Department of
Infrastructure, Planning and Natural Resources

Geotechnical Policy – Kosciuszko Alpine Resorts
Form 4 – Minimal Impact Certification

Date received: ___/___/___ DA no: ____________

This form may be used where minor construction works which present minimal or no geotechnical impact on the site or related land are proposed to be erected within the "G" line area of the geotechnical maps. A geotechnical engineer or engineering geologist must inspect the site and/or review the proposed development documentation to determine if the proposed development requires a geotechnical report to be prepared to accompany the development application. Where the geotechnical engineer determines that such a report is not required then they must complete this form and attach design recommendations where required. A copy of form 4 with design recommendation, if required, must be submitted with the development application.

Please contact the Alpine Resorts Assessments Team in Jindabyne for further information. Phone 02 6456 1733.

To complete this form, please place a cross in the boxes ☐ and fill out the white sections.

1. Declaration made by geotechnical engineer or engineering geologist in relation to a nil or minimal geotechnical impact assessment and site classification

I,

Mr ☑ Ms ☐ Mrs ☐ Dr ☐ Other ____

PAUL D.

Family name

ROBERTS

OF

Company/organisation

JK GEOTECHNICS

certify that I am a geotechnical engineer /engineering geologist as defined by the "Policy" and I have ~~inspected the site~~ reviewed the attached report, Ref: 28248RHrpt, dated 22 April 2015 and reviewed the proposed development known as

PROPOSED ALTERATIONS AND ADDITIONS, HOUSE OF ULLR, THREDBO

As a result of ~~my~~ our site inspection and review of the following documentation

(List of documentation reviewed)

- Architectural drawings prepared by Mysont Berkery Architects (Job No. 1410, Drawing Nos. A1-00^H, A1-01^K, A1-02^K, A1-03^K, A2-01^F, A2.02^E, A2.03^F, dated April 2015).

I have determined that;

☑ the current load-bearing capacity of the existing building will not be exceeded or adversely impacted by the proposed development, and

☑ the proposed works are of such a minor nature that the requirement for geotechnical advice in the form of a geotechnical report, prepared in accordance with the "Policy", is considered unnecessary for the adequate and safe design of the structural elements to be incorporated into the new works, and

☑ in accordance with AS 2870.1 Residential Slabs and Footings, the site is to be classified as a type

(insert classification type)

'P'

☑ I have attached design recommendations to be incorporated in the structural design in accordance with this site classification.

I am aware that this declaration shall be used by the Department as an essential component in granting development consent for a structure to be erected within the "G" line area (as identified on the geotechnical maps) of Kosciuszko Alpine Resorts without requiring the submission of a geotechnical report in support of the development application.

4. Signatures

Signature

Paul Roberts

Name

PAUL D. ROBERTS

Chartered professional status

M.I.E Aust, CP ENG (2307698)

Date

22/4/15

5. Contact details

Alpine Resorts Assessments team
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REPORT

TO

A.HOFFMAN AND E.WORSLEY

ON

GEOTECHNICAL ASSESSMENT

FOR

PROPOSED ALTERATIONS AND ADDITIONS

AT

HOUSE OF ULLR,

MOWAMBA PLACE, THREDBO, NSW

22 April 2015

Ref: 28248RHrpt

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JKGeotechnicsABN17003550801

Date: 22 April 2015
Report No: 28248RHrpt
Revision No: 0

Report prepared by:

Adrian Hulskamp
Senior Associate | Geotechnical Engineer

Report reviewed by:

Paul Roberts
Senior Associate| Engineering Geologist

For and on behalf of
JK GEOTECHNICS
PO Box 976
NORTH RYDE BC NSW 1670

This Report (which includes all attachments and annexures) has been prepared by JK Geotechnics (JK) for its Client, and is intended for the use only by that Client.

This Report has been prepared pursuant to a contract between JK and its Client and is therefore subject to:

a) JK's proposal in respect of the work covered by the Report;

b) the limitations defined in the Client's brief to JK;

c) the terms of contract between JK and the Client, including terms limiting the liability of JK.

If the Client, or any person, provides a copy of this Report to any third party, such third party must not rely on this Report, except with the express written consent of JK which, if given, will be deemed to be upon the same terms, conditions, restrictions and limitations as apply by virtue of (a), (b), and (c) above.

Any third party who seeks to rely on this Report without the express written consent of JK does so entirely at their own risk and to the fullest extent permitted by law, JK accepts no liability whatsoever, in respect of any loss or damage suffered by any such third party.

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BOREHOLE LOG 3

DYNAMIC CONE PENETRATION TEST RESULTS (1, 2 AND 3)

FIGURE 1: GEOTECHNICAL SITE PLAN

FIGURE 2: GEOTECHNICAL MAPPING SYMBOLS

REPORT EXPLANATION NOTES

1 INTRODUCTION

This report presents the results of a geotechnical assessment for the proposed alterations and additions at House of Ullr, Mowamba Place, Thredbo, NSW. The assessment was commissioned by A.Hoffman and E.Worsley by signed 'Acceptance of Proposal' form, dated 18 March 2015. The commission was on the basis of our proposal, Ref: P40048ZH, dated 20 February 2015.

To assist with our assessment, we have been supplied with architectural drawings prepared by Myson and Berkery Architects (Job No. 14 10, Drawing Nos. A1-00^{H}, A1-01^{K}, A1-02^{K}, A1-03^{K}, A2-01^{F}, A2.02^{E}, A2.03^{F}, dated April 2015).

From our review of the supplied drawings, we understand the proposed alterations and additions will comprise the following:

1. A ground floor level extension off the north-western corner of the building to expand the existing bar.
2. A second floor addition off Level 2 at the south-western corner of the building. A porch will be cantilevered off the southern side of the addition.
3. Internal alterations which will not likely require any specific geotechnical advice.
4. Diversion of an existing sewerage main.

We have assumed relatively light structural loads for this type of development.

The purpose of the assessment was to carry out a walkover inspection of the site and to obtain geotechnical information on subsurface conditions, using portable manually operated equipment, as a basis for comments and recommendations on footings. A secondary purpose of the assessment was to determine whether the proposed works present minimal or no geotechnical impact on the site, and if so, to prepare a signed Form 4 – Minimal Impact Certification. Based on our assessment, we would determine whether a further geotechnical report, which includes a risk assessment, would be required.

This report has been prepared in accordance with the requirements of the Geotechnical Policy for Kosciuszko Alpine Resorts (2003). It is understood that this report will be submitted as part of the Development Application documentation.

2 ASSESSMENT PROCEDURE

2.1 Walkover Survey

A walkover survey was carried out by our geotechnical engineer (Adrian Callus) on 1 April 2015.

The assessment was based on a walkover survey of the topographic, surface drainage and geological conditions of the site and its immediate environs. A summary of our site observations is presented in Section 3.1 below.

Record site photographs were taken during the walkover survey, one of which has been included in this report.

Figure 2 presents details of the geotechnical mapping terms and symbols used in Figure 1. The slope angles in Section 3.1 were measured by hand held clinometer and hence are only approximate. We note that should any of the geotechnical features referred to below in Section 3.1 be critical to the proposed alterations and additions, we recommend they be located more accurately using instrument survey techniques.

2.2 Subsurface Investigation

A limited scope geotechnical investigation was carried out concurrently with the walkover survey and included the following scope of work:

- One borehole (BH3) drilled using a hand auger to a refusal depth at 0.3m below existing grade. The borehole was attempted at two other nearby locations and refusal occurred at similar depth; and
- Three Dynamic Cone Penetration (DCP) tests (DCP1, DCP2 and DCP3) completed to depths of 0.35m (DCP1), 3.5m (DCP2) and 0.6m (DCP3) below existing grade. DCP1 and DCP2 were positioned close to the proposed ground floor level extension footprint in an area away from known buried electrical services. DCP3 was positioned in the area of the proposed second floor addition. The concrete pavement at DCP3 was penetrated using an electric impact hammer drill.

The test locations were set out by tape measurements off the existing building and are shown on the attached Figure 1. Figure 1 is based on one of the original supplied architectural drawings (Sheet 1/10, dated March 2003).

A survey plan of the site was not provided to us and therefore the surface reduced level at each test location was not established.

The nature and composition of the subsoils were assessed by visual and tactile examination of the materials recovered during drilling. The state of compaction and density of the subsoil profile was assessed by interpretation of the DCP test results. We note that the refusal of the DCP equipment often indicates the depth to the underlying bedrock. However, due to the equipment's limitations, it may also refuse on obstructions within fill, tree roots, ironstone gravel bands or other 'hard' layers within the soil profile and not necessarily on bedrock. Groundwater observations were made in the borehole during the fieldwork. Further details of the methods and procedures employed in the investigation are presented in the attached Report Explanation Notes.

Our geotechnical engineer was present on a full-time basis during the fieldwork to set out the test locations, nominate the testing and sampling, and prepare the attached borehole log and DCP test results sheet. The Report Explanation Notes define the logging terms and symbols used.

Geotechnical laboratory testing and a contamination screen of site soils and groundwater were outside the agreed scope of this investigation.

3 RESULTS OF THE ASSESSMENT

3.1 Site Observations

The following site observations should be read in conjunction with reference to the attached Figure 1.

The site is located near the toe of a moderately sloping north-west facing hillside, which grades at about 25°. Thredbo Creek meanders along the toe of the hillside. The site is bound by Bobuck Lane to the north and Mowamba Place to the west. A right-of-way bounds the site to the south.

At the time of the fieldwork, the site was occupied by a two to four storey rendered concrete block and stone cladded building, which appeared to be in relatively good external condition based on a cursory inspection. Refer to Plate 1 below. The building appears to have been constructed on a platform formed by cut-to-fill earthworks. The area of cut was over the southern side of the building, whilst the area of fill was located to the north of the building. A granite boulder retaining wall supported the cut into the hillside on the southern side of the building to a maximum height of about 2.2m. A granite boulder and masonry retaining wall supported the northern and western sides of the site, respectively. The retaining walls supported the ground surface within the site to heights between about 0.7m and 1.5m above Bobuck Lane and Mowamba Place. The retaining walls appeared to be in reasonable condition, based on a cursory inspection from within the subject site, with no obvious sign of bulging or vertical rotation. A batter slope which graded down between about 20° and 45° was located between the crest of the southern retaining wall and right-of-way further to the south.

Plate 1: Western elevation of House of Ullr

Based on our surface observations and reference to the supplied architectural drawings, a buried sewerage main, oriented approximately north-south, runs below the proposed ground floor level extension footprint. Details of the sewerage main such as pipe diameter, invert level etc are unknown.

We did not observe any obvious sign of deep seated hillside instability, such as slumping of the ground surface, tension cracks, basal curvature of trees etc at, or in the immediate vicinity of, the subject site.

3.2 Subsurface Conditions

The 1:250,000 geological map of Tallangatta (Series SJ 55-3) indicates the site is underlain by granite bedrock.

Reference should be made to the attached borehole log and DCP test results for specific details at each test location. A summary of the pertinent subsurface characteristics is presented below:

- Fill comprising silty sandy gravel was encountered from the ground surface of BH3 and extended down to the borehole termination depth at 0.3m. Hand auger refusal during drilling occurred on an obstruction within the fill. Based on the DCP test results, the fill in BH3 was assessed to be well compacted.
- DCP1 and DCP3 are inferred to extend through fill materials. DCP refusal occurred at 0.35m (DCP1) and 0.6m (DCP3) depth, most likely on obstructions in the fill profile. The fill in DCP1 was assessed to be poorly compacted.
- DCP2 was located in close proximity to the buried sewerage main. Assuming DCP2 may have extended through trench backfill associated with the buried sewer, fill is inferred to extend down to about 2m depth at that location. The fill in DCP2 was assessed to be poorly to well compacted.
- Medium dense residual silty sand is inferred between about 2m and 3.5m depth in DCP2. DCP2 was terminated within the soil profile. It is also possible that the DCP rods may have extended through a sub-vertical joint plane present between corestones of granite bedrock.
- BH3 was 'dry' during, and on completion of, drilling. We note that the groundwater level may not have stabilised within the short observation period. No long term groundwater monitoring has been carried out.

Based on the good performance of the existing building on site, our site observations and understanding of the site's geology, we infer that the footings which support the existing building are founded within the underlying weathered bedrock.

4 COMMENTS AND RECOMMENDATIONS

Based on our walkover survey and with reference to the supplied architectural drawings, we consider that the proposed alterations and additions will constitute 'minimal or no geotechnical impact' on the site. Therefore, we consider that a geotechnical report prepared in accordance with the Geotechnical Policy for Kosciuszko Alpine Resorts (2003) is not required. This report is preceded by the completed Form 4 – Minimal Impact Certification.

Fill was either encountered or inferred at all test locations down to a maximum depth of 2.0m. We have no records that document the manner of placement, compaction specification and control of the fill. The fill was assessed to be variably compacted. Hence, the fill is deemed not to be a 'controlled' fill as defined in Clause 1.8.13 of AS2870-2011 'Residential slabs and footings'. As the site is locally underlain by more than 0.8m of uncontrolled sand fill, the site is Class 'P' in accordance with AS2870-2011.

The standard footing designs in AS2870-2011 are not relevant to this project and therefore design of the footings will need to be carried out by using engineering principles.

We recommend that the following be taken into account during the design and construction phase:

1. We recommend that where proposed structures rely on existing footings for support, then those existing footings be designed to support a maximum allowable bearing pressure of 600kPa. A review of previous as-built structural drawings may confirm that the footings are founded on bedrock. If there are no as-built drawings available, then we recommend that a test pit be excavated to expose the base of the existing footing to confirm that the footing is founded in the underlying weathered bedrock. Should the footing not be founded in bedrock, then further geotechnical advice must be sought.
2. If new footings are required, then these should be founded in the underlying bedrock and designed for a maximum allowable bearing pressure of 600kPa. Where the bedrock is shallow, say less than 1.2m depth, then pad and/or strip footings would be appropriate. Where the bedrock is deeper than 1.2m depth, then bored piles or bucket piers would be required. An allowance should be made for temporary or permanent liners, as the fill in some areas may potentially collapse into an open pile hole. Care must be taken to not undermine existing footings which support the existing building and nearby buried services. If there is any doubt as to the quality of the foundation material, then further geotechnical advice should be sought.

3. Any new footings located in close proximity to the existing sewerage main must be founded below an imaginary line drawn up from the sewer invert level at 45°.
4. Any existing subsoil drainage or surface drainage measures disturbed as part of the proposed alterations and additions should be reconstructed or diverted around the proposed new structures so that the current site drainage is maintained.
5. Any new unsealed drip lines should be sealed with a concrete lined dish drain which is dispersed in a controlled manner to the stormwater system.
6. All water bearing services be checked for leaks. If leaks are found, then these should be repaired
7. If we are required to sign a Form 3 *'Final Geotechnical Certificate'* for the proposed alterations and additions or to confirm the foundation material below an existing footing, then a geotechnical engineer will need to inspect the foundation materials of any new footings prior to pouring of concrete.

5 GENERAL COMMENTS

The recommendations presented in this report include specific issues to be addressed during the construction phase of the project. In the event that any of the construction phase recommendations presented in this report are not implemented, the general recommendations may become inapplicable and JK Geotechnics accept no responsibility whatsoever for the performance of the structure where recommendations are not implemented in full and properly tested, inspected and documented.

It is possible that the subsurface soil, rock or groundwater conditions encountered during construction may be found to be different (or may be interpreted to be different) from those inferred from our surface observations in preparing this report. Also, we have not had the opportunity to observe surface run-off patterns during heavy rainfall and cannot comment directly on this aspect. If conditions appear to be at variance or cause concern for any reason, then we recommend that you immediately contact this office.

This report provides advice on geotechnical aspects for the proposed civil and structural design. As part of the documentation stage of this project, Contract Documents and Specifications may be prepared based on our report. However, there may be design features we are not aware of or have not commented on for a variety of reasons. The designers should satisfy themselves that all the necessary advice has been obtained. If required, we could be commissioned to review the geotechnical aspects of contract documents to confirm the intent of our recommendations has been correctly implemented.

This report has been prepared for the particular project described and no responsibility is accepted for the use of any part of this report in any other context or for any other purpose. If there is any change in the proposed development described in this report then all recommendations should be reviewed. Copyright in this report is the property of JK Geotechnics. We have used a degree of care, skill and diligence normally exercised by consulting engineers in similar circumstances and locality. No other warranty expressed or implied is made or intended. Subject to payment of all fees due for the investigation, the client alone shall have a licence to use this report. The report shall not be reproduced except in full.

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BOREHOLE LOG

Borehole No.
3
1/1

Client: A. HOFFMAN & E. WORSLEY
Project: PROPOSED ALTERATIONS AND ADDITIONS
Location: HOUSE OF ULLR, MOWAMBA PLACE, THREDBO, NSW

Job No. 28248ZH **Method:** HAND AUGER **R.L. Surface:** N/A
Date: 1-4-15 **Datum:**
Logged/Checked by: A.P.C./A.J.H.

Groundwater Record	SAMPLES ES	SAMPLES U50	SAMPLES DB	SAMPLES DS	Field Tests	Depth (m)	Graphic Log	Unified Classification	DESCRIPTION	Moisture Condition/ Weathering	Strength/ Rel. Density	Hand Penetrometer Readings (kPa.)	Remarks
DRY ON COMPLET-ION					REFER TO DCP TEST RESULTS	0			FILL: Silty sandy gravel, fine to coarse grained sub angular igneous, grey and brown, fine grained sand, with roots and root fibres.	D			GRASS COVER APPEARS WELL COMPACTED
						0.5 1 1.5 2 2.5 3 3.5			END OF BOREHOLE AT 0.3m				HAND AUGER REFUSAL ON OBSTRUCTION IN FILL BOREHOLE ATTEMPTED AT TWO LOCATIONS

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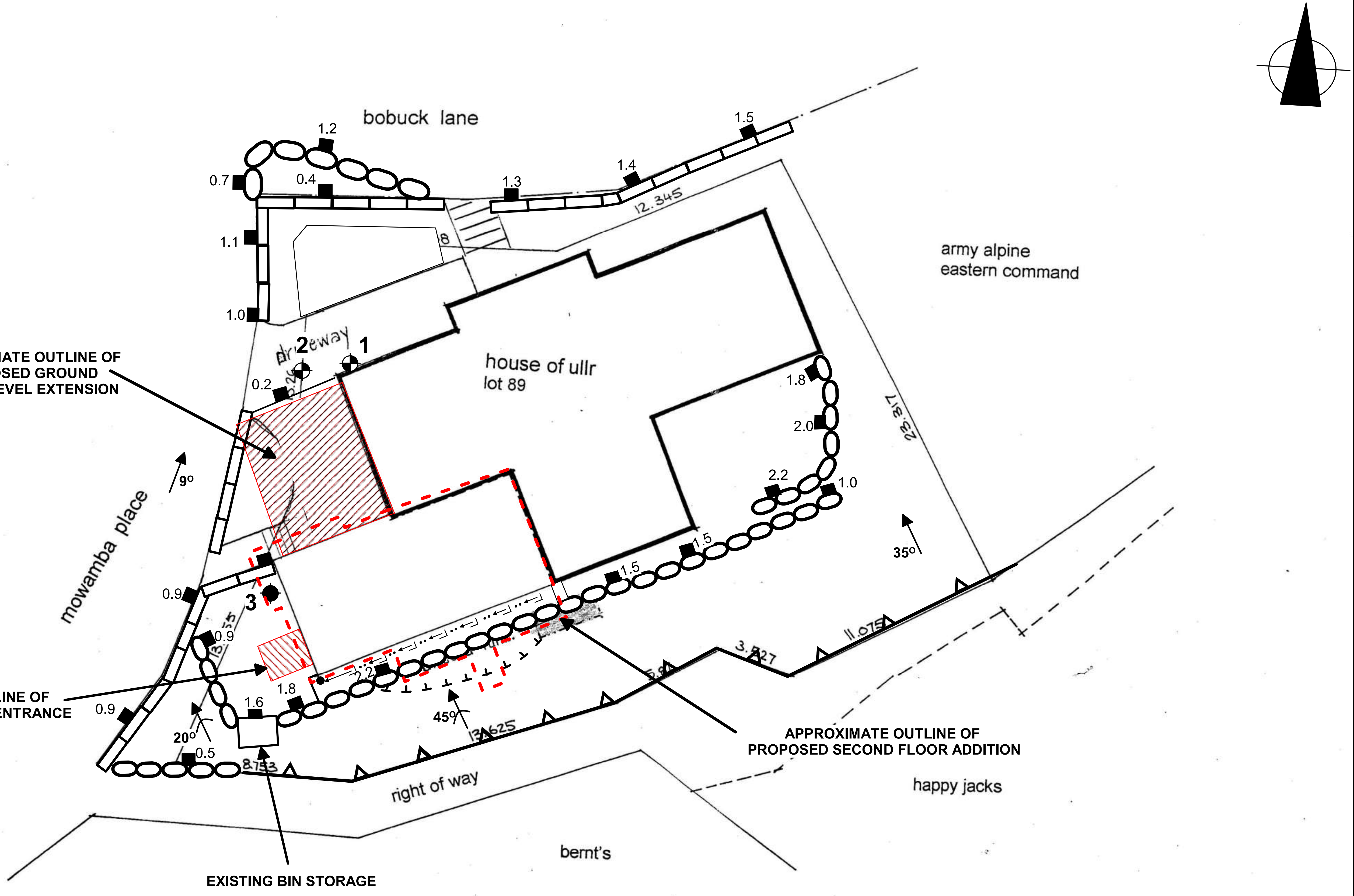
DYNAMIC CONE PENETRATION TEST RESULTS

Client:	A. HOFFMAN & E. WORSLEY		
Project:	PROPOSED ALTERATIONS AND ADDITIONS		
Location:	HOUSE OF ULLR, MOWAMBA PLACE, THREDBO, NSW		
Job No.	28248ZH	Hammer Weight & Drop: 9kg/510mm	
Date:	1-4-15	Rod Diameter: 16mm	
Tested By:	A.P.C.	Point Diameter: 20mm	

Number of Blows per 100mm Penetration

Test Location / Depth (mm)	1	2	3	Test Location / Depth (mm)	2		
0 - 100	SUNK	9	EXCAVATED	3000-3100	8		
100 - 200	1	10	9	3100-3200	8		
200 - 300	2	10	18	3200-3300	8		
300 - 400	2/50mm	4	16	3300-3400	8		
400 - 500	REFUSAL	6	20	3400-3500	8		
500 - 600		9	23	3500-3600	END		
600 - 700		4	REFUSAL	3600-3700			
700 - 800		3		3700-3800			
800 - 900		3		3800-3900			
900 - 1000		3		3900-4000			
1000 - 1100		4		4000-4100			
1100 - 1200		4		4100-4200			
1200 - 1300		3		4200-4300			
1300 - 1400		2		4300-4400			
1400 - 1500		1		4400-4500			
1500 - 1600		1		4500-4600			
1600 - 1700		2		4600-4700			
1700 - 1800		2		4700-4800			
1800 - 1900		2		4800-4900			
1900 - 2000		3		4900-5000			
2000 - 2100		3		5000-5100			
2100 - 2200		4		5100-5200			
2200 - 2300		4		5200-5300			
2300 - 2400		6		5300-5400			
2400 - 2500		6		5400-5500			
2500 - 2600		6		5500-5600			
2600 - 2700		6		5600-5700			
2700 - 2800		8		5700-5800			
2800 - 2900		12		5800-5900			
2900 - 3000		8		5900-6000			

Remarks:
1. The procedure used for this test is similar to that described in AS1289.6.3.2-1997, Method 6.3.2.
2. Usually 8 blows per 20mm is taken as refusal



APPROXIMATE SCALE (m)

0 10

LEGEND

BOREHOLE AND DCP TEST

DCP TEST

NOTES

1. TO BE READ IN CONJUNCTION WITH THE TEXT OF REPORT
2. REFER TO FIGURE 2 FOR AN EXPLANATION OF THE GEOTECHNICAL MAPPING SYMBOLS

GEOTECHNICAL SITE PLAN

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Report No. 28248ZH Figure No. 1

TOPOGRAPHY

Symbol *Ground Profile*

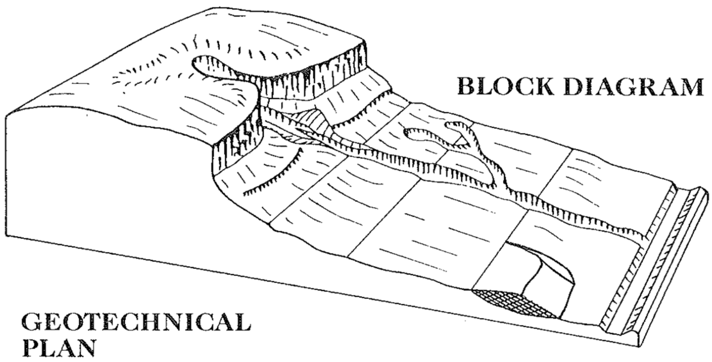
- convex / concave } well defined or angular break of slope
- convex / concave } poorly defined or smooth change of slope
- breaks of slope / changes of slope } convex and concave too close together to allow the use of separate symbols
- sharp / rounded } ridge crest
- Cliff or escarpment or sharp break 40° or more (estimated height in metres) — 3
- 15 Uniform Slope / 10 Concave Slope / 8 Convex Slope } Slope direction and angle (Degrees)
- Top / Bottom } Cut or fill slope, arrows pointing down slope
- Hummocky or irregular ground

OTHER FEATURES

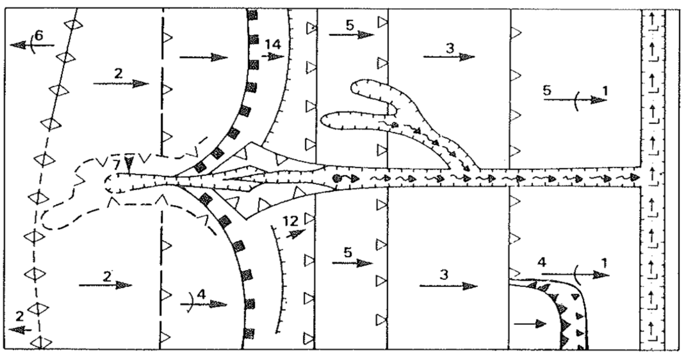
- Boulder
- Seepage/spring
- Swallow hole for runoff
- Natural water course
- Open drain, unlined
- Open drain, lined
- Fenceline
- Property boundary
- Dry Stone Wall
- J —— J 200 Major joint in rock face (opening in millimetres)
- – T – T – 10 Tension crack (opening in millimetres)
- Masonry or concrete wall
- Ponding water
- Boggy or swampy area

EXAMPLE OF USE OF TOPOGRAPHIC SYMBOLS:

BLOCK DIAGRAM



GEOTECHNICAL PLAN



(After Gardiner, V & Dackombe, R.V. (1983), Geomorphological Field Manual; George Allen & Unwin).

GEOTECHNICAL MAPPING SYMBOLS

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Report No. 28248ZH Figure No. 2

REPORT EXPLANATION NOTES

INTRODUCTION

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

The ground is a product of continuing natural and man-made processes and therefore exhibits a variety of characteristics and properties which vary from place to place and can change with time. Geotechnical engineering involves gathering and assimilating limited facts about these characteristics and properties in order to understand or predict the behaviour of the ground on a particular site under certain conditions. This report may contain such facts obtained by inspection, excavation, probing, sampling, testing or other means of investigation. If so, they are directly relevant only to the ground at the place where and time when the investigation was carried out.

DESCRIPTION AND CLASSIFICATION METHODS

The methods of description and classification of soils and rocks used in this report are based on Australian Standard 1726, the SAA Site Investigation Code. In general, descriptions cover the following properties – soil or rock type, colour, structure, strength or density, and inclusions. Identification and classification of soil and rock involves judgement and the Company infers accuracy only to the extent that is common in current geotechnical practice.

Soil types are described according to the predominating particle size and behaviour as set out in the attached Unified Soil Classification Table qualified by the grading of other particles present (e.g. sandy clay) as set out below:

Soil Classification	Particle Size
Clay	less than 0.002mm
Silt	0.002 to 0.075mm
Sand	0.075 to 2mm
Gravel	2 to 60mm

Non-cohesive soils are classified on the basis of relative density, generally from the results of Standard Penetration Test (SPT) as below:

Relative Density	SPT 'N' Value (blows/300mm)
Very loose	less than 4
Loose	4 – 10
Medium dense	10 – 30
Dense	30 – 50
Very Dense	greater than 50

Cohesive soils are classified on the basis of strength (consistency) either by use of hand penetrometer, laboratory testing or engineering examination. The strength terms are defined as follows.

Classification	Unconfined Compressive Strength kPa
Very Soft	less than 25
Soft	25 – 50
Firm	50 – 100
Stiff	100 – 200
Very Stiff	200 – 400
Hard	Greater than 400
Friable	Strength not attainable – soil crumbles

Rock types are classified by their geological names, together with descriptive terms regarding weathering, strength, defects, etc. Where relevant, further information regarding rock classification is given in the text of the report. In the Sydney Basin, 'Shale' is used to describe thinly bedded to laminated siltstone.

SAMPLING

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

Disturbed samples taken during drilling provide information on plasticity, grain size, colour, moisture content, minor constituents and, depending upon the degree of disturbance, some information on strength and structure. Bulk samples are similar but of greater volume required for some test procedures.

Undisturbed samples are taken by pushing a thin-walled sample tube, usually 50mm diameter (known as a U50), into the soil and withdrawing it with a sample of the soil contained 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 used are given on the attached logs.

INVESTIGATION METHODS

The following is a brief summary of investigation methods currently adopted by the Company and some comments on their use and application. All except test pits, hand auger drilling and portable dynamic cone penetrometers require the use of a mechanical drilling rig which is commonly mounted on a truck chassis.

Test Pits: These are normally excavated with a backhoe or a tracked excavator, allowing close examination of the insitu soils if it is safe to descend into the pit. The depth of penetration is limited to about 3m for a backhoe and up to 6m for an excavator. Limitations of test pits are the problems associated with disturbance and difficulty of reinstatement and the consequent effects on close-by structures. Care must be taken if construction is to be carried out near test pit locations to either properly recompact the backfill during construction or to design and construct the structure so as not to be adversely affected by poorly compacted backfill at the test pit location.

Hand Auger Drilling: A borehole of 50mm to 100mm diameter is advanced by manually operated equipment. Premature refusal of the hand augers can occur on a variety of materials such as hard clay, gravel or ironstone, and does not necessarily indicate rock level.

Continuous Spiral Flight Augers: The borehole is advanced using 75mm to 115mm diameter continuous spiral flight augers, which are withdrawn at intervals to allow sampling and insitu testing. This is a relatively economical means of drilling in clays and in sands above the water table. Samples are returned to the surface by the flights or may be collected after withdrawal of the auger flights, but they can be very disturbed and layers may become mixed. Information from the auger sampling (as distinct from specific sampling by SPTs or undisturbed samples) is of relatively lower reliability due to mixing or softening of samples by groundwater, or uncertainties as to the original depth of the samples. Augering below the groundwater table is of even lesser reliability than augering above the water table.

Rock Augering: Use can be made of a Tungsten Carbide (TC) bit for auger drilling into rock to indicate rock quality and continuity by variation in drilling resistance and from examination of recovered rock fragments. This method of investigation is quick and relatively inexpensive but provides only an indication of the likely rock strength and predicted values may be in error by a strength order. Where rock strengths may have a significant impact on construction feasibility or costs, then further investigation by means of cored boreholes may be warranted.

Wash Boring: The borehole is usually 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.

Mud Stabilised Drilling: Either Wash Boring or Continuous Core Drilling can use drilling mud as a circulating fluid to stabilise the borehole. The term 'mud' encompasses a range of products ranging from bentonite to polymers such as Revert or Biogel. The mud tends to mask the cuttings and reliable identification is only possible from intermittent intact sampling (eg from SPT and U50 samples) or from rock coring, etc.

Continuous Core Drilling: A continuous core sample is obtained using a diamond tipped core barrel. Provided full core recovery is achieved (which is not always possible in very low strength rocks and granular soils), this technique provides a very reliable (but relatively expensive) method of investigation. In rocks, an NMLC triple tube core barrel, which gives a core of about 50mm diameter, is usually used with water flush. The length of core recovered is compared to the length drilled and any length not recovered is shown as CORE LOSS. The location of losses are determined on site by the supervising engineer; where the location is uncertain, the loss is placed at the top end of the drill run.

Standard Penetration Tests: Standard Penetration Tests (SPT) are used mainly in non-cohesive soils, but can also be used in cohesive soils as a means of indicating 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 F3.1.

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

The test results are reported in the following form:

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

  N = 13
  4, 6, 7

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

  N>30
  15, 30/40mm

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

Occasionally, the drop hammer is used to drive 50mm diameter thin walled sample tubes (U50) in clays. In such circumstances, the test results are shown on the borehole logs in brackets.

A modification to the SPT test is where the same driving system is used with a solid 60° tipped steel cone of the same diameter as the SPT hollow sampler. The solid cone can be continuously driven for some distance in soft clays or loose sands, or may be used where damage would otherwise occur to the SPT. The results of this Solid Cone Penetration Test (SCPT) are shown as "N_c" on the borehole logs, together with the number of blows per 150mm penetration.

Static Cone Penetrometer Testing and Interpretation: Cone penetrometer testing (sometimes referred to as a Dutch Cone) described in this report has been carried out using an Electronic Friction Cone Penetrometer (EFCP). The test is described in Australian Standard 1289, Test F5.1.

In the tests, a 35mm diameter rod with a conical tip 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 frictional resistance on a separate 134mm long sleeve, immediately behind the cone. Transducers in the tip of the assembly are electrically connected by wires passing through the centre of the push rods to an amplifier and recorder unit mounted on the control truck.

As penetration occurs (at a rate of approximately 20mm per second) the information is output as incremental digital records every 10mm. The results given in this report have been plotted from the digital data.

The information provided on the charts comprise:

- 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 as a percentage.

  The ratios of the sleeve resistance to cone resistance will vary with the type of soil encountered, with higher relative friction in clays than in sands. Friction ratios of 1% to 2% are commonly encountered in sands and occasionally very soft clays, rising to 4% to 10% in stiff clays and peats. Soil descriptions based on cone resistance and friction ratios are only inferred and must not be considered as exact.

Correlations between EFCP and SPT values can be developed for both sands and clays but may be site specific.

Interpretation of EFCP values can be made to empirically derive modulus or compressibility values to allow calculation of foundation settlements.

Stratification can be inferred from the cone and friction traces and from experience and information from nearby boreholes etc. Where shown, this information is presented for general guidance, but must be regarded as interpretive. The test method provides a continuous profile of engineering properties but, where precise information on soil classification is required, direct drilling and sampling may be preferable.

Portable Dynamic Cone Penetrometers: Portable Dynamic Cone Penetrometer (DCP) tests are carried out by driving a rod into the ground with a sliding hammer and counting the blows for successive 100mm increments of penetration.

Two relatively similar tests are used:

- Cone penetrometer (commonly known as the Scala Penetrometer) – a 16mm rod with a 20mm diameter cone end is driven with a 9kg hammer dropping 510mm (AS1289, Test F3.2). The test was developed initially for pavement subgrade investigations, and correlations of the test results with California Bearing Ratio have been published by various Road Authorities.
- Perth sand penetrometer – a 16mm diameter flat ended rod is driven with a 9kg hammer, dropping 600mm (AS1289, Test F3.3). This test was developed for testing the density of sands (originating in Perth) and is mainly used in granular soils and filling.

LOGS

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

The attached explanatory notes define the terms and symbols used in preparation of the logs.

Interpretation of the information shown on the logs, and its application to design and construction, should therefore take into account the spacing of boreholes or test pits, the method of drilling or excavation, the frequency of sampling and testing and the possibility of other than "straight line" variations between the boreholes or test pits. Subsurface conditions between boreholes or test pits may vary significantly from conditions encountered at the borehole or test pit locations.

GROUNDWATER

Where groundwater levels are measured in boreholes, there are several potential problems:

- Although groundwater may be present, in low permeability soils it 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 and may not be the same at the time of construction.
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must be washed out of the hole or 'reverted' chemically if water observations are to be made.

More reliable measurements can be made by installing standpipes which are read after stabilising at intervals ranging from several days to 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 perched water tables or surface water.

FILL

The presence of fill materials can often be determined only by the inclusion of foreign objects (eg bricks, steel etc) or by distinctly unusual colour, texture or fabric. Identification of the extent of fill materials will also depend on investigation methods and frequency. Where natural soils similar to those at the site are used for fill, it may be difficult with limited testing and sampling to reliably determine the extent of the fill.

The presence of fill materials is usually regarded with caution as the possible variation in density, strength and material type is much greater than with natural soil deposits. Consequently, there is an increased risk of adverse engineering characteristics or behaviour. If the volume and quality of fill is of importance to a project, then frequent test pit excavations are preferable to boreholes.

LABORATORY TESTING

Laboratory testing is normally 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.

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 conditions, 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 be partially dependent on borehole spacing and sampling frequency as well as investigation technique.
- Changes in policy or interpretation of policy by statutory authorities.
- The actions of persons or contractors responding to commercial pressures.

If these occur, the company will be pleased to assist with investigation or advice to resolve any problems occurring.

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 that 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.

Copyright in all documents (such as drawings, borehole or test pit logs, reports and specifications) provided by the Company shall remain the property of Jeffery and Katauskas Pty Ltd. Subject to the payment of all fees due, the Client alone shall have a licence to use the documents provided for the sole purpose of completing the project to which they relate. License to use the documents may be revoked without notice if the Client is in breach of any objection to make a payment to us.

REVIEW OF DESIGN

Where major civil or structural developments are proposed <u>or</u> where only a limited investigation has been completed <u>or</u> where the geotechnical conditions/ constraints are quite complex, it is prudent to have a joint design review which involves a senior geotechnical engineer.

SITE INSPECTION

The company will always be pleased to provide engineering inspection services for geotechnical aspects of work to which this report is related.

Requirements could range from:

i) a site visit to confirm that conditions exposed are no worse than those interpreted, to

ii) a visit to assist the contractor or other site personnel in identifying various soil/rock types such as appropriate footing or pier founding depths, or

iii) full time engineering presence on site.

GRAPHIC LOG SYMBOLS FOR SOILS AND ROCKS

SOIL

- FILL
- TOPSOIL
- CLAY (CL, CH)
- SILT (ML, MH)
- SAND (SP, SW)
- GRAVEL (GP, GW)
- SANDY CLAY (CL, CH)
- SILTY CLAY (CL, CH)
- CLAYEY SAND (SC)
- SILTY SAND (SM)
- GRAVELLY CLAY (CL, CH)
- CLAYEY GRAVEL (GC)
- SANDY SILT (ML)
- PEAT AND ORGANIC SOILS

ROCK

- CONGLOMERATE
- SANDSTONE
- SHALE
- SILTSTONE, MUDSTONE, CLAYSTONE
- LIMESTONE
- PHYLLITE, SCHIST
- TUFF
- GRANITE, GABBRO
- DOLERITE, DIORITE
- BASALT, ANDESITE
- QUARTZITE

DEFECTS AND INCLUSIONS

- CLAY SEAM
- SHEARED OR CRUSHED SEAM
- BRECCIATED OR SHATTERED SEAM/ZONE
- IRONSTONE GRAVEL
- ORGANIC MATERIAL

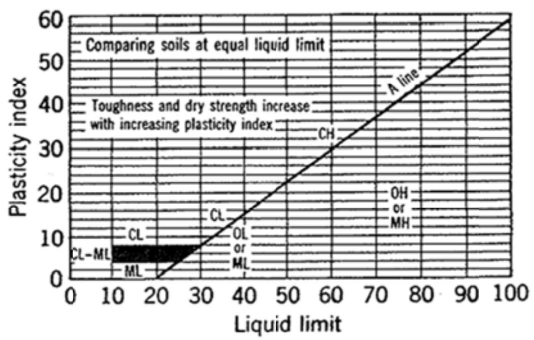
OTHER MATERIALS

- CONCRETE
- BITUMINOUS CONCRETE, COAL
- COLLUVIUM

UNIFIED SOIL CLASSIFICATION TABLE

Field Identification Procedures (Excluding particles larger than 75 μm and basing fractions on estimated weights)				Group Symbols [a]	Typical Names	Information Required for Describing Soils	Laboratory Classification Criteria	
Coarse-grained soils. More than half of material is *larger* than 75 μm sieve size[b] (The 75 μm sieve size is about the smallest particle visible to naked eye)	Gravels. More than half of coarse fraction is larger than 4 mm sieve size	Clean gravels (little or no fines)	Wide range in grain size and substantial amounts of all intermediate particle sizes	*GW*	Well graded gravels, gravel-sand mixtures, little or no fines	Give typical name; indicate approximate percentages of sand and gravel; maximum size; angularity, surface condition, and hardness of the coarse grains; local or geologic name and other pertinent descriptive information; and symbols in parentheses. For undisturbed soils add information on stratification, degree of compactness, cementation, moisture conditions and drainage characteristics. Example: *Silty sand*, gravelly; about 20% hard, angular gravel particles 12 mm maximum size; rounded and subangular sand grains coarse to fine, about 15% non-plastic fines with low dry strength; well compacted and moist in place; alluvial sand; (*SM*)	Use grain size curve in identifying the fractions as given under field identification. Determine percentages of gravel and sand from grain size curve. Depending on percentage of fines (fraction smaller than 75 μm sieve size) coarse grained soils are classified as follows: Less than 5% *GW, GP, SW, SP*; More than 12% *GM, GC, SM, SC*; 5% to 12% *Borderline* cases requiring use of dual symbols	$C_U = \frac{D_{60}}{D_{10}}$ Greater than 4; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
			Predominantly one size or a range of sizes with some intermediate sizes missing	*GP*	Poorly graded gravels, gravel-sand mixtures, little or no fines			Not meeting all gradation requirements for *GW*
		Gravels with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures see *ML* below)	*GM*	Silty gravels, poorly graded gravel-sand-silt mixtures			Atterberg limits below "A" line, or *PI* less than 4 — Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols
			Plastic fines (for identification procedures, see *CL* below)	*GC*	Clayey gravels, poorly graded gravel-sand-clay mixtures			Atterberg limits above "A" line, with *PI* greater than 7
	Sands. More than half of coarse fraction is smaller than 4 mm sieve size	Clean sands (little or no fines)	Wide range in grain sizes and substantial amounts of all intermediate particle sizes	*SW*	Well graded sands, gravelly sands, little or no fines			$C_U = \frac{D_{60}}{D_{10}}$ Greater than 6; $C_C = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3
			Predominantly one size or a range of sizes with some intermediate sizes missing	*SP*	Poorly graded sands, gravelly sands, little or no fines			Not meeting all gradation requirements for *SW*
		Sands with fines (appreciable amount of fines)	Nonplastic fines (for identification procedures, see *ML* below)	*SM*	Silty sands, poorly graded sand-silt mixtures			Atterberg limits below "A" line or *PI* less than 5 — Above "A" line with *PI* between 4 and 7 are *borderline* cases requiring use of dual symbols
			Plastic fines (for identification procedures, see *CL* below)	*SC*	Clayey sands, poorly graded sand-clay mixtures			Atterberg limits below "A" line with *PI* greater than 7

Fine-grained soils. More than half of material is *smaller* than 75 μm sieve size	Identification Procedures on Fraction Smaller than 380 μm Sieve Size:	Dry Strength (crushing characteristics)	Dilatancy (reaction to shaking)	Toughness (consistency near plastic limit)	Group Symbols	Typical Names	Information Required for Describing Soils
	Silts and clays liquid limit less than 50	None to slight	Quick to slow	None	*ML*	Inorganic silts and very fine sands, rock flour, silty or clayey fine sands with slight plasticity	Give typical name; indicate degree and character of plasticity, amount and maximum size of coarse grains; colour in wet condition, odour if any, local or geologic name, and other pertinent descriptive information, and symbol in parentheses. For undisturbed soils add information on structure, stratification, consistency in undisturbed and remoulded states, moisture and drainage conditions. Example: *Clayey silt*, brown; slightly plastic; small percentage of fine sand; numerous vertical root holes; firm and dry in place; loess; (*ML*)
		Medium to high	None to very slow	Medium	*CL*	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays	
		Slight to medium	Slow	Slight	*OL*	Organic silts and organic silt-clays of low plasticity	
	Silts and clays liquid limit greater than 50	Slight to medium	Slow to none	Slight to medium	*MH*	Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts	
		High to very high	None	High	*CH*	Inorganic clays of high plasticity, fat clays	
		Medium to high	None to very slow	Slight to medium	*OH*	Organic clays of medium to high plasticity	
Highly Organic Soils		Readily identified by colour, odour, spongy feel and frequently by fibrous texture			*Pt*	Peat and other highly organic soils	



Plasticity chart
for laboratory classification of fine grained soils

Note: 1 Soils possessing characteristics of two groups are designated by combinations of group symbols (eg. GW-GC, well graded gravel-sand mixture with clay fines).
2 Soils with liquid limits of the order of 35 to 50 may be visually classified as being of medium plasticity.

LOG SYMBOLS

LOG COLUMN	SYMBOL	DEFINITION
Groundwater Record	▼	Standing water level. Time delay following completion of drilling may be shown.
	—c—	Extent of borehole collapse shortly after drilling.
	►——	Groundwater seepage into borehole or excavation noted during drilling or excavation.
Samples	ES	Soil sample taken over depth indicated, for environmental analysis.
	U50	Undisturbed 50mm diameter tube sample taken over depth indicated.
	DB	Bulk disturbed sample taken over depth indicated.
	DS	Small disturbed bag sample taken over depth indicated.
	ASB	Soil sample taken over depth indicated, for asbestos screening.
	ASS	Soil sample taken over depth indicated, for acid sulfate soil analysis.
	SAL	Soil sample taken over depth indicated, for salinity analysis.
Field Tests	N = 17 4, 7, 10	Standard Penetration Test (SPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration. 'R' as noted below.
	N_c = 5 7 3R	Solid Cone Penetration Test (SCPT) performed between depths indicated by lines. Individual figures show blows per 150mm penetration for 60 degree solid cone driven by SPT hammer. 'R' refers to apparent hammer refusal within the corresponding 150mm depth increment.
	VNS = 25	Vane shear reading in kPa of Undrained Shear Strength.
	PID = 100	Photoionisation detector reading in ppm (Soil sample headspace test).
Moisture Condition (Cohesive Soils)	MC>PL	Moisture content estimated to be greater than plastic limit.
	MC≈PL	Moisture content estimated to be approximately equal to plastic limit.
	MC<PL	Moisture content estimated to be less than plastic limit.
(Cohesionless Soils)	D	DRY – Runs freely through fingers.
	M	MOIST – Does not run freely but no free water visible on soil surface.
	W	WET – Free water visible on soil surface.
Strength (Consistency) Cohesive Soils	VS	VERY SOFT – Unconfined compressive strength less than 25kPa
	S	SOFT – Unconfined compressive strength 25-50kPa
	F	FIRM – Unconfined compressive strength 50-100kPa
	St	STIFF – Unconfined compressive strength 100-200kPa
	VSt	VERY STIFF – Unconfined compressive strength 200-400kPa
	H	HARD – Unconfined compressive strength greater than 400kPa
	( )	Bracketed symbol indicates estimated consistency based on tactile examination or other tests.
Density Index/ Relative Density (Cohesionless Soils)		**Density Index (I_D) Range (%)** — **SPT 'N' Value Range (Blows/300mm)**
	VL	Very Loose <15 — 0-4
	L	Loose 15-35 — 4-10
	MD	Medium Dense 35-65 — 10-30
	D	Dense 65-85 — 30-50
	VD	Very Dense >85 — >50
	( )	Bracketed symbol indicates estimated density based on ease of drilling or other tests.
Hand Penetrometer Readings	300 250	Numbers indicate individual test results in kPa on representative undisturbed material unless noted otherwise.
Remarks	'V' bit	Hardened steel 'V' shaped bit.
	'TC' bit	Tungsten carbide wing bit.
	T_{60}	Penetration of auger string in mm under static load of rig applied by drill head hydraulics without rotation of augers.

LOG SYMBOLS continued

ROCK MATERIAL WEATHERING CLASSIFICATION

TERM	SYMBOL	DEFINITION
Residual Soil	RS	Soil developed on extremely weathered rock; the mass structure and substance fabric are no longer evident; there is a large change in volume but the soil has not been significantly transported.
Extremely weathered rock	XW	Rock is weathered to such an extent that it has "soil" properties, ie it either disintegrates or can be remoulded, in water.
Distinctly weathered rock	DW	Rock strength usually changed by weathering. The rock may be highly discoloured, usually by ironstaining. Porosity may be increased by leaching, or may be decreased due to deposition of weathering products in pores.
Slightly weathered rock	SW	Rock is slightly discoloured but shows little or no change of strength from fresh rock.
Fresh rock	FR	Rock shows no sign of decomposition or staining.

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 Journal of Rock Mechanics, Mining, Science and Geomechanics. Abstract Volume 22, No 2, 1985.

TERM	SYMBOL	Is (50) MPa	FIELD GUIDE
Extremely Low:	EL		Easily remoulded by hand to a material with soil properties.
----------------------	-------------	0.03	
Very Low:	VL		May be crumbled in the hand. Sandstone is "sugary" and friable.
----------------------	-------------	0.1	
Low:	L		A piece of core 150mm long x 50mm dia. may be broken by hand and easily scored with a knife. Sharp edges of core may be friable and break during handling.
----------------------	-------------	0.3	
Medium Strength:	M		A piece of core 150mm long x 50mm dia. can be broken by hand with difficulty. Readily scored with knife.
----------------------	-------------	1	
High:	H		A piece of core 150mm long x 50mm dia. core cannot be broken by hand, can be slightly scratched or scored with knife; rock rings under hammer.
----------------------	---------------	3	
Very High:	VH		A piece of core 150mm long x 50mm dia. may be broken with hand-held pick after more than one blow. Cannot be scratched with pen knife; rock rings under hammer.
----------------------	---------------	10	
Extremely High:	EH		A piece of core 150mm long x 50mm dia. is very difficult to break with hand-held hammer. Rings when struck with a hammer.

ABBREVIATIONS USED IN DEFECT DESCRIPTION

ABBREVIATION	DESCRIPTION	NOTES
Be	Bedding Plane Parting	Defect orientations measured relative to the normal to the long core axis (ie relative to horizontal for vertical holes)
CS	Clay Seam	
J	Joint	
P	Planar	
Un	Undulating	
S	Smooth	
R	Rough	
IS	Ironstained	
XWS	Extremely Weathered Seam	
Cr	Crushed Seam	
60t	Thickness of defect in millimetres	