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REPORT ON GEOTECHNICAL INVESTIGATION

for

PROPOSED NEW RESIDENTIAL DEVELOPMENT

at

52-54 BRIGHTON STREET, FRESHWATER, NSW

Prepared For

Laxland 3 Pty Ltd

Project No.: 2023-120

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REPORT ON GEOTECHNICAL INVESTIGATION FOR PROPOSED NEW RESIDENTIAL DEVELOPMENT AT 52-54 BRIGHTON STREET, FRESHWATER, NSW

1. INTRODUCTION:

This report details the results of a Geotechnical Investigation (GI) carried out to provide preliminary advice for feasibility and recommendations for the Development Application submission for a proposed new residential building at 52-54 Brighton Street, Freshwater, NSW. The investigation was undertaken by Crozier Geotechnical Consultants (CGC) at the request of Milane Silva, on behalf of the client, Laxland 3 Pty Ltd.

2. PROPOSED DEVELOPMENT:

The following documents supplied by the client, were relied on in the preparation of the proposed investigation and this report:

- Architectural Design Drawings prepared by Walsh Architects – Drawing Nos:
  - DA000, DA040, DA101 to DA104, DA200 to DA201, and DA300 to DA301, Rev. B, Dated 8 December 2023;
  - DA030, Rev. A, Dated 4 July 2023;
  - DA100, Rev. A, Dated 8 December 2023; and
- Site Survey plan prepared by Bee & Lethbrigdge – Ref No. 22858, Drawing No. 22858, Rev. 00, dated 14 April 2023.

The datum in the survey plan is in Australian Height Datum (AHD), therefore, all the Reduced Levels (RL) mentioned in this report are henceforth in AHD.

Based on the provided documents, it is understood that the proposed works involve the demolition of the existing site structures and the amalgamation of the properties to construct a 9-unit senior housing complex with single-level of basement. The basement is designed to have a finish floor level of RL 9.6m, which indicates a bulk excavation level of approximately RL 9.3m will be required for the allowance of the basement slab. It is also understood that a service room with a designed finished floor level of RL 6.6m under the basement requires a further excavation of about 3.0m.

To achieve this, excavation depth of up to 6.0m below the existing ground level for the proposed service room and basement is anticipated. Locally deeper excavations may be required for footings, lift pits and service trenches. The proposed basement has minimum offsets of about 3.8m to the east/west side site boundary, about 8.5m to the north boundary and 15.7m to the south boundary. The proposed service room under the basement is designed to be a small space with an offset of about 4.0m to the eastern site boundary.

Northern Beaches Council's - Warringah 2011 LEP and DCP states that all building development applications must be accompanied by a geotechnical landslip assessment. That developments within Class 'A', 'B' and 'D' landslip risk zone may require a preliminary assessment only where excavation/fill is <2.0m depth, however Class 'C' and 'E' sites and/or where excavation/fill >2.0m depth is proposed in other sites then a full geotechnical report is required. This site is located within landslip risk Class 'A' within the Northern Beaches Mapping portal.

As per request in Clause 6.2 Earthworks of Warringah Local Environmental Plan 2011, a separated report letter of geotechnical assessment has been attached in Appendix:3.

3. OBJECTIVES AND SCOPE OF WORK:

This report is provided for submission as part of a Development Application (DA) to Northern Beaches Council and to provide preliminary information for use in the structural design. It includes details of investigation works completed, plans showing test locations, a geological section and provides assessment and recommendations for construction. The site investigation and reporting were undertaken as per the Fee Proposal P23-206.1, Dated 31st May 2023.

The investigation comprised:

a) Dial Before You Dig (DBYD) plan request and onsite clearing of test locations by an accredited service location contractor.
b) Detailed geotechnical mapping of the entire site and adjacent land, with identification of geotechnical conditions and hazards related to the existing site and proposed work;
c) A photographic record of site conditions;
d) Auger drilling of two boreholes (BH1 and BH4) within the front grassy area by Dingo – restricted access drill rig using solid stem spiral flight augers equipped with a 'Tungsten-Carbide' (T-C) bit to refusal on bedrock;
e) Hand auger drilling of three boreholes (BH2, BH3 and BH5) within existing rear area, where access for the rig was not possible, to refusal depths;

f) Six Dynamic Cone Penetrometer tests carried out adjacent BH1 to BH5 across the whole site to refusal depths;
g) Soil sample collection and logging as per "AS1726: 2017 Geotechnical Site Investigation";

All fieldwork was conducted under the full-time supervision of an experienced Geotechnical Engineer who logged and ensured the quality of all geotechnical data.

4. SITE FEATURES:

4.1. Description:

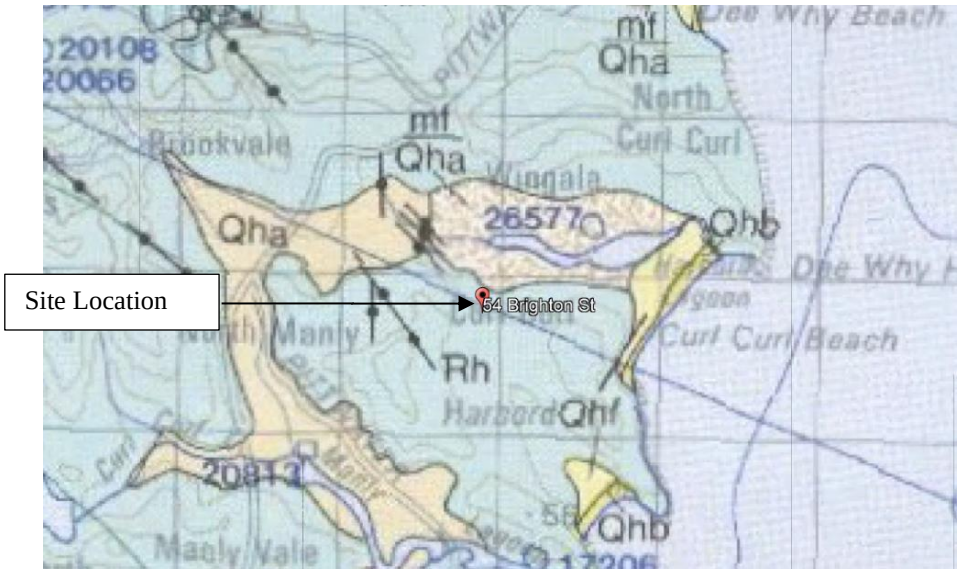
The site contains two rectangular blocks (Lots 38 DP14450 and Lot A in DP 384323) located on the south side of Brighton Street within generally gently (<3º) northern dipping topography.

The site has a front north/rear south boundary of approximately 28.0m, side west boundary of approximately 67.975m and side east boundary of approximately 83.4m. An aerial photograph of the site and its surrounds as Photograph 1, as sourced from NSW Government SIX Maps spatial data website.

Photograph-1: Aerial photo of site and surrounds (source: SIX Maps, access 16/6/2023)

4.2. Geology:

Reference to the Sydney 1: 100,000 Geological Series sheet indicates that the site is positioned near the geological boundary between Hawkesbury Sandstone (Rh) and Quaternary Sands (Qha) associated with the nearby Curl Curl Lagoon. Hawkesbury Sandstone (Rh) typically comprises medium to coarse grained quartz, sandstone, very minor shale and laminate lenses. Quaternary Sands (Qha) typically comprises silty to pearly quartz sand, silt, and clay with ferruginous and humic cementation in places.



Extract of Sydney (9130 Geology Series Map): 1:100000 - Geology underlying the site

5. FIELD WORK:

5.1. Methods:

The field investigation comprised a walk over inspection and mapping of the site and adjacent properties on the 19th June 2023 by a Geotechnical Engineer. It included a photographic record of site conditions as well as geological/geomorphological mapping of the site and adjacent land with examination of existing structures and limited inspection of neighbouring properties. It also included the drilling of five boreholes (BH1 to BH5) using both a restricted access drill rig and hand auger techniques to investigate the sub-surface geology.

Soil sample collection and logging was undertaken by a Geotechnical Engineer by inspection of disturbed soil recovered from the augers. Logging was undertaken in accordance with “AS1726: 2017 Geotechnical Site Investigation”.

Dynamic Cone Penetrometer (DCP) testing (DCP1 to DCP6) was carried out adjacent to the boreholes or within the rear site area in accordance with AS1289.6.3.2 – 1997, "Determination of the penetration resistance of a soil – 9kg Dynamic Cone Penetrometer test" to estimate near surface soil conditions and confirm depths to bedrock.

Explanatory notes are included in Appendix: 1. Mapping information and test locations are shown on Figure: 1, along with detailed bore log and DCP sheets in Appendix: 2. Two geological models/sections are provided as Figure: 2 and Figure:3, Appendix: 2.

5.2. Field Observations:

The site is situated on the southern side of Brighton Street with gently north-east dipping topography. General views of the site are shown in Photograph 2 to 3 (front) and Photograph 4 to 5 (rear).

Photograph-2: View of Eastern front of 52 Brighton Street. View looking west from Brighton Street.

Photograph-3: View of Eastern front of 54 Brighton Street. View looking south from Brighton Street.

Photograph-4: View of rear area of 52 Brighton Street. View looking north from the rear yard.

Photograph-5: View of rear side of the main building at 54 Brighton Street. View looking north from the rear yard.

At the time of fieldwork, the site was occupied by two separate two-storey brick residential dwellings with associated detached swimming pool, pavilions, and other structures comprising garage and storage:

- 52 Brighton Street: a two-storey brick building with a detached swimming pool, a pavilion, two one-storey buildings within the rear site area. The main structures appeared in good condition without any sign of significant cracking on the external wall. The remaining area is occupied by concrete-paved driveway, footpath, timber decking, garden beds, tree, and lawns.
- 54 Brighton Street: a two-storey brick building with a detached parking area at the front of the block, a storage building within the rear area. The main structures appeared in fair to good condition. The remaining area is occupied by a concrete-paved driveway, footpath, brick terrace pavement, garden beds, brick stairs, tree, and lawns.

No sign of significant cracking or geotechnical issue was observed within the site during the investigation.

The surrounding properties are as follows:

- East: Property at 50 Brighton Street, a single-storey brick residential dwelling with a swimming pool, concrete pavement, tree, and grassy area. The main house and the pool have offsets of about 1.0m to the eastern ‘site’ boundary. The main house appearing in good condition whilst the block has a similar elevation to the site.
- South: The rear areas of 8 Waratah Street, 17 and 19 Robert Street which all contain residential dwellings on their front halves. All the main houses have offset of more than 10m to the southern

'site' boundary, however, the swimming pool of 17 Robert Street has an offset of about 5.0m to the 'site' boundary. All properties have similar elevation to the site adjacent the common boundary.

- West: Property at 56 Brighton Street, a single-storey brick residential dwelling with brick pavement, tree, and grassy area. The main house appearing in fair to good condition abuts the western 'site' boundary. This property has a similar elevation to the site.

  Rear areas of 2, 4, and 6 Waratah Street, which all contain residential dwellings. All the main houses have offsets of more than 10m to the western 'site' boundary, however, the associated detached structures within the rear areas have offsets varying from nil to 2.0m to the 'site' boundary. All properties have similar elevations to the 'site'.
- North: Brighton Street, a two-lane, asphalt-paved road with footpath, trees, lawn, and kerbside parking along both sides. The footpath abuts the northern site boundary, and the roadway has an offset of about 3.0m from the boundary with the reserve containing a similar elevation to the site. The roadway was in good condition without any sign of significant cracking.

The neighbouring buildings and properties were only inspected from within the site or from the road reserve however the visible aspects did not show any significant signs of large-scale slope instability or other major geotechnical concerns which would impact the site.

5.3. Investigation Results:

For a description of the ground conditions encountered at the borehole/DCP test locations, the Borehole Log and DCP test result sheets should be consulted, however, a very broad summary of the subsurface conditions encountered is provide below:

- **TOPSOIL/FILL – Silty SAND** encountered in all test locations from the surface or underlying the pavement, to varying depths between 0.3m (BH3) and 1.6m (BH1). The silty sand fill was classified as fine grained, dark grey or brown, moist, with trace of rootlets near surface and gravels.
- **NATURAL SOIL – Silty/Clayey SAND** underlies the fill, encountered within BH1 and BH3 to BH5, to the maximum depth of approximately 4.2m (BH1). It was classified as very loose to loose (BH4 only) or medium dense to dense, fine to medium grained, brown to pale brown then reddish brown, moist.
- **NATURAL SOIL – Sandy CLAY** underlies the fill or the natural sandy soil, encountered in BH1, BH2 and BH4 only locations to depths varying from 1.3m (BH2) to the maximum investigation depths of about 5.5m (RL 5.2m). It was classified as low plasticity, firm to hard, brown/grey-brown to reddish brown, moist, with iron oxide staining. It became hard and was interpreted to grade into extremely weathered bedrock with depth.

Groundwater seepage or a water table were not encountered during the investigation to 5.50m depth (RL 5.20m).

6. COMMENTS:

6.1. Geotechnical Assessment:

The site investigation identified the presence of uncontrolled sandy fill to a maximum depth of 1.6m (BH1), underlain by natural sandy or clayey soil to the maximum investigated depth of 5.5m below the existing surface level. Groundwater seepage was not encountered within the investigation depth.

No signs of existing, previous, or potential instability were observed within the site or adjacent properties.

The proposed works involve the demolition of the existing site structures and the amalgamation of the properties to construct a 9-unit senior housing complex with single-level of basement. The basement is designed to have a finish floor level of RL 9.6m, which indicates a bulk excavation level of approximately RL 9.3m will be required for the allowance of the basement slab. It is also understood that a service room with a designed finished floor level of RL 6.6m under the basement requires a further excavation of about 3.0m.

To achieve this, excavation depth of up to 6.0m below the existing ground level for the proposed service room and basement is anticipated.

The investigation completed was limited by existing structures on site, therefore further detailed investigation and assessment is required to below bulk excavation level prior to final design of engineering support and footing systems.

Prior to any demolition work, we recommend that detailed dilapidation surveys be carried out on all structures and infrastructures surrounding the site that falls within the zone of influence of the excavation considered to be 9.0m from the perimeter to allow assessment of the adjacent condition and protect the client against spurious claims of damage.

Based on the investigation results, it is anticipated that the proposed bulk excavation will comprise of fill, very loose to dense sand soil and firm to hard clay soil which can be excavated using conventional earthmoving equipment.

Due to the sandy soil anticipated to be encountered during the excavation and the setback of neighbours' buildings, vibration impacts above damage or human comfort levels are not anticipated. The excavation contractor should develop an excavation methodology that ensures ground vibration limits are maintained at adjacent structures as per the recommendations of this report. CGC should be consulted regarding the size and type of demolition/excavation equipment proposed and review of the demolition/excavation methodology prior to works to determine via monitoring requirements.

In view of the provided architectural plans, the proposed basement outline has a minimum setback of about 3.8m from the east and west site boundaries, about 8.5m from the northern site boundary and at least about 15.7m to the southern site boundary. The proposed service room has an offset of about 4.0m to the eastern site boundary.

Based on the excavation depths and the investigation results, temporary safe batter slopes can be considered as a suitable option for the northern and southern excavation boundaries during construction. For the western and eastern excavation boundaries, temporary batters appear marginally stable where bulk excavation is no more than 1.5m depth. However, where >1.5m depth, a temporary support system is recommended prior to the excavation. For support post excavation, the construction of steel reinforced concrete/concrete block wall designed in accordance with Australian Standard AS 4678-2002 Earth Retaining Structures is a viable option. The design parameters for both temporary and permanent retention systems are provided in Section 6.2.

In view of the granular natural sand, pre-excavation will be needed in nature soil, therefore, contiguous pile support is recommended to avoid the sand collapse between the piles. A post and beam system could be considered, with the expectation that some erosion and related external settlement will occur. Geotechnical inspections are recommended to assess the material at the base of any piles and confirm the conditions/parameters supplied for structural design prior to the installation of steel and concrete. Based on the excavation depths and separation distances, a cantilever support system is likely suitable, however, this must be confirmed by the structural engineer based on expected deflection in their design.

Based on the site investigation, the groundwater table will be well below the proposed development. Therefore, groundwater is unlikely to be a significant issue for this development and no dewatering or tanking of structures is required. Seepage along isolated flow channels and defects in the soil may be encountered.

Following the bulk excavation, the material at the base is anticipated to be at least very stiff clayey soil or dense sandy soil. It is recommended that all footings for the proposed building be founded within very stiff to hard clayey soil found at a maximum of 3.6m below surface or bedrock of similar strengths to reduce the potential risk of differential settlement. Preliminary allowable bearing pressures appropriate for the

conditions encountered underlying the site are provided in **Section 6.2.1**. Geotechnical inspections of foundations are required to determine or confirm the required bearing capacity and to identify any potential variations between the boreholes.

Driven excavation support systems such as sheet piles are not recommended in this site due to the ground vibration generated and shallow founding nature of adjacent residential dwellings.

The recommendations and conclusions in this report are based on an investigation utilizing only surface observations and a limited number of test boreholes. This test equipment provides limited data from small, isolated test points across the entire site, therefore some minor variation to the interpreted sub-surface conditions is possible, especially between test locations.

The proposed works are considered suitable for the site and may be completed with negligible impact to existing nearby structures within the site or on neighbouring properties provided the recommendations of this report are implemented in the design and construction phases.

6.2. Design & Construction Recommendations:

The following recommendations should be considered to be preliminary and will need to be confirmed following further investigation.

6.2.1. New Footings:	
Site Classification as per AS2870 – 2011 for new footing design	Class 'P' due to the uncontrolled fill and presence of trees. Class 'S' at the base of excavation.
Type of Footing	Strip/Pad or Slab at base of excavation or piles.
Founding material and Maximum Allowable Bearing Capacity for Footing Design	- Dense Sand or better: 250kPa - Very Stiff Clay or better: 300kPa
Site sub-soil classification as per *Structural design actions AS1170.4 – 2007, Part 4: Earthquake actions in Australia*	Class C_e – Shallow soil. The hazard factor (z) for Sydney is 0.08.
Remark: All new footings must be inspected by an experienced geotechnical professional before concrete or steel are placed to verify the preliminary maximum bearing capacities provided above and the in-situ nature of the founding strata. This is mandatory to allow them to be 'certified' at the end of the project.	

Individual structures should not be founded on materials with varying bearing and settlement characteristics unless the potential for differential movement has been allowed for in structural design. Large open footings in sandy soils are very difficult to maintain and will tend to loosen on exposure and disturbance. Therefore, open pad footings will need to be wet down on excavation and maintained in a moist state with geotechnical inspection and testing prior to placement of concrete.

6.2.2. Excavation Methodology and Monitoring:

Basement Excavation

Table 1: Basement excavation and structure separation distances

Boundary	Adjacent Property	Proposed Structure	Bulk Excavation Depth** (m bgl)	Separation Distances (m)	
				Boundary* (m)	Structure* (m)
North	Brighton Street	Roadway	Up to 2.0m	8.5	Footpath abuts the boundary; roadway has a further 3.0m
East	50 Brighton Street	Main house and pool	Up to 6.0m (Service Room)	3.0	a further 1.0m to the main house and the pool
South	8 Waratah Street, 17 and 19 Robert Street	Rear pool	Up to 3.0m	At least 15.5m	A further 5.0m to the pool of 17 Robert Street.
West	56 Brighton Street, and 2-8 Waratah Street	Main house and rear structures	Up to 3.0m	3.0	Main house of 56 Brighton Street abuts the boundary; Associated structures within the rear area of 2-8 Waratah Street have offsets varying from 0.0 to 2.0 to the boundary.

* All the distances are approximate.

** Due to the designed size of the service room, only eastern site boundary which is considered to be impacted will include this further excavation.

Type of Material to be Excavated.	Fill ≤ 1.6m depth (BH1)	
	Natural Soil: clay/silty sand or sandy clay.	
Equipment for Excavation	Fill and residual soil	Excavator with bucket

Guidelines for un-surcharged batter slopes for this site are tabulated below:

Material	Safe Batter Slope (H:V)*	
	Short Term/ Temporary	**Long Term/ Permanent**
Fill and very loose to loose sand	1.5:1.0	2.0:1.0
Medium dense sand or better/Firm sandy clay	1.0:1.0	1.5:1.0
Stiff sandy clay or better	0.75:1.0	1.25:1.0

Remarks:

Where safe batter slopes cannot be implemented due to the excavation's proximity to the boundaries, the stability of the excavation cannot be guaranteed until the installation of permanent support measures. This should also be considered with respect to safe working conditions.

As a general guide, any surcharge loads (e.g., load out points, adjacent building or structure footings) should be at a distance greater than 2.5H (H being height of batter) away from the crest/top of any adjacent excavated batter within soils. If this separation distance cannot be maintained positive retention will be required.

Recommended Vibration Limits (Maximum Peak Particle Velocity (PPV))	Adjacent residential structure = 5mm/s (Frequency ≥1.3 Hz) Road Reserve = 5mm/s (Frequency ≥1.3 Hz)
Full time vibration Monitoring Required	Not required
Dilapidation Surveys Requirement	Required on the neighbouring structures/infrastructures or parts within 12m of the excavation perimeter. **Note:** CGC have the experience in performing Dilapidation Surveys.

6.2.3. Retaining Structures:

Required	Pre-excavation or post excavation retention systems around perimeter of basement excavation is required as part of the works.
Types	Pre-excavation retention system: such as contiguous pile wall; Or post-excavation concrete block/concrete wall. Maybe cantilever where deflection criteria can be met. Designed in accordance with AS4678:2002 'Earth-Retaining Structures'

Parameters for calculating pressures acting on retaining walls for the materials likely to be retained:

Material	Unit Weight (kN/m3)	Long Term (Drained) friction angle ϕ'	Earth Pressure Coefficients		Passive Earth Pressure Coefficient * (K_p)
			Active (Ka)	At Rest (K_0)	
Sandy Fill and Loose Sand	18	28°	0.35	0.52	N/A
Clay – Firm	18	28°	0.35	0.52	N/A
Sand – Medium Dense to Dense	20	33°	0.29	0.46	3.39
Clay – Stiff to hard	20	30°	0.33	0.50	3.00

Remarks:

In suggesting these parameters, it is assumed that the retaining walls will be fully drained with suitable subsoil drains provided at the rear of the wall footings. If this is not done, then the walls should be designed to support full hydrostatic pressure in addition to pressures due to the soil backfill. It is suggested that the retaining walls should be backfilled with free-draining granular material (preferably not recycled concrete) which is only lightly compacted to minimize horizontal stresses.

Retaining structures near site boundaries or existing structures should be designed with the use of at rest (K_0) earth pressure coefficients to reduce the risk of movement in the excavation support and resulting surface movement in adjoining areas. Backfilled retaining walls within the site, away from site boundaries or existing structures, that may deflect can utilize active earth pressure coefficients (Ka).

6.2.4. Drainage and Hydrogeology		
Groundwater Table or Seepage identified in Investigation		Not encountered within the investigation depth to >2.0m below excavation base at front of site.
Excavation likely to intersect	Water Table	No
	Seepage	May be encountered.
Site Location and Topography		Similar elevation to Brighton Street within gently north dipping low lying topography near base of slope.
Impact of development on local hydrogeology		Negligible
Onsite Stormwater Disposal		Sump and pump system may be required for seepage collection and disposal.

Remarks:

Exposed excavation faces should be expected to receive seepage from surface and subsurface water flow emanating from the soil. This can result in relaxation of excavation faces causing instability. Therefore, excavation faces should not remain open for long periods of time unless assessed to be stable by a geotechnical professional.

An excavation trench should also be installed at the base of excavation cuts to below floor slab levels to reduce the risk of long-term dampness. Trenches, as well as all new building gutters, down pipes and stormwater intercept trenches should be connected to a stormwater system designed by a Hydraulic Engineer which discharges to the Council's stormwater system off site.

6.3. Conditions Relating to Design and Construction Monitoring:

To allow certification as part of construction, building and post-construction activity for this project, it will be necessary for CGC to conduct:

1. Review structural design drawings for implementation of the recommendations of this report and future reporting,
2. Inspect any pre-excavation shoring piles to assess the base material and confirm the structural design;
3. Inspect any excavation where unsupported, at maximum 1.50m depth intervals.
4. At completion of the excavation to confirm the material at the base of the excavation;
5. Inspect all new footings to confirm compliance to design assumptions with respect to allowable bearing pressure and stability prior to the placement of steel or concrete.
6. Where ground conditions vary from those anticipated and outlined in this report are encountered.

The client and builder should make themselves familiar with the requirements spelled out in this report for inspections during the construction phase. Crozier Geotechnical Consultants cannot provide certification for the Occupation Certificate if it has not been called to the site to undertake the required inspections.

7. CONCLUSION:

The site investigation indicated the presence of uncontrolled fill (up to 1.6m BEGL), underlaid by variable natural soil (silty sand, sandy clay and clayey sand) encountered within the depths varying 0.3m to the maximum investigated depth of 5.5m. The presence of groundwater seepage was not encountered during the investigation.

It is anticipated that the proposed bulk excavation up to approximately 3.0m depth for the proposed basement will comprise of fill profiles and natural soil, which indicates that only excavator with bucket is required for the excavation work. Local deeper excavation of up to 6.0m depth for the proposed service room is anticipated.

Based on the proposed basement perimeter and the subsurface conditions, temporary batters are suitable for the northern and southern excavation boundaries, however, due to the fill profiles and loose sand, pre-excavation support is recommended for at least parts of the eastern and western excavation boundaries. Alternatively, a pre-excavation support system such as contiguous pile wall is appropriate for the site to avoid the sand collapse between the piles.

It is recommended that all new footings be founded on the same material of similar bearing to avoid any differential settlement.

As such the site is considered suitable for the proposed construction works provided that the recommendations outlined in this report and any future geotechnical reporting or directive are followed.

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8. REFERENCES:

i. Australian Standard AS1726:2017, Geotechnical Site Investigations;

ii. Australian Standard AS2159:2009, Piling – Design and Installation;

iii. Australian Standard AS2870:2017, Residential Slabs and Footings;

iv. Australian Standard AS3600:2009, Concrete Structures;

v. Australian Standard AS3798:2007, Guidelines on Earthworks for Commercial and Residential Developments;

vi. Australian Standard AS 4678:2002, Earth-Retaining Structures;

vii. Sydney 1:100,000 Geological Series Sheet 9130 (Edition 1). Geological Survey of New South Wales, Department of Mineral Resources;

viii. Spatial Information Viewer, maps.six.nsw.gov.au, NSW Department of Finance and Service.

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Appendix 1

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NOTES RELATING TO THIS REPORT

Introduction

These notes have been provided to amplify the geotechnical report in regard to classification methods, specialist field procedures and certain matters relating to the Discussion and Comments section. Not all, of course, are necessarily relevant to all reports.

Geotechnical reports are based on information gained from limited subsurface test boring and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Description and classification Methods

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, Geotechnical Site Investigation Code. In general, descriptions cover the following properties - strength or density, colour, structure, soil or rock type and inclusions.

Soil types are described according to the predominating particle size, qualified by the grading of other particles present (eg. Sandy clay) on the following bases:

Soil Classification	Particle Size
Clay	less than 0.002 mm
Silt	0.002 to 0.06 mm
Sand	0.06 to 2.00 mm
Gravel	2.00 to 60.00mm

Cohesive soils are classified on the basis of strength either by laboratory testing or engineering examination. The strength terms are defined as follows:

Classification	Undrained Shear Strength kPa
Very soft	Less than 12
Soft	12 - 25
Firm	25 – 50
Stiff	50 – 100
Very stiff	100 - 200
Hard	Greater than 200

Non-cohesive soils are classified on the basis of relative density, generally from the results of standard penetration tests (SPT) or Dutch cone penetrometer tests (CPT) as below:

Relative Density	SPT "N" Value (blows/300mm)	CPT Cone Value (Qc – MPa)
Very loose	less than 5	less than 2
Loose	5 – 10	2 – 5
Medium dense	10 – 30	5 -15
Dense	30 – 50	15 – 25
Very dense	greater than 50	greater than 25

Rock types are classified by their geological names. Where relevant, further information regarding rock classification is given on the following sheet.

Sampling

Sampling is carried out during drilling to allow engineering examination (and laboratory testing where required) of the soil or rock.

Disturbed samples taken during drilling to allow information on colour, type, inclusions and, depending upon the degree of disturbance, some information on strength and structure.

Undisturbed samples are taken by pushing a thin-walled sample tube into the soil and withdrawing a sample of the soil in a relatively undisturbed state. Such samples yield information on structure and strength, and are necessary for laboratory determination of shear strength and compressibility. Undisturbed sampling is generally effective only in cohesive soils.

Drilling Methods

The following is a brief summary of drilling methods currently adopted by the company and some comments on their use and application.

Test Pits – these are excavated with a backhoe or a tracked excavator, allowing close examination of the insitu soils if it is safe to descent into the pit. The depth of penetration is limited to about 3m for a backhoe and up to 6m for an excavator. A potential disadvantage is the disturbance caused by the excavation.

Large Diameter Auger (eg. Pengo) – the hole is advanced by a rotating plate or short spiral auger, generally 300mm or larger in diameter. The cuttings are returned to the surface at intervals (generally of not more than 0.5m) and are disturbed but usually unchanged in moisture content. Identification of soil strata is generally much more reliable than with continuous spiral flight augers, and is usually supplemented by occasional undisturbed tube sampling.

Continuous Sample Drilling – the hole is advanced by pushing a 100mm diameter socket into the ground and withdrawing it at intervals to extrude the sample. This is the most reliable method of drilling soils, since moisture content is unchanged and soil structure, strength, etc. is only marginally affected.

Continuous Spiral Flight Augers – the hole is advanced using 90 – 115mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are very disturbed and may be contaminated. Information from the drilling (as distinct from specific sampling by SPT's or undisturbed samples) is of relatively lower reliability, due to remoulding, contamination or softening of samples by ground water.

Non-core Rotary Drilling - the hole is advanced by a rotary bit, with water being pumped down the drill rods and returned up the annulus, carrying the drill cuttings. Only major changes in stratification can be determined from the cuttings, together with some information from 'feel' and rate of penetration.

Rotary Mud Drilling – similar to rotary drilling, but using drilling mud as a circulating fluid. The mud tends to mask the cuttings and reliable identification is again only possible from separate intact sampling (eg. From SPT).

Continuous Core Drilling – a continuous core sample is obtained using a diamond-tipped core barrel, usually 50mm internal diameter. Provided full core recovery is achieved (which is not always possible in very weak rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation.

Standard Penetration Tests

Standard penetration tests (abbreviated as SPT) are used mainly in non-cohesive soils, but occasionally also in cohesive soils as a means of determining density or strength and also of obtaining a relatively undisturbed sample. The test procedures is described in Australian Standard 1289, "Methods of Testing Soils for Engineering Purposes" – Test 6.3.1.

The test is carried out in a borehole by driving a 50mm diameter split sample tube under the impact of a 63kg hammer with a free fall of 760mm. It is normal for the tube to be driven in three successive 150mm increments and the 'N' value is taken

as the number of blows for the last 300mm. In dense sands, very hard clays or weak rock, the full 450mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

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

The results of the test can be related empirically to the engineering properties of the soil. Occasionally, the test method is used to obtain samples in 50mm diameter thin wall sample tubes in clay. In such circumstances, the test results are shown on the borelogs in brackets.

Cone Penetrometer Testing and Interpretation

Cone penetrometer testing (sometimes referred to as Dutch Cone – abbreviated as CPT) described in this report has been carried out using an electrical friction cone penetrometer. The test is described in Australia Standard 1289, Test 6.4.1.

In tests, a 35mm diameter rod with a cone-tipped end is pushed continually into the soil, the reaction being provided by a specially designed truck or rig which is fitted with an hydraulic ram system. Measurements are made of the end bearing resistance on the cone and the friction resistance on a separte 130mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are connected buy electrical wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20mm per second) their information is plotted on a computer screen and at the end of the test is stored on the computer for later plotting of the results.

The information provided on the plotted results comprises: -

- Cone resistance – the actual end bearing force divided by the cross-sectional area of the cone – expressed in MPa.
- Sleeve friction – the frictional force on the sleeve divided by the surface area – expressed in kPa.
- Friction ratio - the ratio of sleeve friction to cone resistance, expressed in percent.

There are two scales available for measurement of cone resistance. The lower scale (0 – 5 MPa) is used in very soft soils where increased sensitivity is required and is shown in the graphs as a dotted line. The main scale (0 – 50 MPa) is less sensitive and is shown as a full line. The ratios of the sleeve friction to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios 1% - 2% are commonly encountered in sands and very soft clays rising to 4% - 10% in stiff clays.

In sands, the relationship between cone resistance and SPT value is commonly in the range: -

Qc (MPa) = (0.4 to 0.6) N blows (blows per 300mm)

In clays, the relationship between undrained shear strength and cone resistance is commonly in the range: -

Qc = (12 to 18) Cu

Interpretation of CPT values can also be made to allow estimation of modulus or compressibility values to allow calculations of foundation settlements.

Inferred stratification as shown on the attached reports is assessed from the cone and friction traces and from experience and information from nearby boreholes, etc. This information is presented for general guidance, but must be regarded as being to some extent interpretive. The test method provides a continuous profile of engineering properties, and where precise information on soil classification is required, direct drilling and sampling may be preferable.

Dynamic Penetrometers

Dynamic penetrometer tests are carried out by driving a rod into the ground with a falling weight hammer and measuring the blows for successive 150mm increments of penetration. Normally, there is a depth limitation of 1.2m but this may be extended in certain conditions by the use of extension rods.

Two relatively similar tests are used.

- Perth sand penetrometer – a 16mm diameter flattened rod is driven with a 9kg hammer, dropping 600mm (AS1289, Test 6.3.3). The test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.
- Cone penetrometer (sometimes known as Scala Penetrometer) – a 16mm rod with a 20mm diameter cone end is driven with a 9kg hammer dropping 510mm (AS 1289, Test 6.3.2). The test was developed initially for pavement sub-grade investigations, and published correlations of the test results with California bearing ratio have been published by various Road Authorities.

Laboratory Testing

Laboratory testing is generally carried out in accordance with Australian Standard 1289 "Methods of Testing Soil for Engineering Purposes". Details of the test procedure used are given on the individual report forms.

Borehole Logs

The bore logs presented herein are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable, or possible to justify on economic grounds. In any case, the boreholes represent only a very small sample of the total subsurface profile.

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

Details of the type and method of sampling are given in the report and the following sample codes are on the borehole logs where applicable:

D	Disturbed Sample	E	Environmental sample	DT	Diatube
B	Bulk Sample	PP	Pocket Penetrometer Test		
U50	50mm Undisturbed Tube Sample	SPT	Standard Penetration Test		
U63	63mm " " " " "	C	Core		

Ground Water

Where ground water levels are measured in boreholes there are several potential problems:

- In low permeability soils, ground water although present, may enter the hole slowly or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report.
- The use of water or mud as a drilling fluid will mask any ground water inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water observations are to be made. More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be interference from a perched water table.

Engineering Reports

Engineering reports are prepared by qualified personnel and are based on the information obtained and on current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal (eg. A three-storey building), the information and interpretation may not be relevant if the design proposal is changed (eg. to a twenty-storey building). If this happens, the Company will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface condition, discussion of geotechnical aspects and recommendations or suggestions for design and construction**.** However, the Company cannot always anticipate or assume responsibility for:

- unexpected variations in ground conditions – the potential for this will depend partly on bore spacing and sampling frequency,
- changes in policy or interpretation of policy by statutory authorities,
- the actions of contractors responding to commercial pressures,

If these occur, the Company will be pleased to assist with investigation or advice to resolve the matter.

Site Anomalies

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

Reproduction of Information for Contractual Purposes

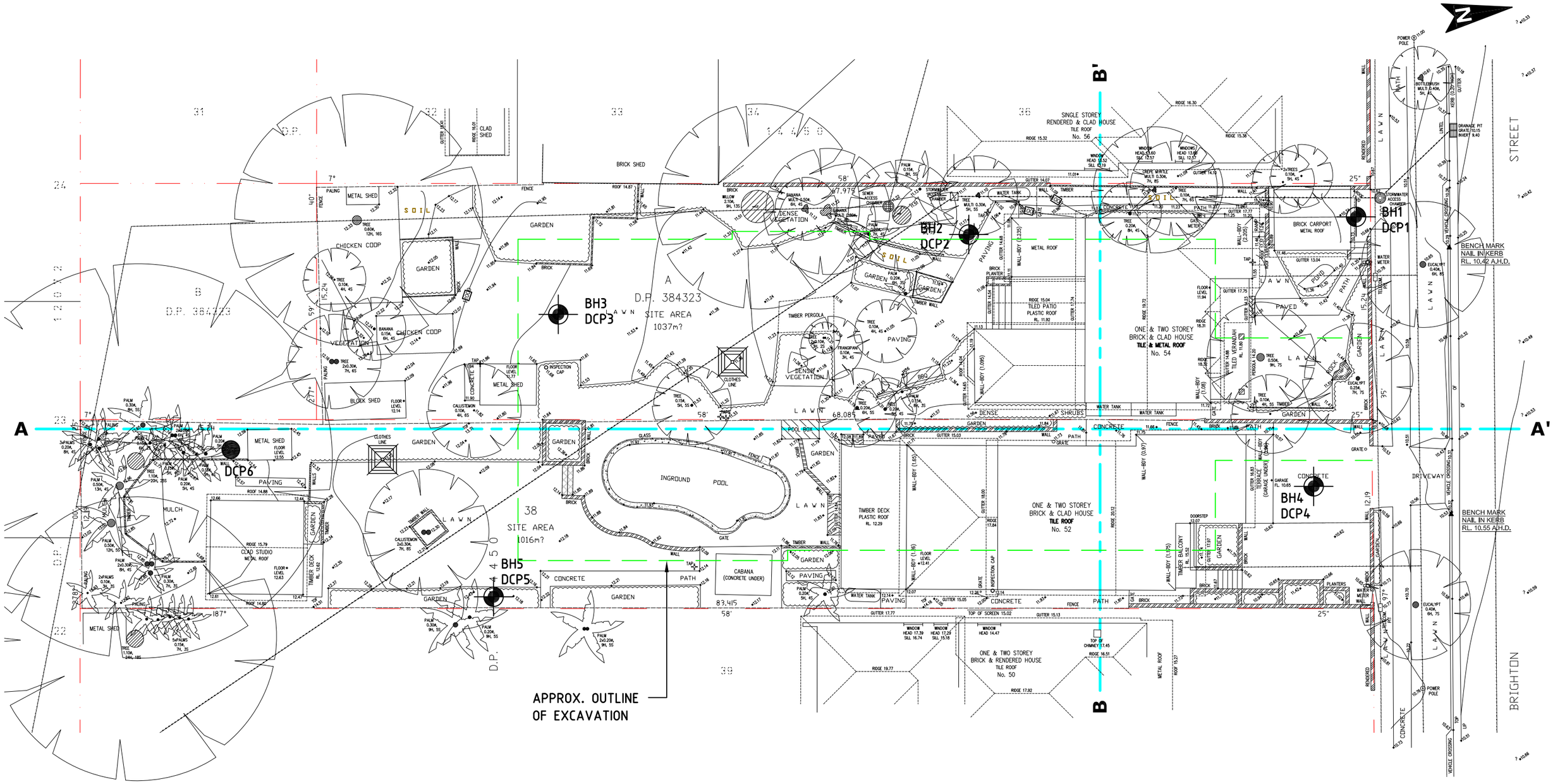
Attention is drawn to the document “Guidelines for the Provision of Geotechnical Information in Tender Documents”, published by the Institution of Engineers Australia. Where information obtained from this investigation is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a special ally edited document. The Company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The Company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

CROZIER
GEOTECHNICAL CONSULTANTS

Appendix 2



SITE PLAN AND TEST LOCATIONS FIGURE 1

CROZIER GEOTECHNICAL CONSULTANTS

Crozier Geotechnical ABN: 96 113 453 624
Unit 12, 42-46 Wattle Road Phone: (02) 9939 1882
Brookvale NSW 2100 Email: Info@crozliergeotech.com.au
Crozier Geotechnical is a division of PJC Geo-Engineering Pty Ltd

LEGEND

- BH- AUGER LOCATION
- DCP- DYNAMIC PENETRATION TEST
- A——A' CROSS SECTION REFERENCE LINE
- X° SLOPE ANGLE
- TP- TEST PIT LOCATION
- CBR- CALIFORNIA BEARING RATIO LOCATION
- BOUNDARY LINE
- PROPOSED ADDITION

SCALE :	1:250
DRAWING :	FIGURE 1
DATE :	13.07.23
APPROVED BY :	J.L.
DRAWN BY :	A.C.W.
PROJECT :	2023-120

PREPARED FOR :
LAXLAND 3 Pty Ltd

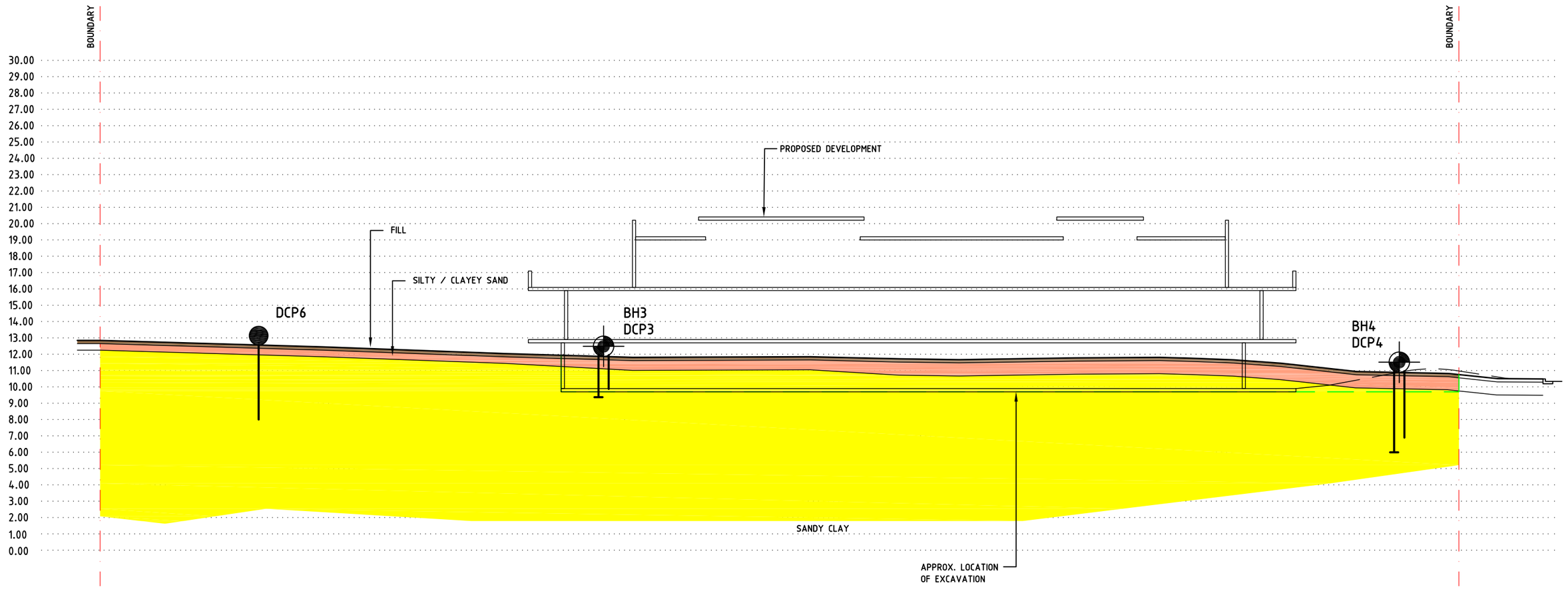
ADDRESS :
52 - 54 BRIGHTON STREET
FRESHWATER, N.S.W.

A

A'

SOUTH

NORTH



0 2.5 5 7.5 10 12.5

5 4 3 2 1

SCALE 1:250

VL - Very Loose	VS - Very Soft	ELS - Extremely Low Strength	EW - Extremely Weathered	fg - Fine Grained
L - Loose	S - Soft	VLS - Very Low Strength	HW - Highly Weathered	mg - Medium Grained
MD - Medium Dense	F - Firm	LS - Low Strength	DW - Distinctly Weathered	cg - Coarse Grained
D - Dense	St - Stiff	MS - Medium Strength	MW - Moderately Weathered	MAS - Massive
VD - Very Dense	VSt - Very Stiff	HS - High Strength	SW - Slightly Weathered	BD - Bedded
	H - Hard	VHS - Very High Strength	FR - Fresh	OC - Outcrop

GEOLOGICAL MODEL FIGURE 2

CROZIER GEOTECHNICAL CONSULTANTS

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LEGEND

AUGER LOCATION

DCP- DYNAMIC PENETRATION TEST

AUGER / DYNAMIC PENETRATION TEST

BOUNDARY LINE

FILL

SILTY CLAYEY SAND

SANDY CLAY

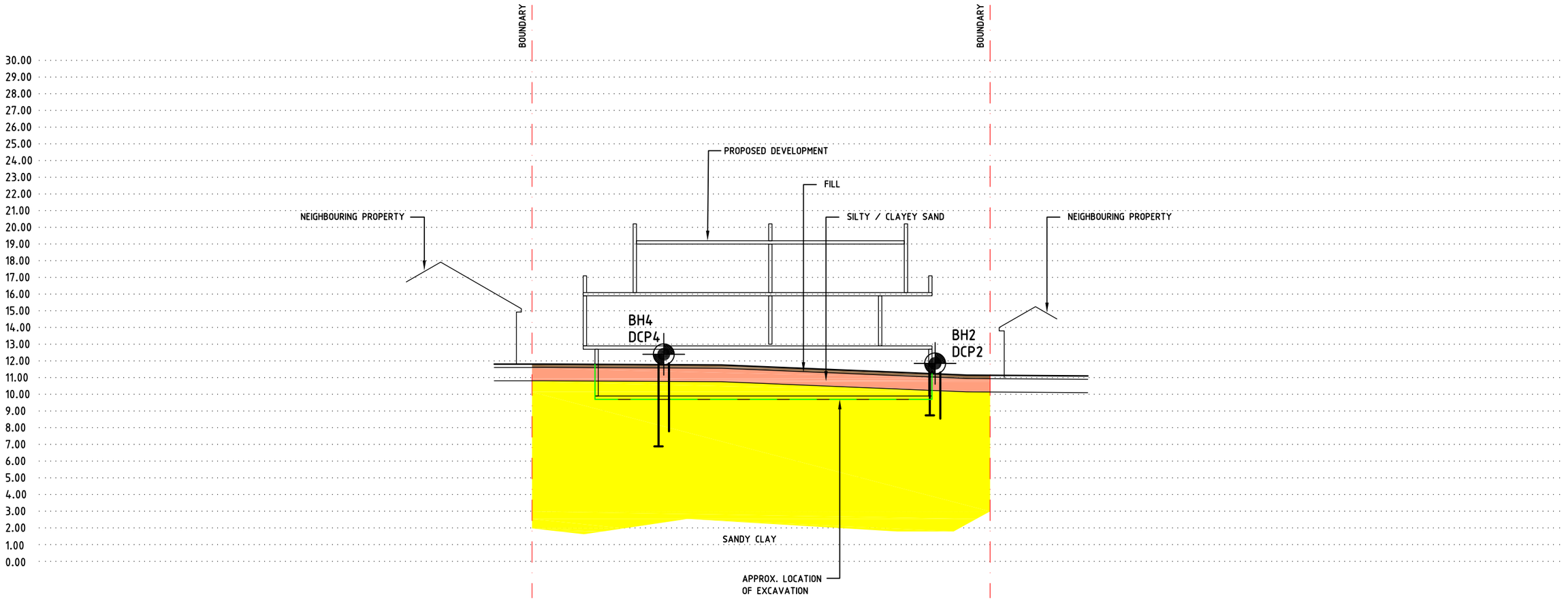
SCALE :	1:250
DRAWING :	FIGURE 2
DATE :	13.07.23
APPROVED BY :	J.L.
DRAWN BY :	A.C.W.
PROJECT :	2023-120

PREPARED FOR :
LAXLAND 3 Pty Ltd

ADDRESS :
52 - 54 BRIGHTON STREET
FRESHWATER, N.S.W.

B **B'**

EAST **WEST**



0 2.5 5 7.5 10 12.5

5 4 3 2 1

SCALE 1:250

VL - Very Loose	VS - Very Soft	ELS - Extremely Low Strength	EW - Extremely Weathered	fg - Fine Grained
L - Loose	S - Soft	VLS - Very Low Strength	HW - Highly Weathered	mg - Medium Grained
MD - Medium Dense	F - Firm	LS - Low Strength	DW - Distinctly Weathered	cg - Coarse Grained
D - Dense	St - Stiff	MS - Medium Strength	MW - Moderately Weathered	MAS - Massive
VD - Very Dense	VSt - Very Stiff	HS - High Strength	SW - Slightly Weathered	BD - Bedded
	H - Hard	VHS - Very High Strength	FR - Fresh	OC - Outcrop

GEOLOGICAL MODEL FIGURE 3

CROZIER GEOTECHNICAL CONSULTANTS

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LEGEND

AUGER LOCATION

DCP- DYNAMIC PENETRATION TEST

AUGER / DYNAMIC PENETRATION TEST

BOUNDARY LINE

FILL

SANDY CLAY

SILTY CLAYEY SAND

SCALE :	1:250
DRAWING :	FIGURE 3
DATE :	13.07.23
APPROVED BY :	J.L.
DRAWN BY :	A.C.W.
PROJECT :	2023-120

PREPARED FOR :
LAXLAND 3 Pty Ltd

ADDRESS :
52 - 54 BRIGHTON STREET
FRESHWATER, N.S.W.

BOREHOLE LOG

CLIENT: Laxland 3 Pty Ltd **DATE:** 19/06/2023 **BORE No.:** 1

PROJECT: Proposed New Development **PROJECT No.:** 2023-120 **SHEET:** 1 of 2

LOCATION: 52 & 54 Brighton Street, Freshwater, NSW **SURFACE LEVEL:** 10.7m AHD

Depth (m)	Classification	Description of Strata **PRIMARY SOIL** - consistency / density, colour, grainsize or plasticity, moisture condition, soil type and secondary constituents, other remarks	Sampling		In Situ Testing	
			Type	Depth	Type	Results
0.00						
0.10	-	PAVEMENT: Concrete Slab, 100mm thick.				
	-	FILL: Very loose to loose, brown, fine to medium grained, moist, silty sand, with fine to medium gravels and rootlets.				
1.00						
		…becoming pale brown,				
1.60						
	SC	Clayey SAND: medium dense, brown to pale brown, medium grained, moist, clayey sand.		1.80		
2.00			D	2.00		
2.40		…becoming reddish brown with pale grey brands, medium to coarse grained.		2.80		
3.00			D	3.00		
3.50		… becoming pale grey and reddish brown, increse in moisture.				
4.00						
4.20						
	CL	Sandy CLAY: very stiff to hard, reddish brown to pink, low plasticity, moist to wet, trace quartz		4.50		
			D	4.70		

RIG: Dingo - Restrict Access Drill Rig DRILLER: PS

METHOD: Auger Drilling LOGGED: PS

GROUND WATER OBSERVATIONS: Groundwater not encountered

REMARKS: D=Disturbed CHECKED: TMC

BOREHOLE LOG

CLIENT: Laxland 3 Pty Ltd **DATE:** 19/06/2023 **BORE No.:** 1

PROJECT: Proposed New Development **PROJECT No.:** 2023-120 **SHEET:** 2 of 2

LOCATION: 52 & 54 Brighton Street, Freshwater, NSW **SURFACE LEVEL:** 10.7m AHD

Depth (m)	Classification	Description of Strata **PRIMARY SOIL** - consistency / density, colour, grainsize or plasticity, moisture condition, soil type and secondary constituents, other remarks	Sampling		In Situ Testing	
			Type	Depth	Type	Results
5.00		Sandy CLAY: very stiff to hard, reddish brown to pink, low plasticity, moist to wet, trace quartz				
5.30		…becoming reddish brown.				
5.50		Terminated at 5.5m, target depth.				

RIG: Dingo - Restrict Access Drill Rig DRILLER: PS

METHOD: Auger Drilling LOGGED: PS

GROUND WATER OBSERVATIONS:

REMARKS: D=Disturbed CHECKED: TMC

BOREHOLE LOG

CLIENT: Laxland 3 Pty Ltd **DATE:** 19/06/2023 **BORE No.:** 2

PROJECT: Proposed New Development **PROJECT No.:** 2023-120 **SHEET:** 1 of 1

LOCATION: 52 & 54 Brighton Street, Freshwater, NSW **SURFACE LEVEL:** 11.1m AHD

Depth (m)	Classification	Description of Strata **PRIMARY SOIL** - consistency / density, colour, grainsize or plasticity, moisture condition, soil type and secondary constituents, other remarks	Sampling		In Situ Testing	
			Type	Depth	Type	Results
0.00	-	TOPSOIL/FILL: very loose to loose, fine grained, dark grey, moist, silty sand, trace rootlets.				
0.50						
1.00						
1.30	CL	Sandy CLAY: firm to very stiff, low to medium plasticity, grey brown, moist, dry of plastic limit, sandy clay; sand is fine grained; trace silt.		1.40		
1.50		…mottle red brown	D	1.60		
2.00		…trace iron-stained sandstone gravels.	D	2.00		
2.40				2.20		
		Terminated at 2.4m, hand auger refusal on hard sandy clay.				

RIG: N/A DRILLER: SK

METHOD: Hand Auger LOGGED: JL

GROUND WATER OBSERVATIONS: Groundwater not encountered

REMARKS: D=Disturbed CHECKED: TMC

BOREHOLE LOG

CLIENT: Laxland 3 Pty Ltd **DATE:** 19/06/2023 **BORE No.:** 3

PROJECT: Proposed New Development **PROJECT No.:** 2023-120 **SHEET:** 1 of 1

LOCATION: 52 & 54 Brighton Street, Freshwater, NSW **SURFACE LEVEL:** 11.7m AHD

Depth (m)	Classification	Description of Strata **PRIMARY SOIL** - consistency / density, colour, grainsize or plasticity, moisture condition, soil type and secondary constituents, other remarks	Sampling		In Situ Testing	
			Type	Depth	Type	Results
0.00	-	TOPSOIL/FILL: very loose to loose, fine grained, dark grey, moist, silty sand, trace rootlets.				
0.30	SM	Silty SAND: very loose to loose, fine grained, brown, moist, silty sand, trace rootlets.				
0.50				0.60		
			D	0.80		
0.90		… medium dense, mottled orange brown, trace clay and irion stained sandstone gravels.		1.00		
			D			
1.20		Terminated at 1.2m, hand auger refusal on sandstone gravels.		1.20		

RIG: N/A DRILLER: SK

METHOD: Hand Auger LOGGED: JL

GROUND WATER OBSERVATIONS: Groundwater not encountered

REMARKS: D=Disturbed CHECKED: TMC

BOREHOLE LOG

CLIENT: Laxland 3 Pty Ltd **DATE:** 19/06/2023 **BORE No.:** 4

PROJECT: Proposed New Development **PROJECT No.:** 2023-120 **SHEET:** 1 of 1

LOCATION: 52 & 54 Brighton Street, Freshwater, NSW **SURFACE LEVEL:** 10.6m AHD

Depth (m)	Classification	Description of Strata **PRIMARY SOIL** - consistency / density, colour, grainsize or plasticity, moisture condition, soil type and secondary constituents, other remarks	Sampling		In Situ Testing	
			Type	Depth	Type	Results
0.00	-	PAVEMENT: Concrete slab, 200mm thick.				
0.20	-	FILL: medium dense to dense, dark brown, fine to medium grained, moist, silty sand.				
0.80	SP	SAND: medium dense, pale brown, medium grained, moist, sand with quartz.		1.00		
1.00			D	1.20		
1.50	SC	Clayey SAND: dense, brown to reddish brown, fine to medium grained, moist, clayey sand.		1.80		
2.00			D	2.00		
2.20		…dark brown with grey bands.				
2.60	SC	Sandy CLAY: very stiff to hard, reddish brown, low plasticity, moist, sandy clay.		2.80		
3.00			D	3.00		
3.80		…reddish brown with grey bands, increse in moisture.				
4.00						
4.80						
4.90		…grading into extremely weathered materials.				
		Terminated at 4.9m, target depth.				

RIG: Dingo - Restrict Access Drill Rig DRILLER: PS

METHOD: Auger Drilling LOGGED: PS

GROUND WATER OBSERVATIONS: Groundwater not encountered

REMARKS: D=Disturbed CHECKED: TMC

BOREHOLE LOG

CLIENT: Laxland 3 Pty Ltd **DATE:** 19/06/2023 **BORE No.:** 5

PROJECT: Proposed New Development **PROJECT No.:** 2023-120 **SHEET:** 1 of 1

LOCATION: 52 & 54 Brighton Street, Freshwater, NSW **SURFACE LEVEL:** 12.2m AHD

Depth (m)	Classification	Description of Strata **PRIMARY SOIL** - consistency / density, colour, grainsize or plasticity, moisture condition, soil type and secondary constituents, other remarks	Sampling		In Situ Testing	
			Type	Depth	Type	Results
0.00	-	FILL: loose to medium dense, fine grained, dark grey, moist, silty sand, trace rootlets and medium to coarse grained gravels.				
0.50						
0.70				0.70		
	SM	Silty SAND: medium dense to dense, fine grained, brown to yellow brown, moist silty sand.	D	0.80		
1.00						
		Terminated at 1.0m, hole collapsed.				

RIG: N/A DRILLER: SK

METHOD: Hand Auger LOGGED: JL

GROUND WATER OBSERVATIONS: Groundwater not encountered

REMARKS: D=Disturbed CHECKED: TMC

DYNAMIC PENETROMETER TEST SHEET

CLIENT: Laxland 3 Pty Ltd Pty Ltd **DATE:** 19/06/2023

PROJECT: Proposed New Development **PROJECT No.:** 2023-120

LOCATION: 52 & 54 Brighton Street, Freshwater, NSW **SHEET:** 1 of 2

	Test Location									
Depth (m)	DCP1	DCP2	DCP3	DCP4	DCP5	DCP6				
0.00 - 0.10	-	1	1	-	2	1				
0.10 - 0.20	3	2	1	12	3	3				
0.20 - 0.30	1	1	1	15	1	7				
0.30 - 0.40	1	4	1	10	2	5				
0.40 - 0.50	1	3	0	6	3	4				
0.50 - 0.60	2	2	1	6	4	5				
0.60 - 0.70	1	1	1	5	3	6				
0.70 - 0.80	1	1	1	4	5	4				
0.80 - 0.90	2	1	2	4	5	15				
0.90 - 1.00	2	1	5	5	6	12				
1.00 - 1.10	1	1	6	4	6	7				
1.10 - 1.20	1	2	7	7	8	11				
1.20 - 1.30	3	2	6	8	9	8				
1.30 - 1.40	3	4	6	7	7	6				
1.40 - 1.50	5	4	8	6	10	9				
1.50 - 1.60	7	4	8	7	10	7				
1.60 - 1.70	7	4	10	11	9	8				
1.70 - 1.80	7	5	9	8	10	8				
1.80 - 1.90	6	6	9	8	15	7				
1.90 - 2.00	8	7	10	11	17	6				
2.00 - 2.10	8	6	10	8	16	8				
2.10 - 2.20	9	6	13	11	END	6				
2.20 - 2.30	8	7	15	10		10				
2.30 - 2.40	10	9	16	10		7				
2.40 - 2.50	13	16	19	10		9				
2.50 - 2.60	13	17	END	8		7				
2.60 - 2.70	15	17		8		8				
2.70 - 2.80	16	END		9		6				
2.80 - 2.90	19			9		10				
2.90 - 3.00	END			7		7				
3.00 - 3.10				6		5				
3.10 - 3.20				7		5				
3.20 - 3.30				8		7				
3.30 - 3.40				8		10				
3.40 - 3.50				9		9				
3.50 - 3.60				11		8				
3.60 - 3.70				12		10				
3.70 - 3.80				18		11				
3.80 - 3.90				15		9				
3.90 - 4.00				17		10				

TEST METHOD: AS 1289. F3.2, CONE PENETROMETER

REMARKS: **(B)** Test hammer bouncing upon refusal on solid object

-- No test undertaken at this level due to prior excavation of soils

DYNAMIC PENETROMETER TEST SHEET

CLIENT: Laxland 3 Pty Ltd Pty Ltd | **DATE:** 19/06/2023

PROJECT: Proposed New Development | **PROJECT No.:** 2023-120

LOCATION: 52 & 54 Brighton Street, Freshwater, NSW | **SHEET:** 2 of 2

	Test Location									
Depth (m)	DCP1	DCP2	DCP3	DCP4	DCP5	DCP6				
4.00 - 4.10				END		11				
4.10 - 4.20						15				
4.20 - 4.30						15				
4.30 - 4.40						17				
4.40 - 4.50						END				
4.50 - 4.60										
4.60 - 4.70										
4.70 - 4.80										
4.80 - 4.90										
4.90 - 5.00										

TEST METHOD: AS 1289. F3.2, CONE PENETROMETER

REMARKS:
(B) Test hammer bouncing upon refusal on solid object
-- No test undertaken at this level due to prior excavation of soils

CROZIER
GEOTECHNICAL CONSULTANTS

Appendix 3

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Development Officer
Northern Beaches Council.

Geotechnical Assessment in Response to Council Request for Additional Information at 52-54 Brighton Street, Freshwater, NSW.

This supplementary report relates to Northern Beaches Council's request for additional information regarding the submitted Development Application for the above site; 52-54 Brighton Street, Freshwater, NSW.

As part of this report we have reviewed the following documents:

- Our Report titled "Report on Geotechnical Investigation for Proposed New Residential Development at 52-54 Brighton Street, Freshwater, NSW", Project No.: 2023-120, Dated: 4 December 2023;
- Architectural Design Drawings prepared by Walsh Architects – Drawing Nos:
  - DA000, DA040, DA101 to DA104, DA200 to DA201, and DA300 to DA301, Rev. B, Dated 8 December 2023;
  - DA030, Rev. A, Dated 4 July 2023;
  - DA100, Rev. A, Dated 8 December 2023; and
- Site Survey plan prepared by Bee & Lethbrigdge – Ref No. 22858, Drawing No. 22858, Rev. 00, dated 14 April 2023;

Development Application Design Drawings

The DA submitted works involve the demolition of the existing site structures and the amalgamation of the properties to construct a 9-unit senior housing complex with single-level of basement.

The basement is designed to have a finish floor level of RL 9.6m, which indicates a bulk excavation level of approximately RL 9.3m will be required for the allowance of the basement slab. It is also understood that a service room with a designed finished floor level of RL 6.6m under the basement requires a further excavation of about 3.0m.

To achieve this, excavation depth of up to 6.0m below the existing ground level for the proposed service room and basement is anticipated. Locally deeper excavations may be required for footings, lift pits and service trenches. The proposed basement has minimum offsets of about 3.8m to the east/west side site

boundary, about 8.5m to the north boundary and 15.7m to the south boundary. The proposed service room under the basement is designed to be a small space with an offset of about 4.0m to the eastern site boundary.

Planning Assessment

Council has identified Clause 6.2 Earthworks of Warringah Local Environmental Plan 2011:

(3) Before granting development consent for earthworks, the consent authority must consider the following matters—

(a) the likely disruption of, or any detrimental effect on, existing drainage patterns and soil stability in the locality,

(b) the effect of the proposed development on the likely future use or redevelopment of the land,

(c) the quality of the fill or the soil to be excavated, or both,

(d) the effect of the proposed development on the existing and likely amenity of adjoining properties,

(e) the source of any fill material and the destination of any excavated material,

(f) the likelihood of disturbing relics,

(g) the proximity to and potential for adverse impacts on any watercourse, drinking water catchment or environmentally sensitive area.

As per Council's request and the relevant sections of Clause 6.2, the following has been assessed and is provided in regard to the proposal:

a) The site is located at middle to bottom portion of a ridge with a generally gently (<3^{o}) northern dipping topography, shown in the below plan acquired from Mecone Mosaic.

Plate 1. Aerial photo of site and surrounds (source: Mecone Mosaic, access 4/12/2023)

New drainage gullies/systems or surface stormwater flow paths (if any) for the proposed development will be discharged via an engineer-designed stormwater disposal system to eliminate the potential disruption of the existing local drainage patterns.

The geotechnical investigations have identified deep natural sandy/clayey soil across the site to the maximum investigation depths of about 5.5m below the surface level. The potential to impact soil stability can be reduced with support methodologies to prevent instability which are listed within the geotechnical report.

b) The proposed works will require a bulk excavation of approximately RL 9.3m for the proposed basement and a local excavation with a further 3.0m for the proposed service room. However, these excavations will be generally within soil profile and be supported by pre-excavated or post retention systems about perimeter of excavation, which is located well away from property boundaries. As such the development will not negatively impact the future re-use of the site and should have negligible impact on neighbouring properties.

c) The material to be excavated on site was identified by inspection and investigation as part of the DA report preparation. These investigations identified that the areas being excavated will generally comprise sandy fill, and natural sandy/clayey soil. It is expected that this excavated soil material will be re-used on site to form any fill component, though there appears limited proposal for fill use. The excavated bedrock, if any, can be considered to be Virgin Excavated Natural Material as per the Protection of the Environment Operations Act 1997 (POEO Act).

d) The proposed works involve the demolition of the existing structures and construction of a new residential building with the proposed bulk excavation anticipated to extend through fill and natural soil. The preference is for the excavation stability to be controlled via the installation of pre-excavation contiguous piles. It should be noted that some risk of instability would remain during the drilling of pre-excavation support; however, separation distances to property boundaries and the expected geological conditions dictate very low potential for any impact to property boundaries or adjacent structures. The geotechnical report details recommendations for control of instability, ground vibrations and geotechnical impact on adjoining properties or development.

e) Whilst there appears no requirement to utilise bulk fill in the proposed works, it is expected that any fill material used on site will comprise re-use of excavated natural material from within the property,

excavated as part of the proposed work, or purchased clean fill (i.e. gravel backfill). The destination of excess material, excavated from on site is expected to be determined by the excavation contractor.

f) As the site is extensively modified from its natural condition it is not likely that relics would be disturbed, however this matter can be dealt with by the conditions of consent in the usual manner and is not within the expertise of the undersigned to assess.

g) The site is located at middle to bottom portion of a ridge with a generally gently (<3o) northern dipping topography. There are no known drinking water catchment areas within proximity to the site and based on site conditions of topography and elevation along with the proposed works there is no potential for adverse impact on adjacent watercourses through sensible construction practices. The existence of environmentally sensitive areas adjacent to the site is beyond the expertise of the undersigned.

The proposed works from a geotechnical perspective are considered achievable and can be completed safely with negligible impact to neighbouring properties or groundwater. Similar projects have been successfully completed throughout Sydney and the local area within the same geological formation.

As such we see no geotechnical reason for the proposed works not to be approved, provided all works are undertaken as per the recommendations of our reports.

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