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
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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).

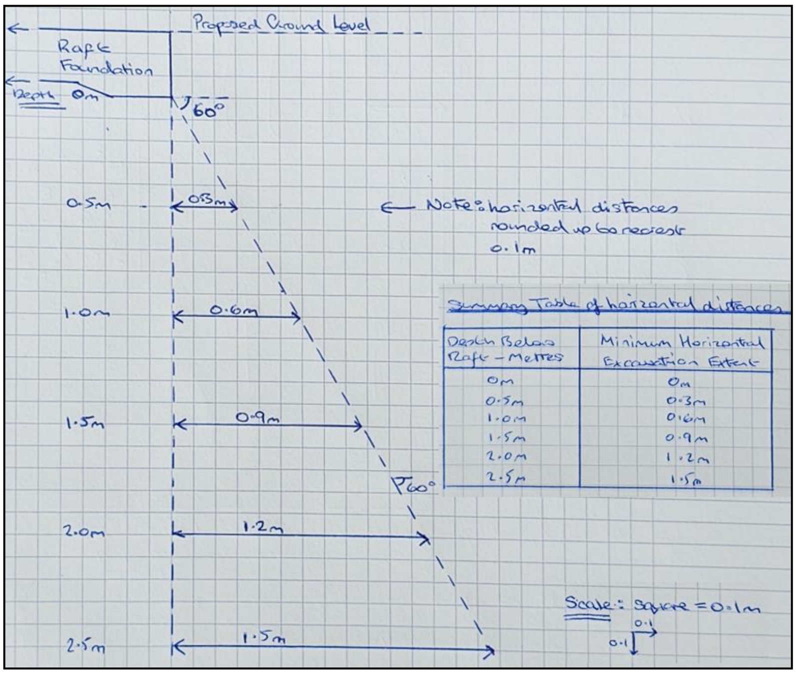


Figure 3-1: Sketch detail – minimum horizontal distances

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.

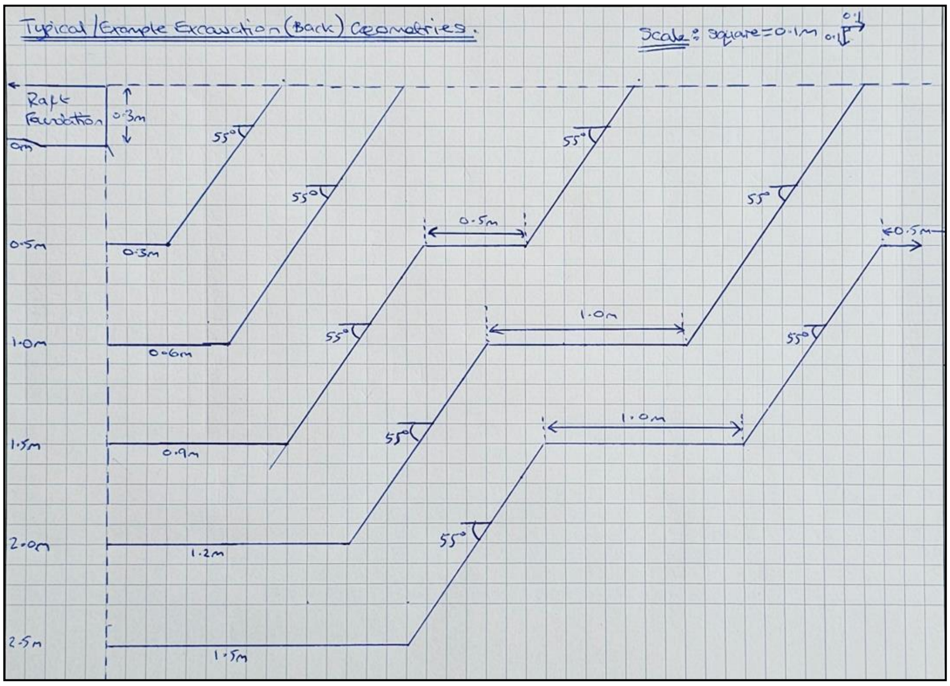


Figure 3-2: Sketch detail – Back excavations

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

Table 4-1: Summary of suggested back excavation rules

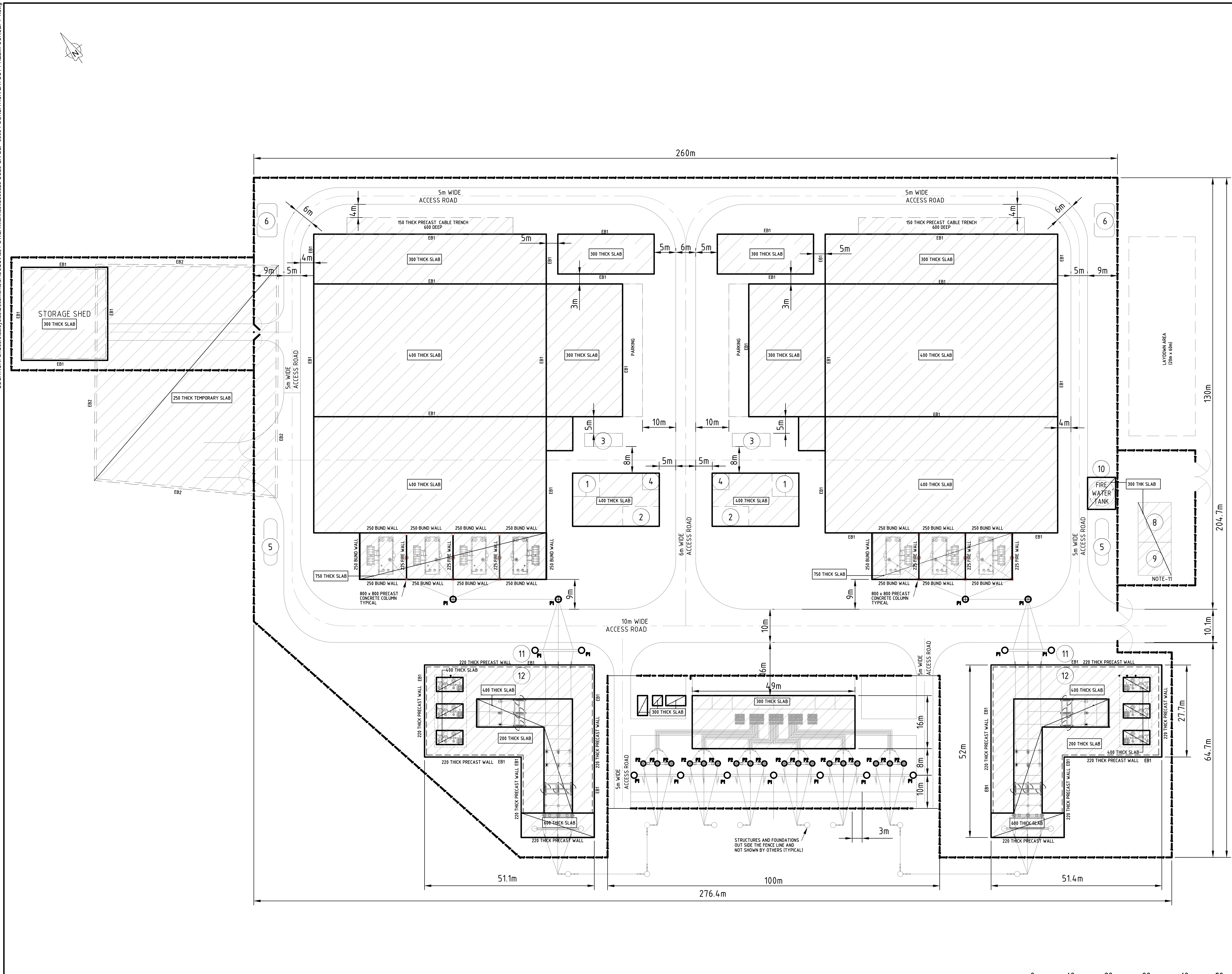
Height of Excavation	Bench 1	Bench 2
0.5m	N/A	N/A
1.0m	N/A	N/A
1.5m	0.5m wide at 1m above excavation base	N/A
2.0m	1.0m wide at 1m above excavation base	N/A
2.5m	1.0m wide at 1m above excavation base	0.5m wide at 2m above excavation base

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

DATE: 8/2/2024 5:19:03 PM NAME: ALOYSIUS, DEREK
LOCATION: C:\Users\daloysius\Documents\JACOBS\Aus POWER\Marinus\IS360328-SO28-GN-DLP-0503-FOUNDATION LAYOUT-PRELIM CONCEPT 1.dwg



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

CONCEPT DESIGN - DRAFT

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

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

SCALES AT A1

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

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

A1

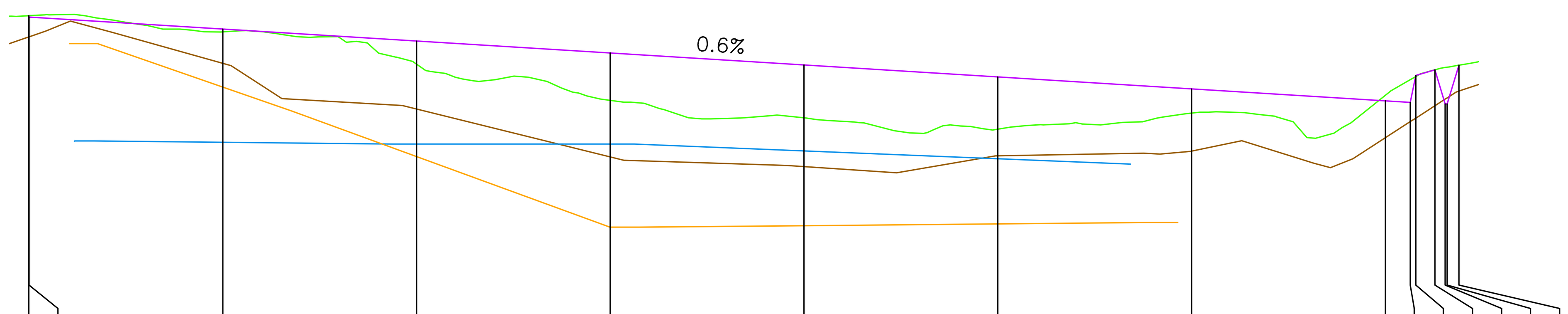
Appendix B – Fill depth site plan

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

CUT DEPTHS

	rom	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

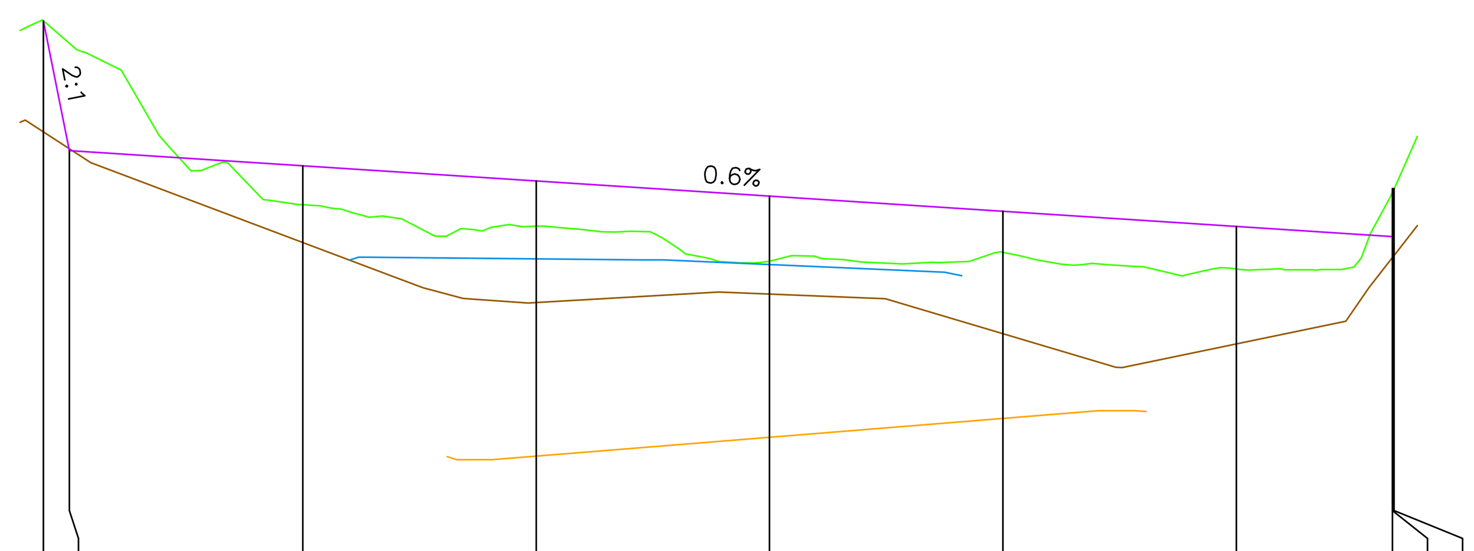
05/08/2024



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	

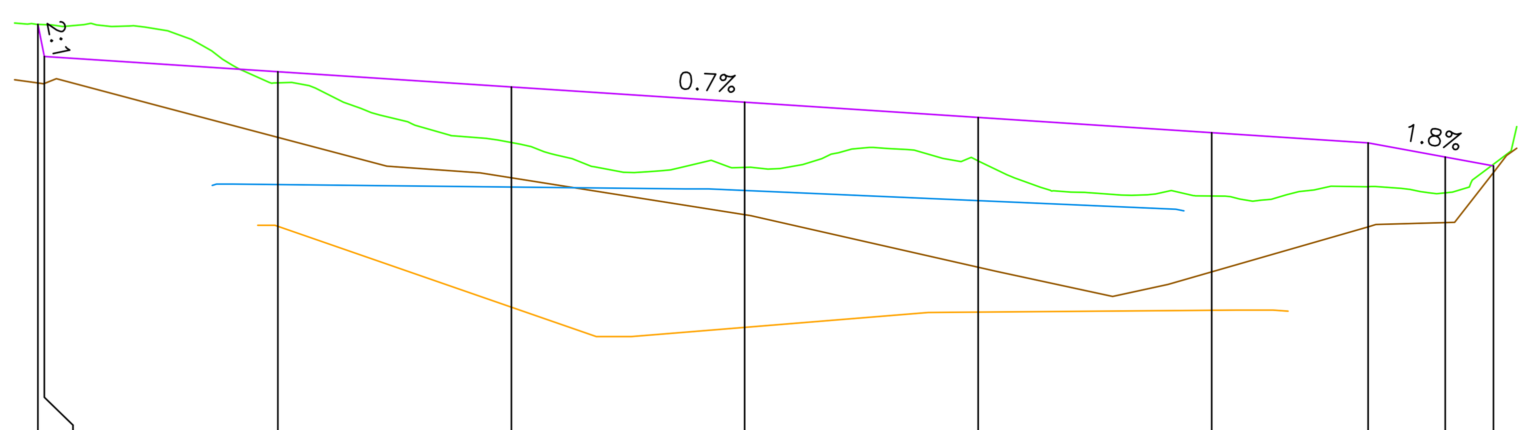
SECTION A-A



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	

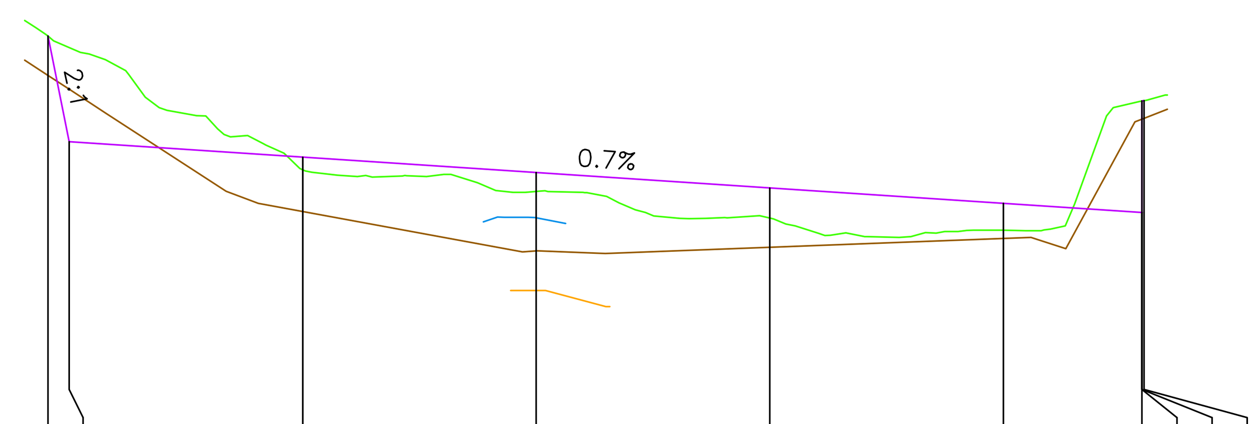
SECTION C-C



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

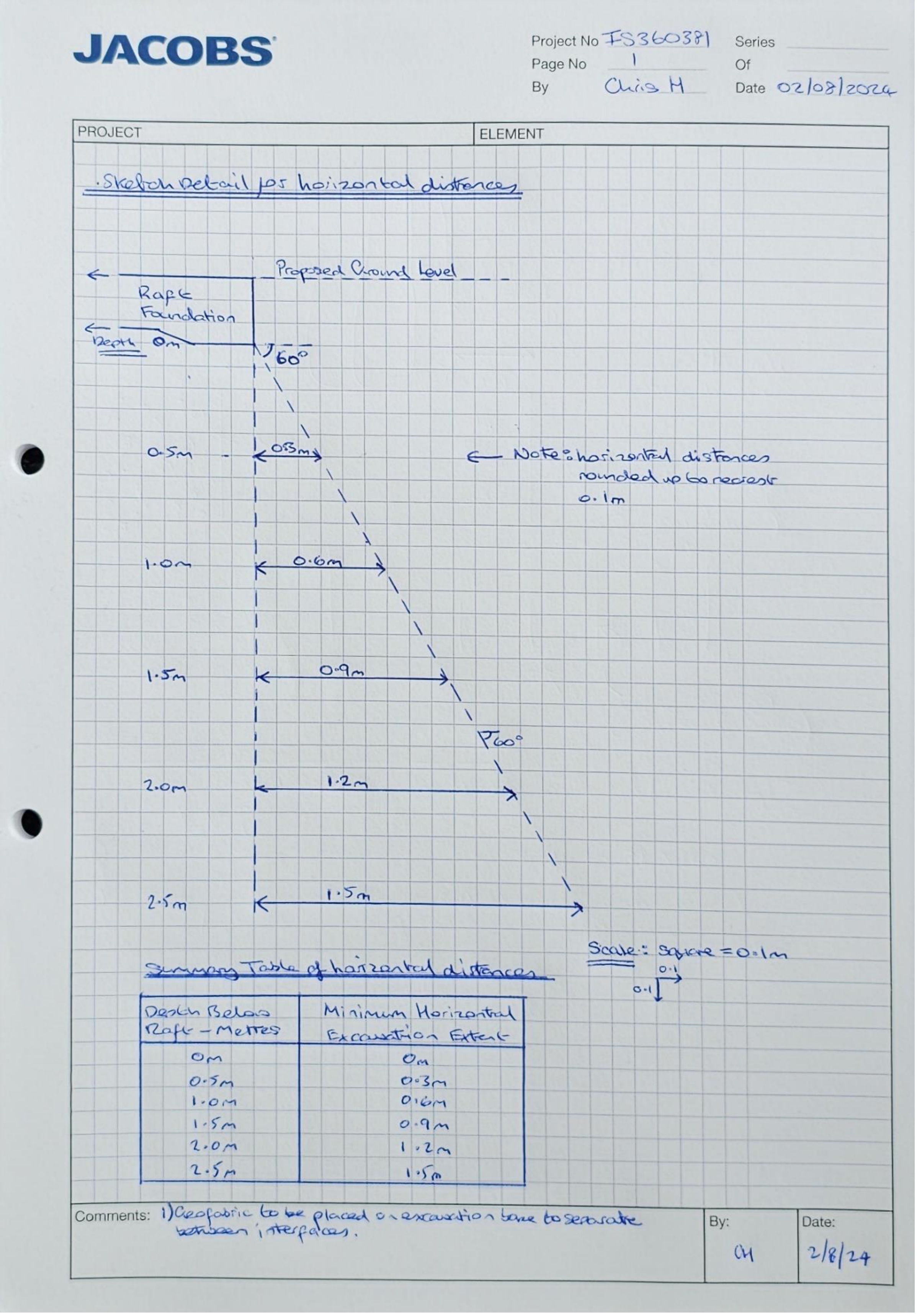


DATUM RL 4.0

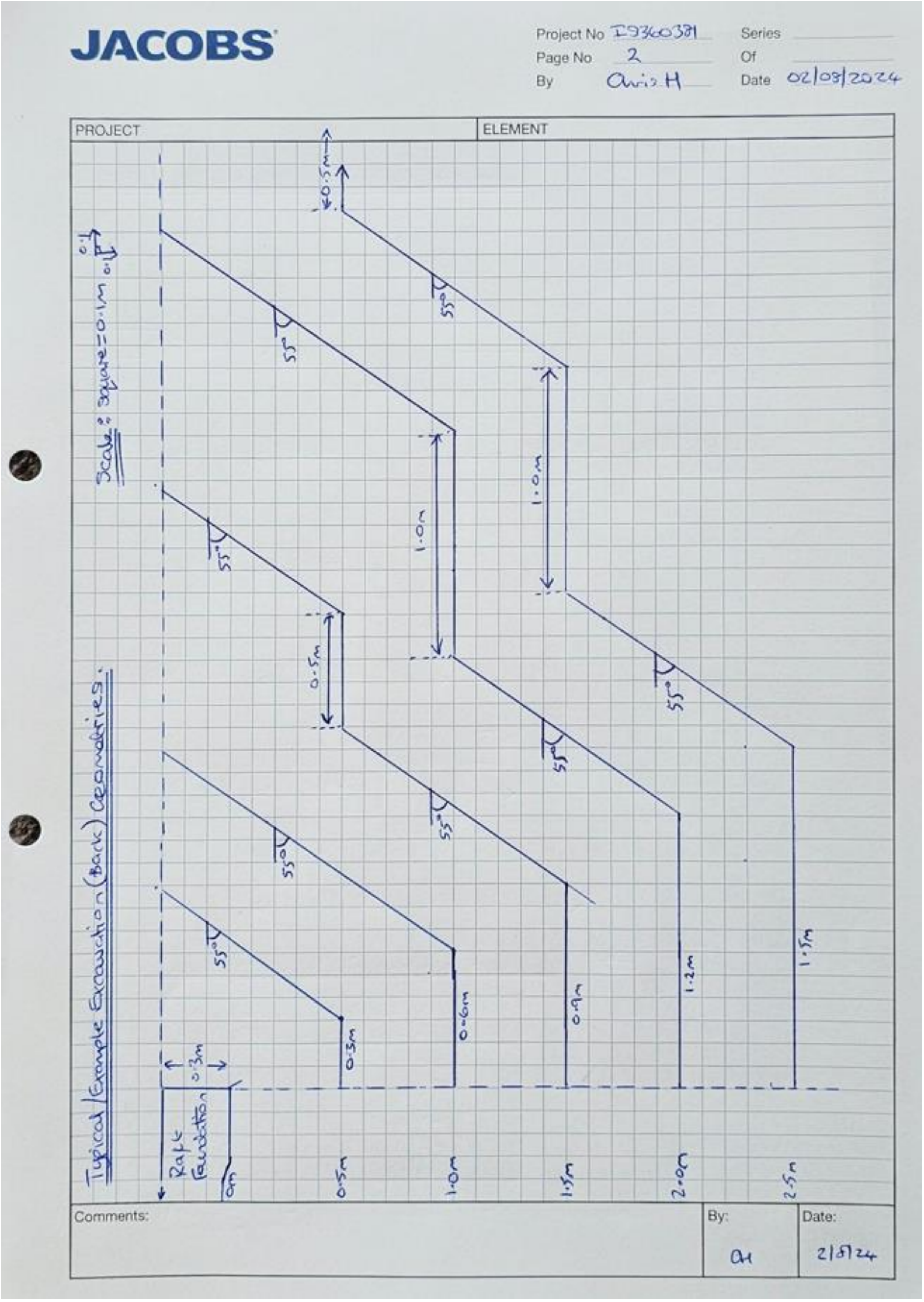
DESIGN SURFACE	12.561	10.299	9.970	9.640	9.310	8.980	8.785	8.785	11.175	11.177	
50 MPa ROCK LAYER				7.120							
GROUNDWATER LEVEL				8.674							
UNCONTROLLED FILL BASE	11.718	11.423	8.808	7.963	8.041	8.232	10.785	10.785	10.785	10.802	
EXISTING SURFACE	12.558	12.316	9.701	9.236	8.666	8.406	11.17	11.17	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



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


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

www.marinesolutions.net.au

HVDC Cable Crossing of Tioxide Outfall

Summary of Works

prepared for

Marinus Link

August 2024

Table of Contents

Version	Contributor/s	Date reviewed	Reviewed by	Notes
1	K.MacAdie	27/08/2024	S.Ibbott	
3		19/09/2024	A. Erskine	Comments from client addressed

Cover photo: Dive footage of Tioxide pipeline: Marine Solutions 2024

Table of Figures

Executive Summary

Field investigations were conducted at the site of the disused Tioxide outfall pipeline off the north coast of Tasmania, at a location proposed for Marinus link to cross the disused outfall (Figure 1).

The purpose of the investigations was to assess:

- Structural integrity of the existing pipeline,
- Potential presence of asbestos in the outfall construction,
- Presence of any residual contaminants within the pipeline (metals, TPH, PAH, Btex), and
- Existing contaminants in the surrounding sediments.

Findings were that the pipeline was structurally intact, and no asbestos or trace asbestos was identified in laboratory testing of the pipeline material. Contaminants were compared to Australian & New Zealand Guidelines (ANZG) toxicant default guideline values (tDGVs) for sediment quality and found no exceedances. However, it should be noted that some toxicants, which may be relevant to the Tioxide works historically undertaken at this site, do not have relevant tDGVs for comparison.

Particle size indicative of this depth and swell exposure reflect coarse sediment which relates to a lower contaminant binding compacity compared to smaller sediment size. This also reduces the potential for generating a persistent plume in the process of removing the pipeline.

Results of this field investigation provide additional information relevant to considerations of options for the project Marinus cable to either a) cross the existing pipelines using a concrete mattress or rock bags, or b) remove sections of the outfall pipelines and lay the project Marinus cable directly on the unencumbered seabed.

Regardless of the method chosen, we recommend any marine equipment coming to site from remote locations should be inspected and cleaned to remove the chance of marine pests being introduced to site. Recommendations and mitigations specific to each method are outlined in Table 1Table 2 below.

Table 1 Recommendations for proposed pipeline crossing methodologies.

Method option	Recommendations
Pipeline crossing (mattress or rock bags)	- We recommend using crossing methods, either employing concrete mattresses or rock bags as per memo (Marinus Link 2024). - In the case of rock bags being the preferred construction methodology, the rock should be sourced from a licenced quarry and be washed to remove fine material before being deposited on the seabed.
Pipeline removal	- Removal of pipeline segment is expected to cause minimal sediment disturbance relevant to natural processes in the region (i.e., large onshore swell). Despite this, we recommend minimising the footprint of construction activities and the size of the segment to be removed where possible. - The pipeline should be removed and disposed of responsibly, recycling materials where possible.

1 Project Background

Marine Solutions was invited by Marinus Link to co-ordinate field investigations offshore from Heybridge Tasmania, where a HVDC cable (Marinus Link) has been proposed to cross a disused Tioxide outfall pipeline (Figure 1). Marinus Link is a proposed undersea and underground electricity and data connector between northwest Tasmania and Latrobe Valley Victoria.

Before deciding on the method to address the cable crossing, understanding the existing condition and composition of the outfall, along with the potential for contaminants to be retained within or on the outfall pipeline was required.

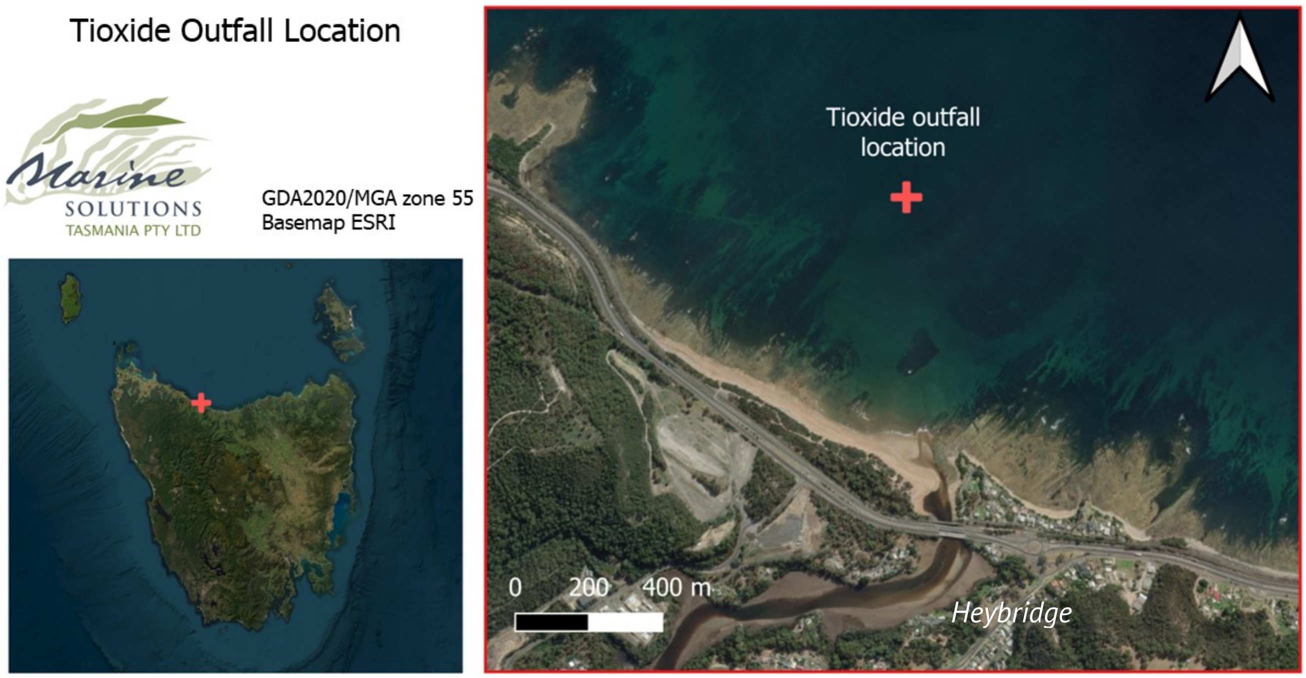


Figure 1 Location of the outfall relative to Heybridge, northwest Tasmania.

1.1 Site specificities

The proposed cable will need to cross existing disused Tioxide outfall pipelines at approximately 10-12 m depth within the western channel of the Heybridge shore approach (Figure 2).

There are multiple options proposed to address the crossing, including building a concrete mattress or removing a section of the outfall pipe, thus allowing the cable to lie directly upon the seabed. For more details on proposed construction methodology see *Memo - HVDC Cable Crossing of Tioxide pipeline 1* (Marinus Link 2023).

Understanding of the condition and composition of the existing Tioxide outfall pipelines (prior to these field investigations) was limited, as the plant and pipelines have been inactive since 2003.

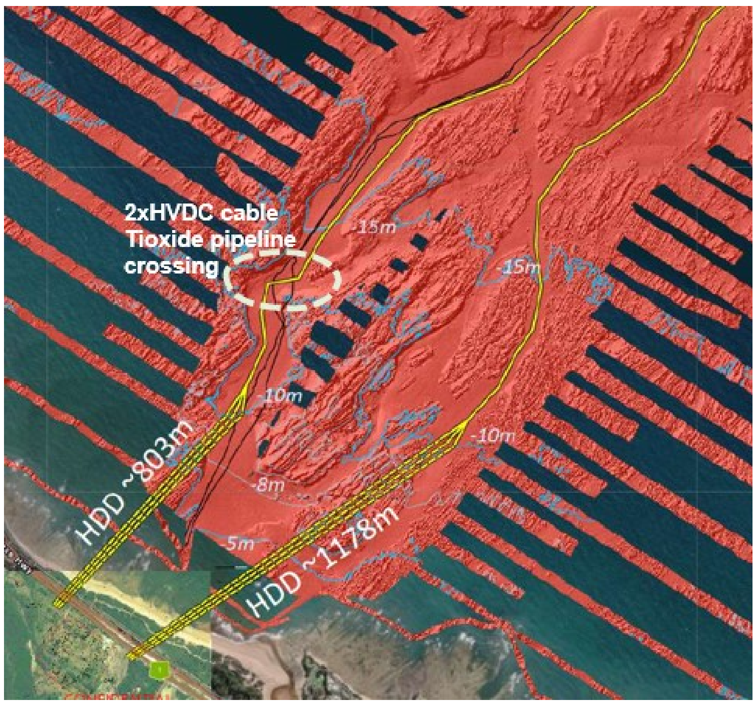


Figure 2 Landfall overview Heybridge, Tasmania. Seafloor bathymetry details displaying channels shown in red (i.e., surveyed areas). Crossing (survey site) shown in the white dashed-line oval. Source: Marinus Link 2023.

2 Field Investigations

Works undertaken for the Marinus Link field investigations included:

- Field survey (via Tasmanian Dive Group/TDG):
    - Pipeline Inspection (diver survey, Section 2.1)
    - Pipeline Material Sampling (diver sampling, Section 2.2)
    - Pipeline Residue and Sediment Sampling (diver sampling, Section 2.3)
- Laboratory testing of samples (ALS Laboratory Group).
- Data analysis and reporting

See below for further information on methodology and results.

2.1 Pipeline Inspection

2.1.1 Methods

Contracted divers (TDG) inspected and filmed the pipeline in the vicinity of the crossing to determine structural integrity and overall condition. The location of the Tioxide outfall, the proposed Marinus Link, and GPS coordinates taken along the pipeline by the contracted divers throughout the survey are displayed in Figure 3.

Video footage is available from Marine Solutions on request (see Appendix 1).

2.1.2 Results

The pipeline was observed to be in good condition overall with no obvious or observable cracks (Figure 4). Note however that small leaks or openings would be difficult to detect due to algal growth and a lack of discharge.

The pipeline was secured to the seabed by steel banding in areas of rocky reef and by concrete collars in regions of unconsolidated material (i.e., sand, cobble or shells).

Overall, the survey determined that the pipeline is structurally intact.

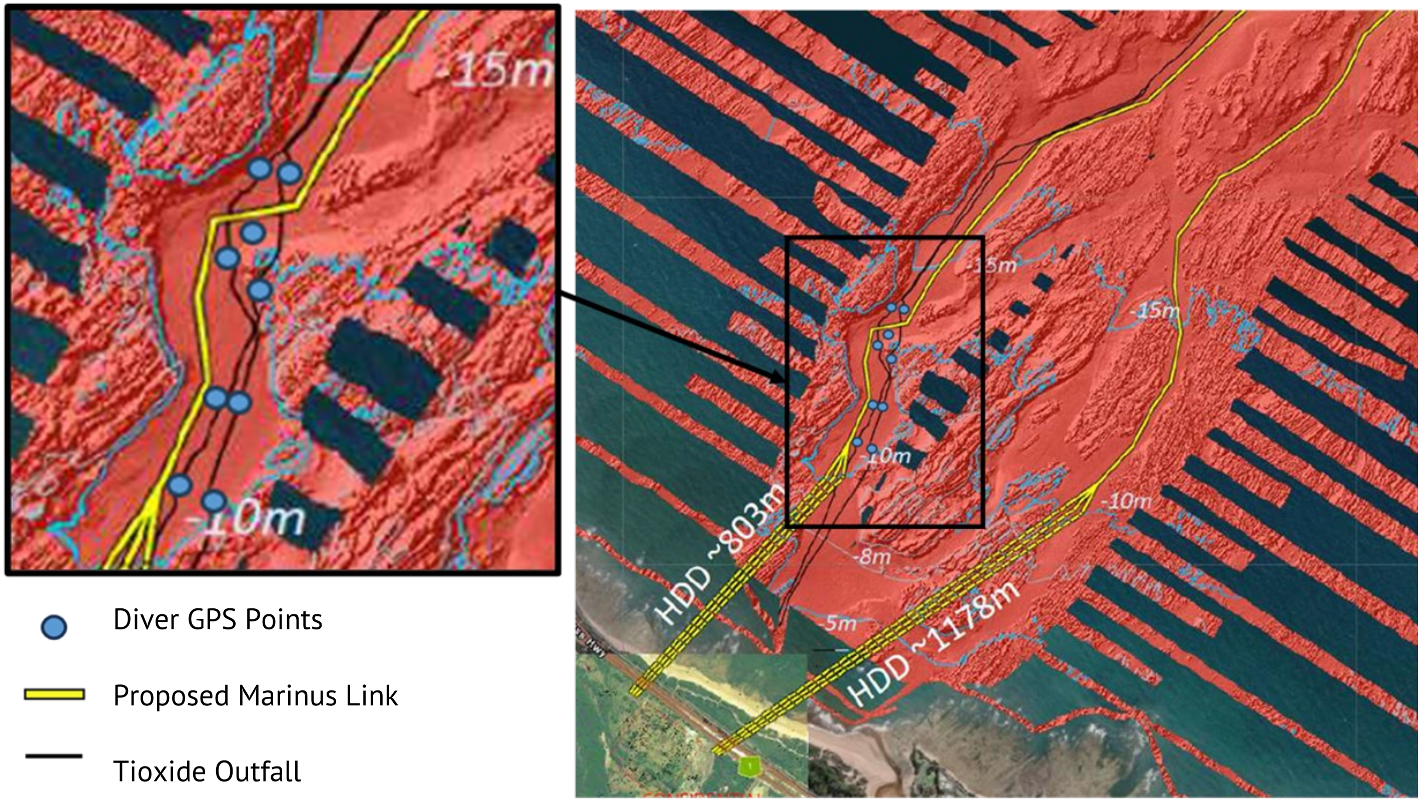


Figure 3 GPS positions of the divers in relation to broader outfall and proposed Marinus Link. Sediment sample sites were taken within this range. Figure provided by TDG.

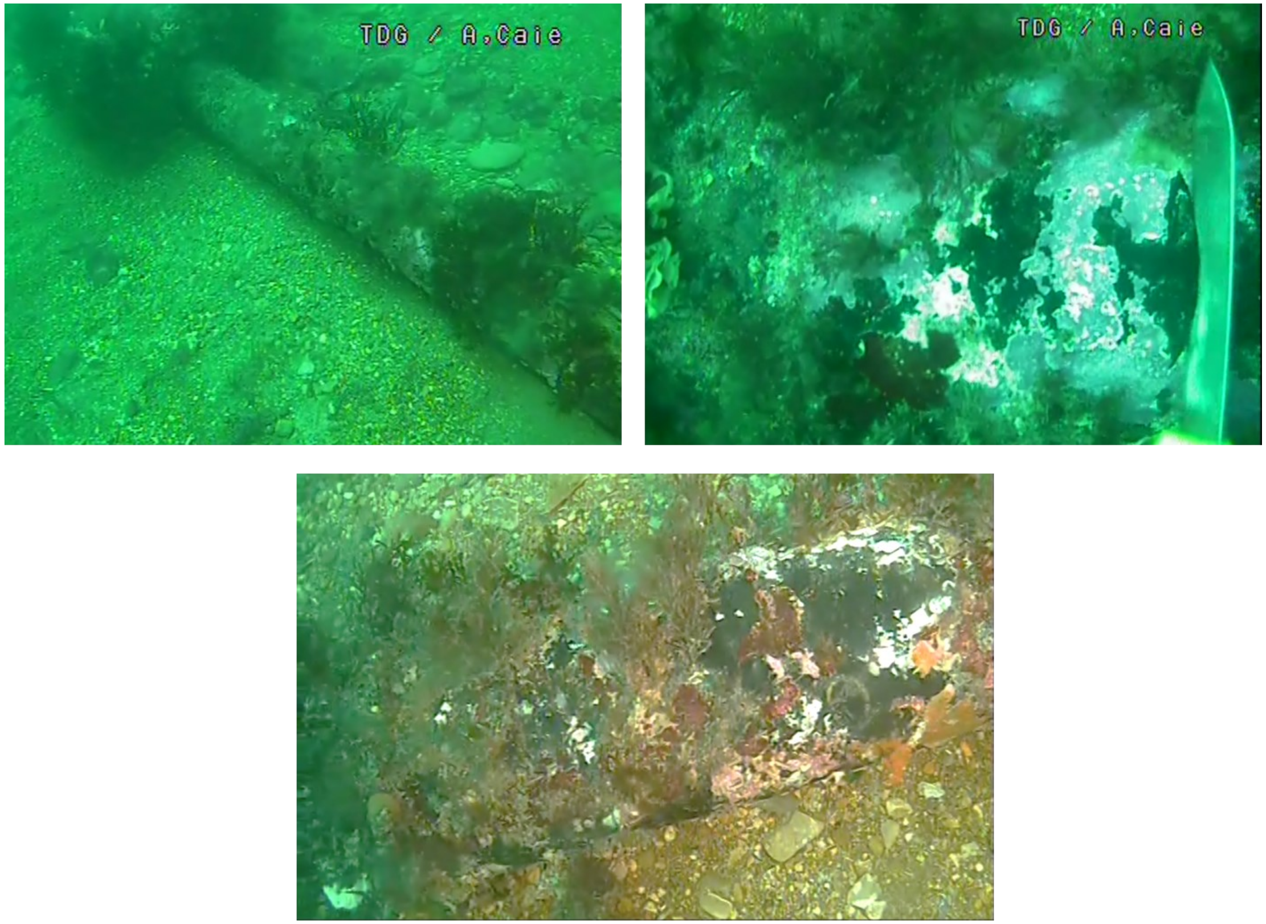


Figure 4 Pipeline inspection showing intact pipeline, algal growth and works to cut into the pipeline.

2.2 Pipeline Material

2.2.1 Methods

Pipeline material was collected by contracted divers (TDG). Samples were delivered to ALS Laboratory Group for analysis, to determine material composition and the presence of any asbestos. These results are also relevant for post removal disposal, storage and transport.

2.2.2 Results

Pipeline samples constituted of black fragments with organic fibres and attached white soil matter. No asbestos or trace asbestos were identified in laboratory testing of the pipeline material samples ("Pipe 1 – material" and "Pipe 2 – material", see Appendix 1).

2.3 Sediment Sampling

2.3.1 Methods

A sediment sample was taken inside and outside of the pipeline on the 15th of August 2024. The sediment sample from the inside of the pipeline was collected by temporarily opening one of the flanges.

Samples were analysed for contaminants, hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAH) and volatile organic compounds (Table 2 and Appendix 1). Contaminant results were compared to the ANZG tDGVs for sediment quality (ANZG, 2024).

The DGVs for sediment quality indicate the concentrations below which there is a low risk of unacceptable effects occurring, and should be used with other lines of evidence, to protect aquatic ecosystems. In contrast, the 'upper' DGVs (GV-high) provide an indication of concentrations at which one might already expect to observe toxicity-related adverse effects (Table 2).

2.3.2 Results

Results from sediment samples inside and outside the pipe found no exceedances of the available ANZG tDGVs for sediment quality (Table 2). However, note that some toxicants (including aluminium, cobalt, iron, manganese, selenium, titanium and vanadium) do not yet have default guideline values due to limitations in existing ANZG data sets. Toxicants likely to be present due to Tioxide production include silica, titanium, iron and a range of other metals (SYRINX).

Generally, toxicant values were similarly low between both samples, however the slight variation in the samples may be explained by a higher proportion of organic material being present outside the pipeline, and thus binding to the toxicants, or perhaps by a flushing of the pipeline during the decommissioning process.

All hydrocarbons (TPH), polycyclic aromatic hydrocarbons (PAH) and volatile organic compounds were present at, or below, the limit of reporting (LOR). Available tDGVs for total TPHs and PAHs suggests levels found in the sediment were negligible.

Table 2 Toxicant default guideline values for sediment quality and results for inside and outside the pipeline. DGVs are absent for some toxicants - This generally reflects absence of an adequate dataset for that toxicant.

Type of toxicant	Toxicant	DGV	GV-high	Inside pipe	Outside pipe
Metals (mg/kg dry weight) [a]	Aluminium	NA	NA	380	790
	Antimony	2.0	25	0.5	< 0.5
	Cadmium	1.5	10	0.1	< 0.1
	Chromium	80	370	4	5
	Cobalt	NA	NA	0.5	1.5
	Copper	65	270	1	1.4
	Iron	NA	NA	5250	8130
	Lead	50	220	2.2	2.6
	Manganese	NA	NA	38	31
	Mercury (inorganic)	0.15	1.0	0.01	< 0.01
	Nickel	21	52	1	1.9
	Selenium	NA	NA	0.1	< 0.1
	Silver	1.0	4.0	0.1	< 0.1

	Titanium	NA	NA	163	128
	Vanadium	NA	NA	15	17.6
	Zinc	200	410	13	15
Metalloids (mg/kg dry weight) [a]	Arsenic	20	70	14.8	19.8
Hydrocarbons (TPH) (mg/kg)	Total TPHs*	280	550	-	-
	C10 – C14			<3	<3
	C10 – C16			<3	<3
	C10 – C36			<3	<3
	C10 – C40			<5	<3
	C15 – C28			<3	<3
	C16 – C34			<3	<3
	C29 - C36			<5	<5
	C34 – C40			<5	<5
	C6 – C10			<3	<3
	C6 - C10 (minus Btex)			<3	<3
	C6 – C9			<3	<3
Polycyclic aromatic hydrocarbons (PAH) (mg/kg)	Total PAHs**	10	50	-	
	Benzene			<0.2	<0.2
	Ethylbenzene			<0.2	<0.2
	Meta & para-Xylene			<0.2	<0.2
	Naphthalene			<0.2	<0.2
	Ortho-Xylene			<0.2	<0.2
	Xylenes (total)			<0.5	<0.5
	Toluene			<0.2	<0.2
Volatile organic compounds (Btex) (mg/kg)	BTEX (sum)			<0.2	<0.2

* Origin described in Appendix A5 of Simpson et al. (2013a).

** The DGV and GV-high values for total PAHs (sum of PAHs) include the 18 parent PAHs: as described in Appendix A3 of Simpson et al. (2013a).

2.3.3 Particle size

Sediment surrounding the pipeline is coarse, which is expected in a high wave and current location. Particle size is relevant as it relates to the bioavailability of toxicity of contaminants is influenced by grain size where the contaminant binding compacity decreases with increasing grain size (ANZG, 2024).

Particle size was not retrieved in this location, however indicative particle size at similar locations such as in Wynyard (where 95% >1mm), and findings of Burnie investigations which found coarse sediment at exposed beach locations due to greater exposure to swell.

This also reduces the capacity of sediment disturbance in the process of removing the pipeline.

The sediment in the area of the pipeline can be described as mobile reworked marine sediments and is typical of unconsolidated sediments along the north coast of Tasmania in a similar depth of water which is impacted regularly by wave action from the NW which mobilises the sediments.

3 Conclusions and Recommendations

The findings of the pipeline investigations detailed in this report suggest that either of the proposed methods for addressing the Marinus Link pipeline crossing –by removal of relevant sections of the Tioxide pipeline or constructing a crossing over the top – are likely to be of low environmental risk.

No asbestos was found in the pipeline material samples, and contaminant results from sediment samples collected within and adjacent to the pipeline did not exceed relevant DGVs. Further, sediment in the vicinity of the pipeline was coarse, meaning that any disturbance caused by pipeline removal methods would be unlikely to cause a large or ongoing plume as sediments will readily resettle to the seabed. Sediment disturbance mitigations such as implementation of silt curtains are not deemed necessary, and therefore not recommended as a mitigation during works.

Based on the findings of the investigations, recommendations for the proposed construction methods include:

- General equipment hygiene:
    - During marine works for the cable crossing any marine equipment coming to site from remote locations should be inspected and cleaned to remove the chance of marine pests being introduced to site.
- Option A - Standard Crossing Technique:
    - We recommend using crossing methods, either employing concrete mattresses or rock bags as per memo (Marinus Link 2024). These are likely to be practical methods which are sensitive to the environment.
    - In the case of rock bags being the preferred construction methodology, the rock should be sourced from a licenced quarry and be washed to remove fine material before being deposited on the seabed.
- Option B - Pipeline Removal:

- Removal of pipeline segment is expected to cause minimal sediment disturbance relevant to natural processes in the region (i.e., large onshore swell). Despite this, we recommend minimising the footprint of construction activities and the size of the segment to be removed where possible. Reducing the size of the pipeline removal will also minimise any disturbance of flora and fauna that have colonised the pipeline structure.
- The pipeline should be removed and disposed of responsibly, recycling materials where possible.

4 References

ANZG (2024) *Toxicant default guideline values for sedimen*t quality. https://www.waterquality.gov.au/anz-guidelines/guideline-values/default/sediment-quality-toxicants. Accessed 22/08/2024.

SYRNINX. ICI Tioxide. https://www.syrinx.net.au/portfolio/ici-tioxide/. Accessed 27/8/2024

Marinus Link (2023). *Rev A, Memo - HVDC Cable Crossing of Tioxide pipeline 1*. Doc No: 2019-003-A-R-0041. Published 2023-02-06.

5 Appendices

Appendix 1. Video footage

File name: *41 04.083S . 145 59.0452E.ASF*

Description: Pipeline outfall inspection

Available on request.

Appendix 2. Laboratory Data (ALS Laboratory)

Sample Name	CAS number	Analyte	Unit	Method	Prefix	Result	Total Or Dissolved	LOR
Pipe 1 - material	*APPROVED IDENTIFIER:	APPROVED IDENTIFIER:	--	EA200	T.KUO		N	
Pipe 1 - material	1332-21-4	Asbestos (Trace)		EA200	No		N	
Pipe 1 - material	1332-21-4	Asbestos Detected	g/kg	EA200	No		N	0.1
Pipe 1 - material	1332-21-4	Asbestos Type	--	EA200	-		N	
Pipe 1 - material	*Description	Description	--	EA200	Black fragments with organic fibres and attached white soil matter approx 75 x 15 x 5mm.		N	
Pipe 1 - material	*Organic Fibre	Organic Fibre		EA200	Yes		N	
Pipe 1 - material	*Sample weight (dry)	Sample weight (dry)	g	EA200		15.9	N	0.01
Pipe 1 - material	*Synthetic Mineral Fibre	Synthetic Mineral Fibre		EA200	No		N	
Pipe 2 - material	*APPROVED IDENTIFIER:	APPROVED IDENTIFIER:	--	EA200	T.KUO		N	
Pipe 2 - material	1332-21-4	Asbestos (Trace)		EA200	No		N	

Pipe 2 - material	1332-21-4	Asbestos Detected	g/kg	EA200	No		N	0.1
Pipe 2 - material	1332-21-4	Asbestos Type	--	EA200	-		N	
Pipe 2 - material	*Description	Description	--	EA200	Black fragments with organic fibres and attached white soil matter approx 65 x 20 x 5mm.		N	
Pipe 2 - material	*Organic Fibre	Organic Fibre		EA200	Yes		N	
Pipe 2 - material	*Sample weight (dry)	Sample weight (dry)	g	EA200		10.3	N	0.01
Pipe 2 - material	*Synthetic Mineral Fibre	Synthetic Mineral Fibre		EA200	No		N	
Pipe 1 - inside	*Moisture Content	Moisture Content	%	EA055		19.8	N	1
Pipe 1 - inside	7429-90-5	Aluminium	mg/kg	EG005-SD		380	T	50
Pipe 1 - inside	7439-89-6	Iron	mg/kg	EG005-SD		5250	T	50
Pipe 1 - inside	7440-36-0	Antimony	mg/kg	EG020-SD	<	0.5	T	0.5
Pipe 1 - inside	7440-38-2	Arsenic	mg/kg	EG020-SD		14.8	T	1
Pipe 1 - inside	7440-43-9	Cadmium	mg/kg	EG020-SD	<	0.1	T	0.1

Pipe 1 - inside	7440-47-3	Chromium	mg/kg	EG020-SD		4	T	1
Pipe 1 - inside	7440-48-4	Cobalt	mg/kg	EG020-SD		0.5	T	0.5
Pipe 1 - inside	7440-50-8	Copper	mg/kg	EG020-SD	<	1	T	1
Pipe 1 - inside	7439-92-1	Lead	mg/kg	EG020-SD		2.2	T	1
Pipe 1 - inside	7439-96-5	Manganese	mg/kg	EG020-SD		38	T	10
Pipe 1 - inside	7440-02-0	Nickel	mg/kg	EG020-SD	<	1	T	1
Pipe 1 - inside	7782-49-2	Selenium	mg/kg	EG020-SD	<	0.1	T	0.1
Pipe 1 - inside	7440-22-4	Silver	mg/kg	EG020-SD	<	0.1	T	0.1
Pipe 1 - inside	7440-62-2	Vanadium	mg/kg	EG020-SD		15	T	2
Pipe 1 - inside	7440-66-6	Zinc	mg/kg	EG020-SD		13	T	1
Pipe 1 - inside	7440-32-6	Titanium	mg/kg	EG020R-T		163	T	1
Pipe 1 - inside	7439-97-6	Mercury	mg/kg	EG035T-LL	<	0.01	T	0.01

Pipe 1 - inside	*>C10 - C16 Fraction	>C10 - C16 Fraction	mg/kg	EP071-SD-SV	<	3	N	3
Pipe 1 - inside	*>C10 - C40 Fraction (sum)	>C10 - C40 Fraction (sum)	mg/kg	EP071-SD-SV	<	3	N	3
Pipe 1 - inside	*>C16 - C34 Fraction	>C16 - C34 Fraction	mg/kg	EP071-SD-SV	<	3	N	3
Pipe 1 - inside	*>C34 - C40 Fraction	>C34 - C40 Fraction	mg/kg	EP071-SD-SV	<	5	N	5
Pipe 1 - inside	*C10 - C14 Fraction	C10 - C14 Fraction	mg/kg	EP071-SD-SV	<	3	N	3
Pipe 1 - inside	*C10 - C36 Fraction (sum)	C10 - C36 Fraction (sum)	mg/kg	EP071-SD-SV	<	3	N	3
Pipe 1 - inside	*C15 - C28 Fraction	C15 - C28 Fraction	mg/kg	EP071-SD-SV	<	3	N	3
Pipe 1 - inside	*C29 - C36 Fraction	C29 - C36 Fraction	mg/kg	EP071-SD-SV	<	5	N	5
Pipe 1 - inside	71-43-2	Benzene	mg/kg	EP080-SD	<	0.2	N	0.2
Pipe 1 - inside	C6_C10	C6 - C10 Fraction	mg/kg	EP080-SD	<	3	N	3
Pipe 1 - inside	C6_C10-BTEX	C6 - C10 Fraction minus BTEX (F1)	mg/kg	EP080-SD	<	3	N	3
Pipe 1 - inside	*C6 - C9 Fraction	C6 - C9 Fraction	mg/kg	EP080-SD	<	3	N	3

Pipe 1 - inside	100-41-4	Ethylbenzene	mg/kg	EP080-SD	<	0.2	N	0.2
Pipe 1 - inside	91-20-3	Naphthalene	mg/kg	EP080-SD	<	0.2	N	0.2
Pipe 1 - inside	*Sum of BTEX	Sum of BTEX	mg/kg	EP080-SD	<	0.2	N	0.2
Pipe 1 - inside	108-88-3	Toluene	mg/kg	EP080-SD	<	0.2	N	0.2
Pipe 1 - inside	*Total Xylenes	Total Xylenes	mg/kg	EP080-SD	<	0.5	N	0.5
Pipe 1 - inside	108-38-3 106-42-3	meta- & para-Xylene	mg/kg	EP080-SD	<	0.2	N	0.2
Pipe 1 - inside	95-47-6	ortho-Xylene	mg/kg	EP080-SD	<	0.2	N	0.2
Pipe 1 - outside	*Moisture Content	Moisture Content	%	EA055		17.4	N	1
Pipe 1 - outside	7429-90-5	Aluminium	mg/kg	EG005-SD		790	T	50
Pipe 1 - outside	7439-89-6	Iron	mg/kg	EG005-SD		8130	T	50
Pipe 1 - outside	7440-36-0	Antimony	mg/kg	EG020-SD	<	0.5	T	0.5
Pipe 1 - outside	7440-38-2	Arsenic	mg/kg	EG020-SD		19.8	T	1

Pipe 1 - outside	7440-43-9	Cadmium	mg/kg	EG020-SD	<	0.1	T	0.1
Pipe 1 - outside	7440-47-3	Chromium	mg/kg	EG020-SD		5	T	1
Pipe 1 - outside	7440-48-4	Cobalt	mg/kg	EG020-SD		1.5	T	0.5
Pipe 1 - outside	7440-50-8	Copper	mg/kg	EG020-SD		1.4	T	1
Pipe 1 - outside	7439-92-1	Lead	mg/kg	EG020-SD		2.6	T	1
Pipe 1 - outside	7439-96-5	Manganese	mg/kg	EG020-SD		31	T	10
Pipe 1 - outside	7440-02-0	Nickel	mg/kg	EG020-SD		1.9	T	1
Pipe 1 - outside	7782-49-2	Selenium	mg/kg	EG020-SD	<	0.1	T	0.1
Pipe 1 - outside	7440-22-4	Silver	mg/kg	EG020-SD	<	0.1	T	0.1
Pipe 1 - outside	7440-62-2	Vanadium	mg/kg	EG020-SD		17.6	T	2
Pipe 1 - outside	7440-66-6	Zinc	mg/kg	EG020-SD		15	T	1
Pipe 1 - outside	7440-32-6	Titanium	mg/kg	EG020R-T		128	T	1

Pipe 1 - outside	7439-97-6	Mercury	mg/kg	EG035T-LL	<	0.01	T	0.01
Pipe 1 - outside	*>C10 - C16 Fraction	>C10 - C16 Fraction	mg/kg	EP071-SD-SV	<	3	N	3
Pipe 1 - outside	*>C10 - C40 Fraction (sum)	>C10 - C40 Fraction (sum)	mg/kg	EP071-SD-SV	<	3	N	3
Pipe 1 - outside	*>C16 - C34 Fraction	>C16 - C34 Fraction	mg/kg	EP071-SD-SV	<	3	N	3
Pipe 1 - outside	*>C34 - C40 Fraction	>C34 - C40 Fraction	mg/kg	EP071-SD-SV	<	5	N	5
Pipe 1 - outside	*C10 - C14 Fraction	C10 - C14 Fraction	mg/kg	EP071-SD-SV	<	3	N	3
Pipe 1 - outside	*C10 - C36 Fraction (sum)	C10 - C36 Fraction (sum)	mg/kg	EP071-SD-SV	<	3	N	3
Pipe 1 - outside	*C15 - C28 Fraction	C15 - C28 Fraction	mg/kg	EP071-SD-SV	<	3	N	3
Pipe 1 - outside	*C29 - C36 Fraction	C29 - C36 Fraction	mg/kg	EP071-SD-SV	<	5	N	5
Pipe 1 - outside	71-43-2	Benzene	mg/kg	EP080-SD	<	0.2	N	0.2
Pipe 1 - outside	C6_C10	C6 - C10 Fraction	mg/kg	EP080-SD	<	3	N	3
Pipe 1 - outside	C6_C10-BTEX	C6 - C10 Fraction minus BTEX (F1)	mg/kg	EP080-SD	<	3	N	3

Pipe 1 - outside	*C6 - C9 Fraction	C6 - C9 Fraction	mg/kg	EP080-SD	<	3	N	3
Pipe 1 - outside	100-41-4	Ethylbenzene	mg/kg	EP080-SD	<	0.2	N	0.2
Pipe 1 - outside	91-20-3	Naphthalene	mg/kg	EP080-SD	<	0.2	N	0.2
Pipe 1 - outside	*Sum of BTEX	Sum of BTEX	mg/kg	EP080-SD	<	0.2	N	0.2
Pipe 1 - outside	108-88-3	Toluene	mg/kg	EP080-SD	<	0.2	N	0.2
Pipe 1 - outside	*Total Xylenes	Total Xylenes	mg/kg	EP080-SD	<	0.5	N	0.5
Pipe 1 - outside	108-38-3 106-42-3	meta- & para-Xylene	mg/kg	EP080-SD	<	0.2	N	0.2
Pipe 1 - outside	95-47-6	ortho-Xylene	mg/kg	EP080-SD	<	0.2	N	0.2