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PLANS AND DOCUMENTS
referred to in the PDA
DEVELOPMENT APPROVAL

Approval no: DEV2024/1491

Date: 7 May 2025

Queensland Government

Geotechnical Site Investigation & Landslide Risk Assessment @ Context 3, New Beith Road Flagstone QLD 4280

August 22, 2024

Presented To

PEET Flagstone City Pty Ltd

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Geotechnical Investigation & Landslide Risk Assessment @ Context 3, New Beith Road, Flagstone Qld 4280

Interpretative Report

Report Ref. No.: 6464 – 24-338

August 22, 2024

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0	22/08/2024	Dennis Alazigha – RPEQ 22169	Dennis Alazigha – RPEQ 22169	Issued for Comments

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1 INTRODUCTION

This report presents the findings of the geotechnical investigation, including a landslide risk assessment work undertaken at Context Area 3, New Beith Road, Flagstone Qld. It is understood that a staged residential subdivision is proposed for the site and that this geotechnical report will be relied upon to inform all phases of the engineering designs and incorporation into any civil construction tender documents.

The site is located at New Beith Road, Flagstone QLD 4280, described as Lots 911 & 908 on SP335853, with the intention to reconfigure 2 lots into 1635 lots and parks.

It is understood that a Development Application is underway with EDQ for the proposed development works (EDQ ref: DEV2024/1491). As part of finalising this application, EDQ has issued an RFI dated 20/05/2024 which outlines in detail the geotechnical information to be provided.

The work was commissioned by Troy Thompson, representing PEET Flagstone City Pty Ltd (The Client) following the acceptance of our (Qualtest Geotechnical & Laboratory) fee proposal dated August 01, 2024, with reference QGQ24-336-6288.

The fieldwork was undertaken on August 09, 2024.

The approximate geographical location of the site is highlighted in red per *Figure 1.*

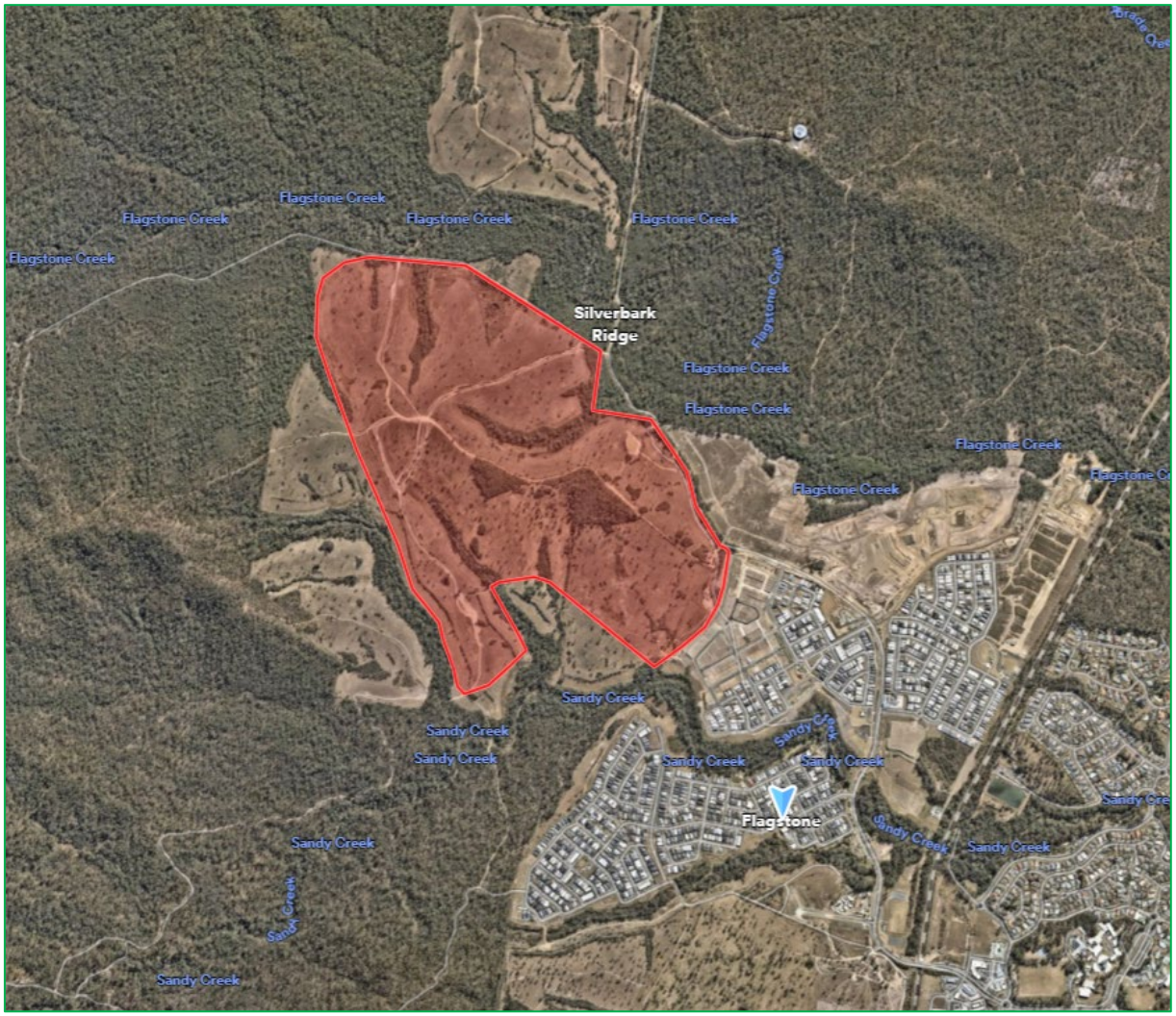

Figure 1: The Geographical Location of The Site Highlighted in Red

For clarity, this report has been prepared in two sections:

- Section A – Geotechnical Site Investigation Report; and
- Section B – Landslide Risk Assessment Report.

1.1 Proposed Development

It is understood that the site, which covers a gross land area of approximately 144.41ha will be subdivided into 1,635 residential lots. A review of the available information shows the following structures are included in the proposed development:

- Bulk earthworks, including cut and fill to create allotments;
- 1 medium density lot;
- 3 potential child care centre lots;
- 1 district centre lot;
- 2 local centre lots;
- 1 state primary school lot;
- 2 community infrastructure lots (community centre and emergency service);
- Stormwater management lots;
- Retaining structures;
- Road and drainage networks, including easement;
- Sewer and water reticulation works;
- Detention basin;
- Recreational parks, environmental & open space; and
- Soft and hard landscaping.

Figure 2 presents an excerpt from *the Wolter Consulting Group* Staging Plan, showing the development's proposed lot and road layout.

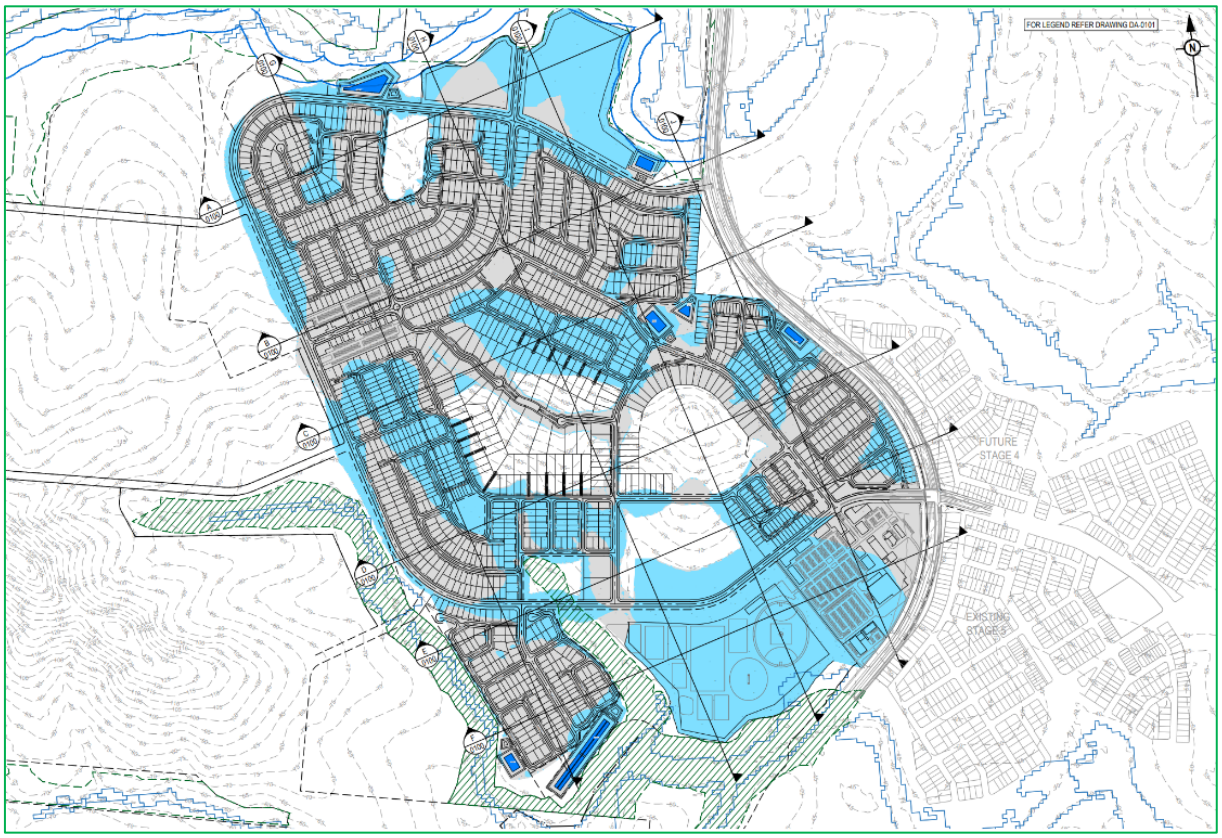

Figure 2 – Site Layout Plan Showing the Proposed Development

1.2 Purpose

This interpretative report aims to present PEET Flagstone City Pty Ltd and their partners with a geotechnical report addressing the scope of work per Section 1.3.

1.3 Scope of Work

The geotechnical brief requests the following scope of work as a minimum:

- Site investigation and field sampling works are required to address the items below;
- Investigation location plan, site description and site geology map;
- Site visit reports, field testing results and laboratory testing reports;
- A representative number of boreholes along with DCP tests and surface levels at the borehole locations;
- Site soil reactivity classification and shrink/swell characteristics;
- Surface / subsurface soil/rock conditions including but not limited to soil density, particle size distribution, shear strength, Poisson's Ratio, short and long-term Young's modulus, and in-situ subgrade CBR;
- Recommendations for pavement, such as design CBR, subgrade level and preparation, and if subgrade CBR values < 3%, cost-efficient methods of improving based on flexible pavements;
- The extent of underlying rock if present and recommendation of rock excavation methods;
- Groundwater location, condition and possible impact on construction (if encountered);
- Recommendations for site preparation earthworks, such as excavation, engineering fill material, controlled placement/compaction methodology, topsoil reuse (blending) and batter slopes;
- Design parameters for temporary and permanent retention systems and batters;
- Recommendations for building foundation design including but not limited to, footing type options incl. Bearing capacity and pile shaft adhesion, foundation levels, expected capacity and settlement parameters, and required site surcharge and monitoring if any;
- Emerson Class testing/Dispersive soils and recommendations for the management of dispersive soils if relevant; and
- Landslide Risk Assessment in accordance with the Australian Geomechanics Society 'Landslide Risk Management Guidelines' (AGS 2007) shows the stability risk level ranging from very low to very high.

Included within the attachments are the latest civil engineering drawings including bulk earthworks and servicing as well as concept earthworks plans for the remainder of the site to provide context around the proposed extent of works.

SECTION A – GEOTECHNICAL SITE INVESTIGATION

2 Methodology

2.1 Standards

This investigation has predominantly been undertaken in line with the following Australian Standards (AS):

- AS 1289 – Methods of testing soils for engineering purposes;
- AS 1289.6.3.2-1997 – Soil strength and consolidation tests – Determination of the penetration resistance of a soil – 9 kg dynamic cone penetrometer;
- AS 3798 – Guidelines on earthworks for commercial and residential developments;
- AS 2870 – Residential slabs and footings; and
- AS 1726:2017 – Geotechnical site investigations.

2.2 Literature Review

An initial literature review was undertaken before conducting the site investigation, covering the site's geology and geomorphology, a review of documents provided by Colliers on behalf of PEET Flagstone City Pty Ltd, and a search for any other information that was publicly available.

2.2.1 Information Provided

The Client provided the following information to assist in preparing this report:

- Geotechnical Brief – Provided in an email dated July 31, 2024;
- State Development and Infrastructure – Further Issues Letter, Our Ref: DEV2024/1491, Dated 20 May 2024; and
- Colliers Engineering Drawings – Residential Subdivision Context Area 3, New Beith Road, Flagstone for "PEET Flagstone City Pty Ltd" Project No: 20-0211, Drawing No: DA-0001, Revision A, Dated 18.03.24.

2.2.2 Previous Reports

At the time of writing this report, Qualtest is unaware of any previous geotechnical report for the site or nearby sites.

2.2.3 Site Geology

The online *NationalMap* Detailed Surface Geology (1:100k) map shows the site is underlain by the Gatton Sandstone geological rock units (Jbmg). This sedimentary rock-dominated unit, formed in the Early Jurassic Era and consists of lithic labile and feldspathic labile sandstone.

The Regional Moreton Region Surface Geology (1:1M) map shows a similar lithological profile as the Detailed Surface Geology map. The lithological profile consists of lithofeldspathic labile and sublabile sandstone, siltstone, shale, minor coal, ferruginous oolite marker, formed during the Early Jurassic – Middle Jurassic Geological Era.

Therefore, the shallow soils encountered onsite are residual in nature derived from the recent weathering of the underlying parent rock.

An extract from the Detailed Surface Geology map showing the site is presented in *Figure 3.*

Figure 3: The Detailed Surface Geology Map, The Site Highlighted in Red

2.2.4 Site Description

The site is located at New Beith Road, Flagstone (Logan City Council) QLD 4280 with Plan Number Lots 911 & 908 on SP335853, covering a gross land area of approximately 144.41ha. Current access to the site is via Flagstonian Drive within the ongoing residential development. To the north, east, and west of the site is undeveloped bushland. Sandy Creek and the ongoing residential development border the site to the south.

At the time of this investigation, no structures were noted on the site. Major features of the site, however, were natural drainage gullies, Sandy Creek, access tracks, and isolated bushlands.

Vegetation on the site at the time of the fieldwork was recently slashed grass, overgrown weeds, bare ground, some regrowth shrubs, stockpiles of topsoils, gates/fence lines, water dams, and established trees. Evidence of recently removed trees was noted with stockpiles of wood chips scattered across the site.

The topography was noted to have planar slopes transversing in all directions. Evidence of soil creep was recorded on the existing trees and shrubs leaning downslope, with slight to moderate gradients measuring between 2 to 30°. Photographs showing typical site conditions are presented in *Figures 4a & b*.

Figure 4: Selected Photographs of The Site

2.3 Site Investigation

2.3.1 Underground Services

The location of underground services was not required on site as it was an underdeveloped bushland.

2.3.2 Geotechnical Investigation

The geotechnical investigation comprised a desktop study, fieldwork, and laboratory testing.

The Client in collaboration with Qualtest nominated the location of the boreholes to maximise geotechnical information gathering. Ten (10) boreholes designated QT1 to QT10 were drilled at various locations across the site to a target depth of 3.0. The boreholes were drilled using a 4WD Ute-mounted light-duty Zenith Engineering drill rig fitted with a 100mm diameter solid auger and a Tungsten Carbide drill bit. A 250mm diameter auger was used to recover bulk samples for CBR testing at selected borehole locations.

The fieldwork was supervised by a Qualtest's Geotechnical Engineer, who logged the boreholes per Australian Standard AS 1726-2017.

For subsequent laboratory testing, disturbed and undisturbed soil samples were collected at various depths in the boreholes. Select materials were tested to address the scope of work.

All boreholes were backfilled with spoil won from the drilling operations.

The approximate location of the boreholes as drilled on the day of investigation is illustrated in *Figure 5*.

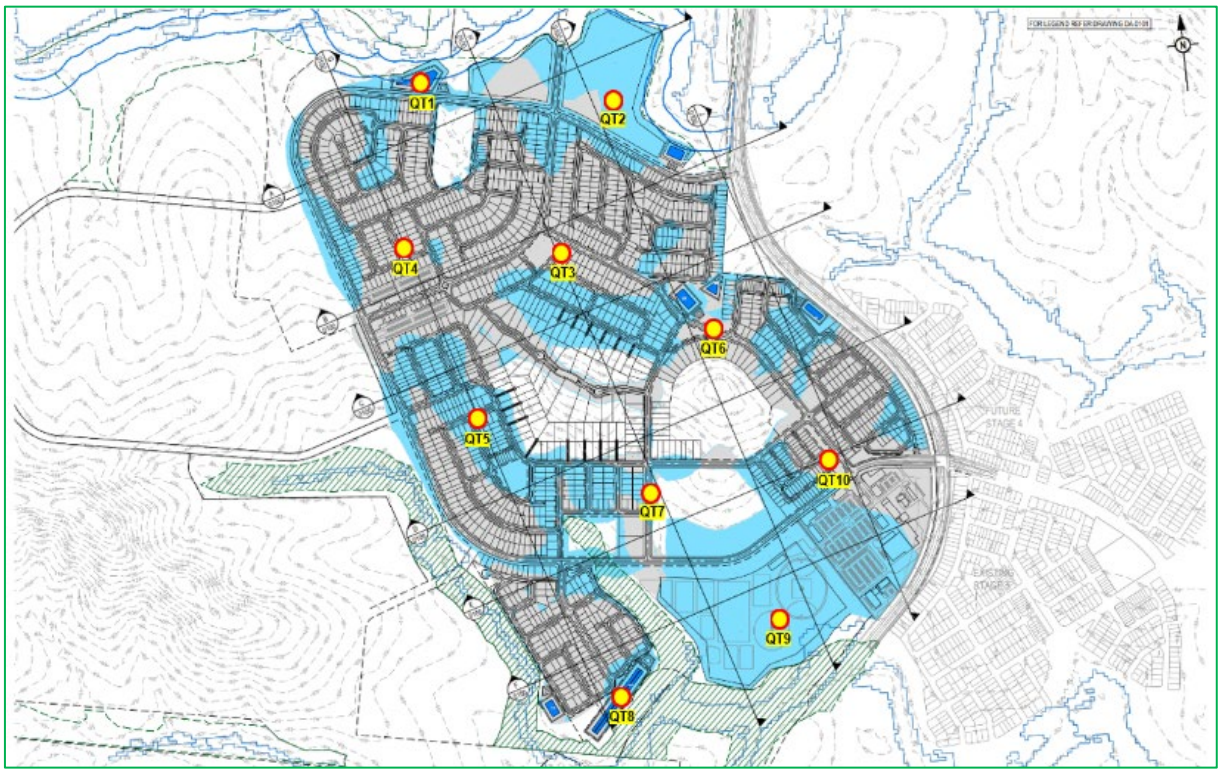

Figure 5: The Site Showing the Approximate Borehole Locations

2.3.2.1 DCP Testing

Dynamic cone penetrometer (DCP) testing was carried out at each borehole (QT1 to QT10) location prior to drilling. The DCP tests extended to depths between 0.3m to 1.1m bgl. All DCP tests were terminated at refusal in residual soils or on weathered sandstone rock.

The results of the DCP tests are included in the borehole logs (*Appendix A*). In summary, DCP blow counts ranged from 2 blows per 100mm penetration to refusal (hammer bouncing), indicative of firm/hard or loose/very dense soils or very low to low strength weathered sandstone rock.

2.3.2.2 Subsurface Conditions

The detailed subsurface conditions encountered at the borehole locations, together with the DCP test results, are presented in *Appendix A.*

In general, the boreholes (QT1 – QT10) encountered a layer of loose to dense silty sand topsoil overlying loose to dense sand-based alluvial soils underlain by very stiff to hard residual soils which graded into weathered sandstone bedrock. Once encountered, the weathered rock extended to borehole termination depths.

The subsurface profile is further described as follows:

Topsoil	Observed at all borehole locations except QT7 and typically classified as loose to dense silty sand. The topsoil layer was noted to be relatively thin at most locations, ranging from 0.05m up to 0.1m in thickness. The topsoil has been disturbed due to clearing and grubbing activities in some areas within the site, underlain by:
Fill	Observed in QT5 and QT7 only and extending to a maximum depth of 0.5m bgl. This fill was described as sandy clay, medium plasticity, brown, fine to medium-grained sand, trace subangular gravel. The fill is likely to be associated with recent ground disturbance at these locations, underlain by:
Alluvium	Observed underneath the topsoil or fill at all borehole locations except QT, QT2, QT3, QT5, and QT7 extending to a maximum depth of 1.0m in QT9. The materials were predominantly silty sand, loose to dense, fine to medium-grained.
Residual Soils	Observed in all boreholes except in QT5, QT8, and QT10. These materials were encountered underneath the topsoil or alluvial soils and predominantly consisted of sandy clay/clay sand/clay interbedded with clayey sand. Generally, the maximum depth of the underside of the residual soils across the site was at about 1.2m bgl, except in QT9 which extended from 1.0m to 3.0m termination depth, underlain by:
Weathered Siltstone / Sandstone	Observed in all boreholes except QT9. The materials identified as weathered sandstone rock were encountered in all the boreholes. These materials were typically extremely to moderately weathered sandstone at termination depth. The materials were recovered as dense to very dense clayey sand. These materials were encountered at relatively shallow depths of about 0.6m except for QT1 and QT4 at 1.0m and 2.7m depths. Once encountered, the weathered rock material extended down to termination depth.

2.3.2.3 Groundwater

Groundwater or seepage was not encountered in any of the boreholes at the time of the investigation. However, it is noted that groundwater could be influenced by climatic conditions as well as the soil material properties and profile. For example, relatively permeable silty sand overlying the lower impermeable clayey soils and weathered rock is conducive to the development of perched groundwater conditions at the interface.

2.3.2.4 Geotechnical Model

A preliminary geotechnical model of the subsurface conditions encountered based on the boreholes is illustrated in *Table 1.*

Table 1: *The Preliminary Geotechnical Model Based on Borehole Profiles*

BH ID	Depth Range (m)					
	Topsoil	Fill	Alluvial Soils	Residual Soil	Weathered Rock	Termination Depth
QT1	0.0 – 0.10	NE	0.0 – 0.70	0.7 – 1.2	1.20 – 2.0	2.0(R)
QT2	0.0 – 0.10	NE	NE	0.1 – 0.8	0.80 – 0.9	0.9(R)
QT3	0.0 – 0.05	NE	NE	0.05 – 0.6	0.60 – 0.7	0.7(R)
QT4	0.0 – 0.10	NE	0.1 - 0.90	0.9 – 2.7	2.70 – 3.0	3.0(R)
QT5	0.0 – 0.10	0.10 – 0.8	NE	0.8 – 1.0	1.00 – 1.2	1.2(R)
QT6	0.0 – 0.10	NE	0.1 – 0.65	NE	0.65 – 0.7	0.7(R)
QT7	0.0 – 0.40	0.40 – 0.5	NE	0.5 – 0.6	0.60 – 0.7	0.7(R)
QT8	0.0 – 0.10	NE	0.1 – 0.60	NE	0.60 – 0.8	0.8(R)
QT9	0.0 – 0.10	NE	0.1 – 1.00	1.0 – 3.0	NE	3.0(R)
QT10	0.0 – 0.10	NE	0.1 – 0.60	NE	0.60 – 0.7	0.7(R)
N/E = not encountered, R = refusal						

3 Laboratory Testing and Results

Selected soil samples were tested for geotechnical properties at Qualtest's NATA-accredited laboratory in Brisbane in accordance with relevant Australian Standards (AS). Tests outside the scope of Qualtest laboratory were outsourced.

The quantity and type of laboratory tests performed in this investigation are summarised in *Table 2.*

Table 2: *Laboratory Testing Program*

Laboratory Test	Quantity	Reference Standard
4-Day Soaked CBR	4	AS1289.6.1.1
Atterberg Limits	4	AS1289.3.1.2, 3.2.1, 3.3.3, 3.4.1
Particle Size Distribution	4	AS1289.3.6.1
Shrink-Swell	3	AS1289.7.1.1
Emerson Class Number	10	AS1289.3.8.1
Permeability	2	AS1289.6.7.3

The laboratory test certificates for the investigation are presented in *Appendix B*.

3.1 California Bearing Ratio (CBR)

Selected soil samples recovered from across the site were tested for 4-day soaked CBR using the test methods described in AS1289.6.1.1-2014. The samples were compacted using Standard compaction effort at optimum moisture content and soaked for four days under a 4.5kg surcharge. The tests were conducted at Qualtest's NATA-accredited laboratory in Brisbane.

Select soil samples collected from QT1, QT6, QT8, and QT9 at shallow depths were tested for 4-day soaked CBR. A summary of the laboratory CBR test results for the subgrade materials is presented in *Table 3*. The results of the CBR tests returned about 1.5% for the clay-based soils and 9 to 17% for the coarse-grained soils.

Table 3: Summary of Laboratory CBR Test Results

BH ID	Sample Depth, m	MDD (t/m3)	OMC (%)	Swell (%)	CBR (%)
QT1	0.2 – 0.7	1.82	15.5	0.0	1.5
QT6	0.1 – 0.5	1.86	12.5	0.0	9.0
QT8	0.1 – 0.4	1.90	12.0	0.0	17
QT9	0.1 – 0.5	18.2	15.5	2.5	2.0

3.2 Particle Size Distribution

The behaviour of coarse-grained soils (sands and gravels) can be predicted by classifying the soil in terms of its particle size distribution (PSD). AS 1726-2017 denotes soils with fine contents (≤75 µm) greater than or equal to 35% will behave geomechanically as fine-grained soil and, therefore, are to be described as cohesive soils.

Five soil samples recovered from boreholes QT1, QT6, QT8, and QT9 were tested for particle size distribution. The results of the particle size distribution tests conducted on the selected samples are presented in *Table 4*. The results indicate the site soils are predominantly a mix of clayey sand and sandy clay.

Table 4: Results of Particle Size Distribution Tests

BH ID	Sample Depth, m	Material Type	Grading		
			Gravel (%)	Sand (%)	Fines (%)
QT1	0.2 – 0.7	Sandy Clay	1	59	40
QT6	0.1 – 0.5	Clayey Sand	1	73	26
QT8	0.1 – 0.4	Clayey Sand	1	79	20
QT9	0.1 – 0.5	Sandy Clay	0	43	57

3.3 Atterberg Limits

The behaviour of fine-grained soils (silts and clays) can be predicted by classifying the soil in terms of its plasticity. Plasticity is broadly described as either “High”, “Medium”, or “Low”.

Soils behave very differently depending on their moisture content. It can exist as either a solid at very low moisture contents, semi-solid, plastic, or liquid at ever-increasing moisture contents. To determine plasticity, the moisture contents are determined to define the boundaries between semi-solid, plastic, and liquid. The minimum moisture content at which the soil becomes plastic is known as the “Plastic Limit”, and the minimum moisture content at which the soil behaves as a liquid is known as the “Liquid Limit”. These limits collectively are known as the Atterberg Limits.

Soils with liquid limits below 35% are described as Low plasticity, liquid limits between 35 and 50% are described as medium plasticity and liquid limits above 50% are described as High plasticity.

The ‘Plasticity Index’ of soil is the range of moisture contents where the soil exhibits plastic behaviour. This is calculated by subtracting the Plastic Limit from the Liquid Limit of the soil. Soils with a plasticity Index greater than 20% are often referred to as high plasticity.

The Atterberg limits of soil samples recovered from selected boreholes QT1, QT6, QT8, and QT9 were tested, including linear shrinkage. The test results are presented in *Table 5 and Figure 6,* indicating low to medium-plasticity clays.

Table 5: Results of the Atterberg Limit Tests

BH ID	Sample Depth, m	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Weighted Plasticity Index (%)	Linear Shrinkage (%)
QT1	0.2 – 0.7	26	12	14	1294	4.5
QT6	0.1 – 0.5	24	13	11	823	2.0
QT8	0.1 – 0.4	17	11	6	549	0.5
QT9	0.1 – 0.5	42	13	29	2723	9.0

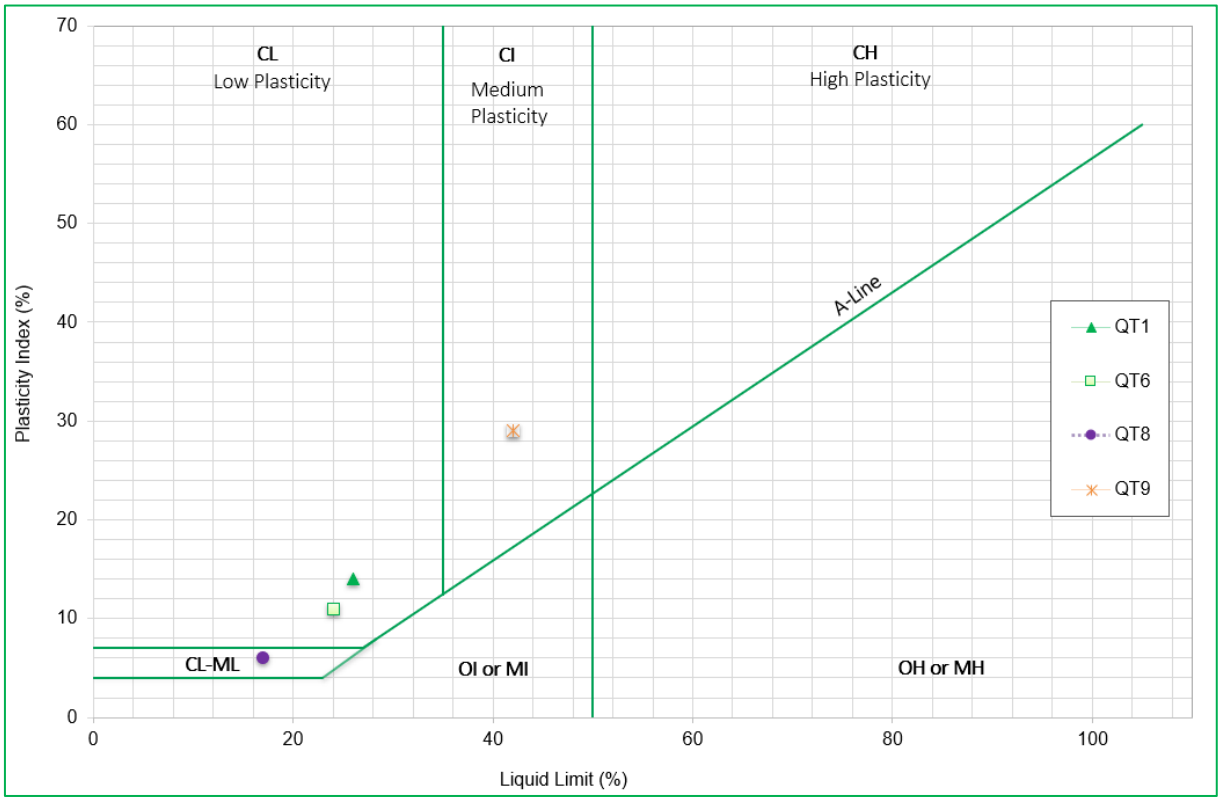

Figure 6: Soil Classification Based on the Unified Soil Classification Scheme

3.4 Shrink-Swell

The shrink-swell test is a simple test routinely employed in Australian geotechnical engineering practice to quantitatively assess the expansive potential of undisturbed or remoulded clay soils and to guide the design of footings on these soils. A fundamental rationale for using the shrink-swell test is that it evaluates the soil over both wetting (swell) and drying (shrink) phases. Hence, the result is independent of the initial moisture state of the soil sample and defines a unique soil class related to the fundamental properties of the soil.

Five (5) undisturbed soil samples (U50) were recovered from boreholes QT4, QT5, and QT9 were subjected to shrink-swell testing. The test results are summarised in *Table 6*.

The results show a maximum shrink-swell index (I_{ss}) of 4.9% in the QT5 location for the clay-based soils, indicative of the presence of highly reactive clays.

Table 6: *Summary of the Shrink-Swell Test Results*

Borehole ID	Sample Depth, m	Shrinkage (%)	Swell (%)	Shrink-Swell Index (I_{ss}), %
QT4	1.0 – 1.20	1.8	3.4	1.9
QT5	0.4 – 0.53	2.4	13.0	4.9
QT9	0.5 – 0.79	3.2	3.0	2.9

3.5 Emerson Class Number Test

When brought into contact with water, soil can release silt and clay particles into suspension and increase the turbidity of water. Turbid water in soils indicates susceptibility to erosion.

The Emerson Class Number can measure the potential of soil to release silt and clay particles to suspension. The values range from one (high potential) to eight (low potential). Classes 1 to 3 are considered dispersive, Class 4 indicates the presence of carbonate or gypsum and is slightly dispersive, Classes 5 and 6 are deemed non-dispersive, and Classes 7 and 8 are water-stable Soils (non-slaking), but if it swells (Class 7), retain its original size and shape (Class 8).

Samples collected from Qt1, QT2, QT3, QT4, QT5, QT6, QT7, QT8, QT9, and QT10 were subjected to Emerson Class tests. The tested samples returned as 2, 3, 5, and 6, which corresponds to dispersive and non-dispersive soils.

The dispersive potential of the soils, as assessed by the Emerson Class Number, is presented in *Table 7*.

Table 7: *Summary of Emerson Class Test Results*

BH ID	Sample Depth (m)	Material	Emerson Class Number	Remarks
QT1	0.50 – 0.60	Sandy Clay	5	Non-Dispersive
QT2	0.40 – 0.50	Silty Sand	6	Non-Dispersive
QT3	0.40 – 0.50	Silty Sand	5	Non-Dispersive
QT4	1.00 – 1.10	Sandy Clay	2	Dispersive
QT5	0.85 – 1.00	Clay	3	Dispersive
QT6	0.65 – 0.70	Clayey Sand	5	Non-Dispersive
QT7	0.60 – 0.70	Sandy Clay	2	Dispersive
QT8	0.60 – 0.70	Clayey Sand	5	Non-Dispersive
QT9	0.10 – 0.20	Sandy Clay	2	Dispersive
QT10	0.60 – 0.70	Silty Sand	3	Dispersive

3.6 Permeability Test

Soil permeability, also termed hydraulic conductivity, refers to the rate at which soil allows water to flow through it due to its grain structure and void spaces. Knowing how easily water can travel through soil structure is important for engineering purposes.

Several field and laboratory test methods exist to determine the permeability of the soil. The two most common are “the laboratory constant head permeability method” and “the laboratory falling head permeability method”.

The laboratory falling head permeability test method was adopted to determine the coefficient of permeability (k) of two samples recovered from QT4 and QT9.

The results of the tests are presented in *Table 8* and indicate the presence of two soil types with varying permeability.

Table 8: Summary of Soil Permeability Test Result

BH ID	Sample Depth, m	Material Description	FMC (%)	MDD (t/m^3)	OMC (%)	Coefficient of Permeability (k)
QT4	1.0 - 1.5	Sandy Clay	12.8	1.82	15.5	8.2 x 10^{-7} cm/s
QT9	0.4 – 0.9	Clayey Sand	15.3	1.90	12.4	1.14 x 10^{-6} cm/s

4 Geotechnical Engineering Assessment

Based on our understanding of the proposed development, the following sections have been provided to assist with the geotechnical aspects of the design and construction phases. It is noted that the recommendations and comments given in this report are broadscale in nature.

4.1 Bearing Capacity of Soils

The bearing capacity of the subsurface profiles encountered onsite was determined using DCP test data acquired during the August 09, 2024 investigation.

Campanella & Robertson (1983) developed a correlation between DCP blow counts and the bearing capacity of soils. This relation was adopted to derive the allowable bearing capacity of the subsurface profile with a safety factor of 4.0 for cohesive soils with foundation factor Nc = 5.

The allowable bearing capacity of the subsurface soils at the DCP test locations (QT1 to QT10) with depth is presented in *Figure 7*.

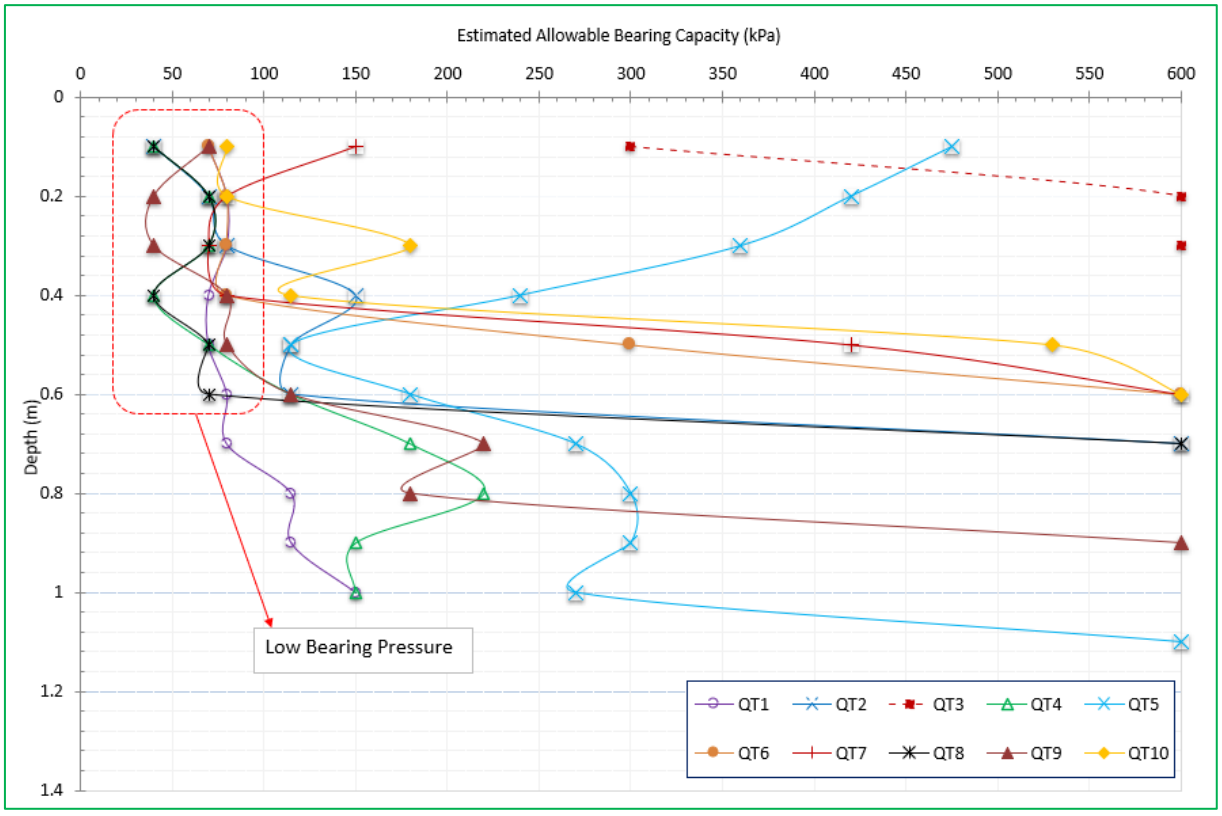

Figure 7: The Allowable Bearing Capacity of Onsite Soils with Depth; Derived from DCP Data

Based on *Figure 7* above, the upper 0.6m soil profile shows a bearing capacity of less than 100kPa. This could be associated with the water-softened conditions onsite. These soils are considered unsuitable for pad or fill foundations. Beyond 0.6m, the allowable bearing pressure increased significantly.

Qualtest recommends an allowable bearing capacity of 150kPa and 250kPa for the soils and weathered rock, respectively.

It is highly recommended that a competent person assess all exposed foundations to ensure that the recommended bearing pressures are achieved during construction.

At locations where the bearing capacity is determined to be less than the recommended values, the area should be excavated to depths exposing competent ground and reassessed by a competent person prior to backfill and compaction activities.

Any engineered fill, placed in accordance with Table 8 of AS3798, is considered appropriate as a foundation material and can be assigned an allowable bearing pressure of 100kPa.

4.2 Young's Modulus of Soils

Young's modulus is an elastic soil parameter and a measure of soil stiffness, and it is defined as the ratio of the stress along an axis over the strain along that axis in the range of elastic soil behaviour.

In this investigation, the soil Young's modulus (E), commonly referred to as soil elastic modulus, was calculated using correlation equations with DCP test data.

For the clay or sand-based upper low-strength soils, the known CBR values were used to calculate the elastic deformation modulus (E) using a correlation published by Powell et al. (1984), per Equation 1.

$$E(MPa) = 17.6 \times CBR^{0.64} \qquad \textit{Eqn. 1}$$

For the stiff to very stiff underlying alluvial soils, the correlation proposed by Jianzhou et al. (2022) was used to determine Young's modulus of the soil, per Equation 2.

$$E(MPa) = 338 \times PR^{-0.39} \qquad \textit{Eqn. 2}$$

Where

PR = the number of hammer blows required to produce 300mm of rod penetration.

From equations 1 and 2, Qualtest recommends 1.0MPa for the upper firm or loose soils and a conservative Young's modulus of 5MPa for the stiff to hard or medium dense to very dense alluvial/residual soils. For weathered rock, a Young's modulus of 10kPa can be adopted.

4.3 Site Classification

To determine the broadscale soil classification, a number of site features are considered, including the subsurface profile, the surface topography, existing vegetation, and the proposed development. Given the existing upper subsurface profile presents a bearing capacity of less than 100kPa, and earthworks development would also likely create fill heights greater than 0.4m, the site is assigned a ***Class P*** per AS2870-2011.

The site was also classified based on characteristic surface movement (y_s) estimated in accordance with Clause 2.3 and applying Table 2.3 of AS2870-2011. The I_{ss} (i.e., 4.9) obtained from laboratory testing was adopted to calculate y_s. The change in suction was estimated from published literature as 1.2pF, and the design soil suction change (H_s) depth of 2.2m was acquired from the literature and a cracked % Hs of 10%.

Though the depth to top of rock is shallow onsite, at locations with substantial clay soils, a potential ground surface movement of up to about 85mm can be expected under normal moisture conditions, which is consistent with a site ***Class E***. The occurrence of such soils is expected to be isolated on this site.

Due to the generally shallow depth of bedrock, it is recommended that the clay soils be removed and replaced.

4.4 Dispersive soils/Emerson Class

Five (5) out of the ten (10) samples subjected to Emerson Class Number tests returned as 2 or 3, indicative of dispersive soils. The remainder of the tested samples (5) returned an Emerson Class Number of 5 or 6, which corresponds to non-dispersive soils.

The Emerson Class 2 or 3 indicate a degree of tunnelling susceptibility, though desirable for water storage structures to ensure sealing. Class 2 or 3 soils disperse on wetting and readily form a crust. Dispersion of surface soils can be prevented by applying gypsum or lime additives.

Soils with Emerson Class 5 or 6 would be non-erodible in their natural or disturbed state. However, Class 2 soils will be highly erodible when they have undergone disturbance and reworking, such as during earthworks operations.

Effective erosion and sedimentation control measures relevant to clearing and trenching operations should be installed and maintained for the duration of construction. Adequate drainage of all working areas shall be maintained throughout construction to ensure runoff does not pond.

4.5 Embedment Recommendations for Sewer and Water

Trench foundations at this site are likely to include controlled fill, alluvial/residual soils and weathered rock. The Emerson Class testing shows five samples out of five returned a value indicating dispersive soil characteristics. To allow for variability of materials onsite, the preliminary recommended trench embedment types are presented in *Table 9*.

The actual trench foundation and embedment materials, as well as the presence of groundwater, should be verified at the time of construction.

Table 9: Recommended Trench Embedment Types

Material	Trench Embedment Type	Comments
Site Won Controlled Fill	Type 4 – Sewer, Type D – Water	Trench Foundation > 50 kPa
Alluvial / Residual Soils	Type 4 – Sewer, Type D – Water	Trench Foundation > 50 kPa
Weathered Sandstone (at least highly weathered)	Type 3 – Sewer, Type C – Water	Trench Foundation > 50 kPa

4.6 Pavement Design

Four (4) near-surface soil samples were collected and tested for 4-day soaked CBR to indicate the suitability of the existing near-surface clays as subgrade support. The 4-day soaked California Bearing Ratio (CBR) tests returned values between 1.5 and 17.0% for the site materials.

Qualtest recommends a preliminary CBR design value of 6% for the sand-based materials and 1.5% for the clay-based alluvial/residential soils to account for natural variations in the subsurface profile. It is suggested that the low CBR clay-based soils be treated with lime to improve CBR values. Insitu-treated clay layers should be considered as a subbase layer with a CBR of 15%.

Where weathered rock is exposed at the subgrade level, a preliminary CBR of 30% may be adopted for pavement design.

4.7 Shallow Footing Systems

Slab-on-ground, pad, and strip footings are considered appropriate for the site, provided the allowable bearing pressures presented in *Table 10* are adhered to.

Based on ground conditions, all structures should be supported by select engineered fill and keyed into the existing slope face, if applicable.

Table 10: Preliminary Recommended Parameters for Foundation Design

Material		Allowable Bearing Pressure (kPa)	
		Slab on ground/Strip Footing	Pad Footings
Topsoil, Uncontrolled Fill, Water-softened Upper Soils	Soft or Loose	<100 (NR)	<100 (NR)
Controlled Fill	Stiff or better	100	100
Alluvial/Residual Soils	VSt to H or D to VD	150	150
Weathered Rock	Very Low to Low Strength	250	250
Note: *NR = not recommended, VSt = very stiff, H = Hard, D = Dense, VD = very dense* *All founding materials should be verified by a suitably qualified person during construction.*			

4.8 Deep Foundations

For deep foundation options, Qualtest recommends an allowable bearing pressure and skin friction of 200kPa and 20kPa for the alluvial/residual soils at depths greater than 2.0m bgl. For the extremely to highly weathered sandstone rock, an allowable bearing pressure of 250kpa and skin friction of 50kPa is recommended. For moderately weathered or better rock (which is likely to be encountered with increasing depth) Qualtest recommends an allowable bearing pressure of 700kPa and skin friction of 100kPa.

4.9 Thrust Block Design Parameters

Thrust blocks may be designed based on the allowable horizontal bearing capacities provided in *Table 11*.

Table 11: *Preliminary Parameters for Thrust Block Design*

Material		Allowable Horizontal Bearing Pressure (kPa)
Topsoil, Uncontrolled Fill, Water-softened Upper layer	Soft or Loose	NA
Controlled Fill	Stiff or better	50
Residual Soil	Loose/firm	NR
Residual Soil	VSt to H or D to VD	75
Weathered Rock	Very Low to Low Strength	150
NR = not recommended, VSt = very stiff, H = Hard, D = Dense, VD = very dense		

4.10 Bulking Factors

The bulking factor is the ratio or percentage of the volume change of excavated material to the volume of the original volume before excavation.

Bulking occurs when soil is excavated. One cubic metre of insitu material expands and does not always translate into one cubic metre of fill when placed and compacted on the site. Bulking can significantly affect the balance of cut and fill volumes and, hence, the cost of the earthworks.

Excavation increases the volume of material. It is, therefore, necessary to use a bulking factor to determine the volume of material that will be created by excavation. The bulking factor is defined as:

$$Bulking\ Factor = \frac{Volume\ after\ Excavation}{Volume\ before\ Excavation}$$

Based on experience, engineering judgement, laboratory demonstrations, and published typical values (Look, 2014), *Table 12* provides estimated bulking factors for the material types encountered on the site.

Table 12: Bulking Factors

Material	Bulking Factor for Transportation
Clay-Based Soil	1.25
Sand-Based Soil	1.15
Weathered Rock	1.50

Typical wastage of approximately 5% by volume may be adopted.

4.11 Cohesion and Friction Angles

The internal friction angle of the stiff (or better) clay-based soil material was determined using graphical correlations proposed by Ladd et al. (1977) and Bjerrum and Simons (1960).

For the stiff or better alluvial/residual clay-based soils with a plasticity index of 29%, the corresponding effective internal friction angle was measured at 26°, with an effective cohesion of 5kPa.

For the weathered rock underlying the residual soils, an effective friction angle of 32° with cohesion of 10kPa is considered appropriate.

4.12 Retaining Wall Parameters

This section provides advice and recommendations for free-headed and fixed-headed retaining walls that may be constructed as part of the proposed development.

Passive earth pressures for the site can be calculated by the Rankine (1857) method, which assumes no soil cohesion or wall soil friction.

The design of fixed or free-headed permanent retaining wall systems supporting fill or natural clay soil can be based on the lateral earth pressure distribution given as:

$$p_a = {}^1/_2\, k_a \gamma H^2 - 2cH + 2c^2/\gamma$$

In the above equation, H(m) is the height of the wall, γ (kN/m^3) is the unit weight of the soil, k_a is the coefficient of active earth pressure, and c is soil cohesion.

Retaining walls are to be designed with respect to internal stability properties such as sliding, overturning, and bearing capacity failure. The retaining walls are also to be assessed and designed for global stability. Internal and global stability design should be carried out in accordance with AS4678:2002 (Earth-Retaining Structures).

Preliminary design parameters for retaining walls onsite are shown in *Table 13*.

Table 8: Retaining Wall Design Parameters for Backfill Slope Angle

Origin	Description	Bulk density, ɣ (kN/m3)	Long-Term Friction Angle, (°)	K_o	K_a	K_p	Long-Term Cohesion, C' (kPa)
Controlled Fill	Stiff or better	18	24	0.59	0.42	2.37	0
Alluvial / Residual	Stiff or Better	19	26	0.56	0.39	2.56	5
Weathered Rock	Very Low to Low Strength	22	32	0.47	0.31	3.25	10

Drainage is perhaps one of the most important considerations in the design and construction of earth-retaining structures, and it is necessary to separate the surface drainage from the subsoil drainage system.

Surface water must be diverted away from the back of retaining walls to prevent ponding surface water behind the top of the wall. This usually includes placing a 500mm to 800mm thick layer of compacted clay over the subsoil system to act as a seal.

Subsoil drainage comprising free-draining granular material connected to slotted PVC pipes must be placed behind the permanent retaining walls to prevent the buildup of groundwater pressures behind the walls, and this must be discharged to the point of legal discharge.

4.13 Permeability

Figure 8 can be used as a rough guide for the flow (laminar or turbulent) and drainage (well or poorly-drained) characteristics of the major soil groups, and the ranges of their permeability values as suggested by Terzaghi and Peck (1967).

The testing samples returned as silty clays, very low permeability, poorly drained, and laminar flow. The permeability values obtained from the two samples are highlighted in red in *Figure 8.*

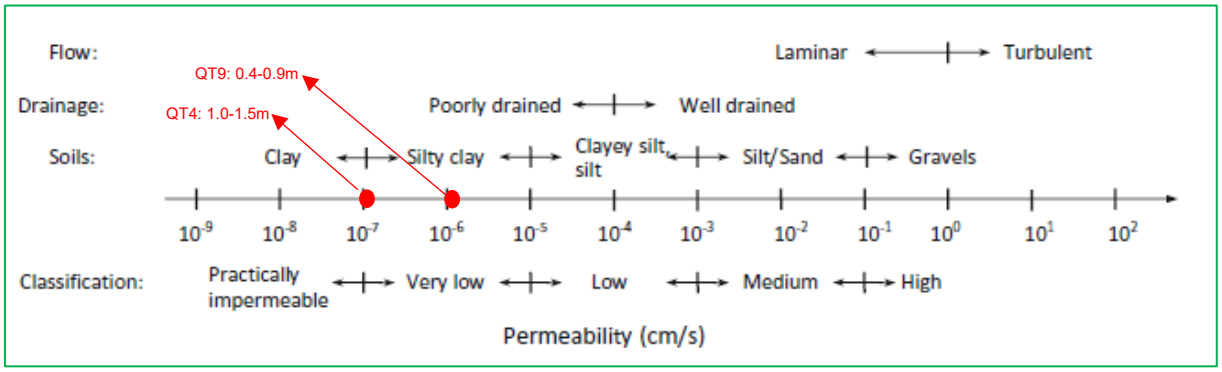

Figure 8: Typical Values of Permeability

4.14 Earthworks Recommendations

All earthwork procedures should be carried out in a responsible manner in accordance with AS.3798-2007 "Guidelines on Earthworks for Commercial and Residential Developments". The earthworks contractor should make themselves familiar with the site conditions.

Given the subsurface profile encountered on site and considering the proposed earthworks operations, it is recommended that all earthwork activities be supervised under Level 1 engineering supervision and an engineering certification provided by a registered professional engineer (RPEQ).

The earthwork recommendations are presented in the following subsections:

4.14.1 Existing Onsite Fill

The investigation did not reveal any fill at the borehole locations except QT7. However, given that the site has experienced partial clearing and grubbing, localised fill sections should be expected. All uncontrolled fill within the development should be removed and replaced in accordance with AS 3798 recommendations.

4.14.2 Stripping Depths

Topsoil was encountered at all drilled locations. Based on the observed subsurface profiles, the topsoil is expected to be relatively thin. The stripping depth for topsoil at the site is expected to range between 50 to 100mm. Following the removal of topsoil, the exposed surface should be proof-rolled prior to any fill placement.

In addition, the upper soils were identified as water-softened alluvial/residual soils to about 0.6m depth. These materials are regarded as unsuitable for foundation subgrade, and it is recommended to be stripped and replaced under a Level 1 Supervision and Testing Program, where required. Stripping of topsoil and the water-softened materials will vary from 50 to 600m across the site.

4.14.3 Founding Depth

At depths greater than the water-softened soils, the subsurface is considered appropriate as foundation materials. The thickness of the water-softened soils is expected to range from 0.1 to 0.6m bgl.

4.14.4 Depth to Rock

The ten (10) boreholes drilled onsite were terminated on refusal on weathered rock except for QT9, which extended to 3.0m termination depth. Generally, depth to top or rock varied between 0.6 to 2.7m across the site. Weathered rock is shallower along the northern and southern fringes of the site.

4.14.5 Excavation Conditions

Shallow depths to rock were recorded in all boreholes drilled at the site except at QT4 & QT9 and may require ripping tools with increasing depth. Generally, it is expected that 6 to 10+ excavators fitted with general-purpose/toothed buckets will be required to excavate to a depth of 1.0m. At depths greater than 1.0m, a 20+ excavator may be required to efficiently excavate site material, as the materials are expected to grade into moderately to slightly weathered sandstone rock with depth; at least a D6 to D8 Dozer will be required to excavate materials with increasing depths. Exceptions to the above inference should be expected around QT4 and QT9 locations.

4.14.6 Trafficability

At the time of the field investigation, trafficability was generally considered to be good due to the dry conditions and existing vegetation cover, though with localised very soft or very loose soils.

Trafficability problems could arise for earthworks and construction machinery from:

- Softening of the upper-level soils during and after periods of rainfall. This may require the installation of seepage cut-off drains should construction commence during or following an extended period of wet weather; and
- Disturbance of the upper-level soil fabric with the removal of vegetation. Depressions could be formed, resulting in potential water traps, which could cause further softening of exposed soils.

To improve the site trafficability, it is recommended that the exposed surface be inspected and assessed following stripping. Areas that demonstrate excessive movement and/or do not improve sufficiently under proof rolling should be removed and replaced as required.

Maintaining adequate drainage conditions is also essential. It should be ensured that runoff is diverted away from the construction area to prevent the ponding of water.

Preferably, earthworks should be scheduled in dry weather following a period of not less than one week of little or no rainfall.

The contractors should fully inform themselves of the ground conditions onsite prior to the commencement of earthworks. This requirement should be explicit in any earthwork specifications or contract.

4.14.7 Subgrade Preparation and Compaction Standards

The following earthworks procedures are recommended:

- Clearing, grubbing, and stripping should be carried out across the site;
- The existing topsoil and encountered soft soils should be excavated from the development areas to expose competent, very stiff or better soils. All tree roots must be removed, the perimeter excavated to the maximum depth of tree roots, and replaced with compacted fill layers;
- Following stripping and removal of the topsoil and any upper weak soils, the competent exposed natural surface should be proof rolled under the supervision of a geotechnical engineer using a vehicle with a tare of at least 20 tonnes and then compacted to 98% at +2 or -2% OMC, Standard Maximum Dry Density (SMDD). Areas demonstrating excessive movement should be treated (dried and recompacted) or removed and replaced with compacted fill. Treatment should be to a standard sufficient so that the subgrade passes proof rolling and that compaction can be achieved in the first layer of fill;
- Temporary cut batters in existing alluvial/residual materials should generally not exceed 27^{o}, subject to inspection and approval by an experienced geotechnical engineer; and
- Depressions formed by the removal of vegetation, underground elements, etc., should have all disturbed and weakened soils removed.

If the development includes a water retention basin, the exposed base of the basin must be rolled to seal any cracks.

The following earthworks procedures can be considered by the Civil Engineer and Earthworks Contractor:

- Remove all debris and vegetation, including grass and trees. Root bowls from trees are to be excavated and backfilled as required;
- Remove all wet soils and associated sediments to a surface capable of supporting filling operations;
- Remove topsoil (to stockpile) to depths exposing the underlying residual soils. The nominal thickness of topsoil and disturbed soil to be removed ranges between 0.1m and 0.5m bgl;

- Following removal of debris, vegetation, topsoil, and disturbed soil, the exposed surface should be proof rolled to identify any weak areas using rubber wheeled or pad foot plant of at least 10 tonnes or tracked plant of at least 10t. Identified weak areas should be repaired as required;
- Sloping areas that are to be filled should be benched prior to fill placement;
- All fill required to raise the ground surface should be placed in thin layers (250mm max Loose) and compacted to a density ratio of at least 98% Standard at moisture contents of OMC +/- 2%;
- If imported fill is required, it is recommended to be low reactivity and conform to the following imported fill specification:
    - Max Particle Size 150mm;
    - Minimum soaked CBR 7%; and
    - Shrink Swell Index 1.0% Max.

Testing of the placed and compacted fill should be carried out at frequencies defined in AS3798 *Table 8.1* for Type 1 Earthworks.

The subgrade shall be graded to drain effectively to subsoil drains and should be cleaned of any softened material prior to pouring of footings or placement of fill materials. Foundation gradients shall be verified by a competent person to avoid the formation of a potential slide plane.

4.14.8 Reuse of Excavated Material

All site-won materials (sand/clay-based, weathered rock) are suitable for reuse as fill onsite, provided the materials are moisture-conditioned and are free of organics, topsoil, soft soils, slopewash, and deleterious materials.

All earthworks should be carried out by experienced contractors in general accordance with AS3798-2007 (Guidelines on Earthworks for Commercial and Residential Developments). Quality control of the earthworks should be carried out under Level One Inspection and Testing as defined in AS3798 – 2007.

4.14.9 Safe Batter Angles

Batters can be constructed to the following short and long-term gradients presented in *Table 14*. This is very significant as fill batters may be placed on slope ground.

The short-term is deemed to be no longer than a 4-week period, and following wet weather (rainfall), the short-term batter slopes would need to be reassessed for stability.

Temporary and permanent batters exceeding 3.0m in height will require benching at 3.0m high vertical intervals. The benches should be at least 2.0m wide.

Batters should be covered by topsoil, mulched, and vegetated to prevent drying and cracking. Further assessment of the batter angles may be required once the exact geometry and materials have been finalised.

It is essential that permanent batter faces are suitably protected from erosion and scour by appropriate drainage.

Table 14: Recommendations for Cut and Fill Batters

Material	Short term	Long term
Controlled Fill	18° (1V:3H)	14° (1V:4H)
Residual Soils (stiff or Better)	18° (1V:3H)	14° (1V:4H)
Weathered Rock	27° (1V:2H)	18° (1V:3H)

4.15 Phreatic Surface

Groundwater and seepage were not encountered in any of the boreholes at the time of the investigation. However, perched water may be encountered at the loose/firm/water-softened and indurated alluvial/residual soils/weathered rock interface following a prolonged rain event. Therefore, it is recommended that permanent retaining walls and temporary shoring systems be designed to allow groundwater to reach a height of 50% of the retained height.

4.16 Excavation Support

Based on the encountered ground conditions at the drill locations, a temporary shoring box system may not be required during trenching activities onsite. However, this recommendation is based on the exact drill location profiles, which may differ from the balance of the site. If the ground conditions are different per the attached logs during construction, further advice should be sought to ensure workers' safety in trenches.

SECTION B – LANDSLIDE HAZARD

5 LANDSLIDE RISK ASSESSMENT

This section of the report aims to establish the landslide risk of the existing slopes and post-construction conditions.

5.1 Scope of Work

The site has been identified as subject to unstable soils/landslip hazards and, as such, requires a slope stability report from an RPEQ geotechnical engineer.

This site-specific slope stability assessment report is prepared in accordance with the following:

- With section 2.2.6 of Planning Scheme Policy 5 - Infrastructure to address the landslide hazard and steep slope area overlay code for works proposed within the overlay;
- Assessing the suitability of the proposed development based on existing geotechnical conditions of the site;
- Identify all risk mitigation measures required to ensure the development remains geologically stable in the long term; and
- A certification by a Registered Professional Engineer of Queensland specialising in geotechnical engineering that the development of the subject will not initiate instability in or around the site.

5.2 The Site Slopes

The several ridges and sloping surfaces across the site significantly influence the surface topography. The ground slopes vary from about 2 - 30 degrees, falling in all directions, with localised slopes exceeding 30^{o} towards the valley corridors.

A photograph showing typical site conditions is presented in *Figure 8.*

Figure 9: Photograph of The Existing Site Conditions

5.3 Landslide Risk Assessment/Methodology

Based on the information provided by the Client, our methodology in addressing the geotechnical brief included the following:

- A geotechnical site walkover for landslide risk assessment of the existing site slopes, fill conditions, and proposed earthworks;
- Review of the survey data for the site (if available);
- Review of proposed development plans;
- Review of the engineering drawings; and
- Review of AS3798 – Guidelines on Earthworks for Commercial and Residential Developments.

A suitably qualified and experienced geotechnical engineer undertook the detailed site walkover on August 09, 2024.

5.3.1 Geotechnical Issues

Based on the site conditions, issues of geotechnical relevance are the following:

- The disturbance of a site with slopes of approximately 5 to 30^{o} that can cause the current stable slopes to become unstable;
- The proposed footing types onsite;
- Proposed fill placement on sloping ground; and
- The potential and consequences of failure of the proposed new structures on the site, including cut-to-fill batters, retaining structures and footing systems.

5.3.2 Landslide Assessment Criteria and Methodology

With a view to managing risks to life and property associated with natural disasters such as landslides, etc., pose to occupants in a development, it is Council's requirement that the susceptibility of such developments to natural disasters should be addressed. The following criteria are considered as part of Council's Operational Work condition for approving a Site:

- That the landslide risk susceptibility of a site should be deemed to be 'low' in accordance with 'Landslide Risk Management' Australian Geomechanics Journal Vol. 43, No. 1 March 2007.
- Part B of the Council's requirement indicates that where the average grade of a finished lot surface exceeds 15%, the site must be certified by a geotechnical professional as having a 'low risk' in relation to landslide.

The methodology adopted for the landslide risk assessment at this site was to the requirement of Australian Geomechanics (AGS) Landslide Risk Management guidelines as contained in the Australian

Geomechanics Journal Vol. 42 No. 1, March 2007. Due to the broad scope of the AGS journal, it does not specifically cover small-sized developments. The work of Hargreaves and Kidd (2012), which is in line with AGS Vol. 42, No. 1 2007, has conceptualised landslide risk management in a way that is amenable to small-sized developments and has been adopted for this assessment.

This study by Hargreaves and Kidd (2012) provides an evaluation of the level of site hazards in relation to landsliding. The hazard rating is based on a five-level system and classified into Very Low, Low, Moderate, High, and Very High categories.

The implications of this hazard rating classification are indicated in *Table 14*.

Table 9: Implications of Hazard Classification

Hazard Rating	Description	Implications
Very Low (VL)	The event is conceivable but only under exceptional circumstances	Accepted. Managed by routine procedures
Low (L)	The event might occur under very adverse conditions	Can be accepted. Treatment to maintain or reduce risk level should be defined
Moderate (M)	The event could occur under adverse conditions	May be acceptable provided treatment plan is implemented to maintain or reduce risk level
High (H)	The event will probably occur under adverse conditions	Detailed investigation, planning and implementation of treatment options essential to reduce risk to acceptable levels.
Very High (VH)	The event is expected to occur	Extensive investigation, planning and implementation of treatment options essential to reduce risk to acceptable levels

5.3.3 Assessment of Site Features and Relative Frequency Analysis

Logan City Council's online Landslide Hazard Overlay Map has identified the site as having a landslide risk potential (> 15% slope).

An extract from the Landslide Overlay map showing the site is presented in *Figure 9* and highlighted in red.

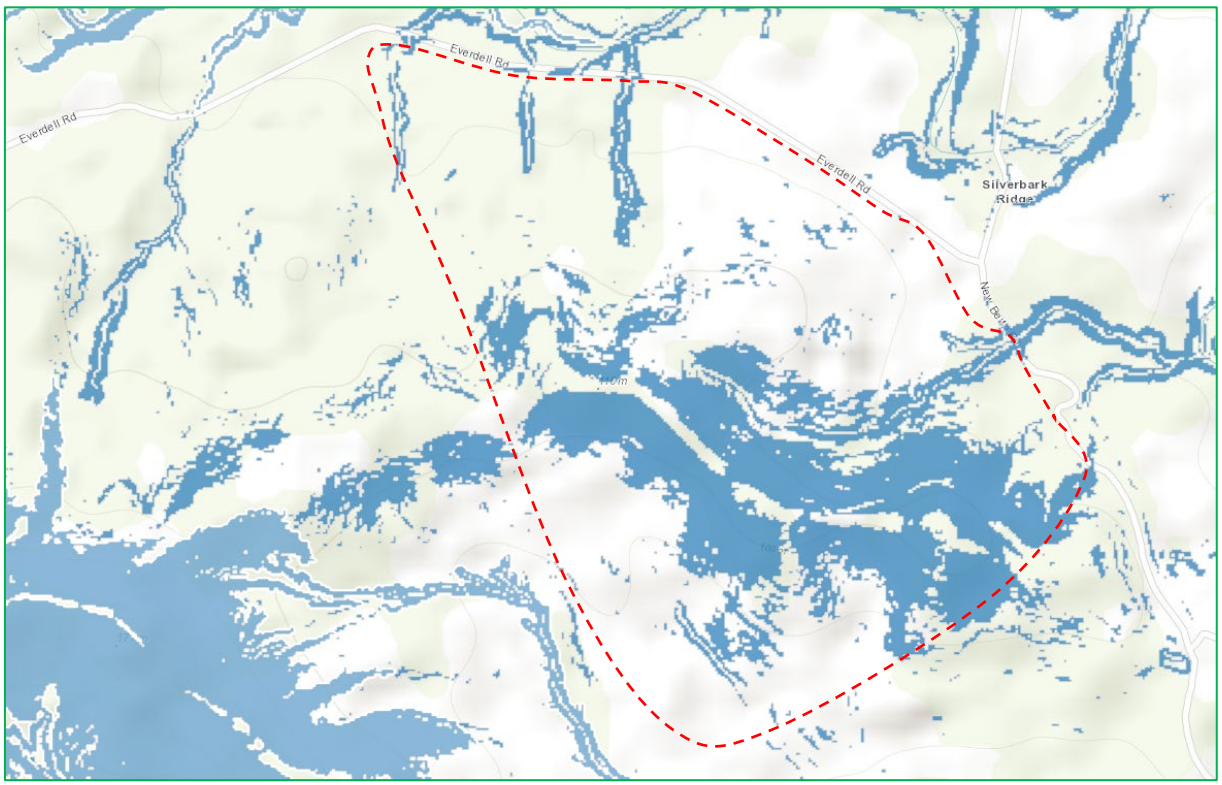

Figure 10: Logan City Council Landslide Hazard and Steep Slope Area Trigger – The Approximate Location of The Site Highlighted in Red

5.3.4 Geotechnical Site Walkover

A site inspection was undertaken to confirm the geological, geomorphology, fill conditions, and to assess the likely hazard rating based on site features that contribute to the initiation of a landslide.

The slope stability walkover assessment was undertaken on August 09, 2024.

A site report and frequency analysis were undertaken during the visit. The site report is a standard form that identifies the site features that contribute to the occurrence of a landslide.

The major site features relevant to this assessment for natural and man-made slopes are:

1. Slope Angle: In general, the steeper the average surface slope angle, the higher the risk of slope instability. Slope angles were directly measured onsite as well as calculated based on the detailed survey plan;
2. Slope Shape and Features: The shape of the slope provides an indication of the method of slope development and the materials below the surface. Concave shapes often indicate past movements;
3. Engineering Properties of Sub-surface Materials: The engineering properties of the materials forming the subsurface profile contribute to the risk of slope instability. Most slope failures occur in soil-strength material, and deeper soils increase the likelihood of slope failure. The available information indicates shallow soils overlying weathered rock. However, care should be taken where uncontrolled fill and colluvium soils occur as these materials have a higher potential to trigger instability;
4. The Concentration of Surface/Ground Water: Water is one of the most important factors in landslides' occurrence. The majority of slope failures occur during or following rainfall events when there is a combination of surface erosion and saturation of subsurface materials. The concentration of Groundwater: The presence of a high groundwater table can provide a similar long-term situation to a rainfall event and contribute to slope failure without a major rainfall event;
5. Evidence of Instability: In many cases, slope failures occur due to the reactivation of previous landslides. The presence of features that indicate past slope instability provides evidence that could initiate future slope movement;
6. Regional position on a hillside; and
7. Site geology
8. Cut depth;
9. Cut batter angle;
10. Cut batter support;
11. Fill depth;
12. Fill batter angle;
13. Fill Batter Support;
14. Type of fill;
15. Wastewater, sewerage, etc;
16. Stormwater disposal;
17. Expandable/mechanical stormwater and drainage pipe connectors;
18. Footing system;
19. The foundation strata;
20. In-ground tanks (any type); and
21. Landscaping.

Additional observations onsite include:

- No areas of major distress or slope instability were observed onsite;
- No groundwater or seepage was observed across the site;
- No tension cracks were observed within the site;
- Hummocky or bulging soils were not identified on the site slopes. There were sections of uneven ground, which is, however, attributed to the previous removal of trees;
- Physical observations made on trees indicate signs of soil creep; and
- The existing concrete driveway and culvert that crosses the drainage gully do not show signs of distress.

Evaluation of these features in a Landslide Frequency Assessment Form provided an indication of their relative importance to slope failure. The assessment of the features included the allocation of a weighted factor for each feature based on site observations, judgment, and experience. This allows a Relative Frequency to be calculated by multiplying the selected factors together for each of the above site conditions highlighted in blue and green.

From the assessment of results from their study (Hargreaves and Kidd 2012) and other studies in similar terrain, a correlation between Relative Frequency and Hazard Rating has been established, as shown in *Table 15*.

Table 10: Correlation between Relative Frequency and Hazard Rating

Relative Frequency (Output)	Hazard Rating (Susceptibility)
< 0.2	Very Low (VL)
0.2 – 0.6	Low (L)
> 0.6 – 2.0	Moderate (M)
> 2.0 – 6.0	High (H)
> 6.0	Very High (VH)

The above major site features listed in Section 5.3.4 have been considered in determining a likelihood estimate of landslides in this property. The features relevant to this site under consideration, as recommended by Hargreaves and Kidd (2012), apply to **Case 1 (1 - 7)** and **Case 4 (1 – 22)**.

With knowledge of the proposed development (earthworks, retention systems, fill, etc.), the assessment has been carried out for the pre and post-development stages. The assessment indicates that the relative frequency (Output) pre-development is ***0.45*** for Case 1 (items 1 to 7), which implies that the landslide risk on the site is "**Low**" (Appendix C).

To ensure the potential landslide risk level remains "**Low**" or better post-development, the recommendations presented in Section 5.4 should be implemented during and after construction.

5.4 Landslide Risk Mitigation Strategy

The following recommendations are provided to maintain the “low” or better landslide risk level onsite during and post-earthworks.

5.4.1 Fill

The borehole logs disclosed no fill onsite. However, given the landform and the disturbed state, it is expected that minor localised areas of fill would be present across the site. Any material identified as fill is deemed unsuitable to support structural loads. In addition, colluvium material, especially on sloping ground may be present, this may present an increased landslide risk. In areas subject to structural loads, these materials must be removed and replaced with fill that is engineered and certified. All fill must be such that it is keyed into the competent sloping surface.

5.4.2 Fill Placement

A site won, or imported fill must be placed in accordance with AS3798-2007. Imported select fill material should be a good quality select fill material with a soaked CBR of at least 10%, a maximum aggregate size of 50mm, and a maximum Shrink/Swell Index of 1.0%. Fill must be keyed into the existing slopes.

5.4.3 Cut and Fill Batter Support

Cut/fill batters must be cut to a grade no greater than 14 degrees (1V:4H). Batters steeper than 14 degrees must be appropriately retained. A post and concrete sleeper wall is deemed appropriate for the subsurface conditions. However, if the bedrock is exposed, boulder/sandstone block walls will be appropriate.

5.4.4 Stormwater Disposal

Stormwater collected within the site should be directed into designated drains and directed to Council's stormwater system. Disposal of stormwater on the surface is not permitted in the immediate vicinity of proposed building areas;

5.4.5 Site Drainage

Surface runoff should be diverted away from proposed retaining walls and dwellings to prevent scouring, riling, and erosion. The site drain shall be designed and inspected by a qualified person.

5.4.6 Footing System

All footings must be designed in accordance with AS2870-2011. It is expected that piers supported slab-on-ground, pad and strip footing systems will be used onsite.

However, the following should be noted:

- Piers must be extended beyond any fill and sufficiently socketed into at least very stiff or dense alluvial/residual for fill on sloping surfaces. Under no circumstances should the piers be terminated within fill placed on sloping surfaces.
- The fill pad for a raft/slab footing must be constructed under a Level 1 inspection regime and certified as a controlled fill. The footings for the retaining wall must be well socketed into the underlying rock.
- Strip footings are not a preferred foundation system on sloping ground. To reduce the risk of ongoing creep causing foundation movements and, thus, cracks to the above brickwork, it is recommended that the strip footings be found on a horizontal trench base excavated well into the underlying rock.
- The most efficient foundation system for the site based on site conditions is the post or stump foundations with minimal disturbance on existing slopes. The structural engineer may consider this system of foundation support for the buildings or the above-listed options.

5.4.7 Roof Water Control

Ensure house downspouts are not flowing onto any fill/slopes but are collected and channelled into storm water drains. Leaks along these lines should be avoided.

5.4.8 Erosion Control

Erosion protection of all exposed batters should be carried out at the site. All runoff at the site should be appropriately channelled to ensure that runoff does not cause severe erosion that may result in adverse ground profiles.

5.4.9 Retaining Walls

All proposed retaining structures should be designed by a qualified person and checked for global stability, sliding, and rotational failure.

*Following the implementation of the above recommendations, the site has been reassessed, based on Cases 1 – 22, to have a hazard rating of **0.40**, remaining at a "**Low**" landslide risk.*

6 Conclusions

This geotechnical interpretative report is a product of a site investigation conducted at New Beith Road, Flagstone Qld, with real property description Lots 911 & 908 on SP335853 (Context 2 Area). The property covers a gross land area of approximately 144.41ha and it is proposed for the configuration of 2 lots into 1635 lots.

The site lies within alluvial/residual soil deposits underlain by a sandstone rock unit. The depth to top of rock across the site was relatively shallow, ranging from 0.6 to 1.2m bgl.

The site has been assigned a **Class P** site classification given the current slopes and likely quantum of fill to be placed on the site, the low bearing pressure at the upper soil, and susceptibility to landslide.

The underlying alluvial/residual clays were established to have a potential ground movement of up to 85mm under normal moisture conditions which corresponds to a ***Class E*** site in accordance with AS2870-2011.

The available plans show cut-to-fill construction along with retaining structures proposed for the site. The report provides design and construction recommendations and advice to ensure that the development is appropriate for the site conditions.

The site has been identified as being within the map overlay for landslide hazards. As such, the Council requested a site-specific report addressing the stability of the site slopes pre and post-construction.

The slope stability (landslide) assessment has been conducted, and the site, in its current state, has been assigned a "Low" landslide risk category. The site was also reassessed following the completion of the proposed earthworks. Provided the recommendations itemised in Section 5.4 is adhered to, the risk of landslide events remains “Low” for the site.

Based on the results of the geotechnical investigation, including the potential landslide assessment, we conclude that the site is suitable for the proposed development and has a “Low" risk of slope instability, provided the recommendations outlined in this report are adhered to.

7 Disclaimer

This report has been prepared on behalf of and for the exclusive use of PEET Flagstone City Pty Ltd and their design partners in accordance with the scope of work outlined in Proposal *QGQ24-336*, Ref No: 6288, dated August 01, 2024. This report is not intended for and should not be relied upon by any third party. In preparing this report, Qualtest relied upon information provided by PEET Flagstone Pty Ltd. This report must be read in conjunction with the attached appendices and kept in its entirety without separating individual pages or sections. This report, or sections from this report, should not be used as part of a specification for a project without review and agreement by Qualtest.

Interpretations and recommendations provided in the report are based on the ground conditions at the site, only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. This is because ground conditions are subject to change from place to place and with time due to geological processes and/or because of human influences.

The advice provided by Qualtest is based on the conditions encountered onsite at the time of the investigation. If different ground conditions are encountered following the issuance of this report, Qualtest should be notified so that further advice can be provided.

Should you require further information regarding the above, please do not hesitate to contact this office.

Yours faithfully,

MICHAEL MORRISON **DENNIS ALAZIGHA,** *RPEQ 22169*

For and on behalf of
QUALTEST LABORATORY PTY LTD

Appendix A: Engineering Logs
Appendix B: Laboratory Test Certificates
Appendix C: The Landslide Frequency Assessment Form

APPENDIX A

Engineering Logs

Qualtest Laboratory
Est. 1987

Qualtest Laboratory
Est. 1987

Qualtest
2/40 Boyland Ave, Coopers Plains QLD 4108
Phone: (07) 3875 1898

Geotechnical Log - Borehole

QT1

UTM	: 56J	Drill Rig	: Jacro 200	Job Number	: 24-338
Easting (m)	: 492,763.30	Driller Supplier	: Qualtest	Client	: Peet
Northing (m)	: 6,926,906.90	Logged By	: TS	Project	: GI site investigation Proposed residential Development
Ground Elevation	: Not Surveyed	Reviewed By	: DA	Location	: New Beith Road, Flagstone QLD
Total Depth	: 2 m BGL	Date	: 09/08/2024	Loc Comment	:

Depth (m)	Soil Origin	Classification Code	Moisture	Material Description	Consistency/Density	Samples	DCP graph
0.1	Topsoil	SM	M	Silty SAND: fine to medium grained, loose, light brown, moist, with rootlets.	L		2
	Alluvial	CI-CH	w ≈ PL	Sandy CLAY: medium to high plasticity, firm, light brown mottled red, fine to medium grained sand, w ≈ pl.	F	D: EM	3 3 2 2 3 3
0.7	Residual	SC	D	Clayey SAND: fine to medium grained, loose to medium dense, orange mottled yellow, dry, low plasticity clay.	L-MD		4 4 5
1.2	Rock	SST		Silty SAND: fine to medium grained, very dense, brown mottled grey, dry.	VD		
				QT1 refusal at 2m (Max Tc)			

METHOD

EX	Excavator bucket
R	Ripper
HA	Hand auger
PT	Push tube
SON	Sonic drilling
AH	Air hammer
PS	Percussion sampler
AS	Short spiral auger
AD/V	Solid flight auger:V-Bit
AD/T	Solid flight auger:TC-Bit
HFA	Hollow flight auger
WB	Washbore drilling
RR	Rock roller

PENETRATION

VE	Very Easy(No Resistance)
E	Easy
F	Firm
H	Hard
VH	Very Hard(Refusal)

WATER

- Water Level on Date
- Water inflow
- Water outflow

FIELD TESTS

SPT	- Standard Penetration Test
PP	- Hand/Pocket Penetrometer
DCP	- Dynamic Cone Penetrometer
PSP	- Perth Sand Penetrometer
MC	- Moisture Content
PBT	- Plate Bearing Test
IMP	- Borehole Impression Test
PID	- Photo Ionisation Detector
VS	- Vane Shear; P=Peak, R=residual (unconnected kPa)

SAMPLES

B	- Bulk disturbed sample
D	- Disturbed sample
ES	- Environmental sample
U	- Thin wall tube "undisturbed"

MOISTURE

D	- Dry
M	- Moist
W	- Wet
PL	- plastic limit
LL	- liquid limit
W	- Moisture content

SOIL CONSISTENCY

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

RELATIVE DENSITY

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

Refer to explanatory notes for details of abbreviations and basis of descriptions

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Phone: (07) 3875 1898

Geotechnical Log - Borehole

QT10

UTM	: 56J	Drill Rig	: Jacro 200	Job Number	: 24-338
Easting (m)	: 493,025.80	Driller Supplier	: Qualtest	Client	: Peet
Northing (m)	: 6,925,198.30	Logged By	: TS	Project	: GI site investigation Proposed residential Development
Ground Elevation	: 60.32 (m)	Reviewed By	: DA	Location	: New Beith Road, Flagstone QLD
Total Depth	: 0.7 m BGL	Date	: 09/08/2024	Loc Comment	:

Drilling Method	DCP graph	Water	Depth (m)	Soil Origin	Graphic Log	Classification Code	Moisture	Material Description	Consistency/Density	Samples	Testing
	3		0.1	Topsoil		SM	M	Silty SAND: fine to coarse grained, loose, dark grey grey, moist.	L		
	3			Alluvial		SM		Silty SAND: fine to coarse grained, loose to medium dense, brown.	L-MD		
	6										
	4		0.4								
	18			Alluvial		CI-CH	w ≈ PL	Sandy CLAY: medium to high plasticity, hard, brown mottled grey, fine to medium grained sand, w ≈ pl.	H		
	20.....30		0.6								
				Rock		SST	D	Silty SAND: fine to coarse grained, very dense, brown brown.	VD	D: Em	
								QT10 refusal at 0.7m			

METHOD

EX	Excavator bucket
R	Ripper
HA	Hand auger
PT	Push tube
SON	Sonic drilling
AH	Air hammer
PS	Percussion sampler
AS	Short spiral auger
AD/V	Solid flight auger:V-Bit
AD/T	Solid flight auger:TC-Bit
HFA	Hollow flight auger
WB	Washbore drilling
RR	Rock roller

PENETRATION

VE	Very Easy(No Resistance)
E	Easy
F	Firm
H	Hard
VH	Very Hard(Refusal)

WATER

- Water Level on Date
- Water inflow
- Water outflow

FIELD TESTS

SPT	- Standard Penetration Test
PP	- Hand/Pocket Penetrometer
DCP	- Dynamic Cone Penetrometer
PSP	- Perth Sand Penetrometer
MC	- Moisture Content
PBT	- Plate Bearing Test
IMP	- Borehole Impression Test
PID	- Photo Ionisation Detector
VS	- Vane Shear; P=Peak, R=residual (unconnected kPa)

SAMPLES

B	- Bulk disturbed sample
D	- Disturbed sample
ES	- Environmental sample
U	- Thin wall tube "undisturbed"

MOISTURE

D	- Dry
M	- Moist
W	- Wet
PL	- plastic limit
LL	- liquid limit
W	- Moisture content

SOIL CONSISTENCY

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

RELATIVE DENSITY

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

Refer to explanatory notes for details of abbreviations and basis of descriptions

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Est. 1987

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2/40 Boyland Ave, Coopers Plains QLD 4108

Phone: (07) 3875 1898

Geotechnical Log - Borehole

QT2

UTM	: 56J	Drill Rig	: Jacro 200	Job Number	: 24-338
Easting (m)	: 493,533.60	Driller Supplier	: Wagner Drilling	Client	: Peet
Northing (m)	: 6,926,586.40	Logged By	: TS	Project	: GI site investigation Proposed residential Development
Ground Elevation	: Not Surveyed	Reviewed By	: DA	Location	: New Beith Road, Flagstone QLD
Total Depth	: 0.9 m BGL	Date	: 09/08/2024	Loc Comment	:

Drilling Method	DCP graph	Water	Depth (m)	Soil Origin	Graphic Log	Classification Code	Moisture	Material Description	Consistency/Density	Samples	Testing
	1		0.1	Topsoil		SM	M	Silty SAND: fine to medium grained, loose, light brown, moist, with rootlets.	L		
	2			Residual		SM	W-M	Silty SAND: fine to medium grained, loose to medium dense, brown, wet to moist.	L-MD		
	3										
	5										
	4									D: EM	
	4										
	20/60		0.6	Residual		CI-CH	w < PL	Sandy CLAY: medium to high plasticity, hard, brown mottled orange, fine to medium grained sand, w < pl.	H		
			0.8	Rock		SST	D	Clayey SAND: fine to medium grained, very dense, orange, dry, low plasticity clay.	VD		
								QT2 refusal at 0.9m (Max Tc)			

METHOD

EX	Excavator bucket
R	Ripper
HA	Hand auger
PT	Push tube
SON	Sonic drilling
AH	Air hammer
PS	Percussion sampler
AS	Short spiral auger
AD/V	Solid flight auger:V-Bit
AD/T	Solid flight auger:TC-Bit
HFA	Hollow flight auger
WB	Washbore drilling
RR	Rock roller

PENETRATION

VE	Very Easy(No Resistance)
E	Easy
F	Firm
H	Hard
VH	Very Hard(Refusal)

WATER

- Water Level on Date
- Water inflow
- Water outflow

FIELD TESTS

SPT	- Standard Penetration Test
PP	- Hand/Pocket Penetrometer
DCP	- Dynamic Cone Penetrometer
PSP	- Perth Sand Penetrometer
MC	- Moisture Content
PBT	- Plate Bearing Test
IMP	- Borehole Impression Test
PID	- Photo Ionisation Detector
VS	- Vane Shear; P=Peak, R=residual (unconnected kPa)

SAMPLES

B	- Bulk disturbed sample
D	- Disturbed sample
ES	- Environmental sample
U	- Thin wall tube "undisturbed"

MOISTURE

D	- Dry
M	- Moist
W	- Wet
PL	- plastic limit
LL	- liquid limit
W	- Moisture content

SOIL CONSISTENCY

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

RELATIVE DENSITY

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

Refer to explanatory notes for details of abbreviations and basis of descriptions

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Geotechnical Log - Borehole

QT3

UTM	: 56J	**Drill Rig**	: Jacro 200	**Job Number**	: 24-338
Easting (m)	: 493,035.10	**Driller Supplier**	: Wagner Drilling	**Client**	: Peet
Northing (m)	: 6,926,409.50	**Logged By**	: TS	**Project**	: GI site investigation Proposed residential Development
Ground Elevation	: Not Surveyed	**Reviewed By**	: DA	**Location**	: New Beith Road, Flagstone QLD
Total Depth	: 0.7 m BGL	**Date**	: 09/08/2024	**Loc Comment**	:

Drilling Method	DCP graph	Water	Depth (m)	Soil Origin	Graphic Log	Classification Code	Moisture	Material Description	Consistency/Density	Samples	Testing
	10 30 20/40		0.05	Topsoil		SM	M	Silty SAND: fine to medium grained, dense, dark grey, moist, with rootlets.	D		
				Residual		SM		Silty SAND: fine to medium grained, trace fine to medium sized gravel, very dense, red, moist.	VD	D: EM	
			0.6	Rock		SST	D	Clayey SAND: fine to medium grained, very dense, red, dry, low plasticity clay.			
								QT3 refusal at 0.7m (Max Tc)			

METHOD

EX	Excavator bucket
R	Ripper
HA	Hand auger
PT	Push tube
SON	Sonic drilling
AH	Air hammer
PS	Percussion sampler
AS	Short spiral auger
AD/V	Solid flight auger:V-Bit
AD/T	Solid flight auger:TC-Bit
HFA	Hollow flight auger
WB	Washbore drilling
RR	Rock roller

PENETRATION

VE	Very Easy(No Resistance)
E	Easy
F	Firm
H	Hard
VH	Very Hard(Refusal)

WATER

- Water Level on Date
- Water inflow
- Water outflow

FIELD TESTS

SPT	- Standard Penetration Test
PP	- Hand/Pocket Penetrometer
DCP	- Dynamic Cone Penetrometer
PSP	- Perth Sand Penetrometer
MC	- Moisture Content
PBT	- Plate Bearing Test
IMP	- Borehole Impression Test
PID	- Photo Ionisation Detector
VS	- Vane Shear; P=Peak, R=residual (unconnected kPa)

SAMPLES

B	- Bulk disturbed sample
D	- Disturbed sample
ES	- Environmental sample
U	- Thin wall tube "undisturbed"

MOISTURE

D	- Dry
M	- Moist
W	- Wet
PL	- plastic limit
LL	- liquid limit
W	- Moisture content

SOIL CONSISTENCY

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

RELATIVE DENSITY

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

Refer to explanatory notes for details of abbreviations and basis of descriptions

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Qualtest

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Geotechnical Log - Borehole

QT4

UTM	: 56J	Drill Rig	: Jacro 200	Job Number	: 24-338
Easting (m)	: 492,596.30	Driller Supplier	: Wagner Drilling	Client	: Peet
Northing (m)	: 6,926,496.60	Logged By	: TS	Project	: GI site investigation Proposed residential Development
Ground Elevation	: Not Surveyed	Reviewed By	: DA	Location	: New Beith Road, Flagstone QLD
Total Depth	: 3 m BGL	Date	: 09/08/2024	Loc Comment	:

Drilling Method	DCP graph	Water	Depth (m)	Soil Origin	Graphic Log	Classification Code	Moisture	Material Description	Consistency/Density	Samples	Testing
	1		0.1	Topsoil		SM	M	Silty SAND: fine to medium grained, loose, dark brown, moist, with rootlets.	L		
	2			Alluvial		SM			L-MD		
	2							Silty SAND: fine to medium grained, loose to medium dense, brown, moist.			
	1										
	2										
	4										
	6		0.7								
	7			Alluvial		CI	w ≈ PL	Sandy CLAY: medium plasticity, stiff, brown mottled orange, fine to medium grained sand, w ≈ pl.	St		
	5		0.9								
	5			Residual		CH		Sandy CLAY: high plasticity, stiff, orange mottled grey, fine to medium grained sand, w ≈ pl.		D: PERM/EM U50: ISS	
			2.7	Rock		SST	D	Silty SAND: fine to medium grained, very dense, light grey mottled yellow, dry.	VD		
								QT4 Terminated at 3m (Target Depth)			

METHOD

EX	Excavator bucket
R	Ripper
HA	Hand auger
PT	Push tube
SON	Sonic drilling
AH	Air hammer
PS	Percussion sampler
AS	Short spiral auger
AD/V	Solid flight auger:V-Bit
AD/T	Solid flight auger:TC-Bit
HFA	Hollow flight auger
WB	Washbore drilling
RR	Rock roller

PENETRATION

VE	Very Easy(No Resistance)
E	Easy
F	Firm
H	Hard
VH	Very Hard(Refusal)

WATER

- Water Level on Date
- Water inflow
- Water outflow

FIELD TESTS

SPT	- Standard Penetration Test
PP	- Hand/Pocket Penetrometer
DCP	- Dynamic Cone Penetrometer
PSP	- Perth Sand Penetrometer
MC	- Moisture Content
PBT	- Plate Bearing Test
IMP	- Borehole Impression Test
PID	- Photo Ionisation Detector
VS	- Vane Shear; P=Peak, R=residual (unconnected kPa)

SAMPLES

B	- Bulk disturbed sample
D	- Disturbed sample
ES	- Environmental sample
U	- Thin wall tube "undisturbed"

MOISTURE

D	- Dry
M	- Moist
W	- Wet
PL	- plastic limit
LL	- liquid limit
W	- Moisture content

SOIL CONSISTENCY

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

RELATIVE DENSITY

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

Refer to explanatory notes for details of abbreviations and basis of descriptions

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Phone: (07) 3875 1898

Geotechnical Log - Borehole

QT5

UTM	: 56J	**Drill Rig**	: Jacro 200	**Job Number**	: 24-338
Easting (m)	: 493,567.10	**Driller Supplier**	: Wagner Drilling	**Client**	: Peet
Northing (m)	: 6,962,109.10	**Logged By**	: TS	**Project**	: GI site investigation Proposed residential Development
Ground Elevation	: Not Surveyed	**Reviewed By**	: DA	**Location**	: New Beith Road, Flagstone QLD
Total Depth	: 1.2 m BGL	**Date**	: 09/08/2024	**Loc Comment**	:

Drilling Method	DCP graph	Water	Depth (m)	Soil Origin	Graphic Log	Classification Code	Moisture	Material Description	Consistency/Density	Samples	Testing
	16		0.1	Topsoil		SM	D	Silty SAND: fine to medium grained, trace fine to medium sized gravel, very dense, light grey, dry, with rootlets.	VD		
	14			Fill		Cl	w < PL		VSt-H		
	12							Sandy CLAY: medium plasticity, light brown mottled orange red, very stiff to hard, fine to medium grained sand, w < pl.			
	8		0.4								
	4			Residual		CH	w ≈ PL		St-VSt	U50: ISS	
	6							Sandy CLAY: high plasticity, stiff to very stiff, red mottled grey, fine to medium grained sand, w ≈ pl.			
	9										
	10		0.8								
	10			Residual		Cl	w < PL	CLAY: medium plasticity, very stiff, yellow, trace fine to medium grained sand, w < pl.	VSt	D: EM	
	9		1								
	20/50			Rock		SST	D	Clayey SAND: fine to medium grained, very dense, dark brown mottled yellow, dry, low plasticity clay.	VD		
								QT5 refusal at 1.2m (Max Tc)			

METHOD

EX	Excavator bucket
R	Ripper
HA	Hand auger
PT	Push tube
SON	Sonic drilling
AH	Air hammer
PS	Percussion sampler
AS	Short spiral auger
AD/V	Solid flight auger:V-Bit
AD/T	Solid flight auger:TC-Bit
HFA	Hollow flight auger
WB	Washbore drilling
RR	Rock roller

PENETRATION

VE	Very Easy(No Resistance)
E	Easy
F	Firm
H	Hard
VH	Very Hard(Refusal)

WATER

- Water Level on Date
- Water inflow
- Water outflow

FIELD TESTS

SPT	- Standard Penetration Test
PP	- Hand/Pocket Penetrometer
DCP	- Dynamic Cone Penetrometer
PSP	- Perth Sand Penetrometer
MC	- Moisture Content
PBT	- Plate Bearing Test
IMP	- Borehole Impression Test
PID	- Photo Ionisation Detector
VS	- Vane Shear; P=Peak, R=residual (unconnected kPa)

SAMPLES

B	- Bulk disturbed sample
D	- Disturbed sample
ES	- Environmental sample
U	- Thin wall tube "undisturbed"

MOISTURE

D	- Dry
M	- Moist
W	- Wet
PL	- plastic limit
LL	- liquid limit
W	- Moisture content

SOIL CONSISTENCY

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

RELATIVE DENSITY

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

Refer to explanatory notes for details of abbreviations and basis of descriptions

Qualtest

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Est. 1987

Qualtest

2/40 Boyland Ave, Coopers Plains QLD 4108

Phone: (07) 3875 1898

Geotechnical Log - Borehole

QT6

UTM	: 56J	**Drill Rig**	: Jacro 200	**Job Number**	: 24-338
Easting (m)	: 492,493.60	**Driller Supplier**	: Wagner Drilling	**Client**	: Peet
Northing (m)	: 6,926,112.30	**Logged By**	: TS	**Project**	: GI site investigation Proposed residential Development
Ground Elevation	: Not Surveyed	**Reviewed By**	: DA	**Location**	: New Beith Road, Flagstone QLD
Total Depth	: 0.7 m BGL	**Date**	: 09/08/2024	**Loc Comment**	:

Drilling Method	DCP graph	Water	Depth (m)	Soil Origin	Graphic Log	Classification Code	Moisture	Material Description	Consistency/Density	Samples	Testing
	2		0.1	Topsoil		SM	M	Silty SAND: fine to medium grained, loose, brown, moist, with rootlets.	L		
	3			Alluvial		SM		Silty SAND: fine to medium grained, loose, brown mottled grey, moist.			
	3										
	3		0.4								
	10			Alluvial		SM		Silty SAND: fine to medium grained, dense to very dense, brown mottled grey, moist.	D-VD		
	20/20										
			0.65	Rock		SST	M-D	Clayey SAND: fine to medium grained, very dense, brown mottled orange, moist to dry, low plasticity clay.	VD	D: EM	

QT6 refusal at 0.7m (Max Tc)

METHOD

EX	Excavator bucket
R	Ripper
HA	Hand auger
PT	Push tube
SON	Sonic drilling
AH	Air hammer
PS	Percussion sampler
AS	Short spiral auger
AD/V	Solid flight auger:V-Bit
AD/T	Solid flight auger:TC-Bit
HFA	Hollow flight auger
WB	Washbore drilling
RR	Rock roller

PENETRATION

VE	Very Easy(No Resistance)
E	Easy
F	Firm
H	Hard
VH	Very Hard(Refusal)

WATER

- Water Level on Date
- Water inflow
- Water outflow

FIELD TESTS

SPT	- Standard Penetration Test
PP	- Hand/Pocket Penetrometer
DCP	- Dynamic Cone Penetrometer
PSP	- Perth Sand Penetrometer
MC	- Moisture Content
PBT	- Plate Bearing Test
IMP	- Borehole Impression Test
PID	- Photo Ionisation Detector
VS	- Vane Shear; P=Peak, R=residual (unconnected kPa)

SAMPLES

B	- Bulk disturbed sample
D	- Disturbed sample
ES	- Environmental sample
U	- Thin wall tube "undisturbed"

MOISTURE

D	- Dry
M	- Moist
W	- Wet
PL	- plastic limit
LL	- liquid limit
W	- Moisture content

SOIL CONSISTENCY

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

RELATIVE DENSITY

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

Refer to explanatory notes for details of abbreviations and basis of descriptions

Qualtest

Qualtest Laboratory
Est. 1987

Qualtest

2/40 Boyland Ave, Coopers Plains QLD 4108

Phone: (07) 3875 1898

Geotechnical Log - Borehole

QT7

UTM	: 56J	Drill Rig	: Jacro 200	Job Number	: 24-338
Easting (m)	: 493,744.10	Driller Supplier	: Wagner Drilling	Client	: Peet
Northing (m)	: 6,925,949.90	Logged By	: TS	Project	: GI site investigation Proposed residential Development
Ground Elevation	: Not Surveyed	Reviewed By	: DA	Location	: New Beith Road, Flagstone QLD
Total Depth	: 0.7 m BGL	Date	: 09/08/2024	Loc Comment	:

Drilling Method	DCP graph	Water	Depth (m)	Soil Origin	Graphic Log	Classification Code	Moisture	Material Description	Consistency/Density	Samples	Testing
	5			Fill		CI	w < PL	Sandy CLAY: medium plasticity, grey brown, firm to stiff, fine to medium grained sand, trace fine to medium sized gravel, w < pl.	F-St		
	3										
	2										
	3		0.4								
	14			Fill		CI		Sandy CLAY: medium plasticity, grey brown, hard, fine to medium grained sand, trace fine to medium sized gravel, w < pl.	H		
	20/50		0.5	Residual		CI					
			0.6	Rock		SST		Sandy CLAY: medium plasticity, hard, grey mottled brown, fine to medium grained sand, w < pl.		D: EM	
								CLAY: medium to high plasticity, hard, brown mottled grey, trace fine to medium sized gravel, trace fine to medium grained sand, w < pl.			
								QT7 refusal at 0.7m (Max Tc)			

METHOD

EX	Excavator bucket
R	Ripper
HA	Hand auger
PT	Push tube
SON	Sonic drilling
AH	Air hammer
PS	Percussion sampler
AS	Short spiral auger
AD/V	Solid flight auger:V-Bit
AD/T	Solid flight auger:TC-Bit
HFA	Hollow flight auger
WB	Washbore drilling
RR	Rock roller

PENETRATION

VE	Very Easy(No Resistance)
E	Easy
F	Firm
H	Hard
VH	Very Hard(Refusal)

WATER

- Water Level on Date
- Water inflow
- Water outflow

FIELD TESTS

SPT	- Standard Penetration Test
PP	- Hand/Pocket Penetrometer
DCP	- Dynamic Cone Penetrometer
PSP	- Perth Sand Penetrometer
MC	- Moisture Content
PBT	- Plate Bearing Test
IMP	- Borehole Impression Test
PID	- Photo Ionisation Detector
VS	- Vane Shear; P=Peak, R=residual (unconnected kPa)

SAMPLES

B	- Bulk disturbed sample
D	- Disturbed sample
ES	- Environmental sample
U	- Thin wall tube "undisturbed"

MOISTURE

D	- Dry
M	- Moist
W	- Wet
PL	- plastic limit
LL	- liquid limit
W	- Moisture content

SOIL CONSISTENCY

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

RELATIVE DENSITY

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

Refer to explanatory notes for details of abbreviations and basis of descriptions

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2/40 Boyland Ave, Coopers Plains QLD 4108

Phone: (07) 3875 1898

Geotechnical Log - Borehole

QT8

UTM	: 56J	**Drill Rig**	: Jacro 200	**Job Number**	: 24-338
Easting (m)	: 493,256.10	**Driller Supplier**	: Wagner Drilling	**Client**	: Peet
Northing (m)	: 6,925,715.30	**Logged By**	: TS	**Project**	: GI site investigation Proposed residential Development
Ground Elevation	: Not Surveyed	**Reviewed By**	: DA	**Location**	: New Beith Road, Flagstone QLD
Total Depth	: 0.8 m BGL	**Date**	: 09/08/2024	**Loc Comment**	:

Drilling Method	DCP graph	Water	Depth (m)	Soil Origin	Graphic Log	Classification Code	Moisture	Material Description	Consistency/Density	Samples	Testing
	1		0.1	Topsoil		SM	W-M	Silty SAND: fine to medium grained, loose, dark brown, wet to moist, with rootlets.	L		
	2			Alluvial		SM		Silty SAND: fine to medium grained, loose, grey brown, wet to moist.			
	2										
	1		0.4								
	2			Alluvial		CI	w ≈ PL	Sandy CLAY: medium plasticity, firm, light grey brown, fine to medium grained sand, w ≈ pl.	F		
	2		0.6								
	20/40			Rock		SST	D	Clayey SAND: fine to medium grained, very dense, brown mottled yellow, dry, low plasticity clay.	VD	D: EM	
								QT8 refusal at 0.8m (Max Tc)			

METHOD

EX	Excavator bucket
R	Ripper
HA	Hand auger
PT	Push tube
SON	Sonic drilling
AH	Air hammer
PS	Percussion sampler
AS	Short spiral auger
AD/V	Solid flight auger:V-Bit
AD/T	Solid flight auger:TC-Bit
HFA	Hollow flight auger
WB	Washbore drilling
RR	Rock roller

PENETRATION

VE	Very Easy(No Resistance)
E	Easy
F	Firm
H	Hard
VH	Very Hard(Refusal)

WATER

- Water Level on Date
- Water inflow
- Water outflow

FIELD TESTS

SPT	- Standard Penetration Test
PP	- Hand/Pocket Penetrometer
DCP	- Dynamic Cone Penetrometer
PSP	- Perth Sand Penetrometer
MC	- Moisture Content
PBT	- Plate Bearing Test
IMP	- Borehole Impression Test
PID	- Photo Ionisation Detector
VS	- Vane Shear; P=Peak, R=residual (unconnected kPa)

SAMPLES

B	- Bulk disturbed sample
D	- Disturbed sample
ES	- Environmental sample
U	- Thin wall tube "undisturbed"

MOISTURE

D	- Dry
M	- Moist
W	- Wet
PL	- plastic limit
LL	- liquid limit
W	- Moisture content

SOIL CONSISTENCY

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

RELATIVE DENSITY

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L	- Loose
MD	- Medium dense
D	- Dense
VD	- Very dense

Refer to explanatory notes for details of abbreviations and basis of descriptions

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Est. 1987

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2/40 Boyland Ave, Coopers Plains QLD 4108

Phone: (07) 3875 1898

Geotechnical Log - Borehole

QT9

UTM	: 56J	**Drill Rig**	: Jacro 200	**Job Number**	: 24-338
Easting (m)	: 493,602.90	**Driller Supplier**	: Wagner Drilling	**Client**	: Peet
Northing (m)	: 6,925,376.70	**Logged By**	: TS	**Project**	: GI site investigation Proposed residential Development
Ground Elevation	: Not Surveyed	**Reviewed By**	: DA	**Location**	: New Beith Road, Flagstone QLD
Total Depth	: 3 m BGL	**Date**	: 09/08/2024	**Loc Comment**	:

Drilling Method	DCP graph	Water	Depth (m)	Soil Origin	Graphic Log	Classification Code	Moisture	Material Description	Consistency/Density	Samples	Testing
	2		0.1	Topsoil		SM	M	Silty SAND: fine to medium grained, loose, grey, moist, with rootlets.	L		
	1			Alluvial		CI	w > PL		S	D: EM	
	1		0.3					Sandy CLAY: medium plasticity, soft, light grey mottled brown, fine to medium grained sand, w > pl.			
	3			Alluvial		CI			F-St		
	3							Sandy CLAY: medium plasticity, firm to stiff, light grey mottled brown, fine to medium grained sand, w > pl.		U50: ISS	
	4										
	7										
	6		0.8								
	20/90			Alluvial		CI		Sandy CLAY: medium plasticity, hard, light grey mottled brown, fine to medium grained sand, w > pl.	H		
			1	Residual		SC	M	Clayey SAND: fine to medium grained, very dense, orange brown, moist, low to medium plasticity clay.	VD		
								QT9 Terminated at 3m (Target Depth)			

METHOD

EX	Excavator bucket
R	Ripper
HA	Hand auger
PT	Push tube
SON	Sonic drilling
AH	Air hammer
PS	Percussion sampler
AS	Short spiral auger
AD/V	Solid flight auger:V-Bit
AD/T	Solid flight auger:TC-Bit
HFA	Hollow flight auger
WB	Washbore drilling
RR	Rock roller

PENETRATION

VE	Very Easy(No Resistance)
E	Easy
F	Firm
H	Hard
VH	Very Hard(Refusal)

WATER

- Water Level on Date
- Water inflow
- Water outflow

FIELD TESTS

SPT	- Standard Penetration Test
PP	- Hand/Pocket Penetrometer
DCP	- Dynamic Cone Penetrometer
PSP	- Perth Sand Penetrometer
MC	- Moisture Content
PBT	- Plate Bearing Test
IMP	- Borehole Impression Test
PID	- Photo Ionisation Detector
VS	- Vane Shear; P=Peak, R=residual (unconnected kPa)

SAMPLES

B	- Bulk disturbed sample
D	- Disturbed sample
ES	- Environmental sample
U	- Thin wall tube "undisturbed"

MOISTURE

D	- Dry
M	- Moist
W	- Wet
PL	- plastic limit
LL	- liquid limit
W	- Moisture content

SOIL CONSISTENCY

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

RELATIVE DENSITY

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

Refer to explanatory notes for details of abbreviations and basis of descriptions

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APPENDIX B

Laboratory Test Certificates

Qualtest Laboratory

Est. 1987

Material Test Report

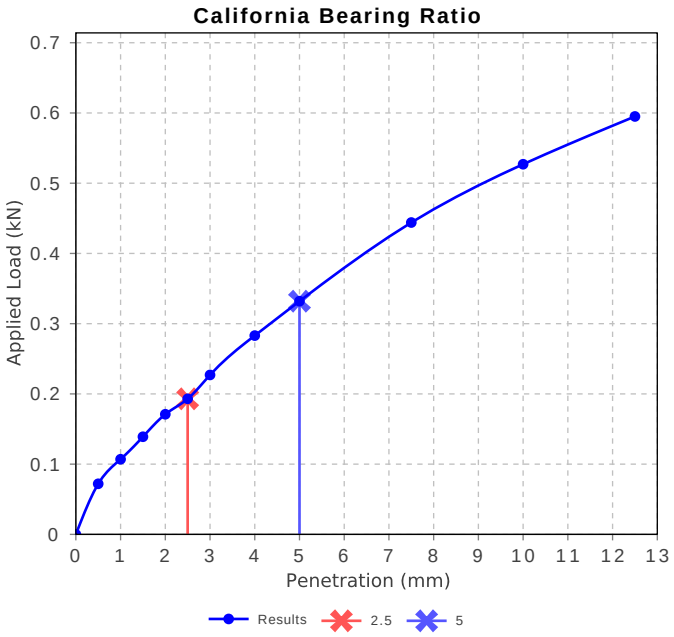
Report Number: 24-338-2
Issue Number: 1
Date Issued: 21/08/2024
Client: PEET FLAGSTONE CITY PTY LTD
Level 3, 167 Eagle Street, Brisbane QLD 4000
Contact: TROY THOMPSON
Project Number: 24-338
Project Name: GEOTECHNICAL SITE INVESTIGATION - CONTEXT AREA 3
Project Location: NEW BEITH ROAD, FLAGSTONE QLD
Work Request: 1366
Sample Number: S1366A
Date Sampled: 09/08/2024
Dates Tested: 13/08/2024 - 20/08/2024
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Preparation Method: AS 1289.1.1 - Sampling and Preparation of Soils
Site Selection: Selected by Client
Sample Location: **QT1, Depth: 0.2 - 0.7m**

Qualtest Laboratory Pty Ltd
Caboolture Laboratory
3 / 64 Evans Drive Caboolture QLD 4510
Phone: 0417 011 515
Email: ryan@qualtestgeo.com

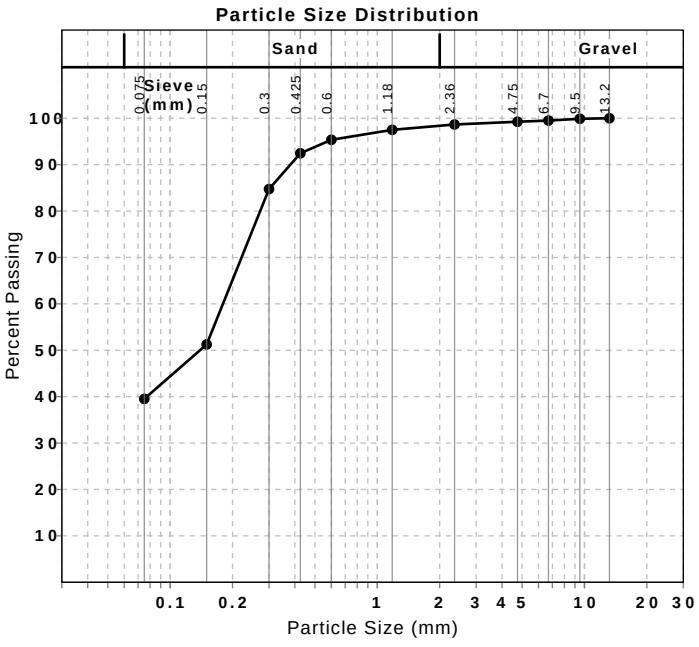
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Ryan Osborne
Soil Technician
NATA Accredited Laboratory Number: 2316

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**1.5**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual		
Maximum Dry Density (t/m^3)	1.82		
Optimum Moisture Content (%)	15.5		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	99.5		
Dry Density after Soaking (t/m^3)	1.82		
Field Moisture Content (%)	12.4		
Moisture Content at Placement (%)	15.5		
Moisture Content Top 30mm (%)	19.4		
Moisture Content Rest of Sample (%)	18.8		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	2.0		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)			



Particle Size Distribution (AS1289 3.6.1)						
Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
13.2 mm	**100**			0		
9.5 mm	**100**			0		
6.7 mm	**100**			0		
4.75 mm	**99**			0		
2.36 mm	**99**			1		
1.18 mm	**98**			1		
0.6 mm	**95**			2		
0.425 mm	**92**			3		
0.3 mm	**85**			8		
0.15 mm	**51**			33		
0.075 mm	**40**			12		



Material Test Report

Report Number: **24-338-2**
Issue Number: 1
Date Issued: 21/08/2024
Client: PEET FLAGSTONE CITY PTY LTD
Level 3, 167 Eagle Street, Brisbane QLD 4000
Contact: TROY THOMPSON
Project Number: 24-338
Project Name: GEOTECHNICAL SITE INVESTIGATION - CONTEXT AREA 3
Project Location: NEW BEITH ROAD, FLAGSTONE QLD
Work Request: 1366
Sample Number: S1366A
Date Sampled: 09/08/2024
Dates Tested: 13/08/2024 - 20/08/2024
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Preparation Method: AS 1289.1.1 - Sampling and Preparation of Soils
Site Selection: Selected by Client
Sample Location: **QT1, Depth: 0.2 - 0.7m**

Qualtest Laboratory Pty Ltd
Caboolture Laboratory
3 / 64 Evans Drive Caboolture QLD 4510
Phone: 0417 011 515
Email: ryan@qualtestgeo.com

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Approved Signatory: Ryan Osborne
Soil Technician
NATA Accredited Laboratory Number: 2316

Atterberg Limit (AS1289 3.9.2 & 3.2.1 & 3.3.2 & Q252)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Passing 0.425 (%)	92		
Retained 0.425 (%)	3		
Liquid Limit (%)	26		
Plastic Limit (%)	12		
Plasticity Index (%)	**14**		
Weighted Plasticity Index (%)	1294		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.9.2		
Linear Shrinkage (%)	**4.5**		
Cracking Crumbling Curling	Cracking		

Material Test Report

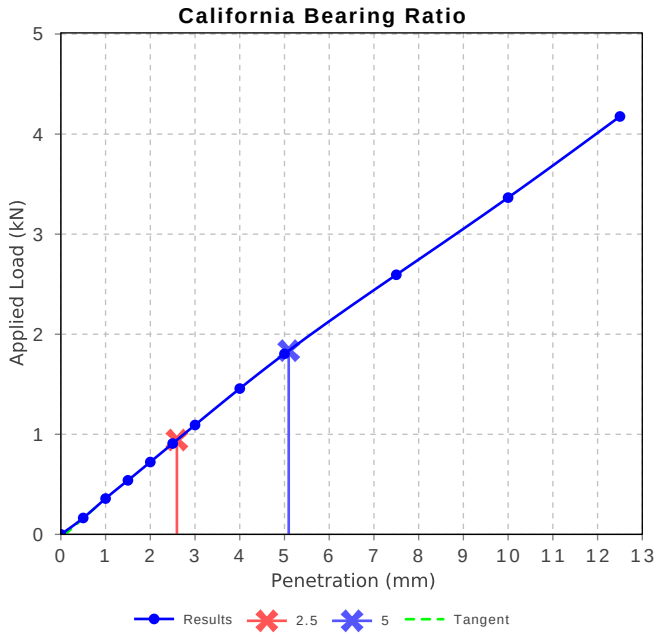
Report Number: **24-338-2**
Issue Number: 1
Date Issued: 21/08/2024
Client: PEET FLAGSTONE CITY PTY LTD
Level 3, 167 Eagle Street, Brisbane QLD 4000
Contact: TROY THOMPSON
Project Number: 24-338
Project Name: GEOTECHNICAL SITE INVESTIGATION - CONTEXT AREA 3
Project Location: NEW BEITH ROAD, FLAGSTONE QLD
Work Request: 1366
Sample Number: S1366B
Date Sampled: 09/08/2024
Dates Tested: 13/08/2024 - 20/08/2024
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Preparation Method: AS 1289.1.1 - Sampling and Preparation of Soils
Site Selection: Selected by Client
Sample Location: **QT6, Depth: 0.1 - 0.5m**

Qualtest Laboratory Pty Ltd
Caboolture Laboratory
3 / 64 Evans Drive Caboolture QLD 4510
Phone: 0417 011 515
Email: ryan@qualtestgeo.com

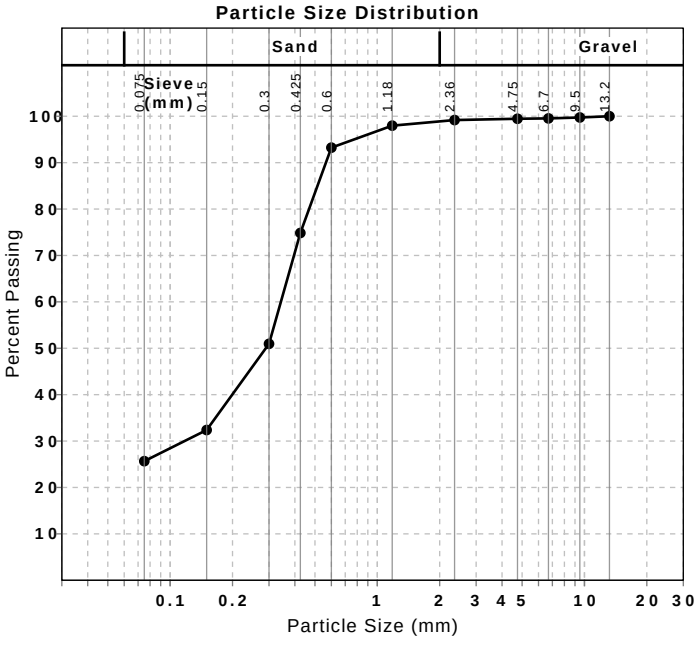
Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Ryan Osborne
Soil Technician
NATA Accredited Laboratory Number: 2316

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**9**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual		
Maximum Dry Density (t/m^3)	1.86		
Optimum Moisture Content (%)	12.5		
Laboratory Density Ratio (%)	101.0		
Laboratory Moisture Ratio (%)	101.5		
Dry Density after Soaking (t/m^3)	1.88		
Field Moisture Content (%)	12.8		
Moisture Content at Placement (%)	12.5		
Moisture Content Top 30mm (%)	14.9		
Moisture Content Rest of Sample (%)	13.7		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	2.0		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)			



Particle Size Distribution (AS1289 3.6.1)						
Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
13.2 mm	**100**			0		
9.5 mm	**100**			0		
6.7 mm	**100**			0		
4.75 mm	**99**			0		
2.36 mm	**99**			0		
1.18 mm	**98**			1		
0.6 mm	**93**			5		
0.425 mm	**75**			18		
0.3 mm	**51**			24		
0.15 mm	**32**			19		
0.075 mm	**26**			7		



Material Test Report

Report Number: **24-338-2**
Issue Number: 1
Date Issued: 21/08/2024
Client: PEET FLAGSTONE CITY PTY LTD
Level 3, 167 Eagle Street, Brisbane QLD 4000
Contact: TROY THOMPSON
Project Number: 24-338
Project Name: GEOTECHNICAL SITE INVESTIGATION - CONTEXT AREA 3
Project Location: NEW BEITH ROAD, FLAGSTONE QLD
Work Request: 1366
Sample Number: S1366B
Date Sampled: 09/08/2024
Dates Tested: 13/08/2024 - 20/08/2024
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Preparation Method: AS 1289.1.1 - Sampling and Preparation of Soils
Site Selection: Selected by Client
Sample Location: **QT6, Depth: 0.1 - 0.5m**

Qualtest Laboratory Pty Ltd
Caboolture Laboratory
3 / 64 Evans Drive Caboolture QLD 4510
Phone: 0417 011 515
Email: ryan@qualtestgeo.com

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Approved Signatory: Ryan Osborne
Soil Technician
NATA Accredited Laboratory Number: 2316

Atterberg Limit (AS1289 3.9.2 & 3.2.1 & 3.3.2 & Q252)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Passing 0.425 (%)	75		
Retained 0.425 (%)	18		
Liquid Limit (%)	24		
Plastic Limit (%)	13		
Plasticity Index (%)	**11**		
Weighted Plasticity Index (%)	823		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.9.2		
Linear Shrinkage (%)	**2.0**		
Cracking Crumbling Curling	Cracking		

Material Test Report

Report Number: **24-338-2**
Issue Number: 1
Date Issued: 21/08/2024
Client: PEET FLAGSTONE CITY PTY LTD
Level 3, 167 Eagle Street, Brisbane QLD 4000
Contact: TROY THOMPSON
Project Number: 24-338
Project Name: GEOTECHNICAL SITE INVESTIGATION - CONTEXT AREA 3
Project Location: NEW BEITH ROAD, FLAGSTONE QLD
Work Request: 1366
Sample Number: S1366C
Date Sampled: 09/08/2024
Dates Tested: 13/08/2024 - 20/08/2024
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Preparation Method: AS 1289.1.1 - Sampling and Preparation of Soils
Site Selection: Selected by Client
Sample Location: **QT8, Depth: 0.1 - 0.4m**

Qualtest Laboratory Pty Ltd
Caboolture Laboratory
3 / 64 Evans Drive Caboolture QLD 4510
Phone: 0417 011 515
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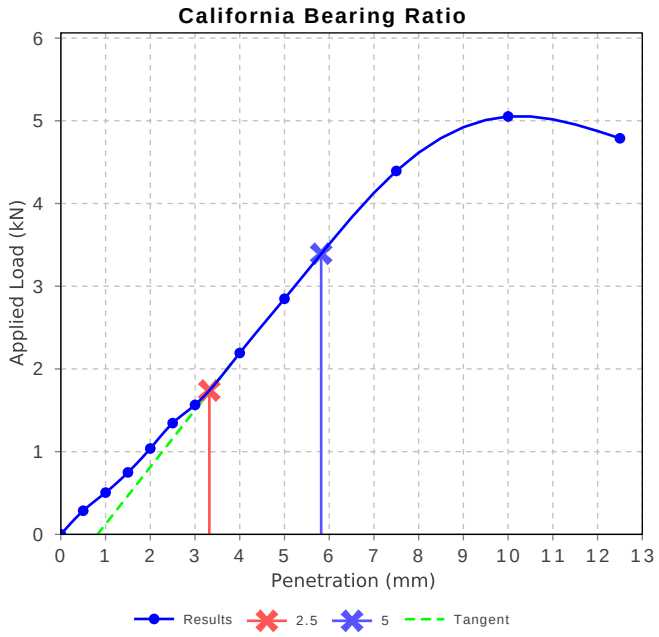
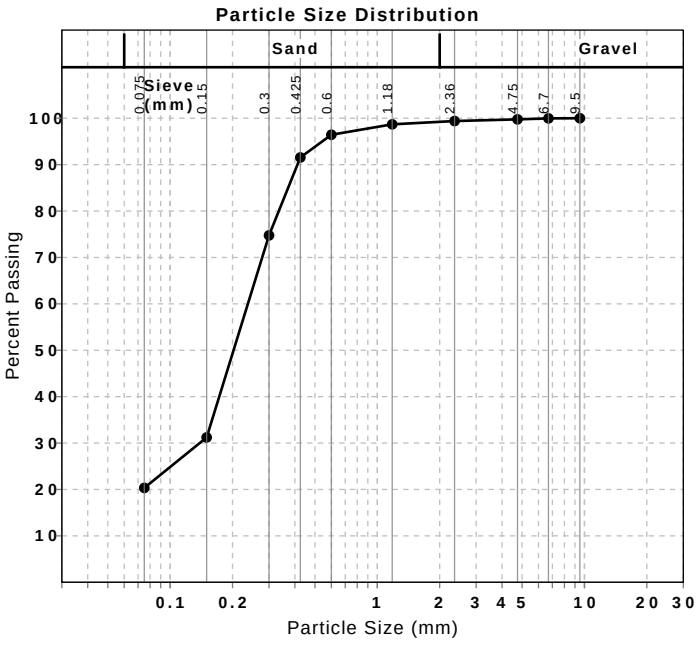
Approved Signatory: Ryan Osborne
Soil Technician
NATA Accredited Laboratory Number: 2316

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	5 mm		
CBR %	**17**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual		
Maximum Dry Density (t/m^3)	1.90		
Optimum Moisture Content (%)	12.0		
Laboratory Density Ratio (%)	99.5		
Laboratory Moisture Ratio (%)	100.0		
Dry Density after Soaking (t/m^3)	1.90		
Field Moisture Content (%)	12.8		
Moisture Content at Placement (%)	11.9		
Moisture Content Top 30mm (%)	12.9		
Moisture Content Rest of Sample (%)	12.1		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	-3.0		
Swell (%)	0.0		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)			



Particle Size Distribution (AS1289 3.6.1)						
Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
9.5 mm	**100**			0		
6.7 mm	**100**			0		
4.75 mm	**100**			0		
2.36 mm	**99**			0		
1.18 mm	**99**			1		
0.6 mm	**96**			2		
0.425 mm	**92**			5		
0.3 mm	**75**			17		
0.15 mm	**31**			44		
0.075 mm	**20**			11		



Material Test Report

Report Number: **24-338-2**
Issue Number: 1
Date Issued: 21/08/2024
Client: PEET FLAGSTONE CITY PTY LTD
Level 3, 167 Eagle Street, Brisbane QLD 4000
Contact: TROY THOMPSON
Project Number: 24-338
Project Name: GEOTECHNICAL SITE INVESTIGATION - CONTEXT AREA 3
Project Location: NEW BEITH ROAD, FLAGSTONE QLD
Work Request: 1366
Sample Number: S1366C
Date Sampled: 09/08/2024
Dates Tested: 13/08/2024 - 20/08/2024
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Preparation Method: AS 1289.1.1 - Sampling and Preparation of Soils
Site Selection: Selected by Client
Sample Location: **QT8, Depth: 0.1 - 0.4m**

Qualtest Laboratory Pty Ltd
Caboolture Laboratory
3 / 64 Evans Drive Caboolture QLD 4510
Phone: 0417 011 515
Email: ryan@qualtestgeo.com

Accredited for compliance with ISO/IEC 17025 - Testing

Approved Signatory: Ryan Osborne
Soil Technician
NATA Accredited Laboratory Number: 2316

Atterberg Limit (AS1289 3.9.2 & 3.2.1 & 3.3.2 & Q252)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Passing 0.425 (%)	92		
Retained 0.425 (%)	5		
Liquid Limit (%)	17		
Plastic Limit (%)	11		
Plasticity Index (%)	**6**		
Weighted Plasticity Index (%)	549		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.9.2		
Linear Shrinkage (%)	**0.5**		
Cracking Crumbling Curling	None		

Material Test Report

Report Number: **24-338-2**
Issue Number: 1
Date Issued: 21/08/2024
Client: PEET FLAGSTONE CITY PTY LTD
Level 3, 167 Eagle Street, Brisbane QLD 4000
Contact: TROY THOMPSON
Project Number: 24-338
Project Name: GEOTECHNICAL SITE INVESTIGATION - CONTEXT AREA 3
Project Location: NEW BEITH ROAD, FLAGSTONE QLD
Work Request: 1366
Sample Number: S1366D
Date Sampled: 09/08/2024
Dates Tested: 13/08/2024 - 20/08/2024
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Preparation Method: AS 1289.1.1 - Sampling and Preparation of Soils
Site Selection: Selected by Client
Sample Location: **QT9, Depth: 0.1 - 0.5m**

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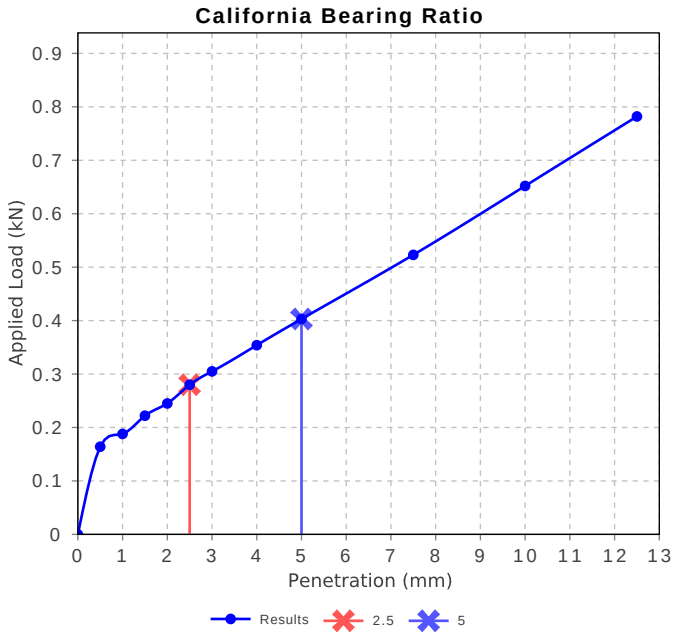
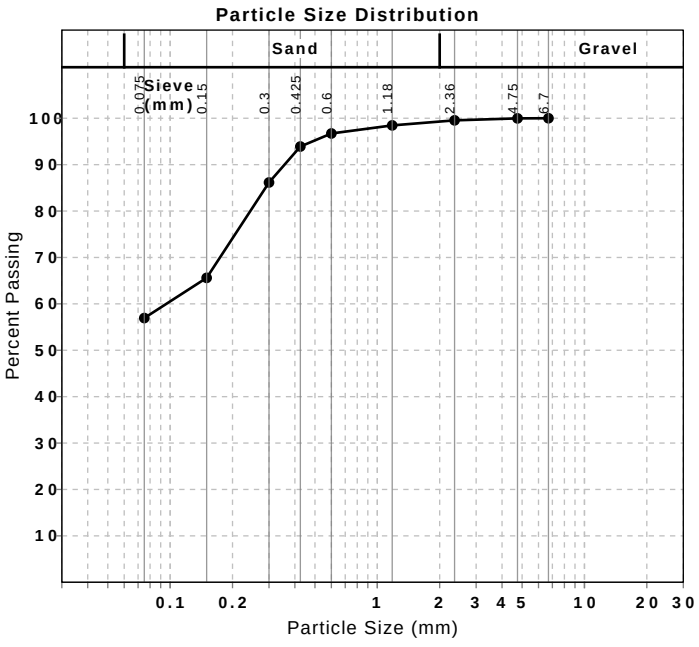
Soil Technician
NATA Accredited Laboratory Number: 2316

California Bearing Ratio (AS 1289 6.1.1 & 2.1.1)		Min	Max
CBR taken at	2.5 mm		
CBR %	**2.0**		
Method of Compactive Effort	Standard		
Method used to Determine MDD	AS 1289 5.1.1 & 2.1.1		
Method used to Determine Plasticity	Visual		
Maximum Dry Density (t/m^3)	1.82		
Optimum Moisture Content (%)	15.5		
Laboratory Density Ratio (%)	100.5		
Laboratory Moisture Ratio (%)	99.0		
Dry Density after Soaking (t/m^3)	1.78		
Field Moisture Content (%)	21.5		
Moisture Content at Placement (%)	15.3		
Moisture Content Top 30mm (%)	23.9		
Moisture Content Rest of Sample (%)	17.4		
Mass Surcharge (kg)	4.5		
Soaking Period (days)	4		
Curing Hours	2.0		
Swell (%)	2.5		
Oversize Material (mm)	19		
Oversize Material Included	Excluded		
Oversize Material (%)			



Particle Size Distribution (AS1289 3.6.1)						
Sieve	Passed %	Passing Limits		Retained %	Retained Limits	
6.7 mm	**100**			0		
4.75 mm	**100**			0		
2.36 mm	**100**			0		
1.18 mm	**98**			1		
0.6 mm	**97**			2		
0.425 mm	**94**			3		
0.3 mm	**86**			8		
0.15 mm	**66**			21		
0.075 mm	**57**			9		



Material Test Report

Report Number: **24-338-2**
Issue Number: 1
Date Issued: 21/08/2024
Client: PEET FLAGSTONE CITY PTY LTD
Level 3, 167 Eagle Street, Brisbane QLD 4000
Contact: TROY THOMPSON
Project Number: 24-338
Project Name: GEOTECHNICAL SITE INVESTIGATION - CONTEXT AREA 3
Project Location: NEW BEITH ROAD, FLAGSTONE QLD
Work Request: 1366
Sample Number: S1366D
Date Sampled: 09/08/2024
Dates Tested: 13/08/2024 - 20/08/2024
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Preparation Method: AS 1289.1.1 - Sampling and Preparation of Soils
Site Selection: Selected by Client
Sample Location: **QT9, Depth: 0.1 - 0.5m**

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Atterberg Limit (AS1289 3.9.2 & 3.2.1 & 3.3.2 & Q252)		Min	Max
Sample History	Oven Dried		
Preparation Method	Dry Sieve		
Passing 0.425 (%)	94		
Retained 0.425 (%)	3		
Liquid Limit (%)	42		
Plastic Limit (%)	13		
Plasticity Index (%)	**29**		
Weighted Plasticity Index (%)	2723		

Linear Shrinkage (AS1289 3.4.1)		Min	Max
Moisture Condition Determined By	AS 1289.3.9.2		
Linear Shrinkage (%)	**9.0**		
Cracking Crumbling Curling	Cracking & Crumbling		

Material Test Report

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Approved Signatory: Ryan Osborne
Soil Technician

NATA Accredited Laboratory Number: 2316

Report Number:	**24-338-1**
Issue Number:	2 - *This version supersedes all previous issues*
Reissue Reason:	*re report*
Date Issued:	21/08/2024
Client:	PEET FLAGSTONE CITY PTY LTD
	Level 3, 167 Eagle Street, Brisbane QLD 4000
Contact:	TROY THOMPSON
Project Number:	24-338
Project Name:	GEOTECHNICAL SITE INVESTIGATION - CONTEXT AREA 3
Project Location:	NEW BEITH ROAD, FLAGSTONE QLD
Work Request:	1367
Sample Number:	S1367A
Date Sampled:	09/08/2024
Dates Tested:	13/08/2024 - 20/08/2024
Sampling Method:	AS 1289.1.2.1 6.5.3 - Power auger drilling
Site Selection:	Selected by Client
Sample Location:	**QT1, Depth: 0.5 - 0.6m**

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**5**		
Soil Description	sandy CLAY		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	19		

Material Test Report

Report Number: **24-338-1**
Issue Number: 2 - *This version supersedes all previous issues*
Reissue Reason: *re report*
Date Issued: 21/08/2024
Client: PEET FLAGSTONE CITY PTY LTD
Level 3, 167 Eagle Street, Brisbane QLD 4000
Contact: TROY THOMPSON
Project Number: 24-338
Project Name: GEOTECHNICAL SITE INVESTIGATION - CONTEXT AREA 3
Project Location: NEW BEITH ROAD, FLAGSTONE QLD
Work Request: 1367
Sample Number: S1367B
Date Sampled: 09/08/2024
Dates Tested: 13/08/2024 - 20/08/2024
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Site Selection: Selected by Client
Sample Location: **QT2, Depth: 0.4 - 0.5m**

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Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**6**		
Soil Description	silty SAND		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	19		

Material Test Report

Report Number: **24-338-1**
Issue Number: 2 - *This version supersedes all previous issues*
Reissue Reason: *re report*
Date Issued: 21/08/2024
Client: PEET FLAGSTONE CITY PTY LTD
Level 3, 167 Eagle Street, Brisbane QLD 4000
Contact: TROY THOMPSON
Project Number: 24-338
Project Name: GEOTECHNICAL SITE INVESTIGATION - CONTEXT AREA 3
Project Location: NEW BEITH ROAD, FLAGSTONE QLD
Work Request: 1367
Sample Number: S1367C
Date Sampled: 09/08/2024
Dates Tested: 13/08/2024 - 20/08/2024
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Site Selection: Selected by Client
Sample Location: **QT3, Depth: 0.4 - 0.5m**

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NATA Accredited Laboratory Number: 2316

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**5**		
Soil Description	silty SAND		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	19		

Material Test Report

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Soil Technician

NATA Accredited Laboratory Number: 2316

Report Number: **24-338-1**
Issue Number: 2 - *This version supersedes all previous issues*
Reissue Reason: *re report*
Date Issued: 21/08/2024
Client: PEET FLAGSTONE CITY PTY LTD
Level 3, 167 Eagle Street, Brisbane QLD 4000
Contact: TROY THOMPSON
Project Number: 24-338
Project Name: GEOTECHNICAL SITE INVESTIGATION - CONTEXT AREA 3
Project Location: NEW BEITH ROAD, FLAGSTONE QLD
Work Request: 1367
Sample Number: S1367D
Date Sampled: 09/08/2024
Dates Tested: 13/08/2024 - 20/08/2024
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Site Selection: Selected by Client
Sample Location: **QT4, Depth: 1.0 - 1.1m**

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	sandy CLAY		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	19		

Material Test Report

Report Number: **24-338-1**
Issue Number: 2 - *This version supersedes all previous issues*
Reissue Reason: *re report*
Date Issued: 21/08/2024
Client: PEET FLAGSTONE CITY PTY LTD
Level 3, 167 Eagle Street, Brisbane QLD 4000
Contact: TROY THOMPSON
Project Number: 24-338
Project Name: GEOTECHNICAL SITE INVESTIGATION - CONTEXT AREA 3
Project Location: NEW BEITH ROAD, FLAGSTONE QLD
Work Request: 1367
Sample Number: S1367E
Date Sampled: 09/08/2024
Dates Tested: 13/08/2024 - 20/08/2024
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Site Selection: Selected by Client
Sample Location: **QT5, Depth: 0.85 - 1.0m**

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Soil Technician
NATA Accredited Laboratory Number: 2316

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**3**		
Soil Description	CLAY		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	19		

Material Test Report

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NATA Accredited Laboratory Number: 2316

Report Number: **24-338-1**
Issue Number: 2 - *This version supersedes all previous issues*
Reissue Reason: *re report*
Date Issued: 21/08/2024
Client: PEET FLAGSTONE CITY PTY LTD
Level 3, 167 Eagle Street, Brisbane QLD 4000
Contact: TROY THOMPSON
Project Number: 24-338
Project Name: GEOTECHNICAL SITE INVESTIGATION - CONTEXT AREA 3
Project Location: NEW BEITH ROAD, FLAGSTONE QLD
Work Request: 1367
Sample Number: S1367F
Date Sampled: 09/08/2024
Dates Tested: 13/08/2024 - 20/08/2024
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Site Selection: Selected by Client
Sample Location: **QT6, Depth: 0.65 - 0.7m**

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**5**		
Soil Description	clayey SAND		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	19		

Material Test Report

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Approved Signatory: Ryan Osborne
Soil Technician

NATA Accredited Laboratory Number: 2316

Report Number: **24-338-1**
Issue Number: 2 - *This version supersedes all previous issues*
Reissue Reason: *re report*
Date Issued: 21/08/2024
Client: PEET FLAGSTONE CITY PTY LTD
Level 3, 167 Eagle Street, Brisbane QLD 4000
Contact: TROY THOMPSON
Project Number: 24-338
Project Name: GEOTECHNICAL SITE INVESTIGATION - CONTEXT AREA 3
Project Location: NEW BEITH ROAD, FLAGSTONE QLD
Work Request: 1367
Sample Number: S1367G
Date Sampled: 09/08/2024
Dates Tested: 13/08/2024 - 20/08/2024
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Site Selection: Selected by Client
Sample Location: **QT7, Depth: 0.6 - 0.7m**

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	sandy CLAY		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	19		

Material Test Report

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Approved Signatory: Ryan Osborne
Soil Technician

NATA Accredited Laboratory Number: 2316

Report Number:	**24-338-1**
Issue Number:	2 - *This version supersedes all previous issues*
Reissue Reason:	*re report*
Date Issued:	21/08/2024
Client:	PEET FLAGSTONE CITY PTY LTD
	Level 3, 167 Eagle Street, Brisbane QLD 4000
Contact:	TROY THOMPSON
Project Number:	24-338
Project Name:	GEOTECHNICAL SITE INVESTIGATION - CONTEXT AREA 3
Project Location:	NEW BEITH ROAD, FLAGSTONE QLD
Work Request:	1367
Sample Number:	S1367H
Date Sampled:	09/08/2024
Dates Tested:	13/08/2024 - 20/08/2024
Sampling Method:	AS 1289.1.2.1 6.5.3 - Power auger drilling
Site Selection:	Selected by Client
Sample Location:	**QT8, Depth: 0.6 - 0.7m**

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**5**		
Soil Description	clayey SAND		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	19		

Material Test Report

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Approved Signatory: Ryan Osborne
Soil Technician

NATA Accredited Laboratory Number: 2316

Report Number: **24-338-1**
Issue Number: 2 - *This version supersedes all previous issues*
Reissue Reason: *re report*
Date Issued: 21/08/2024
Client: PEET FLAGSTONE CITY PTY LTD
Level 3, 167 Eagle Street, Brisbane QLD 4000
Contact: TROY THOMPSON
Project Number: 24-338
Project Name: GEOTECHNICAL SITE INVESTIGATION - CONTEXT AREA 3
Project Location: NEW BEITH ROAD, FLAGSTONE QLD
Work Request: 1367
Sample Number: S1367I
Date Sampled: 09/08/2024
Dates Tested: 13/08/2024 - 20/08/2024
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Site Selection: Selected by Client
Sample Location: **QT9, Depth: 0.1 - 0.2m**

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**2**		
Soil Description	Sandy CLAY		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	19		

Material Test Report

Report Number: **24-338-1**
Issue Number: 2 - *This version supersedes all previous issues*
Reissue Reason: *re report*
Date Issued: 21/08/2024
Client: PEET FLAGSTONE CITY PTY LTD
Level 3, 167 Eagle Street, Brisbane QLD 4000
Contact: TROY THOMPSON
Project Number: 24-338
Project Name: GEOTECHNICAL SITE INVESTIGATION - CONTEXT AREA 3
Project Location: NEW BEITH ROAD, FLAGSTONE QLD
Work Request: 1367
Sample Number: S1367J
Date Sampled: 09/08/2024
Dates Tested: 13/08/2024 - 20/08/2024
Sampling Method: AS 1289.1.2.1 6.5.3 - Power auger drilling
Site Selection: Selected by Client
Sample Location: **QT10, Depth: 0.6 - 0.7m**

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Approved Signatory: Ryan Osborne
Soil Technician
NATA Accredited Laboratory Number: 2316

Emerson Class Number of a Soil (AS 1289 3.8.1)		Min	Max
Emerson Class	**3**		
Soil Description	silty SAND		
Nature of Water	Distilled		
Temperature of Water (^{o}C)	19		

Material Test Report

Report Number:	**24-338-3**
Issue Number:	1
Date Issued:	21/08/2024
Client:	PEET FLAGSTONE CITY PTY LTD
	Level 3, 167 Eagle Street, Brisbane QLD 4000
Contact:	TROY THOMPSON
Project Number:	24-338
Project Name:	GEOTECHNICAL SITE INVESTIGATION - CONTEXT AREA 3
Project Location:	NEW BEITH ROAD, FLAGSTONE QLD
Work Request:	1368
Sample Number:	S1368A
Date Sampled:	09/08/2024
Dates Tested:	13/08/2024 - 13/08/2024
Sample Location:	**QT4, Depth: 1.0 - 1.2m**

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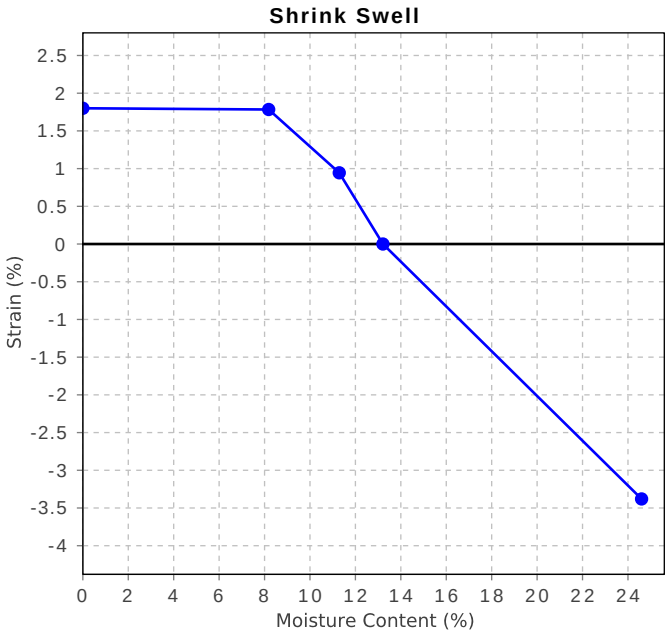
Ryan Osborne (Soil Technician)

Shrink Swell Index (AS 1289 7.1.1 & 2.1.1)	
Iss (%)	**1.9**
Visual Description	Sandy Clay
* Shrink Swell Index (Iss) reported as the percentage vertical strain per pF change in suction.	

Core Shrinkage Test	
Shrinkage Strain - Oven Dried (%)	**1.8**
Estimated % by volume of significant inert inclusions	
Cracking	Uncracked
Crumbling	No
Moisture Content (%)	13.2

Swell Test	
Initial Pocket Penetrometer (kPa)	580
Final Pocket Penetrometer (kPa)	260
Initial Moisture Content (%)	20.8
Final Moisture Content (%)	24.6
Swell (%)	**3.4**
* NATA Accreditation does not cover the performance of pocket penetrometer readings.	



Material Test Report

Report Number:	**24-338-3**
Issue Number:	1
Date Issued:	21/08/2024
Client:	PEET FLAGSTONE CITY PTY LTD
	Level 3, 167 Eagle Street, Brisbane QLD 4000
Contact:	TROY THOMPSON
Project Number:	24-338
Project Name:	GEOTECHNICAL SITE INVESTIGATION - CONTEXT AREA 3
Project Location:	NEW BEITH ROAD, FLAGSTONE QLD
Work Request:	1368
Sample Number:	S1368B
Date Sampled:	09/08/2024
Dates Tested:	13/08/2024 - 13/08/2024
Sample Location:	**QT5, Depth: 0.4 - 0.53m**

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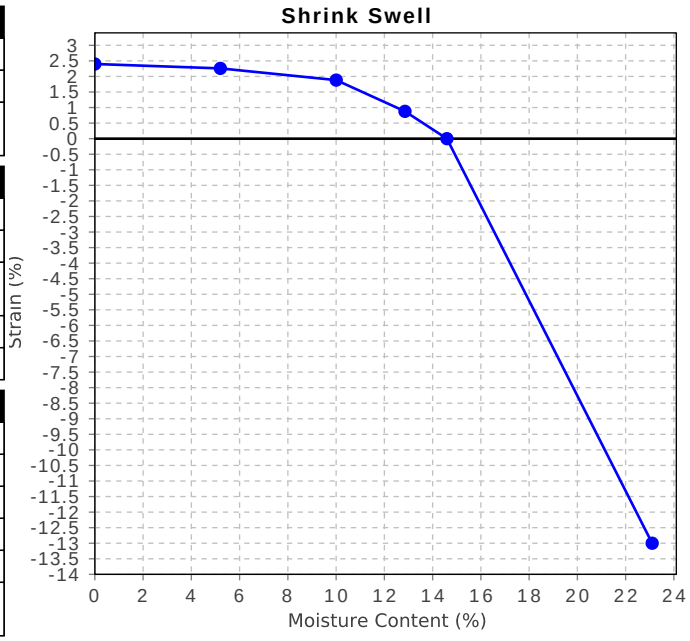
Ryan Osborne (Soil Technician)

Shrink Swell Index (AS 1289 7.1.1 & 2.1.1)	
Iss (%)	**4.9**
Visual Description	Clay with sand
* Shrink Swell Index (Iss) reported as the percentage vertical strain per pF change in suction.	

Core Shrinkage Test	
Shrinkage Strain - Oven Dried (%)	**2.4**
Estimated % by volume of significant inert inclusions	
Cracking	Slightly Cracked
Crumbling	No
Moisture Content (%)	14.6

Swell Test	
Initial Pocket Penetrometer (kPa)	>600
Final Pocket Penetrometer (kPa)	<100
Initial Moisture Content (%)	14.5
Final Moisture Content (%)	23.1
Swell (%)	**13.0**
* NATA Accreditation does not cover the performance of pocket penetrometer readings.	



Material Test Report

Report Number:	**24-338-3**
Issue Number:	1
Date Issued:	21/08/2024
Client:	PEET FLAGSTONE CITY PTY LTD
	Level 3, 167 Eagle Street, Brisbane QLD 4000
Contact:	TROY THOMPSON
Project Number:	24-338
Project Name:	GEOTECHNICAL SITE INVESTIGATION - CONTEXT AREA 3
Project Location:	NEW BEITH ROAD, FLAGSTONE QLD
Work Request:	1368
Sample Number:	S1368C
Date Sampled:	09/08/2024
Dates Tested:	13/08/2024 - 13/08/2024
Sample Location:	**QT9, Depth: 0.5 - 0.79m**

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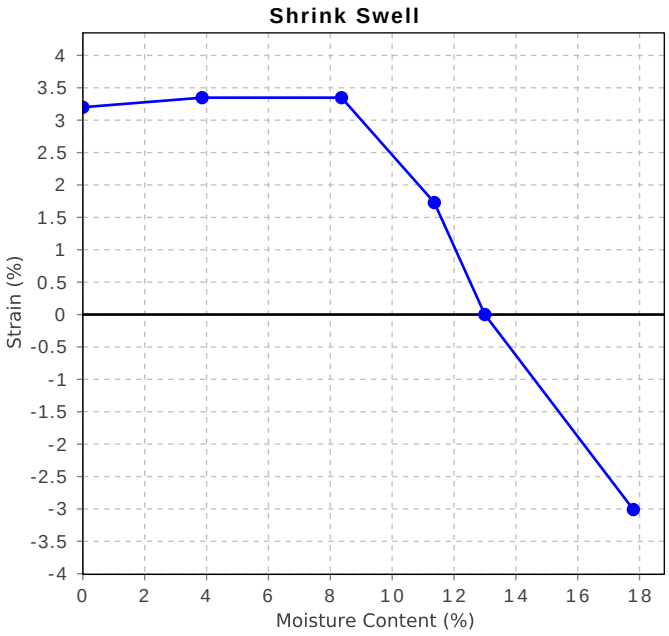
Ryan Osborne (Soil Technician)

Shrink Swell Index (AS 1289 7.1.1 & 2.1.1)	
Iss (%)	**2.6**
Visual Description	Sandy Clay
* Shrink Swell Index (Iss) reported as the percentage vertical strain per pF change in suction.	

Core Shrinkage Test	
Shrinkage Strain - Oven Dried (%)	**3.2**
Estimated % by volume of significant inert inclusions	
Cracking	Slightly Cracked
Crumbling	No
Moisture Content (%)	13.0

Swell Test	
Initial Pocket Penetrometer (kPa)	500
Final Pocket Penetrometer (kPa)	<60
Initial Moisture Content (%)	13.4
Final Moisture Content (%)	17.8
Swell (%)	**3.0**
* NATA Accreditation does not cover the performance of pocket penetrometer readings.	



Material Test Report

Report Number: **24-338-3**
Issue Number: 1
Date Issued: 21/08/2024
Client: PEET FLAGSTONE CITY PTY LTD
Level 3, 167 Eagle Street, Brisbane QLD 4000
Contact: TROY THOMPSON
Project Number: 24-338
Project Name: GEOTECHNICAL SITE INVESTIGATION - CONTEXT AREA 3
Project Location: NEW BEITH ROAD, FLAGSTONE QLD
Work Request: 1368
Dates Tested: 13/08/2024 - 13/08/2024
Location: Geotechnical Investigation

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Ryan Osborne (Soil Technician)

Shrink Swell Index AS 1289 7.1.1 & 2.1.1					
Sample Number	S1368A	S1368B	S1368C		
Date Sampled	09/08/2024	09/08/2024	09/08/2024		
Date Tested	13/08/2024	13/08/2024	13/08/2024		
Material Source	In-situ	In-situ	In-situ		
Sample Location	QT4 (1.0 - 1.2m)	QT5 (0.4 - 0.53m)	QT9 (0.5 - 0.79m)		
Inert Material Estimate (%)	**	**	**		
Pocket Penetrometer before (kPa)	580	>600	500		
Pocket Penetrometer after (kPa)	260	<100	<60		
Shrinkage Moisture Content (%)	13.2	14.6	13.0		
Shrinkage (%)	**1.8**	**2.4**	**3.2**		
Swell Moisture Content Before (%)	20.8	14.5	13.4		
Swell Moisture Content After (%)	24.6	23.1	17.8		
Swell (%)	**3.4**	**13.0**	**3.0**		
Shrink Swell Index Iss (%)	**1.9**	**4.9**	**2.6**		
Visual Description	Sandy Clay	Clay with sand	Sandy Clay		
Cracking	UC	SC	SC		
Crumbling	No	No	No		
Remarks	**	**	**		

Shrink Swell Index (Iss) reported as the percentage vertical strain per pF change in suction.
Cracking Terminology: UC Uncracked, SC Slightly Cracked, MC Moderately Cracked, HC Highly Cracked, FR Fragmented.
NATA Accreditation does not cover the performance of pocket penetrometer readings.

APPENDIX C

Landslide Assessment Form

Qualtest Laboratory
Est. 1987

Qualtest Engineering Slope Stability Assessment Tool – Hargreaves & Kidd (2012)

Slope Hazard Rating – Context 3 Area, New Beith Rd, Flagstone

Grade	(1) Natural Surface Conditions	Level	Factor
	<5	L	0.1
	5^0 to 15^0	M	0.5
✓	15^0 to 30^0	M	0.8
	30^0 to 45^0	H	0.8
	> 45^0	M	0.8

	(2) Slope Shape/Appearance	Level	Factor
	Crest or ridge	L	0.7
✓	Planar/convex	M	0.9
	Rough/irregular	H	1.2
	Concave	H	1.5

Grade	(3) Site Geology	Level	Factor
	Problematical geological boundary	VH	1.5
	Volcanic extrusive (basalts etc)	H	1.2
	Volcanic intrusive (granites etc)	M	1.0
✓	Sedimentary rocks	M	1.0
	Low-grade metamorphic rocks	M	1.0
	High-grade metamorphic rocks	L	0.9
	Hill wash (recent colluvial)	VH	2.0

Grade	(4) Soil Profile	Level	Factor
	Bedrock at surface	VL	0.1
	Residual Soil – bedrock < 1m	L	0.5
✓	Residual Soil – bedrock 1 to 3m	M	0.9
	Residual Soil – bedrock > 3m	H	1.5
	Transported Soil - < 1m deep	H	1.5
	Transported Soil - 1 to 3m deep	VH	2.0
	Transported Soil – 3 to 6m deep	VH	4.0
	Transported Soil - > 6m deep	VH	2.0

Grade	(5) Regional Position on Hillside (refer AS4055-2066)	Level	Factor
	Ridgeline	VL	0.7
	Crest	L	0.8
✓	Upper 1/3 of slope	M	0.9
	Mid 1/3 of slope	H	1.2
	Lower 1/3 of slope	H	1.5

Grade	(6) Evidence of Groundwater	Level	Factor
✓	No evidence	L	0.7
	Minor moistness	M	0.9
	Generally wet	H	1.5
	Evidence of spring	VH	3.0
	Do not know	VH	4.0

Grade	(7) Evidence of Slope Instability	Level	Factor
	No sign of instability	L	0.8
✓	Indicators of soil creep	H	1.2
	Minor irregularity	VH	2.0
	Major irregularity	VH	5.0
	Active instability	VH	10.0
	Don't know	VH	15.0
As Proposed Output = 0.8x0.9x1.0x0.9x0.9x0.7x1.2			0.45

Grade	(8) Cut Depth	Level	Factor
	No cut existing nor proposed	L	0.9
	<1m	M	1.1
	1 to 3m	M	1.5
✓	3 to 6m	H	1.7
	>6m	VH	2.5

Grade	(9) Cut Angle	Level	Factor
✓	<30	L	0.5
	30º to 45º	M	1.0
	45º to 60º	M	1.5
	>60º	VH	3.0

Grade	(10) Cut Batter Support	Level	Factor
	Engineered concrete / masonry wall	L	0.5
	Engineered crib wall	M	0.9
	V gabion wall	M	1.0
	Engineered dry rock stack wall	H	1.2
✓	Engineered post and wale wall	H	1.5
	Other (including non-engineered)	VH	2.0

Grade	(11) Fill	Level	Factor
	No fill – existing nor proposed	L	0.9
	<1m	M	1.1
	1 to 3m	M	1.5
✓	3 to 6m	H	1.7
	>6m	VH	2.5

Grade	(12) Fill Batter Angle	Level	Factor
✓	<30	L	0.5
	30º to 45º	H	1.2
	45º to 60º	VH	2.0
	>60º	VH	4.0

Grade	(13) Fill Batter Support	Level	Factor
	Engineered concrete / masonry wall	L	0.8
	Engineered crib wall	M	1.0
	V gabion wall	H	1.2
	Engineered dry rock stack wall	VH	1.5
✓	Engineered post and wale wall	V	1.8
	Other (including non-engineered)	VH	4.0

Grade	(14) Type of Fill	Level	Factor
✓	AS3798 (Level 1 Certified)	L	0.7
	Compacted but not certified	M	1.0
	Track-rolled fill (Clay)	H	1.2
	Tracked-rolled fill (sand)	VH	1.5
	Obvious compressible fill	VH	3.0

	(15) Wastewater, Sewerage	Level	Factor
✓	Fully sewered	M	0.8
	Onsite surface disposal within 10m of structure	H	1.5
	Onsite surface disposal > 10m of structure	M	0.9
	Onsite subsurface disposal within 10m of structure	VH	2.0
	Onsite subsurface disposal > 10m of structure	H	1.0
	Not known	VH	4.0

Grade	(16) Stormwater Disposal	Level	Factor
✓	To the kerb or council system	M	0.7
	Rainwater tank with engineer approved overflow	M	0.7
	Rainwater tank without engineer approved overflow	H	1.2
	Dispersed >10m downslope (approved)	M	1.0
	Directly onto ground	M	1.5
	Onsite rubble pit	VH	3.0
	Not known	VH	4.0

Grade	(17) Expandable / Mechanical Stormwater & Drainage Pipe Connectors	Level	Factor
	Specifically, engineer designed and inspected	L	0.8
✓	As per AS2870-2011 for extremely reactive sites	M	1.0
	Not used	VH	2.0
	Not known	VH	4.0

Grade	(18) Footing System	Level	Factor
	Timber/flexible floor (suspended, able to be re-levelled)	L	0.7
	Engineer designed suspended slab	M	1.0
✓	As per AS2870-2011	H	1.2
	Less than AS2870-2011 generally applies to old houses)	VH	2.0
	Not known	VH	4.0

Grade	(19) The Foundation Strata	Level	Factor
	Bedrock	L	0.7
	Residual Soil	M	1.0
✓	Transported Soil	H	1.2
	Fill	VH	3.0
	Not Known	VH	4.0

Grade	(20) In-ground Tank	Level	Factor
	>10m from footing	L	0.7
	6 to 10m from footing	M	1.0
	3 to 6m from footing	H	1.2
	<3m from footing	VH	3.0
	Not known	VH	4.0

Grade	(21) Landscaping	Level	Factor
	AS2870-2011 compliant (+upslope diversion bund/swale)	L	0.7
✓	AS2870-2011 compliant	M	0.9
	Non-AS2870-2011 compliant	H	1.5
	Obvious evidence of water ponding/poor drainage	VH	2.5
	Not known	VH	4.0

Grade	(22) For Upslope Boulder / Flow Event Only	Level	Factor
	Engineer designed catching net	L	0.7
	Engineer designed upslope bund	M	0.9
	Engineer designed upslope fence	M	1.0
	Non engineer approved method	H	1.5
	No action taken	VH	4.0

Summary		
1	Natural Soil Conditions	0.8
2	Slope Shape/Appearance	0.9
3	Site Geology	0.9
4	Soil Profile	0.5
5	Regional Position on Hillside	0.9
6	Evidence of Groundwater	0.7
7	Evidence of Slope Instability	0.8
8	Cut depth	1.7
9	Cut batter angle	3
10	Cut batter support	0.5
11	Fill depth	NA
12	Fill batter angle	NA
13	Fill batter support	NA
14	Type of fill	NA
15	Wastewater system (sewerage etc)	0.8
16	Stormwater disposal	0.7
17	Expandable/mechanical pipes	NA
18	Footing system	1.0
19	The foundation strata	1.0
20	In-ground tanks	NA
21	Landscaping	NA
22	Upslope boulder/flow events only	NA
Remediation Output = 0.8x0.9x1.0x0.9x0.9x0.7x1.2x 1.7x0.5x1.5x1.7x0.5x1.8x0.7X0.8x0.7x1.0x1.0x1.2x0.8		**0.40**

* The numeral factors allocated to these site features are based on visual observations, engineering judgment, and experience.

Output	Susceptibility
< 0.2	Very Low Risk (VLR)
0.2 – 0.6	Low Risk (LR)
0.6 – 2.0	Moderate Risk (MR)
2.0 – 6.0	High Risk (HR)
>6.0	Very High Risk (VHR)

VLR = Acceptable. Manage by normal slope maintenance procedures.

LR = Usually acceptable to regulators. Where treatment has been required to reduce the risk to this level, ongoing maintenance is required.

MR = May be tolerated in certain circumstances (subject to regulator's approval) but requires investigation, planning, and implementation of treatment options to reduce the risk to Low. Treatment options to reduce to Low risk should be implemented as soon as practicable.

HR = Unacceptable without treatment. Detailed investigation, planning, and implementation of treatment options required to reduce risk to Low. Work would cost a substantial sum in relation to the value of the property.

VHR = Unacceptable without treatment. Extensive detailed investigation and research, planning, and implementation of treatment options essential to reduce risk to Low; may be too expensive and not practical. Work is likely to cost more than the value of the property.