

HUP2 - T0 - Seismic Assessments - DSA Report

PUKA - 4 Brooklyn Road, Aro Valley

06-Dec-2024 WCC HUP2-T0-Seismic Assessments



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HUP2 - T0 - Seismic Assessments - DSA Report

PUKA - 4 Brooklyn Road, Aro Valley

Client: Wellington City Council

Co No.: N/A

Prepared by

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Executive Summary

Scope and Basis of Assumptions

This report has been prepared for Wellington City Council to describe the results of our detailed seismic assessment for the Pukehinau Flat Block A at 4 Brooklyn Road, Aro Valey, and to provide a concept strengthening scheme if needed.

This report has been prepared in accordance with the scope of work described in *Consultancy* Agreement – Structural Engineering Services, WCC Housing Upgrade Programme Phase 2 (HUP2) Seismic Assessment Project dated 15 December 2023.

Results Summary

The results of our detailed seismic assessment indicate the buildings' earthquake rating to be 34%NBS (IL2) assessed in accordance with the guideline document *The Seismic Assessment of Existing Buildings - Technical Guidelines for Engineering Assessments*, dated July 2017 (Engineering Assessment Guidelines). The earthquake rating is based on an Importance Level 2 (IL2), in accordance with the joint Australian/ New Zealand Standard – Structural Design Actions Part 0, AS/NZS 1170/0:2002 as being deemed appropriate for these buildings. The link bridge is considered separately from the building earthquake rating and has a rating of 15%NBS (IL2). The results are summarised in the tables below.

Item	Description	
Building %NBS rating		34%NBS (IL2)
Importance level	Ordinary building	IL2
Assessed %NBS score and	Concrete Shear Walls (Piers)	35%NBS
importance level (IL2)	Concrete Shear Walls (Spandrels)	34 <i>%NB</i> S
	Walls Out-of-Plane	40%NBS
	Beams	90%NBS
	Columns	95%NBS
	Diaphragms (rigid)	35 <i>%NB</i> S
	Foundation - Ground Beams	35 <i>%NB</i> S
	Foundation – Piles (axial)	70%NBS
	Foundation - Global Shear Resistance	45%NBS
Seismic grade and relative risk	sk Grade C, Medium Risk	
Potential Critical structural weaknesses	Concrete Shear Walls (spandrels) in shear.	

Table 1 Summary of results – Main Building

Table 2 Summary of Results - SSNS

Item	Description	
SSNS %NBS rating		15%NBS (IL2)
Importance level	Ordinary building IL2	
Assessed %NBS score and	Stairs	100 <i>%NB</i> S
importance level (IL2)	Link Bridge	15%NBS
	Walkways	100 <i>%NB</i> S
Seismic grade and relative risk	risk Grade E, Very High Risk	
Potential Critical structural weaknesses	Buckling of link bridge support columns, which will loss the gravity support with no redundancy which will lead to collapse.	

The focus of the assessment using these guidelines is on the life safety of those occupying and those immediately outside the building, rather than building damage and reparability considerations or business interruption. A building with an earthquake rating less than 34%*NBS* fulfils one of the requirements for the Territorial Authority to consider it to be an Earthquake-Prone Building (EPB) in terms of the Building Act 2004. A building rating less than 67%*NBS* is an Earthquake Risk Building (ERB) by the Engineering Guidelines.

The 4 Brooklyn Road, Block A building is therefore categorised as an Earthquake Risk Building.

Recommendations

We recommend that a cost-benefit analysis be performed to assess whether the building should be strengthened or demolished. Any strengthening works should be preceded by a detailed geotechnical investigation to confirm soil parameters and intrusive investigations to verify material strengths.

We highly recommend to carry out strengthening of the link bridge as soon as possible.

See Appendix F for strengthening concepts.

1.0 Introduction

AECOM New Zealand Ltd (AECOM) has been engaged by Wellington City Council (Client) to conduct a Detailed Seismic Assessment (DSA) of Block A at 4 Brooklyn Road, Wellington.

The objective of this DSA is to evaluate the likely seismic behaviour of the buildings in terms of percentage of New Building Standard (%NBS) and provide recommendations for seismic strengthening of the building, if necessary.

This report presents the result of this assessment and high-level strengthening works if applicable. The building has been assessed based on AECOM's interpretation of the information obtained from the existing drawings and site inspection.

1.1 Scope of Assessment

This report has been prepared in accordance with the scope of work described in *Consultancy Agreement – Structural Engineering Services, WCC Housing Upgrade Programme Phase 2 (HUP2) Seismic Assessment Project* dated 15 December 2023. AECOM's scope of works for this DSA is as follows:

- Review the existing drawings and other pertinent information provided by the Client.
- Undertake a site inspection to correlate the buildings with the information provided.
- Undertake a suitable structural analysis of the primary structure to establish a *%NBS* score for the building.
- Assistance to WCC in the establishment of a priority list for the installation of seismic upgrades.
- Development of a 67%NBS strengthening concept for primary structure elements (if needed).
- Assessment of SSNS items is not included in the scope of this DSA.

1.2 Regulatory Environment and Design Standards

The Earthquake-prone Building regulatory framework underwent significant changes during 2016 and 2017 as a result of learnings from the Christchurch earthquakes, and the more recent 2016 Kaikōura earthquake.

This resulted in the building (Earthquake-prone Buildings) Amendment Act 2016, the building (Specified Systems, Change the Use, and Earthquake-prone Buildings) Regulations 2005 including the Earthquake-prone Building Methodology, and the technical guideline document The Seismic Assessment of Existing Buildings - Technical Guidelines for Engineering Assessments (Engineering Assessment Guidelines). The important aspects of this regulatory framework are summarised below.

Earthquake-Prone Buildings (EPBs) are defined in Section 133AB of the building (Earthquake-prone Buildings) Amendment Act 2016 as buildings whose ultimate capacity will be exceeded in a moderate earthquake and, if it were to collapse, would likely result in injury or death or damage to another property. A moderate earthquake is defined as approximately one-third as strong but of the same duration as the earthquake shaking assumed in the design of a new building.

The official determination of whether a building is Earthquake-prone is the responsibility of the relevant Territorial Authority (TA). The earthquake rating resulting from an engineering assessment is only one, albeit significant, aspect considered by the TA in making their determination. If the TA determines a building to be Earthquake-prone, it will issue an EPB notice for the building and include it on the EPB register. The building (Earthquake-prone Buildings) Amendment Act 2016 then defines timeframes within which the owner must carry out building work (i.e. upgrade or demolish) to ensure the building is no longer Earthquake-prone.

These timeframes range from 7.5 to 35 years depending on the building type (priority or normal) and location (high, medium, or low risk area).

The building (Specified Systems, Change the Use, and Earthquake-prone Buildings) Regulations 2005 made significant changes to the system for identifying and remediating Earthquake-prone buildings. These include:

- providing an operational basis for identifying earthquake-prone buildings the EPB methodology
- new definitions for key terms including 'Earthquake-prone Buildings' and 'ultimate capacity.'
- a requirement to categorise Earthquake-prone Buildings in terms of their earthquake rating.
- providing a national-based system in place of individual earthquake-prone building policies for each TA.

The Engineering Assessment Guidelines document used by engineers to carry out seismic assessments is an integral part of the EPB methodology.

In addition, the New Zealand Society for Earthquake Engineering (NZSEE) defines a building with an earthquake rating less than 67%NBS as an Earthquake-Risk Building (ERB) and recommends a minimum target strengthening level of 67%NBS.

It is considered impractical and unaffordable to design every building to withstand the largest earthquake imaginable. Consequently, with respect to the determination of design loads for natural hazards, the New Zealand Loading Standard (NZS 1170) adopts a probabilistic approach taking into account the exposure hazard at a given location, along with factors such as building importance. Thus, the Loading Standard may be said to adopt a risk management approach in setting the loading levels that a given building is required to withstand.

For Importance Level 2 (IL2) buildings (e.g. normal structures), the 'design' earthquake load is set at the 1 in 500-year return period earthquake event. This event has approximately a 10% probability of exceedance over the assumed 50-year life of a building.

1.3 Assessment Methodology

This DSA follows the Engineering Assessment Guidelines, employing a force-based assessment procedure outlined in Section C2 of the guidelines.

Our methodology is briefly summarised below:

- Review of the available structural drawings to identify the main structural elements (primary and secondary) and any apparent 'structural weaknesses' of the buildings.
- Non-intrusive visual inspection of key elements of the buildings where visible including the general presence and arrangement of the concrete shear walls, stairs, bridge, and relationship to adjacent buildings, carried out on 31 January 2024.
- Selection of appropriate member properties and determination of structural element probable capacities.
- Determination of the likely earthquake rating of the buildings compared with equivalent new buildings at the site based on our inspections, the structural weaknesses identified, our calculations, and our engineering judgment.

1.3.1 Analysis Method and Application of Design Actions

Seismic analysis has been undertaken using the equivalent static method, conforming to NZS 1170.5:2002. The demand on the lateral load resisting system in the two directions has been calculated considering the recommended values of ductility and S_p factor from the NZS 1170.5 and NZS3101:2006. The calculated loads were applied in separately in two principal directions as well in combination with the 30% of the load in the orthogonal direction. Additionally, a modal response spectrum analysis was performed as defined in Section C2 of the Assessment Guidelines and the NZS 1170.5. The modal response was determined based on modes determined in ETABS V20.3.0, scaled so that the base shear was equal to or greater than the equivalent static base shear. The principal axes were adjusted to match those specified and the modes were combined using the complete quadratic combination (CQC) method. The directions were combined similarly to the equivalent static method with 100% in a given direction and 30% in the orthogonal direction.

1.3.2 Analysis of Diaphragms

The demand on the diaphragms was calculated following the pESA method as per section C2E.5 of the Assessment Guidelines with an overstrength factor ϕ_{ob} =1.0 (due to S_p = 0.925, μ = 1.25).

Upper bound forces on the diaphragms are those resulting from an ESA based on μ =1.25 and S_P=0.90.

These forces were amplified by 1.25 to account for accidental eccentricity and the possibility of an earthquake action not directly along an axis (100% +30%).

1.3.3 Site Inspection

A site inspection was carried out on 31st January 2024; that included a visual inspection from the outside with no internal inspections available. In undertaking our assessment we have, therefore, assumed that the wall layout shown in the drawings and the information inferred from the Specification are correct and that no damage affecting the seismic rating is present.

1.4 Building Description

The building is located on 4 Brooklyn Road, Aro Valley, Wellington. Refer to Figure 1 for the site location.



Figure 1 Site location

1.5 General

The Block A building was constructed circa 1976. The site consists of four other blocks also constructed around this time. The building shares a link bridge with the Block B building, though a sliding joint is present at the Block B interface.



Figure 2 General structural layout

Table 3 below provides summary information for Block A.

Table 3 Building summary information

Building information	Details	Comment
Building name	Block A	
Street Address	4 Brooklyn Road	
Location	Wellington	
Construction time	Built circa 1976	
Description / Building Occupancy	Residential buildings	
Importance Level	IL2	
Building Footprint / Floor Area	378 m ²	
No. of storeys / basements	8 storeys	A lift room exist above the roof level
Structural system	Cast in-situ reinforced concrete shear walls	
Floor system	Reinforced concrete cast in-situ slabs	
Roof system	Light weight steel roofing on timer frame	
Earthquake resisting system	Reinforced concrete shear walls with rigid cast in-situ diaphragms at all floor levels and flexible timber roof.	
Foundation system	Reinforced concrete piles below strip footings	
Stair system	Steel framed tied back (bolted) into the building	Two stairs present, full height
Other notable features	Link Bridge supported at the 3 rd floor by Block A which links to Block B but is not rigidly connected to. Vertical discontinuities and transfer structures along longitudinal walls (gridline A & 6) Significant openings along external shear walls Irregular in plan (L-shaped) Elevator core wall	
Past seismic strengthening	No	Recent initial seismic assessment was done in 2022 which showed a 45%/NBS rating. A past detailed seismic assessment was done in 2008

Building information	Details	Comment
		which showed a >67 <i>%NBS</i> rating.
Construction information	Original drawings (structures and architectural) Original specifications	
Likely Design Standards	NZS 3101:1970; NZSS 1693:1962; Ministry of Works Code of Practice: 1968	NZSS 1900 Chapter 9.3A also mentioned in the specs for concrete.
Heritage Status	No	
Seismic Risk Area	High risk (Wellington)	
Priority building status	Normal	
Other	N/A	

1.5.1 Building Construction

Block A is an eight-storey building with cast in-situ reinforced concrete shear walls at all levels, with cast-in situ reinforced concrete floor. The overall building dimensions are approximately 27.5m by 20m in an L-shape for an area of 378m².

The roof was constructed of timber framing with a light metal decking which appears to have been replaced post construction. The framing consists of 200x50 joists running longitudinally with 50x50 dwangs (blocking) running in the transverse directions with occasional 200x50 dwangs. These are all spaced at 600mm centres.

The ground floor slab is a 150mm thick cast in-situ reinforced concrete slab.

Strip footings were constructed below the walls with reinforced concrete bulb piles below them.

1.6 Geotechnical Site Conditions

AECOM geotechnical engineers conducted a site-specific desktop assessment. Key findings include subsoil class C, a distant fault (1.5km away) and low risk of liquefaction, lateral spreading and slope instability.

Refer to the geotechnical assessment report in Appendix C.

1.7 Previous Assessments

A previous DSA was performed by Romulus Consulting Group in 2008 with the building reported to resist about 80% of the NZS 1170.5:2004 seismic forces. This DSA consisted of equivalent static method (ESM) and modal response spectrum method (MRSM) analysis. Significant implication was performed in the capacity calculations for this DSA including averaging the capacities despite brittle shear failure.

An initial seismic assessment (ISA) was performed by AECOM in 2022 with a potential earthquake rating of 45%NBS assigned.

1.8 Structural Systems – Longitudinal and Transverse

1.8.1 Gravity Load Resisting System

The lightweight roof is supported by timber rafters, which carry the gravity loads to the inter-tenancy reinforced concrete walls. All of the floors are reinforced concrete cast in-situ two-way slabs which are supported by reinforced concrete shear walls in both directions. The gravity load in the shear walls is supported by ground beams which transfer loads to the piles into the soil. On the bottom four stories, there are also drying areas which consist of reinforced concrete cast in-situ slabs supported by

reinforced concrete beams and columns. The bottom storey drying area is supported by shear walls like the majority of the structure.

1.8.2 Lateral Load Resisting System

This building is arranged irregularly in an L-shape with the lateral load resisting system being similar in both directions. The lateral loads are resisted by reinforced concrete shear walls (internal and external) as well as a reinforced concrete lift core formed of shear walls. The external shear walls have significant quantities of large openings leading to frame like behaviour occurring. The elevations along Grid A and 6 also have vertical discontinuities where walls go "in-and-out" with transfer beams required to continue the load path. All floors are formed of reinforced concrete slabs which will behave as rigid diaphragms transferring seismic loads based on stiffness. The roof, consisting of timber framing, will act as a flexible diaphragm, transferring loads based on tributary area. The shear walls will transfer the lateral loads down the building into the bulb piles through the ground beams. Some shear will also be resisted by sliding friction of the base slab and passive resistance on the ground beams. The lateral load resisting shear walls are highlighted blue in Figure 3 below.



Figure 3 Lateral load resisting system

2.0 Results of Seismic Assessment

The results of the DSA indicate the building's earthquake rating is **34%NBS** (*IL2*) assessed in accordance with the Guidelines. This rating is governed by the shear failure of reinforced concrete shear wall spandrels along external faces of the building. The link bridge is considered separately from the building and has a rating of **15%NBS** (*IL2*).

The building is therefore categorised as **Grade C** following the MBIE grading scheme. **Grade C** buildings represent a medium risk to occupants of 5-10 times greater than the expected from a new building, indicating a Medium-risk exposure. The link bridge is categorised as **Grade E** and represents a risk to occupants of 25 times greater than the expected from a new building. The following table sets out the performance of structural elements within the building. The lowest score structural weakness is termed Potential Critical Structural Weakness (CSW). Table 4 presents the assessment results for key structural elements.

System	Direction	Seismic Performance in %NBS	Life Safety Risk
Shear walls (piers and spandrels)	X-Direction	34 <i>%NBS</i>	High
Walls Out-of-Plane	Both Directions	40 <i>%NB</i> S	Medium
Beams	Both Directions	90 <i>%NBS</i>	Low
Columns	Both Directions	95%NBS	Low
Floor slab (Rigid Diaphragm)	Both Directions	35 <i>%NBS</i>	Medium
Foundation – Ground beams	Both Directions	35 <i>%NB</i> S	Medium
Foundation – Piles (axial)	Both Directions	70%NBS	Low
Foundation – Global shear resistance	Y-Direction	45%NBS	Medium

Table 4 Summary of building seismic performance

3.0 Secondary Structural and Non-Structural (SSNS) Elements

The external steel stairs, link bridge and walkways have been assessed as part of the SSNS elements. Of these, the link bridge has the lowest overall score at 15%*NBS* and is considered to be a significant life safety risk.

The timber frame walls are not part of the lateral load resisting elements; hence they are considered as a secondary structural element. These walls are supported (restrained all-along their perimeter as shown in the architectural drawings. These walls are not considered a life-safety hazard.

There are water tanks above the roof shown in the drawings, but they are not existing on site.

Table 5 presents the assessment results for secondary structural and non-structural elements.

System	Direction	Seismic Performance in %NBS	Life Safety Risk
Parapet (Masonry)	Both Directions	100 <i>%NB</i> S	No
Walkway Slab	Both Directions	100 <i>%NB</i> S	No
Stairs (Steel)	Both Directions	100 <i>%NB</i> S	No
Timber Wall	Both Directions	100 <i>%NB</i> S	No
Link Bridge	Both Directions	15 <i>%NB</i> S	High
Water Tanks	Water tanks at the roof level are shown in the drawings but are not present on site as confirmed by the sit visit.		

Table 5 Summary of secondary structural seismic performance

4.0 Risks From Adjacent Buildings

Block A is not immediately adjacent to any of the other blocks within the same site or any other buildings off-site. A link bridge is present that is integrally connected and supported by Block A which spans to Block B. At the Block B interface, the bridge is not rigidly connected and instead has a sliding joint (SAKB 18F Rod) with a seismic gap. On this end, the bridge is instead supported by steel columns spanning to foundations at the ground level.

5.1 Seismic Risk and Performance Levels

The quantitative seismic assessment we have completed of the Block A building at 4 Brooklyn Road, Aro Valley indicates an earthquake rating of 34%*NBS* (IL2) governed by the shear failure of reinforced concrete shear wall spandrels. The building has been assessed in accordance with the guideline document "*The Seismic Assessment of Existing Buildings - Technical Guidelines for Engineering Assessments, dated July 2017 (Engineering Assessment Guidelines)* and the *draft concrete Section C5, 2018.* The earthquake rating is based on an Importance Level 2 (IL2), in accordance with the joint Australian/New Zealand Standard – Structural Design Actions Part 0, AS/NZS 1170/0:2002 as being deemed appropriate for this building. The building is a **Grade C** building following the Engineering Assessment Guidelines grading scheme. **Grade C** buildings represent a medium risk to occupants 5 to 10 times greater than the expected for a similar new building, indicating a relative medium-risk exposure. The new building standard requires an IL2 building to have a low probability of collapse in a 1 in 500-year 'design level' earthquake (i.e. an earthquake with a probability of exceedance of approximately 10% over the assumed 50-year design life of a building).

Percentage of new building standard (%NBS)	Alpha rating grade	Approx. risk relative to a new building	Life-safety risk description
> 100	A+	Less than or comparable to	Low risk
80 - 100	A	1-2 times greater	Low risk
67 - 79	В	2-5 times greater	Low to Medium risk
34 - 66	С	5-10 times greater	Medium risk
20 - 33	D	10-25 times greater	High risk
< 20	E	25 times greater	Very high risk

Table 6 Relative risk description

A building with an earthquake rating less than 34%*NBS* fulfils one of the requirements for the Territorial Authority to consider it to be an Earthquake-Prone Building (EPB) in terms of the Building Act 2004. A building rating less than 67%*NBS* is considered as an Earthquake Risk Building (ERB) by the New Zealand Society for Earthquake Engineering. The Block A building at 4 Brooklyn Road, Aro Valley has a rating of **34%***NBS* as per this assessment. Therefore, this building is categorised as a medium-risk building and is therefore categorised as an Earthquake Risk Building.

6.0 Comment on Future Seismic Hazard

The NZ seismic loading standard in undergoing a review and a draft version of the proposed new standard has been issued by Standards New Zealand for consultation as a Technical Specification *TS 1170.5 Structural Design Actions*. The consultation is said to end on 14 March and the final version of the Technical Specification is expected to be published later in the year 2024.

The draft standard incorporates learnings gained since the publication of both the updated National Seismic Hazard Model 2022 (NSHM) and the existing building code compliant standard NZS 1170.5:2004.

Figure 4 below provides a comparison between the ULS elastic site spectra (seismic loading) for an Importance Level 2 building located in Wellington, calculated considering the current loading standard NZS 1170.5 (black) and the TS 1170.5 Structural Design Actions (red).



Figure 4 Site spectra in the current code (NZS1170.5) and draft of the new code

Table 7 provides a comparison of key seismic parameters used to calculate the seismic loading in accordance with the two documents. Note this is compared for the x-direction only.

Parameter	Soil Class	Site Spectral acceleration	Horizontal design seismic coefficient, Cd (μ =1.25, Sp=0.93)	Horizontal design seismic coefficient – Part and Coefficient	Site Spectral acceleration
Current Code	С	0.40	0.94	0.76	2.71 (roof)
TS draft	*	0.91	1.84	1.36	4.55
%Change (TS draft/Current code)	N/A	128%	195%	178%	168%

 Table 7
 Comparison of seismic parameters

* Subsoil class type C is equivalent to subsoil class type III.

6.1 Effect on Block A Building

Based on the proposed Technical Specification, the seismic demand for Block A building at 4 Brooklyn Road, Aro Valley would be 178% of the current standard. This will likely reduce the earthquake rating of the building below the current rating of 34%*NBS* to approximately 20%*NBS* depending on other new code provisions.

We note that NZS 1170.5:2004 remains the referenced standard for compliance with the New Zealand Building Code. As per what was advised from Standards NZ, the proposed Technical Specification does not change the requirements of the earthquake-prone building (EPB) system. They advise that all seismic assessments, including the voluntary seismic assessments, should adopt the same approach as for the national earthquake-prone building system and use the current seismic loading standard NZS 1170.5:2004.

We also note that the Technical Specification has been issued as a draft document and is subject to change.

7.0 Seismic Concept Strengthening

We note that by law, Earthquake Prone Buildings, when confirmed, are required to be strengthened to at least 34%*NBS* within a prescribed time relative to the seismic zone of the building. Furthermore, WCC's requirement is to strengthen their assets to a minimum of 67%*NBS*.

Block A has an overall rating of 34%*NBS*. Additionally, the link bridge, which is being considered separately, has an overall rating of 15%*NBS*. Therefore, strengthening will be required for the primary structure and link bridge. Our indicative high-level strengthening to 67%*NBS* is summarised below.

The strengthening works will require a building consent and as such section 112 of the Building Act becomes relevant as strengthening works are considered under alterations and additions to the building of the Building Consent Authority. As such, further compliance may be required for:

- Access and facilities for persons with disabilities.
- Means of escape from fire.

7.1 Concept strengthening scheme to 67%NBS

Refer to the 67%NBS concept strengthening scheme markups in Appendix F.

The strengthening comprises the following key elements:

- The machine room suspended reinforced concrete shear wall is reinforced with two steel PFC members to shorten span lengths and spread loads to support walls.
- Lower-storey external reinforced concrete wall piers are strengthened with reinforced concrete shotcrete to increase their in-plane capacity.
- Reinforced concrete wall spandrels are strengthened using steel PFC members anchored to lowscoring elements to increase flexural and shear capacities.
- Fibre-Reinforced-Polymer (FRP) strips are added to areas of the cast in-situ diaphragm to provide additional tension strength to distribute the seismic load from the diaphragm to the shear walls.
- Supplementary ground beams along Grids 1, 6, A and E. These will transfer loads to new cast-in piles below to improve the global shear resistance performance.
- Steel SHS columns will be added to the existing link bridge columns with braces provided to transfer the loads to the existing foundation. We highly recommend to carry out strengthening of the link bridge as soon as possible.

8.0 Explanatory Statement

- AECOM has prepared this Report in accordance with the usual care and diligence of the consulting profession for the use of our Client. AECOM has used reasonable endeavours to determine the seismic resistance of the subject building. However, in doing so AECOM has made certain assumptions about material strengths, hidden construction details, deterioration, foundations etc. Intrusive investigations and testing, which were outside the scope of work, would be required to verify these assumptions.
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- 8. Where existing structural documentation is available, it is assumed that all reasonable measures have been taken during construction to erect the building in accordance with these documents. Any reinforcement size/spacing, strength grades and connection details indicated on the existing drawings have been assumed to be correct on-site.
- 9. This detailed seismic assessment is based on the structure in its current state and no future building modifications or additions have been accounted for.

Appendix A

Technical Summary

Appendix A Technical Summary

Table 8 Technical summary

1. Building Information	
Building name / description	Block A Eight storey residential building
Street address	4 Brooklyn Road
Territorial authority	Wellington City Council
No. of storeys	8 Storeys + Lift machine room
Area of typical floor (approx.)	378 m ²
Year of design (approx.)	1975
NZ standards designed to	NZS 3101: 1970 NZSS 1693: 1962 Ministry of Works Code of Practice: 1968
Structural system including foundations	The roof is a lightweight system comprised of lightweight metal sheeting supported by timber rafters spanning between reinforced concrete shear walls. The flooring comprised of cast in-situ reinforced concrete slab at
	all levels excluding the roof which consists of flexible timber framing. These are both supported by the shear walls. The reinforced concrete shear walls resist lateral loads in both
	directions. The shear walls transfer vertical and lateral loads to ground beams which are supported by bulb piles. There are cantilevered walkways along the internal sides of the L-shape of the building supported by cantilever beams.
	The stairs are primarily steel framed connected back into the building on one end.
	There are significant vertical discontinuities in both directions (i.e. transfer beams).
Does the building comprise a shared structural form or shares structural elements with any other adjacent titles?	The building supports a steel framed link bridge which spans to the Block B building. At the block B interface, a 50mm seismic gap exists, which is adequate to prevent pounding/compression effects. On the Block B side, bridge lateral loads are supported by a sliding rod joint and gravity loads are transferred to the bridge columns. The bridge is fixed to Block A side from the third floor up.
Key features of ground profile and identified geohazards	Refer to geotechnical report in Appendix E Subsoil class C. Lateral spreading – Low. Liquefaction induced settlement – Low. Fault rupture – no risk. Slope instability – Low.
Previous strengthening and/ or significant alteration	None. Appears to have a new lightweight metal decking for the roof.
Heritage issues/ status	No.

1. Building Information	
Other relevant information	Nil.

2. Assessment Information	
Consulting practice	AECOM New Zealand Limited
Structural engineer responsible include:	
Name	
CPEng number	
Statement of experience	With over 28 years' experience with practice area in structural design of low-rise to medium-rise commercial buildings, civil structures, heavy industrial projects, large water retaining structures, railway related buildings and under-ground structures with emphasis on seismic engineering, post-earthquake structural assessment, seismic assessment, and seismic retrofit design of existing buildings. With more than 17years NZ consulting experience.
Documentation reviewed, including:	Structural and architectural drawings, 1975 Specifications, 1975
 Date / version of drawings / calculations 	Previous DSA calculations, 2008
Previous seismic assessments	Previous ISA calculations, 2022
Geotechnical report(s)	2022 Geotechnical Desktop Study Report by AECOM Report attached in Appendix E
Date(s) building inspected and extent of inspection	Visual external and internal inspection with photographs taken conducted on 31 January 2024.
Description of any structural testing undertaken and results summary	No structural testing undertaken.
Previous assessment reports	2008 DSA by Romulus Consulting Group
	2022 ISA by AECOM
Other relevant information	Nil.

3. Summary of engineering assessment methodology and key parameters used.		
Occupancy type(s) and importance level (IL)	Residential IL2	
Site subsoil class	Class C – NZS 1170.5:2004	
For an ISA		
Summary of how Part B was applied, including:	N/A.	
 Key parameters such as u, S_p and F factors 		
Supplementary calculations		

3. Summary of engineering assessment methodology and key parameters used.		
For the DSA		
Summary of how Part C was applied, including: • Analysis methodology(s) used from C2	The assessment procedure used is the forced based elastic analysis using both equivalent static method and modal response spectrum analysis. Modelling is being carried out using ETABS.	
Other sections of Part C applied	Sections C5 (Concrete) and C6 (Steel) of MBIE Guidelines were used.	
Other relevant information	Nil.	

4. Assessment Outcomes			
Assessment status	Final		
Assessed %NBS rating	Main Building: <i>34%NBS</i> (IL2) Link Bridge: 15 <i>%NBS</i> (IL2)		
Seismic grade and relative risk	Main Building: Seismic Grade C Link Bridge: Seismic Grade E, V	, Medium risk ′ery High risk	
For an ISA			
Describe the potential critical structural weaknesses.	N/A		
Does the result reflect the buildings expected behaviour, or is more information/analysis required?	N/A		
If the results of this ISA are being used for earthquake prone decision purposes, and	Engineering statement of structural weaknesses and location	Mode of failure and physical consequence statement(s)	
elements rating <34% <i>NBS</i> have been identified:	N/A	N/A	
For a DSA			
Comment on the nature of secondary structural and non- structural elements/ parts identified and assessed	The link bridge spanning between Block A and B is considered a secondary structural and non-structural (SSNS) component. The bridge has the lowest score of SSNS of 15%NBS due to flexural failure of the columns. This is deemed to pose a significant life safety hazard and is categorised as Seismic Grade E, very high risk.		
Describe the governing critical structural weakness	The governing Critical Structural Weaknesses (CSWs) is the shear failure of reinforced concrete shear wall spandrels.		
If the results of this DSA are being used for earthquake prone decision purposes, <u>and</u> elements rating <34% <i>NBS</i> have been identified (including Parts):	Engineering statement of structural weaknesses and location	Mode of failure and physical consequence statement(s)	
	The link bridge columns fail in flexure.	The failure is in flexure which while ductile have nowhere to redistribute and upon failure could lead to partial or full collapse of the link bridge.	

4. Assessment Outcomes		
Recommendations	Wellington City Council (WCC) to review the engineering	
(optional for EPB purposes)	assessment undertaken by AECOM.	
	WCC to determine whether the building is earthquake prone accordance with the Building Act 2004.	
	WCC to assign an earthquake rating for the building. The earthquake rating of the building will be the governing <i>%NBS</i> specified in engineering assessment report.	
	If the WCC determines the building to be an EPB, then the WCC determine the form of the EPB notice that is to be issued for based on the determined earthquake rating category.	
	Any required strengthening is to take place within a timeframe accordance with section 133AM of the Building Act 2004.	

Appendix B

Sources of Information

Appendix B Sources of Information

The following information has been used to undertake the seismic assessment:

- Structural drawings
- Architectural drawings
- Geotechnical report
- Previous DSA report and calculations from Romulus Consulting Group.
- ISA report by AECOM.

The following documents and references have been used to undertake the seismic assessment:

- New Zealand Standard NZS 1170 'Structural Design Actions'.
- New Zealand Standard NZS 3101:2006 'Concrete Structures Standard'.
- The Seismic Assessment of Existing Buildings Technical Guidelines for Engineering Assessments, dated July 2017. C5 revised 31 November 2018.
- Ministry of Business Innovation and Employment. (2018). B1-VM4: Acceptable Solutions and Verification Methods for New Zealand Building Code Clause B1 Structure.
- Geonet (2019). Retrieved 10 July 2019 from http://www.geonet.org.nz/
- New Zealand Active Faults Database (2013). Retrieved 2 January 2016 from http://data.gns.cri.nz/af/
- New Zealand Geotechnical Society (2016). Earthquake Geotechnical Engineering Module 3 Liquefaction Hazards, New Zealand Geotechnical Society, New Zealand.

Appendix C

Initial Review Form -Basis of Seismic Assessment

AECOM III BECA aurecon Robert Bird Group

1 SEISMIC ASSESSMENT – INITIAL REVIEW FORM

The purpose of this document is to provide a record of agreed initial parameters for a seismic assessment project.

Building Name:

PUKA – Block A – 4 Brooklyn Road

Structural Description:	
Describe the building	
Building Age/Year Constructed	1976
Previously strengthened? Y/N	Ν
Location	4 Brooklyn Road, Wellington
No. levels	8 + lift machine room
Plan Area (sq.m.)	300 m2
Structural Form	Cast in-situ RC walls
Roof Type	Timber joists, metal decking
Floor Type	Cast in-situ RC
Foundation Type	RC Piles below strip footings
Stair Type (Precast, Steel, etc)	Steel
Seismic Gaps (mm)/Pounding	No
Appendages/Parapets/Canopies	Link Bridge and Machine room. Walkways.
Precast Walls (reo type)	Ν
Veneers Present	Ν

Lateral Load-Resisting Mechanism (in each direction - confirm with drawings):		
Describe the lateral load resisting system in each direction		
Longitudinal:	RC shear walls (some act as frames due to large openings)	
Transverse:	RC shear walls (some act as frames due to large openings)	
	•	

Assessment Methodology

List components and proposed analysis method e.g. eqv Static, pushover, modal analysis, rocking, force based, displacement based, part and portions, tributary area, flexible/rigid diaphragms

Type of analysis method:

Due to significant plan and vertical irregularities, SlaMA is not applicable. Create an ETABS model which will first be analysed with an ELA and MRSA. If this results in significant pile uplift or other geotechnical failure modes, geotechnical engineers will be engaged, and non-linear springs will be created. If structural failures are observed to be governing a Non-linear static analysis will be performed on targeted elements. The diaphragm will be considered rigid as it is RC cast in-situ. Deformation/rotation capacity of key elements to be sought early for estimates of ductility.

Analysis method of diaphragms:

Grillage method with PESA demands.

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Initial Assessment of Ductility

List the components of the structural system and the expected ductility to be achieved from them, eg plain round bar reinforced concrete moment frame ductility 1 - 1.25 or rocking

1.25-1.5 (initial)

RC shear walls with deformed bars doubly reinforced, some shear failure shown in previous DSA and many transfer structures exist.

Assessment Loadings:		
Loads to be used as part of assessment:		
Seismic Loadings		
Building Importance Level:	2	
Site Subsoil Class:	С	
Annual Probability of Exceedance:	1/500	
Return Period Factor, Ru:	1.0	
Near Fault Factor, N(T,D):	1.0	
Hazard Factor, Z:	0.4	
Code of the Day:	NZS 1170.5:2004, C5 (Yellow book, 2018), C2 (2017)	
Sp	0.925	
Design Working Life (yrs):	50	
Dead Loads/Superimposed Dead Loa	ads	
Concrete floor	3.12 kPa	
Machine Room	5 kPa	
Partitions	0.3 kPa	
Ceiling load	0.1 kPa	
Roof services	0.1 kPa	
Live Loads:		
General Area	1.5 kPa	
Communal Area	4 kPa	
Stairs	4 kPa	
Roof	0.25 kPa (0 for seismic combination)	
Deflection Criteria		
ULS Deflection Limit (%)	2.5% ULS lateral	
Reason for Limit	Based on 1170 5	

Material Properties:				
Material Rename material as appropriate		Design Strength (MPa)	Strength Mod Factor	Assessment Strength (MPa)
Reinforcement	Plain or Deformed bars?	Deformed (with s	some plain stirru	ps)
	High Tensile (HT)			
	Medium Tensile (MT)			



	Mild Steel (MS)	228	1.25	280 (fu = 475)
Concrete	Foundations	25	1.5	40
	Slab on Grade	25	1.5	40
	Shear Walls	25	1.5	40
	Columns	25	1.5	40
	Beams	25	1.5	40
Structural Steel	Beams	247	1.15	284
	Columns	247	1.15	284
	CHS	247	1.15	284
	Plate	247	1.15	284
	Other members	247	1.15	284
Bolts				fy=240, fu=400
Weld Strength				fu=410

Stiffness Reduction Factors in ETABS software:		
Columns Lower floors	0.5	
Columns Upper floors	0.5	
Beams	0.4	
Walls	0.35	
Diaphragms	0.25	

Foundation Assessment Criteria:	
Geotechnical Report Available?	Yes, 2022 AECOM desktop study
Foundation type:	Strip footings with RC piles
Soil type:	Class C
Geotechnical Investigation:	None, recommended if strength is limited by piles
Ult. Bearing Pressure:	300 kPa
Sliding Resistance:	The friction angle and sliding will be determined if required (pile failure)

Pending Code/Guideline Changes to Take into Account : Are there any upcoming code changes to take into account? Updated parts method may be considered.

Kick-off Meeting: Record minutes of the kick off meeting here, including key actions for people	
Task / Note	Actioned By Who?
SlaMA agreed to be not applicable for this building due to significant irregularities (plan and vertical) and transfer structures.	Taine – Update the initial review form
ETABS model decided to be of high importance, RSA should be run to assess the demands on the piles early in the process.	Taine – Update the initial review form
Deformation/rotation capacity of key elements should be assessed.	Taine – Update the initial review form
PR submittals to be: 1. Initial form, 2. Loading, 3. Model, 4. 90% completion including capacity calculations, 5. Report.	All



Additional Project-Specific Issues to take into account

E.g. Beam elongation, non-ductile mesh connection, minimal flexural steel, fracture issues, eccentric floor plate, bar anchoring, insufficient seating, unusual site characteristics, poor detailing

- Shear wall step change/transfer structures
- Shear wall openings
- Torsion
- External Link Bridge supported by Block A.
- Cast in-situ walls/flange effect.
- Elevator Core wall.

Additional Project-Site Investigation Scope

Issued by	Date	Notes
AECOM	17/01/2024	Issue for review
AECO<	19/01/2024	Issue for review following kick-off

Appendix D

Photographs from Inspection




























































Appendix E

Geotechnical Report



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Memorandum

То		Page	1	
CC	-			
Subject	Brooklyn Geotechnical Information			
From				
File/Ref No.	60723635 - WCC HUP2 T0 Seismic	Date	16-Fe	eb-2024

Hi Taine,

Below is a table giving end bearing and skin friction values for the piles Brooklyn Road.

Vsu = Skin Friction

Vb = End Bearing

Groundwater has been assumed to be 2.0m below ground level.

Block A

Depth	X.	۷'	C'	Ø'	Undrained		Drained	
					V _{su}	V _{bu}	V _{su}	V _{bu}
m RL	kN/m ³	kN/m ³	kPa	0	kN	kN	kN	kN
0	18	18	1	28	0	0	0	12
1	18	18	1	28	0	0	7	89
2	18	8	1	28	0	0	20	167
3	18	8	3	30	54	88	39	264
4	18	8	3	30	109	88	64	311
5	20	10	5	35	160	176	98	801
6	20	10	5	35	211	176	140	927
7	21	11	10	38	283	338	199	1779
8	23	13	20	38	437	720	285	2071
9	23	13	20	38	591	720	401	2342
10	23	13	20	38	745	720	545	2613
11	23	13	20	38	899	720	717	2884
12	23	13	20	38	1053	720	919	3155
13	23	13	20	38	1207	720	1148	3425
14	23	13	20	38	1361	720	1407	3696
15	23	13	20	38	1515	720	1694	3967

Tension Capacity: 437 kN Compression Capacity: 1157 kN Spring (tension) = 17480 kN/m Spring (compression) = 46280 kN/m Block B

Depth	γ.	y' c' Ø' Undrained		d	Drained			
					V _{su}	V _{bu}	V _{su}	V _{bu}
m RL	kN/m ³	kN/m ³	kPa	0	kN	kN	kN	kN
0	18	18	1	28	0	0	0	12
1	18	18	3	30	54	88	10	122
2	20	10	5	35	106	176	31	518
3	20	10	5	35	157	176	61	623
4	21	11	10	38	229	338	107	1274
5	21	11	10	38	301	338	168	1504
6	21	11	10	38	374	338	245	1734
7	21	11	10	38	446	338	337	1963
8	21	11	10	38	518	338	445	2193
9	21	11	10	38	590	338	568	2423
10	21	11	10	38	663	338	707	2653
11	21	11	10	38	735	338	861	2882
12	23	13	20	38	889	720	1044	3175
13	23	13	20	38	1043	720	1256	3446
14	23	13	20	38	1197	720	1496	3717
15	23	13	20	38	1351	720	1764	3988

A graphical representation of the end bearing and skin friction is provided below.

Given that groundwater is shallow, I recommend using the undrained values.

Tension Capacity: 518 kN Compression Capacity: 856 kN Spring (tension) = 20720 kN/m Spring (compression) = 34240 kN/m

ΑΞϹΟΜ



AECOM

60723635-CAL-LC-0001 Calculation Sheet

Ground Engineering and Tunnelling (GET) Team

REFERENCE CALC SHEET:

60723635-CAL-LC-0001

Determination of horizontal and vertical soil springs

Calculation Sheet

TITLE:

PURPOSE:

SUMMARY RESULTS

Vertical springs have been calculated for all shallow foundations.

The values provided have not been adjusted to take into consideration - allowable settlement.

All spring values are unfactored.

	Dept	Pepth (m) Horizontal Springs; k (kN/m ³ per			k (kN/m ³ per m)	
Material	From	То	Static Design;	Siesmic Design; k		
	FIUIII		k	Cyclic	Liquefaction	
FILL	0.0	2.2	61614	123228	14	
PLEISTOCENE ALLUVIUM	2.2	5.0	105624	211249	32	
CW GREYWACKE	5.0	6.5	211249	422498	47	
HW GREYWACKE	6.5	7.5	404894	809787	57	
MW GREYWACKE	7.5	15.0	862599	1725199	124	

VERSION HISTORY:

Version	Date	Initiated by	Reviewed by	Approve to Use	Notes
А	7/02/2024	JG	JC		

REFERENCES:

DISCLAIMER:

This spreadsheet should only be "Authorised for Use" after written approval from both the Reviewer and GET Team Manager. The design document register should be updated to the correct version of this spreadsheet along with the name of the reviewer and approving manager. At no point the name of the reviewer or the approval enterered in the sheet register prior to "Authorised for Use".



60723635-CAL-LC-0001 Calculation Sheet

Ground Engineering and Tunnelling Team



\\na.aecomnet.com\lfs\APAC\Christchurch-


60723635-CAL-LC-0001 Calculation Sheet

Ground Engineering and Tunnelling Team

	Project :	WCC HUP2 DSA -	4 Brooklyn Rd	J	ob Number:		60723635		I
	Filer/Ref No.: Subject:	Calc Sheet Soil Springs A	Revision: A sessment	Ca (lculated by: Checked by:	JG JC	Date: Date:	7/01/2024 0/01/1900	I
Depth (m)	Geological Desci	ription	Test Records		Cu (kPa)	Density (kN/m ³)	Phi (deg)	E _s (kPa)	Poissons Ratio
GL GW (m b	FILL: Sandy grav	velly CLAY, soft to firm.	Mean SPT; N =	12	35	18	28	5000	0.30
2.2	Pleistocene Allux	/ium: Sandy SILT, firm.	Mean SPT; N =	7	60	18	30	15000	0.3
5.0	CW Greywacke:	Sandy SILT, very stiff	Mean SPT; N =	27	120	20	35	50000	0.3
6.5	HW Greywacke:	Sandy SILT, very stiff	Mean SPT; N =	50	230	21	38	75000	0.3
7.5	MW Greywacke:	Sandy SILT, very stiff	Mean SPT; N = >50		490	23	38	100000	0.2

>15



60723635-CAL-LC-0001 Calculation Sheet

								er edita Eriginea	sting and rannening rear
	Project :		WCC HUP2 DSA - 4 Bro	ooklyn Rd			Job Number:	60723635	ō
Fil	ler/Ref No.:		Calc Sheet	Revision:	A		Calculated by:	JG Date	: 7/01/2024
	Subject:		Soil Springs Assess	ment			Checked by:	JC Date	: 0/01/1900
	-						-		
Horizontal S	Springs								
								Siesmic	: Design; k
Material			Sta	atic Design;	k			Cyclic	Liquefaction
								2 x k _{static}	(0.05 to 0.01) x k _{Lin}
0.0	k	=	1000 x (56 x N(100 x	x D) ^{-3/4})	=	61614 kN/m ³	ber m	123228 kN/m ³	14 kN/m ³
0.0	Cu	=	35 kPa	(2))			po		
	N	=	17.5 D	=	0.4 m				
ľ	α.'	-	v x H =	18	kN/m ³	x	22 m	= 40) kPa
	<u></u>		0.00 x σ' kDo		264)e			
	Cu _{Liq}	=	0.09 X 0 _v KPa	=	3.0 KF	a			
FILL	E _{uLiq}	=	400 x Cu _{Liq} KPa	=	1426 kF	Pa			
	Plimit	=	0.5 x P _u =	12	KN/m			Siesmic	; Design; P
	P,	=	3 x kp x v x D x B	D	=	0.4 m		Cyclic	Liquefaction
	φ	_	28 deg	kn	_	2 77		P	P.
	Ψ	-	10 LNI/3	np D	_	0.4 m		' u	
	¥	=		D	=	0.4 m			(Cu _{Liq} X D)
2.2	Cu _{Liq}	=	0.09 x σ _v ' kPa	=	3.6 kF	Pa		24 kPa	1.4 kPa
								Siesmic	: Design; k
Material			Sta	atic Design;	k			Cyclic	Liquefaction
								2 x k _{static}	(0.05 to 0.01) x k _{Liq}
2.2	k	=	1000 x (56 x N(100 x	x D) ^{-3/4})	=	105624 kN/m ³	'per m	211249 kN/m ³	32 kN/m ³
٨	Cu	=	60 kPa						
5	Ν	=	30 D	=	0.4 m				
	σv	=	γ×H =	18	kN/m ³	x	5.0 m	= 90) kPa
Ļ	Cuira	=	0.09 χ σ.' kPa	=	81⊮⊑	Pa			
⊲ Ш	⊊ ⇒⊔q				2240 45	а)а			
Z .	⊏uLiq	=	400 X Cu _{Liq} KPa	=	3240 KF	a		1	
Ö	P _{limit}	=	$0.5 \times P_u =$	13	KN/m			Siesmic	: Design; P
STO	Pu	=	3 x kp x ɣ x D x B	D	=	0.4 m		Cyclic	Liquefaction
Щ.	φ	=	30 deg	kp	=	3.00		P.,	P _{L-max}
Ц	v	_	18 kN/m ³	B	-	0.4 m		ŭ	(Cute x D)
5.0	• •	_	0.00 x m / LD-	D	- 0.4 1/	0.4 11		00 1-D -	
5.0	Cu _{Liq}	=	0.09 X 0 _v KPa		8.1 KF	a		26 KPa	3.2 KPa
Matarial			01-	die Deelene	1.			Cuolio	July Design, K
Material			518	alic Design,	к			Cyclic 2 y k	
			1000 (50 N/(100	D)-3/4)				Z X N _{static}	(0.03 to 0.01) X K _{Liq}
5.0	n	=	1000 X (50 X N(100 X		_	211 2/10 BIN///11			
	0		400 HD-	×D))	-	211243 NWIII	perm	422490 KIN/III	47 KN/III
	Cu	=	120 kPa	×D))	- 0.1 m	211245 80011	perm	422490 KN/III	47 KN/III
щ	Cu N	=	120 kPa 60 D	=	- 0.4 m	211245 Kiviii	65 m	422490 KN/III	
СКЕ	Cu N o'	= = =	120 kPa 60 D γ x H =	= 20 I	- 0.4 m kN/m ³	X	6.5 m	= 130	kPa
NACKE	Cu N σ _v ' Cu _{Liq}	= = = =	$\begin{array}{ccc} 120 & kPa \\ \hline 60 & D \\ \gamma \times H & = \\ 0.09 \times \sigma_{v}' & kPa \end{array}$	= 20 =	– <u>0.4 m</u> kN/m ³ 11.7 kF	x 24	6.5 m	= 130	PkPa
EYWACKE	Cu N Gv' Cu _{Liq} E _{uLiq}	= = = =	120 kPa 60 D γ x H = 0.09 x σ _v ' kPa 400 x Cu _{Liq} KPa	= 20 = =	– <u>0.4 m</u> kN/m ³ 11.7 kF 4680 kF	x 2a 2a	6.5 m	= 130) kPa
BREYWACKE	$\begin{array}{c} Cu \\ N \\ \sigma_{v}' \\ Cu_{Liq} \\ E_{uLiq} \\ \hline P_{limit} \end{array}$	= = = = =	$\begin{array}{c c} 120 & kPa \\ 60 & D \\ \hline \gamma x H &= \\ 0.09 x \sigma_{v}' & kPa \\ 400 x Cu_{Liq} KPa \\ \hline 0.5 x P_{u} &= \\ \end{array}$	= 20 = = 18	- 0.4 m kN/m ³ 11.7 kF 4680 kF KN/m	x Pa Pa	6.5 m	= 130) kPa
N GREYWACKE	$\begin{array}{c} Cu \\ N \\ \sigma_{v}' \\ Cu_{Liq} \\ E_{uLiq} \\ \hline P_{limit} \\ P_{u} \end{array}$	= = = = =	$\begin{array}{ccc} 120 & \text{kPa} \\ 60 & D \\ \hline \gamma x H &= \\ 0.09 x \sigma_v' & \text{kPa} \\ 400 x Cu_{Liq} & \text{kPa} \\ \hline 0.5 x P_u &= \\ 3 x \text{kp} x y x \text{p} x \text{B} \\ \end{array}$	= 20 = = 18	- 0.4 m kN/m ³ 11.7 kF 4680 kF KN/m =	x 2a 2a 2a	6.5 m	= 130) kPa
CW GREYWACKE	$\begin{array}{c} Cu \\ N \\ \sigma_{v}' \\ Cu_{Liq} \\ E_{uLiq} \\ \hline P_{limit} \\ P_{u} \\ \bullet \end{array}$	= = = = = =	$\begin{array}{ccc} 120 & kPa \\ 60 & D \\ \hline \gamma x H & = \\ 0.09 x \sigma_{v}^{'} & kPa \\ 400 x Cu_{Liq} & KPa \\ \hline 0.5 x P_{u} & = \\ 3 x kp x \gamma x D x B \\ \hline 25 d pa \end{array}$	=	- 0.4 m kN/m ³ 11.7 kF 4680 kF KN/m =	x 2a 2a 0.4 m 3.60	6.5 m	= 130) kPa ; Design; P Liquefaction
CW GREYWACKE	$\begin{array}{c} Cu \\ N \\ \sigma_{v}' \\ Cu_{Liq} \\ E_{uLiq} \\ P_{limit} \\ P_{u} \\ \varphi \end{array}$	= = = = = = =	$ \begin{array}{cccccccccccccccccccccccccccccccccccc$	=		x 2a 2a 0.4 m 3.69	6.5 m	= 130) kPa : Design; P Liquefaction
CW GREYWACKE	$\begin{array}{c} Cu \\ N \\ \hline \sigma_v' \\ Cu_{Liq} \\ \hline B_{uLiq} \\ \hline P_{limit} \\ P_u \\ \phi \\ \gamma \end{array}$	= = = = = = =	$\begin{array}{cccc} 120 & kPa \\ 60 & D \\ \gamma x H & = \\ 0.09 x \sigma_v^{'} & kPa \\ 400 x Cu_{Liq} KPa \\ \hline 0.5 x P_u^{} & = \\ 3 x kp x \gamma x D x B \\ \hline 35 deg \\ 20 kN/m^3 \end{array}$	=20 = = B		x 2a 2a 0.4 m 3.69 0.4 m	6.5 m	= 130	: Design; P Liquefaction P _{L-max} (Cu _{Liq} x D)
CW GREYWACKE	$\begin{array}{c} Cu \\ N \\ \sigma_v^{~} \\ Cu_{Liq} \\ E_{uLiq} \\ \hline P_{limit} \\ P_u \\ \phi \\ \Upsilon \\ Cu_{Liq} \\ \end{array}$	= = = = = = = = =	$\begin{array}{c c} 120 & kPa \\ \hline 60 & D \\ \hline \gamma \times H & = \\ 0.09 \times \sigma_v^{'} & kPa \\ \hline 400 \times Cu_{Uq} & KPa \\ \hline 0.5 \times P_u^{} & = \\ \hline 3 \times kp \times \gamma \times D \times B \\ \hline 35 & deg \\ \hline 20 & kN/m^3 \\ \hline 0.09 \times \sigma_v^{'} & kPa \\ \end{array}$	= 20 i = 20 i = 18 i D kp B =		x 2a 2a 0.4 m 3.69 0.4 m 2a	6.5 m	= 130 Siesmic Cyclic Pu 35 kPa	: Design; P Liquefaction P _{L-max} (Cu _{Liq} x D) 4.7 kPa
CW GREYWACKE	$\begin{array}{c} Cu \\ N \\ \sigma_v' \\ Cu_{Liq} \\ E_{uLiq} \\ P_{limit} \\ P_u \\ \phi \\ \gamma \\ Cu_{Liq} \end{array}$		$\begin{array}{c c} 120 & kPa \\ \hline 60 & D \\ \hline \gamma x H & = \\ 0.09 x \sigma_v' & kPa \\ 400 x Cu_{Uq} KPa \\ \hline 0.5 x P_u & = \\ 3 x kp x \gamma x D x B \\ \hline 35 \ deg \\ 20 \ kN/m^3 \\ \hline 0.09 x \sigma_v' & kPa \\ \end{array}$	= 20 [= 20 [= 18] D kp B = =	0.4 m kN/m ³ 11.7 kF 4680 kF KN/m = = = 11.7 kF	x Pa 0.4 m 3.69 0.4 m Pa	6.5 m	= 130 = 130 Siesmic Cyclic P _u 35 kPa Siesmic	 Design; P Liquefaction PL-max (Cu_{Liq} x D) 4.7 kPa Design; k
C Material	$\begin{array}{c} Cu \\ N \\ \sigma_v' \\ Cu_{Liq} \\ E_{uLiq} \\ P_{limit} \\ P_u \\ \phi \\ Y \\ Cu_{Liq} \end{array}$		$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	=		x Pa Pa 0.4 m 3.69 0.4 m Pa	6.5 m	= 130 = 130 Siesmic Cyclic P _u 35 kPa Siesmic Cyclic	 Design; P Liquefaction P_{L-max} (Cu_{Liq} x D) 4.7 kPa Design; k Liquefaction
C N OKE C N OKE C N OKE C N OKE C N OKE C N	$\begin{array}{c} Cu \\ N \\ \sigma_v^{'} \\ Cu_{Liq} \\ E_{uLiq} \\ P_{limit} \\ P_u \\ \phi \\ \gamma \\ Cu_{Liq} \end{array}$		$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	=		x Pa 0.4 m 3.69 0.4 m Pa	6.5 m	= 130 = 130 Cyclic P _u 35 kPa Siesmic Cyclic 2 x k _{static}	2 Design; P Liquefaction P _{L-max} (Cu _{Liq} x D) 4.7 kPa 2 Design; k Liquefaction (0.05 to 0.01) x k _{Liq}
C K GK K K K K K K K K K K K K K K K K K	$\begin{array}{c} Cu \\ N \\ \sigma_{v}^{'} \\ Cu_{Liq} \\ E_{uLiq} \\ P_{limit} \\ P_{u} \\ \phi \\ Y \\ Cu_{Liq} \\ \end{array}$		$\begin{array}{c c} 120 & kPa \\ \hline 60 & D \\ \hline \gamma \times H & = \\ 0.09 \times \sigma_v^{'} & kPa \\ \hline 400 \times Cu_{Liq} & KPa \\ \hline 0.5 \times P_u & = \\ 3 \times kp \times \gamma \times D \times B \\ \hline 35 & deg \\ 20 & kN/m^3 \\ \hline 0.09 \times \sigma_v^{'} & kPa \\ \hline \\ Sta \\ \hline 1000 \times (56 \times N(100)) \\ \hline \end{array}$	=	0.4 m kN/m ³ 11.7 kF 4680 kF KN/m = = = 11.7 kF k =	x 2a 0.4 m 3.69 0.4 m 2a 404894 kN/m ³	6.5 m	= 130 = 130 Siesmic Cyclic P _u 35 kPa Siesmic Cyclic 2 x k _{static} 809787 kN/m ³	 b kPa c) kPa c) Liquefaction P_{L-max} (Cu_{Liq} x D) c) 4.7 kPa c) 2 Design; k c) Liquefaction (0.05 to 0.01) x k_{Liq} 57 kN/m³
C K C K C K C K C K C K C K C K C K C K	$\begin{array}{c} Cu \\ N \\ \sigma_v^{} \\ Cu_{Liq} \\ E_{uLiq} \\ P_{limit} \\ P_u \\ \phi \\ Y \\ Cu_{Liq} \\ \end{array}$		$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	=	0.4 m kN/m ³ 11.7 kF 4680 kF KN/m = = 11.7 kF k =	x 2a 2a 0.4 m 3.69 0.4 m 2a 404894 kN/m ³	6.5 m	= 130 = 130 Siesmic Cyclic P _u 35 kPa Siesmic Cyclic 2 x k _{static} 809787 kN/m³	kPa Liquefaction PL-max (Cu _{Liq} x D) 4.7 kPa Design; k Liquefaction (0.05 to 0.01) x k _{Liq} 57 kN/m ³
6.5 Material	Cu N $\sigma_v^{'}$ Cu _{Liq} P_{uiq} P_u ϕ Y Cu _{Liq} k Cu N		$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	= 20 = 20 = 18 D kp B = 20 10 20 20 20 20 20 20 20 20 20 20 20 20 20	- 0.4 m 11.7 kF 4680 kF KN/m = = 11.7 kF k = 0.4 m	x 2a 2a 0.4 m 3.69 0.4 m 2a 404894 kN/m ³	6.5 m	= 130 = 130 Siesmic Cyclic P _u 35 kPa Siesmic Cyclic 2 x k _{static} 809787 kN/m ³	2 Design; P Liquefaction P _{L-max} (Cu _{Liq} x D) 4.7 kPa 2 Design; k Liquefaction (0.05 to 0.01) x k _{Liq} 57 kN/m ³
G.5 Material	$\begin{array}{c} Cu \\ N \\ \sigma_v^{~} \\ Cu_{Liq} \\ E_{uLiq} \\ P_{u} \\ \phi \\ \gamma \\ Cu_{Liq} \\ \phi \\ \gamma \\ Cu_{Liq} \\ \end{array}$		$\begin{array}{cccc} 120 & kPa \\ 60 & D \\ \gamma x H & = \\ 0.09 x \sigma_v' & kPa \\ 400 x Cu_{Uq} KPa \\ \hline 0.5 x P_u & = \\ 3 x kp x \gamma x D x B \\ \hline 35 deg \\ 20 kN/m^3 \\ \hline 0.09 x \sigma_v' & kPa \\ \hline \\ 1000 x (56 x N(100 x)) \\ \hline 230 & kPa \\ \hline 115 & D \\ \gamma x H & = \\ \end{array}$	= 20 = 20 = 20 = 20 = 20 = 20 = 20 = 20	- 0.4 m kN/m ³ 11.7 kF 4680 kF KN/m = 11.7 kF k	x 2a 2a 0.4 m 3.69 0.4 m 2a 404894 kN/m ³ x	6.5 m	= 130 = 130 Siesmid Cyclic P _u 35 kPa Siesmid Cyclic 2 x k _{static} 809787 kN/m ³ = 158	2 Design; P 2 Liquefaction PL-max (Cu _{Liq} x D) 4.7 kPa 2 Design; k Liquefaction (0.05 to 0.01) x k _{Liq} 57 kN/m ³ kPa
ACKE C.W. GREYWAACKE C.W. GREYWAACKE C.W. GREYWAACKE	$\begin{array}{c} Cu \\ N \\ \sigma_{v}' \\ Cu_{Liq} \\ E_{uLiq} \\ P_{limit} \\ P_{u} \\ \phi \\ Y \\ Cu_{Liq} \\ \end{array}$		$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	= 20 = 20 = 20 = 20 = 20 = 20 = 20 = 20	- 0.4 m kN/m ³ 11.7 kF 4680 kF KN/m = 11.7 kF k = 0.4 m kN/m ³ 14.2 kF	x 2a 2a 0.4 m 3.69 0.4 m 2a 404894 kN/m ³ x 2a	6.5 m	= 130 = 130 Siesmic Cyclic P _u 35 kPa Siesmic Cyclic 2 x k _{static} 809787 kN/m ³ = 158	kPa besign; P Liquefaction PL-max (Cu _{Liq} x D) 4.7 kPa Design; k Liquefaction (0.05 to 0.01) x k _{Liq} 57 kN/m ³ kPa
C N OKE KANACKE C N OKE ANACKE Material	$\begin{array}{c} Cu \\ N \\ \hline \sigma_{v}' \\ Cu_{Liq} \\ \hline P_{uimit} \\ P_{u} \\ \phi \\ \gamma \\ Cu_{Liq} \\ \hline \\ k \\ Cu \\ N \\ \sigma_{v}' \\ Cu_{Liq} \\ \hline \\ E \\ \\ \end{array}$		$\begin{array}{cccc} 120 & kPa \\ 60 & D \\ \gamma x H & = \\ 0.09 x \sigma_v' & kPa \\ 400 x Cu_{Liq} & KPa \\ \hline 0.5 x P_u & = \\ 3 x kp x \gamma x D x B \\ 35 & deg \\ 20 & kN/m^3 \\ 0.09 x \sigma_v' & kPa \\ \hline 1000 x (56 x N(100 x + 100 x + 100$	= 20 = 20 = 18 D kp B = 20 18 x D) -3/4 x D) -3/4 = 21 = 21 = 21 = 21	- 0.4 m kN/m ³ 11.7 kF 4680 kF KN/m = = 11.7 kF k k 0.4 m 14.2 kF 5670 kT	x 2a 2a 0.4 m 3.69 0.4 m 2a 404894 kN/m ³ x 2a	6.5 m	= 130 = 130 Siesmic Cyclic P _u 35 kPa Siesmic Cyclic 2 x k _{static} 809787 kN/m³ = 158	kPa besign; P Liquefaction PL-max (Cu _{Liq} x D) 4.7 kPa besign; k Liquefaction (0.05 to 0.01) x k _{Liq} 57 kN/m ³ bkPa
C M GREYWACKE C C GREYWACKE C S C C C C C C C C C C C C C C C C C C	$\begin{array}{c} Cu \\ N \\ \hline \sigma_{v}^{'} \\ Cu_{Liq} \\ \hline P_{limit} \\ P_{u} \\ \phi \\ Y \\ Cu_{Liq} \\ \hline \\ K \\ Cu \\ N \\ \hline \\ \sigma_{v}^{'} \\ Cu_{Liq} \\ \hline \\ EuLiq \\ \hline \end{array}$		$\begin{array}{cccc} 120 & kPa \\ 60 & D \\ \gamma x H & = \\ 0.09 x \sigma_v^{'} kPa \\ 400 x Cu_{Uq} KPa \\ \hline 0.5 x P_u & = \\ 3 x kp x \gamma x D x B \\ \hline 35 deg \\ 20 kN/m^3 \\ \hline 0.09 x \sigma_v^{'} kPa \\ \hline \\ 1000 x (56 x N(100 x)) \\ 230 & kPa \\ \hline 115 & D \\ \gamma x H & = \\ 0.09 x \sigma_v^{'} kPa \\ \hline \\ 400 x Cu_{Uq} kPa \\ \hline \\ \end{array}$	= 20 = 20 = 18 D kp B = 341 x D) ^{-3/4}) = 21 = 21		x 2a 2a 0.4 m 3.69 0.4 m 2a 404894 kN/m ³ x 2a	6.5 m	= 130 = 130 Siesmic Cyclic P _u 35 kPa Siesmic Cyclic 2 x k _{static} 809787 kN/m ³ = 158	Design; P Liquefaction PL-max (Cu _{Liq} x D) 4.7 kPa > Design; k Liquefaction (0.05 to 0.01) x k _{Liq} 57 kN/m ³ kPa
GREYWACKE CW GREYWACKE 6.5	$\begin{array}{c} Cu \\ N \\ \sigma_v^{~} \\ Cu_{Liq} \\ E_{uLiq} \\ P_{limit} \\ P_u \\ \phi \\ \gamma \\ Cu_{Liq} \\ \hline \\ k \\ Cu \\ N \\ \sigma_v^{~} \\ Cu_{Liq} \\ E_{uLiq} \\ \hline \\ P_{limit} \\ \end{array}$		$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	= 20 = 20 = 18 D kp B = 21 x D) ^{-3/4}) = 21 = 21	0.4 m kN/m ³ 11.7 kF 4680 kF KN/m = = 11.7 kF k k 0.4 m kN/m ³ 14.2 kF 5670 kF	x 2a 2a 0.4 m 3.69 0.4 m 2a 404894 kN/m ³ x 2a 2a	6.5 m	= 130 = 130 Cyclic Pu 35 kPa Siesmic Cyclic 2 x k _{static} 809787 kN/m ³ = = 158 Siesmic Siesmic	2 Design; P 2 Liquefaction P _{L-max} (Cu _{Liq} x D) 4.7 kPa 2 Design; k 2 Liquefaction (0.05 to 0.01) x k _{Liq} 57 kN/m ³ 4 kPa 2 Design; P
TW GREYWACKE	$\begin{array}{c} Cu \\ N \\ \sigma_v^{~} \\ Cu_{Liq} \\ \textbf{P}_{limit} \\ \textbf{P}_u \\ \phi \\ \gamma \\ Cu_{Liq} \\ \textbf{k} \\ Cu \\ N \\ \sigma_v^{~} \\ Cu_{Liq} \\ \textbf{k} \\ Cu \\ N \\ \textbf{P}_{limit} \\ \textbf{P}_u \\ \textbf{P}_{limit} \\ \textbf{P}_u \end{array}$		$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	= 20 = 20 = 18 D kp B = 20 = 20 = 20 = 20 = 20 = 20 = 20 = 20		x 2a 2a 0.4 m 3.69 0.4 m 2a 404894 kN/m ³ x 2a 0.4 m	6.5 m	= 130 = 130 Cyclic Pu 35 kPa Siesmic Cyclic 2 x k _{static} 809787 kN/m ³ = = 158 Siesmic Cyclic	2 Design; P 2 Design; P 2 Liquefaction 3 PL-max 3 (Cu _{Liq} x D) 4.7 kPa 3 Design; k 1 iquefaction 4.0.05 to 0.01) x k _{Liq} 57 kN/m ³ 4 kPa 5 Design; P 1 iquefaction
CM GREYWACKE CW GREYWACKE HW GREYWACKE	$\begin{array}{c} Cu \\ N \\ \sigma_{v}^{'} \\ Cu_{Liq} \\ \textbf{P}_{limit} \\ P_{u} \\ \phi \\ Y \\ Cu_{Liq} \\ \textbf{K} \\ Cu \\ N \\ \sigma_{v}^{'} \\ Cu_{Liq} \\ \textbf{E}_{uLiq} \\ \textbf{P}_{limit} \\ P_{u} \\ \phi \\ \end{array}$		$\begin{array}{cccc} 120 & kPa \\ 60 & D \\ y \times H & = \\ 0.09 \times \sigma_v' & kPa \\ 400 \times Cu_{Uq} & KPa \\ \hline 0.5 \times P_u & = \\ 3 \times kp \times y \times D \times B \\ 35 & deg \\ 20 & kN/m^3 \\ \hline 0.09 \times \sigma_v' & kPa \\ \hline 1000 \times (56 \times N(100 \times 230 \times 10^{-1} \times 10^{-1$	= 20 = 20 = 20 = 20 = 20 = 20 = 20 = 20		x 2a 0.4 m 3.69 0.4 m 2a 404894 kN/m ³ x 2a 0.4 m 4.20	6.5 m	= 130 = 130 Siesmid Cyclic Pu 35 kPa Siesmid Cyclic 2 x k _{static} 809787 kN/m³ = 158 Siesmid Cyclic Pu Siesmid Siesmid Cyclic	2 Design; P 2 Design; P 2 Liquefaction 3 PL-max 3 (Cu _{Liq} x D) 4.7 kPa 3 Design; k 1 iquefaction 4.7 kN/m ³ 4 kPa 5 Design; P 1 iquefaction 9 Liquefaction 9 L
CV GREYWACKE Buterial 9.9 Waterial	$\begin{array}{c} Cu \\ N \\ \hline \sigma_v' \\ Cu_{Liq} \\ \hline P_{limit} \\ P_u \\ \phi \\ \gamma \\ Cu_{Liq} \\ \hline \\ k \\ Cu \\ N \\ \hline \\ Cu_{Liq} \\ \hline \\ P_{limit} \\ P_u \\ \hline \\ P_{limit} \\ P_u \\ \phi \\ \gamma \\ \end{array}$		$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	= 20 = 20 = 20 = 20 = 20 = 20 = 20 = 20		x 2a 0.4 m 3.69 0.4 m 2a 404894 kN/m ³ x 2a 0.4 m 4.20 0.4 m	6.5 m ¹ per m 7.5 m	= 130 = 130 Siesmic Cyclic Pu 35 kPa Siesmic Cyclic 2 x k _{static} 809787 kN/m³ = 158 Siesmic Cyclic Siesmic Siesmic Siesmic Cyclic	b kPa b kPa consistent of the second s
C M GREYWACKE C W GREYWACKE HW GREYWACKE	$\begin{array}{c} Cu \\ N \\ \hline \sigma_{v}' \\ Cu_{Liq} \\ \hline P_{uimit} \\ P_{u} \\ \phi \\ \gamma \\ Cu_{Liq} \\ \hline \\ K \\ Cu \\ U_{Liq} \\ \hline \\ F_{uliq} \\ \hline \\ P_{limit} \\ P_{u} \\ \phi \\ \gamma \\ Cu_{Liq} \\ \hline \\ Cu_{Liq} \\ Cu_{Liq} \\ \hline \\ Cu_{Liq} \\ \hline \\ Cu_{Liq} \\ Cu_{Liq} \\ \hline \\ Cu_{Liq} \\ Cu_{Li$		$\begin{array}{cccc} 120 & kPa \\ 60 & D \\ y \times H & = \\ 0.09 \times \sigma_v' & kPa \\ 400 \times Cu_{Liq} & KPa \\ \hline 0.5 \times P_u & = \\ 3 \times kp \times y \times D \times B \\ 35 & deg \\ 20 & kN/m^3 \\ 0.09 \times \sigma_v' & kPa \\ \hline \\ 1000 \times (56 \times N(100 \times 10^{-1} \times 1$	=		x 2a 0.4 m 3.69 0.4 m 2a 404894 kN/m ³ x 2a 0.4 m 4.20 0.4 m 4.20 0.4 m	6.5 m ¹ per m 7.5 m	= 130 = 130 Cyclic Pu 35 kPa Siesmic Cyclic 2 x k _{static} 809787 kN/m ³ = Siesmic Cyclic Siesmic Siesmic Cyclic Siesmic Siesmic Cyclic Pu Siesmic Cyclic Pu 42 kPa 42 kPa	c kPa > b kPa > b kPa > Liquefaction PL-max (Cu _{Liq} x D) 4.7 kPa > Design; k > Liquefaction (0.05 to 0.01) x k _{Liq} 57 kN/m ³ ; besign; P Liquefaction Cu _{Liq} x D)
C M GREYWACKE C W GREYWACKE HW GREYWACKE HW GREYWACKE HW 2.9	$\begin{array}{c} Cu \\ N \\ \hline \sigma_v' \\ Cl_{Liq} \\ \hline E_{uLiq} \\ \hline P_{limit} \\ P_u \\ \phi \\ \gamma \\ Cu_{Liq} \\ \hline \\ \hline \\ Cu \\ N \\ \hline \\ \sigma_v' \\ Cu_{Liq} \\ \hline \\ P_{limit} \\ P_u \\ \phi \\ \gamma \\ Cu_{Liq} \\ \hline \\ P_{umit} \\ P_u \\ \phi \\ \gamma \\ Cu_{Liq} \\ \hline \end{array}$		$\begin{array}{cccc} 120 & kPa \\ 60 & D \\ \gamma x H & = \\ 0.09 x \sigma_{v}^{'} kPa \\ 400 x Cu_{Liq} KPa \\ 0.5 x P_{u} & = \\ 3 x kp x \gamma x D x B \\ 35 deg \\ 20 kN/m^{3} \\ 0.09 x \sigma_{v}^{'} kPa \\ \end{array}$	= 20 = 20 = 18 D kp B = 18 atic Design; x D) ^{-3/4}) = 21 = 21 D kp B = 21 D kp B = 21		x 2a 0.4 m 3.69 0.4 m 2a 404894 kN/m ³ x 2a 0.4 m 4.20 0.4 m 4.20 0.4 m 2a	6.5 m	= 130 = 130	
C M GK E A M	$\begin{array}{c} Cu \\ N \\ \sigma_v^{~i} \\ Cu_{Liq} \\ E_{uLiq} \\ P_{iimit} \\ P_u \\ \phi \\ Y \\ Cu_{Liq} \\ \hline \\ K \\ Cu \\ N \\ \sigma_v^{~i} \\ Cu_{Liq} \\ \hline \\ P_{iimit} \\ P_u \\ \phi \\ Y \\ Cu_{Liq} \\ \hline \\ P_{iimit} \\ P_u \\ \phi \\ Y \\ Cu_{Liq} \\ \hline \end{array}$		$\begin{array}{cccc} 120 & kPa \\ 60 & D \\ y \times H & = \\ 0.09 \times \sigma_v^{'} & kPa \\ 400 \times Cu_{Liq} & KPa \\ \hline 0.5 \times P_u & = \\ 3 \times kp \times y \times D \times B \\ \hline 35 & deg \\ 20 & kN/m^3 \\ \hline 0.09 \times \sigma_v^{'} & kPa \\ \hline \\ 1000 \times (56 \times N(100 \times 10^{-1})) \\ 230 & kPa \\ \hline 115 & D \\ y \times H & = \\ 0.09 \times \sigma_v^{'} & kPa \\ \hline \\ 1000 \times Cu_{Liq} & KPa \\ \hline \\ 0.5 \times P_u & = \\ 3 \times kp \times y \times D \times B \\ \hline \\ 38 & deg \\ 21 & kN/m^3 \\ \hline \\ 0.09 \times \sigma_v^{'} & kPa \\ \hline \end{array}$	= 20 = 20 = 18 D kp B = 30 N kp B = 21 D kp B = 21 D kp B = 21 D kp B = 21 D kp B = 21 D kp S S S S S S S S S S S S S S S S S S		x 2a 2a 0.4 m 3.69 0.4 m 2a 404894 kN/m ³ x 2a 0.4 m 4.20 0.4 m 4.20 0.4 m 2a	6.5 m per m 7.5 m	= 130 = 130	
CM CKE CM CKE CM CKE AMACKE AM	$\begin{array}{c} Cu \\ N \\ \sigma_v^{~} \\ Cu_{Liq} \\ E_{uLiq} \\ P_{limit} \\ P_u \\ \phi \\ \gamma \\ Cu_{Liq} \\ \hline \\ k \\ Cu \\ N \\ \sigma_v^{~} \\ Cu_{Liq} \\ \hline \\ P_{limit} \\ P_u \\ \phi \\ \gamma \\ Cu_{Liq} \\ \hline \\ P_{limit} \\ P_u \\ \phi \\ \gamma \\ Cu_{Liq} \\ \hline \end{array}$		$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	= 20 = 20 = 18 D kp B = 21 x D) ^{-3/4}) = 21 D kp B = 21 D kp B = 21 z1 D		x 2a 2a 0.4 m 3.69 0.4 m 2a 404894 kN/m ³ x 2a 0.4 m 4.20 0.4 m 4.20 0.4 m 2a	6.5 m	= 130 = 130	2 Design; P 2 Design; P 2 Liquefaction 2 PL-max 3 (Cu _{Liq} x D) 4.7 kPa 2 Design; k 2 Liquefaction 4.7 kN/m ³ 3 kPa 2 Design; P 2 Liquefaction 7 Liquefaction 9 L-max (Cu _{Liq} x D) 5.7 kPa 2 Design; k 1 Liquefaction 9 L-max (Cu _{Liq} x D) 5.7 kPa 2 Design; k 1 Liquefaction 1 (0.05 to 0.01) 2 (0.05 to 0.01) 3 k = 0.01
CM OGREAMAGE CM OG	$\begin{array}{c} Cu \\ N \\ \sigma_{v}^{'} \\ Cu_{Liq} \\ E_{uLiq} \\ \end{array} \\ \begin{array}{c} P_{limit} \\ P_{u} \\ \phi \\ Y \\ Cu_{Liq} \\ \end{array} \\ \begin{array}{c} k \\ Cu \\ N \\ \sigma_{v}^{'} \\ Cu_{Liq} \\ E_{uLiq} \\ \end{array} \\ \begin{array}{c} P_{limit} \\ P_{u} \\ \phi \\ Y \\ Cu_{Liq} \\ \end{array} \\ \begin{array}{c} cu_{Liq} \\ Cu_{Liq} \\ \end{array} \\ \begin{array}{c} cu_{Liq} \\ cu_{Liq} \\ \end{array} \\ \end{array} \\ \begin{array}{c} cu_{Liq} \\ cu_{Liq} \\ cu_{Liq} \\ \end{array} \\ \begin{array}{c} cu_{Liq} \\ cu_{Liq} \\ cu_{Liq} \\ \end{array} \\ \begin{array}{c} cu_{Liq} \\ cu_{Liq} \\ cu_{Liq} \\ cu_{Liq} \\ cu_{Liq} \\ \end{array} \\ \begin{array}{c} cu_{Liq} \\ cu$		120 kPa 60 D $\gamma \times H$ = 0.09 x σ_v' kPa 400 x Cu _{Liq} KPa 0.5 x Pu = 3 x kp x $\gamma x D x B$ 35 deg 20 kN/m ³ 0.09 x σ_v' kPa 1000 x (56 x N(100 x) 230 2030 kPa 115 D $\gamma x H$ = 0.09 x σ_v' kPa 0.09 x σ_v' kPa 0.5 x Pu = 3 x kp x $\gamma x D x B$ 38 deg 21 kN/m ³ 0.09 x σ_v' kPa	= 20 = 20 = 18 D kp B = 20 = 20 = 20 = 20 = 20 = 20 = 20 = 20		x 2a 2a 0.4 m 3.69 0.4 m 2a 404894 kN/m ³ x 2a 0.4 m 4.20 0.4 m 4.20 0.4 m 2a	6.5 m	= 130 = 130 Cyclic Pu 35 kPa Siesmic Cyclic 2 x k _{static} 809787 kN/m³ = = 158 Siesmic Cyclic Pu 3 = 158 Siesmic Cyclic Pu 3 42 kPa Siesmic Cyclic Pu 42 kPa Siesmic Cyclic 2 x k _{static}	2 Design; P 2 Design; P 2 Liquefaction 2 PL-max 2 (Cu _{Liq} x D) 4.7 kPa 2 Design; k 2 Liquefaction 3 (0.05 to 0.01) x k _{Liq} 57 kN/m ³ 3 kPa 2 Design; P 2 Liquefaction 2 PL-max 3 (Cu _{Liq} x D) 5.7 kPa 3 Design; k 3 Liquefaction 4 (Cu _{Liq} x D) 5.7 kPa 5 (Cu _{Liq} x D)
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AMATERIAL CANACKE Material C.5 Material Material Material C.5	$\begin{array}{c} Cu \\ N \\ \hline \sigma_v' \\ Cu_{Liq} \\ \hline P_{limit} \\ P_u \\ \phi \\ \gamma \\ Cu_{Liq} \\ \hline \\ k \\ Cu \\ N \\ \hline \\ \sigma_v' \\ Cu_{Liq} \\ \hline \\ P_{limit} \\ P_u \\ \phi \\ \gamma \\ Cu_{Liq} \\ \hline \\ P_{limit} \\ P_u \\ \phi \\ \gamma \\ Cu_{Liq} \\ \hline \\ \hline \\ R \\ Cu \\ U_{Liq} \\ \hline \\ R \\ Cu \\ V \\ Cu_{Liq} \\ \hline \\ R \\ Cu \\ V \\ Cu_{Liq} \\ \hline \\ R \\ Cu \\ V \\ Cu_{Liq} \\ \hline \\ R \\ Cu \\ V \\ Cu_{Liq} \\ \hline \\ R \\ Cu \\ V \\ Cu \\ Cu \\ V \\ Cu \\ Cu \\ V \\ V \\ Cu \\ V \\ V \\ Cu \\ V \\ $		$\begin{array}{cccccccccccccccccccccccccccccccccccc$	= 20 = 20 = 18 D kp B = 18 atic Design; x D) ^{-3/4}) = 21 1 D kp B = 21 1 D kp B = 21 1 x D) ^{-3/4})	0.4 m kN/m ³ 11.7 kF 4680 kF KN/m = = 11.7 kF k kN/m ³ 14.2 kF 5670 kF KN/m = = 14.2 kF k 14.2 kF	x 2a 0.4 m 3.69 0.4 m 2a 404894 kN/m ³ x 2a 0.4 m 4.20 0.4 m 4.20 0.4 m 4.20 0.4 m 4.20 0.4 m	6.5 m ¹ per m 7.5 m	= 130 = 130 Cyclic Pu 35 kPa Siesmic Cyclic 2 x k _{static} 809787 kN/m³ =	 2 Design; P Liquefaction P_{L-max} (Cu_{Liq} x D) 4.7 kPa 2 Design; k Liquefaction (0.05 to 0.01) x k_{Liq} 57 kN/m³ 5 kPa 2 Design; P Liquefaction Cu_{Liq} x D) 5.7 kPa 2 Design; k Liquefaction (Cu_{Liq} x D) 5.7 kPa 2 Design; k Liquefaction (0.05 to 0.01) x k_{Liq} 124 kN/m³
C M CKE C M C	Cu N σ',' Cluq Euliq Piimit Pu φ Y Cuuq K Cu Culiq Euliq Piimit Piimit Q',' Cuuq K Cu Q',' Culiq Puimit Pu Q Y Cuuqq Q Y Cuuqq K Cu N Cuuq		120 kPa 60 D $\gamma \times H$ = 0.09 x σ_v ' kPa 400 x Cu _{Liq} KPa 0.5 x Pu = 3 x kp x $\gamma x D x B$ 35 deg 20 kN/m ³ 0.09 x σ_v ' kPa 000 x (56 x N(100 x) 230 kPa 115 D $\gamma x H$ = 0.09 x σ_v ' kPa 400 x Cu _{Liq} KPa 0.5 x Pu = 3 x kp x $\gamma x D x B$ 38 deg 21 kN/m ³ 0.09 x σ_v' kPa Sta 38 deg 21 kN/m ³ 0.09 x $\sigma_v' kPa$ Sta 38 deg 21 kN/m ³ 0.09 x $\sigma_v' kPa$	$=$ $=$ $=$ $=$ 18 D kp B $=$ $=$ $atic Design;$ $x D)^{-3/4})$ $=$ $=$ 211 D kp B $=$ $=$ 211 D kp B $=$ $atic Design;$ $x D)^{-3/4})$ $=$ $=$ $=$ $=$ $=$ $=$ $=$ $=$ $=$ $=$	0.4 m kN/m ³ 11.7 kF 4680 kF KN/m = = 11.7 kF k = 11.7 kF k = 14.2 kF 5670 kF KN/m = = 14.2 kF k = 14.2 kF	x 2a 0.4 m 3.69 0.4 m 2a 404894 kN/m ³ x 2a 0.4 m 4.20 0.4 m 4.20 0.4 m 2a 862599 kN/m ³	6.5 m ³ per m 7.5 m ¹ per m	= 130 = 130 Cyclic Pu 35 kPa Siesmic Cyclic 2 x k _{static} 809787 kN/m³ = = 158 Siesmic Cyclic Pu Siesmic Cyclic Pu 42 kPa Siesmic Cyclic Pu 42 kPa Siesmic Cyclic 2 x k _{static} 1725199 kN/m³	kPa Liquefaction PL-max (Cu _{Liq} x D) 4.7 kPa Design; k Liquefaction (0.05 to 0.01) x k _{Liq} 57 kN/m ³ kPa Design; P Liquefaction PL-max (Cu _{Liq} x D) 5.7 kPa Design; k Liquefaction (0.05 to 0.01) x k _{Liq} 124 kN/m ³
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4 Brooklyn Road, Aro Valley

Geotechnical Desktop Study Report

09-Aug-2022

Summary of Geotechnical Findings

Ground Conditions	
Subsoil Classification as per NZS 1170.5:2004	C (shallow soil)
Water Table Depth	2-3 m below existing ground level
Inferred Ultimate Bearing Capacity	N/A (founded on piles)
Indicated Ultimate Pile Capacity (compression)	800 kN
Geotechnical Hazard Risk	
Liquefaction	Low
Lateral Spreading	Low
Slope Instability	Low

The buildings are indicated to be found on strip footings and piles which extend approximately 10 m below existing ground level. Ultimate bearing and pile capacities are based on geological and engineering principals and information presented within the drawings/specification. A site subsoil class of C (shallow soil) is recommended based on the depth to rock >1 MPa.

If analysis shows the indicated pile capacities are insufficient it is recommended site-specific investigations are used to verify likely pile capacities and lengths. Site investigations are also recommended if foundation loads increase as a result of strengthening work. Investigations are recommended to comprise of machine boreholes situated along the buildings' length.

1.0 Introduction

Wellington City Council (WCC) has engaged AECOM New Zealand Limited (AECOM) to undertake structural and geotechnical seismic assessments on a portfolio of buildings across Wellington City as a part of the WCC Housing Upgrade Project 2 programme. A Detailed Seismic Assessments (DSA) was previously undertaken by Romulus Consulting Group (Romulus) in 2008. The objective of a DSA is to assess the likely seismic behaviour of a building in terms of percentage of New Building Standard (%NBS) and provide recommendations for seismic strengthening of the building, if required.

This report summarises the geotechnical desktop study for 4 Brooklyn Road, Aro Valley including potential geotechnical hazards and site subsoil class. This desktop study report is intended to form an appendix to the structural DSA.

1.1 Scope of work

This report serves to summarise the following:

- historical aerial imagery
- published geological maps for the site
- Geological and Nuclear Sciences (GNS) Active Fault database

- assessment of any relevant publicly available ground investigation or geotechnical data within the vicinity of the site
- existing geotechnical assessments
- anticipated ground conditions and bearing capacities
- initial assessment of the site subsoil class based on NZS1170.5:2004 and in accordance with recent technical publications
- initial high-level geological hazard identification including liquefaction, lateral spreading, and slope instability at the site
- recommendation of geotechnical investigations where required.

2.0 Site Information

2.1 Site Layout and Foundation System

The site is located at 4 Brooklyn Road, Aro valley, Wellington on a 6960 m² site. The site is bound by Ohiro road to the west, Willis Street to the east, Aro Street to the north and residential dwellings to the South.

Block A is an eight-storey building situated in the south-eastern corner of the site. The lift core which links the two wings of the building is slightly higher having 11 levels. The wings of the building is approximately 26 m long and 6 m wide. The lift core is 6.7 m wide and 8.1 m long.

Block B is predominately a four-storey building, however a fifth storey is present above a small portion of the building. The building and located along the southern perimeter of the site. The building is approximately 24m long and 6 m wide.

Block C comprises of two rectangular three-storey buildings, approximately 20 m long and 6.5 m wide. The buildings are separated by a seismic gap. Block C is connected to Block D which is irregularly shaped and approximately 13.5 m long and 6.5 m wide. Blocks C and D are situated along the eastern perimeter of the site.

Block E is a two-storey building and roughly rectangular. The building is situated along the western perimeter of the site and 39 m long and 7 m wide.

All of the buildings are indicated to be founded on strip footings and 400 mm diameter reinforced concrete piles. Approximately 30% of the site is occupied by buildings, with the remainder comprising of grassed areas and car parking as indicated in Figure 1.

A cantilevered reinforced concrete retaining wall is situated along the southern perimeter of the site and indicated to be up to 5.65 m high. The retaining walls are indicated to have a backslope varying between 0-20° and retain the neighbouring properties.



Figure 1 Site and surrounding area





Figure 2 Typical foundation drawings

3.0 Historic Aerial Imagery

Aerial photographs were reviewed from the Retrolens¹ aerial photograph database and recent satellite imagery available on Google Earth². Aerial photographs taken between 1938 and 2022 were reviewed. A summary of the findings is presented in Table 1 below.

Table 1 Aerial photograph review

Aerial Photo	ography Review
1938	The majority of the site appears to be vacant with small residential dwellings situated along Ohiro Road and Willis Street to the west and east respectively. The vacant area appears to be grassed and used a recreational area.
1945	No significant changes observed within the site area. Another residential building is constructed towards the southern part.
1969-1974	Residential buildings along the Ohiro road are demolished.
1980	Blocks A, B,C,D and E are constructed.
Present	No notable changes to the site are identified since the building's construction.

¹ Retrolens, 2022. Historical Image Resource. Retrieved August 2022.

https://retrolens.co.nz/map/#/4%20Brooklyn%20Road,%20Aro Valley,%20Wellington,%206022

² Google Earth Pro, 2022. Google Earth Aerial Imagery, Retrieved August 2022.

4.0 Existing Information

4.1 Geological setting

The published 1:50,000 scale geological map of the area³ indicates the western part of the site (Blocks B and E) to be underlain by Late Triassic basement rock comprising of interbedded sandstone and mudstone sequences (argillite) and collectively termed greywacke. Greywacke rock is often deeply weathered across the Wellington Region because of its Geological history. The remainder of the site is indicated to be underlain by Holocene alluvium.

An excerpt of the geological map is shown in Figure 3.



Figure 3 Geological map extract 1:50,000 (Begg & Mazengarb, 1996)

4.1.1 Geomorphological Mapping

GNS and WCC have produced a geomorphological map for the Wellington Region⁴. The map indicates the majority of the site (Blocks B, C, D and E) to be underlain by mixed fill, colluvium and rock. Block A is indicated to be underlain by mixed fill and colluvium. The boundaries indicated are approximate, however, still indicate rockhead to be at shallower depths towards the west. This change in rockhead is in general agreement with the geological map and relief of the surrounding area.

³ Begg, J.G., Mazengarb, C., 1996. Geology of the Wellington area. Scale 1:50,000. Institute of Geological & Nuclear Sciences geological map 22. 1 sheet + 128 p. Institute of Geological & Nuclear Sciences Ltd., Lower Hutt, New Zealand

⁴ Institute of Geological and Nuclear Sciences, 2022. GNS SLIDE Geomorphological Map. Retrieved August 2022.



Figure 4 Geomorphological map extract (GNS, 2022)

4.2 Geotechnical Investigations

4.2.1 Existing Nearby Data

Publicly available geotechnical investigations situated within 200 m of the site⁵ are summarised below in Table 2. A site location plan and investigations indicated below are provided in Appendix A.

Investigation Reference	Source	Investigation Type	Depth (m bgl)	Date	Proximity to Site (m)
BH_144271			13.3	2/12/2008	05.0
BH_144270			11.8	3/12/2008	95 3
BH_144269			12.92	1/12/2008	125 SW
BH_174342			9.65	4/11/2021	185 SE
BH_106118			8.0	16/8/2001	200 E
BH_106103		Darahala	17.3	14/9/2001	135 E
BH_106102	NZGD	Dorenole	17.2	11/9/2001	140 NE
BH_106127			4.5	4/9/2001	150 NE
BH_106128			4.5	6/9/2001	155 NE
BH_106130			4.5	12/9/2001	140 NE
BH_106104			25.5	19/9/2001	160 ENE
BH_106124			4.0	29/8/2001	180 ENE

 Table 2
 Summary of geotechnical investigations within 200m of 4 Brooklyn Road

⁵ New Zealand Geotechnical Database, 2022. Retrieved August 2022. <u>https://www.nzgd.org.nz/.</u>

Investigation Reference	Source	Investigation Type	Depth (m bgl)	Date	Proximity to Site (m)
BH_106121			5.0	17/8/2001	195 ENE
BH_106123			4.0	27/8/2001	200 ENE
BH_106122			4.0	26/8/2001	200 ENE
Other_160782			3.7		140 W
Other_160781		Window sample	5.0		140 W
Other_160780			4.0	1/5/2020	145 W
DCP_160779		Dynamic cone	4.6		130 W
Other_180921		penetration test ¹	4.8		130 W

Notes: 1) NZGD location revised based on relevant site location plan

4.2.2 Existing On-site Data

No site-specific geotechnical information is available for the site.

A bulk earthworks plan is provided in the architectural drawings (177/A/5). Shallow cut batters are indicated around the southern perimeter of Block A. Landscaping and recontouring of grassed areas are also indicated.

'Major fill' is indicated to be placed beneath Block E (up to approximately 1.8 m thick) and a shallow cut slope has been formed to the west of the building. Fill is also indicated to be placed to the east of Blocks C and D, however do not coincide with the building footprint.

Clause ca.6. of the specifications indicate over excavated areas were to be backfilled with 'weak mix concrete.

The 400 mm diameter concrete piles are indicated to have a bulb comprising of compacted granular fill. The founding depths are indicated to have an average length of 8 m and a presumed maximum length of 12 m. The drawings and specification indicate piles were to be constructed to provide a safe working capacity of 400 kN. Axial pile testing (compression) is indicated to have taken place using a load of 800 kN.

5.0 Existing Geotechnical Assessment

Key geotechnical considerations discussed within the existing DSA are summarised below:

- The site was previously assumed to be site subsoil class C (shallow soil).
- No previous geotechnical reports/data is available.
- Pile were assumed to be 9.0 m long, as scaled from the drawings.
- The previous assessment for Block A, B and C indicates the buildings can resist 80% of NZS 1170.5:2004 seismic forces.
- The previous assessment for Block D and E indicates the buildings can resist 87% of NZS 1170.5:2004 seismic forces.

6.0 AECOM Geotechnical Assessment

6.1 Anticipated Ground Conditions

The inferred ground conditions, recommended ultimate bearing capacities and pile capacities are summarised in Table 3. These recommendations are based on the site history, geological map, geomorphological map, drawings, and geotechnical investigation data where available.

Geological Unit	Depth to top (m bgl)	Thickness (m)	Soil Type	Ultimate Bearing Capacity (kPa)
Stabilised Fill / Granular Fill	0	0 - 1.8	Silty, sandy GRAVEL . Inferred dense to very dense. Weakly bound with cement beneath foundations where over-excavated.	300
Alluvium / Colluvium	0 – 1.8	5 - 12	Silt, gravel, sand and clay mixtures. Inferred loose to medium dense.	100
Completely to Highly Weathered Greywacke	Typically 8 m	-	Completely to highly weathered SANDSTONE/SILTSTONE. Inferred extremely weak to weak.	N/A Ultimate axial pile capacity (compression) indicated to be 800 kN

Table 3 Anticipated ground conditions beneath the buildings

Notes: 1) Unsuitable soils are assumed to have been undercut as indicated in the structural foundation drawings

The ultimate bearing and pile capacities presented in Table 3 should be factored in accordance with the New Zealand Building Code B1/VM4 Table 1⁶.

Lateral and tensile capacities of piles have not been assessed due to the uncertainties associated with ground conditions and pile lengths.

6.2 Groundwater

No onsite groundwater measurements are available. Based on the low-lying relief, elevation of the site and nearby investigations groundwater is expected to be encountered within 2-3 m depth from the current ground level.

It should be noted that groundwater levels at the site may fluctuate with changes in rainfall. Following heavy and/or prolonged rainfall, it may be possible for a perched groundwater level or transient flow to develop on clay interbeds.

6.3 Site Subsoil Classification

Highly weathered greywacke in the Wellington Region is typically extremely weak to very weak. In-situ testing and soil/rock descriptions from nearby investigations indicate a thick mantle of residual soil and completely weathered rock (extremely weak) on the hills west of the site.

Based on the indicated pile lengths and inferred ground conditions, rock with an unconfined compressive strength (UCS) greater than 1 MPa is expected to be encountered deeper than 3.0 m from existing ground level. This exceeds the class B (rock) requirements stipulated NZS1170.5:2004 clause 3.1.3⁷. Therefore, a site subsoil class of C (shallow soil) is recommended.

We recommend that if analysis indicates that strengthening of the structure is required, site-specific geotechnical investigations should be carried out prior to designing such strengthening works to verify ground conditions and pile capacities.

6.4 Geotechnical Hazards

6.4.1 Faulting

The closest active fault is the Wellington Fault which is a dextral strike slip fault located approximately 1.5 km west of the site⁸. The Wellington Fault is classed as one of the major fault systems of New

⁶ Ministry of Business, Innovation and Employment, 2016. Acceptable Solutions and Verification Methods For New Zealand Building Code Clause B1 Structure.

⁷ New Zealand Standard NZS1170.5, 2004. Structural Design Actions, Part 5: Earthquake Actions - Standards New Zealand, 2004

⁸ Institute of Geological and Nuclear Sciences, 2022. New Zealand Active Fault Database. Retrieved August 2022. <u>https://data.gns.cri.nz/af/</u>

Zealand and capable of producing displacements on the order of 5 m horizontally and 1 m vertically during a single event. The fault has an average slip rate of approximately 6.3 mm/yr for the last 100 ka. Ninis et. al. (2013)⁹ state that the Wellington Fault has experienced an increase in surface rupture activity between 10-8 ka and the last 4.5 ka. Studies of the fault have indicated the recurrence interval to be between 610-1500 years^{10&11}, with the last event occurring 300-500 years ago.

Numerous north-south trending faults are identified within 1 km of the site, however inferred to be inactive.

6.4.2 Slope Stability

The site is situated on relatively flat ground. Greater Wellington Regional Council web maps indicate the slope failure risk at the site to be low.

Based on the inferred ground conditions and shallow soil slopes the risk of slope instability affecting the foundation system is low.

6.4.3 Liquefaction

Greater Wellington Regional Council hazard maps indicate a low liquefaction risk for the site. The buildings are indicated to be supported on piles and inferred to be founded on weathered rock. In turn, the liquefaction risk at the site is considered to be low.

6.4.4 Lateral Spreading

Lateral spreading will only occur if both a shallow liquefiable layer exists, and sloping ground or an unsupported free face is within the vicinity of the site. Based on the low risk of liquefaction and shallow relief, lateral spreading is not considered to be a risk.

7.0 **Recommended Geotechnical Investigations**

Inferences about ground conditions over the site are made using geological principles and engineering judgment. It is recommended that a site subsoil class C (shallow soil) based on the expected rock depth/strength beneath the buildings.

If analysis shows the indicated pile capacities are insufficient it is recommended site-specific investigations are used to verify likely pile capacities and lengths. Site investigations are also recommended if foundation loads increase as a result of strengthening work. Investigations are recommended to comprise of machine boreholes situated along the buildings' length.

⁹ Ninis, D., Little, T.A., Van Dissen, R.J., Litchfield, N.J., Smith, E.g.c., Wang, N., Rieser, U. & Henderson, M. 2013. Slip Rate on the Wellington Fault, New Zealand, during the Late Quaternary: Evidence for Variable Slip during the Holocene. Bulletin of the Seismological Society of America, Vol. 103, No. 1, pp. 559–579 ¹⁰ Little, T. A., R. Van Dissen, U. Rieser, E. G. C. Smith, and R. Langridge, 2010. Coseismic strike-slip at a point during the last

four earthquakes on the Wellington fault near Wellington, New Zealand, J. Geophys. Res. 115, B05403

¹¹ Langridge, R., R. Van Dissen, D. Rhodes, P. Villamor, T. Little, N. Litchfield, K. Clark, and D. Clark, 2011. Five thousand years of surface ruptures on the Wellington fault, New Zealand: Implications for recurrence and fault segmentation, Bull. Seismol. Soc. Am. 101, no. 5, 2088-2107

Prepared by

Reviewed by

Revision History

Rev	Revision Date	Details	Authorised	
1.07		Dotano	Name/Position	Signature
0	10-Aug-2022	For Issue		

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The information, interpretation, recommendations and opinions contained in this report are based on a brief desktop study, site observations and a site investigation undertaken by others as described in this report. Inferences about ground conditions over the site are made using geological principles and engineering judgment. However, it is possible that conditions over the site may vary and it is therefore not possible to guarantee the continuity of ground conditions away from the existing investigation locations.

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Appendix A

Site Location Plan and Nearby Logs





PROJECT

WCC Seismic HUP2 4 Brooklyn Road

CLIENT

Absolutely Positively Wellington City Council Me Helse Ki Pöneke

CONSULTANT

AECOM L19 171 Featherston Street Wellington, 6011

REGISTRATION

(FOR INFORMATION ONLY)

PROJECT MANAGEMENT INITIALS

MR	MR	RA
DESIGNER	CHECKED	APPROVED

ISSUE/REVISION

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I/R	DATE	DESCRIPTION

KEY PLAN

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60687912

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Site Plan

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	Concrete, rock,	sand and silt	ПП	TIT	TT	1	TT			TT		Loose concrete block	k fragmen	ts	1	ate		
	,	• 7				tri			10.			rock debris in a matris	e of sand	2				
	LEIC	r]		111		ore.			. 7.			and SIT.						
ľ	Brown sandy GR	AVEL.						0.8	0.0			Loose, Sand-Ghavel mi	octure.					
-	Light brown and da	[FILL]				0 5		1.3	:0:					-1				N=7 (1.14)
	SAND.	Ter 17		111		4 1			× ·			Loose, gravel in mati	sili ۴۵ عر ۳	•				
	Ĺ	FILL				Gre		2.0	·0 7.					-11				
	Brown GRAVEL	•						2.2	x.º			Madin days Coold	÷	-				
	<u>I</u>	FILL]				14		-	00			mediane denses Grader.						84748
	light brown cle	angu siltu sandu				Ŷ			0 X			Medium danse very sti	htly day.	-	-	V		N = 25 (1074)
	GRAVEL	271-21-2						2.0 -	-0			silty sandy Gravel.	1 1 1	3				
	<u>.</u>					Core		-	Ó,									
	LHOLDEEL	E DEPOSITS							*0					-11				
						T		4.0	O X									10.6.6.6.6
		3 • 3				4			* *									
									.0									
						Gre		5.0-	0j								1111	
									10		Н							
									0.×									9 6 5 5 6 N= 22
	2	·,				<u>`</u>		L.O-	×.0					_		1		
	Blue Igrey, claye	ey, silty, Sandy GRAVEL						6.25	0 ×*		1	7 silty, sandy Gravel	Jeloyey	AL				
	LHOLOC	ENE DEPOSITS				Ge			. · · ×			Madium dense, silty	iand	11				
	due Igrey, sing	SHND.						3.0	× . ×			1						
	LHOLOCE					Tube		1.0-	××									
	Dark brown, 5	ILT [HOLOCENE DEPOSITS]			111			7.5-	* *			Medium dense organ	ic silt.	-			1111	1 2 6 7 12
	Green/brown	with blue I grey, silty				•			0. 7			in silt/sand matrix	se, grave					N= 27
	Sandy GRAVEL							8.0-	×°			4						
	[[HOLOG	ENE DEPOSITS	Ш			Core		- -	X					4		. 4		
								(3) (1)									1111	
						_		9.0-	. 4									20 00 000
						+	100		0,							i i	1111	N= SD+
	Brown silty same	dy GRAVEL.						9.55	X O			Dense, gravelina :	silt /sand	2				
	THOLOG B	LE DEDOUTET				Core		10.0-				Matrize.						
	[[INE DEPOSITS					and all		ô ×									12 8 9 9 10
		ы				Г			1.0									N= 36
				Ш		ł		11.0-	No -									
									. 0									
						Gre	and the second s	-	0*			. I						
			111				A liber	12:0-	×.0			с. С					111	
			Ш			T	11										IIII	14.9 9 13 17
						+		-										N=47
	Ring /annu at Il	- L Chaup	-111			Lore		12.8	- × ·			D	L/a 1	-1			111	
	Drue igreed sing	, sandy, GRAVEL.						13.0-				Matrix.	r/saval	. 11			111	
	[HOLOC	ENE DEPOSITS		Ш					× •	H.		B. Contradices Black						13 8 10 12 16
						1		13.95	0,0						$\left(\right)$			N= 46
	Blue /grey, SILT	-/SAND	111			1		14.0-	×			Dense, Sand / silt wi	the organic					
	[H010	LENE DEPOSITS]				È		11.2	×			traces	-		11			
	grey notfled brown	NE DEPOSITE				2		14.18	×			Dense, silty ciny, some	sandy silly	Ľ				
	LEIOF CE	ROCK WEATHERING	<u></u>	Щ		OCK I	IARDN	USS ISS	<u>-1x '</u>	<u></u>		FRACTIME LOG	gravel .	M El-	<u> </u>	اــــــــــــــــــــــــــــــــــــ		1 · · · · · · · ·
	DRILLER:	SW - Unwaathered SW - Slightly waathared			11-1	Hard Modure	nd huly ha	ind		100	00	(cms) Spacing of 우 ip	DATE: N	19/01	สมบุ	<u> </u>	0110	но ВН 304
	STARTED:	HW - Highly weathered			MS - 1 S - 1	Modera	anely us	əlt		-	- -+	Harding Harding	1RACED				I FIN	311.17.20~
	8/9/01	EXPLANATION Brek	ole d	-ille	d b	S Gr	iffith	s Dri	Iling Li		<u>.</u>	= ci == ol core	CLIECKED					
	11111311ED:	Core: Denotes Triple	Tube	dri T	Emili	·			5		12				T			
	DRILL:	T: Standard Penetro	ation	les	п.												J	205
חטצו	Triple Tube	2Parate		المعط		. /-	~		ς	10.			SUFET	DF 2	-	DDC	NO BH	1304
200		LIMEDMETERS Sciel	100	o ett	wee	n (5	.um 1	0 6.0.	mland	1 4.0	m	and itml depth.			••••	- Sitte	ing othe	

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			,	06		ורו :		JO	IE				· [HC N	IO.	Вн	1 30	4		
PROJECT	- City Bypass			.00 	700	042	6.60	MN	2.9	195	CATION W	ellington $1E$ DA	IUM Mis	 L					•••••	
ANGLE FROM H	IORIZONTAL 90°		DI	REC	TION	1.14	rtical	a ya wa	. н	.A.D	. GROUND	. 20.78	Santania di kara	<u></u>	н	.A.D.	CC	DLLA	R	1
DESCRIPTION O WEATHERING, HARDN RUCK OR SOR, TYPE, I HITHOLOGICAL FEATU Insture, Longol, etc), ST	OF CORE IESS, STREFIGTH, COLOUR, DEFECT SPACING. RES (bedding, lobition, numeratog) RATIGRAPTIIC HAME	SW ROCK	H ROCK	S Samla tuna		이(LL D) (SS/ 1 (/ 음양	Care size V 11 casing C 11/1 GRAPHIC LOG	IR. IST Ina Ina Ina Ina	ACTU LOG aboug aboug actures of p of	111 11 11 11 11 11 11 11 11 11 11 11 11	ROCK DEF HOMINENT JOIN HATTER, SHEAR ALIOH SCHISTOS moothness) (OR SOIL I tennisteney, con	ECTS IS, BEDDING, I, AND CRUSH SITY (adducte, w DESCRIP I npactness, wath	SEAMS, VEIH 1 ZOTIES, FOI nditi, apacing, 10N) ar content,	DATE/DEPTH	RCD. %	EVEL	DRII WATE LOS "%	L S Er P S 11	ANI ENE ES I 1777	٥٨ ١١ (S
Grey mottled bri [Horoc	own, silty CLAY. ENE DEPOSITS]							x x x x x			vedice desistance sandy some sandy secessional o	silty bane	clay with					52	3 3	4
Greenish brown Sandy GRAVEL [HOLC End of borch	De ene de posits]	-			ē		7-0×0.	0×0,0,0×0			Medium den GRAUEL .	ce, silty :	saudy	-						
							ոսպաստորություն													
	9						سياسيساسيساسي			1										
							سامسامسطمس													
							փոտեսութեուն					€								
							المسطيسياتين . ا													
					-		ավատվանու													
					K HA	ROHES	<u>اخ</u> SS			1-1-	FRACTURE L	OG	LOGGED .	NF	Jenir		1			.2
DRILLER:	ROCK WEATHERING	<u></u>	VI	1 - Ve	ry hard				0	£	(Gina)	Spacing n				·····	PR	OILC	1	
DRILLER:	ROCK WEATHERING UW - Unwashered SW - Shightly washered MW - Moderately washered IIW - Hightly washered	<u></u>	VI MM	1 - Vu 1 - Vu 1 - Ma 5 - Ma 5 - Sa	ry hard rd ideratel iderate fl	ly hard ly solt			100	3 -1-1	[III]-+-[2]	Spacing of natural fractures	DATE	/9/	01	9	. PR	NE H) B	H
DRILLER: T. Bolfon STARTED: 8/9/01	ROCIC WEATHERING UW - Unweathered SW - Shighly weathered MW - Muderately weathered IW - Highly weathered CW - Completely weathered EXPLANATION	<u> </u>	VI Mi Mi VS	1 - Va 1 - Ha 1 - Ma 5 - Ma 5 - So 5 - Va	ry hard rd ideratel iderate iderate it ry soll	ly hard ly solt			1 100	8 -1-1 :)	000 33 20 000 ++ 0111	Spacing of natural fractures Fractures/m of core	DATE	/9/	01	3	. PR 110.	NE N NE N NGIL) B .17:	H 20
DRILLER: T. Bollon STARTED: 8/9/01 FINISHED: 1/9/01	ROCIC WEATHERING UW - Unwathered SW - Shiphily weathered MW - Muderately weathered UW - Highly weathered GW - Completely weathered EXPLANATION Core: Dewote 5 Triple	Tubec		1 - Vo 1 - Vo 1 - Ma 5 - Ma 5 - So 5 - Vo 5 - Vo 5 - Vo	ry hard rd iderate iderate li ry soll	ly hard ly solt			001 1	∂ - -	30 30 1000 1000 1000 1000 1000 1000 1000	Spacing of natural fractures Fractures/m of core	DATE	19/ /		2) B .17:	H 19

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NZGD ID: BH_106102

PROJECT June City Burges			LO	GC	DF	DRIL	LŀI	OL	Ε,	0		, 1	N	Э.	BI	4 30	5
GRID REF.		CO-	OR		00	381.	73 m	N	24	1.9	577.99 mE DA	TUM _w	15 <u>L</u>	•••••		<u>-</u>	·····
	19	t		CTIC	COM	Vertic	<u>ام</u>		H.	A.[D. GROUND 23-80)		- 1-	H.A.D	. CO	LLAR
WEATHERING, HARDNESS, STRENGTH, COLOUR, NUCKOR SOIL TYPE, DEFECT SPACING. THEOLOGICAL FEATURES (bedding, lokalien, mineralogy histore, cument, etc), STRATIGRAPFIIC NAME	-SW ROCK -MW WEATHERIN	HH ROCK	- MS HARUNESS	Sample type	1 OSS 1 IF I "7., n9.?	Core size 11	GRAPHIC LOG	Li ISpainatu Iraci	G Cund Cund Cund Cund Cund Cund Cund Cund		ACOMINENT JOINTS, BEDDING, STATTER, STEAR, AID CRUSS ATION SCHISTOSITY (attidude, a annuollinoss) (OR SOIL DESCRIP (consistency, compactness, val group symbol etc)	SEAMS, VEI 17 ZOHES, FC width, spacing, FION) ler content,	DATE/DETH	ROD. %	LEVEL	VATEI 1.OSS "/. 0-100	STANDAI PENEIR/ IEST (SP
Concrete and Timber	TITI	TT	TT			1	0.0	\prod		Π	Verydanse Concrete an	d Timber,		T	Daid	ΠΠ	
[FILL] Brown, Silty sandy GRAVEL [HOLOCEUE DEPOSITS] Blue / Gray, Silty, sandy GRAVEL. [HOLOCENE DEPOSITS]				Tri Core Core Core Core			0 × 0 × 0 × 0 × 0 × 0 × 0 × 0 × 0 × 0 ×				Dense, silty sandy (France of			_ ∇		$\begin{array}{c} 322,9,1,5,9,\\ N=38\\ N=38\\ 12,9,10,9,1\\ N=50^{+}\\ 12,9,10,9,1\\ N=38\\ N=3$
[HOLOCENE DEPOSITS]				-		11.0-	× 0				Disa L d L silh 6 s	and and	_				
Durch lying Bunched dark brown silty SAND and SILT. [HOLOCENE DEPOSITS] Dark brown, sandy, gravelly SILT. [HOLOCENE DEPOSITS]				Core		H. 35 12.0- -	× × × × × × × × × ×				Conse, slightly sandy line gravelly silt.	, slightly	7				N= 33
Blue lorey, silty, sandy GRAVEL.				C₀re			× 0 ° 0 ° 0 ° 0 ° 0 ° 0 ° 0 ° 0 ° 0 ° 0	2			Dense, silty, sandy with trace of organiz	,Gravel s.					16.12.11.14 N≂so ⁺
DRILLER: ROCK WEATHERING UW - Unweathered T. B.Hen. SW - Stiphily weathered STARTED: IIW - Highly weathered D.C.C. C. C	•••	1	R	OCK 1 Very ha Hard Moders Solt Very m	iard ind itely is itely is	IESS and olt			100	-1-1	FRACTURE LOG (cms) Spacing of p -5 matural -1-[j]III[-1+1]2[.fractures/m	I OGGED DATE: .!!#.0 TRACED:	M.Ek			PRC HOL	овест 5<279 е по ВН 30. апт. 17-30.
12/9.101 EXPLANATION Borch FINISHED: Core: Denotes Triplet JH.19.101 T: Standard Tenetra DRILL: Tiplet	ole d inhed tion	rille rest	3.) Gri	11.11	s Drilli	~ <u>3</u> ++	d.			ol core	CHECKED:	ME				PUS

		LC	G (of D	RILL I I	OLE				NC	B. B.	1305	
PROJECT Inner City Bypess	 (1003	B1.73 m	N 2	L() 99	SATION Wellington	х ТЦИ ме		•••••		
ANGLE FROM HORIZONTAL		DIR	ECTI	ONV	rtical	H	.A.E). GROUND 23-8	0 0		H.A.C). COI	LAR
DESCRIPTION OF CORE WEATHERING, HARDNESS, STREHGTH, COLOUR, NOCK OR SOIL TYPE, DEFECT SPACING, HITTOLOGICAL FEATURES (Inciding, Inhation, Innerator Institute, content, etc.), STRATIGRAPHIC HAME	-SW ROCK	HH ROCK	Sample type	COI(I: () LOSS/ LIF '''.	Core size VI	IRACIU LOG (Spacing natural tracture		ROCK DEFECTS ROMMENT JOINTS, BEDDING BLATTER, SI BAR, AUD CRUSS ALICH SCHISTOSITY fathindo, minutimess) (OR SOIL DESCRIP (consistency, compactness, va imenu symbol etc)	, SEAMS, VEIL 11 ZONES, FC willin, spacing, FION) ler content,	DATE/DE-TH	LEVEL	URILL WATER LOSS "7 0-100	STAND. PENETI IEST (1 159, 75, 75
Bue /gray, Silly Sandy Gravel, [Howocave DEPOSIT	3	TIT			5.0			ense, silly sandy Grave	1,	s	TDate	TTT	
Blue grey SLETY SAND HOLOCENE DEPOSITS] Blue grey suffed brown CLAY. [HOLOCENE DEPOSITS] Blue / grey , clayey, silty, sandy GRAVI [HOLOCENE DEPOSITS] End of brahole at 17:30m depth.			Core					Tim, Clay. Medium dense, Silt Kine Firm, Clay. Medium dense, Slight Silty Sandy Gravel.	Sand				6562
DRILLER: T.Bolton STARTED: NOCK WEATHERING UW - Unwashured SW - Sightly washbured IW - Hudratuly washbured IW - Highly washbured IW - Highly washbured		VII- 11- 11- 11- 12- 12- 12- 12- 12- 12- 12	ROCK Vory I Hard Madda Sult	LIARDNE:		001	26-1-1-1	FIACIURE LOG (caus) Spacing of P m 5 	LOGGED. DATE: TRACED:	m. Fiz	migg	PRC	лест: 5<2: е по .ВИ. зп. 17-3/
FINISI-IED: .14./9./01 FINISI-IED: .14./9./01 EXPLANATION Core: Denotes Triple T: Standard Penett	Tube d ation T	vs -	Very :	ទូប[<u>-</u>		Q Q 20 I Frachites/in ol core	CHECKED	m Ek	ming		PUS

		10	IG OF	י דוומט	OLE			HO	LĿ O.	B	H 30(6
PROJECT Inner City Bypass						OCATION Wellington	<u>م.</u>		•••••			
ANGLE FROM HORIZONTAL 90°	C	1002 גוונו	RD. 700 #	Vertical	N 299	1504-11 ME DA	TUM .m.	<u>ş</u> L.	922 4			
	9				Inactuo	ROCK DEFECTS	\$			H.A.L	Long	LAR
WEATHERING, HARDNESS, STRENGTH, COLOUR,	Х ^Щ	NUCK NUCK		S/ IIAD S	LOG	PROMINENT JOINTS, BEDDING, SHAFTER, SHEAR, AND CRUSH	SEAMS, VEI	HS I	í	LEVEL	WATER	PENEIDAT
ROCK OR SOIL TYPE, DEFECT SPACING.	/EATI	RO	a Uiti	뢚매년	(Spacing of natural	I IATION SCI IISTOSITY latitude, w smoothnoss)	valu, spacing.	DES	3. 410		1.OSS "%"	TESI (SPT
HITICI OGICAL FEATURES (bedding, foliation, nineralogy	333	IN	E a u	Core Casin RAP!	frachines)	OR SOIL DESCRIPT	ION)	ATE	ROL		1 1	1 2 4 2 4 2 4 2 4 2 4 2
inside, canent, alc, STRATISTAFTIC TAME	I I I I	1220		μ ⁽ ~) _E ⁽⁰⁾	in Sin-	group symbol etc)	er comuni,			Date	0-100	
Dark brown, gravelly sandy SILT.				× .	<	Loose, slightly sandy occasional gravel. Ora	silt with	ed,				
						3 3	2					·· ·· ·· ··
Brown, silty sandy GRAVEL			Core	1.0-0.	<	Loose to dense, coa	rse					
HOLOCENE DEPOSITS]						cobbles within silt	/sond					
				- Ox		matrize,						2111
				2.0 -		Gravel and Cobbles	highly					
	• .		Gre	0	·							
				- × · c	<u>-</u>							
				3.0-02						V	1111	84455
			v	0	1							NSIR
			100	10,0								1
				4.0	2				1			
10 10			$\left \right $							1 1		
			+		>			1				N= 37
	111			00								
			Core								1111	
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الر عو						60 60						1497101
			*	0								N= ST
			Core	-0	,						111	
					2						1111	
				TO DO								15.9 12.9 9 N=39
				and and							1111	
	-111		Core	8.0-01								
				0.	×							
				1 1.0						1 1	4111	13.10.10.10.1
			+									N= 41
				1								
			Core	0	×							
				10.0-0								
			ONF		2							N=38
				ΠÔ.	0							
			Core	1.0-1 0	>							
			6	0	0							
					×							18 11 10 8
			+	12.0-	5							N= 42
				0	°						1117	
			Core	-07								•• •• •• •
				13.0	.							
				×	•			* .		1 1		N=42
-2			1	0	×							
Charadola cille a di CRAIIEL	-111		Core	14.00	0							
[HOLOCENE DEPOSITS]				14.3 0 *	0 1	Danse sitty sandy Gran Medium dense, silty s	iandu Grau	PI				
Blue larey, silty sandy GRAVEL				0.00	0 *0	Traces of clay and organ	ics.					0 - 1 -
ROCK WEATHERING	- <u>Ļ</u>	կուղ	ROCK HAR	THESS	.0	FRACTURE LOG			1		цп	7:3:6:7
DRILLER: UW - Unweathered T BHo- SW - Slightly weathered			Very hard Hard Modurately	hard	00 00	(cms) Spacing of 우마 _쥰 natural	LOGGED.	19/01		nJ	PRO	HECI: 5027
STARTED: IIW - Highly weathered		MS - S -	Moderately Sull	noft	- -	1-1-1-1111-1-1-1 Liaclures	IRACED: /	M FL	mi	ina.		GUL.
ENISHED EXPLANATION Bores	ole d	rilled	by Groff.	the Drilling	_imited	- ci == ol care	CHECKED:			7		
19/9/01 Core: Devotes Triple T	Tube c ation 1	Test .		7							0	ans
DRILL:	847 - 1 72											65
DriberTure 66104 Piezounters some	ened	belw-	en (12m1	o 16m) and	19-1-0	2m) da-dh	SHEET.	1 NT	2	DRG	NO B	H.306

ID: BH 10610	4	3 1.5						_							ĸ
				10		NE.	ווסח	1 1.10					_E).	BH 30	6
PROJECT	Pr City Bypass	•••••	•••••	۲		л :		L T N		LC	DUATION Wellington				· ··· ·····
GRID REF.			C	00	RD7	00	532	- 7 21	nN	.2	99504 11.ME DATUM	nsl.			na ana ang kana at
NECODIDITION O		1 9	T	<u>. 1711</u>	ECIR		Verne		F	1.A.	D. GROUND 24.05	<u>.</u>	<u>. H</u>	A.D. CO	LLAR
DESCRIPTION O	F CORE	Х Ц Х Ц Ц		NE35	type	1.055	ILA D	106	LOG	5 5	PROMINENT JOINTS, BEDDING, SEAMS, V SUATTER SUEAR AUD CRUSH ZONES	ER4S	LE	ATEN DRILL	STANDARD
NOCK OR SOIL TYPE, I	DEFECT SPACING.	CR1		HARD(el	1 IF 1 "V.,	33 0	¥	(Spacing natural	y ol	IATION SCHISTOSITY (atthode, width, space smoothness)	NJ.	24	1.055	(SPI)
LITHOLOGICAL FEATUR	IES (bedding, Ioliation, mineralogy	33	3	τω	Eag		Core	ビイン	frar:hire	aa) Sins	(OR SOIL DESCRIPTION)	ATE	202		150,75,75,75,75,7
insume, comoni, eic), ST	CATIGRAPHIC NAME	UN X	I I	1220	2	11.1	5 <u> </u>	Ø	in Qu Luilun	n - Inti	(consistency, compactness, water content, group symbol etc.)		D	ale	
Blue / gray, silly,	sandy, GRAVEL.							0°.0			Medium dense, silty, sandy GRAVEL . Traces at clay and orgo	anies			
[1020-2]	se berosnisj						1	0,×			5				
1					5.0		16.0	×0°				·		- (111)	
								0°×.							
Light brown 410	Hend orange, clayer	-111			1+		16.5	X·X			Dense, slightly clayer, slight	-Hy			N= 504
Sandy gravell	y SILT.						17.0-	.*.X			sandy silt with occassional	-			
[HOLO	CENE DEPOSITS	•			core	a la contrata de la contr		· * *			grave 13-	Call	ľ		
Brown sitty so	CRAVE!	-				Sub line		00			Dense, coarse gravel with				
	7-1-1-1						18.0	· 0			occasional cobbles within				25 18 18 R . 4
LINCEDE	DEPOSITS				+			00			silt/sand matrixe. Grave				N = 50*
								xoo			my coupies nigning weather	cd.			
					Pore		19.0	0.0							
								00							
								°x°							25 18 18 14 for
Light bound wat	lled at a Cond all T	-				- Marine	_ه. م2	<u> </u>			De la companya de la comp				N= 50
	mer brange savay sirl				Gre			i x x			Vense, slightly sandy SILI.				
	DEENEDEPOSITS	-				and a second	20.7	× ×							
Brown, silty s	andy GRAVEL						21.0	00			Dense, coarse gravel with				
F .					T			0.0	6		silt/sand matrix Crow	,			32 21 24 Paluna
HOLOCE	NE DEPOSITS							20			and cobbles highly weather	red			N= 50+
					Core		22.0-	×0							(solid Nose SP
		11					-	0							
					T			×o							1818 18 19 N- 50+
					+		23.0-	. ×							(Solid Nose SPT)
								0.					.	- 1111	
					Cote		24.0	× O							
							24.0-	0							
							-	.0							
							25:0-	0.0							25 21 18 19
					*			60	7						(Solid Nose SP
End of borehol	e at 25.5m depth.						<u> </u>								
							- 1								
								1.11							
							11 -								
í.							-	1	11						
								1000							
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DRILLER:	ROCK WEATHERING				ROCK I		HESS				FRACTURE LOG (cans) _ Spacing of LOGGE	D. M. Fle		g Pitt	DECT S=27%.
DRILLER:	ROCK WEATHERNIG UW - Unwasthered SW - Sightly westhered MW - Moderately westhered IW - History westhered			VI LING	ROGK I - Very ha - Hard - Moder - Moder - Son	IARDA Induitedy b	HESS		100		FRACTURE LOG Luns) Spacing of 은 마 -주) natural -T-T-[D11] 1-1-1] fractures	0. m. Fle 19/9/01	mię	g	Олест 5⊂27%. се но. ВН. Заб.
DRILLER: T.Bolloc. STARTED: J5/12/0	ROCK WEATHERING UW - Unwaniharad SW - Slightly wantherad MW - Moderately wantherad UW - Highty weatherad CW - Completely wantherad	· .		VII MS VS	ROCK I - Vary In - Markar - Markar - Moder - Soll - Vary S	IARDA ind indy b anely is	HESS and iol		001 -		FRACTURE LOG (Luns) Spacing of P m -5 -1-1-[D11] 1-H c] P S S S Tractures/m P S S S Tractures/m P S S S Tractures/m P S S S C C C C C C C C C C C C C C C C	0. m. Fis 19/9/01 0. M. Els	min	g PHR 1100 3.9 LEN	рист <u>SC 2.7%.</u> се но ВН Заб. адит 25:55
DRILLER: T.Beller STARTED: Js/1/0 FINISHED:	ROCK WEATHERING UW - Unwouthord SW - Slightly wouthered MW - Moderately wouthered UW - Completely wathered CW - Completely wathered EXPLANATION Core: Denotes Triple-		ed		ROCK I - Vary hi - Hard - Moder - Solt - Very s	IARIOA and and balley b	HESS and ant		100		FRACTURE LOG Lung) Spacing of P m _6 -1-1-[DIII] I-H] fractures Fractures/Int P R 22 of core CLIECKI	0. m. Fle 19/9/or 0. m. Ele		g PH(Олест, S⊂.2.7% се но. ВН. За& іст но. ВН. За&
DRILLER: 	ROCK WEATHERING UW - Univoutharad SW - Slightly wasthered MW - Maderately wasthered UW - Highty weathered CW - Completely wasthered EXPLANATION Core: Denotes Triple T : Standard Proch		e d	VII MII MII VS VS	ROCK I - Vary hi - Hand - Moden - Moden - Solt - Very S	IARDA Industries	HESS and aut		001	.0 <u>0</u> -7	FRACTURE LOG Luns) Spacing of P m -5 natural -1-1-[mi] 1-1-1 P S S S ut going CLIECKI	D. m. F/s 19 /9/or m. F/s D: 		9 PR0 110 ag LEF	DJECH SC 2.7%. LE NO DH 306 IGHT 25:55 PUS

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l., .	DRILL:	F: Denotes Standar	よん	ietra	ation T	est.								11/1/	ATION	L CON	INLTANTI
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IIII DUCLIC FRAMES Bandres Latine unitation 20	AUCK ON SOIL TYPE, DEFECT SPACING.	R		ARD	e	1151	Size	Q	(Sp	acang	l of	ATION SCHENCER AND CHUSH	valm, spacing,		5	,	LOSS	IEST (SPT)
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$\begin{bmatrix} [k_{k}] \\ [k$	Grey Sandy GRAVEL	TTT	T	TTT		1		10.	TT	TT		Loose soudy Com	1	++			₩	1
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DRILLER: ROCK WEATHERING I.OCK HAMPHESS FRACIURE LOG IOGGED. M. F.Kming. PHOIECT. S2-274 M. Griffiths SW - Unvoultured MI - Vary hand MI - Vary hand Bighty wastland Bighty wastland MI - Vary hand Bighty wastland								-										
DRILLER: INOCK WEATHERING INOCK HAMPHESS UW - Unwaltured INOCK HAMPHESS FRACTURE LOG M. Griffills IV - Vary had I - Malturedy hard M. Griffills IV - Unwaltured II - Malturedy hard M. Griffills IV - Unwaltured II - Malturedy hard M. Griffills IV - Unwaltured II - Malturedy hard M. Haddenedy waltured II - Malturedy hard II - Malturedy hard II - Malturedy waltured II - Malturedy hard II - Malturedy hard III - Malturedy waltured III - Malturedy hard III - Malturedy hard III - Malturedy waltured VS - Very soft III - Malturedy hard III - Repling VS - Very soft III - Malturedy hard III - Repling VS - Very soft IIII - Malturedy hard III - Repling VS - Very soft IIII - Malturedy (IIII) III - Repling VS - Very soft IIII - Malturedy (IIII) III - Repling VS - Very soft IIII - Malturedy (IIII) III - Repling VS - Very soft IIIIII - Malturedy (IIIII) III - Repling VS - Very soft IIIIII - Malturedy (IIIII) III - Repling			11				1		11		1				1	- 11	111	and a second second
DRILLER: INOCK WEATHERING INOCK INMEDIESS DRILLER: UW - Unwoutherud INOCK INMEDIESS M.G.RHLes WW - Unwoutherud II - Vory Indid M.G.RHLes WW - Unwoutherud II - Vory Indid STARTED: UW - Unwoutherud II - Molurately turit IF-8-01 EXPLANATION Bore Lole drilling Griffithes Drilling (UZ) Limited. IF-8-01 PB: Denotes Standard Renetration Test. Griffithes Drilling (UZ) Limited.							11.	-								-11	111	
DRILLER: ROCK WEATHERING ROCK IARDNESS FRACTURE LOG LOGGED. M. E.Sming. PROJECT. SC 2.74. DRILLER: UW - Unwoollound WI - Vury hard NI - Vury hard Spacing of tailoral factors IOGGED. M. E.Sming. PROJECT. SC 2.74. MK - Srightly weathered MV - Maderately woulliered HI - Vury hard Project. SC 2.74. DICIECT. SC 2.74. STARTED: UW - Unwoollound VI - Vury hard Project. SC 2.74. DICIECT. SC 2.74. IT - 8 - 01 IW - Baderately woulliered HI - Molorately hard Project. SC 2.74. DICIECT. SC 2.74. FINISHED: IW - Unglight weathered S - Sol Project. SC 2.74. DICIECT. SC 2.74. FINISHED: EXPLANATION BoreLole drilled by Griffiths Drilling (DZ) Limited. Project. SC 2.74. DICIECT. SC 2.74. IT - 8-01 B: Deardes dry barrel drilling Griffiths Drilling (DZ) Limited. CHECKED: CHECKED: IT - 8-01 J: Deardes Standard Revertation Test. For Corputation Test. CHECKED: CHECKED:								-			11						111	
DRILLER: ROCK WEATHERING ROCK HARDNESS FRACTURE LOG LOGGED M. Eleming PROJECT SC 2.7%. DRILLER: UW - Unweathered WI - Very hard B Spacing of natural DOGED M. Eleming PROJECT SC 2.7%. STARTIED: IW - Highly weathered MI - Moderately hard B So and the school of the sch								- International Action of the									111	
DRILLER: ROCK WEATHERING IROCK HARDNESS FRACTURE LOG LOGGED M. Eksnong PROECT SC 2.7%. DRILLER: UW - Unweathered VI - Very hard III Protect SC 2.7%. IOGGED M. Eksnong PROECT SC 2.7%. STARTED: UW - Inglity weathered MI - Moderately hard Protect SC 2.7%. IOGED M. Eksnong PROECT SC 2.7%. IV - Started: W - Moderately kind MI - Moderately hard Protect SC 2.7%. IOGED M. Eksnong PROECT SC 2.7%. STARTED: UW - Inglity weathered MI - Moderately hard Protect SC 2.7%. IOFE HO BH.407. IOFE HO BH.407. IT-9-01 EXPLANATION BoreLole drilled beg Griffiths Drilling (NZ) Limited. Protect SC 2.7%. INCE HO BH.407. IT-9-01 PS: Denotes standard Remetration Test. OPUS OPUS						Ľ.						í -		11	1		111	
DRILLER: ROCK WEATHERING ROCK HARDNESS FRACTURE LOG LOGGED M. Flowing PROJECT SC 2.7%. DRILLER: WW - Unwaatharud VI - Vary hard II - Vary hard II - Iard Spacing of Long LOGGED M. Flowing PROJECT SC 2.7%. M Griffills StarTED: IW - Unwaatharud VI - Vary hard II - Iard III - Iard				1111														
DRILLER: ROCK WEATHERING IOCK HANDNESS FRACTURE LOG IOGGED M. Flowing PROJECT.SC 2.7%. DRILLER: UW - Unwaithand VI - Vury hard Spacing of the structure IOGECT.SC 2.7%. M Griffills WW - Unwaithand VI - Vury hard Spacing of the structure IOGECT.SC 2.7%. STARTED: IW - Unwaithand MI - Molecularly would and the structure MI - Molecularly would and the structure Spacing of the structure IOGED M. Flowing DATE I.T - S - QI IT - S - QI III - Hard MS - Molecularly would and the structure MS - Molecularly would and the structure IOFE HO BH MORE DATE I.T - S - QI HOTE HO BH MORE IT - S - QI III - Hard So of the structure VS - Very solt - (I - Q - Q - Q) DATE I.T - S - QI HOTE HO BH MORE IT - S - QI III - Hard VS - Very solt - (I - Q - Q - Q) IRACED. M. Flowing LENGIT S. Some IT - S - QI EXPLANATION Borehole drilled beg Griffiths Drilling (NZ) Limited IIIECKED CHECKED IIIECKED IT - S - QI Flowing To enotes Standard Remetration Test. OPUS								in i								- F		
DRILLER: ROCK WEATHERING ROCK TIARDNESS FRACTURE LOG LOGGED M. Eleming. PROJECT SC 2.7%. DRILLER: UW - Unwoothered W - Very hard I - Iand I -																1		
DRILLER: ROCK WEATHERING IROCK IARDALESS FRACTURE IOG IOGGED M. Flemmag. PROJECT SC 2.7%. DRILLER: UW - Unwoolland VI - Vary hard II - Vary hard III - Vary hard III - Vary hard IIII - Vary hard IIII - Vary hard IIIII - Vary hard IIIII - Vary hard IIIIII - Vary hard IIIIII - Vary hard IIIIII - Vary hard IIIIIII - Vary hard IIIIIII - Vary hard IIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII			H					-										
DRILLER: ROCK WEATHERING ROCK TARDHESS FRACTURE LOG LOGGED M. Eleming PROJECT SC 2796. DRILLER: UW - Unweathered WI - Very hand Spacing of tarted Date: 17-9-01																		
DRILLER: UW - Unweathered WI - Very sold III - Hard Spacing of the data and data and the data and the data and the data an	ROCK WEATHERING	÷	Ч		ROCI	HAR	DNESS			_		FRACTURE LOG	LOCOLD		-			502796
MW - Multirately woulliered MS - Madianely cont STARTED: IW - Lighty woulliered NS - Madianely cont IT-8-01 EXPLANATION Borehole drilled by Griffiths Drilling (NZ) Limited. Finistied. FINISt-IED: DBI: Denotes dry karrel drilling Drilling (NZ) Limited. IT-8-01 T: Denotes standard Remetration Test.	DRILLER: UW - Unwoathered				- Hard	hard I uralely	hard			100	R	(cms) Spacing of 문 ip ~쥰] natural		-8-0	21	7		: un BH 407
17-8-01 CW - Completely weathered VS - Very solt - (i U S) US ut core ITTOCED. FINISHED: EXPLANATION Bore Lole drilled by Griffiths Drilling (UZ) Limited. CHECKED: 17-8-01 PB: Denotes dry barrel drilling T: Denotes Standard Remetration Test.	STARTED: MW - Moderately weathered			MS	- Mad - Sult	orately	noli			-	-1-	-1-1111 1+1 - fracturos	104050. #	A Flow			1 COL	
FINISHED: 17-8-01 DBI 1: T: Denotes standard Renetration Test.	17-8-01 CW - Completely weathered	1 1/2	-	VS	- Very	soft	111	n!!	- 41			은 원 요요. ul core	CUECKED	1	J.		1.ENG	
DRILL. J: Denotes Standard Penetration Test.	FINISHED: Denotes dry ba	rrel	dr	illina	69	Gri	renus .	rund	Ιω	<u>(</u>)	- 114	.il <d .<="" td=""><td>GUEGRED.</td><td>m</td><td>5</td><td></td><td></td><td></td></d>	GUEGRED.	m	5			
	DDILL. J: Denotes Stande	and	Per	netra	tion	Tes	t-,					×.					215	US

NZGD ID: BH 106121Eore-ble dry

SHEET ... J. OF. I... DRG NO BH HQT

.GD ID: BH_106122									•	н	OLE	BH	408	4 3
ROJECT Inner City Bypass		LC)G (OF	DRII	_L ŀl(OLE	LC	DCATION Wellington		<u>NO.</u>			
IRID REF NGLE FROM HORIZONTAL	C	diri	RD. 7 ECTI	190 5 ON	52.e Vert	ical	J Z 	994 H.A.	D. GROUND 24.12	M MSL	f	H.A.C). CO	LLAR
ESCRIPTION OF CORE JEATHERING, HARDNESS, STREHGTH, COLOUR, UCK OR SOIL TYPE, DEFECT SPACING. ITTOLOGICAL FEATURES [headding, hillingin, mineratogy entime, commit, etc), STRATIGRAPHIC MAME	-SW ROCK -MW WEATHERING	H ROCK MH ROCK MS HARDNESS	Sample type			GRAPHIC LOG	IRACI LO (Spice nator: tractor	IUIIII G ny of al rus) Cons -	ROCK DEFECTS PROMINENT JOINTS, BEDDING, SEA STIATTER, STEAR, AND CRUST 2C JATCH SCHSTOSITY (atthibute, widit, anticulturess) (OR SOIL DESCRIPTIO (compactness, water cc proup symbol etc)	MS, VEIHS MS, FOL- sparang, N) antent,	DATE/DEPTH R.O.D. V.	VATEI LEVEL	DRILL WATER LOSS '%	STANDAID PENETRATION IESI' (SPI) IS9,75,75,75,75
Ark arcy Ibrown Iblack, gravelly silty AND [FILL] ight brown notfled dark grey, Sandy gravelly SILT. [FILL] brown notfled black and grey, sandy SILT [Possibly ASH] Brown, gravelly sandy SILT [ASH] Brown, gravelly sandy SILT [ASH] Brown, gravelly sandy SILT [ASH] Grey brown, silty sandy GRAVEL. [Possibly ASH] Brown notfled dark brown, silty candy GRAVEI			DB		0.3 	$\begin{array}{c} & & & \\ & & & & \\ & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\$			Loose, slightly gravelly s Loose, fine sandy grav Silt. Medium dense, fine san Medium dense, fine sand medium dense, fine gravel sandy Silt. Medium dense, slightly sandy Gravel.	Line time to silt.		V		3 2 2 1 2 U = 7 2 2 3 3 3 M=1) 10 6 6 4 3
End of borchole at 4. an depth.			De	B	3.0 3.3 3.7	<u> </u>	0.0×1 0.0×1.10000		Firm, silty Clay Medium dense, silty s Gravel. Medium dense, silty : Gravel.	landy Sansly				3 3 6 8 10 N=27 N=27 N=27
DRILLER: M. Gridfiths STARTED: NW - Unwashered STARTED: NW - Mailerately weathered NW - Mailerately weathered NW - Mailerately weathered			HOC - Ver - Hai - Moi - Sol	K HAR y hard durately durately	DNESS hard	يسيس سيسا سيسا سيسا سيسا		1 100	FRACTURE LOG Lons) Spacing of 9 m 5 matural L-1+- [1m] 1+1-[2] Iractures Ifactures	OGGED M	Flen	uing.	Phi 	юест. <i>\$</i> 2776. е и в по В <i>Н 4</i> 08 и в по В <i>Н 4</i> 08
27-8-01 CW - Completely weathered FINISHED: EXPLANATION Bore 27-8-01 DB: Dry Barrel DRILL: T: standard Part	etrot	drilled	<u>- Va</u> 1 bay st	<u>y salı</u> G-rifi	fiths	Dulling	[(N;	2) L	td.				0	PUS

GD ID: BH_106123		HOLE
9.7.7. X ·	LOG OF DRILL HOLE	NO. BHHO9
PROJECT <u>Inter City</u> Bypess	LOCATION Wellingt	an market
ANGLE FROM HORIZONTAL	DIRECTION Vertical HAD, GROUND 23	/2HAD. COLLAR
DESCRIPTION OF CORE	CONTROLLETING RACTOR ROCK DEFECTS	IG, SEAMS, VEINS
WEATHERING, HARDNESS, STRENGTH, COLOUR, OTH	Grand Stratter, StieAR, AND CRU	(S) I ZOHES, FOI - L u, will, spacing, b) s ^c I.OSS IEST (SP1)
11101 OGICAL FEATURES filedding, lobahon, mineralogy,		PTION)
	112 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	Date
Srown, silty saway GRAVEL.	Loose, Sing Danay	Graver.
-+ LEALIN , OFAVEILL SANGU SILT	0.65 Y 1 10000 Stickty aravel	v_{3} sindy silt. $v_{2} = 6$
[TPPSOIL]	0,×	3
own/onange sandy CLAY [FILL]	+ I.O Soft, sandy Clay.	
rown mottled dark brown, silty sandy	0.0 Medium dense, silly 0.0 Gravel.	3 sandy 5 3 4 4 5
[HOLOGENE DEPOSITS]		
	DB ?Ô	
	ו 0	
		5 2 3 2 7
		N= 62
	×°0	
Dark brown, gravelly sandy SILT. [ASH]	DB 218 Yor: 2.9 Yor: Median dense, slight	JAine gravelly
Brown, gravelly silty SHND.	3.0 0 0 medium dense, slight	Hyfine grovely 45889
[POSEIBLY ASH]	3.2 × 0	
Brown, silty sandy GRAVEL .	o o medium dense, si	my savary
HOLOGENE DEPOSITS		
	0	
Ed al how hale at 400 denti		
ing of Dienaic - from april.		10 7 6 6 8
		$\mathcal{D} = 24$
~		
DRILLER: UW - Unweathered	HOCK HARDHESS FRACTURE LOG VII - Very bard Spacing List bard Spacing	of LOGGED M. Flaming PROJECT: 5-2796-03
M.G.r.ffiths SW - Slightly weathered MW - Moderately wouthered HW - Highly weathered	Mi - Moderately hand MS - Moderately hand S - Solt	DATE HOLENO BHHOS
27/8/01 EXPLANATION Borehold	VS-Vay solt Criffiths Drilling (NZ) Ltd.	CHECKED
1-INISI-ILD: 27/8/01 DB: Dry Barrel		OPUS
DRILL: T: Standard Ponetratio	~ 1055-	INTERNATIONAL CONSULTANTS
		SHEET

1

DID: BH_106124											7
							HON	ILE	Вн	410	
PROJECT Inner City Bypass					OCATION .W	lellington	<u>نانیسا</u> به بوده				
NGLE FROM HORIZONITAL 90°	0001	RD.7	00523.2/MA	5 29	9543.47 m	E. DATUM .n	154	·· ···			
DESCRIPTION OF CORE				RACIUR	ROCK DE	$\frac{1}{2}$	11	 	H.A.D	COL	_LAR
WEATHERING, HARDNESS, STRENGTH, COLOUR,	DNES	type	LOSS/ IIAD O	LOG	PROMINENT JOIN	ITS, BEDDING, SEAMS, VE R, AND CRUSH ZONES, P	NS OL-E		LEVEL	WATER	PENETRATIC
TIOLOGICAL FEATURES (bedding, lokation, minuralion)	HAR	mple		spacing n natural hacturas)	supportiness)		E/DEF	20. %		"/"	150,75,75,25,7
dure, coment, etc), STRATIGRAPHIC NAME	THE	Sa	102 S 10 E 5		(CR SOIL (consistency, con	mpactness, water content,	DAT	RO		0-100	
Brown, Sandy GRAVEL [FILL]	TITIT			TTT	Loose, Sandy	Gravel.		Π	17ale	Π	
are brown, sitty sandy GRAVEL [FIL]			0.2 0. ×		Loose SHy,	sandy Gravel.	_				
rown, silty sandy GRADEL		DB			Gravel.	use, silty sandy					
[Probably FILL]			0,								54455
			- 0 ·								N=18
			· ·								
		-	10 0 4								
			1.2 × 0								535710
TOPSOIL]			1.3 × ×		Medium dense	se, sitty fine Sand.	byed				N=26
Brown, silly sandy GRAVEL. [HOLOCENE DEPOSITS]		A A	1.5 × a			, J					
own, sitty sandy GRAVEL			000		hedium de	use, silly, sandy					
[HOLOCENE DEPOSITS]		DB	- 0								
ark brown mottled brown, gravely			119 0'X		mediumden	se, fine gravelly, si	144				
עמאל ביי			× 0		fine sand	(Possibly HSL))		<u>_</u>		
ark brown nottled brown, sitty sandy			2.25 0 ×		Madium den	se silly soudy GRAU	EL				32355 N=15
RAVEL		*									
he /grey, silly sandy GRAVEL .			4's		Medium de	use, silly sandy					
		DB	0 * .		GLEVEL.						
			× 0								
rown mottled derk brown, silty sandy			3.0 0.0		Medium der	se, silly sandy					43444
SRAVEL.					Gravel.				ç		N=15
		+	0 × 0								
			0.×								
		DB									
			× 0								
End of borchole at 4. Om depth.		T	4.0								
											T 5 7 8 8 N= 2 8
5. E											
*					1						
			ind in the second se								
			1111								
ROCK WEATHERING				┟┻┸	FRACTURE 10	DG LOCAED	M Flo.	L	1		FCI 5<9796.
A Griffiths MW - Unweathered MW - Sightly weathered MW - Moderately weathered	MI -	Llard Modern Modern	itely hard stely soft	100	-1-1-1111-1-1-1 -1-1-1111-1-1-1	Spacing of natural fractures DATE25	18/0		7	HOLE	NO BHAID
STARTED: 11W - Highly weathered CW - Completely weathered	vs -	Sull Very se		<u> </u>	6 % 65 1	Fractures/m TRACED:	M.Ele:	min	<u>دا</u>	I.ENG	111. 4.0m
INISHED: EXPLANATION Borehole T; denotes standard Pe	netratio	ey G	st	UZ) L	-d.	CHECKED					
DRILL: DB: denotes Dry barra	I drilling	2								OP	US .
2ry.Barrel		-				SUEET 1	OF		-	AL CON	SULTANTS

NZGD 1D: BH_106127	· ·	HOLE BH HIH
PROJECT Inner City Bapass	LOG OF DRILL HOLE	NO. CHAN
GRID REF.	CO-ORD 70043548MN 29956595ME DATUM M	SL.
DESCRIPTION OF CORE		WATER DRILL STANDARD
WEATHERING, HARDNESS, STRENGTH, COLOUR, ROCK OR SUIL TYPE, DEFECT SPACING,	LINT & LOSS/IIAD O LOG CONTROL AND CONTROL OF CONTROL O	OL- U- U- U- U- U- U- U- U- U- U
1 III IOLOGICAL FEATURES fligtding, lobation, mineralogy,	x I E I I I I I I I I I I I I I I I I I	
Brown, silty sandy GRAVEL	I I I I I I I I I I I I I I I I I I I	
[FILL]	0000 mm	
Red and brown, sandy silt with building		en 2.1.1.1.9
debris.	B. bricks and building debris	N= 5
L		
	B .	
Brown, sandy SILT	Loose, sanchy silt with so	ne
[FILL]		N=6
n eilt coour		
(HOLOCENE DEPOSITS)	10 - X O	
Brown, silty, sandy GRAVEL	DB 2.2 = 0x Dense, silty fine sandy Gra	
[HOLOCENE DEPOSITS]	-00	
		11 8 7 8 9 N= 32
	Y 0 0	
	3.0	
	DB	
	× 0	
		127.0.1.0
()		N=35
	NR XO	
LI.		
End of Borchole at 45m depth.		
		12 8 7 10 10 N=35
(
ROCK WEATHERING	ROCK HARDNESS FRACTURE LOG	D. M. Fleming PHOIECI: 502796.03
M Griffiths.	Constraint Constraint 11 - Hard 111 - Hard </td <td>HOLE NO BHAILE</td>	HOLE NO BHAILE
STARTED: 6-9-01 EXPLANATION Boreh	vs-son l- a 28 221 Machinesin IRACEN ole drilling by Griffiths Drilling (UZ) Ltd. CIIECK	ED:
DB: Dry Barrel, 6-9-01 T. standard Penetr	ation Test.	OPUS
DRILL: Dry Barred	SHEET	

DID: BH_106128								-									10
					0-	DDU	15	~	-			•	HOL	E	зн н	+15	
PROJECT Inner City Bypass			LC)G (OF-	DRIL	L HI	OL	E L	OCATION	Wellingtor	L		<u>, </u>			
GRID REF.	2	C	00	RD. 3	700	42.8.1	7 MA	1 2	-9.9	577.00	ME DI	TUM MS.					
ANGLE FROM HORIZONTAL	1 (1	 T	DIR	ECTI	NOI	Vertic	a(H.A	A.D. GROU	ND	58		. H.A	ND.	COL	LAR
DESCRIPTION OF CORE	ERINE	3	X Solution	ype	LOS	E DLPIII S7 ITA D	DG	11140	CIUN OG	PROMINENT	JEFECTS JOINTS, BEDDING	, SEAMS, VEIN	5	LEV	TEI I /EL /	VATEN	STANDARD
ROCK OR SOIL TYPE, DEFECT SPACING,	RO		AZDA	ple	1 IFT "7.,	Side Co	¥	(Spur	cing a	I IATION SCH	STOSITY lando,	width, spacing,	E Bag		- 1	.OSS	TEST (SPT)
HIHOLOGICAL FEATURES (bedding, lokation, mineralog)	y. 5 333	3	ΙŊ	Sam		Core	RAPH	haci	hires) cine	OR SO	IL DESCRIP	TION)	ATEN	L C D			150,75,75,75,7
INTOIR COMMAN, CIC), STRATIGICALLIC HAME	6≥1		IZZU	<u>""</u>	11 11	S mi	0	10 10	2.0	(consistency (roup symb	, compactness, we iol etc.)	aler content,		Dat	e1 (0-100	
Dark grey, SILT/SAND and building debris.							×□			Loose, Si	ilf/sand and	building					
[FILL]	12						Г х.										··· ··· ··· ···
				₽B			0										
Concrete				T	+11	0.5	× * *				Concrete						
Brown, sitty sandy GRAVEL [FILL]]					0.5	0. x			mediuma	mec, sitty si	andy Gravel					N=14
Gray Silty gravelly SAUD LFILL	-					0.8	· • · .			Meoliumole	ense, sitty gr	welly fine sa	<u>त</u> .				
Brown, silty sandy GRAVEL				1		1.0	.0			Loose, s	silty sanoly	Grajel,					
HOLOCENE DEPOSITS							00						11				
				DB		- The second sec	o ×										
						1	00										
				T	-		0.0										
×							0.0										42112
							0.0										N= 6
Brown, silty SAND [HOLOCENE DEPOSIT	5			+		1.9	×			Loose, si	Ity sand.						
Dark brown notfled lightbrown, silty						2.0-	0 :			Loose to	o medium a	danse,	11				
SANAY OFAVEL				DB			×°			silty ser	ndy Gravel	t					
HOLDCENE DEHOSITS							0 · ×										
					-111		0										
						5	<u></u>										1112
						T -	O ×										v≈s
-				*		1	:0								-		
						0.0	00										
<u>.</u>				DB		-	٥`٥								6		
						-	× 0						11				
				T	-		0.0										
						0 51	×o										23445
						-	0.	2								111	N= 16
				Ý		4-0-	0										
Сь.							0.										
				₽B		-	0,0										
						-	0.0	"									
					-111	L	, . , .										
						5	00	2									65569
						1	00	×									
				*		5.0-	0 × 0										
							00										
				DB		Stangeller.	00	2									
							0.										
End of Borehole at 5.5m depth.		T											-11				
							, IIII										
						- 11	-							li			
	ЩĻ	1	IIII,					4							Ц		
DRILLER: UW - Unweathered	•	ľ.	VI1 - 11 -	· Very) · [tard	nard	NE55			8 0	FRACTURE (cms)	LOG Spacing of	LOGGED	Flee	ning.		PRO	ECI. 522796 .
M. Graffithe MW - Moderately weathered STARTED: HW - Highly weathered			MI - MS - S -	- Mode - Mode - Suft	ratuly 1 ratuly	had				เ-เ-เ-โทปุ๊เ+ริ	d fractures	DATE.	Fle	 		non	110 BH 415
8-9-01 CW - Completely weathered EXPLANATION Bore h	ale d	rill	VS-	y Gr	sull 144, 4	Ls Deill	ny (NZ)) Lito	- (1 4.	0 8 0	e ol cure	CHECKED:				1.ENG	011E
PINISTIEU: DB: Dry barrel drilling	7			-			7								6	-	na
DRILL; T: Standard Renetration	m Tes	51.	-												-		
DID BH 106128												SHEET J	OF.1.	D	RGN	0.8H	H(5

ZGD ID: BH_106130					8
		HOLE NO.	BH	1417-	
PROJECT	CO-ORD 709463 86mN 299537 76 ME DATING A				
ANGLE FROM HORIZONTAL	DIRECTION Vertical HAD GROUND 22.68	» 	H.A.D	. COL	LAR
DESCRIPTION OF CORE WEATHERING, HARDNESS, STRENGTH, COLOUR, INOCK OR SOIL TYPE, DEFECT SPACING. THEOLOGICAL FEATURES (bedding, bubbion, numeralogy, harbure, coment, etc), STRATIGRAPHIC NAME	March CORL DLPTI Display VIA OCK DEFECTS VIA OCK <t< td=""><td>ج 5 DATE/DEPTH ROD. %</td><td>WATER</td><td>DRILL WATER 1.055 "/" -</td><td>STANDARD PENETRATION IEST (SP1) ISO,75,75,75,75,</td></t<>	ج 5 DATE/DEPTH ROD. %	WATER	DRILL WATER 1.055 "/" -	STANDARD PENETRATION IEST (SP1) ISO,75,75,75,75,
Brown, silty sandy GRAVEL	Do s Loose to medium dense, sitt		Date	$\parallel \parallel \parallel$	
[FILL]	DB 				ν <u>λ</u> <u>ν</u> - μ
Brown mottled dark brown, sitty sandy GRAVEL [HOLOCENE DERSITS]	DB Contractions dense to dense, silt DB DB DB DB DB DB DB DB DB DB	5			5;4:4:5 4 ν= 17
Brown mottled light grey and orange sifty, gravelly sand. [HOLOCENE DEPOSITS] Brown, silty Sandy GRAUEL [HOLOCENE DEPOSITS] Brown mottled grey, silty sandy GRAVEL. [HOLOCENE DEPOSITS]	Dense, silty fine gravelly fine 2.8 - 2.0 2.8 - 2.0 2.9 - 2.0 2.0 2.0 2.0 2.0 2.0 2.0 2.0		· · ·		1 8 7 8 ю м=33 I ³ Ю:10 II 12 N=43
End of borehole at 4.5m depth.	4.0 - 0 × 0 ×				
DRILLER: M C- MM SW - Slightly weathered	ROCK HARONESS VII - Vary bind Lins) Spacing of LOGGED.	M. Elsm	ling	. PROJE	CI. Sc. 2796. 0.3
STARTED: WW - Middeately weathered IIW - Ilighty weathered CW - Completely weathered	MS - Model and both S - Solt VS - Very solt	- 1-91. A Flemi	ing	LENG	110 BH 417
EXPLANATION Borehole (FINISHED: 20-9-01 DRILL: Dry Barrel IZGD'ID: BH 106130	drilled by Griffiths Drilling (UZ) Ltd CHECKED: Test				



BOREHOLE LOG

BOREHOLE No: 1 Hole Location: Grass verge adjacent to Brooklyn Rd

SHEET 1 OF 2



NZGD ID: BH 144269



BOREHOLE LOG

BOREHOLE No: 1 Hole Location: Grass verge adjacent to Brooklyn Rd

SHEET 2 OF 2

CO-ORDINTES INC DRLL TYPE: HOLE STATED: 1/2008 RL, m Reference in photograph DRLL METHOD: Weads/SPTH/O Corr DRLL DE NY: GRIPTING DATUM on page 2 of BH3 DRLL METHOD: Weads/SPTH/O Corr DRLL DE NY: GRIPTING DRLL DE NY: GRIPTING GEOLOGICAL EXCINEEEING DESCRIPTION EXCINEEEING DESCRIPTION Excine the main Excine the main GEOLOGICAL EXCINEEING DESCRIPTION Excine the main Excine the main Excine the main GEOLOGICAL Excine the main Excine the main Excine the main Excine the main GRUMARES CONCORDER Excine the main Excine the main Excine the main Excine the main GRUMARES CONCORDER Excine the main Excine the main Excine the main Excine the main GRUMARES CONCORDER Excine the main Excine the main Excine the main Excine the main GRUMARES CONCORDER Excine the main Excine the main Excine the main Excine the main GRUMARES CONCORDER Excine the main Excine the main Excine the main Excine the main GRUMARES CONCORDER Excine the main Excine the main Excine the main Excine the main GRUMARES CONCORDER Excine the main Excine the main Excine the main	PROJECT: WCC Cent	ral F	Park	Fla	ts						LOC	ATIO	N: Broo	oklyn F	Road					JOB No: 84427.001
Image: 1 / The Sector our photograph DRLL MUE HOD: Wash/SPTH/O C/mp HOLE FINISHE: 27208 DATUM migrap: 2 of BH3 DRLL MUB Benchnick & CA657 LOGGED BY: SBS CHECKED: TRU GECLORGAL Terming graph Grap	CO-ORDINATES m				DRILL TYPE:									HOLE STARTED: 1/12/08						
The montpage 2 of BH3 DRLL PLUD: Bentonic & CR850 DALLE DP : Setting 0 CHCACED : TRJ GEOLOGICAL EXAMPLE TRUE EXAMPL		ت ا	Refe	er to	o air	. phc	otograph				DRIL	L ME	THOD	: Was	sh/Sf	PT/H	Q Coi	re _		LE FINISHED: 2/12/08
Chromosofie Constraint Constr		(on p	oage	e 2 c	of Bl	H3				וופח		ın. I	Benton	ite 8	& CR	.650	L I	JNI NU	
BEDOCH UM. OPERATION BEDOCH UM. (STRUE STRUE STRUE <thstrue< th=""> STRUE</thstrue<>	GEOLOGICAL												טוע.			ENG	GINE	ERI	NG	DESCRIPTION
Greyvnade Bedrock Image: Structure Status and S	GEOLOGICAL UNIT, GENERIC NAME, ORIGIN, MINERAL COMPOSITION.	FLUID LOSS	WATER	CORE RECOVERY (%)	МЕТНОD	CASING	TESTS	SAMPLES	R.L. (m)	DEPTH (m)	GRAPHIC LOG	CLASSIFICATION SYMBOL		STRENGTH/DENSITY CLASSIFICATION	25 25 50 25 25 25 25 25 25 25 25 25 25 25 25 25	100 (KPa) 200 COMPRESSIVE	20 STRENGTH 50 (MPa) 250 (MPa)	250 DEFECT SPACING	- 1000 - 2000 (mm)	SOIL DESCRIPTION Soil type, minor components, plasticity or particle size, colour. ROCK DESCRIPTION Substance: Rock type, particle size, colour, minor components. Defects: Type, indination, thickness, roughness, filling.
Image:	Greywacke Bedrock			100	HQ Core	Uncased				11		1	HW-MV HW	7						SANDSTONE, Same as previous with relic structures. Med. sandy silt, green grey, occasional clay veins. J@10.5m, 87, Pl, Sm, T, CV & FeSt. SANDSTONE, dark orange brown to yellow brown. HW-MW, weak (weaker towards base), Jointed (dark stained defect surfaces) highly fractured. J@11m, 46, Pl, Sm, T, FeSt. J@11.1m, 45, Pl, Sm, T, FeSt. J@12m, 90, Pl, Sm, T, FeSt. J@12m, 90, Pl, Sm, T, FeSt. HW-MW, weak, joints Fe stained, minor clay veneer (low plasticity), highly fractured
Image:		-								13-			HW							towards base. J 52 & 88.
																				locatore terminated at 12.32m (Target depth). 14- 15- 16- 16- 18- 18- 19- 19-

NZGD ID: BH_144269



BOREHOLE LOG

BOREHOLE No: 2 Hole Location: Carpark adjacent to block V

SHEET 1 OF 2

PROJECT: WCC C	entra	al P	ark	Fla	ts						LOC	ATIO	N: Nari	rin St	Carpa	ark					JOB No: 84427.001						
CO-ORDINATES	m١	N.									DRII	L TY	PE:						Н	101	LE STARTED: 2/12/08						
	mE	=	Re	efer	to a	ir pl	notograph				DRII	_L ME	THOD	: Wa	sh/SF	PT/H	HQ C	Core	, H		LE FINISHED: 3/12/08						
	m		on	n pa	ge 2	of	BH3				ווסח		חוו 🖯	Bento	nite 8	èС	R65	0		RI	LLED BY: Griffiths						
GEOLOGICAL													JD			EN	IGIN	IEE		VG	DESCRIPTION						
GEOLOGICAL UNIT,													ŰZ		Ŧ	Т			c)		SOIL DESCRIPTION						
GENERIC NAME,				(9								MBOL	THER		ENGT		SSIVE	-	ACIN	_	Soil type, minor components, plasticity or particle size, colour.						
MINERAL COMPOSITION.				ERY (9			TESTS					YS NC	WEA'	UNSIT: NO	R STF		APRE IRENC	MLN)	CTSF	mm)	ROCK DESCRIPTION						
		SS		COVI				0		Ê	DOL COG	ICATIO	No ≝	TH/DE	SHEA		ο Ο Ο		DEFE		Substance: Rock type, particle size, colour,						
		I DT OT OT	TER	RE RI	THOD	SING		MPLE	(E)	PTH (i	APHIC	ASSIF	ISTUR	RENG			_			38	Defects: Type, indination, thickness,						
E:11		E	Ň	8	M	Š		SAI	R.L	DE	GR	C	N O	STI CL	2883	₽ã 	- 1 1 1 1 1 1 1	52(s¤≊	500							
1,111										_		GP	M								GRAVEL, basecoarse, angular sandstone						
																					gravels.						
										_											med. sand, dark grey brown. Gravel is						
				0	Vac			$\left \right $		1-											angular, med. pebble-cobble (up to 0.25m),						
					Jet					_											consist of low plasticity silty clay with trace						
										_											fine-med. sand.						
										_																	
										2_	X	,															
L																											
Alluvium										_		ML		S							Clayey SILT with traces of coarse sand and organics, light brown orange, Soft, Moist,						
				6	ΡT		2//1/1/2/1			_											low plasticity, sub-angular sand, occasional						
			008		S		N=5			2 -											fine gravel.						
			12/2							3											3-						
			3/							_																	
			=	~	F	1	מבירו בירו בי			-											Some as previous but more yellow in colour						
				6	SF		N=9																				
										4											4-						
										_																	
					н	1	2,112,12,12,15			-											Same as previous but with lenses of light						
				6	SP		3//3/3/3/3/ N=14			_											green grey low plasticity fine sandy clay.						
						Ised				5											5-						
						Unce				_																	
					н	ſ				_											As above, mottled with some Fe staining,						
				6	SP		3//3/5/5/4 N=17			-											occasional brown silt (ML) lenses.						
										6-											6						
										_																	
					L					_											As above with a trace of green grey low						
				6	SP		4//4/4/5/7 N=20			-											plasticity fine sandy clay lenses.						
						1				7-											7-						
Residual Soil										=																	
				-						-				F							As above with some relic structures.						
				89	SPT		8//4/6/7/8 N=25			_											-						
							11-25			8_											8-						
										=											1						
					-					-								$\left \right \right $			As above with some dark staing along relic						
				78	SPT		9//7/7/8/11 N= 22			_								$\left \right \right $			surfaces.						
				-	-		IN=33			9—											9-						
Greywacke Sandsto	ne -									_		Rock	CW	VD							SANDSTONE light orange brown CW						
				<u> </u>			4//11/13/16/1	0 (4	5mm)	_								$\left \right \right $			Fine sandy silt, some gravel lenses, relic						
				79	SPT		N>50			_								$\left \right \right $			structures with dark surface staining.						
Log Scale 1:50										10 -	::::										BORFLOG BOREHOLE 2 LOG GPL 16/1/09						

NZGD ID: BH_144270



BOREHOLE LOG

BOREHOLE No: 2 Hole Location: Carpark adjacent to block V

SHEET 2 OF 2

PROJECT: WCC Centr	al F	Park	Fla	ts			LOCATION: Narrin St Carpark											JOB No: 84427.001							
CO-ORDINATES ml	N					DRILL TYPE:											HOLE STARTED: 2/12/08								
ml	E		Re	fer	to ai	ir photograph	l			וופח			· Wae	h/SI		но и	Con	۲	ю	LE FINISHED: 3/12/08					
R.L. m			or	n pa	ge 2	of BH3												DRILLED BY: Griffiths							
										DRIL	L FL	JID:	Bento	onite	e &	CRE	550		-00	GGED BY: SBS CHECKED: TRJJ					
GEOLOGICAL		<u> </u>		<u> </u>				1								VGIN	VEE T	RI	NG	DESCRIPTION					
GEOLOGICAL UNIT, GENERIC NAME.											Ъ.	RING		GTH		₩		SING		SOIL DESCRIPTION					
ORIGIN,			(%)								SYMB	ATHE	Ł	TREN	a)	NGTH	Pa)	SPAC	(Line)	particle size, colour.					
MINERAL COMPOSITION.			/ERY			TESTS				U	NOL	ME	ION	AR S	ž –	STRE	Σ	ECT	E	ROCK DESCRIPTION					
	oss		ECO				S		Ē	IC LO	FICAT	IN	STH/E FICAT	SHE		8		DEF		Substance: Rock type, particle size, colour, minor components.					
	np L	VTER	RER	THO	SING		MPLE	Ű.	PTH	APH	ASSII	NDITU NDIT	RENG						88	Defects: Type, indination, thickness, roughness, filling					
	1	Š	8	ME	ð		SAI	R.L	DE		G	v S S	STI CL	2339	1898 1898	88a-	22(10)	52 72 10	₽ã H						
									_			Cw								fractures, J@10.4m, 45, Pl, Sm, T, FeSt.					
									_											J@10.5m, 90, Pl, Sm, T, FeSt.					
				e					-											-					
			8	Co					-	::::															
Greywacke Sandstone			[-	HQH	ed				11-											11-					
					ncas				_																
					5				_			сw-ну	7							Same as previous but less weathered.					
									-			CW								Fine SANDSTONE, light orange brown,					
									12-	-										highly fractured.					
									12 -											Borehole terminated at 11.8m (target depth					
									_																
									_											-					
									-											-					
									13-											13-					
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मू									20 -																
Log Scale 1:50	-	-																		BORFLOG BORFHOLE 2 LOG GPL 16/1/09					

NZGD ID: BH_144270

BORELOG BOREHOLE 2 LOG.GPJ 16/1/09



BOREHOLE LOG

BOREHOLE No: 3 Hole Location: Adjacent to Narrin St

SHEET 1 OF 2

PROJECT: WCC C	entra	al P	ark	Flat	ts						LOC	ATIO	N: Entr	ance (o	of Na	arrir	n St)			JOB No: 84427.001						
CO-ORDINATES	m١	1									DRIL	L TYI	PE:						нс	DLE STARTED: 3/12/08						
	mE	-	R	Refe	r to	air	photograph o	on pa	age 2		DRIL	L ME	THOD	: Wasł	ח/SP	PT/H	HQ Co	ore	HC	DLE FINISHED: 3/12/08						
	m										ווחח			ontoni	ito 8		Deen									
GEOLOGICAL													ם, טו	entoni	le o		IGINE	FF		G DESCRIPTION						
GEOLOGICAL UNIT.													ŋ		т.	Ť		T								
GENERIC NAME,												MBOL	HERIP		ENGTI		SIVE	100	ACING	Soil type, minor components, plasticity or						
ORIGIN, MINERAL COMPOSITION.				RY (%								N SYN	VEAT	\SITY N	(kPa)	(M d)	PRES (MPa)		(mm)							
		ss		COVE			TESTS			÷	LOG	CATIO		H/DEI	HEAF		ST			Substance: Rock type, particle size, colour,						
		DLO	Ë	če re	DOH.	DN D		PLES	(E)	TH (r	PHIC	SSIFIC	STUR IDITIC	SSIFIC	0)					minor components. Defects: Type, inclination, thickness,						
		FLU	WA	COF	MET	CAS		SAM	R.L.	DEP	GR/	CLA	MOI	STR CLA	2885	28 - 82	2022	202	3368	roughness, fi l ing.						
Fill										_	• • •	GP	М	L-MD						ASPHALT 7						
										-	\mathcal{N}	GC								(50mm)						
					/ac					-										Clayey GRAVEL with some silt, brown						
				0	Jet-V			\square		-										is angular to sub-angular, cobble to pebble,						
										1										SW-MW sandstone. Matrix is silty clay						
										-																
Alluvium						1				-		CL		s						Clayey SILT, bright brown orange with						
				71	SP7		1//1/1/2/2 N=6			_										plasticity, trace amounts of med. to fine						
						1	14 0			2_										sand. 2						
										_										=						
						-				_										Same as previous wth brown silty lenses						
				78	SPT		2//1/2/2/3			-										low plasticity.						
							N=8			3-										3-						
										-																
			~							_																
			200	91	Γ		2//1/1/2/2			_										occasional dark silt mottling, trace of fine						
			8/12/		s		N=6			4										sub-rounded gravel, some organic matter. 4						
			Õ							Ľ.																
			=							-										-						
				0	Ţ		בורובורוור			-										Same as previous with low plasticity.						
				Ĕ	SI		N=10													=						
						Ised				5										5-						
						Unce				-																
					Г	1				-										As above, moderate plasticity.						
				10	SP		3//3/3/3/5 N=14			-																
						1				6-										6						
Residual Soil										_										-						
										-		ML		F						Gravelly sandy SILT, light yellow brown						
				89	TAS		5//5/6/7/10			-										with dark brown staining on relic structures.						
						1	N=20			7-										fine, angular geywacke sandstone, low 7–						
										-										plasticity silt. CW sandstone.						
										-										-						
				100	SPT		4//3/5/5/7			-										clay seam.						
					•		N=20			8-										8-						
										_										-						
										-]															
				8	ЪТ		8//6/7/7/9			_										Sandy SILT with traces of clay, light yellow – brown with dark brown staining on relic						
					S		N=29]									structures. Firm, moist, lenses of yellow grey						
										-										gravel fine, angular geywacke sandstone,						
										_	1									low plasticity silt. CW sandstone.						
				~	F	1	0//0/0/10/15			-]			St						Same as previous						
				6	SF		N=41			10 -																
Log Scale 1:50			<u> </u>	·		1			I	10							9111		11	BORELOG BOREHOLE 3 LOG GPL 16/1/09						

NZGD ID: BH_144271



BOREHOLE LOG

BOREHOLE No: 3 Hole Location: Adjacent to Narrin St

SHEET 2 OF 2

PROJECT: WCC Centra	al P	Park	(Fla	ats						LOC	CATIO	N: Entr	ance	(of	Narr	in St)				JOB No: 84427.001	
CO-ORDINATES m	N									DRI	LL TYI	PE:						Н	0	LE STARTED: 3/12/08	
mE	=	I	Ref	er to	air	photograph b	oelov	w		DRI	LL ME	THOD	: Wa	sh/	SPT	HQ C	Core	Н	0	LE FINISHED: 3/12/08	
R.L. m										וחח											
												ם: חונ	entor	me	F	NGIN				DESCRIPTION	
GEOLOGICAL UNIT,			Τ									Ű		Γ ₁	Ī		T	'n		SOIL DESCRIPTION	
GENERIC NAME,											MBOL	HERIN		ENGT		SIVE		ACING		Soil type, minor components, plasticity or particle size, colour	
ORIGIN, MINERAL COMPOSITION.			RY (%			TEOTO					N SYI	WEAT	VSIT Y	R STRI	(kPa)	RENG	(MPa	LISH	(mm)		
	ss		COVE			TESTS			Ê	LOG	CATIC		H/DEI	HEAF		CON ST				Substance: Rock type, particle size, colour,	
		TER	RE RE	THOD	SING		APLES	(E	PTH (n	APHIC	SSIFI	ISTUR VDITIO	RENG	Ĩ				0		Defects: Type, indination, thickness,	
	E	MA	Ö	ME	CAS		SAN	R.L.	DEF		5 C	COI MOI	STF	\$9	38688 H H ₽	-200 1111111	550	982 HH	- 200		
Greywacke Sandstone			8	Cor					_		Rock	RW								yellow brown. CW, fine sandy silt with	
Grey waeke Sanastone				ΗĞ					-											some clay, trace angular gravel, relic	
				>			Ň		_		_	RW-CW	ł							J@10.2m, 97, Pl, Sm, T, FeSt.	
																				Lost Core	
				Ore	cased				-											T, FeSt.	
			12	Ϊĝ	Unc				_												
				Ц					-												
				>			0		-	::::		RW-CW	ł							Lost Core	
									_			CW-HW	,							Same as previous but darker.	
			8	Core					-											Pl, Sm, T, FeSt. J@13m, 48, Pl, Sm, T,	
			-	Ηğ					-											FeSt.	
																				13-	
			+		\vdash				_					╫							
									-											-	
									-												
									14-											Borehole terminated at 13.3m (Target depth ^{14–}	
									-											reached), hole finished as piezometer.	
												_		Ш					Ш		
COLOR T	4	20			T			56		1		27	-		1	3			-		
		R	4	1			2	2	1				2	H	7				- 11-	15-	
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J + N SPILE		-	1							and in the				-	F		5		Y		
	Y		-	-	-0			-	100	-	-	1	E.M.	2			5		5		
				1			No.	X				al.	-		ł	Y	1		-		
Log Scale 1:50	-																			BORELOG BOREHOLE 3 LOG.GPJ 16/1/09	

NZGD ID: BH_144271

BORELOG BOREHOLE 3 LOG.GPJ 16/1/09

				GEO	L	.00	G O	F	B	OR	ING I	BH	01		
	Ge	eot 27 M	echi 7 Th t Co 195	nical Investigation ompson Street ok, Wellington 520.000.000 N/A	Client: Stratum Management Ltd. Core Diameter: 83 mm Date: 04/11/2021 Energy Transfer Ratio: 89.9 % Hole Depth: 9.65 m Logged By/Reviewed By: CW / CC Drilling Method: HQ Coring Latitude: -41.2984' Drilling Contractor: Griffiths Drilling Longitude: 174.7715										
Depth (m BGL	Material	Sample Type	USCS Symbol	DESCRIPTI	ИС	Log Symbol	Elevation (mRL)	Water Level	Moisture	Consistency/ Density Index	SPT N-Value	Torvane Shear (kPa)	Total Core Recovery (%)	Notes	
	RESIDUAL SOIL	NR	AB ML ML	ASPHALT Hydro excavation: [BASE CO, coarse GRAVEL with minor sa graded; angular to subangular sand is fine to coarse. Hydro excavation: SILT with n brown. Low plasticity; sand is coarse. Hydro excavation: SILT; orang	ARSE] Fine to and; grey. Well r, greywacke; ninor sand; medium to ge. Low plasticity.										
			ML	Completely weathered rock re with trace sand and trace grav brown. Low plasticity; sand is gravel is fine to coarse, angul greywacke. Completely weathered rock re with some sand; reddish brow sand is fine to medium.	covered as: SILT rel; reddish fine to coarse; ar to subangular, covered as: SILT n. Low plasticity;		-42	Ţ		Very soft	1/0//0/1/0/0 N=1				
- 2.5 - - - - -	STONE			 2.4 m - Contains trace gravel, subangular, greywacke. 2.6 m - Gravel is lost; colour b brown with brown mottles. 2.7 m - Sand fraction become 	angular to becomes reddish s minor.					_					
3.5 -	aia Terrane SANDS		ML	Completely weathered rock re with minor sand and trace gra with grey mottles. Low plastic medium; gravel is fine to med subangular, greywacke.	covered as: SILT vel; yellow brown ty; sand is fine to ium, angular to covered as: SILT					Firm	1/0//2/1/2/2 N=7				
 4.0 	Rak			with minor sand and trace gra with black veins. Low plasticit medium; gravel is fine to med subangular, greywacke.	vel; light brown y, sand is fine to ium, angular to		40			-					
4.5 -			ML	Core loss. Completely weathered rock re with minor sand; light brown w Low plasticity, sand is fine to p	covered as: SILT /ith black veins. medium.	HELEVER Z				Stiff	1/1//3/2/3/2 N=10				
Borel 32 m	nole m pi	me ezc	et targ	et depth at 9.65 m. r installed. Ground water dippe	d at 1.82 m on 18	/11/20:		d 1.9)2 m	on 25	/11/2021.				
			Λ	GEO	L	.00	6 O	F	B	OR	ING I	BH	01		
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	Geotechnical Investigation 27 Thompson Street Mt Cook, Wellington 19520.000.000 N/A			Cli D Hole De Drilling Mett Drilling Contrac	Client : Stratum Management Ltd. Core Diameter : 83 mmDate : 04/11/2021Energy Transfer Ratio : 89.9 %Hole Depth : 9.65 mLogged By/Reviewed By : CW / CCDrilling Method : HQ CoringLatitude : -41.298417Drilling Contractor : Griffiths DrillingLongitude : 174.77153) 117 53				
Depth (m BGL)	Material	Sample Type	USCS Symbol	DESCRIPTI	NC	Log Symbol	Elevation (mRL)	Water Level	Moisture	Consistency/ Density Index	SPT N-Value	Torvane Shear (kPa)	Total Core Recovery (%)	Notes	
	Rakaia Terrane SANDSTONE	C.a	ML ML ML	Completely weathered rock rewith trace sand and trace gravel is fine to medium, angusubangular, greywacke. Completely weathered rock rewith minor sand; light brown weathered rock rewith minor sand; light brown weathered rock rewith some sand and trace grawith black veins. Low plasticity medium; gravel is fine to med subangular, greywacke.	covered as: SILT vel; reddish fine to coarse; ilar to covered as: SILT vith black veins. medium. es some. covered as: SILT vel; light brown y, sand is fine to ium, angular to covered as: light brown with nd is fine to to subangular. black and grey VE; very weak.			M N	W	Very stiff	2/2//3/4/5/6 N=18 5/8//9/9/10/12 N=50+ for 25mm	To (Kf			
			ML -	Completely weathered rock re Sandy SILT; light brown. Low fine to medium. Highly weathered, brown with veins, greywacke SANDSTON End of Hole Depth: 9.65 m Termination: Target depth	covered as: plasticity; sand is black and grey IE; very weak.		- - - - - - - -			-					
Borel 32 m	nole m pi	me	et targ	jet depth at 9.65 m. er installed. Ground water dippe	d at 1.82 m on 18	/11/202	21 and	11.9	02 m	on 25	/11/2021.				

		=	VGEO	LO	GΟ	F١	NI	NI	DOV	V SAI	MPLE WS01
	Geotechnical Investigation 6 Maarama Crescent Te Aro, Wellington 17188.000.000			Client : T Irrcher & C Tremblay Shear Vane No : 2036 Client Ref. :- Logged By : CC Date : 01/05/2020 Reviewed By : CM Hole Depth : 3.7 m Latitude : -41.296766 Hole Diameter : 80 mm Longitude : 174.768545							ane No : 2036 ged By : CC wed By : CM atitude : -41.296766 ngitude : 174.768545
Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	CRIPTION			Water Level	Moisture Cond.	Consistency/ Density Index	Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Penetrometer Blows per 100mm 2 4 6 8 10 12
		ML	Sandy SILT with trace gravel; brow plasticity; sand is fine to coarse; gr medium, angular to subangular. Co rootlets, brick and porcelain. 0.45 m - sand content decreases to	<i>n</i> . Low avel is fine to ontains o minor.				D	Soft Stiff to Very Stiff Soft Firm to Stiff		
- - 1.0		SW	Fine to coarse SAND with minor silt and trace gravel; dark grey. Well graded; gravel is fine to medium, angular. Contains brick and mortar. Sandy SILT with trace gravel; brown. Low plasticity: sand is fine to coarse: gravel is fine to					1	Medium Dense	_	
- - 1.5 - - -	L SOIL	ML	medium, angular to subangular. Co rootlets, brick and porcelain. SILT with minor sand; light brown. sand is fine. 1.5 m - sand content increases to	ontains Low plasticity; some.					Firm to Stiff Stiff to Very Stiff	f	
2.0	RESIDUA	ML	Sandy SILT; light brown mottled wiplasticity.	hite. Low				М	Very Stiff to Hard	217+	
	GW	ML	SILT; light brown mottled orange a plasticity; sand is fine to coarse. Co rock fabric.	red as sandy nd white. Low ontains parent					Hard		
2.601 6/5/20	RN		No recovery.	red as sandy	NR				-		
ATA TEMPLAIE	9 ND	ML	SILT; light brown mottled orange a plasticity; sand is fine to coarse. Co rock fabric. End of Hole Depth: 3.7 m	nd white. Low ontains parent							
4.0			Termination Condition: Practical re	rusai							
- 4.5 - 4.5											
GEOTECH HAND Sc Sta GFOTECH HAND GFOTECH HAND	Window sampler met practical refusal at 3.7 m depth on inferred bedrock. Scala Penetrometer met target depth at 2.9 m. Standing groundwater was not encountered. GW = RAKAIA TERRANE GREYWACKE, NR = NO RECOVERY										

			VGEO	LO	G C)F	W	IN	DO	N SA	MPL	ΕV	NS	02
	Geotechnical Investigation 6 Maarama Crescent Te Aro, Wellington 17188.000.000			Client : T Irrcher & C Tremblay Client Ref. : - Date : 01/05/2020 Hole Depth : 5 m Hole Diameter : 80 mm					Shear Vane No : 2036 Logged By : CC Reviewed By : CM Latitude : -41.296698 Longitude : 174.768582					
h (m BGL)	(Jager) (Ja		nic Symbol tion (mRL)		ture Cond.	istency/ ity Index	iear Vane ained Shear angth (kPa) v/Remolded	Sca	Scala Penetrometer		eter			
Dept	Mate	USC:			Grapl	Eleva	Wate	Moist	Cons Dens	Streek	2 4	ws pei 6	r 100m 8 1	nm 0 12
-		ML	SILT with some sand; dark brown. sand is fine to medium; gravel is fi subangular.	Low plasticity; ne, angular to					Soft					
0.5 -				X					Stiff Hard	-				
-			Sandy SILT; light brown mottled or	ange and										>>
1.0			white. Low plasticity; sand is fine to	o medium.						127/12				
- - - 1.5 - -	RESIDUAL SOIL	ML							Stiff					
-		N/I	SILT with trace sand; light brown r Low plasticity; sand is fine.	nottled brown.										
2.0	2.0 No recovery.								217+					
-			Clayey SILT; light brown mottled o	range.				м	-	-				
- 2.5 -		ML	Moderate plasticity.											
	RS	ML	SILT with some sand; light brown i Low plasticity; sand is fine.	mottled brown.					Hard	047				
3.0	ъ		No recovery.							217+	17+			
	RS	ML	SILT with some sand; light brown i Low plasticity; sand is fine.	mottled brown.					Hard					
4.0	NR		No recovery.		NR					•				
	GW	ML	Completely weathered rock recove SILT; light brown mottled white wit sand is fine to medium. Contains p fabric.	red as sandy h black veins; parent rock				D	-					
- 0.c			End of Hole Depth: 5 m Termination Condition: Practical re	fusal									•	
Wi Sc Sta NF	ndov ala P andin R = N	/ sam enetro g grou O RE	oler met practical refusal at 5 m dep ometer met target depth at 2.9 m. undwater was not encountered. COVERY, RS = RESIDUAL SOIL, 0	th on inferred b GW = RAKAIA	bedrock. TERRAI	NE GF	REYN	VACł	KE					

			VGEO	LO	G C)F \	W	IN	DO	N SAI	MPLE WS03	
	Geotechnical Investigation 6 Maarama Crescent Te Aro, Wellington 17188.000.000				Client : T Irrcher & C Tremblay Client Ref. : - Date : 01/05/2020 Hole Depth : 4 m Hole Diameter : 80 mm					Shear Vane No : 2036 Logged By : CC Reviewed By : CM Latitude : -41.296716 Longitude : 174.768619		
Depth (m BGL)	Material	USCS Symbol	DESCRIPTION	Graphic Symbol Elevation (mRL) Mater Level Moisture Cond. Consistency/			Shear Vane Undrained Shear Strength (kPa) Peak/Remolded	Scala Penetrometer Blows per 100mm 2 4 6 8 10 12				
- - - 0.5 - -	FILL	ML 	SILT with minor sand and trace gra- brown mottled light brown. Low pla fine to coarse; gravel is fine to med to subangular. Contains organics a Gravelly fine to coarse SAND with grav. Well graded, gravel is fine to	avel; dark isticity; sand is dium, angular and rootlets. trace silt; medium					Soft to Stiff			
- - 1.0-		ML	grey. Weil graded, graden's fine to angular to subrounded. SILT with some sand and trace gra brown mottled light brown. Low pla fine to coarse: gravel is fine to mer	avel; dark asticity; sand is						217+		
- - - 1.5 - -		ML	to subangular. SILT with some sand; light brown i Low plasticity; sand is fine to medi	mottled white. um.								
- - 2.0 - -	RESIDUAL SOIL	ML	Sandy SILT; light brown mottled w Low plasticity; sand is fine to medi Clayey SILT with trace sand; light orange. Moderate plasticity; sand i	hite and black. um. brown mottled s fine.				М	Hard	217+		
- 2.5 - - - - -	-	ML									•	
- 0.6 	NR		No recovery.		NR				_	217+		
TA TEMPLATE 2.0	RS	ML	Sandy SILT; light brown mottled w Low plasticity; sand is fine to medi	hite and black. um.					Hard			
	GW	ML	Completeley weathered rock recov SILT; light brown mottled orange v veins. Low plasticity; sand is fine to Contains parent rock fabric. End of Hole Depth: 4 m Termination Condition: Practical re	ered as sandy /ith black o coarse. /fusal					-			
GEOTECH HAND AUGI	5.0- Window sampler met practical refusal at 4 m depth on inferred bedrock. Scala Penetrometer met target depth at 2.9 m. Standing groundwater was not encountered. NR = NO RECOVERY, RS = RESIDUAL SOIL, GW = RAKAIA TERRANE GREYWACKE											







KEY Test Locations



Date	01/05/2020	Client	T Irrcher & C Tremblay
Drawn by	СС	Project	6 Maarama Crescent
Approved by	РВ	Description	Site Plan
Scale (approx.)	NTS	ENGEO Ref.	17188.000.000

Appendix F

Seismic Retrofit Concepts



MACHINE ROOM SUSPENDED WALL ELEVATION + PLAN

NOTES

1. A NUMBER OF NON-STRUCTURAL ITEMS MAY REQUIRE DEMOLITION TO EFFECT STRENGTHENING WORKS. 2. ALLOW FOR ACCESSIBILITY AND FIRE ENGINEERING REPORTS FOR COST FSTIMATE

2. ALL SIZES ARE INDICATIVE, ONLY SUBJECT ON THE ENGINEERING REPORTS FOR COST ESTIMATE. 3. QUANTITY SURVEYOR TO REFER TO ARCHITECTURAL DRAWINGS FOR NON-STRUCTURAL ELEMENTS TO UNDERSTAND EXTENT OF DEMOLITION OF EXISTING FITOUT AND RECONSTRUCTION (WHERE APPLICABLE). 4. EXISTING DRAWINGS HAVE BEEN OVER-MARKED. 5. SITE SPECIFIC GEOTECHNICAL INVESTIGATION TO BE COMPLETED PRIOR TO STRENGTHENING WORKS 6. OTHER WALLS SCORE APPROX 61 %NBS AND DO NOT REQUIRE STRENGTHENING DUE TO LOW LIFE SAFETY RISK AND LIKELY HIGHER DUCTILITY AVAILABLE. 7. ALL SIZES ARE INDICATIVE, ONLY USED FOR COSTING. 8. ALL EPOXY ANCHOR BOLTS SHALL BE GRADE 830MPa. 9. ALL EPOXY SHALL BE RAMSET EPCON C8 Xtrem OR EQUIVALENT.

EXISTING MACHINE ROOM RC WALL



CONCEPT ONLY NOT FOR CONSTRUCTION								
67%NBS(IL2) PRIMARY STRUCTURE STRENGTHENING								
AECOM								
PROJECT TITLE:	4 Brooklyn	Road, Block A	A (PUKA)					
PROJECT NO:	60723635	DATE: 1	9/04/24					
SKT-001	SKT-001							
67% CONCEPT STRENGTHENING SCHEME A WALLS OUT-OF-PLANE - PFC STRENGTHENING								
DRAWN: VERIFIED: APPROVED:								











	NOTES			×
E 0 DID-300 − DIO-300 E E DIZ-300	1. A NUMBER OF N DEMOLITION TO E 2. ALLOW FOR AC REPORTS FOR CO 3. QUANTITY SURY DRAWINGS FOR N UNDERSTAND EXC FITOUT AND RECC 4. EXISTING DRAW 5. SITE SPECIFIC C COMPLETED PRIC 6. ALL SIZES ARE I 7. SHOTCRETE TC 8. ALL EPOXY ANC 9. ALL EPOXY SHA EQUIVALENT.	ION-STRUCTURAL I IFFECT STRENGTHE CESSIBILITY AND FI ST ESTIMATE. VEYOR TO REFER TO ON-STRUCTURAL E TENT OF DEMOLITIC JINGS HAVE BEEN O SEOTECHNICAL INVI OR TO STRENGTHEN NDICATIVE, ONLY U DE 40 MPA. CHOR BOLTS SHALL ALL BE RAMSET EPC	TEMS MAY RE NING WORKS RE ENGINEER DARCHITECT LEMENTS TO DN OF EXISTIP SEA PPLICAE VER-MARKEE ESTIGATION ING WORKS SED FOR CO BE GRADE 8: ON C8 Xtrem	QUIRE , ING URAL VG 3LE). TO BE STING. 30MPa. OR
20	2-020 - 010-150 h	3 Lops in reinforcement 4 Concrete cover torein and 40mm to external and 40mm to external 5 Wells to be 200mm 5 See architects drawin holes etc	tobe a minimum of 40 forcement tobe 25mm faces of walls. thick. gs for details of drips.r	diameters. to internol ebates,
/	150PFC TOP SPANDRELS OTHERWISE OFFSET FRC	AND BOTTOM OF UNLESS SHOWN . 300mm MIN M BOTH ENDS		
/				-
N				-
	INSIDE			
		M16 EPOXY ANC SPACED AT MIN 300mm WITH MIN 150mm EMBEDE	HORS MENT	F
3 - (1G	SPANDRI THENING	EL		9 DEC 975 RECEIVED WILLIAM
10 10 10 10	RID-150 d 2-D14 2-D14	ouble links		
+	C NOT F	ONCEPT ON OR CONSTR	LY UCTION	
-storter well ste	67%NRS/II		STRUCT	
<u>-D</u> 1:1	ST / ST DO(IL	RENGTHEN	NG	
JKEH	AECOM	(5) ACT	. LINK	
S ST	PROJECT TITLE:	4 Brooklyn	Road, Block A	(PUKA)
LINGTC WO	PROJECT NO:	60723635	DATE: 1	9/04/24
STR	SKT-006 67% CONCEPT ST	RENGTHENING SCH	IEME	REV
	SPANDREL STREN			A
			ALL NOVED:	









	NOTES	3		
vertical b shewn o line 250 shewn o shewn o line 250	1. A NUMBER OF N DEMOLITION TO E 2. ALLOW FOR AC REPORTS FOR CO 3. QUANTITY SURY DRAWINGS FOR N UNDERSTAND EXT FITOUT AND RECO 4. EXISTING DRAW 5. SITE SPECIFIC C COMPLETED PRIC 6. ALL SIZES ARE I 7. SHOTCRETE TO 8. ALL EPOXY ANC 9. ALL EPOXY SHA EQUIVALENT.	ION-STRUCTURAL I FFECT STRENGTHE CESSIBILITY AND FI ST ESTIMATE. /EYOR TO REFER TC ON-STRUCTURAL E FENT OF DEMOLITIC JNSTRUCTION (WHE /INGS HAVE BEEN O SEOTECHNICAL INV R TO STRENGTHEN NDICATIVE, ONLY U BE 40 MPA. CHOR BOLTS SHALL LL BE RAMSET EPC	TEMS MAY RE NING WORKS RE ENGINEER DARCHITECTI LEMENTS TO DN OF EXISTIN ERE APPLICAE VER-MARKE ESTIGATION ING WORKS SED FOR COS BE GRADE 83 ON C8 Xtrem	COUIRE ING URAL IG 3LE). CO BE STING. SOMPa. OR
010-250		2-024 DID-200	1.1	
SE	CTION A-A 1:50	300 SECTIO	DN B-B 1:50	
o Dio-z	5015 [010-200			
	where shown otherwise			
SECT	ION C-C 1:50			
		*		
	Reinforcement to be mid steel Laps in reinforcement to be o min Courrele cover to reinforcement Walls to be 200mm thick exce Starter bors to match wall steel See architect's drawings for di See lift namifiacturer's drawi	structural grade deformed or round num of 40 diameters to be 25nm to internal and 40mm to at where shown. Italls of rebates etc. Ings for details of holes and su at the shown. ONCEPT ON OR CONSTR	bors as specified. ports for lift equipments and the second sec	t -
4	NUIF			
	67%NBS(IL: S1	2) PRIMARY FRENGTHEN	STRUCT NG	
UKEH	ΑΞϹΟΜ			
IS ST	PROJECT TITLE:	4 Brooklyn	Road, Block A	(PUKA)
LINGTO	PROJECT NO:	60723635	DATE: 1	9/04/24
WO	SKT-0010		<u> </u>	REV
	67% CONCEPT ST	RENGTHENING SCH	IEME	А
•	SPANDREL STREN	GTHENING - LIFT CO VERIFIED:		
				_



PLAN VIEW - DIAPHRAGM STRENGTHENING

NOTES

1. A NUMBER OF NON-STRUCTURAL ITEMS MAY REQUIRE DEMOLITION TO EFFECT STRENGTHENING WORKS.

DEMOLITION TO EFFECT STRENGTHENING WORKS. 2. ALLOW FOR ACCESSIBILITY AND FIRE ENGINEERING REPORTS FOR COST ESTIMATE. 3. QUANTITY SURVEYOR TO REFER TO ARCHITECTURAL DRAWINGS FOR NON-STRUCTURAL ELEMENTS TO UNDERSTAND EXTENT OF DEMOLITION OF EXISTING FITOUT AND RECONSTRUCTION (WHERE APPLICABLE). 4. EXISTING DRAWINGS HAVE BEEN OVER-MARKED. 5. SITE SPECIFIC GEOTECHNICAL INVESTIGATION TO BE COMPLETED PRIOR TO STRENGTHENING WORKS 6. ALL SIZES ARE INDICATIVE, ONLY USED FOR COSTING. 7. FRP TO BE TYFO SCH-41 COMPOSITE WITH TYFO S EPOXY OR EQUIVALENT. (MAPEI, ETC). EPOXY OR EQUIVALENT. (MAPEI, ETC). 8. FRP WILL NEED TO BE INSTALLED BY TRAINED AND CERTIFIED APPLICATORS.

NOTE THIS IS THE THIRD FLOOR PLAN WITH SIMILAR ARRANGEMENTS USED FOR ALL FLOORS



CONCEPT ONLY NOT FOR CONSTRUCTION

67%NBS(IL2) PRIMARY STRUCTURE **STRENGTHENING**

AECOM			
PROJECT TITLE:	4 Brooklyn	Road, Block A	. (PUKA)
PROJECT NO:	60723635	DATE: 1	9/04/24
SKT-0011			REV
67% CONCEPT ST	RENGTHENING SCH	EME	Λ
DIAPHRAGM STRE	NGTHENING		~
DRAWN:	VERIFIED:	APPROVED:	





Appendix G

Existing Structural Drawings



BLOCK.E.

PUKEHINAU FLATS STRUCTURAL DRAWING INDEX

BLOCK.A.

BLOCK.B.

		7	1				
	1. FOUNDATIONS & SLAB LEVEL.1.		22. FOUNDATIONS & GRND. FLOOR SL	AB.	39. FOUNDATIONS & GRN		
	2. FOUNDATION BEAM DETAILS.		23. FOUNDATION DETAILS.		40. FOUNDATION DETAIL		
	3. FLOOR SLAB LEVEL 2.		24. FLOOR SLABS LEVELS 4&5.		41. WALLS T, U, V, W, P& R		
	4. FLOOR SLAB LEVEL 3.		25. FLOOR SLABS LEVELS 3&6.		42. WALLS 21 to 27.		
	5. FLOOR SLAB LEVEL 4.		26 WALL 7.	CTUD	DDAIAUNOC		
	6. FLOOR SLAB LEVEL 5.		27. WALL 8.	STAIR	DRAWINGS.		
	7. FLOOR SLAB LEVEL 6.		28. WALLS P, O, N, M & L.		43. STAIRWAY 2& 3.		
	8. FLOOR SLAB LEVEL 7.		29 DRYING AREA WALLS BEAMS		44. STAIRWAY 1,4 & 5.		
	9. FLOOR SLABS LEVELS 8,9 & 10.	DIOCI	IC C2D	1	45. STAIR SUPPORT FI		
	10. WALLS 1 & 2.	BLUCK	13. CQ D.				
	11. WALLS 3 & 4		30. SLAB BLOCKS C&D	SILE	WALLS.		
	12. WALL 5.		31. FOUNDATION DETAILS.	-	46 WALLS A. B. C & D.		
	13. WALL 6.		32. FLOOR SLAB LEVEL 4.		47. WALLS E&F.		
	14. WALL A.		33. CONC. BEAMS, BALUSTRADE		48 WALLS G H& J. CRIL		
	15. WALLS B&C.		34 WALL I.		STAIRS U.G. I.		
	16. WALLS D&E.		35. WALL K.				
	17. LIFT WALLS.		36. WALLS 9, 10, 11, 12 & 13.				
	18. MISCELLANEOUS WALLS.		37. WALLS 14,15,16 & 17.				
			38 WALLS BLOCK D.	-			
LINK	BRIDGE.				WELLINGTON C		
	19. GENERAL ARRANGEMENT.				WORKS L		
		-					

20. TRUSS DETAIL.

21. DETAIL BTM. TRUSS & BRACING.

















2.DIL Topebte

-(E)

550x200 bm under Details similar to Sect F.F

2-02410p 4-025 btm

-2-012-300 btm

2.0%

2.010-300top

-(B)

-2-170 7-RID-200 E

SECTION H-H 1:50

NOTES

1. Concrete to have a minimum crushing strength of 25MPa at 28 days. 2. Reinforcement to be mild steel structural grade deformed bars. 3. Laps in reinforcement to be a minimum of 40 diameters.

+ Concrete cover to reinforcement to be 20mm in slabs, 40mm in beams to main steel

to main steel. 5 Contractor to check position of holes against architect's general and service drawings 6 Baution of construction joints where required to be at the third points of slobs and agreed with the Engineer 7. For emanged detail of balcony and block balustrade see drawing Str(253)4.

A TTT 19 DEC 19 -(A) TI KEY PLAN HEET No. CONTRACT 2469 PUKEHINAU FLATS Scale 1:50 7 WILLIS ST AND ARO ST FLOOR SLAB LEVEL 6 TOWER BLOCK A N SET OF 48 TRACING NO. STRL 253 7 WELLINGTON CITY CORPORATION WORKS DEPARTMENT DESIGNED TPN Dec 74 STRUCTURAL BRANCH March 75 DRAWN TRACED KIP APPROVED I Multide and CHIEF STRUCTURAL ENGINEER A. D. MARTIN, CITY ENGINEER









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-C





















NOTES

14

- ES i Concrete to have a maximum crushing strength of 25 MFb at 28 days. a ReinForcement to be mild steel structural grade deformed or round bars as specified. 3 Laps in reinforcement to be a maximum of 40 diameters. 4 Concrete cover to reinforcement to be 25mm to internal 40mm to external faces of walls. 3 See architect's drawings for details of rebotes holes etc. 6 See lift manufacturer's drawings for details of holes, fixings, lifting beans etc.

			N 19 DEC 1975
UKEHINAU FLATS IS ST AND ARO ST DWER BLOCK A	3 5 KEY CONTRACT 246 Scale 1:50 MISCELLANE	PLAN 9 OUS WALLS	SHEET NO.
LINGTON CITY CORPORATION WORKS DEPARTMENT STRUCTURAL BRANCH A. D. MARTIN CITY ENGINEER	TRACING NO. DESIGNED DRAWN TRACED CHECKED APPROVED QHECK ST	STRL 253	Dec 746 April 75





37 20

34

