Pacific Geotech
Consulting Geotechnical Engineers

GEOTECHNICAL REPORT: Proposed Residential Development

69 & 71 Banana Street & 18 Outridge Street

Redland Bay

LA5 Trust & LA6 Trust & LA7 Trust & LA9 Trust

May 2020

PG-7911

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Pacific Geotech
Consulting Geotechnical Engineers

Ref: PG-7911, 2022-05-09, GR VER 1
Author: Chris Kosiek

11th May, 2020

LA5 Trust & LA6 Trust & LA7 Trust & LA9 Trust
Email: Rachel.yin@nfrealestate.com.au

ATTN: RACHEL YIN

Dear Sir,

GEOTECHNICAL INVESTIGATION – PROPOSED RESIDENTIAL DEVELOPMENT
69 & 71 BANANA STREET & 18 OUTRIDGE STREET, REDLAND BAY

Enclosed is a copy of our report for the above project dated May 2020. An electronic copy of the report has been issued.

Should you have any queries regarding this report, please do not hesitate to contact Chris Kosiek or Peter Elkington at this office.

Yours faithfully,

C. KOSIEK (RPEQ 24394)

For and on behalf of
PACIFIC GEOTECH PTY LTD

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Appendices

1.0 INTRODUCTION

This report contains the results of the geotechnical investigation and provides advice and recommendations relating to the following:

- Subsurface conditions in accordance with AS 1726
- Foundation Recommendations
- Characteristic ground surface movements
- Earthworks considerations
- Batter slope recommendations
- Indicative pavement design parameters
- Construction considerations
- Preliminary acid sulfate conditions

Proposed Development

It is understood that the proposed development is to comprise of the construction of a new 7 storey unit building above a 2 to 3 level basement.

2.0 METHODOLOGY

The geotechnical investigation comprised the drilling and sampling of 2 boreholes to depths of 7.5m and 9.0m, using a Digga PDT 1 drilling rig using 100mm solid flight augers techniques. Dynamic Cone Penetrometer (DCP) testing was conducted adjacent to the boreholes. 3 Cone Penetrometer Tests (CPT's) were also pushed to depths of 16.7m, 18.2m and 10.5m, using our truck mounted cordless CPT pushing equipment.

The soil classification descriptions and field tests were carried out in general accordance with Australian Standards.

AS 1726	Geotechnical Site Investigations
AS 1289	Methods of Testing Soils for Engineering Purposes

Borehole records, Dynamic Cone Penetrometer test results and a site plan showing the test locations are appended to the report.

3.0 SITE DESCRIPTION

The site of the proposed development is located at 69 & 71 Banana Street & 18 Outridge Street, Redland Bay.

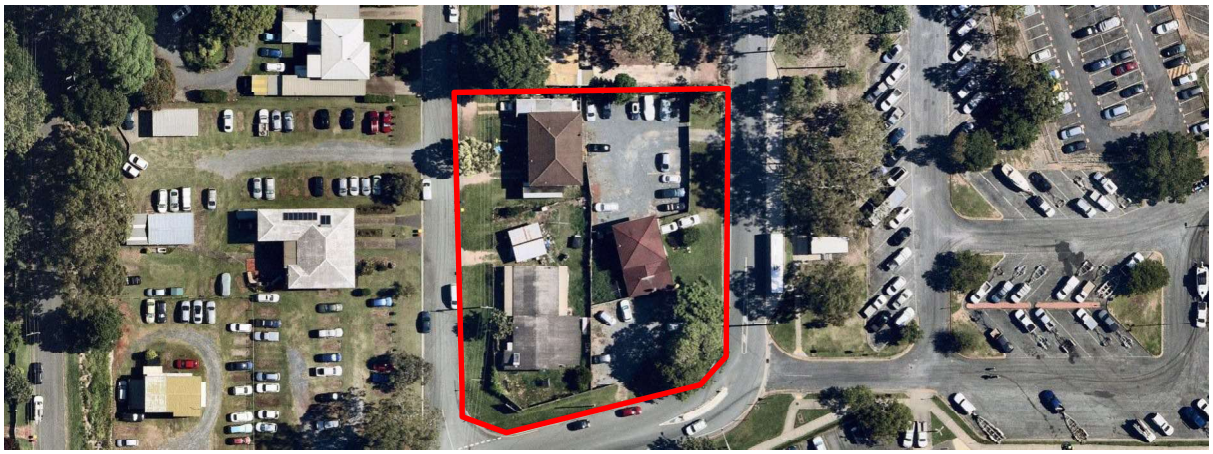
At the time of the investigation, the site was occupied by existing residential dwellings.

Vegetation comprised a variety of trees and plants around the existing structures.

The site was relatively level and drainage conditions where considered poor.

Refer following aerial for typical site conditions.

AERIAL IMAGE



4.0 GEOTECHNICAL MODEL

The subsurface profile encountered in the boreholes typically consisted a shallow layer of fill material and natural sands overlying a silty/sandy clay profile with an intermittent layer of gravel at approximately 1m to 2m depth.

The natural clays were typically of a very stiff or stronger consistency in the upper profile to approximately 7 to 8m depth and of stiff to very stiff consistency below this to the CPT termination depths. An approximately 1.0m to 1.5m thick layer of firm clay was encountered at approximately 1.5m to 2m below existing ground surface level.

In the absence of documentation to confirm the fill was placed under controlled conditions, the fill is necessarily considered to be "uncontrolled Fill"

Table 1 presents a summary of the encountered subsurface profile. Detailed borehole record sheets are appended to this report.

TABLE 1 SUBSURFACE PROFILE SUMMARY

BH No.	FILL	NATURAL					BH TD
		SAND	Sandy Gravel	Silty/Sandy CLAY			
		Loose	Medium Dense	Firm	Stiff	Very Stiff/Hard	
BH01	0.0 – 0.1	0.1 – 1.2	1.2 – 1.6	1.6 – 2.2	NE	2.2 - TD	7.5
BH02	0.0 – 0.6	NE	1.6 – 2.3	2.3 – 3.2	7.0 - TD	0.6 – 16 3.2 – 7.0	9.0
CPT1	0.0 – 0.2	0.8 – 1.1	NE	1.1 – 2.0	8.4 - TD	0.2 – 0.8 2.0 – 8.4	16.7
CPT2	NE	1.0 – 1.7	NE	1.7 – 2.8	7.2 – TD	2.8 – 7.2	18.26
CPT3	NE	NE	NE	1.6 – 2.8	8.2 – TD	0.0 – 1.6 2.8 – 8.2	10.52

Notes:
1. All depths in metres below ground level at time of investigation.
2. NE - Not Encountered; TD - Termination Depth.

5.0 GROUNDWATER

Groundwater was not encountered at the time of drilling, however some seepage was noted.

Typically the standing groundwater levels would be expected at approximately RL0.5m and could be expected to fluctuate very slightly with tidal influences from the adjacent creek.

6.0 LABORATORY TESTING

Laboratory testing was carried out on samples retrieved from the site investigation program and was directed towards assessing the reactivity and subgrade characteristics of the subsurface material.

Laboratory testing included

- Shrink/Swell Index - to assess the reactivity of the subsurface material.
- pH_f/pH_{fox} – screening tests for potential acid sulfate soils.
- Chromium Suite – quantitative testing to determine the acid sulfate potential of the on-site soils.

The results of the laboratory testing are contained in Appendix C.

7.0 SITE CLASSIFICATION

Site investigation and laboratory test results indicate the development site would be classified Class 'H1', in accordance with AS 2870-2011 'Residential Slabs and Footings'.

It is recommended that the readers satisfy themselves that the use of AS 2870-2011 is applicable for the proposed design and the above site classification re-confirmed following the completion of the bulk earthworks operation.

8.0 EARTHWORKS AND SITE PREPARATION CONSIDERATIONS

Earthworks are expected to comprise excavation of two to three level basement.

It is recommended that the following site preparation and earthworks procedures be carried out as part of the earthworks procedures during development.

- All earthworks operations should be carried out in general accordance with AS 3798-2007 "Guidelines on Earthworks for Commercial and Residential Developments".
- Trafficability across the site at the time of the investigation was assessed to be fair to good with no difficulties encountered at the time.
- If significant rainfall events occur during the earthworks operation, some difficulties could be experienced in trafficing the exposed surface, if removal of the existing surficial gravelly fill is undertaken.

- All topsoil (i.e. soil containing organic matter) and soils containing deleterious matter should be stripped from the construction area at the commencement of the earthworks operation.
- Treatment and/or assessment of the existing surficial fill should be undertaken to determine its suitability for reuse on site. The testing undertaken to date indicates that the existing fill appears to be of a good quality and may be suitable for the support of the proposed pavements, with suitable insitu assessment and treatment.
- The stripped surface should be proof rolled under Pacific Geotech's supervision using a large vibrating roller of minimum weight of at least 12 tonnes, to identify areas of weak surficial soils and to compact the upper level fill material. Test pitting of the fill material should be undertaken as part of the assessment of the suitability of the existing fill.
- If the suitability of the existing on-site fill cannot be confirmed, consideration could be given to the removal of the fill to expose the natural soils, and the replacement of the fill using the removed material following suitable treatment.
- The majority of the soils on site will be suitable for re-use as structural fill, provided material is free of organic matter and deleterious material. It is likely that the soils require conditioning to bring the soils to optimum If the clays were overly moist, difficulty in achieving compaction of the materials will be encountered and moisture conditioning will be required.
- The natural clays would be expected to be highly reactive and if they are re-used as structural fill on site, an increase in the potential ground surface movements may result.
- Imported fill should be of fair to good quality with a minimum Soaked CBR value of 10%, a maximum Iss=1.0% and a maximum particle size of 75mm.
- All filling should be undertaken in layer thicknesses of approximately 250mm (or as appropriate for the compaction equipment being used). Fill should be compacted to a minimum dry density ratio of 98% Standard in accordance with AS1289 5.1.1.
- Field density testing should be carried out to check the standard of compaction achieved and the placement moisture content. The frequency and extent of testing should be as per guidelines in AS.3798-2007.
- All earthworks operations should be performed under appropriate supervision, in general accordance with the requirements of AS3798 and should be certified as controlled fill by the testing authority.

9.0 BATTERS

Considering a proposed maximum height of cut in the order of 6m to 8m for the basement levels, the following recommendations are made for the bulk excavation of the site.

Batters < 3.0m in height

- 1V:1.5H batter with crest of batter >2m from buildings or structures.

Batters > 3.0m in height

- 1V:1.5H batter with the crest of the batter at least 2.0m inside the site boundary.
- 2.0m minimum distance from any building or structure.

If batters are to be left exposed for an extended period of time, a battler angle of 1V:2H is recommended and berm widths are to be strictly maintained. The above batter slopes assume no seepage is present in the batters and the batters are above the water table.

Regardless of the design, it is important that all cuts be inspected (progressively as construction proceeds) by an experienced Geotechnical Engineer/Engineering Geologist.

10.0 TEMPORARY EXCAVATION SUPPORT

Cuts of up to 6m to 8m are expected to be retained during construction.

Where the excavations are below ground water level or cannot be battered to a stable angle, they will need to be supported to prevent instability. Support systems could include:

- Sheet Piles – anchoring or internal bracing of the excavation will to be required for a sheet piled retention system, and due consideration should be given to the potential for anchor installation and vibration to adversely affect adjacent areas.
- Secant or Contiguous Piles – whilst no vibration is associated with their installation, it is likely a more expensive solution. This may be required to provide sufficient support to the adjacent structures. Anchoring or bracing is still likely to be required.

Where sheet piles are to installed through layers of gravel or hard clay, pre-drilling may be required to ensure installation is achievable. Difficulties have been experienced with the use of sheet pile retention systems when adopted in a clay soil profile.

Dewatering requirements may control the retention system able to be adopted on site.

Shoring pressures should be based on the lateral earth pressure coefficients given in Table 2, provided the excavation is not surcharged by adjacent buildings/services and some tolerance or movement exists.

TABLE 2 LATERAL EARTH PRESSURE COEFFICIENTS

Material	Strength	Unit Weight (kN/m^3)	Lateral Earth Pressure Coefficients (K)	
			Flexible	Propped
Sandy Clay	Firm	18	0.42	0.59
Sandy Clay	Stiff to hard	19	0.33	0.50

Pressures for unsurcharged propped walls could be designed based on a uniform pressure distribution with depth, where the pressure P = 0.65K δ H (kPa) where H is the depth of the excavation.

The temporary support system should also take into consideration the possible needs to over-excavate the basement for ground improvement works, although this is expected to be minimal.

It should be noted that lateral deflection of the retention system will occur, irrespective of the retention system adopted. In additional to lateral movements, vertical movement of the soils behind the retention system will result. The effects of the vertical and horizontal movements may be seen at a distance equal to 2 or 3 times the height of the excavation.

Subject to detailed design, movements as much as 1% of the depth of the excavation could occur behind a cantilevered pile wall.

Detailed assessment of the wall deflections should be undertaken as part of the retention design.

11.0 PERMANENT RETAINING WALLS

Basement walls should be designed using a pressure coefficient for the at rest case of $K_0 = 0.5$.

Unit wall force P is given by:-

$$P = 0.5\ K_0\ \gamma\ H_1^2 \text{ (kN/m run of wall)}$$

Passive resistance at the base of the wall can be calculated from:-

$$P = 0.5\ K_p\ \gamma\ H_w^2$$

where K_p = 2.5 (ignores wall friction effects) for very stiff clays

H_w = front face of wall contributing to passive resistance (m)

12.0 BUILDING FOUNDATIONS.

A seven storey tower over a two to three level basement is proposed.

Given the encountered subsurface profile, a high level footing system or a deep foundation system could be considered with due consideration of the potential hydrostatic uplift forces.

12.1 High Level Footings

A high level footing system may be adopted for the support of the proposed buildings.

An allowable bearing capacity of 150kPa in the natural stiff to very stiff clays would be available, subject to inspection at the time of excavation.

Where the existing uncontrolled fill is encountered, footings should be deepened to penetrate the uncontrolled fill material and found into the natural soils.

It is recommended that footing inspections be undertaken by Pacific Geotech, following excavation, to confirm the specified founding strata has been reached.

It is recommended that masonry walls supported on high level footings be suitably articulated.

Where footings are located adjacent to excavations such as underground service trenches, it is recommended that the footings be deepened to found at least 200mm below a line drawn up at 45 degrees from the base of the trench.

12.1.1 Raft Design Considerations

Given the encountered subsurface profile, a high level raft type system could be used for the support of the proposed structures, with due consideration of the potential hydrostatic uplift forces, and provided the structure is able to tolerate the potential settlements and adequate bearing capacity is available.

Assuming an excavation depth of 6m for the basement, very stiff clay fill is expected to be exposed across the basement excavation an allowable bearing capacity of 175kPa could be adopted for preliminary raft foundation design.

If weaker materials are encountered at the proposed raft foundation level, some localised over excavation and replacement could be considered.

Settlement Potential

It is expected that the total building load will result in a bearing pressure of about 100kPa under the building footprint area. However, with the proposed basement involving excavation to 6m to 8m depth, the net stress increase at foundation level is estimated to be close to zero.

Total settlement potential is expected top be less than 10mm.

Differential settlements across the raft are estimated to be at least in the order of about 50% of the total settlement.

On a preliminary basis, a modulus of subgrade reaction of 10kPa/mm could be adopted for preliminary raft design analysis and should be refined with further assessment as structural design is refined and loads developed.

Hydrostatic Uplift Forces

For a fully tanked basement, hydrostatic uplift forces should be considered in the design. It is recommended hydrostatic uplift forces in groundwater levels to at least RL0.5 be taken into consideration on this site and checked for the Q_{100} flood condition.

12.2 Deep Foundations

General

If the loads or settlements are excessive, or holddown to resist hydrostatic uplift is required, consideration could be given to adopting a deep foundation system.

Piles should be designed in accordance with AS2159 'Piling - Design and Installation'. For the limit state design as outlined in the Code, both the geotechnical strength Rg* and the structural strength Rs* for a single pile or pile group must be greater or equal to the design action effect S*, i.e.

$$Rg^* \geq S^* \text{ and } Rs^* \geq S^*.$$

Bored piers or possbily timber push or screw piles could be considered for the support of the proposed structure.

The deep foundation system should be designed in accordance with the recommendations of AS 2159-2009 'Piling - Design and Installation'.

The ultimate geotechnical strength ($R_{d,ug}$) of piles can be calculated using the unfactored, ultimate shaft adhesion and end bearing values given in Table 3. The $R_{d,ug}$ values given in Table 3 will need to be multiplied by a suitable geotechnical strength reduction factor ($ø_g$) to obtain the design geotechnical strength ($R_{d,g}$) of piles. In accordance with AS2159-2009, the $ø_g$ value must be determined by the designer, but based on the anticipated site, design and installation risk factors, a $ø_g$ value of 0.43 is suggested. Higher values may be applicable with suitable supervision.

If working stress methods are used in the pile design, the $R_{d,ug}$ values given in Table 3 will need to be divided by a factor of safety of 2.5 to caluculate the maximum single pile working load.

TABLE 3 ULTIMATE (UNFACTORED) PILE DESIGN PARAMETERS

Material	Ultimate Unfactored End Bearing* (kPa)		Ultimate Unfactored Shaft Adhesion* (kPa)
	L < 4D	L > 4D	
Firm Clays	NR	NR	10
Stiff	300	450	20
Very Stiff to Hard Clays	750[3]	1150[3]	40

Notes:
*Geotechnical strength reduction factor needs to be applied to these parameters.
1. NR – Not Recommended.
2. L – pile length; D – pile diameter.
3. Consideration must be given to the affect of the underlying weaker material and are subject to detailed design.

Construction Considerations

The bases of bored pile holes must be thoroughly cleaned of all loose soil and rock debris using a proper cleaning tool. The practice of adding water and spinning the auger is generally not acceptable.

Whilst seepage was not observed, in the boreholes during the investigation at this site, an allowance for the use of liners, which will likely have to be socketed into rock to achieve an impermeable seal against any water charged soils above, should be made. The groundwater seepages may be controllable by pumping. Shaft adhesion must be ignored for the portion of the pile that is permanently lined.

Drilling piles is not only dependent on the subsurface profile characteristics, but also the type (power and size) of the bored pile drilling rig, drilling teeth, size of pile, etc. It is recommended that a specialist drilling contractor be consulted to be able to manage the above conditions and materials encountered.

During construction, all bored piles must be inspected by a geotechnical engineer to confirm the geotechnical strength parameters presented in Table 3 and to check the capacity of the piles.

Pile Groups

Pile groups may be required to achieve the required pile load capacity.

Where pile groups are required, a pile spacing of not less than 2.5 times the pile diameter is recommended. Table 4 presents the recommended relationship between pile group efficiency and spacing (Tomlinson 1969).

TABLE 4 PILE GROUP EFFICIENCY

Pile Spacing	Group Efficiency Ratio
2 x pile diameter	0.7
4 x pile diameter	0.8
6 x pile diameter	0.9
8 x pile diameter, or more	1.0

Hydrostatic Uplift Forces

For a fully tanked basement, hydrostatic uplift forces should be considered in the design. It is recommended hydrostatic uplift forces in groundwater levels to at least RL1.5 to 2.0 be taken into consideration on this site and checked for the Q_{100} flood condition.

13.0 DEWATERING CONSIDERATIONS

13.1 Groundwater Control

Temporary groundwater control will be required to enable satisfactory completion of construction and to enable economic sizing of temporary support works.

It will be essential to ensure that all services connecting into the site that are to be terminated are properly sealed off (including trench backfill) to prevent them becoming water conduits to the site and causing water pressure surcharging of excavation support works.

If a deep, temporarily battered excavation is to be adopted (refer Section 4.2) it may be necessary (subject to the results of detailed stability assessment) to undertake temporary dewatering of soils using a pumped well point system.

13.1.1 Wall Drainage

In order to control the groundwater level behind the walls, it will be necessary to install drainage behind shotcrete facing, typically comprising full height strips of 'Core Drain' (or equivalent) of 20mm minimum thickness, spaced horizontally at not more than approximately 1.8m centres.

13.1.2 Under Slab Drainage

Groundwater seepage will occur through the floor of the excavation that could adversely affect floor slab performance and building amenity, unless a fully tanked basement is adopted. In order to control seepage flows for a 'non-tanked' floor slab, the slab should be cast over a free draining layer (incorporating agricultural drains) graded to sumps so that groundwater is removed and pressure does not build-up under the slab; 'normal' slab joint spacing could be adopted with this option. The

drainage system would need to be properly analysed and designed, however, for initial costing a 150mm thick layer of single sized aggregate should be allowed for, together with 100mm diameter geotextile wrapped agricultural drains laid one way at 6m to 8m centres and connected to sumps. It may be necessary to place the drainage layer over a geotextile to prevent 'contamination' by the underlying subgrade.

If a non-tanked basement is to be adopted, assessment of the seepage inflow and groundwater levels should be made to allow the drainage/pumping system to be appropriately sized. Alternatively, a tanked basement, held down with an appropriate ground anchor system should be considered. It is expected that hold down would be achievable through the use of rock bolts or anchors.

14.0 CONSTRUCTON MONITORING

Vibrations associated with construction works could potentially cause settlement of upper level sands, possibly resulting in damages to nearby structures. Prior to commencement of on site works, it is therefore recommended that a dilapidation survey be undertaken to establish the condition of adjacent structures and services.

This survey could include the following:

- The extent of exiting damage (if any)
- The general condition of the property, i.e. condition of all exposed columns and beams, partition walls and cladding etc.
- Road, kerb and channel and footpath condition adjacent development site.

14.1.1 Retention System Monitoring

It is recommended that monitoring points should be established on the retention system to check for deflections during excavation. A suggested spacing of the monitoring points would be at 10m along the walls. A regular monitoring program of these stations should be implemented.

Monitoring must commence before any excavation to establish baseline readings.

15.0 PRELIMINARY ACID SULFATE SOIL CONSIDERATIONS

The boreholes were sampled for Acid Sulfate determination, in addition to geotechnical sampling.

The soil classification descriptions and field tests were carried out in general accordance with Australian Standards.

QASSIT	Queensland Acid Sulfate Soil Investigation Team Dept. of Natural Resources, 'Guidelines for Sampling and Analysis of Lowland Acid Sulfate Soils (ASS) in Queensland, 1998' (Oct. 1998, Revision 4.0).
QUEENSLAND GOVERNMENT	State Planning Policy Guideline, December 2013, Acid Sulfate Soils

Preliminary laboratory testing was undertaken in general accordance with the recommendations outlined in the QASSIT 'Acid Sulfate Soils Laboratory Methods Guidelines 2004' and was undertaken by Octief Pty Ltd to assess the potential acid sulfate conditions across the site. The results of the testing program are appended to this report.

The testing program comprised of initial screening tests on recovered samples, followed by quantitative testing using the Chromium Reducible Sulfur (CRS) suite.

Screening Tests

Screening tests were undertaken on soil samples collected from the bores. Two small sub-samples of each soil sample were prepared; one sub-sample from each sample was mixed with approximately 20mL of distilled water, and the other sub-sample mixed with approximately 20mL of hydrogen peroxide (H_2O_2), buffered to a pH of 5.4 with sodium hydroxide.

Slurry pHs were measured with a calibrated pH meter. The pH of the distilled water/soil slurry (pH_F) was measured approximately one hour after mixing, whilst the pH of the hydrogen peroxide/soil slurry (pH_{FOX}) was measured approximately one to two hours after mixing.

The pH screening tests can be used for the preliminary identification of a potential or actual ASS using a combination of three trigger factors as follows:

a) The strength of the reaction with peroxide is a useful indicator but cannot be used alone. Organic matter and other soil constituents such as manganese oxides can also cause a reaction.

b) A pH_{FOX} value at least one unit below pH_F may indicate a potential ASS. The great the difference between the two measurements, the more indicative the value is of a potential ASS. The lower the final pH_{FOX} value the better the indication of a positive result.

c) If the pH_{FOX} is less than 3, and the other two conditions apply, then it strongly indicates a potential ASS. The more the pH_{FOX} drops below 3, the more positive the presence of sulfides.

The results of the screening tests were used to assist in the selection of samples for more detailed, quantitative laboratory testing.

Chromium Suite Analysis

Chromium suite analysis is currently being undertaken. This report will be updated once the test results are available.

Summary

On the basis of the field screening, acid sulfate soils may be present in the layer of firm clay encountered in Borehole BH2 between 2.3m to 3.2m below existing ground surface level. The Chromium Suite Analysis will confirm liming requirements for this material.

16.0 SITE MANAGEMENT

To maintain the long term performance of the structure, good management of the soil conditions and the development is vital throughout the life of the development.

The following are some specific comments with respect to site management.

- The ground surface around the perimeter of the buildings should slope away from the structure and fall to the stormwater system. Water should not be allowed to pond adjacent to the buildings.
- Founding soils should not be allowed to become saturated.
- Service trenches under the buildings should be kept to a minimum. Saturation of the on-site material will result in an increase in potential ground surface movements.
- Footings should be poured immediately after excavation. If footings cannot be poured on the same day as excavation, a blinding layer of 50mm thickness is recommended.
- Trees, garden beds and other vegetation should be planted at a distance at least equivalent to their mature height away from the structures. This will assist in minimising shrinkage movements in the expansive on-soils.

17.0 LIMITATIONS

We have prepared this report for the Proposed Residential Development at 69 & 71 Banana Street & 18 Outridge Street, Redland Bay. The report is provided for the exclusive use of LA5 Trust & LA6 Trust & LA7 Trust & LA9 Trust, for this project only and for the purposes outlined in the report. It should not be used by, or relied upon, for other projects on the same or different sites or by a third party. In preparing this report, we have relied upon information provided by the client or their agents.

The results are indicative of the subsurface conditions on site only at the specific testing locations. Subsurface conditions can change between test locations and the

design and construction should take the spacing of the testing and testing methods adopted and the potential for variation between the test locations.

It is recommended that Pacific Geotech be engaged to provide advice and ensure the development is undertaken in accordance with the assumptions made in writing this report.

This is not to reduce the level of responsibility accepted by Pacific Geotech, but rather to ensure that the parties who may rely on the information contained in this report are aware of the responsibilities they assume in doing so.

C. KOSIEK (RPEQ 24394)

For and on behalf of
PACIFIC GEOTECH PTY LTD

APPENDICES

APPENDIX A

NOTES RELATING TO THIS REPORT

Notes Relating to this Report

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis.

Every care has been taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical conditions and contains recommendations or suggestions for design and construction. However, unexpected variations in ground conditions will occur. The potential for this will depend partly on testing, spacing and sampling frequency.

If variations are identified, Pacific Geotech would be pleased to assist with additional investigations or advice to resolve the matter.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Description and Classification Methods

The description and classification of soils and rocks used in this report are based on AS 1726.

Soil types are described according to the predominating particle size and behaviour as set out in the attached Unified Soil Classification Table qualified by the percent of other particles present (e.g. sandy clay) as set out below:

Soil Classification	Particle Size
Clay	less than 0.002mm
Silty	0.002 to 0.06mm
Sand	0.06 to 2mm
Gravel	2 to 60mm

Non-cohesive soils are classified on the basis of relative density which can be correlated from the results of Standard Penetration Test (SPT) as below:

Relative Density	SPT 'N' Value (blows/300mm)
Very Loose	less than 4
Loose	4 – 10
Medium Dense	10 – 30
Dense	30 – 50
Very Dense	greater than 50

Cohesive soils are classified on the basis of strength (consistency) and can be quantified by the Pocket Penetrometer test, Vane Shear test, laboratory testing or engineering examination. The strength terms are defined as follows:

Classification	Unconfined Compressive Strength kPa
Very Soft	less than 25
Soft	25 - 50
Firm	50 – 100
Stiff	100 – 200
Very Stiff	200 - 400
Hard	greater than 400
Friable	strength not attainable – soil crumbles

Rock types are classified by their geological names, together with descriptive terms regarding weathering, strength, defects, etc.

Planarity	
CU	Curved
DIS	Discontinuous
IR	Irregular
PR	Planar
ST	Stepped
UN	Undulose

Roughness	
POL	Polished
RJ	Rough
S	Smooth
SL	Slickened
VR	Very Rough

Defects	Type
BP	Bedding Parting
CL	Cleavage
CO	Contact
CS	Crushed Seam
CZ	Crushed Zone
DB	Drilling Break
DK	Dyke
DL	Drill Lift
DZ	Decomposed Zone
FC	Fracture
FL	Foliation
FZ	Fracture Zone
HB	Handling Break
IS	Infilled Seam
JT	Joint
H	Schistosity
SI	Sill
SM	Seam
SS	Shear Seam
SZ	Shear Zone
VN	Vein
VO	Void

Sampling

Sampling is undertaken during the fieldwork to allow examination of the soil or rock and to allow laboratory testing to be undertaken.

Disturbed samples taken during drilling provide information on plasticity, grain size, colour, moisture content and minor constituents. Bulk samples are similar but of greater volume required for some test procedures such as CBR testing.

Undisturbed samples are taken by pushing a thin-walled sample tube, usually 50mm diameter (known as a U50), into the soil and collecting a sample of the soil contained in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Details of the type and method of sampling used are given on the attached logs.

Investigation Methods

Test Pits: These are typically undertaken with a backhoe or a tracked excavator, allowing examination of the insitu soils. Limitations of test pits are the problems associated with collapse of the pits, disturbance and difficulty of reinstatement and the consequent effects on close-by structures. Care must be taken if construction is to be carried out near test pit locations to either properly recompact the backfill during construction or to design and construct the structure so as not to be adversely affected by poorly compacted backfill at the test pit location.

Hand Auger Drilling: A borehole of typical diameter of between 50mm to 75mm advance manually operated equipment. Premature refusal of the hand augers can occur on a variety of materials such as fill, gravel, hard clays and collapse of the borehole (typically in non-cohesive soil).

Continuous Spiral flight Augers: The borehole is advanced using 65mm to 100mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling and insitu testing. Augers of up to 300mm in diameter are used to recover larger volumes of sample. Samples are returned to the surface by the flights or may be collected after withdrawal of the auger flights. Samples can be disturbed and layers may become mixed. Augering below the groundwater table can be less reliable than augering above the water table.

A Tungsten Carbide (TC) bit for auger drilling into rock can be used to indicate rock strength and continuity by variation in drilling resistance and from examination of recovered rock fragments but provides only an indication of the likely rock strength. Where rock strengths may have a significant impact on construction feasibility or costs, then further investigation by means of cored boreholes may be warranted.

Wash Boring: The borehole is advanced by a bit attached to the end of a hollow rod string, with water being pumped down the drill rods and returned up the annulus of the borehole, carrying the drill cuttings. Changes in stratification can be determined from the return, together with information from "feel" and rate of penetration.

The borehole can be stabilised through the use of drilling mud as a circulating fluid. The term 'mud' encompasses a range of products ranging from bentonite to polymers such as Revert or Biogel.

Continuous Core Drilling: A continuous core sample is obtained using a diamond tipped core barrel. This technique provides a reliable (but relatively expensive) method of investigation. In rocks, an NMLC triple tube core barrel is used, which gives a core of about 50mm diameter. The length of core recovered is compared to the length drilled and any length not recovered is shown as CORE LOSS.

Standard Penetration Tests: Standard Penetration Tests (SPT) are used mainly in non-cohesive soils, but can also be used in cohesive soils as a means of indicating density or strength and also of obtaining a disturbed sample. The test procedure is described in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposed", Test 6.3.1.

The test is carried out in a borehole by driving a 50mm diameter split sample tube with a tapered shoe, under the impact of a 63kg hammer, with a free fall of 760mm. The sample is driven in three successive 150mm increments and the 'N' value is taken as the number of blows for the last 300mm. In dense soils, hard clays or weak rock, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form:

- In the case where full penetration is obtained with successive blow counts for each 150mm of , say, 4, 6 and 7 blows, as
  N = 13
  4, 6, 7
- In a case where the test is discontinued short of full penetration, say after 15 blows for the first 150mm and 30 blows for the next 40mm, as
  N > 30
  15, 30/40mm

Cone Penetrometer Testing (CPT): Cone Penetrometer Testing with or without pore pressure measurement (CPTu) is carried out using a Cone Penetrometer in general accordance with AS 1289 6.5.1, 1999.

In the tests, a 36mm diameter rod with a conical tip is pushed continuously into the soil, the reaction being provided by a hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the fractional resistance on a separate 135mm long sleeve, immediately behind the cone. Pore Pressure is recovered through a pore ring located either within, or more usually immediately behind the cone/tip.

As penetration occurs (at a rate of approximately 20mm per second) and data is recorded every 20mm of penetration, the results are presented graphically.

The information provided on the plot comprises:

- Cone resistance – expressed in mPa
- Sleeve friction – expressed in kPa
- Friction ratio – the ratio of sleeve friction to cone resistance expressed as a percentage.
- Pore pressure in kPa
- Tilt of probe (in degrees).

The ratios of the sleeve resistance to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1% to 2% are commonly encountered in sands and rising to 2% to as high as 8%, and higher in organic soils. Soil descriptions based on cone resistance and friction ratios are only inferred and must not be considered as exact.

Stratification can be inferred from the cone and friction traces and from experience and information from nearby boreholes, etc. Where shown, this information is presented for general guidance, but must be regarded as interpretive.

Dynamic Cone Penetrometers:

Dynamic Cone Penetrometer (DCP) tests are carried out by driving a 16mm diameter rod into the ground with a 9kg sliding hammer dropping 510mm and counting the blows for successive 100mm increments of penetration.

Logs

The borehole or test pit logs are an interpretation of the subsurface conditions, and their reliability will depend to some extent on the frequency of sampling and the method of drilling or excavation.

Interpretation of the information shown on the logs, and its application to design and construction, should therefore take into account the spacing of the boreholes or test pits, the method of drilling or excavation, the frequency of sampling and testing and the possibility of other than "straight line" variations between the boreholes or test pits. Subsurface conditions between boreholes or test pits may vary significantly from conditions encountered at the borehole or test pit locations.

Groundwater

Where groundwater levels are measured in boreholes, there are several potential problems:

- Although groundwater may be present, in low permeability soils it may enter the hole slowly or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent weather changes and may not be the same at the time of construction.
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be flushed from the hole and drilling mud must be washed out of the hole or 'reverted' chemically if water observations are to be made.

More reliable measurements can be made by installing standpipes from which ongoing monitoring can be undertaken.

Fill

The present of fill materials can often be determined only by the inclusion of foreign objects (e.g. bricks, steel ,etc.) or by distinctly unusual colour, texture or fabric. Identification of the extent of fill materials will also depend on investigation methods and frequency. Where natural soils similar to those at the site are used for fill, it may be difficult to reliably determine the extent of the fill.

Laboratory Testing

Laboratory testing is carried out in general accordance with Australian Standard 1289 'Methods of Testing Soil for Engineering Purposes'.

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, the company requests that it immediately be notified. Most problems are much more readily resolved when conditions are exposed than at some later stage.

Review of Design

Where major civil or structural developments are proposed or where only a limited investigation has been completed or where the geotechnical conditions/constraints are quite complex, it is prudent to have a design review.

Site Inspection

Pacific Geotech would be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related:

Requirements could range from:

i. a site visit to confirm that conditions exposed are no worse than those interpreted, to
ii. a visit to assist the contractor or other site personnel in identifying various soil/rock types such as appropriate footing or pier founding depths, or
iii. full time engineering present on site.

APPENDIX B

BOREHOLE RECORD SHEETS

Pacific Geotech
Consulting Geotechnical Engineers

Borehole No.
BH 01
Page 1 of 1

Project No.: PG-7911

Client:	LA5 Trust & LA6 Trust & LA7 Trust & LA9 Trust	Commenced:	21/04/2022
Project Name:	Proposed Residential Development	Logged By:	EA
Hole Location:	69 & 71 Banana Street and 18 Outridge Street, Redland Bay	Checked By:	
Hole Position:			
Drill Model and Mounting:	Digga PDT 1	RL Surface:	No survey
Hole Diameter:		Datum:	AHD Operator: EA

Drilling Information							Soil Description			DCP
Method	Casing	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	DCP TEST (AS 1289.6.3.2-1997) Blows per 100 mm
AD/T			ASS 0.00-0.50 m ASS ASS 0.50-1.00 m ASS D 0.70-1.00 m ASS 1.00-1.50 m ASS U50 1.20-1.50 m >600kPa ASS 1.50-2.00 m ASS D 1.80-2.00 m U50 1.80-2.00 m PP=>600kPa ASS 2.00-2.50 m ASS U50 2.00-2.50 m PP=>600kPa ASS 2.50-3.00 m ASS ASS 3.00-3.50 m ASS ASS 3.50-4.00 m ASS ASS 4.00-4.50 m ASS ASS 4.50-5.00 m ASS ASS 5.00-5.50 m ASS ASS 5.50-6.00 m ASS ASS 6.00-6.50 m ASS ASS 6.50-7.00 m ASS ASS 7.00-7.50 m ASS			0.10 1.20 1.60 2.20 3.70 4.00 6.60 6.80 7.50	SP SP GM CL CI CI CI CI CI	FILL SAND (SP) Loose, fine grained, dark brown, with fine to coarse sized gravel, moist. NATURAL SAND (SP) Loose, fine grained, dark brown, moist. Silty Sandy GRAVEL (GM) Medium dense, fine to medium sized, brown, fine to medium grained sand, low plasticity fines, moist. Sandy CLAY (CL) Firm, low plasticity, brown, fine to medium grained sand, with fine sized gravel, w>pl. Sandy CLAY (CI) Very stiff to hard, medium plasticity, light red brown mottled grey, fine to medium grained sand, w>pl. Silty Sandy CLAY (CI) Very stiff to hard, medium plasticity, light grey, fine grained sand, w>pl. Sandy CLAY (CI) Very stiff to hard, medium plasticity, brown grey mottled, fine to medium grained sand, w>pl. Sandy CLAY (CI) Very stiff, medium plasticity, light brown, fine grained sand, w>pl. Sandy CLAY (CI) Very stiff to hard, medium plasticity, light grey mottled light red, fine to medium grained sand, w>pl. (seepage noted)	0 5 10 15 20 25
						8			Hole Terminated at 7.50 m	

Method
AS - Auger
RR - Rock Roller
WB- Washbore

Water
Level (Date)
Inflow

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
B - Bulk Sample

Remarks
1.DCP refusal met at 2.6m.

Support
C - Casing

Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

Pacific Geotech
Consulting Geotechnical Engineers

Borehole No.
BH 02
Page 1 of 1

Project No.: PG-7911

Client:	LA5 Trust & LA6 Trust & LA7 Trust & LA9 Trust	Commenced:	20/04/2022
Project Name:	Proposed Residential Development	Logged By:	EA
Hole Location:	69 & 71 Banana Street and 18 Outridge Street, Redland Bay	Checked By:	
Hole Position:			
Drill Model and Mounting:	Digga PDT 1	RL Surface:	No survey
Hole Diameter:		Datum:	AHD Operator: EA

Drilling Information							Soil Description			DCP
Method	Casing	Water	Samples Tests Remarks	Recovery	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description Fraction, Colour, Structure, Bedding, Plasticity, Sensitivity, Additional	DCP TEST (AS 1289.6.3.2-1997) Blows per 100 mm
AD/T			ASS 0.00-0.50 m ASS U50 0.40-0.50 m PP=>600kPa ASS 0.50-1.00 m ASS ASS 1.00-1.50 m ASS ASS 1.50-2.00 m ASS ASS 2.00-2.50 m ASS ASS 2.50-3.00 m ASS D 2.60-3.00 m ASS 3.00-3.50 m ASS ASS 3.50-4.00 m ASS D 3.80-4.00 m ASS 4.00-4.50 m ASS ASS 4.50-5.00 m ASS ASS 5.00-5.50 m ASS ASS 5.50-6.00 m ASS D 5.50-6.00 m ASS 6.00-6.50 m ASS ASS 6.50-7.00 m ASS ASS 7.00-7.50 m ASS ASS 7.50-8.00 m ASS ASS 8.00-8.50 m ASS ASS 8.50-9.00 m ASS			0.05 0.15 0.60 1.10 1.40 1.60 2 2.30 3.20 4 6 7.00 7.70 8 8.20 9.00		GP SM CL CL-CI GC GC GM CL-CI CI-CH CI CI-CH CI	FILL Sandy GRAVEL (GP) Medium dense, fine to coarse sized, grey, fine to medium grained sand, moist. FILL Silty SAND (SM) Medium dense, fine to medium grained, dark brown, low plasticity fines, trace of fine sized gravel, moist. NATURAL Sandy CLAY (CL) Very stiff, low plasticity, dark brown, fine to medium grained sand, trace of fine sized gravel, w>pl. Sandy Gravelly CLAY (CL-CI) Hard, low to medium plasticity, light red brown, fine sized gravel, fine to medium grained sand, w>pl. (seepage noted) Clayey Sandy GRAVEL (GC) Medium dense, fine to medium sized, light red brown, low plasticity fines, fine to medium grained sand, wet. Clayey Sandy GRAVEL (GC) Dense, fine to medium sized, light red brown, low plasticity fines, fine to medium grained sand, wet. Silty Sandy GRAVEL (GM) Medium dense to dense, fine to medium sized, light red brown, fine to medium grained sand, low plasticity fines, wet. Sandy CLAY (CL-CI) Firm, low to medium plasticity, grey, fine grained sand, with organics, w>pl. Sandy CLAY (CI-CH) Very stiff to hard, medium plasticity, grey mottled orange red brown, fine grained sand, w>pl. Sandy CLAY (CI) Stiff to very stiff, medium plasticity, grey, fine grained sand, w>pl. CLAY (CI-CH) Stiff to Very stiff, medium to high plasticity, grey, with fine grained sand, w>pl. Sandy CLAY (CI) Stiff to Very stiff, medium plasticity, light red brown mottled grey, fine grained sand, with fine sized gravel, w>pl. Hole Terminated at 9.00 m	0 5 10 15 20 25

Method
AS - Auger
RR - Rock Roller
WB- Washbore

Water
Level (Date)
Inflow

Samples and Tests
U - Undisturbed Sample
D - Disturbed Sample
SPT - Standard Penetration Test
B - Bulk Sample

Remarks
1. Standpipe installed to 9m.
2. DCP refusal met at 1.39m and 4.31m.

Support
C - Casing

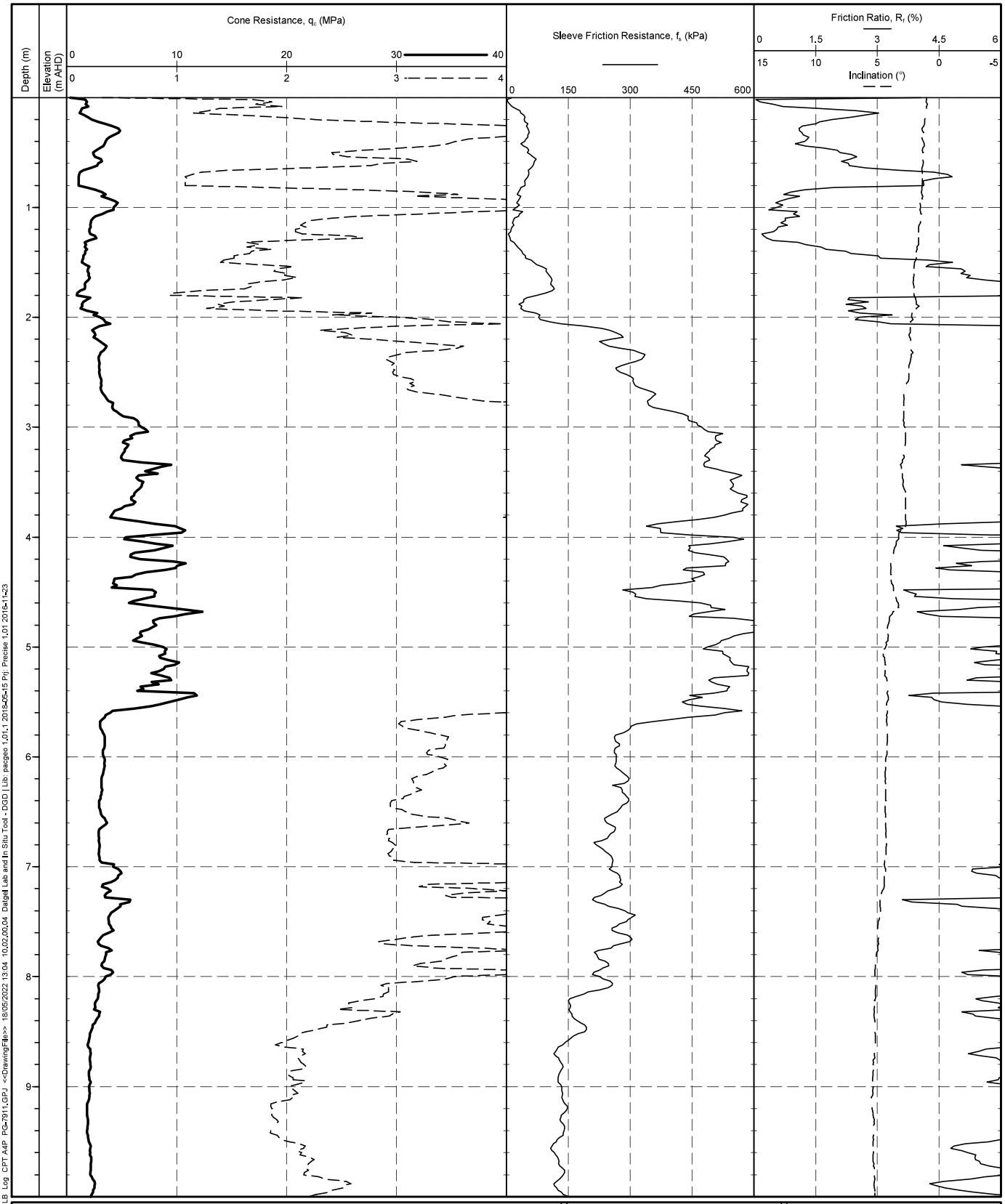
Classification Symbols and Soil Descriptions
Based on Unified Soil Classification System

CPT LOG

Pacific Geotech
Consulting Geotechnical Engineers

PointID
CPT 01

CLIENT	: LA5 Trust & LA6 Trust & LA7 Trust & LA9 Trust	AREA	: PG-7911	SHEET	: 1 OF 2
ENGINEER	:	EASTING	:	STATUS	:
PROJECT	: Proposed Residential Development	NORTHING	:	DATE	: 26/04/2022
LOCATION	: 69 & 71 Banana Street and 18 Outridge Street, Kearneys Bay	COORD SYS	: MGA94 Zone 56		
PROJECT No.	: PG-7911	ELEVATION	:		



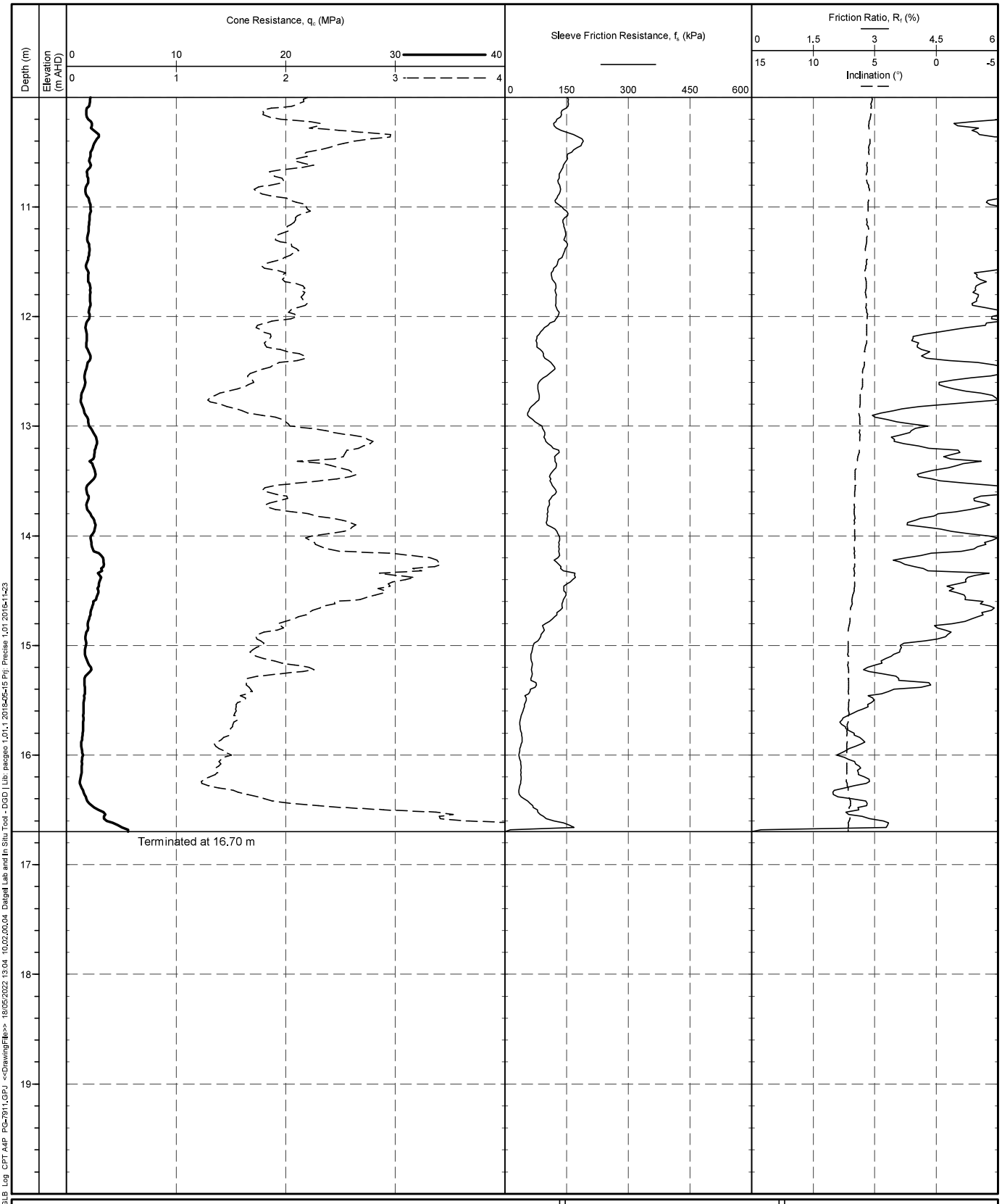
RIG	:	CHECKED BY	:	REMARK
CONE TYPE	: Geotech AB	CHECKED DATE	:	
CONE ID	: 4992	APPROVED BY	:	
OPERATOR	: TB	APPROVED DATE	:	

CPT LOG

Pacific Geotech
Consulting Geotechnical Engineers

PointID
CPT 01

CLIENT	: LA5 Trust & LA6 Trust & LA7 Trust & LA9 Trust	AREA	: PG-7911	SHEET	: 2 OF 2
ENGINEER	:	EASTING	:	STATUS	:
PROJECT	: Proposed Residential Development	NORTHING	:	DATE	: 26/04/2022
LOCATION	: 69 & 71 Banana Street and 18 Outridge Street, Kelvin Bay	COORD SYS	: MGA94 Zone 56		
PROJECT No.	: PG-7911	ELEVATION	:		



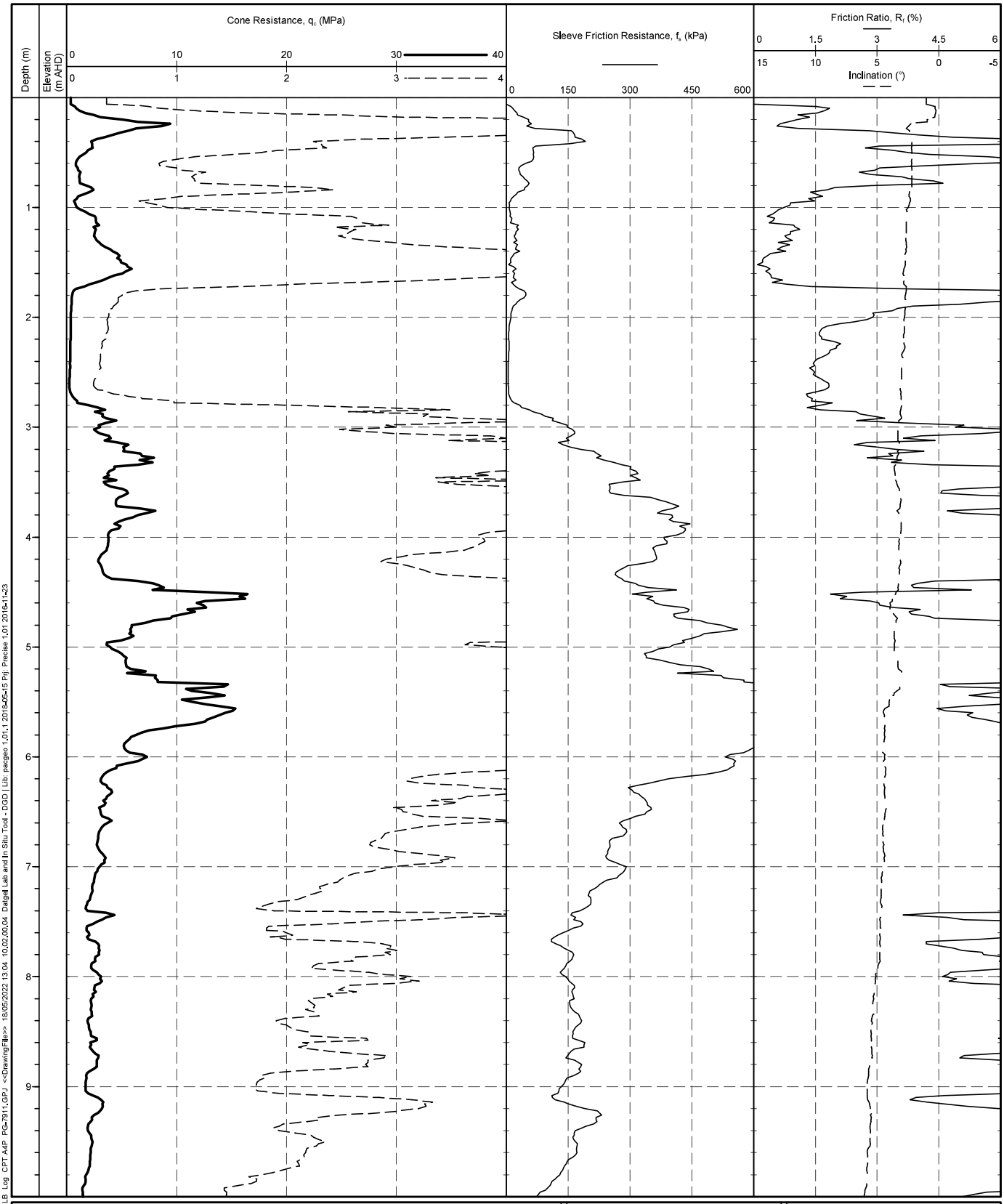
RIG	:	CHECKED BY	:	REMARK
CONE TYPE	: Geotech AB	CHECKED DATE	:	
CONE ID	: 4992	APPROVED BY	:	
OPERATOR	: TB	APPROVED DATE	:	

CPT LOG

Pacific Geotech
Consulting Geotechnical Engineers

PointID
CPT 02

CLIENT	: LA5 Trust & LA6 Trust & LA7 Trust & LA9 Trust	AREA	: PG-7911	SHEET	: 1 OF 2
ENGINEER	:	EASTING	:	STATUS	:
PROJECT	: Proposed Residential Development	NORTHING	:	DATE	: 26/04/2022
LOCATION	: 69 & 71 Banana Street and 18 Outridge Street, Kedumba	COORD SYS	: MGA94 Zone 56		
PROJECT No.	: PG-7911	ELEVATION	:		



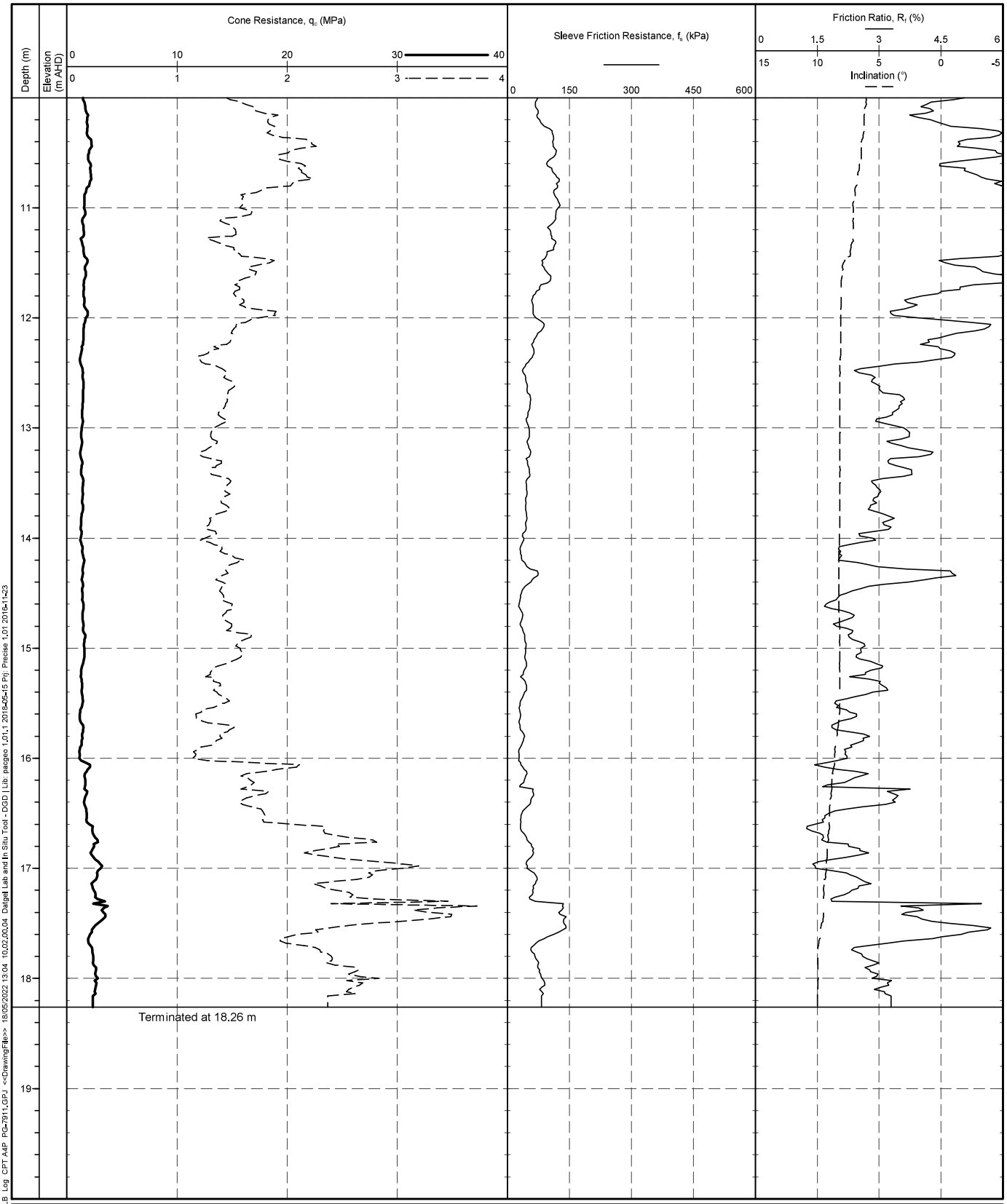
RIG	:	CHECKED BY	:	REMARK
CONE TYPE	: Geotech AB	CHECKED DATE	:	
CONE ID	: 4992	APPROVED BY	:	
OPERATOR	: TB	APPROVED DATE	:	

CPT LOG

Pacific Geotech
Consulting Geotechnical Engineers

PointID
CPT 02

CLIENT	: LA5 Trust & LA6 Trust & LA7 Trust & LA9 Trust	AREA	: PG-7911	SHEET	: 2 OF 2
ENGINEER	:	EASTING	:	STATUS	:
PROJECT	: Proposed Residential Development	NORTHING	:	DATE	: 26/04/2022
LOCATION	: 69 & 71 Banana Street and 18 Outridge Street, Kelvin Bay	COORD SYS	: MGA94 Zone 56		
PROJECT No.	: PG-7911	ELEVATION	:		



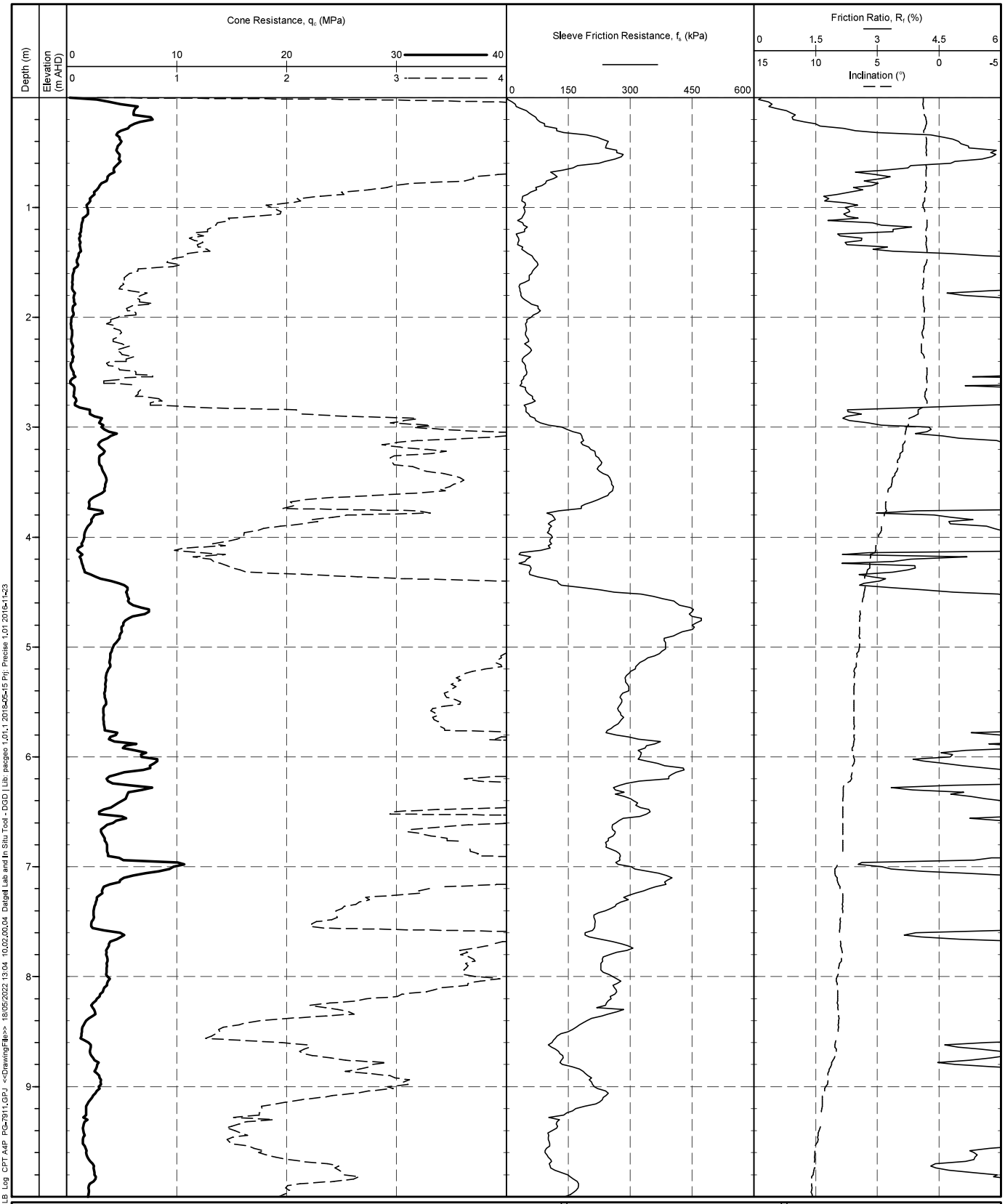
RIG	:	CHECKED BY	:	REMARK
CONE TYPE	: Geotech AB	CHECKED DATE	:	
CONE ID	: 4992	APPROVED BY	:	
OPERATOR	: TB	APPROVED DATE	:	

CPT LOG

Pacific Geotech
Consulting Geotechnical Engineers

PointID
CPT 03

CLIENT	: LA5 Trust & LA6 Trust & LA7 Trust & LA9 Trust	AREA	: PG-7911	SHEET	: 1 OF 2
ENGINEER	:	EASTING	:	STATUS	:
PROJECT	: Proposed Residential Development	NORTHING	:	DATE	: 26/04/2022
LOCATION	: 69 & 71 Banana Street and 18 Outridge Street, Kelvin Bay	COORD SYS	: MGA94 Zone 56		
PROJECT No.	: PG-7911	ELEVATION	:		



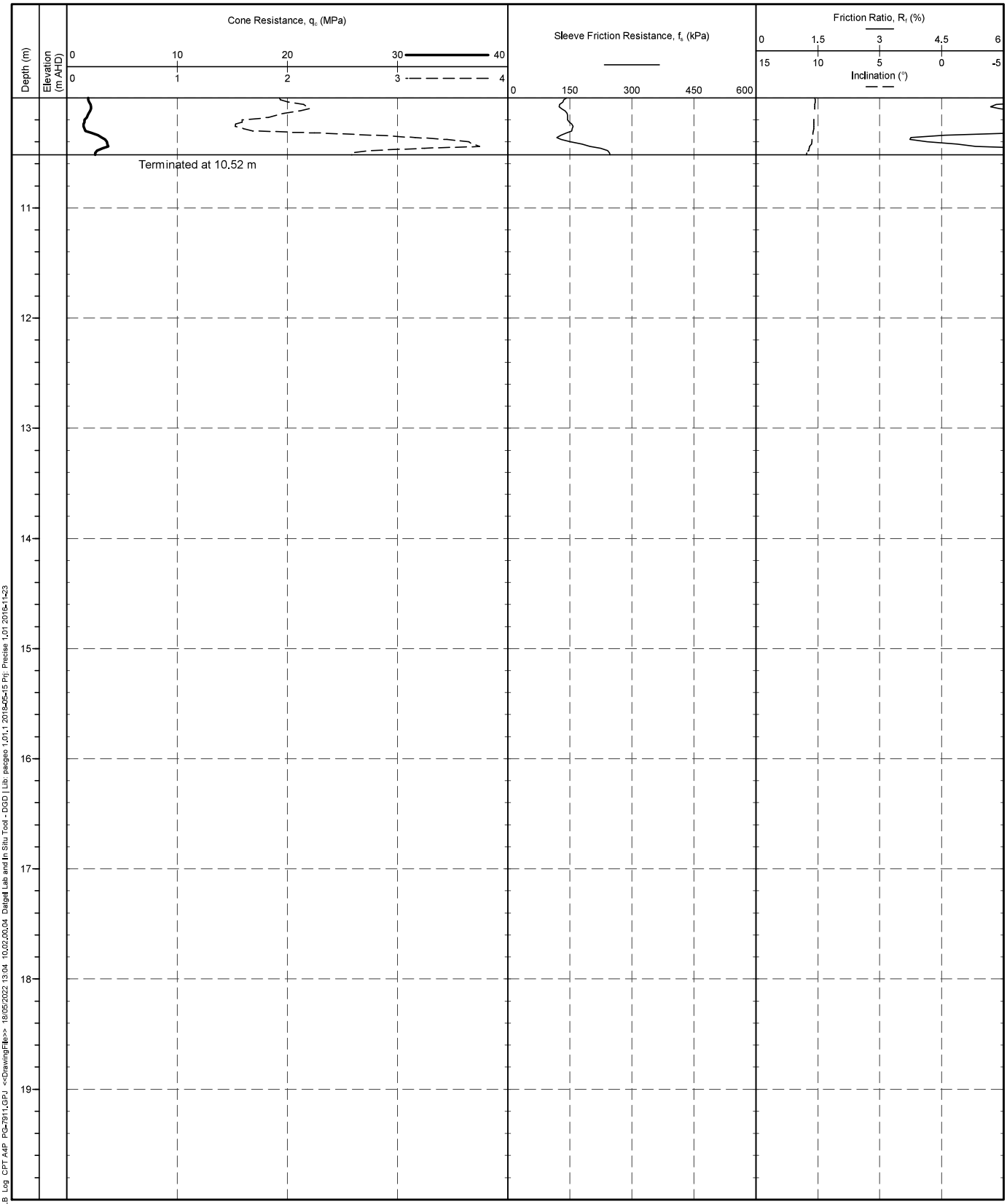
RIG	:	CHECKED BY	:	REMARK
CONE TYPE	: Geotech AB	CHECKED DATE	:	
CONE ID	: 4992	APPROVED BY	:	
OPERATOR	: TB	APPROVED DATE	:	

CPT LOG

Pacific Geotech
Consulting Geotechnical Engineers

PointID
CPT 03

CLIENT	: LA5 Trust & LA6 Trust & LA7 Trust & LA9 Trust	AREA	: PG-7911	SHEET	: 2 OF 2
ENGINEER	:	EASTING	:	STATUS	:
PROJECT	: Proposed Residential Development	NORTHING	:	DATE	: 26/04/2022
LOCATION	: 69 & 71 Banana Street and 18 Outridge Street, Kelvin Bay	COORD SYS	: MGA94 Zone 56		
PROJECT No.	: PG-7911	ELEVATION	:		



RIG	:	CHECKED BY	:	REMARK
CONE TYPE	: Geotech AB	CHECKED DATE	:	
CONE ID	: 4992	APPROVED BY	:	
OPERATOR	: TB	APPROVED DATE	:	

APPENDIX C

LABORATORY TEST CERTIFICATES

Pacific Geotech
Consulting Geotechnical Engineers

SHRINK SWELL INDEX REPORT

CLIENT:	NF Realestate	PROJECT NUMBER:	PG-7911
ADDRESS:	& 71 Banana st and 18 Outridge St Redland b	REPORT NUMBER:	PG-7911-SS-01
PROJECT NAME:	Proposed residential Development	REPORT DATE:	12/05/2022
		TEST METHOD:	AS 1289.7.1.1

SAMPLE LOCATION:	**BH01 @ 1.8m**
SAMPLING METHOD:	U50
SAMPLED BY:	PACIFIC GEOTECH
DATE SAMPLED:	22/04/2022
DATE TESTED:	11/05/2022
MATERIAL TYPE:	Silty CLAY

SHRINKAGE MOISTURE CONTENT (%):	21.1
SHRINKAGE (%):	2.7
SWELL MOISTURE CONTENT INITIAL (%):	22.7
SWELL MOISTURE CONTENT FINAL (%):	29.2
SWELL (%):	0.4
UNIT WEIGHT (t/m³):	1.80
SHRINK SWELL INDEX Iss (%):	**1.5**
CRACKING:	no
CRUMBLING:	no

REMARKS:

P: (07) 5636 4680 F: (07) 5636 0286 E: info@pacgeo.com.au
3 Jowett Street, Coomera, Qld, 4209 | PO Box 499, Paradise Point, Qld, 4216
www.pacgeo.com.au
ABN: 62 615 248 952

Pacific Geotech
Consulting Geotechnical Engineers

SHRINK SWELL INDEX REPORT

CLIENT:	NF Realestate	PROJECT NUMBER:	PG-7911
ADDRESS:	& 71 Banana st and 18 Outridge St Redland b	REPORT NUMBER:	PG-7911-SS-02
PROJECT NAME:	Proposed residential Development	REPORT DATE:	12/05/2022
		TEST METHOD:	AS 1289.7.1.1

SAMPLE LOCATION:	**BH02 @ 0.4m**
SAMPLING METHOD:	U50
SAMPLED BY:	PACIFIC GEOTECH
DATE SAMPLED:	22/04/2022
DATE TESTED:	11/05/2022
MATERIAL TYPE:	Silty CLAY

SHRINKAGE MOISTURE CONTENT (%):	17.1
SHRINKAGE (%):	3.0
SWELL MOISTURE CONTENT INITIAL (%):	14.9
SWELL MOISTURE CONTENT FINAL (%):	19.9
SWELL (%):	0.6
UNIT WEIGHT (t/m³):	2.06
SHRINK SWELL INDEX Iss (%):	**1.8**
CRACKING:	slight
CRUMBLING:	no

REMARKS:

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3 Jowett Street, Coomera, Qld, 4209 | PO Box 499, Paradise Point, Qld, 4216
www.pacgeo.com.au
ABN: 62 615 248 952

Main Laboratory: Unit 34 / 53-57 Link Drive, Yatala QLD 4207, Australia
Tel: +61 (07) 3386 1164
Email: octieflab@octief.com.au
Website: www.octief.com.au

CERTIFICATE OF ANALYSIS

Report No. 22-2116
Rev No. 00

Client:	Pacific Geotech Pty Ltd	Sample Date:	22/04/2022
Client Contact:	Peter Elkington	Date Samples Received:	11/05/2022
Client Address:	3 Jowett Street Coomera QLD 4209	Date Analysis Commenced:	11/05/2022
		No. Samples Received:	32
Purchase Order #:	PG-5697	No. Samples Analysed:	32
Project / Site Ref:	69-71 Banana St & 18 Outridge St Redland Bay	Date Issued:	11/05/2022

Lab Ref No.			pH	pH_{FOX}	pH_{FOX} Reaction Rating
Units	Sample Description	Depth (m)	pH	pH	
LOR			0.1	0.1	
22-2116/1	BH01	0.0-0.5	6.6	5.5	X
22-2116/2	BH01	0.5-1.0	6.6	5.3	X
22-2116/3	BH01	1.0-1.5	6.5	5.2	X
22-2116/4	BH01	1.5-2.0	5.3	5.3	X
22-2116/5	BH01	2.0-2.5	5.2	5.0	X
22-2116/6	BH01	2.5-3.0	5.3	4.2	X
22-2116/7	BH01	3.0-3.5	5.5	3.6	X
22-2116/8	BH01	3.5-4.0	5.2	3.6	X
22-2116/9	BH01	4.0-4.5	5.5	4.2	X
22-2116/10	BH01	4.5-5.0	5.3	4.5	X
22-2116/11	BH01	5.0-5.5	5.1	4.9	X
22-2116/12	BH01	5.5-6.0	5.1	5.2	X
22-2116/13	BH01	6.0-6.5	5.2	4.8	X
22-2116/14	BH01	6.5-7.0	5.5	4.7	X
22-2116/15	BH02	0.0-0.5	5.9	4.9	X
22-2116/16	BH02	0.5-1.0	5.9	4.6	X
22-2116/17	BH02	1.0-1.5	5.6	4.9	X
22-2116/18	BH02	1.5-2.0	5.7	3.3	X
22-2116/19	BH02	2.0-2.5	6.6	3.1	X
22-2116/20	BH02	2.5-3.0	7.1	2.7	XXXX
22-2116/21	BH02	3.0-3.5	6.3	3.3	XXX
22-2116/22	BH02	3.5-4.0	6.7	3.0	X
22-2116/23	BH02	4.0-4.5	6.2	3.4	X
22-2116/24	BH02	4.5-5.0	5.9	4.3	X
22-2116/25	BH02	5.0-5.5	5.7	4.4	X
22-2116/26	BH02	5.5-6.0	5.6	4.3	X
22-2116/27	BH02	6.0-6.5	5.4	3.7	X
22-2116/28	BH02	6.5-7.0	6.2	4.1	X
22-2116/29	BH02	7.0-7.5	5.7	3.5	X
22-2116/30	BH02	7.5-8.0	5.8	4.8	X
22-2116/31	BH02	8.0-8.5	5.8	2.9	X
22-2116/32	BH02	8.5-9.0	5.6	3.0	X

Test Methodology: Analysis is conducted in accordance with inhouse method LAB300 which is in compliance with AS 4969-2008.
Analysis Methods are derived from: Ahern CR, McElnea AE, Sullivan LA (2004). Acid Sulfate Soils Laboratory Methods

Guidelines. Queensland Acid Sulfate Soils Manual 2004. Department of Natural Resources, Mines and Energy, Indooroopilly, Queensland, Australia.

pH Screen Reaction Rating Table

Reaction Scale	Rate of Reaction
X	Slight Reaction
XX	Moderate Reaction
XXX	High Reaction
XXXX	Very vigorous reaction, gas evolved and heat generated, commonly >80°C

Approved Signatories:

Checked By: Lachlan Modina
Senior Laboratory Technician

Approved By: Daryl Surkitt
Manager Laboratory Technical Services

Notes: *NATA Accreditation does not cover the sampling performance*
OCTIEF accepts no responsibility for the collection, packaging and transportation of samples submitted by external parties
All samples are analysed as received and the results contained within this report relate only to the sample(s) submitted for analysis.
Measurement uncertainty data is available here.

NATA Accreditation Number: 15172
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CERTIFICATE OF ANALYSIS

Report No. 22-2117
Rev No. 00

Client:	Pacific Geotech Pty Ltd	Date Samples Received:	11/05/2022
Client Contact:	Peter Elkington	Date Analysis Commenced:	11/05/2022
Client Address:	3 Jowett Street Coomera QLD 4209	No. Samples Received:	16
		No. Samples Analysed:	16
Purchase Order #:	PG-5697	Date Issued:	13/05/2022
Project / Site Ref:	69-71 Banana St & 18 Outridge St Redland Bay		

Lab Ref No.	UNIT	LOR	22-2117-1	22-2117-2	22-2117-3	22-2117-4	22-2117-5	22-2117-6	22-2117-7
Sample Desc.			BH01	BH01	BH01	BH01	BH01	BH01	BH01
Depth (m)			1.0	2.0	3.0	4.0	5.0	6.0	7.0
Sample Date			22/04/2022	22/04/2022	22/04/2022	22/04/2022	22/04/2022	22/04/2022	22/04/2022
pH_{KCL}	pH Unit	0.1	7.0	4.9	5.4	5.1	5.0	5.4	5.0
Chromium Reducible Sulfur	%w/w S	0.005	0.009	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
Chromium Reducible Sulfur	mol H^+/t	3	5	<3	<3	<3	<3	<3	<3
TAA pH 6.5	mol H^+/t	5	<5	48	10	12	13	9	15
s-TAA pH 6.5	%S w/w	0.005	<0.005	0.078	0.015	0.019	0.021	0.014	0.024
KCl Ext S	%w/w S	0.005	<0.005	0.060	0.069	0.075	0.075	0.084	0.066
HCl Ext S	%w/w S	0.005	0.017	0.097	0.102	0.092	0.186	0.110	0.086
Retained Acidity	%S	0.005	N/R	N/R	N/R	N/R	N/R	N/R	N/R
ANC	mol H^+/t	5	19	7	6	10	13	16	8
Net Acidity	mol H^+/t	5	5	48	10	12	13	9	15
Net Acidity	%w/w S	0.005	0.008	0.077	0.016	0.019	0.021	0.014	0.024
Net Acidity-ANC	mol H^+/t	5	<5	43	6	5	<5	<5	10
Liming Rate	kg $CaCO_3$/t	1	<1	4	1	1	1	1	1
Liming rate-ANC	kg $CaCO_3$/t	1	<1	3	<1	<1	<1	<1	1

Lab Ref No.	UNIT	LOR	22-2117-8	22-2117-9	22-2117-10	22-2117-11	22-2117-12	22-2117-13	22-2117-14
Sample Desc.			BH02	BH02	BH02	BH02	BH02	BH02	BH02
Depth (m)			1.0	2.0	3.0	4.0	5.0	6.0	7.0
Sample Date			22/04/2022	22/04/2022	22/04/2022	22/04/2022	22/04/2022	22/04/2022	22/04/2022
pH_{KCL}	pH Unit	0.1	6.7	6.9	6.6	7.0	5.9	6.0	5.9
Chromium Reducible Sulfur	%w/w S	0.005	<0.005	<0.005	0.680	0.066	0.027	0.018	0.012
Chromium Reducible Sulfur	mol H^+/t	3	<3	<3	424	41	17	11	8
TAA pH 6.5	mol H^+/t	5	<5	<5	<5	<5	<5	<5	<5
s-TAA pH 6.5	%S w/w	0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
KCl Ext S	%w/w S	0.005	0.038	0.037	0.051	0.053	0.073	0.117	0.069
HCl Ext S	%w/w S	0.005	0.068	0.069	0.145	0.087	0.133	0.120	0.141
Retained Acidity	%S	0.005	N/R	N/R	N/R	N/R	N/R	N/R	N/R
ANC	mol H^+/t	5	12	17	24	14	14	14	12
Net Acidity	mol H^+/t	5	<5	<5	424	41	17	11	8
Net Acidity	%w/w S	0.005	<0.005	<0.005	0.678	0.066	0.027	0.018	0.013
Net Acidity-ANC	mol H^+/t	5	<5	<5	408	32	8	<5	<5
Liming Rate	kg $CaCO_3$/t	1	<1	<1	33	3	1	1	1
Liming rate-ANC	kg $CaCO_3$/t	1	<1	<1	32	2	1	<1	<1

Lab Ref No.	UNIT	LOR	22-2117-15	22-2117-16
Sample Desc.			BH02	BH02
Depth (m)			8.0	9.0
Sample Date			22/04/2022	22/04/2022
pH_{KCL}	pH Unit	0.1	5.6	5.5
Chromium Reducible Sulfur	%w/w S	0.005	0.005	0.008
Chromium Reducible Sulfur	mol H^+/t	3	3	5
TAA pH 6.5	mol H^+/t	5	6	7
s-TAA pH 6.5	%S w/w	0.005	0.009	0.011
KCl Ext S	%w/w S	0.005	0.086	0.073
HCl Ext S	%w/w S	0.005	0.092	0.126
Retained Acidity	%S	0.005	N/R	N/R
ANC	mol H^+/t	5	7	20
Net Acidity	mol H^+/t	5	9	12
Net Acidity	%w/w S	0.005	0.014	0.019
Net Acidity-ANC	mol H^+/t	5	<5	<5
Liming Rate	kg $CaCO_3$/t	1	1	1
Liming rate-ANC	kg $CaCO_3$/t	1	<1	<1

General Comments

I. *OCTIEF accepts no responsibility for the collection, packaging and transportation of samples submitted by external parties*
II. *All samples are analysed as received (unless indicated otherwise) and the results contained within this report relate only to the sample(s) submitted for analysis.*
III. *Measurement uncertainty data is available here.*
IV. *NATA Accreditation Number: 15172*
V. *Accredited for compliance with ISO/IEC 17025 – Testing*
VI. *This document may not be reproduced except in full*
VII. *Tests not covered by NATA are denoted with **

Report Comments

Test Methodology: Analysis is conducted in accordance with inhouse method LAB-300 which is in compliance with AS 4969-2008. Analysis Methods are derived from: Ahern CR, McElnea AE, Sullivan LA (2004). Acid Sulfate Soils Laboratory Methods Guidelines. Queensland Acid Sulfate Soils Manual 2004. Department of Natural Resources, Mines and Energy, Indooroopilly, Queensland, Australia.
Notes:

1. Net Acidity = Actual Acidity + Retained Acidity + Potential Sulfidic Acidity.
2. ANC is typically only included in the Net Acidity calculation where the neutralising capacity of the soil has been corroborated with other data.
3. Retained Acidity required where pHKCl <4.5. Retained Acidity (SNAS) calculated as (2 * S-HCl) - S-KCl.
4. Acid Neutralising Capacity is required only where pHKCl >=6.5, however, the ANC results have been reported to identify any previous lime dosing.
5. Liming Rate calculation and Acidity - ANC calculation assumes the use of agricultural lime and incorporates a safety factor of 1.5.
6. The neutralising capacity for Ag lime is 96, hence to convert from kg $CaCO_3$ to kg Ag Lime ($CaCO_3$/t), multiply by 100/96.
7. N/R denotes Not Required.

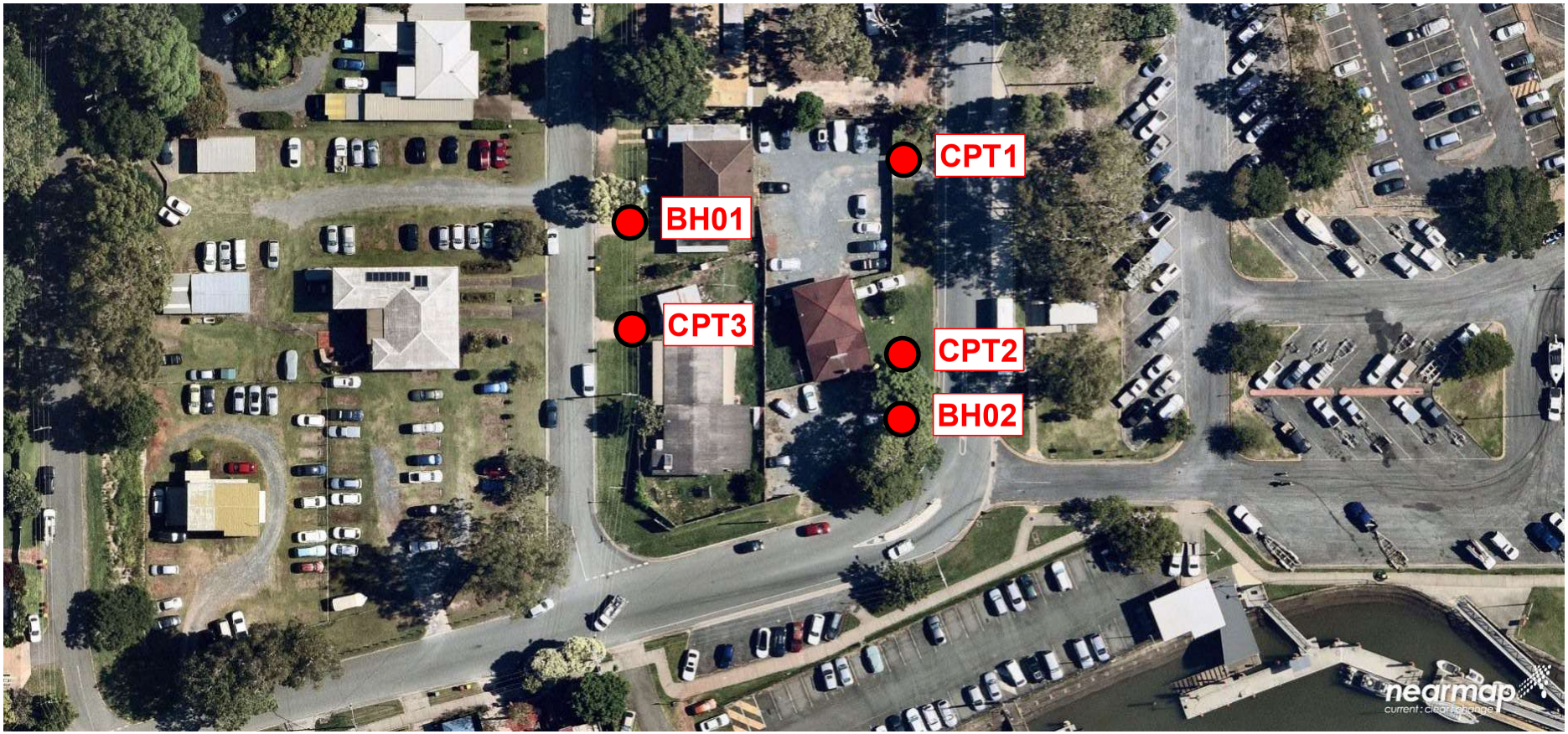
Approved Signatories:

Report Checked By: Lachlan Modina

Report Approved By: Lachlan Modina

APPENDIX D

SITE PLAN



Pacific Geotech
Consulting Geotechnical Engineers

Drawn	Project:	Proposed Residential Unit Development	Drawing No. PG-7911-01	A4
Date	Location:	69 & 71 Banana Street and 18 Outridge Street, Redland Bay		
Checked	Client:	LA5 Trust & LA6 Trust & LA7 Trust & LA9 Trust		