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GEOTECHNICAL SITE INVESTIGATION REPORT

- i. SITE ADDRESS: 25 Ormond Street
BANNOCKBURN, VICTORIA
- ii. PROPOSED DEVELOPMENT: Municipal infrastructure
- iii. CLIENT: CARDNO TGM
PO BOX 1137
GEELONG VIC 3220
- iv. ISSUE DATE: 26th May 2021
- v. OUR REFERENCE NUMBER: 16964E
- vi. DISTRIBUTION: CARDNO TGM
ATT: Chris Marshall
- vii. SUPERVISING GEOLOGIST: Andrew Redman BSc
- viii. AUTHOR: Andrew Redman BSc



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i. INTRODUCTION

Provincial Geotechnical Pty Ltd has been commissioned to provide a Geotechnical Site Investigation report for the nominated address. We understand that construction of new municipal infrastructure is proposed.

The Location Plan is appended (Appendix i).

The site investigation hereby reported has been carried out with regard to the information supplied to us by our client or client's agents at the date of our commission. Should the client or his agent have omitted to supply us with relevant information or make significant changes to the building type, building envelope, or site our report may be irrelevant and/or inappropriate. No responsibility will be accepted by us for the consequences of such action. The client should acknowledge that this is a Geotechnical Site Investigation report specifically prepared for the proposed building development at the identified location and does not extend beyond that brief.

All site works related to the building project must be undertaken to comply with the relevant Codes and Standards and must not potentially adversely impact upon the building envelope. Provincial Geotechnical Pty Ltd accepts no liability or responsibility for any site works outside of our specific commission.

ii. SITE CLASSIFICATION

The scope of AS2870-2011 allows for the classification of sites for some light commercial and institutional buildings. However, the proposed development appears to fall outside the scope of the code and the design should be based on engineering principles.

This site would normally be classified as CLASS P (PROBLEM SITE-ABNORMAL MOISTURE CONDITIONS), noting the underlying soil profile is moderately reactive CLASS M (Moderately Reactive Clay).

Site Classification is based upon Section 2 Clauses 2.2 of AS2870 - 2011. The method adopted for clay sites primarily includes 2.2.1 (a). Clause 2.2.1 (b) can be adopted under instruction from the client.

Classification of the site has taken into account the following:

- Identification of the sub soil profile.
- Field classification of the soil type and plasticity.

iii. SITE SOIL CHARACTERISTICS SUMMARY

SITE FILLING: None encountered.

UNSUITABLE FOUNDATION

CONDITIONS: Depth to satisfactory foundation soils may necessitate localised deepening of footings in excess of standard types.

PERCHED WATER: None observed. The installation of suitable site drainage should ensure that destabilisation of the foundation soils does not occur.



iii. SITE SOIL CHARACTERISTICS SUMMARY - continued

GROUND WATER: None encountered.

BEDROCK: None encountered.

FLOATERS: None encountered.

ABNORMAL MOISTURE
CONDITIONS: Established vegetation present. Proximity and potential
influence should be considered.

GEOLOGY: Tertiary Sediments (Mapcode Nbm & Nhn)
Identification assisted by reference to appropriate geological survey
map. This report contains a geology map obtained from the
Department of Natural Resources Geovic website including the site
under investigation. It is provided as a guide to mapping of the local
geology only and not to be used as a basis for design (Appendix ii).

SOIL TYPES: Natural: Silty clayey sand topsoils overlying silty clays, typical of
area's geology. Clays of the above sedimentary origin are generally
considered moderately reactive.

Fill: None encountered.

iv. TERRAIN EVALUATION SUMMARY

CLIMATIC ZONE: CZ 2

SITE LOCATION: North-east side of Ormond Street.

SLOPE: Gentle fall over site predominantly to the east.

DRAINAGE: SURFACE: Fair to Poor.
SUB-SURFACE: Poor. Installation of cut off drains may be
required.

EARTHQUAKE
CLASS: Australian Standard AS1170.4-2007, 'Minimum Design Loads on
Structures, Part 4: 'Site Sub-Soil Class' outlines the methods for
assigning the site's Sub-soil Class. Based on the anticipated
stratigraphy, Table 4.1 'Maximum Depth Limits for Sub-Soil Class C'
and Table 3.2 'Hazard Factor (Z) For Specific Australian Locations' of
the standard, we recommend the following Hazard Factor and Sub-
Soil Class are adopted:
SUB-SOIL CLASS: Class C_e – Shallow soil site
HAZARD FACTOR (Z): 0.10



iv. TERRAIN EVALUATION SUMMARY - continued

PROXIMATE VEGETATION (POTENTIAL ABNORMAL MOISTURE CONDITIONS):

GRASSES: Present.
SHRUBS: Occasional present.
TREES: Occasional present.

INFRASTRUCTURE WITHIN OR IN PROXIMITY TO BUILDING ENVELOPE: No. Greenfield site.

NOTE: The designing engineer should review available aerial mapping data and/or available site context information to assess the current or pre-existing conditions in respect to design considerations for Abnormal Moisture Conditions.

This report provides photographic evidence of either existing or pre-existing site context (Refer to Appendix iii).

v. TESTING PROGRAMME

Four (4) test sites were established and excavated using a 100mm direct drive drilling rig at the approximate locations shown on the appended Test Site Location Plan (Appendix iv).

Where soil conditions dictated, investigation was assisted by the use of a penetrometer to confirm profile depth and condition. Where penetrometer testing is not undertaken the soil profile depths and conditions may be extrapolated from our knowledge of the geology and soils in this area.

Disturbed samples were collected and hand classified.

A vane shear apparatus was used to determine the strength of all cohesive soils in conjunction with tactile assessment.

Site history: The client is advised that site classification can be altered by past activities on this site not known at the time of our site investigation and report preparation. The client is advised that failure to investigate and report past history may invalidate the report.

vi. FINDINGS

The soil profiles encountered are shown on the appended borelog sheet (Appendix v).

The cohesion value obtained is quoted on the log sheet.

The sedimentary nature and depth of the Tertiary aged soils indicates a moderate soil reactivity and seasonal heave potential.

The client should recognise that the soil profiles encountered during our testing are deemed representative of the building envelope for the purpose of classifications.



vi. FINDINGS CONTINUED

The client should be aware however that in some cases soil conditions can change dramatically over short distances and although all effort is made to determine possible soil profile variations, no responsibility is taken for any undetected variations. The most careful exploration programme may not locate all soil profile variations due to time and economic restraints.

If footing excavations reveal soil conditions differing from those shown on the log sheet in this report, we recommend that Provincial Geotechnical be contacted immediately to carry out further testing to confirm or revise our conclusions and recommendations.

vii. CONCLUSIONS AND RECOMMENDATIONS

1. CONCRETE SLAB FLOOR – RESIDENTIAL STYLE STRUCTURES:

The use of stiffened raft slab construction is recommended for residential proportioned buildings constructed on a residual clay profile. An Allowable Bearing Pressure of 100kPa may be considered for preliminary proportioning of stiffened raft slab edge beams and internal load bearing ribs a minimum of 100mm into stiff clay.

Minimum dimensions and reinforcement of footings will need to meet the minimum requirements of Australian Standard AS2870-2011, 'Residential Slabs and Footings – Construction' for a CLASS M (Moderately Reactive Clay) site classification.

Where the depth of fill exceeds 0.3 metres it will be necessary to adopt suspended raft slab construction. All edge beams and internal ribs will need to be founded in stiff clay at the base of any fill and topsoils, and the slab panels will need to be designed as fully suspended.

A suspended concrete slab on piles may use an Allowable Bearing Pressure of 250kPa at a depth of 300mm into natural stiff clay and a minimum foundation depth of 1000mm below finished ground level.

Considerable attention to site drainage and existing (and any proposed or retained) trees will be required to ensure adequate performance of structures. Failure to take these factors into account will result in poor footing performance.

2. LOW RISE STRUCTURES:

Strip and pad footings founded within residual clay are routinely adopted for flexible commercial style structures constructed on a clay foundation. The use of pad and strip footings founded on clay may be considered for any proposed low rise structures subject to:

- The superstructures being flexible and well-articulated. Steel portal framed construction and precast concrete panel construction normally satisfies this criteria.
- The superstructures not being sensitive to footing movements associated with seasonal volume changes within the clay.



2. LOW RISE STRUCTURES - CONTINUED:

- The moisture content regime of the clay beneath the structures being maintained as uniform as possible. The clays must not be subject to extremes in moisture conditions resulting from poor site drainage and/or the drying effects of trees.

If the proposed structures are not flexible and/or well-articulated, or the structures are sensitive to footing movements associated with seasonal volume changes within the highly plastic residual clay, it will be necessary to deepen the footings to a depth of negligible seasonal soil moisture variation.

Minimum dimensions and reinforcement of footings founded on clay should meet the minimum requirements of Australian Standard AS2870-2011, 'Residential Slabs and Footings – Construction' for a CLASS M site classification.

An Allowable Bearing Pressures of 250kPa may be considered for preliminary proportioning of strip and pad footings respectively where founded a minimum of 300mm into stiff clay, subject to a minimum founding depth of 1000mm. It is recommended that a uniform founding stratum be provided throughout any structure to minimize differential movements.

During our investigation a suitable foundation level was found at the following depths:

SITE	FOUNDATION DEPTH	FOUNDATION MATERIAL	ALLOWABLE BEARING PRESSURE
1	1000mm	Natural stiff clay	250kPa
2	1000mm	Natural stiff clay	250kPa
3	1000mm	Natural stiff clay	250kPa
4	1000mm	Natural stiff clay	250kPa

NOTE:

The site derived clays are not recommended for use as structural fill. Plastic clays are generally difficult to compact and are potentially subject to appreciable volume changes if they are not properly moisture conditioned. Use of a suitable imported granular or low plasticity clay fill will assist in assuring efficient placement and present less risk with respect to long term performance of structures and pavements based on soil reactivity.

Structural fill must be placed in uniform layers no exceeding a loose thickness of 200mm and compacted to at least 98% of the standard maximum dry density value as determined in accordance with Australian Standard AS1289 5.1.1-1993.

Australian Standard AS3798, 'Guidelines on Earthworks for Commercial and Residential Developments' provides guidance on the specification, execution and control of earthworks relevant to the subject site. Level 1 supervision in accordance with Australian Standard AS3798 is recommended for all proposed earthworks at the site.

Construction of pavements is likely to be problematic during the wetter months of the year. Pavement construction should be undertaken during the drier months of the year to avoid the need for additional subgrade improvement and delays in construction.



EXCAVATION/CONSTRUCTION DIFFICULTIES

SITE VEHICLE ACCESS: Good.

SITE VEHICLE MANEUVERABILITY: Fair.

EXCAVATION CONDITIONS: The clays should be readily excavated using a 20 tonne capacity hydraulic excavator.

EXISTING STRUCTURES AROUND CONSTRUCTION AREA: No – greenfield site.

VEGETATION AROUND CONSTRUCTION AREA: Yes – on eastern boundary.

WET WEATHER IMPACT: Possible.

Sites without good natural or installed drainage can be adversely impacted upon during construction. The client should be aware that the following impacts can occur after wet weather.

- * Site may become slippery and boggy.
- * Foundation soils may become inundated and unworkable.
- * Site drainage may need to be installed.
- * Site may need to be abandoned for a period.
- * Deeper footings or additional earthworks may be required.

ix. CONSTRUCTION REQUIREMENTS

1. CONSTRUCTION ADJACENT TO EASEMENTS, EXCAVATIONS AND SERVICE PIPE TRENCHES

Buried services should be located adjacent to footings. Where this cannot be avoided, the trench should be backfilled in such a way as to prevent moisture ingress. Any footings located adjacent to easements, excavations or backfilled service trenches should be founded below a line drawn up at 40° above horizontal from the base of the easement or excavation. If the angle of repose is to be intersected, a piled footing will be required.

2. SITE DRAINAGE AND MAINTENANCE OF FOOTINGS

Effective drainage of the site should be maintained at all times. Water run-off should be collected and diverted away from all structures during construction. Water should not be allowed to pond against footings during or after construction. The ground adjacent to footings should be graded to provide a permanent fall of 1(V):50(H) away from the footings over the first two metres. Water supply and drainage infrastructure should be maintained so that no leakage occurs.

3. ARTICULATION OF STRUCTURE

Adequate articulation should be provided in accordance with The Cement and Concrete Association of Australia – Technical Note TN61. In addition to the requirements of TN61, a full height articulation joint should be provided at the following locations:

- At the junction where two different footing types intersect.
- Where new structures adjoin existing structures.

4. INSPECTION OF FOOTING EXCAVATIONS

All footing excavations should be inspected by a suitably qualified geotechnical consultant to ensure that the required founding stratum has been achieved. The presence of any unusual features or conditions should be brought to the attention of this office before construction proceeds.

For shallow footing and trench excavations, based on the ground conditions information obtained, it appears excavations will be predominantly in natural clays. Personnel should not be permitted to enter confined excavations in excess of 1.5 metres deep unless such excavations are appropriately battered or shored. Shallower excavations, particularly in loosely compacted fill, may also need to be battered or shored and will need to be assessed at the time of construction.

5. BATTER SLOPES

It is recommended that temporary batter slopes should be steeper than 1H:1V, but flatter slopes may need to be considered within fill materials. Permanent batter slopes should not be steeper than 2H:1V and should be protected from erosion by vegetation or proprietary protection systems. Drainage should be provided at the top of batter slopes to divert run-off away from the slope face. The above recommendations are provided for batter slopes up to 3 metres in height; further geotechnical advice should be sought where higher batter slopes are proposed.

x. REPORT LIMITATIONS

This report is for the use of the party to whom it is addressed only and has been produced for the proposed development as described and for no other purpose. It has been assumed that the conditions encountered by the limited number of boreholes are representative of the site in general. Some variation from the conditions encountered by the boreholes is expected over the site.

ANDREW REDMAN BSc.
GEOLOGIST.
AR: hs



APPENDICES

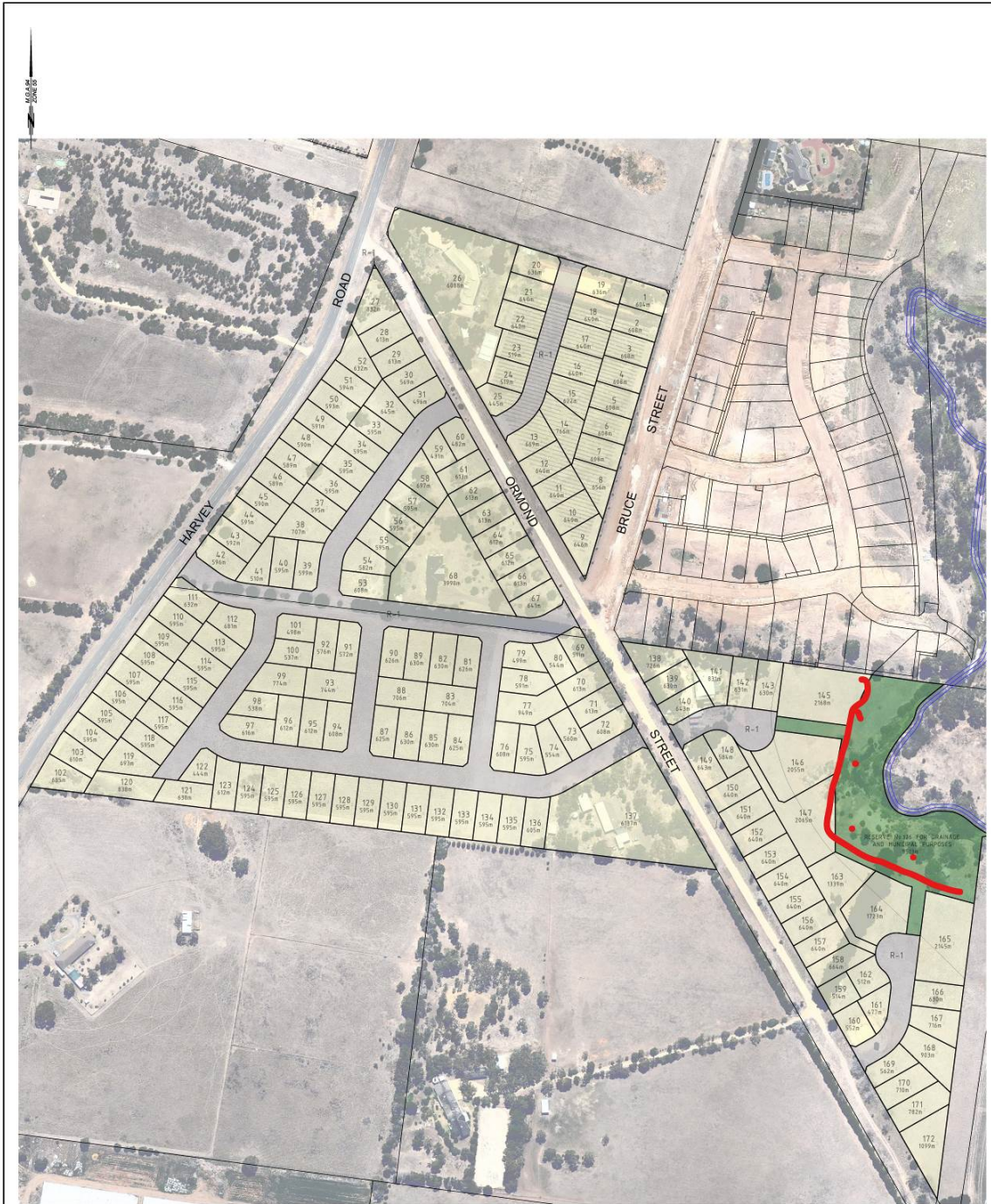
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A.B.N. 88 090 400 114

LOCATION PLAN

APPENDIX i



LAND BUDGET	
SITE AREA	16.14ha
OPEN SPACE	0.95ha
NET DEVELOPABLE AREA	15.19ha
No. OF LOTS	172
LOT DENSITY	11.3 LOTS/ha

Rev.	Revision	Date

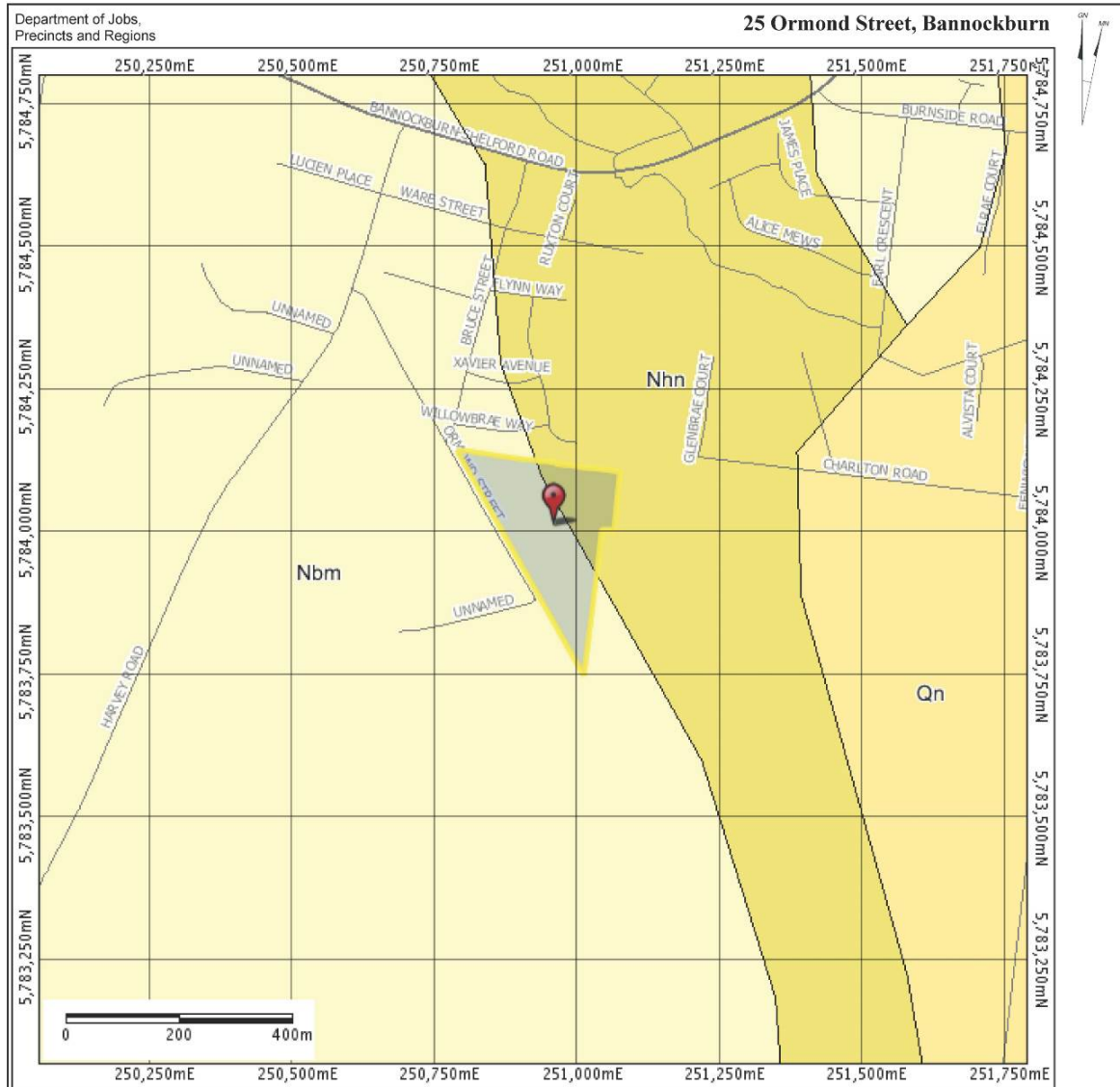
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25/04/2018 (revised) Survey 50-800 - (246) 16964E - Development 501 16964E

PLAN OF PROPOSED SUBDIVISION		Job Number: 17170-100	Date of Issue: 13/02/2018
5, 20, 25 & 30 ORMOND STREET BANNOCKBURN, 3331		Sheet: 1 of 1	Date of Survey: N/A
		LENGTHS ARE IN METRES	
		12.50 0 12.50 25 37.50 50 62.50	At Size A1
		Survey: N/A	Drawn: RLD
		Checked: RLD	
		DWG: 17170-100-PROPOSAL1 REV. 2	



GEOVIC MAP

APPENDIX ii



Legend

Towns (25K)

Geologic
Faults 25K

Map Scale: 1:10,000

Projection: MGA 55

- Geologic mapped.
- Geologic inferred.
- Geologic concealed.
- Intrusive mapped.

Disclaimer: This map is a snapshot generated from Victoria Government data. This material may be of assistance to you but the State of Victoria does not guarantee that the publication is without flaw of any kind or is wholly appropriate for your particular purposes and therefore disclaims all liability for error, loss or damage which may arise from reliance upon it. All persons accessing this information should make appropriate enquiries to assess the currency of the data.

Generated from GeoVic 3

Map Created Wed May 26 2021 11:00:33 GMT+1000 (AEST)



AERIAL PHOTOGRAPH

(Approximate Location)

Client: CARDNO TGM
Ref. Number: 16964E
Date: 19/05/2021
Site: 25 Ormond Street, BANNOCKBURN











TEST SITE LOCATION PLAN

○ - Approximate borehole locations

Client: CARDNO TGM
Ref. Number: 16964E
Date: 19/05/2021
Site: 25 Ormond Street, BANNOCKBURN



PROVINCIAL GEOTECHNICAL PTY. LTD.

CONSULTING GEOLOGISTS



A.B.N. 88 090 400 114

APPENDIX v

Client: CARDNO TGM
Ref. Number: 16964E
Date: 19/05/2021
Site: 25 Ormond Street, BANNOCKBURN

TEST SITE 1 EXCAVATION METHOD: HYDRAULIC DRILLING RIG					TEST SITE 2 EXCAVATION METHOD: HYDRAULIC DRILLING RIG				
Depth mm	FILL	SOIL PROFILE	"C"	ABP	Depth mm	FILL	SOIL PROFILE	"C"	ABP
100		SILTY CLAYEY SAND brown moist; dense		100	100		SILTY CLAYEY SAND brown moist; dense		100
200			200						
300			300						
400			400						
500			500						
600			600						
700			700						
800			800						
900			900						
1000			1000						
1100			1100						
1200			1200						
1300			1300						
1400			1400						
1500			1500						
1600			1600						
1700		1700							
1800		1800							
1900		1900							
2000		2000							
2100		CLAY orange brown light grey mottle moist; stiff becoming soft	130+		2100		CLAY orange brown moist; stiff	130+	
2200					2200				
2300					2300				
2400					2400				
2500					2500				
2600					2600				
2700					2700				
2800					2800				
2900					2900				
3000					3000				
3100		END BORE HOLE			3100		END BORE HOLE		
3200			3200						
3300			3300						
3400			3400						
3500			3500						
3600			3600						
3700			3700						
3800			3800						
3900			3900						
4000			4000						

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APPENDIX v

Client: CARDNO TGM
Ref. Number: 16964E
Date: 19/05/2021
Site: 25 Ormond Street, BANNOCKBURN

TEST SITE 3 EXCAVATION METHOD: HYDRAULIC DRILLING RIG					TEST SITE 4 EXCAVATION METHOD: HYDRAULIC DRILLING RIG				
Depth mm	FILL	SOIL PROFILE	"C"	ABP	Depth mm	FILL	SOIL PROFILE	"C"	ABP
100		SILTY CLAYEY SAND		100	100		SILTY CLAYEY SAND		100
200		brown moist; dense			200		brown		
300		CLAY			300		moist; dense		
400		orange brown			400				
500		moist; stiff	130+		500		CLAY		
600					600		orange brown		
700					700		moist; stiff	130+	
800					800				
900					900				
1000		becoming silty			1000				
1100		yellow-yellow			1100				
1200		light grey			1200				
1300					1300				
1400					1400				
1500					1500				
1600					1600				
1700					1700				
1800					1800				
1900					1900				
2000					2000		becoming silty		
2100					2100		orange		
2200					2200				
2300					2300				
2400					2400				
2500		VERY SILTY CLAY			2500				
2600		orange			2600				
2700		moist; stiff			2700				
2800					2800				
2900					2900				
3000					3000				
3100		END BORE HOLE			3100		END BORE HOLE		
3200					3200				
3300					3300				
3400					3400				
3500					3500				
3600					3600				
3700					3700				
3800					3800				
3900					3900				
4000					4000				