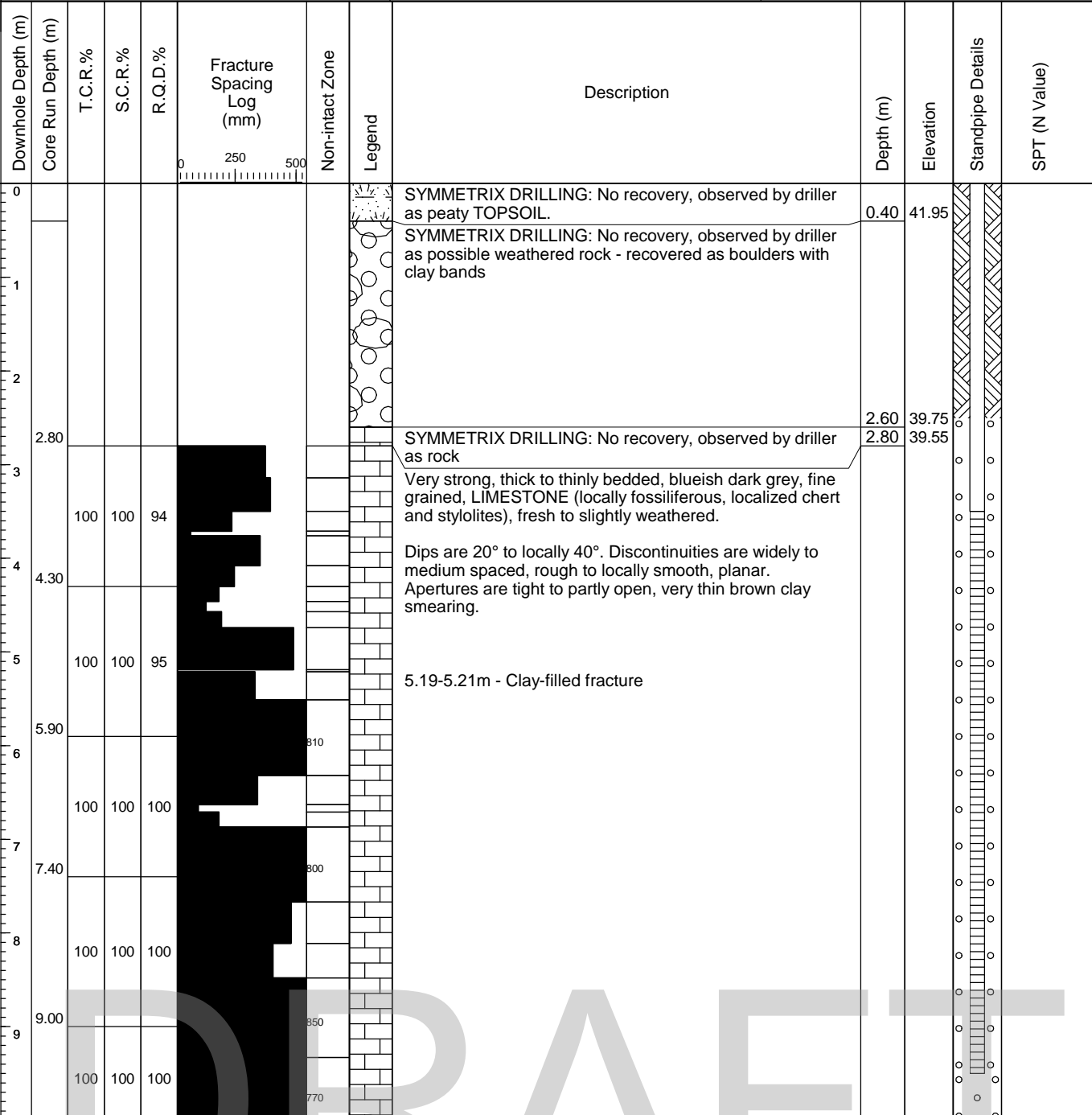


GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER

18963

CONTRACT N6 Galway City Transport Project - Phase 3		DRILLHOLE NO BH3/40R
CO-ORDINATES 534,439.24 E 727,295.41 N		SHEET Sheet 1 of 2
GROUND LEVEL (mOD) 42.35	RIG TYPE Knebel	DATE DRILLED 29/02/2016
CLIENT Galway County Council	FLUSH Air/Mist	DATE LOGGED 29/02/2016
ENGINEER ARUP	INCLINATION (deg) -90	DRILLED BY S. Petersen
	CORE DIAMETER (mm) 80	LOGGED BY D. O'Shea



REMARKS Hole cased 0.00-2.80m.					WATER STRIKE DETAILS					
					Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
										No water strike recorded
INSTALLATION DETAILS					GROUNDWATER DETAILS					
					Date	Hole Depth	Casing Depth	Depth to Water	Comments	
Date	Tip Depth	RZ Top	RZ Base	Type						
29-02-16	9.50	2.50	10.10	50mm SP						

IGSL RC Fl 10M 18963.GPJ IGSL.GDT 24/6/16



GEOTECHNICAL CORE LOG RECORD

REPORT NUMBER

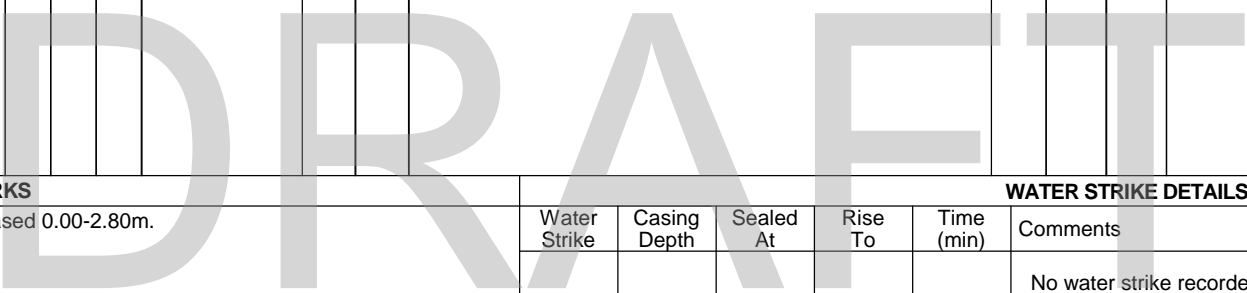
18963

CONTRACT N6 Galway City Transport Project - Phase 3		DRILLHOLE NO BH3/40R
CO-ORDINATES 534,439.24 E 727,295.41 N		SHEET Sheet 2 of 2
GROUND LEVEL (MOD) 42.35	RIG TYPE Knebel	DATE DRILLED 29/02/2016
CLIENT Galway County Council	FLUSH Air/Mist	DATE LOGGED 29/02/2016
ENGINEER ARUP	INCLINATION (deg) -90	DRILLED BY S. Petersen
	CORE DIAMETER (mm) 80	LOGGED BY D. O'Shea

Downhole Depth (m)	Core Run Depth (m)	T.C.R.%	S.C.R.%	R.Q.D.%	Fracture Spacing Log (mm)	Non-intact Zone	Legend	Description	Depth (m)	Elevation	Standpipe Details	SPT (N Value)
10	10.10				0 250 500			End of Borehole at 10.10 m	10.10	32.25	°	°
11												
12												
13												
14												
15												
16												
17												
18												
19												

REMARKS Hole cased 0.00-2.80m.					WATER STRIKE DETAILS					
					Water Strike	Casing Depth	Sealed At	Rise To	Time (min)	Comments
										No water strike recorded
INSTALLATION DETAILS					GROUNDWATER DETAILS					
					Date	Hole Depth	Casing Depth	Depth to Water	Comments	
Date	Tip Depth	RZ Top	RZ Base	Type						
29-02-16	9.50	2.50	10.10	50mm SP						

IGSL RC Fl 10M 18963.GPJ IGSL.GDT 24/6/16





IRISH DRILLING LTD.
LOUGHREA, CO. GALWAY
Telephone: 091 841274
Fax: 091 847687

DRILLHOLE LOG

Project N6 Galway City Outer Bypass				DRILLHOLE No RC 1104	
Job No	Date 29-11-06 30-11-06	Ground Level (m) 9.39	Co-Ordinates () E 131,197.5 N 228,895.3		
Contractor IDL				Sheet 1 of 3	

RUN DETAILS					STRATA				Geology	Instrument/Backfill
Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thickness)	DESCRIPTION				
						Discontinuities	Detail	Main		
0.00	0 (-) -	NA			(2.00)	0.00 - 2.00		Open hole drilling - no recovery.		
2.00			7.39		2.00	2.00 - 17.00		Grey slightly sandy gravelly SILT/CLAY with some assorted limestone cobbles and boulders.		
3.00	30 (-) -	(50/150)								
4.00	20 (-) -									
4.50	67 (-) -									
6.00	25 (-) -	(NA)								
7.50	21 (-) -									
9.00	21 (-) -	(45)								
10.00	26 (-) -				(15.00)					

Drilling Progress and Water Observations							Rotary Flush				GENERAL REMARKS	
Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing	From	To	Type		Returns
												19mm standpipe piezometer installed to 19.70m. 2gls of polydrill used to assist drilling.

All dimensions in metres Scale 1:62.5	Client Galway County Council	Method/ Plant Used	County Tractor	Bit Design	HQ	Logged By	EAT
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IDL AGS3 UK DH N6GCOB_ROTARY2006.GPJ IDL TP TEMPLATE GDT 09/02/07



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DRILLHOLE LOG

Project N6 Galway City Outer Bypass				DRILLHOLE No RC 1104	
Job No	Date 29-11-06 30-11-06	Ground Level (m) 9.39	Co-Ordinates () E 131,197.5 N 228,895.3		
Contractor IDL				Sheet 2 of 3	

RUN DETAILS						STRATA			Geology	Instrument/ Backfill
Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION				
						Discontinuities	Detail	Main		
11.50	100 (-)	(50/150)					Grey slightly sandy gravelly SILT/CLAY with some assorted limestone cobbles and boulders. (continued)			
13.00	44 (-)									
14.50	100 (-)	NA				13.20 - 13.20 becoming orange brown slightly gravelly.				
15.50	100 (-)									
17.00	100 (-)		-7.61			17.00				
17.30	(86)	3					Strong slightly weathered grey thinly bedded fine and medium grained slightly sandy LIMESTONE.			
18.50	100 (77) 49	NI				17.00 - 20.00 Medium spaced, dipping 38 to 40deg's, planar, locally irregular, rough, with orange brown silt smear. 17.60 to 18.2m: Joint: subvertical, undulating, locally irregular, rough, with greyish brown silt, open. 17.80 to 18.0m: non-intact, fractured rock. 18.75 to 18.95m: Joint: subvertical, undulating, locally irregular, rough, with greyish brown mottled orange silt, wide.				
20.00	100 (71) 60	5	-10.61			20.00				

IDL AGS3 UK DH N6GCOB_ROTARY2006.GPJ IDL TP TEMPLATE.GDT 09/02/07

Drilling Progress and Water Observations								Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing	From	To	Type	Returns	
												19mm standpipe piezometer installed to 19.70m. 2gls of polydrill used to assist drilling.

All dimensions in metres Scale 1:62.5	Client Galway County Council	Method/ Plant Used County Tractor	Bit Design HQ	Logged By EAT
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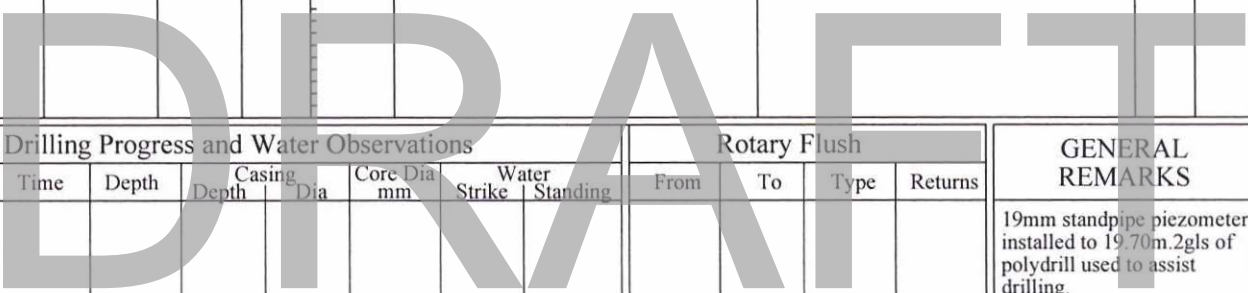


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DRILLHOLE LOG

Project N6 Galway City Outer Bypass				DRILLHOLE No RC 1104	
Job No	Date 29-11-06 30-11-06	Ground Level (m) 9.39	Co-Ordinates () E 131,197.5 N 228,895.3		
Contractor IDL				Sheet 3 of 3	

RUN DETAILS						STRATA						Geology	Instrument/ Backfill
Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION							
						Discontinuities		Detail		Main			
						BH terminated at 20.0m bgl on RE's Instruction.							



Drilling Progress and Water Observations								Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing	From	To	Type	Returns	
												19mm standpipe piezometer installed to 19.70m. 2gls of polydrill used to assist drilling.

All dimensions in metres Scale 1:62.5	Client Galway County Council	Method/ Plant Used	County Tractor	Bit Design	HQ	Logged By	EAT
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IDL AGS3 UK DH N6GCOB_ROTARY2006.GPJ IDL TP TEMPLATE.GDT 09/02/07



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DRILLHOLE LOG

Project N6 Galway City Outer Bypass				DRILLHOLE No MW 01	
Job No	Date 06-10-06 09-10-06	Ground Level (m) 16.14	Co-Ordinates () E 128,703.9 N 227,927.7		
Contractor IDL				Sheet 1 of 2	

RUN DETAILS					STRATA			Geology	Instrument/ Backfill	
Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'ed Level	Legend	Depth (Thick- ness)	DESCRIPTION				
						Discontinuities	Detail			Main
0.00 0.50	0 (-)	NA	15.64		(0.50) 0.50	0.00 - 0.50	Open hole drilling - no recovery.			
1.40	100 (57) 50	1			0.50 - 13.80 Closely spaced to 2.8m, medium spaced to 7.6m, then widely spaced, dipping 30 to 32o, undulating, locally irregular, smooth, with a little grey silt.	Very strong fresh grey thickly bedded fine to coarse grained slightly sandy LIMESTONE with some shelly debris.				
		10								
2.90	100 (98) 53	6								
		3								
4.40	100 (99) 96	2								
		4								
6.00	100 (94) 88	1								
		3								
7.60	100 (98) 83	1								
		3								
9.20	100 (96) 95	1			5.15 to 5.42m: Joint: subvertical, planar, locally irregular, stepped, rough, with a little greenish brown silt, open.					
		3								
	100				(13.30)					

Drilling Progress and Water Observations								Rotary Flush				GENERAL REMARKS
Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing	From	To	Type	Returns	
												50mm standpipe installed to 13.80m.

All dimensions in metres Scale 1:62.5	Client Galway County Council	Method/ Plant Used	County Tractor	Bit Design	HQ	Logged By EAT
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IDL AGS3 UK DH N6GCOB_ROTARY2006.GPJ IDL TP TEMPLATE.GDT 09/02/07

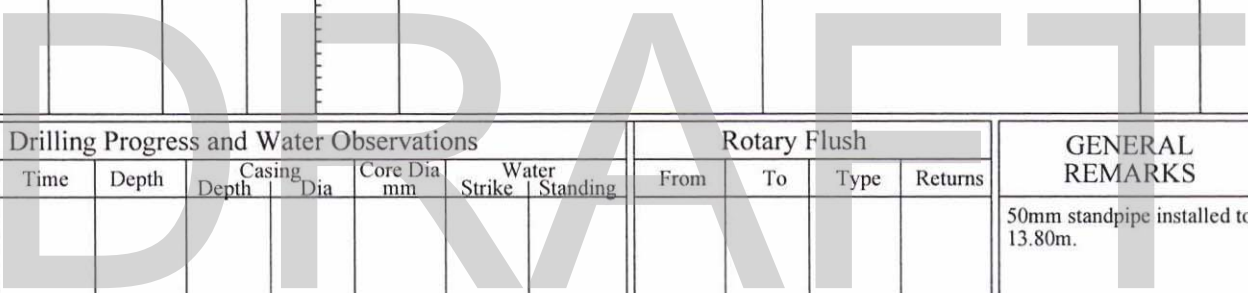


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DRILLHOLE LOG

Project N6 Galway City Outer Bypass				DRILLHOLE No MW 01	
Job No	Date 06-10-06 09-10-06	Ground Level (m) 16.14	Co-Ordinates () E 128,703.9 N 227,927.7		
Contractor IDL				Sheet 2 of 2	

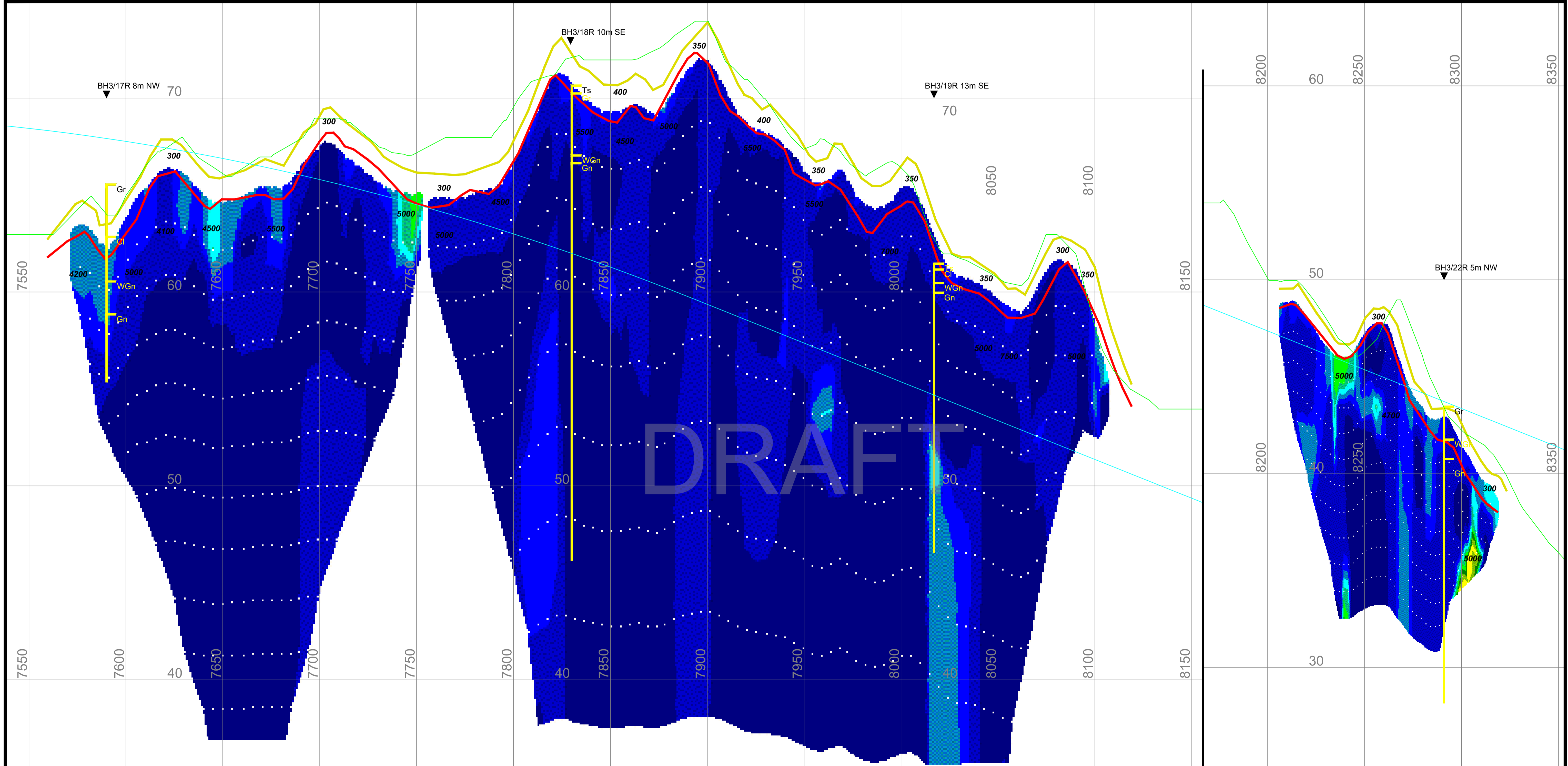
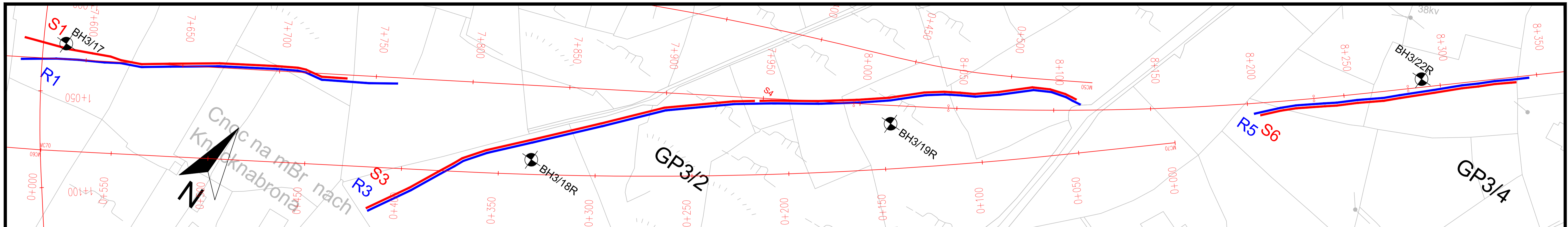
RUN DETAILS				STRATA				Geology	Instrument/ Backfill	
Depth Date	TCR (SCR) RQD	(SPT) Fracture Spacing	Red'cd Level	Legend	Depth (Thick- ness)	DESCRIPTION				
						Discontinuities	Detail	Main		
10.80	(96) 95	1						Very strong fresh grey thickly bedded fine to coarse grained slightly sandy LIMESTONE with some shelly debris. <i>(continued)</i>		
12.20	100 (99) 98	1								
13.80	100 (99) 98	0	2.34		13.80					
								BH terminated at 13.8m bgl on RE's Instruction.		

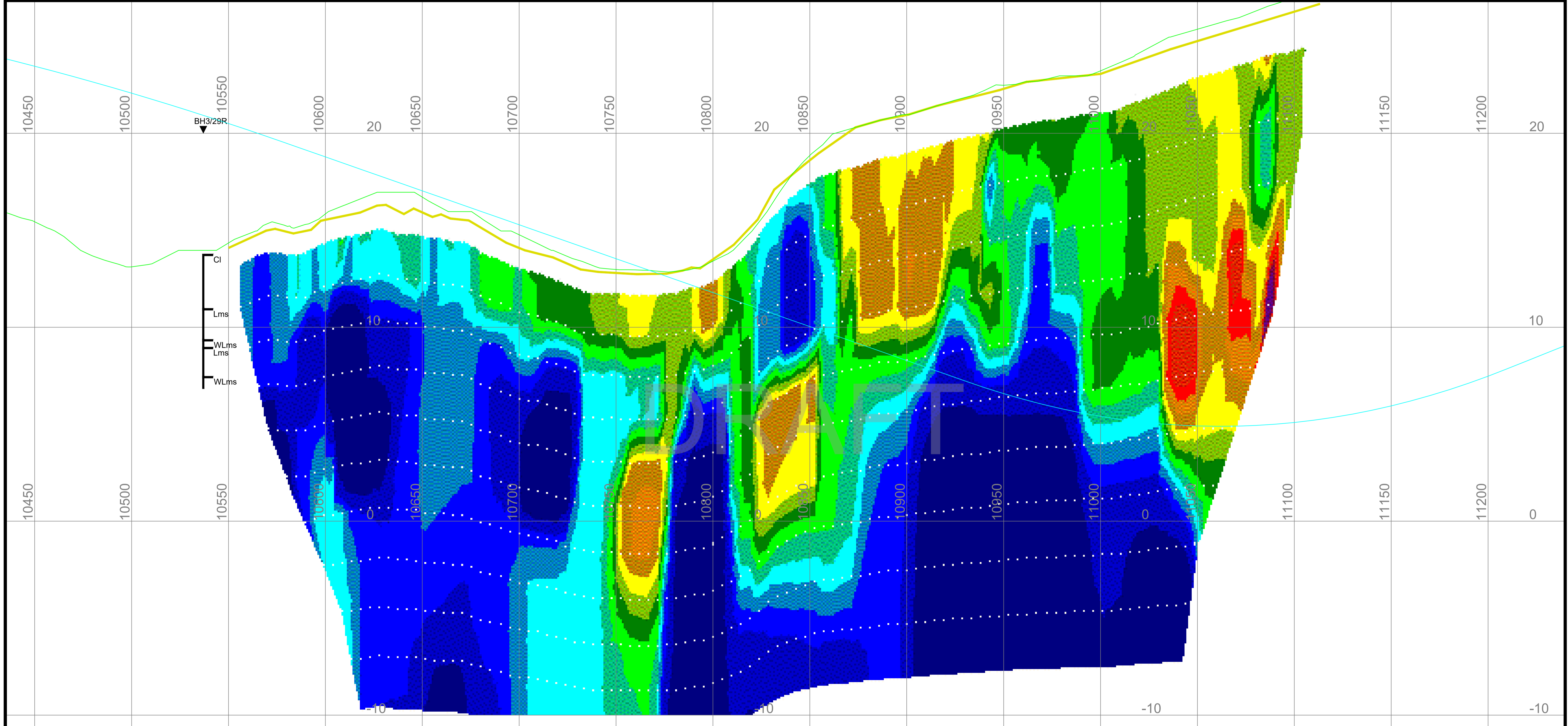
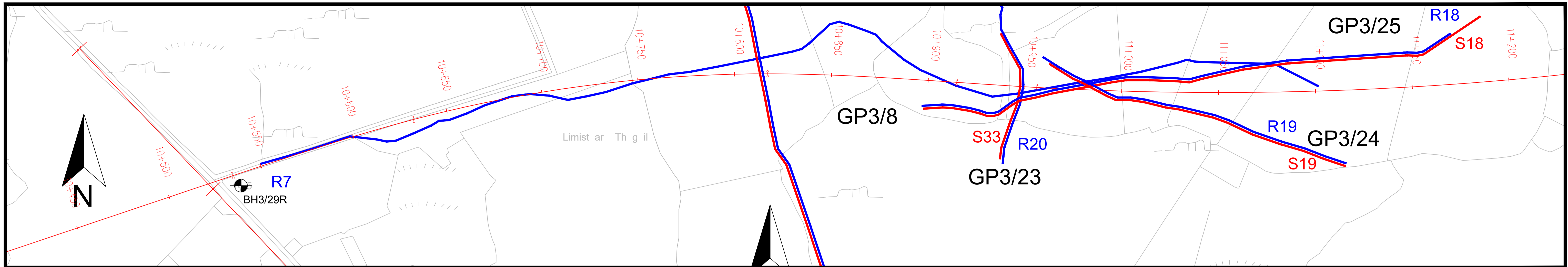


Drilling Progress and Water Observations							Rotary Flush				GENERAL REMARKS	
Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing	From	To	Type		Returns
												50mm standpipe installed to 13.80m.

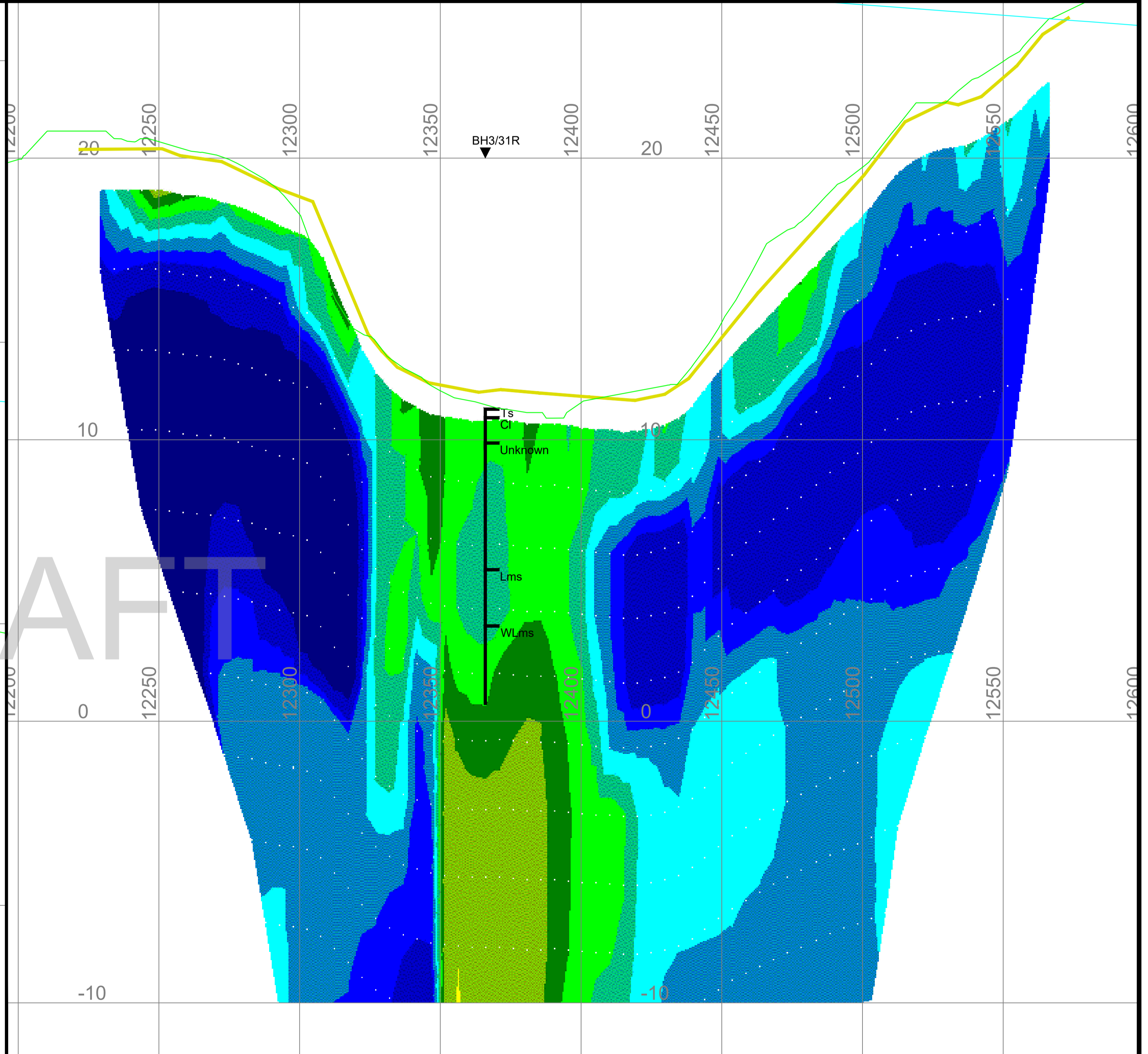
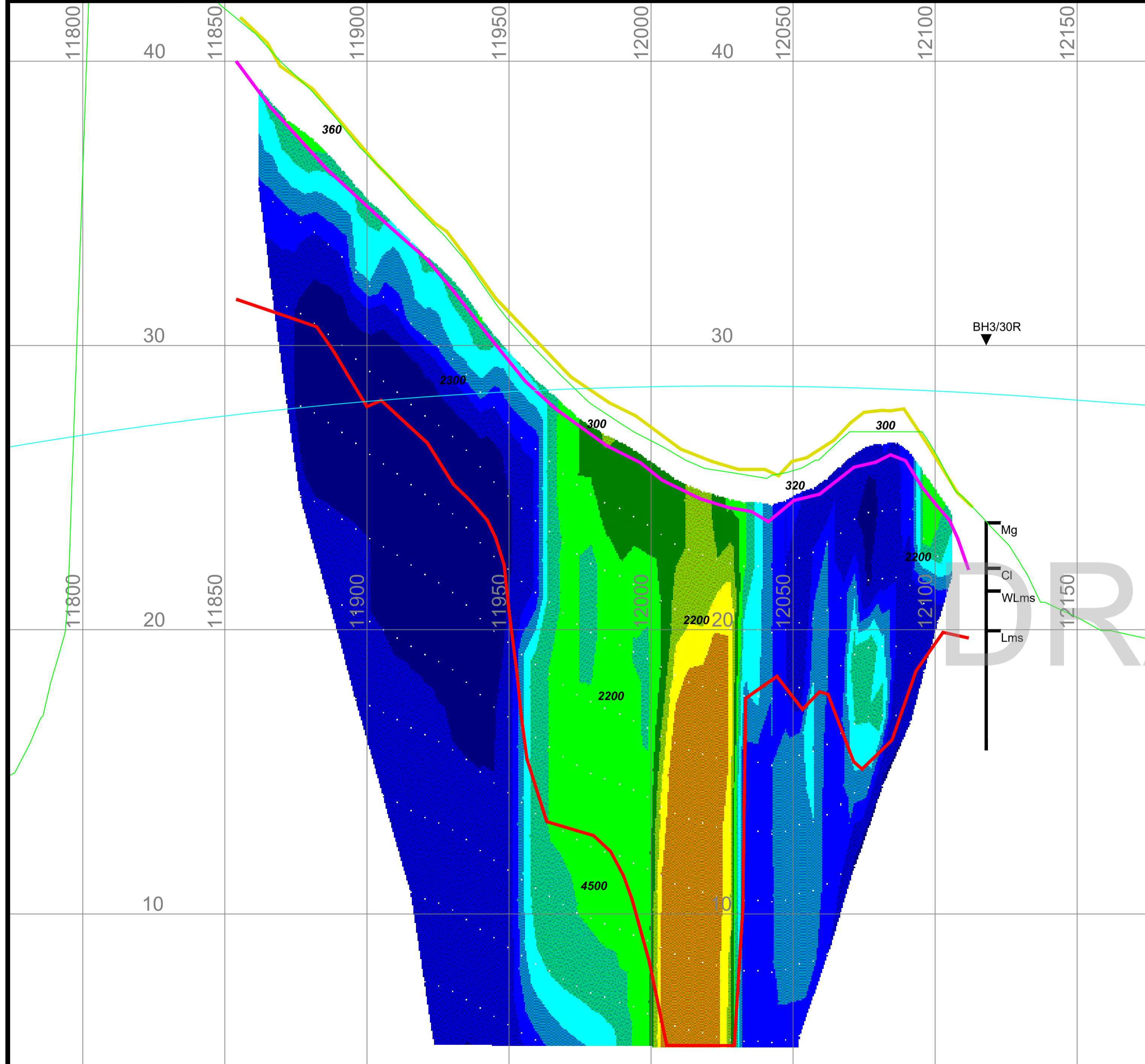
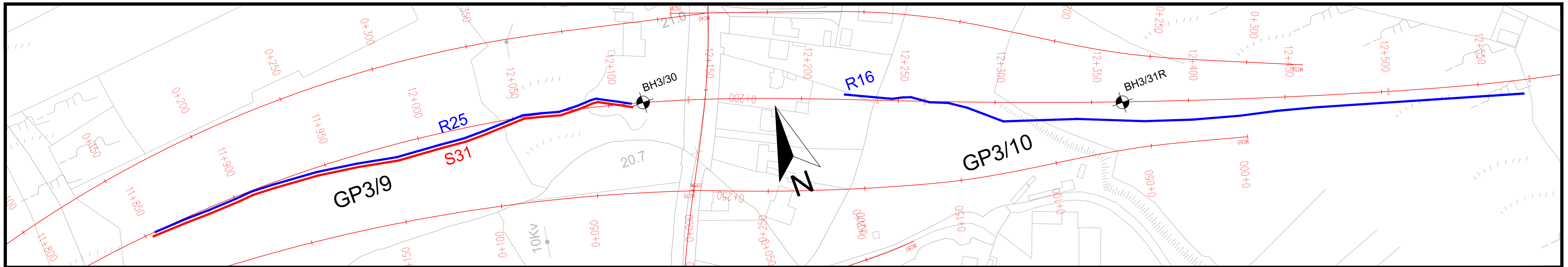
All dimensions in metres Scale 1:62.5	Client Galway County Council	Method/ Plant Used	County Tractor	Bit Design	HQ	Logged By EAT
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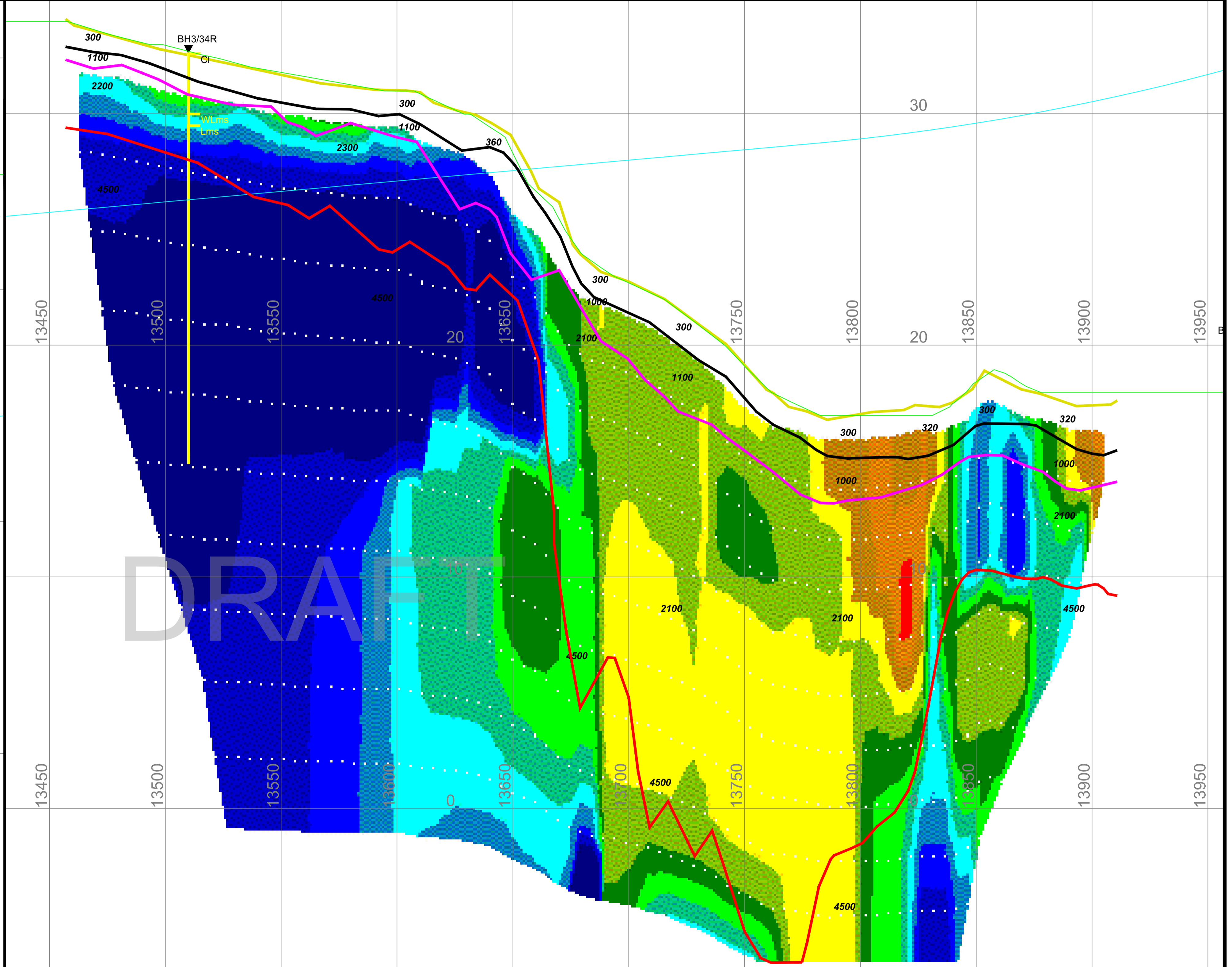
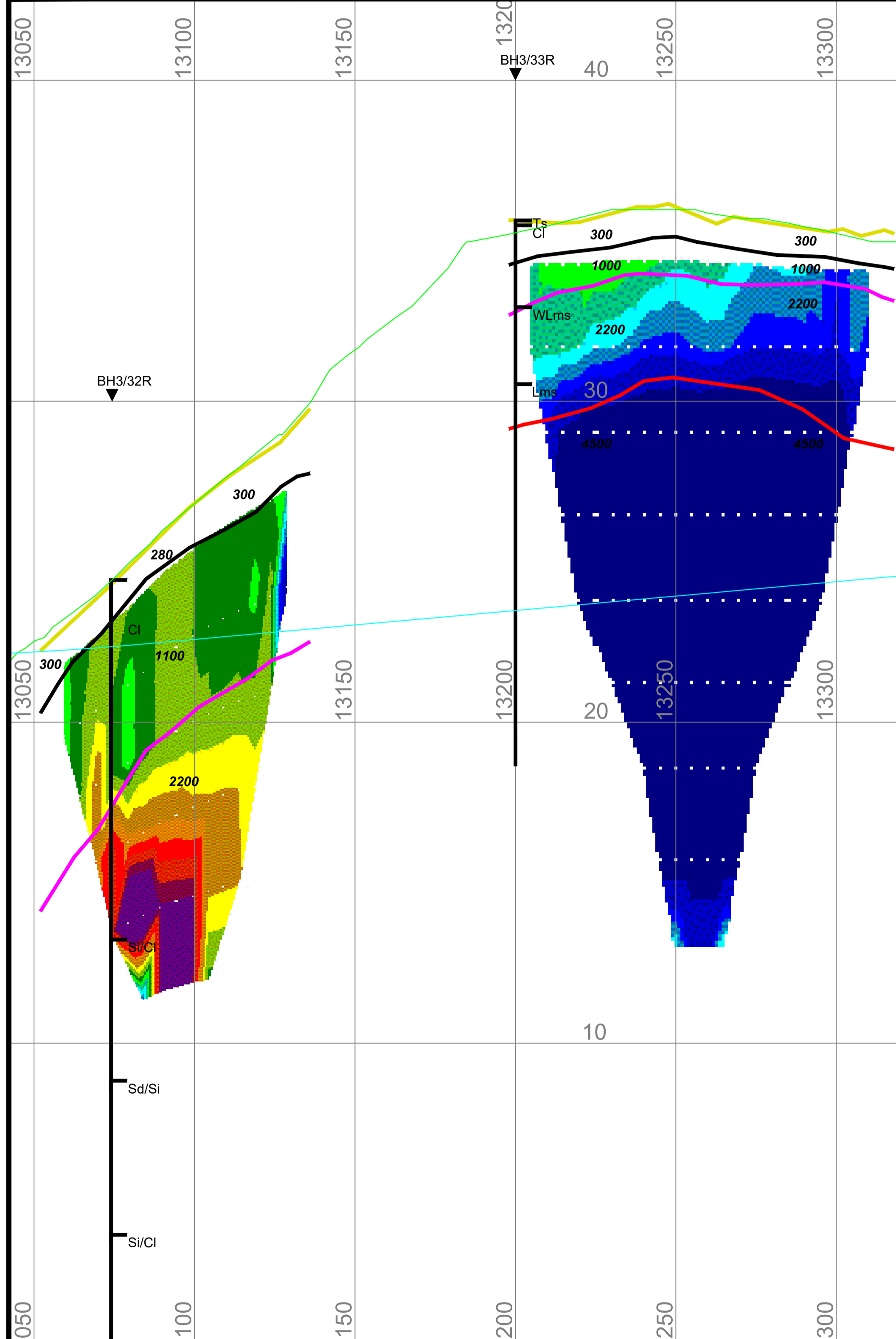
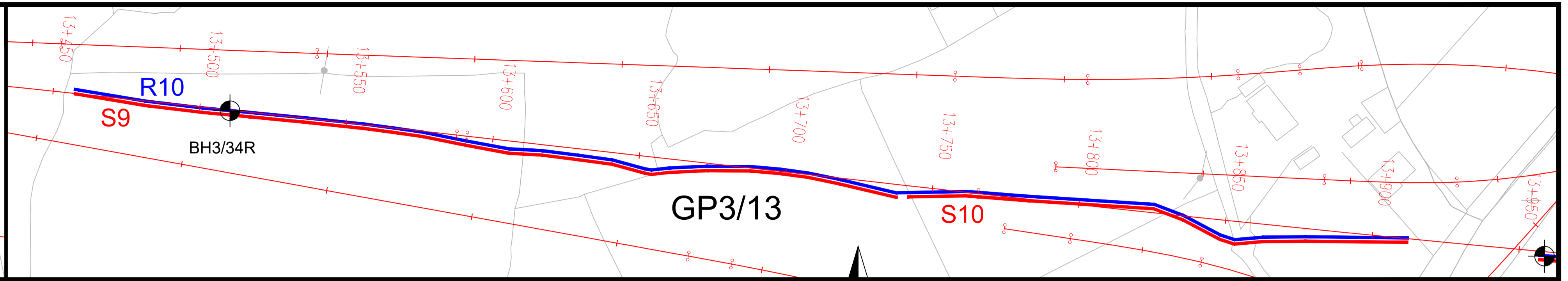
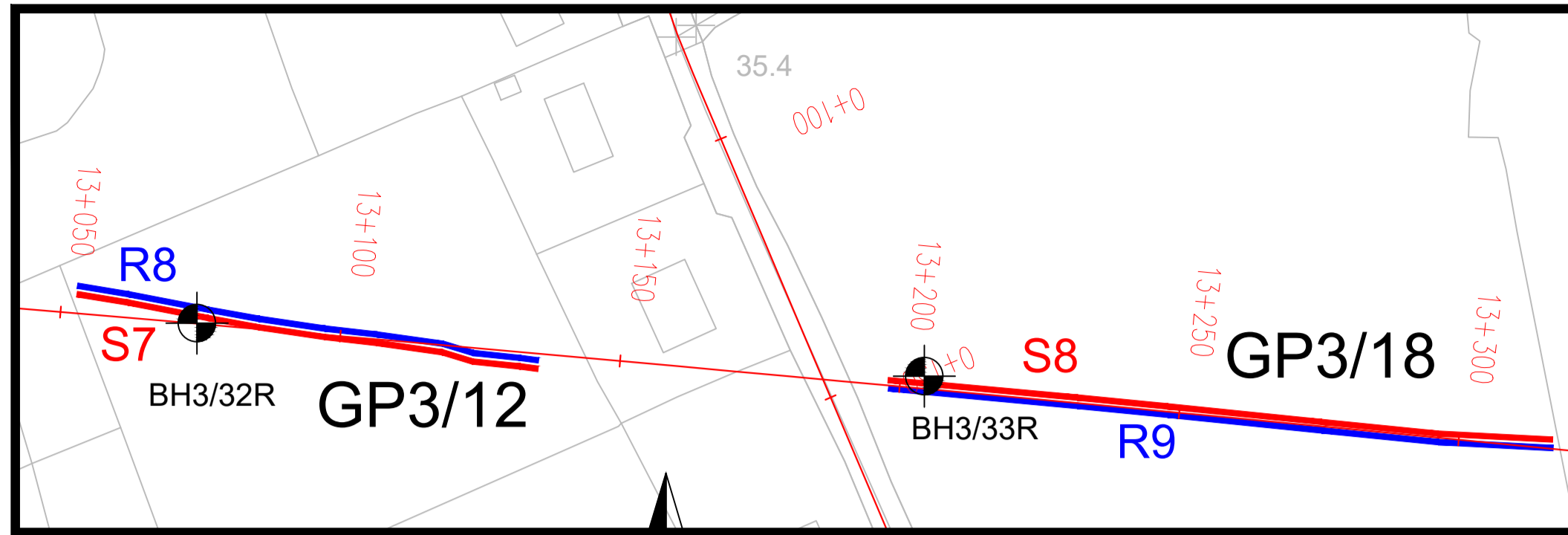
IDL AGS3 UK DH N6GCOB_ROTARY2006.GPJ IDL TP TEMPLATE.GDT 09/02/07



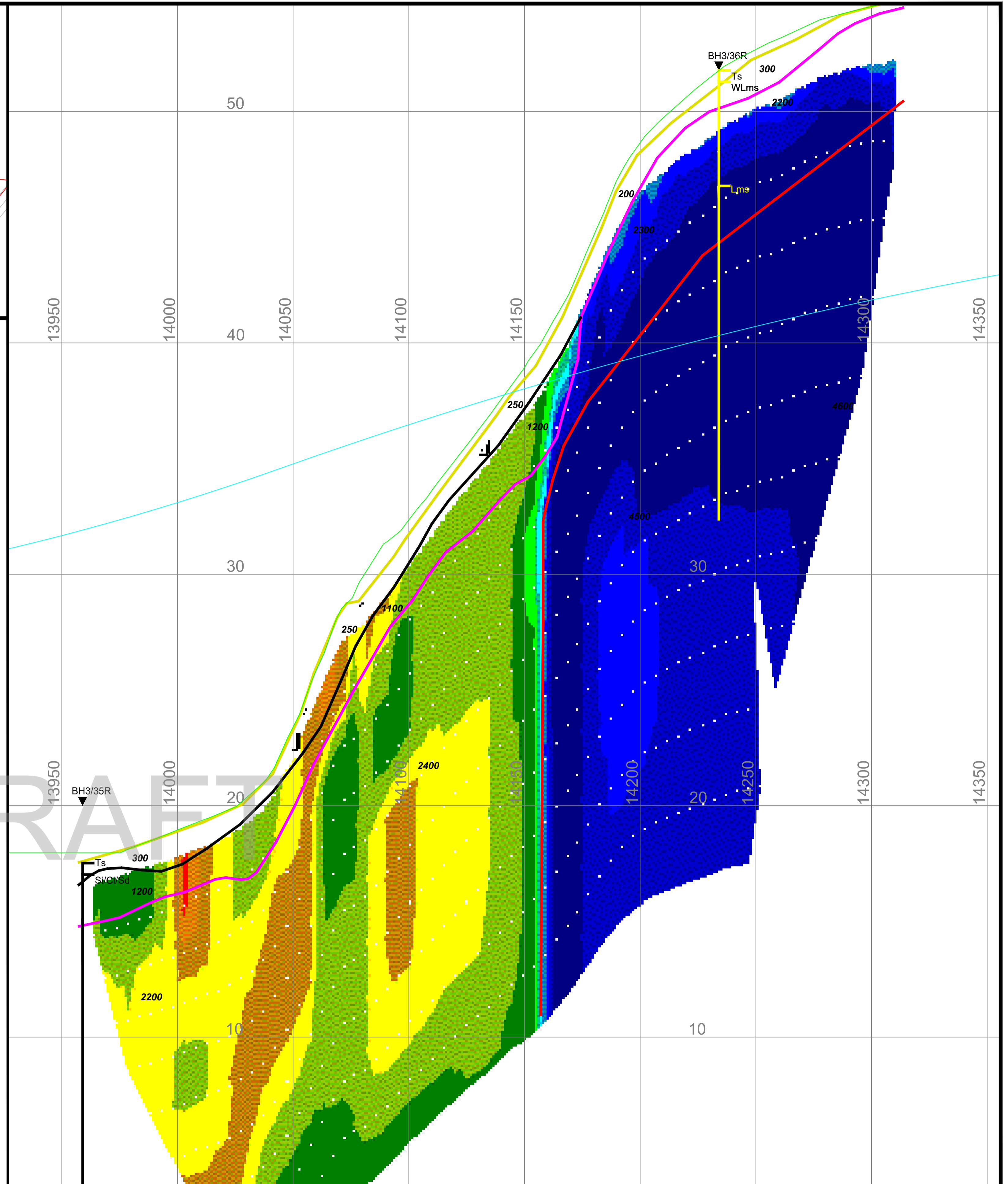
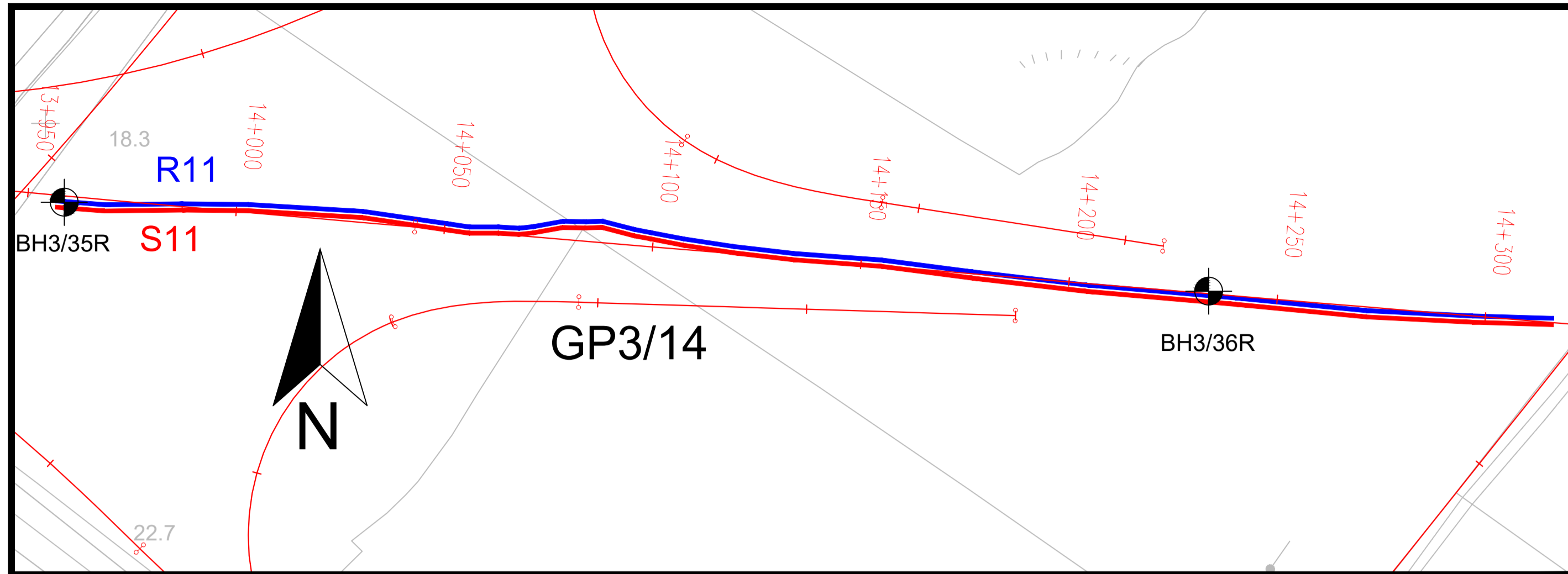


<p>Unit F4, Maynooth Business Campus Maynooth, Co. Kildare Tel: (01) 6510030 Fax: (01) 6510033 Email: info@mgx.ie Web: www.mgx.ie</p>	CLIENT	IGSL ARUP	SCALE:	Hor 1:1000 @ A1, Ver 1:100 @ A1, VE x 10	Geophysical Survey Locations: 	Geophysical Survey Locations: <p>2D Resistivity and Seismic Reflection results are projected onto the Centre Line</p>	2D-Resistivity Model Values: 	Abbreviated GI Logs: BH3/18R Borehole Name and Location <table border="1"> <tr> <td>Pt</td><td>Peat</td><td>Si</td><td>Silt</td></tr> <tr> <td>Cl</td><td>Clay</td><td>Lms</td><td>Limestone</td></tr> <tr> <td>Ts</td><td>Topsoil</td><td>WLms</td><td>Weathered Limestone</td></tr> <tr> <td>Mg</td><td>Made Ground</td><td>Gn</td><td>Granite</td></tr> <tr> <td>Gr</td><td>Gravel</td><td>WGr</td><td>Weathered Granite</td></tr> <tr> <td>Sd</td><td>Sand</td><td></td><td></td></tr> </table>	Pt	Peat	Si	Silt	Cl	Clay	Lms	Limestone	Ts	Topsoil	WLms	Weathered Limestone	Mg	Made Ground	Gn	Granite	Gr	Gravel	WGr	Weathered Granite	Sd	Sand		
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PROJECT	N6 GCTP Phase 3 Geophysical Survey	DRAWN:	RJ																													
TITLE	Plan 1g: Survey Locations and Models for GP3/08	DATE:	18/06/2016																													
		MGX FILE:	603H_Plans.dwg																													
		STATUS:	Final	<small>Chainage based on Alignment received 12.02.2016 Locations are in Irish Transverse Mercator. Elevations are in mOD (Mean Head)</small>																												





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<p>PROJECT N6 GCTP Phase 3 Geophysical Survey</p>	<p>DRAWN: RJ DATE: 18/06/2016</p>	<p>2D Resistivity and Seismic Reaction results are projected onto the Centre Line</p>	<p>1800 Seismic Velocity in m/s</p>	<p>Locations are in Irish Transverse Mercator. Elevations are in mOD (Main Head)</p>																											
<p>TITLE Plan 1i: Survey Locations and Models for GP3/12, GP3/18, GP3/13</p>	<p>MGX FILE: 603H_Plans.dwg STATUS: Final</p>																														



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<p>Unit F4, Maynooth Business Campus Maynooth, Co. Kildare Tel: (01) 6510030 Fax: (01) 6510033 Email: info@mgx.ie Web: www.mgx.ie</p>	CLIENT IGSL ARUP	SCALE: Hor 1:1000 @ A1, Ver 1:100 @ A1, VE x 10	LEGEND:	Layers from Seismic Reaction Model: <ul style="list-style-type: none"> — Ground Surface/Top of Layer 1 (200 - 340 m/s) — Top of Layer 2 (600 - 1200 m/s) — Top of Layer 3 (2000 - 2400 m/s) — Top of Layer 4 (4000 - 5000 m/s) 	2D-Resistivity Model Values: Resistivities (Ohmms) or 2D-Resistivity Model 	Abbreviated GI Logs: BH3/18R Borehole Name and Location <table style="width: 100%; font-size: 8px;"> <tr> <td>Pt</td><td>Peat</td><td>Si</td><td>Silt</td></tr> <tr> <td>Cl</td><td>Clay</td><td>Lms</td><td>Limestone</td></tr> <tr> <td>Ts</td><td>Topsoil</td><td>WLms</td><td>Weathered Limestone</td></tr> <tr> <td>Mg</td><td>Made Ground</td><td>Gn</td><td>Granite</td></tr> <tr> <td>Gr</td><td>Gravel</td><td>WGr</td><td>Weathered Granite</td></tr> <tr> <td>Sd</td><td>Sand</td><td></td><td></td></tr> </table>	Pt	Peat	Si	Silt	Cl	Clay	Lms	Limestone	Ts	Topsoil	WLms	Weathered Limestone	Mg	Made Ground	Gn	Granite	Gr	Gravel	WGr	Weathered Granite	Sd	Sand		
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TITLE Plan 1j: Survey Locations and Models for GP3/14	MGX FILE: 603H_Plans.dwg STATUS: Final	Chainage based on Alignment received 12.02.2016 Locations are in Irish Transverse Mercator, Elevations are in mOD (Main Head)	1800 Seismic Velocity in m/s																											

