HDB Town Planning and Design

Proposed Rezoning

Weemala Development Stage E2

Geotechnical Assessment

Report No. RGS50006.1 - AC

5 May 2022

REGIONAL GEOTECHNICAL SOLUTIONS

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Manning-Great Lakes
Port Macquarie
Coffs Harbour

RGS50006.1 - AC

5 May 2022

HDB Town Planning and Design
PO Box 40
MAITLAND NSW 2320

Attention: Rod Fletcher

Dear Rod,

RE: Proposed Rezoning – Weemala Development Stage E2
Geotechnical Assessment

As requested, Regional Geotechnical Solutions Pty Ltd (RGS) has undertaken a geotechnical assessment for the Proposed Rezoning of Weemala Development Stage E2 located to the east of Main Road Boolaroo.

The results of assessment are presented in this report, together with comments and recommendations regarding the proposed rezoning, slope stability, and proposed deep cuts.

If you have any questions regarding this project, or require any additional consultations, please contact the undersigned.

For and on behalf of **Regional Geotechnical Solutions Pty Ltd**

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1 INTRODUCTION

Regional Geotechnical Solutions Pty Ltd (RGS) has undertaken a geotechnical assessment for the proposed rezoning of a parcel of land located off Main Road, Boolaroo. The rezoning is for Stage E2 of the Weemala Development as illustrated on Diagram 1 below.

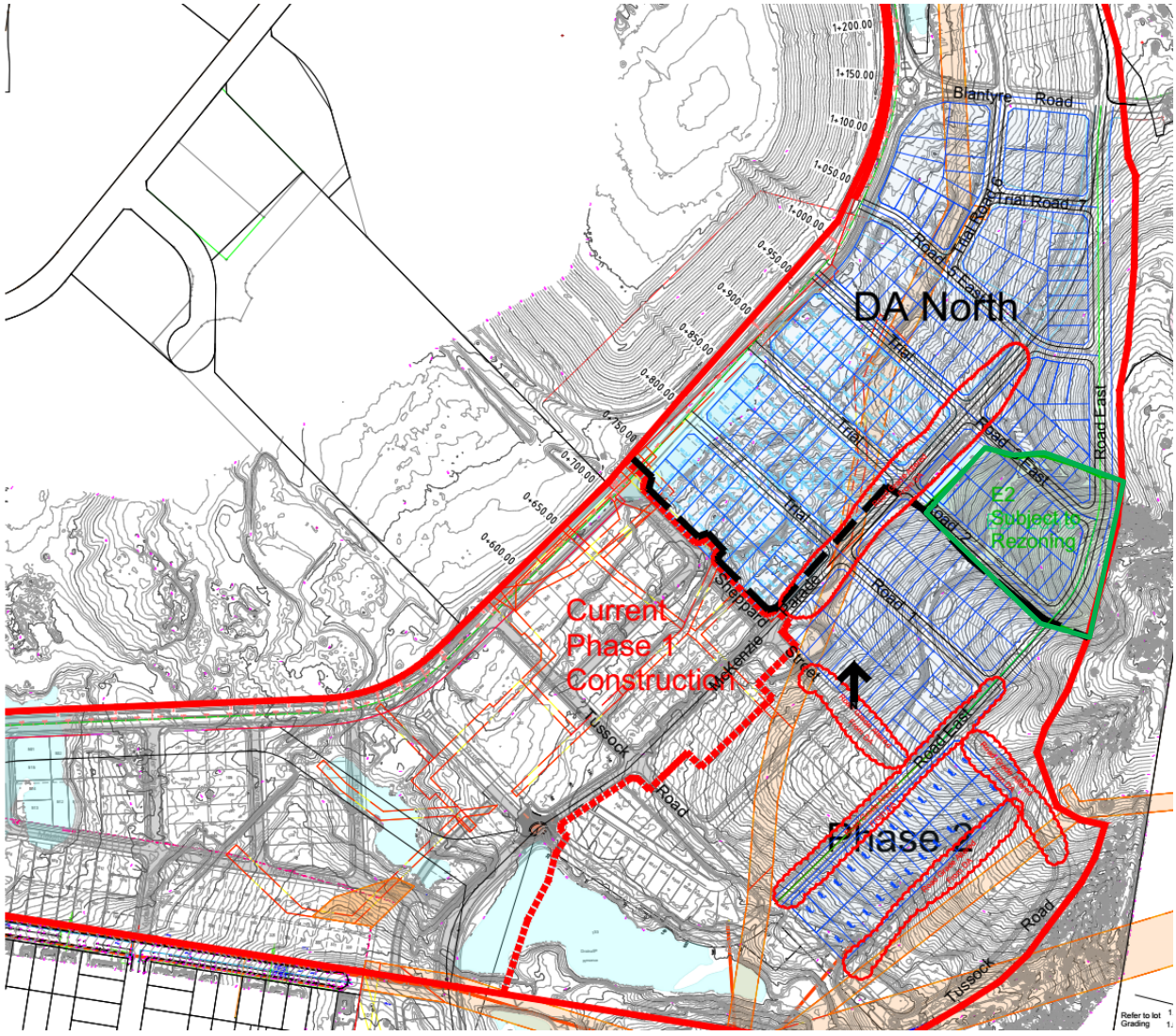


Diagram 1: *Development plan for the site. Stage E2 is outlined green.*

Stage E2 is a parcel of land within Lot 1006 DP 1270101, that is subject to a large-scale subdivision with Phase 1 currently under construction and future stages currently in the planning phase. E2 occupies an area of approximately 2ha and is located near the centre of the lot on the eastern boundary as illustrated above. The site is proposed to be rezoned from C2 Environmental Conservation Zone to R2 Residential Zone.

As part of the rezoning application(s), geotechnical assessment is required. The purpose of the work presented herein is to satisfy the geotechnical requirement to support the re-zoning.

Based on the above, in order to support a rezoning application, the geotechnical assessment herein provides comments and recommendations on the following:

- Review of previous investigations undertaken by RGS for previous stages of the development;
- Assessment of soil properties and reactivity;
- Subsurface profile including the presence and extent of fill (if any) and the presence of groundwater (if encountered within the depths of the investigation);
- Preliminary indication of earthworks requirements;
- Preliminary indication of foundation conditions and road pavement subgrade conditions; and
- Additionally, the investigation has assessed the following:
    - Feasibility and retention of the proposed 8m to 10m cuts in the area;
    - Slope stability within previously identified instability risk area.

2 METHODOLOGY

Field work for the assessment was undertaken by a Senior Geotechnical Engineer from RGS and included:

- A walkover assessment to map the geotechnical conditions including identifying geotechnical hazards, geotechnical terrains, and identification of geotechnical materials;
- The excavation of twelve test (12) pits within the rezoning area and slope instability area;
- The drilling of three (3) boreholes along the crest of the proposed 8m to 10m cut to depths of up to 12.1m with a track mounted rig;
- Collection of samples for subsequent laboratory testing.

Engineering logs of the borehole are presented in Appendix A. The test locations are shown on Figure 1.

3 SITE CONDITIONS

3.1 Surface Conditions

Topographically, the wider site is dominated by two broad, northwesterly plunging ridge spurs that run off the main Munibung Hill ridgeline to the southeast of the site.

The location of E2 was not marked out at the time of the investigation, however, based on a Google Earth overlay, the area was assessed the encompass a west-northwest tending spur located on the western face of the main plunging ridgeline running along the eastern boundary of the site. The location is illustrated below in the satellite image below reproduced from Google Earth with three times elevation exaggeration to illustrate the geomorphology.

Diagram 2: *Google Earth image that illustrates geomorphology of the site. The map has been oriented in a west-northwest direction.*

The spur generally falls to the west-northwest at grades of up to 15°. It is bound by gullies on either side of the spur that are also running down the western face of the main ridge in a west northwest direction. The sides of the spur fall towards the gullies at grades of about 25°, with some localised steeper slopes falling at grades of up to 40° that were in areas generally approaching the centre of the gullies.

Vegetation over the upper portion of the slope comprises thick grass cover with sparse tree regrowth.

The lower portion of E2 is transected by an access track. Weathered sandstone and claystone outcrops are exposed in the toe of the slope above the track. The exposed rock is highly fractured and estimated to be low to medium strength. Weathered rock is also on the surface below the batter of the track and extends over the surface of the entire lower section of E2.

The track is 8.5m wide and the batter has been constructed at about 1.5:1 (about 35°). The track is constructed over the gully that runs along the southwest boundary of the section. Surface water flows from the gully are diverted along the track and directed into the next gully to the north. Some ponding was observed along the track.

Site photographs are presented below.

Looking south over the upper portion of E2.

Lower portion of the slope with weathered rock exposed in the toe above the access track.

Looking up the gully on the northern side of E2

Access track constructed through the site with water pooling.

3.2 Subsurface Conditions

The site is situated within an area underlain by the Boolaroo Sub-Group of the Newcastle Coal Measures. The elevated ridges and steep slopes of Munibung Hill to south and east of the site are formed by the rocks of the Moon Island Beach Sub-Group, which encroaches onto the elevated southern end of the site.

The materials encountered during the investigation are summarised in Table 1 and Table 2. Further details are presented on the attached engineering logs.

Table 1: Summary of Geotechnical Units

Unit	Material	Material Description
Unit 1	Colluvial Soil	Silty CLAY, medium to high plasticity, with some fine to coarse grained angular gravel, firm to stiff
Unit 2	Residual Soil	Sandy CLAY and Silty CLAY, medium to high plasticity, fine to medium grained sand, firm to very stiff.
UNIT 3	Extremely Weathered Sandstone/Siltstone	Sandy CLAY, medium to plasticity, fine to medium grained sand, hard/friable.
UNIT 4	Moderately Weathered Sandstone/Siltstone	SANDSTONE/SILTSTONE, fine to medium grained, laminated to thinly bedded fractures generally spaced at 50mm to 400mm, generally low to medium strength, with medium to high strength bands of slightly weathered material. Generally interbedded with very low strength tuffaceous sandstone and coal layers.
UNIT 5	Tuffaceous Sandstone	TUFFACEOUS SANDSTONE, fine grained, laminated, very low to medium strength
UNIT 6	Coal	Weathered Coal, generally fragmented to highly fractured, very low to low strength
UNIT 7	Moderately to Fresh Weathered Sandstone/ Siltstone	SANDSTONE/SILTSTONE, fine to medium grained, laminated to thinly bedded fractures generally spaced at 50mm to 400mm, medium to high strength

Table 2: Summary of Subsurface Profile

Borehole	Depth of Material Layer (m)						
	UNIT 1 Colluvial Soil	UNIT 2 Residual Soil	UNIT 3 EW Sandstone/ Siltstone	UNIT 4 HW - MW Sandstone/ Siltstone	UNIT5 Tuffaceous Sandstone	UNIT 6 Coal	UNIT 7 MW - FR Sandstone/ Siltstone
BH1	--	0 – 1.1	--	1.1 – 3.95	3.95 – 8.4	--	8.4 - ≥9.3
BH2	--	--	--	0 – 6.8		8.65-8.9+ 945 – 9.55	6.8 – ≥10
BH3			2^ – 8	--	9.1 – 11.5	3.4 – 8 (interbedded with unit 3) 9 – 9.1	11.5 – ≥12.1
TP1	--	0 – 0.5	--	0.5 - 2	--	--	2 – ≥2.3*
TP2	--	0 – 0.8	0.8 – 1.3	1.3 – 1.8	--	--	1.8 – ≥2.3*
TP3	0 - 1	1.2 – 1.6			2.1 – 2.9 3.2 – ≥3.5	1 – 1.2 1.6 – 2.1 2.9 – 3.2	--
TP4	--	0 - 0.8	--	0.8 – 1.4	--	--	1.4 – ≥1.9*
TP5	0 – 0.8	--	--	0.8 – 1.1	1.1 – 1.3	1.3 - ≥1.4*	--
TP6	0 – 0.6	--	0.6 -1.1	1.1 – 1.4	--	1.4 - ≥1.6*	--
TP7	0 – 0.4				0.4 – 1.0	1 – 1.1	1.1 – ≥1.2*
TP8	0 – 0.8	--	--	--	1.0 – ≥3.0	--	--

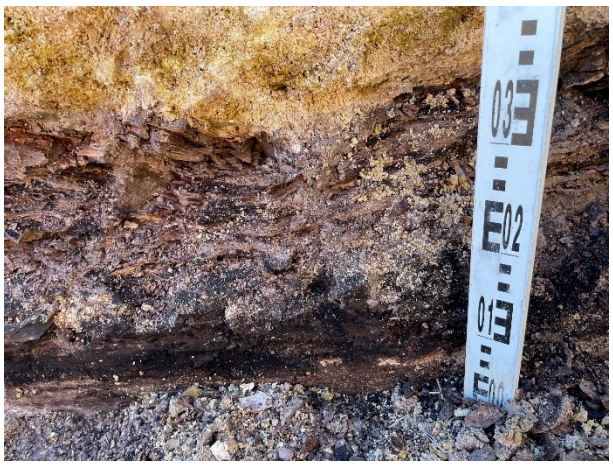
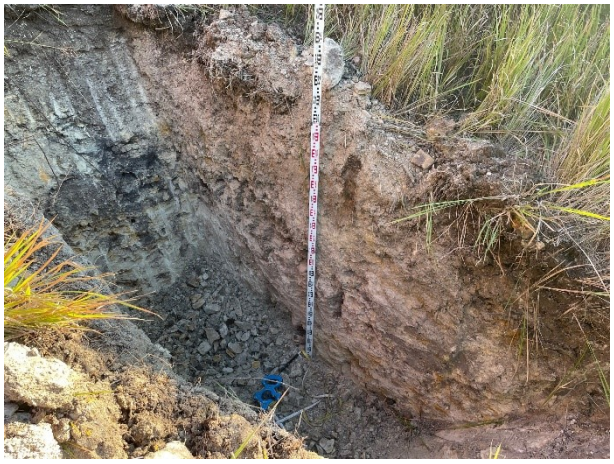
Borehole	Depth of Material Layer (m)						
	UNIT 1 Colluvial Soil	UNIT 2 Residual Soil	UNIT 3 EW Sandstone/ Siltstone	UNIT 4 HW - MW Sandstone/ Siltstone	UNIT5 Tuffaceous Sandstone	UNIT 6 Coal	UNIT 7 MW - FR Sandstone/ Siltstone
TP9	--	--	--	--	0 – 0.9	--	0.9 – ≥1.2*
TP10	--	--	--	--	0 – 0.7 0.9 – 1.5 2.0 – ≥3.5	0.7 – 0.9 1.5 – 2.0	--
TP11	0 – 0.7	--	--	--	0.7 – 1.4	--	1.4 – ≥2.0
TP12	0 – 0.6	--	--	--	0.6 – 1.1	1.1 – ≥1.3*	--

Note:
≥ Indicates that base of material layer was not encountered
* Indicates that the borehole was terminated due to practical refusal on rock
-- Indicates that the material was not encountered at the test location
+ Indicates material inferred based on core loss
^ Indicates material above comprised conglomerate, borehole was drilled at approx. 2m above top of proposed cut
Up to 0.2m of topsoil was encountered in some of the borehole/test pit locations

A general representation of the profile encountered is illustrated below.

TP3 was excavated in the upper slope of the spur and encountered colluvial/residual soil overlying tuffaceous sandstone with interbedded coal layers.

TP 4 was excavated about 20m downslope of TP3 and did not encounter coal seams. The test pit encountered practical refusal at 1.9m

	
TP6 was excavated in the mid slope of the spur above the access track and encountered a low strength coal layer followed by practical refusal at 1.6m	*Close up of material refused on in TP6.*
	
TP11 was excavated on the upper slope of the northern face of the spur and encountered colluvial soil overlying very low strength tuffaceous material overlying medium strength sandstone.	*TP12 was excavated about 20m downslope of TP11 and encountered colluvial soil overlying tuffaceous material overlying interbedded claystone/coal followed by practical refusal at 1.3m.*

Groundwater was encountered within TP1, TP2, and TP10, at depths ranging from 03m to 1.8m, and in some test pits at multiple depths, groundwater was not encountered within the other test pits. Due to the use of drilling water groundwater levels could not be accurately read within the boreholes. No long-term monitoring was undertaken.

It should be noted that fluctuations in groundwater levels can occur as a result of seasonal variations, temperature, rainfall, and other similar factors, the influence of which may not have been apparent at the time of the assessment.

A summary of the laboratory Atterberg limits test and point load test results are presented in Table 3 and Table 4. Laboratory test result sheets are presented in Appendix B.

Table 4: Laboratory Test Results Summary – Atterberg Limits

Test Location	Depth	Material	Liquid Limit (%)	Plasticity Index (%)	Linear Shrinkage (%)	Inferred Shrink – Swell Index (%)
TP3	1.4 – 1.5	Residual CLAY	62	38	13	2.6
TP4	0.4 – 0.5	Residual CLAY	73	48	18	3.6
TP5	0.4 – 0.5	Colluvial CLAY	73	44	14	2.8
TP6	0.4 – 0.4	Colluvial CLAY	82	58	21	4.2
TP11	0.55 – 0.75	Colluvial CLAY	65	38	15	3.0

Table 5: Laboratory Test Results Summary – Point Load Index

Test Location	Depth	Rock Type	Diametral $I_{s(50)}$ (MPa)	Strength Classification	Axial $I_{s(50)}$ (MPa)	Strength Classification	Inferred UCS (MPa)
BH1	2.81-2.94	MW Sandstone	0.08	**VL**	0.12	**L**	**2.36**
BH1	3.43-3.55	MW Sandstone	0.63	**M**	0.66	**M**	**13.22**
BH1	5.0-5.07	MW Tuffaceous Sandstone	0.62	**M**	0.25	**L**	**4.92**
BH1	7.66-7.75	MW Tuffaceous Sandstone	0.07	**VL**	0.10	**L**	**2.08**
BH1	8.73-8.81	SW Siltstone	2.26	**H**	2.56	**H**	**51.11**
BH1	8.92-9.0	SW Sandstone	2.28	**H**	--	--	--
BH2	5.25-5.35	MW Sandstone	0.18	**L**	0.28	**L**	**5.66**
BH2	7.05-7.2	SW Siltstone	1.98	**H**	3.08	**VH**	**61.66**
BH2	7.64-7.7	SW Sandstone	0.56	**M**	2.61	**H**	**52.22**
BH2	9.8-9.88	MW Siltstone	0.05	**VL**	0.15	**L**	**2.95**
BH3	8.46-8.58	EW Tuffaceous Sandstone	0.11	**L**	0.06	**VL**	**1.22**
BH3	10.86-10.95	EW Tuffaceous Sandstone	0.05	**VL**	0.18	**L**	**3.64**
BH3	12.0-12.1	MW Sandstone	0.11	**L**	0.06	**VL**	**1.22**

4 PROPOSED DEVELOPMENT

Cuts of up to 10m are proposed within the E2 section as illustrated below.

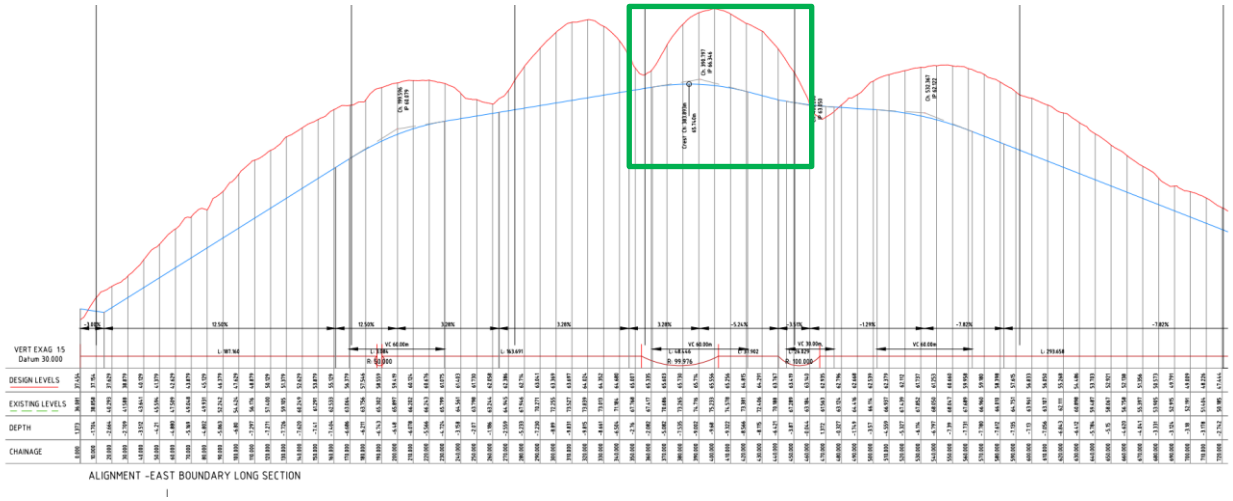
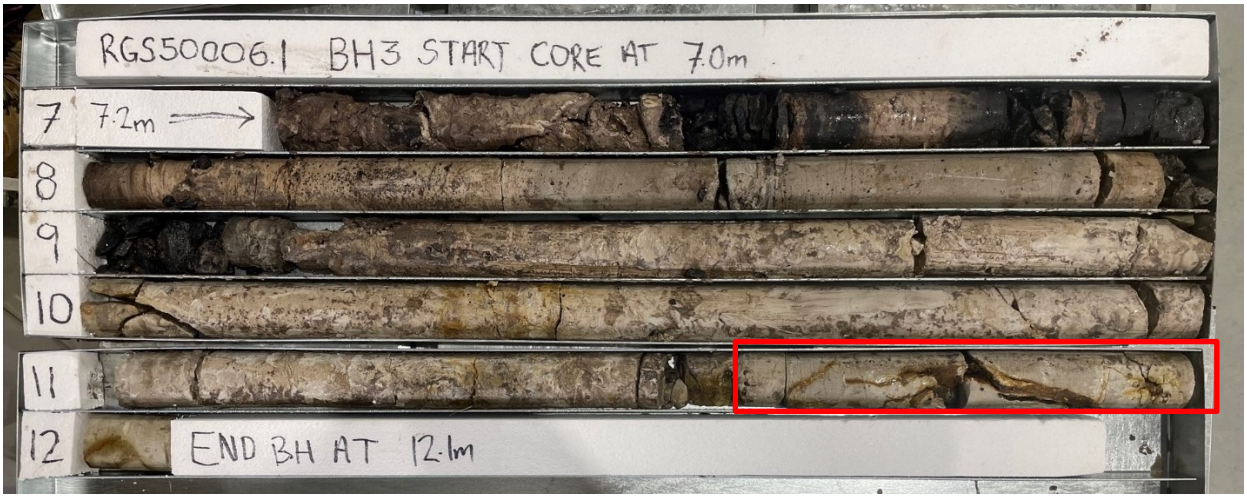


Diagram 3: *Proposed Civil Design with approximate location of E2 outlined green.*

Based on the contour map it is understood that the base of the cut will be at approximately the level of the exposed weathered rock located on the downslope side of the access track that bisects the site. Based on the boreholes undertaken this material is expected to extend through the base of the entire cut.

Weathered rock outcrops exposed below the access track



Similar material encounterd in BH3 from a depth of 11.5m

5 SOIL CAPABILITY

5.1 Nature of Site Soils & Suitability for Reuse as Engineered Fill

The site generally had a subsurface profile comprising:

- Topsoil; overlying
- Colluvial soils comprising medium to high plasticity firm to stiff Silty CLAY; or
- Residual Soil comprising Silty CLAY and Sandy CLAY medium to high plasticity, firm to very stiff; overlying
- Weathered Rock comprising interbedded extremely weathered to slightly weathered sandstone, siltstone, tuffaceous sandstone, and coal.

A summary of the suitability of the site materials for reuse as controlled fill is presented below:

- Topsoil will not be suitable for reuse as controlled fill, however, the material may be reused for landscaping purposes;
- The colluvial and residual soils will be suitable for reuse as controlled fill, however, the material is highly reactive and consideration is required for future foundation designs as discussed in Section 4.3. The firm material encountered in TP6 and TP7 will require some moisture conditioning;
- The weathered rock profile will be suitable for reuse as controlled fill, however, the following should be considered:
    - Moisture control will be required for the tuffaceous sandstone layers due to the high silt content, it would be recommended to be placed and compacted slightly dry of optimum moisture content;
    - The slightly weathered siltstone and sandstone layers are expected to be excavated in large blocks up to 1m diameter and may require rock hammers or large compactors to breakdown.

5.2 Excavatability

The proposed deep cuts will predominantly encounter colluvial and residual soils overlying low to medium strength fractured sandstone and siltstone, tuffaceous sandstone, and coal that will generally excavate with the use of a medium to large excavator. As a guide the investigation was undertaken with a 23.5 tonne excavator, that achieved excavation within the low strength material, however, practical refusal was encountered within the high strength sandstone and coal layers. Generally, the edges of the spur and the lower portion of the slope encountered practical refusal at depths ranging from 1.2m to 1.9m. In the central and upper portions of the slope test pits were extended to up to 3.5m without refusal.

In a large bulk excavation these materials are likely to be excavatable by ripping with a large dozer, equipped with ripping tynes. Some harder rock that might require harder ripping or the use of rock hammers will likely be encountered. Of note is the siltstone encountered in BH1 from 8.4m and the sandstone encountered in BH2 from 7.2m.

Due to the nature of the weathering process of the tuffaceous materials some areas will encounter higher strength weathered sandstone/siltstone underlain by very low strength extremely weathered tuffaceous sandstone.

The use of rock hammers may be required in detailed excavations such as service trenches, or to avoid overbreak in detailed excavations. Where permanent cut batters will remain in the proposed deep cuts on the site boundaries, the use of pre-drilling, header wheels, or rock breakers to avoid overbreak will result in a cleaner and less fractured final batter than that produced by ripping alone, which would be advantageous for aesthetic appearance and future maintenance within a residential development area in the long term.

5.3 Preliminary Earthworks Requirements

Site preparation prior to the proposed site regrade will involve selective stripping and stockpiling of vegetation, localised areas of topsoil, and any organic, deleterious or otherwise unsuitable materials. These should be removed to spoil or stockpiled for re-use as landscaping materials within the proposed subdivision.

Residual and colluvial soils, and weathered rock excavated for proposed cuts can be stockpiled for later use. Some material may need to be moisture conditioned. Stripped surfaces should be proof rolled to identify any soft, excessively wet or heaving areas that should be removed and replaced with approved engineering fill prior to placement of further fill above.

The groundwater table is not expected to be encountered within the proposed excavations. However, water flows through joints and other defects within the weathered rock profiles may be encountered. The water tends to flow laterally through these layers and daylights as seepage on the slopes below wherever the coal or lower sandstone beds intersect the slope.

As discussed above, the access track constructed through the site has filled over the gully that runs along the southeast boundary of E2 impeding the natural flow path of surface waters. It is recommended that this is cleared or where filling of these gullies is required a drainage blanket must be incorporated. The blanket should comprise a geofabric wrapped drainage blanket of durable hard crushed rock placed in the base of the gully.

Some scouring of the surface was observed generally within the exposed weathered rock in the lower portion of the section. Scour and erosion are expected to be managed by controlling

stormwater runoff to divert away from the site into the stormwater system and re-establishing vegetation. Erosion protection such as geosynthetic meshes, geo-cells, etc will be required on cut/fill batter faces.

5.4 Preliminary Foundation Conditions

Based on the proposed cut depths the subgrade level is expected to be within a low to medium strength weathered sandstone profile. Based on this shallow footing systems are likely to be suitable for the support of structures at the site.

For conceptual purposes, for structures that meet the performance requirements detailed within AS2870-2011 '*Residential slabs and footings*' founded within weathered sandstone to be classified in accordance with AS2870-2011 as Class A.

If filling is undertaken in areas of proposed areas of structures, it is recommended to utilise the ripped weathered rock as engineered fill. The use of residual and colluvial clay in the upper 1.5m profile will result in significant shrink swell movement. The Atterberg limits testing indicates the residual and colluvial clay could have a shrink swell index of up to 4.2%. The use of this material in the upper 1.5m would be expected to produce a site classification of Class H2 or even high if trees are planted within the zone of influence of proposed structures.

Further assessment must be undertaken during the design stage of the development.

5.5 Preliminary Pavement Subgrade Conditions

Subgrades beneath proposed pavements are likely to comprise weathered siltstone or sandstone. These materials are likely to produce subgrades with four day soaked CBR values of about 8 to 10%. CBR values of 3 to 5% are likely if clay fill is proposed below pavements.

Investigations will need to be undertaken at completion of the bulk earthworks to confirm subgrade conditions and resultant pavement thickness designs.

6 SITE SUITABILITY

Based on the results of the assessment as outlined herein the site is considered suitable for the proposed residential development from a geotechnical perspective.

Further geotechnical assessment will be required for the purpose of specific earthworks, road pavement, and foundation design.

7 SLOPE STABILITY

7.1 Risk Assessment

The risk of slope instability has been assessed using the principles and procedures of the Australian Geomechanics Society publication *Practice Note Guidelines for Landslide Risk Management, 2007*. This methodology represents the currently accepted state of practice for landslide risk assessment in Australia.

The slope risk assessment process involves identification of a potential slope failure event, or hazard, followed by an estimation of the likelihood of the event occurring, and the potential consequences should the event occur. The onus is on the property owner, potential owner, or other interested party to decide whether the assessed level of risk is acceptable taking into account likely economic consequences of the risk and the recommended geotechnical constraints.

The terms used in the risk assessment process are defined below:

Hazard: A condition with the potential for causing an undesirable consequence.

Likelihood: The estimated probability that the hazardous event will occur.

Consequence: Loss or damage resulting from a hazard event.

Risk: A term combining the likelihood and consequence of an event in terms of adverse effects to property or the environment.

7.2 Hazard Identification

Based on the site walk over the following areas of concern were identified:

- Steep gully walls in particular within the northern face of the spur to the south of E2; and
- Over steep batter of track constructed through the site.

These areas are illustrated in the satellite image and photographs below.

Diagram 4: *Identified slope risk areas outlined red.*

Steep gully walls within spur face south of E2.

Access track bisecting site with a batter up to 35°.

Material encounter in spur face (TP1).

Fractured rock with clay coating encountered in TP1.

The following potential slope stability hazards were assessed in relation to the site and the consequences to surrounding properties:

Hazard 1: Translational slide of soil and weathered rock profile within steep gully wall resulting from ongoing stress relief due to erosion and valley formation processes that would cause debris flows. Debris flows could impact on structures or property located below the zone of instability. Debris flows of the magnitude that would typically cause moderate to major damage to structures or property in their path.

Hazard 2: Translational or rotational sliding due to failure of unsupported cuts and fills or poorly designed, constructed, or otherwise inadequate retaining walls. Such a failure could cause localised damage requiring moderate repairs to part of an individual structure or property.

Hazard 3: Translational or rotational slide of profile along weak tuffaceous or coal layers. Should such a failure occur it could potentially cause extensive structural damage

and require large scale, costly repairs, and possibly temporary evacuation of the building until repairs are complete.

7.3 Risk Evaluation for Existing Site Conditions

Table 2 summarises the factors affecting slope stability in relation to each of the hazards identified and assesses the risk of slope instability for each using the risk assessment matrix provided in Appendix C of the Australian Geomechanics Society (AGS) publication *Practice Note Guidelines for Landslide Risk Management, 2007*.

A copy of the risk matrix from the AGS document is presented in Appendix C.

Table 6: Assessed risk of Slope Instability

Hazard	H1 – Large scale landslide and debris flow	H2 – Localised failure of poorly retained cuts/fill batters	H3 – Translational or rotational slide of profile along weak tuffaceous or coal layers
Slope height	10m	Up to 3m	10 - 20m
Cause or trigger	Slope deterioration followed by extreme prolonged weather	Cut steeper than angle of repose, unsupported,1 in 10yr rain event	Slope deterioration followed by extreme weather
Proportion of slope	0.5	0.1	0.5
Estimated probability	10^{-5} yr	10^{-3} yr	10^{-5} yr
Assessed Risk Without Mitigation			
Likelihood	Rare	Possible	Unlikely
Consequence	Major	Minor	Major
Risk	Low	Moderate	Moderate
Proposed Mitigation	Install upslope drainage to divert water flows away from the face, install erosion protection.	Avoid or retain cuts >1m. Deep cuts constructed in accordance with Section 8 of this report. Remove or reconstruct access track with batt of up to 3:1	Potential failure plane expected to be removed within proposed cut depth, if not further assessment required. All structures should be founded within weathered rock.
Assessed Risk with Mitigation			
Likelihood	Rare	Rare	Rare
Consequence	Major	Minor	Major
Risk	Low	Very Low	Low

7.4 Evaluation of Risk Level

The assessment indicates a **Low to Moderate** risk of slope instability affecting the site. As shown in Table 6, by adopting the recommendations of this report, the risks can be reduced to **Low**.

This risk rating would normally be considered acceptable in Australia for hillside residential construction.

8 PROPOSED DEEP CUTS

8.1 Cut batters up to 1V:2H in soil or 1V:1H in rock

The permanent cut batters in the excavations at the site boundary will expose shallow soil profiles overlying weathered rock, predominantly comprising thinly bedded and fractured moderately to highly weathered sandstone and siltstone interbedded with coal and tuffaceous sandstone. Where space permits, these permanent cut slopes can be battered at 2H:1V for the shallow soil profile, and 1H:1V in rock. For cuts deeper that 4m a 1m wide horizontal bench would be recommended at the mid-point of the cut.

The boreholes revealed a profile of shallow soils underlain by weathered sandstone and siltstone, underlain by weathered tuffaceous sandstone, underlain by weathered sandstone/siltstone. Due to the weathering process of the tuffaceous material, it will generally behave like the residual clay profile.

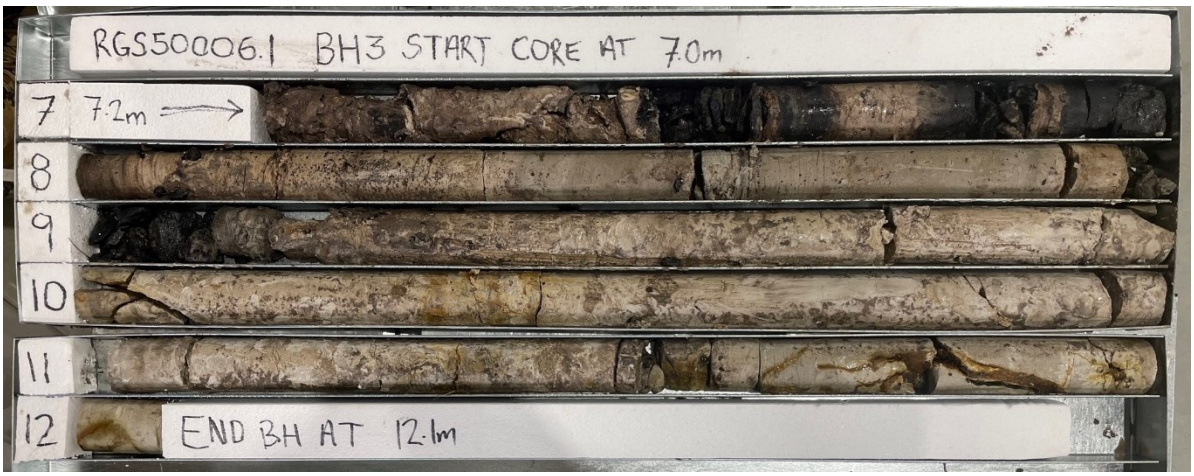
The face is likely to fret and erode with time and therefore some erosion protection should be applied to the face to prevent accumulation of fines at the base of the cuttings which is likely to clog drainage and be aesthetically unacceptable in a residential development in the long term. Options include geosynthetic meshes, geo-cells and the like, used to support landscaping soil and vegetation, or shotcreting of the face.

If shotcrete is used for long term support, it must be doweled into the slope and provided with drainage measures such as strip drain pinned to the rock face and connected to weep holes at regular spacings through the shotcrete to prevent accumulation of water between the rock surface and the shotcrete facing. Fibrecrete sprayed directly onto the face with no dowelling, as is often used for temporary protection of rock faces in construction excavations, would not be suitable for the long-term protection of the face.

8.2 Support of cut Batters Steeper than 1H:1V

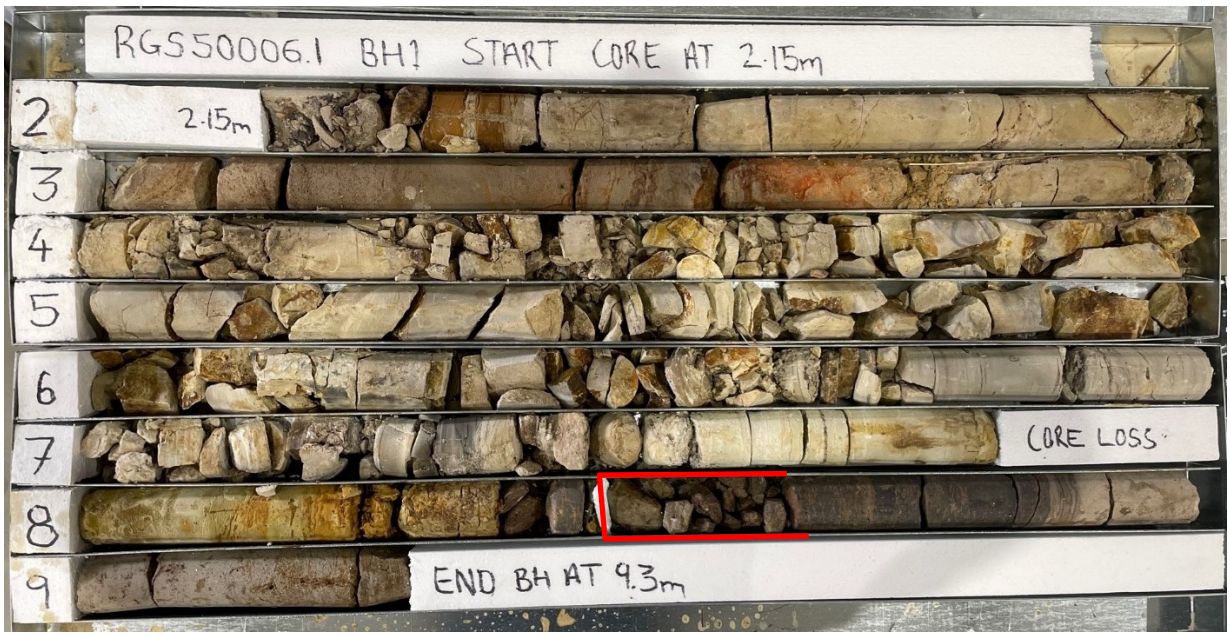
It is anticipated that the deep cut along the eastern boundary may be required to be steeper than 1H:1V due to space constraints.

The majority of the cuttings will expose weathered, highly fractured, and low strength rock with isolated seepage along defects for the full depth of the cut. Materials typically exposed below the upper soil profile would be similar to those encountered by the coring in borehole BH2, as illustrated in the photograph below.



Cuts exceeding 1.5m depth and battered at 1H:1V batter angle of steeper in materials of this nature will require support by a pattern of rock bolting and shotcrete facing. Bolts would be grouted in to Bolt and shotcrete requirements to support cuts. Detailed design of rock bolts and shotcreteing can be undertaken when further details of the proposed cuts are known.

Based on the boreholes the spur to the north will encounter better quality, slightly to moderately weathered sandstone/siltstone, with typical fracture spacings varying from fractured zones at 20mm spacing to 400mm spacings from about 7m to 8.5m. It is expected that the profile will be similar to that encountered by borehole BH1, as illustrated in the core photograph below.



Medium to high strength material encountered in BH1 from 8.4m

Medium to high strength material encountered in BH2 from 7.2m

For this lower part of the cutting, at the batter angles of 0.75H:1V the profile would be expected to be generally "self-supporting" over a large proportion of the cut, and retention measures such as rock bolts are only expected to be required in isolated locations where fracturing and other adverse features are exposed. Bolt and shotcrete requirements for the lower half of this cutting would need to be assessed progressively as excavation proceeds on site, to allow for spot rock bolting of potentially unstable blocks and wedges in the face, together with localised shotcreting.

9 LIMITATIONS

This report comprises the results of an investigation carried out for a specific purpose and client as defined in the document. The report should not be used by other parties or for purposes or projects other than those assumed and stated within the report, as it may not contain adequate or appropriate information for applications other than those assumed or advised at the time of its preparation. The contents of the report are for the sole use of the client and no responsibility or liability will be accepted to any third party. The report should not be reproduced either in part or in full, without the express permission of Regional Geotechnical Solutions Pty Ltd.

Geotechnical site investigation is based on data collection, judgment, experience, and opinion. By its nature, it is less exact than other engineering disciplines. The findings presented in this report and used as the basis for the recommendations presented herein were obtained using normal, industry accepted geotechnical design practises and standards. To our knowledge, they represent a reasonable interpretation of the general condition of the site. Under no circumstances, however, can it be considered that these findings represent the actual state of the site at all points.

The recommended depth and properties of any soil, rock, groundwater, or other material referred to in this report is an engineering estimate based on the information available at the time of its writing. The estimate is influenced and limited by the fieldwork method and testing carried out in the site investigation, and other relevant information as has been made available. In cases where information has been provided to Regional Geotechnical Solutions for the purposes of preparing this report it has been assumed that the information is accurate and appropriate for such use. No responsibility is accepted by Regional Geotechnical Solutions for inaccuracies within any data supplied by others.

If site conditions encountered during construction vary significantly from those discussed in this report, Regional Geotechnical Solutions Pty Ltd should be contacted for further advice.

This report alone should not be used by contractors as the basis for preparation of tender documents or project estimates. Contractors using this report as a basis for preparation of tender documents should avail themselves of all relevant background information regarding the site before deciding on selection of construction materials and equipment.

If you have any questions regarding this project, or require any additional consultations, please contact the undersigned.

For and on behalf of **Regional Geotechnical Solutions Pty Ltd**

Prepared by

Louis Davison

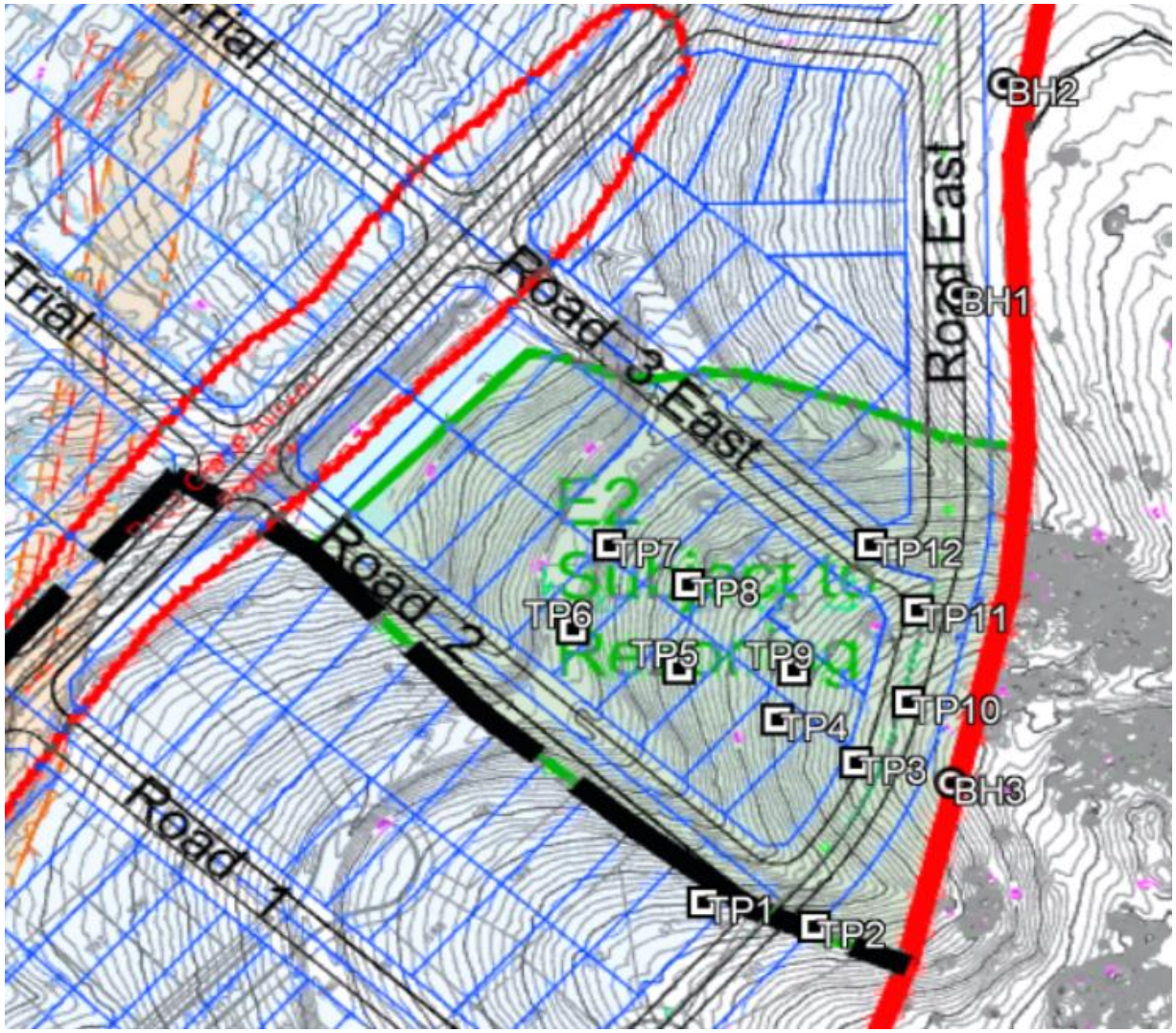
Senior Geotechnical Engineer

Reviewed by

Adam Holzhauser

Principal Geotechnical Engineer

Figures



REGIONAL GEOTECHNICAL SOLUTIONS	**Client:**	HDB Town Planning and Design	Job No.	RGS50006.1
	Project:	Proposed Rezoning	Drawn By:	LD
		Weemala Development Stage E2 Boolaroo	Date:	6-May-22
	Title:	Test Plan Over Proposed Works	Drawing No.	**Figure 1**

REGIONAL GEOTECHNICAL SOLUTIONS	**Client:**	HDB Town Planning and Design	Job No.	RGS50006.1
	Project:	Proposed Rezoning	Drawn By:	LD
		Weemala Development Stage E2 Boolaroo	Date:	6-May-22
	Title:	Test Plan Satellite Image	Drawing No.	**Figure 2**

Appendix A

Results of Field Investigations

REGIONAL GEOTECHNICAL SOLUTIONS

ENGINEERING LOG - TEST PIT

TEST PIT NO: TP1

CLIENT: HDB Town Planning and Design | **PAGE:** 1 of 1

PROJECT NAME: Proposed Rezoning | **JOB NO:** RGS50006.1

SITE LOCATION: Weemala Development Stage E2 | **LOGGED BY:** LD

TEST LOCATION: Refer to Figure 1 | **DATE:** 5/4/22

EQUIPMENT TYPE: 15T Excavator | **EASTING:** 372326 m | **SURFACE RL:**

TEST PIT LENGTH: 4.0 m | **WIDTH:** 1.5 m | **NORTHING:** 6353684 m | **DATUM:** AHD

Excavation and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (Not measured)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E				0.5		CL	**Sandy CLAY:** Medium plasticity, pale grey, dark grey, fine to medium grained sand	M < w_P	St - VSt			RESIDUAL
							0.50m					
				1.0			**SANDSTONE:** Fine to medium grained, pale brown, grey, laminated, fractured, spaced at 10-200mm, fractures coated with clay, dark grey					MODERATELY WEATHERED SANDSTONE VERY LOW TO LOW STRENGTH Minor greywater inflow at 0.8m
				1.5								
				2.0								
							2.00m **SANDSTONE:** Fine to medium grained, pale grey					SLIGHTLY WEATHERED TO FRESH SANDSTONE MEDIUM STRENGTH
				2.5			2.30m Hole Terminated at 2.30 m Practical Refusal					
				3.0								
				3.5								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

REGIONAL GEOTECHNICAL SOLUTIONS

ENGINEERING LOG - TEST PIT

TEST PIT NO: TP2

CLIENT: HDB Town Planning and Design
PAGE: 1 of 1
PROJECT NAME: Proposed Rezoning
JOB NO: RGS50006.1
SITE LOCATION: Weemala Development Stage E2
LOGGED BY: LD
TEST LOCATION: Refer to Figure 1
DATE: 5/4/22

EQUIPMENT TYPE: 15T Excavator
EASTING: 372354 m
SURFACE RL:
TEST PIT LENGTH: 3.5 m
WIDTH: 1.2 m
NORTHING: 6353678 m
DATUM: AHD

Excavation and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (Not measured)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E						CH	**Silty CLAY:** Medium to high plasticity, grey	M > w_P	F	HP	60	RESIDUAL
							0.30m					
				0.5		CL	**Sandy CLAY:** Medium plasticity, grey, fine to medium grained sand	M < w_P	St	HP	120 - 160	
							0.80m					
				1.0		CL	**Sandy CLAY:** Medium plasticity, grey, pale grey		H / Fr			EXTREMELY WEATHERED SANDSTONE
							1.30m					
				1.5			**SANDSTONE:** Fine to medium grained, pale grey, pale brown, fractures spaced at 20-200mm, with clay coating					SLIGHTLY WEATHERED SANDSTONE LOW TO MEDIUM STRENGTH Minor greywater inflow at 1.5m
							1.80m					
				2.0			**SANDSTONE:** Fine to medium grained, pale grey					SLIGHTLY WEATHERED TO FRESH SANDSTONE MEDIUM STRENGTH
							2.30m					
							Hole Terminated at 2.30 m Practical Refusal					
				2.5								
				3.0								
				3.5								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

REGIONAL GEOTECHNICAL SOLUTIONS

ENGINEERING LOG - TEST PIT

TEST PIT NO: TP3

CLIENT: HDB Town Planning and Design
PAGE: 1 of 1
PROJECT NAME: Proposed Rezoning
JOB NO: RGS50006.1
SITE LOCATION: Weemala Development Stage E2
LOGGED BY: LD
TEST LOCATION: Refer to Figure 1
DATE: 5/4/22

EQUIPMENT TYPE: 15T Excavator
EASTING: 372364 m
SURFACE RL:
TEST PIT LENGTH: 5.0 m
WIDTH: 1.5 m
NORTHING: 6353721 m
DATUM: AHD

Excavation and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (Not measured)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered			0.5		CH	**Silty CLAY:** Medium to high plasticity, grey-brown, with some sandstone gravel, fine to medium grained, angular	M < w_P	St			COLLUVIAL
				1.0			1.00m					
							COAL: Dark brown					COAL EXTREMELY LOW STRENGTH
							1.20m					
						CH	**CLAY:** Medium to high plasticity, grey-brown, pale brown			HP	140 - 200	RESIDUAL
				1.5			1.60m					
							COAL: Dark brown/black					COAL LOW STRENGTH
				2.0								
							2.40m					
				2.5			**TUFFACEOUS SANDSTONE:** Fine grained, pale grey					MODERATELY WEATHERED TUFFACEOUS SANDSTONE VERY LOW TO LOW STRENGTH
							2.90m					
				3.0			**COAL:** Black					COAL LOW STRENGTH
							3.20m					
							TUFFACEOUS SANDSTONE: Fine grained, pale grey					MODERATELY WEATHERED TUFFACEOUS SANDSTONE LOW STRENGTH
				3.5			3.50m					
							Hole Terminated at 3.50 m					

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

REGIONAL GEOTECHNICAL SOLUTIONS

ENGINEERING LOG - TEST PIT

TEST PIT NO: TP4

CLIENT: HDB Town Planning and Design
PAGE: 1 of 1
PROJECT NAME: Proposed Rezoning
JOB NO: RGS50006.1
SITE LOCATION: Weemala Development Stage E2
LOGGED BY: LD
TEST LOCATION: Refer to Figure 1
DATE: 5/4/22

EQUIPMENT TYPE: 15T Excavator
EASTING: 372344 m
SURFACE RL:
TEST PIT LENGTH: 4.0 m
WIDTH: 1.5 m
NORTHING: 6353732 m
DATUM: AHD

Excavation and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (Not measured)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered			0.5		CI	**TOPSOIL:** Silty CLAY, medium plasticity, brown, with rootlets	$M > w_P$				TOPSOIL
							0.20m					
						CH	**Silty CLAY:** Medium to high plasticity, grey, with a trace of sand, fine grained	$M < w_P$	St	HP	120	RESIDUAL
										HP	120	
				1.0			**SANDSTONE:** Fine to medium grained, pale grey, orange-brown, fractures spaced at 10-50mm, with dark grey clay on fractures					HIGHLY TO MODERATELY WEATHERED SANDSTONE VERY LOW TO LOW STRENGTH
							1.40m					
				1.5			**SANDSTONE:** Fine to medium grained, pale grey, pale brown					MODERATELY TO SLIGHTLY WEATHERED SANDSTONE LOW TO MEDIUM STRENGTH
							1.90m					
				2.0			Hole Terminated at 1.90 m Practical Refusal					
				2.5								
				3.0								
				3.5								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

REGIONAL GEOTECHNICAL SOLUTIONS

ENGINEERING LOG - TEST PIT

TEST PIT NO: TP5

CLIENT: HDB Town Planning and Design
PAGE: 1 of 1
PROJECT NAME: Proposed Rezoning
JOB NO: RGS50006.1
SITE LOCATION: Weemala Development Stage E2
LOGGED BY: LD
TEST LOCATION: Refer to Figure 1
DATE: 5/4/22

EQUIPMENT TYPE: 15T Excavator
EASTING: 372519 m
SURFACE RL:
TEST PIT LENGTH: 5.0 m
WIDTH: 1.5 m
NORTHING: 6353745 m
DATUM: AHD

Excavation and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (Not measured)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E				0.5		CH	**Gravelly CLAY:** Medium to high plasticity, grey, with cobbles and boulders up to 300mm in diameter	M > w_P	St	HP	140	COLLUVIAL
				1.0			0.80m **SANDSTONE:** Fine grained, dark grey, highly fractured, with a 30mm coal seam at 0.9m dipping east					MODERATELY WEATHERED SANDSTONE LOW TO MEDIUM STRENGTH
							1.10m **TUFFACEOUS SANDSTONE:** Fine grained, pale grey, pale brown, fragmented					TUFFACEOUS SANDSTONE VERY LOW STRENGTH
							1.30m **COAL:** Dark brown/black					COAL
				1.5			1.40m Hole Terminated at 1.40 m Practical refusal on Sandstone					
				2.0								
				2.5								
				3.0								
				3.5								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

REGIONAL GEOTECHNICAL SOLUTIONS

ENGINEERING LOG - TEST PIT

TEST PIT NO: TP6

CLIENT: HDB Town Planning and Design
PAGE: 1 of 1
PROJECT NAME: Proposed Rezoning
JOB NO: RGS50006.1
SITE LOCATION: Weemala Development Stage E2
LOGGED BY: LD
TEST LOCATION: Refer to Figure 1
DATE: 5/4/22

EQUIPMENT TYPE: 15T Excavator
EASTING: 372292 m
SURFACE RL:
TEST PIT LENGTH: 5.0 m
WIDTH: 1.5 m
NORTHING: 6353755 m
DATUM: AHD

Excavation and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (Not measured)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered	0.20m B 0.60m		0.5		CH	**CLAY:** Medium to high plasticity, grey, with gravel, fine to coarse grained, angular	$M > w_P$	F	HP	80	COLLUVIAL
							0.60m					
				1.0		CL	**Gravelly CLAY:** Medium plasticity, pale grey, pale brown	$M < w_P$	H / Fr			EXTREMELY WEATHERED TUFFACEOUS SANDSTONE
							1.10m					
							SANDSTONE: Fine grained, dark grey, highly fractured to fragmented, laminated					MODERATELY WEATHERED SANDSTONE LOW TO MEDIUM STRENGTH
							1.40m					
				1.5			**COAL:** Dark brown/black					COAL EXTREMELY LOW STRENGTH
							1.60m					
							Hole Terminated at 1.60 m Practical Refusal					
				2.0								
				2.5								
				3.0								
				3.5								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

REGIONAL GEOTECHNICAL SOLUTIONS

ENGINEERING LOG - TEST PIT

TEST PIT NO: TP7

CLIENT: HDB Town Planning and Design
PAGE: 1 of 1
PROJECT NAME: Proposed Rezoning
JOB NO: RGS50006.1
SITE LOCATION: Weemala Development Stage E2
LOGGED BY: LD
TEST LOCATION: Refer to Figure 1
DATE: 5/4/22

EQUIPMENT TYPE: 15T Excavator
EASTING: 372301 m
SURFACE RL:
TEST PIT LENGTH: 5.0 m
WIDTH: 1.5 m
NORTHING: 6353777 m
DATUM: AHD

Excavation and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (Not measured)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered			0		CH	**CLAY:** Medium to high plasticity, grey, with gravel, fine to medium grained, angular	$M > w_P$	F - St			COLLUVIAL
							0.40m					
				0.5		CL	**Gravelly CLAY:** Medium plasticity, pale grey, pale brown	$M < w_P$	H / Fr			EXTREMELY WEATHERED TUFFACEOUS SANDSTONE
							0.80m					
							SHALE: Fine grained, dark grey, highly fractured					MODERATELY WEATHERED SHALE
				1.0			1.00m					
							COAL: Black					COAL
							1.10m					VERY LOW STRENGTH
							SANDSTONE: Fine grained, grey					SLIGHTLY WEATHERED TO FRESH SANDSTONE
							1.20m					MEDIUM TO HIGH STRENGTH
							Hole Terminated at 1.20 m Practical Refusal					
				1.5								
				2.0								
				2.5								
				3.0								
				3.5								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

REGIONAL GEOTECHNICAL SOLUTIONS

ENGINEERING LOG - TEST PIT

TEST PIT NO: TP8

CLIENT: HDB Town Planning and Design
PAGE: 1 of 1
PROJECT NAME: Proposed Rezoning
JOB NO: RGS50006.1
SITE LOCATION: Weemala Development Stage E2
LOGGED BY: LD
TEST LOCATION: Refer to Figure 1
DATE: 5/4/22

EQUIPMENT TYPE: 15T Excavator
EASTING: 372321 m
SURFACE RL:
TEST PIT LENGTH: 5.0 m
WIDTH: 1.5 m
NORTHING: 6353767 m
DATUM: AHD

Excavation and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (Not measured)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered			0.5		CH	**CLAY:** Medium to high plasticity, grey, with gravel, fine to medium grained, angular	M > w_P	St			COLLUVIAL
						CL	**Gravelly CLAY:** Medium plasticity, pale grey, fine to coarse grained, angular gravel	M < w_P	H / Fr			
				1.0			**TUFFACEOUS SANDSTONE:** Fine grained, pale brown, pale grey					MODERATELY WEATHERED TUFFACEOUS SANDSTONE VERY LOW STRENGTH
				1.5								
				2.0								
				2.5			**TUFFACEOUS SANDSTONE:** Fine grained, grey, dark grey					MODERATELY WEATHERED TUFFACEOUS SANDSTONE LOW STRENGTH
				3.0			Hole Terminated at 3.00 m					
				3.5								

0.40m
0.80m
2.30m
3.00m

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

REGIONAL GEOTECHNICAL SOLUTIONS

ENGINEERING LOG - TEST PIT

TEST PIT NO: TP9

CLIENT: HDB Town Planning and Design
PAGE: 1 of 1
PROJECT NAME: Proposed Rezoning
JOB NO: RGS50006.1
SITE LOCATION: Weemala Development Stage E2
LOGGED BY: LD
TEST LOCATION: Refer to Figure 1
DATE: 5/4/22

EQUIPMENT TYPE: 15T Excavator
EASTING: 372348 m
SURFACE RL:
TEST PIT LENGTH: 3.0 m
WIDTH: 1.5 m
NORTHING: 6353745 m
DATUM: AHD

Excavation and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (Not measured)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered			0		CI	**TOPSOIL:** Silty CLAY, medium plasticity, grey, with some gravel, fine to medium grained					TOPSOIL
							0.20m **TUFFACEOUS SANDSTONE:** Fine grained, pale brown, pale grey, highly fractured					MODERATELY WEATHERED TUFFACEOUS SANDSTONE LOW STRENGTH
				0.5								
							0.90m **SANDSTONE:** Fine to coarse grained, grey, brown					MODERATELY WEATHERED SANDSTONE MEDIUM STRENGTH
				1.0			1.20m Hole Terminated at 1.20 m Practical Refusal					
				1.5								
				2.0								
				2.5								
				3.0								
				3.5								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

REGIONAL GEOTECHNICAL SOLUTIONS

ENGINEERING LOG - TEST PIT

TEST PIT NO: TP10

CLIENT: HDB Town Planning and Design
PAGE: 1 of 1
PROJECT NAME: Proposed Rezoning
JOB NO: RGS50006.1
SITE LOCATION: Weemala Development Stage E2
LOGGED BY: LD
TEST LOCATION: Refer to Figure 1
DATE: 5/4/22

EQUIPMENT TYPE: 15T Excavator
EASTING: 372377 m
SURFACE RL:
TEST PIT LENGTH: 5.0 m
WIDTH: 1.5 m
NORTHING: 6535737 m
DATUM: AHD

Excavation and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (Not measured)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E				0.5			**TUFFACEOUS CLAYSTONE:** Grey, fractured					MODERATELY WEATHERED TUFFACEOUS CLAYSTONE LOW STRENGTH
							0.70m **COAL:** Dark brown					COAL EXTREMELY LOW STRENGTH
				1.0			0.90m **TUFFACEOUS SANDSTONE:** Fine grained, pale grey					TUFFACEOUS SANDSTONE
				1.5			1.50m **COAL:** Black					COAL VERY LOW STRENGTH Minor groundwater inflow
				2.0			2.00m **TUFFACEOUS SANDSTONE:** Fine grained, pale grey					TUFFACEOUS SANDSTONE
				2.5								
				3.0								
				3.5			3.50m Hole Terminated at 3.50 m					

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

REGIONAL GEOTECHNICAL SOLUTIONS

ENGINEERING LOG - TEST PIT

TEST PIT NO: TP11

CLIENT: HDB Town Planning and Design
PAGE: 1 of 1
PROJECT NAME: Proposed Rezoning
JOB NO: RGS50006.1
SITE LOCATION: Weemala Development Stage E2
LOGGED BY: LD
TEST LOCATION: Refer to Figure 1
DATE: 5/4/22

EQUIPMENT TYPE: 15T Excavator
EASTING: 372379 m
SURFACE RL:
TEST PIT LENGTH: 3.5 m
WIDTH: 1.5 m
NORTHING: 6535761 m
DATUM: AHD

Excavation and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (Not measured)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered			0.5		CI	**Sandy CLAY:** Medium plasticity, grey, orange-brown, with some sandstone gravel					COLLUVIAL
				1.0			0.70m **TUFFACEOUS SANDSTONE:** Fine grained, pale grey, grey, orange-brown, highly fractured					HIGHLY TO MODERATELY WEATHERED TUFFACEOUS SANDSTONE VERY LOW TO LOW STRENGTH
				1.5			1.40m **SANDSTONE:** Fine to coarse grained, pale grey, orange-brown, fractured					MODERATELY WEATHERED SANDSTONE MEDIUM STRENGTH
				2.0			2.00m Hole Terminated at 2.00 m					
				2.5								
				3.0								
				3.5								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

REGIONAL GEOTECHNICAL SOLUTIONS

ENGINEERING LOG - TEST PIT

TEST PIT NO: TP12

CLIENT: HDB Town Planning and Design
PAGE: 1 of 1
PROJECT NAME: Proposed Rezoning
JOB NO: RGS50006.1
SITE LOCATION: Weemala Development Stage E2
LOGGED BY: LD
TEST LOCATION: Refer to Figure 1
DATE: 5/4/22

EQUIPMENT TYPE: 15T Excavator
EASTING: 372367 m
SURFACE RL:
TEST PIT LENGTH: 3.5 m
WIDTH: 1.5 m
NORTHING: 6353778 m
DATUM: AHD

Excavation and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (Not measured)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
E	Not Encountered			0.5		CH	**CLAY:** Medium to high plasticity, grey, with some gravel, fine to coarse grained, angular					COLLUVIAL
				1.0			0.60m **TUFFACEOUS CLAYSTONE:** Fine grained, grey, pale grey, fragmented					TUFFACEOUS CLAYSTONE LOW STRENGTH
							1.10m **COAL/CLAYSTONE:** Interbedded 1.30m					COAL EXTREMELY LOW STRENGTH
				1.5			Hole Terminated at 1.30 m Practical refusal on Claystone					
				2.0								
				2.5								
				3.0								
				3.5								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

REGIONAL GEOTECHNICAL SOLUTIONS

ENGINEERING LOG - BOREHOLE

BOREHOLE NO: BH1

CLIENT: HDB Town Planning and Design
PAGE: 1 of 3
PROJECT NAME: Proposed Rezoning
JOB NO: RGS50006.1
SITE LOCATION: Weemale Development
LOGGED BY: LD
TEST LOCATION: Ch530
DATE: 19/4/22

DRILL TYPE: Tracked Drill Rig
EASTING: 373288 m
SURFACE RL:
BOREHOLE DIAMETER: 100 mm
INCLINATION: 90°
NORTHING: 6353844 m
DATUM: AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (Not measured)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
AD/T	Not Encountered	1.00m SPT 4,25/100mm N=R 1.25m		1.0		CI CI	0.10m **TOPSOIL:** Silty CLAY, medium plasticity, grey **Silty CLAY:** Medium plasticity, dark brown, with some sand, fine grained	M > w_P	F - St			TOPSOIL RESIDUAL
				2.0			1.10m **SANDSTONE:** Fine grained, grey 2.15m					HIGHLY WEATHERED SANDSTONE LOW STRENGTH
				3.0			Continued as Cored Drill Hole					
				4.0								
				5.0								
				6.0								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

ENGINEERING LOG - CORED BOREHOLE

REGIONAL GEOTECHNICAL SOLUTIONS

BOREHOLE NO: BH1
PAGE: Page 2 of 3
JOB NO: RGS50006.1
LOGGED BY: LD
DATE: 19/4/22

CLIENT: HDB Town Planning and Design
PROJECT NAME: Proposed Rezoning
SITE LOCATION: Weemale Development
TEST LOCATION: Ch530

DRILL TYPE: Tracked Drill Rig
BOREHOLE DIAMETER: 100 mm
INCLINATION: 90°
EASTING: 373288 m
NORTHING: 6353844 m
SURFACE RL:
DATUM: AHD

Drilling and Sampling				Material description and profile information				Testing	Rock Mass Defects		
METHOD	WATER	RL Not measured	DEPTH (m)	GRAPHIC LOG	Material Description: Rock type, particle characteristics, colour, minor components, structure	WEATHERING	ESTIMATED STRENGTH	$I_{s(50)}$D/A	RQD %	Defect Spacing mm	Defect Description: Type, inclination, planarity, roughness, coating, thickness
			1.0								
			2.0		START CORING AT 2.15m						
NMLC			3.0		**SANDSTONE:** Fine grained, grey, orange-brown, laminated	MW	L		35	25 50 140 150	JT 80° RO PL SN SM 50° CLAY 5mm Highly fractured core SM 5° CLAY 8mm JT 5° RO PL SN JT 5° RO PL SN
					SANDSTONE: Fine to medium grained, pale grey, with orange-brown staining, indistinctly bedded		L - M		40	75 250 150	JT 40° RO PL SN JT 30° PL VN JT 10° RO PL SN JT 5° RO PL CN JT 5° RO PL SN JT 10° RO CU SN SM EW SANDSTONE 10mm
			4.0		**TUFFACEOUS SANDSTONE:** Fine grained, pale grey, with orange-brown staining, laminated		VL L			50 30	JT 70° RO PL SN JT 5° RO PL SN Highly fractured core
							L - M			150 30	Highly fractured core
			5.0						0	60 30	JT 10° RO PL SN Rehealed joint Highly fractured core JT 45° RO PL SN JT 40° RO PL SN JT 35° RO PL SN JT 35° RO ST CN
			6.0								Highly fractured core
									45	20 125 30	JT 90° RO PL CN CS 0° 20mm

LEGEND:

Method

WB	Wash Bore
RR	Rock Roller
CB	Claw or Blad Bit
NMLC	NMLC Core
NQ,HQ,PQ	Wireline Coring

Bedding

Laminated	<20mm
Thinnly Bedded	20-200mm
Medium Bedded	200-600mm
Thickly Bedded	600-2000mm
Very Thickly Bedded	2000mm
Massive	No Visible Bedding

Degree of Fracturing

Fragmented	<20mm
Highly Fractured	20mm to 40mm
Fractured	40mm to 200mm
Slightly Fractured	200mm to 1000mm

Weathering

EW	Extremely Weathered
HW	Highly Weathered
MW	Moderately Weathered
SW	Slightly Weathered
FR	Fresh

Strength

		$I_{s(50)}$
VL	Very Low	<0.1
L	Low	0.1 - 0.3
M	Medium	0.3 - 1
H	High	1 - 3
VH	Very High	3 - 10
EH	Extremely High	>10

Defect Type

JT	Joint
PT	Parting
SM	Seam
SZ	Shear Zone
CS	Crushed Seam

Roughness

VR	Very Rough
RO	Rough
SO	Smooth
SL	Slickensided

Coating

CN	Clean
SN	Stained
VN	Veneer(<1mm)
CO	Coating(1-5mm)

Planarity

PL	Planar
CU	Curved
ST	Stepped
IR	Irregular

REGIONAL GEOTECHNICAL SOLUTIONS

ENGINEERING LOG - CORED BOREHOLE

BOREHOLE NO: BH1

CLIENT: HDB Town Planning and Design
PAGE: Page 3 of 3
PROJECT NAME: Proposed Rezoning
JOB NO: RGS50006.1
SITE LOCATION: Weemale Development
LOGGED BY: LD
TEST LOCATION: Ch530
DATE: 19/4/22

DRILL TYPE: Tracked Drill Rig
EASTING: 373288 m
SURFACE RL:
BOREHOLE DIAMETER: 100 mm
INCLINATION: 90°
NORTHING: 6353844 m
DATUM: AHD

Drilling and Sampling				Material description and profile information				Testing	Rock Mass Defects		
METHOD	WATER	RL Not measured	DEPTH (m)	GRAPHIC LOG	Material Description: Rock type, particle characteristics, colour, minor components, structure	WEATHERING	ESTIMATED STRENGTH	$I_{s(50)}$D/A	RQD %	Defect Spacing mm	Defect Description: Type, inclination, planarity, roughness, coating, thickness
NMLC					**TUFFACEOUS SANDSTONE:** Fine grained, pale grey, with orange-brown staining, laminated *(continued)*	MW	L - M		17.5	30	Highly fractured core
										50	JT 50° RO IR CN JT 5° RO PL CN
										150	JT 5° RO PL CN JT 5° RO IR CN JT 5° SO PL CN JT 5° SO PL SN JT 5° RO PL CN
			8.0		**NO CORE**						
					TUFFACEOUS SANDSTONE: Fine grained, pale grey, pale brown, laminated	XW - MW	VL - L		45	220	
										80	JT RO PL SN JT RO PL SN
					SILTSTONE: Dark grey, laminated	SW	M - H			50	Highly fractured core
	100% LOSS								62	20	
										100	JT 15° RO IR SN JT 10° RO PL SN
			9.0		**SANDSTONE:** Fine to medium grained, grey, with orange-brown staining, indistinctly bedded					400	
										50	JT 5° RO PL SN
					Hole Terminated at 9.30 m						
			10.0								
			11.0								
			12.0								
			13.0								

LEGEND:

Method

WB	Wash Bore
RR	Rock Roller
CB	Claw or Blad Bit
NMLC	NMLC Core
NQ,HQ,PQ	Wireline Coring

Bedding

Laminated	<20mm
Thinnly Bedded	20-200mm
Medium Bedded	200-600mm
Thickly Bedded	600-2000mm
Very Thickly Bedded	2000mm
Massive	No Visible Bedding

Degree of Fracturing

Fragmented	<20mm
Highly Fractured	20mm to 40mm
Fractured	40mm to 200mm
Slightly Fractured	200mm to 1000mm

Weathering

EW	Extremely Weathered
HW	Highly Weathered
MW	Moderately Weathered
SW	Slightly Weathered
FR	Fresh

Strength

		$I_{s(50)}$
VL	Very Low	<0.1
L	Low	0.1 - 0.3
M	Medium	0.3 - 1
H	High	1 - 3
VH	Very High	3 - 10
EH	Extremely High	>10

Defect Type

JT	Joint
PT	Parting
SM	Seam
SZ	Shear Zone
CS	Crushed Seam

Roughness

VR	Very Rough
RO	Rough
SO	Smooth
SL	Slickensided

Coating

CN	Clean
SN	Stained
VN	Veneer(<1mm)
CO	Coating(1-5mm)

Planarity

PL	Planar
CU	Curved
ST	Stepped
IR	Irregular

REGIONAL GEOTECHNICAL SOLUTIONS	Client	HDB Town Planning and Design	Job No. RGS50006.1
	Project	Proposed Rezoning Weemala Development Boolaroo Stage E2	Drawn By LD Date 11/05/2022
	Title	Core Photograph - BH1	Drawing No. **Core Photo 1**

REGIONAL GEOTECHNICAL SOLUTIONS

ENGINEERING LOG - BOREHOLE

BOREHOLE NO: BH2

CLIENT: HDB Town Planning and Design
PAGE: 1 of 3
PROJECT NAME: Proposed Rezoning
JOB NO: RGS50006.1
SITE LOCATION: Weemale Development
LOGGED BY: LD
TEST LOCATION: Ch570
DATE: 20/4/22

DRILL TYPE: Tracked Drill Rig
EASTING: 372399 m
SURFACE RL:
BOREHOLE DIAMETER: 100 mm
INCLINATION: 90°
NORTHING: 6353899 m
DATUM: AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (Not measured)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
AD/T	Not Encountered	1.00m SPT 4,25/100mm N=R 1.25m		1.0		Cl	0.20m **TOPSOIL:** Silty CLAY, medium plasticity, dark brown **SANDSTONE:** Fine grained, grey					TOPSOIL HIGHLY TO MODERATELY WEATHERED SANDSTONE VERY LOW TO LOW STRENGTH
				2.0								
				3.0			3.00m					
				4.0			Continued as Cored Drill Hole					
				5.0								
				6.0								

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

ENGINEERING LOG - CORED BOREHOLE

REGIONAL GEOTECHNICAL SOLUTIONS

BOREHOLE NO: BH2

CLIENT: HDB Town Planning and Design
PAGE: Page 2 of 3
PROJECT NAME: Proposed Rezoning
JOB NO: RGS50006.1
SITE LOCATION: Weemale Development
LOGGED BY: LD
TEST LOCATION: Ch570
DATE: 20/4/22

DRILL TYPE: Tracked Drill Rig
EASTING: 372399 m
SURFACE RL:
BOREHOLE DIAMETER: 100 mm
INCLINATION: 90°
NORTHING: 6353899 m
DATUM: AHD

Drilling and Sampling				Material description and profile information				Testing	Rock Mass Defects		
METHOD	WATER	RL Not measured	DEPTH (m)	GRAPHIC LOG	Material Description: Rock type, particle characteristics, colour, minor components, structure	WEATHERING	ESTIMATED STRENGTH	$I_{s(50)}$D/A	RQD %	Defect Spacing mm	Defect Description: Type, inclination, planarity, roughness, coating, thickness
			1.0								
			2.0								
			3.0		START CORING AT 3.00m						
NMLC					**NO CORE**						
					SANDSTONE: Fine grained, grey, pale brown, laminated	HW	L		20	80	JT RO IR CN
										200	JT 30° RO PL CN
						MW	L - M		25	30	JT 5° RO PL SN
										100	JT 50° RO PL SN
										20	PT RO PL SN
			4.0							100	PT SO PL SN
										100	Fragmented core
										30	Highly fractured core
									25	25	JT 5° RO PL SN
										170	Highly fractured core
									50		
										50	JT 10° SP PL SN
											Highly fractured core
			5.0						60		PT PL VN
											JT IR VN
						XW	VL				JT PL CO
						MW	L - M			100	JT 10° RO CU CN
											JT 10° RO ST SN
					NO CORE						
					SANDSTONE: Fine grained, grey, with pale brown staining, laminated	MW	VL		0		Highly fractured core
			6.0								
						XW				50	SM CLAY 5mm
					SANDSTONE: FIne grained, brown, with orange-brown staining, laminated	HW	VL - L				JT 15° RO IR SN
											JT 35° RO PL SN
											JT 30° RO ST SN
					NO CORE	SW					
					SILTSTONE: Dark grey, with pink/brown staining				65		Highly fractured core
										100	JT RO PL SN

LEGEND:

Method

WB	Wash Bore
RR	Rock Roller
CB	Claw or Blad Bit
NMLC	NMLC Core
NQ,HQ,PQ	Wireline Coring

Bedding

Laminated	<20mm
Thinnly Bedded	20-200mm
Medium Bedded	200-600mm
Thickly Bedded	600-2000mm
Very Thickly Bedded	2000mm
Massive	No Visible Bedding

Degree of Fracturing

Fragmented	<20mm
Highly Fractured	20mm to 40mm
Fractured	40mm to 200mm
Slightly Fractured	200mm to 1000mm

Weathering

EW	Extremely Weathered
HW	Highly Weathered
MW	Moderately Weathered
SW	Slightly Weathered
FR	Fresh

Strength

		$I_{s(50)}$
VL	Very Low	<0.1
L	Low	0.1 - 0.3
M	Medium	0.3 - 1
H	High	1 - 3
VH	Very High	3 - 10
EH	Extremely High	>10

Defect Type

JT	Joint
PT	Parting
SM	Seam
SZ	Shear Zone
CS	Crushed Seam

Roughness

VR	Very Rough
RO	Rough
SO	Smooth
SL	Slickensided

Coating

CN	Clean
SN	Stained
VN	Veneer(<1mm)
CO	Coating(1-5mm)

Planarity

PL	Planar
CU	Curved
ST	Stepped
IR	Irregular

REGIONAL GEOTECHNICAL SOLUTIONS

ENGINEERING LOG - CORED BOREHOLE

BOREHOLE NO: BH2

CLIENT: HDB Town Planning and Design
PAGE: Page 3 of 3
PROJECT NAME: Proposed Rezoning
JOB NO: RGS50006.1
SITE LOCATION: Weemale Development
LOGGED BY: LD
TEST LOCATION: Ch570
DATE: 20/4/22

DRILL TYPE: Tracked Drill Rig
EASTING: 372399 m
SURFACE RL:
BOREHOLE DIAMETER: 100 mm
INCLINATION: 90°
NORTHING: 6353899 m
DATUM: AHD

Drilling and Sampling				Material description and profile information				Testing	Rock Mass Defects		
METHOD	WATER	RL (Not measured)	DEPTH (m)	GRAPHIC LOG	Material Description: Rock type, particle characteristics, colour, minor components, structure	WEATHERING	ESTIMATED STRENGTH	$I_{s(50)}$D/A	RQD %	Defect Spacing mm	Defect Description: Type, inclination, planarity, roughness, coating, thickness
NMLC					**SILTSTONE:** Dark grey, with pink/brown staining *(continued)*	SW	M - H				JT RO PL SN JT RO IR SN JT 5° RO PL SN
					SANDSTONE: Fine grained, grey, with dark grey veins, thinly bedded					350	JT 5° RO PL SN
					SANDSTONE: Fine to medium grained, grey, indistinctly bedded				65	50	PT RO PL SN PT RO PL SN
			8.0		**SANDSTONE:** Fine grained, grey, with dark grey and brown veins, thinly bedded					150	JT 5° RO PL SN JT 80° RO PL SN
										300	JT 10° RO PL SN
					SILTSTONE: Dark grey, laminated	XW	VL				Highly fractured core
					NO CORE: Inferred coal seam				0		CM COAL 30mm
			9.0		**SILTSTONE:** Grey, laminated	HW	L				
					NO CORE						
					COAL: Black				0		Fragmented core
					SILTSTONE: Dark grey, laminated	MW	L				PT RO PL SN SM COAL 2mm PT RO PL CN SM COAL 2mm PT RO PL SN SM COAL 2mm PT RO PL CN
			10.0								
					Hole Terminated at 10.00 m						
			11.0								
			12.0								
			13.0								

LEGEND:

Method

WB	Wash Bore
RR	Rock Roller
CB	Claw or Blad Bit
NMLC	NMLC Core
NQ,HQ,PQ	Wireline Coring

Bedding

Laminated	<20mm
Thinnly Bedded	20-200mm
Medium Bedded	200-600mm
Thickly Bedded	600-2000mm
Very Thickly Bedded	2000mm
Massive	No Visible Bedding

Degree of Fracturing

Fragmented	<20mm
Highly Fractured	20mm to 40mm
Fractured	40mm to 200mm
Slightly Fractured	200mm to 1000mm

Weathering

EW	Extremely Weathered
HW	Highly Weathered
MW	Moderately Weathered
SW	Slightly Weathered
FR	Fresh

Strength

		$I_{s(50)}$
VL	Very Low	<0.1
L	Low	0.1 - 0.3
M	Medium	0.3 - 1
H	High	1 - 3
VH	Very High	3 - 10
EH	Extremely High	>10

Defect Type

JT	Joint
PT	Parting
SM	Seam
SZ	Shear Zone
CS	Crushed Seam

Roughness

VR	Very Rough
RO	Rough
SO	Smooth
SL	Slickensided

Coating

CN	Clean
SN	Stained
VN	Veneer(<1mm)
CO	Coating(1-5mm)

Planarity

PL	Planar
CU	Curved
ST	Stepped
IR	Irregular

REGIONAL GEOTECHNICAL SOLUTIONS	Client	HDB Town Planning and Design	Job No. RGS50006.1
	Project	Proposed Rezoing Weemala Development Boolaroo Stage E2	Drawn By LD Date 11/05/2022
	Title	Core Photograph - BH2	Drawing No. **Core Photo 2**

REGIONAL GEOTECHNICAL SOLUTIONS

ENGINEERING LOG - BOREHOLE

BOREHOLE NO: BH3

CLIENT: HDB Town Planning and Design | **PAGE:** 1 of 3

PROJECT NAME: Proposed Rezoning | **JOB NO:** RGS50006.1

SITE LOCATION: Weemale Development | **LOGGED BY:** LD

TEST LOCATION: Ch400 | **DATE:** 21/4/22

DRILL TYPE: Tracked Drill Rig | **EASTING:** 372388 m | **SURFACE RL:**

BOREHOLE DIAMETER: 120 mm | **INCLINATION:** 90° | **NORTHING:** 6353716 m | **DATUM:** AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (Not measured)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
AD/T	Not Encountered					CI	0.15m **TOPSOIL:** Sandy CLAY, medium plasticity, dark brown, with fine to medium grained gravel					TOPSOIL
				1.0			**CONGLOMERATE:** Fine to coarse grained, grey, pale brown					MODERATELY WEATHERED CONGLOMERATE LOW STRENGTH
							1.10m Advanced with NMLC, no recovery					
				2.0			2.00m					
						CI	**Sandy CLAY:** Medium plasticity, pale brown, pale grey	$M < w_P$	H / Fr			EXTREMELY TO HIGHLY WEATHERED SANDSTONE
		2.50m										
WB		SPT 15,25/120mm N=R										Upper 100mm of SPT was fall in
		2.77m		3.0			3.50m					
							SILTSTONE: Dark grey					HIGHLY TO MODERATLEY WEATHERED SILTSTONE VERY LOW STRENGTH
		4.00m		4.0								
		SPT 8,15,20 N=35										
		4.45m										
				5.0			5.00m					
							COAL: Dark brown					COAL
		5.50m					5.50m					
		SPT 3,7,13 N=20					**INTERBEDDED SILTSTONE AND COAL:** Grey, dark grey and black					EXTREMELY TO HIGHLY WEATHERED SILTSTONE VERY LOW TO LOW STRENGTH INTERBEDDED WITH COAL
		5.95m		6.0								
		7.00m										

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency

		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Moisture Condition

D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

Density

V	Very Loose	Density Index <15%
L	Loose	Density Index 15 - 35%
MD	Medium Dense	Density Index 35 - 65%
D	Dense	Density Index 65 - 85%
VD	Very Dense	Density Index 85 - 100%

REGIONAL GEOTECHNICAL SOLUTIONS

ENGINEERING LOG - BOREHOLE

BOREHOLE NO: BH3

CLIENT: HDB Town Planning and Design
PAGE: 2 of 3
PROJECT NAME: Proposed Rezoning
JOB NO: RGS50006.1
SITE LOCATION: Weemale Development
LOGGED BY: LD
TEST LOCATION: Ch400
DATE: 21/4/22

DRILL TYPE: Tracked Drill Rig
EASTING: 372388 m
SURFACE RL:
BOREHOLE DIAMETER: 120 mm
INCLINATION: 90°
NORTHING: 6353716 m
DATUM: AHD

Drilling and Sampling					Material description and profile information					Field Test		
METHOD	WATER	SAMPLES	RL (Not measured)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL	MATERIAL DESCRIPTION: Soil type, plasticity/particle characteristics,colour,minor components	MOISTURE CONDITION	CONSISTENCY DENSITY	Test Type	Result	Structure and additional observations
WB		SPT 11 13,20/100mm N=R					7.20m Continued as Cored Drill Hole					

8.0
9.0
10.0
11.0
12.0
13.0

LEGEND:

Water
- Water Level (Date and time shown)
- Water Inflow
- Water Outflow

Strata Changes
- Gradational or transitional strata
- Definitive or distict strata change

Notes, Samples and Tests

U_{50}	50mm Diameter tube sample
CBR	Bulk sample for CBR testing
E	Environmental sample
ASS	Acid Sulfate Soil Sample
B	Bulk Sample

Field Tests

PID	Photoionisation detector reading (ppm)
DCP(x-y)	Dynamic penetrometer test (test depth interval shown)
HP	Hand Penetrometer test (UCS kPa)

Consistency		UCS (kPa)
VS	Very Soft	<25
S	Soft	25 - 50
F	Firm	50 - 100
St	Stiff	100 - 200
VSt	Very Stiff	200 - 400
H	Hard	>400
Fb	Friable	

Density		
	V	Very Loose
	L	Loose
	MD	Medium Dense
	D	Dense
	VD	Very Dense

Density Index
<15%
15 - 35%
35 - 65%
65 - 85%
85 - 100%

Moisture Condition	
D	Dry
M	Moist
W	Wet
W_p	Plastic Limit
W_L	Liquid Limit

ENGINEERING LOG - CORED BOREHOLE

REGIONAL GEOTECHNICAL SOLUTIONS

BOREHOLE NO: BH3
PAGE: Page 3 of 3
JOB NO: RGS50006.1
LOGGED BY: LD
DATE: 21/4/22

CLIENT: HDB Town Planning and Design
PROJECT NAME: Proposed Rezoning
SITE LOCATION: Weemale Development
TEST LOCATION: Ch400

DRILL TYPE: Tracked Drill Rig
BOREHOLE DIAMETER: 120 mm
INCLINATION: 90°
EASTING: 372388 m
NORTHING: 6353716 m
SURFACE RL:
DATUM: AHD

Drilling and Sampling				Material description and profile information				Testing	Rock Mass Defects		
METHOD	WATER	RL Not measured	DEPTH (m)	GRAPHIC LOG	Material Description: Rock type, particle characteristics, colour, minor components, structure	WEATHERING	ESTIMATED STRENGTH	$I_{s(50)}$D/A	RQD %	Defect Spacing mm	Defect Description: Type, inclination, planarity, roughness, coating, thickness
					START CORING AT 7.20m						
WB					**SILTSTONE:** Pale grey, indistinctly bedded	XW	VL		0		
					COAL: Black					70	Highly fractured core
			8.0		**TUFFACEOUS SANDSTONE:** Fine grained, grey, with some orange-brown staining, laminated	XW	VL		75	200	
										30	Highly fractured core
										50	JT RO PL CN
						XW	VL			200	JT 5° RO PL SN
			9.0							800	
					COAL: Black					30	Highly fractured core
			10.0		**TUFFACEOUS SANDSTONE:** Fine grained, grey, with orange-brown staining, indistinctly bedded				90	2500	
			11.0								
			12.0		**SANDSTONE:** Fine grained, pale grey, with orange-brown staining, laminated				80	100	PT RO PL CN
										150	JT 5° RO PL SN Various rehealed joints JT 60° RO PL SN JT 20° RO ST SN
			13.0		Hole Terminated at 12.10 m						

LEGEND:

Method

WB	Wash Bore
RR	Rock Roller
CB	Claw or Blad Bit
NMLC	NMLC Core
NQ,HQ,PQ	Wireline Coring

Bedding

Laminated	<20mm
Thinnly Bedded	20-200mm
Medium Bedded	200-600mm
Thickly Bedded	600-2000mm
Very Thickly Bedded	2000mm
Massive	No Visible Bedding

Degree of Fracturing

Fragmented	<20mm
Highly Fractured	20mm to 40mm
Fractured	40mm to 200mm
Slightly Fractured	200mm to 1000mm

Weathering

EW	Extremely Weathered
HW	Highly Weathered
MW	Moderately Weathered
SW	Slightly Weathered
FR	Fresh

Strength

		$I_{s(50)}$
VL	Very Low	<0.1
L	Low	0.1 - 0.3
M	Medium	0.3 - 1
H	High	1 - 3
VH	Very High	3 - 10
EH	Extremely High	>10

Defect Type

JT	Joint
PT	Parting
SM	Seam
SZ	Shear Zone
CS	Crushed Seam

Roughness

VR	Very Rough
RO	Rough
SO	Smooth
SL	Slickensided

Coating

CN	Clean
SN	Stained
VN	Veneer(<1mm)
CO	Coating(1-5mm)

Planarity

PL	Planar
CU	Curved
ST	Stepped
IR	Irregular

REGIONAL GEOTECHNICAL SOLUTIONS	Client	HDB Town Planning and Design	Job No.	RGS50006.1
	Project	Proposed Rezoing Weemala Development Boolaroo Stage E2	Drawn By	LD
			Date	11/05/2022
	Title	Core Photograph - BH3	Drawing No.	**Core Photo 3**

Appendix B

Laboratory Test Result Sheets

QUALTEST Laboratory (NSW) Pty Ltd (20708)
2 Murray Dwyer Circuit, Mayfield West, NSW 2304
T: 02 4968 4468
F: 02 4960 9775
E: admin@qualtest.com.au
W: www.qualtest.com.au
ABN: 98 153 268 896

Report No: MAT:NEW22W-1088-S01
Issue No: 1

Material Test Report

Client: Regional Geotechnical Solutions Pty Ltd
44 Bent Street
Wingham NSW 2429

Project No.: MNC16P-0001
Project Name: Various Testing
Project Location: Boolaroo, NSW

Accredited for compliance with ISO/IEC 17025-Testing.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
Results provided relate only to the items tested or sampled.

Approved Signatory: Brent Cullen
(Engineering Geologist)
NATA Accredited Laboratory Number: 18686
Date of Issue: 3/05/2022

Sample Details

Sample ID: NEW22W-1088-S01
Date Sampled: 14/04/2022
Date Received: 19/04/2022
Source: On-Site
Material: Insitu
Specification: No Specification
The results outlined below apply to the sample as received
TRN: RGS50006.1
Sample Location: TP3 - (1.4 - 1.5m)

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	13.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	62	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	24	
Plasticity Index (%)	AS 1289.3.3.1	38	
Date Tested		29/04/2022	

Comments

N/A

QUALTEST Laboratory (NSW) Pty Ltd (20708)
2 Murray Dwyer Circuit, Mayfield West, NSW 2304
T: 02 4968 4468
F: 02 4960 9775
E: admin@qualtest.com.au
W: www.qualtest.com.au
ABN: 98 153 268 896

Report No: MAT:NEW22W-1088-S02
Issue No: 1

Material Test Report

Client: Regional Geotechnical Solutions Pty Ltd
44 Bent Street
Wingham NSW 2429

Project No.: MNC16P-0001
Project Name: Various Testing
Project Location: Boolaroo, NSW

Accredited for compliance with ISO/IEC 17025-Testing.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
Results provided relate only to the items tested or sampled.

Approved Signatory: Brent Cullen
(Engineering Geologist)
NATA Accredited Laboratory Number: 18686
Date of Issue: 3/05/2022

Sample Details

Sample ID: NEW22W-1088-S02
Date Sampled: 14/04/2022
Date Received: 19/04/2022
Source: On-Site
Material: Insitu
Specification: No Specification
The results outlined below apply to the sample as received
TRN: RGS50006.1
Sample Location: TP4 - (0.4 - 0.5m)

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	18.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		Yes	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	73	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	25	
Plasticity Index (%)	AS 1289.3.3.1	48	
Date Tested		29/04/2022	

Comments

N/A

QUALTEST Laboratory (NSW) Pty Ltd (20708)
2 Murray Dwyer Circuit, Mayfield West, NSW 2304
T: 02 4968 4468
F: 02 4960 9775
E: admin@qualtest.com.au
W: www.qualtest.com.au
ABN: 98 153 268 896

Report No: MAT:NEW22W-1088-S03
Issue No: 1

Material Test Report

Client: Regional Geotechnical Solutions Pty Ltd
44 Bent Street
Wingham NSW 2429

Project No.: MNC16P-0001
Project Name: Various Testing
Project Location: Boolaroo, NSW

Accredited for compliance with ISO/IEC 17025-Testing.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
Results provided relate only to the items tested or sampled.

Approved Signatory: Brent Cullen
(Engineering Geologist)
NATA Accredited Laboratory Number: 18686
Date of Issue: 3/05/2022

Sample Details

Sample ID: NEW22W-1088-S03
Date Sampled: 14/04/2022
Date Received: 19/04/2022
Source: On-Site
Material: Insitu
Specification: No Specification
The results outlined below apply to the sample as received
TRN: RGS50006.1
Sample Location: TP5 - (0.4 - 0.5m)

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	14.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	73	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	29	
Plasticity Index (%)	AS 1289.3.3.1	44	
Date Tested		29/04/2022	

Comments

N/A

QUALTEST Laboratory (NSW) Pty Ltd (20708)
2 Murray Dwyer Circuit, Mayfield West, NSW 2304
T: 02 4968 4468
F: 02 4960 9775
E: admin@qualtest.com.au
W: www.qualtest.com.au
ABN: 98 153 268 896

Report No: MAT:NEW22W-1088-S04
Issue No: 1

Material Test Report

Client:	Regional Geotechnical Solutions Pty Ltd 44 Bent Street Wingham NSW 2429
Project No.:	MNC16P-0001
Project Name:	Various Testing
Project Location:	Boolaroo, NSW

Accredited for compliance with ISO/IEC 17025-Testing.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
Results provided relate only to the items tested or sampled.

Approved Signatory: Brent Cullen
(Engineering Geologist)
NATA Accredited Laboratory Number: 18686
Date of Issue: 3/05/2022

Sample Details

Sample ID:	NEW22W-1088-S04
Date Sampled:	14/04/2022
Date Received:	19/04/2022
Source:	On-Site
Material:	Insitu
Specification:	No Specification
	The results outlined below apply to the sample as received
TRN:	RGS50006.1
Sample Location:	TP6 - (0.4 - 0.6m)

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	21.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		Yes	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	82	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	24	
Plasticity Index (%)	AS 1289.3.3.1	58	
Date Tested		29/04/2022	

Comments

N/A

QUALTEST Laboratory (NSW) Pty Ltd (20708)
2 Murray Dwyer Circuit, Mayfield West, NSW 2304
T: 02 4968 4468
F: 02 4960 9775
E: admin@qualtest.com.au
W: www.qualtest.com.au
ABN: 98 153 268 896

Report No: MAT:NEW22W-1088-S05
Issue No: 1

Material Test Report

Client: Regional Geotechnical Solutions Pty Ltd
44 Bent Street
Wingham NSW 2429

Project No.: MNC16P-0001
Project Name: Various Testing
Project Location: Boolaroo, NSW

Accredited for compliance with ISO/IEC 17025-Testing.
The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards.
Results provided relate only to the items tested or sampled.

Approved Signatory: Brent Cullen
(Engineering Geologist)
NATA Accredited Laboratory Number: 18686
Date of Issue: 3/05/2022

Sample Details

Sample ID: NEW22W-1088-S05
Date Sampled: 14/04/2022
Date Received: 19/04/2022
Source: On-Site
Material: Insitu
Specification: No Specification
The results outlined below apply to the sample as received
TRN: RGS50006.1
Sample Location: TP11 - (0.2 - 0.5m)

Test Results

Description	Method	Result	Limits
Sample History	AS 1289.1.1	Oven-dried	
Preparation	AS 1289.1.1	Dry Sieved	
Linear Shrinkage (%)	AS 1289.3.4.1	15.0	
Mould Length (mm)		250	
Crumbling		No	
Curling		No	
Cracking		No	
Liquid Limit (%)	AS 1289.3.1.1	65	
Method		Four Point	
Plastic Limit (%)	AS 1289.3.2.1	27	
Plasticity Index (%)	AS 1289.3.3.1	38	
Date Tested		29/04/2022	

Comments

N/A

Point Load Strength Report - Diametral and Axial Testing of Rock Core

REGIONAL GEOTECHNICAL SOLUTIONS

Client:	HDB Town Planning and Design	Job Number:	RGS50006.1
Project:	Proposed Rezoning	Date:	28/04/2022
Location:	Weemala Development	By:	TMc

Date Sampled:	
Date Tested:	28-Apr-22

Test Method: AS4133.4.1 - 2007

Test Machine: HMA 6510

Date of Calibration: 18-Aug-20

Borehole	Test Depth (m)	Rock Type	Moisture Condition	Diametral Test							Axial Test								
				Length L (mm)	Diameter D (mm)	Load P (kN)	I_s (Mpa)	Size Correction	$I_{s(50)}$ (Mpa)	Strength Classification	Width W (diameter)	Platen Separation	Load P (kN)	I_s (Mpa)	Size Correction	$I_{s(50)}$ (Mpa)	Strength Classification	UCS (Mpa)	Anisotropy Index $I_{a(50)}$
BH1	2.81-2.94		N	130.0	52.0	0.22	0.08	1.02	0.08	VL	52	37	0.29	0.12	0.995	0.12	L	2.35682	0.70
BH1	3.43-3.55		N	120.0	52.0	1.67	0.62	1.02	0.63	M	52	48	1.99	0.63	1.055	0.66	M	13.2183	0.95
BH1	5.0-5.07		N	70.0	52.0	1.64	0.61	1.02	0.62	M	52	39	0.63	0.24	1.007	0.25	L	4.91531	2.51
BH1	7.66-7.75		N	90.0	52.0	0.19	0.07	1.02	0.07	VL	52	34	0.24	0.11	0.977	0.10	L	2.08257	0.69
BH1	8.73-8.81		N	80.0	52.0	6.01	2.22	1.02	2.26	H	52	40	6.68	2.52	1.013	2.56	H	51.1053	0.89
BH1	8.92-9.0		N	80.0	52.0	6.07	2.24	1.02	2.28	H									
BH2	5.25-5.35		N	100.0	52.0	0.49	0.18	1.02	0.18	L	52	50	0.88	0.27	1.065	0.28	L	5.66326	0.65
BH2	7.05-7.2		N	110.0	52.0	5.26	1.95	1.02	1.98	H	52	51	9.73	2.88	1.070	3.08	VH	61.664	0.64
BH2	7.64-7.7		N	60.0	52.0	1.50	0.55	1.02	0.56	M	52	29	5.32	2.77	0.942	2.61	H	52.2202	0.22
BH2	9.8-9.88		N	80.0	52.0	0.12	0.04	1.02	0.05	VL	52	42	0.40	0.14	1.024	0.15	L	2.94664	0.31
BH3	8.46-8.58		N	120.0	52.0	0.30	0.11	1.02	0.11	L	52	40	0.16	0.06	1.013	0.06	VL	1.22408	1.85
BH3	10.86-10.95		N	90.0	52.0	0.13	0.05	1.02	0.05	VL	52.0	34.0	0.42	0.19	0.977	0.18	L	3.64451	0.27
BH3	12.0-12.1		N	100.0	52.0	0.30	0.11	1.02	0.11	L	52	40	0.16	0.06	1.013	0.06	VL	1.22408	1.85

Moisture Condition:
D = Dry
N = Natural
S = Saturated

Strength Classification:

$I_{s(50)}$ Mpa	Term	Abbreviation
> 10	Extremely High Strength	EH
3 to 10	Very High Strength	VH
1 to 3	High Strength	H
0.3 to 1	Medium Strength	M
0.1 to 0.3	Low Strength	L
< 0.1	Very Low Strength	VL

Template Revision: B

Appendix C

Landslide Risk Management Risk Matrix

Examples of Good & Poor Hillside Practice

PRACTICE NOTE GUIDELINES FOR LANDSLIDE RISK MANAGEMENT 2007

APPENDIX C: LANDSLIDE RISK ASSESSMENT

QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY

QUALITATIVE MEASURES OF LIKELIHOOD

Approximate Annual Probability		Implied Indicative Landslide Recurrence Interval		Description	Descriptor	Level
Indicative Value	Notional Boundary					
10^{-1}	$5x10^{-2}$	10 years	20 years	The event is expected to occur over the design life.	ALMOST CERTAIN	A
10^{-2}	$5x10^{-3}$	100 years	200 years	The event will probably occur under adverse conditions over the design life.	LIKELY	B
10^{-3}	$5x10^{-4}$	1000 years	2000 years	The event could occur under adverse conditions over the design life.	POSSIBLE	C
10^{-4}	$5x10^{-5}$	10,000 years	20,000 years	The event might occur under very adverse circumstances over the design life.	UNLIKELY	D
10^{-5}	$5x10^{-6}$	100,000 years	200,000 years	The event is conceivable but only under exceptional circumstances over the design life.	RARE	E
10^{-6}		1,000,000 years		The event is inconceivable or fanciful over the design life.	BARELY CREDIBLE	F

Note: (1) The table should be used from left to right; use Approximate Annual Probability or Description to assign Descriptor, not *vice versa*.

QUALITATIVE MEASURES OF CONSEQUENCES TO PROPERTY

Approximate Cost of Damage		Description	Descriptor	Level
Indicative Value	Notional Boundary			
200%	100%	Structure(s) completely destroyed and/or large scale damage requiring major engineering works for stabilisation. Could cause at least one adjacent property major consequence damage.	CATASTROPHIC	1
60%	40%	Extensive damage to most of structure, and/or extending beyond site boundaries requiring significant stabilisation works. Could cause at least one adjacent property medium consequence damage.	MAJOR	2
20%	10%	Moderate damage to some of structure, and/or significant part of site requiring large stabilisation works. Could cause at least one adjacent property minor consequence damage.	MEDIUM	3
5%	1%	Limited damage to part of structure, and/or part of site requiring some reinstatement stabilisation works.	MINOR	4
0.5%		Little damage. (Note for high probability event (Almost Certain), this category may be subdivided at a notional boundary of 0.1%. See Risk Matrix.)	INSIGNIFICANT	5

Notes: (2) The Approximate Cost of Damage is expressed as a percentage of market value, being the cost of the improved value of the unaffected property which includes the land plus the unaffected structures.

(3) The Approximate Cost is to be an estimate of the direct cost of the damage, such as the cost of reinstatement of the damaged portion of the property (land plus structures), stabilisation works required to render the site to tolerable risk level for the landslide which has occurred and professional design fees, and consequential costs such as legal fees, temporary accommodation. It does not include additional stabilisation works to address other landslides which may affect the property.

(4) The table should be used from left to right; use Approximate Cost of Damage or Description to assign Descriptor, not vice versa

PRACTICE NOTE GUIDELINES FOR LANDSLIDE RISK MANAGEMENT 2007

APPENDIX C: – QUALITATIVE TERMINOLOGY FOR USE IN ASSESSING RISK TO PROPERTY (CONTINUED)

QUALITATIVE RISK ANALYSIS MATRIX – LEVEL OF RISK TO PROPERTY

LIKELIHOOD		CONSEQUENCES TO PROPERTY (With Indicative Approximate Cost of Damage)				
	Indicative Value of Approximate Annual Probability	1: CATASTROPHIC 200%	2: MAJOR 60%	3: MEDIUM 20%	4: MINOR 5%	5: INSIGNIFICANT 0.5%
A – ALMOST CERTAIN	10^{-1}	VH	VH	VH	H	M or **L** (5)
B - LIKELY	10^{-2}	VH	VH	H	M	**L**
C - POSSIBLE	10^{-3}	VH	H	M	M	**VL**
D - UNLIKELY	10^{-4}	H	M	**L**	**L**	**VL**
E - RARE	10^{-5}	M	**L**	**L**	**VL**	**VL**
F - BARELY CREDIBLE	10^{-6}	**L**	**VL**	**VL**	**VL**	**VL**

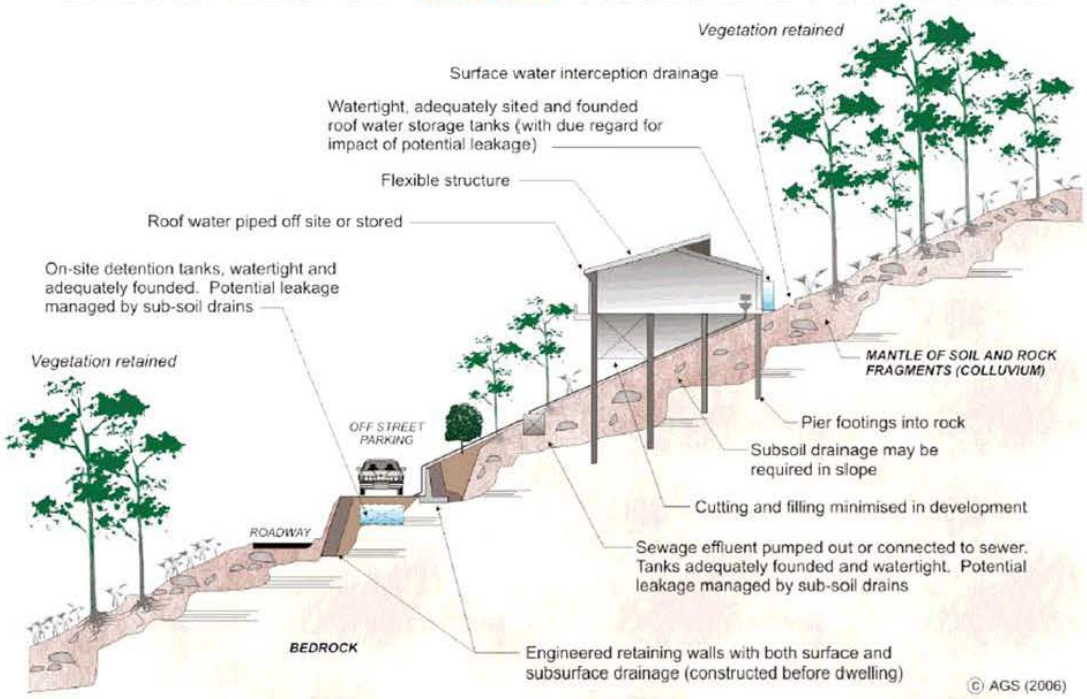
Notes: (5) For Cell A5, may be subdivided such that a consequence of less than 0.1% is Low Risk.
(6) When considering a risk assessment it must be clearly stated whether it is for existing conditions or with risk control measures which may not be implemented at the current time.

RISK LEVEL IMPLICATIONS

Risk Level		Example Implications (7)
VH	VERY HIGH RISK	Unacceptable without treatment. Extensive detailed investigation and research, planning and implementation of treatment options essential to reduce risk to Low; may be too expensive and not practical. Work likely to cost more than value of the property.
H	HIGH RISK	Unacceptable without treatment. Detailed investigation, planning and implementation of treatment options required to reduce risk to Low. Work would cost a substantial sum in relation to the value of the property.
M	MODERATE RISK	May be tolerated in certain circumstances (subject to regulator's approval) but requires investigation, planning and implementation of treatment options to reduce the risk to Low. Treatment options to reduce to Low risk should be implemented as soon as practicable.
L	LOW RISK	Usually acceptable to regulators. Where treatment has been required to reduce the risk to this level, ongoing maintenance is required.
VL	VERY LOW RISK	Acceptable. Manage by normal slope maintenance procedures.

Note: (7) The implications for a particular situation are to be determined by all parties to the risk assessment and may depend on the nature of the property at risk; these are only given as a general guide.

EXAMPLES OF **GOOD** HILLSIDE PRACTICE



EXAMPLES OF **POOR** HILLSIDE PRACTICE