Appendix H
Geotechnical Assessment

Pacific Geotech
Consulting Geotechnical Engineers

GEOTECHNICAL REPORT: Proposed Town Centre Precinct

Precincts 7, 11, 13B and 16

Yarrabilba

Lendlease Communities (Yarrabilba) Pty Ltd

October, 2024

PG-5335-G

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Pacific Geotech
Consulting Geotechnical Engineers

Ref: PG-5335-G, 2024-10-14, GR VER 1
Author: Robert Maxwell

29th October, 2024

Lendlease Communities (Yarrabilba) Pty Ltd
Email: jedda.david@lendlease.com

ATTN: JEDDA DAVID

Dear Jedda,

ADDITIONAL GEOTECHNICAL INVESTIGATION
PROPOSED TOWN CENTRE PRECINCT
PRECINCTS 7, 11, 13B AND 16, YARRABILBA

Enclosed is a copy of our report for the above project dated October, 2024. An electronic copy of the report has been issued.

Should you have any queries regarding this report, please do not hesitate to contact Robert Maxwell at this office.

Yours faithfully,

R. MAXWELL (RPEQ 16596)

For and on behalf of
PACIFIC GEOTECH PTY LTD

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1.0 INTRODUCTION

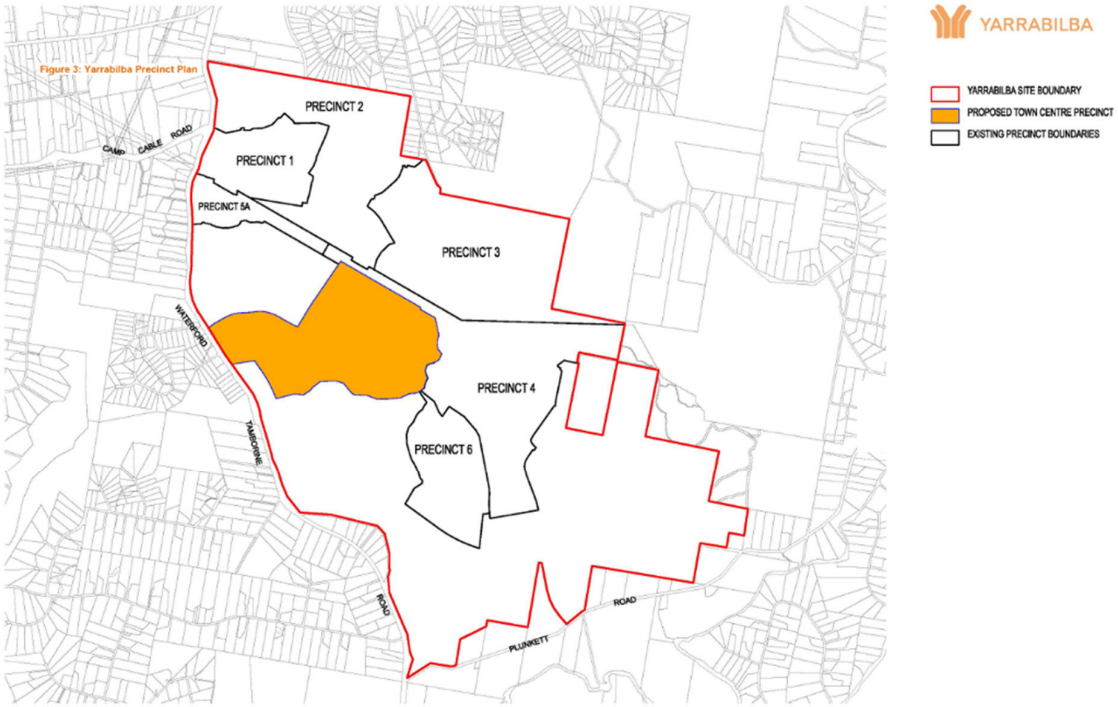
This report contains the results of the geotechnical investigation and provides advice and recommendations relating to the following:

- Subsurface conditions in accordance with AS 1726
- Foundation recommendations
- Characteristic ground surface movements
- Earthworks considerations
- Batter slope recommendations
- Indicative pavement design parameters
- Construction considerations
- Sediment/erosion control considerations

Proposed Development

The proposed future Town Centre Precinct is bound by Waterford Tamborine Road and MIBA South to the west, the powerline easement to the north and Yarrabilba Drive to the east. Earthworks are envisaged to consist of balanced cut to fill operations to create the bulk earthwork levels. The proposed development is indicated below.

PROPOSED TOWN CENTRE PRECINCT LAYOUT



2.0 METHODOLOGY

The additional geotechnical investigation comprised the excavation and sampling of eleven (11) test pits at nominated locations across the proposed Town Centre Precinct.

The test pits were excavated to depths of ranging between 0.85m and 4.9m, using a 35-tonne excavator fitted with a 2m wide batter bucket and ripper attachment. Dynamic Cone Penetrometer (DCP) testing was conducted adjacent to the test pits.

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

Test pit 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 future town centre precinct is bound by Waterford Tamborine Road and MIBA South to the west, the powerline easement to the north and Yarrabilba Drive to the east.

At the time of the investigation, the site is mostly covered by medium and long grass with areas of native regrowth and pine trees. The Town Centre East-West Road had been constructed connecting Waterford Tamborine Road from the west to Yarrabilba Drive to the east.

Site drainage in the majority of the site was considered fair, however in the creek areas around the centre of the site, drainage was considered poor and expected to be unpassable during and following periods of wet weather.

Refer following aerial and site photographs for typical site conditions.

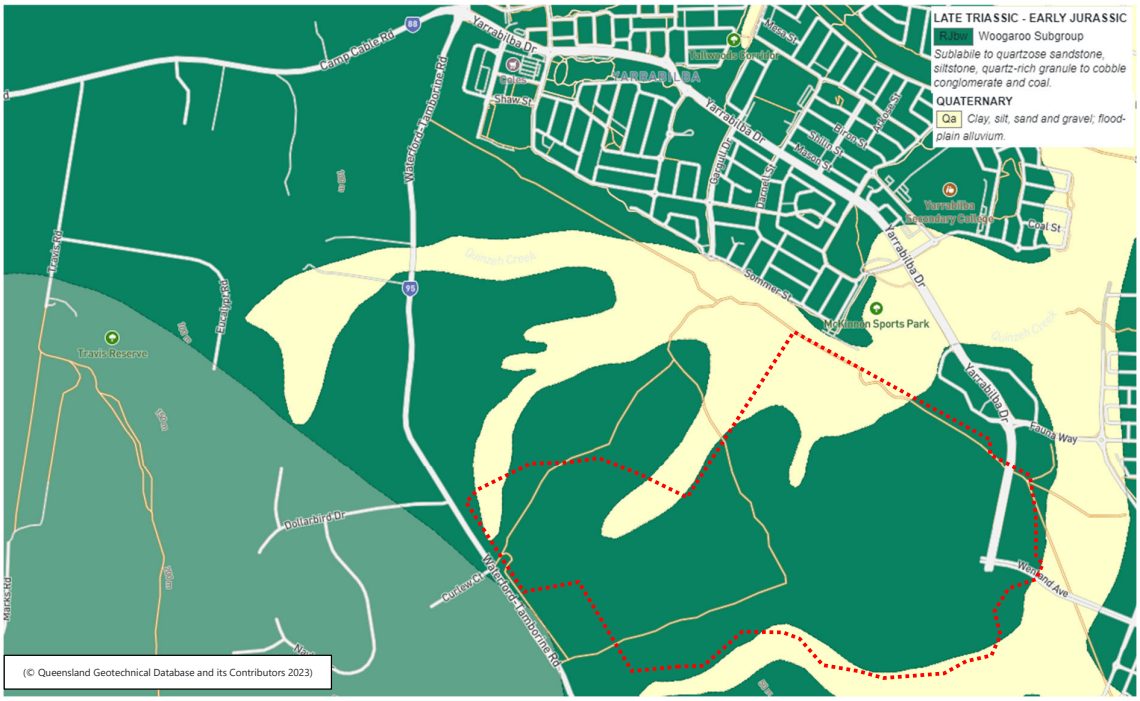
AERIAL IMAGE

SITE PHOTOGRAPHS

4.0 REGIONAL GEOLOGY

Published geological information indicates that the site of the proposed future Yarrabilba Town Centre Precinct is mostly underlain by Late Triassic to Early Jurassic aged Woogaroo Subgroup comprising sublabile to quartzose sandstone, siltstone, quartz-rich granule to cobble conglomerate and coal. Quaternary aged flood plain alluvium associated with Quinzeh Creek extends along the northern boundary and through the centre of the development site. The alluvium generally comprised clay, silt, sand and gravel.

FIGURE 1 EXTRACT OF SURFACE GEOLOGY



5.0 GEOTECHNICAL MODEL

The typical subsurface profile encountered in the test pits generally consisted of a 0.2m to 0.3m thick surficial topsoil layer overlying natural very loose to loose and medium dense silty and clayey sands, which is in turn overlying natural sandy clay.

The natural sandy clays were initially stiff, increasing in strength to very stiff and hard.

Extremely to highly weathered sandstone was typically encountered underlaying the natural sandy clays in test pits TP01, TP05, TP06, TP07, TP09, and TP10, at depths ranging between 0.4m and 3.2m and continued to the termination depths. Effective refusal was met in TP01, TP05, TP07, and TP09 at depths ranging between 3.0m and 4.9m.

Table 1 presents a summary of the encountered subsurface profile in the test pits. Detailed test pit record sheets are appended to this report.

TABLE 1 SUBSURFACE PROFILE SUMMARY

No.	TOPSOIL	NATURAL					TD
		Silty / Clayey Sand		Sandy Clay		Sandstone	
		Very Loose to Loose	Loose to Medium Dense	Stiff	Very Stiff / Hard	XW/HW	
TP01	0.0-0.2	NE	0.2-0.4	0.4-1.0	NE	1.0-TD	3.0[4.]
TP02	0.0-0.3	NE	0.3-0.7	0.7-TD	NE	NE	1.45
TP03	0.0-0.2	NE	0.2-0.5	0.5-TD	NE	NE	0.9
TP04	0.0-0.3	NE	0.3-0.55	0.55-0.8	0.8-TD	NE	0.85
TP05	0.0-0.2	NE	NE	0.2-0.4	NE	0.4-TD	3.5[4.]
TP06	0.0-0.2	NE	0.2-0.7	0.7-2.1	2.1-3.2	3.2-TD	4.34
TP07	0.0-0.3	NE	NE	0.3-0.8	NE	0.8-TD	4.2 [4.]
TP08	0.0-0.3	NE	0.3-0.7	0.7-TD	NE	NE	1.15
TP09	0.0-0.2	NE	0.2-0.5	0.5-2.0	NE	2.0-TD	4.9[4.]
TP10	0.0-0.25	NE	0.25-0.9	0.9-1.1	NE	1.1-TD	1.2
TP11	0.0-0.3	NE	0.3-0.75	0.75-1.1	1.1-TD	NE	1.5

Notes:
1. All depths in metres below ground level at time of investigation.
2. NE - Not Encountered; TD - Termination Depth.
3. Saturated silty sand layer encountered.
4. Effective refusal met using ripper attachment.

In the lower lying areas, seepage and perched groundwater was encountered within the upper silty sand layers and along the underlying clay interface at depths ranging between 0.3m and 1.45m at the time of the investigation. Seepage is also expected to develop through the surficial sandy soils and along the sand/clay and soil/rock interfaces following periods of rainfall.

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:-

- Atterberg Limits - to assess the plastic properties of the subsurface material.
- Particle Size Distribution - to assess the composition of the subsurface material.
- California Bearing Ratio - to assess the subgrade characteristics of the subsurface material under soaked conditions.
- Emerson Class testing - to assess the dispersive characteristics of the soils.

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

7.0 EARTHWORKS AND SITE PREPARATION CONSIDERATIONS

Earthworks for future Town Centre Precinct are envisaged to consist of balanced cut to fill operations to create the bulk earthwork levels.

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 poor to fair. Wet surficial sands were encountered across the low-lying portions of the site, resulting in significant difficulties with site trafficability for the excavator during the investigation. Trafficability for conventional wheeled plant and achieving compaction in these wet sands are likely to be problematic and consideration could be given to improving subsurface drainage throughout the site during the early site preparation works. This may involve installing graded subsoil drains and service trenches to intersect perched groundwater and drain the surficial sands. The base of the drains/ trenches should extend below the sands and into the natural clays below.
- If significant rainfall events occur prior to and during the earthworks operations, the exposed surface conditions are anticipated to further deteriorate and trafficing difficulties will be exacerbated. Consideration could be given to constructing a minimum 150mm thick gravel working platform and/or removal of saturated sands in highly trafficked areas (ie. haul roads) to facilitate access during wet weather periods.
- Difficulties have been experienced in dealing with the surficial silty/clayey sands in the recent residential stages of Yarrabilba. Trafficability is very limited in these materials when the sands are wet of optimum moisture content. The silty/clayey sands encountered on-site have performed poorly when saturated. The removal and mixing of these sands with select clay based imported fill may be required to facilitate filling.
- 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. This is expected to involve the removal of approximately 100mm to 400mm of topsoil, and disturbed material containing organics from the works area but possibly more in localised areas. This material is unsuitable for use as controlled fill or trench backfill and should be stockpiled for use post construction or removed from site. Root balls from trees removed

should have the organic matter fully removed and the excavation backfilled in a controlled manner.

- 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 materials. If fill materials are identified onsite, 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.
- Preferential disposal of the silty/clayey sands may be considered, to reduce the potential handling issues and where sufficient space to spread and condition these materials during trenching operations is not be available. These materials typically require a placement moisture content very close to Optimum Moisture Content (OMC) to achieve adequate compaction. A placement moisture content of ±2% of OMC is recommended. A suitable contingency should be made in the earthworks contract to dispose/treat of these materials as required.
- Imported fill should be of fair to good quality with a minimum Soaked CBR value of 10%, a maximum lss=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 Level 1 supervision, in general accordance with the requirements of AS3798 and should be certified as controlled fill by the testing authority.

8.0 EXCAVATION CHARACTERISTICS

The information and advice presented in this section of the report is based on the conditions encountered at the test locations within the development area only. Variations in these conditions will occur across the site and must be expected.

Earthworks are envisaged to consist of balanced cut to fill operations to create the bulk earthwork levels.

Excavations are expected to encounter natural upper silty sand overlying sandy clay and clayey sand as well as extremely to highly weathered sandstone within the elevated portions of the development site.

Excavations in the soils and extremely weathered sandstone should be achievable using conventional earthmoving machinery such as scrapers, small to medium dozers (say Cat D6) and medium sized excavators (say ~15t to 20t) using general purpose and toothed buckets. Excavations into the highly or less weathered sandstone are likely require the use of medium to large sized dozers (say Cat D7-D9) or large sized excavators (say >24t) using ripper attachments or possibly hydraulic rock breakers.

Additional drilling in the form of core drilling would need to be carried out to the required depths to provide a more accurate assessment of the excavation conditions at the site.

No significant groundwater issues are expected to be encountered under dry weather conditions. Where excavations through existing drainage features are carried out following rainfall, moderate seepage through permeable sand soils should be expected.

9.0 BATTERS

It is envisaged that excavations up to approximately 5.0m will be required as part of the works. It is expected that the profile in the batter excavation will generally consist of surficial loose and medium dense sands, stiff to hard clays and XW to HW sandstone rock which typically becomes stronger and less weathered with depth.

Considering the proposed maximum cut height of 5m, maximum short term batter slopes of 25 degrees within the loose sands, 45 degrees in the stiff to hard clays and medium dense sands and 65 degrees in the weathered sandstone rock is recommended for the temporary slopes (subject to inspection at the time of excavation and assuming the works are above the water table).

For batters over 3m in height it is recommended a 2m wide horizontal bench be cut every 2.5m vertical increment.

A further reduction in the safe batter angle for the loose/weak surficial soils may be required, depending on the degree of saturation at the time of excavation. This material should be assessed by Pacific Geotech once exposed for advice on suitable batter angles. Steeper batters are possible by use of temporary retention systems.

Potential temporary retention systems which could be considered include:

- A shoring box (potentially requiring end plates depending on the size and location of the excavation). The use of stacked shoring boxes may be required and should be assessed for geotechnical adequacy if adopted.
- Driven cantilevered sheet pile retention system.
- Steel plating and internal propping (likely only suitable for shallow excavations).

Temporary retention systems should be designed based on the parameters presented in Table 3 of this report.

For excavations of a very short term nature, and subject to assessment of factors such as the conditions at the time of excavation, length of time excavations are to remain open, working conditions/requirements and most importantly the soil structure in the cut face, etc., steeper excavations could be possible. Pacific Geotech should be contacted to determine an appropriate profile when construction details have been finalised.

Maximum long term batter slopes of 20 degrees are generally recommended for the on-site materials (subject to inspection at the time of excavation). Steeper batters are possible by use of retaining structures.

It is essential that batters be suitably protected from erosion and scour. Runoff should not be allowed to discharge directly across the batters.

10.0 INDICATIVE SITE CLASSIFICATION

Site investigation and laboratory test results indicate the majority of the development site would be classified Class M in accordance with AS 2870-2011 'Residential Slabs and Footings', with a maximum y_s of 30mm calculated for the natural subsurface profile. An increase in reactivity is anticipated as a result of the bulk earthwork activities.

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.

11.0 ALLOWABLE BEARING PRESSURES FOR ENCOUNTERED SOILS

The appropriate foundation system for the support of proposed structures will be dependent on the final loads, ability of the structure to tolerate the settlement and potential ground surface movements and construction considerations on site.

The footing parameters provided in this report should be confirmed with further detailed investigation when information on specific structures are known.

11.1 High Level Footings

An allowable bearing capacity of 100kPa in the natural stiff clays, 200kPa in the natural very stiff clays and 400kPa in the natural hard clays and weathered rock would be available, subject to inspection at the time of excavation. Where the new fill is placed in a controlled manner, consideration could be given to founding the structure in the certified fill. An allowable bearing capacity of 150kPa could be adopted in the controlled fill.

Where the existing uncontrolled fill or loose sand is encountered, footings should be deepened to penetrate the uncontrolled fill / loose sand material and found into the natural soils. This may require minor over-excavation of footings to expose a competent founding material.

It is recommended that footing inspections be undertaken by a suitably qualified geotechnical engineer, following excavation, to confirm the specified founding strata has been reached.

It is recommended that masonry walls supported on high level footings founding in the fill or natural clay 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.

11.2 Deep Foundations

If the bearing capacities of the upper level soils are considered inadequate or unsuitable material is encountered etc., consideration should be given to adopting a deep foundation system. Bored or CFA grout injected piles, driven piles or screw piles could be considered for the support of the proposed structures.

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 2. The $R_{d,ug}$ values given in Table 2 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 0.4 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 2 will need to be divided by a factor of safety of 2.5 to caluculate the maximum single pile working load.

TABLE 2 ULTIMATE (UNFACTORED) PILE DESIGN PARAMETERS

Material		Preliminary Ultimate Unfactored End Bearing* (kPa)		Ultimate Unfactored Shaft Adhesion* (kPa)
		L<4D	L>4D	
Existing Fill & Natural Sand		NR	NR	10
Natural Clay	Stiff	NR	NR	10
	Very Stiff	600	900	30
	Hard	1200	1800	60
Sandstone – XW/HW		1500	2250	70

Notes: *Geotechnical strength reduction factor needs to be applied to these parameters.
1. NR – Not Recommended.
2. L – pile length; D – pile diameter.

Construction Considerations

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

Groundwater was encountered in some of the test pits during the investigation at this site. An allowance for the use of steel liners, which will likely have to be socketed 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.

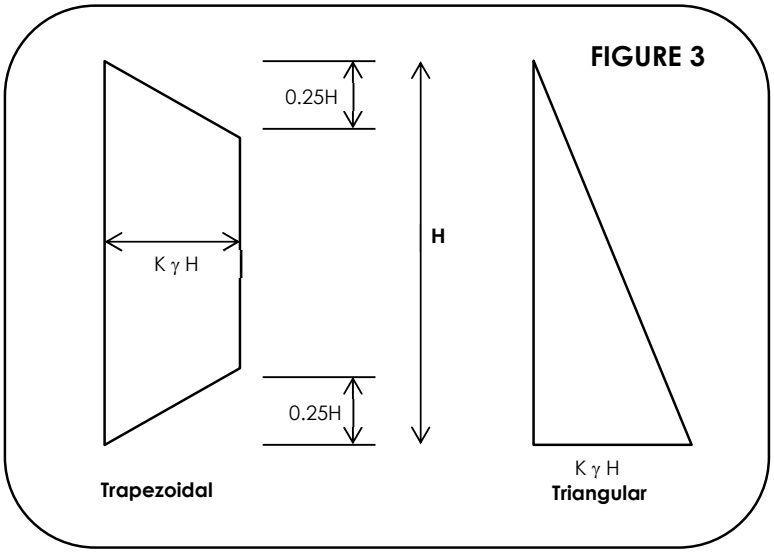
Drilling piles is not only dependent on the subsurface profile characteristics, but also the type (power and size) of the bored pile drilling rig, drilling teeth, size of pile, etc. It is recommended that a specialist drilling contractor be consulted to be able to manage the above conditions and materials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

During construction, all bored piles must be inspected by a geotechnical engineer to confirm the geotechnical strength parameters presented in Table 2 and to check the capacity of the piles.

12.0 RETAINING WALLS

Retaining walls should be specifically engineer designed in accordance with AS 4678-2002 (Ref 9).

The design of flexible retaining walls could be undertaken using a triangular pressure distribution and the earth pressure parameters given in Table 3. Flexible walls are those which are free to rotate or tilt (such as cantilevered walls) and should be designed using active (Ka) earth pressure coefficient. Rigid walls are those which are restrained against rotation or tilt (i.e. single anchored/propped walls) and should be designed using the at-rest earth pressure (Ko) and a trapezoidal pressure distribution as per Figure 3.



Passive resistance (Kp) at the toe of the wall should be ignored in the zone where future disturbance (e.g. services trenches) could occur.

The effects of surcharge in the retained zone should be included by multiplying the vertical pressure developed by the surcharge by the appropriate lateral earth

pressure coefficient. Allowance should also be made for the surcharge due to sloping crests if applicable.

TABLE 3 EARTH PRESSURE COEFFICIENTS (NON-SLOPING CREST BACKFILL)

Material		Unit Weight (kN/m³)	Friction Angle (degrees)	Active Ka	At Rest Ko	Passive Kp
Fill*		19	24	0.42	0.59	2.37
Natural Sand	Very Loose /Loose	17	25	0.41	0.58	2.46
	Medium Dense	19	28	0.36	0.53	2.77
	Dense	20	33	0.29	0.46	3.39
Natural Clay	Stiff	19	24	0.42	0.59	2.37
	Very Stiff	20	26	0.39	0.56	2.56
	Hard	20	28	0.36	0.53	2.77
XW/HW Sandstone	Very Low/Low Strength	21	33	0.29	0.46	3.39

Notes: * Depends on fill material type and level of compaction. Assumes material compacted under 'Level 1' supervision.

Preference should be given to adopting thin soil layers and using small hand-controlled compaction equipment during backfilling against retaining walls. This is in order to limit the stress applied to the walls during construction. Should heavy compaction be required, then wall stresses will be well in excess of Ko and temporary propping should be used.

Clay backfill should not be placed dry of optimum moisture content, as this can lead to increased future swelling with changes to moisture content or inundation from water creating additional load on the back of the wall.

It is recommended that all retaining walls be drained for full height in order to minimise hydrostatic pressure build-up behind the wall. Additional guidelines on wall drainage are provided in Appendix G of AS 4678-2002.

13.0 PAVEMENT DESIGN CONSIDERATIONS

Soaked CBR laboratory testing was conducted on the natural sandy clay samples recovered from TP01 at 0.5-0.6m, TP02 at 0.7-0.8m, and TP09 at 0.65-0.75m. The Soaked CBR tests produced values ranging between of 3.0% and 4.0% in the natural clays.

Considering the nature of the natural clays, a design CBR value of 3.0% and a modulus of subgrade reaction of 25kPa/mm are recommended for the natural clays for preliminary pavement design. Greater values are anticipated for the fill material and

should be confirmed with additional on-site sampling and testing following the bulk earthworks operation on site.

Specific additional construction considerations are offered in regard to the construction of the pavements on the site:-

- Suitable subsurface drainage should be installed around the perimeter of the pavements
- It should be ensured that the subgrade of the pavement is suitably graded to allow any seepage to flow from under the pavement to the perimeter drains.
- Pavement materials should comply with MRS 11.05 specifications and the corresponding minimum dry density ratios are recommended:
  - i) Lower Sub-base (Type 2.5) 95% (Modified)
  - ii) Sub-base (Type 2.3) 95% (Modified)
  - iii) Base (Type 2.1) 98% (Modified)
- Inspections and testing should be carried out by Pacific Geotech following the completion of the bulk earthworks to confirm subgrade conditions across the pavement areas.

14.0 SEDIMENT CONTROL CONSIDERATIONS

14.1 Laboratory Testing

Erosion and dispersion testing was carried out on samples retrieved from the site investigation program and was directed towards assessing the Emerson Class, pH and electrical conductivity characteristics of the subsurface material.

The results of the laboratory testing are contained in Appendix C and summarised in Table 6 below. The results are discussed in further detail below.

TABLE 6 LABORATORY TEST RESULTS

Sample	Description	Emerson Class	pH	Conductivity (dS/m)	Assessment
TP01 0.5-0.6m	NATURAL – Sandy CLAY	2	5.7	0.18	Moderately Acidic Low Salinity Rating **High Dispersive Tendency High Erosion Risk**
TP02 0.7-0.8m	NATURAL – Sandy CLAY	2	5.7	0.22	Moderately Acidic Low Salinity Rating **High Dispersive Tendency High Erosion Risk**
TP09 0.65-0.75m	NATURAL – Sandy CLAY	5	5.4	0.16	Strongly Acidic Low Salinity Rating **Low Dispersive Tendency Medium Erosion Risk**

14.1.1 Emerson Class Results

Emerson class testing was carried out to assess the potential for clay dispersion. The test categorises the tendency of the clay fraction of a soil to go into colloidal suspension when immersed in water.

A description of the Emerson class numbers and associated level of risk is presented in Table 7 below.

TABLE 7 EMERSON CLASS DESCRIPTIONS

Emerson Class No.	Description	Dispersion Tendency	Potential Erosion Risk
Class 1	Strongly Dispersive – Slaking and complete dispersion of natural soil ped	Very High	Very High
Class 2	Dispersive – Slaking and some dispersion of natural soil peds	High	High
Class 3	Dispersive when remoulded - Slaking but no dispersion of natural soil peds.	Moderate	Medium
Class 4	Non Dispersive – Calcite or Gypsum present	Low	Medium
Class 5	Dispersive only after shaking – Slaking but no dispersion of natural soil peds.	Low	Medium
Class 6	Non Dispersive, Flocculation after shaking - Slaking but no dispersion of natural soil peds.	Low	Low
Class 7	Non Dispersive – Swelling	Negligible	Very Low
Class 8	Non Dispersive – No Swelling	Negligible	Very Low

Emerson Class testing was carried out on three samples of the natural subsurface materials. The two of the soil samples recorded a Class 2 indicating a high dispersion risk and one natural clay sample recorded Class 5, indicating a low dispersion risk.

14.1.2 Soil pH

Soil pH is a measure of acidity or alkalinity. The soil pH level is important for healthy plant growth. It can also provide some indication of the risk of soil salinity and consequently soil dispersion. The majority of the samples tested were strongly to very strongly acidic.

14.1.3 Soil Salinity

Soil salinity effects the health of vegetation by altering plant root processes (osmosis).

Electrical conductivity (EC) is used to assess soil salinity (the presence of salts). Electrical conductivity is a measure of electricity through soil or a water extract of soil using a 1:5 Soil/water suspension ($EC_{1:5}$). It can be used to determine the soluble salts in the extract and hence soil salinity.

Three of the samples tested showed $EC_{1:5}$ values typically ranged between 0.16 and 0.22dS/m for the natural sandy clay and are considered to have a low soil salinity rating.

14.2 Summary of Soil Dispersion Risk

Based on the results of the field investigation and laboratory, the natural clays encountered on site exhibited an overall **high soil dispersion risk** and a **high erosion risk.**

14.3 Erosion and Sediment Control Recommendations

Given the high dispersion and erosion risks, a dispersive soil management plan (DSMP), and erosion control program is to be developed and implemented for the site. The DSMP site erosion and sediment control program and stormwater management plan should implemented during the construction phase and should include the follwoing:

- Major earthworks should be avoided where possible to minimise disturbance of possible dispersive soils and should take advantage of the existing topography.
- Removal of vegetation should be kept minimal to reduce erosion potential.
- Any dispersive soils could be treated with gypsum as nominated by an appropriately qualified Geotechnical Engineer.
- Drainage controls should be installed within the early stages of the development.
- Flow paths are to be determined and defined on site and should be indicated on development drawings.
- Drainage measures should be installed to control and divert slope runoff around the development site. This is expected to comprise the use of turfed swales, diversion banks, or geotextile lined catch drains.
- Stormwater should be redirected to turfed areas or onto on-site detention systems and not to be diverted outside the site.
- Sediment barriers are to be installed along the lower slope of site boundaries and soil stockpiles.
- Site traffic and entry should be kept minimal including reducing the number of entry and exit points. Entry and exit points are to be with coarse gravel and stone to both stabilise and not to expose dispersive soils.

- Watercourses / Major water bodies are to have a sediment trap /pond installed upstream.
- Regular inspections and maintenance of sediment, erosion, and drainage control measures should be carried out on a periodic basis throughout construction period.
- Site is to be re-turfed and re-vegetated progressively throughout construction to reduce the amount of exposed soils.

15.0 SITE MANAGEMENT

To maintain the long-term performance of structures, 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.

16.0 LIMITATIONS

We have prepared this report for the Proposed Town Centre Precinct at Precincts 7, 11, 13B and 16, Yarrabilba. The report is provided for the exclusive use of Lendlease Communities (Yarrabilba) Pty Ltd, 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.

R. MAXWELL (RPEQ 16596)

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

TEST PIT RECORD SHEETS

Pacific Geotech

3 Jowett St, Coomera QLD 4209

Phone: (07) 5636 4680

Geotechnical Log - Testpit

TP01

UTM	: 56J	**Excavator**	: 35 tonne	**Job Number**	: PG-5335-G Town Centre
Latitude	: -27.818056	**Excavator Supplier**	:	**Client**	: LendLease Communities (Yarrabilba) Pty Ltd
Longitude	: 153.111944	**Logged By**	: SZTO	**Project**	: Town Centre Precinct
Ground Elevation	: 42.62 (m)	**Reviewed By**	: RM	**Location**	: Yarrabilba QLD, Australia
Total Depth	: 3 m BGL	**Date**	: 20/09/2024	**Loc Comment**	:

Excavator Attachment	Water	Depth (m)	DCP graph	Soil Origin	Graphic Log	Classification Code	Material Description	Moisture	Testing	Samples: 20kg CBR Samples
2m Batter Bucket		0.2	3	Natural		SM	NATURAL Silty SAND SM loose, pale brown, fine to medium grained, moist, trace of organics (topsoil).	M		
			2							
			2	Natural		SM	NATURAL Silty SAND SM loose, brown, fine to medium grained, moist.			
		0.4	3							
			1	Natural		CI	NATURAL Sandy CLAY CI firm to stiff, medium plasticity, pale orange brown, organic, moist, observed organic roots.			
			2							
			2							
			2							
			3							
			3							
		1								
			2	Rock		SST	Extremely weathered, ROCK Silty SAND SST medium dense, pale orange brown mottled pale grey, fine to medium grained.	M-D		
		1.2	10							
Ripper			R/Bouncing	Rock		SST	Rock SANDSTONE highly weathered, low to medium strength, pale yellow brown mottled pale grey, fine grained, dry, required ripper.	D		
		2								
							TP01 refusal at 3m			

Water

- Water inflow
- Water outflow
- Ground water Level during drilling

Weathering

- XW : Extremely weathered
- DW : Distinctly weathered
- HW : Highly weathered
- MW : Moderately weathered
- SW : Slightly weathered
- FR : Fresh

Altering

- XA : Extremely alterated
- DA : Distinctly alterated
- HA : Highly alterated
- MA : Moderately alterated
- SA : Slightly alterated

Consistency

- VS : Very soft
- S : Soft
- F : Firm
- St : Stiff
- VSt : Very stiff
- H : Hard
- FR : Friable

Moisture

- D : Dry
- M : Moist
- W : Wet

Density

- VL : Very loose
- L : Loose
- MD : Medium dense
- D : Dense
- VD : Very dense

Rock Strength

- VLS : Very low
- LS : Low
- MS : Medium
- HS : High
- VH : Very high
- XH : Extremely high

Tests&Results

- U50 : Undisturbed 50mm diam tube.
- D : Disturbed sample.
- SPT : Standard Penetration Test, N = number of blows to drive 50mm sampler 300mm with a 63.6kg hammer falling 762mm.
- PP : Hand penetrometer estimate of unconfined compressive strength, kPa.
- S : Vane shear value kPa.
- DCP : Dynamic Cone Penetrometer test.

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Geotechnical Log - Testpit

TP02

UTM	: 56J	**Excavator**	: 35 tonne	**Job Number**	: PG-5335-G Town Centre
Latitude	: -27.820278	**Excavator Supplier**	:	**Client**	: LendLease Communities (Yarrabilba) Pty Ltd
Longitude	: 153.114167	**Logged By**	: SZTO	**Project**	: Town Centre Precinct
Ground Elevation	: 40.41 (m)	**Reviewed By**	: RM	**Location**	: Yarrabilba QLD, Australia
Total Depth	: 1.45 m BGL	**Date**	: 20/09/2024	**Loc Comment**	:

Excavator Attachment	Water	Depth (m)	DCP graph	Soil Origin	Graphic Log	Classification Code	Material Description	Moisture	Testing	Samples: 20kg CBR Samples
2m Batter Bucket	▼	0.3	2, 3, 3	Natural		SM	NATURAL Silty SAND SM loose, grey-brown, fine to medium grained, moist, trace of organics (topsoil).	M		
		0.6	3, 2, 1	Natural		SM	NATURAL Silty SAND SM loose, pale brown, fine to medium grained, moist.			
		0.7	1	Natural		SC	NATURAL Clayey SAND SC loose, medium to high plasticity clay, pale orange brown, fine to medium grained, wet to moist.	W-M		
		1	2, 3, 3	Natural		CH	NATURAL Sandy CLAY CH stiff, high plasticity, pale grey mottled pale orange brown, fine to medium grained sand, inorganic, wet to moist.			
							TP02 Terminated at 1.45m			
		2								
		3								

Water
- ▶ Water inflow
- ◀ Water outflow
- ▼ Ground water Level during drilling
- ▽ Ground water Level during drilling

Weathering
- **XW** : Extremely weathered
- **DW** : Distinctly weathered
- **HW** : Highly weathered
- **MW** : Moderately weathered
- **SW** : Slightly weathered
- **FR** : Fresh

Altering
- **XA** : Extremely alterated
- **DA** : Distinctly alterated
- **HA** : Highly alterated
- **MA** : Moderately alterated
- **SA** : Slightly alterated

Consistency
- **VS** : Very soft
- **S** : Soft
- **F** : Firm
- **St** : Stiff
- **VSt** : Very stiff
- **H** : Hard
- **FR** : Friable

Moisture
- **D** : Dry
- **M** : Moist
- **W** : Wet

Density
- **VL** : Very loose
- **L** : Loose
- **MD** : Medium dense
- **D** : Dense
- **VD** : Very dense

Rock Strength
- **VLS** : Very low
- **LS** : Low
- **MS** : Medium
- **HS** : High
- **VH** : Very high
- **XH** : Extremely high

Tests&Results
- **U50** : Undisturbed 50mm diam tube.
- **D** : Disturbed sample.
- **SPT** : Standard Penetration Test, N = number of blows to drive 50mm sampler 300mm with a 63.6kg hammer falling 762mm.
- **PP** : Hand penetrometer estimate of unconfined compressive strength, kPa.
- **S** : Vane shear value kPa.
- **DCP** : Dynamic Cone Penetrometer test.

Pacific Geotech

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Geotechnical Log - Testpit

TP03

UTM	: 56H	**Excavator**	: 35 tonne	**Job Number**	: PG-5335-G Town Centre
Latitude	: -27.818611	**Excavator Supplier**	:	**Client**	: LendLease Communities (Yarrabilba) Pty Ltd
Longitude	: 153.115278	**Logged By**	: SZTO	**Project**	: Town Centre Precinct
Ground Elevation	: 38.79 (m)	**Reviewed By**	: RM	**Location**	: Yarrabilba QLD, Australia
Total Depth	: 0.9 m BGL	**Date**	: 20/09/2024	**Loc Comment**	:

Excavator Attachment	Water	Depth (m)	DCP graph	Soil Origin	Graphic Log	Classification Code	Material Description	Moisture	Testing	Samples
2m Batter Bucket		0.2	3 2	Natural		SM	NATURAL Silty SAND SM loose, pale brown, fine to medium grained, moist, trace of organics (topsoil).	M		
		0.5	2 1 1	Natural		SM	NATURAL Silty SAND SM loose, pale brown, fine to medium grained, moist.			
			1 1 2 3	Natural		CH	NATURAL Sandy CLAY CH firm to stiff, high plasticity, pale orange brown mottled pale grey, fine to medium grained sand, inorganic, moist.			
		1 2 3	4				**TP03 Terminated at 0.9m**			

Water

- Water inflow
- Water outflow
- Ground water Level during drilling

Weathering

- **XW** : Extremely weathered
- **DW** : Distinctly weathered
- **HW** : Highly weathered
- **MW** : Moderately weathered
- **SW** : Slightly weathered
- **FR** : Fresh

Altering

- **XA** : Extremely alterated
- **DA** : Distinctly alterated
- **HA** : Highly alterated
- **MA** : Moderately alterated
- **SA** : Slightly alterated

Consistency

- **VS** : Very soft
- **S** : Soft
- **F** : Firm
- **St** : Stiff
- **VSt** : Very stiff
- **H** : Hard
- **FR** : Friable

Moisture

- **D** : Dry
- **M** : Moist
- **W** : Wet

Density

- **VL** : Very loose
- **L** : Loose
- **MD** : Medium dense
- **D** : Dense
- **VD** : Very dense

Rock Strength

- **VLS** : Very low
- **LS** : Low
- **MS** : Medium
- **HS** : High
- **VH** : Very high
- **XH** : Extremely high

Tests&Results

- **U50** : Undisturbed 50mm diam tube.
- **D** : Disturbed sample.
- **SPT** : Standard Penetration Test, N = number of blows to drive 50mm sampler 300mm with a 63.6kg hammer falling 762mm.
- **PP** : Hand penetrometer estimate of unconfined compressive strength, kPa.
- **S** : Vane shear value kPa.
- **DCP** : Dynamic Cone Penetrometer test.

Pacific Geotech

3 Jowett St, Coomera QLD 4209

Phone: (07) 5636 4680

Geotechnical Log - Testpit

TP04

UTM	: 56J	**Excavator**	: 35 tonne	**Job Number**	: PG-5335-G Town Centre
Latitude	: -27.816944	**Excavator Supplier**	:	**Client**	: LendLease Communities (Yarrabilba) Pty Ltd
Longitude	: 153.117778	**Logged By**	: SZTO	**Project**	: Town Centre Precinct
Ground Elevation	: 34.90 (m)	**Reviewed By**	: RM	**Location**	: Yarrabilba QLD, Australia
Total Depth	: 0.85 m BGL	**Date**	: 20/09/2024	**Loc Comment**	:

Excavator Attachment	Water	Depth (m)	DCP graph	Soil Origin	Graphic Log	Classification Code	Material Description	Moisture	Testing	Samples
2m Batter Bucket		0.3	2 2 1	Natural		SM	NATURAL Silty SAND SM loose, grey-brown, fine to medium grained, moist, trace of organics (topsoil).	M		
		0.55	2 1 2	Natural		SM	NATURAL Silty SAND SM loose, pale brown, fine to medium grained, moist.			
		0.8	1 2 5	Natural		CI-CH	NATURAL Silty CLAY CI-CH stiff, medium to high plasticity, pale orange brown mottled pale grey, inorganic, moist.			
		1	6	Natural		CI-CH	As above, but stiff to very stiff, pale orange brown mottled pale grey, tending xw.			
		2					**TP04 Terminated at 0.85m**			
		3								

Water

- Water inflow
- Water outflow
- Ground water Level during drilling

Weathering

- **XW** : Extremely weathered
- **DW** : Distinctly weathered
- **HW** : Highly weathered
- **MW** : Moderately weathered
- **SW** : Slightly weathered
- **FR** : Fresh

Altering

- **XA** : Extremely alterated
- **DA** : Distinctly alterated
- **HA** : Highly alterated
- **MA** : Moderately alterated
- **SA** : Slightly alterated

Consistency

- **VS** : Very soft
- **S** : Soft
- **F** : Firm
- **St** : Stiff
- **VSt** : Very stiff
- **H** : Hard
- **FR** : Friable

Moisture

- **D** : Dry
- **M** : Moist
- **W** : Wet

Density

- **VL** : Very loose
- **L** : Loose
- **MD** : Medium dense
- **D** : Dense
- **VD** : Very dense

Rock Strength

- **VLS** : Very low
- **LS** : Low
- **MS** : Medium
- **HS** : High
- **VH** : Very high
- **XH** : Extremely high

Tests&Results

- **U50** : Undisturbed 50mm diam tube.
- **D** : Disturbed sample.
- **SPT** : Standard Penetration Test, N = number of blows to drive 50mm sampler 300mm with a 63.6kg hammer falling 762mm.
- **PP** : Hand penetrometer estimate of unconfined compressive strength, kPa.
- **S** : Vane shear value kPa.
- **DCP** : Dynamic Cone Penetrometer test.

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3 Jowett St, Coomera QLD 4209

Phone: (07) 5636 4680

Geotechnical Log - Testpit

TP05

UTM	**: 56J**	**Excavator**	**: 35 tonne**	**Job Number**	**: PG-5335-G Town Centre**
Latitude	**: -27.820556**	**Excavator Supplier**	**:**	**Client**	**: LendLease Communities (Yarrabilba) Pty Ltd**
Longitude	**: 153.115833**	**Logged By**	**: SZTO**	**Project**	**: Town Centre Precinct**
Ground Elevation	**: 45.07 (m)**	**Reviewed By**	**: RM**	**Location**	**: Yarrabilba QLD, Australia**
Total Depth	**: 3.5 m BGL**	**Date**	**: 20/09/2024**	**Loc Comment**	**:**

Excavator Attachment	Water	Depth (m)	DCP graph	Soil Origin	Graphic Log	Classification Code	Material Description	Moisture	Testing	Samples
2m Batter Bucket		0.2	3 1	Alluvial		SM	ALLUVIAL Silty SAND SM loose, pale grey, fine grained, moist, on the water way.	M		
		0.4	3 4	Natural		CI	NATURAL Sandy CLAY CI stiff, medium plasticity, pale orange brown, fine grained sand, inorganic, moist.			
		0.7	15/R80	Rock		SST	Extremely weathered, ROCK Silty SAND SST dense, pale grey mottled pale orange brown, fine to medium grained, dry.	D		
Ripper		1		Rock		SST	Rock SANDSTONE highly weathered, low to medium strength, pale orange brown, fine to medium grained, distinct, dry.			
		1.5		Rock		SST	As above, but medium strength.			
		2								
		3					**TP05 refusal at 3.5m**			

Water

- Water inflow
- Water outflow
- Ground water Level during drilling

Weathering

- **XW** : Extremely weathered
- **DW** : Distinctly weathered
- **HW** : Highly weathered
- **MW** : Moderately weathered
- **SW** : Slightly weathered
- **FR** : Fresh

Altering

- **XA** : Extremely alterated
- **DA** : Distinctly alterated
- **HA** : Highly alterated
- **MA** : Moderately alterated
- **SA** : Slightly alterated

Consistency

- **VS** : Very soft
- **S** : Soft
- **F** : Firm
- **St** : Stiff
- **VSt** : Very stiff
- **H** : Hard
- **FR** : Friable

Moisture

- **D** : Dry
- **M** : Moist
- **W** : Wet

Density

- **VL** : Very loose
- **L** : Loose
- **MD** : Medium dense
- **D** : Dense
- **VD** : Very dense

Rock Strength

- **VLS** : Very low
- **LS** : Low
- **MS** : Medium
- **HS** : High
- **VH** : Very high
- **XH** : Extremely high

Tests&Results

- **U50** : Undisturbed 50mm diam tube.
- **D** : Disturbed sample.
- **SPT** : Standard Penetration Test, N = number of blows to drive 50mm sampler 300mm with a 63.6kg hammer falling 762mm.
- **PP** : Hand penetrometer estimate of unconfined compressive strength, kPa.
- **S** : Vane shear value kPa.
- **DCP** : Dynamic Cone Penetrometer test.

Pacific Geotech

3 Jowett St, Coomera QLD 4209

Phone: (07) 5636 4680

Geotechnical Log - Testpit

TP06

UTM	**: 56H**	**Excavator**	**: 35 tonne**	**Job Number**	**: PG-5335-G Town Centre**
Latitude	**: -27.818056**	**Excavator Supplier**	**:**	**Client**	**: LendLease Communities (Yarrabilba) Pty Ltd**
Longitude	**: 153.119167**	**Logged By**	**: SZTO**	**Project**	**: Town Centre Precinct**
Ground Elevation	**: 43.15 (m)**	**Reviewed By**	**: RM**	**Location**	**: Yarrabilba QLD, Australia**
Total Depth	**: 4.34 m BGL**	**Date**	**: 20/09/2024**	**Loc Comment**	**:**

Excavator Attachment	Water	Depth (m)	DCP graph	Soil Origin	Graphic Log	Classification Code	Material Description	Moisture	Testing	Samples
2m Batter Bucket		0.2	1	Natural		SM	NATURAL Silty SAND SM loose, pale grey, fine to medium grained, moist, trace of organics (topsoil).	M		
			2							
			3	Natural		SM	NATURAL Silty SAND SM loose to medium dense, pale brown, fine to medium grained, moist.			
			3							
			3							
			5							
		0.7	4							
			5	Natural		CI-CH	NATURAL Sandy CLAY CI-CH stiff, medium to high plasticity, pale orange brown, fine grained sand, inorganic, moist.			
			5							
			5							
		1	7							
			7							
			6							
			7							
			7							
			5							
			4							
			6							
			6							
		2								
		2.1		Natural		CI-CH	As above, but very stiff to hard, slightly moist, tending xw.	SLM		
		3								
		3.2								
600mm toothed bucket				Rock		SST	Extremely weathered, ROCK Silty SAND SST dense, pale orange brown, fine to medium grained, dry, can be dug with tooth bucket .	D		

Water

- Water inflow
- Water outflow
- Ground water Level during drilling

Weathering

- **XW** : Extremely weathered
- **DW** : Distinctly weathered
- **HW** : Highly weathered
- **MW** : Moderately weathered
- **SW** : Slightly weathered
- **FR** : Fresh

Altering

- **XA** : Extremely alterated
- **DA** : Distinctly alterated
- **HA** : Highly alterated
- **MA** : Moderately alterated
- **SA** : Slightly alterated

Consistency

- **VS** : Very soft
- **S** : Soft
- **F** : Firm
- **St** : Stiff
- **VSt** : Very stiff
- **H** : Hard
- **FR** : Friable

Moisture

- **D** : Dry
- **M** : Moist
- **W** : Wet

Density

- **VL** : Very loose
- **L** : Loose
- **MD** : Medium dense
- **D** : Dense
- **VD** : Very dense

Rock Strength

- **VLS** : Very low
- **LS** : Low
- **MS** : Medium
- **HS** : High
- **VH** : Very high
- **XH** : Extremely high

Tests&Results

- **U50** : Undisturbed 50mm diam tube.
- **D** : Disturbed sample.
- **SPT** : Standard Penetration Test, N = number of blows to drive 50mm sampler 300mm with a 63.6kg hammer falling 762mm.
- **PP** : Hand penetrometer estimate of unconfined compressive strength, kPa.
- **S** : Vane shear value kPa.
- **DCP** : Dynamic Cone Penetrometer test.

Pacific Geotech

3 Jowett St, Coomera QLD 4209

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Geotechnical Log - Testpit

TP06

UTM	: 56H	**Excavator**	: 35 tonne	**Job Number**	: PG-5335-G Town Centre
Latitude	: -27.818056	**Excavator Supplier**	:	**Client**	: LendLease Communities (Yarrabilba) Pty Ltd
Longitude	: 153.119167	**Logged By**	: SZTO	**Project**	: Town Centre Precinct
Ground Elevation	: 43.15 (m)	**Reviewed By**	: RM	**Location**	: Yarrabilba QLD, Australia
Total Depth	: 4.34 m BGL	**Date**	: 20/09/2024	**Loc Comment**	:

Excavator Attachment	Water	Depth (m)	DCP graph	Soil Origin	Graphic Log	Classification Code	Material Description	Moisture	Testing	Samples
600mm toothed bucket				Rock		SST	Extremely weathered, ROCK Silty SAND SST dense, pale orange brown, fine to medium grained, dry, can be dug with tooth bucket .	D		
		5					**TP06 Terminated at 4.34m**			
		6								
		7								

Water

- Water inflow
- Water outflow
- Ground water Level during drilling

Weathering

- XW : Extremely weathered
- DW : Distinctly weathered
- HW : Highly weathered
- MW : Moderately weathered
- SW : Slightly weathered
- FR : Fresh

Altering

- XA : Extremely alterated
- DA : Distinctly alterated
- HA : Highly alterated
- MA : Moderately alterated
- SA : Slightly alterated

Consistency

- VS : Very soft
- S : Soft
- F : Firm
- St : Stiff
- VSt : Very stiff
- H : Hard
- FR : Friable

Moisture

- D : Dry
- M : Moist
- W : Wet

Density

- VL : Very loose
- L : Loose
- MD : Medium dense
- D : Dense
- VD : Very dense

Rock Strength

- VLS : Very low
- LS : Low
- MS : Medium
- HS : High
- VH : Very high
- XH : Extremely high

Tests&Results

- U50 : Undisturbed 50mm diam tube.
- D : Disturbed sample.
- SPT : Standard Penetration Test, N = number of blows to drive 50mm sampler 300mm with a 63.6kg hammer falling 762mm.
- PP : Hand penetrometer estimate of unconfined compressive strength, kPa.
- S : Vane shear value kPa.
- DCP : Dynamic Cone Penetrometer test.

Pacific Geotech

3 Jowett St, Coomera QLD 4209

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Geotechnical Log - Testpit

TP07

UTM	**: 56J**	**Excavator**	**: 35 tonne**	**Job Number**	**: PG-5335-G Town Centre**
Latitude	**: -27.820556**	**Excavator Supplier**	**: Golding**	**Client**	**: LendLease Communities (Yarrabilba) Pty Ltd**
Longitude	**: 153.121389**	**Logged By**	**: SZTO**	**Project**	**: Town Centre Precinct**
Ground Elevation	**: 43.67 (m)**	**Reviewed By**	**: RM**	**Location**	**: Yarrabilba QLD, Australia**
Total Depth	**: 4.2 m BGL**	**Date**	**: 20/09/2024**	**Loc Comment**	**:**

Excavator Attachment	Water	Depth (m)	DCP graph	Soil Origin	Graphic Log	Classification Code	Material Description	Moisture	Testing	Samples
2m Batter Bucket		0.3	8 7 4	Natural		SM	NATURAL Silty SAND SM loose, pale grey-brown, fine to medium grained, moist, topsoil .	M		
			4 4 8/R90	Natural		CI-CH	NATURAL Sandy CLAY CI-CH stiff, medium to high plasticity, pale orange brown, fine to medium grained sand, with fine sized gravel, inorganic, moist, tending xw.			
Ripper		0.8 1 1.1 2 3		Rock		SST	Rock SANDSTONE distinctly weathered, low to medium strength, red brown, fine to medium grained, dry.	D		
				Rock		SST	Rock SANDSTONE highly weathered, medium strength, red brown mottled pale grey, medium grained.			

Water

- Water inflow
- Water outflow
- Ground water Level during drilling

Weathering

- **XW** : Extremely weathered
- **DW** : Distinctly weathered
- **HW** : Highly weathered
- **MW** : Moderately weathered
- **SW** : Slightly weathered
- **FR** : Fresh

Altering

- **XA** : Extremely alterated
- **DA** : Distinctly alterated
- **HA** : Highly alterated
- **MA** : Moderately alterated
- **SA** : Slightly alterated

Consistency

- **VS** : Very soft
- **S** : Soft
- **F** : Firm
- **St** : Stiff
- **VSt** : Very stiff
- **H** : Hard
- **FR** : Friable

Moisture

- **D** : Dry
- **M** : Moist
- **W** : Wet

Density

- **VL** : Very loose
- **L** : Loose
- **MD** : Medium dense
- **D** : Dense
- **VD** : Very dense

Rock Strength

- **VLS** : Very low
- **LS** : Low
- **MS** : Medium
- **HS** : High
- **VH** : Very high
- **XH** : Extremely high

Tests&Results

- **U50** : Undisturbed 50mm diam tube.
- **D** : Disturbed sample.
- **SPT** : Standard Penetration Test, N = number of blows to drive 50mm sampler 300mm with a 63.6kg hammer falling 762mm.
- **PP** : Hand penetrometer estimate of unconfined compressive strength, kPa.
- **S** : Vane shear value kPa.
- **DCP** : Dynamic Cone Penetrometer test.

Pacific Geotech

3 Jowett St, Coomera QLD 4209

Phone: (07) 5636 4680

Geotechnical Log - Testpit

TP07

UTM	: 56J	**Excavator**	: 35 tonne	**Job Number**	: PG-5335-G Town Centre
Latitude	: -27.820556	**Excavator Supplier**	: Golding	**Client**	: LendLease Communities (Yarrabilba) Pty Ltd
Longitude	: 153.121389	**Logged By**	: SZTO	**Project**	: Town Centre Precinct
Ground Elevation	: 43.67 (m)	**Reviewed By**	: RM	**Location**	: Yarrabilba QLD, Australia
Total Depth	: 4.2 m BGL	**Date**	: 20/09/2024	**Loc Comment**	:

Excavator Attachment	Water	Depth (m)	DCP graph	Soil Origin	Graphic Log	Classification Code	Material Description	Moisture	Testing	Samples
Ripper				Rock		SST	Rock SANDSTONE highly weathered, medium strength, red brown mottled pale grey, medium grained.			
							TP07 refusal at 4.2m			

5

6

7

Water

- Water inflow
- Water outflow
- Ground water Level during drilling

Weathering

- **XW** : Extremely weathered
- **DW** : Distinctly weathered
- **HW** : Highly weathered
- **MW** : Moderately weathered
- **SW** : Slightly weathered
- **FR** : Fresh

Altering

- **XA** : Extremely alterated
- **DA** : Distinctly alterated
- **HA** : Highly alterated
- **MA** : Moderately alterated
- **SA** : Slightly alterated

Consistency

- **VS** : Very soft
- **S** : Soft
- **F** : Firm
- **St** : Stiff
- **VSt** : Very stiff
- **H** : Hard
- **FR** : Friable

Moisture

- **D** : Dry
- **M** : Moist
- **W** : Wet

Density

- **VL** : Very loose
- **L** : Loose
- **MD** : Medium dense
- **D** : Dense
- **VD** : Very dense

Rock Strength

- **VLS** : Very low
- **LS** : Low
- **MS** : Medium
- **HS** : High
- **VH** : Very high
- **XH** : Extremely high

Tests&Results

- **U50** : Undisturbed 50mm diam tube.
- **D** : Disturbed sample.
- **SPT** : Standard Penetration Test, N = number of blows to drive 50mm sampler 300mm with a 63.6kg hammer falling 762mm.
- **PP** : Hand penetrometer estimate of unconfined compressive strength, kPa.
- **S** : Vane shear value kPa.
- **DCP** : Dynamic Cone Penetrometer test.

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Geotechnical Log - Testpit

TP08

UTM	: 56J	**Excavator**	: 35 tonne	**Job Number**	: PG-5335-G Town Centre
Latitude	: -27.823056	**Excavator Supplier**	: Golding	**Client**	: LendLease Communities (Yarrabilba) Pty Ltd
Longitude	: 153.122222	**Logged By**	: SZTO	**Project**	: Town Centre Precinct
Ground Elevation	: 31.24 (m)	**Reviewed By**	: RM	**Location**	: Yarrabilba QLD, Australia
Total Depth	: 1.15 m BGL	**Date**	: 20/09/2024	**Loc Comment**	:

Excavator Attachment	Water	Depth (m)	DCP graph	Soil Origin	Graphic Log	Classification Code	Material Description	Moisture	Testing	Samples
2m Batter Bucket	▼	0.3	1 1 1	Natural		SM	NATURAL Silty SAND SM loose, pale brown, fine to medium grained, moist, topsoil .	M		
			0 1 1 1	Natural		SM	NATURAL Silty SAND SM medium dense, pale grey-brown, fine to medium grained, wet to moist, running sand.	W-M		
		0.7	5 6 3 3 4	Natural		CL-CI	NATURAL Sandy CLAY CL-CI stiff, low to medium plasticity, pale grey mottled pale orange brown, fine to medium grained sand, inorganic, wet.	W		
		1								
			4 8 9				**TP08 Terminated at 1.15m**			
		2								
		3								

Water

- Water inflow
- Water outflow
- Ground water Level during drilling

Weathering

- **XW** : Extremely weathered
- **DW** : Distinctly weathered
- **HW** : Highly weathered
- **MW** : Moderately weathered
- **SW** : Slightly weathered
- **FR** : Fresh

Altering

- **XA** : Extremely alterated
- **DA** : Distinctly alterated
- **HA** : Highly alterated
- **MA** : Moderately alterated
- **SA** : Slightly alterated

Consistency

- **VS** : Very soft
- **S** : Soft
- **F** : Firm
- **St** : Stiff
- **VSt** : Very stiff
- **H** : Hard
- **FR** : Friable

Moisture

- **D** : Dry
- **M** : Moist
- **W** : Wet

Density

- **VL** : Very loose
- **L** : Loose
- **MD** : Medium dense
- **D** : Dense
- **VD** : Very dense

Rock Strength

- **VLS** : Very low
- **LS** : Low
- **MS** : Medium
- **HS** : High
- **VH** : Very high
- **XH** : Extremely high

Tests&Results

- **U50** : Undisturbed 50mm diam tube.
- **D** : Disturbed sample.
- **SPT** : Standard Penetration Test, N = number of blows to drive 50mm sampler 300mm with a 63.6kg hammer falling 762mm.
- **PP** : Hand penetrometer estimate of unconfined compressive strength, kPa.
- **S** : Vane shear value kPa.
- **DCP** : Dynamic Cone Penetrometer test.

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Geotechnical Log - Testpit

TP09

UTM	: 56J	**Excavator**	: 35 tonne	**Job Number**	: PG-5335-G Town Centre
Latitude	: -27.824444	**Excavator Supplier**	: Golding	**Client**	: LendLease Communities (Yarrabilba) Pty Ltd
Longitude	: 153.120556	**Logged By**	: SZTO	**Project**	: Town Centre Precinct
Ground Elevation	: 38.70 (m)	**Reviewed By**	: RM	**Location**	: Yarrabilba QLD, Australia
Total Depth	: 4.9 m BGL	**Date**	: 20/09/2024	**Loc Comment**	:

Excavator Attachment	Water	Depth (m)	DCP graph	Soil Origin	Graphic Log	Classification Code	Material Description	Moisture	Testing	Samples: 20kg CBR Samples
2m Batter Bucket		0.2	3 2	Natural		SM	NATURAL Silty SAND SM loose, pale grey-brown, fine to medium grained, moist, topsoil .	M		
		0.5	2 1 3	Natural		SM	NATURAL Silty SAND SM medium dense, brown, fine to medium grained, moist.			
		1	2 2 2 3 2 2 3 2 10 15/R50	Natural		CH	NATURAL Sandy to silty CLAY CH stiff, high plasticity, pale orange brown, fine to medium grained sand, inorganic, moist.			
		2		Rock		SST	Extremely weathered, ROCK Silty SAND SST dense, pale grey, fine to medium grained.	D		
Ripper		2.4 3		Rock		SST	Rock SANDSTONE highly weathered, medium strength, pale orange brown mottled pale grey, fine to medium grained, dry, needs ripper.			

Water

- Water inflow
- Water outflow
- Ground water Level during drilling

Weathering

- **XW** : Extremely weathered
- **DW** : Distinctly weathered
- **HW** : Highly weathered
- **MW** : Moderately weathered
- **SW** : Slightly weathered
- **FR** : Fresh

Altering

- **XA** : Extremely alterated
- **DA** : Distinctly alterated
- **HA** : Highly alterated
- **MA** : Moderately alterated
- **SA** : Slightly alterated

Consistency

- **VS** : Very soft
- **S** : Soft
- **F** : Firm
- **St** : Stiff
- **VSt** : Very stiff
- **H** : Hard
- **FR** : Friable

Moisture

- **D** : Dry
- **M** : Moist
- **W** : Wet

Density

- **VL** : Very loose
- **L** : Loose
- **MD** : Medium dense
- **D** : Dense
- **VD** : Very dense

Rock Strength

- **VLS** : Very low
- **LS** : Low
- **MS** : Medium
- **HS** : High
- **VH** : Very high
- **XH** : Extremely high

Tests&Results

- **U50** : Undisturbed 50mm diam tube.
- **D** : Disturbed sample.
- **SPT** : Standard Penetration Test, N = number of blows to drive 50mm sampler 300mm with a 63.6kg hammer falling 762mm.
- **PP** : Hand penetrometer estimate of unconfined compressive strength, kPa.
- **S** : Vane shear value kPa.
- **DCP** : Dynamic Cone Penetrometer test.

Pacific Geotech

3 Jowett St, Coomera QLD 4209

Phone: (07) 5636 4680

Geotechnical Log - Testpit

TP09

UTM	: 56J	**Excavator**	: 35 tonne	**Job Number**	: PG-5335-G Town Centre
Latitude	: -27.824444	**Excavator Supplier**	: Golding	**Client**	: LendLease Communities (Yarrabilba) Pty Ltd
Longitude	: 153.120556	**Logged By**	: SZTO	**Project**	: Town Centre Precinct
Ground Elevation	: 38.70 (m)	**Reviewed By**	: RM	**Location**	: Yarrabilba QLD, Australia
Total Depth	: 4.9 m BGL	**Date**	: 20/09/2024	**Loc Comment**	:

Excavator Attachment	Water	Depth (m)	DCP graph	Soil Origin	Graphic Log	Classification Code	Material Description	Moisture	Testing	Samples: 20kg CBR Samples
Ripper				Rock		SST	Rock SANDSTONE highly weathered, medium strength, pale orange brown mottled pale grey, fine to medium grained, dry, needs ripper.			
		5					**TP09 refusal at 4.9m**			
		6								
		7								

Water

- Water inflow
- Water outflow
- Ground water Level during drilling

Weathering

- **XW** : Extremely weathered
- **DW** : Distinctly weathered
- **HW** : Highly weathered
- **MW** : Moderately weathered
- **SW** : Slightly weathered
- **FR** : Fresh

Altering

- **XA** : Extremely alterated
- **DA** : Distinctly alterated
- **HA** : Highly alterated
- **MA** : Moderately alterated
- **SA** : Slightly alterated

Consistency

- **VS** : Very soft
- **S** : Soft
- **F** : Firm
- **St** : Stiff
- **VSt** : Very stiff
- **H** : Hard
- **FR** : Friable

Moisture

- **D** : Dry
- **M** : Moist
- **W** : Wet

Density

- **VL** : Very loose
- **L** : Loose
- **MD** : Medium dense
- **D** : Dense
- **VD** : Very dense

Rock Strength

- **VLS** : Very low
- **LS** : Low
- **MS** : Medium
- **HS** : High
- **VH** : Very high
- **XH** : Extremely high

Tests&Results

- **U50** : Undisturbed 50mm diam tube.
- **D** : Disturbed sample.
- **SPT** : Standard Penetration Test, N = number of blows to drive 50mm sampler 300mm with a 63.6kg hammer falling 762mm.
- **PP** : Hand penetrometer estimate of unconfined compressive strength, kPa.
- **S** : Vane shear value kPa.
- **DCP** : Dynamic Cone Penetrometer test.

Pacific Geotech

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Geotechnical Log - Testpit

TP10

UTM	: 56J	**Excavator**	: 35 tonne	**Job Number**	: PG-5335-G Town Centre
Latitude	: -27.822778	**Excavator Supplier**	:	**Client**	: LendLease Communities (Yarrabilba) Pty Ltd
Longitude	: 153.106111	**Logged By**	: SZTO	**Project**	: Town Centre Precinct
Ground Elevation	: 56.81 (m)	**Reviewed By**	: RM	**Location**	: Yarrabilba QLD, Australia
Total Depth	: 1.2 m BGL	**Date**	: 20/09/2024	**Loc Comment**	:

Excavator Attachment	Water	Depth (m)	DCP graph	Soil Origin	Graphic Log	Classification Code	Material Description	Moisture	Testing	Samples
2m Batter Bucket		0.25	6 7 4	Natural		SM	NATURAL Silty SAND SM medium dense, pale grey, fine to medium grained, moist to dry, trace of organics (topsoil).	M-D		
		0.7	2 1 1 2	Natural		SM	NATURAL Silty SAND SM loose, pale brown, fine to medium grained, moist.	M		
		0.9	0 1	Natural		SC	NATURAL Clayey SAND SC medium dense, medium plasticity clay, pale grey mottled pale orange brown, fine to medium grained, with fine to medium sized gravel, moist to dry, tending xw.	M-D		
		1 1.1	2 2	Natural		CI	NATURAL Sandy CLAY CI stiff, medium plasticity, pale orange brown, fine to medium grained sand, inorganic, moist to dry.			
			2	Rock		SST	Extremely weathered, ROCK Silty SAND SST medium dense, pale orange brown mottled pale grey, fine to medium grained.	D		
		2 3	2 7 10 16/R10				**TP10 Terminated at 1.2m**			

Water

- Water inflow
- Water outflow
- Ground water Level during drilling

Weathering

- **XW** : Extremely weathered
- **DW** : Distinctly weathered
- **HW** : Highly weathered
- **MW** : Moderately weathered
- **SW** : Slightly weathered
- **FR** : Fresh

Altering

- **XA** : Extremely alterated
- **DA** : Distinctly alterated
- **HA** : Highly alterated
- **MA** : Moderately alterated
- **SA** : Slightly alterated

Consistency

- **VS** : Very soft
- **S** : Soft
- **F** : Firm
- **St** : Stiff
- **VSt** : Very stiff
- **H** : Hard
- **FR** : Friable

Moisture

- **D** : Dry
- **M** : Moist
- **W** : Wet

Density

- **VL** : Very loose
- **L** : Loose
- **MD** : Medium dense
- **D** : Dense
- **VD** : Very dense

Rock Strength

- **VLS** : Very low
- **LS** : Low
- **MS** : Medium
- **HS** : High
- **VH** : Very high
- **XH** : Extremely high

Tests&Results

- **U50** : Undisturbed 50mm diam tube.
- **D** : Disturbed sample.
- **SPT** : Standard Penetration Test, N = number of blows to drive 50mm sampler 300mm with a 63.6kg hammer falling 762mm.
- **PP** : Hand penetrometer estimate of unconfined compressive strength, kPa.
- **S** : Vane shear value kPa.
- **DCP** : Dynamic Cone Penetrometer test.

Pacific Geotech

3 Jowett St, Coomera QLD 4209

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Geotechnical Log - Testpit

TP11

UTM	: 56J	**Excavator**	: 35 tonne	**Job Number**	: PG-5335-G Town Centre
Latitude	: -27.825000	**Excavator Supplier**	: Golding	**Client**	: LendLease Communities (Yarrabilba) Pty Ltd
Longitude	: 153.122222	**Logged By**	: SZTO	**Project**	: Town Centre Precinct
Ground Elevation	: 31.68 (m)	**Reviewed By**	: RM	**Location**	: Yarrabilba QLD, Australia
Total Depth	: 1.5 m BGL	**Date**	: 20/09/2024	**Loc Comment**	:

Excavator Attachment	Water	Depth (m)	DCP graph	Soil Origin	Graphic Log	Classification Code	Material Description	Moisture	Testing	Samples
2m Batter Bucket		0.3	2 2 2	Natural		SM	NATURAL Silty SAND SM loose, brown, fine to medium grained, moist, topsoil .	M		
		0.75	2 1 1 1 0	Natural		SM	NATURAL Silty SAND SM loose, pale grey-brown, fine to medium grained, moist.			
		1	0 0 2	Natural		CH	NATURAL Sandy CLAY CH stiff to very stiff, high plasticity, red brown mottled pale grey, inorganic, moist.			
	▼	1.1	1 2 2 2 2	Natural		CH	As above, but tending xw water in @ 1.45.			
		2	3 6				**TP11 Terminated at 1.5m**			
		3								

Water

- Water inflow
- Water outflow
- Ground water Level during drilling

Weathering

- **XW** : Extremely weathered
- **DW** : Distinctly weathered
- **HW** : Highly weathered
- **MW** : Moderately weathered
- **SW** : Slightly weathered
- **FR** : Fresh

Altering

- **XA** : Extremely alterated
- **DA** : Distinctly alterated
- **HA** : Highly alterated
- **MA** : Moderately alterated
- **SA** : Slightly alterated

Consistency

- **VS** : Very soft
- **S** : Soft
- **F** : Firm
- **St** : Stiff
- **VSt** : Very stiff
- **H** : Hard
- **FR** : Friable

Moisture

- **D** : Dry
- **M** : Moist
- **W** : Wet

Density

- **VL** : Very loose
- **L** : Loose
- **MD** : Medium dense
- **D** : Dense
- **VD** : Very dense

Rock Strength

- **VLS** : Very low
- **LS** : Low
- **MS** : Medium
- **HS** : High
- **VH** : Very high
- **XH** : Extremely high

Tests&Results

- **U50** : Undisturbed 50mm diam tube.
- **D** : Disturbed sample.
- **SPT** : Standard Penetration Test, N = number of blows to drive 50mm sampler 300mm with a 63.6kg hammer falling 762mm.
- **PP** : Hand penetrometer estimate of unconfined compressive strength, kPa.
- **S** : Vane shear value kPa.
- **DCP** : Dynamic Cone Penetrometer test.

APPENDIX C

LABORATORY TEST CERTIFICATES

Pacific Geotech
Consulting Geotechnical Engineers

SOIL REPORT				
CLIENT:	Lendlease Communities	PROJECT NUMBER:	PH-5335-G	
ADDRESS:	Wongawallam Drive, Yarrabilba	REPORT NUMBER:	E24-567	Rev. No.0
PROJECT NAME:	Town Centre Precinct	REPORT DATE:	2.10.24	

SAMPLE LOCATION	
SAMPLING METHOD:	Disturbed
SAMPLED BY:	Pacific Geotech
DATE SAMPLED:	20.9.24
DATE RECEIVED:	2.9.24
DATE TESTED:	2.9.24
TEST METHOD:	ENV04, ENV05 & AS 1289.3.8.1

Lab Ref No	Sample	Depth	Electrical Conductivity (uS/cm)	pH	Emerson Class
E24-567-1	TP01	0.5-0.6	18	5.7	2
E24-567-2	TP02	0.7-0.8	22	5.7	2
E24-567-3	TP09	0.65-0.75	16	5.4	5
LOR			10	0.1	-

Electrical Conductivity and pH results are derived from a 1:5 soil:water extract.

Pacific Geotech accepts no responsibilty for the collection and transport of samples submitted by external parties.
Measurement uncertainty data is available upon request. LOR denotes Limit of Reporting
All samples are analysed on an as received basis and the results in rhis report pertain only to the sample submitted.
This report supercedes any previous report(s) issued with this reference number. This document shall not be reproduced except in full.

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Form ER019.1

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ABN: 62 615 248 952

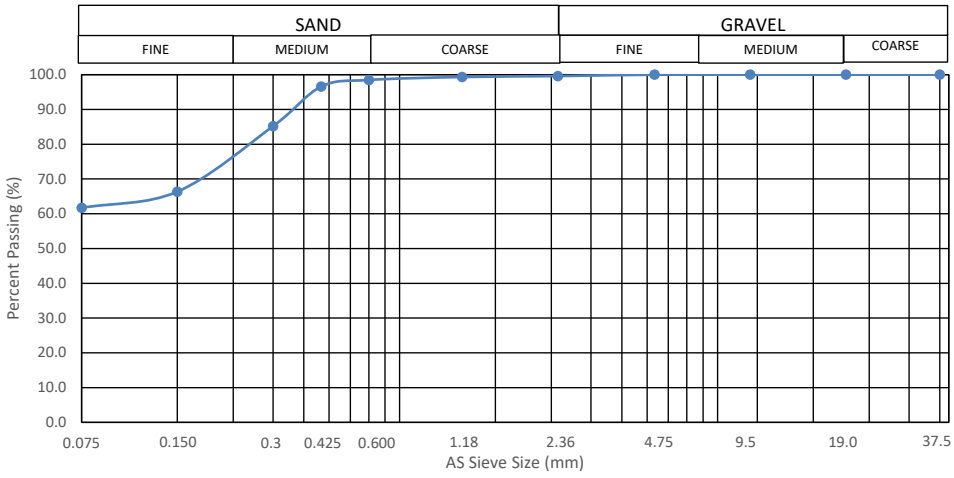
Pacific Geotech
Consulting Geotechnical Engineers

Quality of Material Report

Client:	LendLease Communities (Yarrabilba) Pty Ltd	Project Number:	PG-5335-G
Client Address:	c/o 3 Jowett Street, Coomera Qld 4209	Report Number:	PG-5335-G-TP01-0.5-0.6-QOM
Project Address:	Wongawallam Drive, Yarrabilba	Report Date:	9/10/2024
Project Name:	Town Centre Precinct	Test Method:	AS1289.3.1.2, 3.2.1, 3.3.1, 3.4.1, 3.6.1 & 2.1.1

SAMPLE LOCATION:	**TP01, 0.5-0.6m, BULK**
SAMPLE NUMBER:	24-2178
SAMPLING METHOD:	SAMPLE AS SUPPLIED
SAMPLED BY:	PACIFIC GEOTECH
DATE SAMPLED:	20/09/2024
DATE TESTED:	8/10/2024
MATERIAL TYPE:	**Sandy CLAY**

PARTICLE SIZE DISTRIBUTION / GRADING		**ATTERBERG / WPI**		
AS Sieve Size (mm):	**Percent Passing (%):**	**Test Type**		**Result**
37.5	**100**	**Liquid Limit (%):**		**73**
19.0	**100**	**Plastic Limit (%):**		**29**
9.5	**100**	**Plasticity Index (%):**		**44**
4.75	**100**	**Linear Shrinkage (%):**		**19.5**
2.36	**100**	Mould Length (mm):		122
1.18	**99**	Cracking:		None
0.600	**98**	Crumbling or Curling:		None
0.425	**97**			
0.300	**85**	**WPI**	**Weighted Plasticity Index PI X % Passing 0.425mm**	**4248**
0.150	**66**			
0.075	**62**			



NATA WORLD RECOGNISED ACCREDITATION	**Accredited for Compliance with ISO/IEC 17025 - Testing** **Pacific Geotech Pty Ltd - Accreditation No. 21130** **Gold Coast Laboratory - Site No. 25487**	**Approved Signatory** **Ian Masman** **Laboratory Manager**	bsi ISO 9001 Quality Management Systems CERTIFIED

Report Remarks:

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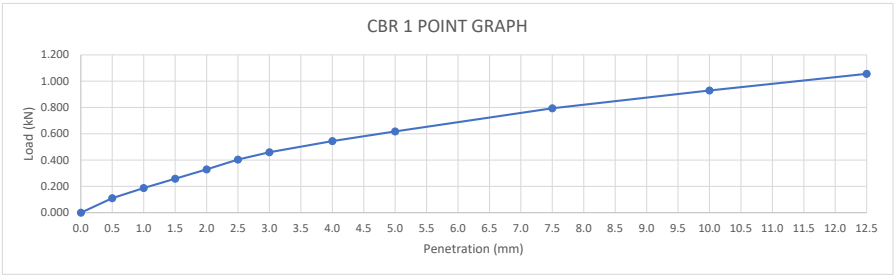
CALIFORNIA BEARING RATIO REPORT (1 POINT)

CLIENT:	Lend Lease Communities (Yarrabilba)	PROJECT NUMBER:	PG - 5335-G
CLIENT ADDRESS:	c/o 3 Jowett Street, Coomera QLD 4209	REPORT NUMBER:	PG-5335-G-TP01-CBR
PROJECT NAME:	Town Centre Precinct	REPORT DATE:	9/10/2024
PROJECT ADDRESS:	Wongawallan Drive, Yarrabilba	TEST METHOD:	AS 1289.6.1.1

SAMPLE LOCATION:	**TP 01 (0.5m-0.6m)**
SAMPLE NUMBER:	24-2178
SAMPLING METHOD:	AS SUPPLIED
SAMPLED BY:	PACIFIC GEOTECH
DATE SAMPLED:	20/09/2024
DATE TESTED:	4/10/2024
PREPERATION METHOD:	AS 1289.1.1
MOISTURE CONTENT METHOD:	AS1289.2.1.1
MATERIAL TYPE:	Sandy Clay, Orange/Brown

MAXIMUM DRY DENSITY (t/m³):	1.46
OPTIMUM MOISTURE CONTENT (%):	28.3
COMPACTIVE EFFORT:	Standard
COMPACTION METHOD:	AS1289.5.1.1
LABORATORY DENSITY RATIO:	100.0
LABORATORY MOISTURE RATIO:	99.0
DRY DENSITY BEFORE SOAK (t/m³):	1.46
DRY DENSITY AFTER SOAK (t/m³):	1.46
FIELD MOISTURE CONTENT:	26.5
MOISTURE CONTENT AT COMPACTION BEFORE SOAK (%):	28.0
MOISTURE CONTENT OF TOP 30mm AFTER PENETRATION (%):	31.0
MOISTURE CONTENT REST OF SAMPLE AFTER PENETRATION (%):	29.5
SWELL (%):	2.0
CBR SURCHARGE (Kg):	4.5
SOAKING PERIOD (Days):	4
CURING TIME (Hours):	66
PERCENTAGE OVERSIZE MATERIAL RETAINED ON 19mm SIEVE (%):	0
METHOD OF ESTABLISHING PLASTICITY:	Visual/Tactile Assessment

CBR 2.5mm (%):	3.0
CBR 5mm (%):	3.0
CBR VALUE (%):	**3.0**



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Pacific Geotech Pty Ltd - Accreditation No. 21130

Gold Coast Laboratory - Site No. 25487

Approved Signatory

Ian Masman
Laboratory Manager

bsi ISO 9001 Quality Management Systems CERTIFIED

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Pacific Geotech
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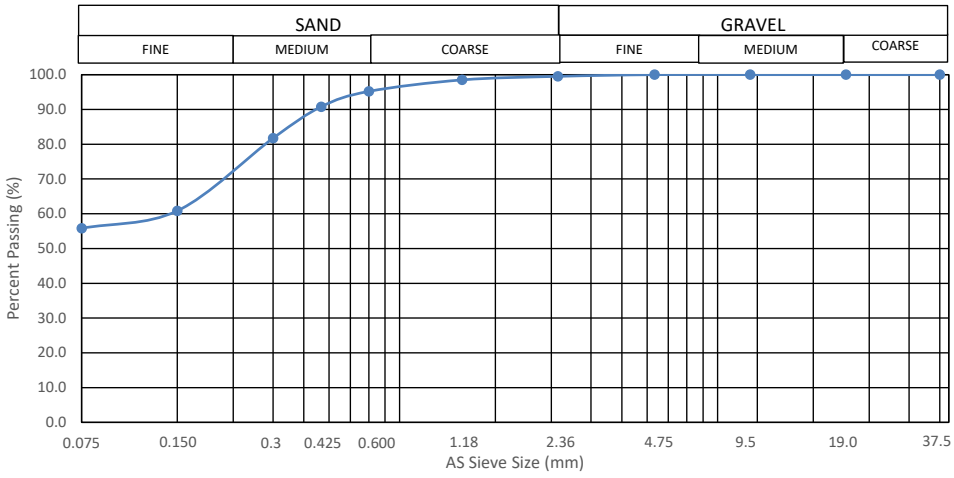
Quality of Material Report

Client:	LendLease Communities (Yarrabilba) Pty Ltd	Project Number:	PG-5335-G
Client Address:	c/o 3 Jowett Street, Coomera Qld 4209	Report Number:	PG-5335-G-TP02-0.7-0.8-QOM
Project Address:	Wongawallam Drive, Yarrabilba	Report Date:	9/10/2024
Project Name:	Town Centre Precinct	Test Method:	AS1289.3.1.2, 3.2.1, 3.3.1, 3.4.1, 3.6.1 & 2.1.1

SAMPLE LOCATION:	**TP02, 0.7-0.8m, BULK**
SAMPLE NUMBER:	24-2179
SAMPLING METHOD:	SAMPLE AS SUPPLIED
SAMPLED BY:	PACIFIC GEOTECH
DATE SAMPLED:	20/09/2024
DATE TESTED:	8/10/2024
MATERIAL TYPE:	**Sandy CLAY**

PARTICLE SIZE DISTRIBUTION / GRADING	
AS Sieve Size (mm):	**Percent Passing (%):**
37.5	**100**
19.0	**100**
9.5	**100**
4.75	**100**
2.36	**100**
1.18	**98**
0.600	**95**
0.425	**91**
0.300	**82**
0.150	**61**
0.075	**56**

ATTERBERG / WPI		
Test Type		**Result**
Liquid Limit (%):		**68**
Plastic Limit (%):		**22**
Plasticity Index (%):		**46**
Linear Shrinkage (%):		**19.5**
Mould Length (mm):		121
Cracking:		None
Crumbling or Curling:		None
WPI	**Weighted Plasticity Index PI X % Passing 0.425mm**	**4176**



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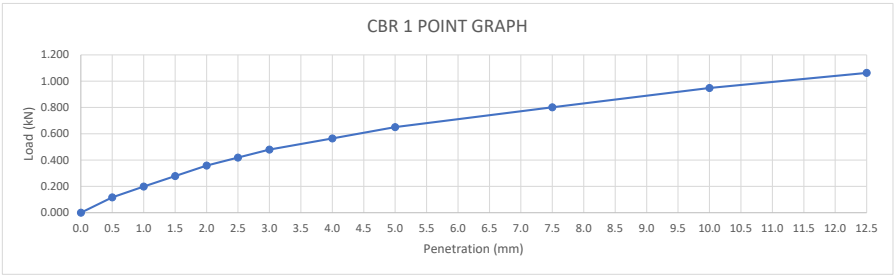
CALIFORNIA BEARING RATIO REPORT (1 POINT)

CLIENT:	Lend Lease Communities (Yarrabilba)	PROJECT NUMBER:	PG - 5335-G
CLIENT ADDRESS:	c/o 3 Jowett Street, Coomera QLD 4209	REPORT NUMBER:	PG-5335-G-TP02-CBR
PROJECT NAME:	Town Centre Precinct	REPORT DATE:	9/10/2024
PROJECT ADDRESS:	Wongawallan Drive, Yarrabilba	TEST METHOD:	AS 1289.6.1.1

SAMPLE LOCATION:	**TP 02 (0.7m-0.8m)**
SAMPLE NUMBER:	24-2179
SAMPLING METHOD:	AS SUPPLIED
SAMPLED BY:	PACIFIC GEOTECH
DATE SAMPLED:	20/09/2024
DATE TESTED:	4/10/2024
PREPERATION METHOD:	AS 1289.1.1
MOISTURE CONTENT METHOD:	AS1289.2.1.1
MATERIAL TYPE:	Sandy Clay, Grey/Brown

MAXIMUM DRY DENSITY (t/m³):	1.56
OPTIMUM MOISTURE CONTENT (%):	23.8
COMPACTIVE EFFORT:	Standard
COMPACTION METHOD:	AS1289.5.1.1
LABORATORY DENSITY RATIO:	100.0
LABORATORY MOISTURE RATIO:	99.0
DRY DENSITY BEFORE SOAK (t/m³):	1.56
DRY DENSITY AFTER SOAK (t/m³):	1.56
FIELD MOISTURE CONTENT:	20.7
MOISTURE CONTENT AT COMPACTION BEFORE SOAK (%):	23.5
MOISTURE CONTENT OF TOP 30mm AFTER PENETRATION (%):	26.5
MOISTURE CONTENT REST OF SAMPLE AFTER PENETRATION (%):	25.2
SWELL (%):	2.0
CBR SURCHARGE (Kg):	4.5
SOAKING PERIOD (Days):	4
CURING TIME (Hours):	67
PERCENTAGE OVERSIZE MATERIAL RETAINED ON 19mm SIEVE (%):	0
METHOD OF ESTABLISHING PLASTICITY:	Visual/Tactile Assessment

CBR 2.5mm (%):	3.0
CBR 5mm (%):	3.5
CBR VALUE (%):	**3.5**



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Gold Coast Laboratory - Site No. 25487

Approved Signatory

Ian Masman
Laboratory Manager

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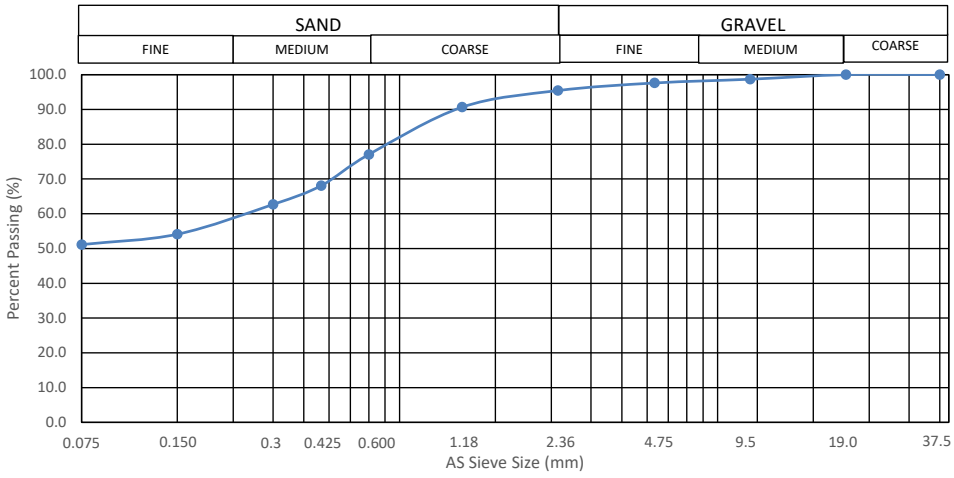
Quality of Material Report

Client:	LendLease Communities (Yarrabilba) Pty Ltd	Project Number:	PG-5335-G
Client Address:	c/o 3 Jowett Street, Coomera Qld 4209	Report Number:	PG-5335-G-TP09-0.65-0.75-QOM
Project Address:	Wongawallam Drive, Yarrabilba	Report Date:	9/10/2024
Project Name:	Town Centre Precinct	Test Method:	AS1289.3.1.2, 3.2.1, 3.3.1, 3.4.1, 3.6.1 & 2.1.1

SAMPLE LOCATION:	**TP09, 0.65-0.75m, BULK**
SAMPLE NUMBER:	24-2180
SAMPLING METHOD:	SAMPLE AS SUPPLIED
SAMPLED BY:	PACIFIC GEOTECH
DATE SAMPLED:	20/09/2024
DATE TESTED:	8/10/2024
MATERIAL TYPE:	**Sandy CLAY, trace of gravel**

PARTICLE SIZE DISTRIBUTION / GRADING		**ATTERBERG / WPI**		
AS Sieve Size (mm):	**Percent Passing (%):**	**Test Type**		**Result**
37.5	**100**	**Liquid Limit (%):**		**83**
19.0	**100**	**Plastic Limit (%):**		**37**
9.5	**99**	**Plasticity Index (%):**		**46**
4.75	**98**	**Linear Shrinkage (%):**		**22**
2.36	**95**	Mould Length (mm):		125
1.18	**91**	Cracking:		None
0.600	**77**	Crumbling or Curling:		None
0.425	**68**			
0.300	**63**	**WPI**	**Weighted Plasticity Index PI X % Passing 0.425mm**	**3132**
0.150	**54**			
0.075	**51**			



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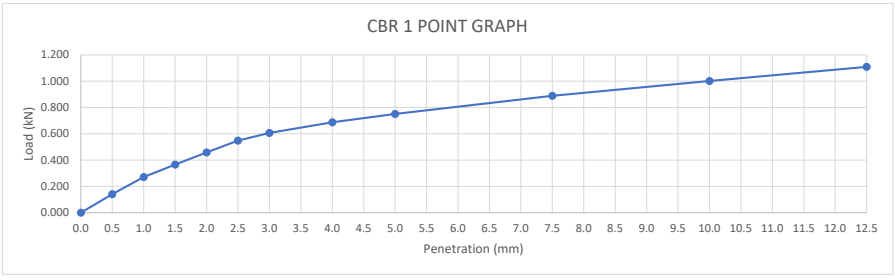
CALIFORNIA BEARING RATIO REPORT (1 POINT)

CLIENT:	Lend Lease Communities (Yarrabilba)	PROJECT NUMBER:	PG - 5335-G
CLIENT ADDRESS:	c/o 3 Jowett Street, Coomera QLD 4209	REPORT NUMBER:	PG-5335-G-TP09-CBR
PROJECT NAME:	Town Centre Precinct	REPORT DATE:	9/10/2024
PROJECT ADDRESS:	Wongawallan Drive, Yarrabilba	TEST METHOD:	AS 1289.6.1.1

SAMPLE LOCATION:	TP 09 (0.65m-0.75m)
SAMPLE NUMBER:	24-2180
SAMPLING METHOD:	AS SUPPLIED
SAMPLED BY:	PACIFIC GEOTECH
DATE SAMPLED:	20/09/2024
DATE TESTED:	4/10/2024
PREPERATION METHOD:	AS 1289.1.1
MOISTURE CONTENT METHOD:	AS1289.2.1.1
MATERIAL TYPE:	Sandy Clay, Orange/Brown

MAXIMUM DRY DENSITY (t/m³):	1.53
OPTIMUM MOISTURE CONTENT (%):	26.2
COMPACTIVE EFFORT:	Standard
COMPACTION METHOD:	AS1289.5.1.1
LABORATORY DENSITY RATIO:	99.5
LABORATORY MOISTURE RATIO:	101.5
DRY DENSITY BEFORE SOAK (t/m³):	1.52
DRY DENSITY AFTER SOAK (t/m³):	1.52
FIELD MOISTURE CONTENT:	24.4
MOISTURE CONTENT AT COMPACTION BEFORE SOAK (%):	26.6
MOISTURE CONTENT OF TOP 30mm AFTER PENETRATION (%):	28.9
MOISTURE CONTENT REST OF SAMPLE AFTER PENETRATION (%):	27.7
SWELL (%):	1.5
CBR SURCHARGE (Kg):	4.5
SOAKING PERIOD (Days):	4
CURING TIME (Hours):	68
PERCENTAGE OVERSIZE MATERIAL RETAINED ON 19mm SIEVE (%):	0
METHOD OF ESTABLISHING PLASTICITY:	Visual/Tactile Assessment

CBR 2.5mm (%):	4.0
CBR 5mm (%):	4.0
CBR VALUE (%):	**4.0**



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Approved Signatory

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APPENDIX D

SITE PLAN


Jinnung Jalli Native Trail
St Clare's Catholic Primary School
Darlington Dr
Bailey St
Yarrabilba State Secondary College
Cafe 63 Yarrabilba
Bells beauty cove
Level up detailing
mb crafts
Quinzeh Creek
Waterford Tamborine Rd
McKinnon Sports Park South
Salvos Stores Yarrabilba
Yarrabilba Dr
Yarrabilba Massage
Ampol Foodary Yarrabilba South
TP04
TP06
TP01
TP03
TP02
TP05
TP07
TP08
TP09
TP11
TP10
Dream transportables pty
Lisa Laker Marriage Maker
Billubera Park
Yarrabilba Sales & Information Centre
South Rock State School
95
N
700 m
Google Earth