REPORT ON

PRFELIMINARY GEOTECHNICAL INVESTIGATION

FOR

PROPOSED MANUFACTURED HOUSING ESTATE AT

CARRS DRIVE, YAMBA, NSW

DESCRIBED AS LOT 2 ON DP 733507

PREPARED FOR

CLIFTON YAMBA LANDPTY LTD

ATF YAMBA LAND TRUST

PROJECT REF: GI 5952-b

DATE: 20 MAY 2022

DRILLING ENVIRONMENTAL GEOTECHNICAL

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Document Details

Project Number	GI 5952
Report Title	Report on Preliminary Geotechnical Investigation Proposed Manufactured Housing Estate
Site Address	Carrs Road, Yamba, NSW described as Lot 2 on DP 733507
Prepared for	Clifton Yamba Land Pty Ltd ATF Yamba Land Trust

Revision	Date	Prepared By	Checked by	Approved for Issue
Final	7/7/21	A O'Carroll	J Walle	J Walle
Revision A	20/05/22	J Walle		J Walle

Report Distribution

Revision	Recipient	Method
Final	Richard Volpe chesney@cliftonlifestyle.com.au Andrew Smith andrew@md-engineer.com.au	Email
Revision A	Andrew Smith andrew@md-engineer.com.au	Email

This document was prepared in accordance with the scope of services described in Geotech Investigations Pty Ltd proposal and trading conditions as agreed with the client. This report is issued for the specific client, project and purpose(s) as described in the report, and should not be used or relied upon for other projects or purposes on the site or other sites.

The undersigned, for and on behalf of Geotechnical Investigations Pty Ltd, confirm that this document and all attached drawings, logs, and test results prepared by Geotech Investigations Pty Ltd have been checked and reviewed for errors, omissions and inaccuracies.

Yours faithfully
For and on behalf of
Geotech Investigations Pty Ltd

Andrew O'Carroll *BEng (Civil),*
Geotechnical Engineer

James Walle *RPEQ (15701), RPEng (Civil), BEng (Civil)*
Senior Geotechnical Engineer

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APPENDICES

1. INTRODUCTION

As requested by Clifton Yamba Land Pty Ltd ATF Yamba Land Trust, Geotech Investigations Pty Ltd (GI) has completed a preliminary geotechnical investigation for the proposed Manufactured Housing Estate at Carrs Road, Yamba, NSW described as Lot 2 on DP 733507.

1.1 Scope of Works

It is understood the purpose of the investigation is to provide a broadscale investigation of the subject site to highlight if any significant geotechnical constraints are likely to be encountered as part of the future development. The report was aimed to assist the proposed owner / developer in their Due Diligence (DD) stage and not provide design advice for the construction / design stage of the development.

The investigation was limited due to access constraints of the majority of the site.

The scope of the geotechnical services provided by GI was directed towards evaluating the following items. The report was to detail information regarding the project, site, and investigation, and provide comments on:-

1) General
    - Summary of subsurface conditions, topsoil depths and groundwater.
    - Present results of laboratory tests, if any.
    - Highlight anticipated construction difficulties.
2) Earthworks
    - Site preparation required prior to the placement of fill.
    - Topsoil stripping depths.
    - Filling procedures.
    - Comments on soft soils and possible preloading requirements.
3) Broadscale Foundation Recommendations
    - Broadscale high-level footing recommendations.
    - Broadscale Typical Site Classification in accordance with AS2870-2011.

2. PROPOSED DEVELOPMENT

The following documents have been provided to GI to assist with the investigation:-

- Concept Plan by Manage Design Engineer Pty Ltd (MDE), referenced: Concept Plan DWG No: SK03 Rev: 6 dated 12 May 2022, attached as Appendix A.

Based on the concept site plans, refer Figure 1, and discussions with MDE representatives, the proposed development is to include the following:-

- Clearing and preparation of part of the site to allow for bulk filling, mostly towards the eastern half.
- Bulk fill to achieve design levels between RL 3.4 to 3.6 m Australian Height Datum (AHD) indicating up 2 to 2.5 m of fill is required.
- Construction of a 'Riparian Corridor' (20 m in width) entering the central portion of the eastern front boundary and traversing towards the western boundary.
- A series of internal roads and entrances will be required as part of the development along with associated Civil infrastructure.
- The construction of lightly loaded, typically single level residential type buildings.

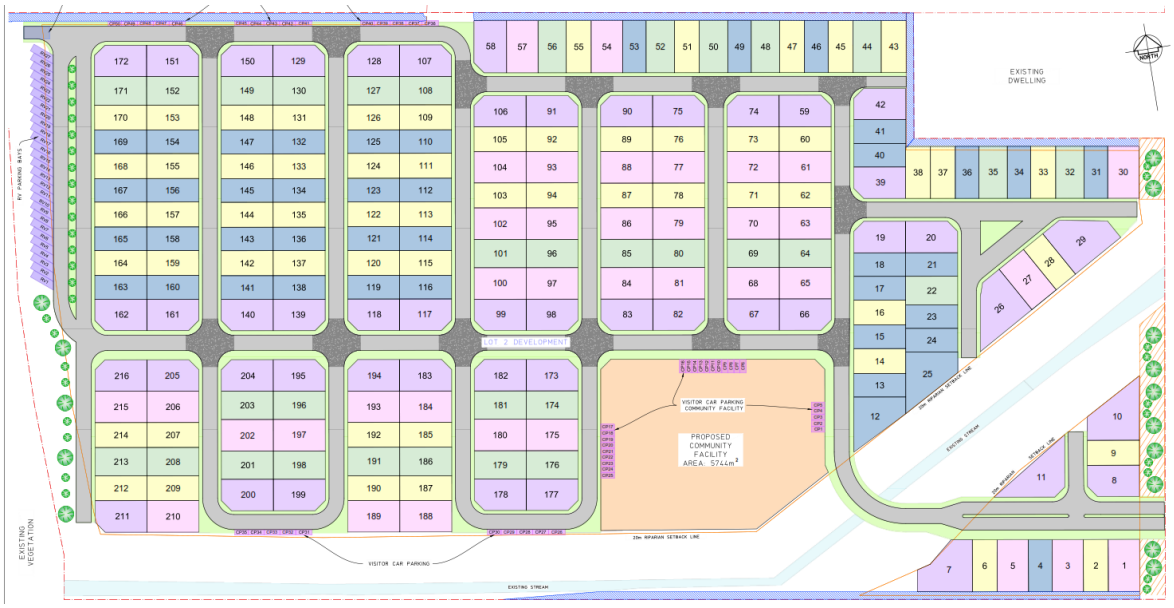

Figure 1 – Concept Site Plan

3. SITE DESCRIPTION

The subject site which is approximately 16 ha in overall area is located on the western side of Carrs Drive, approximately 1.2 km south of the intersection with Yamba Road. The site and surrounds are typically low-lying alluvial floodplains with the western boundary backing onto Oyster Channel, forming part of the tributaries of the Clarence River.

The majority of the site is covered with vegetation consisting recent regrowth and some matured trees, shrubs and grasses. The eastern area abutting the road frontage comprised maintained grass with an existing dwelling and gardens.

Drainage was considered poor across the majority of areas observed during the site investigations.

Pictures of the site are shown below in Figures 2 to 4.

Figure 2: Looking west to existing dwelling

Figure 3: Looking south along the front eastern boundary

Figure 4: Looking north along the front eastern boundary

4. FIELD WORK METHODOLOGY

Fieldwork was initially undertaken on the 1st July 2021, and comprised the drilling and sampling of two (2) boreholes, designated BH 1 to BH 2, using a vehicle mounted auger rig using spiral flight auguring techniques to termination between 2.8 m. Dynamic Cone Penetrometer tests (DCPs) were completed adjacent to each borehole to provide an estimate of the relative density of the sands encountered.

Additional fieldwork was then undertaken on the 6th and 7th of July 2021 and comprised the drilling and sampling of two (2) deep boreholes, designated BH 3 to BH 4. The boreholes were carried out using a truck mounted hydraulic drilling rig with spiral flight auguring techniques to approximately 1.5 m depth, then mud circulation drilling to the terminated depths between 10.9 m and 12.4 m. Standard Penetrometer Tests (SPTs) were completed within each borehole to provide an estimate of the relative density of the sands encountered. The approximate locations of the boreholes are shown on the attached Site Plan S01 in Appendix B along with GPS co-ordinates provided on the attached engineering logs in Appendix C.

This investigation has been carried out in accordance with AS 1726 – 2017[1] in terms of soil description, with the fieldwork supervised by an experienced geotechnical engineer, who positioned and logged the boreholes. At the completion of drilling, the boreholes were backfilled with drill spoil.

5. GEOTECHNICAL CONDITIONS

5.1 Regional Geology

The Geological Survey of NSW, 1:100,000 series Grafton Area shows the site to be located over quaternary aged Pleistocene tidal-delta Plains, which typically comprise *'silt, sands, shells, indurated sands and minor clays'.*

5.2 Subsurface Conditions

The results of the fieldwork are summarised in Table 1 below with more detailed descriptions presented on the Engineering Logs attached in Appendix C, along with explanatory notes.

Table 1: Summary of Subsurface Conditions *(depth below existing surface level)* (2)

Material Descriptions	BH 1 (m)	BH 2 (m)	BH 3 (m)	BH 4 (m)
Alluvial "Topsoil"(1)				
- Sandy CLAY	0 to 0.2	0 to 0.3	0 to 0.2	NE
Alluvial				
- Firm / stiff CLAY	0.2 to 0.3	0.3 to 0.5	0.2 to 0.3	NE
- Loose or worse (SPT 'N' < 10) SAND	2.3 to 2.8	1.0 to 2.8	1.0 to 5.5	0 to 5.4
- Medium Dense (SPT 10 < 'N' < 30) SAND	0.3 to 2.3	0.5 to 1.0	0.3 to 1.0	5.4 to 7.0
	NE	NE	5.5 to 11.1	NE
- Dense (SPT 30 < 'N' < 50) SAND	NE	NE	11.1 to 12.4	NE
- Very Dense (SPT 'N' > 50) SAND	NE	NE	NE	7.0 to 10.9
Terminated Depth (m)	2.8	2.8	12.4	10.9

Notes: NE – Not Encountered (1) Topsoil is described as soils containing vegetation

(2) Strengths were estimated and guessed in some occasions, refer to engineering logs for more details.

[1] Australian Standard AS 1726-2017 *'Geotechnical site investigations'*, Standards Australia

5.3 Groundwater

Groundwater seepage was observed during augering at depths between 0.5 m and 1.2 m below the existing surface levels, as detailed below in Table 2.

Table 2: Summary of Subsurface Conditions *(depth below existing surface level)*

Groundwater	BH 1 (m)	BH 2 (m)	BH 3 (m)	BH 4 (m)
Depth Below Surface Level	0.6	0.5	0.6	1.2

It should be noted that groundwater is affected by climatic conditions, soil permeability and tidal effects, and will therefore vary over time. Where groundwater is critical, it is suggested that a groundwater monitoring well be installed, and levels monitored over a period of time to identify variations prior to excavations.

6. RESULTS AND RECOMMENDATIONS

6.1 Key Geotechnical Constraints

Some of the key geotechnical constraints outlined within this report are summarised below:-

- Ground preparation works.
- The presence of shallow groundwater.
- Site trafficability.
- Variable depth of existing topsoil.

6.2 Earthworks

6.2.1 Summary of Earthworks

Earthworks are understood to involve:-

- Clearing and preparation of the front 450 m (approximately) of the site to allow for bulk filling to achieve estimated design levels of up to RL 3.6 m AHD. This will require bulk fill of up to about 2 to 2.5 m. Should additional earthworks of greater than +/- 1 m be proposed, this office must be contacted to provide further advice.
- Construction of a 'Riparian Corridor' (20 m in width). Although details are not known, it is anticipated that the corridor will comprise excavations and some surface batter shaping.
- A series of internal roads and entrances will be required as part of the development along with associated Civil infrastructure.

6.2.2 Topsoil Stripping and Subgrade Preparation

Based on the recent boreholes completed by GI, the stripping depth over the site will typically be in the order of 100 to 200 mm. The variation will result from a combination of surface vegetation and

in particular the root regrowth of the specific plants / trees, drainage and the weather conditions prior to the site strip.

It was noted and observed during the investigations that an alluvial soft to firm clay layer typically between 100 mm and 500 mm in thickness is located below the organic type topsoil. In conjunction with the shallow water table encountered, it is anticipated that the exposed alluvial clay layer will not be suitable to pass a 'test roll' and cause trafficability issues during construction. Therefore, GI suggests that a 'bridging layer' be considered over the alluvial clay layer as part of the earthwork's methodology, as detailed below in Section 6.2.3. This will have both environmental and cost benefits by reducing the extent of disturbance to the natural ground and limiting both the export and import volumes of structural fill required.

Furthermore, haul roads and areas of high plant traffic (i.e. turn-around and egress / ingress areas) will most likely require a crushed rock or similar layer placed to assist with high traffic movement on the exposed clay.

6.2.3 Bulk Filling Operations

Generally, all earthworks are to be carried out in accordance with AS 3798 – 2007[2]. The following earthworks procedures can be used as a preliminary guide for placing fill to support the bulk fill:-

- Following clearing and grubbing, strip site of organic / deleterious materials. Any building remnants or uncontrolled fill also will be required to be stripped.

  HOLD POINT # 1: Strip inspection required by GI.

- Placement and compaction of a 500 mm layer of clean sand material spanning the alluvial clay subgrade.

- **HOLD POINT # 2:** A test roll completed on the 'bridging layer' in the presence of a suitably qualified Geotechnical Engineer prior to additional fill being placed which will identify any further weak spots.

- Fill material should comprise similar properties to the site's natural soils and surrounding environment, hence it is recommended that **clean cohesionless sands** are used as bulk fill materials. This can often be more expensive upfront, however construction costs of placement (thicker layers) and compaction along with foundation costs of the houses / structures can often offset these initial costs and should be considered where possible. Alternative fill materials can be considered and specified by the design engineer.

- Fill material should be placed in layers not exceeding 250 mm loose thickness, however is dependent on fill material and compaction equipment. Typically for residential type developments in accordance with AS 3798, non-cohesionless material should be compacted to achieve a minimum 95% Maximum Dry Density (MDD) based on the Standard compaction

[2] Australian Standard AS 3798-2007 *'Guidelines on earthworks for residential and commercial developments'*, Standards Australia

test and material moisture controlled to within +/- 2% of Optimum Moisture Content (OMC) and cohesionless material compacted to 70 % Density Index or 98 % standard compaction.

- Compaction should be tested as per AS 3798 – 2007 Table 8.1 by a NATA accredited soils laboratory.
- All fill must be inspected and tested in accordance with Level 1 guidelines as set out in AS 3798.

6.2.4 Groundwater Control

As identified above in Section 5.3, groundwater seepage and anticipated standing groundwater was encountered at shallow depths (i.e. typically around 0.6 m depth below existing surface levels).

The groundwater will rise and fluctuate depending on tidal influences and rain events at the site and it is expected that the groundwater could rise to surface level at times of flooding, which needs to be considered in both the detailed design and construction phase of the project. The activities and problems associated with groundwater include:-

- Where excavations (such as service trenches) are proposed to extend near or below the water table, suitable methods of excavation and localised dewatering needs to be considered.
- Temporary retention (such as 'shore-boxes') will be required where excavations of the groundwater is required.
- Fill placement in areas within 0.5 to 1.0 m of the groundwater (at the time of placement). Fill areas may pump the groundwater into the placed fill causing heaving and compaction difficulties.

6.3 Temporary and Long Term Batter Slopes

The riparian zone is anticipated to be positioned at the 'natural' surface level (i.e. requiring no new fill), with long term batter slopes anticipated. Long term batter slopes of the 'controlled' fill sands above the ground water should be sloped at 1V:4H minimum for a maximum vertical height of 3 m. Steeper batter slopes for various fill materials can be considered.

Some slumping and erosion of the batter face may occur and to minimise this risk, compaction must extend past the final batter slope and be trimmed back to compacted material. The batter must also be protected from erosion with scour protection using suitable vegetation.

Temporary batter slopes (1 week in dry conditions) of the bulk fill and natural soils above the ground water may be based on 1V:1H for a maximum vertical height of 1.5 m. GI must be notified for any deeper trench excavations.

6.4 Site Settlements

Based on the subsurface investigation, the development area is underlain with a thin layer of clay and very loose to loose sands grading to medium dense then dense (or better) sands extending to approximately 10.9 to 12.4 m depth where the deeper boreholes were terminated. The upper stratum comprised a medium dense alluvial sand layer in some of the boreholes, however this was subject to variation between the testing locations.

Settlements of sands is relatively immediate as a result of surcharge loads. Considering the depth of fill to be placed over the site, the resultant settlements of the underlying alluvial sands would be considered negligible (less than 20 to 30 mm). These settlements will occur as the layers of fill surcharge is placed and will not impact the developments infrastructure or future structures. The fill material type / quality and compaction effort of the fill material will have some impact on these structures and will need to be considered in the design. GI can be contacted for further advice if required.

6.5 Broadscale Foundation Recommendations

6.5.1 Broadscale Indicative Shrink-Swell Movements and Site Classification

Following the placement of fill material, the allotments will be classified as **'Class P'** in accordance with the provisions of AS 2870. However, as the proposed new fill material is to be placed and compacted as 'controlled' fill, the sites may be reclassified.

A Site Classification is provided to allow the determination of appropriate footing sizes and slab details to be designed, and is based on the soil profile, the soil reactivity, and the climatic conditions at the site. The soil profile is identified by the site investigation drilling and in-situ testing, while the soil reactivity is determined from laboratory testing to provide the Shrink-Swell Index (I_{SS}). On the majority of sites, this information is used to calculate the characteristic surface movement (y_S), which is an estimation of the amount of movement at the surface of the site, subject to normal seasonal wetting and drying.

Following the proposed bulk earthworks, the subsurface materials will likely comprise recently placed **clean sand fill** (i.e. inert materials), and as such, shrink-swell movements will be minimal. Considering potential settlements due to self-weight of the fill and the surcharge from the individual dwellings, the allotments will most likely be reclassified as 'Class S' (slightly reactive) or 'Class M' (moderately reactive) in accordance with AS 2870. Additional geotechnical investigations will be required following the completion of the 'controlled' fill building platform/s.

6.5.2 Indicative High-Level Footings

Generally, provided the new fill has been placed in accordance with Section 6, the preliminary footing design for footings found in the compacted 'controlled' sands may typically be based on an allowable bearing pressure of 100 kPa. However, this will be dependent on the extent of fill material and strength of the underlying alluvial soils following the completion of the earthworks.

Additional geotechnical investigations will be required following the completion of the 'controlled' fill building platform/s for site specific footing recommendations.

7. LIMITS OF INVESTIGATION

This report has been written with the express intent of providing subsurface information for due diligence purposes, or as otherwise directed by the client and/or other members of the consulting team. Sub-surface conditions relevant to construction works should be assessed by contractors who can make interpretation of the factual data provided as engineering logs and test results, and perform any additional tests as necessary for their own purposes.

There are always some variations in sub-surface conditions across a site that cannot be defined even by exhaustive investigation. Hence, it is unlikely that the measurements and values obtained from sampling and testing during the investigation will represent the extremes of conditions which exist within the site.

Should conditions exposed at the site during excavation vary significantly from the interpretation provided in this report, based on the project specific factors cited in the introductory scope of the report, GI must be informed and have the opportunity to review any of the findings of this report.

The investigation was very limited due to the restricted access of a large portion of the site.

Further, sub-surface conditions, including groundwater levels, can change over time. This should be borne in mind, particularly if the report is used after a protracted delay.

APPENDIX A

CONCEPTUAL SITE PLANS BY MDE

10 5 0 10 20 30 40
Horizontal Scale 1:600 (A1)
1:1200 (A3)

PLANS TO BE PRINTED IN COLOUR

PRELIMINARY FOR SITE PLANNING PURPOSES ONLY
NOT FOR CONSTRUCTION

REVISION 6 - MASTERPLAN YAMBA 2 & 3

12th MAY 2022

AMEND LOT WIDTH TO ADD AN ADDITIONAL 2 LOTS

MIX OF PRODUCT

- LOTS 9.4m WIDTH = 42 LOTS (20%)
- LOTS 9.9m WIDTH = 58 LOTS (26%)
- LOTS 11.3m WIDTH = 32 LOTS (15%)
- LOTS 12.5m WIDTH = 84 LOTS (39%)

27 x RV / CARAVAN STORAGE BAYS
50 x VISITOR CAR PARKING

ALL DWELLING ENTITLEMENTS DEPTHS AT 20.70m

SITE YIELD = 216 LOTS

LEGEND

- CADASTRAL BOUNDARY
- NEW INTERNAL CONCRETE ROAD PAVEMENT
- NEW INTERNAL CONCRETE INTERSECTION TREATMENTS & DRIVEWAYS
- NEW 2.5m WIDE SHARED PATH WITHIN SITE BOUNDARY
- MHE BOUNDARY SETBACK 3m WIDE 'NO BUILD ZONE'
- MHE BOUNDARY SETBACK 10m WIDE 'NO BUILD ZONE'
- PROPOSED MHE ALLOTMENT 9.4m LOT WIDTH
- PROPOSED MHE ALLOTMENT 9.9m LOT WIDTH
- PROPOSED MHE ALLOTMENT 11.3m LOT WIDTH
- PROPOSED MHE ALLOTMENT 12.5m LOT WIDTH
- PROPOSED MHE ALLOTMENT 12.5m LOT WIDTH CORNER SITE
- PROPOSED NEW COMMUNITY FACILITY AREA

ISSUE	DESCRIPTION	DATE
6	MASTERPLAN LAYOUT RE-ISSUED FOR CLIENT REVIEW	12.05.2022
5	MASTERPLAN LAYOUT RE-ISSUED FOR CLIENT REVIEW	11.05.2022
4	MASTERPLAN LAYOUT RE-ISSUED FOR CLIENT REVIEW	02.05.2022
3	MASTERPLAN LAYOUT RE-ISSUED FOR CLIENT REVIEW	07.12.2021
2	MASTERPLAN LAYOUT RE-ISSUED FOR CLIENT REVIEW	18.08.2021
1	MASTERPLAN LAYOUT RE-ISSUED FOR CLIENT REVIEW	23.07.2021
0	MASTERPLAN LAYOUT ISSUED FOR CLIENT REVIEW	28.06.2021

DESIGNED: T.RYDEN
DRAWN: A.SCHMID
SURVEYING:
DATE: MAY 2022
SCALE: AS SHOWN
SHEET SIZE: A1

NOT FOR CONSTRUCTION

MANAGE-DESIGN-ENGINEER PTY LTD
PROJECT MANAGEMENT-CIVIL ENGINEERING-DESIGN-SURVEYING
SUITE 1, 64 BALLINA STREET, LENNOX HEAD NSW 2478
PO Box 44 LENNOX HEAD NSW 2478
www.mde-engineer.com.au
ABN: 88 607 109 357

CLIENT: CLIFTON YAMBA LAND PTY LTD

TITLE: PROPOSED MANUFACTURED HOUSING ESTATE

PROJECT: CARRS DRIVE
YAMBA NSW
LOT 2 DP733507

CIVIL DRAWING

DRAWING TITLE: CONCEPT PLAN
MDE ADDITIONAL LOTS - YAMBA 2-3 URBAN DESIGN

DWG No: SK03 SHEET: 1 OF 1 REV: 6

APPENDIX B

SITE PLAN S01

SITE IMAGE

LOCALITY IMAGE

Locality Image courtesy of
Google Earth & NSW Globe

NORTH

GeoTech INVESTIGATIONS PTY LTD

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CLIENT: CLIFTON YAMBA LAND PTY LTD

PROJECT: NO.120 CARRS ROAD YAMBA

DRAWING REF: S01: SITE PLAN

LEGEND:
Borehole and Dynamic Cone Penetrometer Locat i on

Site Plan provided by Google Earth Image

APPROXIMATE NORTH

NORTH

DATE: 06.07.2021

OUR REF / JOB No.: GI 5952-a sp

DRAWN BY: DC

Drawing not to scale.
Printed dimensions only.

APPENDIX C

BOREHOLE PROFILES BH 1 TO BH 4
GEOTECHNICAL REPORT STANDARD NOTES

GEOTECH INVESTIGATIONS PTY LTD

Unit 3/42 Machinery Drive, Tweed Heads South NSW 2486
Ph: 0755 233 979 Fax: 0755 233 981

ENGINEERING LOG – BOREHOLE PROFILE

GPS:	E:	532118	S:	6742966

CLIENT: CLIFTON YAMBA LAND PTY LTD ATF YAMBA LAND TRUST	**BOREHOLE I.D. :** BH 1
PROJECT: NO.120 CARRS DRIVE, YAMBA (LOT 2 ON DP 733507)	**JOB No.:** GI 5952-a
EQUIPMENT TYPE: GT-10 / **HOLE DIAMETER:** 110mm	**PAGE:** 1 of 1

Method	Water	Depth (m)	Graphic Log	Material Description	Consistency / Rel. Density	Sample / Test	DCP Blows / 100mm	Structure and additional observation
AD	▼	0.5		(CH) Sandy CLAY: High plasticity, Fine sand, Wet (w>wp), Dark grey	F		1 1 1	ALLUVIUM
				(CH) Sandy CLAY: High plasticity, Fine sand, Wet (w>wp), Grey			2 2 3	
		1.0		(SP) SAND: Fine sand, Trace of silt, Wet, Pale grey	MD		3 4 5 10 10 10 12 10 10 8 6 6	
		1.5		(SM) Silty SAND: Fine sand, Moist, Grey				
		2.0			L		5 3 3 3 3 3 3 3 3 4 4 4	
		2.5						
		3.0						
		3.5						
		4.0						
		4.5						

BH 1 TERMINATED AT 2.8m – LIMIT OF INVESTIGATION

METHOD		WEATHERING		CONSISTENCY / DENSITY / ROCK STRENGTH				SAMPLES / TESTS	
AD	Auger Drilling	EW	Extremely	VS	Very Soft	D	Dense	U( )	Undisturbed (size in mm)
C	Casing	HW	Highly	S	Soft	VD	Very Dense	D	Disturbed
MS	Mud Support	DW	Distinctly	F	Firm	Fb	Friable	BS	Bulk Sample
NMLC	Rock Coring	MW	Moderately	St	Stiff	ELw	Extremely Low	DCP	Dynamic Cone Penetrometer
RR	Rock Roller	SW	Slightly	VSt	Very Stiff	VLw	Very Low	SPT	Standard Penetrometer Test
TC	Tri Cone	F	Fresh	Hd	Hard	Lw	Low	N	Number of blows for SPT / 300mm
WB	Wash Bore			VL	Very Loose	M	Medium	VS	Vane Shear
WATER				L	Loose	H	High	A	Acid Sulfate Sample
▼	Water Level			MD	Medium Dense	VH	Very High	PP	Pocket Penetrometer (kPa)
►	Water Seepage								

Logged By:	DAW	Date:	01/07/21	Checked By:	AOC	Date:	7/7/21

GEOTECH INVESTIGATIONS PTY LTD

Unit 3/42 Machinery Drive, Tweed Heads South NSW 2486
Ph: 0755 233 979 Fax: 0755 233 981

ENGINEERING LOG – BOREHOLE PROFILE

GPS:	E:	532082	S:	6743014

CLIENT: CLIFTON YAMBA LAND PTY LTD ATF YAMBA LAND TRUST	**BOREHOLE I.D. :** BH 2
PROJECT: NO.120 CARRS DRIVE, YAMBA (LOT 2 ON DP 733507)	**JOB No.:** GI 5952-a
EQUIPMENT TYPE: GT-10 / **HOLE DIAMETER:** 110mm	**PAGE:** 1 of 1

Method	Water	Depth (m)	Graphic Log	Material Description	Consistency / Rel. Density	Sample / Test	DCP Blows / 100mm	Structure and additional observation
AD		0		(CH) Sandy CLAY: High plasticity, Fine sand, Wet (w>wp), Dark grey	F		1 1 1	ALLUVIUM
				(CH) Sandy CLAY: High plasticity, Fine sand, Wet (w>wp), Grey			2 2	
	▼	0.5		(SP) SAND: Fine sand, Trace of silt, Wet, Pale grey	MD		3 3 4 4 5	
		1.0		(SM) Silty SAND: Fine sand, Moist, Grey	L		4 4 3 3 3 3 3 3 3 3 3 2 2 2 2 3 3 4 4	
		1.5						
		2.0						
		2.5						
		3.0						
		3.5						
		4.0						
		4.5						

BH 2 TERMINATED AT 2.8m – LIMIT OF INVESTIGATION

METHOD		WEATHERING		CONSISTENCY / DENSITY / ROCK STRENGTH				SAMPLES / TESTS	
AD	Auger Drilling	EW	Extremely	VS	Very Soft	D	Dense	U( )	Undisturbed (size in mm)
C	Casing	HW	Highly	S	Soft	VD	Very Dense	D	Disturbed
MS	Mud Support	DW	Distinctly	F	Firm	Fb	Friable	BS	Bulk Sample
NMLC	Rock Coring	MW	Moderately	St	Stiff	ELw	Extremely Low	DCP	Dynamic Cone Penetrometer
RR	Rock Roller	SW	Slightly	VSt	Very Stiff	VLw	Very Low	SPT	Standard Penetrometer Test
TC	Tri Cone	F	Fresh	Hd	Hard	Lw	Low	N	Number of blows for SPT / 300mm
WB	Wash Bore			VL	Very Loose	M	Medium	VS	Vane Shear
WATER				L	Loose	H	High	A	Acid Sulfate Sample
▼	Water Level			MD	Medium Dense	VH	Very High	PP	Pocket Penetrometer (kPa)
►	Water Seepage								

Logged By:	DAW	Date:	01/07/21	Checked By:	AOC	Date:	7/7/21

GEOTECH INVESTIGATIONS PTY LTD

Unit 3/42 Machinery Drive, Tweed Heads South NSW 2486
Ph: 0755 233 979 Fax: 0755 233 981

ENGINEERING LOG – BOREHOLE PROFILE

GPS:	E:	532135	S:	6742977

CLIENT: CLIFTON YAMBA LAND PTY LTD ATF YAMBA LAND TRUST	**BOREHOLE I.D.:** BH 3
PROJECT: NO.120 CARRS DRIVE, YAMBA (LOT 2 ON DP 733507)	**JOB No.:** GI 5952-A
EQUIPMENT TYPE: EXPLORA85 / **HOLE DIAMETER:** 110mm	**PAGE:** 1 of 3

Method	Water	Depth (m)	Graphic Log	Material Description	Consistency / Rel. Density	Sample / Test	DCP Blows / 100mm	Structure and additional observation
AD to 1.5 m then MS (RR)	▼	0.5		(CH) Sandy CLAY: High plasticity, Fine sand, Wet (w>wp), Dark grey				ALLUVIUM
				(CH) Sandy CLAY: High plasticity, Fine sand, Wet (w>wp), Grey				
		1.0		(SP) SAND: Fine sand, Trace of silt, Wet, Pale grey	MD			
		1.5		(SP) SAND: Fine to medium sand, Trace of silt, Wet, Pale grey mottled grey	L	SPT 1.5 3,2,3 N=5		
		2.0						
		2.5						
		3.0		(SP) SAND: Fine to medium sand, Trace of silt, Trace of shell grit throughout, Wet, Pale grey mottled grey	VL/L	SPT 3.0 1,-,1 N=1		
		3.5						
		4.0						
		4.5				SPT 4.5 -,-,2 N=2		
		5.0						
		5.5		(SP) SAND: Fine to medium sand, Trace of silt, Wet, Brown	MD			

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ENGINEERING LOG – BOREHOLE PROFILE

CLIENT: CLIFTON YAMBA LAND PTY LTD ATF YAMBA LAND TRUST	**BOREHOLE I.D.:** BH 3
PROJECT: NO.120 CARRS DRIVE, YAMBA (LOT 2 ON DP 733507)	**JOB No.:** GI 5952-A
EQUIPMENT TYPE: EXPLORA85 / **HOLE DIAMETER:** 110mm	**PAGE:** 2 of 3

Method	Water	Depth (m)	Graphic Log	Material Description	Consistency / Rel. Density	Sample / Test	DCP Blows / 100mm	Structure and additional observation
MS (RR)		6.0		(SP) SAND: Fine to medium sand, Trace of silt, Wet, Brown	MD	SPT 6.0 1,13,17 N=20		ALLUVIUM
		7.0		(SP) SAND: Fine to medium sand, Trace of silt, Wet, Brown mottled orange		SPT 7.5 5,11,13 N=24		
		9.0		(SP) SAND: Fine to medium sand, Trace of silt, Wet, Pale brown		SPT 9.0 7,17,0 N=17		
		10.5				SPT 10.5 9,17,21 N=35		
		11.0		(SP) SAND: Fine to medium sand, Trace of silt, Wet, Brown mottled orange	D			

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ENGINEERING LOG – BOREHOLE PROFILE

CLIENT: CLIFTON YAMBA LAND PTY LTD ATF YAMBA LAND TRUST	**BOREHOLE I.D. :** BH 3
PROJECT: NO.120 CARRS DRIVE, YAMBA (LOT 2 ON DP 733507)	**JOB No.:** GI 5952-A
EQUIPMENT TYPE: EXPLORA 85 / **HOLE DIAMETER:** 110mm	**PAGE:** 3 of 3

Method	Water	Depth (m)	Graphic Log	Material Description	Consistency / Rel. Density	Sample / Test	DCP Blows / 100mm	Structure and additional observation
MS (RR)		11.5 12.0 12.45		(SP) SAND: Fine to medium sand, Trace of silt, Wet, Brown mottled orange	D	SPT 12.0 11,17,23 N=40		ALLUVIUM
		13.0 13.5 14.0 14.5 15.0 15.5 16.0						

BH 3 TERMINATED AT 12.45m – LIMIT OF INVESTIGATION

METHOD		WEATHERING		CONSISTENCY / DENSITY / ROCK STRENGTH				SAMPLES / TESTS	
AD	Auger Drilling	EW	Extremely	VS	Very Soft	D	Dense	U( )	Undisturbed (size in mm)
RR	Rock Roller	HW	Highly	S	Soft	VD	Very Dense	D	Disturbed
MS	Mud Support	DW	Distinctly	F	Firm	Fb	Friable	BS	Bulk Sample
NMLC	Rock Coring	MW	Moderately	St	Stiff	ELw	Extremely Low	DCP	Dynamic Cone Penetrometer
WB	Wash Bore	SW	Slightly	VSt	Very Stiff	VLw	Very Low	SPT	Standard Penetrometer Test
WATER		F	Fresh	Hd	Hard	Lw	Low	N	Number of blows for SPT / 300mm
▼	Water Level			VL	Very Loose	M	Medium	VS	Vane Shear
▶	Water Seepage			L	Loose	H	High	A	Acid Sulfate Sample
»–	Partial Loss			MD	Medium Dense	VH	Very High	PP	Pocket Penetrometer (kPa)
–«	Complete Loss								

Logged By:	JW	**Date:**	06/07/21	**Checked By:**	AOC	**Date:**	7/7/21

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ENGINEERING LOG – BOREHOLE PROFILE

GPS:	E:	531912	S:	6743140

CLIENT: CLIFTON YAMBA LAND PTY LTD ATF YAMBA LAND TRUST	**BOREHOLE I.D. :** BH 4
PROJECT: NO.120 CARRS DRIVE, YAMBA (LOT 2 ON DP 733507)	**JOB No.:** GI 5952-a
EQUIPMENT TYPE: EXPLORA85 / **HOLE DIAMETER:** 110mm	**PAGE:** 1 of 2

Method	Water	Depth (m)	Graphic Log	Material Description	Consistency / Rel. Density	Sample / Test	DCP Blows / 100mm	Structure and additional observation
AD to 1.5 m then MS (RR)	▼	0.5		(SM) Silty SAND: Fine to medium sand, Moist, Dark brown	L			FILL
		1.0		(SP) SAND: Fine sand, Trace of silt, Moist, Pale brown				
		1.5		(SP) SAND: Fine sand, Trace of silt, Wet, Pale grey mottled grey	L	SPT 1.5 4,3,3 N=6		ALLUVIUM
		2.0						
		2.5						
		3.0		As above:	VL / L	SPT 3.0 3,1,2 N-3		
		3.5						
		4.0						
		4.5				SPT 4.5 1,-,- N=0		
		5.0						
		5.5		(SP) SAND: Fine sand, Trace of silt, Wet, Pale brown	MD			

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ENGINEERING LOG – BOREHOLE PROFILE

CLIENT: CLIFTON YAMBA LAND PTY LTD ATF YAMBA LAND TRUST	**BOREHOLE I.D. :** BH 4
PROJECT: NO.120 CARRS DRIVE, YAMBA (LOT 2 ON DP 733507)	**JOB No.:** GI 5952-a
EQUIPMENT TYPE: EXPLORA85 / **HOLE DIAMETER:** 110mm	**PAGE:** 2 of 2

Method	Water	Depth (m)	Graphic Log	Material Description	Consistency / Rel. Density	Sample / Test	DCP Blows / 100mm	Structure and additional observation
MS (RR)		6.0		(SP) SAND: Fine sand, Trace of silt, Wet, Pale brown	MD			ALLUVIUM
						SPT 6.0 10,11,16 N=27		
		7.0		(SP) SAND: Fine sand, Trace of silt, Wet, Pale brown	VD			
		7.5				SPT 7.5 17,27,25 N=52		
		8.0						
		8.5						
		9.0				SPT 9.0 11,26,29 N=55		
		9.5						
		10.9				SPT 10.5 15,23,31 N=54		

BH 4 TERMINATED AT 10.9m – LIMIT OF INVESTIGATION

METHOD		WEATHERING		CONSISTENCY / DENSITY / ROCK STRENGTH				SAMPLES / TESTS	
AD	Auger Drilling	EW	Extremely	VS	Very Soft	D	Dense	U( )	Undisturbed (size in mm)
RR	Rock Roller	HW	Highly	S	Soft	VD	Very Dense	D	Disturbed
MS	Mud Support	DW	Distinctly	F	Firm	Fb	Friable	BS	Bulk Sample
NMLC	Rock Coring	MW	Moderately	St	Stiff	ELw	Extremely Low	DCP	Dynamic Cone Penetrometer
WB	Wash Bore	SW	Slightly	VSt	Very Stiff	VLw	Very Low	SPT	Standard Penetrometer Test
		F	Fresh	Hd	Hard	Lw	Low	N	Number of blows for SPT / 300mm
WATER				VL	Very Loose	M	Medium	VS	Vane Shear
▼	Water Level			L	Loose	H	High	A	Acid Sulfate Sample
►	Water Seepage			MD	Medium Dense	VH	Very High	PP	Pocket Penetrometer (kPa)
»–	Partial Loss								
–«	Complete Loss								

Logged By:	JW	**Date:**	06/07/21	**Checked By:**	AOC	**Date:**	7/7/21

SCOPE These standard notes may be of assistance when understanding terms and recommendations given in this report. These notes are for general conditions and not all terms given may be of concern to the report attached. The descriptive terms adopted by Geotech Investigations Pty Ltd are given below and are largely consistent with Australian Standards AS1726-1993 'Geotechnical Site Investigations'.

CLIENT can be described and is limited to the financier of this geotechnical investigation.

LEGALITY and privacy of this document is based on communication between Geotech Investigations Pty Ltd and the client. Unless indicated otherwise the report was prepared specifically for the client involved and for the purposes indicated by the client. Use by any other party for any purpose, or by the client for a different purpose, will result in recommendations becoming invalid and Geotech Investigations Pty Ltd will hold no responsibility for problems which may arise.

GEOTECHNICAL REPORTS are predominantly derived using professional estimates determined from the results of fieldwork, in-situ and laboratory testing and experience from previous investigations in the area, from which geotechnical engineers then formulate an opinion about overall subsurface conditions. The client must be made aware that the investigations are undertaken to ensure minimal site impact using test-pits or small diameter boreholes and soil conditions on-site may vary from those encountered during the investigation.

CLIENTS RESPONSIBILITY to notify this office should there be adjustments in proposed structure/location or inconsistencies with material descriptions given in this report and those encountered on site. Geotech Investigations Pty Ltd is able to provide a range of services from on-site inspections to full project supervision to confirm recommendations given in the report.

CSIRO Publication BTF 18 'Foundation Maintenance and Footing Performance: A Homeowner's Guide' explains how to adequately maintain drainage during and post construction which lies as the responsibility of the client. Suitable drainage ensures recommendations given in this report remain valid.

INVESTIGATION METHODS adopted by Geotech Investigations Pty Ltd are designed to incorporate individual project-specific factors to obtain information on the physical properties of soil and rock around a site to design earthworks and foundations for proposed structures. The following methods of investigation currently adopted by this company are summarised below:-

HAND AUGER – investigations enable field work to be undertaken where access is limited. The materials must have sufficient cohesion to stand unsupported in an unlined borehole and there must be no large cobbles boulders or other obstructions which would prevent rotation of the auger.

TEST-PITS – investigations are carried out with an excavator or backhoe, allowing a visual inspection of sub-surface material in-situ and from samples removed. The limit of investigation is restricted by the reach of the excavator or backhoe.

CONTINUOUS SPIRAL FLIGHT AUGERING TECHNIQUES – investigations are advanced by pushing a 100mm diameter spiral into the sub-surface and withdrawing it at regular intervals to allow sampling or testing as it emerges.

WASH BORING – investigations are advanced by removing the loosened soil from the borehole by a stream of water or drilling mud issuing from the lower end of the wash pipe which is worked up and down or rotated by hand in the borehole. The water or mud carries the soil up the borehole where it overflows at ground level where the soil in suspension is allowed to settle in a pond or tank and the fluid is re-circulated or discharged to waste as required.

NON-CORE ROTARY DRILLING – investigations are advanced using a rotary bit with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from feel and rate of penetration.

ROTARY MUD DRILLING – is carried out as above using mud as support and circulating fluid for the borehole drilling. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling.

CONTINUOUS CORE DRILLING – investigations are carried out in rock material, specimens of rock in the form of cylindrical cores are recovered from the drill holes by the means of core barrel. The core barrel is provided at its lower end with a detachable core bit which carries industrial diamond chips in a matrix of metal. Rotation of the barrel by means of the drill rods causes the core bit to cut an annulus in the rock, the cuttings being washed to the surface by a stream of pumped down the hollow drill rods.

TESTING METHODS adopted by Geotech Investigations Pty Ltd to determine soil properties include but not limited to the following:-

U50 – Undisturbed samples are obtained by inserting a 50mm diameter thin-walled steel tube into the material and withdrawing with a sample of the soil in a moderately undisturbed condition.

PP – Pocket Penetrometer tests are commonly used on thin walled tube samples of cohesive soils to evaluate consistency and approximate unconfined compressive strength of saturated cohesive soils. They may also be used for the same purpose in freshly excavated trenches.

VS – Vane Shear test are commonly used in-situ or on thin walled tube samples of cohesive soils by introducing the vane into the material where the measurement of the undrained shear strength is required. Then the vane is rotated and the torsional force required to cause shearing is calculated.

DCP – Dynamic Cone Penetrometer tests are commonly used in-situ to measure the strength attributes of penetrability and compaction of sub-surface materials.

SPT – Standard Penetration Tests are commonly used to determine the density of granular deposits but are occasionally used in cohesive material as a means of determining strength and also of obtaining a relatively unmixed sample. Samples and results are obtained by driving a 50mm diameter split tube through blows from a slide hammer with a weight of 63.5kg falling through a distance of 760mm. Blow counts are recorded for 150mm intervals with the sum of the number of blows required for the second and third 150mm of penetration is termed the "standard penetration resistance" or the "N-value".

GEOLOGICAL ORIGINS of sub-surface material plays a considerable role in the development of engineering parameters and have been summarised as follows:-

FILL – materials are man made deposits, which may be significantly more variable between test locations than naturally occurring soils.

RESIDUAL – soils are present in a region because of weathering over the geological time scale.

COLLUVIAL – soils have been deposited recently, on the geological time scale, as soils being transported slowly down slope due to gravitational creep.

ALLUVIAL – soils have been deposited recently, on the geological time scale, as water borne materials.

AEOLIAN – soils have been deposited recently, on the geological time scale, as wind borne materials.

SOIL DESCRIPTION is based on an assessment of disturbed samples, as recovered from boreholes and excavations, and from undisturbed materials. Soil descriptions adopted by Geotech Investigations Pty Ltd are largely consistent with AS 1726-2017 '*Geotechnical Site Investigation'.* Soil types are described according to the predominating particle size and behaviour, qualified by the grading of other particles present on the following bases detailed in Table 1.

COHESIVE SOILS ability to hold moisture known as its liquid limit is the state of a soil when it goes from a solid state to a liquid state described in Table 2

TABLE 1

Soil Classification	Particle Size
Clay	< 0.002 mm
Silt	0.002 – 0.06 mm
Sand	0.06 – 2.00 mm
Gravel	2.00 – 60.0 mm

TABLE 2

Descriptive Type	Range of Liquid Limit %
Of low plasticity	≤ 35
Of medium plasticity	> 35 ≤ 50
Of high plasticity	> 50

Furthermore to soil description cohesive soils are described on their strength (assessed in conjunction with penetration tests) and liquid limit. Non-cohesive soil strengths are described by their density index. With descriptions for cohesive and non-cohesive soils summarised in Table 3.

TABLE 3

COHESIVE SOILS		NON-COHESIVE SOILS	
Term	**Undrained Shear Strength kPa**	**Term**	**Density Index %**
Very soft	≤ 12	Very Loose	≤15
Soft	> 12 ≤25	Loose	> 15 ≤35
Firm	> 25 ≤50	Medium Dense	> 35 ≤65
Stiff	> 50 ≤100	Dense	> 65 ≤85
Very Stiff	> 100 ≤200	Very Dense	> 85
Hard	> 200		

Description of terms used to describe material portion are summarised in Table 4.

TABLE 4

COARSE GRAINIED SOILS		FINE GRAINED SOILS	
% Fines	**Modifier**	**% Coarse**	**Modifier**
≤ 5	Omit or 'trace'	≤ 15	Omit or 'trace'
> 5 ≤12	Describe as 'with'	> 15 ≤30	Describe as 'with'
> 12	Prefix soil as 'silty/clayey'	> 30	Prefix soil as 'sandy/gravelly'

ROCK DESCRIPTIONS are determined from disturbed samples or specimens collected during field investigations. A rocks presence of defects and the effects of weathering are likely to have a great influence on engineering behaviour.

Rock Material Weathering Classification is summarised in Table 5.

TABLE 5

Term	Symbol	Definition
Residual Soils	-	Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported
Extremely Weathered Rock	XW	Rock is weathered to such an extent that it has 'soil' properties, i.e. it either disintegrates or can be remoulded, in water
Distinctly Weathered Rock	DW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by iron staining. Porosity may be increased by leaching, or may be decreased due to decomposition of weathering products in pores
Slightly Weathered Rock	SW	Rock is slightly discoloured but shows little or no change of strength from fresh rock
Fresh rock	FR	Rock shows no signs of decomposition or staining

Rock Material Strength Classification is summarised in Table 6.

TABLE 6

Term	Symbol	Point load index (MPa) I_s50	Field guide to strength
Extremely Low	EL	≤0.03	Easily remoulded by hand to a material with soil properties
Very Low	VL	>0.03 ≤0.1	Material crumbles under firm blows with sharp end of pick; can be peeled with knife; too hard to cut a triaxial sample by hand. Pieces up to 3cm thick can be broken by finger pressure
Low	L	>0.1 ≤0.3	Easily scored with a knife; indentations 1mm to 3mm show in the specimen with firm blows of the pick point; has dull sound under hammer. A piece of core 150mm long 50mm diameter may be broken by hand. Sharp edges of core may be friable and break during handling
Medium	M	>0.3 ≤1.0	Readily scored with a knife; a piece of core 150mm long by 50mm diameter can be broken by hand with difficulty
High	H	>1.0 ≤3.0	A piece of core 150mm long by 50mm diameter cannot be broken by hand but can be broken by a pick with a single firm blow; rock rings under hammer
Very High	VH	>3.0 ≤10	Hand specimen breaks with pick after more than one blow; rock rings under hammer
Extremely High	EH	>10	Specimen requires many blows with geological pick to break through intact material; rock rings under hammer

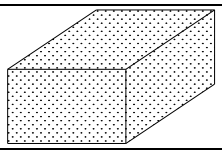
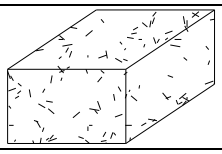
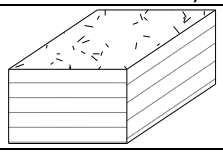
Rock Material Defect Shapes are summarised in Table 7.

TABLE 7

Term	Description
Planar	The defect does not vary in orientation.
Curved	The defect has a gradual change in orientation
Undulating	The defect has a wavy surface
Stepped	The defect has one or more well defined steps.
Irregular	The defect has many sharp changes of orientation
Smooth	The defect has a flat even finish
Rough	The defect has a irregular disoriented finish

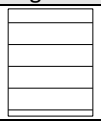
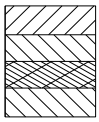
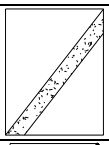
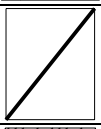
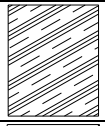
Rock Material Texture and Fabric are summarised in Table 8.

TABLE 8

Geological Description	Massive		Layered (Bedded foliate cleaved)
Diagram			
Fabric Type	Effectively homogenous and isotropic. Bulky or equi-dimensional grains uniformly distributed	Effectively homogeneous and isotropic. Elongated	Effective homogeneous with planar anisotropy. Elongated or tabular grains or pores in a layered arrangement

Rock Material Defect Type is summarised in Table 9

TABLE 9

Term	Definition	Diagram
Bedding	Signifying existence of beds or laminate. Planes dividing sedimentary rocks of the same or different lithology. Structure occurring in granite and similar rocks evident in a tendency to split more or less horizontally to the land surface	
Cross Bedding	Also called cross-lamination or false bedding. The structure commonly present in granular sedimentary rocks, which consists of tabular, irregularly lenticular or wedge-shaped bodies lying essentially parallel to the general stratification and which them selves show pronounced lamination structure in which the laminae are steeply inclined to the general bedding.	
Crushed Seam	A fracture at a more or less acute angle to applied force generally with some pulverized material along its surface	
Joint	A fracture in rock, generally more or less vertical or transverse to bedding, along which no appreciable movement has occurred.	
Parting	A small joint in rock or a layered rock where the tendency of crystals to separate along certain planes that are not true cleavage planes.	
Sheared Zone	A fracture that results from stresses which tend to shear one part of a specimen past the adjacent part