Douglas Partners
Geotechnics · Environment · Groundwater

REPORT
on
PRELIMINARY GEOTECHNICAL INVESTIGATION

PROPOSED RESIDENTIAL SUBDIVISION
AREA C
THORNTON NORTH

Prepared for
URBIS PTY LTD
on behalf of
BEACHWOOD HOMES

Project 31729A
NOVEMBER 2003

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REPORT ON
PRELIMINARY GEOTECHNICAL INVESTIGATION
PROPOSED RESIDENTIAL SUBDIVISION
AREA C
THORNTON NORTH

1. INTRODUCTION

This report presents the results of a preliminary geotechnical investigation to provide comment on the feasibility of a proposed residential subdivision Thornton North Investigation Area C. The work was carried out for Urbis Pty Ltd on behalf of Beechwood Homes.

Douglas Partners Pty Ltd (DP) have undertaken a previous investigation on the subject site, Report 31729, dated 13 May 2003. It is understood that an additional 11.7 hectares of land to the north of the previously investigated area will be incorporated into the development.

Assessment was required for the additional area together with preparation of this report presenting assessment of the issues relevant to the proposed development and possible constraints to the development for the entire site (103 hectares).

The investigation comprised a desk top study of available information in the vicinity of the site, a walk over survey of the site, together with the excavation of test pits.

For the purpose of the investigation, the client supplied a detailed survey plan of the site.

It should be noted that a contamination or hazardous material assessment was not required as part of this work.

2. SITE DESCRIPTION AND REGIONAL GEOLOGY

The site is located within Lot 12 (DP 603613) to the north of Raymond Terrace Road, Thornton. It is part of a larger area identified as "Thornton North Investigation Area C" on the client supplied drawing number 4876all.dwg, prepared by Palmer Bruyn & Parker Pty Ltd.

The site is of irregular shape covering an area of approximately 103 hectares. The site is bounded to the north, east and west by farmland containing some poultry sheds and a rural residential development to the south (Timber Lane Estate).

Currently the site consists of open farmland divided into paddocks separated by post and wire fences. There are four operational poultry farms on the site, three within the southern portion of the site and one within the northern portion of the site. The poultry sheds are contained within fenced areas and positioned on constructed filling platforms. Several single storey residential dwellings are situated on the site, each associated with the poultry farms.

The majority of the northern portion of the site is open paddocks.

Vegetation on the site generally comprises low grass cover with scattered mature trees and tree stumps.

The topography of the site is generally dominated by a central shallow and broad gully sloping down towards the north-west, and two surrounding broad spurs. There were some smaller gullies leading to the main central gully located approximately in the middle of the site.

Several small farm dams are located across the site generally in the main gully area. The dams were observed to be full at the time of investigation. There was a small excavated area located in the north western section of the site that appeared to be being used as a rubbish disposal area. Generally the site slopes from east down to the west. Slopes on the site were generally around 5%. There were minimal signs of erosion on the site.

Reference to the 1:100,000 Newcastle Regional Coalfields Geological Sheet indicates the site lies near the border between the Tomago Coal Measures and the Mulbring Siltstone formation.

3. FIELD WORK

3.1 Methods

Walk Over Survey

A detailed walkover survey was undertaken by the project manager and the field geotechnical engineer on 1 May 2003. Subsequent to the initial walk over survey, further assessment was undertaken on 4 November 2003 by the project manager to assess the additional area to the north. Dominant geomorphologies were noted, together with site slopes, areas of site features such as gullies and existing dams.

Test Pits

The field work was undertaken on 1 May 2003, and comprised the backhoe excavation of 19 test pits (Pits 1 to 19). The position of the pits was recorded using a hand help GPS unit and are indicated on attached Drawing 1. Surface levels for each test pit were interpolated from the client supplied drawing, which shows site contours.

The pits were located across the site in areas which were anticipated to consist of a range of soil types and subsurface conditions, i.e. within the gullies and also on the hill slopes.

The pits were set out by a geotechnical engineer from Douglas Partners Pty Ltd (DP), who also logged the subsurface profile in each pit and took regular samples for laboratory testing and identification purposes. Pocket penetrometer and dynamic cone penetrometer tests were performed at selected depths and locations to determine the strength of cohesive soils encountered.

3.2 Results

The subsurface conditions encountered are presented in detail in the attached test pit report sheets. These should be read in conjunction with the general notes preceding them, which explain the descriptive terms and classification methods used in the reports. The following is a summary of these subsurface conditions.

FILLING/TOPSOIL	Sandy silt or silty sand topsoil was encountered in Pits 11 to 19 to depths ranging from 0.08 m to 0.15 m. Clayey sand filling was encountered in Pit 3 to a depth of 0.55 m
SILTY SAND OR SANDY SILT	Medium dense silty sand or sandy silt was encountered in Pits 1, 4 to 7, 10, 12, 18 and 19 generally at the surface or underlying the topsoil and extended to depths ranging from 0.2 m to 0.6 m.
SANDY CLAY/CLAYEY SAND	Hard sandy clay or clayey sand was encountered in Pits 1, 2, 5, 7, 10 and 17 at depths ranging from the surface to 0.5 m and extended to the sandstone bedrock at depths of between 0.45 m to 1.4 m. Firm clayey sand was encountered in Pits 8 and 9 at the surface and extended to depths of 0.2 m and 0.15 m respectively.

SILTY CLAY	Very stiff to hard silty clay was encountered in all pits except Pits 1, 2, 5, 7, 10 and 12 at depths ranging from 0.08 m to 0.55 m and continued to termination depth or bedrock at depths ranging from 0.7 m to 2.6 m.
SANDSTONE/SILTSTONE	Extremely low to low strength sandstone or siltstone bedrock was encountered in all pits except Pits 4 and 8 at depths ranging from 0.45 m to 1.9 m and extended to depths of between 0.75 m and 2.9 m. Backhoe refusal was encountered in Pits 1, 2, 5, 7, 12 and 17 to 19 at depths of between 0.75 m and 1.45 m. Further data on the bedrock conditions is given in Table 1 in Section 4.2.2.

Groundwater was not encountered during the time that the excavations were open. It should be noted that groundwater levels are affected by climatic conditions and soil permeability and will therefore vary with time.

4. COMMENTS

4.1 Subsurface Conditions

Based on the observations made during the site survey and the results of the test pits, subsurface conditions encountered within in the pits are relatively uniform. The following pertinent features are considered relevant to the proposed subdivision:

- the site generally falls to the west with a general slope of around 6%, and local slopes within the gullies and hill slopes of 5% to 7%. The steeper slopes were generally located within the gully located within the central portion of the site.

- the silty clay, encountered within all the pits, is considered the dominant soil type on the site;
- relatively shallow sandstone or siltstone bedrock; at depths ranging from 0.45 m to 1.9 m;
- backhoe refusal, on siltstone or sandstone bedrock, was encountered in Pits 1, 2, 5, 7, 12 and 17 to 19 at depths of between 0.75 m and 1.45 m;
- several features which may be filled-in trenches, were observed across the site, as indicated on Drawing 1. It is unknown if these trenches were former burial trenches for the poultry. From a geotechnical viewpoint, additional earthworks may be required to remove and recompact these trenches in the event that proposed allotments or pavements be located in these positions;
- a depressed area was observed in the vicinity of Pits 2 and 3, which is possibly a former dam. Several mounds of filling were observed in this area, containing pieces of steel, concrete pieces, soil and plastic.

Based on these observations, the geomorphology of the site is dominated by the north-west trending gully and the two broad spurs on either side. There area a number of small, shallow broad gullies within the two spurs.

The soil types are generally consistent throughout the site, with residual soils overlying relatively shallow bedrock.

A number of geotechnical issues and potential constraints to development have been identified. These are discussed individually as follows.

4.2 Proposed Allotments

Owing to the relatively flat ground slopes over the majority of the site, it is anticipated that only limited earthworks would be necessary to prepare the allotments for construction of house. Should significant site regrading be required within the proposed allotments, fill should be placed under geotechnical inspection and control testing. Excavation conditions are discussed below.

There is only limited additional geotechnical data available in the immediate vicinity of the site, however, DP has undertaken numerous investigations in the Thornton area. Results of these investigations indicate that typical site classifications for this area vary from Class S to Class H, but are predominantly Class H.

Future lots within the proposed subdivision would need to be investigated at a later stage to determine appropriate site classifications to AS 2870-1996 (Ref 2).

4.3 Bedrock/Excavation Conditions

Bedrock was encountered in a number of pits across the site. Refusal was also encountered in a number of these pits. The depth to bedrock and backhoe refusal is shown in Table 1, below:

Table 1 – Summary of Bedrock

Pit	Depth to Bedrock (m)	Depth to Backhoe Refusal (m)	Termination Depth of Pit (m)
1	0.45	0.75	0.75
2	1.4	1.45	1.45
3	1.7	NE	2.4
4	NE	NE	2.2
5	0.95	1.1	1.1
6	1.9	NE	2.4
7	0.8	0.95	0.95
8	NE	NE	2.6
9	0.9	NE	2.5
10	NE	NE	2.8
11	1.5	NE	2.8
12	0.6	1.9	1.9
13	1.7	NE	2.5
14	1.4	NE	2.7
15	0.75	0.8	0.8
16	0.8	NE	2.7
17	0.7	0.85	0.85
18	0.7	1.05	1.05
19	1.0	NE	1.25

Excavation of the soil throughout the site is anticipated to be readily achievable using conventional earthmoving equipment. Similarly, excavation within the upper layers of the bedrock (approximately 0.5 m), should be achievable with machinery fitted with rock breaking teeth.

4.4 Slope Stability Issues

Slopes at the site a generally about 6° with some localised greater slopes on dam embankments and within the gullies.

The factors which influence slope instability and the assessment of the risk of instability are discussed in Ref 1 and summarised in Table 2 (see attached), reproduced from Ref 1. No evidence of deep seated or active instability were observed and the site is considered to have a low risk of instability. Sites classified as low risk of instability are normally considered suitable for development subject to good hillside engineering practice. This risk category would require reassessment should any cuts or fills be proposed greater than 2 m vertical height.

4.5 Erosion Observations

No laboratory testing was undertaken on the dispersivity of the soil, however, few obvious signs of surface erosion were observed throughout the site.

Minor signs of erosion, however, were observed in the vicinity of Pits 10, 13 and 18, generally within the existing shallow gullies and was characterised by localised scours of the topsoil material to depths less than 0.5 m. Erosion was also observed on the downstream embankments of a number of the existing dams on the site.

Due consideration should be given to drainage design to prevent erosion once the proposed allotments and pavements have been constructed.

4.6 Road Pavements

At this stage of the project, final layout of the proposed allotments and road pavements has not been prepared.

Based on the conditions encountered within the pits, it is anticipated that, dependant on the vertical alignment of the future roads, the subgrade material will consist predominantly of clay or sandstone bedrock.

A few pits encountered firm clayey sand within the initial 0.3 m from the surface. This material may require removal prior to construction of any future pavements for constructability considerations.

4.7 Mine Subsidence Issues

Discussion was undertaken with the Mine Subsidence Board, who advised that there are no recorded mine workings beneath the site.

4.8 Acid Sulphate Soils

Reference to the 1:250 000 Beresfield Acid Sulphate Soil Risk Map, Edition Two, indicates that there is no known occurrence of acid sulphate soils within the area of the site.

4.9 Clay Resource Quality

It is understood that the site lies near the extent of the clay conservation zone identified by the Council. Furthermore, there are a number of currently operational clay quarries in the vicinity of the site.

The following comments are made in relation to the quality of the on-site subsurface material for brick making activities:

- reference to the 1:100,000 Newcastle Regional Coalfields Geological Sheet indicates the site lies near the border between the Tomago Coal Measures and the Mulbring Siltstone formation. Material from both these formations are utilised in brick making operations;
- material is extracted to depths of up to 30 m for brick making activities in the area, and includes both clays and weathered bedrock. Coal is not used for the brick making activities;
- there are no specific geotechnical criteria for assessing the suitability of brick making materials. Generally speaking, the controlling issues for the suitability of the material are grain size, ease of extrusion and plasticity. However, the suitability is normally assessed by simulated firing trials by specialist consultants.

Overall, the material on-site may be suitable for use in brick making operations. Assessment would require further investigation at a later stage.

4.10 Conclusion

Based on the results of the field work it is considered that there are no major geotechnical constraints to the proposed development of the site as a residential subdivision.

The site is suitable for the proposed development from a geotechnical perspective, provided that the geotechnical guidelines are incorporated into the design of the development.

It is understood that the proposed subdivision will be connected to the waste water sewerage system.

The additional investigation work required for this project to proceed to detailed design will be dependent on the final layout of the subdivision, and is expected to include the following:

- site classification investigation once allotment layout has been established;
- pavement subgrade investigation when road alignments and long-sections have been finalised;
- pavement thickness design;
- geotechnical inspection and control during earthworks; and possibly
- assessment of on-site materials suitability for brick making operations.

DOUGLAS PARTNERS PTY LTD

Reviewed by:

Michael Gawn
Geotechnical Engineer

Stephen Jones

Stephen Jones
Principal

REFERENCES

1. Walker B, et al "Geotechnical Risks Associated with Hillside Development", Australian Geomechanics News, No 10, December 1985.

2. AS 2870-1996 "Residential Slabs and Footings – Construction".

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NOTES RELATING TO THIS REPORT

Introduction

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

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

Description and Classification Methods

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

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

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

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

Classification	Undrained Shear Strength kPa
Very soft	less than 12
Soft	12—25
Firm	25—50
Stiff	50—100
Very stiff	100—200
Hard	Greater than 200

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

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

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

Sampling

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

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

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

Details of the type and method of sampling are given in the report.

Drilling Methods.

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

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

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

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

Continuous Spiral Flight Augers — the hole is advanced using 90—115 mm diameter continuous spiral flight augers which are withdrawn at intervals to allow sampling or in-situ testing. This is a relatively economical means of drilling in

clays and in sands above the water table. Samples are returned to the surface, or may be collected after withdrawal of the auger flights, but they are very disturbed and may be contaminated. Information from the drilling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively lower reliability, due to remoulding, contamination or softening of samples by ground water.

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

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

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

Standard Penetration Tests

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

The test is carried out in a borehole by driving a 50 mm diameter split sample tube under the impact of a 63 kg hammer with a free fall of 760 mm. It is normal for the tube to be driven in three successive 150 mm increments and the 'N' value is taken as the number of blows for the last 300 mm. In dense sands, very hard clays or weak rock, the full 450 mm penetration may not be practicable and the test is discontinued.

The test results are reported in the following form.

- In the case where full penetration is obtained with successive blow counts for each 150 mm of say 4, 6 and 7

  as 4, 6, 7
  N = 13

- In the case where the test is discontinued short of full penetration, say after 15 blows for the first 150 mm and 30 blows for the next 40 mm

  as 15, 30/40 mm.

The results of the tests can be related empirically to the engineering properties of the soil.

Occasionally, the test method is used to obtain samples in 50 mm diameter thin walled sample tubes in clays. In such circumstances, the test results are shown on the borelogs in brackets.

Cone Penetrometer Testing and Interpretation

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

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

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

The information provided on the plotted results comprises: —

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

There are two scales available for measurement of cone resistance. The lower scale (0—5 MPa) is used in very soft soils where increased sensitivity is required and is shown in the graphs as a dotted line. The main scale (0—50 MPa) is less sensitive and is shown as a full line.

The ratios of the sleeve friction to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1%—2% are commonly encountered in sands and very soft clays rising to 4%—10% in stiff clays.

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

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

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

q_c = (12 to 18) c_u

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

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

Hand Penetrometers

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

Two relatively similar tests are used.

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

Laboratory Testing

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

Bore Logs

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

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

Ground Water

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

- In low permeability soils, ground water although present, may enter the hole slowly or perhaps not at all during the time it is left open.
- A localised perched water table may lead to an erroneous indication of the true water table.
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report.
- The use of water or mud as a drilling fluid will mask any ground water inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water observations are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Engineering Reports

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

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

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

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

Site Anomalies

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

Reproduction of Information for Contractual Purposes

Attention is drawn to the document "Guidelines for the Provision of Geotechnical Information in Tender Documents", published by the Institution of Engineers, Australia. Where information obtained from this investigation is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section

is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. The Company would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

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

AN ENGINEERING CLASSIFICATION OF SEDIMENTARY ROCKS IN THE SYDNEY AREA

This classification system provides a standardized terminology for the engineering description of the sandstone and shales in the Sydney area, but the terms and definitions may be used elsewhere when applicable.

Under this system rocks are classified by Rock Type, Degree of Weathering, Strength, Stratification Spacing, and Degree of Fracturing. These terms do not cover the full range of engineering properties. Descriptions of rock may also need to refer to other properties (e.g. durability, abrasiveness, etc.) where these are relevant.

ROCK TYPE DEFINITIONS

Rock Type	Definition
Conglomerate:	More than 50% of the rock consists of gravel sized (greater than 2 mm) fragments.
Sandstone :	More than 50% of the rock consists of sand sized (.06 to 2 mm) grains.
Siltstone:	More than 50% of the rock consists of silt-sized (less than .06 mm) granular particles and the rock is not laminated
Claystone:	More than 50% of the rock consists of clay or sericitic material and the rock is not laminated.
Shale:	More than 50% of the rock consists of silt or clay sized particles and the rock is laminated.

Rocks possessing characteristics of two groups are described by their predominant particle size with reference also to the minor constituents, e.g., clayey sandstone, sandy shale.

DEGREE OF WEATHERING

Term	Symbol	Definition
Extremely Weathered	EW	Rock substance affected by weathering to the extent that the rock exhibits soil properties — i.e. it can be remoulded and can be classified according to the Unified Classification System, but the texture of the original rock is still evident.
Highly Weathered	HW	Rock substance affected by weathering to the extent that limonite staining or bleaching affects the whole of the rock substance and other signs of chemical or physical decomposition are evident. Porosity and strength may be increased or decreased compared to the fresh rock usually as a result of iron leaching or deposition. The colour and strength of the original fresh rock substance is no longer recognisable.
Moderately Weathered	MW	Rock substance affected by weathering to the extent that staining extends throughout the whole of the rock substance and the original colour of the fresh rock is no longer recognisable.
Slightly Weathered	SW	Rock substance affected by weathering to the extent that partial staining or discolouration of the rock substance usually by limonite has taken place. The colour and texture of the fresh rock is recognisable.
Fresh	Fr	Rock substance unaffected by weathering.

STRATIFICATION SPACING

Term	Separation of Stratification Planes
Thinly laminated	<6 mm
Laminated	6 mm to 20 mm
Very thinly bedded	20 mm to 60 mm
Thinly bedded	60 mm to 0.2 m
Medium bedded	0.2 m to 0.6 m
Thickly bedded	0.6 m to 2 m
Very thickly bedded	>2m

ROCK STRENGTH

Rock strength is defined by the Point Load Strength Index (Is 50) and refers to the strength of the rock substance in the direction normal to the bedding. The test procedure is described by the International Society of Rock Mechanics (Reference).

Strength Term	Is(50) MPa	Field Guide	Approx. qu MPa*
Extremely Low:	0.03	Easily remoulded by hand to a material with soil properties.	0.7
Very Low:	0.1	May be crumbled in the hand. Sandstone is "sugary" and friable.	2.4
Low:	0.3	A piece of core 150 mm long x 50 mm dia. may be broken by hand and easily scored with a knife. Sharp edges of core may be friable and break during handling.	7
Medium:	1	A piece of core 150 mm long x 50 mm dia. can be broken by hand with considerable difficulty. Readily scored with knife.	24
High:	3	A piece of core 150 mm long x 50 mm dia. core cannot be broken by unaided hands, can be slightly scratched or scored with knife.	70
Very High:	10	A piece of core 150 mm long x 50 mm dia. may be broken readily with hand held hammer. Cannot be scratched with pen knife.	240
Extremely High:		A piece of core 150 mm long x 50 mm dia. is difficult to break with hand held hammer. Rings when struck with a hammer.	

*The approximate unconfined compressive strength (qu) shown in the table is based on an assumed ratio to the point load index of 24:1. This ratio may vary widely.

DEGREE OF FRACTURING

This classification applies to diamond drill cores and refers to the spacing of all types of natural fractures along which the core is discontinuous. These include bedding plane partings, joints and other rock defects, but exclude known artificial fractures such as drilling breaks.

Term	Description
Fragmented:	The core is comprised primarily of fragments of length less than 20 mm, and mostly of width less than the core diameter.
Highly Fractured:	Core lengths are generally less than 20 mm — 40 mm with occasional fragments.
Fractured:	Core lengths are mainly 30 mm — 100 mm with occasional shorter and longer section.
Slightly Fractured:	Core lengths are generally 300 mm —1000 mm with occasional longer sections and occasional sections of 100 mm — 300 mm.
Unbroken:	The core does not contain any fracture.

REFERENCE

— International Society of Rock Mechanics, Commission on Standardisation of Laboratory and Field Tests, Suggested Methods for Determining the Uniaxial Compressive Strength of Rock Materials and the Point Load Strength Index, Committee on Laboratory Tests Document No. 1. Final Draft October 1972.

Prepared by the Sydney Group of the Australian Geomechanics Society, January, 1975.

GRAPHIC SYMBOLS FOR SOIL & ROCK

SOIL

BITUMINOUS CONCRETE

CONCRETE

TOPSOIL

FILLING

PEAT

CLAY

SILTY CLAY

SANDY CLAY

GRAVELLY CLAY

SHALY CLAY

SILT

CLAYEY SILT

SANDY SILT

SAND

CLAYEY SAND

SILTY SAND

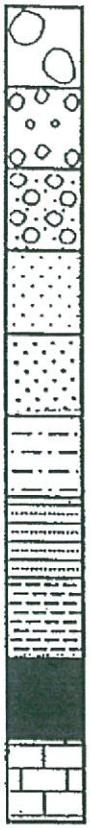
GRAVEL

SANDY GRAVEL

COBBLES/BOULDERS

TALUS

SEDIMENTARY ROCK



BOULDER CONGLOMERATE

CONGLOMERATE

CONGLOMERATIC SANDSTONE

SANDSTONE FINE GRAINED

SANDSTONE COARSE GRAINED

SILTSTONE

LAMINITE

MUDSTONE, CLAYSTONE, SHALE

COAL

LIMESTONE

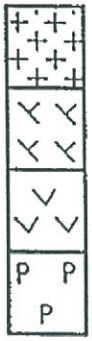
METAMORPHIC ROCK

SLATE, PHYLLITE, SCHIST

GNEISS

QUARTZITE

IGNEOUS ROCK



GRANITE

DOLERITE, BASALT

TUFF

PORPHYRY

SEAMS

SEAM
> 10 mm

SEAM
< 10 mm

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TEST PIT REPORT

CLIENT: Beechwood Homes
PROJECT: Proposed Rezoning
LOCATION: Area C – Thornton North

DATE: 1 May 2003
PROJECT No.: 31729
SURFACE LEVEL: 6.5m AHD*

PIT No: 1
SHEET 1 of 1

Depth (m)	Description of Strata	Graphic Log	Sampling & Testing: Type	Depth (m)	Results	Water
0.25	SILTY SAND: Loose to medium dense, dark brown sand with trace clay and some rootlets, damp		D,pp	0.15	100kPa	
0.45	SANDY CLAY: Hard, light grey mottled orange sandy clay, M<<Wp		D,pp	0.3	>600kPa	
0.75	SANDSTONE: Very low strength, highly weathered, light grey mottled orange sandstone		D	0.6		
	Test Pit 1 discontinued at 0.75m depth, refusal					

RIG: John Deere 310D Backhoe
LOGGED: Taylor
GROUND WATER OBSERVATIONS: No free groundwater observed
REMARKS: *Levels interpolated from contour plan

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
B	Bulk sample	U_x	Tube sample (x mm dia.)
D	Disturbed sample	Wp	Plastic limit (%)
M	Moisture content	HV	Hand Vane

CHECKED
Initials:
Date: 13/5/03

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TEST PIT REPORT

CLIENT: Beechwood Homes
PROJECT: Proposed Rezoning
LOCATION: Area C – Thornton North

DATE: 1 May 2003
PROJECT No.: 31729
SURFACE LEVEL: 12.75m AHD*

PIT No: 2
SHEET 1 of 1

Depth (m)	Description of Strata	Graphic Log	Sampling & Testing: Type	Sampling & Testing: Depth (m)	Sampling & Testing: Results	Water
	SANDY CLAY: Hard, light grey sandy clay with trace rootlets and ironstaining in fissures		pp	0.3	>600kPa	
			D,pp	0.5	>600kPa	
			pp	1.2	>600kPa	
1.4						
1.45	SANDSTONE: Low strength, highly weathered, light grey mottled orange sandstone					
	Test Pit 2 discontinued at 1.45m depth, refusal.					

RIG: John Deere 310D Backhoe
LOGGED: Taylor

GROUND WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Levels interpolated from contour plan

SAMPLING & IN SITU TESTING LEGEND

A Auger sample	pp Pocket penetrometer (kPa)
B Bulk sample	U_x Tube sample (x mm dia.)
D Disturbed sample	Wp Plastic limit (%)
M Moisture content	HV Hand Vane

CHECKED
Initials:
Date: 13/5/03

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TEST PIT REPORT

CLIENT: Beechwood Homes
PROJECT: Proposed Rezoning
LOCATION: Area C – Thornton North

DATE: 1 May 2003
PROJECT No.: 31729
SURFACE LEVEL: 15.5m AHD*

PIT No: 3
SHEET 1 of 1

Depth (m)	Description of Strata	Graphic Log	Sampling & Testing: Type	Sampling & Testing: Depth (m)	Sampling & Testing: Results	Water
0.1	FILLING: Generally comprising brown silty sand with some rootlets		D	0.05		
	FILLING: Generally comprising orange brown gravelly clayey sand, damp		D	0.3		
0.55	SILTY CLAY: Hard, light grey mottled orange silty clay, M<<Wp		D,pp	0.9	>600kPa	
	Grading to siltstone		pp	1.5	>600kPa	
1.7	SILTSTONE: Extremely low strength, highly weathered, light grey mottled orange siltstone		D	2.0		
2.4	Test Pit 3 discontinued at 2.4m depth					

RIG: John Deere 3100 Backhoe
LOGGED: Taylor

GROUND WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Levels interpolated from contour plan

SAMPLING & IN SITU TESTING LEGEND

A Auger sample	pp Pocket penetrometer (kPa)
B Bulk sample	U_x Tube sample (x mm dia.)
D Disturbed sample	Wp Plastic limit (%)
M Moisture content	HV Hand Vane

CHECKED
Initials: NG
Date: 13/5/03

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TEST PIT REPORT

CLIENT: Beechwood Homes
PROJECT: Proposed Rezoning
LOCATION: Area C – Thornton North

DATE: 1 May 2003
PROJECT No.: 31729
SURFACE LEVEL: 13m AHD*

PIT No: 4
SHEET 1 of 1

Depth (m)	Description of Strata	Graphic Log	Sampling & Testing: Type	Sampling & Testing: Depth (m)	Sampling & Testing: Results	Water
0.4	SILTY SAND: Medium dense, dark brown silty sand with trace rootlets, dry		D	0.2		
	SILTY CLAY: Hard, light grey mottled orange silty clay with trace sand, M>Wp		D,pp	0.6	450–550kPa	
1	From 1.0m depth, light grey mottled yellow		D,pp	1.3	510kPa	1
2	From 1.7m depth, very stiff		pp	2.0	390kPa	2
2.2	Test Pit 4 discontinued at 2.2m depth					

RIG: John Deere 310D Backhoe
LOGGED: Taylor
GROUND WATER OBSERVATIONS: No free groundwater observed
REMARKS: *Levels interpolated from contour plan

SAMPLING & IN SITU TESTING LEGEND

A Auger sample	pp Pocket penetrometer (kPa)
B Bulk sample	U_x Tube sample (x mm dia.)
D Disturbed sample	Wp Plastic limit (%)
M Moisture content	HV Hand Vane

CHECKED
Initials: MG
Date: 13/5/03

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TEST PIT REPORT

CLIENT: Beechwood Homes
PROJECT: Proposed Rezoning
LOCATION: Area C – Thornton North

DATE: 1 May 2003
PROJECT No.: 31729
SURFACE LEVEL: 15m AHD*

PIT No: 5
SHEET 1 of 1

Depth (m)	Description of Strata	Graphic Log	Sampling & Testing			Water
			Type	Depth (m)	Results	
	SILTY SAND: Medium dense, dark brown silty sand with trace rootlets, dry					
0.3	SANDY CLAY: Hard, grey mottled orange sandy clay, M<<Wp		D,pp	0.6	>600kPa	
			pp	0.8	>600kPa	
0.95	SANDSTONE: Low strength, highly weathered, light grey mottled orange sandstone		D	1.0		
1.1	Test Pit 5 discontinued at 1.1m depth, refusal.					

RIG: John Deere 310D Backhoe
LOGGED: Taylor
GROUND WATER OBSERVATIONS: No free groundwater observed
REMARKS: *Levels interpolated from contour plan

SAMPLING & IN SITU TESTING LEGEND

A Auger sample	pp Pocket penetrometer (kPa)
B Bulk sample	U_x Tube sample (x mm dia.)
D Disturbed sample	Wp Plastic limit (%)
M Moisture content	HV Hand Vane

CHECKED
Initials: MG
Date: 13/5/03

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TEST PIT REPORT

CLIENT: Beechwood Homes
PROJECT: Proposed Rezoning
LOCATION: Area C – Thornton North

DATE: 1 May 2003
PROJECT No.: 31729
SURFACE LEVEL: 23m AHD*

PIT No: 6
SHEET 1 of 1

Depth (m)	Description of Strata	Graphic Log	Sampling & Testing: Type	Depth (m)	Results	Water
	SILTY SAND: Medium dense, dark brown silty sand with trace rootlets, dry		D	0.1		
0.2	SILTY CLAY: Hard, light grey silty clay, M>Wp		D,pp	0.5	>600kPa	
	From 0.8m depth, light grey mottled orange		D,pp	1.3	>600kPa	
			pp	1.7	500–550kPa	
1.9	SILTSTONE: Extremely low strength, extremely weathered, light grey mottled orange siltstone		D	2.2		
2.4	Test Pit 6 discontinued at 2.4m depth					

RIG: John Deere 310D Backhoe
LOGGED: Taylor

GROUND WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Levels interpolated from contour plan

SAMPLING & IN SITU TESTING LEGEND

A Auger sample	pp Pocket penetrometer (kPa)
B Bulk sample	U_x Tube sample (x mm dia.)
D Disturbed sample	Wp Plastic limit (%)
M Moisture content	HV Hand Vane

CHECKED
Initials: AG
Date: 13/5/03

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TEST PIT REPORT

CLIENT: Beechwood Homes
PROJECT: Proposed Rezoning
LOCATION: Area C – Thornton North

DATE: 1 May 2003
PROJECT No.: 31729
SURFACE LEVEL: 11m AHD*

PIT No: 7
SHEET 1 of 1

Depth (m)	Description of Strata	Graphic Log	Sampling & Testing: Type	Sampling & Testing: Depth (m)	Sampling & Testing: Results	Water
0.25	SILTY SAND: Medium dense, dark brown silty sand with trace rootlets, dry					
0.8	SANDY CLAY: Hard, grey mottled orange sandy clay, M<<Wp		D,pp	0.5	>600kPa	
0.95	SANDSTONE: Very low strength, highly weathered, light grey mottled orange sandstone		D	0.9		
	Test Pit 7 discontinued at 0.95m depth, refusal					

RIG: John Deere 310D Backhoe
LOGGED: Taylor

GROUND WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Levels interpolated from contour plan

SAMPLING & IN SITU TESTING LEGEND

A Auger sample	pp Pocket penetrometer (kPa)
B Bulk sample	U_x Tube sample (x mm dia.)
D Disturbed sample	Wp Plastic limit (%)
M Moisture content	HV Hand Vane

CHECKED
Initials: MJ
Date: 13/5/03

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TEST PIT REPORT

CLIENT: Beechwood Homes
PROJECT: Proposed Rezoning
LOCATION: Area C – Thornton North

DATE: 1 May 2003
PROJECT No.: 31729
SURFACE LEVEL: 19m AHD*

PIT No: 8
SHEET 1 of 1

Depth (m)	Description of Strata	Graphic Log	Sampling & Testing: Type	Sampling & Testing: Depth (m)	Sampling & Testing: Results	Water
0.2	CLAYEY SAND: Firm, dark brown clayey sand with trace gravel and rootlets, moist					
	SILTY CLAY: Very stiff, grey silty clay with trace gravel, M>Wp		D,pp	0.7	270–300kPa	
	From 1.2m depth, light grey mottled yellow with trace gravel, M>Wp Grading to extremely weathered siltstone		D,pp	1.9	300–340kPa	
	From 2.4m depth, with trace extrmely low strength, extremely weathered siltstone cobbles					
2.6	Test Pit 8 discontinued at 2.6m depth					

RIG: John Deere 310D Backhoe
LOGGED: Taylor

GROUND WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Levels interpolated from contour plan

SAMPLING & IN SITU TESTING LEGEND

A Auger sample	pp Pocket penetrometer (kPa)
B Bulk sample	U_x Tube sample (x mm dia.)
D Disturbed sample	Wp Plastic limit (%)
M Moisture content	HV Hand Vane

CHECKED
Initials: MG
Date: 13/5/03

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TEST PIT REPORT

CLIENT: Beechwood Homes
PROJECT: Proposed Rezoning
LOCATION: Area C – Thornton North

DATE: 1 May 2003
PROJECT No.: 31729
SURFACE LEVEL: 20.25m AHD*

PIT No: 9
SHEET 1 of 1

Depth (m)	Description of Strata	Graphic Log	Sampling & Testing: Type	Sampling & Testing: Depth (m)	Sampling & Testing: Results	Water
0.15	CLAYEY SAND: Firm, dark brown clayey sand with trace gravel and rootlets, moist					
	SILTY CLAY: Hard, grey mottled orange silty clay, M<Wp		D,pp	0.7	>600kPa	
0.9	SILTSTONE: Extremely low to very low strength, extremely to highly weathred, light grey mottled orange siltstone		D	1.5		
	Strength increasing with depth					
2.5	Test Pit 9 discontinued at 2.5m depth					

RIG: John Deere 310D Backhoe
LOGGED: Taylor

GROUND WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Levels interpolated from contour plan

SAMPLING & IN SITU TESTING LEGEND

A Auger sample	pp Pocket penetrometer (kPa)
B Bulk sample	U_x Tube sample (x mm dia.)
D Disturbed sample	Wp Plastic limit (%)
M Moisture content	HV Hand Vane

CHECKED
Initials: MG
Date: 13/5/03

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TEST PIT REPORT

CLIENT: Beechwood Homes
PROJECT: Proposed Rezoning
LOCATION: Area C – Thornton North

DATE: 1 May 2003
PROJECT No.: 31729
SURFACE LEVEL: 8.75m AHD*

PIT No: 10
SHEET 1 of 1

Depth (m)	Description of Strata	Graphic Log	Sampling & Testing: Type	Depth (m)	Results	Water
	SILTY SAND: Medium dense, dark brown silty sand with trace rootlets, dry					
	From 0.25m depth, hard, light grey		D,pp	0.2	150kPa	
			pp	0.35	>600kPa	
0.5	SANDY CLAY: Hard, grey mottled orange sandy clay, M<Wp		D,pp	0.75	490kPa	
1.0	CLAYEY SAND/SANDY CLAY: Very stiff, grey mottled orange clayey sand/sandy clay, moist		D,pp	1.3	300kPa	
			pp	1.7	350kPa	
	From 2.3m depth, with some iron cemented areas		D	2.6		
2.8	Test Pit 10 discontinued at 2.8m depth					

RIG: John Deere 310D Backhoe
LOGGED: Taylor

GROUND WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Levels interpolated from contour plan

SAMPLING & IN SITU TESTING LEGEND

A Auger sample	pp Pocket penetrometer (kPa)
B Bulk sample	U_x Tube sample (x mm dia.)
D Disturbed sample	Wp Plastic limit (%)
M Moisture content	HV Hand Vane

CHECKED
Initials: MG
Date: 13/5/03

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TEST PIT REPORT

CLIENT: Beechwood Homes
PROJECT: Proposed Rezoning
LOCATION: Area C – Thornton North

DATE: 1 May 2003
PROJECT No.: 31729
SURFACE LEVEL: 28.5m AHD*

PIT No: 11
SHEET 1 of 1

Depth (m)	Description of Strata	Graphic Log	Sampling & Testing: Type	Depth (m)	Results	Water
0.00	TOPSOIL: Dark grey/brown sandy silt, with abundant rootlets, moist		D,pp	0.05	<100kPa	
	SILTY CLAY: Very stiff to hard, dark grey silty clay, trace fine gravel, M<Wp Moisture content increasing with depth					
	From 0.5m depth, M>Wp		D,pp	0.5	>600kPa	
	From 0.9m depth, M>>Wp, light grey					
1.1	SILTY CLAY: Very stiff to hard, light grey mottled orange silty clay with trace fine grained sand, M<Wp Grading to extremely weathered siltstone		D,pp	1.2	450–>600kPa	
	From 1.3m depth trace siltstone gravel					
1.5	CLAYSTONE/SILTSTONE: Extremely low strength, extremely weathered, light grey mottled light brown claystone/siltstone		D,pp	2.3	350–450kPa	
2.8	Test Pit 11 discontinued at 2.8m depth					

RIG: John Deere 310D Backhoe
LOGGED: Blackert
GROUND WATER OBSERVATIONS: No free groundwater observed
REMARKS:

SAMPLING & IN SITU TESTING LEGEND

A Auger sample	pp Pocket penetrometer (kPa)
B Bulk sample	U_x Tube sample (x mm dia.)
D Disturbed sample	Wp Plastic limit (%)
M Moisture content	HV Hand Vane

CHECKED
Initials: MG
Date: 13/5/03

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TEST PIT REPORT

CLIENT: Beechwood Homes
PROJECT: Proposed Rezoning
LOCATION: Area C – Thornton North

DATE: 1 May 2003
PROJECT No.: 31729
SURFACE LEVEL: 23m AHD*

PIT No: 12
SHEET 1 of 1

Depth (m)	Description of Strata	Graphic Log	Sampling & Testing: Type	Sampling & Testing: Depth (m)	Sampling & Testing: Results	Water
0.1	TOPSOIL: Grey/brown sandy silt with abundant rootlets					
	SILTY SAND: Dark grey silty sand with trace rootlets		D	0.3		
	Slightly cemented from 0.4m depth, light grey, silt content decreases					
0.6	SANDSTONE: Extremely low to very low strength, highly weathered, light grey mottled orange, fine to medium grained sandstone with occasional low strength seams		D	1.0		
	Becoming weaker from 1.1m depth					
	Strength increasing from 1.7m depth					
1.9	Test Pit 12 discontinued at 1.9m depth, near refusal					

RIG: John Deere 310D Backhoe
LOGGED: Blackert

GROUND WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Levels interpolated from contour plan

SAMPLING & IN SITU TESTING LEGEND

A Auger sample	pp Pocket penetrometer (kPa)
B Bulk sample	U_x Tube sample (x mm dia.)
D Disturbed sample	Wp Plastic limit (%)
M Moisture content	HV Hand Vane

CHECKED
Initials: MG
Date: 13/5/03

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TEST PIT REPORT

CLIENT: Beechwood Homes
PROJECT: Proposed Rezoning
LOCATION: Area C – Thornton North

DATE: 1 May 2003
PROJECT No.: 31729
SURFACE LEVEL: 16.75m AHD*

PIT No: 13
SHEET 1 of 1

Depth (m)	Description of Strata	Graphic Log	Sampling & Testing: Type	Depth (m)	Results	Water
0.15	TOPSOIL: Dark grey, fine grained sandy silt with abundant rootlets, moist		D	0.1		
	SILTY CLAY: Hard, light grey/grey mottled orange silty clay, M<Wp		D,pp	0.5	>600kPa	
				0.65		
	From 0.8m depth, M>Wp		U_{50}			
1.0	SILTY CLAY: Hard, grey mottled orange/red silty clay with trace orange/red ironstained gravel		pp	1.05	>600kPa	
			D,pp	1.2	>600kPa	
1.7	SILTSTONE: (Hard clay), extremely low strength, extremely weathered, light grey mottled yellow siltstone		D	2.3		
2.5	Test Pit 13 discontinued at 2.5m depth					

RIG: John Deere 310D Backhoe
LOGGED: Blackert

GROUND WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Levels interpolated from contour plan

SAMPLING & IN SITU TESTING LEGEND

A Auger sample	pp Pocket penetrometer (kPa)
B Bulk sample	U_x Tube sample (x mm dia.)
D Disturbed sample	Wp Plastic limit (%)
M Moisture content	HV Hand Vane

CHECKED
Initials:
Date: 13/5/03

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TEST PIT REPORT

CLIENT: Beechwood Homes
PROJECT: Proposed Rezoning
LOCATION: Area C – Thornton North

DATE: 1 May 2003
PROJECT No.: 31729
SURFACE LEVEL: 15m AHD*

PIT No: 14
SHEET 1 of 1

Depth (m)	Description of Strata	Graphic Log	Sampling & Testing: Type	Depth (m)	Results	Water
0.1	TOPSOIL: Dark grey brown sandy silt with abundant rootlets, moist		D	0.05		
	SILTY CLAY: Hard, dark grey silty clay, trace fine grained sand, M<Wp		D,pp	0.2	>600kPa	
	From 0.3m depth, light grey mottled orange yellow, M>Wp					
			D,pp	0.8	>600kPa	
1	From 1.0m depth, M<Wp grading to extremely low strength siltstone					1
1.4	SILTSTONE: (Hard clay), extremely low strength, extremely weathered, light grey mottled yellow siltstone					
	From 1.8m depth, with some ironcemented gravel					
2			D,pp	2.1	400–>600kPa	2
			D	2.3		
2.7	Test Pit 14 discontinued at 2.7m depth					

RIG: John Deere 310D Backhoe
LOGGED: Blackert

GROUND WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Levels interpolated from contour plan

SAMPLING & IN SITU TESTING LEGEND

A Auger sample	pp Pocket penetrometer (kPa)
B Bulk sample	U_x Tube sample (x mm dia.)
D Disturbed sample	Wp Plastic limit (%)
M Moisture content	HV Hand Vane

CHECKED
Initials: MG
Date: 13/5/03

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TEST PIT REPORT

CLIENT: Beechwood Homes
PROJECT: Proposed Rezoning
LOCATION: Area C – Thornton North

DATE: 1 May 2003
PROJECT No.: 31729
SURFACE LEVEL: 22.25m AHD*

PIT No: 15
SHEET 1 of 1

Depth (m)	Description of Strata	Graphic Log	Sampling & Testing: Type	Depth (m)	Results	Water
0.1	TOPSOIL: Dark grey/brown sandy silt with abundant rootlets		D	0.05		
	SILTY CLAY: Hard, grey silty clay with some fine grained sand, M<Wp		D,pp	0.5	>600kPa	
0.75						
0.8	SANDSTONE: Very low to low strength, extremely weathered, light grey mottled yellow sandstone		D	0.77		
	Test Pit 15 discontinued at 0.8m depth, refusal					
1						1
2						2

RIG: John Deere 310D Backhoe
LOGGED: Blackert

GROUND WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Levels interpolated from contour plan

SAMPLING & IN SITU TESTING LEGEND

A Auger sample	pp Pocket penetrometer (kPa)
B Bulk sample	U_x Tube sample (x mm dia.)
D Disturbed sample	Wp Plastic limit (%)
M Moisture content	HV Hand Vane

CHECKED
Initials: MG
Date: 13/5/03

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TEST PIT REPORT

CLIENT: Beechwood Homes
PROJECT: Proposed Rezoning
LOCATION: Area C – Thornton North

DATE: 1 May 2003
PROJECT No.: 31729
SURFACE LEVEL: 14.5m AHD*

PIT No: 16
SHEET 1 of 1

Depth (m)	Description of Strata	Graphic Log	Sampling & Testing: Type	Depth (m)	Results	Water
0.1	TOPSOIL: Dark grey/brown sandy silt, with abundant rootlets, moist		D	0.05		
	SILTY CLAY: Hard, grey silty clay, trace fine grained sand, M<Wp		D,pp	0.5	>600kPa	
				0.7		
0.8	SILTSTONE: Extremely low strength, extremely weathered, light grey yellow siltstone (hard clay)		U_{50}			
				1.1		
	Strength increasing with depth					
				1.5		
	With some ironcemented gravel from 1.8m depth					
2.7	Test Pit 16 discontinued at 2.7m depth					

RIG: John Deere 310D Backhoe
LOGGED: Blackert

GROUND WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Levels interpolated from contour plan

SAMPLING & IN SITU TESTING LEGEND

A Auger sample	pp Pocket penetrometer (kPa)
B Bulk sample	U_x Tube sample (x mm dia.)
D Disturbed sample	Wp Plastic limit (%)
M Moisture content	HV Hand Vane

CHECKED
Initials: HG
Date: 13/5/03

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TEST PIT REPORT

CLIENT: Beechwood Homes
PROJECT: Proposed Rezoning
LOCATION: Area C – Thornton North

DATE: 1 May 2003
PROJECT No.: 31729
SURFACE LEVEL: 15.5m AHD*

PIT No: 17
SHEET 1 of 1

Depth (m)	Description of Strata	Graphic Log	Sampling & Testing: Type	Sampling & Testing: Depth (m)	Sampling & Testing: Results	Water
	TOPSOIL: Dark grey/brown silty sand, moist		D	0.1		
0.15	SANDY CLAY: Hard, light grey sandy clay with trace fine gravel and silt, M<Wp		D,pp	0.5	>600kPa	
0.7	SILTSTONE: Very low strength, light grey/grey siltstone, grading to fine to coarse grained sandstone with depth		D	0.8		
0.85	Test Pit 17 discontinued at 0.85m depth, refusal					

RIG: John Deere 310D Backhoe
LOGGED: Blackert

GROUND WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Levels interpolated from contour plan

SAMPLING & IN SITU TESTING LEGEND

A Auger sample	pp Pocket penetrometer (kPa)
B Bulk sample	U_x Tube sample (x mm dia.)
D Disturbed sample	Wp Plastic limit (%)
M Moisture content	HV Hand Vane

CHECKED
Initials: MG
Date: 13/5/03

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TEST PIT REPORT

CLIENT: Beechwood Homes
PROJECT: Proposed Rezoning
LOCATION: Area C – Thornton North

DATE: 1 May 2003
PROJECT No.: 31729
SURFACE LEVEL: 12.75m AHD*

PIT No: 18
SHEET 1 of 1

Depth (m)	Description of Strata	Graphic Log	Sampling & Testing: Type	Sampling & Testing: Depth (m)	Sampling & Testing: Results	Water
0.15	TOPSOIL: Dark brown sandy silt with some to abundant rootlets, moist					
	SANDY SILT: Hard, grey/light grey sandy silt, damp		D	0.3		
0.4	SILTY CLAY: Hard, grey silty clay, M<Wp		D,pp	0.55 0.6	>600kPa	
0.7	SANDSTONE: Extremely low to low strength, light grey/grey mottled yellow sandstone		U_{50}			
	Mottled orange from 0.95m depth		1.0	0.95 1.0		
1.05	Test Pit 18 discontinued at 1.05m depth, refusal					

RIG: John Deere 310D Backhoe
LOGGED: Blackert

GROUND WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Levels interpolated from contour plan

SAMPLING & IN SITU TESTING LEGEND

A	Auger sample	pp	Pocket penetrometer (kPa)
B	Bulk sample	U_x	Tube sample (x mm dia.)
D	Disturbed sample	Wp	Plastic limit (%)
M	Moisture content	HV	Hand Vane

CHECKED	
Initials:	HC
Date:	13/5/03

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TEST PIT REPORT

CLIENT: Beechwood Homes
PROJECT: Proposed Rezoning
LOCATION: Area C – Thornton North

DATE: 1 May 2003
PROJECT No.: 31729
SURFACE LEVEL: 11.5m AHD*

PIT No: 19
SHEET 1 of 1

Depth (m)	Description of Strata	Graphic Log	Sampling & Testing: Type	Sampling & Testing: Depth (m)	Sampling & Testing: Results	Water
0.15	TOPSOIL: Dark grey/brown sandy silt with some to abundant rootlets, moist					
0.35	SILTY SAND: Dark grey/brown silty sand, moist		D	0.2		
1.0	SILTY CLAY: Hard, dark grey/brown, mottled orange silty clay with trace siltstone/sandstone cobbles/gravel, M<Wp		D,pp	0.6	>600kPa	
1.25	SILTSTONE: Extremely low to low strength, grey mottled orange/yellow siltstone		D	1.1		
	Test Pit 19 discontinued at 1.25m depth					

RIG: John Deere 310D Backhoe
LOGGED: Blackert

GROUND WATER OBSERVATIONS: No free groundwater observed

REMARKS: *Levels interpolated from contour plan

SAMPLING & IN SITU TESTING LEGEND

A Auger sample	pp Pocket penetrometer (kPa)
B Bulk sample	U_x Tube sample (x mm dia.)
D Disturbed sample	Wp Plastic limit (%)
M Moisture content	HV Hand Vane

CHECKED
Initials: MG
Date: 13/5/03

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RESULTS OF DYNAMIC PENETROMETER TESTS

CLIENT	Beechwood Homes	DATE	1.5.03
PROJECT	Proposed Rezoning	PROJECT NO	31729
LOCATION	Area C - Thornton North	PAGE NO	1 of 1

TEST LOCATIONS	1	2	3	4	5	6	7	8	9	10
RL OF TEST										
DEPTH m	PENETRATION RESISTANCE BLOWS/150mm									
0.00 - 0.15	3	-	2	2	4	2	3	2	2	2
0.15 - 0.30	5	4	5	6	4	7	7	4	9	4
0.30 - 0.45	10	5	6	5	5	6	9	4	10	5
0.45 - 0.60	20 ref	5	9	7	7	7	20	2	10	6
0.60 - 0.75		12	9	3	14/100	4	25/100	2	7	6
0.75 - 0.90		7	7	2	bounce	7	refusal	3	6	10
0.90 - 1.05		5	7	4		7		5	6	15
1.05 - 1.20			7	5		9		4	6	10
1.20 - 1.35										
1.35 - 1.50										
1.50 - 1.65										
1.65 - 1.80										
1.80 - 1.95										
1.95 - 2.10										
2.10 - 2.25										
2.25 - 2.40										
2.40 - 2.55										
2.55 - 2.70										
2.70 - 2.85										
2.85 - 3.00										

TEST METHOD AS 1289.6.3.2, CONE PENETROMETER ☑
AS 1289.6.3.3, FLAT END PENETROMETER ☐

TESTED BY: GT
CHECKED BY:

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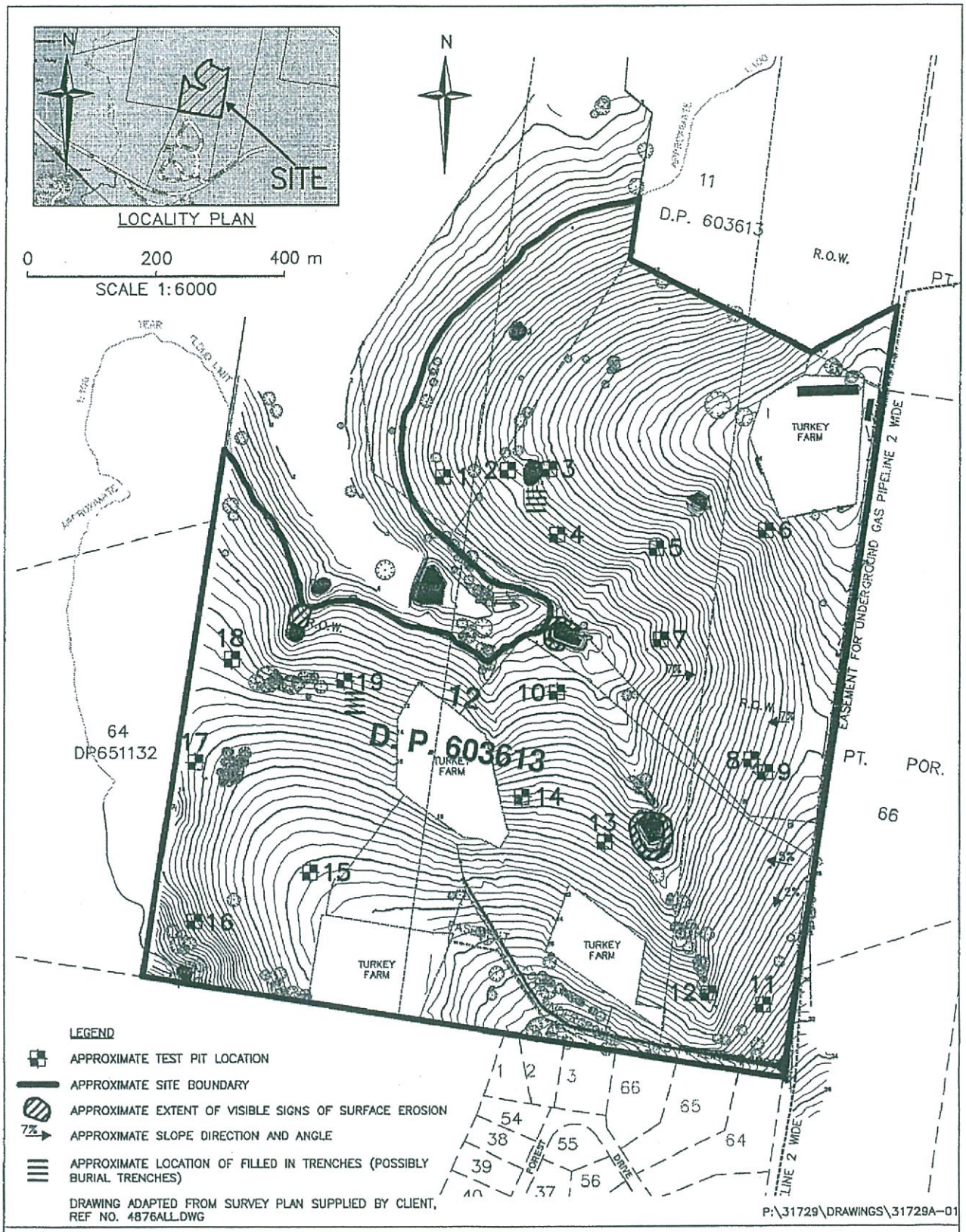

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Sydney, Newcastle, Brisbane, Melbourne, Perth, Wyong,

Wollongong, Campbelltown, Townsville, Cairns

TITLE: TEST LOCATION PLAN
PRELIMINARY GEOTECHNICAL ASSESSMENT – PROPOSED REZONING
AREA C – THORNTON NORTH

CLIENT: BEECHWOOD HOMES			OFFICE: NEWCASTLE
DRAWN BY: PH	SCALE: 1:6000	PROJECT No. 31729A	
APPROVED BY:		DATE: 7-11-03	DRAWING No: 1.