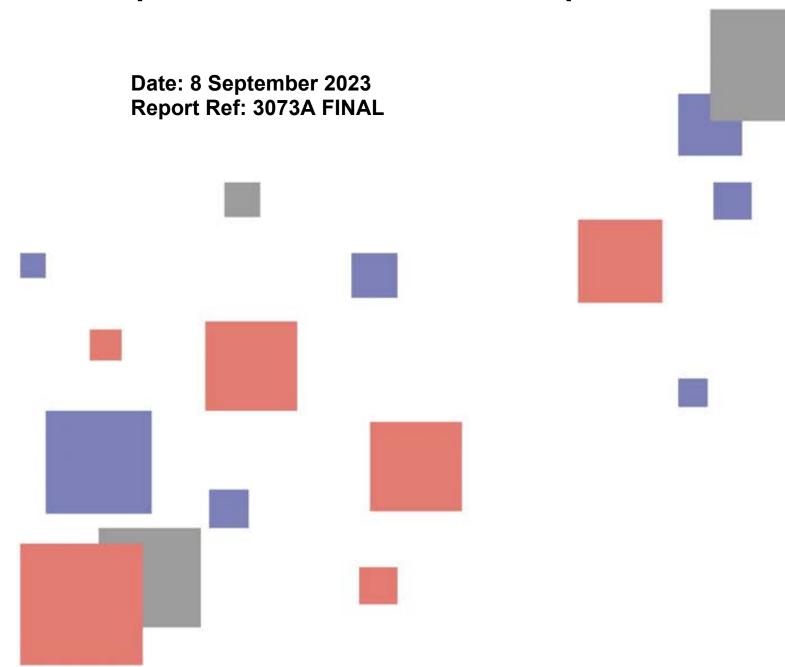


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Report

Geotechnical Investigation for Coastal Erosion Vulnerability Assessment.

Hopetoun, Shire of Ravensthorpe WA.





DOCUMENT HISTORY

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EXECUTIVE SUMMARY

A geotechnical investigation has been carried out as part of a coastal erosion assessment at Hopetoun in the Shire of Ravensthorpe, Western Australia. During the investigation ground geophysical and intrusive geotechnical testing was conducted within a 1800m corridor of coastal beach and dune formation adjacent to the Hopetoun settlement which has been identified as an at-risk site as part of Coastal Hotspot #54.

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. 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 subsurface models of the level to rock substrate (relative to AHD) and overlying sand thickness 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 following observations have been made:

- Interpreted rock substrate was observed along the entirety of the transects and within the maximum target investigation depth of 10-15m below ground level.
- Interpreted top of rock substrate on the along-shore transects on the beach ranges from -11.5mAHD to -2mAHD and averages approximately -5mAHD, and is overlain by an average of 5m of variably compacted sediment.
- Interpreted top of rock substrate on the along-shore transects adjacent to the settlement including along the Esplanade ranges from -5.5mAHD to 3mAHD and averages approximately -1.75mAHD, and is overlain by an average of 6.5m of variably compacted sediment.
- Interpreted top of rock substrate for the cross-shore transects extending over the dune formation ranges from -8.5mAHD to 1.5mAHD and averages -3.5mAHD, and is overlain by an average of 6m of variably compacted sediment.



CONTENTS

1	INTRODUCTION					
2	INVESTIGATION SITE					
3	INVESTIGATION METHODOLOGY					
	3.1	FIELD SURVEY LOGISTICS	6			
	3.2	MULTI-CHANNEL ANALYSIS OF SURFACE WAVES	7			
	3.3	CONE PENETRATION TESTING	9			
	3.4	SPATIAL POSITIONING AND PHOTOGRAMMETRY	9			
4	RES	ULTS AND INTERPRETATION	10			
	4.1	PRESENTATION OF RESULTS	10			
	4.2	SEISIMC SHEAR WAVE VELOCITY SECTIONS	11			
	4.3	INTERPRETED GEOLOGICAL SECTIONS	11			
	4.4	CALIBRATION WITH GEOTECHNICAL TESTING AND ROCK MAPPING	12			
	4.5	MODELLED LEVEL TO TOP OF ROCK AND SAND THICKNESS	13			
5	PRC	DJECT SUMMARY	14			
ΑP	PEND	DIX A – INVESTIGATION SITE MAP	16			
ΑP	PEND	IX B – GEOPHYSICAL AND INTERPRETED SECTIONS	17			
ΑP	PEND	IX C – MODELLED TOP OF ROCK AND SAND THICKNESS	18			
ΔΡ	DENIC	NX D _ CONE PENETRATION TEST PLOTS	10			



1 INTRODUCTION

At the request of The Government of Western Australia Department of Transport (DoT), GBG Group carried out a geotechnical investigation at Hopetoun, Shire of Ravensthorpe in June 2023. During the investigation seismic geophysical testing and intrusive geotechnical testing was conducted within a 1800m corridor of coastal beach and dune formation which has been identified as an at risk site as part of Coastal Hotspot #54.

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 so as 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. **Intrusive geotechnical testing** by way of Cone Penetration Testing (CPT) to measure sediment strength and compressibility, and for calibration and ground truthing of the geophysical dataset.
- 4. **Topographic survey** using Differential GNSS receiver and photogrammetry.

2 INVESTIGATION SITE

The investigation was carried out within an approximate 1800m corridor of coastal beach and dune formation extending from the foreshore to the south, and to the Esplanade to the north from Canning Boulevard to Chambers Street. The extent of the investigation site is shown as a yellow dashed area in Figure 1.

Data was acquired as a series of transects for the seismic geophysical testing and point locations for the intrusive geotechnical testing. These were positioned so as to best utilise existing roads, tracks, and beach whilst not impacting native vegetation and in order to ensure the most optimal, efficient and economical 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 undulating with an elevation difference between the foreshore at ~0mAHD, dune formation up to ~5-10mAHD, and the existing settlement at ~5mAHD. A topographic map showing surface level is provided in Appendix C drawing 3073A-15.



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



Figure 2: Site conditions at Hopetoun including on the Esplanade (left image) and the beach foreshore (right image).

3 INVESTIGATION METHODOLOGY

3.1 FIELD SURVEY LOGISTICS

Geophysical data acquisition was carried out on 26 to 30 June 2023 by a two-person crew from GBG Group consisting of qualified geophysicists. CPT data acquisition was carried out by a technician from Probedrill on the 28 June 2023. Where required, the site work was carried out under appropriate traffic and pedestrian management commissioned by the Shire of Ravensthorpe.

Prior to the commencement of data acquisition, a site assessment was carried out with representatives from the Shire of Ravensthorpe. Potential concerns and issues including the placement of and access to the MASW transects and CPT points were addressed and the initial indicative survey plan was adjusted, where necessary.

The site work for the investigation consisted of a total of 3552m of MASW profiling acquired as 7 along-shore transects (parallel to the coast) and 6 cross-shore transects (perpendicular to the coast), and a total of 8 CPT points along the transects. Details of the acquired MASW transects and CPT points are provided in Tables 1 and 2 respectively. The extents of the MASW transects and locations of the CPT points overlaid onto aerial imagery are shown in Appendix A drawing 3073A-01.

Table 1 - Acquired MASW Transects (Coordinates in GDA94, MGA Zone 51).

Transect	Orientation	Start Coordinate		End Coordinate		Length
ID Orientation		East	North	East	North	(m)
MASW01	Along-shore	233679.5	6239863.0	233854.8	6239404.3	492
MASW02a	Along-shore	233863.7	6239405.3	234304.7	6239496.6	465
MASW02b	Along-shore	234345.3	6239477.5	234447.9	6239446.4	108
MASW03	Along-shore	234478.4	6239527.3	234855.2	6239900.6	536
MASW04a	Along-shore	233868.0	6239777.9	234030.7	6239561.5	336
MASW04b	Along-shore	234026.7	6239555.8	234079.2	6239588.2	64
MASW05	Along-shore	234098.4	6239586.4	234818.1	6239971.1	952
MASW06	Cross-shore	233703.3	6239877.1	233772.2	6239884.1	72
MASW07	Cross-shore	233737.3	6239722.5	233825.1	6239768.2	108
MASW08	Cross-shore	233789.6	6239523.5	233889.2	6239590.9	120
MASW09	Cross-shore	233968.5	6239452.4	234000.7	6239544.0	104
MASW10	Cross-shore	234446.7	6239586.3	234482.9	6239451.8	144
MASW11	Cross-shore	234629.1	6239809.3	234673.6	6239774.0	60



Table 2 – Acquired CPT Points (Coordinates in GDA94, MGA Zone 51).

СРТ	Coordinate		Surface	Probing	
ID	East	North	Level (mAHD)	Depth (m)	
CPT01	233740.3	6239726.8	2.41	6.28	
CPT02	233791.4	6239525.6	1.84	6.64	
CPT03	233968.8	6239453.7	1.72	3.14	
CPT04	234100.6	6239582.1	10.76	9.98	
CPT05	234269.0	6239527.4	7.70	11.1	
CPT06	234503.8	6239682.6	5.75	9.42	
CPT07	234680.6	6239769.1	2.76	4.88	
CPT08	234749.7	6239914.5	7.80	7.30	

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 light 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 or softened steel sledgehammer with source points made at a constant offset from receiver array. MASW acquisition parameters are provided in Table 3. Photographs of MASW data acquisition are shown in Figure 3.

Table 3 - 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	0.25 ms	
Source	40kg AWD or 6.35kg sledgehammer	
Source offset	4 m	
Sounding interval	8m	
Source stacks	3	

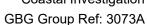








Figure 3: MASW data acquisition using a seismic streamer.

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 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, left image).
- 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 (Figure 4, right image).

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.

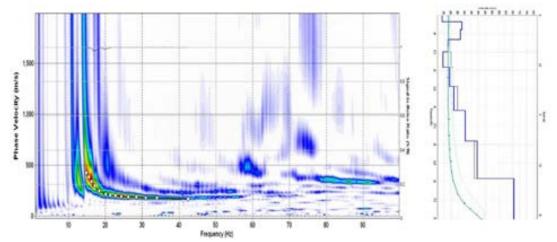


Figure 4: MASW overtone image with high signal to noise ratio and picked dispersion curve.



3.3 CONE PENETRATION TESTING

CPT is a geotechnical test method for evaluating the properties of soils and assessing subsurface stratigraphy including the sediment/rock interface at spot locations. The method involves pushing a calibrated cone and rod into the ground with a measured force with the resulting friction resistance plotted against depth to provide sediment compaction rates as well as the refusal depth indicating the depth to competent rock.

Testing was carried out using a M2 (Morooka) 11 tonne track mounted CPT Rig, specifications of which are provided in Appendix D. The test points were initially marked out at suitable locations within 2m of the intersecting geophysical transects. Dial Before You Dig enquiries and if necessary, utility locating was carried out prior to testing commencing.

CPT readings was made with sufficient ground bearing pressure to obtain a target depth of 10m or prior refusal. Where shallow refusal depths of less than 2m was encountered, when deemed necessary, an additional offset test was made to ascertain whether shallow refusal was due to a rock floater or other shallow obstruction. A photograph of CPT data acquisition is shown in Figure 5.





Figure 5: CPT data acquisition during a previous coastal investigation.

3.4 SPATIAL POSITIONING AND PHOTOGRAMMETRY

Spatial positioning of the acquired geophysical transects was achieved using Reach RS2 (Emlid) or S631 (Hemisphere) GNSS receivers with a coordinate recorded for each MASW sounding location and CPT point. Coordinates of the geophysical transects have been provided in GDA94, MGA zone 51 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 Standard Survey Markers (SSM) as known reference points for the base corrections. Details of the SSM used for this investigation are provided in Table 4.



Table 4 - Details of Standard Survey Marker

Parameter	Value
Standard Survey Marker	RAVENSTHORPE 38
Latitude	S 33 57 00.14731
Longitude	E 120 07 28.39936
Derived GDA94 ellipsoidal height (m)	-16.126
N-Value (m)	-30.071
Height (m) (AHD)	13.945

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 (http://www.ga.gov.au/scientific-topics/positioning-navigation/geodesy/datumsprojections/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 Matrice 300 (DJI) multi-rotor drone, equipped with a L1 (Zenmuse) camera 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.

RESULTS AND INTERPRETATION

PRESENTATION OF RESULTS 4.1

The results of the geotechnical investigation at Hopetoun, Shire of Ravensthorpe are presented in Appendices B and C of this report as follows:

Appendix B – Geophysical and Interpreted Sections

- 3073A-02 and 3073A-03. Transect 1 seismic S-wave velocity model and interpreted geological section.
- 3073A-04 and 3073A-05. Transects 2a and 2b seismic S-wave velocity model and interpreted geological section.
- 3073A-06 and 3073A-07. Transect 3 seismic S-wave velocity model and interpreted geological section.
- **3073A-08.** Transect 4a seismic S-wave velocity model and interpreted geological section.
- **3073A-09.** Transect 4b seismic S-wave velocity model and interpreted geological section.
- 3073A-10, 3073A-11 and 3073A-12. Transect 5 seismic S-wave velocity model and interpreted geological section.



- **3073A-13.** Transects 6, 7 and 8 seismic S-wave velocity model and interpreted geological section.
- 3073A-14. Transects 9, 10 and 11 seismic S-wave velocity model and interpreted geological section.

Appendix C - Modelled Level to Top of Rock and Sand Thickness

- 3073A-15 and 3073A-16. Contoured surface level model derived from aerial photogrammetry.
- 3073A-17 and 3073A-18. Contoured level to modelled top of rock.
- 3073A-19. Class post map level to modelled top of rock.
- 3073A-20 and 3073A-21. Contoured modelled sand thickness over rock.
- 3073A-22. Class post map modelled sand thickness over rock.

4.2 SEISIMC SHEAR WAVE VELOCITY SECTIONS

The seismic S-wave velocity (Vs) sections modelled from the MASW data acquired along the alongshore and cross-shore transects are presented at the top of each drawing in Appendix B. These sections show variations in the modelled Vs 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.

Seismic S-wave velocity
$$V_{_{S}}=\sqrt{\frac{G}{\rho}}$$

where; G =Shear modulus, $\rho =$ 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 correlated with the CPT. Four classes have been defined representing different subsurface material conditions as follows:

Very low seismic S-wave velocity (Vs <250m/s). Representing the lowest seismic velocities
modelled during the investigation, this class is interpreted as sediment consisting of SAND of
low compaction from either the beach or dune formation.



- 2. **Low seismic S-wave velocity** (Vs 250-350m/s). This class is interpreted as sediment consisting of SAND of moderate compaction either 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 (Vs 350-475m/s). This class is interpreted as low strength rock consisting of variably weathered CALCARENITE. Where continuous and at base of the sections it likely represents a transitional zone to stronger, more competent underlying CALCARENITE. Where present as isolated anomalies within the interpreted SAND it is likely to represent partially lithified SAND and/or CALCARENITE lenses.
- 4. Moderate to high seismic wave velocity (Vs >475m/s). This class is interpreted as moderate strength rock consisting of slightly weathered to fresh CALCARENITE. It is typically observed at the base of the sections as competent rock underlying the variably weathered CALCARENITE.

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 Transects 1 and 7 refusal of 70MPa was at a depth of 6.3m Below Ground Level (BGL) and approximately 1m into interpreted low strength rock on both intersecting transects. An increase in CPT tip resistance occurs at 4.0mBGL corresponding to the top of interpreted low strength rock.
- **CPT-02 on Transect 1 and 8** refusal due to inclination was at 6.6mBGL and approximately 2m into interpreted low strength rock on both intersecting transects. This suggests that the rock at this location has highly variable weathering and is potentially undulating.
- CPT-03 on Transect 2 and 9 refusal of 75MPa was at 3.1mBGL which corresponds to the top of interpreted low strength rock on both intersecting transects.
- CPT-04 on Transect 5 refusal of 60MPa plus rod friction was at 10mBGL and approximately 2.5m into interpreted low strength rock suggesting a variably weathered material. An increase in CPT tip resistance occurs at 7.5mBGL corresponding to the top of interpreted low strength rock.
- CPT-05 on Transect 5 refusal due to inclination was at 11.1mBGL and approximately 3.5m into interpreted low strength rock. An increase in CPT tip resistance occurs at 7.5mBGL corresponding to the top of interpreted low strength rock.
- CPT-06 on Transect 5 refusal of 70MPa plus rod friction was at 9.3mBGL and approximately 3.5m into interpreted low strength rock. An increase in CPT tip resistance occurs at 5.5mBGL corresponding to the top of interpreted low strength rock.



- **CPT-07 on Transect 3** refusal of 70MPa plus rod friction was at 4.9mBGL within interpreted sand of moderate compaction above interpreted low strength rock. This is potentially due to a rock floater or partially lithified lens within the beach sand.
- **CPT-08 on Transect 5** refusal of 60MPa plus rod friction was at 7.3mBGL which corresponds to the top of interpreted low strength rock.

The differences in the modelled level to low strength and moderate strength rock as interpreted from the MASW transects and from the 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.

Surface outcropping rock was observed onsite at 300m along and 12m offset to Transect 2a. This corresponds to interpreted surface lens of low strength rock evident in the interpreted geological section. Analysis of the orthomosaic image from the aerial photogrammetry indicates no other evidence of outcropping rock within the area between the coastal foreshore and settlement.

4.5 MODELLED LEVEL TO TOP OF ROCK AND SAND THICKNESS

Subsurface models for the level to top of rock substrate and overlying sand thickness within the region between the coastal foreshore and settlement are presented in Appendix C. These has been generated by digitising the interface between the interpreted sediment and underling rock profile from the interpreted geological sections along the acquired along-shore and cross-shore transects and calibrated with the CPT plots. The modelled sand thickness was then generated by subtracting this from the surface elevation. The following subsurface models have been provided:

- Contoured Surface Level Model (drawing 3073A-15 and 3073A-16) generated from the aerial photogrammetry, this presents the level to ground surface ranging from 0mAHD to 15mAHD. Note: vegetation height has not been removed from these models.
- Contoured Level to Top of Rock Substrate (drawing 3073A-17 and 3073A-18) this presents the level to the top of rock substrate ranging from -8mAHD to 2mAHD.
- Classed Post Map Level to Top of Rock Substrate (drawing 3073A-19) this presents the level to the top of rock substrate along the acquired transects at 2m level increments from -8mAHD to 4mAHD.
- Contoured Sand Thickness Over Rock (drawing 3073A-20 and 3073A-21) this presents the thickness of sand overlying the rock substrate ranging from 1mBGL to 10mBGL.



Classed Post Map Sand Thickness Over Rock (drawing 3073A-22) – this presents the
thickness of sand overlying the rock substrate along the acquired transects at 2m depth
increments from 2m to 12m.

The following limitations should be considered when assessing the subsurface models for the level to top of rock substrate and overlying sand thickness:

The expected accuracy of the top of rock substrate modelled from this investigation is +/-0.5mAHD. Similarly, an accuracy of +/-0.5m is expected for the modelled sand thickness over rock. The quoted accuracies have been based on consideration to the accuracy of the GNSS receivers using during the site work, 1D inversion of the MASW dataset using a 10-layer model, and expected undulations in the sand/rock interface. Note the quoted accuracies are only valid along the geophysical transects. Values given between transects have been interpolated in the contour maps and as such the accuracy in this case is indeterminable.

The generated contours will give the general trend of the top of rock profile however will not image local variations when the extent of these are less then transect spacing. Spatially small features such as karst sinkholes or pinnacle features may not be imaged. The significance of this limitation is considered minor for this investigation since although local geological features such as pinnacles may not be represented in the data, the generated surface of the top of rock will show the broad trends in the geology over the site which is suitable for a coastal erosion assessment.

Transition zones including between fresh and weathered rock and between sediment and lithified/partially lithified sediment may be gradational and as such the interface between these layers are not well defined.

The calculated levels to the top of rock will only be valid along the geophysical transects. Values shown on the contour maps not on the transects have been interpolated using the krigging algorithm and as such the accuracy of these levels is indeterminable. The contour surface will give the general trend of the interface however may not image local variations, it is recommended that the interpreted geological sections presented in Appendix B be used to obtain more accurate top of rock levels and overlying sand thickness.

5 PROJECT SUMMARY

A geotechnical investigation has been carried out as part of a coastal erosion assessment at Hopetoun in the Shire of Ravensthorpe, Western Australia. During the investigation ground geophysical and intrusive geotechnical testing was conducted within a 1800m corridor of coastal beach and dune formation adjacent to the Hopetoun settlement which has been identified as an at risk site as part of Coastal Hotspot #54.

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 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. 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 subsurface models of the level to rock substrate (relative to AHD) and overlying sand thickness 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 limited 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 geophysical investigation, please do not hesitate to contact the undersigned on 08 9354 6300.

For and on behalf of

GBG GEOTECHNICS (AUSTRALIA)

ANDREW SPYROU

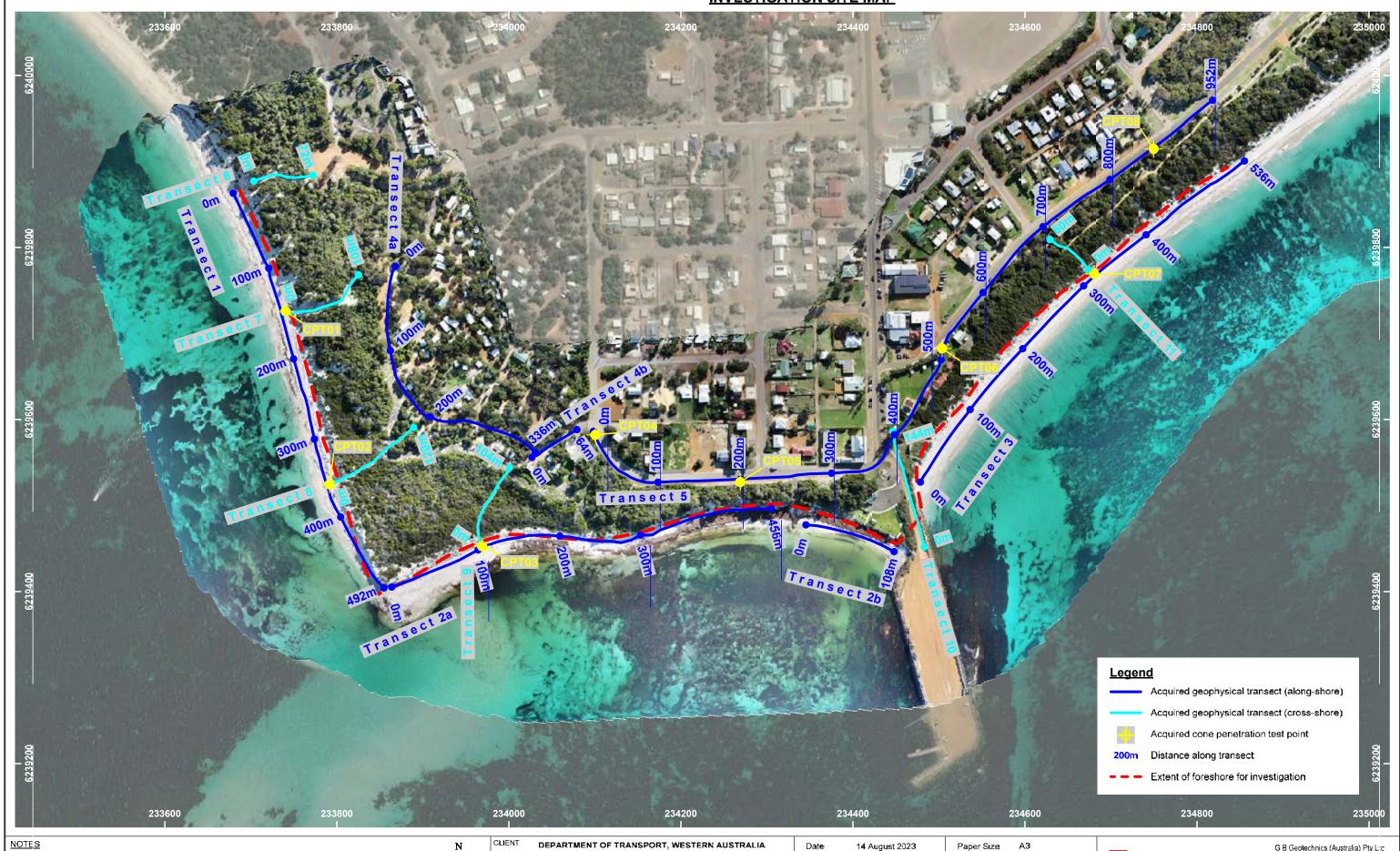
Operations Manager, Western Australia / Senior Geophysicist



APPENDIX A – INVESTIGATION SITE MAP



INVESTIGATION SITE MAP



Drawing to be used in conjunction with Report 3073A Map Projection GDA94 MGA Zone 51.
Aerial image from Google Earth Pro and GBG photogrammetry.



GEOPHYSICAL INVESTIGATION FOR COASTAL EROSION VULNERABLITY ASSESSMENT HOPETOUN, SHIRE OF RAVENSTHORPE WA
 Date
 14 August 2323
 Paper Size
 A3

 Scale
 1:4000
 Drawn
 PJE

 Drawing
 3073A-01
 Revision
 1

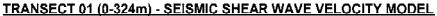


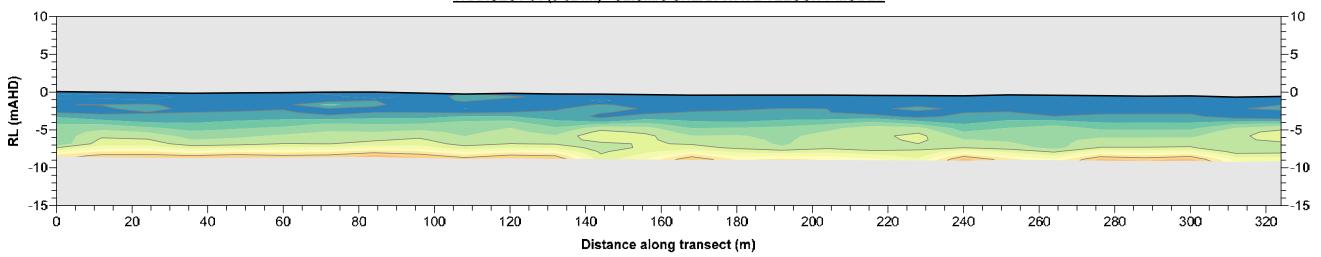
G B Geolechnics (Australia) Pty Lic 1/11 Gympie Way Willetton WA 6155 ABN: 77 009 550 869 Telephone: 02 9890 2122 Email; info@gbgoz com.au



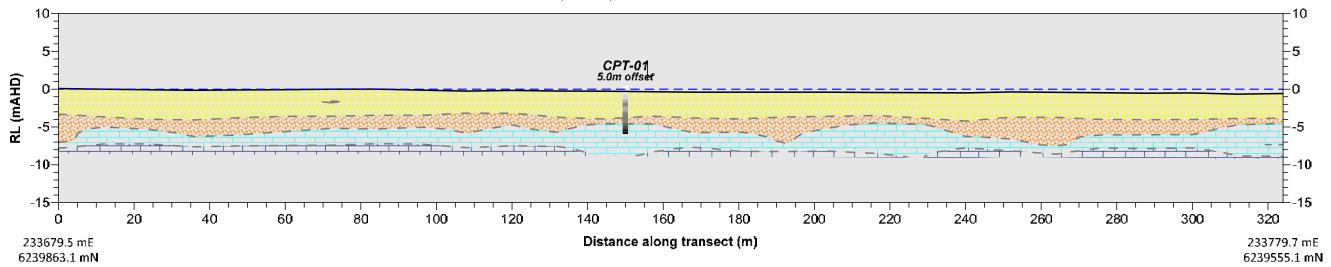
APPENDIX B - GEOPHYSICAL AND INTERPRETED SECTIONS

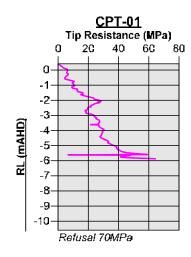


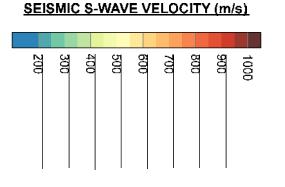




TRANSECT 01 (0-324m) - INTERPRETED GEOLOGICAL SECTION

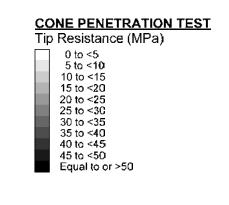






SAND - LOW COMPACTION S-WAVE VELOCITY < 250 m/s SAND - MODERATE COMPACTION S-WAVE VELOCITY 250-350 m/s LOW STRENGTH WEATHERED ROCK S-WAVE VELOCITY 350-475 m/s MODERATE STRENGTH COMPETENT ROCK S-WAVE VELOCITY > 475 m/s.

0m AUSTRALIAN HEIGHT DATUM



NOTES	
Drawing to be used in conjunction with Re Positioning is given in GDA 94 zone 51. Levels are given in Australian Height Datu	

GEOPHYSICAL INVESTIGATION FOR COASTAL EROSION VULNERABLITY ASSESSMENT HOPETOUN, SHIRE OF RAVENSTHORPE WA

DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA

CLIENT

 Date
 14 August 2023
 Paper Size
 A3

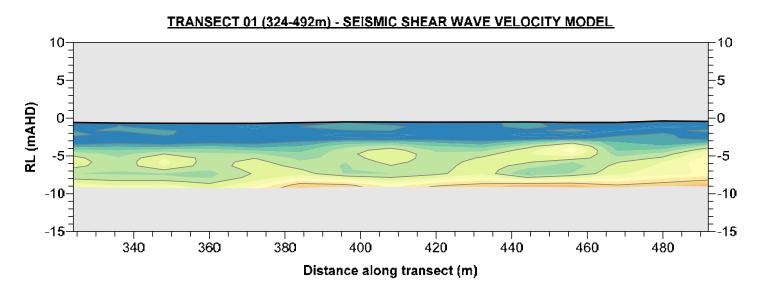
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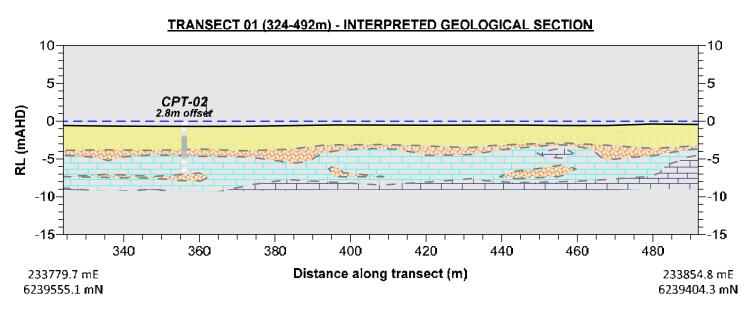
 Drawing
 3073A-02
 Revision
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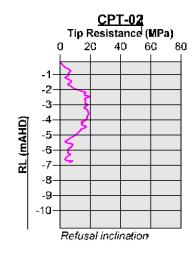


G B Geolechnics (Australia) Pty Ltc 1/11 Gympie Way Willetton WA 6155 ABN: 77 009 550 869 Telephone: 02 989¢ 2122 Email; info@gbgoz com.au

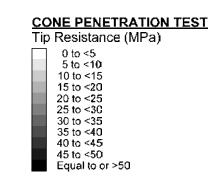








SEISMIC S-WAVE VELOCITY (m/s) INTERPRETED MATERIAL TYPE SAND - LOW COMPACTION S-WAVE VELOCITY < 250 m/s 600 400 700 SAND - MODERATE COMPACTION S-WAVE VELOCITY 250-350 m/s LOW STRENGTH WEATHERED ROCK S-WAVE VELOCITY 350-475 m/s MODERATE STRENGTH COMPETENT ROCK S-WAVE VELOCITY > 475 m/s. 0m AUSTRALIAN HEIGHT DATUM



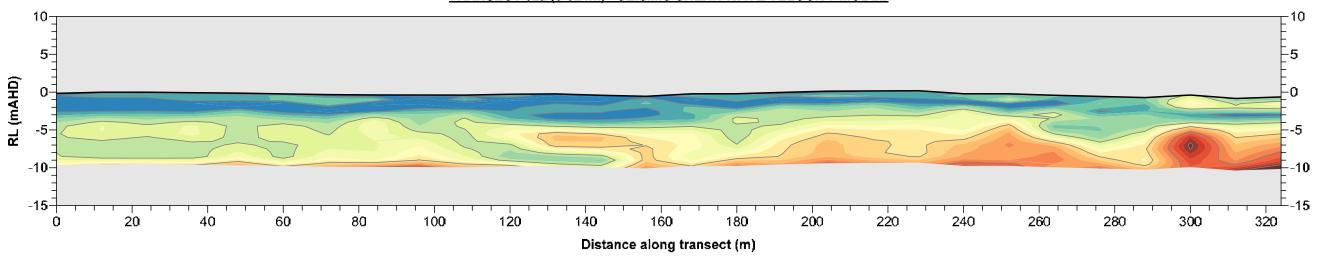
Drawing to be used in conjunction with Report 3073A Positioning is given in GDA 94 zone 51. Levels are given in Australian Height Datum (AHD).

CLIENT	DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA
	GEOPHYSICAL INVESTIGATION FOR COASTAL EROSION VULNERABLITY ASSESSMENT HOPETOUN, SHIRE OF RAVENSTHORPE WA
	HOPETODIN, SHIRE OF RAVEING HORFE MA

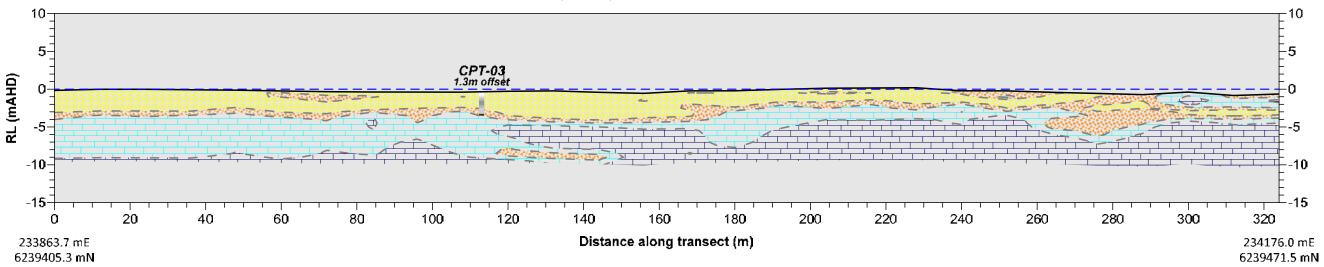
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Drawing	3073A-03	Revision	1

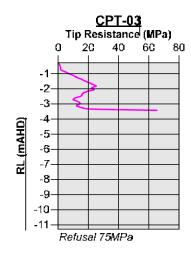






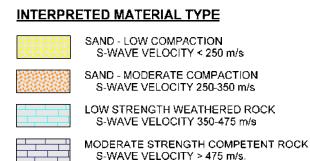
TRANSECT 02a (0-324m) - INTERPRETED GEOLOGICAL SECTION



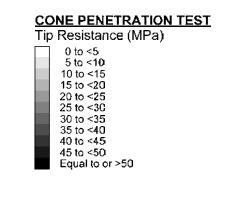


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SEISMIC S-WAVE VELOCITY (m/s)



0m AUSTRALIAN HEIGHT DATUM

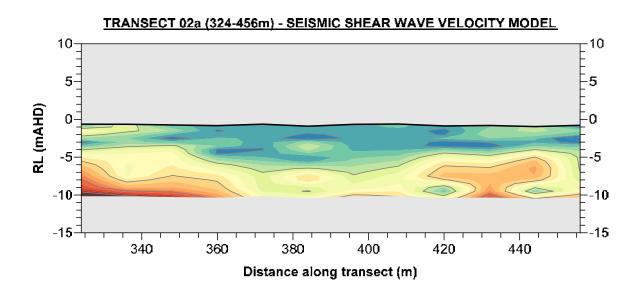


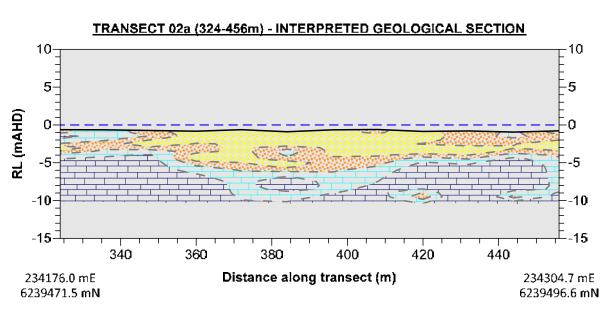
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Positioning is given in GDA 94 zone 51.
Levels are given in Australian Height Datum (AHD).

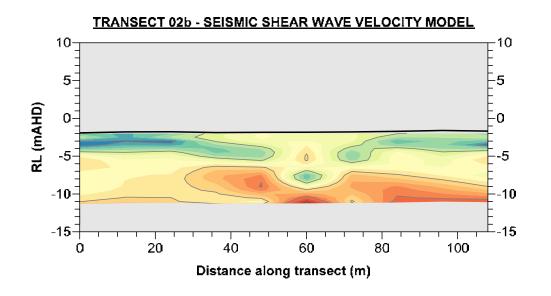
GEOPHYSICAL INVESTIGATION FOR COASTA
EROSION VULNERABLITY ASSESSMENT
HOPETOUN, SHIRE OF RAVENSTHORPE WA

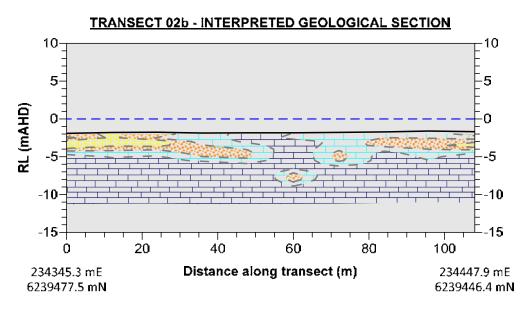
DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA

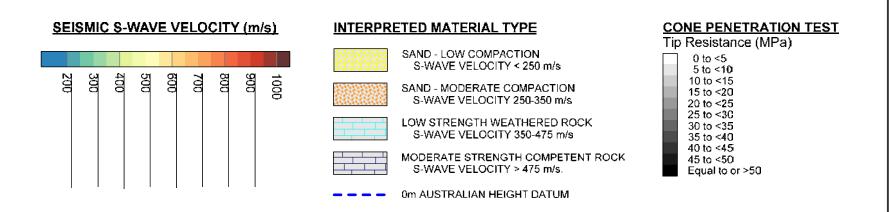












NOTES

Drawing to be used in conjunction with Report 3073A Positioning is given in GDA 94 zone 51.

Levels are given in Australian Height Datum (AHD).

DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA

GEOPHYSICAL INVESTIGATION FOR COASTAL

EROSION VULNERABLITY ASSESSMENT

HOPETOUN, SHIRE OF RAVENSTHORPE WA

CLIENT

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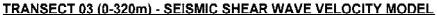
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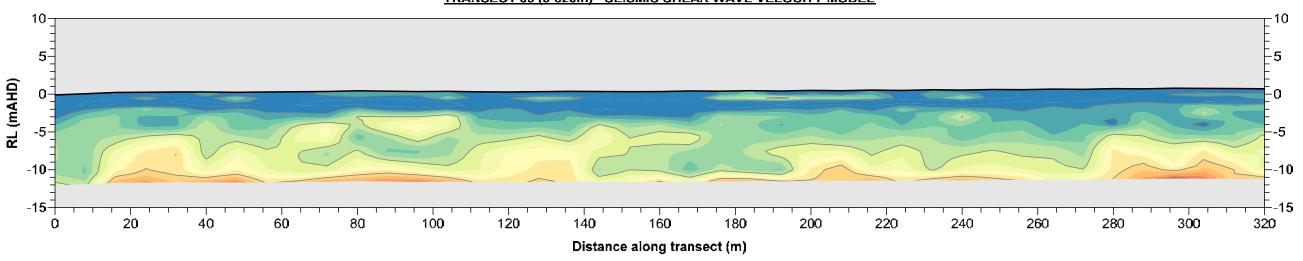
 Drawing
 3073A-05
 Revision
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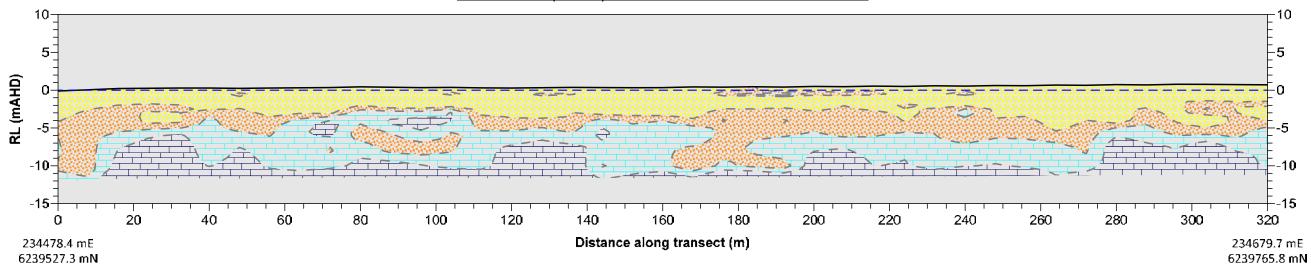
G B Geolechnics (Australia) Pty Ltc 1/11 Gympie Way Willetton WA 6155 ABN: 77 009 550 869 Telephone: 02 989C 2122 Email; info@gbgoz com.au



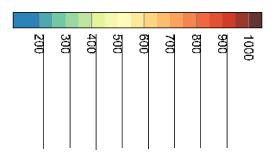




TRANSECT 03 (0-320m) - INTERPRETED GEOLOGICAL SECTION



SEISMIC S-WAVE VELOCITY (m/s)

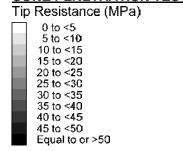


INTERPRETED MATERIAL TYPE



0m AUSTRALIAN HEIGHT DATUM

CONE PENETRATION TEST



NOTES

Drawing to be used in conjunction with Report 3073A Positioning is given in GDA 94 zone 51. Levels are given in Australian Height Datum (AHD).

DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA

GEOPHYSICAL INVESTIGATION FOR COASTAL

EROSION VULNERABLITY ASSESSMENT

HOPETOUN, SHIRE OF RAVENSTHORPE WA

CLIENT

 Date
 14 August 2023
 Paper Size
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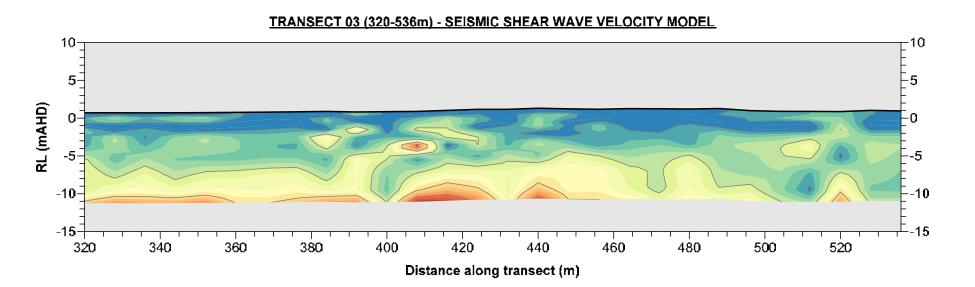
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 Drawn
 PJE

 Drawing
 3073A-06
 Revision
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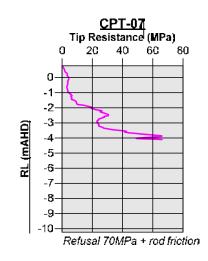


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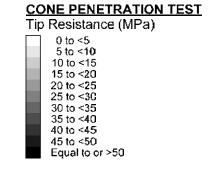




TRANSECT 03 (320-536m) - INTERPRETED GEOLOGICAL SECTION CPT-07 RL (mAHD) -15-400 340 360 380 440 460 480 500 320 420 520 Distance along transect (m) 234679.7 mE 234855.2 mE 6239765.8 mN 6239900.6 mN

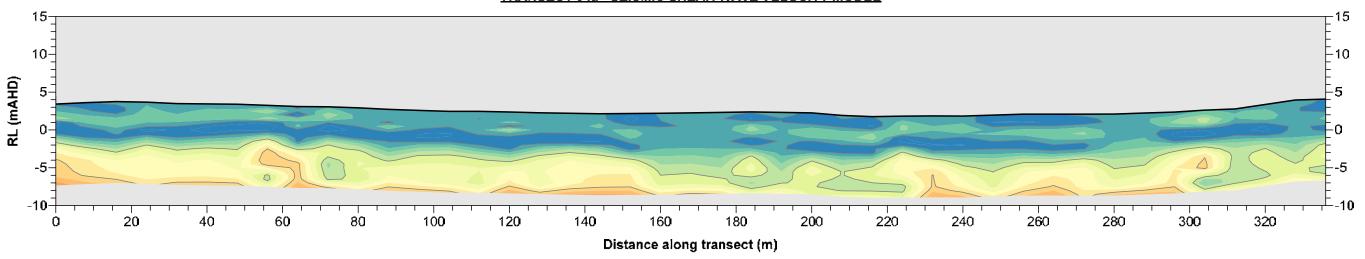


SEISMIC S-WAVE VELOCITY (m/s) INTERPRETED MATERIAL TYPE SAND - LOW COMPACTION S-WAVE VELOCITY < 250 m/s 600 300 400 500 700 1000 SAND - MODERATE COMPACTION S-WAVE VELOCITY 250-350 m/s LOW STRENGTH WEATHERED ROCK S-WAVE VELOCITY 350-475 m/s MODERATE STRENGTH COMPETENT ROCK S-WAVE VELOCITY > 475 m/s. 0m AUSTRALIAN HEIGHT DATUM

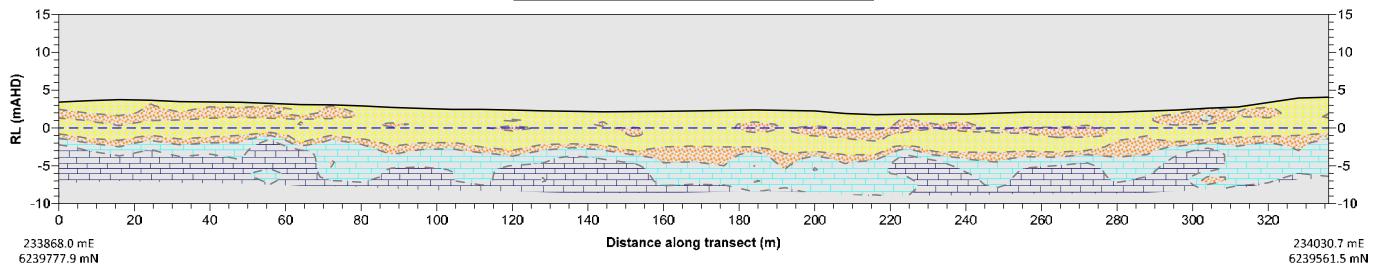




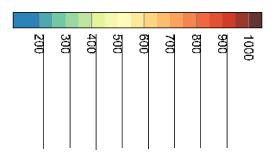
TRANSECT 04a - SEISMIC SHEAR WAVE VELOCITY MODEL



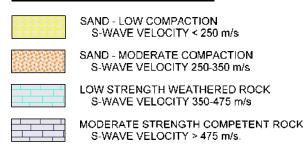
TRANSECT 04a - INTERPRETED GEOLOGICAL SECTION



SEISMIC S-WAVE VELOCITY (m/s)

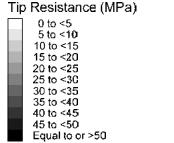


INTERPRETED MATERIAL TYPE



0m AUSTRALIAN HEIGHT DATUM

CONE PENETRATION TEST



NOTES

Drawing to be used in conjunction with Report 3073A Positioning is given in GDA 94 zone 51.
Levels are given in Australian Height Datum (AHD).

DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA

GEOPHYSICAL INVESTIGATION FOR COASTAL

EROSION VULNERABLITY ASSESSMENT

HOPETOUN, SHIRE OF RAVENSTHORPE WA

CLIENT

 Date
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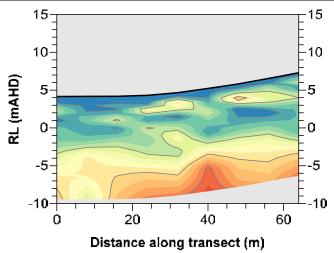
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 3073A-08
 Revision
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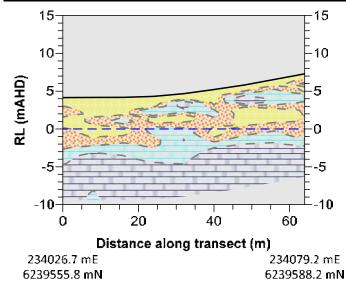
G B Geolechnics (Australia) Pty Ltc 1/11 Gympie Way Willetton WA 6155 ABN: 77 009 550 869 Telephone: 02 989C 2122 Email: info@gbgoz com.au



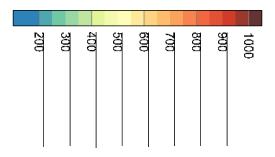
TRANSECT 04b - SEISMIC SHEAR WAVE VELOCITY MODEL



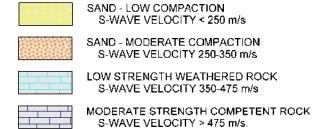
TRANSECT 04b - INTERPRETED GEOLOGICAL SECTION



SEISMIC S-WAVE VELOCITY (m/s)

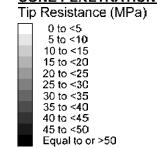


INTERPRETED MATERIAL TYPE



- 0m AUSTRALIAN HEIGHT DATUM

CONE PENETRATION TEST



NOTES

Drawing to be used in conjunction with Report 3073A Positioning is given in GDA 94 zone 51.
Levels are given in Australian Height Datum (AHD).

CLIENT	DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA
	GEOPHYSICAL INVESTIGATION FOR COASTAL
	EROSION VULNERABLITY ASSESSMENT
	HOPETOUN, SHIRE OF RAVENSTHORPE WA

 Date
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 PJE

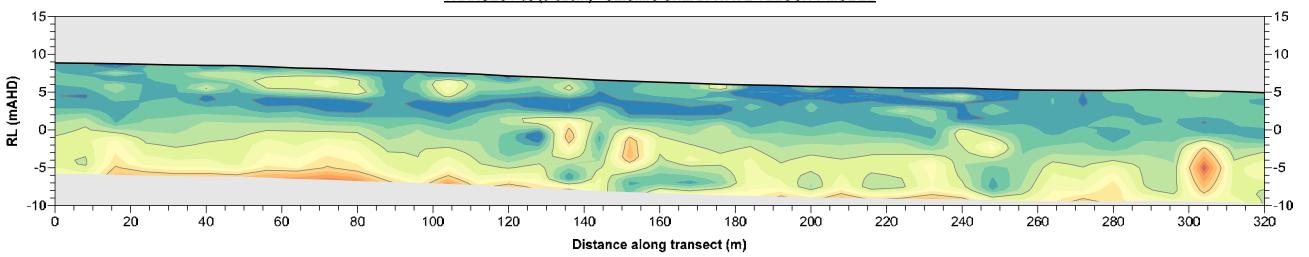
 Drawing
 3073A-09
 Revision
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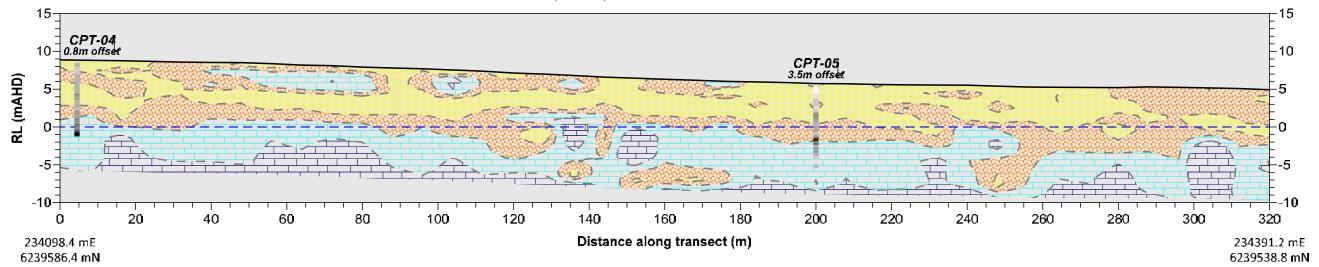
G B Geotechnics (Australia) Pty Ltc 1/11 Gympie Way Willetton WA 6155 ABN: 77 009 550 869 Telephone: 02 9890 2122 Email; info@gbgoz com.au

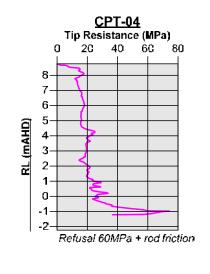


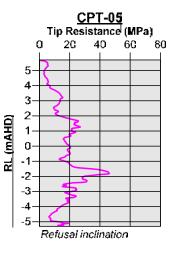
TRANSECT 05 (0-320m) - SEISMIC SHEAR WAVE VELOCITY MODEL

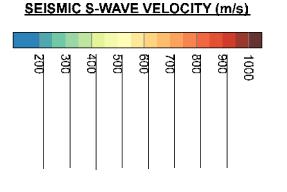


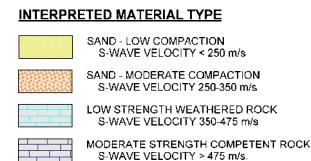
TRANSECT 05 (0-320m) - INTERPRETED GEOLOGICAL SECTION



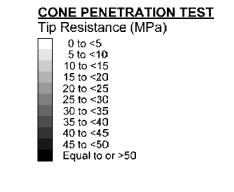








0m AUSTRALIAN HEIGHT DATUM



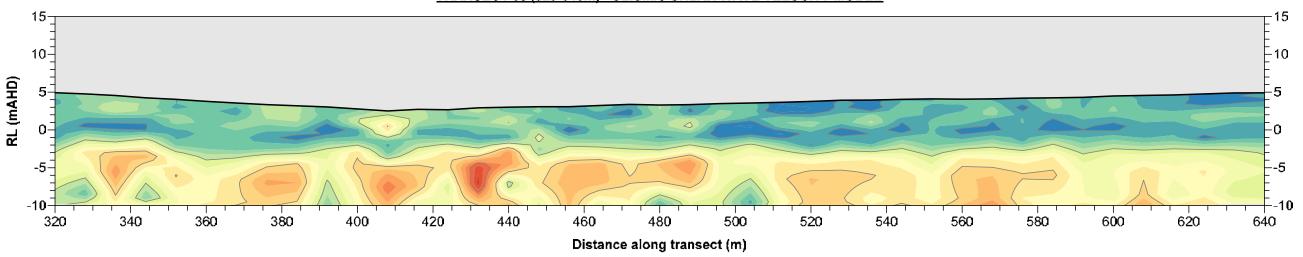
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Drawing to be used in conjunction with Report 3073A
Positioning is given in GDA 94 zone 51.
Levels are given in Australian Height Datum (AHD).

NOTES

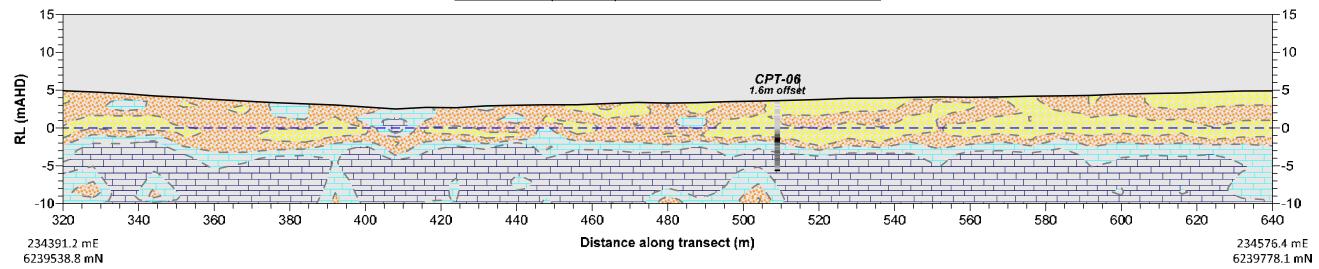
DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA

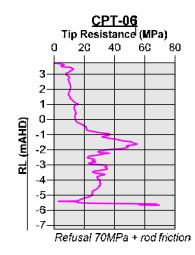


TRANSECT 05 (320-640m) - SEISMIC SHEAR WAVE VELOCITY MODEL



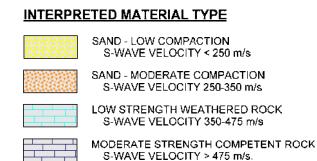
TRANSECT 05 (320-640m) - INTERPRETED GEOLOGICAL SECTION



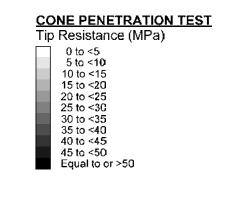


600 400 700 1000

SEISMIC S-WAVE VELOCITY (m/s)



0m AUSTRALIAN HEIGHT DATUM



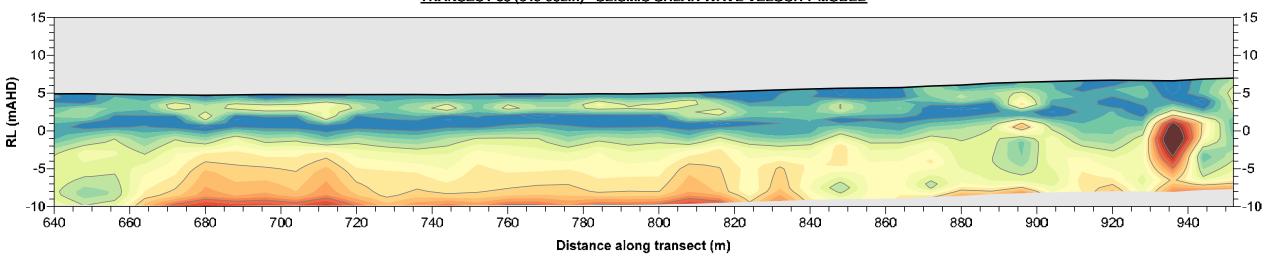
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Drawing to be used in conjunction with Report 3073A Positioning is given in GDA 94 zone 51. Levels are given in Australian Height Datum (AHD).	

LIENT	DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA
	GEOPHYSICAL INVESTIGATION FOR COASTAL EROSION VULNERABLITY ASSESSMENT HOPETOUN, SHIRE OF RAVENSTHORPE WA

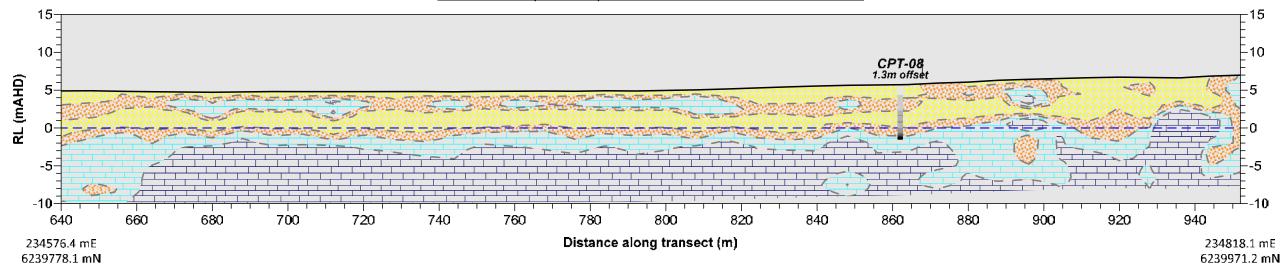
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Drawing	3073A-11	Revision	1

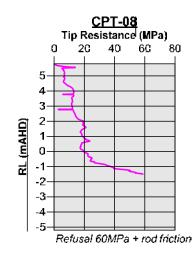


TRANSECT 05 (640-952m) - SEISMIC SHEAR WAVE VELOCITY MODEL



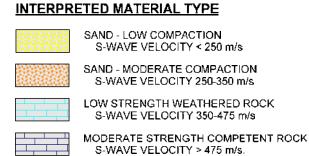
TRANSECT 05 (640-952m) - INTERPRETED GEOLOGICAL SECTION



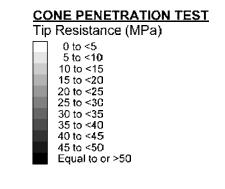


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SEISMIC S-WAVE VELOCITY (m/s)



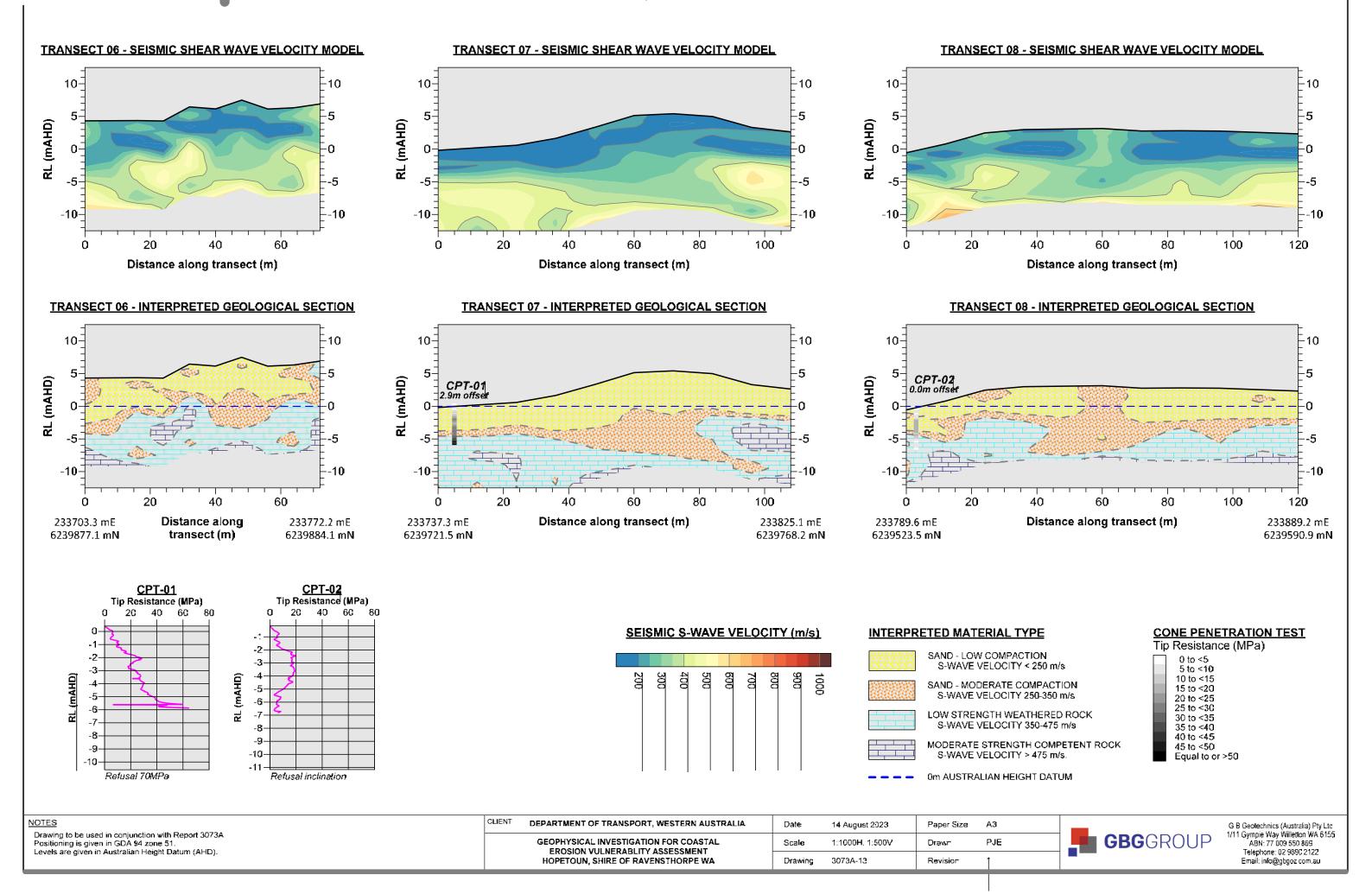
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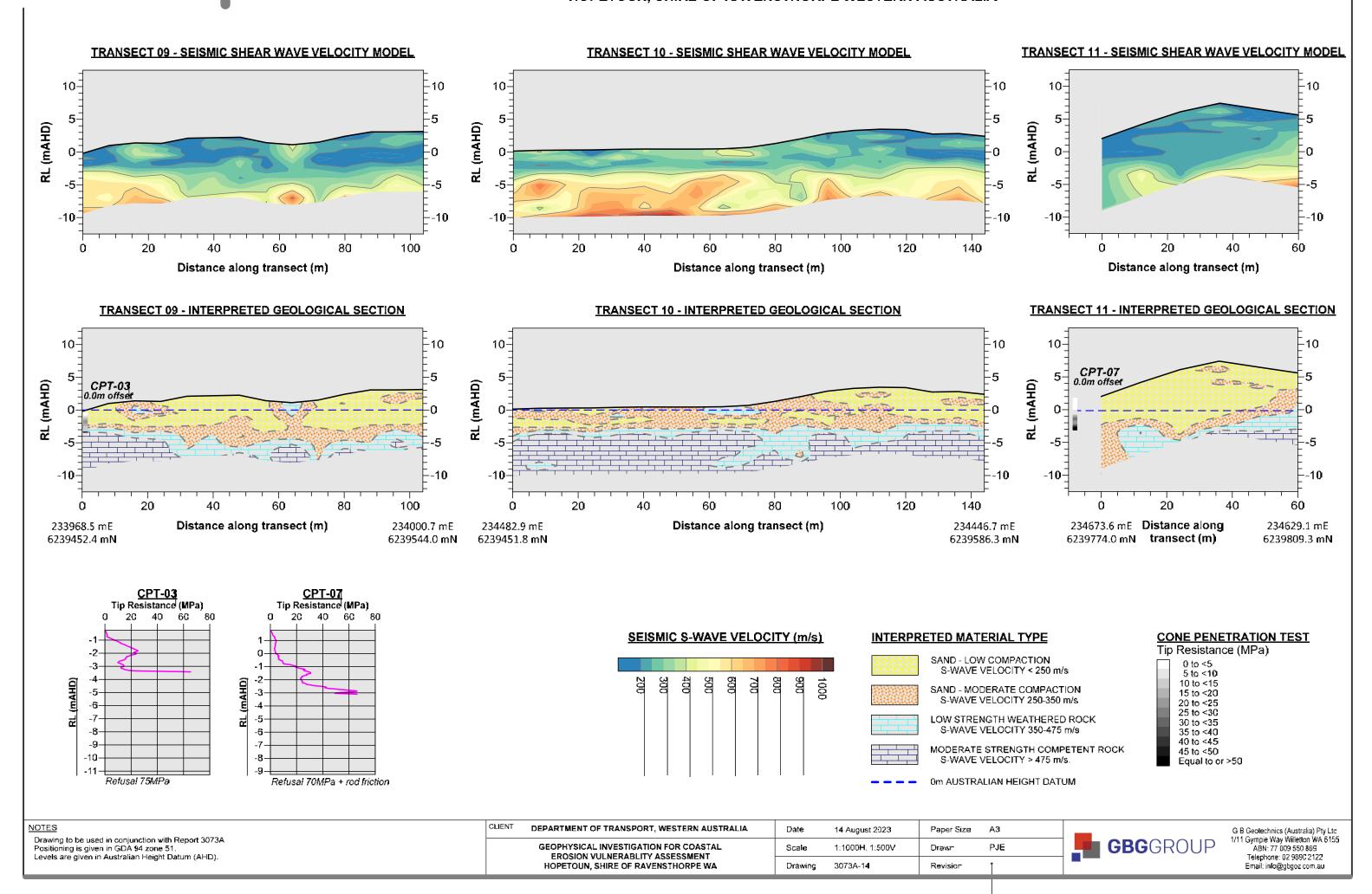
NOTES .
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Positioning is given in GDA 94 zone 51.
Levels are given in Australian Height Datum (AHD).

DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA







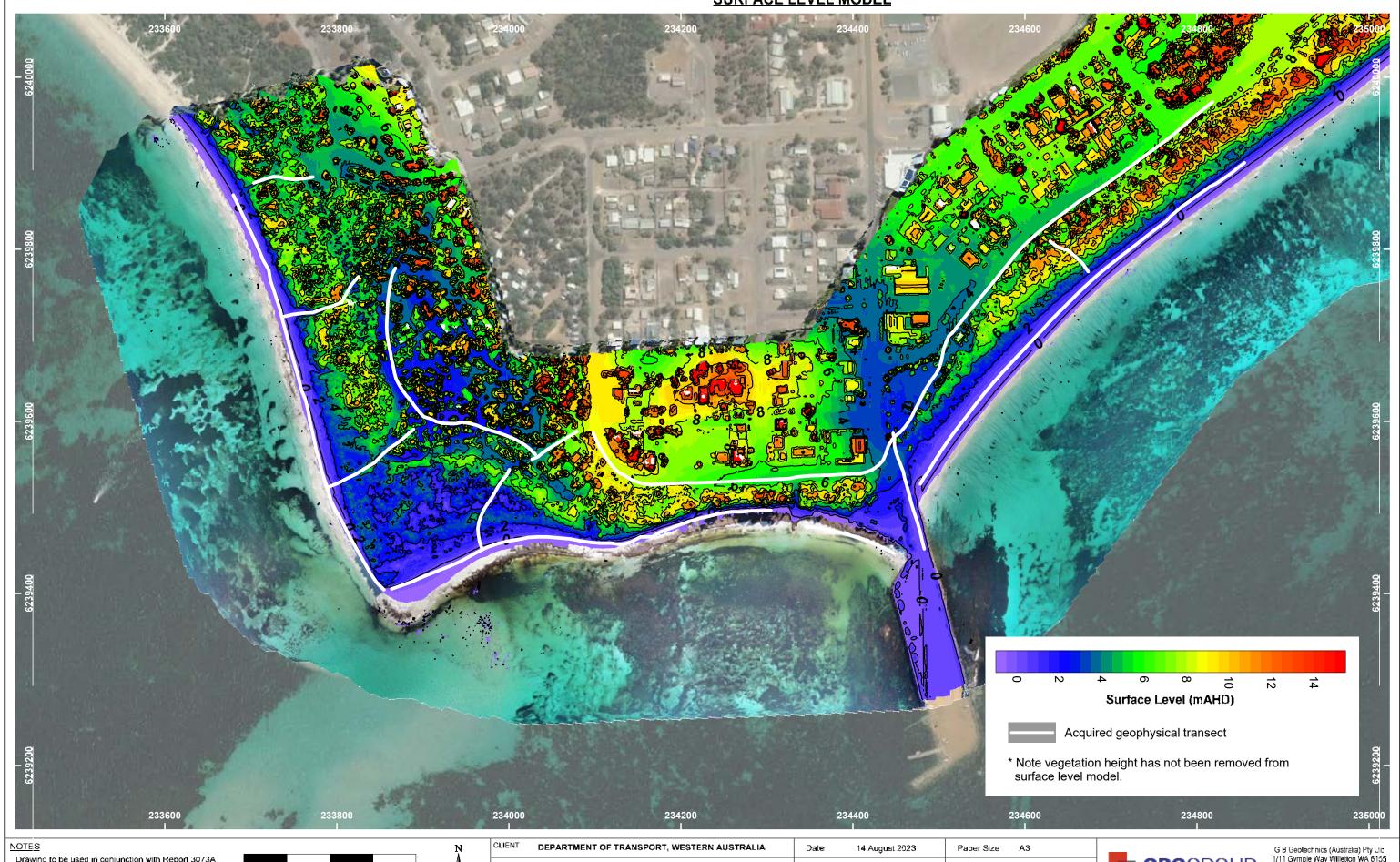




APPENDIX C -	- MODELLED	TOP OF ROCK	AND SAND	THICKNESS
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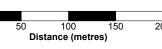


SURFACE LEVEL MODEL



Drawing to be used in conjunction with Report 3073A Map Projection GDA94 MGA Zone 51.

Aerial image from Google Earth Pro and GBG photogrammetry.



GEOPHYSICAL INVESTIGATION FOR COASTAL
EROSION VULNERABLITY ASSESSMENT
HOPETOUN, SHIRE OF RAVENSTHORPE WA

 Date
 14 August 2023
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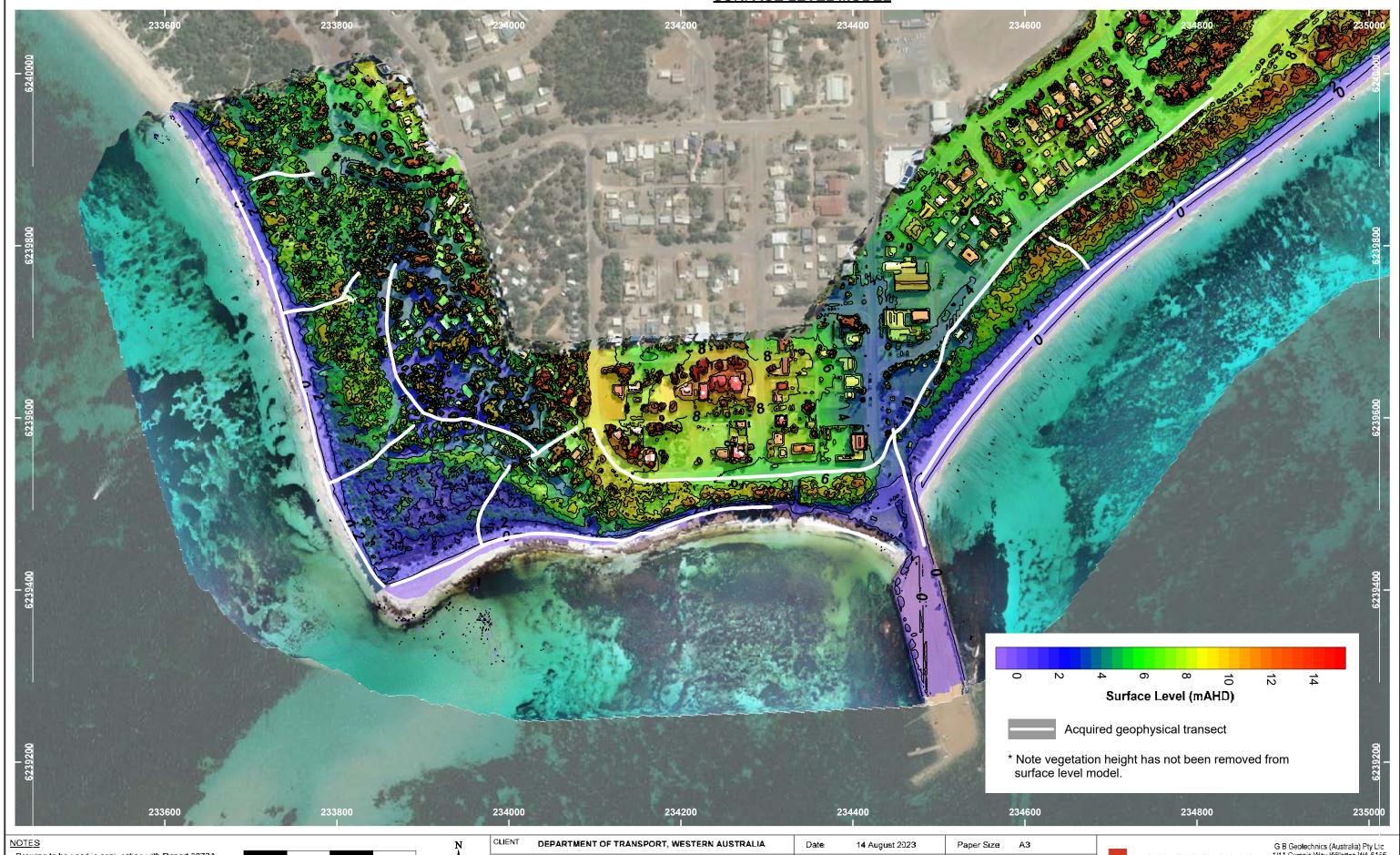
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 Revision
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SURFACE LEVEL MODEL



Drawing to be used in conjunction with Report 3073A Map Projection GDA94 MGA Zone 51.

Aerial image from Google Earth Pro and GBG photogrammetry.



GEOPHYSICAL INVESTIGATION FOR COASTAL EROSION VULNERABLITY ASSESSMENT HOPETOUN, SHIRE OF RAVENSTHORPE WA
 Date
 14 August 2023
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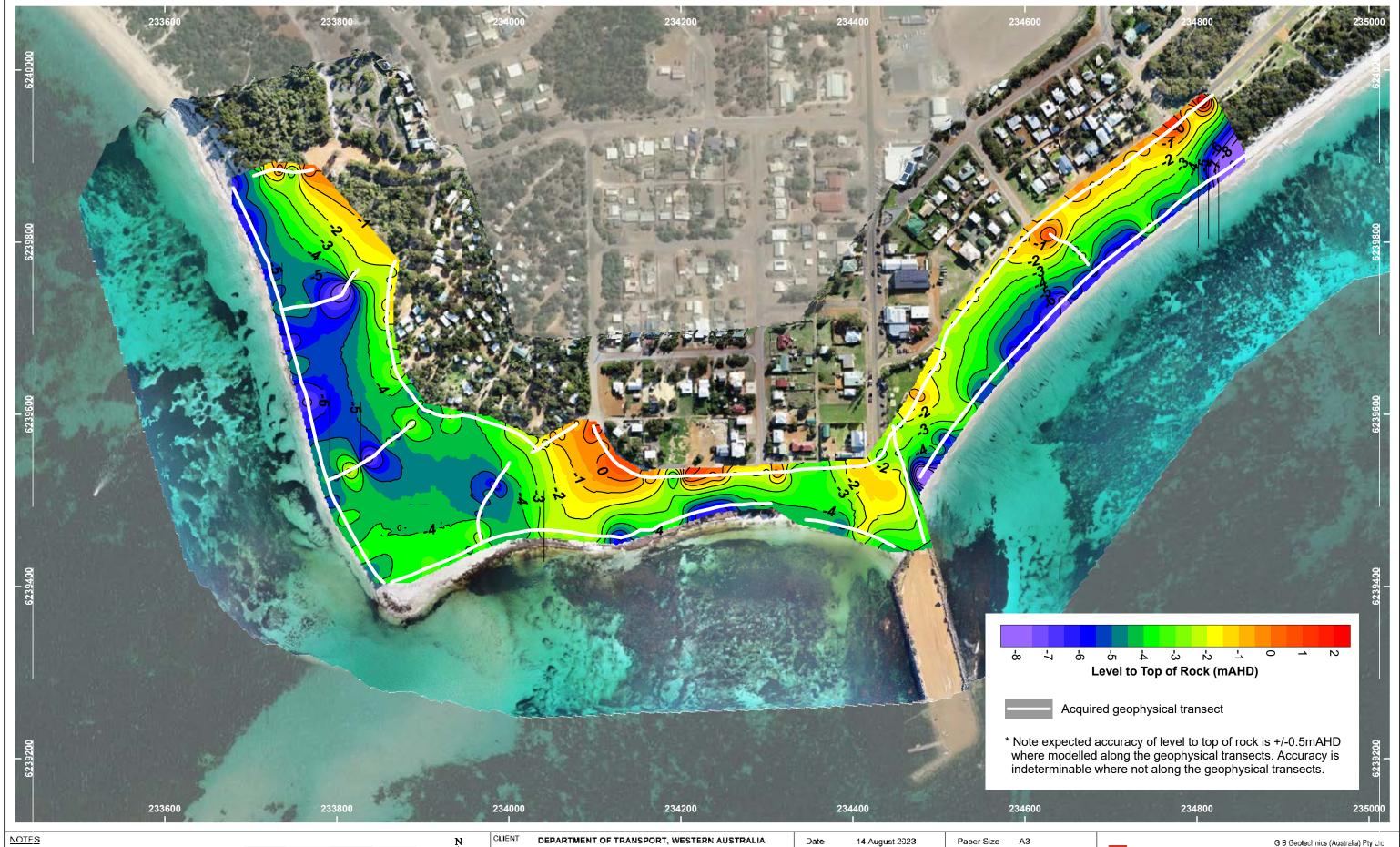
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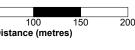
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CONTOURED LEVEL TO TOP OF ROCK



Drawing to be used in conjunction with Report 3073A Map Projection GDA94 MGA Zone 51.
Aerial image from Google Earth Pro and GBG photogrammetry.



GEOPHYSICAL INVESTIGATION FOR COASTAL
EROSION VULNERABLITY ASSESSMENT
HOPETOUN, SHIRE OF RAVENSTHORPE WA

 Date
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 3073A-17
 Revision
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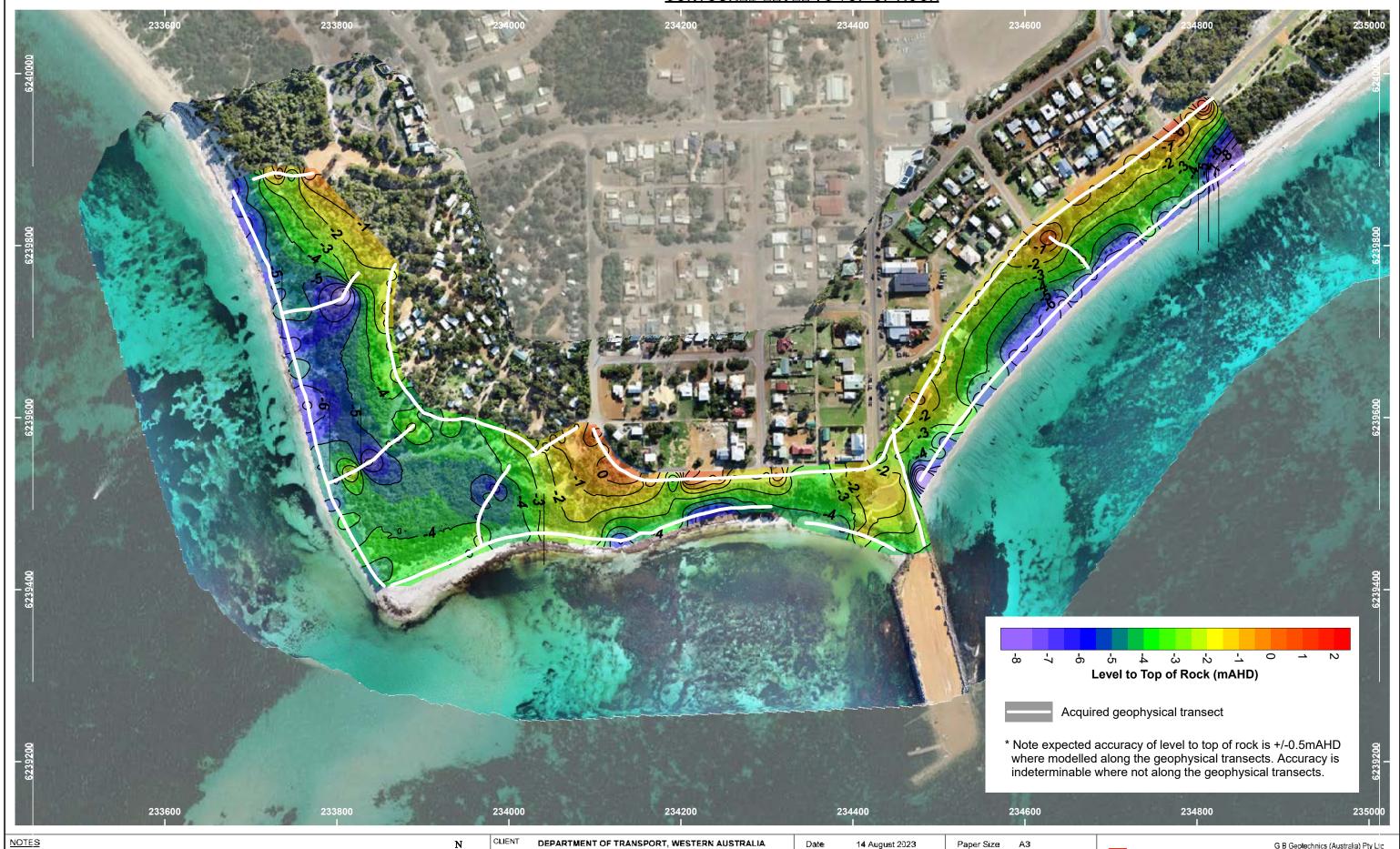


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GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT HOPETOUN, SHIRE OF RAVENSTHORPE WESTERN AUSTRALIA

CONTOURED LEVEL TO TOP OF ROCK



Drawing to be used in conjunction with Report 3073A Map Projection GDA94 MGA Zone 51.
Aerial image from Google Earth Pro and GBG photogrammetry.



GEOPHYSICAL INVESTIGATION FOR COASTAL EROSION VULNERABLITY ASSESSMENT HOPETOUN, SHIRE OF RAVENSTHORPE WA

1:4000 Drawn Drawing 3073A-18 Revision

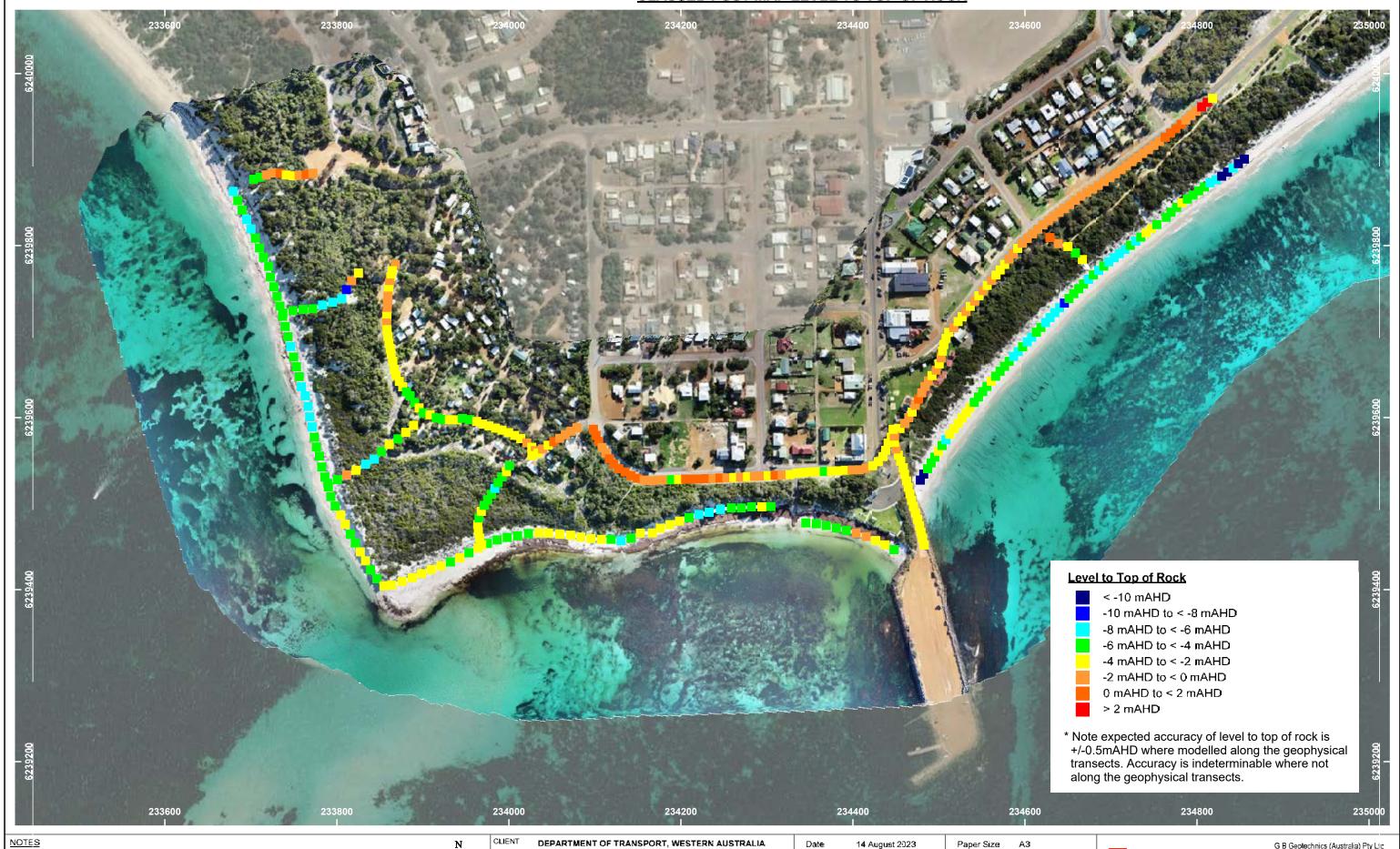


G B Geolechnics (Australia) Pty Lic 1/11 Gympie Way Willetton WA 6155 ABN: 77 009 550 869 Telephone: 02 989C 2122 Email: info@gbgoz com.au



GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT HOPETOUN, SHIRE OF RAVENSTHORPE WESTERN AUSTRALIA

CLASSED POST MAP LEVEL TO TOP OF ROCK



Drawing to be used in conjunction with Report 3073A Map Projection GDA94 MGA Zone 51.

Aerial image from Google Earth Pro and GBG photogrammetry.



DEPARTMENT OF TRANSPORT, WESTERN AUSTRALIA GEOPHYSICAL INVESTIGATION FOR COASTAL EROSION VULNERABLITY ASSESSMENT HOPETOUN, SHIRE OF RAVENSTHORPE WA

1:4000 Drawing 3073A-19

Drawn

Revision

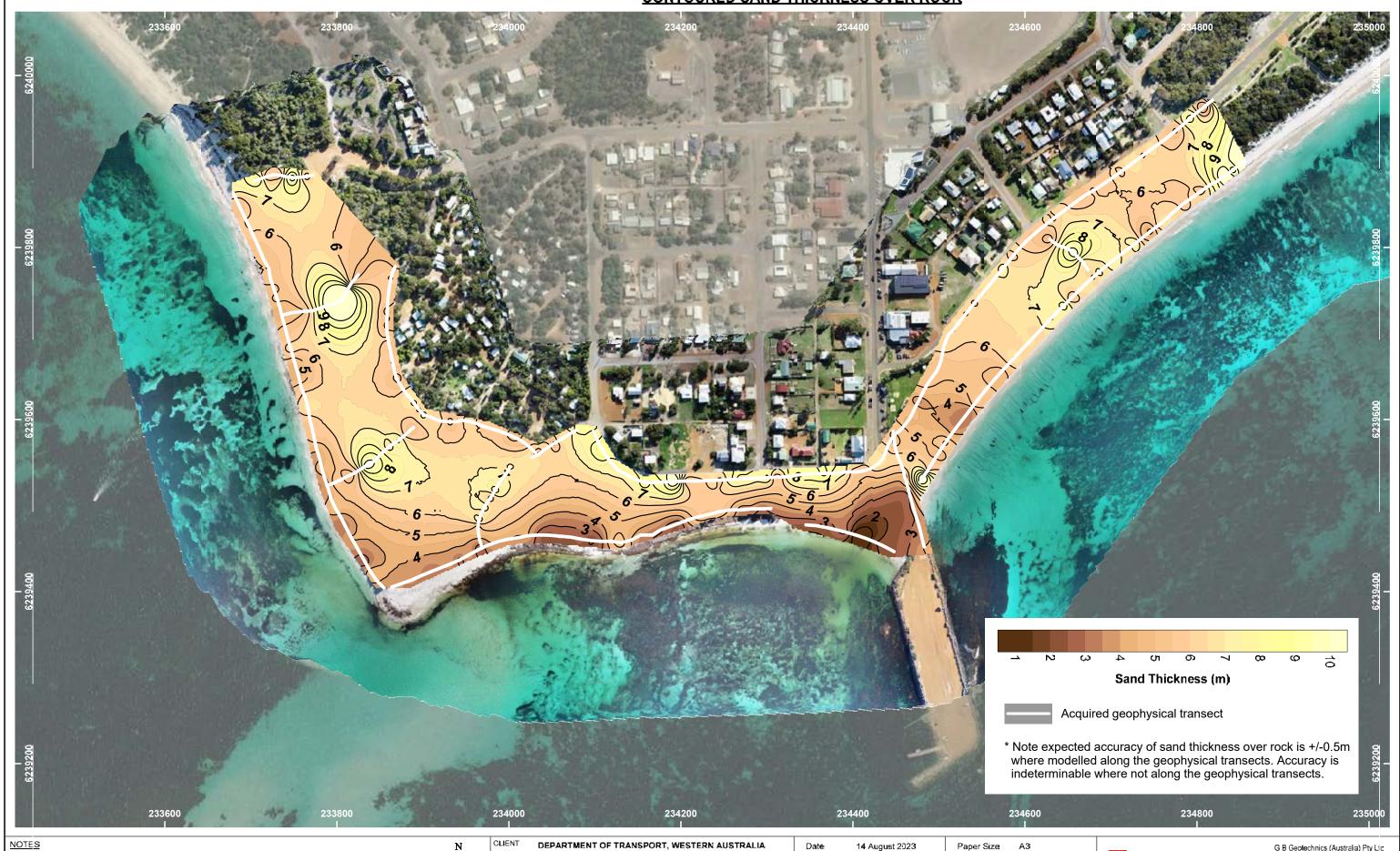


G B Geolechnics (Australia) Pty Ltc 1/11 Gympie Way Willetton WA 6155 ABN: 77 009 550 869 Telephone: 02 9890 2122 Email; info@gbgoz com.au



GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT HOPETOUN, SHIRE OF RAVENSTHORPE WESTERN AUSTRALIA

CONTOURED SAND THICKNESS OVER ROCK



Drawing to be used in conjunction with Report 3073A Map Projection GDA94 MGA Zone 51.
Aerial image from Google Earth Pro and GBG photogrammetry.



GEOPHYSICAL INVESTIGATION FOR COASTAL EROSION VULNERABLITY ASSESSMENT HOPETOUN, SHIRE OF RAVENSTHORPE WA
 Date
 14 August 2923
 Paper Size
 A3

 Scale
 1:4000
 Drawn
 PJE

 Drawing
 3073A-2C
 Revision
 †

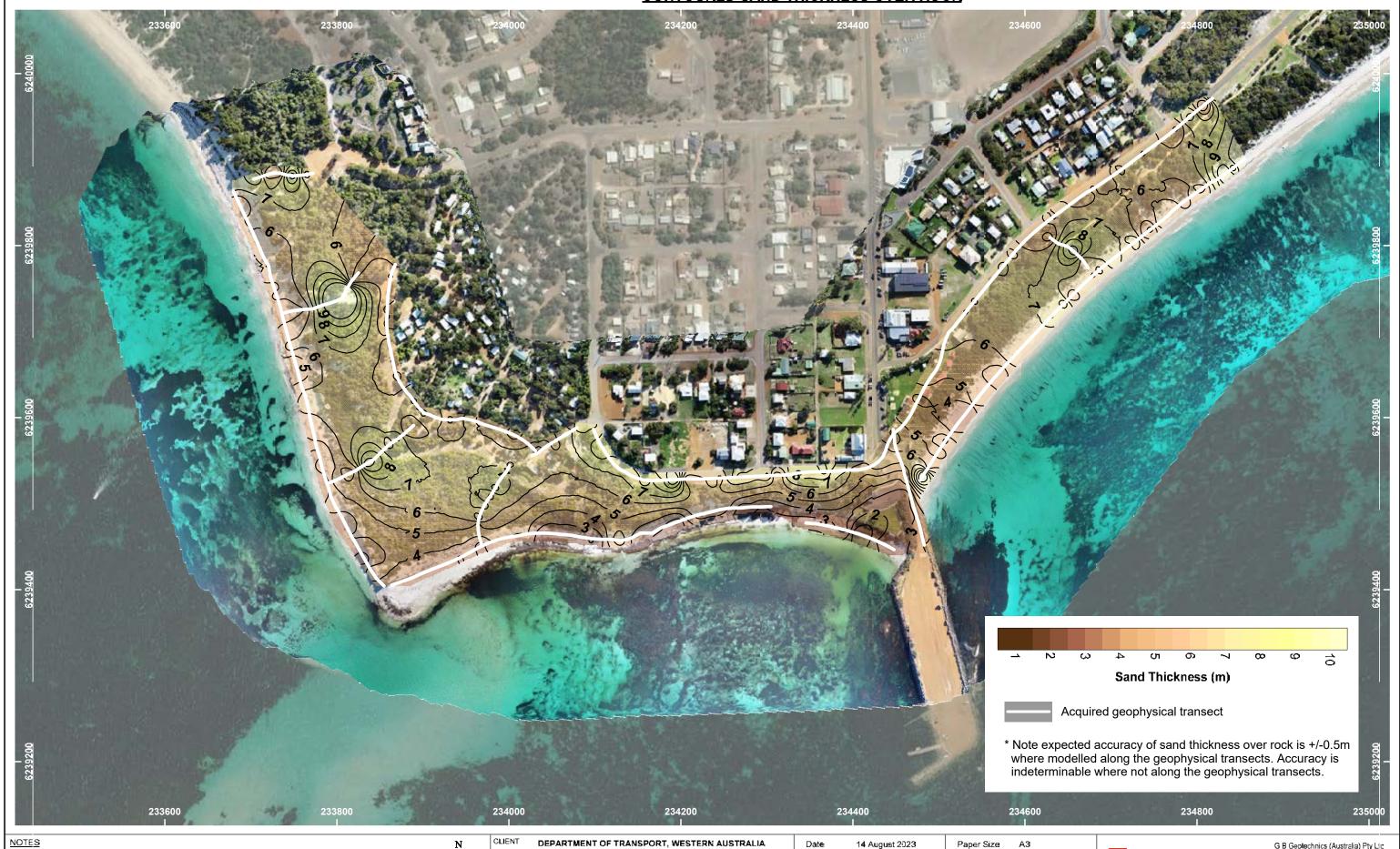


G B Geotechnics (Australia) Pty Lic 1/11 Gympie Way Willetton WA 6155 ABN: 77 009 550 869 Telephone: 02 9890 2122 Email: info@gbgoz com.au



GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT HOPETOUN, SHIRE OF RAVENSTHORPE WESTERN AUSTRALIA

CONTOURED SAND THICKNESS OVER ROCK



Drawing to be used in conjunction with Report 3073A Map Projection GDA94 MGA Zone 51.
Aerial image from Google Earth Pro and GBG photogrammetry.



GEOPHYSICAL INVESTIGATION FOR COASTAL EROSION VULNERABLITY ASSESSMENT HOPETOUN, SHIRE OF RAVENSTHORPE WA

1:4000 Drawn Drawing 3073A-21 Revision

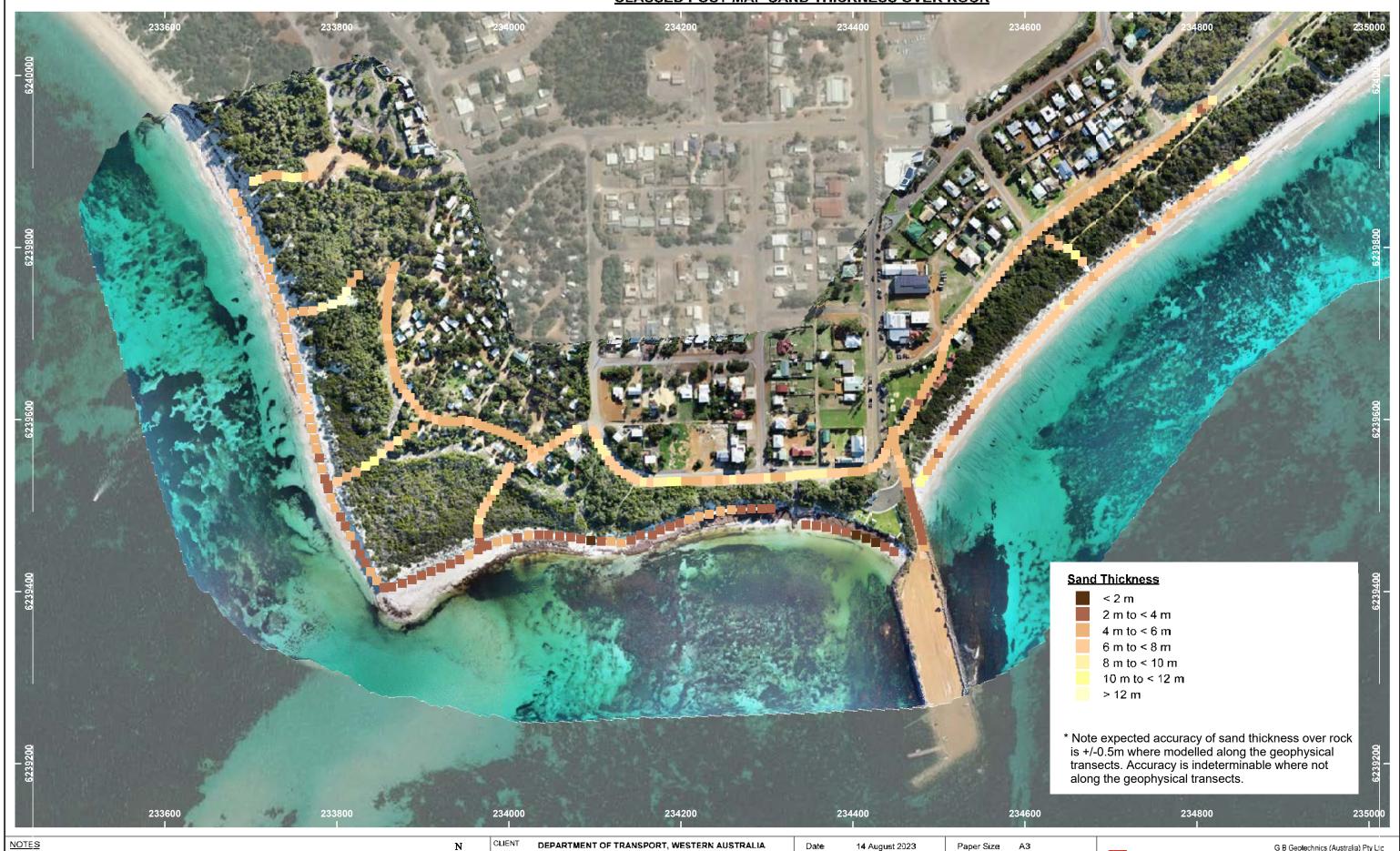


G B Geolechnics (Australia) Pty Lic 1/11 Gympie Way Willetton WA 6155 ABN: 77 009 550 869 Telephone: 02 989C 2122 Email: info@gbgoz com.au

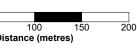


GEOTECHNICAL INVESTIGATION FOR COASTAL EROSION VULNERABILITY ASSESSMENT HOPETOUN, SHIRE OF RAVENSTHORPE WESTERN AUSTRALIA

CLASSED POST MAP SAND THICKNESS OVER ROCK



Drawing to be used in conjunction with Report 3073A Map Projection GDA94 MGA Zone 51.
Aerial image from Google Earth Pro and GBG photogrammetry.



GEOPHYSICAL INVESTIGATION FOR COASTAL
EROSION VULNERABLITY ASSESSMENT
HOPETOUN, SHIRE OF RAVENSTHORPE WA

 Date
 14 August 2923
 Paper Size
 A3

 Scale
 1:4000
 Drawn
 PJE

 Drawing
 3073A-22
 Revision
 †



G B Geotechnics (Australia) Pty Lic 1/11 Gympie Way Willetton WA 6155 ABN: 77 009 550 869 Telephone: 02 989C 2122 Email; info@gbgoz com.au



APPENDIX D - CONE PENETRATION TEST PLOTS

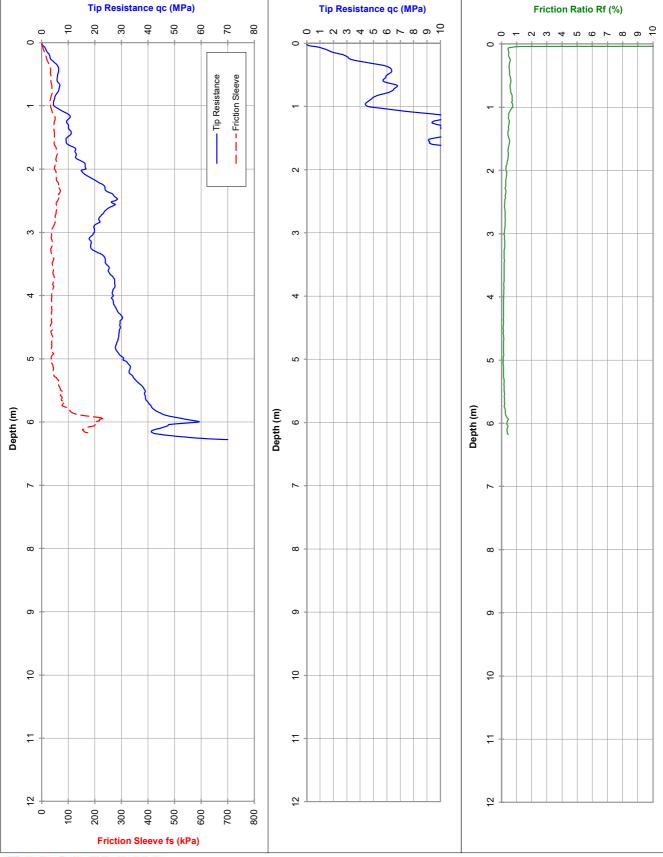
CLIENT: Department of Transport Job No.: 3073

PROJECT: Geophysical Investigation for Coastal Erosion Study RL (m): LOCATION: Hopetoun Co-ords:

Probe I.D

CPT 01

28-Jun-23



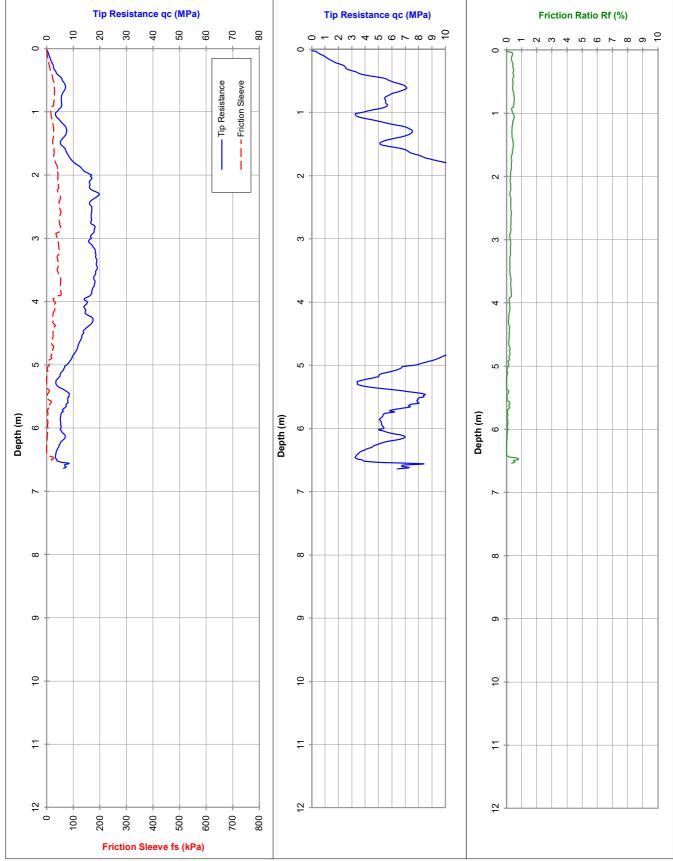
CLIENT: Department of Transport Job No.: 3073

PROJECT: Geophysical Investigation for Coastal Erosion Study RL (m): LOCATION: Hopetoun Co-ords:

Probe I.D

CPT 02

28-Jun-23



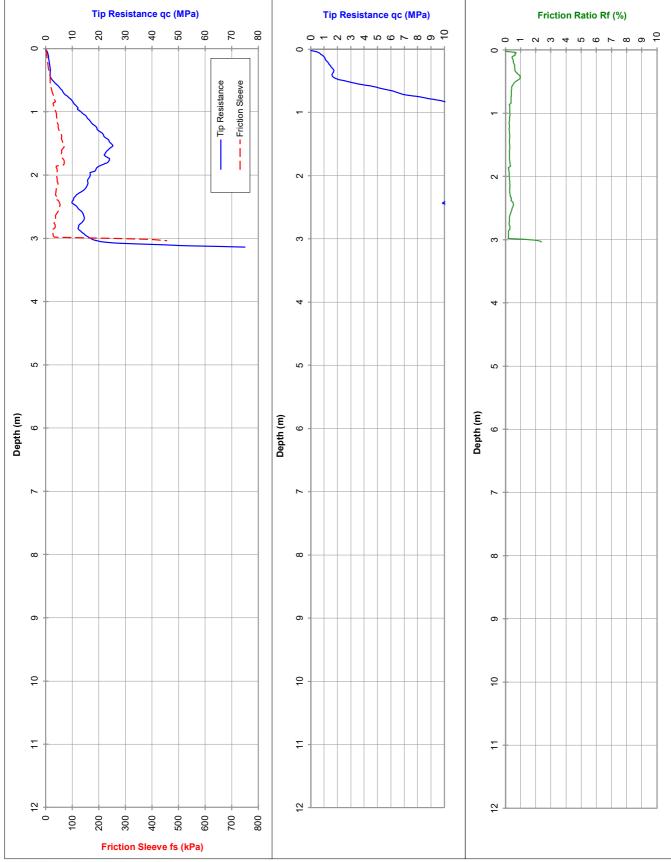
CLIENT: Department of Transport Job No.: 3073

PROJECT: Geophysical Investigation for Coastal Erosion Study RL (m): LOCATION: Hopetoun Co-ords:

Probe I.D

CPT 03

28-Jun-23



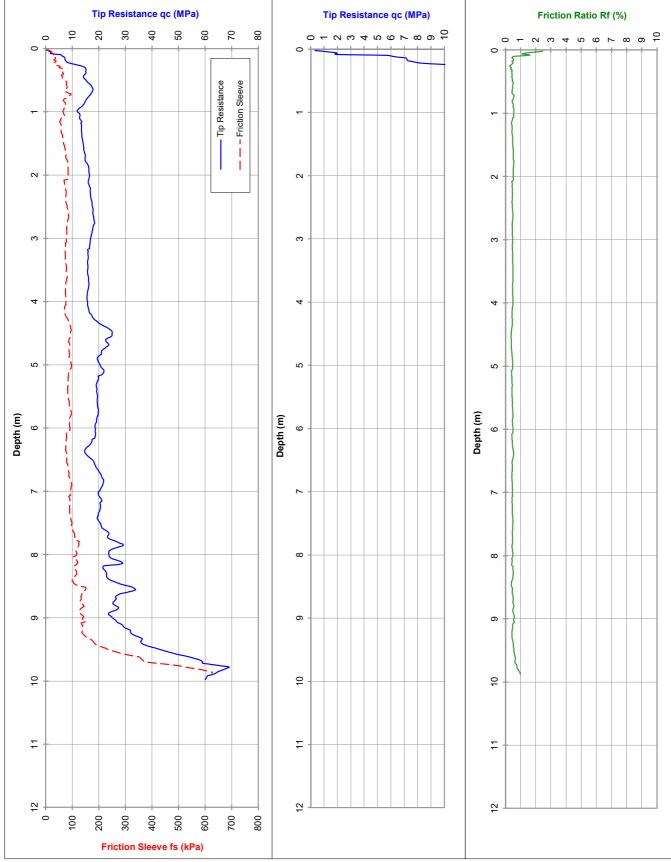
CLIENT: Department of Transport Job No.: 3073

PROJECT: Geophysical Investigation for Coastal Erosion Study RL (m): LOCATION: Hopetoun Co-ords:

Probe I.D

CPT 04

28-Jun-23





Approx. water (m): Dry to 9.7

Dummy probe to (m):

Refusal: 60 MPa + Rod Friction

Cone I.D.: EC16

File: GB0021M2

Rig Type: 11t track (M2)

CLIENT: Department of Transport Job No.: 3073

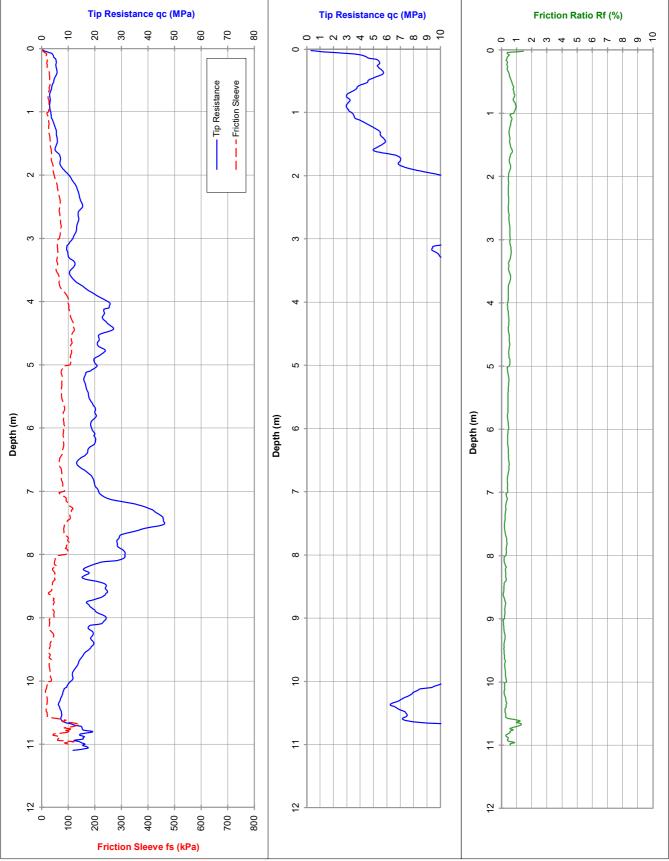
PROJECT: Geophysical Investigation for Coastal Erosion Study RL (m):

LOCATION: Hopetoun Co-ords:

Probe I.D

CPT 05

28-Jun-23



Approx. water (m): Dry to 10.8

Dummy probe to (m):

Refusal: Inclination

Cone I.D.: EC16

File: GB0022M2

Rig Type: 11t track (M2)

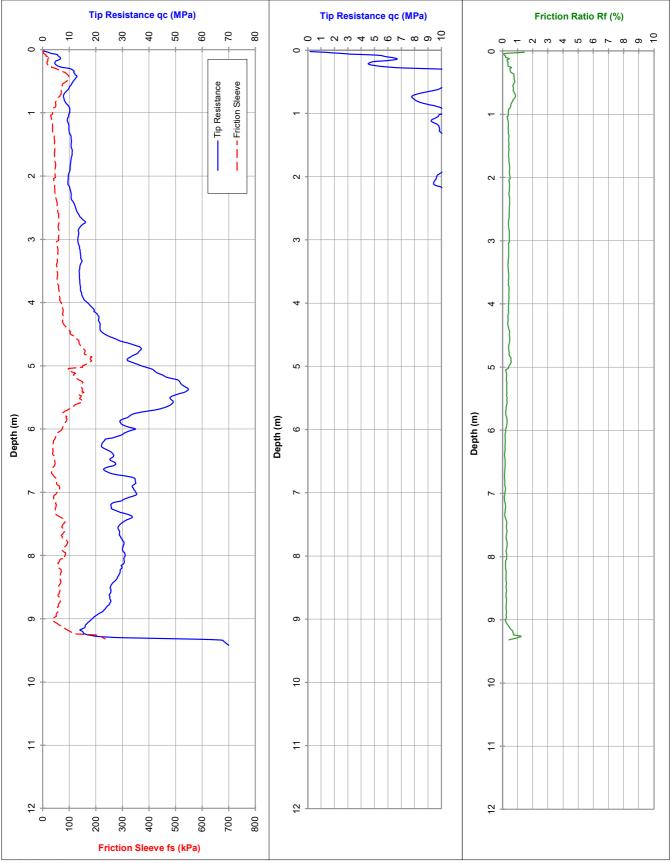
CLIENT: Department of Transport Job No.: 3073

PROJECT: Geophysical Investigation for Coastal Erosion Study RL (m): LOCATION: Hopetoun Co-ords:

Probe I.D

CPT 06

28-Jun-23



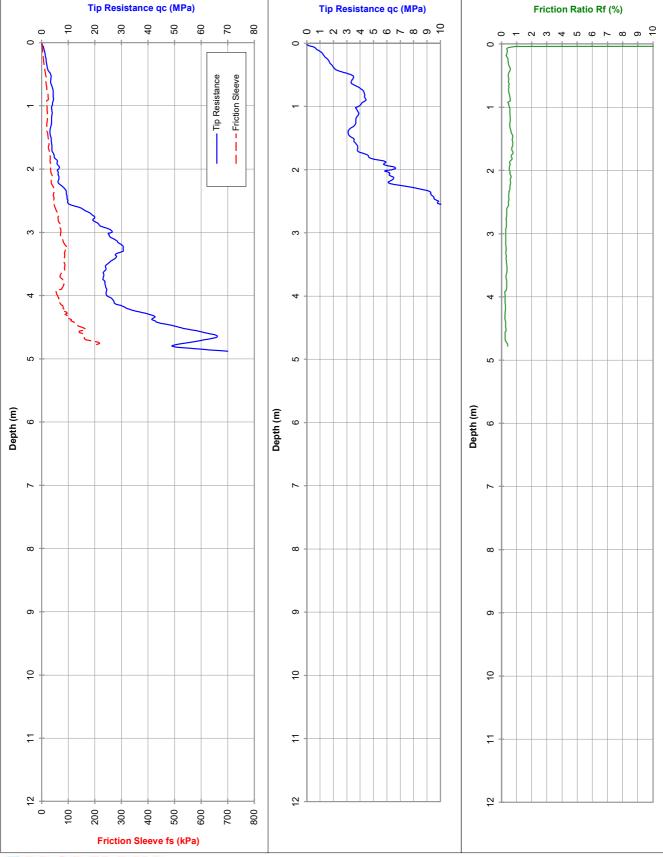
CLIENT: Department of Transport Job No.: 3073

PROJECT: Geophysical Investigation for Coastal Erosion Study RL (m): LOCATION: Hopetoun Co-ords:

Probe I.D

CPT 07

28-Jun-23



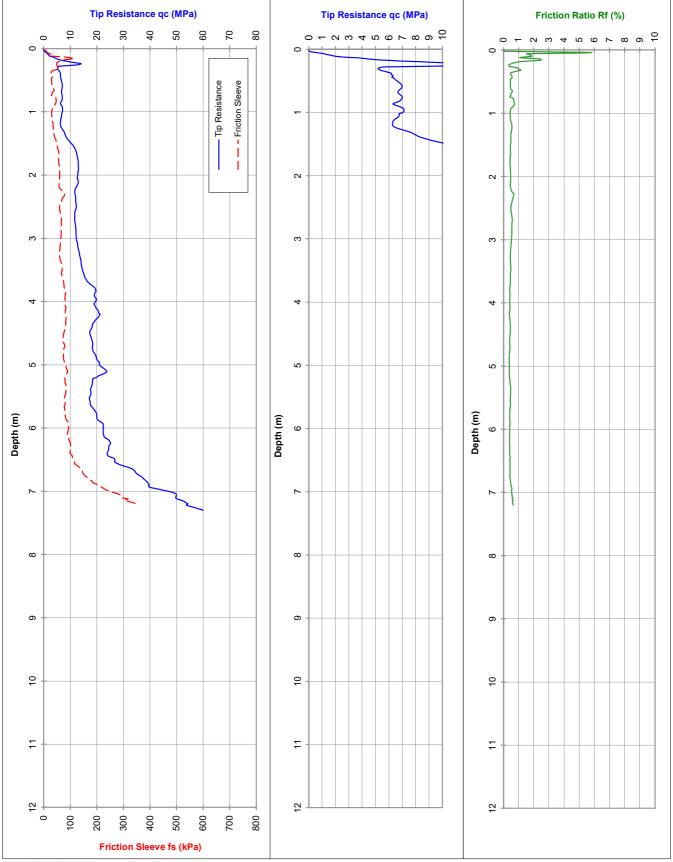
CLIENT: Department of Transport Job No.: 3073

PROJECT: Geophysical Investigation for Coastal Erosion Study RL (m): LOCATION: Hopetoun Co-ords:

Probe I.D

CPT 08

28-Jun-23





CALIBRATION CERTIFICATE

CONE ID: EC16

Cone Type: Compression
Calibration Date (qc/fs): 10 May 2023
Calibration Date (u): 10 February 2023

Preliminary Inspection:

Calibrated By: Henky Lawer

Calibration Procedure: ISO 22476-1:2012, IRTP 2001

Force Application: Compression

Reference Equipment: PT - S type 100kN Serial # 5126009 (Calibrated 10/03/23 - NATA approved Cert. No. 230664)

Bongshin - S type 50kN Serial #W05345 (Calibrated 10/03/23 - NATA approved Cert. No. 230663)

Digitron Panel Meter Serial #: 060213/01 (Calibrated 09/03/23 - NATA endorsed Report No. 230658, 230659, 230660)

u (pore pressure):

Note: In accordance with AS1289 F5.1 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 15000mm³ respectively.

Results of Calibration:

qc (tip resistance):		
Capacity:	100 (MPa)	
Area	1000 (mm²)	
Applied	Eqv. Mean	
Load	Pressure	Observed
kN	MPa	Reading
		Volts
0	0	0.000
10	10	0.757
20	20	1.517
30	30	2.279
40	40	3.040
50	50	3.802
60	60	4.564
70	70	5.326
80	80	6.088
90	90	6.850
100	100	7.613
90	90	6.862
80	80	6.108
70	70	5.351
60	60	4.591
50	50	3.830
40	40	3.067
30	30	2.303
20	20	1.536
10	10	0.769
0	0	0.002
R^2 Value =	1.000	

fs (sleeve friction):		
Capacity:	2000 (kPa)	
Area	15000 (mm²)	
Applied	Eqv.	Mean
Force	Load	Observed
kN	kPa	Reading
		Volts
0	0	0.000
3	200	0.753
6	400	1.512
9	600	2.267
12	800	3.025
15	1000	3.784
18	1200	4.544
21	1400	5.302
24	1600	6.067
27	1800	6.829
30	2000	7.592
27	1800	6.843
24	1600	6.088
21	1400	5.332
18	1200	4.574
15	1000	3.814
12	800	3.054
9	600	2.292
6	400	1.529
3	200	0.764
0	0	0.004
R^2 Value =	1.000	

Capacity:	3500	(kPa)
Position	u2	
Applied	Eqv.	Mean
Pressure	Pressure	Observed
bar	kPa	Reading
		Volts
0	0	0.000
3	300	0.415
6	600	0.830
9	900	1.245
12	1200	1.662
15	1500	2.077
18	1800	2.492
21	2100	2.907
25	2500	3.462
30	3000	4.153
35	3500	4.843
30	3000	4.157
25	2500	3.467
21	2100	2.912
18	1800	2.497
15	1500	2.082
12	1200	1.667
9	900	1.250
6	600	0.834
3	300	0.418
0	0	0.001
R^2 Value =	1.000	

 Zero Load Error:
 0.02%

 Max. Linearity
 0.26%

 Max. Hysteris
 0.38%

MPa/Volt:

Zero Load Error:0.05%Max. Linearity0.23%Max. Hysteris0.40%

263.37

Max. Hysteris 0.14% kPa/Volt: 722.25 Net Area (calibrated): 0.81

Zero Load Error:

Max. Linearity

0.01%

0.12%

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

13.126

kPa/Volt:

Calibration Checked & Authorised: _	Kylie Walker		
Job Details			
Client:	GB Geotechnics	Date of Job:	28/06/2023
Rep:	Andrew Spyrou	Tip Diameter:	35.68
Location:	Hopetoun	Sleeve Diameter	36.0



MOROOKA (M2)

11 tonne track mounted CPT Rig





SPECIFICATIONS

Overall Dimensions	Width: 2.3m; Length: 5.3m; Height: 3.2m (while travelling) Height: 4.4m (while probing)
Gross Weight	11 tonne
Ground Bearing Capacity	0.38 kg/cm ² (37kPa / 5.4psi)
Speed (Low/High)	Low gear: 8.3km High gear: 12km/h on level ground
Grade ability	60%
Engine	Mitsubishi (3910cc) 110 HP @ 2,800 rpm
Fuel Tank	80 L (Diesel)
Drive System	HST
Tracks	600mm wide rubber tracks
Levelling Jacks	0.8m stroke

EQUIPMENT / FEATURES

Other Equipment / Features	2.4m x 1.2m Plastic Bog Boards
	1 x 9kg ABE Fire extinguisher
	Air conditioned work cabin and drive cabin
Transport	Prime Mover & 10m Drop-deck trailer with ramps

SERVICES

Cootoobaical Comissos	CDT CDT., CCDT CCDT., /1 F 10 9 15 tonno conce)
Geotechnical Services	CPT, CPTu, SCPT, SCPTu (1, 5, 10, & 15 tonne cones)
provided	DMT, SDMT
	Dissipation Testing
	Ball Penetrometer
	CPT casing for additional rod support
	Dual Tube (percussion) sampling
	Piston Sampling
	MOSTAP and PROBEDRILL soil sampling
	Vane Shear Testing (Electronically driven)
	Vibrating Wire Installation
	Water Sampling
	Standpipe Installation (20mm; 32mm & 50mm)