

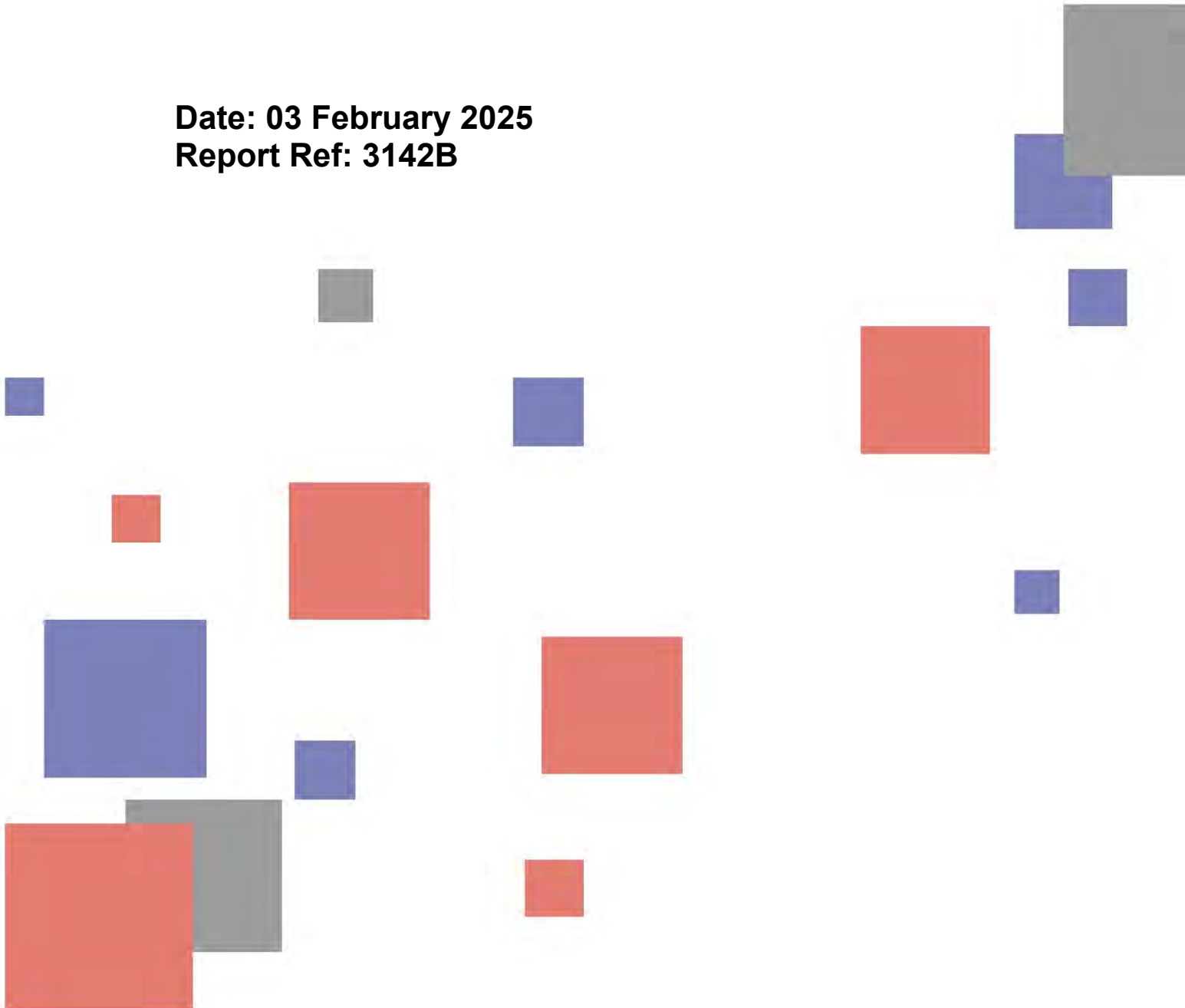
Report

Geotechnical Investigation for Coastal Erosion Vulnerability Assessment.

Harbourside, City of Albany WA.

Date: 03 February 2025

Report Ref: 3142B



DOCUMENT HISTORY

DETAILS

Project number	3142B
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COMPANY DETAILS

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EXECUTIVE SUMMARY

A geotechnical investigation has been carried out as part of a coastal erosion assessment at Harbourside in the City of Albany, Western Australia. During the investigation ground geophysical and intrusive geotechnical testing was conducted within a 1025m corridor along the Harbourside settlement.

The investigation scope consisted of acquiring multi-channel analysis of surface waves data as a series of specified transects either along-shore (parallel to the coast) or cross-shore (perpendicular to the coast) and cone penetration testing at spot locations along these transects. This was supplemented with geological mapping of surface rock outcrops and topographic survey using high resolution aerial photogrammetry for the generation of a surface level model and orthomosaic image.

The acquired MASW dataset was processed for the generation of seismic velocity sections along the transects showing variations in the seismic shear wave velocity of the subsurface material to a target depth of 10-15m below ground level (BGL). The seismic velocity sections were calibrated with the CPT plots and demarcated into velocity ranges representing different material types and conditions for the generation of interpreted geological sections consisting of loose to compacted sediment and variably weathered to fresh rock.

The interpreted geological sections have been compiled to develop a subsurface model of the region between the foreshore and the settlement. This model will be used to assess the potential vulnerability of the site to erosion and future inundation risk, and whether there is a continuous rock barrier located below the ground surface of sufficient strength and height that may prevent the advancement of erosion to the settlement.

The following observations have been made:

- No substantial rock substrate was observed along any of the transects within the maximum target investigation depth of 10-15m BGL except on one 150m section on Transect 03.
- Sediment thickness is generally greater than 15m across the site with relatively increasing level of compaction in the landward direction.

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1 INTRODUCTION

At the request of The Government of Western Australia Department of Transport (DoT), GBG Group carried out a geotechnical investigation at Harbourside, City of Albany in January 2025. During the investigation seismic geophysical testing and intrusive geotechnical testing was conducted within a 1025m corridor along the Harbourside settlement.

The objective of the investigation was to provide detailed mapping of the extent, elevation and consistency/strength of the rock underlying the coastal beach and dune formation. In particular, the key outcome of the investigation was to develop a subsurface model of the level to competent rock substrate (relative to AHD) within the region between the foreshore and the settlement. This model will be used to assess the potential vulnerability of the site to erosion and future inundation risk, and whether there is a continuous rock barrier located below the ground surface of sufficient strength and height that may prevent the advancement of erosion to the settlement.

To achieve the project objectives, data from the following investigation methods was acquired, processed and analysed to obtain the required subsurface information within the anticipated geological conditions:

1. **Geological mapping** of surface rock outcrops within the study area using high resolution photogrammetry.
2. **Geophysical testing** by way of Multi-channel Analysis of Surface Waves (MASW) to obtain seismic shear wave velocity models related to variations in subsurface material stiffness.
3. **Topographic survey** using Differential GNSS receiver and photogrammetry.

2 INVESTIGATION SITE

The investigation was carried out within approximate 1025m corridor adjacent to the coastal beach and dune formation extending from the eastern end of the old Albany woolstore, and 650m along the Bibbulmun track in the west. The site extents are shown as a yellow dashed polygon in Figure 1.

Data was acquired as a series of transects for the seismic geophysical testing. These were positioned so as to best utilise existing roads, tracks, and beach whilst not impacting on native vegetation and in order to ensure the most optimal, efficient and economic acquisition methodology. Data was not acquired where surface obstructions were present such as thick vegetation, steep topography or where the beach was inundated with seawater. Photographs showing the typical site conditions are provided in Figure 2.

Topography at the site was generally flat to undulating and surface level ranged from 0mAHD to 3.5mAHD. Topographic maps showing surface level are provided in Appendix C drawing 3142B-09.



Figure 1: The extent of the geophysical investigation (yellow polygon) at the Harbourside site. Aerial imagery from drone photogrammetry (main image) and Google Maps (inset image).



Figure 2: Site conditions at Harbourside including the beach (left image) and along-shore transect on the Bibbulmun track (right image).

3 INVESTIGATION METHODOLOGY

3.1 FIELD SURVEY LOGISTICS

Geophysical data acquisition was carried out from the 14th – 16th January 2025 by a two-person team from GBG Group consisting of qualified geophysicists. CPT data acquisition was carried out by a technician from Probedrill on 15th and 16th of January 2025.

Prior to the commencement of data acquisition, a site assessment was carried out with potential concerns and issues including the placement of and access to the MASW transects were addressed.

The site work for the investigation consisted of a total of 2824m of MASW profiling acquired as 3 along-shore transects (parallel to the coast) and 7 cross-shore transects (perpendicular to the coast). Details of the acquired MASW transects are provided in Table 1. The extents of the MASW transects overlaid onto aerial imagery are shown in Appendix A drawing 3142B-01.

Table 1 – Acquired MASW Transects (Coordinates in GDA2020, MGA Zone 50).

Transect ID	Orientation	Start Coordinate		End Coordinate		Length (m)
		East	North	East	North	
MASW-01	Along-shore	577912.4	6123321.0	578410.2	6123667.0	632
MASW-02	Along-shore	578465.6	6123585.8	578796.7	6123590.8	344
MASW-03	Along-shore	577717.1	6123481.0	578422.3	6123792.0	824
MASW-04	Cross-shore	577918.8	6123336.0	577771.4	6123486.0	216
MASW-5A	Cross-shore	578010.2	6123390.0	577960.8	6123487.0	112
MASW-5B	Cross-shore	577929.9	6123468.0	577889.5	6123552.0	96
MASW-06	Cross-shore	578188.4	6123583.0	578128.7	6123716.0	152
MASW-07	Cross-shore	578347.1	6123660.0	578343.2	6123758.0	104
MASW-08	Cross-shore	578451.1	6123604.7	578445.9	6123773.9	176
MASW-09	Cross-shore	578820.2	6123606.9	578802.8	6123763.6	168

3.2 MULTI-CHANNEL ANALYSIS OF SURFACE WAVES

MASW is a seismic geophysical method that utilises phase and frequency information to calculate Shear wave (S-wave) velocities in vertical layer models averaged over an array of linearly spaced geophones. These 1D models can be laterally stacked to provide 2D cross-sections of S-wave velocity in layers. Under most circumstances it is an indicator of material stiffness and as such the method can be used to provide quantitative results on the compaction of the subsurface material.

MASW data was acquired using a Geode (Geometrics) seismograph connected to a receiver array of 24 geophones set at 1m intervals for a total array length of 23m. The receiver array was mobilised on a land streamer whereby the geophones are mounted on base plates attached to webbing, and either towed behind a 4WD vehicle or manually pulled by the field team. Seismic energy was generated using summed impacts from a PEG-40 (R.T. Clark) vehicle mounted accelerated weight drop (AWD) or softened steel sledgehammer with source points made at a constant offset from the receiver array.

MASW acquisition parameters are provided in Table 2. Photographs of MASW data acquisition are shown in Figure 3.

Table 2 – MASW Acquisition Parameters

Parameter	Value
Number of geophones	24
Geophone spacing	1 m
Array length	23 m
Geophone frequency	4.5 Hz
Record length	1 s
Sample interval	0.125 ms
Source	40kg AWD / 5.9kg Sledgehammer
Source offset	4 m
Sounding interval	8m
Source stacks	3



Figure 3: MASW data acquisition using a seismic streamer and AWD inside the old Albany woolstore

The MASW data was observed to be of high quality with the seismic records having high signal to noise ratio. The generated overtone images plotting phase velocity against frequency mostly showed a prominent dispersion curve of the surface wave component. The MASW data was processed using SurfSeis version 6++ (Kansas Geological Survey, 2017) with the following processing routine:

1. Import acquired seismic data files and apply geometry including geophone spacing, source offset and sounding interval.

2. Generate overtone images giving the percentage intensity of phase velocity versus frequency for each seismic record (Figure 4).
3. Pick the maximum intensity across the useful range of frequencies for each overtone image resulting in a dispersion curve.
4. Run the dispersion curves through a 10-layer inversion algorithm to produce 1D soundings plotting seismic S-wave velocity with depth.

The S-wave velocity soundings were compiled with reference to distance along the transects and gridded with Surfer version 25 (Golden Software, 2023). The resulting contoured cross-sections show the variation in the modelled S-wave velocity of the subsurface material in metres per second laterally along each of the transects and with elevation.

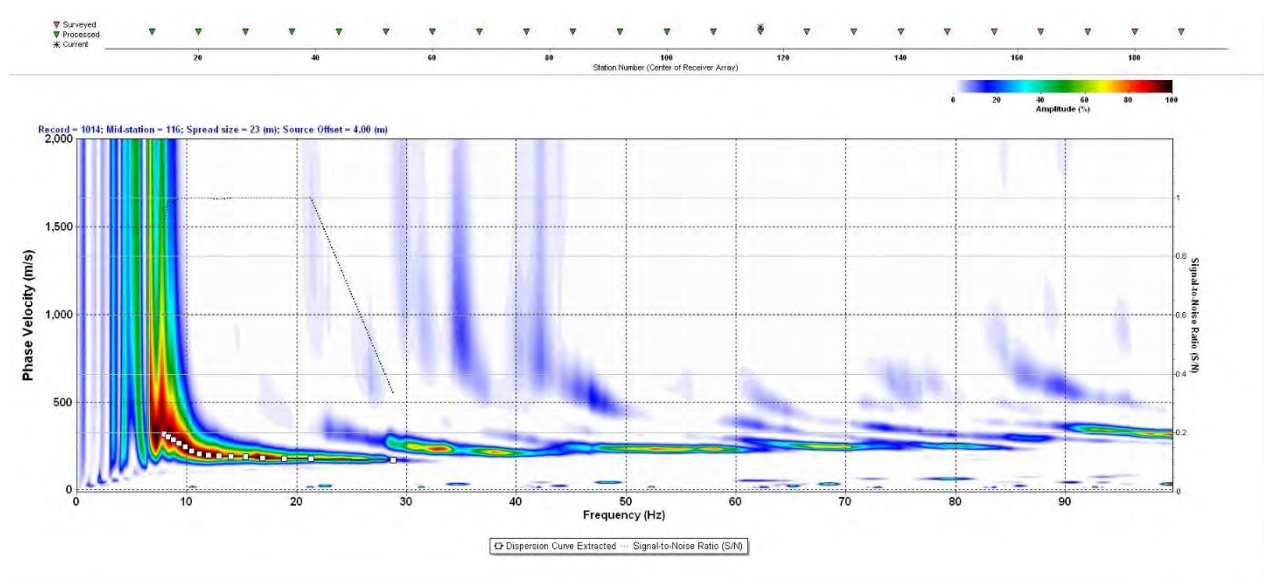


Figure 4: MASW overtone image with high signal to noise ratio and picked dispersion curve.

3.3 SPATIAL POSITIONING AND PHOTOGRAMMETRY

Spatial positioning of the acquired geophysical transects was achieved using Reach RS2+ (Emlid) GNSS receivers with a coordinate recorded for each MASW sounding location. Coordinates of the geophysical transects have been provided in GDA2020, MGA zone 50 for horizontal component and Australian Height Datum (mAHD) for vertical component. An accuracy of +/-0.2m is expected for both vertical and horizontal components.

To achieve precise reduced levels referenced to AHD, the positioning data was acquired with Real-Time Kinematics (RTK) using a Geoscience Australia AUSCORS station in Albany for the base corrections. Details of the AUSCORS station used for this investigation are provided in Table 3.

Table 3 – Details of AUSCORS station

Parameter	Value
Mount Point	ABNY00AUS0
Latitude	S 33° 1' 37.74"
Longitude	E 117° 53' 11.652"
Ellipsoidal height (m)	-13m

A reduced level of 0.0mAHD is considered to be the Mean Sea Level (MSL) for the purpose of this investigation. This relationship for Mean Sea Level was established by the Geoscience Australia Survey in 1971*.

*<http://www.ga.gov.au/scientific-topics/positioning-navigation/geodesy/datums-projections/australian-height-datum-ahd>

Aerial photogrammetry was carried out to obtain an up-to-date high-resolution aerial image and a surface level model of the survey area. Data was acquired with a Mavic 3E (DJI) multi-rotor drone with RTK capability for the capture of multiple overlapping images.

The acquired photogrammetry images were processed using Metashape Professional (Agisoft) for the generation of a point cloud, surface level model and orthomosaic image of the survey area. Note for this investigation, vegetation has not been removed during the processing stage and as such the height of existing vegetation needs to be considered when assessing surface levels.

4 RESULTS AND INTERPRETATION

4.1 PRESENTATION OF RESULTS

The results of the geotechnical investigation at Harbourside, City of Albany are presented in Appendices B and C of this report as follows:

Appendix B – Geophysical and Interpreted Sections

- **3142B-02.** Transect 01 seismic S-wave velocity model and interpreted geological section.
- **3142B-03.** Transect 02 seismic S-wave velocity model and interpreted geological section.
- **3142B-04.** Transect 03 (0-600m) seismic S-wave velocity model and interpreted geological section.
- **3142B-05.** Transect 03 (600-824m) seismic S-wave velocity model and interpreted geological section.
- **3142B-06.** Transects 04, 5A, and 5B seismic S-wave velocity model and interpreted geological section.
- **3142B-07.** Transects 06 and 07 seismic S-wave velocity model and interpreted geological section.

- **3142B-08.** Transects 08 and 09 seismic S-wave velocity model and interpreted geological section.

Appendix C – Modelled Level to Surface, and Sediment Thickness

- **3142B-09.** Contoured surface level models derived from aerial photogrammetry.
- **3142B-10.** Class post map modelled sediment thickness

4.2 SEISMIC SHEAR WAVE VELOCITY SECTIONS

The seismic S-wave velocity (V_s) sections modelled from the MASW data acquired along the along-shore and cross-shore transects are presented at the top of each drawing in Appendix B. These sections show variations in the modelled V_s as per the colour scale with velocity ranging from 150m/s to 1000m/s representing a wide range of material types and conditions.

Seismic S-wave velocity is governed by the elastic properties of the medium that the wave propagates through as shown in the equation below. In particular, it is primarily a function of soil density, void ratio and effective stress. As such calculated values can provide a useful guide to the subsurface material condition with increasing velocity an indication of increasing material stiffness.

$$\text{Seismic S-wave velocity} \quad V_s = \sqrt{\frac{G}{\rho}}$$

where; G = Shear modulus,
 ρ = In-situ material density

4.3 INTERPRETED GEOLOGICAL SECTIONS

Below the seismic S-wave velocity sections are the interpreted geological sections based on detectable seismic velocity contrasts. Four classes have been defined representing different subsurface material conditions as follows:

1. **Very low seismic S-wave velocity** ($V_s < 250\text{m/s}$). Representing the lowest seismic velocities modelled during the investigation, this class is interpreted as sediment of low compaction from either the beach or dune formation.
2. **Low seismic S-wave velocity** ($V_s 250\text{-}450\text{m/s}$). This class is interpreted as sediment of moderate compaction due to increased depth of cover on the beach and dune formation, or due to development adjacent to the settlement.
3. **Moderate seismic S-wave velocity** ($V_s 450\text{-}600\text{m/s}$). This class is interpreted as low strength variably weathered rock. Where continuous and at base of the sections it likely represents a transitional zone to stronger, more competent underlying rock. Where present

as isolated anomalies within the interpreted sediment, it is likely to represent partially lithified sediment or rock lenses.

4. **Moderate to high seismic wave velocity** ($V_s > 600\text{m/s}$). This class is interpreted as moderate strength slightly weathered to fresh rock. This class was not observed on any of the geophysical transects within the target investigation depth of 10-15m BGL except for transect 03 between 150-300m chainage.

4.4 CALIBRATION WITH GEOTECHNICAL TESTING AND ROCK MAPPING

The results of the CPTs are presented in Appendix D showing the plots of cone tip resistance in megapascals against depth in metres. The CPT plots are also shown in Appendix B and overlayed onto the interpreted geological sections with the following observations being made:

- **CPT-01 on Transect 08** – refusal due to inclination at a depth of 7.7m Below Ground Level (BGL) which corresponds to an interpreted partially lithified sediment or boulders within the sediment.
- **CPT-02 on Transect 09** – no refusal to 11.2 m Below Ground Level (BGL)
- **CPT-03 on Transect 01** – no refusal to 11.2 m Below Ground Level (BGL)
- **CPT-04 on Transect 01/ 06** – no refusal to 11.2 m Below Ground Level (BGL)
- **CPT-05 on Transect 01/ 5A** – no refusal to 11.2 m Below Ground Level (BGL)
- **CPT-06 on Transect 01 / 04** – no refusal to 11.2 m Below Ground Level (BGL)

Subtle differences in the modelled MASW data and CPT data can be attributed to the fact that the geophysical methods used are broad scale whilst the CPT is a point method. Geophysical methods sample a volume of subsurface material with the calculated depths at any particular point representing an average value over this volume. The CPT method samples the subsurface directly below the probe and is influenced by local variations in the subsurface such as rock floaters, highly weathered zones or lenses of partially lithified sediment. The differences in the type of subsurface sampling of the methods will not adversely affect the results as the CPT results have been used to constrain the geophysics interpretation and as such the results represent the best modelled fit between the datasets.

No outcropping rock was observed on the Harbourside site.

4.5 MODELLED LEVEL TO TOP OF ROCK AND SEDIMENT THICKNESS

Subsurface model for the level to top of rock substrate has not been presented in this report since no significant competent rock was observed along any of the transects except Transect 03. Consequently, sediment thickness can be considered to be greater than the maximum investigation depth of 10m since no substantial rock interface was observed from the surface to maximum depth on any of the

geophysical transects. This finding is further supported by the CPT results. The following subsurface models have been provided:

- **Contoured Surface Level Model** (drawings 3142B-09) – generated from the aerial photogrammetry, this presents the level to ground surface ranging from 0mAHD to 5mAHD. Note: vegetation and built-up features have not been removed from these models.
- **Classed Post Map Sediment Thickness** (drawings 3142B-10) – this presents the thickness of sediment overlying the rock substrate along the acquired transects at 2m depth increments from <6mBGL to >16mBGL.

5 PROJECT SUMMARY

A geotechnical investigation has been carried out as part of a coastal erosion assessment at Harbourside in the City of Albany, Western Australia. During the investigation ground geophysical and intrusive geotechnical testing was conducted within a 1025m corridor along the Harbourside settlement.

The investigation scope consisted of acquiring multi-channel analysis of surface waves data as a series of specified transects either along-shore (parallel to the coast) or cross-shore (perpendicular to the coast). This was supplemented with geological mapping of surface rock outcrops and topographic survey using high resolution photogrammetry for the generation of a surface level model and orthomosaic image. No surface rock outcrops were identified in the survey area.

The acquired MASW dataset was processed for the generation of seismic velocity sections along the transects showing variations in the seismic shear wave velocity of the subsurface material to a target depth of 10-15m below ground level. The seismic velocity sections were calibrated with the CPT plots and demarcated into velocity ranges representing different material types and conditions for the generation of interpreted geological sections consisting of loose to compacted sediment and variably weathered to fresh rock.

The interpreted geological sections have been compiled to develop a subsurface model within the region between the foreshore and the settlement. This model will be used to assess the potential vulnerability of the site to erosion and future inundation risk, and whether there is a continuous rock barrier located below the ground surface of sufficient strength and height that may prevent the advancement of erosion to the settlement.

The methods used during the investigation are geophysical and as such the results are based on indirect measurements and the processing and interpretation of seismic wave signals calibrated with intrusive geotechnical testing. The findings in this report represent the professional opinions of the authors, based on experience gained during previous similar investigations.

We trust that this report and the attached drawings provide you with the information required. If you require clarification on any points arising from this investigation, please do not hesitate to contact the undersigned on 08 9354 6300.

For and on behalf of
GBG GEOTECHNICS (AUSTRALIA)



QASIM ASAD
Senior Geophysicist

APPENDIX A – INVESTIGATION SITE MAP

GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT HARBOURSIDE, CITY OF ALBANY WESTERN AUSTRALIA

INVESTIGATION SITE MAP



NOTES

Drawing to be used in conjunction with Report 3142B.
Map Projection GDA94 MGA Zone 50.
Aerial image from Google Earth Pro and GBG
photogrammetry.



CLIENT DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA

GEOPHYSICAL INVESTIGATION FOR COASTAL
EROSION VULNERABILITY ASSESSMENT
HARBOURSIDE, CITY OF ALBANY WA

Date 17 January 2025

Scale 1:3500

Drawing 3142B-01

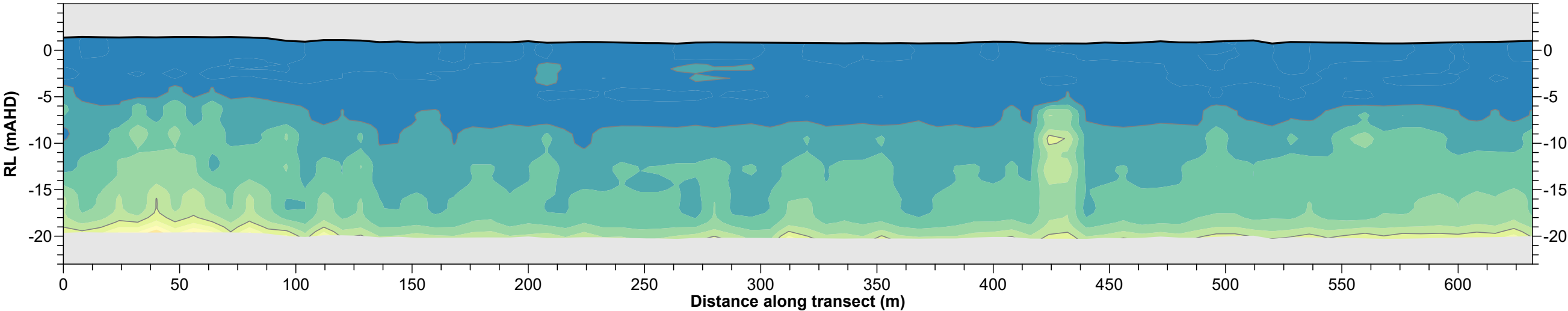
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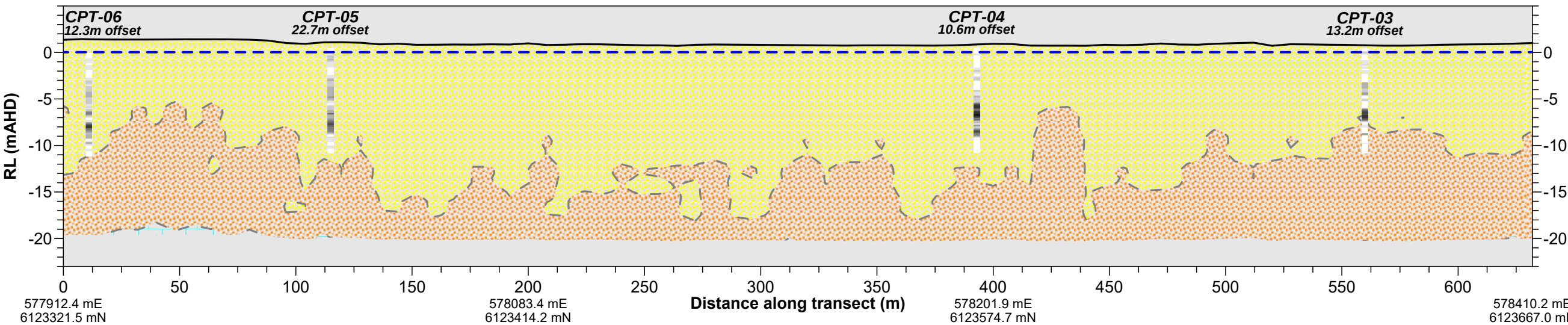
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APPENDIX B – GEOPHYSICAL AND INTERPRETED SECTIONS

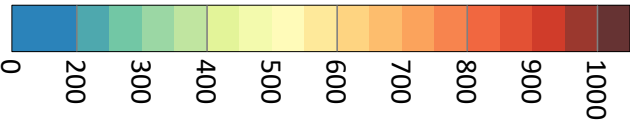
TRANSECT 01 - SEISMIC SHEAR WAVE VELOCITY MODEL



TRANSECT 01 - INTERPRETED GEOLOGICAL SECTION



SEISMIC S-WAVE VELOCITY (m/s)

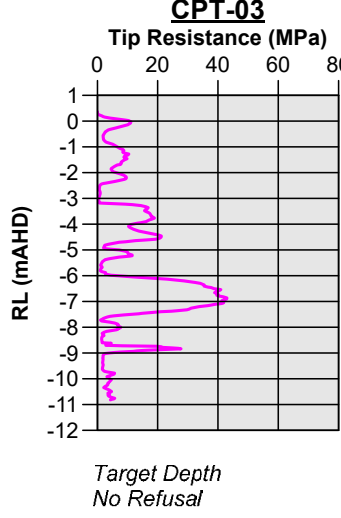
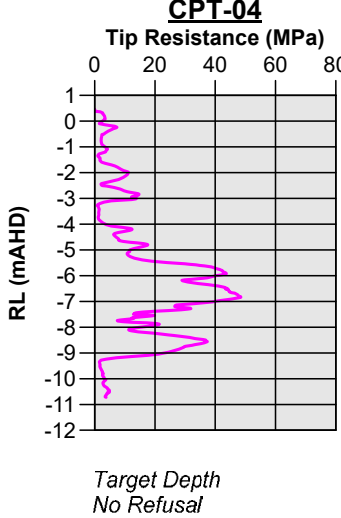
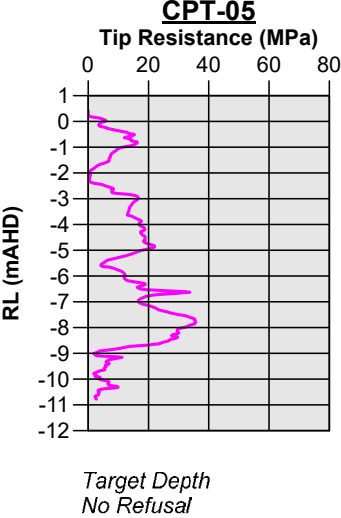
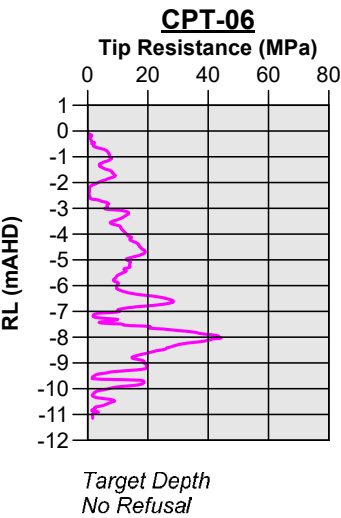


INTERPRETED MATERIAL TYPE

- SEDIMENT - LOW COMPACTION
S-WAVE VELOCITY < 250 m/s
- SEDIMENT - MODERATE TO HIGH COMPACTION
S-WAVE VELOCITY 250-450 m/s
- LOW STRENGTH WEATHERED ROCK
S-WAVE VELOCITY 450-600 m/s
- MODERATE STRENGTH COMPETENT ROCK
S-WAVE VELOCITY > 600 m/s.
- 0m AUSTRALIAN HEIGHT DATUM

CONE PENETRATION TEST

- Tip Resistance (MPa)
- 0 to <5
 - 5 to <10
 - 10 to <15
 - 15 to <20
 - 20 to <25
 - 25 to <30
 - 30 to <35
 - 35 to <40
 - 40 to <45
 - 45 to <50
 - Equal to or >50



NOTES

Drawing to be used in conjunction with Report 3142B.
Positioning is given in GDA2020 zone 50.
Levels are given in Australian Height Datum (AHD).

CLIENT

DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA

GEOTECHNICAL INVESTIGATION FOR COASTAL
EROSION VULNERABILITY ASSESSMENT.
HARBOURSIDE, CITY OF ALBANY WA

Date 21 January 2025

Scale 1:2000H, 1:500V

Drawing 3142B-02

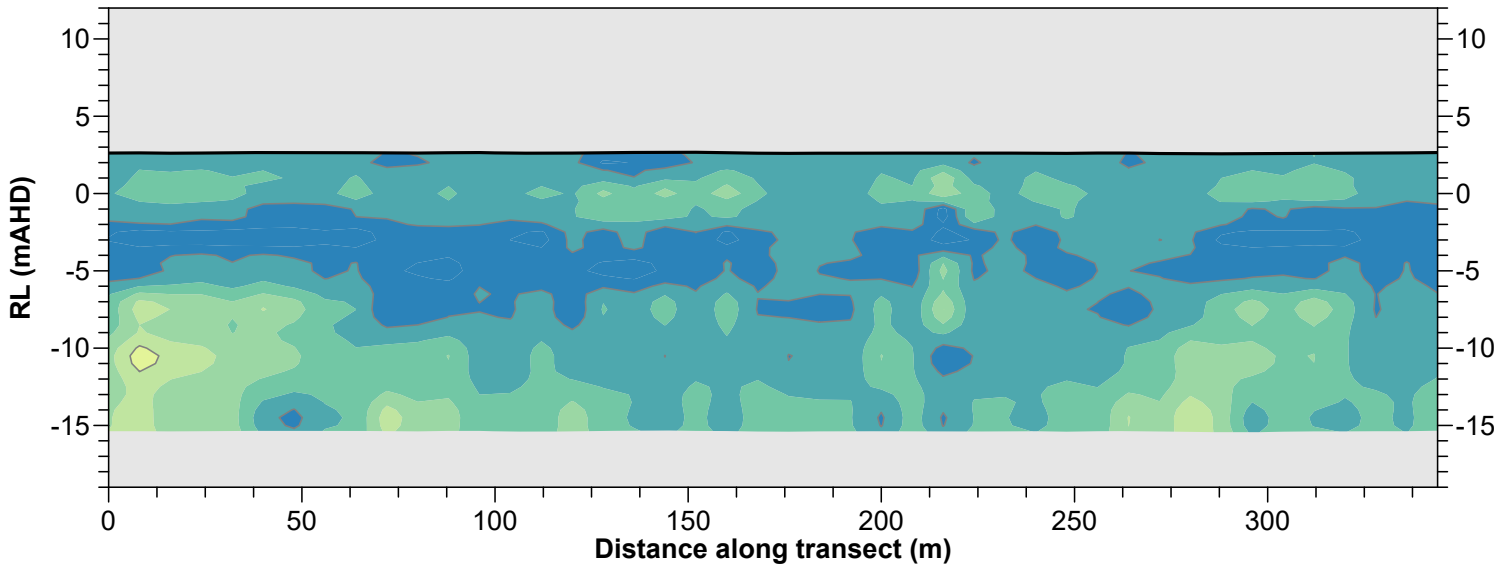
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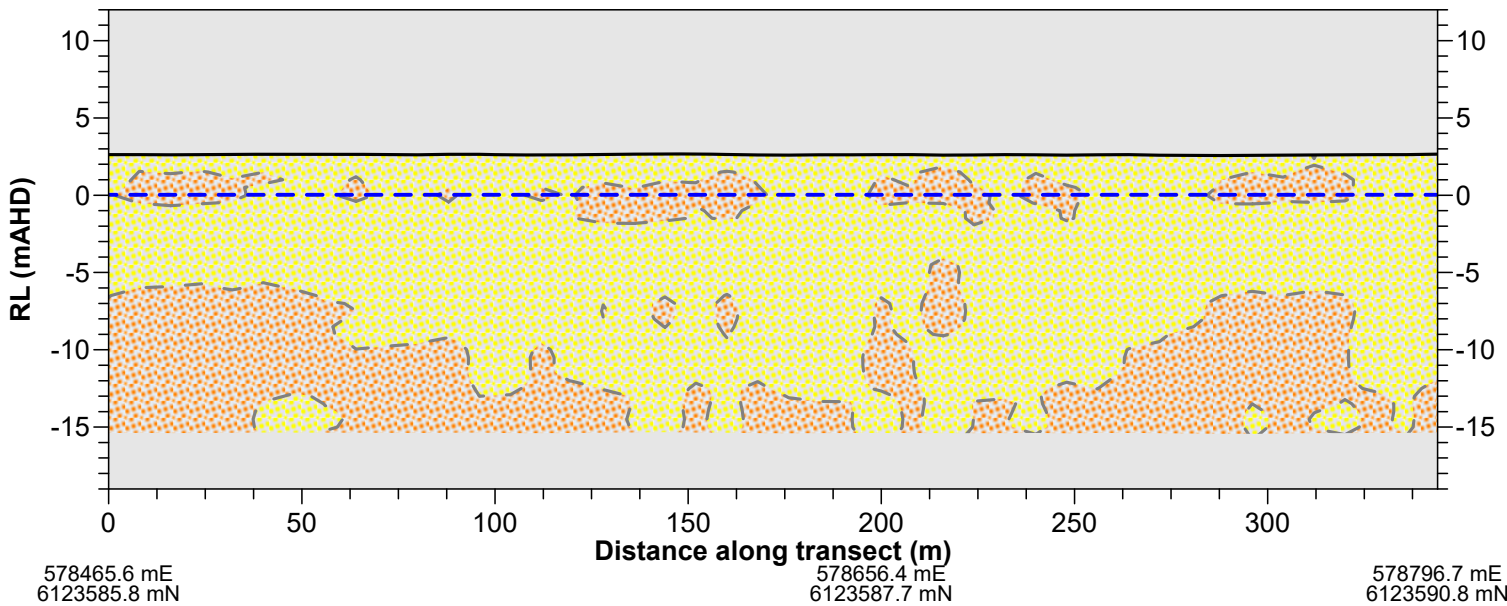
Revision 0

GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT
HARBOURSIDE, CITY OF ALBANY WESTERN AUSTRALIA

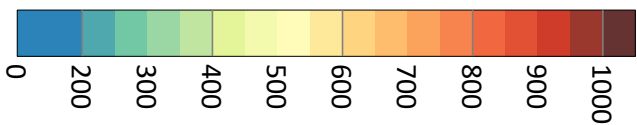
TRANSECT 02 - SEISMIC SHEAR WAVE VELOCITY MODEL



TRANSECT 02 - INTERPRETED GEOLOGICAL SECTION



SEISMIC S-WAVE VELOCITY (m/s)



INTERPRETED MATERIAL TYPE

- SEDIMENT - LOW COMPACTION
S-WAVE VELOCITY < 250 m/s
- SEDIMENT - MODERATE TO HIGH COMPACTION
S-WAVE VELOCITY 250-450 m/s
- LOW STRENGTH WEATHERED ROCK
S-WAVE VELOCITY 450-600 m/s
- MODERATE STRENGTH COMPETENT ROCK
S-WAVE VELOCITY > 600 m/s.
- 0m AUSTRALIAN HEIGHT DATUM

CONE PENETRATION TEST

- Tip Resistance (MPa)
- 0 to <5
 - 5 to <10
 - 10 to <15
 - 15 to <20
 - 20 to <25
 - 25 to <30
 - 30 to <35
 - 35 to <40
 - 40 to <45
 - 45 to <50
 - Equal to or >50

NOTES

Drawing to be used in conjunction with Report 3142B.
Positioning is given in GDA2020 zone 50.
Levels are given in Australian Height Datum (AHD).

CLIENT DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA

GEOTECHNICAL INVESTIGATION FOR COASTAL
EROSION VULNERABILITY ASSESSMENT.
HARBOURSIDE, CITY OF ALBANY WA

Date 21 January 2025

Scale 1:2000H, 1:500V

Drawing 3142B-03

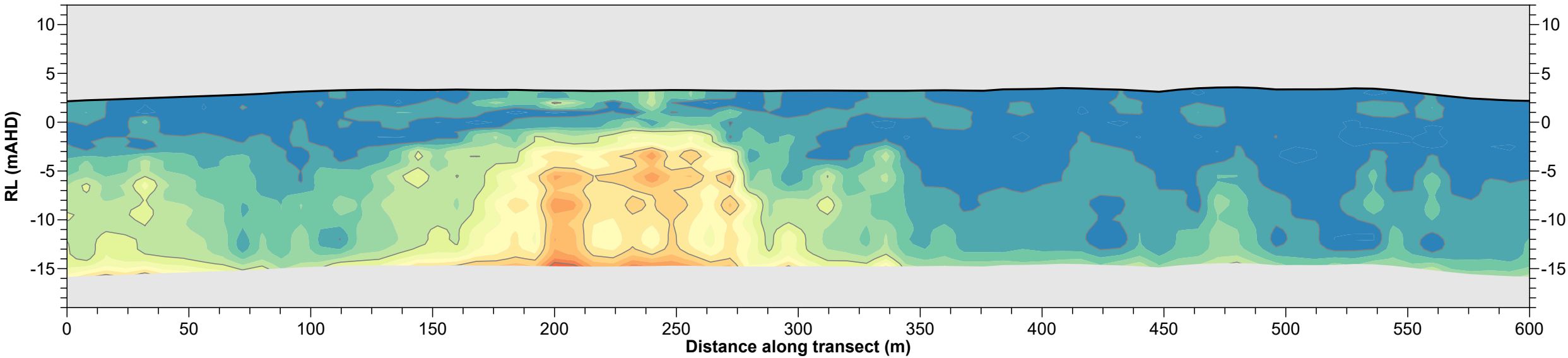
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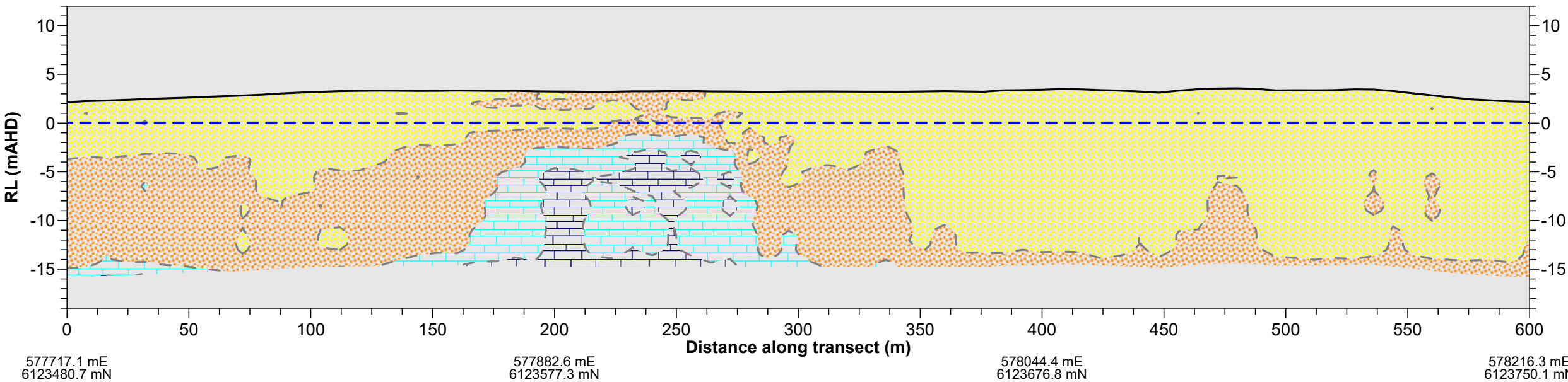
Revision 0

GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT
HARBOURSIDE, CITY OF ALBANY WESTERN AUSTRALIA

TRANSECT 03 - SEISMIC SHEAR WAVE VELOCITY MODEL



TRANSECT 03 - INTERPRETED GEOLOGICAL SECTION



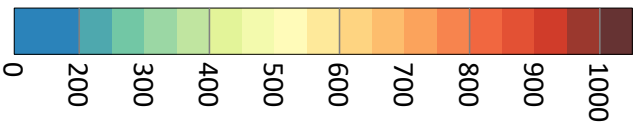
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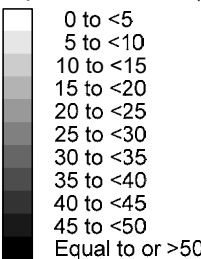
SEISMIC S-WAVE VELOCITY (m/s)



INTERPRETED MATERIAL TYPE

- SEDIMENT - LOW COMPACTION
S-WAVE VELOCITY < 250 m/s
- SEDIMENT - MODERATE TO HIGH COMPACTION
S-WAVE VELOCITY 250-450 m/s
- LOW STRENGTH WEATHERED ROCK
S-WAVE VELOCITY 450-600 m/s
- MODERATE STRENGTH COMPETENT ROCK
S-WAVE VELOCITY > 600 m/s.
- 0m AUSTRALIAN HEIGHT DATUM

CONE PENETRATION TEST
Tip Resistance (MPa)



NOTES

Drawing to be used in conjunction with Report 3142B.
Positioning is given in GDA2020 zone 50.
Levels are given in Australian Height Datum (AHD).

CLIENT DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA

GEOTECHNICAL INVESTIGATION FOR COASTAL
EROSION VULNERABILITY ASSESSMENT.
HARBOURSIDE, CITY OF ALBANY WA

Date 21 January 2025

Scale 1:2000H, 1:500V

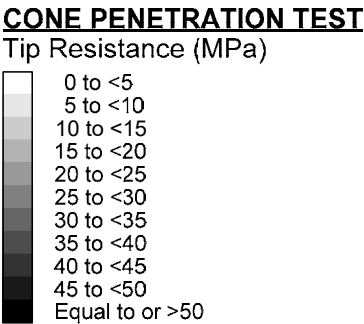
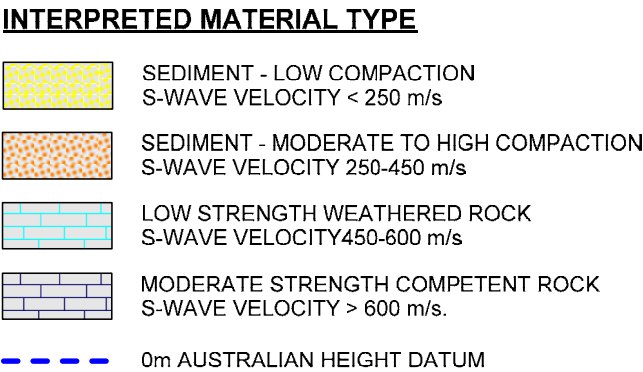
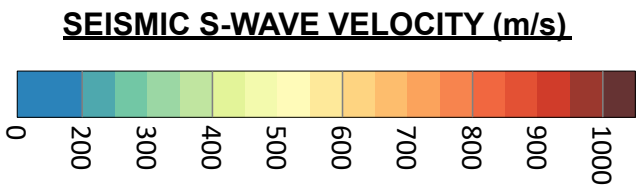
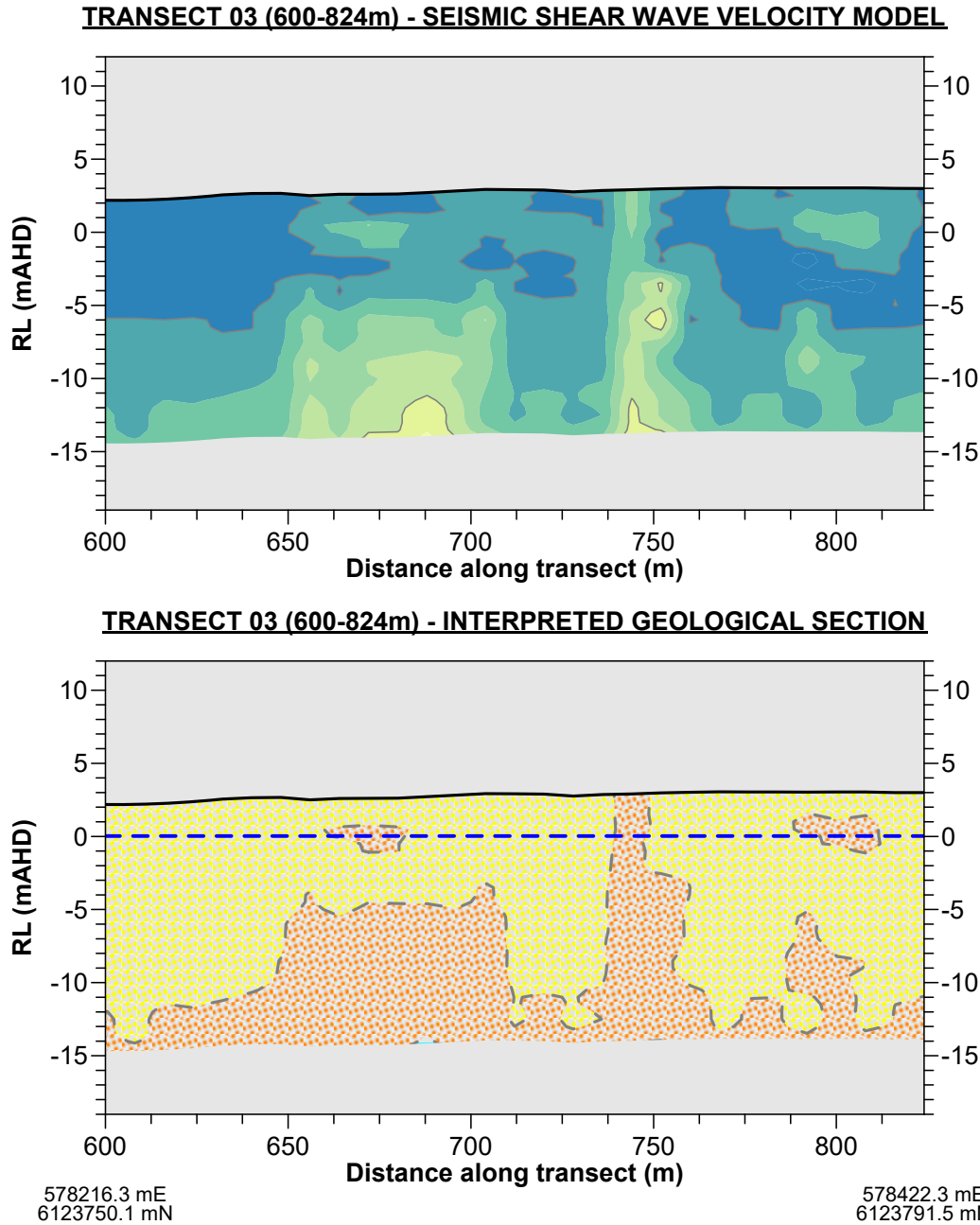
Drawing 3142B-04

Paper Size A3

Drawn PJE

Revision 0

GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT
HARBOURSIDE, CITY OF ALBANY WESTERN AUSTRALIA



NOTES

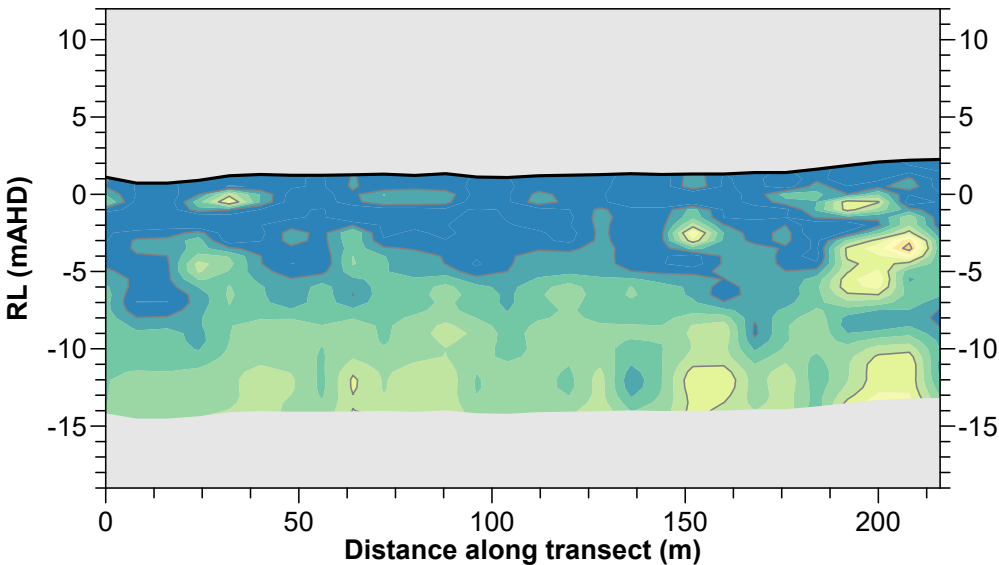
Drawing to be used in conjunction with Report 3142B.
Positioning is given in GDA2020 zone 50.
Levels are given in Australian Height Datum (AHD).

CLIENT	DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA
	GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT. HARBOURSIDE, CITY OF ALBANY WA

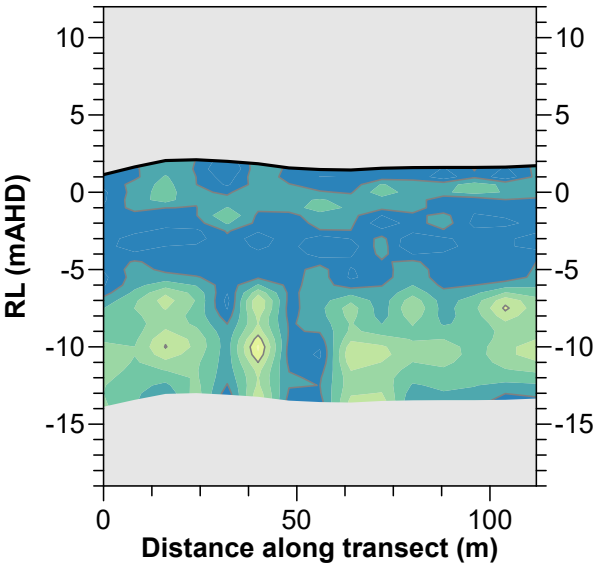
Date	21 January 2025	Paper Size	A3
Scale	1:2000H, 1:500V	Drawn	PJE
Drawing	3142B-05	Revision	0

GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT
HARBOURSIDE, CITY OF ALBANY WESTERN AUSTRALIA

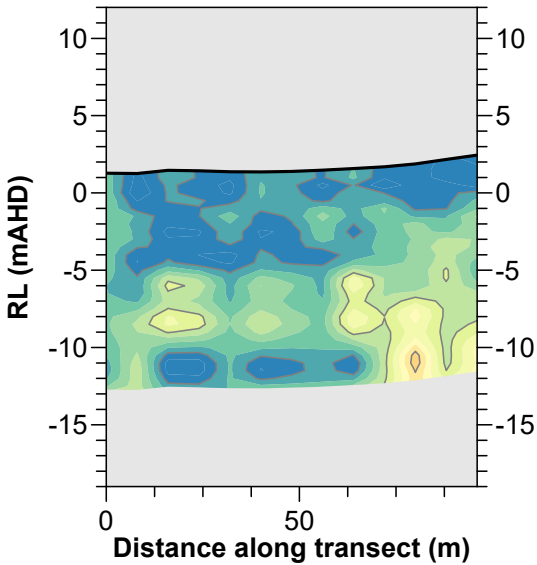
TRANSECT 04 - SEISMIC SHEAR WAVE VELOCITY MODEL



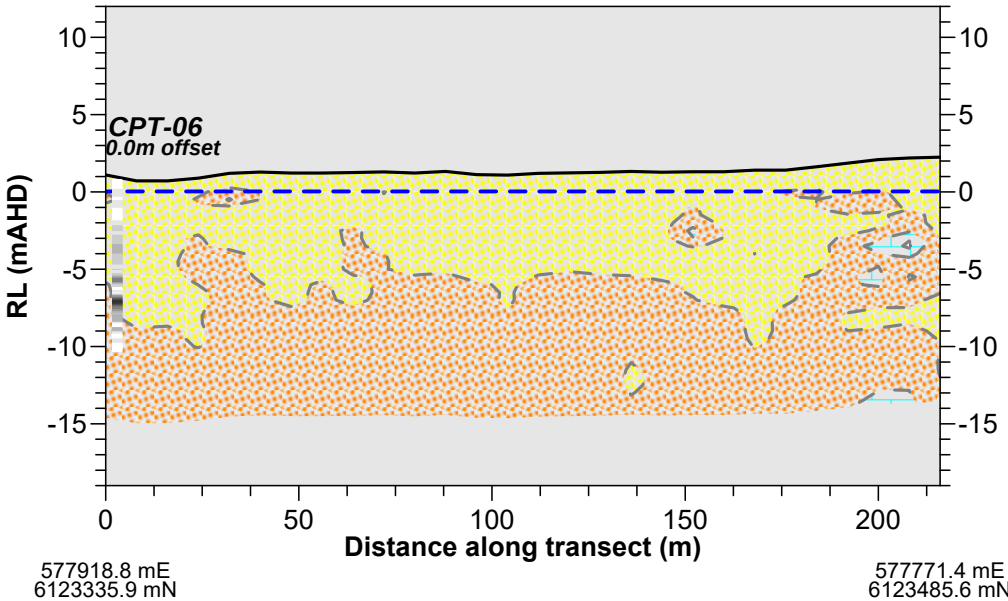
TRANSECT 5A - SEISMIC SHEAR WAVE VELOCITY MODEL



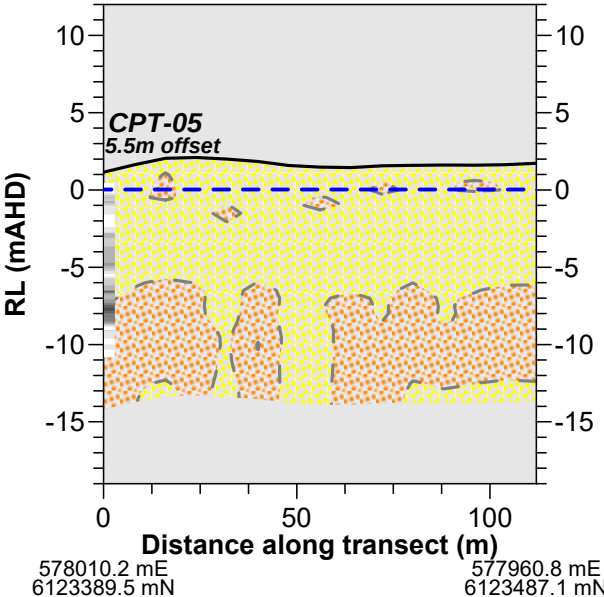
TRANSECT 05B - SEISMIC SHEAR WAVE VELOCITY MODEL



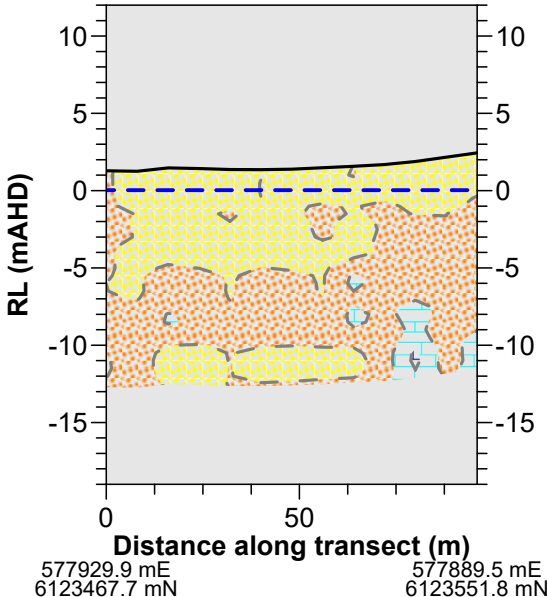
TRANSECT 04 - INTERPRETED GEOLOGICAL SECTION



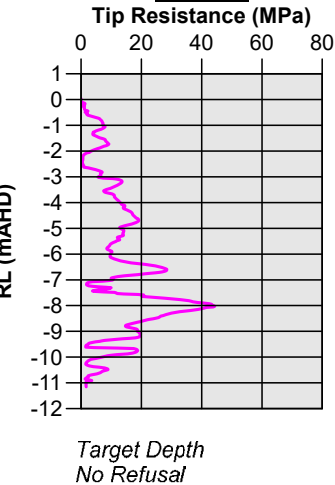
TRANSECT 5A - INTERPRETED GEOLOGICAL SECTION



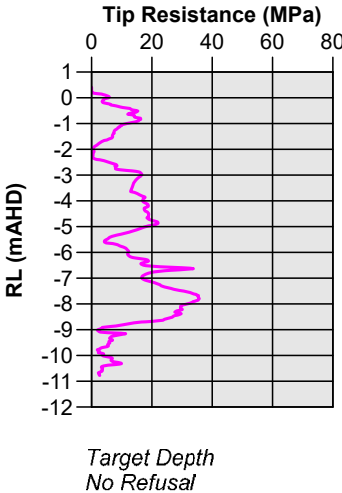
TRANSECT 05B - INTERPRETED GEOLOGICAL SECTION



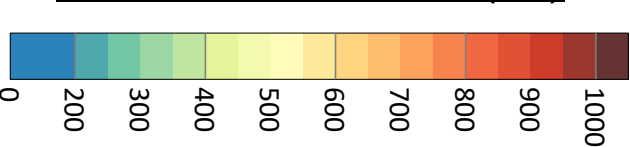
CPT-06



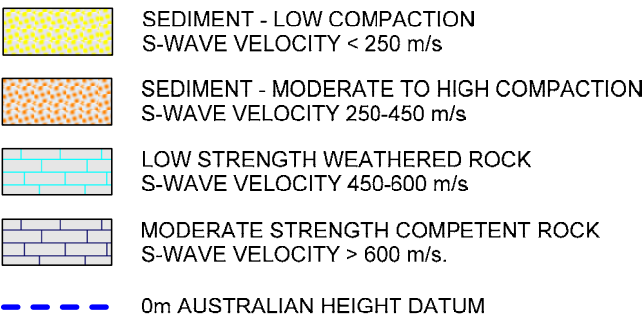
CPT-05



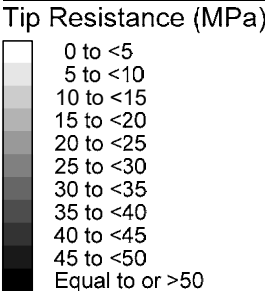
SEISMIC S-WAVE VELOCITY (m/s)



INTERPRETED MATERIAL TYPE



CONE PENETRATION TEST



NOTES

Drawing to be used in conjunction with Report 3142B.
Positioning is given in GDA2020 zone 50.
Levels are given in Australian Height Datum (AHD).

CLIENT

DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA

Date 21 January 2025

Paper Size A3

GEOTECHNICAL INVESTIGATION FOR COASTAL
EROSION VULNERABILITY ASSESSMENT.
HARBOURSIDE, CITY OF ALBANY WA

Scale 1:2000H, 1:500V

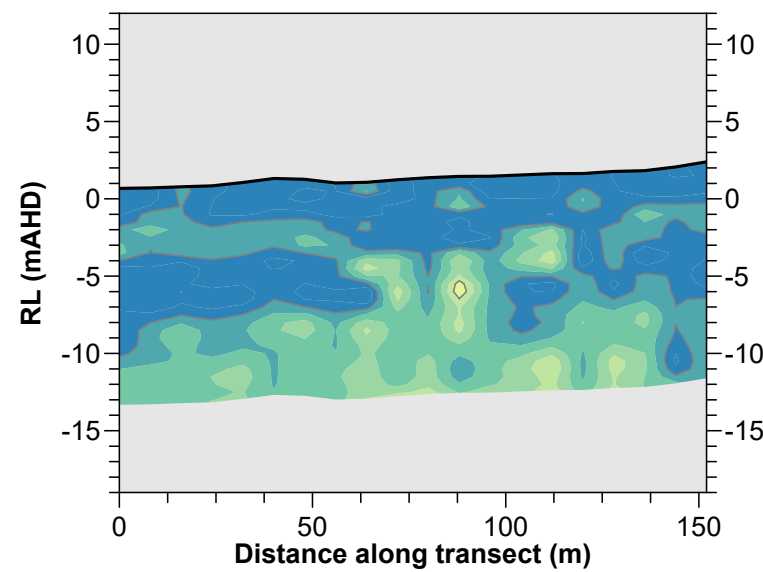
Drawn PJE

Drawing 3142B-06

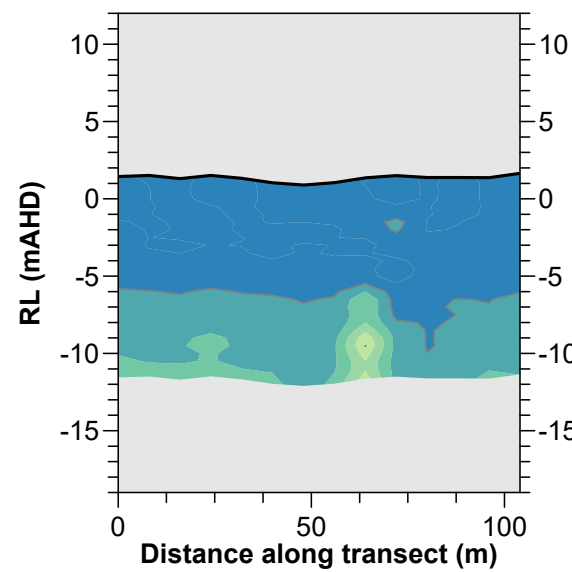
Revision 0

GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT
HARBOURSIDE, CITY OF ALBANY WESTERN AUSTRALIA

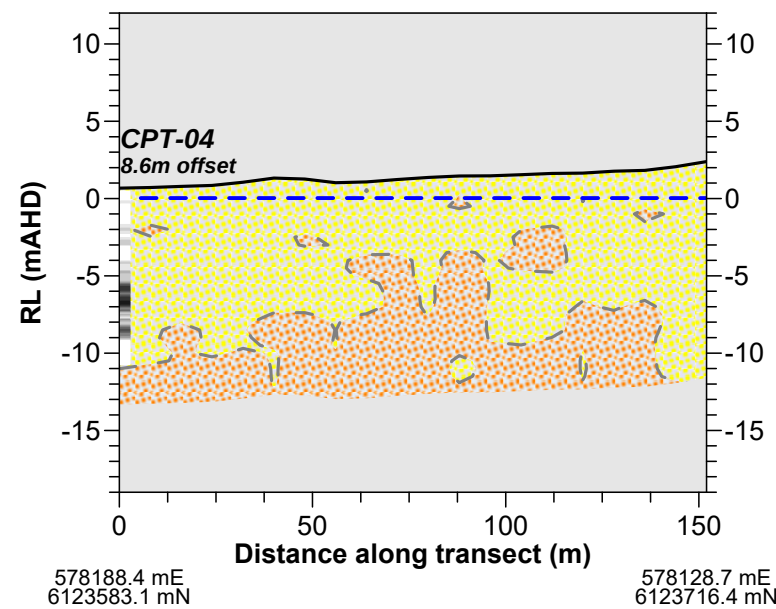
TRANSECT 06 - SEISMIC SHEAR WAVE VELOCITY MODEL



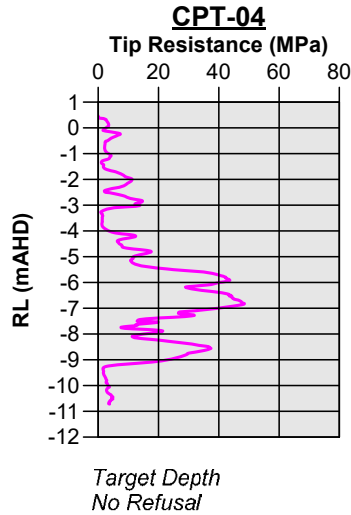
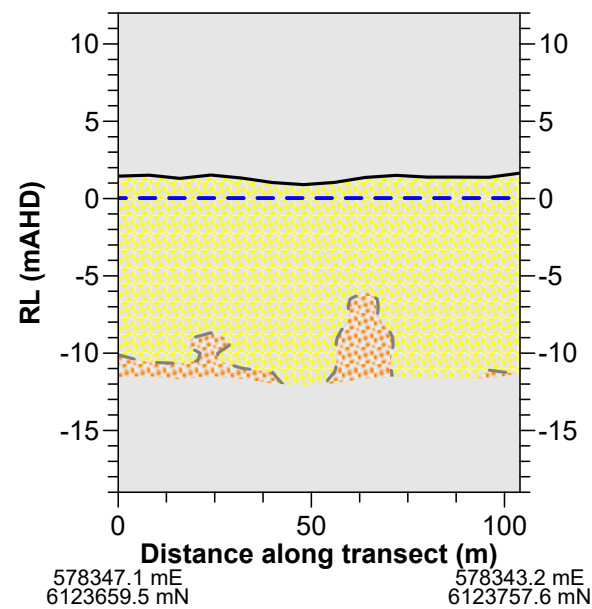
TRANSECT 07 - SEISMIC SHEAR WAVE VELOCITY MODEL



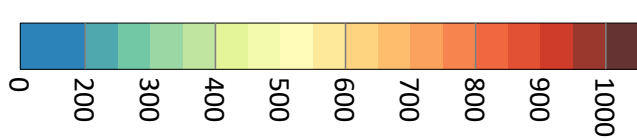
TRANSECT 06 - INTERPRETED GEOLOGICAL SECTION



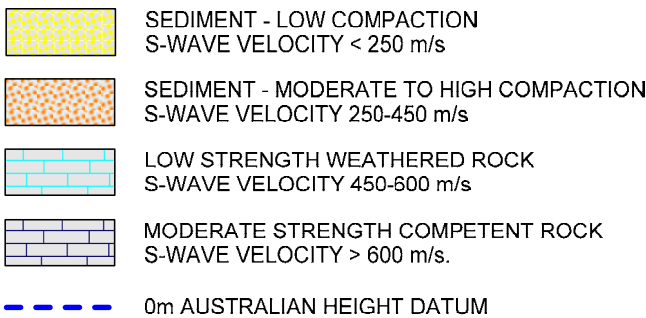
TRANSECT 07 - INTERPRETED GEOLOGICAL SECTION



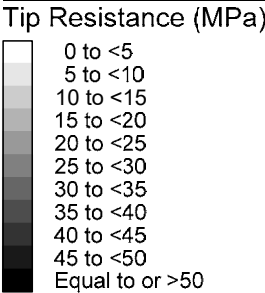
SEISMIC S-WAVE VELOCITY (m/s)



INTERPRETED MATERIAL TYPE



CONE PENETRATION TEST



NOTES

Drawing to be used in conjunction with Report 3142B.
Positioning is given in GDA2020 zone 50.
Levels are given in Australian Height Datum (AHD).

CLIENT

DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA

GEOTECHNICAL INVESTIGATION FOR COASTAL
EROSION VULNERABILITY ASSESSMENT.
HARBOURSIDE, CITY OF ALBANY WA

Date 21 January 2025

Scale 1:2000H, 1:500V

Drawing 3142B-07

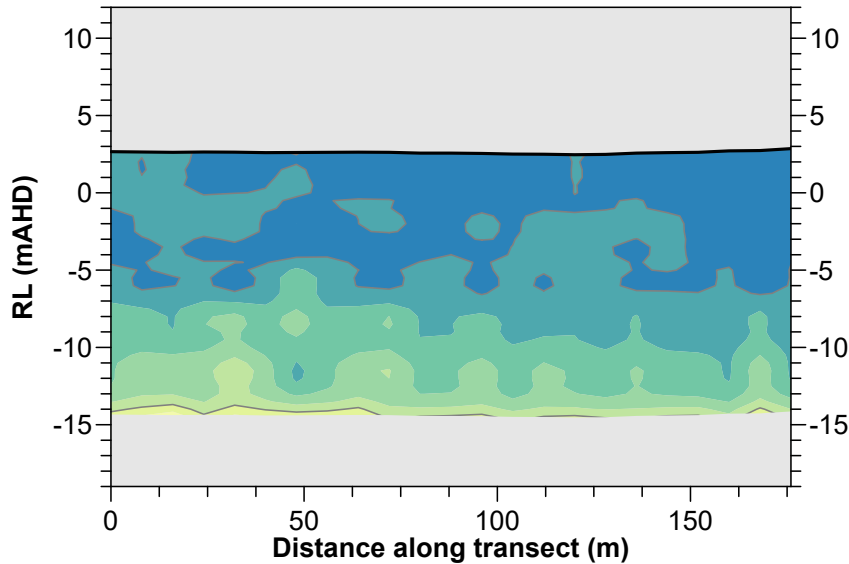
Paper Size A3

Drawn PJE

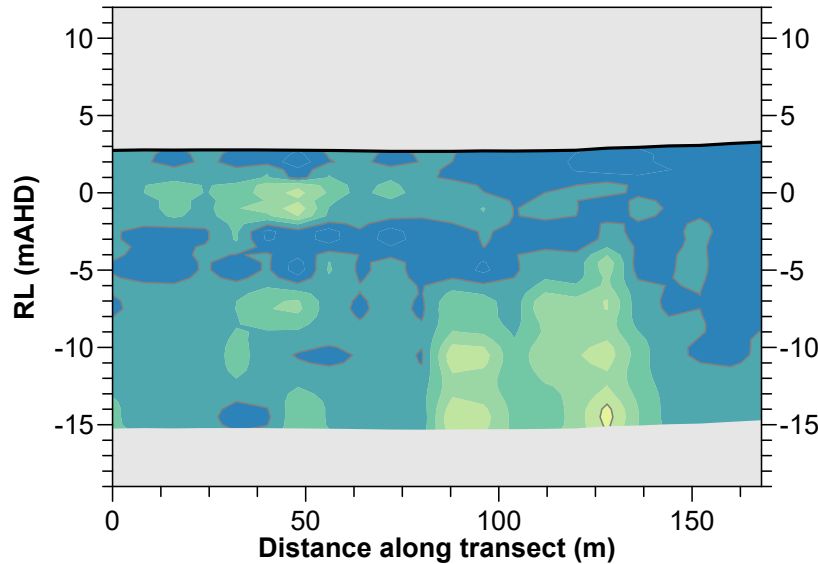
Revision 0

GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT
HARBOURSIDE, CITY OF ALBANY WESTERN AUSTRALIA

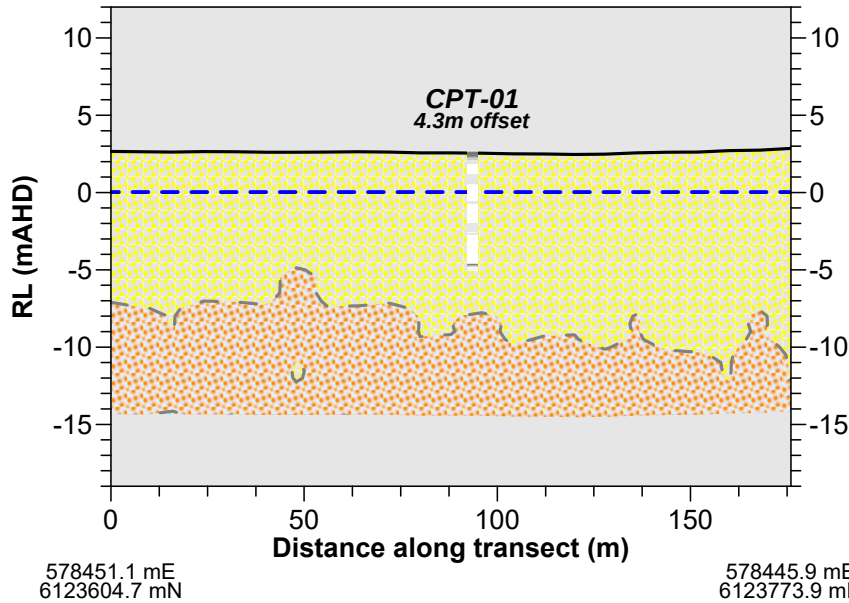
TRANSECT 08 - SEISMIC SHEAR WAVE VELOCITY MODEL



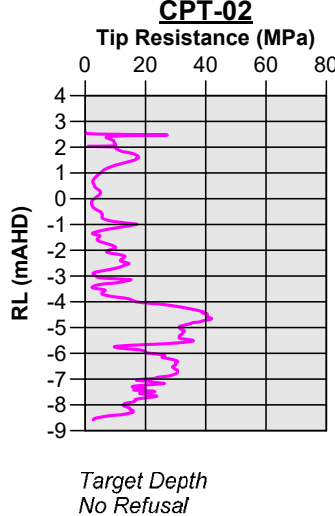
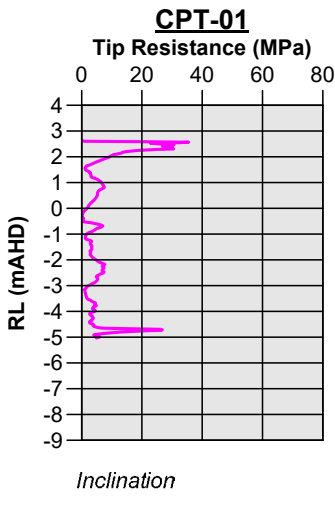
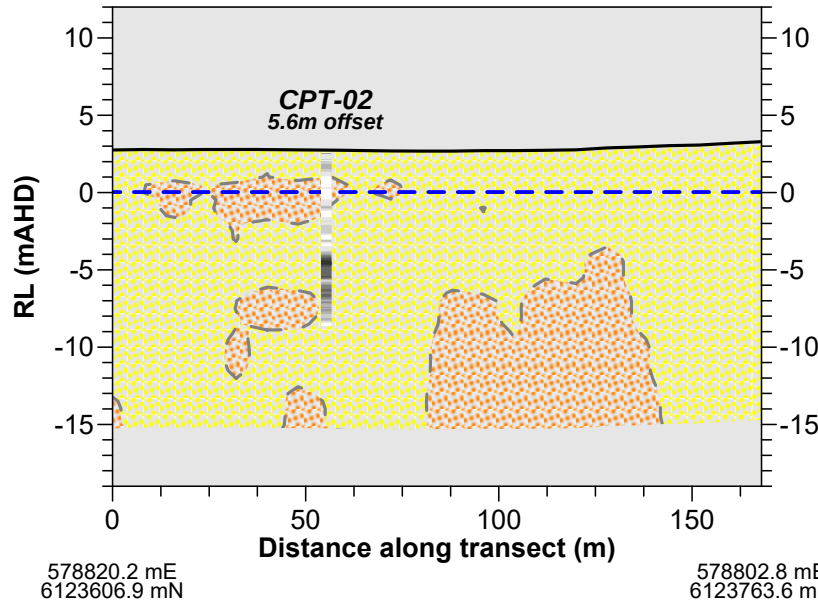
TRANSECT 09 - SEISMIC SHEAR WAVE VELOCITY MODEL



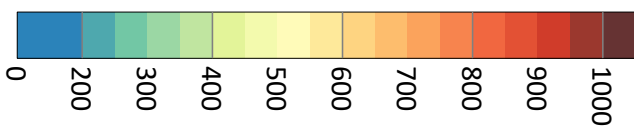
TRANSECT 08 - INTERPRETED GEOLOGICAL SECTION



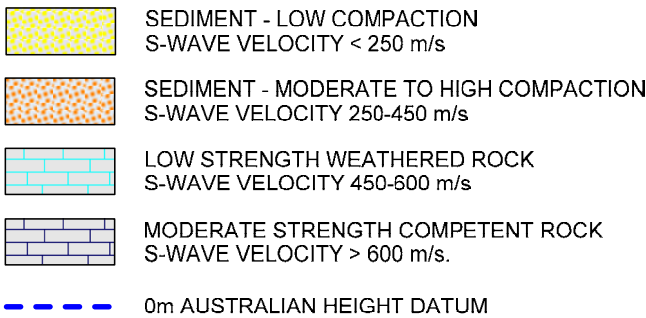
TRANSECT 09 - INTERPRETED GEOLOGICAL SECTION



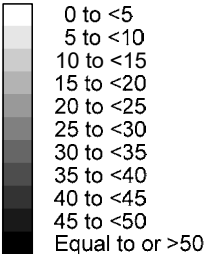
SEISMIC S-WAVE VELOCITY (m/s)



INTERPRETED MATERIAL TYPE



CONE PENETRATION TEST
Tip Resistance (MPa)



NOTES

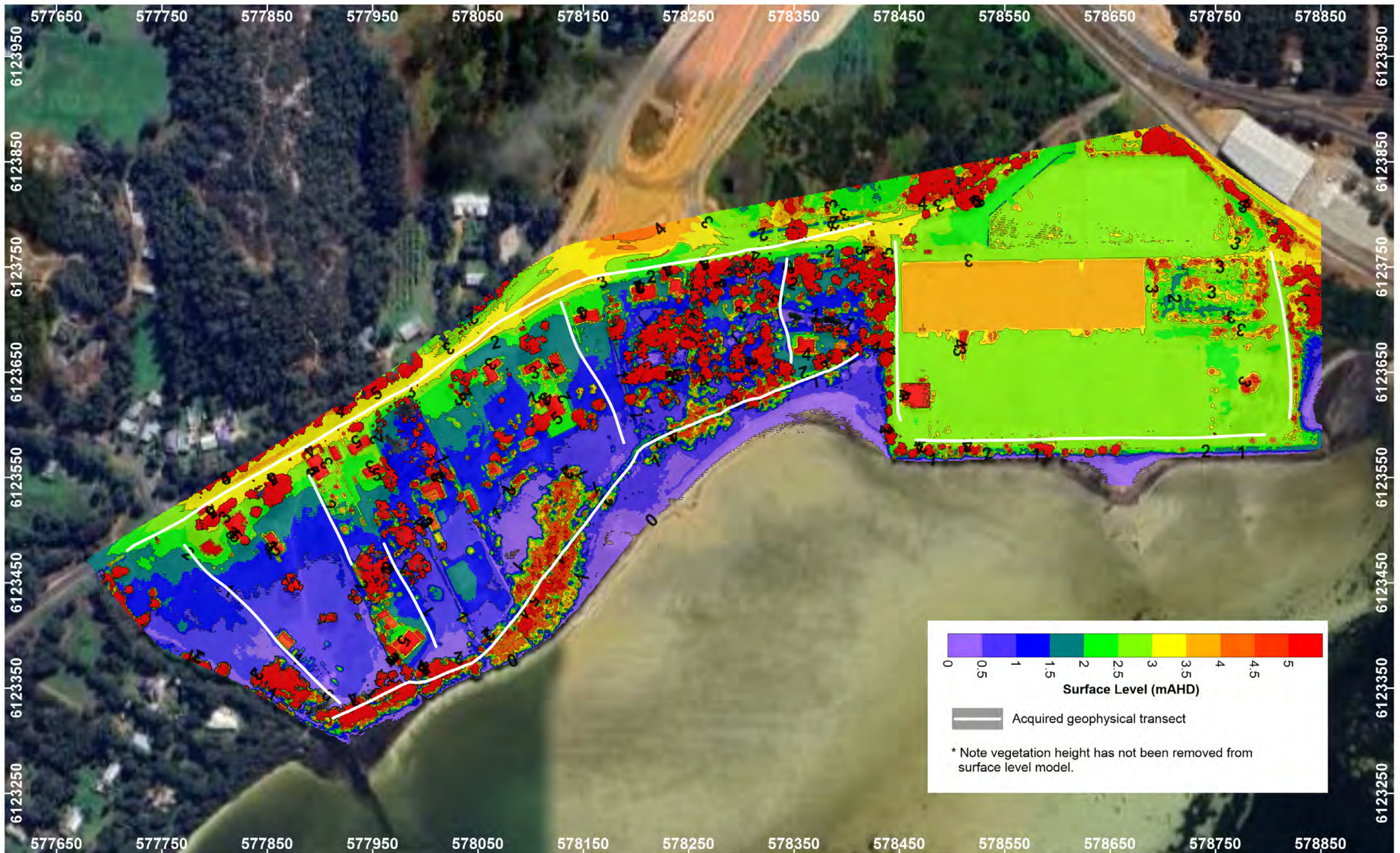
Drawing to be used in conjunction with Report 3142B.
Positioning is given in GDA2020 zone 50.
Levels are given in Australian Height Datum (AHD).

CLIENT DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA
GEOTECHNICAL INVESTIGATION FOR COASTAL
EROSION VULNERABILITY ASSESSMENT.
HARBOURSIDE, CITY OF ALBANY WA

Date 21 January 2025
Scale 1:2000H, 1:500V
Drawing 3142B-08
Paper Size A3
Drawn PJE
Revision 0

APPENDIX C – MODELLED SURFACE LEVEL AND SEDIMENT THICKNESS

SURFACE LEVEL MODEL



NOTES

Drawing to be used in conjunction with Report 3142B.
Map Projection GDA94 MGA Zone 50.
Aerial image from Google Earth Pro and GBG
photogrammetry.



CLIENT DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA

GEOPHYSICAL INVESTIGATION FOR COASTAL
EROSION VULNERABILITY ASSESSMENT
HARBOURSIDE, CITY OF ALBANY WA

Date 17 January 2025

Scale 1:3500

Drawing 3142B-09

Paper Size A3

Drawn SMK

Revision 0

**GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT
HARBOURSIDE, CITY OF ALBANY WESTERN AUSTRALIA
CLASSED POST MAP SEDIMENT THICKNESS OVER ROCK**



NOTES

Drawing to be used in conjunction with Report 3142B.
Map Projection GDA94 MGA Zone 50.
Aerial image from Google Earth Pro and GBG photogrammetry.



CLIENT	DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA
	GEOPHYSICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT HARBOURSIDE, CITY OF ALBANY WA

Date	17 January 2025
Scale	1:3500
Drawing	3142B-10
Paper Size	A3
Drawn	SMK
Revision	0

APPENDIX D – CONE PENETRATION TEST PLOTS

ELECTRIC FRICTION-CONE PENETROMETER

Probe I.D

CLIENT: GBG Group

Job No.: 3142

PROJECT: Southern and Southwest Coastal

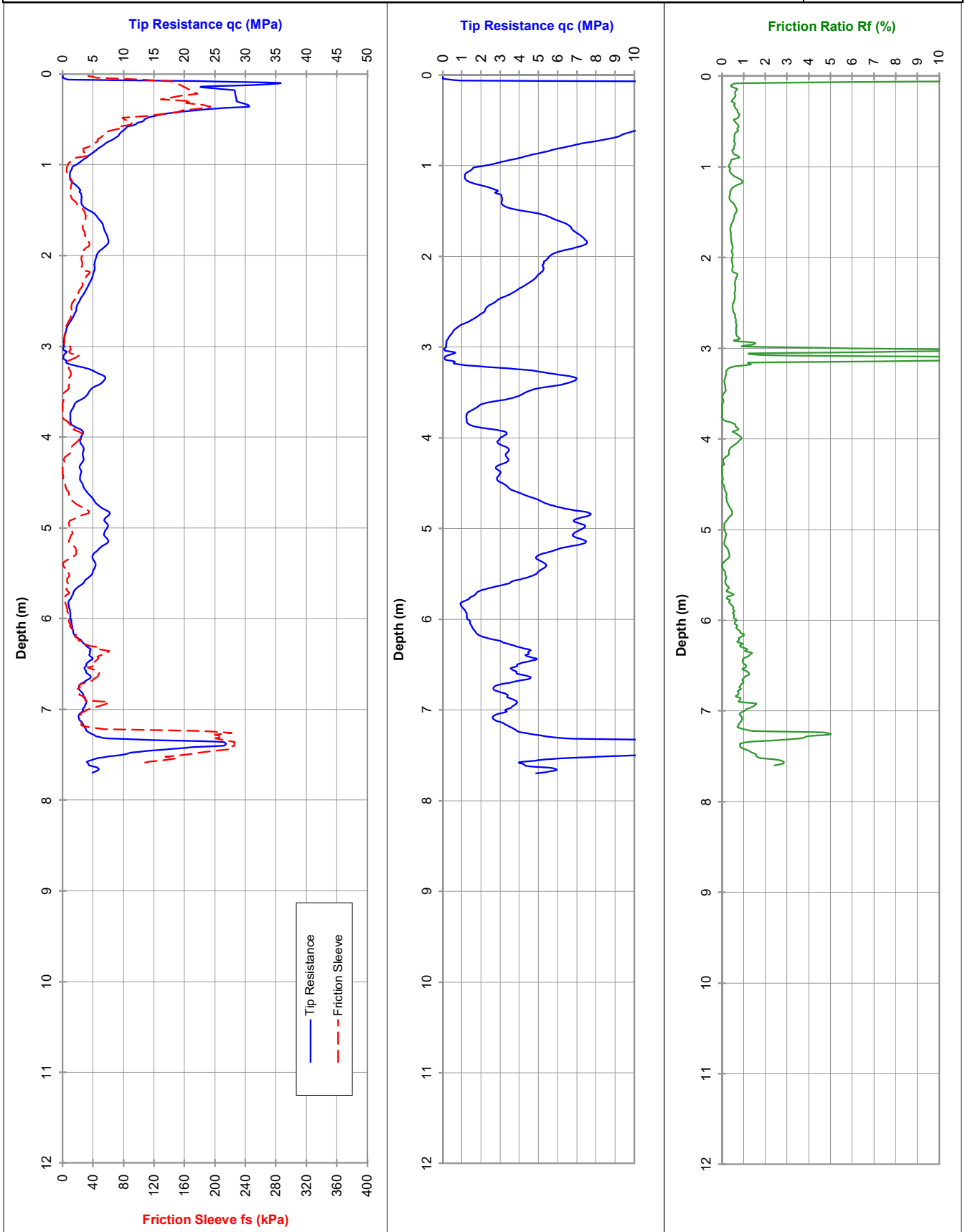
RL (m): 3.01

LOCATION: Harbourside

Co-ords: 578451.91mE, 6123693.48mN

CPT 01

15-Jan-25



ELECTRIC FRICTION-CONE PENETROMETER

Probe I.D

CLIENT: GBG Group

Job No.: 3142

PROJECT: Southern and Southwest Coastal

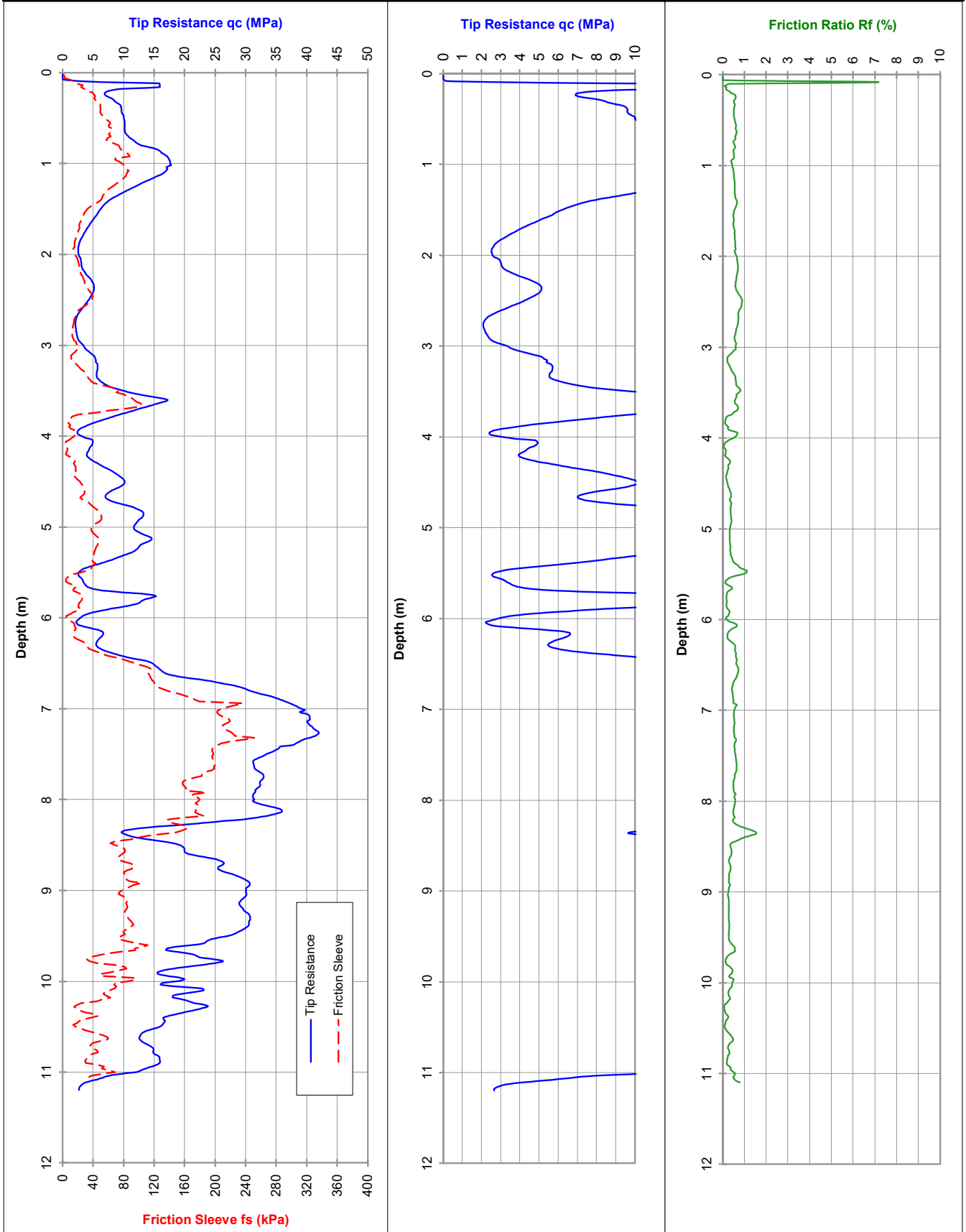
RL (m): 3.51

LOCATION: Harbourside

Co-ords: 578815mE, 6123656.29mN

CPT 02

15-Jan-25



ELECTRIC FRICTION-CONE PENETROMETER

Probe I.D

CLIENT: GBG Group

Job No.: 3142

PROJECT: Southern and Southwest Coastal

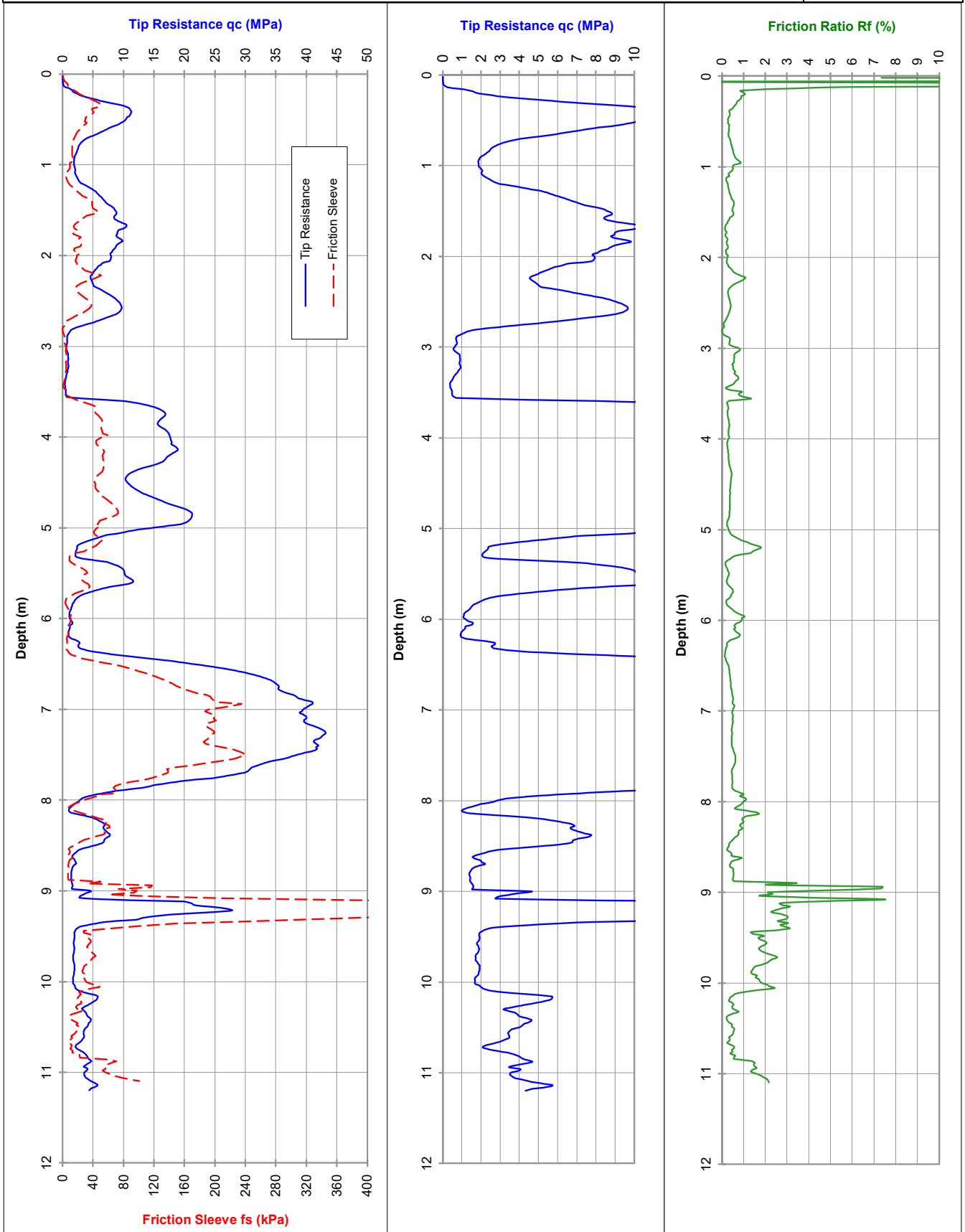
RL (m): 3.42

LOCATION: Harbourside

Co-ords: 578351.91mE, 6123624.79mN

CPT 03

16-Jan-25



Tested in accordance with AS 1289.6.5.1-1999
and IRTF 2001 for friction reducer

Approx. water (m): 1.2

Dummy probe to (m):

Refusal:

Cone I.D.: EC47

File: GB0074TT

Rig Type: 22t truck (Track-Truck)

ELECTRIC FRICTION-CONE PENETROMETER

Probe I.D

CLIENT: GBG Group

Job No.: 3142

PROJECT: Southern and Southwest Coastal

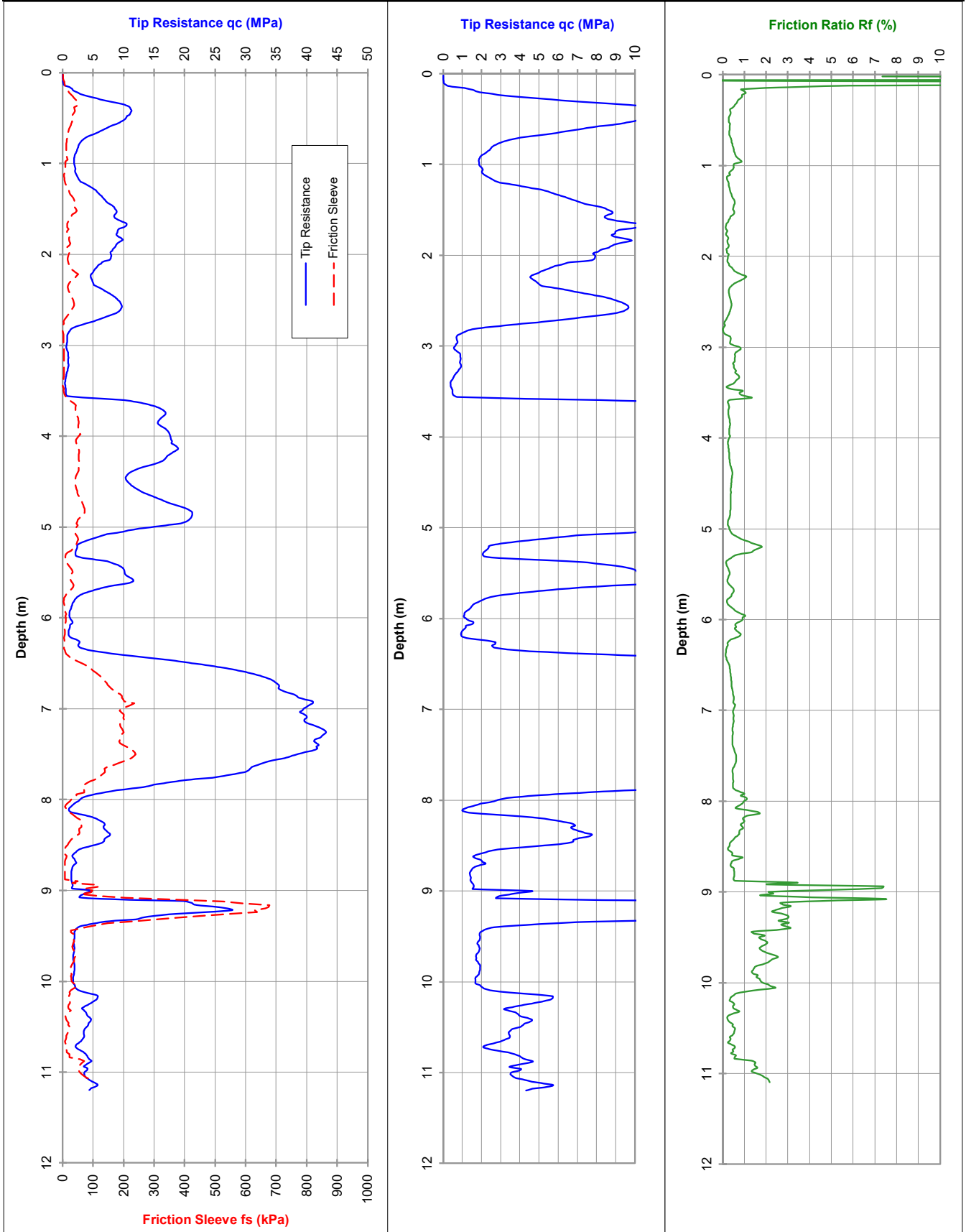
RL (m): 3.42

LOCATION: Harbourside

Co-ords: 578351.91mE, 6123624.79mN

CPT 03

16-Jan-25



Tested in accordance with AS 1289.6.5.1-1999
and IRTF 2001 for friction reducer

Approx. water (m): 1.2

Dummy probe to (m):

Refusal:

Cone I.D.: EC47

File: GB0074TT

Rig Type: 22t truck (Track-Truck)

ELECTRIC FRICTION-CONE PENETROMETER

Probe I.D

CLIENT: GBG Group

Job No.: 3142

PROJECT: Southern and Southwest Coastal

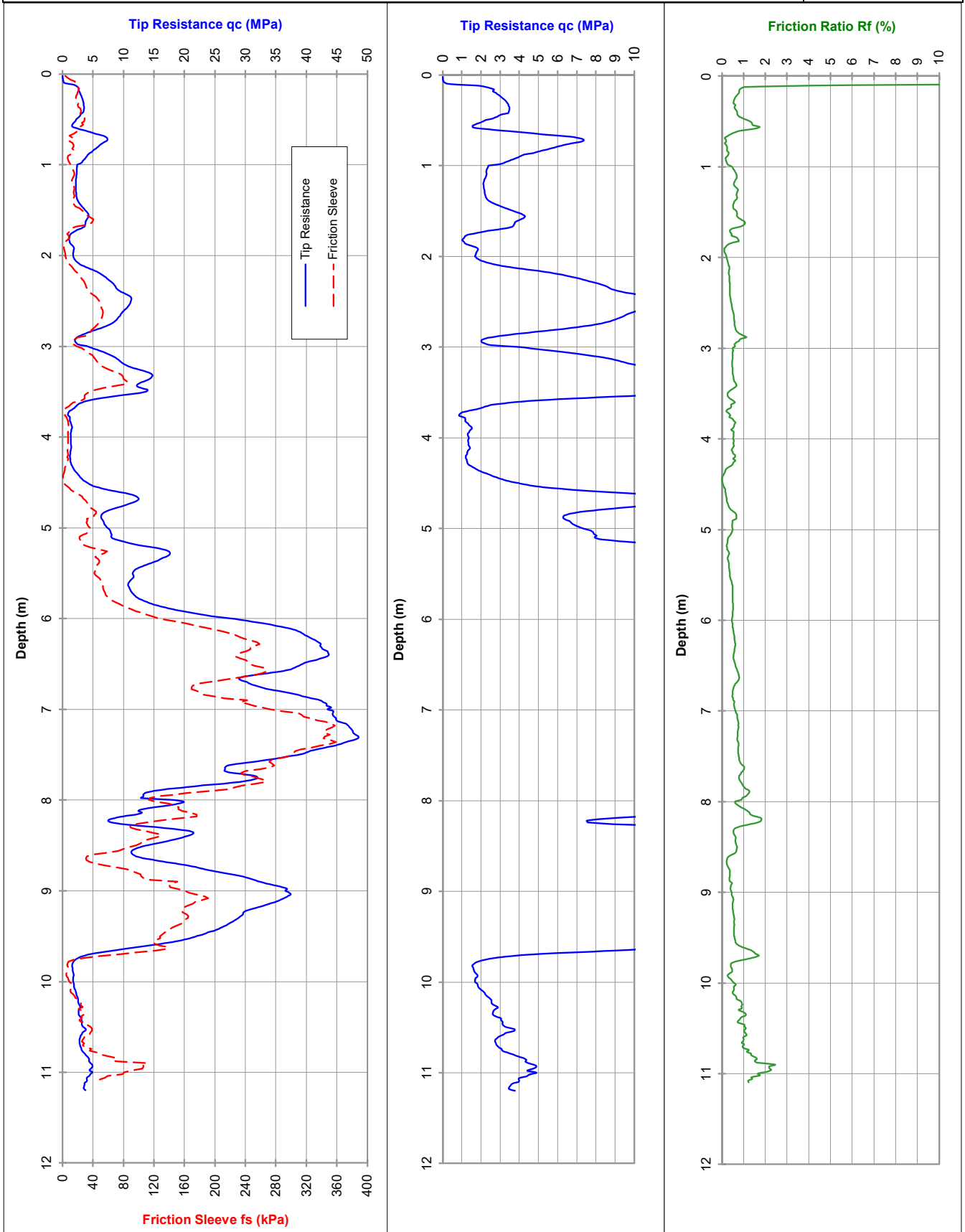
RL (m): 0.2

LOCATION: Harbourside

Co-ords: 578189.59mE, 6123573.71mN

CPT 04

16-Jan-25



Tested in accordance with AS 1289.6.5.1-1999
and IRTF 2001 for friction reducer

Approx. water (m): 0.2

Dummy probe to (m):

Refusal:

Cone I.D.: EC47

File: GB0075TT

Rig Type: 22t truck (Track-Truck)

ELECTRIC FRICTION-CONE PENETROMETER

Probe I.D

CLIENT: GBG Group

Job No.: 3142

PROJECT: Southern and Southwest Coastal

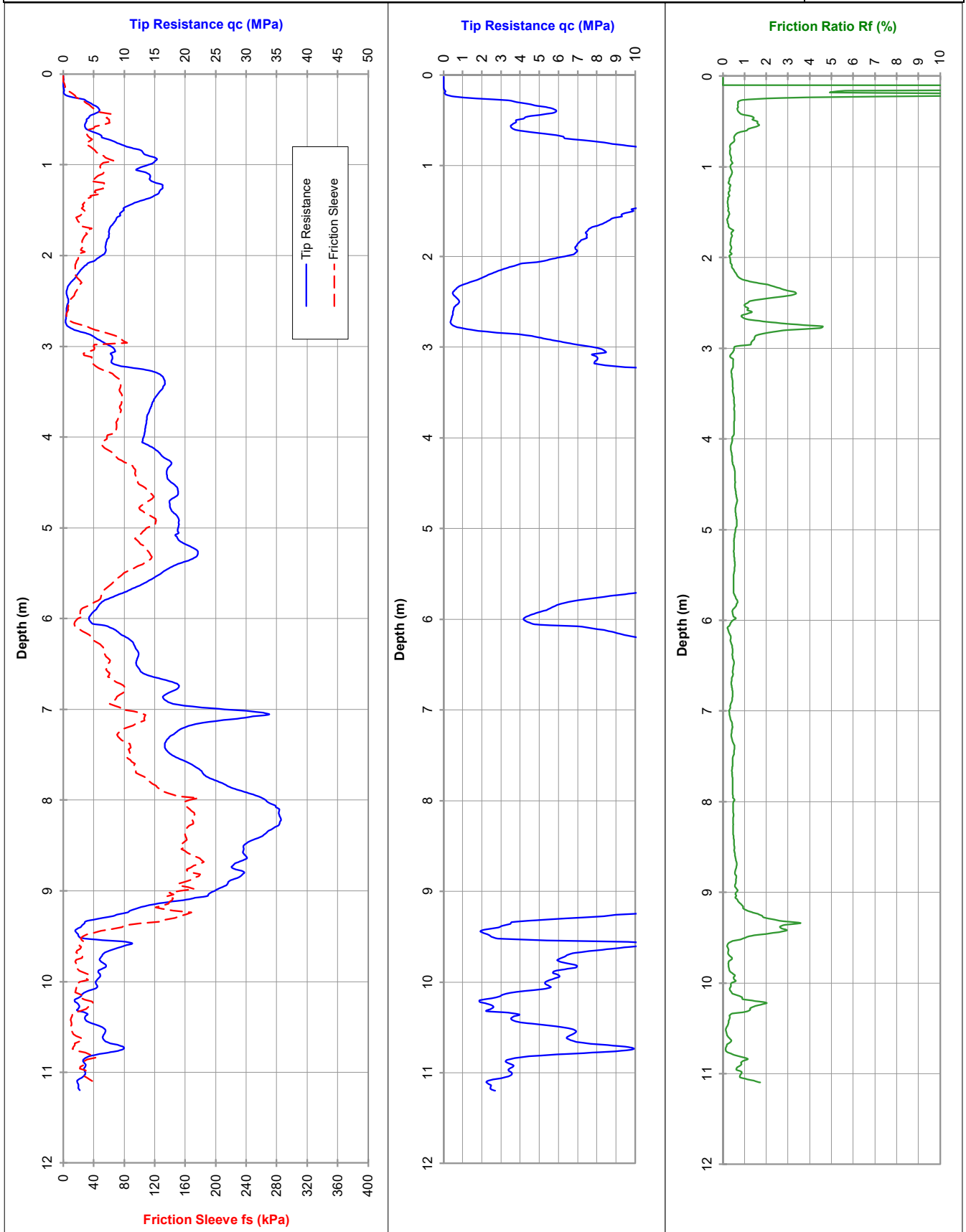
RL (m): 1.68

LOCATION: Harbourside

Co-ords: 578010.78mE, 6123384.41mN

CPT 05

16-Jan-25



Tested in accordance with AS 1289.6.5.1-1999 and IRTF 2001 for friction reducer

Approx. water (m): Dry to 0.7

Dummy probe to (m):

Refusal:

Cone I.D.: EC47

File: GB0076TT

Rig Type: 22t truck (Track-Truck)

ELECTRIC FRICTION-CONE PENETROMETER

Probe I.D

CLIENT: GBG Group

Job No.: 3142

PROJECT: Southern and Southwest Coastal

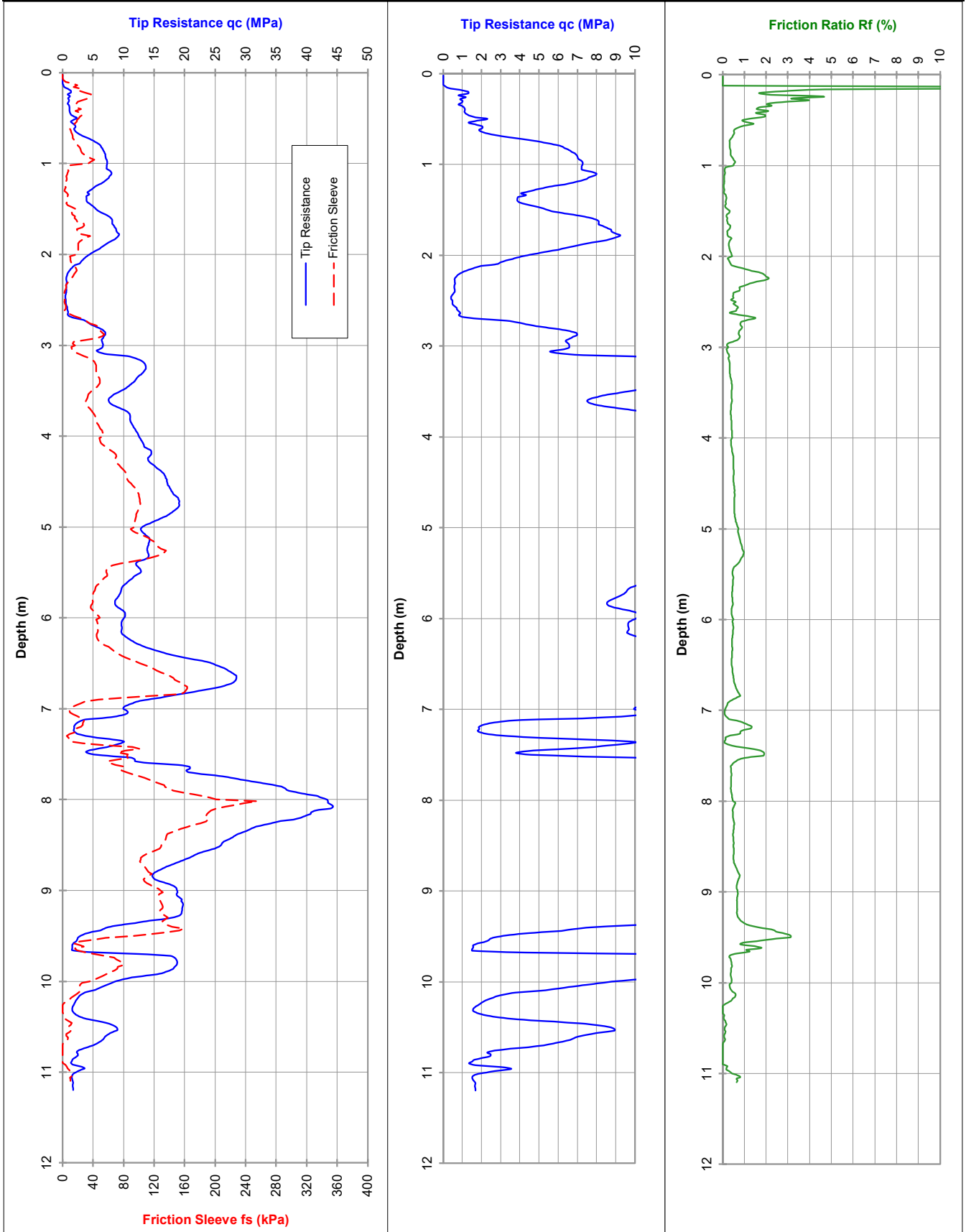
RL (m): 1.9

LOCATION: Harbourside

Co-ords: 577916.62mE, 6123337.05mN

CPT 06

16-Jan-25



Tested in accordance with AS 1289.6.5.1-1999
and IRTF 2001 for friction reducer

Approx. water (m): -

Dummy probe to (m):

Refusal:

Cone I.D.: EC47

File: GB0077TT

Rig Type: 22t truck (Track-Truck)

CALIBRATION CERTIFICATE

CONE ID:

EC47

Cone Type:
Calibration Date (qc/fs):
Calibration Date (u):
Preliminary Inspection:
Calibrated By:
Calibration Procedure:
Force Application:
Reference Equipment:

Compression
20 November 2024
25 November 2024
Pass
Henky Lawer
ISO 22476-1:2012, IRTP 2001
Compression
PT - S type 100kN Serial # 5126009 (Calibrated 10/03/23 - NATA approved Cert. No. 230664)
Bongshin - S type 50kN Serial #44427 (Calibrated 05/06/24 - NATA approved Cert. No. 241683)
Digitron Panel Meter Serial #: 060213/01 (Calibrated 09/03/23 - NATA endorsed Report No. 230658, 230659, 230660)

Note: In accordance with AS1289 FS.1 the force calibration derived by NATA Calibration Certificates are converted to a qc reading in MPa and fs reading in kPa by dividing by 1000 mm² and 15000mm² respectively.

Results of Calibration:

qc (tip resistance):		
Capacity:	100 (MPa)	
Area	1000 (mm ²)	
Applied Load kN	Eqv. Pressure MPa	Mean Observed Reading Volts
0	0	0.000
10	10	0.757
20	20	1.514
30	30	2.273
40	40	3.033
50	50	3.797
60	60	4.562
70	70	5.330
80	80	6.100
90	90	6.865
100	100	7.634
90	90	6.889
80	80	6.131
70	70	5.372
60	60	4.610
50	50	3.850
40	40	3.084
30	30	2.318
20	20	1.549
10	10	0.780
0	0	0.004
R ² Value =	1.000	

Zero Load Error: 0.06%
Max. Linearity 0.38%
Max. Hysteris 0.70%

MPa/Volt: **13.094**

fs (sleeve friction):		
Capacity:	2000 (kPa)	
Area	15000 (mm ²)	
Applied Force kN	Eqv. Load kPa	Mean Observed Reading Volts
0	0	0.000
3	200	0.746
6	400	1.502
9	600	2.259
12	800	3.014
15	1000	3.766
18	1200	4.517
21	1400	5.270
24	1600	6.022
27	1800	6.780
30	2000	7.540
27	1800	6.814
24	1600	6.067
21	1400	5.315
18	1200	4.563
15	1000	3.809
12	800	3.055
9	600	2.296
6	400	1.528
3	200	0.765
0	0	0.002
R ² Value =	1.000	

Zero Load Error: 0.03%
Max. Linearity 0.47%
Max. Hysteris 0.61%

kPa/Volt: **264.97**

u (pore pressure):		
Capacity:	3500 (kPa)	
Position	u2	
Applied Pressure bar	Eqv. Pressure kPa	Mean Observed Reading Volts
0	0	0.000
3	300	0.351
6	600	0.700
9	900	1.050
12	1200	1.399
15	1500	1.749
18	1800	2.098
21	2100	2.443
25	2500	2.909
30	3000	3.488
35	3500	4.066
30	3000	3.495
25	2500	2.916
21	2100	2.452
18	1800	2.103
15	1500	1.754
12	1200	1.405
9	900	1.053
6	600	0.702
3	300	0.352
0	0	0.001
R ² Value =	1.000	

Zero Load Error: 0.01%
Max. Linearity 0.25%
Max. Hysteris 0.22%

kPa/Volt: **859.97**
Net Area (calibrated): **0.81**

"Class 1" Application Accuracy achieved (in accordance with ISO 22476:2012 classification)

Calibration Checked & Authorised: Kylie Walker

Job Details

Client:	<u>GBG Maps</u>	Date of Job:	<u>14/01/2025</u>
Rep:	<u>Peter Eccleston</u>	Tip Diameter:	<u>35.85</u>
Location:	<u>Albany/ Harbourside</u>	Sleeve Diameter:	<u>35.97</u>