Appendix O

Supporting Technical Memos

MARINUS LINK

Jacobs

Heybridge Foundations and Construction – Technical Memo

Date:	9/8/24
Project name:	Project Marinus
Project no:	IS360381
Attention:	KG, SH, JB
Company:	Marinus Link
Prepared by:	CH, MW, HK
Document no:	IS360381-SO81-MEM-0002
Copies to:	PG, DA

Jacobs Group (Australia) Pty Ltd
Floor 13, 452 Flinders Street
Melbourne, VIC 3000
PO Box 312, Flinders Lane
Melbourne, VIC 8009
Australia
T +61 3 8668 3000
F +61 3 8668 3001
www.jacobs.com

1.0 Purpose

This technical memo has been prepared assuming the reader has background knowledge to the Heybridge Converter Station project. Hence all previous documentation and description of the project are not provided here.

This technical memo has been prepared to support the consenting submittals for the Heybridge Converter Station project. Our method is to provide description and details on conservative foundation requirements at the Heybridge Converter Station (HCS) site alongside a commentary of the activities required to achieve this.

This memo does **not** describe an optimal design or methodology that is likely to be adopted for the project, but instead explores a conservative scenario for the foundations and their construction. The scenario comprises:

1. Summary of the foundation systems at the site that may be considered 'conservative case' in terms of ground preparation and material volumes to be handled. In this scenario raft type solutions are considered, although some areas of piled foundations are noted to be needed due to the proposed loadings.
2. A calculation of earthworks volumes that may be anticipated to achieve the above.

The purpose of the above work is to support the calculation of earthworks quantities for a conservative design solution, knowing that when optimal design is carried out later, the volumes for that would likely be no more than those assumed here. This means that the project (subject to consenting authority approvals) is likely to involve material volumes less than that stipulated here and hence help the awarded contractor to avoid a consent breach of permitted activity volumes.

2.0 Assumptions and Inputs

The foundation commentary covered in this memo assumes the following:

i. Where structural loadings allow, a raft type footing solution will be adopted (majority of the HCS). Refer Appendix A for structural layout design.

ii. Piled (bored) foundation solutions will be assumed for all other footings (for poles and gantry type structures in the southern part of the site.

iii. Given the presence and variable nature of the uncontrolled fill present at the site, which includes admixed construction material such as former concrete floor slabs, foundations (piles and other shallow footings) as well as the potential for contamination to be present, these materials are not considered a suitable bearing medium for foundations.

The very nature of the fill described above is also not conducive to being re-used on site as an engineered fill without significant sorting of unsuitable material such as blocks >100mm size, biodegradable material such as timber and other organic or contaminated material. The fill is assumed to be required to be removed offsite for this conservative design.

Construction management of 25% of the fill, such as breaking down very large blocks to facilitate handling and transport shall be allowed for.

Based on the findings of previous reporting for the project, the fill thickness across the site varies from approximately 1m to 2.5m.

iv. Fill removed off site is assumed to be handled as a contaminated material requiring disposal at a landfill facility.

v. Imported bulk fill is assumed to be required for this design. It will be required to be granular, free of organic and deleterious materials, meet with clean fill requirements and comprise a quarried rock material with a grading <75mm in size and with between 5% and 15% fines (passing a 75micron sieve). No bulking factor is applied to the fill volumes.

vi. The model for the bottom of the uncontrolled fill surface was interpolated using the levels from the borehole and test pit results.

vii. The exposed natural subgrade (following removal of uncontrolled fill material) consists of a consistency of stiff or better to allow backfilling of engineered fill. For the purposes of this design memo this subgrade is not benched prior to backfilling of engineered fill.

viii. No analysis of groundwater has been undertaken. Section views in appendix B show groundwater levels taken from a single site investigation.

ix. No analysis of construction or excavation staging has been undertaken.

x. A contingency factor has not been applied to the uncontrolled fill volumes for any uncertainty of uncontrolled fill depths across the site due to the limited number of investigative bore holes.

3.0 Estimated fill thickness

A high-level assessment was carried out to assess the underlying fill material thickness expected within the site. Fill depths were based on information presented within the Jacobs 2022 Geotechnical Interpretive report (GIR) and Coffey 2023 Contaminated Land and Acid Sulfate soils Impact Assessment (CLASIA) – Heybridge Converter Station, Tasmania. A summary of the investigation locations used to assess the fill material is provided below in Table 4-1.

Test ID	Easting (m)	Northing (m)	Encountered Fill depth (m bgl)	Source
HB-BH01-C	413994.58	5452650.66	1.0	Jacobs 2022, GIR
HB-BH02-C	414106.50	5452568.21	1.5	
HB-BH03-C	414223.19	5452487.41	-	

Test ID	Easting (m)	Northing (m)	Encountered Fill depth (m bgl)	Source
HB-BH04-C	414002.48	5452548.23	2.2	
HB-BH05-C	414109.17	5452459.64	1.3	
HB-BH06-C	414058.70	5452425.87	1.2	
HB-TP01-C	414073.25	5452518.78	1.0	
HB-TP02-C	414027.59	5452590.39	2.3	
HB-TP03-C	414152.56	5452492.63	1.0	
HB-TP04-C	414200.93	5452441.74	1.3	
HB-TP05-C	413982.15	5452515.41	0.8	
HB-TP06-C	414106.51	5452387.29	1.3	
HB-TP07-C	414154.11	5452362.91	0.8	
HB-TP08-C	413932.08	5452687.33	0.25	
HB-TP09-C	413871.18	5452741.47	0.25	
HEY1*	413938.00	5452704.00	0.9	Coffey 2023, CLASIA
HEY2*	413983.00	5452669.00	0.7	
HEY3*	414032.00	5452644.00	0.3	
HEY4*	414103.00	5452596.00	0.8	
HEY5*	414152.00	5452564.00	1.5	
HEY6*	414196.00	5452532.00	1.5	
HEY7*	414231.00	5452454.00	1.5	
HEY8*	414205.00	5452514.00	0.4	
*Investigation locations potentially terminated prior to encountering natural strata.				

Table 4-2: Summary of investigation locations used to estimate fill depths across the site

A site plan has been prepared to visually represent the fill depth variation across the site (Refer to Appendix B). Additional approximate fill depth zones have been defined to calculate fill volumes. Approximate fill volumes expected within the site will be provided in the next revision of this memorandum.

4.0 Earthworks quantities

A high-level assessment was carried out to calculate the earthwork quantities required to excavate the underlying uncontrolled fill material and to calculate the additional earthworks required to build up the proposed bench for the site. Using the fill depths listed in Section 4, the volume of excavation was calculated for the project site area that included new pavement, structural foundations, and laydown areas. A summary of the earthwork quantities required for this conservative scenario have been provided below in Table 7-1.

A total cut amount of 63,800m^3 was calculated to strip away the uncontrolled fill material and to strip to the finish surface level of the bench. Refer to Appendix B for a visual representation of the fill depth variation across the site. Section views within Appendix B show the uncontrolled fill depths, groundwater levels, rock depths and finished design surface level. These quantities and their depicted figures are shown by limited site data and interpolated values which form a concept illustration of the site and would be further refined through additional investigation during the next design phases.

Table 7-1: Summary of Earthwork Quantities

	Volume (-) = Cut, (+) = Fill
Existing Surface Level to Base of Uncontrolled Fill Layer	-62,200 m^3
Base of Uncontrolled Fill Layer to Finish Surface Level	-1,600 m^3, +93,500 m^3

5.0 Foundation loads and bearing requirements

5.1 Slab/raft foundations

Engineered fill that comprises an imported quarried angular rock material all passing 75mm type material, with minimum 15% fines will be required to:

a) Be placed in layers no thicker than 200mm prior to compaction activities.

b) Be compacted to 95% Maximum Dry Density (MDD, Standard Compaction) within plus or minus 2% of Optimum Moisture Content.

c) Allow for a geotextile filter fabric to be placed at the excavation base to provide separation between the underlying natural soils and imported material.

Provided the compaction and construction are in accordance with the requirements summarised above, the engineered fill material laid across the site is expected to provide sufficient bearing capacity to support the slab foundations consisted within the proposed structures on-site.

5.2 Piled foundations

Piled foundations will be required to support the gantry and pole structures located within the southern extents of the site. Preliminary critical loads have been provided as shown by structural design within Appendix A to assist with the estimation of pile length, embedment and toe levels of the proposed foundations. A summary of loads applied on the proposed pile foundations are summarised below in Table 5-1.

Table 5-1: Summary of applied loads on piled foundations (loads are per pile)

Structure/Load Case	Bending Moment (kNm)	Shear Force (kN)	Axial Force (kN)
Gantry/F1	3000	180	150

A high-level geotechnical pile assessment undertaken using Ensoft LPILE v2022 software suggests that a pile embedment length of 7.5m into competent (Moderately Weathered or better) rock will be required using 1500mm diameter piles to support the proposed structural loading.

It is assumed the use of bored pilling as the preferred method of pile construction based on the current site conditions.

6.0 Other considerations & recommendations

6.1 Pavements and laydown Areas

We recommend pavements and laydown areas are treated with the same excavation and fill compaction requirements described above, and for the purposes of calculation material volumes. This is to ensure good quality materials are in place (i.e. acceptable working platforms) to help facilitate construction operations such as using cranes on site to lift the converter station components into place on their foundations.

6.2 Slab/raft foundations – excavation

The existing variable fill materials are to be excavated from below the footprint of raft foundations. The extent of excavation is to allow for both the depth of excavation and the pressure bulb that will be imposed from the raft footings into the ground below (Refer Figure 1 below and Appendix C).

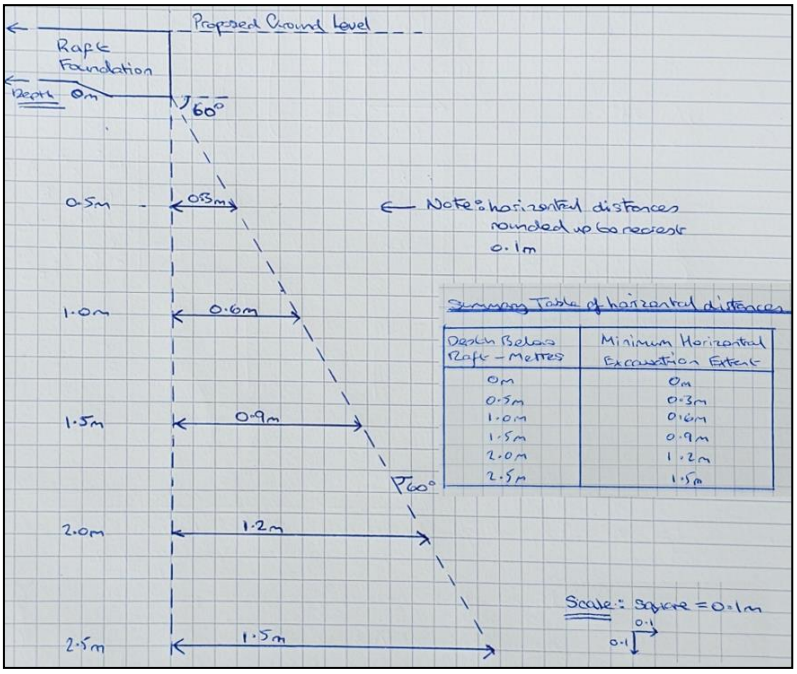


Figure 3-1: Sketch detail – minimum horizontal distances

For the purposes of this memo, a 60^{o} line is assumed from the edge of the footing to help determine the extent of the excavations required. Actual pressure bulb (e.g. Boussinesq distributions) will need to be confirmed at detailed design and may reduce the extents described here.

The horizontal distances set out in the summary table in Figure 1 are distances from the edge of the proposed raft footing solution. The depths shown on the same figure are metres below the base of the raft footing.

The temporary batter of the excavations will also need to be accounted for in the design of excavations. We recommend here that these take the form of a 55° back slope and with benches incorporated where the depth >1.5m. This is a temporary works consideration and actual slopes and benches will need to be adjusted based on observed safety and performance. Example batters are provided in Figure 3-2 below and the appended sketches to this memo.

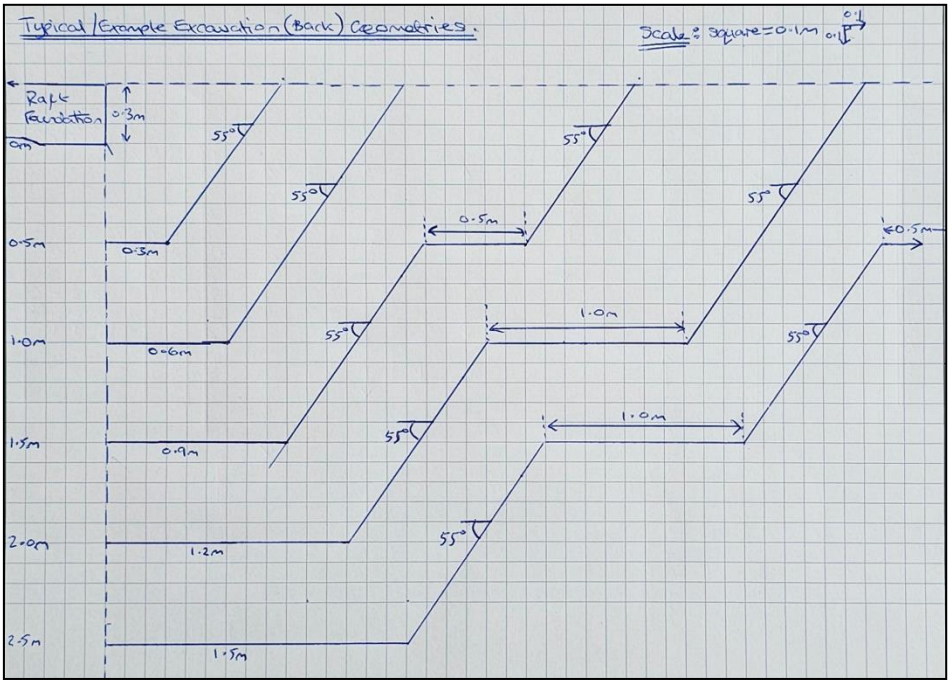


Figure 3-2: Sketch detail – Back excavations

The following Table sets out some of the suggested back excavation rules:

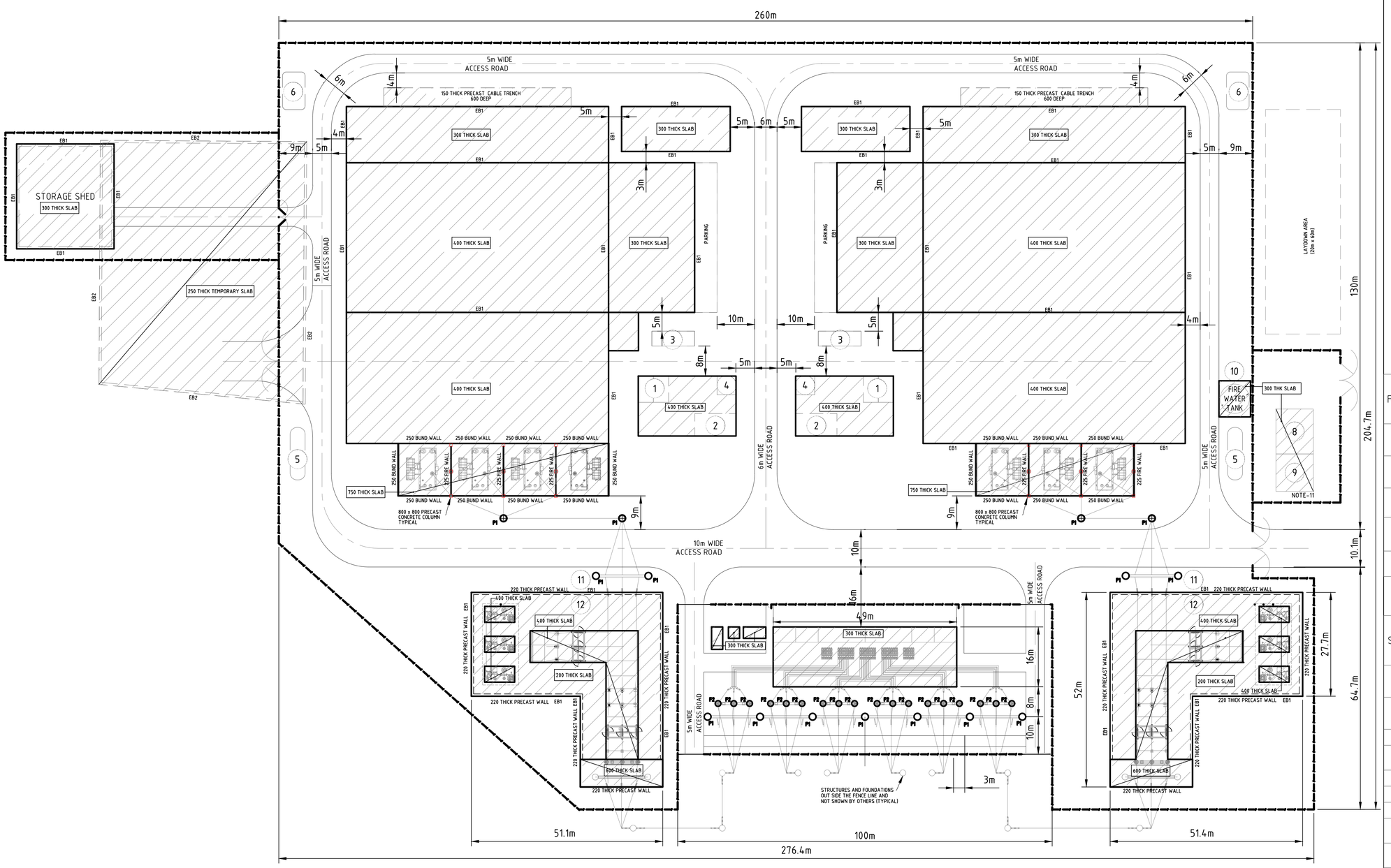
Table 4-1: Summary of suggested back excavation rules

Height of Excavation	Bench 1	Bench 2
0.5m	N/A	N/A
1.0m	N/A	N/A
1.5m	0.5m wide at 1m above excavation base	N/A
2.0m	1.0m wide at 1m above excavation base	N/A
2.5m	1.0m wide at 1m above excavation base	0.5m wide at 2m above excavation base

The above guidance, along with approximated existing variable fill thickness (refer section 4 below) and the existing / proposed finished surfaces across the project site should enable basic calculation of excavation volumes. This is for both unsuitable fill to remove from site, and imported fill to be engineered in place.

It is expected that the actual back excavation detailing will be assessed by the contractor as part of its temporary works design, and other options may be considered to help reduce disturbance extents – these include provision for sheet pile support for example.

Appendix A – Structural design layout



NOTES:

1. ALL DIMENSIONS ARE IN METERS UNLESS STATED OTHERWISE.
2. FOR NOTES REFER TO DRG T14/613/333 UNO.
3. FOR GEOTECHNICAL INFORMATION REFER TO GEOTECHNICAL SITE INVESTIGATION AND INTERPRETIVE REPORT PROVIDED BY JACOBS (REPORT No. IS360318-S018-CG-RPT-0007, DATED: 08 JUNE 2022. GEOTECHNICAL ENGINEER TO INSPECT AND APPROVE THE EXCAVATION AND FOUNDING DEPTHS TO ENSURE CAPACITY/CONFORMANCE.
4. PILE FOOTINGS ARE GENERALLY EXPECTED TO BE SOCKETED INTO COMPETENT ROCK STRATUM AND THE SLABS AND SHALLOW FOUNDATION CAN BE FOUNDED INTO WELL COMPACTED ENGINEERED FILL AS PER THE GEOTECHNICAL REPORT RECOMMENDATIONS.
5. ASSUMED MOST SLAB ON GROUND SUPPORTED ON MINIMUM 50 kPa BEARING PRESSURES AND ALL ALL SLAB BEAMS , PAD AND STRIP FOOTINGS AND TRANSFORMER SLABS SLABS TO BE SUPPORTED ON MINIMUM 100 kPa BEARING PRESSURES.
6. REFER GEOTECHNICAL ADVISE ON DEWATERING REQUIREMENTS DURING PILING WORKS.
7. CONCEPT DESIGN BASED ON PRIMARY CONCEPT DESIGN LAYOUT IS360328-SO28-GN-DLP-0503- REV A.. NO EQUIPMENT, STRUCTURE DRAWINGS AVAILABLE AT CONCEPT DESIGN PHASE AND STRUCTURES AND BUILDINGS ARE BASED ON TYPICAL INDUSTRY STANDARD REQUIREMENTS AND THUS FOOTINGS AND SLABS DOCUMENTED TO BE FURTHER DEVELOPED, COORDINATED AND DETAILED AT DETAIL DESIGN PHASE.

LEGEND

- ROAD
- FENCE
- R.C PRECAST COLUMN
- R.C SLAB ON GROUND (BLINDING CONCRETE TO FOUNDING MATERIAL)
- F1 BORE PILE FOUNDATION. TYPICAL. (REFER SCHEDULE BELOW)

FOOTING.	Description	NOMINAL. LENGTH MIN. (m)	REINF %.
F1	1800 ϕ BORED PILE	6.5	1.5%
F2	1500 ϕ BORED PILE	5.0	1.5%
EB1	600 WIDE x 600DEEP EDGE BEAM	-	1%
EB2	400 WIDE x 500 DEEP EDGE BEAM	-	0.5%
-		-	-

Sl . No.	Description	Length (m)	Width (m)
1	STATION SERVICES TRANSFORMER	7	4
2	DIESEL GENERATOR Incl. FUEL TANK & LOAD BANK	11	6
3	SEPTIC TANK	11	4
4	DNO AUXILIARY TRANSFORMER	5	5
5	OIL SEPARATOR TANK	-	-
6	RETENTION POND	-	-
7	220kV GANTRY	-	-
8	TELECOM BUILDING FOR STAGE 1 & STAGE 2	12	10
9	MV BUILDING FOR STAGE 1 & STAGE 2	10	10
10	FIRE WATER TANK	-	-
11	220kV THROUGHWALL BUSHING		
12	AC FILTER/PIR/PLC BULDING	75	36.5

SCALE 1:500 (A1) 0 10 20 30 40 50m (108642)

CONCEPT DESIGN - DRAFT

CONSULTANT DWG No.
IS360328-SO28-GN-DLP-0001

REV	DATE	APP'D	REVISION
C	02/08/24		CONCEPT DESIGN-DRAFT ISSUE
B	16/06/23		CONCEPT DESIGN
A	09/06/23		ISSUED FOR INFORMATION

SCALES AT A1

MARINUS LINK

ABN 37 001 024 095 and ACN 001 024 095
Jacobs Group (Australia) Pty Ltd
Ground Floor, 100 Melville Street
HOBART, TAS 7000
AUSTRALIA

Tel: +61 3 6221 3711
Fax: +61 3 6224 2325
Web: www.jacobs.com

Jacobs

CLIENT: MARINUS LINK
PROJECT: MARINUS LINK HEYBRIDGE CONVERTER STATION

DRAWN	DRAWING CHECK	REVIEWED	APPROVED
DA	KH	CK	HK
DESIGNED	DESIGN REVIEW	DATE	DATE
DA	CK		

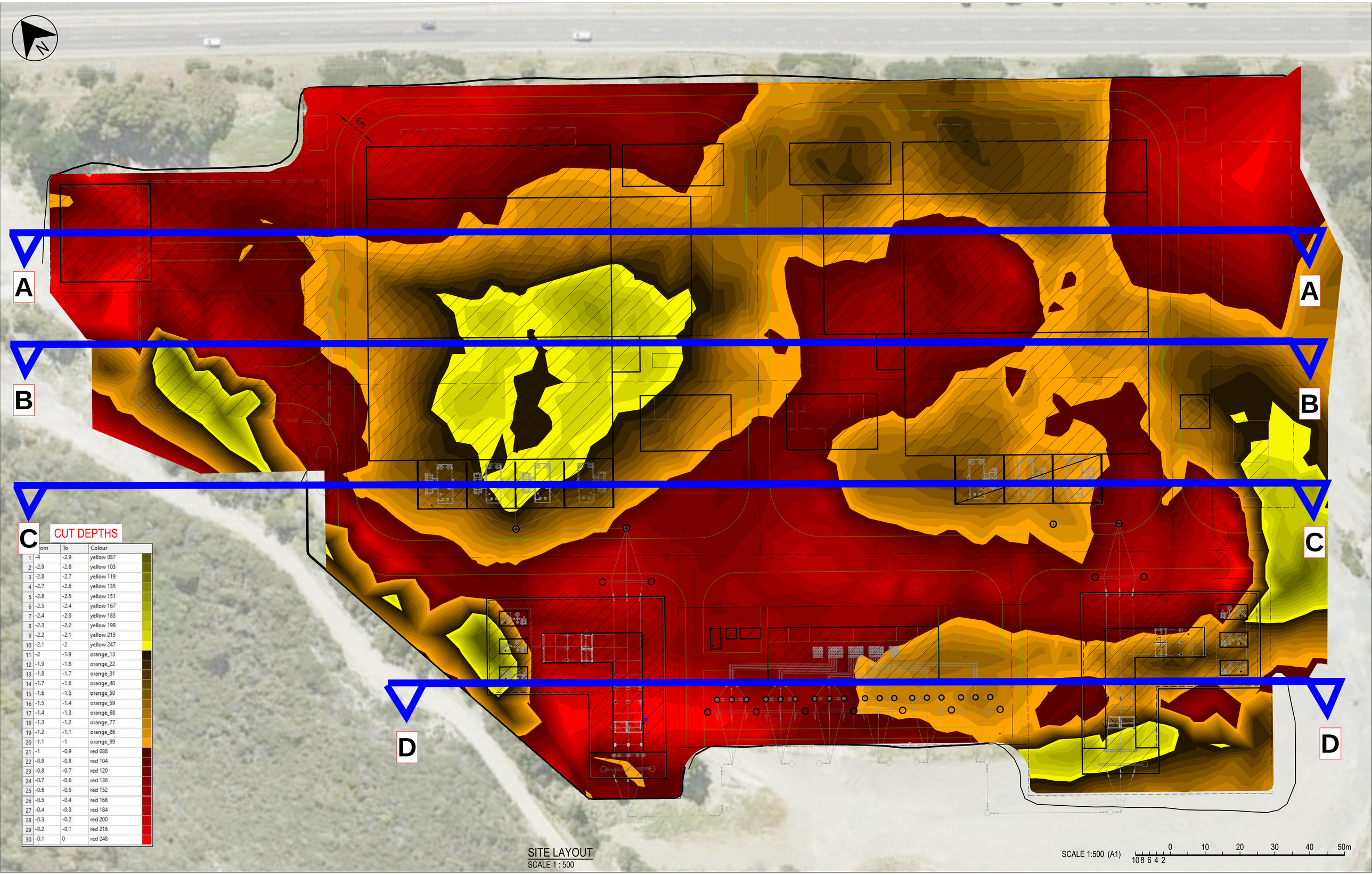
TITLE
MARINUS LINK
HEYBRIDGE CONVERTER STATION
FOUNDATION LAYOUT

SCALE	DRAWING No	REV
1:500	IS360328-SO28-GN-DLP-0001	C

A1

Appendix B – Fill depth site plan

FILL DEPTH SITE PLAN
EXISTING SURFACE LEVEL TO BASE OF UNCONTROLLED FILL LAYER



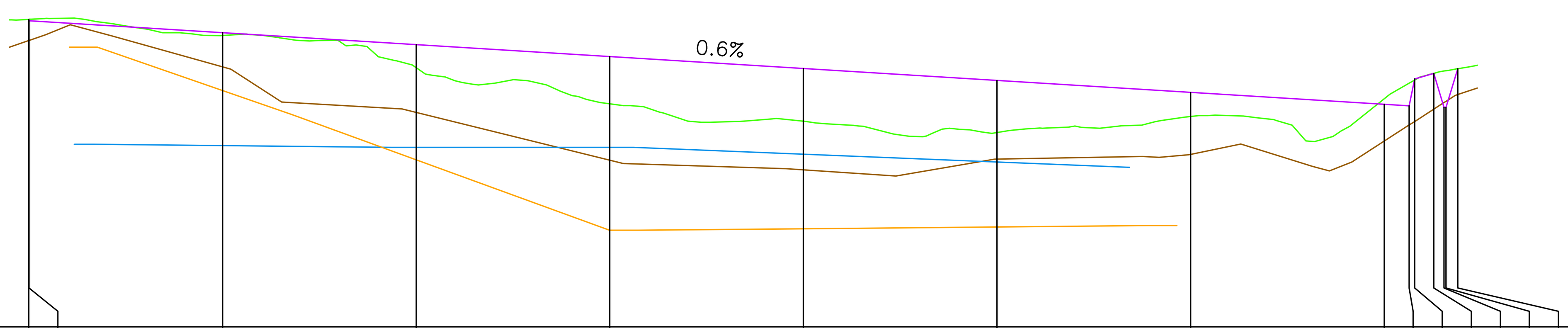
CUT DEPTHS

	om	To	Colour
1	-4	-2.9	yellow 087
2	-2.9	-2.8	yellow 103
3	-2.8	-2.7	yellow 119
4	-2.7	-2.6	yellow 135
5	-2.6	-2.5	yellow 151
6	-2.5	-2.4	yellow 167
7	-2.4	-2.3	yellow 183
8	-2.3	-2.2	yellow 199
9	-2.2	-2.1	yellow 215
10	-2.1	-2	yellow 247
11	-2	-1.9	orange_13
12	-1.9	-1.8	orange_22
13	-1.8	-1.7	orange_31
14	-1.7	-1.6	orange_40
15	-1.6	-1.5	orange_50
16	-1.5	-1.4	orange_59
17	-1.4	-1.3	orange_68
18	-1.3	-1.2	orange_77
19	-1.2	-1.1	orange_86
20	-1.1	-1	orange_99
21	-1	-0.9	red 088
22	-0.9	-0.8	red 104
23	-0.8	-0.7	red 120
24	-0.7	-0.6	red 136
25	-0.6	-0.5	red 152
26	-0.5	-0.4	red 168
27	-0.4	-0.3	red 184
28	-0.3	-0.2	red 200
29	-0.2	-0.1	red 216
30	-0.1	0	red 248

SITE LAYOUT
SCALE 1 : 500

SCALE 1:500 (A1)
0 10 20 30 40 50m
10 8 6 4 2

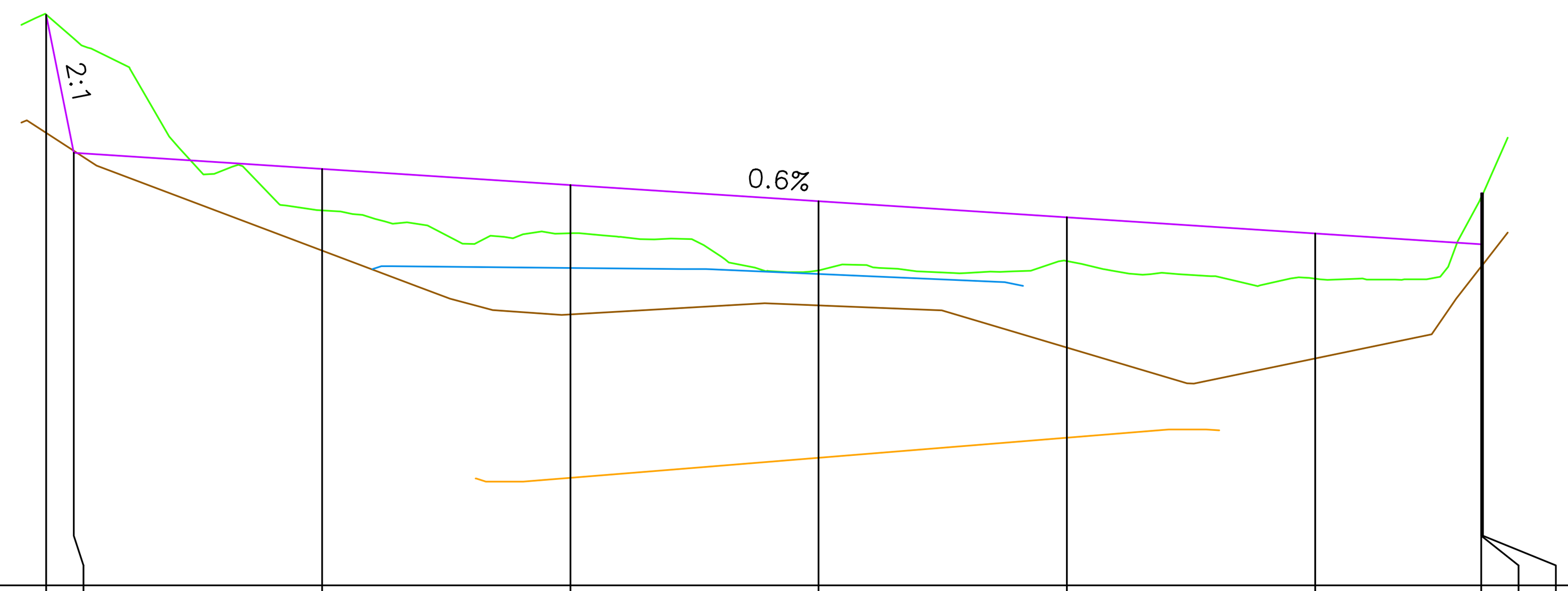
05/08/2024



DATUM RL 1.0

DESIGN SURFACE	8.938	8.900	8.592	8.283	7.975	7.666	7.358	7.050	6.741	6.701	7.397	7.539	6.666	6.665	7.664
50 MPa ROCK LAYER			7.099	5.309	3.490	3.529	3.574								
GROUNDWATER LEVEL			5.676	5.630	5.630	5.453	5.252								
UNCONTROLLED FILL BASE	8.390	8.392	7.709	6.532	5.299	5.051	5.327	5.451	5.793	6.209	6.299	6.616	6.788	6.821	6.994
EXISTING SURFACE	8.938	8.938	8.517	7.69	6.758	6.309	6.017	6.428	6.883	7.288	7.368	7.543	7.602	7.61	7.664
OFFSETS	-0.075	0.000	50.000	100.000	150.000	200.000	250.000	300.000	350.000	356.469	357.860	362.791	365.460	365.970	369.028

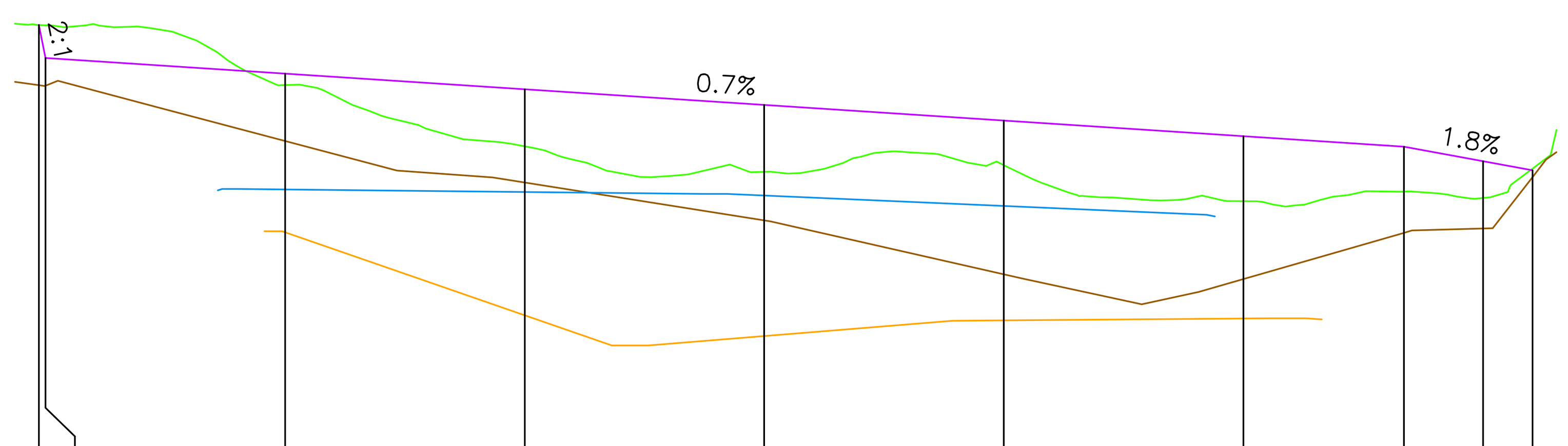
SECTION A-A



DATUM RL 1.0

DESIGN SURFACE	12.485	9.705	9.381	9.057	8.733	8.409	8.085	7.868	8.894	8.894
50 MPa ROCK LAYER				3.164	3.570	3.974				
GROUNDWATER LEVEL				7.389	7.265					
UNCONTROLLED FILL BASE	10.105	9.746	7.740	6.452	6.634	5.787	5.566	7.417	7.417	7.456
EXISTING SURFACE	12.488	12.004	8.546	8.088	7.338	7.525	7.173	8.815	8.815	8.883
OFFSETS	-5.560	0.000	50.000	100.000	150.000	200.000	250.000	283.466	283.466	283.766

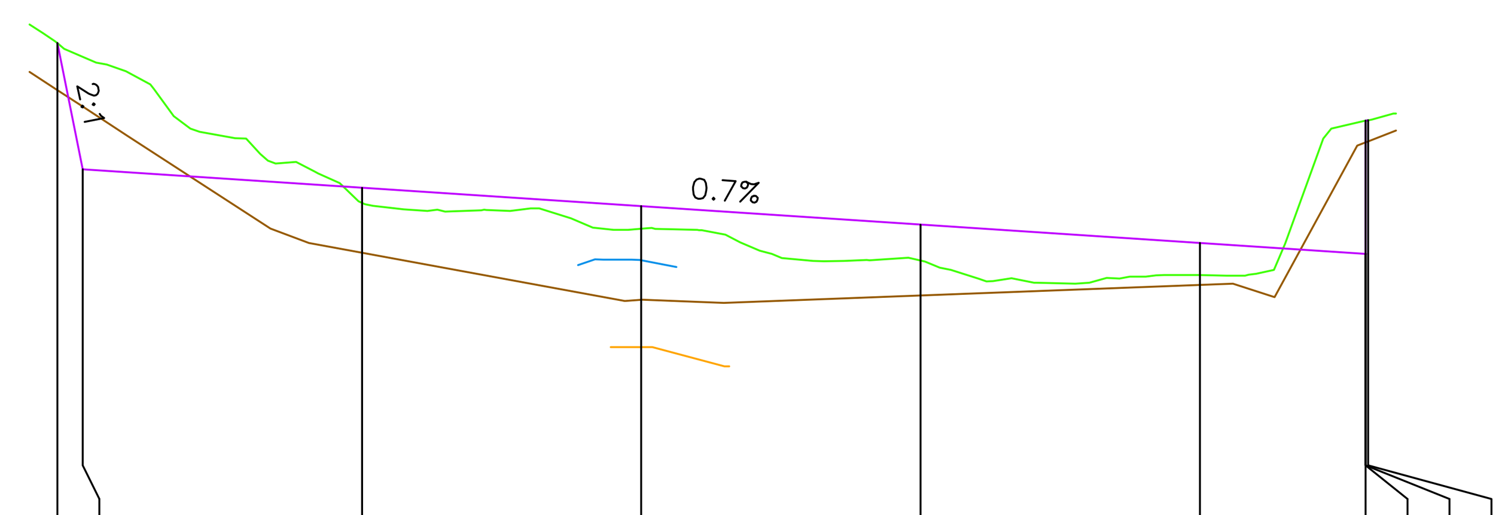
SECTION C-C



DATUM RL 1.0

DESIGN SURFACE	9.994	9.303	8.976	8.649	8.322	7.995	7.668	7.449	7.147	6.959
50 MPa ROCK LAYER			5.664	3.930	3.497	3.826	3.864			
GROUNDWATER LEVEL			6.559	6.506	6.433	6.213				
UNCONTROLLED FILL BASE	8.734	8.724	7.570	6.702	5.913	4.783	4.688	5.651	5.741	6.816
EXISTING SURFACE	9.994	9.988	8.737	7.457	6.927	7.062	6.314	6.511	6.38	6.993
OFFSETS	-1.384	0.000	50.000	100.000	150.000	200.000	250.000	283.466	300.000	310.312

SECTION B-B



DATUM RL 4.0

DESIGN SURFACE	12.561	10.299	9.970	9.640	9.310	8.980	8.785	8.785	11.175	11.177
50 MPa ROCK LAYER				7.120						
GROUNDWATER LEVEL				8.674						
UNCONTROLLED FILL BASE	11.718	11.423	8.808	7.963	8.041	8.232	10.785	10.785	10.785	10.802
EXISTING SURFACE	12.558	12.316	9.701	9.236	8.666	8.406	11.17	11.17	11.17	11.18
OFFSETS	-4.524	0.000	50.000	100.000	150.000	200.000	229.676	229.676	229.676	230.128

SECTION D-D

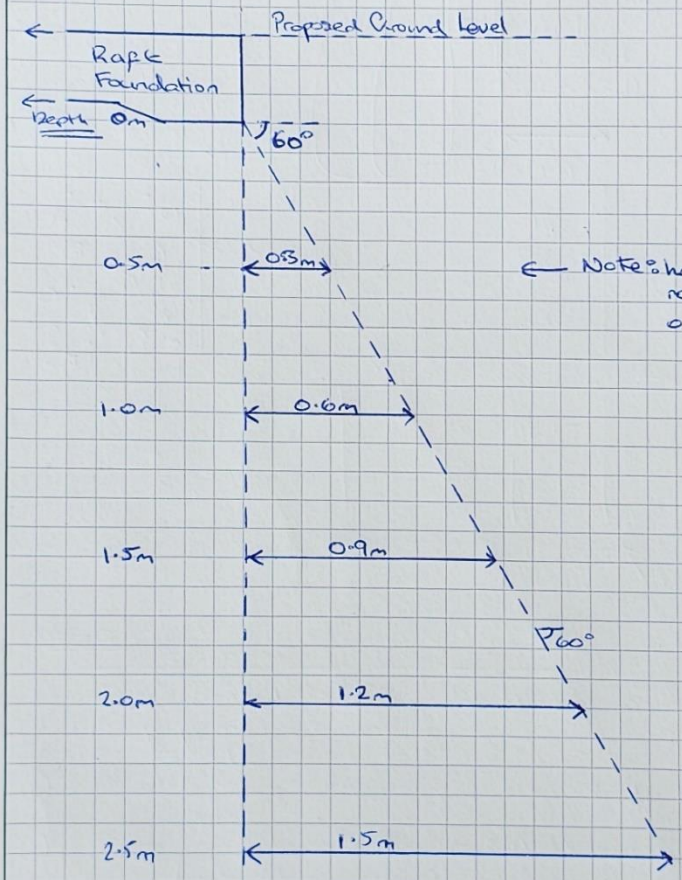
Appendix C – Appended sketch details

JACOBS

Project No IS360381 Series
Page No 1 Of
By Chris H Date 02/08/2024

PROJECT | ELEMENT

Sketch Detail for horizontal distances



← Note: horizontal distances rounded up to nearest 0.1m

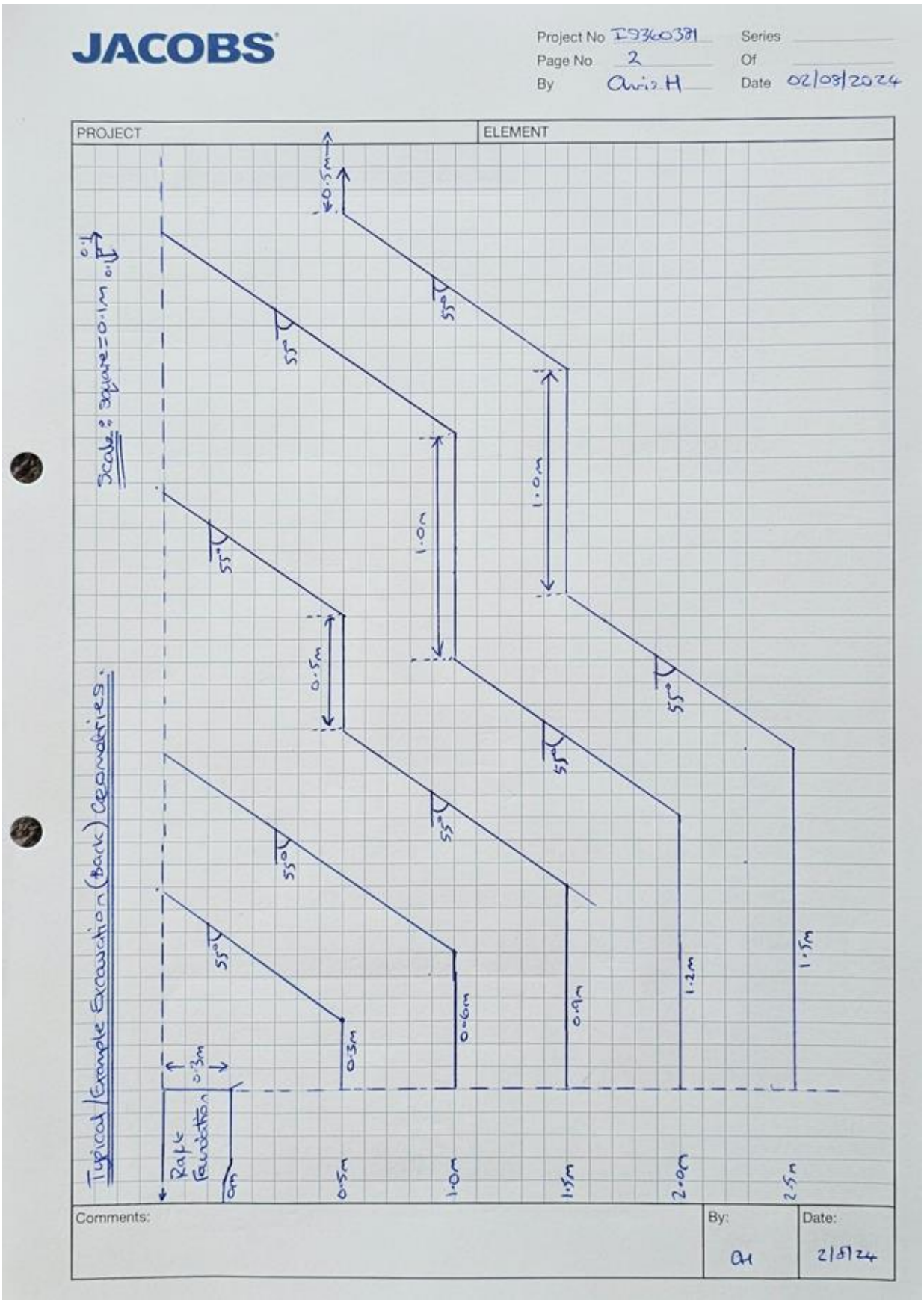
Scale: square = 0.1m

Summary Table of horizontal distances

Depth Below Raft – Metres	Minimum Horizontal Excavation Extent
0m	0m
0.5m	0.3m
1.0m	0.6m
1.5m	0.9m
2.0m	1.2m
2.5m	1.5m

Comments: 1) Geofabric to be placed on excavation base to separate between interfaces.

By: CH Date: 2/8/24


JACOBS
Project No IS360381
Page No 2
By Amis H
Series
Of
Date 02/08/2024
PROJECT
ELEMENT
Typical Example Excavation (Back) Geometries
Scale: square = 0.1m
0.1
0.1
55°
0.5m
1.0m
1.0m
0.5m
0.3m
0.6m
0.9m
1.2m
1.5m
0.3m
Rock face
0m
0.5m
1.0m
1.5m
2.0m
2.5m
Comments:
By:
Date:
21/8/24