NSW Department of Commerce | NSW Water Solutions

HUNTER WATER

Hunter Water Corporation

Tillegra Dam Site
Interim Engineering Geotechnical Report - Volume II

Geotechnical & Environmental
Report No. 09-GN31A-R1/VII
February 2009

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Seismic Refraction Survey Results

Coffey Geotechnics Pty Ltd

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SPECIALISTS MANAGING THE EARTH

TILLEGRA DAM SITE SESIMIC REFRACTION STUDY

Department of Commerce \

Dams and Civil Unit, NSW

GEOTLCOV23357AA/AA

20 December, 2007

Coffey Geotechnics Pty Ltd ABN 93 056 929 483
8/12 Mars Road Lane Cove West NSW 2066 Australia

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

20 December, 2007

Department of Commerce Dams and Civil Unit, NSW

Level 13, McKell Building
2-24 Rawson Place
Sydney NSW 2000

Attention: John Young

Dear John,

RE: Tillegra Dam Site Seismic Refraction Study

This letter introduces our report on the results of the geophysical seismic refraction study carried out at the Tillegra Dam site, Williams River, Dungog, NSW.

Should you have any questions related to the report, please do not hesitate to contact the undersigned, or Simon Stewart on 02 9911 1000.

For and on behalf of Coffey Geotechnics Pty Ltd

Dr Bob Whiteley

Senior Principal

Distribution: Original held by Coffey Geotechnics Pty Ltd

1 copy Coffey Geotechnics Pty Ltd

3 copies Department of Commerce

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1 INTRODUCTION

This report presents the results of the seismic refraction study carried out at the Tillegra Dam site, NSW. This work was commissioned by the Department Of Commerce – Dams and Civil Unit, NSW and the scope of work was carried out generally in accordance with Coffey Geotechnics Pty Ltd (Coffey) proposal reference GEOTLCOV23357AA/AA, dated 10 August 2007.

The objective of the seismic study was to assist in providing subsurface information to assist excavation assessment and design for the proposed Tillegra Dam.

Seismic refraction testing was carried out along seven (7) lines selected by the Dams and Civil Unit with a total length of 4000m.

The locations of the seismic profiles are shown in Figure 1 using site plans provided by Department of Commerce.

The seismic refraction fieldwork was carried out from 26 September to 17 October, 2007.

2 METHODOLOGY AND FIELD PROCEDURES

The seismic refraction study was completed in accordance with ASTM D5777. Seismic data were acquired with a Geometrics Geode 24-channel digital signal enhancement seismograph and a sample interval of 0.064 milliseconds. After quality assessment in the field the seismic data were stored on computer disk for later processing and analysis.

A geophone interval of 5m was used on all the seismic profiles. Geospace GS11D, 8Hz geophones were rigidly coupled with the ground by pressing 75mm tapered spikes on each geophone base into the soil. A nominal 15m to 25m source spacing with 11 seismic source positions per 24-channel seismic spread was used. In accordance with accepted practice, reversed seismic refraction data was acquired using source - detector offsets up to 52.5m from the ends of each seismic spread.

Seismic energy was provided using buried Powergel explosives for end and offset source points and summed sledgehammer impacts on a metal plate for source points within the geophone spread. The explosive charges were placed in augered and tamped shot holes 1.0 to 1.5m deep and were detonated by a licensed shot firer using approved safety methods.

Table 1 provides a listing of the seismic lines and their locations. Each seismic line was assigned a relative chainage starting at Ch. 0m (Figure 1 and Table 1) and the results obtained are discussed in the next section using these chainages for relative chainages along each line.

It was not possible to complete normal seismic refraction profiling across the William's River due to the very steep terrain on the right abutment near the river level.

Table 1: Seismic Refraction Line Locations

Line	Start location	Relative chainage	End location	Relative chainage	Total length	Description
1A	376748E 6423900N	0	376459E 6423748N	340m	340m	Spillway crest (left abutment)
1B	376459E 6423748N	335	376464E 6423475N	560m	230m	Spillway crest (centre)
1C	376467E 6423227N	830m	376528E 6422871N	1245m	385m	Spillway crest (lright abutment)
2A	376459E 6423748N	0	376374E 6423504N	225m	230m	Embankment toe (left abutment)
2B	376374E 6423462N	290	376370E 6423353N	405m	115m	Embankment toe (centre)
2C	376401E 6423214N	535	376470E 6423058N	760m	225m	Embankment toe (right abutment)
3	376275E 6422895N	0	376963E 6423241N	775m	775m	Spillway channel (right abutment)
4A	376634E 6423273N	440	376819E 6423106N	775m	250m	Diversion alignment
4B	376200E 6423153N	0m	376634E 6423273N	440m	440m	Diversion alignment (cont.)
5	376612E 6423911N	0	377053E 6423353N	700m	700m	Spillway channel (left abutment)
6	376258E 6423431N	0	376263E 6423325N	110m	110m	Upstream coffer dam
7	376957E 6423827N	0	377140E 6423724N	230m	230m	

3 RESULTS AND INTERPRETATION

All the seismic data collected at the site has been archived in electronic form in the Coffey's Seismic Database.

Each digital seismic record was examined on computer, and the first arrival times were determined using FBPICK software (RTA, NSW). These data were analysed in accordance with accepted practice using the interpretation program REFRACT 2006 (RTA NSW), which is based on the Intercept Time Method and the Reciprocal Method.

In general, the seismic data obtained were of good quality and adequate for interpretation. No unusual or anomalous conditions were observed in the seismic data that could indicate violations of the seismic models that were used for interpretation.

As with all seismic methods, seismic refraction has inherent limitations and problems in effectively representing subsurface conditions in all geological environments. Some of these issues are presented in Appendix A that offers some general information on the seismic refraction method including the precision and accuracy of results and the effects of violations of the assumptions on which the method and interpretation procedure is based.

The interpreted seismic sections showing interpreted subsurface layers are provided on Figures 2 to 7. The RL's shown on these sections are based on elevation measurements provided by the Dams and Civil Unit and on relative elevations measured along individual seismic lines with a laser level during the seismic survey.

Preliminary borehole logs from three inclined boreholes drilled along the spillway crest (DDH 6,7 and 8) were provided by the Dams and Civil Unit. The subsurface seismic conditions as revealed by the seismic interpretation, these boreholes and our experience in similar environments are generally summarised in Table 2 and discussed in more detail for each seismic line below.

Table 2: General Summary of Subsurface Seismic Conditions

Layer	Depth to upper layer boundary (m)	Velocity Range (m/s)	Material
1	0	400-900	Soil, alluvium, highly weathered Tuffaceous Sandstone
2	0.2-8.9	1300-2800	Tuffaceous Sandstone – highly to moderately to weathered Some Meta-shale interbeds
3	1.0-24.5	2500-4200	Tuffaceous Sandstone – slightly weathered to fresh Some Meta-shale interbeds

Generally, three seismic layers of differing velocity were evident in most of the area as listed on Table 1. Although at some locations, discussed below, two layers or four layers were interpreted, generally over limited intervals.

3.1 Spillway Crest: Left Abutment (Line 1A and 1B, Figure 2)

Tables 3 and 4 summarise the subsurface seismic conditions beneath these lines.

An intermediate 2200m/s layer is present on Line 1B near Ch. 375m and Ch. 455m, possibly representing colluvial materials.

Table 3: Line 1A - Summary of Subsurface Seismic Conditions

1	0	450-600	Alluvium
2	0.7-2.4	1500-2800	Tuffaceous Sandstone – moderately to highly weathered
3	2-15.8	2600-3500	Tuffaceous Sandstone – slightly weathered to fresh

Table 4: Line 1B - Summary of Subsurface Seismic Conditions

1	0	400-700	Alluvium
2	0.8-5.9	2200-3000	Tuffaceous Sandstone – moderately to highly weathered
3	3.1-13.1	3500-3700	Tuffaceous Sandstone – slightly weathered to fresh

3.2 Embankment Toe: Left Abutment (Line 2A and 2B, Figure 3)

Tables 5 and 6 summarise the subsurface seismic conditions beneath these lines.

On Line 2A from Ch. 170m to Ch. 220m the intermediate seismic layer is absent as is the case for the ends of Line 2B. The interval from Ch. 310m to Ch. 350m on Line 2B may represent a shallow palaeochannel.

Table 5: Line 2A - Summary of Subsurface Seismic Conditions

1	0	400-500	Alluvium
2	0.7-1.6	1900-2600	Tuffaceous Sandstone – moderately to highly weathered
3	4.6-10.6	2900-3700	Tuffaceous Sandstone – slightly weathered to fresh

Table 6: Line 2B - Summary of Subsurface Seismic Conditions

1	0	450-800	Alluvium
2	1.3-2.2	1300-1600	Tuffaceous Sandstone – moderately to highly weathered
3	6.4-10.6	2900-4000	Tuffaceous Sandstone – slightly weathered to fresh

3.3 Spillway Channel: Left Abutment (Line 5, Figure 4)

Table 7 summarises the subsurface seismic conditions beneath this line.

Table 7: Line 5 - Summary of Subsurface Seismic Conditions

1	0	450-900	Alluvium
2	0.9-3.9	1700-2800	Tuffaceous Sandstone – moderately to highly weathered
3	5.2-24.5	3200-4200	Tuffaceous Sandstone – slightly weathered to fresh

3.4 Upstream Coffer Dam (Line 6, Figure 5)

Table 8 summarises the subsurface seismic conditions beneath this line.

Table 8: Line 6 - Summary of Subsurface Seismic Conditions

1		400-600	Alluvium
2	1.8-4.9	2200-2500	Tuffaceous Sandstone – moderately to highly weathered
3	6.6-14.8	~3800	Tuffaceous Sandstone – slightly weathered to fresh

3.5 Line 7, (Figure 5)

Table 9 summarises the subsurface seismic conditions beneath this line.

Table 9: Line 7 - Summary of Subsurface Seismic Conditions

1	0	~500	Alluvium
2	1.0-3.8	900-2500	Tuffaceous Sandstone – moderately to highly weathered
3	4.2-20.4	2600-4000	Tuffaceous Sandstone – slightly weathered to fresh

3.6 Spillway Crest: Right Abutment (Line 1C, Figure 6)

Table 10 summarises the subsurface seismic conditions beneath this line.

The lower velocity zone (2500m/s) in Layer 3 from about Ch. 950m to Ch. 980m may represent a fault or fracture zone.

Table 10: Line 1C - Summary of Subsurface Seismic Conditions.

1	0	450-550	Alluvium
2	0.8-2.5	2300-2500	Tuffaceous Sandstone – moderately to highly weathered
3	4.2-20.6	2500-4000	Tuffaceous Sandstone – slightly weathered to fresh

3.7 Embankment Toe: Right Abutment (Line 2C, Figure 7)

Table 11 summarises the subsurface seismic conditions beneath this line.

Table 11: Line 2C - Summary of Subsurface Seismic Conditions

1	0	400-700	Alluvium
2	1.1-2.2	2200-2600	Tuffaceous Sandstone – moderately to highly weathered
3	1.0-15.0	3000-3500	Tuffaceous Sandstone – slightly weathered to fresh

3.8 Diversion Alignment (Line 4B and 4A, Figure 8)

Table 12 and 13 summarises the subsurface seismic conditions beneath these lines.

On Line 4B lower velocity zones in layer 3 near Ch. 325m and Ch. 210m may represent fault or fracture zones.

Table 12: Line 4B- Summary of Subsurface Seismic Conditions

1		400-800	Alluvium
2	0.2-3.7	1800-2100	Tuffaceous Sandstone – moderately to highly weathered
3	4.8-19.1	2800-4500	Tuffaceous Sandstone – slightly weathered to fresh

Table 13: Line 4a - Summary of Subsurface Seismic Conditions

1	0	600-900	Alluvium
2	0.2-8.9	800*-1500	Tuffaceous Sandstone – moderately to highly weathered
3	7.2-16.2	3400-3800	Tuffaceous Sandstone – slightly weathered to fresh

*isolated low velocity 2nd layer

3.9 Spillway Channel: Right Abutment (Line 3, Figure 9)

Table 14 summarises the subsurface seismic conditions beneath this line.

Four seismic layers are present on this line from about Ch. 70m to Ch. 230m.

Table 14: Line 3 - Summary of Subsurface Seismic Conditions

1	0	400-700	Alluvium
2	0.7-2.4	1000-2000	Tuffaceous Sandstone – moderately to highly weathered
3	4.4-14.7	2800-4100	Tuffaceous Sandstone – slightly weathered to fresh

4 CONCLUSIONS AND RECOMMENDATIONS

The seismic refraction study has been successfully completed along the pre-selected lines at the proposed Tillegra Dam Site. This has revealed a variable subsurface with seismic velocities in the range of about 400 to 4200 m/s reflecting mainly soils and alluvial sediments and highly weathered to fresh tuffaceous sandstone. Only a few lower velocity regions of limited width have been interpreted within the deepest seismic layer possibly representing the less weathered rock, faults, fracture zones or zones of enhanced permeability suggesting that major fracture zones are generally absent at the site along the seismic lines.

For and on behalf of Coffey Geotechnics Pty Ltd

Dr Bob Whiteley

Senior Principal

Important Information about Your Coffey Report

The reader's attention is drawn to the important information about this report, which follows the main text.

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SPECIALISTS MANAGING THE EARTH

Important information about your **Coffey** Report

As a client of Coffey you should know that site subsurface conditions cause more construction problems than any other factor. These notes have been prepared by Coffey to help you interpret and understand the limitations of your report.

Your report is based on project specific criteria

Your report has been developed on the basis of your unique project specific requirements as understood by Coffey and applies only to the site investigated. Project criteria typically include the general nature of the project; its size and configuration; the location of any structures on the site; other site improvements; the presence of underground utilities; and the additional risk imposed by scope-of-service limitations imposed by the client. Your report should not be used if there are any changes to the project without first asking Coffey to assess how factors that changed subsequent to the date of the report affect the report's recommendations. Coffey cannot accept responsibility for problems that may occur due to changed factors if they are not consulted.

Subsurface conditions can change

Subsurface conditions are created by natural processes and the activity of man. For example, water levels can vary with time, fill may be placed on a site and pollutants may migrate with time. Because a report is based on conditions which existed at the time of subsurface exploration, decisions should not be based on a report whose adequacy may have been affected by time. Consult Coffey to be advised how time may have impacted on the project.

Interpretation of factual data

Site assessment identifies actual subsurface conditions only at those points where samples are taken and when they are taken. Data derived from literature and external data source review, sampling and subsequent laboratory testing are interpreted by geologists, engineers or scientists to provide an opinion about overall site conditions, their likely impact on the proposed development and recommended actions. Actual conditions may differ from those inferred to exist, because no professional, no matter how qualified, can reveal what is hidden by earth, rock and time. The actual interface between materials may be far more gradual or abrupt than assumed based on the facts obtained. Nothing can be done to change the actual site conditions which exist, but steps can be taken to reduce the impact of unexpected conditions. For this reason, owners should retain the services of Coffey through the development stage, to identify variances, conduct additional tests if required, and recommend solutions to problems encountered on site.

Your report will only give preliminary recommendations

Your report is based on the assumption that the site conditions as revealed through selective point sampling are indicative of actual conditions throughout an area. This assumption cannot be substantiated until project implementation has commenced and therefore your report recommendations can only be regarded as preliminary. Only Coffey, who prepared the report, is fully familiar with the background information needed to assess whether or not the report's recommendations are valid and whether or not changes should be considered as the project develops. If another party undertakes the implementation of the recommendations of this report there is a risk that the report will be misinterpreted and Coffey cannot be held responsible for such misinterpretation.

Your report is prepared for specific purposes and persons

To avoid misuse of the information contained in your report it is recommended that you confer with Coffey before passing your report on to another party who may not be familiar with the background and the purpose of the report. Your report should not be applied to any project other than that originally specified at the time the report was issued.

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SPECIALISTS MANAGING THE EARTH

Important information about your **Coffey** Report

Interpretation by other design professionals

Costly problems can occur when other design professionals develop their plans based on misinterpretations of a report. To help avoid misinterpretations, retain Coffey to work with other project design professionals who are affected by the report. Have Coffey explain the report implications to design professionals affected by them and then review plans and specifications produced to see how they incorporate the report findings.

Data should not be separated from the report*

The report as a whole presents the findings of the site assessment and the report should not be copied in part or altered in any way.

Logs, figures, drawings, etc. are customarily included in our reports and are developed by scientists, engineers or geologists based on their interpretation of field logs (assembled by field personnel) and laboratory evaluation of field samples. These logs etc. should not under any circumstances be redrawn for inclusion in other documents or separated from the report in any way.

Geoenvironmental concerns are not at issue

Your report is not likely to relate any findings, conclusions, or recommendations about the potential for hazardous materials existing at the site unless specifically required to do so by the client. Specialist equipment, techniques, and personnel are used to perform a geoenvironmental assessment.
Contamination can create major health, safety and environmental risks. If you have no information about the potential for your site to be contaminated or create an environmental hazard, you are advised to contact Coffey for information relating to geoenvironmental issues.

Rely on Coffey for additional assistance

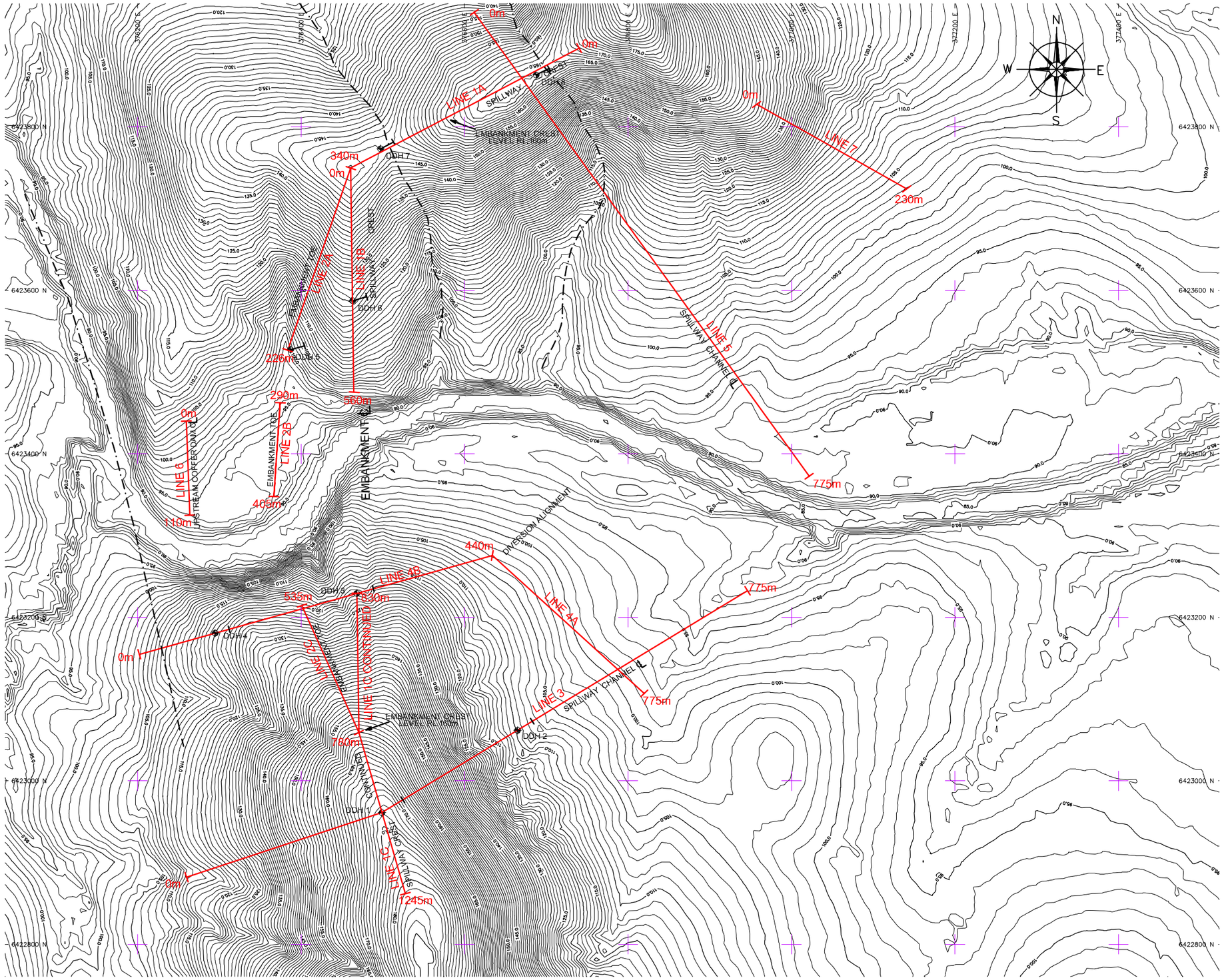
Coffey is familiar with a variety of techniques and approaches that can be used to help reduce risks for all parties to a project, from design to construction. It is common that not all approaches will be necessarily dealt with in your site assessment report due to concepts proposed at that time. As the project progresses through design towards construction, speak with Coffey to develop alternative approaches to problems that may be of genuine benefit both in time and cost.

Responsibility

Reporting relies on interpretation of factual information based on judgement and opinion and has a level of uncertainty attached to it, which is far less exact than the design disciplines. This has often resulted in claims being lodged against consultants, which are unfounded. To help prevent this problem, a number of clauses have been developed for use in contracts, reports and other documents. Responsibility clauses do not transfer appropriate liabilities from Coffey to other parties but are included to identify where Coffey's responsibilities begin and end. Their use is intended to help all parties involved to recognise their individual responsibilities. Read all documents from Coffey closely and do not hesitate to ask any questions you may have.

* For further information on this aspect reference should be made to "Guidelines for the Provision of Geotechnical information in Construction Contracts" published by the Institution of Engineers Australia, National headquarters, Canberra, 1987.

Figures



- KEY -

GEOLOGICAL LINEATION

LINE 6 — UPSTREAM COFFER DAM — SEISMIC REFRACTION LINE

DDH 7 — BOREHOLE

revision	description	drawn	approved	date

50 0 100 200

Scale (metres)

drawn	PE/LT
approved	RJW
date	10/12/2007
scale	1: 5000
original size	A3

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

client: NSW DEPARTMENT OF COMMERCE

project: SHALLOW SEISMIC REFRACTION STUDY TILLEGRA DAM, NSW

title: LOCATION OF SEISMIC REFRACTION LINES

project no: GEOTLCOV23357AA

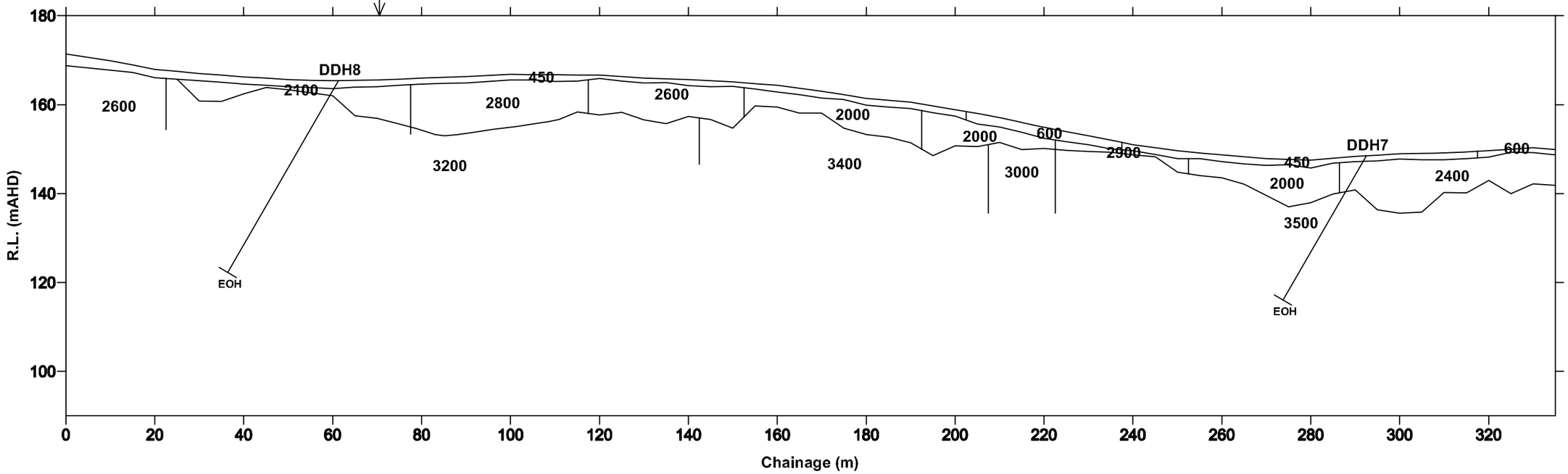
figure no: FIGURE 1

376748.4 E
6423900 N

376671.4 E
6423858 N
(LINE 5 @ 100m)

376459.7 E
6423748 N

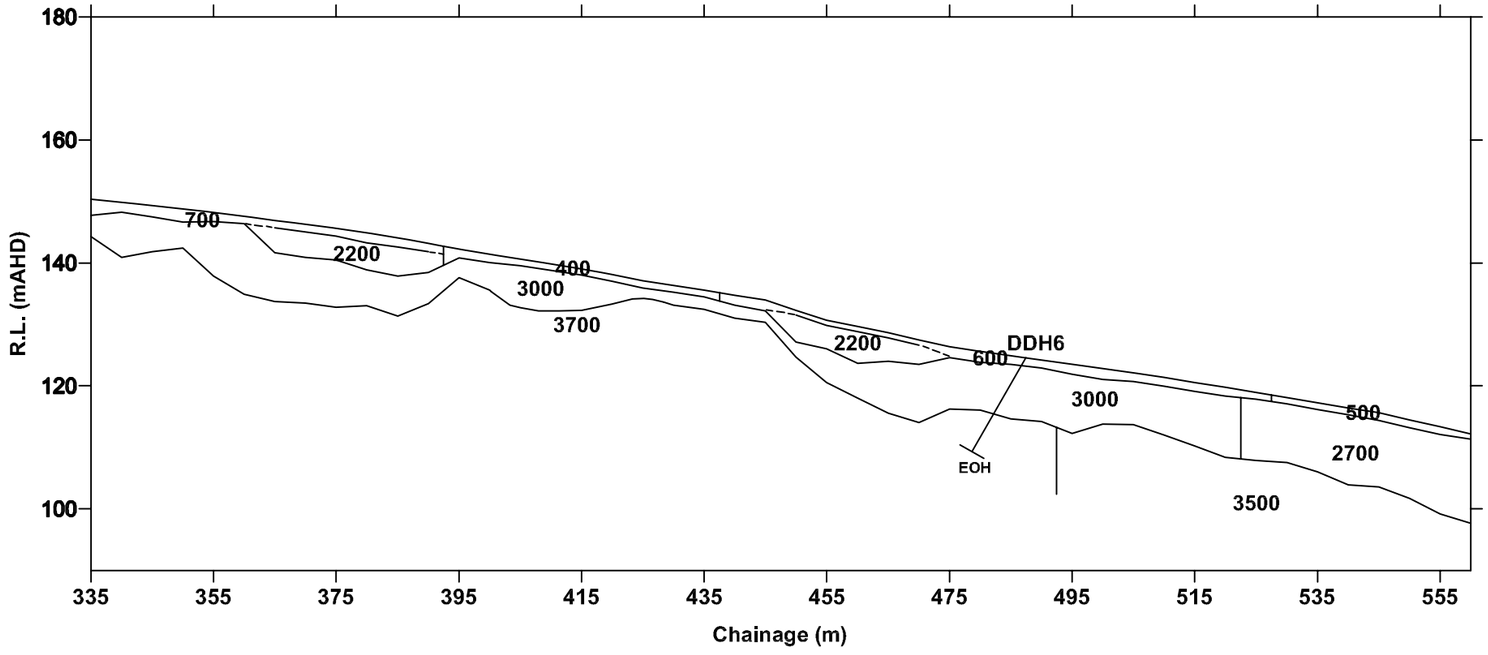
LINE 1A: SPILLWAY CREST, LEFT ABUTMENT



376459.7 E
6423748 N

376464.2 E
6423475 N

LINE 1B: SPILLWAY CREST, LEFT ABUTMENT



LEGEND

- Ground surface level on seismic line
- Interpreted seismic velocity (m/s) and refractor boundary
- Interpreted refractor boundary based on limited data
- 1800 — Lateral seismic velocity boundary
- EOH — End of hole

revision	description	drawn	approved	date

0 10 20 40 60
Scale (metres)

drawn	PE/LT
approved	RJW
date	10/12/07
scale	1:1000
original size	A3

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

client: NSW DEPARTMENT OF COMMERCE

project: SHALLOW SEISMIC REFRACTION STUDY
TILLEGRA DAM, NSW

title: INTERPRETED SEISMIC REFRACTION SECTION - LINE 1A, B

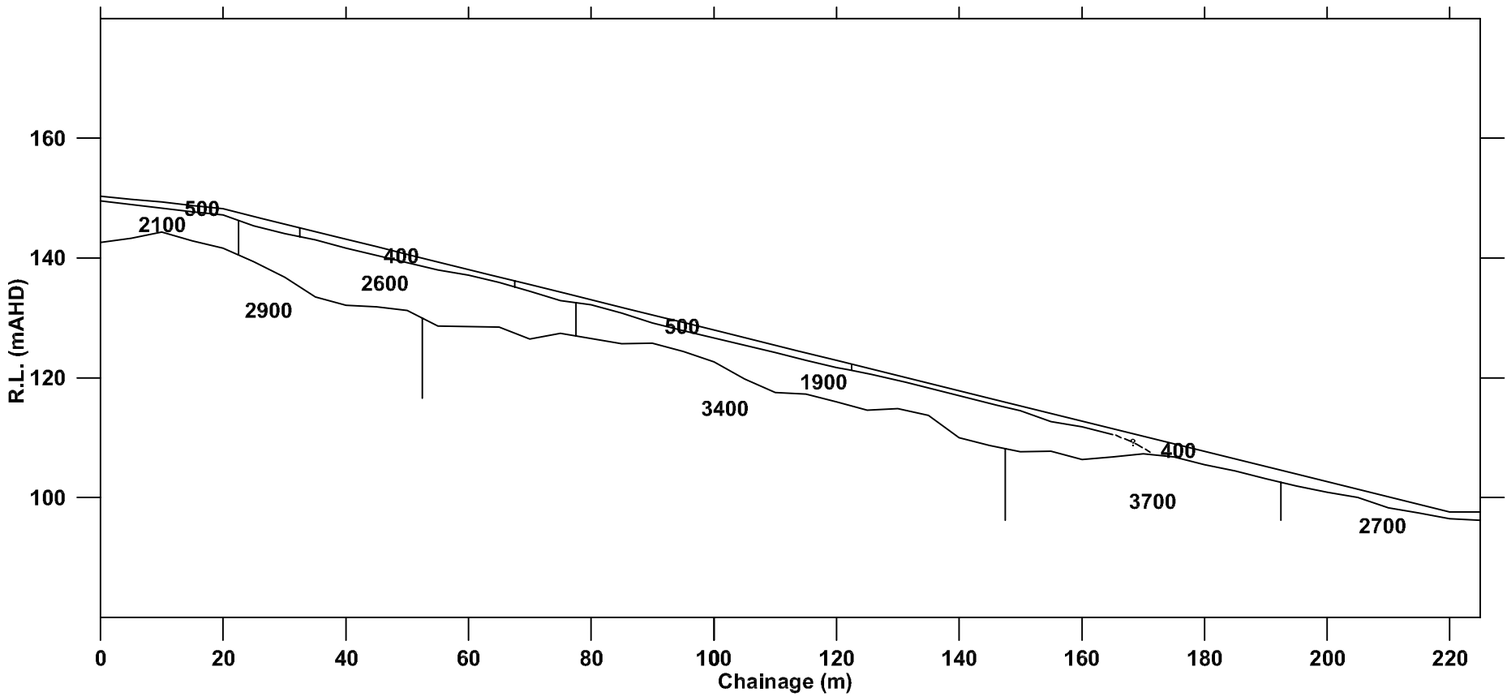
project no: GEOTLCOV23357AA

figure no: FIGURE 2

376459.7 E
6423748 N

376374.9 E
6423504 N

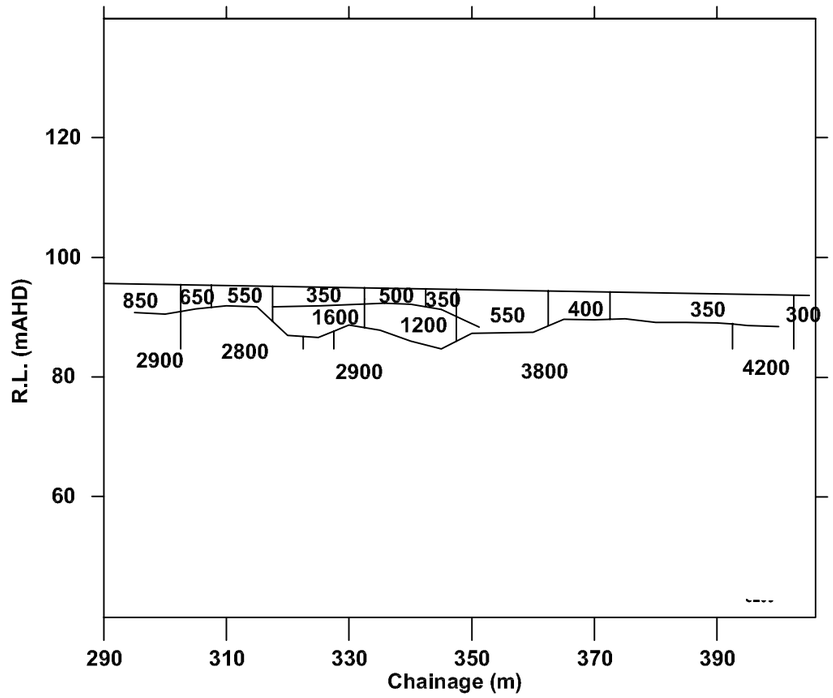
LINE 2A: EMBANKMENT TOE, LEFT ABUTMENT



376374.0 E
6423462 N

376263.0 E
6422325 N

LINE 2B: EMBANKMENT TOE, LEFT ABUTMENT



LEGEND

- Ground surface level on seismic line
- Interpreted seismic velocity (m/s) and refractor boundary
- Interpreted refractor boundary based on limited data
- 1800 — Lateral seismic velocity boundary

revision	description	drawn	approved	date

0 10 20 40 60
Scale (metres)

drawn	PE/LT
approved	RJW
date	10/12/07
scale	1:1000
original size	A3

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

client: NSW DEPARTMENT OF COMMERCE

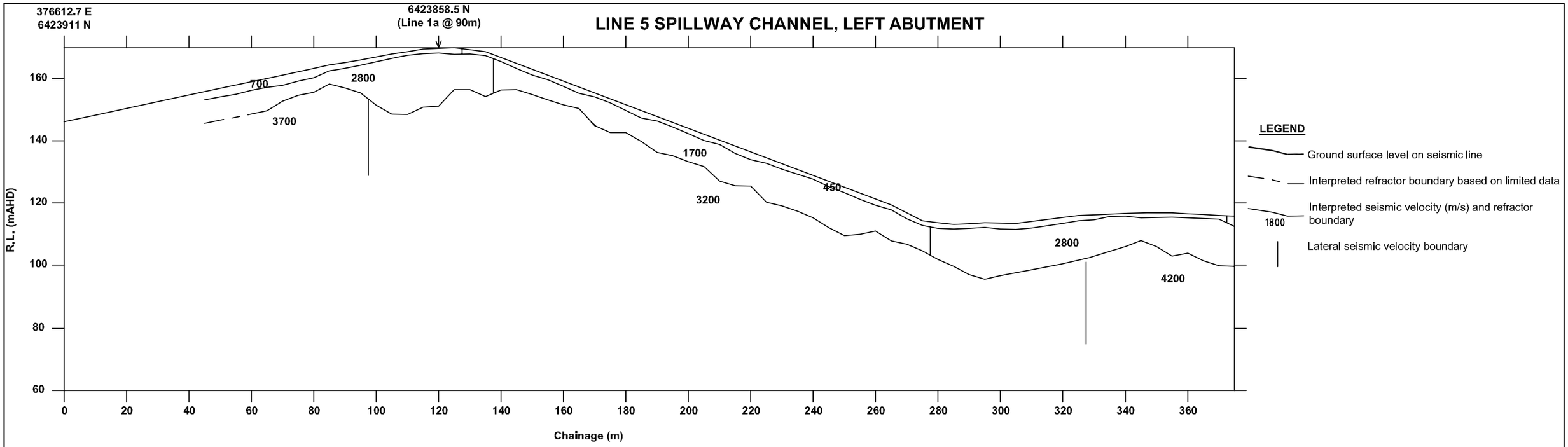
project: SHALLOW SEISMIC REFRACTION STUDY
TILLEGRA DAM, NSW

title: INTERPRETED SEISMIC REFRACTION SECTION - LINE 2A, B

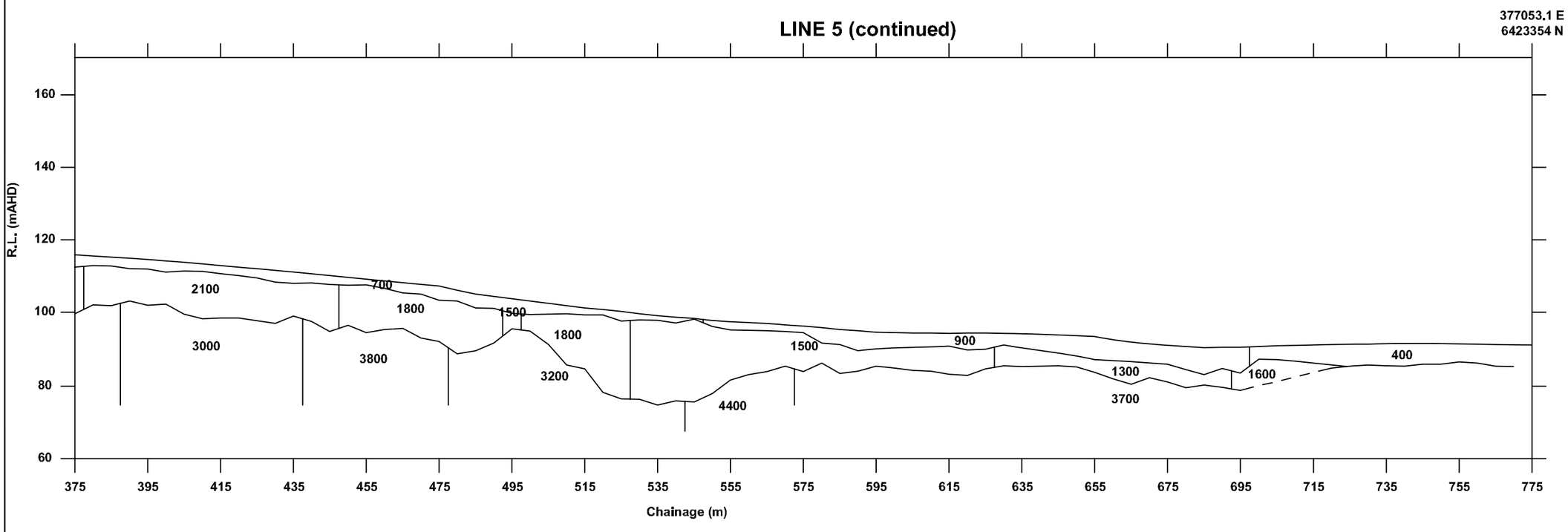
project no: GEOTLCOV23357AA

figure no: FIGURE 3

LINE 5 SPILLWAY CHANNEL, LEFT ABUTMENT



LINE 5 (continued)



revision	description	drawn	approved	date

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Scale (metres)

drawn	PE/LT
approved	RJW
date	10/12/07
scale	1:1250
original size	A3

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SPECIALISTS MANAGING THE EARTH

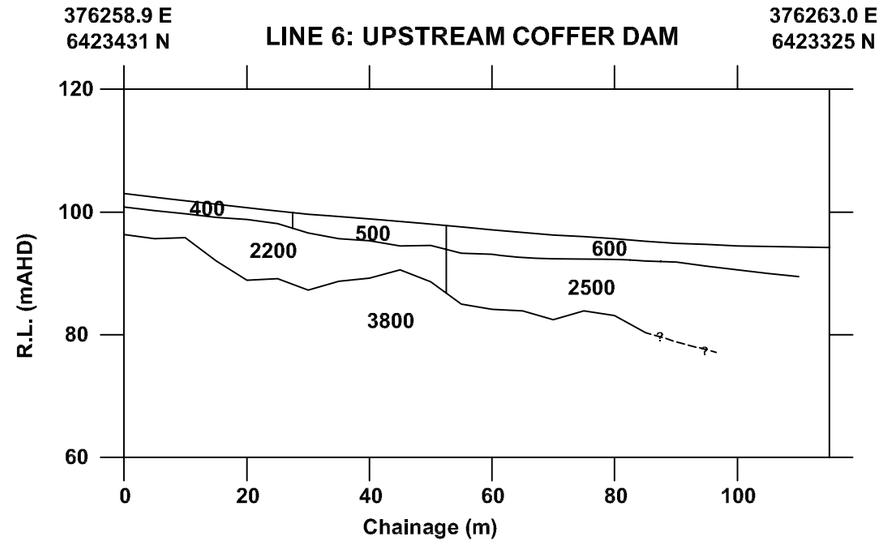
client: NSW DEPARTMENT OF COMMERCE

project: SHALLOW SEISMIC REFRACTION STUDY
TILLEGRA DAM, NSW

title: INTERPRETED SEISMIC REFRACTION SECTION- LINE 5

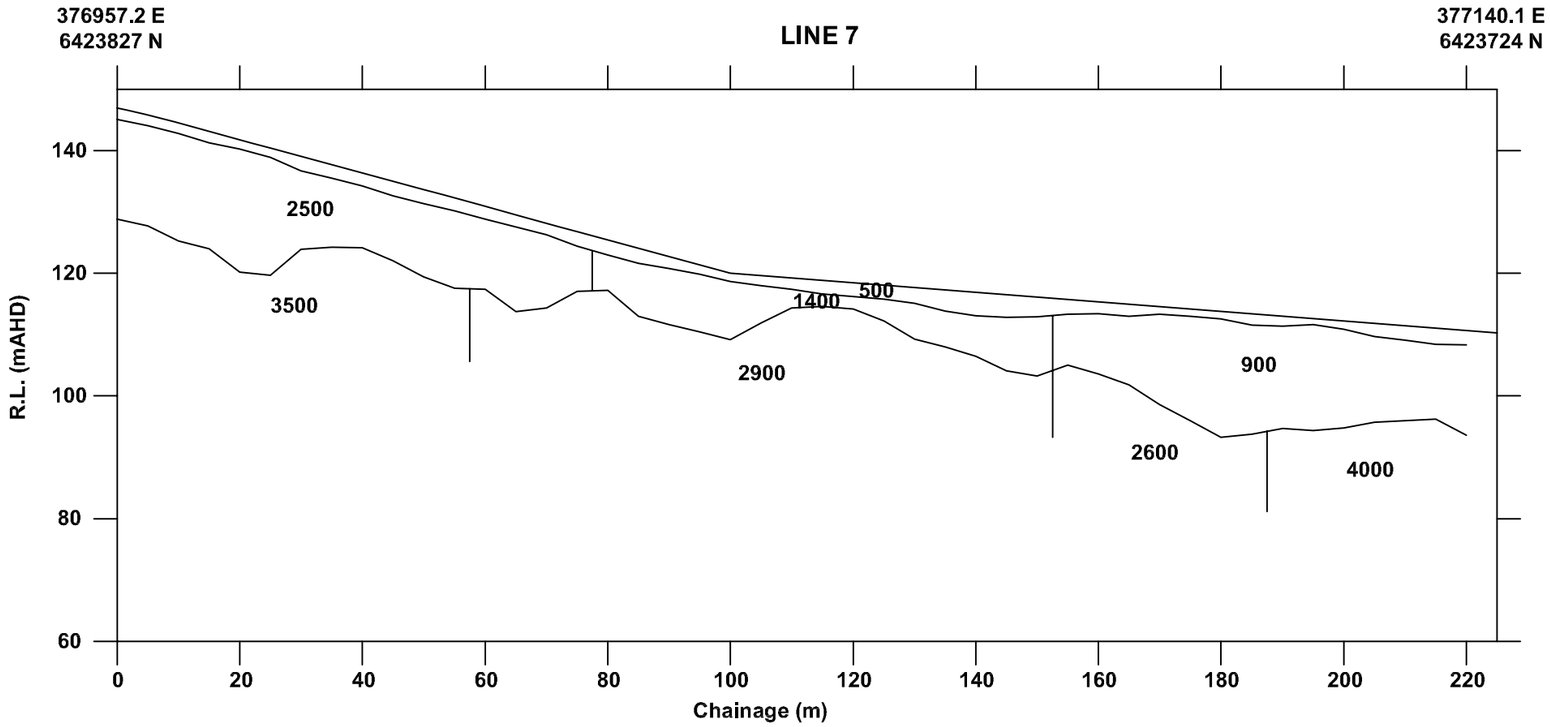
project no: GEOTLCOV23357AA

figure no: FIGURE 4



LEGEND

- Ground surface level on seismic line
- Interpreted seismic velocity (m/s) and refractor boundary
- Interpreted refractor boundary based on limited data
- 1800 — Lateral seismic velocity boundary



revision	description	drawn	approved	date

0 10 20 40 60
Scale (metres)

drawn	PE/LT
approved	RJW
date	10/12/07
scale	1:1000
original size	A3

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

client: NSW DEPARTMENT OF COMMERCE

project: SHALLOW SEISMIC REFRACTION STUDY TILLEGRA DAM, NSW

title: INTERPRETED SEISMIC REFRACTION SECTION - LINE 6 AND 7

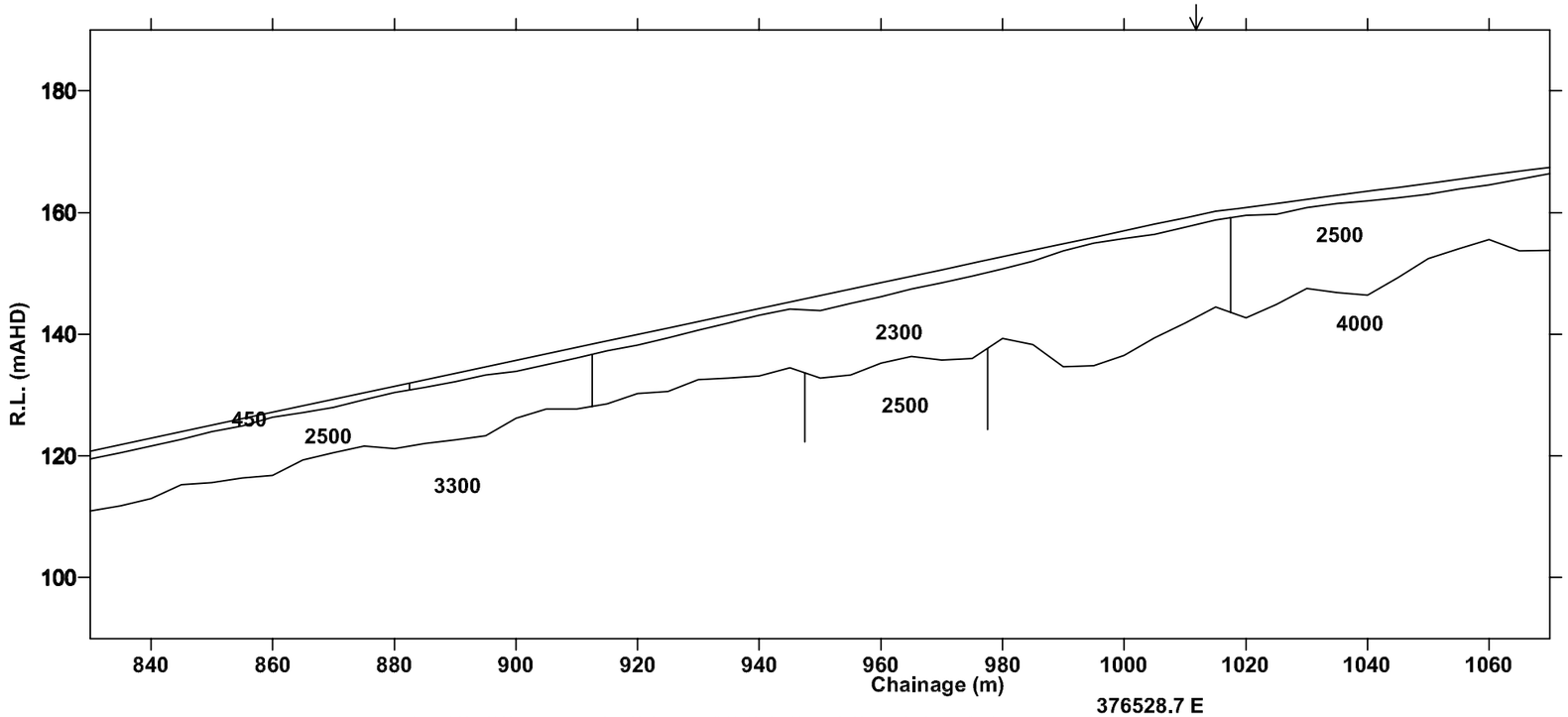
project no: GEOTLCOV23357AA

figure no: FIGURE 5

376467.1 E
6423227 N

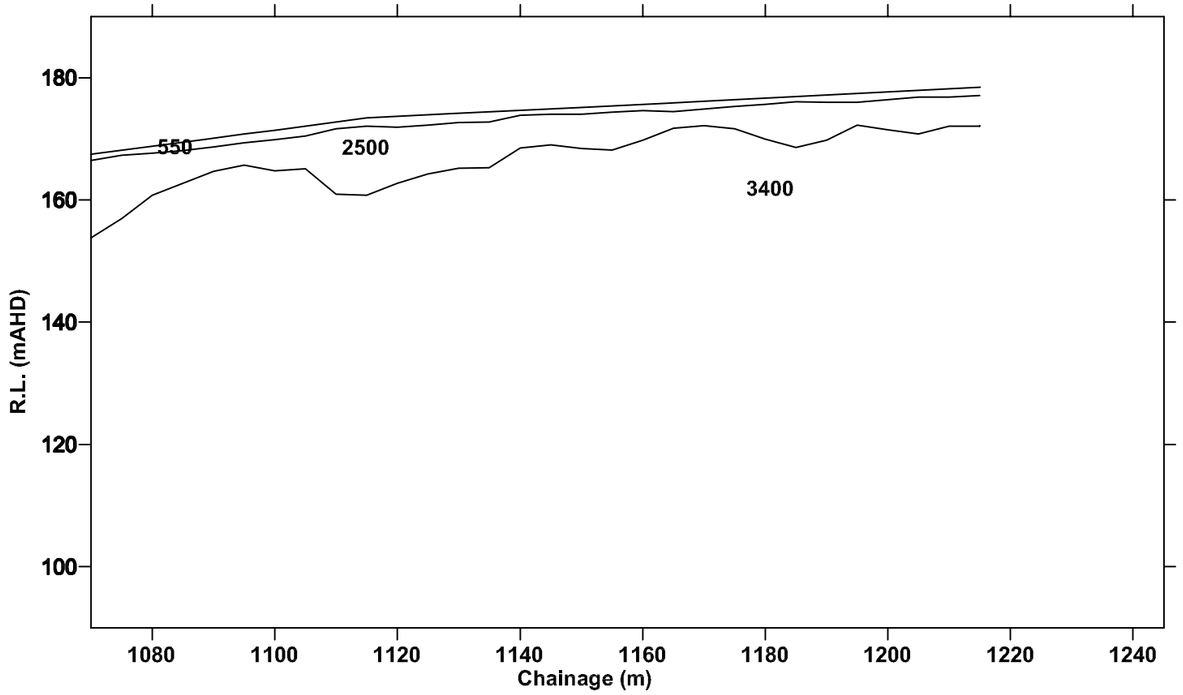
LINE 1C: SPILLWAY CREST, RIGHT ABUTMENT

(Line 2c @ 760m)



376528.7 E
6422871 N

LINE 1C (CONTINUED): SPILLWAY CREST, RIGHT ABUTMENT



LEGEND

Ground surface level on seismic line

1800 Interpreted seismic velocity (m/s) and refractor boundary

Lateral seismic velocity boundary

revision	description	drawn	approved	date

0 10 20 40 60

Scale (metres)

drawn	PE/LT
approved	RJW
date	10/12/07
scale	1:1000
original size	A3

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

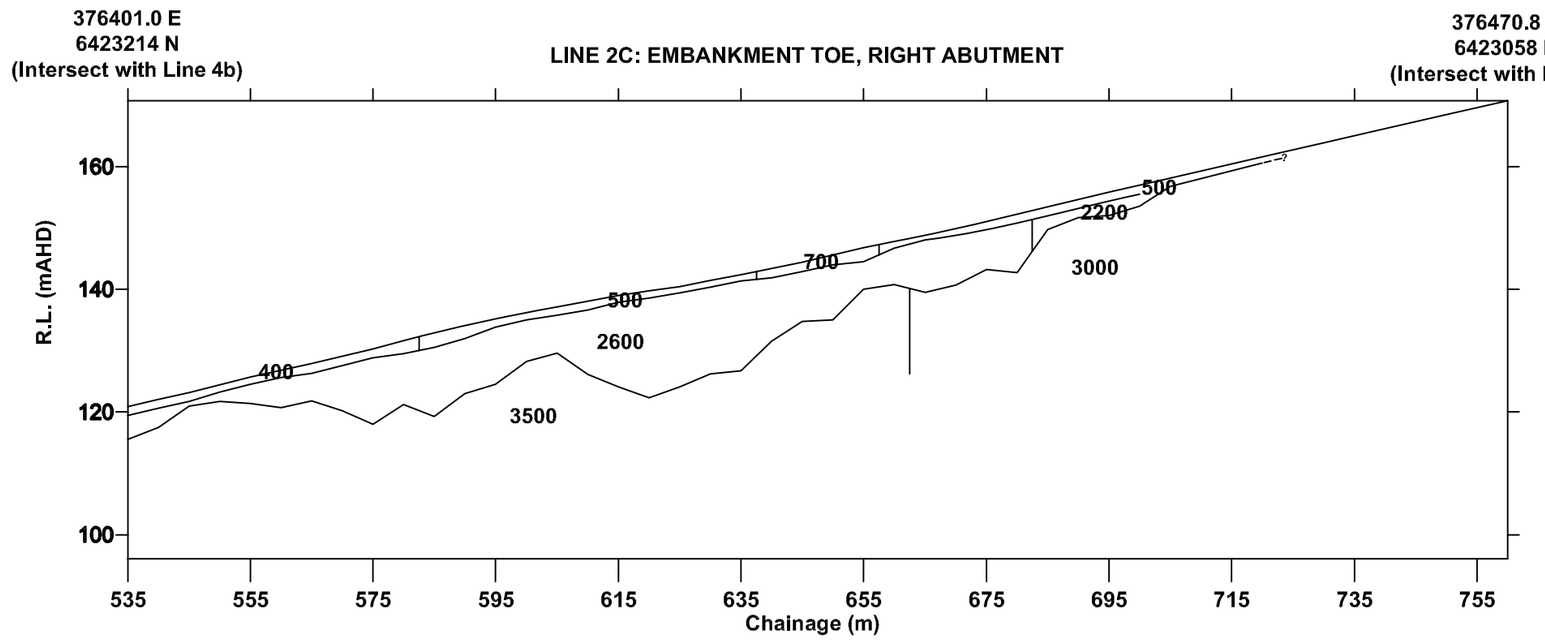
client: NSW DEPARTMENT OF COMMERCE

project: SHALLOW SEISMIC REFRACTION STUDY
TILLEGRA DAM, NSW

title: INTERPRETED SEISMIC REFRACTION SECTION - LINE 1c

project no: GEOTLCOV23357AA

figure no: FIGURE 6



LEGEND

- Ground surface level on seismic line
- Interpreted seismic velocity (m/s) and refractor boundary
- Interpreted refractor boundary based on limited data
- 1800 — Lateral seismic velocity boundary

revision	description	drawn	approved	date

0 10 20 40 60
Scale (metres)

drawn	PE/LT
approved	RJW
date	10/12/07
scale	1:1000
original size	A3

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

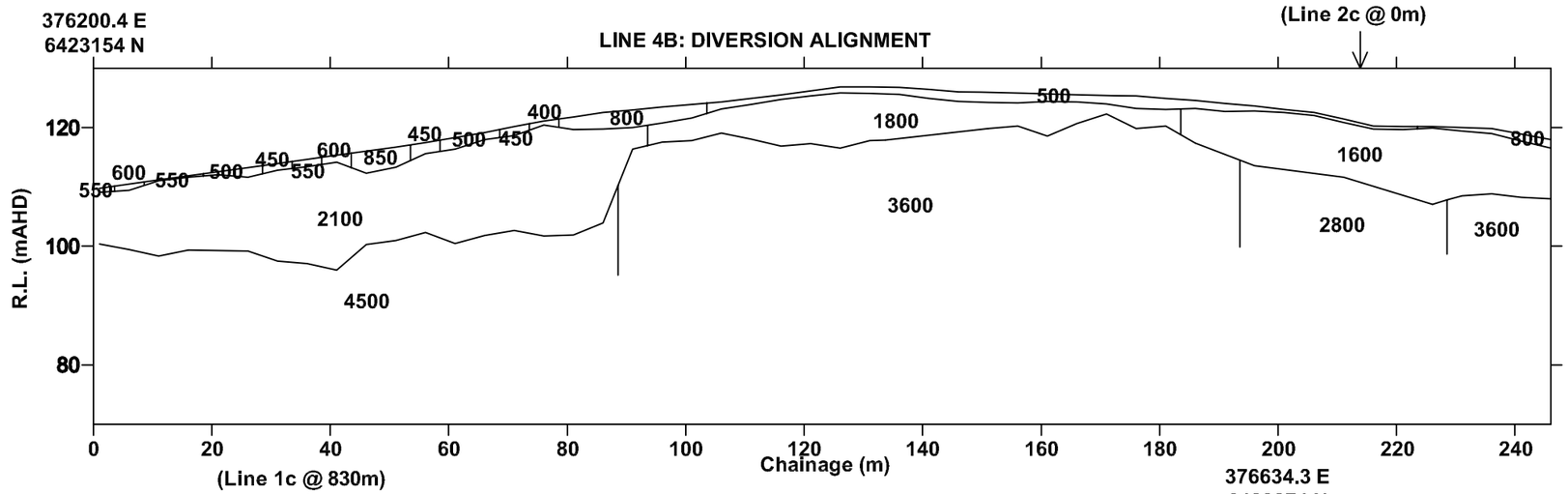
client: NSW DEPARTMENT OF COMMERCE

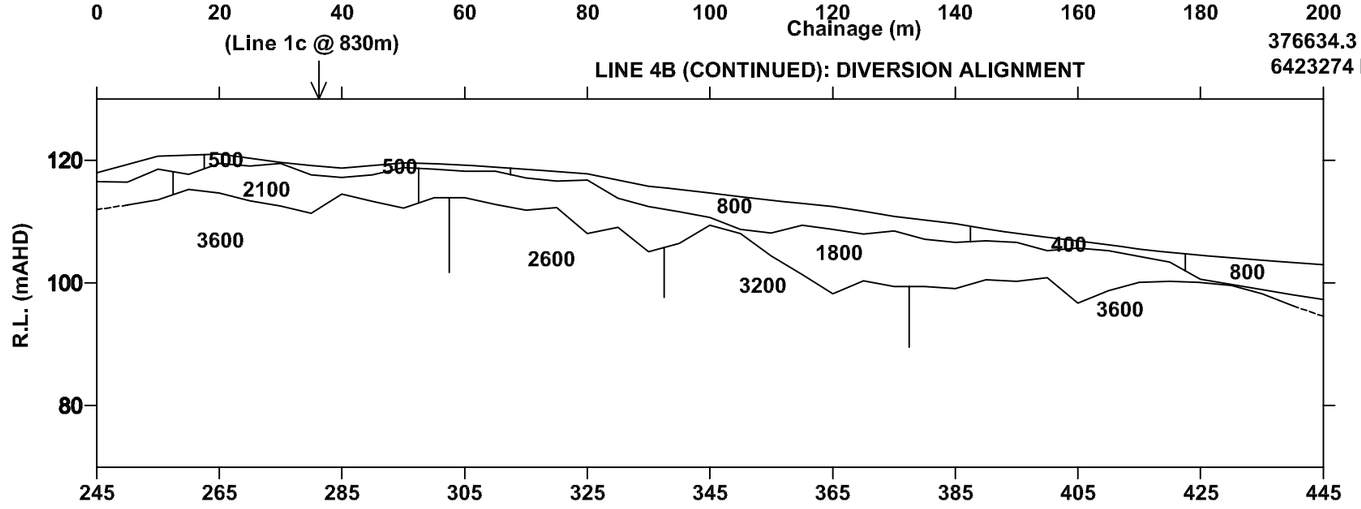
project: SHALLOW SEISMIC REFRACTION STUDY
TILLEGRA DAM, NSW

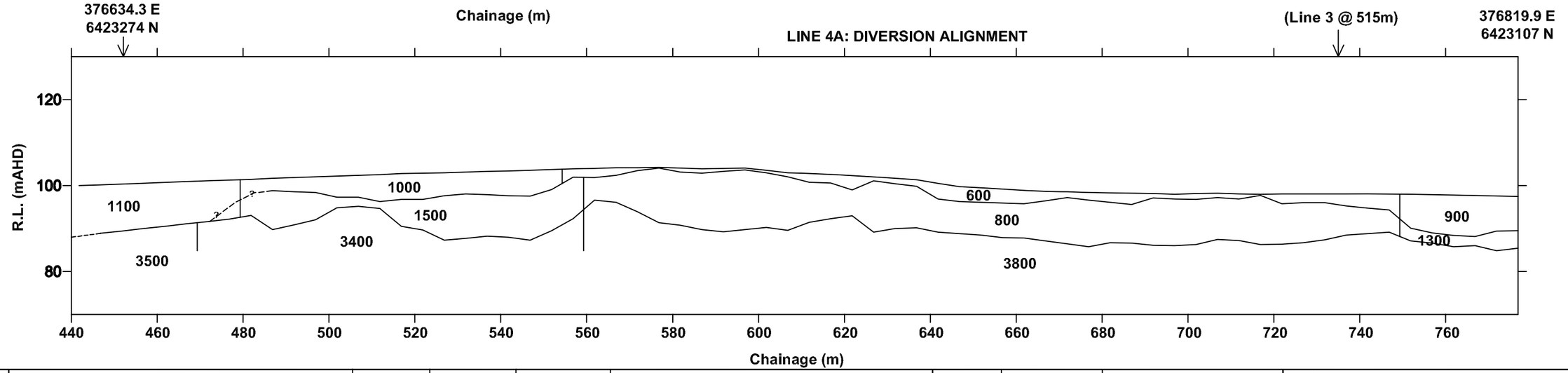
title: INTERPRETED SEISMIC REFRACTION SECTION - LINE 2C

project no: GEOTLCOV23357AA

figure no: FIGURE 7







LEGEND

- Ground surface level on seismic line
- Interpreted seismic velocity (m/s) and refractor boundary
- Interpreted refractor boundary based on limited data
- 1800 — Lateral seismic velocity boundary

revision	description	drawn	approved	date

0 10 20 40 60
Scale (metres)

drawn	PE/LT
approved	RJW
date	10/12/07
scale	1:1000
original size	A3

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

client: NSW DEPARTMENT OF COMMERCE

project: SHALLOW SEISMIC REFRACTION STUDY TILLEGRA DAM, NSW

title: INTERPRETED SEISMIC REFRACTION SECTION - LINE 4

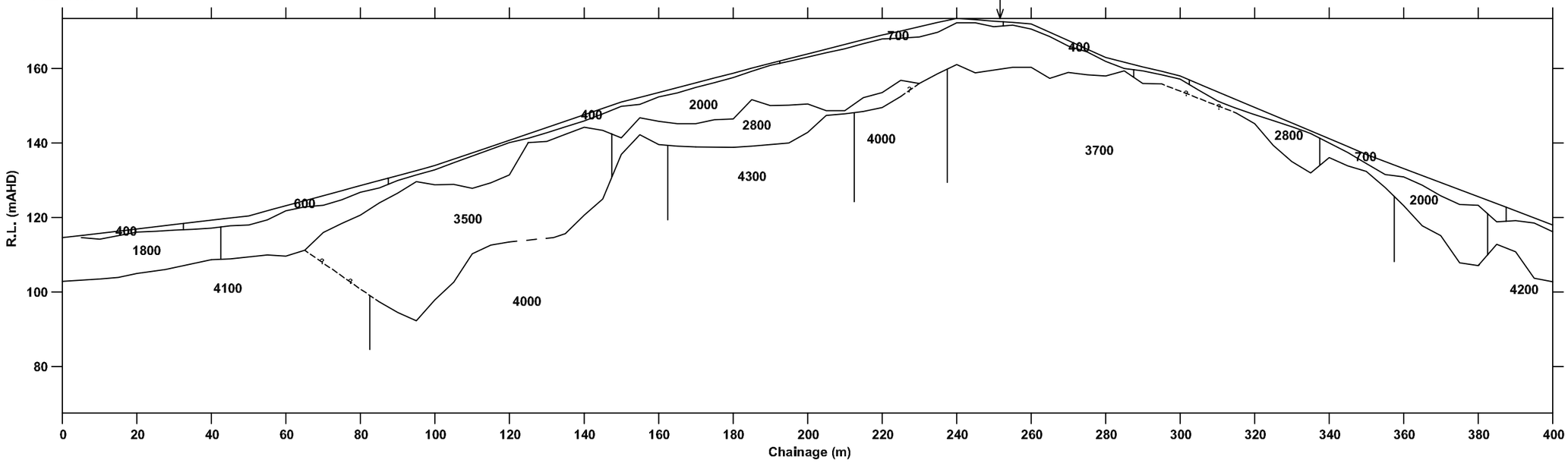
project no: GEOTLCOV23357AA

figure no: FIGURE 8

LINE 3 SPILLWAY CHANNEL, RIGHT ABUTMENT

376275.4 E
6422895 N

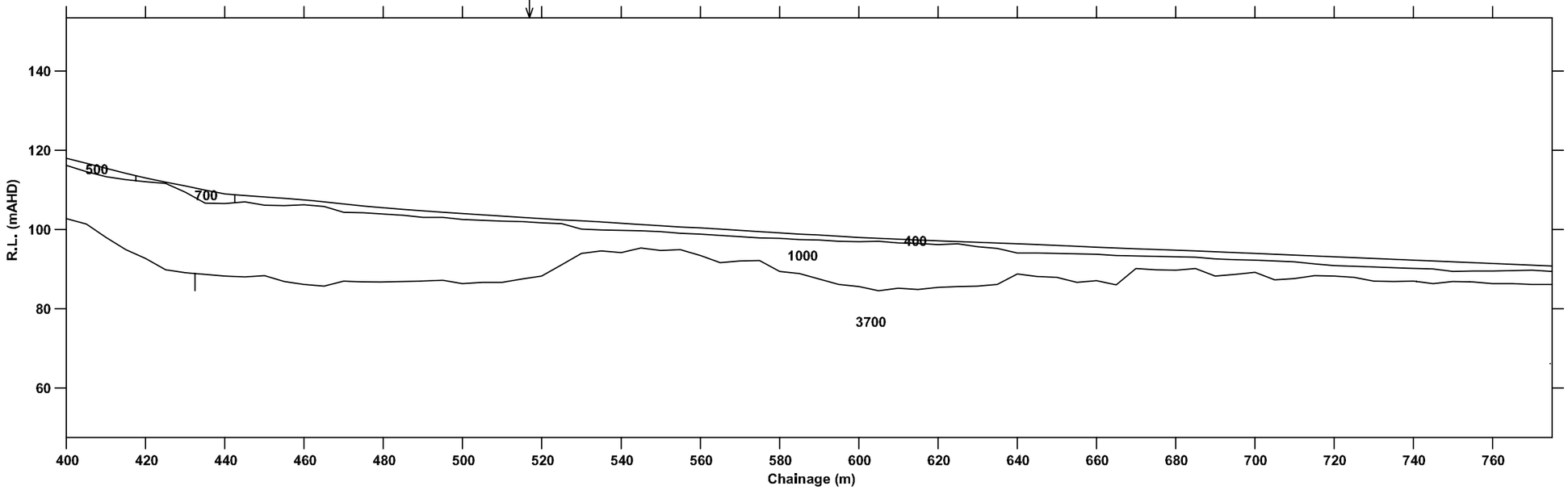
376496.3 E
6422962 N
(Line 1c @ 1140m)



LINE 3 (continued)

(Line 4a @ 735m)

376963.7 E
6423241 N



LEGEND

- Ground surface level on seismic line
- Interpreted seismic velocity (m/s) and refractor boundary
- Interpreted refractor boundary based on limited data
- 1800 — Lateral seismic velocity boundary

revision	description	drawn	approved	date

0 25 50 75
Scale (metres)

drawn	PE/LT
approved	RJW
date	10/12/07
scale	1:1250
original size	A3

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

client: NSW DEPARTMENT OF COMMERCE

project: SHALLOW SEISMIC REFRACTION STUDY
TILLEGRA DAM, NSW

title: INTERPRETED SEISMIC REFRACTION SECTION - LINE 3

project no: GEOTLCOV23357AA

figure no: FIGURE 9

Appendix A

The Use of Interpreted Seismic Sections

APPENDIX A – THE USE OF INTERPRETED SEISMIC SECTIONS

The results of seismic refraction surveys are presented as sections beneath the line of traverse. These sections show a two-dimensional distribution of velocities with depth, which has been interpreted from first arrival travel time data obtained in the field.

The following general summary is similar to the standard RTA guidelines and is intended to assist in the understanding of interpreted seismic sections.

1 Methods Of Interpretation

First arrival travel times obtained for individual source locations representing the arrival at individual detectors of seismic waves which have travelled through the earth via least-time or near least-time paths are picked interactively from computer recorded traces (or a permanent record of them). These times are plotted against distance from the source, as travel time curves. These times are examined, reviewed and edited as necessary.

Further quantitative seismic interpretation, aimed at providing subsurface depth and velocity information, is carried out using the intercept time or reciprocal methods (Dobrin, 1976; Hawkins, 1961) as appropriate. The interpretation method applied is determined by the field procedure used, the nature of the subsurface at the site, and by the objectives of the seismic study.

The interpretation provides a simplified seismic picture of the subsurface and depends on a number of assumptions about its nature. The major assumptions are:

i) the subsurface essentially consists of a series of discrete uniform layers which may vary laterally in velocity.

ii) the boundaries between these layers are distinct. For the simpler methods of interpretation, these boundaries are also assumed to be planar, but can be highly irregular

iii) The seismic velocities of successive layers increase with depth.

iv) Each layer is of sufficient thickness to critically refract energy, and to produce a refracted wave arrival at the surface of sufficient energy to be detected as a first arrival.

These assumptions demonstrate requirements of the interpretation procedure for ideal conditions of which all of the requirements are unlikely to be fulfilled in reality. The extent to which each assumption is valid may vary greatly from site to site and within a site. Consequently, at all sites, interpreted seismic sections are a simplification of the actual subsurface velocity distribution. The degree of simplification depends on the interpretative method used, the amount of data available for analysis and the extent to which the basic assumptions are violated at a site.

Some violations such as diffractions from large irregularities and non-critical refraction's may be observed in the data or may be undetectable. Consequently the interpretation process is partly subjective, other interpretations of the data are possible and may differ considerably from the interpretation presented.

The effects of common violations of the assumptions are discussed in Section B5.3, below. Other effects which may be relevant to the understanding of the seismic sections are discussed in Section B5.4.

It should be noted that, at a given site, these effects can occur in virtually any combination and that, as a result, even highly complex subsurface conditions may give rise to relatively simple-looking seismic sections.

2 Precision And Accuracy Of Results

A given seismic velocity does not necessarily uniquely determine the engineering properties of an earth material, even for the one rock type. For example a medium strength rock may have the same seismic velocity as a mixture of extremely low strength rock, and boulders or corestones of very high strength rock.

Moreover a relatively small proportion of extremely low strength material can dramatically lower the composite seismic velocity. For example a material composed of 50% boulders with seismic velocity 4000 m/s, and 50% of material with seismic velocity 800 m/s, then the composite velocity is lowered to 1333 mm/s. The theoretical equation for the composite seismic velocity of a mixture of two materials is set out below:

$$V_r = \frac{V_1 \, V_2}{f.V_2 + (1-f).V_1}$$

where V_r = resultant seismic velocity

V_1 = seismic velocity of material type 1

V_2 = seismic velocity of material type 2

f = fraction of material type 1

1-f = fraction of material type 2

Interpreted velocities are usually shown on the sections to the nearest 50 or 100 m/s. Interpreted velocities, as a measure of the actual field velocities, are not regarded as being accurate to better than ± 10%, but can be independently calibrated using drilling or excavation.

Calculated layer thickness are subject to a similar level of experimental error. This has a cumulative effect on interpreted depths to deeper interfaces. For example, the interpreted depth to the base of the first layer defined is often considered accurate to better than ± 10%, however depths to deeper layers may not be accurate to better than ± 30% (Dampney and Whiteley, 1978). Quality assurance procedures such as seismic raytracing, which can use the entire travel-time data set can often improve velocity and depth accuracy.

These experimental errors are inherent in the procedure and must be taken into account in any use which is made of the seismic sections eg., in estimating the volume of material represented by each layer in a proposed excavation.

3 Effects Of Violation Of Assumptions

3.1 Assumption of Discrete, Uniform Layers.

The most common problems are:

i) continuous increase in velocity with depth.

ii) inhomogeneity below the scale of resolution of the survey.

The first of these occurs in many geological settings, particularly in sediments, highly weathered sedimentary rocks, or phyllitic rocks. It can be allowed for in a number of ways but contributes to the uncertainty in depth calculations based on constant layer velocity. Often the seismic sections show the "average" velocity of the layer.

For the second type of problem, under ideal conditions a refraction study can resolve features as small as 1.5-2 times the geophone spacing. In general, however, the practical limit of resolution is 2-3 times this spacing although the presence of inhomogeneity may be observable from the travel time curves, without more detailed interpretation being possible.

Calculated seismic velocities are averages which represent the bulk properties of the interpreted layers. It is possible for this averaging to conceal major, local variations in velocity on a scale up to at least twice the geophone spacing. The likely nature of these variations depends on the geological setting of the site but clearly boulder conditions and rapid lateral changes in weathering or lithology would be among the difficult sites.

3.2 Assumptions of Distinct Boundaries

Real geological boundaries, especially those related to weathering, are often gradational and/or irregular. The seismic method inevitably disguises gradation and smoothes irregularity. The importance of this varies from site to site but it is common for interpreted seismic boundaries to appear at an intermediate level somewhere between the limits of gradation. For example, if there is an irregular boundary between fresh and highly weathered rock, the interpreted boundary frequently appears at a level some metres below the highest points at which fresh rock is found.

3.3 Assumption of Increasing Velocity With Depth

This assumption may be violated for a number of different reasons and such violations (termed velocity reversals, or velocity inversions) often cannot be detected from the travel time data alone. It may be possible (in some, but not all cases) to infer them from the geological setting, from borehole information, or from surface-to-borehole seismic. If the inversion layers do not persist laterally their effect may also be observable on the travel-time data.

In general, it is not possible to allow for a velocity inversion in the interpretation unless there is an independent means of estimating both the thickness and the velocity of the layer. If an undetected velocity reversal is present, all calculated depths below the reversal will be in error. In particular, depths to underlying high velocity layers may be significantly overestimated (Whiteley and Greenhalgh, 1979). Areas where strong layers overlay weaker layers, for example, cretes overlying sands, or sandstone overlying coal, are sites where these problems sometimes occur.

3.4 Assumption of Detectability

Two main types of violation occur:

i) When a layer is too thin to transmit the seismic wave.

ii) When a layer transmits the wave but is not detected because waves from a deeper, higher velocity layer reach the detector first.

The first type of problem may occur in many geological settings and means that relatively thin, higher velocity layers may occur undetected within lower velocity materials. "Thin" in this context is defined in terms of seismic detectability and can imply thickness of the order of 1-1.5m. The effect cannot be detected from the surface seismic refraction data alone, but may be inferable from borehole information, surface mapping or surface-to-borehole seismic. If such a layer were thick enough to be detected, it would form a velocity reversal (see Section B3.3).

The second type of problem (termed a hidden layer or blind zone) may be inferable from the geological setting, borehole data or sometimes from the surface seismic refraction data. If it is not detected, it also results in erroneous depth calculations in the interpreted section, normally the calculated depth to deeper interfaces is underestimated. In theory, between every pair of layers there could be a hidden layer (or blind zone), whose maximum thickness may be calculated for a range of intermediate velocities.

4 Other Factors

Other common factors may lead to differences between the surface seismic refraction model and reality. While not strictly due to assumptions made in interpretation, they should still be taken into account, if the site conditions dictate, in any further use of the interpreted sections. These factors are:

i) Three-dimensional effects

ii) Effect of water

iii) Anisotropy

4.1 Three-dimensional effects

The interpreted sections are two-dimensional representations and only apply to a narrow zone below the line of traverse typically 5-20m either side of the seismic line. However, the real subsurface is three-dimensional and as a result significant lateral variations in conditions can occur without being detected, even within a short distance to the side of a traverse. If seismic signals originating from such features are obtained, they may result in the interpreted sections containing features which are non-existent, displaced from their true position or shown with incorrect velocities. This problem is most common in sites with irregular topography, boulders and broken rock masses.

In some cases three-dimensional effects may be observed by using cross seismic spreads at right angles to the main profile, or additional parallel seismic lines, or from other information.

4.2 Effect of Water

The presence of water can greatly increase the field velocity of materials which have low velocities in the dry condition. The effect is most pronounced in soils or unconsolidated materials and is due to the difference in seismic velocity between air and water (340 m/s and 1470 m/s, respectively). It may however occur to a significant degree in materials with dry velocities as high as 2000-2500m/s. The change is not related to the normal trends of change in material properties with velocity.

Less frequently, it is possible for water saturation to cause a decrease in field velocity, most commonly in low velocity materials where highly expansive clay minerals are present and the material is unconfined. In the marine environment or at sites with newly deposited level sediments, the presence of gas in otherwise water saturated sediments can lower velocities below that in water.

Velocity changes due to the presence of a water table cannot normally be distinguished from the seismic data alone in other than relatively uniform coarse grained material (ie sands). The effect may be inferable from the geological setting and the interpreted velocities, but can only be confirmed by contemporaneous drilling.

4.3 Anisotropy

Field velocities may vary with the direction of the seismic line. Usually if the velocity measured in different directions agree to within ± 10% the condition is treated as isotropic. Anisotropy is most common in steeply dipping sediments or metasediments but can occur in other settings. When measured across strike the velocity is an average for the different materials present. Along strike the higher velocity of the fresher or more competent materials is measured. This effect may be detectable from cross spreads which show a markedly higher or lower velocity than longitudinal traverses. However it may not be detected, depending on the relative orientations of the traverses and the strike of the subsurface materials.

A more subtle form of anisotropy occurs in many sedimentary rocks where the vertical velocity differs from the horizontal velocity. Normally seismic refraction studies provide information on the horizontal velocities which are commonly higher than the vertical velocities.

The possible effects of anisotropy are similar to those discussed under Section B3.1 above.

5 References

Dampney, CNG and Whiteley, RJ (1978). Velocity determination and error analysis for the seismic refraction method. Geophysical Prospecting, 28, pp. 1-17.

Dobrin, MG (1976). Introduction to geophysical prospecting. 3rd edition. McGraw-Hill, New York.

Hawkins, LV (1961). The reciprocal method of routine shallow seismic refraction investigations. Geophysics, 26(6), pp. 806-19.

Whiteley, RJ and SA Greenhalgh, (1979). Velocity inversion and the shallow seismic refraction method. Geoexploration, 17, pp. 125-141.

Whiteley, RJ.(1994) Seismic Refraction Tetsing - A Tutorial, in Geophysical Characterisation of sites, Oxford & IBH publishing, New Delhi, pp. 45-49.

APPENDIX C

Test Pit Logs

TP37 to TP109

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP37

PROJECT: TILLEGRA DAM — DATE: 29.10.07

LOCATION: FARLEYS PROPERTY - ALLUVIAL FLAT — SURFACE RL: 92.1m

CONTRACTOR: R. & I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
5						--- (continued from previous sheet) --- CLAYEY SAND; grey/orangebrown, mottled; firm to soft; moist to very moist with depth.
6			D	SC (v)		
7						END at 7.00 Ends as above. No water encountered.
8						
9						
10						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 2 OF 2 SHEETS
SCALE 1 : 25

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT — TP38

PROJECT: TILLEGRA DAM — DATE: 29.10.07

LOCATION: FARLEYS PROPERTY - ALLUVIAL FLAT — SURFACE RL: 90.6m

CONTRACTOR: R. & I. CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION (Soil type, colour, consistency, grainsize, moisture, remarks)
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - sandy silt with clay, rootlets; dark grey; loose; just moist. — 0.40
1				SC (v)		**Slightly CLAYEY SILTY SAND;** brown; firm (pit sides collapsing); just moist. — 2.50
2						
3				GM (v)		**SANDY GRAVEL;** well rounded; brown; loose; just moist. Gravel ranges to cobble size. — END at 3.70
4						Ends in gravel. Pit collapsing.
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP39

PROJECT: TILLEGRA DAM

DATE: 29.10.07

LOCATION: FARLEYS PROPERTY - ALLUVIAL FLAT

SURFACE RL: 89.0m

CONTRACTOR: R. & I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0				CL/CI (v)		**CLAYEY SILT with trace of sand, rootlets; dark grey; loose; just moist.**
						0.35
						SILTY SAND; brown; loose; moist.
1						
			D			
2				SM (v)		
3						
						3.60
						SANDY GRAVEL; well rounded; brown; loose; very moist/wet. Gravel ranges to cobble size. Pit making water.
4				GM (v)		
	4.75m					**Ends in gravel. Pit collapsing.**
5						END at 5.00

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP40

PROJECT: TILLEGRA DAM
DATE: 29.10.07
LOCATION: FARLEYS PROPERTY
SURFACE RL: 94.4m
CONTRACTOR: R. & I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - sandy silt with trace of clay, rootlets; pale brown; loose; dry. 0.20
				CL/CI (v)		**SANDY CLAY;** yellowbrown/brown, streaked; stiff/very stiff; just moist. 0.90
1				CL/CI (v)		**SILTY CLAY/CLAYEY SILT;** redbrown/grey, mottled; very stiff; just moist. 3.40
2						
3						
4				SC (v)		**GRAVELLY CLAYEY SAND/CLAYEY SAND** with gravel; pale grey/orangebrown, mottled; very stiff; just moist. Gravel well rounded to 75mm dia. END at 4.70
5						Ends as above.

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP41

PROJECT: TILLEGRA DAM
DATE: 29.10.07
LOCATION: FARLEYS PROPERTY
SURFACE RL: 95.4m
CONTRACTOR: R. & I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			CL/CI (v)		**TOPSOIL** - clayey silt with sand, rootlets; pale brown; loose; dry.
0.35						
				CH (v)		**SILTY CLAY;** grey; very stiff; just moist.
3.10						
				GM (v)		**SANDY GRAVEL;** brown; medium dense/dense; just moist/moist. Gravel well rounded to cobble size.
5.00						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

V : visual
L : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 2 SHEETS
SCALE 1 : 25

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP41

PROJECT: TILLEGRA DAM

DATE: 29.10.07

LOCATION: FARLEYS PROPERTY

SURFACE RL: 95.4m

CONTRACTOR: R. & I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
5				GM (v)		**SANDY GRAVEL;** brown; medium dense to dense (towards 5.5m); lightly cemented; just moist/moist. Gravel well rounded to cobble size. **END at 5.50**
6						Ends as above.
7						
8						
9						
10						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 2 OF 2 SHEETS
SCALE 1 : 25

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT — TP42

PROJECT: TILLEGRA DAM
DATE: 29.10.07
LOCATION: FARLEYS PROPERTY
SURFACE RL: 97.1m
CONTRACTOR: R. & I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION (Soil type, colour, consistency, grainsize, moisture, remarks)
0	N.G.E			SM (v)		TOPSOIL - sandy silt, rootlets; pale brown; loose; dry. — 0.20
				SC (v)		CLAYEY SANDY SILT/SILTY SAND; pale brown; firm; dry. — 0.50
				CL/CI (v)		SANDY CLAY; brown; stiff/very stiff; dry. — 0.70
1				ROCK		TUFFACEOUS SANDSTONE; highly weathered/moderately weathered; weak; fine grained; massive, difficult digging. No indication of bedding, possibly flat lying. — END at 1.00
						Ends as above.
2						
3						
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP43

PROJECT: TILLEGRA DAM
DATE: 29.10.07
LOCATION: FARLEYS PROPERTY
SURFACE RL: 96.8m
CONTRACTOR: R. & I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - sandy silt, rootlets; pale brown; loose; dry. 0.30
1				CH (v)		**SILTY CLAY;** greybrown with orangebrown streaks; stiff just moist/moist. 1.40
				ROCK		**TUFFACEOUS SANDSTONE;** extremely weathered; extremely weak; medium grained; behaves as clayey sand; brown; just moist. END at 1.90
2						Ends as above.
3						
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP44

PROJECT: TILLEGRA DAM
DATE: 29.10.07
LOCATION: FARLEYS PROPERTY
SURFACE RL: 95.6m
CONTRACTOR: R. & I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0				SM (v)		TOPSOIL - sandy silt with clay, rootlets; dark grey; loose; dry. 0.25
1				SC (v)		CLAYEY SAND; pale grey/orangebrown, mottled; firm to stiff; moist to very moist with depth. Seepage into pit at 2.5m.
2	2.5m					2.60
3				SM (v)		SANDY GRAVEL; brown; medium dense; just moist/moist. Gravel well rounded to cobble size.
4						Dense towards 4.0m, lightly cemented. 4.09
5						Ends as above.

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP45

PROJECT: TILLEGRA DAM

DATE: 29.10.07

LOCATION: FARLEYS PROPERTY - ALLUVIAL FLAT

SURFACE RL: 106.8m

CONTRACTOR: R. & I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SM (v)		TOPSOIL - gravelly sandy silt, rootlets; pale brown; loose; dry. 0.15
1				ROCK		META-SHALE; highly weathered; weak/medium strong; laminated. Bedding 33°/245°. Major joint sets: 68°/343° (into LA), 54°/072° (across bedding). Defect spacing very close/close.
						Highly weathered/moderately weathered towards 1.5m; medium strong. END at 1.50
2						Ends as above.
3						
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

V : visual
L : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP46

PROJECT: TILLEGRA DAM
DATE: 30.10.07
LOCATION: FARLEYS PROPERTY
SURFACE RL: 109.1m
CONTRACTOR: R. & I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION (Soil type, colour, consistency, grainsize, moisture, remarks)
0	No Groundwater Encountered			SM (v)		TOPSOIL - sandy silt with trace of clay, rootlets; pale brown; loose; dry. 0.15
1				ROCK		META-SHALE with fine grained tuffaceous sandstone interbeds; highly weathered/moderately weathered; weak/mediumn strong; laminated to thinly bedded. Bedding 41°/248°; major joint set 73 °/068 ° (across bedding). Defect spacing very close/close. Surfaces Ironstained, minor clay coating. END at 1.60
2						Ends as above.
3						
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP47

PROJECT: TILLEGRA DAM
DATE: 30.10.07
LOCATION: FARLEYS PROPERTY
SURFACE RL: 108.3m
CONTRACTOR: R. & I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION (Soil type, colour, consistency, grainsize, moisture, remarks)
0	N.G.E			SM (v)		TOPSOIL - sandy silt, rootlets; pale brown; loose; dry. — 0.15
				CL/CI (v)		SANDY SILTY CLAY; brown with orangebrown streaks; stiff; just moist. — 0.75
1				ROCK		Pebbly TUFFACEOUS SANDSTONE, includes well rounded gravel to 5mm dia; highly weathered; generally weak (difficult digging); fine grained. No indication of bedding. (may represent GRAVELLY CLAYEY SAND, lightly cemented). — END at 1.10
						Ends as above.
2						
3						
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT — TP48

PROJECT: TILLEGRA DAM
LOCATION: FARLEYS PROPERTY
DATE: 30.10.07
SURFACE RL: 108.6m
CONTRACTOR: R. & I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION (Soil type, colour, consistency, grainsize, moisture, remarks)
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - sandy silt, rootlets; pale brown; loose; dry. — 0.15
				CL/CI (v)		**SANDY SILTY CLAY;** brown with orangebrown streaks; stiff; just moist. — 0.70
1				SC (v)		**GRAVELLY CLAYEY SAND;** brown/yellowbrown; stiff/very stiff; just moist. Includes well rounded gravel to 5mm dia.
2						Extremely weathered/highly weathered towards 2.0m; extremely weak/very weak. — 2.50
3				GC (v)		**GRAVELLY SANDY CLAY/CLAYEY SAND;** greybrown; stiff/very stiff; just moist. Includes highly weathered angular tuffaceous sandstone/meta-shale fragments to 15mm dimension. Rare well rounded gravel to 5mm dia still persists.
4						
5						— 5.00

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 2 SHEETS
SCALE 1 : 25

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GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP48

PROJECT: TILLEGRA DAM

DATE: 30.10.07

LOCATION: FARLEYS PROPERTY

SURFACE RL: 108.6m

CONTRACTOR: R. & I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
5				GC (v)		**GRAVELLY SANDY CLAY/CLAYEY SAND;** greybrown; stiff/very stiff; just moist. Includes highly weathered angular tuffaceous sandstone/meta-shale fragments to 15mm dimension. Rare well rounded gravel to 5mm dia still persists.
						END at 6.00
6						Ends as above.
7						
8						
9						
10						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 2 OF 2 SHEETS
SCALE 1 : 25

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT — TP49

PROJECT: TILLEGRA DAM — DATE: 30.10.07

LOCATION: FARLEYS PROPERTY - ALLUVIAL FLAT — SURFACE RL: 112.6m

CONTRACTOR: R. & I. CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION (Soil type, colour, consistency, grainsize, moisture, remarks)
0	N.G.E			SM (v)		TOPSOIL - slightly clayey sandy silt, rootlets; pale brown; loose; dry. — 0.15
				SC (v)		GRAVELLY CLAYEY SAND; brown/yellowbrown, mottled; stiff; dry. — 0.55
				GC (v)		CLAYEY SANDY GRAVEL; pale greybrown; very stiff/hard; just moist. Has the appearance of concrete. Gravel fraction comprises angular, weathered meta-sedimentary fragments to 25mm. — END at 0.75
1						Ends as above (very difficult digging).
2						
3						
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

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GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP50

PROJECT: TILLEGRA DAM — DATE: 30.10.07

LOCATION: FARLEYS PROPERTY - ALLUVIAL FLAT — SURFACE RL: 107.0m

CONTRACTOR: R. & I. CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION (Soil type, colour, consistency, grainsize, moisture, remarks)
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - slightly clayey sandy silt, rootlets; pale brown; loose; dry. — 0.25
1				CH (v)		**SILTY CLAY/CLAYEY SILT;** yellowbrown/brown; stiff; moist. — 1.60
2				GC (v)		**CLAYEY SANDY GRAVEL;** angular meta-sedimentary fragments to 25mm in greybrown/orangebrown clayey sand/sandy clay matrix; cemented; very weak/weak - probable slopewash. — END at 1.90
3						Ends as above. Massive, slow digging.
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP51

PROJECT: TILLEGRA DAM

DATE: 30.10.07

LOCATION: FARLEYS PROPERTY - ALLUVIAL FLAT

SURFACE RL: 116.2m

CONTRACTOR: R. & I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	N.G.E			SC (v)		TOPSOIL - gravelly clayey sand, rootlets; greybrown; loose; dry. 0.15
				ROCK		META-SHALE; moderately weathered; medium strong; thinly bedded. Common clay fill to 0.7m depth. Bedding 42°/073°.
1						END at 1.20
						Ends as above, moderately weathered/slightly weathered; medium strong/strong.
2						
3						
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

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GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP52

PROJECT: TILLEGRA DAM — DATE: 30.10.07

LOCATION: FARLEYS PROPERTY - ALLUVIAL FLAT — SURFACE RL: 117.3m

CONTRACTOR: R. & I. CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SC (v)		TOPSOIL - gravelly sandy silt, rootlets; pale brown; loose; dry. 0.20
1				ROCK		TUFFACEOUS SANDSTONE; moderately weathered/slightly weathered; medium strong/strong; very fine grained. Defect spacing very close to moderately wide. Bedding indistinct. Possibly 58°/265° ? Major joint sets 20°/073° across bedding ?
2						END at 2.10
3						Ends as above.
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

V : visual
L : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP53

PROJECT: TILLEGRA DAM

DATE: 30.10.07

LOCATION: LA - SPILLWAY CHANNEL

SURFACE RL: 108.7m

CONTRACTOR: R.& I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - clayey silty sand, rootlets; pale brown; loose; dry. 0.20
				SC (v)		**GRAVELLY CLAYEY SAND;** brown with orangebrown mottle; stiff; dry. 0.70
1				ROCK		**META-SHALE;** moderately weathered; medium strong; laminated to thinly bedded. Bedding 36°/265°. Major joint set 55°/005° (into LA). Defect spacing (including partings) very close/close. Surfaces iron stained, commonly clay coated. END at 1.60
2						Ends as above; moderately weathered; tight. Close to refusal.
3						
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP54

PROJECT: TILLEGRA DAM

DATE: 30.10.07

LOCATION: LA - SPILLWAY CHANNEL

SURFACE RL: 114.8m

CONTRACTOR: R.& I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, groinsize, moisture, remarks
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - sandy silt, rootlets; pale greybrown; loose; dry. 0.25
				CL/CI (v)		**SANDY SILTY CLAY;** brown/yellowbrown, mottled; very stiff; just moist. 0.75
1				ROCK		**TUFFACEOUS SANDSTONE;** highly weathered/moderately weathered; generally weak. No distinct bedding. Defect spacing generally moderately wide, iron stained surfaces clay coated. END at 1.50
2						Ends as above, moderately weathered, tight. Refusal.
3						
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP55

PROJECT: TILLEGRA DAM

DATE: 30.10.07

LOCATION: LA - SPILLWAY CHANNEL

SURFACE RL: 112.4m

CONTRACTOR: R.& I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SM (v)		TOPSOIL - clayey sandy silt, rootlets; pale brown; loose; dry. 0.25
				ROCK		TUFFACEOUS SANDSTONE; highly weathered; very weak/weak. Bedding:40°/245°. Defect spacing close to generally moderately wide. Surfaces Fe/Mn stained, commonly clay coated to 1.3m. END at 1.55
1						
2						Ends as above, moderately weathered, tight. Refusal.
3						
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP56

PROJECT: TILLEGRA DAM
DATE: 31.10.07
LOCATION: LOWREYS PROPERTY
SURFACE RL: 145.8m
CONTRACTOR: R.& I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SM (v)		**TOPSOIL - sandy silt, rootlets;** pale yellowbrown; loose; dry. 0.25
1				SC (v)		**GRAVELLY CLAYEY SAND;** orangebrown/pale yellowbrown, mottled; firm; just moist. 1.40
2				ROCK		**TUFFACEOUS SANDSTONE;** highly weathered; very weak; fine grained; medium to thickly bedded. Bedding 43°/240°. END at 2.30
3						Ends as above, highly weathered/moderately weathered, tight. Refusal.
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP57

PROJECT: TILLEGRA DAM

DATE: 31.10.07

LOCATION: LOWREYS PROPERTY

SURFACE RL: 125.1m

CONTRACTOR: R.& I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE OR TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SM (v)		**TOPSOIL - sandy silt, rootlets; pale brown; loose; dry.** 0.20
1				SC (v)		**CLAYEY SAND/SANDY CLAY with trace of gravel; orangebrown/yellowbrown mottled; firm; moist.** 1.80
2				ROCK		**META-SHALE; highly weathered/moderately weathered; weak/medium strong; laminated to thinly bedded. Bedding: 40 °/225 °.** END at 2.00 **Ends as above.**
3						
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP58

PROJECT: TILLEGRA DAM

DATE: 31.10.07

LOCATION: LOWREYS PROPERTY

SURFACE RL: 118.1m

CONTRACTOR: R.& I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - sandy silt with clay, rootlets; pale brown; loose; dry. 0.15
				SC (v)		**CLAYEY SAND** with gravel; orangebrown/yellowbrown, streaked; firm; just moist. 0.65
1				ROCK		**META-SHALE;** highly weathered/moderately weathered; generally medium strong; lamianted to very thinly bedded. Includes thin clay seams to approx 1.3m depth. Bedding: 13 °/125 °. END at 1.70
2						Ends as above.
3						
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP59

PROJECT: TILLEGRA DAM — DATE: 31.10.07

LOCATION: LA - SPILLWAY CREST — SURFACE RL: 165.7m

CONTRACTOR: R.& I. CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION (Soil type, colour, consistency, grainsize, moisture, remarks)
0	N.G.E			SM (v)		**TOPSOIL** - sandy silt, rootlets; pale brown; loose; dry. — 0.20
				SC (v)		**CLAYEY SAND;** brown/yellowbrown, mottled; stiff; dry. — 0.65
1				ROCK		**TUFFACEOUS SANDSTONE;** highly weathered; very weak/weak. No indication of bedding. Joint sets: 60°/120° and 85°/340°. Spacing varies from close (in narrow zones) to wide. Surfaces planar, rough, Fe/Mn stained. — END at 1.00
						Ends as above, tight. Close to refusal.
2						
3						
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP60

PROJECT: TILLEGRA DAM

DATE: 31.10.07

LOCATION: LA - D/S OUTER ZONE

SURFACE RL: 127.8m

CONTRACTOR: R.& I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SM (v)		TOPSOIL - sandy silt with trace of clay, rootlets; pale brown; dry. 0.25
				SC (v)		CLAYEY SAND; pale brown/orangebrown, mottled; firm; moist. 0.90
1				ROCK		TUFFACEOUS SANDSTONE; highly weathered; generally weak; fine grained; clay fill up to 10mm, ranging to clay coatings with depth. Bedding: 46°/252°. Major joint sets: 75°/333°(into LA), 80°/104° (across bedding). Bedding thickness varies from thinly bedded to thick. Defect spacing close/moderately wide. Surfaces planar, rough, iron stained, commonly clay coated.
2						END at 2.30
3						Ends as above, highly weathered/moderately weathered, tight. Refusal.
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP61

PROJECT: TILLEGRA DAM — DATE: 31.10.07

LOCATION: LA - D/S OUTER ZONE — SURFACE RL: 118.4m

CONTRACTOR: R.& I. CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION (Soil type, colour, consistency, groinsize, moisture, remarks)
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - sandy silt, rootlets; pale brown; loose; dry. — 0.20
				SC (v)		**SANDY CLAY/CLAYEY SAND;** pale brown/orangebrown, mottled; stiff; dry to just moist. — 0.95
1				ROCK		**TUFFACEOUS SANDSTONE;** highly weathered; generally weak; fine grained. Includes meta-shale interbed (200mm thick); laminated. Bedding: 46°/260°. No joint pattern visible. END at 1.40
						Ends as above, highly weathered/moderately weathered; tight. Refusal.
2						
3						
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP62

PROJECT: TILLEGRA DAM — DATE: 31.10.07

LOCATION: LA - D/S OUTER ZONE — SURFACE RL: 112.1m

CONTRACTOR: R.& I. CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - sandy silt, rootlets; pale brown; loose; dry. 0.25
				SC (v)		**SANDY CLAY** with gravel; brown/yellowbrown, mottled; stiff; dry. 0.45
1				ROCK		**META-SHALE;** highly weathered with clayey seams; generally weak; laminated to very thinly bedded. Clayey seams persist to 1.1m depth. Moderately weathered; medium strong from 1.1m. Bedding: 40°/258°. Major joint set: 65°/345° (into LA), 42°/055° (across bedding). Defect spacing (including partings) extremely close to very close. Surfaces planar, generally rough, Fe/Mn stained, clay coated
2						Tightening towards 2.5m. END at 2.50
3						Ends as above. Very slow digging. NOTE: Pit across strike. Highly weathered/moderately weathered tuffaceous sandstone at eastern end. Meta-shale band approximately 1.6m thick.
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP63

PROJECT: TILLEGRA DAM — DATE: 31.10.07

LOCATION: LA - TOE SLAB ALIGNMENT — SURFACE RL: 140.9m

CONTRACTOR: R.& I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION (Soil type, colour, consistency, grainsize, moisture, remarks)
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - sandy silt, rootlets; pale brown; loose; dry. — 0.15
				CL/CI (v)		**SANDY CLAY;** grey/orangebrown, mottled; stiff; dry. Includes boulder scree to 600mm dia. — 1.00
1				ROCK		**TUFFACEOUS SANDSTONE;** highly weathered; weak/medium strong; fine grained; No indications of bedding. Massive. — END at 1.40
						Ends as above, highly weathered/moderately weathered, tight. Refusal.
2						
3						
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP64

PROJECT: TILLEGRA DAM — DATE: 31.10.07

LOCATION: LA - TOE SLAB ALIGNMENT — SURFACE RL: 129.8m

CONTRACTOR: R.& I. CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION (Soil type, colour, consistency, grainsize, moisture, remarks)
0	N.G.E			SM (v)		**TOPSOIL** - sandy silt, rootlets; pale brown; loose; dry. — 0.15
				SC (v)		**CLAYEY SAND;** pale brown/orangebrown, mottled; stiff; just moist. Includes boulder scree to 300mm dia. — END at 0.90
1						Ends on tuffaceous sandstone; highly weathered/ moderately weathered; medium strong; massive. Refusal.
2						
3						
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP65

PROJECT: TILLEGRA DAM

DATE: 31.10.07

LOCATION: LA - TOE SLAB ALIGNMENT

SURFACE RL: 119.6m

CONTRACTOR: R.& I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - sandy silt, rootlets; pale brown; loose; dry. 0.20
				SC (v)		**CLAYEY SAND** with gravel; pale grey/yellowbrown, streaked; stiff; dry. 0.50
1				ROCK		**META-SHALE** (overlying fine grained tuffaceous sandstone at the eastern end of the pit); moderately weathered; medium strong; laminated to very thinly bedded. Bedding: 43°/255°. Major joint set: 30°/100° (across bedding). Defect spacing very close/close. Surfaces iron stained, planar, rough. Clay infill to 5mm persists to 1.2m depth, otherwise clay coated. Tightens towards 1.4m. END at 1.40
2						Ends as above, tight. Difficult digging. NOTE: Refusal on highly weathered/moderately weathered tuffaceous sandstone (eastern end) at 1m.
3						
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP66

PROJECT: TILLEGRA DAM — DATE: 31.10.07

LOCATION: LA - TOE SLAB ALIGNMENT — SURFACE RL: 104.8m

CONTRACTOR: R.& I. CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - sandy silt, rootlets; greybrown; loose; dry. 0.20
				SC (v)		**GRAVELLY CLAYEY SAND;** brown/orangebrown, mottled; stiff; dry. 0.50
1				ROCK		**META-SHALE;** highly weathered/moderately weathered; medium strong; laminated to thinly bedded. Includes altered clayey seams parallel to bedding, 150mm thick - possible shear zones. Clay fill to 8mm persists to 1.6m depth. Bedding: 45°/260°. Major joint set 44°/105° (across bedding). 81°/320° (into LA). Defect spacing (including partings) very close/close. Surfaces planar, generally smooth, minor iron staining, common clay coatings. Grading to moderately weathered/slightly weathered towards 1.85m. END at 1.85
2						Ends as above, tight. Difficult digging.
3						
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP67

PROJECT: TILLEGRA DAM — DATE: 01.11.07

LOCATION: LA - TOE SLAB ALIGNMENT — SURFACE RL: 96.2m

CONTRACTOR: R.& I. CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION (Soil type, colour, consistency, grainsize, moisture, remarks)
0	No Groundwater Encountered			FILL		**TOPSOIL** - gravelly sandy silt with trace of clay, rootlets; pale brown; loose; dry. — 0.20
				FILL		**SILTY CLAY/CLAYEY SILT;** dark brown; stiff; dry/just moist. — 0.75
1				FILL		**CLAYEY SANDY GRAVEL;** mid brown; medium dense; just moist.
2						
3						3.10
				ROCK		**TUFFACEOUS SANDSTONE;** moderately weathered; medium strong/strong; fine grained. — END at 3.30
						Ends as above, tight. Close to refusal.
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP68

PROJECT: TILLEGRA DAM
DATE: 01.11.07
LOCATION: LA - TOE SLAB ALIGNMENT
SURFACE RL: 93.3m
CONTRACTOR: R.& I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SM (v)		**TOPSOIL - sandy silt, rootlets;** brown; loose; dry.
0.50						
1				SC (v)		**SANDY CLAYEY SILT;** brown/orangebrown, mottled; firm; moist.
1.50						
2				SC (v)		**SANDY CLAY/CLAYEY SAND;** pale grey/orangebrown, streaked; firm to stiff; moist.
2.10						
3				ROCK		**TUFFACEOUS SANDSTONE;** highly weathered/moderately weathered; weak/medium strong; fine grained; spoil dimension indicates close to moderately wide defect spacing. Fe/Mn stained, commonly clay coated Moderately weathered/slightly weathered towards 3.3m.
3.30						END at 3.30
4						Ends as above, tight. Very difficult digging.
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP69

PROJECT: TILLEGRA DAM

DATE: 01.11.07

LOCATION: LA - TOE SLAB ALIGNMENT

SURFACE RL: 93.1m

CONTRACTOR: R.& I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - slightly clayey sandy silt, rootlets; dark brown; loose; dry.
0.90						
1				SC (v)		**CLAYEY SAND/SANDY CLAY;** mid brown; firm; moist.
2						
3			D			
4						
4.70				GM/GC (v)		**CLAYEY SANDY GRAVEL;** --- (continued next sheet) ---
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 2 SHEETS
SCALE 1 : 25

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP69

PROJECT: TILLEGRA DAM — DATE: 01.11.07

LOCATION: LA - TOE SLAB ALIGNMENT — SURFACE RL: 93.1m

CONTRACTOR: R.& I. CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
5			D	GM/GC (v)		--- (continued from previous sheet) --- CLAYEY SANDY GRAVEL; brown; loose; moist. Gravel well rounded, rarely to 100mm dia.
6						
7						END at 7.00 Ends as above. Pit collapsed.
8						
9						
10						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 2 OF 2 SHEETS
SCALE 1 : 25

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP70

PROJECT: TILLEGRA DAM

DATE: 01.11.07

LOCATION: UPSTREAM COFFER DAM

SURFACE RL: 101.8m

CONTRACTOR: R.& I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - sandy silt, rootlets; pale brown; loose; dry. 0.20
				CL/CI (v)		**SANDY CLAY** with gravel; grey/orangebrown, streaked; stiff; dry. 1.00
1				ROCK		**TUFFACEOUS SANDSTONE;** highly weathered/moderately weathered; generally medium strong; fine grained. Bedding: 33°/225°. Major joint sets:88 /165 (into RA), 35°/070° (across bedding). Defect spacing (including partings) very close to moderately wide. Surfaces planar, rough, Fe/Mn stained, occasionally clay filled to 8mm, commonly clay coated to approx 1.8m depth
2						Moderately weathered, medium strong/strong towards 2.1m. END at 2.80
3						Ends as above, tight. Very difficult digging.
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP71

PROJECT: TILLEGRA DAM

DATE: 01.11.07

LOCATION: UPSTREAM COFFER DAM

SURFACE RL: 98.4m

CONTRACTOR: R.& I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SM (v)		**TOPSOIL - sandy silt with clay, rootlets; pale brown; loose; dry.** 0.30
1				SC (v)		**SANDY CLAY/CLAYEY SAND; grey/orangebrown, streaked; stiff; just moist.** 1.90
2				GC (v)		**CLAYEY SANDY GRAVEL; pale greengrey with orangebrown streaks; sstiff; just moist. Gravel fraction well rounded to 100mm dia.**
3						
4						
5						**END at 4.90**

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP72

PROJECT: TILLEGRA DAM

DATE: 01.11.07

LOCATION: UPSTREAM COFFER DAM

SURFACE RL: 95.0m

CONTRACTOR: R.& I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - sandy silt, rootlets; dark brown; loose; dry.
						0.45
1				CL/CI (v)		**GRAVELLY SILTY CLAY;** dark grey with orangebrown/redbrown speckles; stiff; moist. Gravel is well rounded, rarely to 100mm, towards the base of the horizon.
						1.40
2				ROCK		**TUFFACEOUS SANDSTONE;** extremely weathered/highly weathered; extremely weak/very weak. Behaves as clayey sand; grey/ orangebrown, streaked. Highly weathered/moderately weathered from 1.8m, generally medium strong. Probable bedding: 50°/230°. Major joint sets:75°/003° (into LA), 30°/080° (across bedding). Defect spacing very close to moderately wide, surfaces planar, rough, Fe/Mn stained, occasional clay fill to 6mm, common clay coatings
						END at 2.90
3						Ends as above, moderately weathered, medium strong. Blocky excavation, very slow digging.
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP73

PROJECT: TILLEGRA DAM DATE: 01.11.07

LOCATION: RA - DIVERSION TUNNEL OUTLET PORTAL SURFACE RL: 103.4m

CONTRACTOR: R.& I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - sandy silt, rootlets; pale brown; loose; dry. 0.25
				CL/CI (v)		**SANDY CLAY** with gravel; pale grey/orangebrown, streaked; firm to stiff; just moist. 0.50
1						**META-SHALE** with thin tuffaceous sandstone interbeds; highly weathered/moderately weathered; very weak (tufffaceous sandstone) to weak/medium strong (meta-shale). Meta-shale is laminated to very thinly bedded. Bedding:60 °/235 ° Major joint set: 50 °/008 ° (across bedding). Defect spacing (including partings) extremely close to close. Surfaces planar, smooth to rough, iron stained, commonly clay coated. Occasional clay infill persists to 1.8m depth.
2				CL/CI (v)		Grades to generally moderately weathered around 2.5m.
3						END at 3.90
4						Ends as above. Slow digging (still excavatable).

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 20

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP74

PROJECT: TILLEGRA DAM — DATE: 01.11.07

LOCATION: RA - DIVERSION TUNNEL OUTLET PORTAL — SURFACE RL: 103.2m

CONTRACTOR: R.& I. CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION (Soil type, colour, consistency, grainsize, moisture, remarks)
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - sandy silt, rootlets; pale brown; loose; dry.
0.25						
1				SC (v)		**SANDY CLAY/CLAYEY SAND;** pale brown; stiff; just moist/moist.
1.50						
2				SC (v)		**CLAYEY SAND;** pale grey with orangebrown streaks; stiff; moist.
3.30						
3				ROCK		**TUFFACEOUS SANDSTONE;** extremely weathered; extremely weak; fine grained. Behaves as clayey sand; greybrown/orangebrown/ redbrown, mottled. May represent lightly cemented slopewash material.
4						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 2 SHEETS
SCALE 1 : 20

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP74

PROJECT: TILLEGRA DAM — DATE: 01.11.07

LOCATION: RA - DIVERSION TUNNEL OUTLET PORTAL — SURFACE RL: 103.2m

CONTRACTOR: R.& I. CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
4						--- (continued from previous sheet) --- TUFFACEOUS SANDSTONE; extremely weathered; extremely weak; fine grained. Behaves as clayey sand; greybrown/orangebrown/ redbrown, mottled. May represent lightly cemented slopewash material.
5				ROCK		- Highly weathered from approx 5.0m, very weak. Behaves as clayey sand, includes minor well rounded pebbles to 3mm dia.
6						END at 6.00 Ends as above. Still easy digging.
7						
8						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 2 OF 2 SHEETS
SCALE 1 : 20

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP75

PROJECT: TILLEGRA DAM — DATE: 02.11.07

LOCATION: RA - SPILLWAY CHANNEL — SURFACE RL: 99.7m

CONTRACTOR: R.& I. CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE OR TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION (Soil type, colour, consistency, grainsize, moisture, remarks)
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - sandy silt, rootlets; pale brown; loose; dry. — 0.20
1				SC (v)		**CLAYEY SAND/SANDY CLAY** with gravel; grey/yellowbrown/orangebrown, mottled; stiff; just moist. Gravel fraction comprises angular, highly weathered/moderately weathered, meta-sedimentary fragments mostly to 50mm max dimension - probable slopewash. — 2.40
2						
3				ROCK		Interbedded **META-SHALE** and medium grained **TUFFACEOUS SANDSTONE**; Meta-shale is highly weathered/moderately weathered, weak/ medium strong, laminated to very thinly bedded. Sandstone is extremely weathered to highly weathered with depth, extremely weak to weak.
4						Ends as above. Slow digging. — END at 4.00

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 20

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP76

PROJECT: TILLEGRA DAM — DATE: 02.11.07

LOCATION: RA - SPILLWAY CHANNEL — SURFACE RL: 103.8m

CONTRACTOR: R.& I. CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION (Soil type, colour, consistency, grainsize, moisture, remarks)
0				SM (v)		TOPSOIL - sandy silt, rootlets; pale brown; loose; dry.
0.25						
				SC (v)		CLAYEY SAND/SANDY CLAY; brown/yellowbrown, streaked; firm to stiff; moist.
1.00						
1	No Groundwater Encountered		D	CL/CI (v)		GRAVELLY SANDY CLAY; redbrown/orangebrown/grey mottled; stiff; moist. Gravel fraction comprises angular highly weathered/ moderately weathered meta-sedimentary fragments mostly to 50mm max dimension-probable slopewash.
2						
3.00						
3			D	SC (v)		CLAYEY SAND with trace of gravel; greybrown/orangebrown/redbrown, mottled; stiff; just moist/moist. Gravel fraction rounded, rarely to 10mm dia.
4						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 2 SHEETS
SCALE 1 : 20

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP76

PROJECT: TILLEGRA DAM

DATE: 02.11.07

LOCATION: RA - SPILLWAY CHANNEL

SURFACE RL: 103.8m

CONTRACTOR: R.& I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
4				SC (v)		--- (continued from previous sheet) --- 4.10 CLAYEY SAND with trace of gravel; greybrown/orangebrown/redbrown, mottled; stiff; just moist/moist. Gravel fraction rounded, rarely to 10mm dia.
						SILTY CLAY; fissured; mid grey with occasional orangebrown streaks; stiff/very stiff; just moist.
5			D			
				CH (v)		
6						END at 6.50
						Ends as above.
7						
8						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 2 OF 2 SHEETS
SCALE 1 : 20

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP77

PROJECT: TILLEGRA DAM

DATE: 02.11.07

LOCATION: SPILLWAY CHANNEL

SURFACE RL: 108.5m

CONTRACTOR: R.& I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE OR TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - sandy silt, rootlets; pale brown; loose; dry.
						0.35
1				CL/CI (v)		**GRAVELLY SANDY CLAY;** orangebrown/yellowbrown, mottled; stiff/very stiff; dry to just moist. Gravel fraction comprises angular, highly weathered meta-sedimentary fragments generally to 25mm max dimension - probable slopewash.
2						
						2.40
3				SC (v)		**CLAYEY SAND** with gravel; brown/orangebrown, mottled; hard; dry. Gravel fraction as above, generally to 5mm dimension. Includes charcoal fragments.
						3.30
4				SC (v)		**GRAVELLY CLAYEY SAND;** pale grey with orangebrown streaks; very stiff to hard (lightly cemented, slow digging); dry. Gravel fraction angular meta-sedimentary; highly weathered; very weak; generally to 10mm dimension. Slopewash.

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 2 SHEETS
SCALE 1 : 20

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP77

PROJECT: TILLEGRA DAM
DATE: 02.11.07
LOCATION: SPILLWAY CHANNEL
SURFACE RL: 108.5m
CONTRACTOR: R.& I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
4						--- (continued from previous sheet) --- GRAVELLY CLAYEY SAND; pale grey with orangebrown streaks; very stiff to hard (lightly cemented, slow digging); dry. Gravel fraction angular meta-sedimentary; highly weathered; very weak; generally to 10mm dimension. Slopewash.
5				SC (v)		
6						END at 6.20
7						Ends as above. Still reasonable digging.
8						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 2 OF 2 SHEETS
SCALE 1 : 20

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP78

PROJECT: TILLEGRA DAM
DATE: 02.11.07
LOCATION: RA - SPILLWAY CHANNEL
SURFACE RL: 97.1m
CONTRACTOR: R.& I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - sandy silt, rootlets; pale brown; loose; dry. 0.25
1				SC (v)		**GRAVELLY CLAYEY SAND/SANDY CLAY;** brown/yellowbrown/orangebrown, mottled; stiff/very stiff; dry to just moist with depth. Gravel fraction generally comprises angular highly weathered/moderately weathered meta-sedimentary fragments generally to 25mm max dimension. Also includes minor well rounded pebbles to 5mm dia. - probable slopewash.
2						
3						3.30
4				GM/GC (v)		Well rounded gravel/boulders to 150mm dia in clayey sand matrix; pale greengrey; medium dense; just moist. Matrix includes extremely weathered/ highly weathered angular meta-sedimentary fragments. (probably alluvial)

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 2 SHEETS
SCALE 1 : 20

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP78

PROJECT: TILLEGRA DAM

DATE: 02.11.07

LOCATION: RA-SPILLWAY CHANNEL

SURFACE RL: 97.1m

CONTRACTOR: R.& I.CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
4				GM/GC (v)		--- (continued from previous sheet) --- Well rounded gravel/boulders to 150mm dia in clayey sand matrix; pale greengrey; medium dense; just moist. Matrix includes extremely weathered/ highly weathered angular meta-sedimentary fragments. (probably alluvial)
5						END at 5.30
6						Ends on tuffaceous sandstone; highly weathered; generally weak; massive, very slow digging.
7						
8						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 2 OF 2 SHEETS
SCALE 1 : 20

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP79

PROJECT: TILLEGRA DAM — DATE: 02.11.07

LOCATION: RA - SPILLWAY CHANNEL — SURFACE RL: 94.3m

CONTRACTOR: R.& I. CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION (Soil type, colour, consistency, grainsize, moisture, remarks)
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - sandy silt with trace of clay, rootlets; pale brown; loose; dry.
0.30						
				SC (v)		**GRAVELLY CLAYEY SAND/SANDY CLAY;** brown/yellowbrown, mottled; stiff/very stiff; just moist. Gravel fraction comprises well rounded gravel to 25mm dia, with highly weathered/moderately angular meta-sedimentary fragments to 30mm dimension.
1.40						
				GM (v)		Well rounded gravel/cobbles to 150mm dia in clayey sand matrix; pale greengrey with orangebrown iron stained bands; medium dense; just moist. Matrix includes extremely weathered/ highly weathered, angular meta-sedimentary fragments to 20mm dimension. (probably alluvial)
2.10						
				ROCK		**TUFFACEOUS SANDSTONE;** highly weathered; generally weak; fine grained.
3						END at 3.10
						Ends as above, massive, slow digging.
4						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 20

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GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP80

PROJECT: TILLEGRA DAM — DATE: 05.11.07

LOCATION: LA-SPILLWAY CREST — SURFACE RL: 176.9m

CONTRACTOR: R.& I. CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE OR TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION (Soil type, colour, consistency, grainsize, moisture, remarks)
0	No Groundwater Encountered			SM (v)		TOPSOIL - silty sand, rootlets; yellowbrown; loose; moist. — 0.15
				SP (v)		Slightly CLAYEY GRAVELLY SAND, rootlets persist; pale yellowbrown; firm; moist. — 0.50
1				ROCK		Interbedded META-SHALE and TUFFACEOUS SANDSTONE. Meta-shale; highly weathered to moderately weathered with depth; weak to medium strong; laminated. Bedding: 43 °/243 ° Major joint set: 62°/353 °. (into RA). Defect spacing (including partings) very close to close. Surfaces planar, generally rough, Fe/Mn stained, clay coated. Tuffaceous sandstone: highly weathered to highly weathered/moderately weathered with depth; weak to medium strong. END at 1.50
2						Ends as above, slow digging in meta-siltstone. Refusal on tuffaceous sandstone at 1.1m.
3						
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP81

PROJECT: TILLEGRA DAM

DATE: 05.11.07

LOCATION: LA - SPILLWAY CREST

SURFACE RL: 169.3m

CONTRACTOR: R.& I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE OR TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SC (v)		**TOPSOIL** - clayey silty sand, rootlets; brown; loose; just moist. 0.20
				CL/CI (v)		**SANDY CLAY**, rootlets still persist; orangebrown/yellowbrown, mottled; firm to stiff; just moist. 0.90
1				ROCK		**TUFFACEOUS SANDSTONE**; highly weathered; generally weak; fine grained; thinly to medium bedded. Bedding: 46°/248° Major joint sets: 68°/330° (into RA) 64°/060° (across bedding). Defect spacing (including partings) very close to moderately wide. Surfaces planar, rough, iron stained, clay coated, rare fill. 2.29
2						
3						Ends as above, highly weathered/moderately weathered, very slow digging. Close to refusal on zones with wider defect spacing.
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP82

PROJECT: TILLEGRA DAM DATE: 05.11.07

LOCATION: RA-INTERSECTION OF ℄ & TOE SLAB ALIGNMENT SURFACE RL: 160.9m

CONTRACTOR: R.& I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION (Soil type, colour, consistency, grainsize, moisture, remarks)
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - silty sand, rootlets; brown; loose; just moist. — 0.10
				SC (v)		**CLAYEY GRAVELLY SAND**, rootlets persist; yellowbrown; loose; just moist. — 0.50
1				ROCK		**TUFFACEOUS SANDSTONE** with meta-shale interbed. Tuffaceous sandstone; moderately weathered; medium strong/strong; fine grained. Defect spacing generally moderately wide, surfaces planar, rough, iron stained, minor clay coatings. Meta-shale; highly weathered; generally weak; laminated. Bedding: 48°/250° Major joint set: 75°/320° (into LA). Defect spacing (including partings) extremely close/very close. Surfaces planar, generally rough, iron stained,clay coated. — END at 1.40
2						Ends as above in meta-shale, slow digging. Refusal on tuffaceous sandstone at 1.0m.
3						
4						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 20

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GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP83

PROJECT: TILLEGRA DAM

DATE: 05.11.07

LOCATION: RA - INTERSECTION OF ℄ (UPPER ABUTMENT)

SURFACE RL: 148.5m

CONTRACTOR: R.& I. CONTRACTING

OPERATOR: PHIL GARLAND

EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - silty sand, rootlets; brown; loose; just moist. 0.10
				SP (v)		Slightly CLAYEY GRAVELLY SAND, rootlets persist; yellowbrown/orangebrown, mottled; loose; moist. 0.50
1				ROCK		**META-SHALE;** highly weathered to moderately weathered with depth (0.9m); weak to generally medium strong; laminated to very thinly bedded. Bedding: 60°/245°. Major joint sets: 80°/345° (into LA) 52°/068° (across bedding). Defect spacing (including partings) extremely close to close, surfaces palnar, rough, iron stained. Clay fill/clayey seams persist to 0.9m, rare clay coatings below 0.9m. END at 1.40
2						Ends as above in meta-shale, slower digging, tightening.
3						
4						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 20

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GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP84

PROJECT: TILLEGRA DAM

DATE: 05.11.07

LOCATION: RA - CENTRELINE (UPPER ABUTMENT)

SURFACE RL: 137.3m

CONTRACTOR: R.& I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	N.G.E			SM (v)		**TOPSOIL** - silty sand, rootlets; brown; loose; moist. 0.10
				SM/SC (v)		**SILTY SAND** with trace of clay, rootlets persist; yellowbrown; loose; moist. 0.50
				ROCK		**TUFFACEOUS SANDSTONE**; highly weathered; generally weak; fine grained. END at 0.80
1						Ends on moderately weathered/slightly weathered tuffaceous sandstone, strong, tight. Refusal.
2						
3						
4						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 20

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP85

PROJECT: TILLEGRA DAM — DATE: 05.11.07

LOCATION: RA - CENTRELINE (MIDDLE ABUTMENT) — SURFACE RL: 127.4m

CONTRACTOR: R.& I. CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION (Soil type, colour, consistency, grainsize, moisture, remarks)
0	No Groundwater Encountered			SM (v)		TOPSOIL - silty sand, rootlets; brown; loose; just moist. — 0.10
				SP (v)		Slightly CLAYEY GRAVELLY SAND, rootlets persist; pale yellowbrown; loose; dry. — 0.55
1				ROCK		TUFFACEOUS SANDSTONE; highly weathered/moderately weathered; medium strong; thinly to medium bedded (where visible). Bedding: 47°/245° Major joint sets: 66°/340° (into LA) 55°/105° (across bedding). Defect spacing (including partings) very close (rarely) to moderately wide. Surfaces planar, rough, iron stained. Rare clay coatings. — 1.14
2						Ends as above, tight. Refusal.
3						
4						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 20

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP86

PROJECT: TILLEGRA DAM — DATE: 05.11.07

LOCATION: RA - CENTRELINE (MIDDLE ABUTMENT) — SURFACE RL: 116.4m

CONTRACTOR: R.& I. CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION (Soil type, colour, consistency, grainsize, moisture, remarks)
0	N.G.E			SM (v)		**TOPSOIL** - silty sand with trace of clay, rootlets; pale brown; loose; dry. — 0.10
				SC (v)		**GRAVELLY CLAYEY SAND**, rootlets persist; yellowbrown; loose; dry. — 0.45
				ROCK		**TUFFACEOUS SANDSTONE**; highly weathered/moderately weathered; medium strong, blocky, tight digging. Defect spacing, generally moderately wide. — END at 0.90
1						Ends as above, tight. Refusal.
2						
3						
4						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 20

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GEOTECHNICAL & ENVIRONMENTAL — TEST PIT — TP87

PROJECT: TILLEGRA DAM — DATE: 05.11.07

LOCATION: RA-TOE SLAB ALIGNMENT (UPPER ABUTMENT) — SURFACE RL: 150.9m

CONTRACTOR: R.& I. CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION (Soil type, colour, consistency, grainsize, moisture, remarks)
0	N.G.E			SM (v)		**TOPSOIL** - silty sand with trace of clay, rootlets; brown; loose; just moist. — 0.10
				CL/CI (v)		**SANDY CLAY;** yellowbrown/orangebrown, mottled; firm to stiff; moist. — 0.60
				ROCK		**TUFFACEOUS SANDSTONE;** highly weathered/moderately weathered; medium strong; fine grained. Bedding: 40 °/245 ° Blocky excavation, defect spacing moderately wide/wide. — END at 0.80
1						Ends as above, tight. Refusal.
2						
3						
4						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 20

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GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP88

PROJECT: TILLEGRA DAM DATE: 05.11.07

LOCATION: RA-TOE SLAB ALIGNMENT (UPPER ABUTMENT) SURFACE RL: 139.3m

CONTRACTOR: R.& I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION (Soil type, colour, consistency, grainsize, moisture, remarks)
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - silty sand, rootlets; brown; loose; just moist. 0.15
				CL/CI (v)		**SANDY CLAY**, rootlets persist; yellowbrown/orangebrown, mottled; firm; moist. 0.50
1				ROCK		**TUFFACEOUS SANDSTONE** with minor meta-shale interbeds. Tuffaceous sandstone; highly weathered/ moderately weathered; medium strong; fine grained. Defect spacing moderately wide. Surfaces planar, rough, iron stained. Commonly clay coated. Meta-shale: highly weathered/moderately weathered; weak to medium strong; laminated. Bedding: 43°/243° Major joint sets: 75°/345° (into LA) 45°/018° (across bedding). Defect spacing(including partings)very close to close. Surfaces, smooth to rough, iron stained, planar, commonly clay coated. END at 1.35
2						Ends as above, moderately weathered, strong. Refusal.
3						
4						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 20

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP89

PROJECT: TILLEGRA DAM DATE: 05.11.07

LOCATION: RA-TOE SLAB ALIGNMENT (MIDDLE ABUTMENT) SURFACE RL: 128.6m

CONTRACTOR: R.& I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - silty sand with gravel, rootlets; brown; loose; dry. 0.20
				CL/CI (v)		**SANDY CLAY;** yellowbrown/orangebrown/grey, mottled; stiff; just moist. 0.80
1				ROCK		**META-SHALE;** highly weathered, grading to moderately weathered with depth (1.1m); weak to generally medium strong; laminated to very thinly bedded. Bedding: 55°/247° Major joint sets: 70°/ 340° (into LA) 44°/065° to 33°/120° (across bedding). Defect spacing (including partings); extremely close to close. Surfaces planar, generally rough, iron stained. Common clay coating to 1.5m depth.
2						Tightening towards 2.1m. Slow digging. END at 2.50
3						Ends as above. Very slow digging in meta-shale. Refusal in part on underlying tuffaceous sandstone bed, moderately weathered; medium strong/strong.
4						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 20

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP90

PROJECT: TILLEGRA DAM DATE: 05.11.07

LOCATION: RA-TOE SLAB ALIGNMENT (MIDDLE ABUTMENT) SURFACE RL: 122.3m

CONTRACTOR: R.& I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - clayey silty sand, rootlets; brown; loose; dry. 0.20
				SM (v)		**GRAVELLY SANDY CLAY;** yellowbrown/orangebrown/grey, mottled; stiff; just moist. 0.60
1				ROCK		**META-SHALE;** moderately weathered, ranging to moderately weathered/slightly weathered, quickly with depth (1.0m); medium strong/strong; laminated to very thinly bedded. Bedding: 44°/247° Major joint sets: 35°/070° across bedding) 78°/160° (into RA). Defect spacing (including partings) extremely close to occasionally close. Surfaces planar, generally rough, iron stained, common clay coatings to 1.0m depth. END at 1.50
2						Ends on underlying tuffaceous sandstone, moderately weathered, medium strong, fine grained, tight. Refusal.
3						
4						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 20

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP91

PROJECT: TILLEGRA DAM
DATE: 06.11.07
LOCATION: BORROW AREA
SURFACE RL: 104.3m
CONTRACTOR: R.& I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - silty sand, rootlets; dark brown; loose; moist.
						0.40
				CL/CI (v)		**SANDY SILTY CLAY;** greybrown with orangebrown streaks; stiff; just moist/moist.
1			D			
						1.15
			D	ROCK		**GRAVELLY CLAYEY SAND;** yellowbrown/orangebrown, mottled; stiff/very stiff; just moist. No visible defects, very difficult digging - possibly cemented slopewash. **END at 1.30**
2						Ends as above.
3						
4						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 20

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP92

PROJECT: TILLEGRA DAM
DATE: 06.11.07
LOCATION: BORROW AREA
SURFACE RL: 103.0m
CONTRACTOR: R.& I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - slightly clayey silty sand, rootlets; dark brown; loose; moist. 0.25
				CL/CI (v)		**SANDY SILTY CLAY;** greybrown/yellowbrown, streaked; stiff; moist. 0.80
1				ROCK		**META-SHALE;** highly weathered to moderately weathered, quickly with depth (1.3m); weak to medium strong; laminated. Bedding: 68 °/ 253 ° Major joint sets: 70 °/ 350 ° 15°/127 ° (across bedding). Defect spacing (including partings) very close to close END at 1.70
2						Ends as above, still reasonable digging.
3						
4						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 20

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP93

PROJECT: TILLEGRA DAM

DATE: 06.11.07

LOCATION: BORROW AREA

SURFACE RL: 103.0m

CONTRACTOR: R.& I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SM (v)		TOPSOIL - silty sand, rootlets; dark brown; loose; just moist. 0.15
				CH (v)		SILTY CLAY; brown; firm to stiff; moist. 1.00
1				GC (v)		CLAYEY SANDY GRAVEL; comprises well rounded gravel to 120mm dia. Sandy matrix with clayey pockets, includes angular, weathered meta-sedimentary rock fragments to 30mm dimension. END at 1.90
2						Ends as above.
3						
4						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 20

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP94

PROJECT: TILLEGRA DAM DATE: 25.03.08

LOCATION: RA, ALTERNATIVE SPILLWAY ALIGNMENT SURFACE RL: 116.6m

CONTRACTOR: R. & I. CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0				SM (v)		**TOPSOIL** - silty sand, rootlets; pale brown; loose; dry. 0.20
	No Groundwater Encountered					**Slightly CLAYEY SANDY GRAVEL;** pale brown/brown; stiff; just moist. Gravel fraction angular meta-sedimentary, highly weathered/moderately weathered, ranges to boulder size, 350mm dia. Predominantly tuffaceous sandstone. Slopewash.
1						At 1.1m - clayey sand grades to pale yellowbrown.
2						At 2.1m - Continues as above, matrix pale brown; very stiff; slow digging.
3				GC (v)		
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 2 SHEETS
SCALE 1 : 25

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP94

PROJECT: TILLEGRA DAM

DATE: 25.03.08

LOCATION: RA, ALTERNATIVE SPILLWAY ALIGNMENT

SURFACE RL: 116.6m

CONTRACTOR: R. & I.CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - silty sand, rootlets; pale brown; loose; dry. 0.20
						Slightly CLAYEY SANDY GRAVEL; pale brown/brown; stiff; just moist. Gravel fraction angular meta-sedimentary, highly weathered/moderately weathered, ranges to boulder size, 350mm dia. Predominantly tuffaceous sandstone. Slopewash.
1						At 1.1m - clayey sand grades to pale yellowbrown.
2						At 2.1m - Continues as above, matrix pale brown; very stiff; slow digging.
3				GC (v)		
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 2 SHEETS
SCALE 1 : 25

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP94

PROJECT: TILLEGRA DAM

DATE: 25.03.08

LOCATION: RA, ALTERNATIVE SPILLWAY ALIGNMENT

SURFACE RL: 116.6m

CONTRACTOR: R. & I.CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
5				GC (v)		--- (continued from previous sheet) --- 5.10 Slightly CLAYEY SANDY GRAVEL; pale brown/brown; stiff; just moist. Gravel fraction angular meta-sedimentary, highly weathered/moderately weathered, ranges to boulder size, 350mm dia. Predominantly tuffaceous sandstone. Slopewash.
				ROCK		TUFFACEOUS SANDSTONE; highly weathered; very weak to weak; very fine/ fine grained. No indication of bedding. Defect spacing appears very close/close.
6						END at 6.20
						Ends as above, very slow digging.
7						
8						
9						
10						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 2 OF 2 SHEETS
SCALE 1 : 25

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP95

PROJECT: TILLEGRA DAM — DATE: 25.03.08

LOCATION: RA - ALTERNATIVE SPILLWAY ALIGNMENT — SURFACE RL: 109.4m

CONTRACTOR: R. & I. CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION (Soil type, colour, consistency, grainsize, moisture, remarks)
0	No Groundwater Encountered			SM (v)		TOPSOIL - silty sand with trace of clay, rootlets; dark greybrown; loose; dry. — 0.40
1				SC (v)		SANDY CLAY/CLAYEY SAND; yellowbrown/pale brown/orangebrown, mottled; stiff; moist. — 1.30
2				GC (v)		Slightly CLAYEY SANDY GRAVEL; grey/greybrown; hard (slightly cemented); dry. Gravel fraction angular, meta-sedimentary; highly weathered; generally weak (to medium strong). Predominantly tuffaceous sandstone. Slopewash. Very slow digging. — 1.95
				CL/CI (v)		Slightly SANDY CLAY; pale greybrown; very stiff; just moist. — 2.40
3				GC (v)		Slightly CLAYEY SANDY GRAVEL; pale greybrown/brown, streaked; hard (partly cemented); dry. Gravel fraction angular, meta-sedimentary; highly weathered/moderately weathered; weak to medium strong. Predominantly tuffaceous sandstone. Slopewash. — 3.65
4				CL/CI (v)		SILTY CLAY with trace of gravel; pale greybrown; very stiff; just moist/moist. Gravel fraction extremely weathered; extremely weak; appears as a cream fleck. — 4.80
5				GC (v)		CLAYEY SANDY GRAVEL; --- (continued next sheet) ---

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 2 SHEETS
SCALE 1 : 25

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP95

PROJECT: TILLEGRA DAM DATE: 25.03.08

LOCATION: RA - ALTERNATIVE SPILLWAY ALIGNMENT SURFACE RL: 109.4m

CONTRACTOR: R. & I.CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
5				GC (v)		--- (continued from previous sheet) --- CLAYEY SANDY GRAVEL; pale greybrown/yellowbrown/orangebrown, mottled; very stiff/hard; just moist. Gravel fraction angular; generally highly weathered; weak. Predominantly tuffaceous sandstone to 15mm dimension. Appears very lightly cemented. Slopewash. END at 5.90
6						Ends as above. Very slow digging.
7						
8						
9						
10						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 2 OF 2 SHEETS
SCALE 1 : 25

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP96

PROJECT: TILLEGRA DAM DATE: 25.03.08

LOCATION: RA, ALTERNATIVE SPILLWAY ALIGNMENT SURFACE RL: 103.7m

CONTRACTOR: R. & I.CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SM (v)		TOPSOIL - slightly clayey silty sand, rootlets; dark grey to grey with depth; loose; just moist. 0.25
1				CL/CI (v)		SILTY CLAY with gravel; pale greybrown/orangebrown/redbrown, mottled; stiff; moist. Gravel fraction angular, meta-sedimentary; highly weathered/ moderately weathered; weak to medium strong. Predominantly tuffaceous sandstone to 10mm dimension. 1.30
2				CL/CI (v)		SANDY CLAY with gravel; pale greybrown with occasional orangebrown mottle; very stiff; just moist. Includes clayey sand lenses; very stiff/hard. (appears slightly cemented). Gravel fraction increases slightly with depth; angular; meta-sedimentary; extremely weathered/ highly weathered; extremely weak to very weak, to 30mm dimension. Slopewash.
3						
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 2 SHEETS
SCALE 1 : 25

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP96

PROJECT: TILLEGRA DAM

DATE: 25.03.08

LOCATION: RA, ALTERNATIVE SPILLWAY ALIGNMENT

SURFACE RL: 103.7m

CONTRACTOR: R. & I.CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
5				CL/CI (v)		--- (continued from previous sheet) --- SANDY CLAY with gravel; pale greybrown with occasional orangebrown mottle; very stiff; just moist. Includes clayey sand lenses; very stiff/hard. (appears slightly cemented). Gravel fraction increases slightly with depth; angular; meta-sedimentary; extremely weathered/ highly weathered; extremely weak to very weak, to 30mm dimension. Slopewash.
6						END at 6.00 Ends as above.
7						
8						
9						
10						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 2 OF 2 SHEETS
SCALE 1 : 25

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP97

PROJECT: TILLEGRA DAM DATE: 25.03.08

LOCATION: RA - ALTERNATIVE SPILLWAY ALIGNMENT SURFACE RL: 98.2m

CONTRACTOR: R. & I.CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			ML (v)		**TOPSOIL** - sandy clayey silt, rootlets; dark grey; loose; just moist. 0.30
1				CH (v)		**SILTY CLAY;** mid grey; stiff; moist.
2						2.60
3				CL/CI (v)		**SANDY CLAY;** pale grey with orangebrown streaks; very stiff; just moist.
4						4.60
5				GC (v)		**CLAYEY SANDY GRAVEL;** --- (continued next sheet) ---

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 2 SHEETS
SCALE 1 : 25

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP97

PROJECT: TILLEGRA DAM — DATE: 25.03.08

LOCATION: RA - ALTERNATIVE SPILLWAY ALIGNMENT — SURFACE RL: 98.2m

CONTRACTOR: R. & I.CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
5				GC (v)		--- (continued from previous sheet) --- CLAYEY SANDY GRAVEL; pale brown/orangebrown, streaked; medium dense/ dense with depth; just moist to dry. Gravel is well rounded; gravel to cobble size, ranging to boulders (maximum 150mm diameter) Orangebrown with depth. Matrix includes rare sub-angular gravel.
6						END at 6.40
7						
8						
9						
10						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 2 OF 2 SHEETS
SCALE 1 : 25

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP98

PROJECT: TILLEGRA DAM

DATE: 25.03.08

LOCATION: RA, ALTERNATIVE SPILLWAY ALIGNMENT

SURFACE RL: 96.9m

CONTRACTOR: R. & I.CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			ML (v)		**TOPSOIL** - sandy clayey silt, rootlets; dark grey; loose; just moist. 0.30
				CH (v)		**SILTY CLAY;** pale greybrown; soft to stiff; moist. 1.00
1				CL/CI (v)		**SANDY CLAY;** pale brown with occasional orangebrown streaks; stiff; just moist. 1.55
2				GC (v)		**Slightly CLAYEY SANDY GRAVEL;** mid grey/orangebrown/redbrown, streaked; dense/ very dense; just moist to dry with depth. Gravel is well rounded; gravel to cobble size, ranging to rare boulders 200mm diameter.
3						Orangebrown with depth.
4						
5						Continues as above; redbrown; ferruginized. Gravel is well rounded to occasionally subrounded, generally to 30mm dimension. 5.00

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 2 SHEETS
SCALE 1 : 25

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP98

PROJECT: TILLEGRA DAM — DATE: 25.03.08

LOCATION: RA, ALTERNATIVE SPILLWAY ALIGNMENT — SURFACE RL: 96.9m

CONTRACTOR: R. & I.CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION (Soil type, colour, consistency, grainsize, moisture, remarks)
5				GC (v)		Slightly CLAYEY SANDY GRAVEL; redbrown; ferruginized. Gravel is well rounded to occasionally subrounded, generally to 30mm dimension.
				ROCK		5.30
						END at 5.55
						TUFFACEOUS SANDSTONE; highly weathered; very weak/weak; fine to medium grained; yellowbrown.
6						Ends as above, difficult digging.
7						
8						
9						
10						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 2 OF 2 SHEETS
SCALE 1 : 25

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP99

PROJECT: TILLEGRA DAM

DATE: 26.03.08

LOCATION: RA, ALTERNATIVE SPILLWAY ALIGNMENT

SURFACE RL: 95.2m

CONTRACTOR: R. & I.CONTRACTING

OPERATOR: PHIL GARLAND

EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - slightly clayey sandy silt, rootlets; dark brown; loose; just moist.
						0.35
				CH (v)		**SILTY CLAY;** grey; stiff; moist.
1						
						1.15
				GC (v)		**CLAYEY SANDY GRAVEL;** pale brown with orangebrown streaks; medium dense; just moist. Gravel subrounded to well rounded, generally gravel to cobble size, ranging to rare boulders 200mm dimension.
2						Yellowbrown/orangebrown, streaked from 2.1m.
3						
						3.20
				ROCK		**TUFFACEOUS SANDSTONE;** highly weathered to moderately weathered with depth; weak to medium strong; fine/medium grained; yellowbrown.
						END at 3.90
4						Ends as above, very difficult digging in moderately weathered rock.
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP100

PROJECT: TILLEGRA DAM — DATE: 26.03.08

LOCATION: RA, ALTERNATIVE SPILLWAY ALIGNMENT — SURFACE RL: 93.6m

CONTRACTOR: R. & I.CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - slightly clayey sandy silt, rootlets; dark brown; loose; just moist. — 0.20
1				GC (v)		**CLAYEY SANDY GRAVEL;** pale yellowbrown; medium dense/dense; just moist. Gravel subrounded to well rounded; gravel to cobble size, ranging to boulders up to 250mm dimension. — 1.60
2				ROCK		**META-SHALE;** moderately weathered to slightly weathered with depth; medium strong; laminated to very thinly bedded; greybrown to mid grey. Bedding 45° /247° Includes shear zone parallel to bedding 150mm wide, crushed, clayey. Major joint sets: 44° /082° (across bedding), 74° /297° (towards LA). Defect spacing generally very close to close, surface Fe/Mn stained, tight. — END at 2.80
3						Ends as above, very difficult digging. Fine grained tuffaceous sandstone overlies meta-shale in western end of pit, highly weathered to moderately weathered with depth.
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP101

PROJECT: TILLEGRA DAM — DATE: 26.03.08

LOCATION: ADJACENT TO SALISBURY ROAD — SURFACE RL: 95.1m

CONTRACTOR: R. & I.CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION (Soil type, colour, consistency, grainsize, moisture, remarks)
0	No Groundwater Encountered			SM (v)		TOPSOIL - clayey sandy silt, rootlets; dark grey; loose; just moist. — 0.25
				CL/CI (v)		Slightly SANDY SILTY CLAY; greybrown/brown; stiff; moist. — 0.80
1				SC (v)		CLAYEY SAND; pale grey with orangebrown streaks; stiff/very stiff; just moist.
2				GC (v)		CLAYEY SANDY GRAVEL; pale grey/orangebrown, streaked; medium dense/dense; just moist. Gravel subrounded to generally well rounded ranging to boulder size up to 200mm dimension. — 2.70
3				ROCK		META-SHALE; moderately weathered/slightly weathered; medium strong; laminated to very thinly bedded; greybrown/grey. — END at 3.20
4						Ends as above, slow digging, tight.
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL

TEST PIT TP102

PROJECT: TILLEGRA DAM

DATE: 26.03.08

LOCATION: ADJACENT TO SALISBURY ROAD

SURFACE RL: 96.4m

CONTRACTOR: R. & I.CONTRACTING OPERATOR: PHIL GARLAND EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SM (v)		TOPSOIL - slightly clayey sandy silt, rootlets; dark brown; loose; just moist. 0.20
				SC (v)		CLAYEY SAND; pale brown with orangebrown mottle; stiff; just moist. 0.55
1				ROCK		META-SHALE; moderately weathered; medium strong; laminated to very thinly bedded; greybrown. Bedding: 58 ° /245 ° Major joint sets: 80 ° /337 ° (towards LA), 30 ° /110 ° (across bedding). Defect spacing extremely close to close, surfaces Fe/Mn stained, commonly clay coated. END at 1.80
2						Ends as above, moderately weathered/slightly weathered, tight, slow digging.
3						
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT — TP103

PROJECT: TILLEGRA DAM — DATE: 26.03.08

LOCATION: ADJACENT TO SALISBURY ROAD — SURFACE RL: 96.3m

CONTRACTOR: R. & I. CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION (Soil type, colour, consistency, grainsize, moisture, remarks)
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - slightly clayey sandy silt, rootlets; dark brown; loose; just moist. — 0.30
1				SC (v)		**GRAVELLY CLAYEY SAND;** pale brown to greybrown with depth; stiff/very stiff; just moist. Gravel fraction angular meta-sedimentary; highly weathered; very weak; includes occasional well rounded gravel to 30mm dimension. Probable slopewash. — 1.40
2				GC (v)		**Slightly CLAYEY SANDY GRAVEL;** yellowbrown/mid brown; medium dense/dense; dry. Gravel rounded to well rounded, gravel to boulder size (increasing with depth) to 450mm dimension (rarely).
3						
4						
5				ROCK		**TUFFACEOUS SANDSTONE;** moderately weathered; weak/medium strong; medium to coarse grained; yellowbrown. Very difficult digging. — 4.70 — END at 5.00

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT — TP104

PROJECT: TILLEGRA DAM — DATE: 26.03.08

LOCATION: DIVERSION OUTLET PORTAL — SURFACE RL: 115.1m

CONTRACTOR: R. & I.CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
0	No Groundwater Encountered			SM (v)		TOPSOIL - gravelly sandy silt, rootlets; pale brown; loose; just moist/dry. — 0.15
				SC (v)		GRAVELLY CLAYEY SAND, rootlets persist; orangebrown/brown, mottled; stiff; just moist. — 0.60
1				ROCK		TUFFACEOUS SANDSTONE; moderately weathered; medium strong; fine grained; brown/greybrown. Bedding: 60 ° /245 ° Major joint sets: 43 ° /355 ° (across bedding) 88 ° /135 ° Defect spacing very close to close (ranging to moderately wide), surfaces Fe/Mn stained. — END at 1.65
2						Ends as above, very difficult digging, tight.
3						
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP105

PROJECT: TILLEGRA DAM — DATE: 26.03.08

LOCATION: RA, SOUTH OF SPILLWAY ALIGNMENT — SURFACE RL: 112.1m

CONTRACTOR: R. & I. CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION (Soil type, colour, consistency, grainsize, moisture, remarks)
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - sandy silt, rootlets; brown; loose; just moist.
0.35						
				GC (v)		**CLAYEY SANDY GRAVEL;** pale brown with orangebrown streaks; stiff; just moist/moist. Gravel fraction angular meta-sedimentary; highly weathered/moderately weathered; generally to 50mm dimension. Slopewash.
1.20						
				SC (v)		**GRAVELLY CLAYEY SAND;** mid greybrown with orangebrown streaks; stiff/very stiff; just moist. Gravel fraction as above, generally highly weathered to 15mm dimension. Slopewash.
						Gravel component increasing with depth, including moderately weathered rock to 100mm dimension; hard; dry. Slow digging.
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 2 SHEETS
SCALE 1 : 25

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP105

PROJECT: TILLEGRA DAM — DATE: 26.03.08

LOCATION: RA, SOUTH OF SPILLWAY ALIGNMENT — SURFACE RL: 112.1m

CONTRACTOR: R. & I.CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
5				SC (v)		--- (continued from previous sheet) --- GRAVELLY CLAYEY SAND; mid greybrown with orangebrown streaks; stiff/very stiff; just moist. Gravel fraction as above, generally highly weathered to 15mm dimension. Slopewash. END at 5.30 Ends as above (dry, hard).
6						
7						
8						
9						
10						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

V : visual
L : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 2 OF 2 SHEETS
SCALE 1 : 25

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP106

PROJECT: TILLEGRA DAM — DATE: 26.03.08

LOCATION: RA, SOUTH OF SPILLWAY ALIGNMENT — SURFACE RL: 104.9m

CONTRACTOR: R. & I.CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION (Soil type, colour, consistency, grainsize, moisture, remarks)
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - sandy silt, rootlets; greybrown; loose; moist. 0.35
1				SC (v)		**GRAVELLY CLAYEY SAND/SANDY CLAY;** pale brown with orangebrown streaks; stiff; moist to just moist with depth. Gravel fraction angular, meta-sedimentary; highly weathered/moderately weathered; generally to 15mm dimension. Slopewash. 2.30
2						
3				CL/CI (v)		**Slightly SANDY SILTY CLAY;** grey/greybrown with orangebrown mottle; very stiff; just moist/moist. 3.40
4				SC (v)		**GRAVELLY CLAYEY SAND;** pale brown/orangebrown, streaked; very stiff; just moist. Gravel fraction angular, meta-sedimentary; highly weathered; generally to 25mm dimension. Slopewash.
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

V : visual
L : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 2 SHEETS
SCALE 1 : 25

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT — TP106

PROJECT: TILLEGRA DAM — DATE: 26.03.08

LOCATION: RA, SOUTH OF SPILLWAY ALIGNMENT — SURFACE RL: 104.9m

CONTRACTOR: R. & I.CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION Soil type, colour, consistency, grainsize, moisture, remarks
5				SC (v)		--- (continued from previous sheet) --- END at 5.20 GRAVELLY CLAYEY SAND; pale brown/orangebrown, streaked; very stiff; just moist. Gravel fraction angular, meta-sedimentary; highly weathered; generally to 25mm dimension. Slopewash.
6						Ends as above, slow digging (very stiff).
7						
8						
9						
10						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 2 OF 2 SHEETS
SCALE 1 : 25

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT — TP107

PROJECT: TILLEGRA DAM — DATE: 27.03.08

LOCATION: RA, SOUTH OF SPILLWAY ALIGNMENT — SURFACE RL: 101.4m

CONTRACTOR: R. & I.CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION (Soil type, colour, consistency, grainsize, moisture, remarks)
0	No Groundwater Encountered			SM (v)		TOPSOIL - slightly clayey sandy silt, rootlets; dark greybrown; loose; just moist. — 0.20
1				SC (v)		SANDY CLAY/CLAYEY SAND with trace of gravel; mid greybrown with occasinal orangebrown streaks; stiff; moist. — 1.20
2				GC (v)		Slightly CLAYEY SANDY GRAVEL; greybrown with orangebrown streaks; hard (cemented); dry. Gravel fraction includes highly meta-sedimentary fragments and occasional subrounded to well rounded gravel generally to 10mm dimension. Slopewash. — 2.60
3				ROCK		TUFFACEOUS SANDSTONE; extremely weathered; extremely weak to very weak; fine/medium grained; dark greybrown/brown. — 3.90
4				ROCK		TUFFACEOUS SANDSTONE; highly weathered; very weak to weak; fine grained; pale brown/orangebrown, layered; Bedding exposed on western end of trench 43 ^{o} /210^{o}.
5						Ends as above, highly weathered/moderately weathered, difficult digging. — END at 5.00

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT — TP108

PROJECT: TILLEGRA DAM — DATE: 27.03.08

LOCATION: RA, SOUTH OF SPILLWAY ALIGNMENT — SURFACE RL: 99.2m

CONTRACTOR: R. & I. CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION (Soil type, colour, consistency, grainsize, moisture, remarks)
0	No Groundwater Encountered			SM (v)		TOPSOIL - sandy silt, rootlets; dark grey to pale grey with depth; loose; moist. 0.25
				SC (v)		GRAVELLY CLAYEY SAND; yellowbrown/orangebrown streaked; stiff; moist. 0.60
1				ROCK		TUFFACEOUS SANDSTONE; highly weathered; very weak/weak; fine grained; pale yellowbrown with orangebrown streaks. No indication of bedding. Major joint set 60° /010° (towards LA). END at 1.80
2						Ends as above, highly weathered/moderately weathered, very difficult digging.
3						
4						
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

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NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL — TEST PIT TP109

PROJECT: TILLEGRA DAM — DATE: 27.03.08

LOCATION: RA, SOUTH OF SPILLWAY ALIGNMENT — SURFACE RL: 99.8m

CONTRACTOR: R. & I. CONTRACTING — OPERATOR: PHIL GARLAND — EQUIPMENT: KOMATSU PC220

DEPTH (m)	WATER	BIT	SAMPLE or TEST	SOIL GROUP	GRAPHIC LOG	SOIL DESCRIPTION (Soil type, colour, consistency, grainsize, moisture, remarks)
0	No Groundwater Encountered			SM (v)		**TOPSOIL** - sandy silt, rootlets; dark grey; loose; moist. — 0.30
1				SC (v)		Slightly CLAYEY/CLAYEY SAND; pale brown with orangebrown streaks; stiff; moist to just moist with depth. Includes trace of meta-sedimentary gravel, generally highly weathered, to 10mm dimension. — 1.60
2				CL/CI (v)		GRAVELLY SANDY CLAY; dark grey; very stiff; just moist. Gravel fraction angular; meta-sedimentary; highly weathered to moderately weathered; generally to 30mm dimension. Slopewash. — 2.75
3				ROCK		TUFFACEOUS SANDSTONE; highly weathered; very weak to weak; fine grained; yellowbrown/orangebrown. — END at 3.60
4						Ends as above, slow digging.
5						

SAMPLE OR TEST
U.....Undisturbed
D.....Disturbed
SPT....Standard Penetration Test
CPT....Cone Penetration Test

v : visual
l : laboratory

WATER
Water Table
Water Inflow

FIELD SUPERVISOR: J.F.YOUNG
PROJECT COORDINATOR: J.F.YOUNG
SHEET 1 OF 1 SHEETS
SCALE 1 : 25

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APPENDIX D

Engineering Geological Borehole Logs

DDH1 to DDH9

(including core photographs)

EXPLANATION OF LOGGING TERMS FOR ENGINEERING GEOLOGY BOREHOLE LOGGING

ROCK SUBSTANCE WEATHERING CLASSIFICATION

RS	Residual soil
EW	Extremely weathered
HW	Highly weathered
MW	Moderately weathered
SW	Slightly weathered
F(s)	Fresh (stained defects)
F	Fresh

ESTIMATED STRENGTH CLASSIFICATION

EW	Extremely weak
VW	Very weak
W	Weak
MS	Medium strong
S	Strong
VS	Very strong
ES	Extremely strong

DEFECTS

Defects include all joints, bedding planes, fracture zones, seams, veins and cleavage partings.

RQD

Rock quality designation:

$$RQD = \frac{\text{length of core in pieces 100mm or longer}}{\text{length of run}} \times 100\%$$

WATER

Water table, with date

Water inflow

Partial drilling water loss

Complete drilling water loss

Angles of joint inclination (and other geological features and drill holes) are angles between the feature and a horizontal plane. In core, angles of joints (and other geological structures) are angles between the structure and the plane normal to the axis of the core. In vertical holes these angles are then the true inclination (dip) of the structure.

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 1 Sheet 1 of 12 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, PROPOSED SPILLWAY CREST
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING 090° M INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED 18.12.07

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
0					NON CORE							
1.00					CORING COMMENCES AT 1.0m							
1.15	HQ	RUN 1			TUFFACEOUS SANDSTONE, medium to fine gr., brown/greybrown.						72%	
1.19					META-SHALE, dk grey, laminated at 15°					1.22 1.29 } 2xs PARTINGS, 15°, planar, rough, Fe st		
					TUFFACEOUS SANDSTONE fine grained, grey/ greybrown/brown.	SW/FR	S			1.65 1.70 } PARTING FRAGMENTS, 10 to 15°, planar, rough, Fe st.		
					Includes META-SHALE laminations as shown at 15°.					1.80 DRILLING BREAK		
1.99		RUN 2				MW/MW	VW/M			1.95 Numerous PARTINGS, 15°/JOINTS, 30 to 60°, planar, rough, Fe/mn st. 2.47	45%	
2.42										2.52		
2.60						MW	MS			Numerous PARTINGS, 15°, with several JOINTS, 30 to 45°, planar, rough, Fe st. Occasional sandy clay coatings to rare full 2mm thick. 3.00	18%	
3		RUN 3										
3.14					META-SHALE, greybrown, laminated at 15°		W/MS			3.14 3.25 } Numerous PARTINGS, 15°, planar, rough, Fe st.		
3.30					CORE LOSS 0.05m					3.30		
3.50		RUN 4			META-SHALE continues					As above.		
					TUFFACEOUS SANDSTONE, fine grained, brown.	MW	MS			3.68	26%	
3.88										3.82 Numerous PARTINGS, 15°, with several JOINTS, 45 to 70°, planar, rough, Fe st, occasional sandy clay coating.		
4					META-SHALE, brown/greybrown, laminated at 10 to 15°					4.13		
4.06					TUFF. S/S, fine grained, brown					4.22		
4.22		RUN 5			META-SHALE, brown/greybrown, laminated at 10 to 15°	MW/SW	MS/S			As above.	13%	
4.66					CORE LOSS 0.15m					4.66		
4.81					META-SHALE continues as above.	MW	MS			4.81 As above		
4.92		RQ			TUFF S/S, fine gr. brown					4.97		

Remarks: BOX 1 ENDS AT 4.66m
Job / Report No. GN 25A

Logged by: JOHN YOUNG Date: 18.12.07 Site Supervisor MARK SCHOMER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DH 1 Sheet 2 of 12 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, PROPOSED SPILLWAY CREST
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING 090° M INCLINATION 60° from horizontal

DRILL DELTA 1000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED
CORE BARREL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED

DRILLING DATA			ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
5											
5.15				TUFFACEOUS SANDSTONE continues, fine grained, brown/grey/brown.	MW	MS			5.07 } JOINT, 45°/PARTING, 15°, FRAGMENTS, planar, rough, Fe st. Core fragmented from 5.15 to 5.39m		
5.39					HW	VW					
5.47		RUN 7			MW	MS			5.47		
5.74				CORE LOSS 0.27m					5.74 } Core fragmented	0%	
5.80		RUN 8		Interbedded fine gr. TUFFACEOUS SANDSTONE / META-SHALE, pale grey / brown / orange brown. Laminations (where visible) at 15° to 20°	MW	MS			5.80 } Core fragmented		
6					HW	VW			5.94 PARTING, 10°, planar, rough, Fe st.	45%	
6.06					MW	MS			6.06 } Core fragmented		
6.16		RUN 9		CORE LOSS 0.17m					6.16	0%	
6.33				As above	MW	MS			6.33 } Core fragmented		
6.43		RUN 10							6.43		
				CORE LOSS 0.67m						0%	
7											
7.10	50	RUN 11		CORE LOSS 0.54m (1.21m TOTAL).						0%	
7.64				As above	MW	MS			7.64 } PARTING FRAGMENTS, 20°, planar, rough, Fe st.		
7.74		12		NON CORE (casing reseated)					7.74		
7.82				As above.					7.82 } As above	0%	
7.98		13							8.00		
8.08				8.08m TUFFACEOUS SANDSTONE very fine / fine grained, brown (to 8.36m) then grey. Includes occasional META-SHALE laminations to 8.51m depth, at 10 to 15°	MW	MS			8.22 BOXING BREAK		
8.36		RUN 14							8.36 } 4x's PARTINGS, 10 to 15°, planar, rough, Fe st.	80%	
									8.57		
8.70		RUN 15			F(3)	S/VS			8.70 DRILLING BREAK		
9									9.02 PARTING, 15°, planar, rough, Fe st.		
									9.15 BOXING BREAK		
									9.30 HANDLING BREAK		
									9.48 } 2x's PARTINGS, 10°, planar, rough, Fe st.	90%	
									9.49		
				9.87m Includes elongate subangular META-SHALE clasts to 40mm length					9.87 PARTING, 15°, planar, rough, Fe st.		
10											

Remarks: BOX 2 ENDS AT 9.15m
Job / Report No. GN 24A

Logged by: JOHN YOUNGS Date: 13.12.07 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 1 Sheet 3 of 17 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, PROPOSED SPILLWAY CREST
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING 090°M INCLINATION 60° from horizontal
DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
10					TUFFACEOUS SANDSTONE continues, fine grained, grey. Elongate META-SHALE clasts persist to 10.40m					10.04 JOINT, 45°, planar, rough, Fe st. 10.15 BOXING BREAK 10.30 PARTING, 10°, planar, rough, Fe st.		
10.40					10.40m							
10.66					10.66 Elongate META-SHALE clast 48mm long					10.74 Probable PARTING, 15°, irregular, rough, Fe st. 10.87 HANDLING BREAK		
11	HQ	RUN 5				F(s)	S/W			11.13 BOXING BREAK		
					TUFFACEOUS SANDSTONE, fine grained, grey.					12.38 } Several JOINTS, 60°, planar to curved, rough, Fe/Mn st. 12.60 }		
11.70										11.70 DRILLING BREAK 11.78 JOINT, 65°, planar, rough, Fe/Mn st.		
12										11.96 Probable DRILLING BREAK 12.17 BOXING BREAK		
		RUN 7								12.38 DRILLING BREAK	70%	
12.78										12.60 JOINT, 70°, planar, rough, Fe st. 12.78 DRILLING BREAK		
13		RUN 8								13.07 BOXING BREAK		
										13.25 } 2x's JOINTS, 60 to 70°, intersecting, planar, rough, Fe st, very minor clay coating 13.46 }	67%	
										13.52 } 3x's PARTINGS, 5°, planar, rough, Fe/Mn st. 13.61 13.68 }		
13.87										13.87 DRILLING BREAK		
14												
		RUN 9								14.14 BOXING BREAK 14.22 JOINT, 50°, planar, rough, Fe/Mn st.		
										14.42 JOINT, 60°, planar, rough, Fe/Mn st.	72%	
										14.50 } 3x's JOINTS, 60°, parallel, planar, rough, Fe/Mn st. 14.64 }		
14.70										14.70 DRILLING BREAK		
15		RUN 10								14.93 JOINT, 50°, planar, rough, Fe/Mn st.		

Remarks: BOX 3 ENDS AT 13.07m
Job / Report No. GN 25A

Logged by: JOHN YOUNG
Date: 8.1.08
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 1 Sheet 4 of 12 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, PROPOSED SPILLWAY CREST.
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING 090°M INCLINATION 60° from horizontal
DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
15				Fine gr. TUFF. s/s. continues							
15.07		RUN TO CONT		Very fine grained from 15.07m					15.07 JOINT, 30°, with intersecting PARTING, 15°, both planar, rough, Fe/Mn st.		
									15.21 As above		
									15.37 JOINT, 60°, planar, rough, Fe st.		
									15.57 JOINT, 50°, planar, rough, Fe st.		
15.68											
15.80				15.80m Includes META-SHALE					15.80 } JOINT, 60°, with associated		
15.90				15.90m laminations at 10°	F(s)	S/VS			15.90 } PARTINGS, 10°, planar, rough, Fe/Mn st		
16		RUN II		TUFFACEOUS SANDSTONE continues, very fine/fine grained, grey.					16.00 } As above. 16.21		
16.60		RUN III							16.53 DRILLING BREAK		
									16.74 PARTING, 10°, planar, rough, Fe st.		
									16.84 JOINT, 175°, planar, rough, Fe st.		
17.00				17.00m					16.98 DRILLING BREAK		
17.06				Includes META-SHALE							
17.13				17.06m laminations at 15° 17.13							
17.29				Interbedded META-SHALE and very fine gr. TUFF. s/s, grey/dk grey, banded at 15° 17.29m					17.18 } Several PARTINGS, 15°, planar, rough, Fe st (possibly 17.25 } DRILLING/HANDLING induced)		
		RUN IV		TUFFACEOUS SANDSTONE, fine grained, grey.							
17.57				17.57m					17.60 PARTING, 10°, planar, rough, Fe st.		
17.70	HQ			Includes META-SHALE 17.70m laminations at 10 to 15°					17.70 } 2x's JOINTS, 65°, planar, rough, 17.90 } Fe/Mn st.		
18				TUFFACEOUS SANDSTONE continues, fine/medium gr., grey.					17.97 PARTING, 10°, planar, rough, Fe/Mn st.		
									18.51 DRILLING BREAK		
									18.57 JOINT, 60°, planar, rough, Fe st.		
		RUN V							18.80 BOXING BREAK		
18.99				18.99m					18.90 DRILLING BREAK		
19				META-SHALE, dk. grey,		MS/S			18.97 } 2x's PARTINGS, 10°, planar, rough,		
19.05				19.05m laminated at 10°					19.02 } Fe st.		
				TUFF. s/s., fine/medium grained, grey.		S/S			19.30 } JOINT, 60°, with associated		
19.43				19.43m					PARTINGS, 10 to 15°, planar,		
19.53		RUN VI		META-SHALE, dk. grey, laminated at 10°		MS/S			19.50 } rough/very rough, Fe/Mn st		
				19.53m TUFF. s/s., fine gr., grey.		S/S			19.65 PARTING, 10°, planar, rough, Fe st. minor carbonate coating.		
19.78				19.78m							
19.94				META-SHALE, dk grey/grey brown, laminated at 15° 19.94m		MS			19.85 } PARTING FRAGMENTS, 15°, planar, rough, Fe st, sandy clay fill		
20				TUFF. s/s. fine gr. grey.		S/S					

Remarks: BOX 4 ENDS AT 16.98m
Job / Report No. GN 27A

Logged by: JOHN YOUNG
Date: 8.1.02
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 1 Sheet 5 of 12 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, PROPOSED SPILLWAY CREST
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING 090° M INCLINATION 60° from horizontal
DRILL DELTA 1000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED

DRILLING DATA			ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
20	HQ	CASE		TUFFACEOUS SANDSTONE continues, fine gr., grey.		S/VS			20.05 As above		
20.27				20.27m META-SHALE, dk grey, laminated at 10°					20.17 PARTING, 15°, planar, rough, Fe st, minor clayey coating		
20.30									20.24 JOINT, 30°, planar, rough, Fe st.		
20.35				20.35m TUFF. s/s., fine gr., grey.		MS/S			20.30 } PARTING FRAGMENTS, planar, rough, Fe st.		
20.53		RUN 16		20.53 Includes elongated META-SHALE clasts to 45mm					20.46 PARTING, 5°, planar, rough, Fe st.	45%	
20.70				TUFFACEOUS SANDSTONE continues, fine gr., grey.					20.70 DRILLING BREAK 20.76 HANDLING BREAK 20.82 BOXING BREAK		
21		RUN 17							20.97 JOINT, 60°, planar, rough, Fe st.		
						S/VS			21.36 JOINT, 30°, planar, rough, Fe/Mn st.		
									21.45 As above		
					F(S)				21.58 Probable PARTING, 15°, planar, very rough, Fe/Mn st.	65%	
									21.70 PARTING, 15°, planar, rough, Fe st, minor carbonate coating.		
21.81				21.81					21.85 JOINT, 65°, planar, rough, Fe st.		
22				META-SHALE, dark grey with occasional grey bands, thinly laminated / laminated at 10 to 15°							
22.22									22.18 JOINT, 50°, planar, rough, Fe st.		
						MS/S			22.27 PARTING, 15°, planar, rough, Fe st.		
		RUN 18							22.40 As above.		
									22.57 Probable DRILLING BREAK		
									22.66 } PARTING FRAGMENTS, 10 to 15°, planar, rough, Fe st.	10%	
22.97									22.97		
23				CORE LOSS 0.73m (Inner barrel not locked in)							
23.70									23.70		
23.85		RUN 20		META-SHALE continues	F(S)					0%	
24									Numerous PARTINGS / PARTING FRAGMENTS, 10 to 15°, planar, rough, Fe st.		
24.03						MS/S					
					SW/F(S)				Includes several JOINTS, 60°, planar, rough, Fe st.	0%	
24.71		RUN 21									
24.94					F(S)				24.94 BOXING BREAK		

Remarks: BOX 5 ENDS AT 20.82m BOX 6 ENDS AT 25.00m
Job / Report No. GN 25A

Logged by: JOHN YOUNG
Date: 8.1.08
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 1
Sheet 6 of 12 Sheets

PROJECT: TILLEGRA DAM
LOCATION: RIGHT ABUTMENT, PROPOSED SPILLWAY CREST
CO-ORDINATES: E / N
R.L. COLLAR / DATUM
BEARING: 090°M
INCLINATION: 60° from horizontal
DRILL: DELTA 2000, TRACK MOUNTED
CONTRACTOR: McDERMOTT DRILLING
CORE BARRELL: HQ TRIPLE
DRILLER: SHAUN TAYLOR
COMMENCED
COMPLETED

DRILLING DATA			ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run, Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
25				TUFFACEOUS SANDSTONE (from 25.00 m), fine grained, grey.		S/VS					
25.22				25.22m							
25.29				META-SHALE, dk grey, laminated at 15°		MS/S			25.29 DRILLING BREAK		
				25.29m							
				TUFFACEOUS SANDSTONE, continues, fine gr., grey							
25.85				25.85					25.86 PARTING, 15°, planar, rough, Fe st.		
26		RUN 24 CONTINUED		Occasional carbonate veining generally to 1mm thick (mostly infilling joints)		S/VS			26.00 JOINT, 30°, planar, rough, Fe st.	85%	
					F(S)				26.48 JOINT, 30°, planar, very rough, Fe st.		
26.60				26.60					26.61 PARTING, 15°, planar, rough, Fe st		
26.70				Interbedded META-SHALE, dk. grey, and very fine grained TUFF. S/s., grey. Laminated at 10 to 15°, banded.		S			26.70 JOINT, 45°, planar, rough, Fe st.		
26.75									26.78 } 26.88 } 3x's PARTINGS, 15°, planar, rough (possibly drilling induced)		
26.95				26.95							
27	HQ			TUFFACEOUS SANDSTONE, fine grained, grey.		S/VS			27.00 BOXING BREAK		
27.64		RUN 25		27.64					27.64 Possible PARTING, 15°, planar, rough. (may be drilling induced)		
				Interbedded META-SHALE, dk grey, and very fine grained TUFFACEOUS SANDSTONE, grey. Laminated at 10 to 15°, banded.	F						
28									28.00 As above		
				(META-SHALE is dominant rocktype)		S					
									28.70 JOINT, 30°, planar, rough, carbonate coated.	95%	
				Rare carbonate veining present, generally to 1mm thickness							
29									28.96 BOXING BREAK		
									29.45 Probable DRILLING BREAK		
29.65											
29.70		RUN 26							29.70 PARTING, 15°, planar, rough, Fe st, minor carbonate coating.		
					F(S)						
30									29.95 BOXING BREAK		

Remarks: BOX 7 ENDS AT 28.96 m
Job / Report No. GN 25A

Logged by: JOHN YOUNG
Date: 9.1.08
Site Supervisor: MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 1
Sheet 1 of 12 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, PROPOSED SPILLWAY CREST.
CO-ORDINATES E N
R.L. COLLAR
DATUM
BEARING 090°M
INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED
CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE
DRILLER SHAUN TAYLOR
COMMENCED
COMPLETED

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
30					Interbedded META-SHALE/ very fine grained TUFFACEOUS SANDSTONE continues. Laminated at 15°. (META-SHALE dominant)					30.12 } JOINT, 50°, with associated PARTINGS, 10°, planar, rough, Fe st. 30.20 }		
										30.43 PARTING, 15°, with associated JOINT, 50°, planar, rough.		
										30.64 Probable DRILLING BREAK		
										30.90 As above 30.95 BOXING BREAK 31.06 HANDLING BREAK		
31					Rare carbonate veining, less than 1mm thick					31.10 PARTING, 15°, planar, rough, Fe st		
						F(s)	S			31.38 } JOINT, 75°, planar, rough, minor Fe st, carbonate coated. Several associated PARTINGS, 15°, planar, rough. 31.78 }	76%	
										31.95 Probable DRILLING BREAK		
32										32.10 As above		
32.35	HQ3	RUN 28 CONTINUED			32.35m TUFFACEOUS SANDSTONE, very fine grained, grey.		S/VS			32.20 PARTING, 10°, planar, rough, minor Fe st.		
										32.45 Possible PARTING, 15°, planar, rough.		
32.58					32.55m					32.55 } 2x's PARTINGS, 15°, planar, rough, Fe st 32.58 }		
32.70					META-SHALE, dk grey, with very fine grained TUFFACEOUS SANDSTONE laminations, grey.					32.70 DRILLING BREAK		
										32.92 BOXING BREAK		
33							S			33.11 PARTING, 15°, planar, rough, minor Fe st. 33.20 As above.		
		RUN 29			Thinly laminated/laminated at 15°							
33.30					33.30m TUFFACEOUS SANDSTONE, very fine grained, grey.		S/VS					
33.56					33.56m					33.50 } Several JOINTS, 60 to 70°, planar, rough, Fe st (heavily) 33.93 }		
					META-SHALE, dk grey, with (minor) very fine grained TUFFACEOUS SANDSTONE laminations, grey.						68%	
34					Thinly laminated to laminated at 15°.					34.01 PARTING, 15°, planar, rough, Fe st.		
							S			34.15 } 4x's JOINTS, 30 to 50°, planar, rough, minor carbonate coating 34.77 34.30 34.40 }		
					Rare carbonate veining generally to 1mm thickness persists					34.50 JOINT, 45°, planar, rough, Fe st.		
										34.74 Probable DRILLING BREAK		
35										34.92 BOXING BREAK		

Remarks: BOX 8 ENDS AT 32.92m
Job / Report No. GN 25A

Logged by: JOHN YOUNGS
Date: 9.1.08
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 1 Sheet 8 of 12 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, PROPOSED SPILLWAY CREST.
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING 090°M INCLINATION 60° from horizontal
DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED

DRILLING DATA			ROCK SUBSTANCE				ROCK MASS DEFECTS			
DEPTH (R.L.) METRES	Method	Casing, Run Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D. / TESTS
35				Continues as above.					35.07 PARTING, 10°, planar, rough, Fe st, carbonate coated.	
		RUN 24 CUT		META-SHALE with very fine grained TUFFACEOUS SANDSTONE laminations.					35.44 JOINT, 50°, planar, rough, minor carbonate coating.	
35.70				Thinly laminated/ laminated at 10 to 15°.					35.67 DRILLING BREAK.	
	HQ			Rare carbonate veining persists, less than 1mm thick.	F (5)	S			35.70 DRILLING BREAK	
36									35.90 BOXING BREAK	
		RUN 25							36.12 HANDLING BREAK	
									36.17 PARTING, 15°, planar, rough, Fe st.	
									36.49 Probable DRILLING BREAK	
									36.62 JOINT, 65°, planar, rough, minor Fe st, minor carbonate coating.	65%
									36.80 JOINT, 70°, planar, rough, minor Fe st, carbonate coated.	
37										
37.09				37.09m TUFFACEOUS SANDSTONE, fine grained, grey		S/VS			37.09	
37.28				37.28 m META-SHALE, dk grey, with with very fine grained TUFFACEOUS SANDSTONE laminations (at 15°)					37.34 JOINT, 60°, planar, rough, minor Fe st, carbonate coated.	
37.47						S			37.47 DRILLING BREAK	
									37.56	
37.70				37.70m					37.70 3 x's PARTINGS, 15°, planar, rough, Fe st	
									37.80	
38										
		RUN 26		TUFFACEOUS SANDSTONE, fine grained ranging to fine-medium with depth, grey.					38.20 JOINT, 60°, planar, rough, Fe st.	100%
									38.44 As above	
									38.58 As above	
38.70						S/VS			38.70 PARTING, 10°, planar, rough, Fe st.	
		RUN 27								
39										
									39.22 JOINT, 45°, planar, rough, carbonate coated	
39.45				39.45m META-SHALE, dk grey, laminated at 10-		VS/S			39.42 3 x's PARTINGS, planar, rough, Fe st. 10°	
39.52				39.52m					39.46	
									39.52 HANDLING BREAK	
				TUFFACEOUS SANDSTONE continues as above.	F	S/MS			39.70 BOXING BREAK	
40										

Remarks: BOX 9 ENDS AT 36.80 m
Job / Report No. GN 25A
Logged by: JOHN YOUNG
Date: 9.1.08
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 1

Sheet 9 of 12 Sheets

PROJECT: TILLEGRA DAM
LOCATION: RIGHT ABUTMENT, PROPOSED SPILLWAY CREST
CO-ORDINATES: E / N
R.L. COLLAR / DATUM
BEARING: 090° M
INCLINATION: 60° from horizontal
DRILL: DELTA 2000, TRACK MOUNTED
CONTRACTOR: McDERMOTT DRILLING
COMMENCED
CORE BARRELL: HQ TRIPLE
DRILLER: SHAUN TAYLOR
COMPLETED

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
40					TUFF. S/S. continues as above		S/VS					
40.09					40.09m Interbedded META-SHALE, dk grey and fine grained TUFFACEOUS SANDSTONE, grey (approx. equal proportions). Laminated to very thinly bedded at 15°		S			40.09 Probable DRILLING BREAK 40.20 JOINT, 65°, planar, rough, carbonate coated 40.60 Possible PARTING, 15°, planar, rough, carbonate coated. 40.70 BOXING BREAK		
40.94		RUN 21 CONTINUED			40.94m					40.92 Possible PARTING, 15°, planar, rough carbonate coated.	98%	
41					41.07m Includes elongate META-SHALE clasts to 35mm.							
41.07					41.16m							
41.17					TUFFACEOUS SANDSTONE, fine grained, grey.					41.28 Probable DRILLING BREAK		
41.70						F				41.70 DRILLING BREAK		
42												
	HQ									42.51 JOINT, 45°, planar, rough, minor carbonate coating 42.65 JOINT, 60, as above. 42.70 2 x JOINTS, 65°, planar, rough, fe st., minor carbonate coating 42.88		
43												
		RUN 22					S/VS			43.31 DRILLING BREAK 43.37 JOINT, 60°, planar, rough, carbonate coated 43.47 JOINT, 65°, as above. 43.63 HANDLING BREAK 43.72 PARTING, 15°, planar, rough, minor fe st.	96%	
43.50												
						F(S)						
44										44.00 JOINT, 60°, planar, rough, fe st.		
										44.40 JOINT, 60°, planar, rough, minor fe st, carbonate coated.		
44.70		RUN 23								44.70 DRILLING BREAK		
45												

Remarks: BOX 10 ENDS AT 40.70m BOX 11 ENDS AT 44.70m
Job / Report No. GN25A

Logged by: JOHN YOUNG
Date: 9.1.07
Site Supervisor: MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 1

Sheet 10 of 12 Sheets

PROJECT TILLEGRA DAM

LOCATION RIGHT ABUTMENT, PROPOSED SPILLWAY CREST

CO-ORDINATES E N

R.L. COLLAR DATUM BEARING 090°M INCLINATION 60° from horizontal

DRILL DELTA 7000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED

CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
46					TUFFACEOUS SANDSTONE continues, fine grained, grey					45.30 JOINT, 60°, with associated PARTING, 5°, planar, rough, Fe st.		
										45.54 HANDLING BREAK		
										45.65 BOXING BREAK		
										45.82 HANDLING BREAK		
		RUN 27 CONTINUED									85%	
46										46.00 JOINT, 50°, planar, rough, Fe st		
										46.28 JOINT, 65°, planar, rough, Fe st, carbonate coated.		
46.57	50					F(3)	S/VS			46.57 DRILLING BREAK		
										46.70 46.78] HANDLING BREAKS		
										46.87 JOINT, 50°, planar, rough, Fe st.		
47		RUN 30								47.05 As above	100%	
47.70										47.70 PARTING, 15°, planar, rough, Fe st.		
48		RUN 31								48.28 JOINT, 45°, planar, rough, minor Fe st.		
										48.47 As above		
										48.65 BOXING BREAK		
										48.74 JOINT, 50°, stepped, rough, Fe st.	45%	
										48.94 JOINT, 60°, planar, rough, Fe st.		
49										49.20 JOINT, 70°, planar, rough, Fe st.		
										49.65 JOINT, 60°, planar, rough, Fe st.		
										49.81 DRILLING BREAK		
49.93 EOH										49.93 DRILLING BREAK		

Remarks: Box 12 ENDS AT 48.65m

Job / Report No. GN 25A

Logged by: JOHN YOUNG

Date: 9.1.08

Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 1
Sheet 11 of 12 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, PROPOSED SPILLWAY CREST.
CO-ORDINATES E N
R.L. COLLAR
DATUM
BEARING 090°M
INCLINATION 60° from horizontal

DRILL DELTA 2000, TANK MOUNTED
CONTRACTOR MCDERMOTT DRILLING
CORE BARRELL HQ TRIPLE
DRILLER SHAUN TAYLOR
COMMENCED
COMPLETED

DRILLING DATA				ROCK SUBSTANCE					ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run Water		GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
50	HQ	RUN 33	RUN 34 LOST		TUFFACEOUS SANDSTONE continues, fine grained, grey.					50.47 JOINT, 45°, planar, rough, Fe st.		
50.70					Rare carbonate veining persists, less than 1mm thickness.					50.70 DRILLING BREAK		
51										51.20 JOINT, 40°, planar, rough, Fe st.		
										51.76 BOXING BREAK		
52						$F_{(s)}$	S/VS			51.87 JOINT, 70°, planar, rough, Fe st (with associated HANDLING BREAKS) 52.17	98%	
										52.30 JOINT, 50°, planar, rough, minor Fe st. 52.31 HANDLING BREAKS 52.34 JOINT, 60°		
53												
53.38					52.38m Interbedded META-SHALE, dk grey, and TUFF, sft., grey, very fine grained. Thinly laminated to 53.63m laminated at 10+15°		S			53.35 4 x Possible PARTINGS, 10 to 15°, planar, rough, minor Fe st. at 53.38° and 53.63m. 53.48 53.58 53.63 53.67 DRILLING BREAK		
53.63												
53.70					TUFFACEOUS SANDSTONE, fine grained, grey.		S/VS			53.82 JOINT, 45°, planar, rough, Fe st.		
53.96					53.96m Interbedded META-SHALE/TUFF, sft. Thinly lam./flam. at 15°		S					
54												
54.17					54.17m		S/VS					
54.33					54.33m META-SHALE, dk grey,		MS/S			54.35 Probable DRILLING BREAK	70%	
54.40					54.40m Laminated at 15°					54.50 Possible PARTING, 15°, planar, rough, minor Fe st.		
					TUFFACEOUS SANDSTONE continues, fine grained, grey.		S/VS					
55												

Remarks: BOX 12 ENDS AT 52.70m
Job / Report No. GN 25A

Logged by: JOHN YOUNG
Date: 9.1.08
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 1

Sheet 12 of 12 Sheets

PROJECT TILLEGRA DAM

LOCATION RIGHT ABUTMENT, PROPOSED SPILLWAY CREST.

CO-ORDINATES E N

R.L. COLLAR DATUM BEARING 090°M INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR MCDERMOTT DRILLING COMMENCED

CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
55	HQ	RUN 54 CONTINUED			TUFFACEOUS SANDSTONE continues, fine grained, grey.	F(S)	S/VS			55.40 55.47] 2 x's Joints, 50°, planar, rough, fest.		
56										56.10 Possible Joint, 50°, planar rough, carbonate coated (may be drilling induced) 56.17 DRILLING BREAK		
56.40					CORE LOSS 0.10m 2 Left down hole					56.40 DRILLING BREAK		
56.50					HOLE ENDS AT 56.50m							
57												
58												
59												
60												

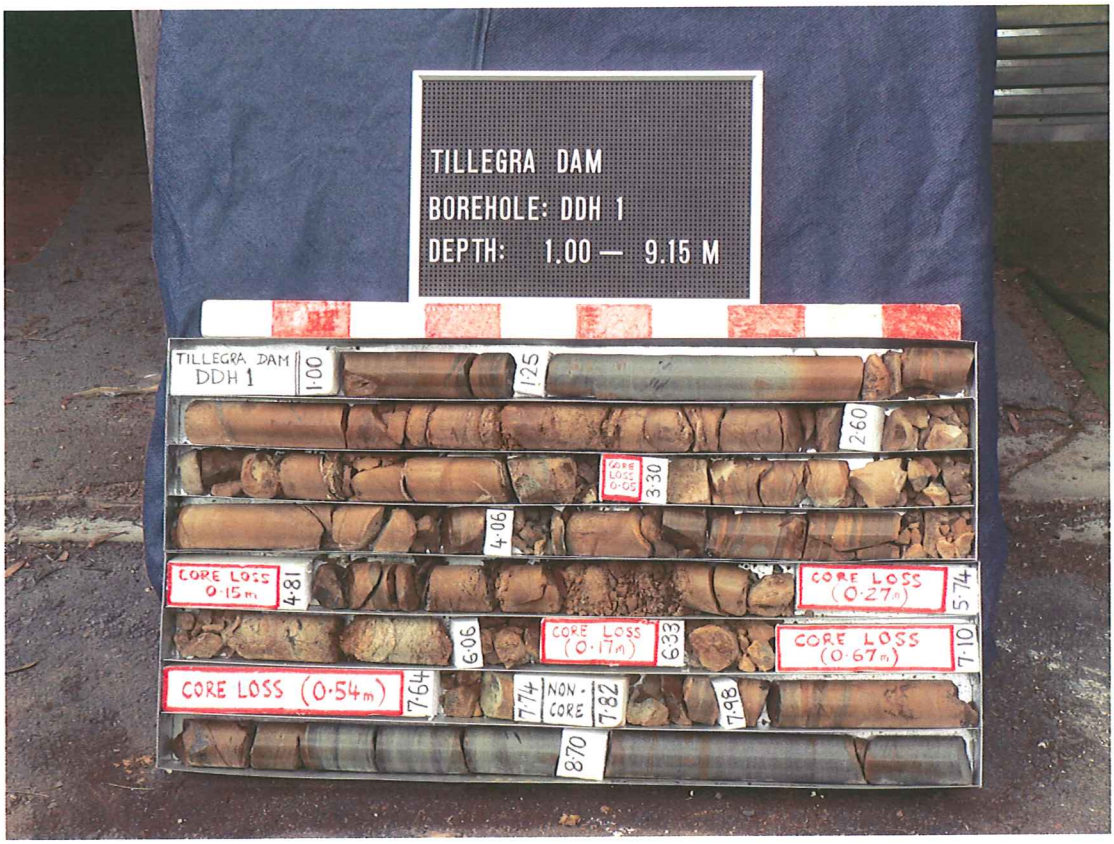
Remarks: BOX 14 ENDS AT 56.50m - END OF HOLE

Job / Report No. GM 15A

Logged by: JOHN YOUNG

Date: 9.1.08

Site Supervisor MARK ASHOVER

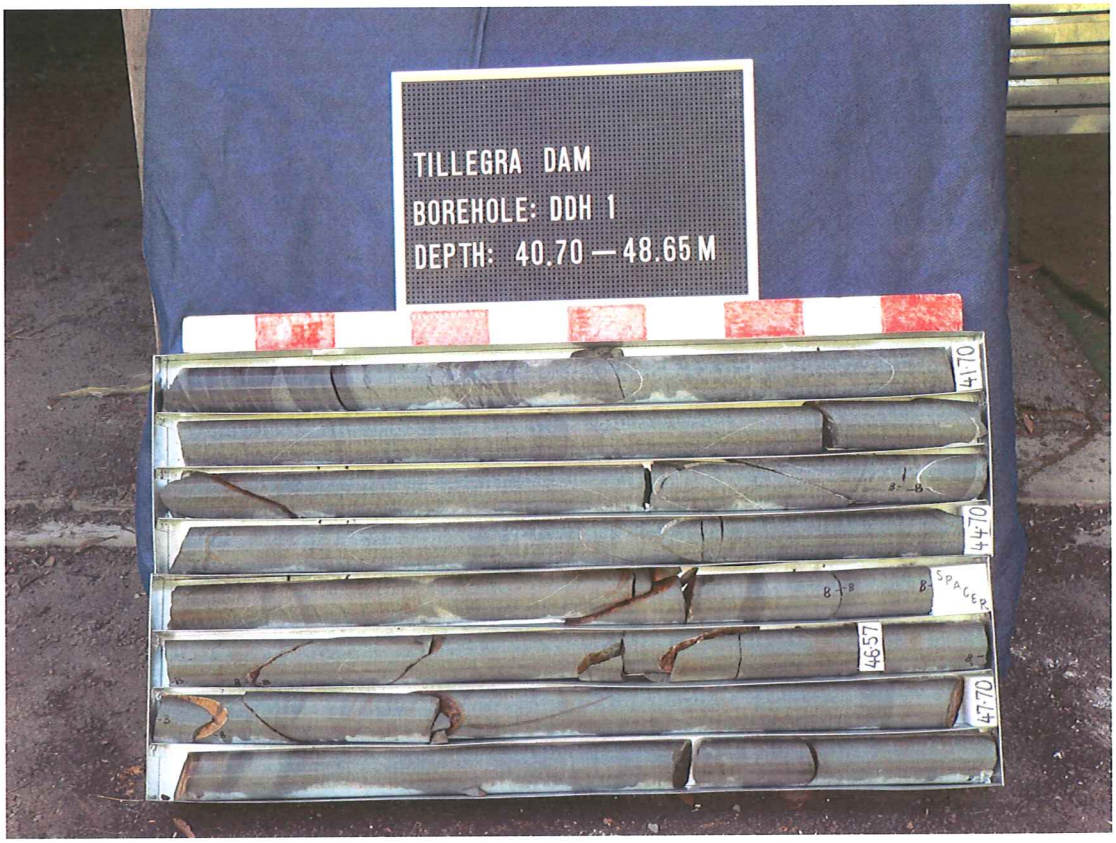

TILLEGRA DAM
BOREHOLE: DDH 1
DEPTH: 1.00 — 9.15 M
TILLEGRA DAM
DDH 1
1·00
1·25
2·60
CORE LOSS 0·05m
3·30
4·06
CORE LOSS 0·15m
4·81
CORE LOSS (0·27m)
5·74
6·06
CORE LOSS (0·17m)
6·33
CORE LOSS (0·67m)
7·10
CORE LOSS (0·54m)
7·64
7·74
NON-CORE
7·82
7·98
8·70

TILLEGRA DAM
BOREHOLE: DDH 1
DEPTH: 9.15 — 16.98 M
11·70
12·78
13·87
14·70
15·64
16·60

TILLEGRA DAM
BOREHOLE: DDH 1
DEPTH: 16.98 — 25.00 M
17.29
17.70
19.43
20.30
20.70
22.22
CORE LOSS (0.73m - INNER NOT LOCKED IN)
23.70
24.03
24.71

TILLEGRA DAM
BOREHOLE: DDH 1
DEPTH: 25.00 — 32.92 M
26.70
29.70
32.70

TILLEGRA DAM
BOREHOLE: DDH 1
DEPTH: 32.92 — 40.70 M
35-70
SPACER
(36-80)
37-47
38-70


TILLEGRA DAM
BOREHOLE: DDH 1
DEPTH: 40.70 — 48.65 M
41-70
44-70
SPACER
46-57
47-70

TILLEGRA DAM
BOREHOLE: DDH 1
DEPTH: 48.65 — 56.50 M
49-13
50-70
53-70
SPACER
DOWN HOLE 56.50

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 2
Sheet 1 of 7 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT SPILLWAY CHANNEL
CO-ORDINATES E N
R.L. COLLAR
DATUM
BEARING 090°M
INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED
CORE BARRELL HQ TRIPLE
CONTRACTOR McDERMOTT DRILLING
DRILLER SHAUN TAYLOR
COMMENCED 24.1.08
COMPLETED 29.1.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
0												
1												
					NON CORE							
2												
3												
3.45					CORING COMMENCES AT 3.45m							
					Meta-sedimentary rock fragments (gravel) in a clayey silty sand matrix Pale yellowish brown/grey brown, very stiff. Gravel: angular, ranging from 1 to 3 mm to 60mm, Xgen HW, ranging to MW							
4											NA	
4.20		RUN 1			CORE LOSS 0.15m							
4.35												
	HQ	RUN 2			As above (Probable slopewash)						NA	
5												

Remarks:
Job / Report No. GN25A

Logged by: JOHN YOUNG
Date: 29.1.08
Site Supervisor MARK ASHDOWN

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 2
Sheet 2 of 7 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT SPILLWAY CHANNEL
CO-ORDINATES E N
R.L. COLLAR
DATUM
BEARING 090°m
INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED
CONTRACTOR McDERMOTT DRILLING
COMMENCED 24.1.08
CORE BARRELL HQ TRIPLE
DRILLER SHAUN TAYLOR
COMPLETED 29.1.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
5					continues as above							
		RUN 2 CONT.			Matrix predominantly pale grey / grey brown, moist, stiff / v. stiff.							
5.85												
6												
	HQ											
7												
		RUN 3										
8												
8.85												
9												
		RUN 4										
10												

Remarks: BOX 1 ENDS AT 7.32 m
Job / Report No. GN 25A

Logged by: JOHN YOUNG
Date: 29.1.08
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 2
Sheet 3 of 7 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT SPILLWAY CHANNEL
CO-ORDINATES E N
R.L. COLLAR
DATUM
BEARING 090° M
INCLINATION 60° from horizontal

DRILL DEETA 1000, TRACK MOUNTED
CONTRACTOR McDERMOTT DRILLING
COMMENCED 24.1.08
CORE BARRELL HQ TRIPLE
DRILLER SHAUN TAYLOR
COMPLETED 29.1.08

DRILLING DATA				ROCK SUBSTANCE					ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
10					continues as above							
11		RUN 5 CONTINUED									NA	
11.85												
12												
12.40	HQ				12.40m Silty clay with gravel, dark grey, moist, stiff. Gravel fraction subangular/angular, meta-sedimentary. Generally HW, rarely to 25mm dimension							
13		RUN 6										
13.20					13.30 Meta-sedimentary gravel in clay silty sand/silty clayey sand matrix, generally pale grey, with orange/brown streaks, moist stiff. Gravel fraction angular to subrounded, HW to MW, ranging from several mm's to 50mm dimension.						NA	
14												
14.85												
15		67										

Remarks: BOX 2 ENDS AT 11.40m
Job / Report No. GN25A
Logged by: JOHN YOUNG
Date: 29.1.08
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 2 — Sheet 4 of 7 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT SPILLWAY CHANNEL
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING 090°m INCLINATION 60° from horizontal

DRILL DELTA 1000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED 24.1.08
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED 29.1.08

DRILLING DATA				ROCK SUBSTANCE					ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION — ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION — TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
16	HQ	RUN 7 CONTINUED			Continues as above 15.40m Well rounded gravel in a sandy clay/clayey sand matrix, generally pale grey/pale grey brown, with narrow orange brown zones. Gravel fraction ranges from several mm's to (say) 50mm dia., mostly fresh rock.						NR	
17												
17.10		RUN 8									NR	
17.85												
18		RUN 9			18.70m META-SHALE, brown/grey brown, thinly laminated/laminated at 10 to 15°						NR	
18.70						MW	W/M			18.70 / 18.80 Parting fragments (gravel recovery), planar, rough, Fe st, occ. clay coated, 10 to 15 (inclined visually).	10	
18.80					CORE LOSS 0.28m							
19												
19.08		RUN 10			META-SHALES continue as above	MW	W/M			19.08 - Numerous Partings, 10 to 15° with associated Joint, 70°, planar, rough, Fe st, commonly clay coated.	70	
19.28						EW	EW					
19.33						MW	W/M					
19.53					CORE LOSS 0.05m					19.53 / 19.58 2 x Partings, 15°, planar, rough, Fe st		
19.58		RUN 11			META-SHALE, dk grey with pale brown laminations (banded). Thinly laminated/laminated at 10 to 15°	SW/MW	MS			19.67 Joint, 30°, planar, rough, Fe st. 19.77 Probable drilling break. 19.87 Joint, 50, planar, rough, Fe st.		
20												

Remarks: BOX 3 ENDS AT 15.40m BOX 4 ENDS AT 19.58m — Job / Report No. GN25A

Logged by: JOHN YOUNG — Date: 25.1.08 — Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 2 — Sheet 5 of 7 Sheets

PROJECT: TILLEGRA DAM
LOCATION: RIGHT SPILLWAY CHANNEL
CO-ORDINATES: E / N
R.L. COLLAR / DATUM / BEARING: 090°M / INCLINATION: 60° from horizontal
DRILL: DELTA 1000, TRACK MOUNTED — CONTRACTOR: McDERMOTT DRILLING — COMMENCED: 24.1.08
CORE BARREL: HQ TRIPLE — DRILLER: SHAUN TAYLOR — COMPLETED: 29.1.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION — ROCK TYPE: Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION — TYPE: Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
20					META-SHALE continues as above	SW/FW	MS			20.00 } Several JOINTS, 30 to 45°, planar, rough, Fe/Mn st. 20.17 }		
		RUN 11 CONT.								20.33 JOINT, 45°, planar, very rough, Fe st.		
										20.47 PARTING, 10°, planar, rough, Fe st.		
										20.59 Probable DRILLING BREAK		
										20.73 JOINT, 50°, planar, rough, Fe st		
20.87										20.85 As above.		
20.90					20.90m TUFFACEOUS SANDSTONE, fine grained, grey/brown							
21						MW						
21.13					21.13m META-SHALE, dk grey/grey/brown, thinly laminated at 10 to 15°	SW/FW(S)				21.11 As above		
	HQ									21.24 } 4 no's PARTINGS, 10 to 15°, planar, rough, Fe/Mn st 21.40 }		
21.48					21.48m					21.47		
21.52					TUFFACEOUS SANDSTONE, medium grained, grey/grey/brown	FW				21.52 JOINT, 60°, planar, rough, Fe st sandy clay coating		
21.65						F(S)				21.65 PARTING, 10° planar, rough, Fe st.		
21.85					21.85m Includes META-SHALE lamination at 10°	SW/FW	S to MS			21.85 JOINT, 30°, planar, rough, Fe st.		
21.90												
22						F(S)						
22.04		RUN 12			22.04m META-SHALE, dk grey/grey-brown, thinly laminated at 10°	SW	MS			22.06 JOINT, 60°, planar, rough, Fe st.		
22.24					22.24m TUFFACEOUS SANDSTONE, fine grained, grey					22.18 } Several intersecting JOINTS, 30 to 75°, planar, rough, Fe/Mn st. 22.27 }		
										22.46 HANDLING BREAK		
22.72										22.67 DRILLING BREAK		
22.86					22.86m Includes META-SHALE lamination at 15°					22.86 PARTING, 15°, planar, rough, Fe st.		
23		RUN 13				F(S)	S/MS					
										23.40 DRILLING BREAK		
23.85					23.85m					23.85 DRILLING BREAK		
23.95					23.95m Includes META-SHALE lamination at 10°							
24					24.00m							
24.07					24.07m as shown at 10°	SW						
24.16					24.16m					24.16 PARTING, 10°, planar, rough, Fe st.		
		RUN 14			TUFFACEOUS SANDSTONE continues.	F(S)				24.35 BOXING BREAK		
24.52										24.56 } Numerous JOINTS, 30 to 60°, planar rough, Fe st. Clay coating at 24.81m		
					24.70m META-SHALE lamination at 10°	SW						
24.80					24.80m							
25					META-SHALE, dk grey laminated dk to dk to 15°		MS			24.92 } PARTING at 24.78m, 10°, planar, rough Fe st.		
					24.98m							

Remarks: BOX 5 ENDS AT 23.40m — Job / Report No. GN 25A

Logged by: JOHN YOUNG — Date: 1.2.08 — Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 2 Sheet 6 of 7 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT SPILLWAY CHANNEL
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING 090°m INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED 24.1.08
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED 29.1.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
25					TUFFACEOUS SANDSTONE, fine grained, grey.	$F_{(s)}$						
25.13										25.13 } Probable DRILLING BREAKS		
25.20					25.20m					25.20 }		
25.30					25.30m Includes META-SHALE laminations as shown at 10 to 15°	SW				25.30 BOXING BREAK		
25.43												
25.50					25.50m					25.67 JOINT, 60°, with associated PARTING, 1/2, planar, rough.		
25.80					25.80 Grades to medium grained, TUFFACEOUS SANDSTONE		S/VS					
26		RUN 14 CONTINUED										
26.25					26.25m	$F_{(s)}$				26.20 } Several JOINTS, 20 to 70°, planar, rough, Fest.		
26.47					META-SHALE, dark grey, laminated at 10° (poorly defined)		MS					
26.67					26.67m					26.67 }		
26.75					TUFFACEOUS SANDSTONE, medium grained, grey.		S/VS					
26.85										26.85 Several DRILLING BREAKS around 26.85m		
27.00	HQ				27.00m META-SHALE, dark grey, lam. at 10°		MS			27.00 } Several parallel JOINTS, 75°, planar, rough, minor carbonate coating.		
27.15					27.15m					27.15 }		
27.30		RUN 15			TUFFACEOUS SANDSTONE, fine grained, grey. (Includes elongate META-SHALE clasts to 27.45m, subrounded to 30mm dimension.					27.30 DRILLING BREAK		
27.45						F						
28										28.00 BOXING BREAK		
							S/VS			28.57 HANDLING BREAK	100%	
										28.72 JOINT, 50°, planar, rough, carbonate coated		
29										29.00 BOXING BREAK		
29.85		18								29.85 DRILLING BREAK		
30												

Remarks: BOX 6 ENDS AT 27.15m
Job / Report No. GN25A

Logged by: JOHN YOUNG Date: 1.2.08 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 2
Sheet 7 of 7 Sheets

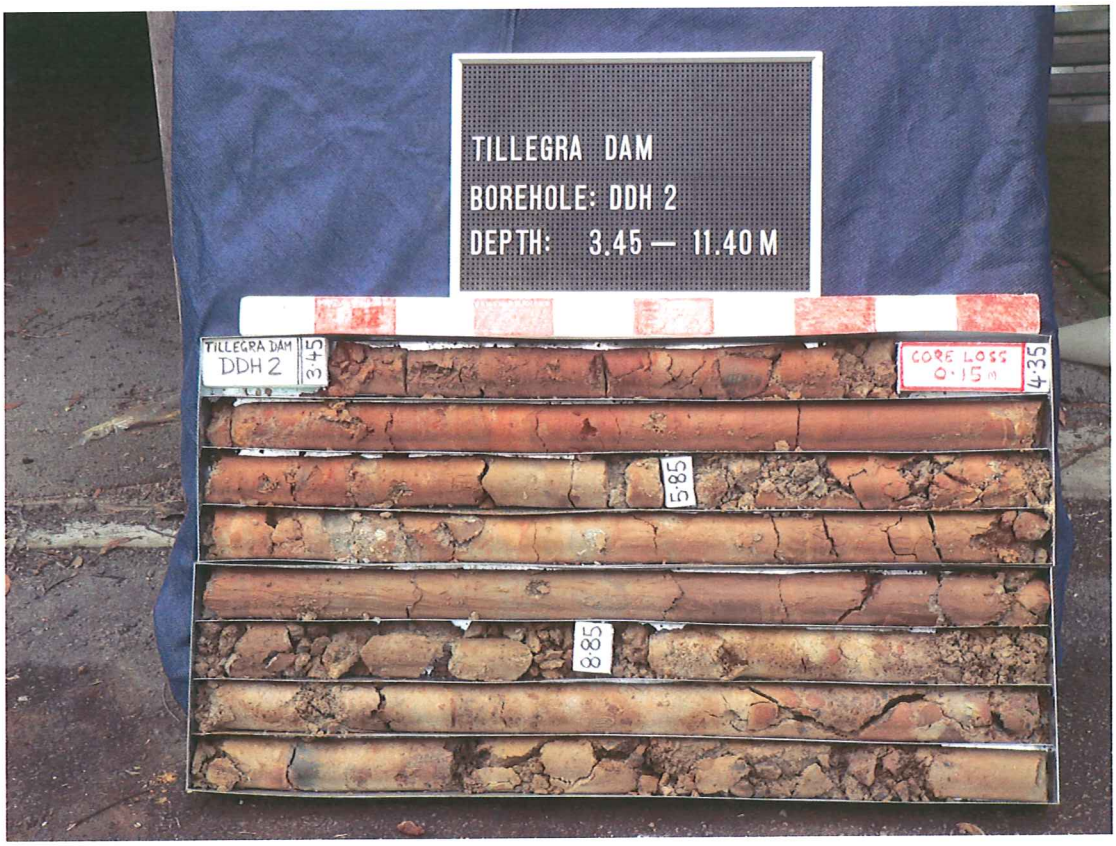
PROJECT TILLEGRA DAM
LOCATION RIGHT SPILLWAY CHANNEL
CO-ORDINATES E N
R.L. COLLAR
DATUM
BEARING 090°M
INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED
CONTRACTOR McDERMOTT DRILLING
COMMENCED 24.1.08
CORE BARRELL HQ TRIPLE
DRILLER SHAUN TAYLOR
COMPLETED 29.1.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
30					TUFFACEOUS SANDSTONE continues, fine grained, grey.					30.33 Possible Joint, 50°, planar, rough. 30.41 As above, 30°. 30.45 Joint, 65°, planar, rough, carbonate fill to 2mm.		
31	HQ	RUN 16 CONTINUED			31.25m Medium grained, poorly defined bedding at 10° Includes subangular lithic clasts to 3mm dimension	F	S/MS			31.03 BOXING BREAK 31.10 Probable DRILLING BREAK 31.92 DRILLING BREAK	100%	
31.85										31.85 DRILLING BREAK 31.93 BOXING BREAK		
33												
34		RUN 17								33.90 DRILLING BREAK 34.19 Joint, 30°, planar, rough, carbonate coated.	100%	
34.80					HOLE ENDS AT 34.80m					34.80 DRILLING BREAK		
35												

Remarks: BOX 7 ENDS AT 31.03m BOX 8 ENDS AT 34.80m = END OF HOLE
Job / Report No. GN 25A

Logged by: JOHN YOUNG
Date: 1.2.08
Site Supervisor MARK ASHOVER


TILLEGRA DAM
BOREHOLE: DDH 2
DEPTH: 3.45 — 11.40 M
TILLEGRA DAM
DDH 2
3.45
4.35
CORE LOSS
0.15 m
5.85
8.85

TILLEGRA DAM
BOREHOLE: DDH 2
DEPTH: 11.40 — 19.58 M
11.85
14.85
17.10
17.85
CORE LOSS
(0.28m)
19.08
CORE
LOSS
0.05
19.58

TILLEGRA DAM
BOREHOLE: DDH 2
DEPTH: 19.58 — 27.15 M
20.85
22.72
23.85
SPACER
26.85
SPACER
(27.05m)

TILLEGRA DAM
BOREHOLE: DDH 2
DEPTH: 27.15 — 34.80 M
29.85
SPACER
32.85
34.80
END
DDH 2

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 3 Sheet 1 of 9 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, INTERSECTION OF ℄ AND DIVERSION TUNNEL
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING INCLINATION 60° from horizontal
DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR
COMMENCED COMPLETED 23.1.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
0					NON CORE							
0.70					CORING COMMENCES AT 0.70m							
1	HQ	RUN 1			META-SHALE, brown/greybrown/dark grey, banded. Thinly laminated to laminated at 10° to 15°	SW/F(S)	MS/S			0.70 } JOINT, 80, with associated PARTINGS, 0.81 } 15°, planar, rough, Fe/Mn st. 1.00 } 3x's PARTINGS, 10° to 15°, planar, 1.11 } rough, Fe st. 1.20 } 1.25 } PARTING FRAGMENTS, 10°, planar, 1.32 } rough, Fe/Mn st. 1.50 PARTING, 10°, planar, rough, Fe st, clay coated.	50%	
1.70		RUN 2			TUFF, s/s, very fine grained, grey, with META-SHALE laminations at 10° to 15°					1.70 JOINT, 60°, planar, rough, Fe st 1.86 DRILLING BREAK	82%	
2.02		RUN 3								2.07 } several PARTINGS, 10°, planar, 2.17 } rough, Fe st.		
2.12					META-SHALE, greybrown/grey/dark grey, banded. Thinly laminated to laminated at 10°					2.32 Probable DRILLING BREAK	55%	
2.16												
2.45		RUN 4								2.45 } 2x's PARTINGS, 10°, planar, rough, 2.47 } Fe st.		
2.75										2.67 PARTING, 10°, planar, rough, Fe st	78%	
2.83					TUFFACEOUS SANDSTONE, very fine grained, grey.	F(S)	S/VS			2.82 DRILLING BREAK		
3		RUN 5								3.25 JOINT, 65°, planar, rough, Fe st 3.30 BOXING BREAK 3.51 HANDLING BREAK	100%	
4										4.10 HANDLING BREAK		
4.33		RUN 6								4.33 DRILLING BREAK		
4.85					4.85 Brown/greybrown	MW	S			4.85 PARTING, 10°, planar, rough, Fe st.		
5										4.93 } See over		

Remarks: BOX 1 ENDS AT 4.33m
Job / Report No. GN25A

Logged by: JOHN YOUNG
Date: 23.1.08
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 3

Sheet 2 of 9 Sheets

PROJECT TILLEGRA DAM

LOCATION RIGHT ABUTMENT, INTERSECTION OF ℄ AND DIVERSION TUNNEL

CO-ORDINATES E N

R.L. COLLAR DATUM BEARING INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED

CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED 22.1.08

DRILLING DATA

DEPTH (R.L.) METRES	Method	Casing, Run	Water
5	HQ	RUN 6 CONT.	
5.33			
5.92			
6			
7		RUN 7	
7.43			
8		RUN 8	
8.70			
8.82			
8.92			
9		RUN 9	
10			

ROCK SUBSTANCE

GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH
	TUFFACEOUS SANDSTONE continues, very fine grained, brown/greybrown.	MW	S
	5.92m		
	Grey.	$F_{(S)}$	S/VS
	8.70m	---	---
	Brown/greybrown, includes META-SHALE	MW	S
	8.92m laminations at 8.82m, 10°.	---	---
	TUFFACEOUS SANDSTONE continues, very fine grained, grey	$F_{(S)}$	S/VS

ROCK MASS DEFECTS

DEFECT SPACING (mm): 2000 600 200 60 20

VISUAL LOG

DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings
5.14 ↑ JOINT / PARTING FRAGMENTS, 45 to 60° and 10° respectively, planar, rough, fest
5.32 PARTING, 10°, planar, rough, Fe st.
5.38 As above.
5.48 JOINT, 45°, planar, rough, Fe st.
5.59 – 5.88 Numerous PARTINGS, 5 to 15°, planar, rough, Fe/Mn st.
6.00 PARTING, 10°, planar, rough, Fe/Mn st.
6.14 – 6.40 5 x's PARTINGS, 5 to 15°, planar, rough, Fe/Mn st.
6.81 JOINT, 50°, planar, rough, Fe st.
6.95 JOINT, 60°, planar, rough, Fe/Mn st.
7.14 DRILLING BREAK
7.20 JOINT, 45°, planar, rough, Fe st.
7.29 DRILLING BREAK
7.43 As above
7.85 – 8.00 2 x's JOINTS, 65°, planar, rough, Fe st.
8.15 HANDLING BREAK
8.25 BOXING BREAK
8.40 JOINT, 65°, planar, rough, Fe st.
8.67 JOINT, 50°, planar, rough, Fe/Mn st.
8.77 – 8.88 SEVERAL PARTINGS, 10°, with JOINT, 45°, planar, rough, Fe st.
9.05 DRILLING BREAK
9.25 BOXING BREAK
9.35 JOINT, 60°, planar, rough, minor Fe st.

R.Q.D.: 50% 69% 60%

TESTS

Remarks: BOX 2 ENDS AT 8.25m

Job / Report No. GN25A

Logged by: JOHN YOUNG Date: 22.1.08 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 3

Sheet 3 of 9 Sheets

PROJECT TILLEGRA DAM

LOCATION RIGHT ABUTMENT, INTERSECTION OF ℄ AND DIVERSION TUNNEL

CO-ORDINATES E N

R.L. COLLAR DATUM BEARING INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING

CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR

COMMENCED

COMPLETED 23.1.08

DRILLING DATA			ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run, Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
10				TUFFACEOUS SANDSTONE continues, very fine grained, grey.					10.05 Probable DRILLING BREAK 10.22 HANDLING BREAK 10.28 BOXING BREAK 10.37 HANDLING BREAK 10.45 Possible JOINT, 60°, planar, rough, carbonate coated 10.61 As above 10.70 } 2x's PARTING, 15°, planar, rough, 10.73 } minor Fe st.		
11	HQ	RUN 1 CONTINUED		Includes occasional carbonate veins, generally less than 1mm	F (S)	S/HS			11.13 Possible JOINT, 60°, planar, rough, carbonate coated 11.28 DRILLING BREAK 11.45 DRILLING BREAK	100%	
11.83									11.83 DRILLING BREAK		
12									12.11 HANDLING BREAK 12.22 Probable JOINT, 50°, planar, rough, minor Fe st., carbonate coated		
									12.64 JOINT, 60°, planar, rough, minor Fe st., carbonate coated 12.78 Possible JOINT, 60°, planar, rough, carbonate coated 12.88 Possible JOINT, 45°, as above		
13									13.10 Probable DRILLING BREAK 13.23 JOINT, 45°, curved, rough, Fe st	76%	
13.48 13.51				13.48m METABASIC laminations at 5 and 10° 13.51m					13.45 PARTING, 5°, planar, rough, Fe st 13.52 As above, minor Fe st		
13.70		RUN 10		Tuff. S/s continues, medium grained 13.70m					13.70 Possible PARTING, 15°, planar, rough, carbonate coated (may be drilling induced) 13.87 Possible JOINT, 40°, planar, rough, carbonate coated		
14				Very fine grained, grey					14.13 } 2x's parallel JOINTS, 75°, planar, 14.37 } rough, minor Fe st.		
14.44		RUN 11								100%	
14.73		RUNS 12							14.70 DRILLING BREAK 14.94 } See over		
15											

Remarks: BOX 3 ENDS AT 12.22m

Job / Report No. GN 25A

Logged by: JOHN YOUNG

Date: 23.1.08

Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 3 Sheet 4 of 7 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, INTERSECTION OF ℄ AND DIVERSION TUNNEL
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED 23.1.08

DRILLING DATA			ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run, Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
15		RUN 12 CONTINUED		TUFFACEOUS SANDSTONE continues, very fine grained, grey.					Several parallel JOINTS, 75, planar, rough, heavy Fe/Mn st.		
									15.28		
16.47				16.47m Medium grained					15.47 JOINT, 45°, planar, rough, Fe st 15.52 PARTING, 5°, planar, v. rough, Fe st		
									15.60 } Probable DRILLING BREAKS 15.70 }		
15.72				15.72m	F(s)	S/VS			15.81 JOINT, 65°, planar, rough, Fe/Mn st.		
									15.96 BOXING BREAK		
16				Very fine grained.							
									16.40 JOINT, 65°, planar, rough, Fe st.	70%	
									16.56 DRILLING BREAK		
16.70				16.70m		MS/S			16.70 } Numerous PARTINGS, 10°, planar, Fe st. 16.91 }		
16.88	HQ			META-SHALE, grey/dark grey, banded, thinly laminated at 10° 16.88m							
17				TUFFACEOUS SANDSTONE, very fine grained to fine-medium grained with depth, grey.		S/VS			17.42 JOINT, 60°, planar, rough, Fe st.		
17.60				17.60m					17.63 PARTING, 10°, planar, rough, minor Fe st.		
17.73				META-SHALE, dark grey, with TUFF. S/S. laminations at 10°, fine grained, grey.		MS/S			17.73 As above		
18									17.93 } 2 x PARTINGS, 5°, planar, rough, minor Fe st. 17.94 }		
18.03		RUN 13		18.03m TUFF. S/S., v. fine/fine grained, grey.		S/VS				98%	
18.20				18.20m META-SHALE, grey/dk grey, banded. Thinly laminated at 5 to 10°		MS/S			18.21 Probable DRILLING BREAK		
									18.41 HANDLING BREAK		
18.50				18.51m		S/VS			18.50 PARTING, 5°, planar, rough, Fe st.		
18.51				TUFF. S/S., v. fine/fine gr.							
18.69				18.69m META-SHALE, dk grey, thinly laminated at 5°		MS/S			18.73 As above		
18.78				18.78m TUFF. S/S., fine gr., grey.		S/VS					
18.95				18.95m META-SHALE, grey/dk grey, banded at 10°		MS/S			18.98 PARTING, 10°, as above		
19											
19.05		RUN 14		19.05m TUFF. S/S., fine gr., grey.		S/VS					
19.17				19.17m META-SHALE, grey/dk grey, banded thinly laminated at 5 to 10°		MS/S			19.26 As above.		
19.29				19.31m TUFFACEOUS SANDSTONE, fine grained, grey.		S/VS			19.37 Intersecting JOINT, 20° and PARTING, 5°, planar, rough, Fe st		
									19.78 BOXING BREAK		
20									19.94 PARTING, 10°, irregular, rough, Fe st		

Remarks: BOX 4 ENDS AT 15.96m BOX 5 ENDS AT 19.78m Job / Report No. GN25A

Logged by: JOHN YOUNG Date: 23.1.08 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 3 Sheet 5 of 9 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, INTERSECTION OF ℄ AND DIVERSION TUNNEL
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING INCLINATION 60° from horizontal
DRILL DELTA 1000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED 23.1.08

DRILLING DATA			ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
20		RUN 14 CORE LOST.		TUFFACEOUS SANDSTONE continues, very fine/ fine grained, grey.					20.43 PARTING, 15°, planar, rough, Fe st.	100%	
20.80					F (S)	S/S			20.73 DRILLING BREAK		
21									21.14 Probable DRILLING BREAK		
21.30		RUN 15		21.30m					21.30		
				Grey/ greybrown	SW				Numerous JOINTS/ JOINT FRAGMENTS, 60 to 70°, planar, rough, Fe st. (sheared)		
22										25%	
22.19	HQ			22.35m					22.68		
22.35				Brown	MW	MS			22.70 DRILLING BREAK		
22.55				22.55m					22.86 JOINT, 60°, planar, rough, Fe st		
		RUN 16		Grey. (very fine/ fine grained).	F (S)	S/S			23.03 As above	100%	
23									23.27 DRILLING BREAK		
23.37		RUN 17								100%	
23.80		RUN 18							23.71 BOXING BREAK 23.80 DRILLING BREAK	100%	
24.00									24.00 DRILLING BREAK		
		RUN 19							24.14 JOINT, 60°, planar, rough, Fe st		
									24.56 JOINT, 65°, planar, rough, Fe st. 24.65 JOINT, 45°, planar, rough, Fe st	100%	
25											

Remarks: BOX 6 ENDS AT 23.71m
Job / Report No. GN 25A

Logged by: JOHN YOUNG Date: 23.1.08 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 3 Sheet 6 of 9 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, INTERSECTION OF ℄ AND DIVERSION TUNNEL
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED 23.1.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
25 25.10	HQ	RUN 10			TUFFACEOUS SANDSTONE continues, very fine/fine grained, grey.	F(S)	S/VS			25.03 } DRILLING BREAKS 25.10 } 25.35 JOINT, 65°, planar, rough, Fe st 25.52 As above		
26										26.00 2x's JOINT, 70°, planar, rough, Fe st 26.46	70%	
26.80 26.90 27		RUN 11			26.90m Grades to medium grained from 26.90m. Includes sub angular, equidimensional lithic clasts to 3mm.					26.80 DRILLING BREAK 27.24 BOXING BREAK 27.71 DRILLING BREAK		
28										28.22 PARTING, 15°, planar, rough, Fe st.	70%	
29 29.06					29.06m META-SHALE, dk grey, thinly laminated / laminated at 10°		S/VS			28.72 JOINT, 55°, planar, rough, Fe st. 28.77 DRILLING BREAK		
29.33 29.47 29.52		R 22			29.33m TUFF, S/S., medium grained, grey. 29.49 META-SHALE, dark grey. Thinly laminated / laminated at 10°. Includes occasional Tuff. S/S laminations, very fine gr.		S/VS VS/F			29.14 Possible JOINT, 65°, planar, rough, (may be drilling induced) 29.21 } JOINT / PARTING FRAGMENTS (gravel ready/dry), planar, rough, Fe st (partly handling induced). 29.33 } 29.44 } Numerous PARTINGS, 10° with associated JOINT, 80°, planar, rough, Fe st. 29.78 29.85 } 2x's PARTINGS, 10°, planar, rough, Fe st. 29.90 }	0%	
29.83 30	NQ	R 23					F/MS				90%	

Remarks: BOX 7 ENDS AT 27.24m
Job / Report No. GN256

Logged by: JOHN YOUNG Date: 24.1.08 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 3 Sheet 1 of 4 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, INTERSECTION OF ℄ AND DIVERSION TUNNEL
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED 23.1.08

DRILLING DATA

DEPTH (R.L.) METRES	Method	Casing, Run	Water
30			
30.66		RUN 24 CASE	
		RUN 25	
31.00	HQ		
31.22			
32			
32.83			
33			
33.15		RUN 26	
33.42			
34			
34.60			
35			

ROCK SUBSTANCE

GRAPHIC LOG	DESCRIPTION — ROCK TYPE: Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH
	META-SHALE continues as above. Includes very fine grained TUFF. s/s laminations (at 5 to 10°).		MS/S
	31.00m TUFF. s/s., very fine grained, grey.		S/S
	31.22m META-SHALE, dark grey, with very fine grained TUFFACEOUS SANDSTONE laminations, grey, banded. Thinly laminated/ laminated at 5 to 15°	F(4)	MS/S
	33.15m TUFFACEOUS SANDSTONE, very fine grained, grey.		S/S
	33.42m META-SHALE, dk grey, with very fine grained TUFF. SANDSTONE laminations/ interbeds, grey. Thinly laminated to very thinly bedded at 5 to 15°		MS/S
	34.60m TUFFACEOUS SANDSTONE, fine-medium to medium grained, grey.		S/S

ROCK MASS DEFECTS

DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION — TYPE: Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
		30.05 Numerous PARTINGS, 5 to 10, with associated JOINTS, 45° to 60°, planar rough, Fe st. Clay filled 10mm thick in parting at 30.26m	18%	
		30.62		
		30.75 PARTING, 10°, planar, rough, minor Fe st.		
		31.00 As above		
		31.22 As above		
		31.41 Numerous PARTINGS, 10 to 15°, planar, rough, Fe st.		
		31.50		
		31.61		
		31.70 Includes crushed zone from 31.72 to 31.76m		
		31.76		
		31.82	65%	
		32.02 Numerous PARTINGS, 10°, planar, rough, minor Fe st. Crushed zone 10mm thick at 32.07m.		
		32.07		
		32.14		
		32.20		
		32.25 JOINT, 60°, planar, rough.		
		32.34 Probable DRILLING BREAKS		
		32.48		
		32.72 PARTING, 5°, planar, rough, Fe st.		
		32.83 DRILLING BREAK		
		33.03 Possible PARTING, 5°, planar, rough, minor Fe st.		
		33.13 Probable DRILLING BREAK		
		33.42 JOINT, 30°, with numerous associated PARTINGS, planar, rough, Fe st. Joint carbonate coated.		
		33.95		
		34.32 Probable DRILLING BREAK	60%	
		34.43 PARTING, 15°, planar, rough, Fe st.		
		34.47 PARTING, 5°, as above		
		34.62		
		34.67 3x's PARTINGS, 15°, planar, rough, Fe st.		
		34.72		
		34.98 JOINT, 65°, planar, rough, Fe st.		

Remarks: BOX 8 ENDS AT 31.00m
Job / Report No. GN 25A

Logged by: JOHN YOULSEY Date: 24.1.08 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 3

Sheet 8 of 9 Sheets

PROJECT TILLEGRA DAM

LOCATION RIGHT ABUTMENT, INTERSECTION OF ℄ WITH DIVERSION TUNNEL

CO-ORDINATES E N

R.L. COLLAR DATUM BEARING INCLINATION 60° from horizontal

DRILL DELTA 2000, TRUCK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED

CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED 23.1.08

DRILLING DATA

DEPTH (R.L.) METRES

Method: HQ

Casing, Run: RUN 27, RUN 28, RUN 29, RUN 30

Water

ROCK SUBSTANCE

GRAPHIC LOG

DESCRIPTION
ROCK TYPE
Grainsize, texture, colour, composition, structure, hardness

WEATHERING

ESTIMATED STRENGTH

ROCK MASS DEFECTS

DEFECT SPACING (mm) 2000 600 200 60 20

VISUAL LOG

DEFECT DESCRIPTION
TYPE
Inclination, planarity, roughness, coatings or infillings

R.Q.D.

TESTS

35

35.16

TUFFACEOUS SANDSTONE, continues, fine - medium to medium grained, grey.

35.05 JOINT, 65°, planar, rough, Fe st.
35.12 DRILLING BREAK
35.22 PARTING, 5°, planar, rough, Fe st.
35.43 JOINT, irregular, rough, Fe st., 45°
35.68 PARTING, 5°, planar, rough, Fe st
35.83 DRILLING BREAK

100%

35.83

36

36.02

36.02m

METB - SHALE, dark grey, thinly laminated at 5°

36.02 JOINT, 80°, with numerous associated PARTINGS, 5°, planar, rough, Fe st.

36.42

36.42m

36.85 JOINT, 60°, planar, rough, Fe st.

37

TUFFACEOUS SANDSTONE, fine - medium to medium grained, grey.

37.31 Probable DRILLING BREAK

37.70 DRILLING BREAK
37.84 HANDLING BREAK

77%

38

Includes occasional carbonate veins, generally less than 1mm

38.42 DRILLING BREAK

38.74 DRILLING BREAK
38.81 DRILLING BREAK

100%

38.83

39

39.03

39.03m

Very fine grained

39.05 Several JOINTS, 60°, with associated PARTINGS, 5 to 10°, planar, rough, often carbonate coated.

39.39

39.52 Possible PARTING, 5°, planar, rough, carbonate coated.

39.67 JOINT/PARTING FRAGMENTS, 60 to 70° and 10° respectively, planar, rough, often carbonate coated.

39.95

40

Remarks: BOX 9 ENDS AT 35.05m BOX 10 ENDS AT 38.74m

Job / Report No. GN 25A

Logged by: JOHN YOUNG

Date: 24.1.08

Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 3
Sheet 9 of 9 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, INTERSECTION OF ℄ AND DIVERSION TUNNEL
CO-ORDINATES E N
R.L. COLLAR
DATUM
BEARING
INCLINATION 60° from horizontal

DRILL DELTA 1000, TRACK MOUNTED
CONTRACTOR McDERMOTT DRILLING
COMMENCED
CORE BARRELL HQ TRIPLE
DRILLER SHAUN TAYLOR
COMPLETED 23.1.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
40	HQ	RUN 30 CONTINUES			TUFFACEOUS SANDSTONE continues, very fine grained, grey.							
40.68					40.68m Medium-coarse grained	F	S/WS			40.03 Possible PARTING, 5°, planar, rough 40.35 Probable DRILLING BREAK 40.68 Possible PARTING, 10°, planar, rough, carbonate fill to 2mm		
41										41.01 DRILLING BREAK	100%	
41.21					41.21m META-SHALE laminations at 10° Medium-coarse grained TUFF. S/S. continues					41.21 Possible PARTING, 10°, planar, rough 41.37 DRILLING BREAK 41.51 As above 41.61 As above 41.69 DRILLING/HANDLING BREAK		
41.85					END OF HOLE					41.85 DRILLING BREAK		
42												
43												
44												
45												

Remarks: BOX 11 ENDS AT 41.85m ∧ END OF HOLE
Job / Report No. GN 25A

Logged by: JOHN YOUNGS
Date: 24.1.08
Site Supervisor MARK ASHOVER

TILLEGRA DAM
BOREHOLE: DDH 3
DEPTH: 0.70 — 4.33 M
TILLEGRA DAM
DDH 3
0·70
1·70
2·12
2·45
2·83
4·33

TILLEGRA DAM
BOREHOLE: DDH 3
DEPTH: 4.33 — 12.22 M
5·83
7·43
8·83
11·83

TILLEGRA DAM
BOREHOLE: DDH 3
DEPTH: 12.22 — 19.78 M
SPACER
SPACER
14.44
14.73
17.73
18.50
SPACER
(1985)

TILLEGRA DAM
BOREHOLE: DDH 3
DEPTH: 19.78— 27.24 M
20.80
22.75
23.37
23.80
24.00
25.10
SPACER
26.80

TILLEGRA DAM
BOREHOLE: DDH 3
DEPTH: 27.24 — 35.05 M
29.33
29.52
29.83
30.66
32.83

TILLEGRA DAM
BOREHOLE: DDH 3
DEPTH: 35.05 — 41.85 M
35.16
35.83
SPACER
38.42
38.83
SPACER
41.85
END DDH 3

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 1 Sheet 1 of 9 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, U/S DIVERSION PORTAL
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING 025° M INCLINATION 60° from horizontal
DRILL DELTA 20m, TRUCK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED 8.1.02
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run, Water	GRAPHIC LOG	DESCRIPTION — ROCK TYPE: Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION — TYPE: Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
0				NON CORE							
0.90				CORING COMMENCES AT 0.90m							
1	HQ	RUN 1		TUFFACEOUS SANDSTONE, fine grained, grey/brown. Includes angular lithic clasts to 2mm dimension, lighter coloured, creating a speckled appearance.	MW/SW	MS			0.90 — JOINT/PARTING FRAGMENTS. PARTINGS, 10 to 15°, planar, rough, Fe/Mn st. Rare sandy clay coatings. JOINTS, 20 to 80°, planar, rough, Fe/Mn st. Occasional sandy clay coatings.	0%	
1.75											
2											
2.10				2.10m Grey/brown/brown.	MW						
2.31				CORE LOSS 0.20 = non core, casing recated.					2.31		
2.51		RUN 3							2.51 — Numerous JOINTS, 45 to 65°, planar, rough, Fe/Mn st.	0%	
2.70				TUFFACEOUS SANDSTONE continues as above.	MW/SW	MS					
3											
3.06		RUN 4							3.06 3.12 JOINT, 20°, planar, rough, Fe/Mn st.	40%	
3.35				3.35m Includes META-SHALE laminations at 10 to 15°	SW	S			3.40 JOINT, 40°, planar, rough, Fe/Mn st. 3.50 3.60 JOINTS, 80°, with associated PARTINGS, 15°, planar, rough, Fe/Mn st, clay 3.62 BOXING BREAK coated, rootlets.		
3.40											
3.45				3.45m							
3.72		RUN 5		3.72 META-SHALE lamination at 15°					3.72 PARTING, 15°, planar, rough, Fe st.	45%	
3.88				3.88 META-SHALE laminations at 10 to 15°							
3.96				3.96							
4.05				4.05 META-SHALE lamination at 10°					4.04 JOINT, 60°, planar, rough, Fe st. 4.12 PARTING, 15°, planar, rough, Fe st		
4.20		RUN 6		TUFFACEOUS SANDSTONE continues.	MW	MS			4.20 — JOINT/PARTING FRAGMENTS, 45 to 60° and 15° respectively, planar, rough, Fe/Mn st	0%	
4.85									4.85		
5.00				CORE LOSS 0.15m							

Remarks: BOX ENDS AT 4.60m
Job / Report No. GN 25A
Logged by: JOHN YOUNG
Date: 10.1.02
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 4 — Sheet 2 of 9 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, U/S DIVERSION PORTAL
CO-ORDINATES E N
R.L. COLLAR
DATUM
BEARING 085°M
INCLINATION 60° from horizontal

DRILL DELTA 7000, TRACK MOUNTED
CONTRACTOR McDERMOTT DRILLING
COMMENCED 8.1.08
CORE BARRELL HQ TRIPLE
DRILLER SHAUN TAYLOR
COMPLETED

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS			
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION — ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION — TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D. / TESTS
5						MW					
5.25					TUFFACEOUS SANDSTONE continues, fine grained with angular clasts rarely to 3mm dimension, greybrown. (speckled appearance)	MW/SW	MS				
6.00					6.00m — Grey.					5.00 Numerous JOINTS, 30 to 60°, with associated PARTINGS, 10 to 15°, planar, rough, Fe/Mn st. 5.39; 5.50 PARTING, 10°, planar, rough, Fe/Mn st.; 5.63 As above 6.00; 6.14 PARTING, 10°, planar, rough, Fe st.; 6.40 As above; 6.62 BOXING BREAK; 6.63 JOINT, 20°, planar, rough, Fe st; 6.75 2x's PARTINGS, 10°, planar, rough, Fe st 6.77	45%
7	HQ	RUN 7				F(s)	S/HS				
7.20										7.02 Several JOINTS, 70°, planar, rough Fe st. 7.20; 7.29 2x's JOINTS, 70°, planar, rough, Fe st. 7.55; 7.32 JOINT, 70°, planar, rough, Fe st	
8.00		RUN 8			8.00m METH-SHALE laminations at 15°					8.00 PARTING, 10°, planar, rough, Fe/Mn st.	
					TUFFACEOUS SANDSTONE continues as above.					8.22 As above; 8.42 As above 8.54; 8.75 JOINT, 50°, planar, rough, Fe st.	76%
9										8.98 3x's PARTINGS, 10 to 15°, planar, rough, Fe st. 9.16 9.35; 9.44 JOINT, 60°, planar, rough, Fe st.	
9.51		RUN 10	R9							9.62 As above	100%
9.67										9.67 Numerous PARTINGS, 45° with associated JOINTS, 45° to 60°, planar, rough, Fe/Mn st.	
10											

Remarks: BOX 2 ENDS AT 8.54m — Job / Report No. GN 25A

Logged by: JOHN YOUNGS — Date: 10.1.08 — Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 4 Sheet 3 of 9 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, U/S DIVERSION PORTAL
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING 085°M INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED 8.1.08
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED 11.1.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
10		RIO			TUFFACEOUS SANDSTONE continues, fine grained, grey, angular lithic clasts persist generally to 2mm dimension (speckled).		S/VS			10.02 As above.		
10.20										10.20 DRILLING BREAK 10.30 BOXING BREAK 10.42 JOINT, 55°, planar, rough, Fe/Mn st.		
10.81		RUN 11			10.81m META-SHALE, dk grey, laminated at 10°		MET			10.86 Probable DRILLING BREAK		
10.86												
11										11.09 PARTING, 10°, planar, rough, Fe/Mn st.		
		HQ				F(S)				11.28 JOINT, 50°, planar, rough, Fe/Mn st.		
					TUFFACEOUS SANDSTONE continues							
										11.80 JOINT, 45°, planar, rough, Fe st.	75%	
12							S/VS			11.44 Numerous JOINTS, 45°, planar, rough, Fe/Mn st. 12.27		
										12.75		
13.10					13.00 META-SHALE lamination 13.02 at 10°					JOINT, 80 to 90°, with associated PARTINGS, 15°, and other intersecting JOINTS, 45 to 60°, planar, rough, Fe/Mn st.		
13.02												
13.20										13.74		
		RUN 12								13.94 JOINT, 60°, planar, rough, Fe/Mn st.		
14					TUFFACEOUS SANDSTONE continues					14.13 JOINT, 70°, planar, rough, Fe/Mn st. 14.42	72%	
										14.56 PARTING, 5°, planar, rough, Fe st.		
15												

Remarks: BOX 3 ENDS AT 12.27 Job / Report No. GM 25A

Logged by: JOHN YOUNGS Date: 11.1.08 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 4 Sheet 4 of 9 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, U/S DIVERSION PORTAL
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING 085°M INCLINATION 60° from horizontal
DRILL DELTA, 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED 8.1.08
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED 11.1.08

DRILLING DATA			ROCK SUBSTANCE			ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
15				TUFFACEOUS SANDSTONE continues, fine grained, grey, includes angular lithic clasts generally in the size range to 2mm (lightly coloured, flecked)					15.25 DRILLING BREAK.		
	HQ	RUN 15 CONT.							15.80 JOINT, 70°, planar, rough, Fe/Mn st, partly carbonate coated. Intersecting PARTING at 16.01m,		
16					F(s)	S/VS			16.08 10°, planar, rough, Fe st		
16.20									16.18 DRILLING BREAK		
									16.71 JOINT, 75°, planar, rough, Fe/Mn st. Intersecting Joint, 60°, at 16.81m, as above.		
17		RUN 16							17.15 17.18 PARTING, 10°, planar, rough, Fe st		
									17.45 JOINT, 65°, planar, rough, Fe/Mn st		
									17.60 DRILLING BREAK		
18									18.18 BOXING BREAK	78%	
18.86				18.86m META-SHALE, dk grey, thinly laminated at 15°							
18.94				18.94m							
19				TUFFACEOUS SANDSTONE continues.					19.05 3x's possible PARTINGS, 15°, planar, rough, minor Fe st (may be drilling induced)		
19.20									19.10 19.13		
19.35		RUN 17		19.35m Angular lithic clasts range to 4mm dimension. (persists to approx. 20m)					19.40 Intersecting JOINTS, 45 and 60°, planar, rough, Fe st (minor)		10%
									19.54 Probable DRILLING BREAK		
									19.77 JOINT FRAGMENTS, 45 to 60°, planar, rough. Fe/Mn st.		
20											

Remarks: BOX 4 ENDS AT 16.18m
Job / Report No. GN25A

Logged by: JOHN YOUNG Date: 11.8.07 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 4 Sheet 5 of 9 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, U/S DIVERSION PORTAL
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING 085° M INCLINATION 60° from horizontal
DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED 8.1.08
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED 11.1.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
20										20.05 BOXING BREAK		
					TUFFACEOUS SANDSTONE continues, fine grained, grey. Lightly coloured, angular lithic clasts generally to 1mm dimension, rarely 2mm					20.12 Probable DRILLING BREAK		
										20.34 DRILLING BREAK		
										20.64 } 3x|s PARTINGS, 15 to 20°, planar, rough, Fe st.		
										20.71		
										20.85		
21										20.98 } Several HANDLING BREAKS plus BOXING BREAK at 21.06m		
	HQ	RUN 14								21.06	35%	
										21.58 Possible JOINT, 50°, planar, rough, minor Fe st, carbonate full 1.5mm thick (may be drilling induced)		
22						(5)	S/S			22.07 DRILLING BREAK		
22.20												
22.43					— 22.43m META-SHALE lamination at 15°							
		RUN 15										
23					TUFFACEOUS SANDSTONE continues.					23.05 BOXING BREAK		
											100%	
24										24.06 BOXING BREAK		
										24.24 Probable DRILLING BREAK		
										24.50 Intersecting PARTING, 15, and JOINT, 45°, planar, rough, Fe st.		
25										24.88 PARTING, 10°, planar, rough, Fe st.		

Remarks: BOX 5 ENDS AT 20.05m BOX 6 ENDS AT 24.06m Job / Report No. GN25A

Logged by: JOHN YOUNG Date: 11/12.1.08 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 4 Sheet 6 of 9 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, u/s DIVERSION PORTAL
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING 085°M INCLINATION 60° from horizontal
DRILL DELTA 2000, TRUCK MOUNTED CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR
COMMENCED 8.1.08 COMPLETED 11.1.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
25												
25.20	HQ	RUN 16	15/15		TUFFACEOUS SANDSTONE continues as above.					25.09 BOXING BREAK 25.20 DRILLING BREAK 25.43 HANDLING BREAK		
26.00					26.00m Lithic clasts less <1mm, less obvious.					26.00 BOXING BREAK 26.12 DRILLING BREAK 26.38 JOINT, 60°, planar, rough, Fe st.	100%	
27						$F_{(s)}$	S/VS			26.95 BOXING BREAK		
27.82					27.82m META-SHALE laminations at 10°					27.79 } HANDLING BREAKS 27.82 }		
28					TUFFACEOUS SANDSTONE continues, very fine/fine grained, grey.					27.98 BOXING BREAK 28.14 DRILLING BREAK		
28.20		RUN 17								28.37 Probable DRILLING BREAK		
28.76					28.76m TUFFACEOUS s/s, very fine gr., with META-SHALE laminations, dk grey, at 10°					28.25 As above (carbonate coated) 28.30 Possible PARTING, 10°, planar, rough. 28.38 BOXING BREAK Fe st. 28.57 DRILLING BREAK	65%	
29												
29.04					29.04m TUFF. s/s., very fine/fine grained, grey.							
29.30					29.30 META-SHALE lamination TUFF. s/s as above					29.30 29.34 } 2x's possible PARTINGS, 10 and 15°, planar, rough (maybe drilling induced).		
29.47					29.47m META-SHALE, grey, laminated at 10°.		MS/S			29.47 29.65 } Numerous PARTINGS, 5 to 10°, with intersecting JOINT, 45°, planar, rough, Fe st.		
29.65					29.65m TUFF. s/s., fine grained, grey.		S/VS			29.75 PARTING, 10°, planar, rough, Fe st.		
29.82					29.82m META-SHALE, grey/dk grey, laminated at 10 & 17°					29.80 29.82 } HANDLING/BOXING BREAKS		
30										29.93 ↓ See over		

Remarks: BOX 1 ENDS AT 27.98m
Job / Report No. GN 25A

Logged by: JOHN YOUNG Date: 12.1.08 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 4

Sheet 7 of 9 Sheets

PROJECT TILLEGRA DAM

LOCATION RIGHT ABUTMENT, U/S DIVERSION PORTAL

CO-ORDINATES E N

R.L. COLLAR DATUM BEARING 085°M INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED 8.1.08

CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED 11.1.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
30				META-SHALE continues,		MS/S			Numerous PARTINGS, 15°, with several associated JOINTS, 30 to 60°, planar, rough, Fe/Mn st. Includes carbonate vein 12mm thick at 30.24m		
30.20		RUN 17 cont.		30.20m TUFFACEOUS SANDSTONE, fine-grained, grey. Occasional carbonate veining, generally 4 1mm					30.45		
30.91									30.66 2x's JOINTS, 60°, with associated PARTINGS, 10°, planar, rough, Fe st. 30.86		
31.01		RUN 18		31.01m Very fine grained.		S/VS			31.10 PARTING, 15°, planar, rough, Fe st.	62%	
31.18				31.18m	F(S)				31.18 DRILLING BREAK		
31.20		RUN 19		Fine grained.					31.34 PARTING, 15°, planar, rough, Fe st.		
									31.60 JOINT, 55°, planar, rough, Fe st.		
31.85	HQ			31.85m META-SHALE, dk grey, laminated at 15 to 20°		MS/S			31.85 Probable DRILLING BREAK		
31.96				31.96m					31.91 PARTING, 20°, stepped, rough, Fe st.	76%	
32											
32.16				32.16m					32.14 JOINT, 45°, planar, rough, Fe st.		
									32.25 Several JOINTS, 45 to 50°, with associated PARTINGS, 10°, planar, rough, Fe st. 32.42		
32.50				Interbedded META-SHALE, dk grey, and TUFFACEOUS SANDSTONE, grey. Thinly laminated to very thinly bedded at 10 to 15°.					32.50 PARTINGS, 10°, planar, rough, Fe st. 32.56		
									32.60 DRILLING BREAKS 32.78 32.88		
						S			32.97 Probable DRILLING BREAK		
33									33.12 DRILLING BREAK		
		RUN 20							33.22 Numerous probable PARTINGS, 15°, planar, rough. 33.45	60%	
									33.52 DRILLING BREAKS 33.60		
33.60				33.60m					33.68 Probable DRILLING BREAK		
				TUFFACEOUS SANDSTONE, fine-medium grained, grey.	F						
34.00				34.00m META-SHALE lamination at 10°					34.00 As above		
34.20						S/VS			34.20 DRILLING BREAK		
									34.33 BOXING BREAK		
		RUN 21									12%
34.59				34.59m MET-SHALE lamination at 15°					34.59 HANDLING BREAK		
34.78				34.78m META-SHALE, dk grey, with Tuff, s/s interbeds, laminated to very thinly bedded at 10°, banded.		S			34.75 As above 34.82 Numerous probable PARTINGS, 10°, planar, rough. 34.98		
35											

Remarks: BOX & ENDS AT 31.60m

Job / Report No. GN25A

Logged by: JOHN YOUNG Date: 12.1.08 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 4

Sheet 8 of 9 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, U/S DIVERSION PORTAL
CO-ORDINATES E N
R.L. COLLAR
DATUM
BEARING 085° M
INCLINATION 60° from horizontal

DRILL DELTA 4000, TRACK MOUNTED
CONTRACTOR McDERMOTT DRILLING
COMMENCED 9.1.08
CORE BARRELL HQ TRIPLE
DRILLER SHAUN TAYLOR
COMPLETED 11.1.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
35					Continues as above.							
35.28					35.38m					35.17 DRILLING BREAK 35.25 HANDLING BREAK 35.30 BOXING BREAK 35.41 35.52 } HANDLING BREAKS 35.87		
36					TUFFACEOUS SANDSTONE, medium grained, grey, mottled appearance.					36.08 Probable DRILLING BREAK 36.22 BOXING BREAK 36.31 36.39 } HANDLING BREAKS 36.44 Probable DRILLING BREAK	95%	
		RUN 21				F	S/VS			36.78 DRILLING BREAK		
37												
37.20	HQ									37.20 DRILLING BREAK		
38		RUN 22								38.19 BOXING BREAK	100%	
38.89 38.94 39					38.89m Includes META-SHALE 38.94m laminations at 10°							
39.40					39.40m Very fine grained					39.20 BOXING BREAK 39.47 Possible PARTING, 10°, planar, rough.		
39.65					39.65m Fine-medium grained							
40												

Remarks: BOX 9 ENDS AT 35.30m BOX 10 ENDS AT 39.20m Job / Report No. GN 25A

Logged by: JOHN YOUNG Date: 12.1.08 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 4

Sheet 9 of 9 Sheets

PROJECT TILLEGRA DAM
LOCATION RIGHT ABUTMENT, U/S DIVERSION PORTAL
CO-ORDINATES E N
R.L. COLLAR
DATUM
BEARING 085°M
INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED
CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE
DRILLER SHAUN TAYLOR
COMMENCED 8.1.08
COMPLETED 11.1.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
40		R22			TUFFACEOUS SANDSTONE continues as above	F	S/W					
40.20										40.20 DRILLING BREAK		
					HOLE ENDS AT 40.20m							
41												
42												
43												
44												
45												

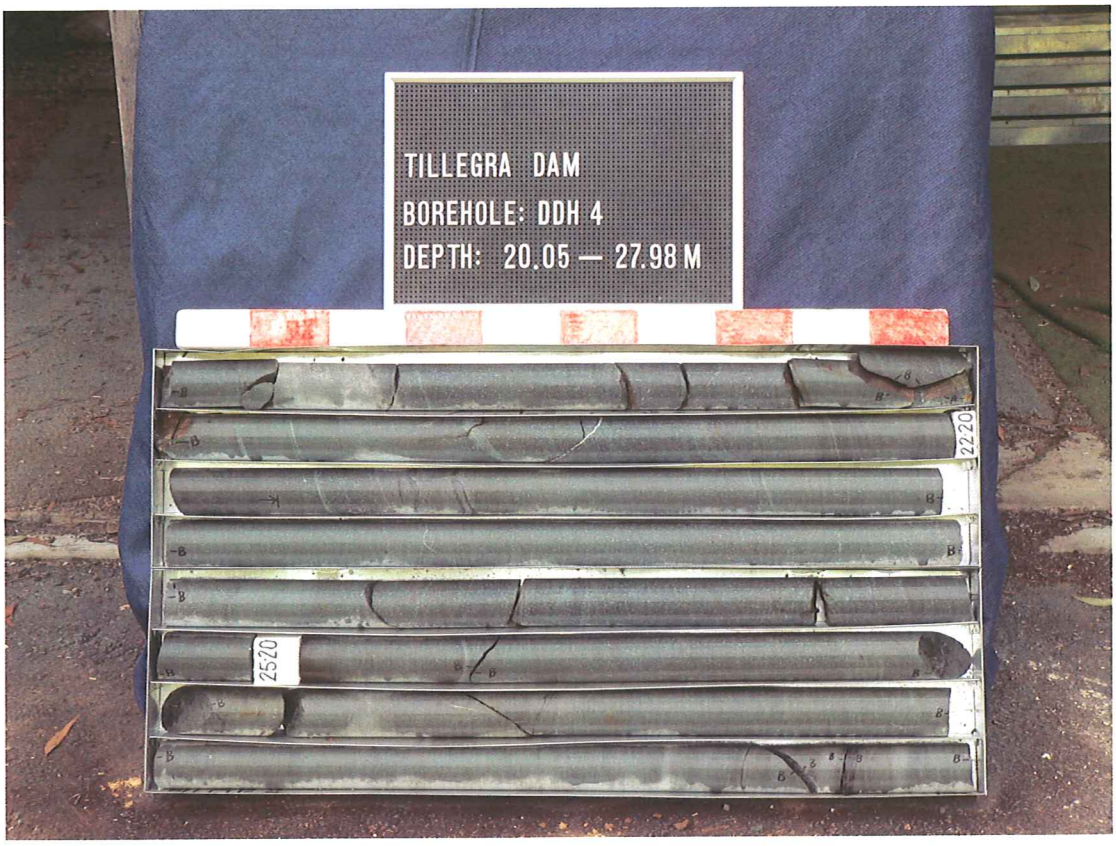
Remarks: BOX 11 ENDS AT 40.20m
Job / Report No. GN 25A

Logged by: JOHN YOUNG
Date: 12.1.08
Site Supervisor MARK ASHOVER

TILLEGRA DAM
BOREHOLE: DDH 4
DEPTH: 0.90 — 4.60 M
TILLEGRA DAM
DDH 4
0·90
1·75
2·31
CORE LOSS - NON CORE
(0·20m)
2·70
3·40
4·20

TILLEGRA DAM
BOREHOLE: DDH 4
DEPTH: 4.60 — 12.27 M
CORE LOSS
(0·15m)
5·00
7·20
9·51
9·67
10·20

TILLEGRA DAM
BOREHOLE: DDH 4
DEPTH: 12.27 — 20.05 M
13:20
16:20
19:20
19:77


TILLEGRA DAM
BOREHOLE: DDH 4
DEPTH: 20.05 — 27.98 M
22:20
25:20

TILLEGRA DAM
BOREHOLE: DDH 4
DEPTH: 27.98 — 35.30 M
28.20
SPACER
SPACER
30.91
31.20
SPACER
(31.60m)
32.50
34.20
SPACER
SPACER
(35.30)

TILLEGRA DAM
BOREHOLE: DDH 4
DEPTH: 35.30 — 40.20 M
SPACER
37.20
40.20
END

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 5
Sheet 1 of 8 Sheets

PROJECT TILLEGRA DAM
LOCATION LOWER LEFT ABUTMENT (UPSTREAM TOE)
CO-ORDINATES E N
R.L. COLLAR
DATUM
BEARING
INCLINATION 60° from horizontal

DRILL DELTA 2000, TRUCK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
0					NON CORE							
1												
1.70					CORING COMMENCES AT 1.70m							
1.82	HQ	RUN 3	RT		META-SHALE, dark grey/ grey brown, banded. Laminated at 10°	SW	MS		1.70	Several JOINTS, 50 to 70°, with numerous PARTINGS, 10°, planar, rough, generally fe st. Sandy clay fill 2mm thick at 2.08m	100%	
1.97									2.35			
2.29		RUN 4			Includes v. thin TUFFACEOUS s/s interbeds towards 2.77m				2.46	4 x ± PARTINGS, 10 to 15°, planar, rough, MINOR Fe staining on some planes	0%	
2.61									2.67			
2.75					2.77m				2.79			
2.77		RUN 5			TUFFACEOUS SANDSTONE, very fine / fine grained, grey / grey brown.				2.95	Numerous JOINTS, 30 to 50° and PARTINGS, 10°, planar, rough, fe st, occasional clay coating.	40%	
3												
3.08												
3.18						MW						
3.35		RUN 6							3.47			
3.62					3.62m	SW						
3.82					META-SHALE, dark grey, laminated at 5° to 10°		MS/S		3.73	Several JOINTS, 60°, with associated PARTINGS, 5 to 10°, planar, rough, fe st.		
3.94									3.94			
4		RUN 7							4.27	JOINT, 50, planar, rough, fe st.	75%	
									4.31	PARTING, 5°, planar, rough, fe st.		
						F(S)			4.46	DRILLING BREAK		
4.62		RUN 8							4.57			
									4.67	4 x ± PARTINGS, 10°, planar, rough, fe st		
									4.83			
5									4.96			

Remarks: Job / Report No. GN15A

Logged by: JOHN YOUNG Date: 18.12.07 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 5
Sheet 2 of 8 Sheets

PROJECT TILLEGRA DAM
LOCATION LOWER LEFT ABUTMENT (UPSTREAM TOE)
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED

DRILLING DATA

DEPTH (R.L.) METRES	Method	Casing, Run	Water
5	HQ	RUN 8 CONT	
5.75		RUN 9	
6			
6.30		RUN 10	
6.82			
6.97		RUN 11	
7			
7.10			
8		RUN 12	
8.39		RUN 13	
8.75		RUN 14	
9			
9.17			
9.20			
9.53			
9.73		RUN 15	
10			

ROCK SUBSTANCE

GRAPHIC LOG

DESCRIPTION
ROCK TYPE
Grainsize, texture, colour, composition, structure, hardness

- 5 – 6.97m: META-SHALE continues, dark grey, laminated at 5° to 10°
- 6.97m
- 7.10 – 9.17m: TUFFACEOUS SANDSTONE, fine grained, grey.
- 9.17 – 9.20: Includes elongate META-SHALE clasts to 35mm. dimension.
- 9.53m: META-SHALE, dk. grey/black, laminated at 5° to 10°
- 9.93: TUFFACEOUS s/s, fine gr. grey

WEATHERING: F(S)

ESTIMATED STRENGTH: MS/S; S/HS; MS/S; HS

ROCK MASS DEFECTS

DEFECT SPACING (mm) 2000 600 200 60 20

VISUAL LOG

DEFECT DESCRIPTION
TYPE
Inclination, planarity, roughness, coatings or infillings

- 5.20 BOXING BREAK
- 5.65 – 5.75: JOINT, 60, with associated PARTINGS, 5°, planar, rough, Fe st.
- 5.97 PARTING, 10°, planar, rough, Fe st.
- 6.10 – 6.30: Several JOINTS, 30°, with associated PARTINGS, 10 to 15°, planar, rough, Fe st.
- 6.46 – 6.58: 2x's PARTINGS, 10°, planar, rough, Fe st.
- 6.72 – 7.18: JOINT, 70°, with associated PARTINGS, 15°, planar, rough, Fe/Mn st.
- 7.41 Probable DRILLING BREAK
- 7.64 JOINT, 30°, planar, rough, Fe st
- 8.00 JOINT, 60°, planar, rough, Fe/Mn st.
- 8.25 – 8.39: 2x's JOINTS, 65°, planar, rough, Fe st.
- 8.60 PARTING, 15°, planar, rough, Fe st.
- 8.70 – 8.95: 2x's JOINTS, 65°, planar, rough, Fe st.
- 9.52 – 9.58: 2x's PARTINGS, 10°, planar, rough Fe st.
- 9.73 DRILLING BREAK
- 9.80 BOXING BREAK
- 9.93 HANDLING BREAK

R.Q.D.: 62%; 64%; 80%; 0%; 98%; 100%; 70%

TESTS

Remarks: BOX 1 ENDS AT 5.20m BOX 2 ENDS AT 8.25m Job / Report No. GN25A

Logged by: JOHN YOUNG Date: 18.12.07 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 5 Sheet 3 of 8 Sheets

PROJECT TILLEGRA DAM
LOCATION LOWER LEFT ABUTMENT (UPSTREAM TOE)
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING INCLINATION 60° from horizontal
DRILL DELTA 1000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED
CORE BARREL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED

DRILLING DATA			ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
10				TUFFACEOUS SANDSTONE continues, fine gr., grey.		S/VS					
10.43				10.43 Elongate META-SHALE clasts to 20mm							
10.57	HQ	RUN 15 CORE		10.57m					10.54 PARTING, 5°, planar, rough, minor fest	82%	
				Interbedded META-SHALE/ TUFFACEOUS SANDSTONE, grey/dk grey, banded.	F (S)				10.62 } 3 x 5's PARTINGS, as above. 10.68 }		
10.83									10.83 DRILLING BREAK		
11				Laminated to thinly bedded at 10°.							
						MS/S			11.28 Probable DRILLING BREAK		
									11.42 PARTING, 5°, planar, rough, fe st.		
11.59		RUN 16							11.59 As above with carbonate fill 7mm thick	100%	
11.75				11.79					11.75 DRILLING BREAK		
12				TUFFACEOUS SANDSTONE, fine grained, grey.							
									12.17 JOINT, 30°, planar, rough		
		RUN 17			F	S/VS			12.40 } Intersecting JOINTS, 65°, planar, rough 12.60 }		88%
12.58				12.58 Includes elongate							
12.67				12.65 META-SHALE clasts to 15mm dimension					12.78 } JOINT, 80°, planar, rough, minor carbonate coating 13.25 }	65%	
13									13.35 } Intersecting JOINTS, 70 and 60°, planar, rough, minor carbonate coating. 13.65 }		
									13.83 JOINT, 60°, planar, rough, minor carbonate coating.		
14									13.99 } 2 x 5's PARTINGS, 10°, planar, rough, carbonate coated to fill 5mm thick 14.04 }		
14.03											
		RUN 18							14.40 JOINT, 60°, planar, rough, minor carbonate coating.	100%	
									14.57 Probable DRILLING BREAK		
14.75									14.75 DRILLING BREAK		
15											

Remarks: BOX 3 ENDS AT 12.78 m
Job / Report No. GN25A

Logged by: JOHN YOUNG
Date: 18.12.07
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 5
Sheet 4 of 8 Sheets

PROJECT TILLEGRA DAM
LOCATION LOWER LEFT ABUTMENT (UPSTREAM TOE)
CO-ORDINATES E N
R.L. COLLAR
DATUM
BEARING
INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED
CONTRACTOR MC DERMOTT DRILLING
COMMENCED
CORE BARRELL HQ TRIPLE
DRILLER SHAUN TAYLOR
COMPLETED

DRILLING DATA				ROCK SUBSTANCE			ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
15					TUFFACEOUS SANDSTONE continues, fine grained, grey							
									15.26	Possible PARTINGS, 10 to 15°, planar, rough, minor carbonate coating (may be drilling induced)		
									15.42			
									15.70			
									15.79			
									15.80	JOINT, 75°, planar, rough, carbonate coated		
16						F	S/S		16.10			
									16.45	Possible JOINT, 50, planar, rough		
									16.79	JOINT, 45°, planar, rough, minor carbonate coating		
									16.87	JOINT, 60°, as above		
17									17.18	JOINT, 30°, planar, rough, minor carbonate coating		
	HQ	RUN 19 CONTINUED							17.42	JOINT, 60°, planar, rough, carbonate coated		
17.75									17.75	DRILLING BREAK		
									17.94	Possible PARTING, 10°, planar, rough, carbonate coated		
18									18.10	JOINT, 45°, planar, rough, carbonate coated.		
									18.30	Probable PARTING, 15°, planar, rough,		
									18.42	JOINT, 60°, planar, rough, carbonate coated.		
		RUN 20							18.55	DRILLING BREAK		
									18.66			
										JOINT, 90°, planar (undulating) rough, carbonate coated.		
19												
19.10		RUN 21										
20												

Remarks: BOX 4 ENDS AT 16.79m
Job / Report No. GN25A

Logged by: JOHN YOUNG
Date: 18.12.07
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 5

Sheet 5 of 8 Sheets

PROJECT TILLEGRA DAM

LOCATION LOWER LEFT ABUTMENT (UPSTREAM TOE)

CO-ORDINATES E N

R.L. COLLAR DATUM BEARING INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED

CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED

DRILLING DATA

DEPTH (R.L.) METRES

Method: HQ3

Casing, Run, Water: RUN 21; RUN 22; RUN 23; RUN 24; RUN 25; RUN 26; RUN 27

ROCK SUBSTANCE

GRAPHIC LOG

DESCRIPTION
ROCK TYPE
Grainsize, texture, colour, composition, structure, hardness

20,07 TUFFACEOUS SANDSTONE continues, fine grained, grey.

22.48 METASHALE, dark grey, laminated at 5° to 10°

23.13 TUFFACEOUS SANDSTONE, fine grained, grey.

WEATHERING: F

ESTIMATED STRENGTH: EW/VL; VL/L; L/M

ROCK MASS DEFECTS

DEFECT SPACING (mm) 2000 600 200 60 20

VISUAL LOG

DEFECT DESCRIPTION
TYPE
Inclination, planarity, roughness, coatings or infillings

20.10 See above

20.18 PARTING, 15°, planar, rough, carbonate coated

20.40 Sound JOINTS, 60 to 90°, planar, rough, minor carbonate coating.

20.65 20.76 20.77 Probable DRILLING BREAKS.

21.20 JOINT, 50°, planar, rough, carbonate coated.

21.34 As above

21.46 DRILLING BREAK

21.50 JOINT, 60°, planar, rough, carbonate coated.

21.70 JOINT FRAGMENTS, 70 to 80°, planar, rough, generally with minor carbonate coating.

23.46 JOINT, 70°, planar, rough, carbonate coated.

23.62 DRILLING BREAK

23.79 JOINT, 40°, planar, rough, minor carbonate coating

24.07 JOINT, 50°, as above.

24.30 BOXING BREAK

24.52 DRILLING BREAK

24.62 Probable DRILLING BREAK

24.79 DRILLING BREAK

R.Q.D.: 50%; 100%; 72%; 0%; 15%

TESTS

Remarks: Box 5 ENDS AT 20.58m Box 6 ENDS AT 24.30m

Job / Report No. GN15A

Logged by: JOHN YOUNG Date: 18.12.07 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 5 Sheet 6 of 2 Sheets

PROJECT TILLEGRA DAM
LOCATION LOWER LEFT ABUTMENT (UPSTREAM TOE)
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING INCLINATION 60° from horizontal

DRILL DELTA 2000, TRUCK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED

DRILLING DATA			ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
25	HQ	RUN 27 CONTINUED		TUFFACEOUS SANDSTONE continues, fine grained, grey.	F	S1/S2			25.02 HANDLING BREAK 25.30 BOXING BREAK 25.63 HANDLING BREAK 26.10 JOINT, 60°, planar, rough, minor carbonate coating. 26.20 BOXING BREAK 26.35 JOINT, 60°, planar, rough, carbonate coated. 26.60 } Probable DRILLING/HANDLING BREAKS 26.65 } 26.75 DRILLING BREAK 26.85 } 2x's JOINTS, 50°, planar, rough, minor carbonate coating. 26.90 } 27.08 JOINT, 70°, planar, rough, minor carbonate coating	100%	
26											
26.75											
27		RUN 28							27.30 BOXING BREAK 27.40 Probable DRILLING BREAK 27.86 Possible PARTING, 5°, planar, rough. 28.00 JOINT, 70°, planar, rough, minor carbonate coating 28.15 Possible PARTING, 5°, planar, rough 28.27 } Probable 28.36 } DRILLING/HANDLING BREAKS 28.49 }	69%	
28											
28.58									28.58 } Intersecting JOINTS, 60 and 70°, 28.70 } planar, rough		
29		RUN 29							29.00 JOINT, 45°, planar, rough, carbonate coated. 29.17 } JOINT, 85°, planar (undulating), rough, carbonate coated Associated PARTINGS, 10° planar rough, carbonate coated infills 6mm thick at 29.21m 29.51 } 29.57 } 2x's PARTINGS, planar, rough, minor carbonate coating. 29.62 } 29.75 DRILLING BREAK 29.92 } 2x's JOINTS, 30 to 45°, planar, rough, minor carbonate coating 29.96 }	50%	
29.75		28.30									
30											

Remarks: BOX 7 ENDS AT 28.30M
Job / Report No. GN15A

Logged by: JOHN YOUNG
Date: 18.12.07
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 5
Sheet 1 of 2 Sheets

PROJECT TILLEGRA DAM
LOCATION LOWER LEFT ABUTMENT (UPSTREAM TOE)
CO-ORDINATES E N
R.L. COLLAR
DATUM
BEARING
INCLINATION 60° from horizontal

DRILL DELTA 1000 TRUCK MOUNTED
CONTRACTOR McDERMOTT DRILLING
COMMENCED
CORE BARRELL HQ TRIPLE
DRILLER SHAUN TAYLOR
COMPLETED

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
30					TUFFACEOUS SANDSTONE continues, fine grained, grey					30.28 JOINT FRAGMENTS, 30 to 70°, planar, rough, minor carbonate coating 30.65	65%	
31		RUN 1 m								30.90 JOINT, 60°, planar, rough (possibly drilling induced)		
31.10		RUN 1.1				F	S/MS			31.10 JOINT, 65°, planar, rough, carbonate coated	100%	
31.65		RUN 0.6								31.65 DRILLING BREAK 31.76 BOXING BREAK		
32	3/6	RUN 2.2								32.04 JOINT, 65°, planar, rough, carbonate coated. 32.17 32.24 2 x JOINTS, 45°, planar, rough, minor carbonate coating 32.36 JOINT, 50°, as above	70%	
32.75										32.73 32.80 JOINT FRAGMENTS, 70°, planar, rough.		
33 33.03					33.03 Interbedded fine gr. TUFF, S/S and META-SHALE, grey/dk grey, banded, Laminated to v. thinly bedded at 10 to 15°					33.00 JOINT, 65°, planar, rough. 33.15 JOINT, 45°, planar, rough, carbonate coated.		
33.43					33.43 TUFFACEOUS SANDSTONE, fine to medium grained (w.r.t. depth), grey. Includes META-SHALE laminations as shown at 10°					33.43 DRILLING BREAK		
33.75 33.78 33.84		RUN 1.75								33.75 BOXING BREAK.	46%	
34										34.16 34.28 3 x JOINTS, 50 to 60°, planar, rough, partly carbonate coated. 34.43		
34.59		RUN 1.75								34.51 DRILLING BREAK 34.69 JOINT, 50°, planar, rough, carbonate coated. 34.75 BOXING BREAK		
35										34.92 JOINT, 50°, planar, rough, carbonate coated.		

Remarks: BOX & ENDS AT 31.10m
Job / Report No. GM 124

Logged by: JOHN YOUNG
Date: 18.12.07
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 5
Sheet 2 of 2 Sheets

PROJECT TILLEGRA DAM
LOCATION LOWER LEFT ABUTMENT (UPSTREAM TOE)
CO-ORDINATES E N
R.L. COLLAR
DATUM
BEARING
INCLINATION 60° from horizontal

DRILL DELTA 7000 TRUCK MOUNTED
CONTRACTOR McDERMOTT DRILLING
COMMENCED
CORE BARRELL HQ TRIPLE
DRILLER SHAUN TAYLOR
COMPLETED

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
35	HQ RUN 3m CORE.				TUFFACEOUS SANDSTONE: continuous, medium grained, grey.	F	L/M			35.10 – 35.23: JOINT FRAGMENTS, 30 to 60°, planar, rough, carbonate coated to filled 4mm thick. 35.37 – 35.65: 2 x ½ JOINTS, 30 and 45°, planar, rough, minor carbonate coating 35.75 DRILLING BREAK	3m %	
35.75					HOLE ENDS AT 35.75m.							
36												
37												
38												
39												
40												

Remarks: BOX 9 ENDS AT 35.75m = END OF HOLE
Job / Report No. GN25A

Logged by: JOHN YOUNGS
Date: 18.12.07
Site Supervisor MARK ASHOVER

TILLEGRA DAM
BOREHOLE: DDH 5
DEPTH: 1.70 — 5.20 M
TILLEGRA DAM
DDH 5
1·70
1·82
1·97
2·29
2·75
3·18
3·82
4·62

TILLEGRA DAM
BOREHOLE: DDH 5
DEPTH: 5.20 — 12.78 M
5·75
6·30
6·82
7·10
SPACER
8·39
8·75
9·73
10·83
11·75

TILLEGRA DAM
BOREHOLE: DDH 5
DEPTH: 12.78 — 20.58 M
14.03
14.75
17.75
19.10
20.05

TILLEGRA DAM
BOREHOLE: DDH 5
DEPTH: 20.58 — 28.30 M
20.75
21.46
22.14
22.81
23.75
26.75

TILLEGRA DAM
BOREHOLE: DDH 5
DEPTH: 28.30 — 35.75 M
28.58
29.75
SPACER
SPACER
SPACER
31.10
31.65
32.75
34.59
35.75
END

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 6

Sheet 1 of 8 Sheets

PROJECT TILLEGRA DAM

LOCATION MIDDLE LEFT ABUTMENT (CENTRELINE).

CO-ORDINATES E N

R.L. COLLAR DATUM BEARING INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED

CORE BARREL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS			
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D. / TESTS
0					NON CORE						
1											
1.50					CORING COMMENCES AT 1.50m					1.50	
		RUN 1			TUFFACEOUS SANDSTONE, fine grained, brown/ orangebrown.	HW/MW	M/MS			1.59 DRILLING BREAK 1.64 PARTING, 15°, planar, rough, fe st. 1.70 JOINT 60°, planar, rough, fe st. 1.84 As above 1.97 PARTING, 15°, planar, rough, fe st. 2.11 JOINT, 60°, planar, rough, fe st. 2.55 As above.	88%
2											
2.75					Pale brown/ grey brown.					2.75 DRILLING BREAK	
3		RUN 2								3.10 JOINT, 35°, planar, rough, fe st. 3.28 BOXING BREAK	
	HQ					MW	MS			3.56 Probable DRILLING BREAK 3.67 JOINT, 60°, planar, rough, fe st. clay coated.	60%
4										3.90 } JOINT, 70°, planar, rough, fe st. sandy clay full to 2mm 4.18 }	
4.35		RUN 3								4.34 Probable DRILLING BREAK	
										4.57 } 2x's JOINTS, 60°, intersecting, planar, rough, fe st 4.72 }	75%
5										4.80 JOINT, 60°, planar, rough, fe/mn st. 4.95 As above	

Remarks:

Job / Report No. GN25A

Logged by: JOHN YOUNG Date: 7.12.07 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 6

Sheet 2 of 8 Sheets

PROJECT TILLEGRA DAM

LOCATION MIDDLE LEFT ABUTMENT (CENTRELINE)

CO-ORDINATES E N

R.L. COLLAR DATUM BEARING INCLINATION 60° from horizontal

DRILL DELTA D6000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED

CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
5					TUFFACEOUS SANDSTONE continues, pale brown/ grey brown.	MW	MS			5.20 JOINT, 65°, planar, rough, Fe/Mn st.		
										5.35 Intersecting Joints, 45 and 60°, planar, rough, minor Fe st.		
5.71		RUN 3 cont								5.71 Intersecting Joints, both 60°, as above.		
5.95					META-SHALE, dk. grey, laminated at 15°	F(s)				5.95 PARTING, 5°, planar, very rough		
6.10										6.10 PARTING, 5°, planar, rough, sandy clay fill to 2mm		
		HQ			TUFFACEOUS SANDSTONE, fine-medium grained, grey brown (5YR) to grey.	SW				6.28 JOINT, 30°, planar, rough, Fe/Mn st		
										6.46 Probable PARTING, 15°, planar, very rough, partly sandy clay coated		
							S			6.75 JOINT, 30°, planar, rough, Fe st		
6.90										6.90 BOXING BREAK		
7												
7.10		RUN 4			Coarse, gravelly lens 20 mm thick.	SW/FR				7.10 DRILLING BREAK.		
7.25										7.25 JOINT, 65°, planar, rough, Mn st, minor clay coating		
7.50						SW				7.52 JOINT, 60°, planar, rough, Fe st.		
7.60										7.79 DRILLING BREAK		
8						F(s)				8.00 PARTING, 5°, planar, rough, Fe st, minor clay fill to 1mm		
		RUN 5								8.45 As above		
										8.52 JOINT, 45°, planar, rough, Fe/Mn st		
8.62					META-SHALE lamination, 5°					8.62 PARTING, 5°, planar, rough, Fe st		
8.70										8.65 Probable DRILLING BREAK		
8.95		RUN 6			TUFFACEOUS SANDSTONE, fine grained, grey/ grey brown (5YR).	SW				8.90 JOINT, 60°, planar, rough, Fe st, sandy clay fill to 5mm		
9.15										9.15 Several JOINTS, 30 to 70°, planar, rough, Fe/Mn st, clay fill to 3mm		
						MW	MS			9.35		
9.50										9.50 JOINT, 70°, planar, rough, Fe/Mn st.		
9.70		RUN 7								9.85		
						F(s)	S					
10												

Remarks: BOX 1 ENDS AT 5.20m BOX 2 ENDS AT 8.65m

Job / Report No. GH 25A

Logged by: JOHN YOUNGS Date: 7.12.07 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 6 Sheet 3 of 8 Sheets

PROJECT TILLEGRA DAM
LOCATION MIDDLE LEFT ABUTMENT (CENTRELINE)
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING INCLINATION 60° from horizontal

DRILL DELTA 7000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
10	HQ	RUN 8	R2		TUFFACEOUS SANDSTONE continues, fine grained,	$F_{(s)}$	S			10.18 JOINT, 30°, planar, rough, Fe/Mn st.		
10.25										10.25 PARTING, 15°, planar, rough, Fe st.		
					Interbedded META-SHALE and fine grained TUFFACEOUS SANDSTONE, brown / grey brown, banded.	MW/SW	MS/MS			10.62 Probable DRILLING BREAK 10.66 PARTING, 5°, planar, rough, Fe st. gravelly clayey zone 30mm		
10.66							EW			10.71 JOINT, 45°, planar, rough thick Fe/Mn st.		
11					Laminated to very thinly bedded at 5 to 10°		MS/MS			10.95 } 3x's JOINTS, planar, rough, 50°, Fe/Mn st. 11.05 }		
11.14							EW			11.14 } PARTING FRAGMENTS, 10°, crushed clayey joint. 11.19 }		
11.19							MS/MS			11.27 } JOINT / PARTING FRAGMENTS, 65 and 5°, planar, rough, Fe/Mn st. minor clay infill to 2mm (may be handling induced) 11.60 }		
11.47					11.74m							
11.74		RUN 9			Grey / dark grey, banded.					11.74 JOINT, 30°, planar, rough, Fe/Mn st. 11.80 } 3x's PARTINGS, 5°, planar, rough, Fe st. 11.99 } 11.96 }		
12		RUN 10				$F_{(s)}$	MS					
12.51					TUFFACEOUS SANDSTONE, fine grained, grey / grey brown / brown					12.28 PARTING, 10°, planar, rough, Fe/Mn st. 12.47 2x's JOINTS, 40°, planar, rough, Fe/Mn st. 12.51 PARTING, 5°, planar, rough, Fe st.		
12.80										12.70 JOINT, 60°, planar, rough, Mn st. 12.81 PARTING, 5°, planar, rough, Fe/Mn st.		
13.00					Includes META-SHALE interbeds (as shown) dark grey / grey brown, laminated at 5 to 10°		S			13.01 } 3x's PARTINGS, 5 to 15°, planar, rough, Fe/Mn st. 13.08 } 13.30 }		
13.15												
13.25										13.25 Probable DRILLING BREAK		
13.28												
13.32												
13.46		RUN 11				MW				13.44 JOINT, 60°, planar, rough, Fe/Mn st. 13.50 PARTING, 5°, planar, rough, Fe/Mn st.		
13.60						MW/MW	MS/MS			13.65 } JOINT, FRAGMENTS, 60 to 15°, planar, rough, Fe st.		
14												
14.10						SW				14.10		
14.20												
14.25										14.32 Probable DRILLING BREAK		
14.52						$F_{(s)}$	S			14.52 PARTING, 10°, planar, rough, Mn st.		
14.60										14.60 As above 14.68 As above		
14.68										14.82 JOINT, 60°, planar (stepped), rough Mn st.		
15										14.97 DRILLING BREAK		

Remarks: BOX 3 ENDS AT 12.51m
Job / Report No. GN 25A

Logged by: JOHN YOCCARIS
Date: 7.12.07
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 6

Sheet 4 of 8 Sheets

PROJECT TILLEGRA DAM

LOCATION MIDDLE LEFT ABUTMENT (CENTRELINE)

CO-ORDINATES E N

R.L. COLLAR DATUM BEARING INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED

CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED

DRILLING DATA			ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
15				Fine gr. TUFFACEOUS s/s continues	F(s)	S					
15.10						MS			15.13 Numerous PARTINGS, 5 to 10°, planar, generally rough, Fe/Mn st.		
15.20		CORE LOSS 0.09m		META-SHALE, dark grey/ grey brown/ brown, banded. Laminated at 5 to 10°	MW	W/MS			15.51		
15.40					F(s)	MS					
15.66											
15.71				CORE LOSS 0.05m					15.71 JOINT/PARTING FRAGMENTS 60 and 5°, planar, rough, Fe/Mn st.		
15.81									15.81		
15.91						MS			15.91 4x's PARTINGS, 5 to 10°, planar, rough, Fe/Mn st.		
16					F(s)				15.99		
16.13									16.13		
16.17									16.17		
16.25				TUFFACEOUS SANDSTONE, fine grained, grey.		S			16.25 DRILLING BREAK		
16.47									16.47 JOINT, 60°, planar, rough, Fe/Mn st.		
16.68				16.68m							
16.87				Grey/brown/brown, includes coarse grained bands up to 20mm thick	MW	W			16.87 JOINT/PARTING FRAGMENTS, 50 and 5 to 10°, planar, rough, Fe/Mn st, clay coated to sandy clay fill 2mm thick.		
17						MS			17.10		
17.26						W			17.26 As above (partly fragmented by drilling process).		
17.35				17.35m					17.35		
17.44									17.44 JOINT, 60, planar, rough, Mn st.		
17.54				Grey, fine-grained	F(s)	S			17.54 JOINT, 45°, planar, rough, Fe/Mn st.		
17.86				17.86m					17.86 JOINT, 30°, planar, rough, Fe/Mn st.		
18				Grey/brown	SW						
18.08					MW	W			18.08 Probable PARTING FRAGMENTS, crushed, Fe st.		
18.11				18.11					18.11		
18.44				Grey	F(s)	S/VS			18.44 JOINT, 65°, planar, rough, Fe/Mn st.		
18.67				CORE LOSS 0.23m					18.67 As above		
18.71									18.71 As above		
19				TUFFACEOUS SANDSTONE continues, very fine/ fine grained, grey.	F(s)	S/VS			19.13 2x's PARTINGS, 10°, planar, rough Mn st.		
19.16									19.16		
19.25									19.25 DRILLING BREAK		
19.76									19.76 JOINT, 70°, planar, rough, carbonate coated.		
19.87									19.87 JOINT, 60°, as above.		
20											

Remarks: Box 4 ENDS AT 16.47m

Job / Report No. GN 15A

Logged by: JOHN YOUNGS

Date: 7.12.07

Site Supervisor MARK ASHOLER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 6 Sheet 5 of 8 Sheets

PROJECT TILLEGRA DAM
LOCATION MIDDLE LEFT ABUTMENT (CENTRELINE)
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING INCLINATION 60° from horizontal
DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
20.05				TUFF, s/s cont., v. fine gr.					20.10 PARTING, 5°, planar, rough, Fe stain		
				Interbedded META-SHALE and very fine gr. TUFFACEOUS SANDSTONE, lt grey/grey, banded, laminated at 5°					20.23 Probable DRILLING BREAK (w/the PARTING direction).		
20.34									20.53 JOINT, 50°, planar, rough, carbonate coated		
				TUFFACEOUS SANDSTONE, very fine/fine grained, grey.					20.90 DRILLING BREAK		
21		RUN 15 cont.		Includes carbonate healed joints to 1mm thick, 60° to 30°.					21.10 JOINT, 60°, planar, rough, Fe st.	100%	
									21.15 BOXING BREAK		
									21.70 JOINT, 60°, planar, rough, carbonate coated		
21.78									21.76 DRILLING BREAK		
22		RUN 16			F(s)	S/VS				100%	
22.25									22.23 DRILLING BREAK		
	HQ								22.44 PARTING, 5°, planar, rough, carbonate coated.		
23		RUN 17							23.20 JOINT, 65°, planar, rough, carbonate coated.	100%	
									23.31 PARTING, 5°, planar, rough, Fe st.		
									23.51 JOINT, 70°, planar, rough, carbonate coated		
									23.73 JOINT, 70°, planar, rough, carbonate coated.		
									23.87 PARTING, 5°, planar, rough, carbonate coated		
24.00		RUN 18							24.00 DRILLING BREAK 24.05 JOINT, 60°, planar, rough, carbonate coated 24.10 BOXING BREAK		
									24.15 JOINT, 70°, planar, rough, carbonate coated. 24.17 JOINT, 45°, as above.	100%	
									24.35 HANDLING BREAK		
25											

Remarks: BOX 5 ENDS AT 20.23m BOX 6 ENDS AT 24.10m
Job /Report No. GN25A
Logged by: JOHN YOUNG Date: 17.12.07 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 6
Sheet 5 of 8 Sheets

PROJECT TILLEGRA DAM
LOCATION MIDDLE LEFT ABUTMENT (CENTRELINE)
CO-ORDINATES E N
R.L. COLLAR
DATUM
BEARING
INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED
CONTRACTOR McDERMOTT DRILLING
COMMENCED
CORE BARRELL HQ TRIPLE
DRILLER SHAUN TAYLOR
COMPLETED

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
25										25.07 BOXING BREAK		
25.15					TUFFACEOUS SANDSTONE continues, very fine/fine-grained, grey.					25.15 DRILLING BREAK		
26										26.15 BOXING BREAK		
27	HQ	RUN 16				F(S)	S/VS			27.10 BOXING BREAK	100%	
27.50					Includes 27.50 META-SHALE laminations at 5°					27.50 PARTING, 5°, slightly curved, rough, Fe st.		
27.71					27.71m TUFF, s/s, coarse gr., grey, includes MTS clasts to 35mm.					27.67 Possible PARTING, 5°, planar, rough 27.71 PARTING, 5°, planar, rough, minor Fe st.		
27.88					27.88m					27.88 } JOINT/PARTING FRAGMENTS, 10 and 5°, planar, rough, minor Fe st (may be drilling induced)		
27.96					META-SHALE, dark grey, laminated at 5 to 10°		MW/S			27.96 }		
28										28.04 BOXING BREAK	100%	
28.25										28.10 PARTING, 5°, planar, rough, Fe st		
28.29					28.29m TUFFACEOUS SANDSTONE, fine to coarse-grained with depth, grey.		S/MS			28.25 DRILLING BREAK 28.34 PARTING, 5°, curved, rough, Fe st		
		RUN 18								28.49 JOINT, 25°, planar, rough, Fe st		
28.70					28.70m META-SHALE, dark grey, laminated at 5°.		MW/S			28.66 } JOINT/PARTING FRAGMENTS, 10 and 5°, planar, rough, Fe staining on some planes.	45%	
28.89										29.03 }		
29					29.06m TUFFACEOUS s/s, medium gr., grey.		S/VS			29.20 }		
29.06					29.20m					29.32 } As above		
29.20					META-SHALE with TUFF. s/s interbeds, dk grey/grey/pale brown, "banded". Laminated to v. thinly bedded at 10°		MW/S			29.47 Possible JOINT, 45°, irregular, v. rough	72%	
29.70					29.70m TUFFACEOUS SANDSTONE, medium/coarse gr., grey.		S/VS			29.64 Probable DRILLING BREAK 29.70 PARTING, 10°, planar, rough, Fe st.		
30										29.98 BOXING BREAK		

Remarks: BOX 7 ENDS AT 28.04m
Job / Report No. GN 25A

Logged by: JOHN YOUNG
Date: 17.12.07
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 6
Sheet 6 of 8 Sheets

PROJECT TILLEGRA DAM
LOCATION MIDDLE LEFT ABUTMENT (CENTRELINE)
CO-ORDINATES E N
R.L. COLLAR
DATUM
BEARING
INCLINATION 60° from horizontal

DRILL DELTA 1000, TRACK MOUNTED
CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE
DRILLER SHAUN TAYLOR
COMMENCED
COMPLETED

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
30					TUFFACEOUS SANDSTONE cont. medium/coarse grained, grey		S/MS			30.17 PARTING, 5°, planar, smooth, minor Fe staining.		
30.37					30.37m META-SHALE, dk. grey, laminated at 15°		MS/S					
30.46					30.46m					30.46 PARTING, 15°, planar, rough, minor fe staining.		
					TUFFACEOUS SANDSTONE, medium/coarse grained, grey.							
31		RUN 19 CONTINUED				F(3)	S/MS			31.00 BOXING BREAK 31.10 JOINT, 65°, planar, rough, Fe st.		
31.25										31.25 DRILLING BREAK		
31.33					31.33m Fine-grained							
31.48		RUN 20			31.48m							
					Medium/coarse gr							
32	HQ									31.91 BOXING BREAK 31.95 JOINT, 50°, planar, rough, Fe st.		
32.25					32.25						78%	
					TUFFACEOUS SANDSTONE, very fine grained, with META-SHALE laminations, dk. grey/grey at 10 to 15°, banded					32.28 BOXING BREAK		
33										33.00 HANDLING BREAK		
33.27					33.27					33.22 Possible PARTING, 20°, planar, rough, minor fe staining.		
					TUFFACEOUS SANDSTONE, medium/coarse grained, grey.							
33.77					33.77m Includes META-SHALE lamination at 15°							
34										33.90 BOXING BREAK.		
34.25					34.25m META-SHALE lamination at 15°					34.22 DRILLING BREAK		
34.71		RUN 21					MS/S			34.71 PARTING, 15°, planar, rough, Fe st 34.78 HANDLING BREAK 34.90 BOXING BREAK 35.00 PARTING, 10°, planar, rough, minor Fe st.		16
35												

Remarks: BOX 8 ENDS AT 31.91m
Job / Report No. GN25A

Logged by: JOHN YOUNG
Date: 17.12.07
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 6
Sheet 7 of 8 Sheets

PROJECT TILLEGRA DAM
LOCATION MIDDLE LEFT ABUTMENT (CENTRELINE)
CO-ORDINATES E N
R.L. COLLAR
DATUM
BEARING
INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED
CONTRACTOR McDERMOTT DRILLING
CORE BARREL HQ TRIPLE
DRILLER SHAUN TAYLOR
COMMENCED
COMPLETED

DRILLING DATA

DEPTH (R.L.) METRES	Method	Casing, Run	Water
35			
35.52		RUN 11 CONT.	
35.88			
36			
36.34			
36.40			
36.55			
36.67			
37			
37.13			
37.48		RUN 12	
38			
38.11			
39			
39.07		RUN 13	
39.52			
39.85			
40			

ROCK SUBSTANCE

GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH
	TUFFACEOUS SANDSTONE, fine to medium grained, grey.		S/MS
	35.52m Includes META-SHALE laminations at 10°		
	35.88m META-SHALE, dark grey, laminated at 10 to 15°		
	Includes thin TUFFACEOUS S/S interbeds as shown.		
	37.48m TUFFACEOUS SANDSTONE, medium/coarse grained, grey	F(s)	S/MS
	38.11m META-SHALE, dark grey, laminated at 10 to 15°		MS/S
	39.52m TUFFACEOUS SANDSTONE, fine grained, grey.		S/MS
	39.85m META-SHALE, dark grey, laminated at 10°		MS

ROCK MASS DEFECTS

DEFECT SPACING (mm): 2000 600 200 60 20

VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
	35.19, 35.28 Probable DRILLING BREAKS		
	35.76 JOINT, 60°, planar, rough.	74%	
	35.82 DRILLING BREAK		
	35.92 PARTING, 5°, with associated JOINT, 60°. Planar, rough, Fe st		
	36.28 PARTING, 5°, planar, crushed clayey zone 5mm thick.		
	36.48 Probable DRILLING BREAK		
	36.81 JOINT, 50°, planar, rough, Fe st		
	37.03, 37.13 JOINT / PARTING FRAGMENTS, 60° and 10°, planar, rough, some planes Fe st (some breaks may be drilling induced)	67%	
	37.35 Probable DRILLING BREAK		
	37.43 As above		
	37.74 Possible JOINT, 45°, planar, rough, carbonate coated.		
	37.94 JOINT, 45°, planar, rough, Fe st.		
	38.11, 38.21 PARTING FRAGMENTS, 10 to 20°, planar, rough, Fe st.		
	38.37 Intersecting JOINTS, both 30°, planar, rough, Fe st.		
	38.47, 38.56 JOINT, 60°, fragmented, planar, rough, Fe st.		
	38.75 PARTING, 10°, planar, rough, Fe st.		
	38.97, 39.14, 39.27 Numerous PARTINGS, 10 to 15°, planar, rough, minor Fe staining / PARTING FRAGMENTS crushed zone, clayey from 39.14 to 39.19m. (sheared)		
	39.41, 39.70, 39.60, 39.63 Numerous PARTINGS, 10 to 15°, planar, rough, generally Fe st.	74%	
	39.77 JOINT, 70°, planar, rough, minor Fe staining		
	39.87		
	39.95 See over		

Remarks: BOX 9 ENDS AT 35.82m BOX 10 ENDS AT 39.73m
Job / Report No. GM 154

Logged by: JOHN YOUNG
Date: 17.12.07
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 6
Sheet 8 of 8 Sheets

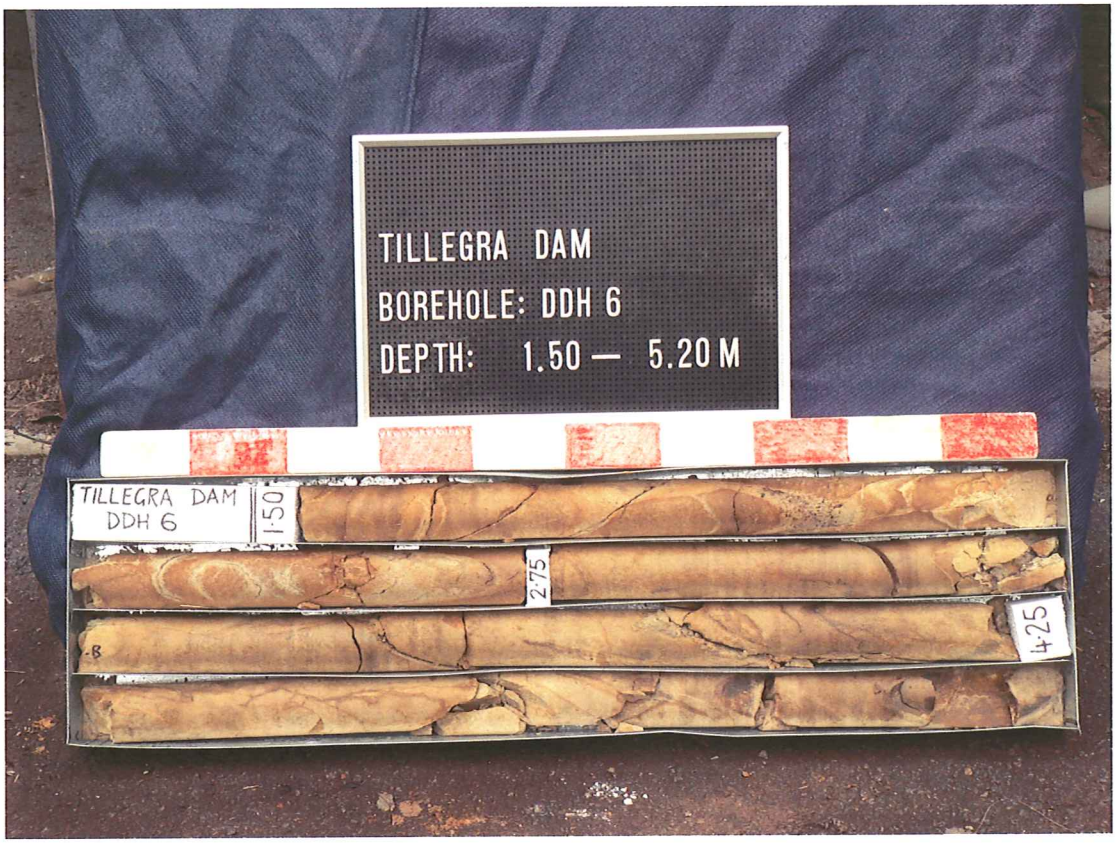
PROJECT TILLEGRA DAM
LOCATION MIDDLE LEFT ABUTMENT (CENTRELINE)
CO-ORDINATES E N
R.L. COLLAR
DATUM
BEARING
INCLINATION 60° from horizontal

DRILL DELTA 7000, TRACK MOUNTED
CORE BARRELL HQ TRIPLE
CONTRACTOR McDERMOTT DRILLING
DRILLER SHAUN TAYLOR
COMMENCED
COMPLETED

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
40					META-SHALE continues, dark grey, laminated at 10							
40.13										JOINT FRAGMENTS, 50 to 70°, with associated PARTINGS, 10°, planar, rough, to st, minor clay coating		
		Run 2.4				F(S)	MS					
40.67										40.43		
										40.67		
										Numerous PARTINGS, 10°, planar rough, occasional carbonate coating.		
										40.82		
										40.89		
41										40.97		
										41.07		
										41.14		
41.23					41.23m					41.30		
					TUFFACEOUS SANDSTONE, fine grained, grey		S/MS					
41.67					41.67m					41.67 BOXING BREAK		
					Interbedded META-SHALE/ TUFFACEOUS SS, grey/dk grey, banded, lam. to v. thinly bedded at 15°	F	S			41.70 HANDLING BREAK		
42.00		Run 2.5			42.00m						76%	
					TUFFACEOUS SANDSTONE, fine grained grey							
42.30					42.30 META-SHALE laminations at 15°							
					Medium grained		S/MS					
42.63					42.63					42.67 BOXING BREAK		
					Fine grained							
42.94					42.94m					42.94		
43					META-SHALE, dk grey/grey, banded, laminated at 15°		MS/S			2 x s intersecting JOINTS, 50 and 70°, planar, rough, minor carbonate coating.		
43.20					CORE LOSS 0.05m. Left down hole					43.20		
43.25					HOLE ENDS AT 43.25m							
44												
45												

Remarks: BOX 12 ENDS AT 43.25m = END OF HOLE
Job / Report No. GN 25A

Logged by: JOHN YOUNGS
Date: 18.12.07
Site Supervisor MARK ASHOVER


TILLEGRA DAM
BOREHOLE: DDH 6
DEPTH: 1.50 — 5.20 M
TILLEGRA DAM
DDH 6
1·50
2·75
4·25

TILLEGRA DAM
BOREHOLE: DDH 6
DEPTH: 5.20 — 12.51 M
5·71
SPACER
7·25
8·70
SPACER
(8·65m)
9·56
10·25
11·47
11·74

TILLEGRA DAM
BOREHOLE: DDH 6
DEPTH: 12.51 — 20.23 M
13.25
CORE LOSS 0.05
15.71
16.25
CORE LOSS (0.23m)
18.67
19.25

TILLEGRA DAM
BOREHOLE: DDH 6
DEPTH: 20.23 — 28.04 M
21.78
22.25
24.00
25.25
27.96

TILLEGRA DAM
BOREHOLE: DDH 6
DEPTH: 28.04 — 35.82 M
28·25
28·99
31·25
34·25
SPACER
(35·82)

TILLEGRA DAM
BOREHOLE: DDH 6
DEPTH: 35.82 — 43.25 M
37·13
39·07
40·13
40·67
DOWN HOLE 0·05
43·25
END DDH 6

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 7 Sheet 1 of 7 Sheets

PROJECT TILLEGRA DAM
LOCATION UPPER LEFT ABUTMENT (SADDLE)
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING INCLINATION 60° from horizontal
DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR
COMMENCED COMPLETED

DRILLING DATA			ROCK SUBSTANCE				ROCK MASS DEFECTS			
DEPTH (R.L.) METRES	Method / Casing, Run / Water	GRAPHIC LOG	DESCRIPTION — ROCK TYPE: Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION — TYPE: Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
0			NON CORE							
1										
1.50			CORING COMMENCES AT 1.5m							
	HQ Run 1		META-SHALE, brown/dark grey, banded, laminated at 5° to 10°		MS			1.50 PARTING FRAGMENTS, 5°, planar, gen. rough, Fe st, clay coated to clay fill 12 mm thick. 1.76		95%
2								1.87 PARTING, 5°, planar, rough, Fe st, clay coated. 1.95 As above, minor crushing. 2.07 PARTING/JOINT FRAGMENTS, planar, rough, Fe st, minor clay coating, 5° (bedding) to 70°		
2.20	HQ Run 2									
2.76					MW	VW		2.57 2.60 2.61 2 x 5 PARTINGS, 5°, planar, rough, Fe st, clay coated. 2.83		25%
2.89										
3	HQ Run 3				MS			PARTING/JOINT FRAGMENTS, planar, rough, Fe st, gen. clay coated, 5 to 10° (Bedding) to 76°		0%
3.36										
3.69	HQ Run 4				MS/MW			Includes clay fill from 3.69 to 3.77m (80mm).		0%
3.77										
3.80										
4.60										
4.74	HQ Run 5		TUFFACEOUS SANDSTONE, fine grained, pale brown, includes elongate, subangular META-SHALE clasts to 35mm		MS			4.33 JOINT, 30°, planar, rough, Fe/Mn st. 4.44 PARTING, 5°, planar, rough, minor Fe/Mn st. 4.56 As above.		45%
4.56										
4.80			META-SHALE, brown/dark grey, bedded, laminated at 5° to 10°					4.84 As above, minor fragmentation, clay coated. 4.94 JOINT, 30°, planar, rough, Fe/Mn st.		85%
5										

Remarks:

Job / Report No. GN25A

Logged by: JOHN YOUNG | Date: 5.12.01 | Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 7 Sheet 2 of 7 Sheets

PROJECT TILLEGRA DAM
LOCATION UPPER LEFT ABUTMENT (SADDLE)
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run, Water	GRAPHIC LOG	DESCRIPTION — ROCK TYPE: Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION — TYPE: Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
5				META-SHALE continues, brown/dark grey, banded. Laminated at 5 to 10°	MW			5.02	Numerous PARTINGS/PARTING FRAGMENTS, planar, rough, Fe/Mn st., occasionally clay coated.		
5.28											
5.35					MW/SW	MS					
								5.77			
								5.68	JOINT, 30°, with associated PARTINGS, 5°, planar, rough, Fe/Mn st.		
5.82					EW	EW		5.77			
5.88					MW/SW			5.82	Several JOINTS, 45 to 65°, with associated PARTINGS, 5 to 15°, planar, rough, Fe/Mn st. occasionally clay coated.		
6					SW						
6.02				TUFFACEOUS SANDSTONE, fine grained, pale brown.				6.20			
6.30					MW	MS		6.30	JOINT, 45°, planar, rough, Fe st, clay coated		
								6.40	JOINT, 30°, as above.		
								6.45	PARTING, 5°, planar, rough, Fe/Mn st.		
								6.54	JOINT, 45°, planar, rough, Fe st, clay coated.		
6.67								6.45	PARTINGS, 10°, planar, rough, Fe/Mn st.		
6.70					HW	VW		6.73			
6.77								6.80			
				META-SHALE, dark grey/ minor brown banding. Laminated at 10°				6.90	JOINT/PARTING FRAGMENTS, 60 to 70° (joints) and 5 to 10° (bedding) planar, rough, Fe/Mn st., occasional clay coating		
7											
7.30				Includes occasional fine grained TUFFACEOUS SANDSTONE laminations				7.47			
					MW/SW	MS		7.59	JOINT, 40°, planar, rough, Fe/Mn st. minor clay coating		
								7.70	Several JOINTS, 90° (parallel to core axis), with associated PARTINGS, 5 to 60°, planar, rough, Fe/Mn st., occasional clay coating.		
8											
8.16											
8.43				CORE LOSS 0.10m				8.47			
8.54								8.53	PARTING, 10°, with JOINT, 65°, planar rough, Fe st.		
				TUFFACEOUS SANDSTONE, fine grained, pale brown grey/brown.				8.76	JOINT, 60°, with associated PARTING, 10°, planar, rough, minor clay coating.		
								8.90	JOINT, 40°, planar, rough, Fe st.		
9				Includes occasional elongate META-SHALE clasts and laminations at 10 to 15°				9.00	JOINT, 60°, with associated PARTINGS, 10°, Fe/Mn stained. clay coated		
								9.20	JOINT, 40°, planar, rough, Fe st.		
					MW (to SW)	MS		9.30	Several JOINTS, 60°, planar, rough, Fe/Mn st.		
9.49								9.49			
								9.55	BOXING BREAK		
								9.65	JOINT, 45°, planar, rough, Fe st.		
10								9.92	PARTING, 5°, planar, rough, Fe st.		

Remarks: BOX 1 ENDS AT 5.02m BOX 2 ENDS AT 8.53m

Job / Report No. GN154

Logged by: JOHN YOUNG Date: 5.12.07 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 7

Sheet 3 of 7 Sheets

PROJECT TILLEGRA DAM

LOCATION UPPER LEFT ABUTMENT (SADDLE)

CO-ORDINATES E N

R.L. COLLAR DATUM BEARING INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED

CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
10		Run 1.4			TUFFACEOUS SANDSTONE: cont. fine gr., pale brown/grey brown							
10.18					META-SHALE, dark grey/grey brown, laminated at 10 to 15°	MW/(HW)	MS			10.18 } Several JOINTS, 30 to 50°, planar, rough, Fe/Mn st. 10.30 }		
10.30												
10.46										10.46 PARTING, 20°, planar, rough, Fe/Mn st.		
					TUFFACEOUS SANDSTONE, fine grained, pale grey with greybrown bands					10.73 DRILLING BREAK		
11		Run 1.4				F(S)						
	HQ						S/VS			11.30 PARTING, 15°, planar, rough, Fe st 11.45 BOXING BREAK 11.55 JOINT, 60°, planar, rough, Fe st.		
11.80												
12						SW				11.95 PARTING, 15°, planar, rough, Fe/Mn st.	100%	
12.40										12.43 BOXING BREAK		
										12.73 PARTING, 5°, undulating, very rough, Fe st.		
13												
13.30		Run 1.5								13.30 DRILLING BREAK 13.42 BOXING BREAK		
						F(S)				13.60 HANDLING BREAK		
14												
										14.42 BOXING BREAK		
14.94						SW				14.86 Probable DRILLING BREAK		
15												

Remarks: BOX 3 ENDS AT 12.43m

Job / Report No. GN 25h

Logged by: JOHN YOUNG Date: 6.12.07 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 7 — Sheet 4 of 7 Sheets

PROJECT TILLEGRA DAM
LOCATION UPPER LEFT ABUTMENT (SADDLE)
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING INCLINATION 60° from horizontal
DRILL DELTA 1000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED

DRILLING DATA			ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run, Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
15											
					SW				15.18 Possible PARTING, 5°, planar, rough, minor fe staining		
				TUFFACEOUS SANDSTONE continues, fine grained, pale grey with greybrown bands (SW)					15.30 JOINT, 60°, planar, rough, fe st.		
15.50											
		RUN 15 CONT.							15.60 Probable DRILLING BREAK		
				Carbonate veining in part up to 1mm thick (healed joints).		SW/S					
16											
					F(S)				16.15 JOINT, 60°, planar, rough, fe st		
16.30									16.30 DRILLING BREAK		
16.50									16.43 PARTING, 5°, planar, rough, fe st		
	HQ										
									16.77		
16.96									Numerous JOINTS, 40 to 65°, with PARTINGS, 15°, planar, generally rough, fe/mn st.		
17		RUN 16		META-SHALE, greybrown, laminated at 15°. Includes laminated/ very thin TUFFACEOUS SANDSTONE interbeds, very fine grained							
17.30					SW	MS					
									17.67		
17.70											
18				TUFFACEOUS SANDSTONE, very fine/fine grained, greybrown (SW) with pale grey bands.					18.00 Probable DRILLING BREAK		
18.10											
		RUN 17							18.32 BOXING BREAK		
				Includes rare elongate META-SHALE clasts to 35mm dimension	F(S)						
18.75						S			18.75 PARTING, 5°, planar, rough, fe st.		
19									19.10 JOINT, 50°, planar, rough, fe/mn st.		
19.30									19.30 DRILLING BREAK		
					SW						
		RUN 18							19.55 Several JOINTS, 60 and 80°, planar, rough, fe/mn st. 19.75		
									19.92 JOINT, 60°, planar, rough, fe/mn st.		
20											

Remarks: BOX 4 ENDS AT 16.30m — Job / Report No. GN 25A

Logged by: JOHN YOUNG — Date: 6.12.07 — Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 7 Sheet 5 of 7 Sheets

PROJECT TILLEGRA DAM
LOCATION UPPER LEFT ABUTMENT (SADDLE)
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
20		RIB CORE		TUFFACEOUS SANDSTONE continues, fine grained grey/brown (SW) / pale grey.				20.14	JOINT FRAGMENTS, 60 to 80°, planar, rough, Fe/Mn st.		
20.47				Includes occasional carbonate healed joints up to 1mm thick.	SW			20.50			
								20.65	JOINT, 70 to 90°, planar, rough, Fe st.		
21		RUN 19								20%	
21.25											
21.48					$F_{(S)}$	S		21.45			
21.98		RUN 20						21.98	PARTING, 5°, planar, very rough, Fe/Mn st.	82%	
22											
22.30	HQ				SW			22.17	JOINT FRAGMENTS, 30 to 70°, planar, rough, Fe/Mn st.		
22.58								22.38			
23								23.02	PARTING, 5°, planar, rough, Fe st.	80%	
								23.20	JOINT, 45°, planar, rough, Fe st.		
23.40		RUN 21		23.40m Very fine grained	$F_{(S)}$	S/VS		23.41	PARTING, 10°, planar, rough, Fe/Mn st.		
23.57				23.57m							
								23.90	As above		
24.00		RUN 22		Medium grained				24.00	JOINT, 45°		
								24.10	BOXING BREAK		
24.50				24.50m						100%	
				Fine grained.				24.68	PARTING, 10°, planar, very rough, Fe st.		
25								24.93	As above		

Remarks: Box 5 ENDS AT 20.74m Box 6 ENDS AT 24.10m Job / Report No. GM 25A

Logged by: JOHN YOUNG Date: 6.12.07 Site Supervisor MARK RICHARDS

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 7 Sheet 6 of 7 Sheets

PROJECT TILLEGRA DAM
LOCATION UPPER LEFT ABUTMENT (SADDLE)
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED

DRILLING DATA			ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
25											
		RUN 23		TUFFACEOUS SANDSTONE continues, fine grained, generally pale grey, with grey breccia (sco) intervals.					25.10 BOXING BREAK		
25.30					F(s)				25.17 HANDLING BREAK		
									25.30 DRILLING BREAK		
25.55				25.55 m							
				Medium grained. Includes subangular clasts generally to 2mm dimension, rarely 5mm.	SW				25.72 JOINT, 45°, planar, rough, Fe st.		
									25.80 } 2x's JOINTS, 30 and 60°, planar, rough, fe st		
25.95									25.97 }		
									26.10 PARTING, 15°, planar, rough, Fe st		
									26.35 As above	90%	
					F(s)	S/HS			26.72 Probable DRILLING BREAK		
27	HQ								26.94 PARTING, 20°, planar, rough, Fe st.		
									27.13 JOINT, 60°, planar, rough, Fe st		
									27.24 } DRILLING BREAKS		
									27.31 }		
27.65		RUN 24							27.65 PARTING, 20°, planar, rough, Fe st.		
									27.78 } HANDLING BREAKS		
27.90				27.90 m					27.90 }		
28				Fine grained							
28.10				28.10 m					28.07 JOINT, 60°, planar, rough, Fe/Mn st.	92%	
28.30									28.30 DRILLING BREAK		
				Fine-medium grained.					28.50 DRILLING BREAK		
									28.88 } 2x's PARTINGS, 15°, planar, rough, Fe st, carbonate coating at 28.88 m		
29									28.98 }		
29.07									29.02 }		
		RUN 25			SW				29.10 } JOINT FRAGMENTS, 45 to 65°, planar, rough, Fe/Mn st.		
29.27									29.27 }	90%	
									29.41 JOINT, 30°, planar, rough, Fe st		
									29.54 As above.		
					F(s)						
30									30.00 BOXING BREAK		

Remarks: Box 6 ENDS AT 28.07 m
Job / Report No. GN25A

Logged by: JOHN YOUNG
Date: 6.12.07
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 7

Sheet 1 of 1 Sheets

PROJECT TILLEGRA DAM

LOCATION UPPER LEFT ABUTMENT (SADDLE)

CO-ORDINATES E N

R.L. COLLAR DATUM BEARING INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR MCDERMOTT DRILLING COMMENCED

CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED

DRILLING DATA

DEPTH (R.L.) METRES	Method	Casing, Run	Water
30			
30.30	HQ	RUN 26	
30.38			
31			
31.30		RUN 27	
31.33			
32			
32.30			
33			
33.94			
34			
34.30			
35			

ROCK SUBSTANCE

GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH
	TUFFACEOUS SANDSTONE continues, grey.		
	Fine-medium grained. Includes subrounded clasts to 1mm dimension	F(S)	VL/L
	— 31.33m		
	Fine grained		
	— 32.30m		
	Medium grained. Includes subrounded clasts to 2mm dimension. Occasion carbonate healed joints/partings persist.		
	— 33.94m		
	Fine grained		
	HOLE ENDS AT 34.30m		

ROCK MASS DEFECTS

DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
		30.10 JOINT, 60°, planar, rough, minor Fest carbonate coated		
		30.29 JOINT, 30°, planar, rough, Fe st.		
		30.34 DRILLING BREAK		
		30.88 BOXING BREAK	100%	
		31.04 HANDLING BREAK		
		31.30 DRILLING BREAK		
		31.75 Possible PARTING, 10°, planar, rough, minor Fe st,		
		31.90 BOXING BREAK		
		32.00 PARTING, 10°, planar, rough, Fe st		
		32.35 DRILLING BREAK		
		32.46 JOINT, 60°, planar, rough, Fe st, carbonate coated.		
		32.66 – 32.87 JOINT, 75°, planar, rough, Fe st carbonate coated.	86%	
		33.29 DRILLING BREAK		
		33.60 JOINT, 30°, planar, rough, Fe st, carbonate coated.		
		33.94 – 33.97 2 x Fe st PARTINGS, 5°, planar, rough.		
		34.30 DRILLING BREAK		

Remarks: BOX 8 ENDS AT 31.90m BOX 9 ENDS AT 34.30m – END OF HOLE

Job / Report No. GN25A.

Logged by: JOHN YOUNGS

Date: 6.12.07

Site Supervisor MARK ASHOVER

TILLEGRA DAM
BOREHOLE: DDH 6
DEPTH: 1.50 — 5.20 M
TILLEGRA DAM
DDH 6
1·50
2·75
4·25

TILLEGRA DAM
BOREHOLE: DDH 7
DEPTH: 5.02 — 12.43 M
5·28
5·35
6·30
7·30
8·16
CORE LOSS
0·10 m
8·53
9·49
10·30

TILLEGRA DAM
BOREHOLE: DDH 7
DEPTH: 12.43 — 20.34 M
13.30
SPACER
16.30
17.30
19.30

TILLEGRA DAM
BOREHOLE: DDH 7
DEPTH: 20.34 — 28.07 M
20.45
21.48
22.30
24.00
25.30
27.65

TILLEGRA DAM
BOREHOLE: DDH 7
DEPTH: 28.07 — 34.30 M
28-30
30-38
31-30
34-30
END DDH 7

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 8 Sheet 1 of 10 Sheets

PROJECT TILLEGRA DAM
LOCATION LEFT ABUTMENT, PROPOSED SPILLWAY CREST
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING 060°M INCLINATION 60° from horizontal
DRILL DELTA 1000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
0					NON CORE							
1												
1.50					CORING COMMENCES 1.50m							
1.65		RUN 1			META-SHALE, very fine gr. dark grey/greybrown.	MW	ms			1.70 PARTING/JOINT FRAGMENTS, planar, generally rough, Fe/Mn stained, 15° (bedding) to 70°	0%	
1.75					CORE LOSS 0.10m					1.65		
2.00		RUN 2			As above (laminated/thinly bedded at 15°)	MW	ms			1.75 As above, clay filled parting at 2.06m, 15mm thick	0%	
2.25					CORE LOSS 0.25m					2.00		
2.43		RUN 3			As above		ms			2.25 As above. Clayey fill from 2.33m to 2.43 and again from 2.80 to 2.83m (20mm thick). Defects commonly clay coated.	0%	10%
2.68												
2.99	HQ				TUFFACEOUS SANDSTONE, fine grained, pale brown.	MW	MS/S			2.99 Numerous PARTINGS/JOINTS, planar, smooth to rough, Fe/Mn stained, generally clay coated. Mostly 15° (bedding) to 75°	0%	
3.31												
3.47		RUN 4			META-SHALE, very fine gr, dark grey/grey brown, laminated to very thinly bedded at 15°		ms			3.65		
3.72										3.72 PARTING, 15°, planar, rough, Fe st.		
4										3.80 JOINT, 50°, planar, rough, Fe/Mn st.		
4.05		RUN 5			TUFFACEOUS SANDSTONE, fine grained, generally pale brown, indistinct bedding at 15° to 20°		MS/S			4.00 PARTING, 15°, planar, rough, minor clay coating	17%	
4.20										4.05 JOINT/PARTING FRAGMENTS, 15° to 70°, planar, rough, Fe st. 4.20	10%	
4.47						MW/SW	S					
4.57		RUN 6										
4.80						MW	MS/S			4.68 PARTING, 15°, planar, rough, Fe/Mn st.		
5					META-SHALE interbed from 4.96 to 5.00m					4.79 JOINT, 45°, planar, rough, Fe st. clay coated	84%	
										4.94 2 x PARTINGS, 15°, planar, rough, Fe st, clay coated. 5.00		

Remarks: BOX ENDS AT 5.00 m
Job / Report No. GN25A
Logged by: JOHN YOUNG
Date: 27.11.07
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 8 Sheet 2 of 10 Sheets

PROJECT TILLEGRA DAM
LOCATION LEFT ABUTMENT PROPOSED SPILLWAY CREST
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING 060° M INCLINATION 60° from horizontal
DRILL DELTA 2000 TRUCK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED

DRILLING DATA			ROCK SUBSTANCE			ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
5				META-CHERT interbed	MW	MS					
5.10				TUFF, S/S, fine gr., pale brown							
5.15				META SHALE interbed, 20°							
5.35	HQ3	RUN 9		TUFFACEOUS SANDSTONE, fine grained, generally grey/brown. Poorly defined bedding at 20°					4 x's PARTINGS, 15 to 20°, planar generally rough, Fe/Mn stained, minor clay coating.	45%	
6									5.54 JOINT, 60°, planar, rough, Fe/Mn st., minor clay coating		
6.41		RUN 10			MW/SW	MS/S			5.72 2 x's JOINTS, as above 5.80 BOXING BREAK 6.08 JOINT, 50, planar, rough, Fe/Mn st. 6.20 PARTING, 20°, planar, rough, Fe/Mn st. 6.35 JOINT FRAGMENTS, 60°, planar, rough, Fe/Mn st., minor clay coating.		
7									6.61 DRILLING BREAK associated with JOINT, 70° 6.80 JOINT, 45°, planar, rough, Fe st. 6.94 JOINT, 50°, planar, rough, Fe/Mn st.	67%	
7.23									7.13 DRILLING BREAK 7.23 JOINT, 50°, planar, rough, Fe/Mn st.		
7.50	HQ3	RUN 11							7.41 JOINT FRAGMENTS. 3 x's parallel JOINTS at 20°, with opposing JOINTS at 50° planar, rough, Fe st, with carbonate fill (shear zone)	19%	
7.65					HW	W					
8											
8.13				CORE LOSS 0.05m							
8.18		RUN 12		TUFFACEOUS SANDSTONE continues. Includes subangular clasts to 2mm dimension	MW/SW	MS/S			8.31 JOINT, 45°, planar, rough, Fe/Mn st 8.47 Numerous JOINTS, 60, planar, rough, Fe/Mn stained. 8.25 8.93 PARTING, 20°, planar rough, Fe/Mn stained. 9.04 JOINT, 70°, with opposing PARTINGS/JOINTS, 20 to 50°, planar, rough, Fe/Mn st, minor carbonate coating. 9.14	78%	
9											
9.18										0%	
9.54		RUN 14									
10									9.91 PARTING, 20°, planar, rough, Mn st.	85%	

Remarks: BOX 1 ENDS AT 5.00 m. BOX 2 ENDS AT 8.62 m
Job / Report No. GA125A

Logged by: JOHN YOUNG
Date: 27.11.07
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 8 Sheet 3 of 10 Sheets

PROJECT TILLEGRA DAM
LOCATION LEFT ABUTMENT, PROPOSED SPILLWAY CREST
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING 060°M INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED

DRILLING DATA			ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
10											
10.27		RUN 11		TUFFACEOUS SANDSTONE continues, generally fine grained with subangular clasts 1 to 2mm dimension, greybrown					10.07 JOINT, 60°, planar, rough, Mn st.		
									10.23 DRILLING BREAK		
									10.34 } 2x's JOINTS, 65°, planar, rough, Fe/Mn stained. 10.45		
									10.64 PARTING, 70°, planar, rough, Fe/Mn stained		
11		RUN 12							11.02 } 2x's PARTINGS, as above. 11.12		
									11.30 BOXING BREAK		
	HQ				MW/SW	MS/S			11.64 JOINT, 45°, irregular (stepped) rough, Fe/Mn stained		98%
12									12.05 PARTING, 10°, planar rough, Fe/Mn stained.		
12.44									12.23 } JOINT/PARTING FRAGMENTS, 15° (bedding) to 65°, planar, rough, Fe/Mn stained. 12.76		
12.50		RUN 13		META-SHALE with fine gr. TUFFACEOUS SANDSTONE interbeds, greybrown/brown. Laminated to very thinly bedded at 10 to 15°.							
13									12.94 } 2x's PARTINGS, 15°, planar, rough, Fe/Mn st. 13.08		75%
13.08		RUN 14							13.08 JOINT, 45°, planar, rough, Fe st.	100	
13.23									13.13 PARTING, 10°, planar, rough, Fe st.		
13.42						Generally MS			13.23 } Several JOINTS, 45° to 60°, with PARTINGS, 15°, planar, rough Fe/Mn stained. 13.54		
		RUN 15		TUFFACEOUS SANDSTONE, fine grained, brown/ greybrown.					13.75 JOINT, 60°, planar, rough, Fe st.		
14									13.82 JOINT, 45°, as above.		47%
14.06					SW	MS/S			14.06 } JOINT, 20°, with opposing PARTINGS/JOINTS, 15° to 45°, planar, rough, Fe/Mn st. 14.38		
14.38					MW/SW	MS/S					
14.56		RUN 16							14.78 JOINT, 60°, curved, rough, Fe/Mn st.		
15									14.98 BOXING BREAK		

Remarks: BOX 3 ENDS AT 12.30 m
Job / Report No. GN 25A

Logged by: JOHN YOUNG Date: 27.4.07 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 8 Sheet 4 of 10 Sheets

PROJECT TILLEGRA DAM
LOCATION LEFT ABUTMENT PROPOSED SPILLWAY CREST
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING 060° M INCLINATION 60° from horizontal
DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED

DRILLING DATA			ROCK SUBSTANCE				ROCK MASS DEFECTS			
DEPTH (R.L.) METRES	Method / Casing, Run / Water	GRAPHIC LOG	DESCRIPTION — ROCK TYPE: Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION — TYPE: Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
16	HQ RUN 14 CONT.		TUFFACEOUS SANDSTONE continues, fine grained.	MW/SW	MS/S			15.04 PARTING, 10°, planar, rough, Fe st. 15.06 JOINT, 40°, irregular, rough, Fest 15.20 JOINT, 45°: planar, rough, Fe st.		
15.40			META-SHALE interbed, 10°					15.41 2x's PARTINGS, 10 to 15°, planar,		
15.45			TUFFACEOUS SANDSTONE, medium grained. Includes subangular, elongate clasts to 25mm dimension.	SW	S			15.44 rough, Fe stained JOINT, 90°, wavering, rough, Fe stained.	65%	
16.00								16.10		
16.23				MW/SW	MS/S			16.23 JOINT, 65°, planar, rough, Fe stained		
16.70			META-SHALE interbed, 10°					16.67 Probable DRILLING BREAK.		
16.78										
16.90			TUFFACEOUS SANDSTONE, medium grained. Includes subangular clasts to 3mm dimension					16.87 JOINT, 45°, planar, rough, Fe stained		
17								17.35 JOINT, 40°, planar, rough, Fe stained		
								17.60 JOINT, 65°, planar, rough, Fe stained	100%	
								16.82 BOXING BREAK		
17.94	RUN 15		TUFFACEOUS SANDSTONE, interbedded fine/medium coarse grained. Very thinly to thinly bedded at 15°	SW	F(S) S			18.29 PARTING, 10°, planar, rough, Fe stained.		
18										
18.63								18.73 HANDLING BREAK 18.84 BOXING BREAK		
19										
19.10			Grades into medium grained around 19.10m	F(S)				19.20 DRILLING BREAK		
19.23	RUN 21								100%	
								19.68 HANDLING BREAK 19.87 BOXING BREAK		
20								19.95 JOINT, 5°, planar, rough, Fe st.		

Remarks: BOX 4 ENDS AT 15.90m BOX 5 ENDS AT 19.83m
Job / Report No. GN26A
Logged by: JOHN YOUNG Date: 29.11.07 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 8
Sheet 5 of 10 Sheets

PROJECT TILLEGRA DAM
LOCATION LEFT ABUTMENT, PROPOSED SPILLWAY CREST.
CO-ORDINATES E N
R.L. COLLAR
DATUM
BEARING 060°M
INCLINATION 60° from horizontal

DRILL DELTA 1000, TRACK MOUNTED CONTRACTOR MCDERMOTT DRILLING COMMENCED
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED

DRILLING DATA			ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
20	HQ	RUN 21 CONTINUED		TUFFACEOUS SANDSTONE continues, medium grained. Includes rare subangular clasts to 5mm dimension	F(S)	S			20.25 Joint, 70°, planar, rough, carbonate coated, minor fe st. 20.83 BOXING BREAK	100%	
21											
21.40									21.40 DRILLING BREAK		
22											
22.23									22.23 DRILLING BREAK		
22.75		RUN 22							22.75 BOXING BREAK	100%	
23											
23.75									23.75 BOXING BREAK		
24											
24.76									24.76 PARTING, 15°, planar, rough, minor fe staining		
25.00									25.00 DRILLING BREAK		
25											

Remarks: BOX 6 ENDS AT 23.75m
Job / Report No. GN 25A
Logged by: JOHN YOUNG
Date: 27.11.07
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 8 Sheet 6 of 10 Sheets

PROJECT TILLEGRA DAM
LOCATION LEFT ABUTMENT, PROPOSED SPILLWAY CREST.
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING 060°M INCLINATION 60° from horizontal
DRILL DELTA 1000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
25												
25.23		LRZZ			TUFFACEOUS SANDSTONE continues, medium grained					25.60 DRILLING BREAK 25.89 DRILLING BREAK 25.52 PARTING, 20°, slightly irregular, rough, Fe st.		
										25.80 BOXING BREAK		
26 26.06	HQ				Fine grained, very thinly bedded at 15°					26.18 4xs PARTINGS, 15°, planar, rough, Fe stained. 26.36 26.42 26.52		
26.60		RUN 23	100% drilling water loss		(Includes META-SHALE laminations at 26.50 to 26.52m).	F(s)	S			26.80 BOXING BREAK	98%	
27					TUFFACEOUS SANDSTONE continues, medium gr.							
27.70										27.70 JOINT, 60°, planar, rough, Fe/Mn stained. 100% WATER LOSS.		
28 28.07		RUN 24			Fine grained					28.18 DRILLING BREAK	100%	
28.23					Grades to medium gr.					28.45 PARTING, 15°, planar, rough, Fe stained		
28.40										28.63 BOXING BREAK		
29		RUN 25			TUFFACEOUS SANDSTONE continues, medium gr. Includes rare subangular clasts to 4mm dimension.					29.64 BOXING BREAK	80%	
										29.89 2xs JOINTS, 45°, planar, rough, Fe stained. 29.99		
30												

Remarks: BOX ENDS AT 27.70m
Job / Report No. GN 29A
Logged by: JOHN YOUNGS
Date: 27.11.07
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 8

Sheet 7 of 10 Sheets

PROJECT TILLEGRA DAM

LOCATION LEFT ABUTMENT, PROPOSED SPILLWAY CREST

CO-ORDINATES E N

R.L. COLLAR DATUM BEARING 060° M INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED

CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED

DRILLING DATA

DEPTH (R.L.) METRES	Method	Casing, Run	Water
30			
30.07			
30.40		HQ CORE LOST	
30.71			
30.76			
31		HQ RUN 27	
31.13			
31.23			
31.57			
32			
31.82			
33.00			
33.65		HQ RUN 28	
34			
34.23			
34.40		HQ RUN 29	
34.85			
35			

ROCK SUBSTANCE

GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH
	TUFFACEOUS SANDSTONE cont., medium grained		
	Fine grained	$F_{(s)}$	S
	Grades into medium gr. around 30.40m		
	CORE LOSS 0.31m		
	TUFFACEOUS SANDSTONE, medium grained.		
	Fine grained	$F_{(s)}$	S
	Medium/coarse grained		
	Includes subangular, elongate clasts to 50mm dimension		
	Coarse grained TUFFACEOUS SANDSTONE continues		
	Fine grained.		
	Fine-medium grained.		
	Includes subangular, elongate clasts to 25mm dimension.		
	Fine-medium grained.		
	Fine grained, laminated to very thinly bedded at 10°		

ROCK MASS DEFECTS

DEFECT SPACING (mm): 2000 600 200 60 20

VISUAL LOG

DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
30.30 DRILLING BREAK		
30.31 JOINT, 60°, planar, rough, Fe st.		
30.53 DRILLING BREAK		
30.60 } JOINT, 60°, planar, rough, Fe st. (fragmented. 30.71		
30.76 } JOINT, 85°, planar, rough, Fe st. 31.00	100%	
31.23 DRILLING BREAK.		
31.62 BOXING BREAK		
32.40 PARTING, 15°, planar, rough, Fe st.	100%	
32.60 BOXING BREAK		
32.68 JOINT, 60°, planar, rough.		
33.10 PARTING, 15°, planar, rough, Fe st.		
33.40 PARTING, 20°, planar, rough.		
33.65 PARTING, 15°, planar, rough, Fe st.		
33.71 JOINT, 45°, planar, rough, Fe st.		
33.95 DRILLING BREAK	60%	
34.10 JOINT, 45°, planar, rough, Fe stained, carbonate fill 1mm fleece.		
34.23 JOINT, 45°, planar, rough, Fe st.		
34.40 DRILLING BREAK		
34.60 BOXING BREAK		
34.88 } 3x's PARTINGS, 10°, Planar, rough, Fe st. 34.98		

Remarks: Box 8 ENDS AT 31.62m

Job / Report No. GN 25A

Logged by: JOHN YOUNG

Date: 27.11.07

Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 8 — Sheet 8 of 10 Sheets

PROJECT TILLEGRA DAM — CO-ORDINATES — R.L. COLLAR

LOCATION LEFT ABUTMENT, PROPOSED SPILLWAY CREST — E — DATUM

N — BEARING 060° M — INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED — CONTRACTOR McDERMOTT DRILLING — COMMENCED

CORE BARRELL HQ TRIPLE — DRILLER SHAUN TAYLOR — COMPLETED

DRILLING DATA

DEPTH (R.L.) METRES	Method	Casing, Run	Water
35			
35.10			
35.25			
35.32			
35.40		RC3 CONST	
36			
36.23			
36.55			
37	HQ	RUN 36	
37.06			
37.12			
37.20			
37.23			
37.30		RUN 37	
38.00			
39			
39.03			
39.12			
40			

ROCK SUBSTANCE

GRAPHIC LOG	DESCRIPTION — ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH
	Fine gr. TUFFACEOUS S/S — Includes META-SHALE lamination at 10°	F(s)	S
	Fine grained.	MW	MS
	Fine-medium grained TUFFACEOUS SANDSTONE	F(s)	S
	META-SHALE, brown to dark grey, laminated at 10 to 15°. Includes general TUFFACEOUS S/S laminations.	MW	W / MS
	TUFFACEOUS SANDSTONE, fine grained. Poorly defined bedding at 15 to 20°	SW	
	Grades to fine-medium grained.	F(s)	S
	Fine grained, grading to fine-medium grained with depth.		
	META-SHALE lamination at 10°		

ROCK MASS DEFECTS

DEFECT SPACING (mm): 2000 / 600 / 200 / 60 / 20

VISUAL LOG

DEFECT DESCRIPTION — TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
35.15 – 35.40: 4x's Joints, 50 to 60°, planar rough, Fe st.		
35.55 BOXING BREAK		
35.70 – 35.79: 2x's PARTINGS, 15°, with intersecting JOINT, 75°. All planar, rough, Fe st.		
35.92 JOINT, 45°, planar, rough, Fe st.	60%	
36.05 As above		
36.15 DRILLING BREAK		
36.23 – 36.28: PARTING FRAGMENTS, 15°, planar rough, Fe st		
36.55 BOXING BREAK		
36.60 – 36.92: 2x's Joints, 60 to 70°, with intersecting PARTINGS, 20°. All planar, rough, Fe st.	25%	
37.12 – 37.28: PARTING FRAGMENTS, 10 to 15°, planar, rough, Fe st. (minor shear zone associated with bedding).		
37.45 JOINT, 45°, planar, rough, Fe st.		
37.60 Probable DRILLING BREAK		
38.00 JOINT, 45°, planar, rough, Fe st.		
38.14 PARTING, 10°, planar, rough, minor Fe st.		
38.45 – 38.88: JOINT, 80 to 90°, planar to curved, rough, Fe st.		
38.96 JOINT, 40°, planar, rough, Fe st.		
39.03 HANDLING BREAK	61%	
39.36 BOXING BREAK		
39.26 PARTING, 10°, planar, rough, Fe st.		
40.00 As above		

Remarks: BOX 9 ENDS AT 35.55m BOX 10 ENDS AT 39.36m. — Job / Report No. GN 15A

Logged by: JOHN YOUNG — Date: 28.11.07 — Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 8

Sheet 9 of 10 Sheets

PROJECT TILLEGRA DAM

LOCATION LEFT ABUTMENT, PROPOSED SPILLWAY CREST

CO-ORDINATES E N

R.L. COLLAR DATUM BEARING 060°M INCLINATION 60° from horizontal

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING

CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR

COMMENCED COMPLETED

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
40.60		RUN 31			Interbedded fine grained TUFFACEOUS SANDSTONE with META-SHALE. Laminated to very thinly bedded at 15°		MS/S			40.65 PARTING, 10°, planar, rough, Fe st.		
40.73										40.73 DRILLING BREAK		
										40.78 } 2x's PARTINGS, 10°, planar, rough, Fe st.		
										40.49 } Numerous PARTINGS, 15°, planar, rough, Fe st.		
40.81										40.73		
						F(s)				40.86 JOINT, 60°, planar, rough, Fe st.	80%	
41		RUN 32			TUFFACEOUS SANDSTONE, fine grained.							
							S			41.28 JOINT, 50°, planar, roigh, Fe st.		
										41.42 } 2x's PARTINGS, 10 to 15°, planar, rough, Fe st.		
41.56										41.46		
										41.56 PARTING, 15°, planar, rough, Fe st.		
41.73												
										41.83 Possible DRILLING BREAK.		
41.91					Interbedded META-SHALE with very fine grained TUFFACEOUS SANDSTONE. Laminated to very thinly bedded at 10 to 15°					41.91		
42						HW	VW			PARTING FRAGMENTS, 10°. (crushed from 41.95 to 42.04m and 42.20 to 42.25m). planar, rough, Fe st., clayey in crushed zones (shearing associated with bedding).		
42.08												
42.40	HQ						W/MS			42.40	60%	
42.44										42.47 JOINT, 40°, planar, rough, Fe st.		
		RUN 33			TUFFACEOUS SANDSTONE, fine grained							
						F(s	S					
43												
43.23										43.23 DRILLING BREAK.		
					Interbedded META-SHALE with very fine grained TUFFACEOUS SANDSTONE, dark grey/grey. Laminated at 10 to 15°.							
										43.66 PARTING, 15°, planar, rough, minor Fe st.		
43.78										43.72 } Several JOINTS, 70 to 90°, planar, rough, Fe st.		
					TUFFACEOUS SANDSTONE, fine grained							
43.97												
44					Includes elongate clasts to 50 mm.							
44.14										44.13		
										44.22 BOXING BREAK		
		RUN 34			Fine grained.					44.45 JOINT, 60°, planar, rough, Fe st, carbonate fill 1mm thick	65%	
45.										44.91 ↓ See over		

Remarks: BOX 11 ENDS AT 43.23 | Job / Report No. GN 25A

Logged by: JOHN YOUNGS | Date: 28.11.07 | Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 8 Sheet 1 of 1 Sheets

PROJECT TILLEGRA DAM
LOCATION LEFT ABUTMENT, PROPOSED SPILLWAY CREST
CO-ORDINATES E N
R.L. COLLAR DATUM BEARING 060°M INCLINATION 60° from horizontal
DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED
CORE BARRELL HQ TRIPLE DRILLER SHAUN COMPLETED

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS					
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
45					TUFFACEOUS SANDSTONE continues, fine grained.	F(d)	S			Several intersecting Joints, 70° and 50 to 60°, planar, rough, fest.		
45.22					Includes elongate angular META-SHALE clasts to 40mm.					45.38		
45.33												
45.38												
					META-SHALE, dark grey, laminated at 10 to 15°					45.60 Joint, 65°, planar, rough, carbonate coated.		
										45.76 Probable PARTING, 10°, planar, rough, carbonate coated.		
										45.87 JOINT, 60°, planar, rough, carbonate coated		
46										46.05 PARTING, 10°, planar, smooth.	72%	
										46.10 HANDLING BREAK		
										46.13 BOXING BREAK		
46.23						F	MS/S			46.23 Probable DRILLING BREAK		
										46.43 } 2x 5° PARTINGS, 15°, planar, rough, minor carbonate coating.		
										46.50		
										46.72 Several Joints, 50 to 70°, planar, rough to smooth, carbonate coated.		
46.89	HQ	RUN 36										
47										47.15		
47.27					TUFFACEOUS SANDSTONE, very fine gr., mid grey. Includes subrounded META-SHALE clasts towards 47.43		S			47.30 Possible PARTING, 10°, planar, rough, minor carbonate coating	55%	
47.43		RUN 37										
					META-SHALE, dark grey, laminated at 10 to 15°		MS/S			47.64 } DRILLING BREAKS		
47.64										47.68		
47.87					TUFFACEOUS SANDSTONE, fine gr., dark grey		S			47.93 Possible PARTING, 10°, planar, rough, minor carbonate coating		
47.93					META-SHALE, lam. at 10 to 15		MS/S					
48.05					TUFFACEOUS SANDSTONE, v. fine to fine gr., mid grey		S			48.13 As above		
48.22										48.23 DRILLING BREAK		
					META-SHALE, dark grey, laminated at 10 to 15°. Includes occasional very fine-grained TUFFACEOUS SANDSTONE laminations.					48.56 Possible PARTING, 60° planar, rough, minor carbonate coating	60%	
		RUN 38								48.67 } Intersecting Joints, 60°, planar, rough, carbonate coated		
							MS/S			48.92		
49										48.96 Possible PARTING, 10°, planer, rough, minor carbonate coating		
										49.05 Joint, 65°, planar, rough, carbonate coated.		
49.18					CORE LOSS 0.05m - left down hole					49.18 DRILLING BREAK		
49.23					HOLE ENDS AT 49.23m							
50												

Remarks: BOX 12 ENDS AT 46.95m BOX 13 ENDS AT 49.23m END OF HOLE | Job / Report No.

Logged by: JOHN YOUNG | Date: 5.12.07 | Site Supervisor MARK ASHOVER

TILLEGRA DAM
BOREHOLE: DDH 8
DEPTH: 1.50 — 5.00 M
TILLEGRA DAM
DDH 8
1·50
CORE LOSS
0·10m.
1·75
CORE LOSS (0·25m)
2·25
2·43
2·68
3·47
4·05
4·20

TILLEGRA DAM
BOREHOLE: DDH 8
DEPTH: 5.00 — 12.30 M
5·35
6·41
7·23
CORE
LOSS
0·05
8·18
9·18
9·54
10·23

TILLEGRA DAM
BOREHOLE: DDH 8
DEPTH: 12.30 — 19.83 M
12.50
13.08
13.23
14.56
SPACER
(15.90)
16.23
19.23

TILLEGRA DAM
BOREHOLE: DDH 8
DEPTH: 19.83 — 27.70 M
22.23
25.23
27.70
100%
WATER
LOSS

TILLEGRA DAM
BOREHOLE: DDH 8
DEPTH: 27.70 — 35.55 M
28.23
CORE LOSS 0.05
30.76
31.23
33.65
34.23

TILLEGRA DAM
BOREHOLE: DDH 8
DEPTH: 35.55 — 43.23 M
36.13
37.23
40.23
SPACER
41.56
43.23

TILLEGRA DAM
BOREHOLE: DDH 8
DEPTH: 43.23 — 49.23 M
4623
4633
4687
4764
0-05 DOWN HOLE
49.23
END DDH 8

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 9
Sheet 1 of 12 Sheets

PROJECT TILLEGRA DAM
LOCATION QUARRY AREA B
CO-ORDINATES E N
R.L. COLLAR
DATUM
BEARING —
INCLINATION VERTICAL

DRILL DELTA 2000, TRACK MOUNTED
CONTRACTOR McDERMOTT DRILLING
COMMENCED
CORE BARRELL HQ TRIPLE
DRILLER SHAUN TAYLOR
COMPLETED 13.2.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
0					NON CORE							
1												
1.40					CORING COMMENCES AT 1.40m							
1.52	HQ	RUN 1			TUFFACEOUS SANDSTONE, fine grained, grey-brown.	MW/SW	S			1.40 PARTING FRAGMENTS, 15°, with Joints, 45°, planar, rough, Fe/Mn st.	100%	
2		RUN 2								2.10 DRILLING BREAK		
2.62										2.42 Several Joints, 50 to 75°, with associated PARTINGS, 15°, planar, rough, Fe st, clay coated to 1/2 1mm thick. 2.76	80%	
3.00		RUN 4								3.00 DRILLING BREAK		
3.20										3.20 Joint, 60°, planar, rough, Fe st.		
3.32										3.30 As above.		
3.46					3.32m META-SHALE, brown/grey-brown, laminated at 10 to 15°					3.46 Several JOINTS, 65 to 70°, with associated PARTINGS, 15°, planar, rough, Fe st. Clay fill in 70° Joint to 5mm thick.	44%	
3.76					3.76m	MW	MS					
3.95		RUN 5			TUFFACEOUS SANDSTONE, fine grained, grey-brown	MW/SW	S			4.15		
4.35					4.39m					4.35 Joint, 50°, planar, rough, Fe/Mn st.	55%	
4.48		RUN 6			Grey from 4.25m					4.48 DRILLING BREAK		
4.65					4.65m Very coarse band	F(6)	S/VS			4.67 HANDLING BREAK		
4.75					4.75m Fine-medium gr., grey					4.86 BOXING BREAK		
5												

Remarks: BOX 1 ENDS AT 4.86m
Job / Report No. GN 25A

Logged by: JOHN YOUNG
Date: 15.2.08
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 9
Sheet 1 of 12 Sheets

PROJECT TILLEGRA DAM
LOCATION QUARRY AREA B
CO-ORDINATES E N
R.L. COLLAR
DATUM
BEARING —
INCLINATION VERTICAL

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR
COMMENCED
COMPLETED 13.2.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
5.05					TUFF. S/S. continues as above	EW	S/VS					
					5.07m					5.15 } 2 x 's PARTINGS, 10°, planar, rough, Fe/Mn st.		
					META-SHALE, greybrown, laminated at 10 to 15°	SW	MS					
5.40					5.40 m							
					TUFFACEOUS SANDSTONE, fine to medium grained with depth, grey.					5.66 DRILLING BREAK		
										5.82 BOXING BREAK		
6.00	HQ	RUN 6 CONTINUED				F(S)	S/VS			6.00 DRILLING BREAK		
		RUN 7										
6.80										6.80 JOINT, 60°, planar, rough, Fe/Mn st.		
6.91					6.91m		S					
7					META-SHALE, greybrown, thinly laminated/laminated at 10°	MW	MS			7.00 } JOINT, 45 & 65° / PARTING, 10 to 15°, FRAGMENTS, planar, rough, Fe/Mn st		
7.31					7.31m					7.30		
							S			7.45 } 2 x 's PARTINGS, 10°, with JOINT, 45°; planar, rough, Fe st.		
7.55					TUFFACEOUS SANDSTONE, fine grained, grey					7.55		
						F(S)				7.66 JOINT, 30°, planar, rough, Fe st.		
7.81										7.81 PARTING, 15°, planar, rough, Fe st		
						SW						
8 8.05										8.00 DRILLING BREAK		
										8.31 PARTING, 15°, planar, rough, Fe st.		
						F(S)	S/VS			8.70 BOXING BREAK		
9.00					9.00 m					9.00 } Several JOINTS, 60 to 80°, planar, rough, Fe/Mn st.		
					Grey/greybrown					9.35		
9.30					9.30 m							
					Grey.							
9.50		RUN 8			9.50m					9.60 JOINT, 50°, planar, rough, Fe/Mn st.		
					Greybrown					9.71 BOXING BREAK		
						MW/SW				9.75 } Numerous JOINTS, 50°, planar, rough, Fe/Mn st.		
10										10.00		

Remarks: BOX 2 ENDS AT 8.70m
Job / Report No. GN 25A

Logged by: JOHN YOUNG
Date: 15.2.08
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 9

Sheet 3 of 12 Sheets

PROJECT TILLEGRA DAM

LOCATION QUARRY AREA B

CO-ORDINATES E N

R.L. COLLAR DATUM BEARING —— INCLINATION VERTICAL

DRILL DELTA 1000, TRACK MOUNTED CONTRACTOR

CORE BARRELL HQ TRIPLE DRILLER

COMMENCED COMPLETED 13.2.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
10.03		S		10.03m Greybrown to 10.07m							
10.08				TUFFACEOUS SANDSTONE continues, fine grained, grey					10.08 DRILLING BREAK		
					$F_{(s)}$				10.47 JOINT, 55°, planar, rough, Fe/Mn st.		
									10.58 BOXING BREAK		
10.70				10.70 m					10.70		
				Greybrown	MW/SW				3x's JOINTS, 50 to 60°, planar, rough, Fe st.		
10.95				10.95m		S/VS			10.95		
11		RUN 9								88%	
	HQ			Grey.	$F_{(s)}$				11.50 JOINT, 40°, planar, rough, Fe/Mn st.		
									11.60 BOXING BREAK		
									11.73 JOINT, 50°, planar, rough, Fe/Mn st.		
11.80				11.80 m							
12.00				Greybrown/brown	MW	S			12.00		
									Numerous JOINTS, 30 to 50°, planar, rough, Fe/Mn st.		
		RUN 10								0%	
12.95											
13									13.45		
									13.60 PARTING, 15°, planar, rough, Fe/Mn st.		
									13.67 3x's JOINTS, 50°, planar, rough, Fe/Mn st.		
				Fine grained TUFFACEOUS SANDSTONE continues. (to 15.10m)					13.85		
		RUN 11							13.96 JOINT FRACTURES, 30 to 75°, planar, rough, Fe/Mn st. (sheared)	50%	
14									14.29		
									14.40 JOINT, 60°, planar, rough, Fe/Mn st.		
									14.75 3x's JOINTS, 50 to 70°, planar, rough, Fe/Mn st.		
15.00									15.00		

Remarks: BOX 3 ENDS AT 12.50m

Job / Report No. GN25A

Logged by: JOHN YOUNG

Date: 15.2.08

Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 9

Sheet 4 of 12 Sheets

PROJECT TILLEGRA DAM
LOCATION QUARRY AREA B
CO-ORDINATES E N
R.L. COLLAR
DATUM
BEARING —
INCLINATION VERTICAL

DRILL DELTA 1000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED 13.2.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
15 (15.10)					TUFFACEOUS SANDSTONE continues, medium/coarse grained from 15.10m, grey							
15.40					15.43m Very coarse band					15.32 Boring break 15.42 Drilling break		
15.70					15.70m (bedding 10°)	F(s)	S/Hs			15.55 Joint, 60°, planar, rough, Fe st. 15.66 Parting, 10°, planar, rough, Fe st.		
16					Fine grained, grey.					15.82 } 2 x's Joints, 50°, planar, rough, Fe st. 15.92 }		
										16.22 } Several Joints, 50 to 70°, planar, rough, Fe/Mn st. 16.42 }	47%	
16.55					16.55m Coarse band							
16.68					16.68m					16.72 Joint, 65°, planar, rough, Fe/Mn st		
17		RUN 12			Fine to fine-medium gr. with depth, grey.					17.10 Joint, 55°, as above 17.20 As above		
17.45					17.45m Coarse band							
17.54					17.54m					17.54 Parting, 10°, planar, rough, Fe st.		
18.00					Fine to fine-medium grained with depth, grey.					18.00 } Joint, 65°, with Parting, 15°, planar, rough, Fe/Mn st. 18.12 }		
										18.31 Joint, 45°, planar, rough, Fe/Mn st.		
18.40					18.40m							
18.45					18.45m Medium-coarse							
18.50		RUN 13			18.50m META-SHALE lamination at 10°					18.50 Parting, 10°, planar, rough, Fe/Mn st.		
					Fine grained, grey							
18.88					18.88m Greybrown from 18.88m to 19.10m	MW/SW				18.88 As above		
19.00					19.00m META-SHALE lamination at 15°					19.00 } Joint, 60°, with Parting, 15°, planar, rough, Fe/Mn st. 19.10 }	52%	
19.10					19.10m							
					Fine grained, grey.					19.32		
19.42					19.42m META-SHALE, grey-brown, laminated at 5/15°					Numerous Joints, 50 to 65°, with associated Partings, 15°, planar, rough, Fe/Mn st.		
19.53					19.53m TUFF. S/S, fine grained, grey.							
19.84					19.84m META-SHALE lam. at 15°							
19.93					19.93m Grey, Greybrown/brown	MW	MS					
20												

Remarks: Box 4 ENDS AT 16.32m

Job / Report No. GN25A

Logged by: JOHN YOUNGS Date: 15.2.08 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 9
Sheet 5 of 12 Sheets

PROJECT TILLEGRA DAM
LOCATION QUARRY AREA B
CO-ORDINATES E N
R.L. COLLAR
DATUM
BEARING
INCLINATION VERTICAL

DRILL DELTA 2000, TRACK MOUNTED
CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE
DRILLER SHAUN TAYLOR
COMMENCED
COMPLETED 13.2.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
20.07					TUFFACEOUS SANDSTONE, fine grained, brown.	MW				As above		
20.36					20.36m				20.29		21%	
	HQ	RUN 14			METH-SHALE, brown/ greybrown/grey, banded. Thinly laminated/ laminated at 10 to 15°	MW/SW			20.60	Numerous Joints, 60° (across bedding) and PARTINGS, 10 to 15°, planar, rough, Fe/Mn st.		
21.08		RUN 15							21.15		72%	
21.60							MS		21.42	As above		
21.73					21.72m				21.65			
22		RUN 16			TUFFACEOUS SANDSTONE, fine-medium grained, brown.	MW			21.80	As above	17%	
22.13					22.12m							
22.63		RUN 17			METH-SHALE, brown/ greybrown/grey, banded. Thinly laminated/ laminated at 10 to 15°.				23.15		0%	
23						MW/SW			23.26	As above		
23.15		RUN 18							23.48		20%	
23.98									23.62	As above		
24		RUN 19			Includes occasional very thin TUFFACEOUS SANDSTONE interbeds, fine grained.						12%	
23.84												
25		TD										

Remarks: BOX 5 ENDS AT 20.07m BOX 6 ENDS AT 23.72m
Job / Report No. GN 25A

Logged by: JOHN YOUNG
Date: 15.2.08
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 9
Sheet 6 of 12 Sheets

PROJECT TILLEGRA DAM
LOCATION QUARRY AREA B
CO-ORDINATES E N
R.L. COLLAR
DATUM
BEARING —
INCLINATION VERTICAL

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED 13.2.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
25					META-SHALE continues as above.	MW/SW	MS			As above		
25.64					25.64					25.64	44%	
26	HQ	RUN 20 CONTINUED			TUFFACEOUS SANDSTONE, fine grained, grey.					26.00 Possible PARTING, 10°, planar, rough (may be drilling induced)		
										26.18 As above		
										26.57 DRILLING BREAK		
										26.77 Possible PARTING, 18°, planar, rough		
										26.88 DRILLING BREAK		
27.00						F	S/VS			27.00 DRILLING BREAK		
		RUN 21								27.38 BOXING BREAK		
										27.54 DRILLING BREAK		
28										27.90 JOINT, 70°, planar, rough, minor carbonate coating		
										28.37 BOXING BREAK	100%	
28.60					28.60m META-SHALE laimination at 15°					28.60 Probable DRILLING BREAK		
29										29.00 JOINT, 75°, planar, rough, minor carbonate coating.		
					Fine grained TUFFACEOUS SANDSTONE continues.					29.36 BOXING BREAK		
										29.71 DRILLING BREAK		
										29.97 JOINT, 60°, planar, rough		
30.00										30.00 As above		

Remarks: BOX 1 ENDS AT 27.38m
Job / Report No. GN 25A

Logged by: JOHN YOUNG
Date: 15.2.08
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 9

Sheet 7 of 12 Sheets

PROJECT TILLEGRA DAM

LOCATION QUARRY AREA B

CO-ORDINATES E N

R.L. COLLAR DATUM BEARING — INCLINATION VERTICAL

DRILL DELTA 7000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING COMMENCED

CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR COMPLETED 13.2.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
30					30.01 META-SHALE laminations at 10°							
										30.20 Possible PARTING, 10°, planar, rough, minor carbonate coating.		
										30.35 BOXING BREAK		
					TUFFACEOUS SANDSTONE continues, fine grained, grey.							
31						F	S1/S				100%	
		RUN 22								31.35 BOXING BREAK		
										31.80 Possible PARTING, 15°, planar, rough		
31.90	HQ					—						
32										32.03 PARTING, 20°, planar, rough, Fest.		
										32.20 Possible PARTING, 20°, planar, rough, minor Fe st.		
32.37					32.37m META-SHALE laminations at 15°					32.37 PARTING, 15°, planar, rough, minor Fe st		
32.42					32.48m							
					Medium grained TUFF. SANDSTONE from 32.48m, grey.					32.71 Intersecting JOINTS, 45 and 60°, planar, rough, minor Fe st.		
32.88					32.88m META-SHALE clast					32.88 Probable DRILLING BREAK		
33.00										33.00 DRILLING BREAK		
						F(s)						
					Medium to very coarse grained with depth.					33.37 BOXING BREAK		
		RUN 23								33.79 PARTING, 20°, planar, rough, Fest.		
34										33.95 Probable DRILLING BREAK		
										34.15 HANDLING BREAK		
34.30					34.30m					34.34 BOXING BREAK		
					TUFFACEOUS SANDSTONE, fine grained, grey							
										34.61 PARTING, 20°, planar, rough, Fest.		
35												

Remarks: BOX 8 ENDS AT 31.35m

Job / Report No. GN25A

Logged by: JOHN YOUNG

Date: 15.2.08

Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 9

Sheet 8 of 12 Sheets

PROJECT TILLEGRA DAM
LOCATION QUARRY AREA B
CO-ORDINATES E N
R.L. COLLAR
DATUM
BEARING
INCLINATION VERTICAL

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR
COMMENCED
COMPLETED 13.2.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
35					Fine grained TUFFACEOUS SANDSTONE continues.							
										35.30 PARTING, 5°, planar, rough, Fe st.		
35.54		RUN 7 continued			35.54m META-SHALE lamination at 5°					35.54 Possible PARTING, 5°, planar, rough.	100%	
										35.97 DRILLING BREAK		
36.00												
										36.32 BOXING BREAK		
						$F_{(s)}$						
										36.67 Possible PARTING, 15°, planar, rough.		
36.88	HQ				36.88m META-SHALE lamination at 10°					36.88 PARTING, 5°, planar, rough, Fe st.		
37										37.04 Possible PARTING, 10°, planar, rough		
							S/VS			37.14 Intersecting JOINTS, 50 and 30°, planar, rough, Fe st.		
										37.31 BOXING BREAK		
		RUN 8								37.55 PARTING, 5°, planar, rough, partly Fe st.	100%	
37.69										37.76 Possible PARTING, 10°, planar, rough.		
38												
					Fine grained TUFFACEOUS SANDSTONE continues.					38.34 BOXING BREAK		
						F				38.66 JOINT, 60°, planar, rough, minor carbonate coating.		
39.00										39.00 DRILLING BREAK		
		RUN 9								39.30 BOXING BREAK		
										39.48 HANDLING BREAK		
39.85					39.85m META-SHALE lamination at 10°					39.85 JOINT, 60°, planar, rough.		
40												

Remarks: BOX 9 ENDS AT 35.30m BOX 10 ENDS AT 39.30m
Job / Report No. GN 25A

Logged by: JOHN YOUNG Date: 16.2.08 Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 9

Sheet 9 of 12 Sheets

PROJECT TILLEGRA DAM
LOCATION QUARRY AREA B
CO-ORDINATES E N
R.L. COLLAR
DATUM
BEARING
INCLINATION VERTICAL

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR
COMMENCED
COMPLETED 13.2.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
40					Fine grained TUFFACEOUS SANDSTONE continues, grey					40.05 } 2x's JOINTS, 50°, planar, rough. 40.12		
										40.26 BOXING BREAK		
										40.32 JOINT, 60°, planar, rough		
40.50					40.50m							
					Fine - medium to coarse grained with depth (to 40.90m)					40.60 JOINT, 45°, as above		
										40.71 } 2x's JOINTS, 50 and 45°, as above 40.77		
										40.81 HANDLING BREAK		
40.90					40.90m							
41												
		RUN 1 CONTINUED			Fine to coarse grained with depth (40.90 to 41.55)					41.25 BOXING BREAK	98%	
						F	S/W					
41.55					41.55m Fine grained							
41.68	10				41.69m META-SHALE clasts							
					Fine gr. Tuff. s/s continues							
42.00										41.96 DRILLING BREAK		
										42.15 BOXING BREAK		
										42.36 JOINT, 60°, planar, rough		
42.50					42.50m							
		RUN 2			Medium grained							
43												
										43.16 BOXING BREAK		
43.25					43.25m						100%	
					Fine grained					43.42 JOINT, 45°, planar, rough, Fe st		
43.55					43.55m							
					Medium grained					43.87 JOINT, 50°, planar, rough, Fe/Mn st, minor carbonate coating		
44						F(s)						
44.13					44.13					44.15 BOXING BREAK		
					Fine grained					44.34 JOINT, 45°, planar, rough, Fe st		
										44.70 Several JOINTS, 45 to 75°, planar, rough, Fe st.		
45.00												

Remarks: BOX 11 ENDS AT 43.16m
Job / Report No. GN 25A

Logged by: JOHN YOUNG
Date: 16.2.08
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 9
Sheet 1 of 2 Sheets

PROJECT TILLEGRA DAM
LOCATION QUARRY AREA B
CO-ORDINATES E N
R.L. COLLAR
DATUM
BEARING —
INCLINATION VERTICAL

DRILL DELTA 7000, TRACK MOUNTED
CORE BARRELL HQ TRIPLE
CONTRACTOR McDERMOTT DRILLING
DRILLER SHAUN TAYLOR
COMMENCED
COMPLETED 13.2.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
45 45.10					Fine gr. TUFF, sfs, continues 45.10m					45.10 ↕ See above 45.16 BOXING BREAK 45.25 JOINT, 40°, planar, rough (may be drilling induced)		
					Medium to very coarse grained with depth.					45.50 As above 45.73 JOINT, 45°, planar, rough, Fast		
46		RUN 27				F(s)				46.08 As above 46.20 As above		
46.22	HQ				46.22m Fine grained.		S/HS			46.67 DRILLING BREAK	100%	
47										47.05 BOXING BREAK 47.18 PARTING, 15°, planar, very rough, Fast		
										47.6 ↕ PARTING, 15° and JOINT, 70°, planar, rough, Fast. 47.84		
48.00										48.00 DRILLING BREAK		
48.40		RUN 28			48.40m Medium grained							
48.50					48.50m Grades to pale grey from 48.50m, medium to coarse grained with depth.					48.66 ↕ JOINT/PARTING FRAGMENTS, (crushed zone, core fragmented), planar, rough/very rough 48.84	85%	
49										48.97 Possible PARTING, 70°, planar, rough 49.03 As above 49.26 As above		
49.85					49.85m Fine-medium gr. (pale grey)					49.95 BOXING BREAK		
50												

Remarks: BOX 12 ENDS AT 47.05m
Job / Report No. GN 25A

Logged by: JOHN YOUNG
Date: 16.2.08
Site Supervisor MARK ASHOVER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 9
Sheet 11 of 17 Sheets

PROJECT TILLEGRA DAM
LOCATION QUARRY AREA B
CO-ORDINATES E N
R.L. COLLAR
DATUM
BEARING —
INCLINATION VERTICAL

DRILL DELTA 2000, TRACK MOUNTED CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE DRILLER SHAUN TAYLOR
COMMENCED
COMPLETED 13.2.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
50					TUFFACEOUS SANDSTONE continues as above, fine-medium grained, pale grey.							
50.40	HQ	RUN 29								50.35 PARTING, 20°, planar, rough, Fe st.	75%	
										50.76 } 3x's possible PARTINGS, planar, rough (may be drilling induced), 15°, slickensided. 50.89 } 50.96 }		
51.00												
		RUN 30								51.30 2x's possible PARTINGS, 15°, planar, rough, slickensided.		
										51.56 JOINT, 60°, planar, rough		
										51.71 PARTING, 10°, planar, rough, Fe st.		
						F(s)	S/W			51.93 JOINT, 50, planar, smooth		
52											100%	
52.70					52.70 m Very coarse grained band.					52.74 PARTING, 15°, planar, rough, slickensided.		
										52.88 JOINT, 50°, planar, very rough		
53.00					53.00 m					53.09 BOXING BREAK		
										53.20 Probable DRILLING BREAK		
					Fine/fine-medium gr., pale grey.							
										53.68 } 2x's JOINTS, 50°, planar, rough, lower Fe st. 53.79 }		
54.00										54.00 JOINT, 55°, planar, rough, Fe st.		
		RUN 31								54.21 PARTING, 10°, planar, rough, Fe st	87%	
										54.38 JOINT, 60°, planar, rough, slickensided.		
										54.57 } Several JOINTS, 50 to 60°, planar, rough. 54.76 }		
										54.82 PARTING, 10°, planar, rough, Fe st.		
55												

Remarks: Box 13 ENDS AT 50.76m Box 14 ENDS AT 54.82m
Job / Report No. GN 25A

Logged by: JOHN YOUNG Date: 17.2.08 Site Supervisor MARK ASHCHER

NSW Department of Commerce

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
ENGINEERING GEOLOGY BOREHOLE LOG

BOREHOLE No. DDH 9
Sheet 12 of 12 Sheets

PROJECT TILLEGRA DAM
LOCATION QUARRY AREA B
CO-ORDINATES E N
R.L. COLLAR
DATUM
BEARING —
INCLINATION VERTICAL

DRILL DELTA 2000, TRACK MOUNTED
CONTRACTOR McDERMOTT DRILLING
CORE BARRELL HQ TRIPLE
DRILLER SHAUN TAYLOR
COMMENCED
COMPLETED 13.2.08

DRILLING DATA				ROCK SUBSTANCE				ROCK MASS DEFECTS				
DEPTH (R.L.) METRES	Method	Casing, Run	Water	GRAPHIC LOG	DESCRIPTION ROCK TYPE Grainsize, texture, colour, composition, structure, hardness	WEATHERING	ESTIMATED STRENGTH	DEFECT SPACING (mm) 2000 600 200 60 20	VISUAL LOG	DEFECT DESCRIPTION TYPE Inclination, planarity, roughness, coatings or infillings	R.Q.D.	TESTS
55												
55.18		45%			TUFFACEOUS SANDSTONE continues, fine to fine-medium gr., pale grey.					55.00 DRILLING BREAK 55.10 } 2x's PARTINGS, 15 and 26°, planar, smooth, Fe st 55.18 } 55.28 } 55.33 } 2x's JOINTS, 45°, planar, smooth 55.40 55.75 BOXING BREAK		
56		RUN 37									100%	
56.45					56.45m META-SHALE laminations at 15°	F(s)	S/VS			56.45 PARTING, 15°, planar, rough 56.80 BOXING BREAK 56.95 JOINT, 60°, planar, rough, Fe st 57.00 DRILLING BREAK 57.11 As above 57.20 JOINT, 60°, planar, rough, Fe st.		
57.00												
	HQ									57.76 BOXING BREAK		
58										58.17 JOINT, 60°, planar, rough, Fe/Mn st. 58.44 As above 58.54 BOXING BREAK	100%	
		RUN 38										
59										59.65 JOINT, 45°, planar, rough, Fe st. 59.72 As above		
60.00					HOLE ENDS AT 60.00m					60.00 JOINT, 60°, planar, smooth.		

Remarks: BOX 15 ENDS AT 58.54m BOX 16 ENDS AT 60.00m & END OF HOLE
Job / Report No. GN254

Logged by: JOHN YOUNG
Date: 17.2.08
Site Supervisor MARK ASHOVER

TILLEGRA DAM
BOREHOLE: DDH 9
DEPTH: 1.40 — 8.70 M
TILLEGRA DAM
DDH 9
1·40
1·52
2·62
3·00
3·76
4·84
6·00

TILLEGRA DAM
BOREHOLE: DDH 9
DEPTH: 8.70 — 16.32 M
9·00
10·08
12·00
12·95
15·00

TILLEGRA DAM
BOREHOLE: DDH 9
DEPTH: 16.32 — 23.72 M
SPACER
18:00
20:07
21:00
21:60
22:63
23:15

TILLEGRA DAM
BOREHOLE: DDH 9
DEPTH: 23.72 — 31.35 M
23:98
24:84
RE-CORED TO → 27 m
27:00
30:00

TILLEGRA DAM
BOREHOLE: DDH 9
DEPTH: 31.35 — 39.30 M
33·00
SPACER
SPACER
(35·30)
36·00
39·00

TILLEGRA DAM
BOREHOLE: DDH 9
DEPTH: 39.30 — 47.05 M
42·00
SPACER
45·00
SPACER

TILLEGRA DAM
BOREHOLE: DDH 9
DEPTH: 47.05 — 54.82 M
48·00
50·40
51·00
SPACER
54·00

TILLEGRA DAM
BOREHOLE: DDH 9
DEPTH: 54.82 — 60.00 M
55·18
57·00
SPACER
(58·54m)
60·00
END DDH 9

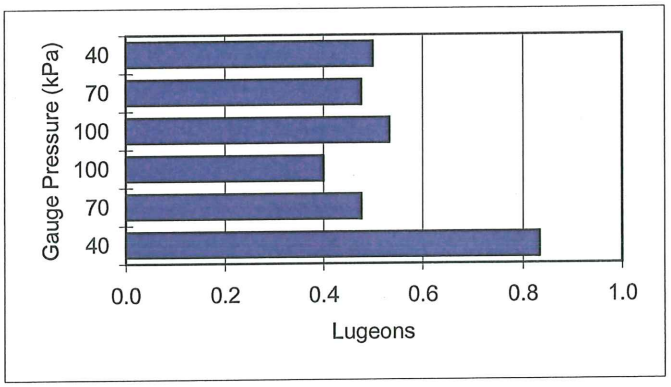
APPENDIX E

Water Pressure Test Results

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: **DDH 1** Test 1 of 11

PROJECT: TILLEGRA DAM SITE LOCATION: RIGHT ABUTMENT SPILLWAY	RL (m) BEARING 090° INCLINATION 60°	SECTION DEPTH (m) From 8.70 to 11.70 LENGTH OF SECTION (m) 3.00
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 7.8	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 250 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 70, 100, 175	GROUNDWATER DEPTH (m) - DATE	TIME AT START 13.00 TIME AT FINISH 14.30 TOTAL TEST TIME(hrs) 1.50

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	40	0.2	0.7	0.5	0.1	0.03	0.8
5	70	0.8	1.3	0.5	0.1	0.03	0.5
5	100	1.5	2.1	0.6	0.1	0.04	0.4
5	100	2.1	2.9	0.8	0.2	0.05	0.5
5	70	2.9	3.4	0.5	0.1	0.03	0.5
5	40	3.5	3.8	0.3	0.1	0.02	0.5

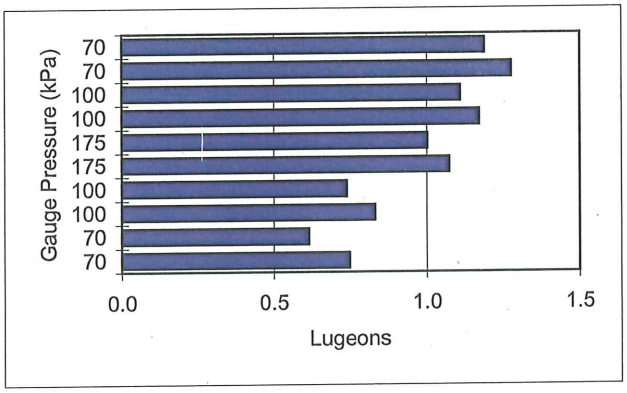


COMMENTS	REPRESENTATIVE LUGEON VALUE: **< 1** FLOW TYPE: LAMINAR
SITE SUPERVISOR M.ASHOVER DATE 10-Dec-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: **DDH 1** Test 2 of 11

PROJECT: TILLEGRA DAM SITE LOCATION: RIGHT ABUTMENT SPILLWAY	RL (m) BEARING 090° INCLINATION 60°	SECTION DEPTH (m) From 11.20 to 17.70 LENGTH OF SECTION (m) 6.50
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 7.8	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 250 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 70, 100, 175	GROUNDWATER DEPTH (m) - DATE	TIME AT START 7.45 TIME AT FINISH 9.45 TOTAL TEST TIME(hrs) 2.00

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	70	0.6	2.3	1.7	0.3	0.05	0.7
5	70	2.3	3.7	1.4	0.3	0.04	0.6
5	100	4.1	6.8	2.7	0.5	0.08	0.8
5	100	6.8	9.2	2.4	0.5	0.07	0.7
5	175	10.4	16.5	6.1	1.2	0.19	1.1
5	175	16.5	22.2	5.7	1.1	0.18	1.0
5	100	22.9	26.7	3.8	0.8	0.12	1.2
5	100	26.7	30.3	3.6	0.7	0.11	1.1
5	70	30.8	33.7	2.9	0.6	0.09	1.3
5	70	33.7	36.4	2.7	0.5	0.08	1.2

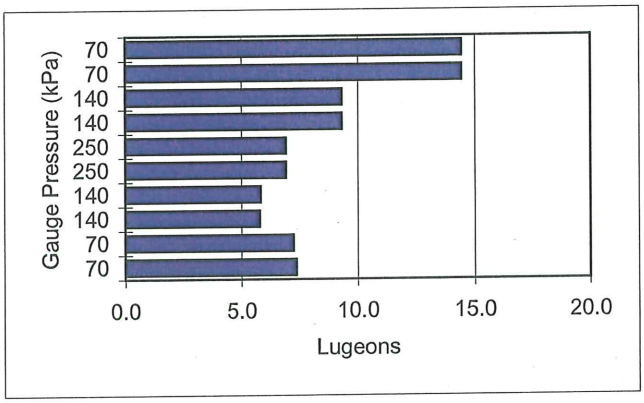


COMMENTS	REPRESENTATIVE LUGEON VALUE: **1.0** FLOW TYPE: LAMINAR
SITE SUPERVISOR M.ASHOVER DATE 11-Dec-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: **DDH 1** Test 3 of 11

PROJECT: TILLEGRA DAM SITE LOCATION: RIGHT ABUTMENT SPILLWAY	RL (m) BEARING 090° INCLINATION 60°	SECTION DEPTH (m) From 17.20 to 24.03 LENGTH OF SECTION (m) 6.83
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 7.8	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 250 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 70, 140, 250	GROUNDWATER DEPTH (m) - DATE	TIME AT START 14.30 TIME AT FINISH 16.15 TOTAL TEST TIME(hrs) 1.75

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	70	3.0	20.6	17.6	3.5	0.52	7.4
5	70	20.6	37.9	17.3	3.5	0.51	7.2
5	140	41.0	68.7	27.7	5.5	0.81	5.8
5	140	68.7	96.6	27.9	5.6	0.82	5.8
5	250	107.0	166.0	59.0	11.8	1.73	6.9
5	250	166.0	225.0	59.0	11.8	1.73	6.9
5	140	231.0	275.5	44.5	8.9	1.30	9.3
5	140	275.5	320.0	44.5	8.9	1.30	9.3
5	70	324.0	358.5	34.5	6.9	1.01	14.4
5	70	358.5	393.0	34.5	6.9	1.01	14.4

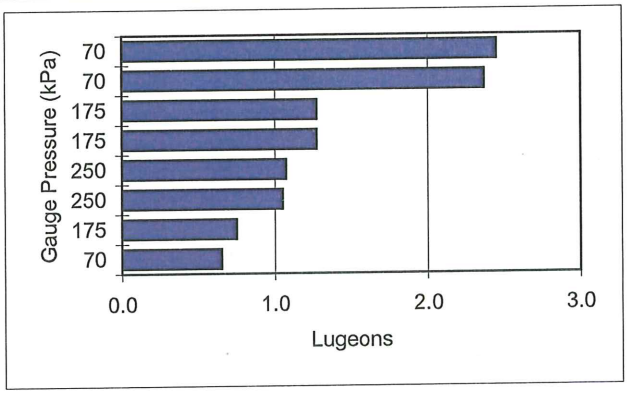


COMMENTS	REPRESENTATIVE LUGEON VALUE: **14** FLOW TYPE: WASHOUT (Turbulent Flow)
SITE SUPERVISOR M.ASHOVER DATE 11-Dec-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: **DDH 1** Test 4 of 11

PROJECT: TILLEGRA DAM SITE LOCATION: RIGHT ABUTMENT SPILLWAY	RL (m) BEARING 090° INCLINATION 60°	SECTION DEPTH (m) From 23.20 to 26.70 LENGTH OF SECTION (m) 3.50
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 7.8	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 250 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 70, 175, 250	GROUNDWATER DEPTH (m) - DATE	TIME AT START 10.15 TIME AT FINISH 12.15 TOTAL TEST TIME(hrs) 2.00

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	70	0.5	1.3	0.8	0.2	0.05	0.7
5	175	1.7	4.0	2.3	0.5	0.13	0.8
5	250	4.6	9.2	4.6	0.9	0.26	1.1
5	250	9.2	13.9	4.7	0.9	0.27	1.1
5	175	14.7	18.6	3.9	0.8	0.22	1.3
5	175	18.6	22.5	3.9	0.8	0.22	1.3
5	70	23.0	25.9	2.9	0.6	0.17	2.4
5	70	25.9	28.9	3.0	0.6	0.17	2.4



COMMENTS	REPRESENTATIVE LUGEON VALUE: **2.5** FLOW TYPE: WASHOUT
SITE SUPERVISOR M.ASHOVER DATE 17-Dec-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: **DDH 1** Test 5 of 11

PROJECT: TILLEGRA DAM SITE LOCATION: RIGHT ABUTMENT SPILLWAY	RL (m) BEARING 090° INCLINATION 60°	SECTION DEPTH (m) From 26.20 to 32.70 LENGTH OF SECTION (m) 6.50
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 7.8	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 400 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 100, 200, 300	GROUNDWATER DEPTH (m) - DATE	TIME AT START 14.30 TIME AT FINISH 16.15 TOTAL TEST TIME(hrs) 1.75

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	100	0.1	0.1	0.0	0.0	0.00	0.0
5	200	0.3	0.3	0.0	0.0	0.00	0.0
5	300	0.5	0.6	0.1	0.0	0.00	0.0
5	300	0.6	0.7	0.1	0.0	0.00	0.0

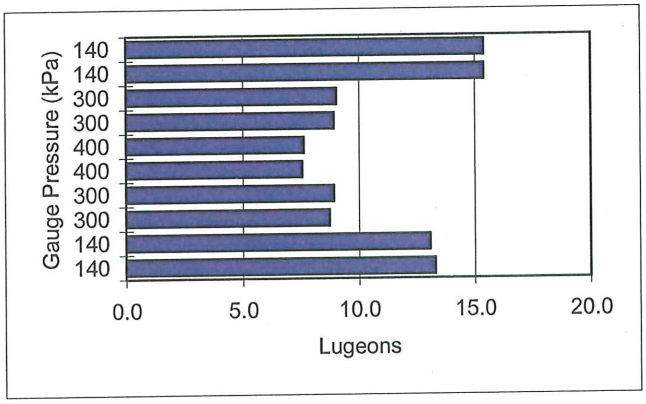
COMMENTS	REPRESENTATIVE LUGEON VALUE: **0** FLOW TYPE: N/A
SITE SUPERVISOR M.ASHOVER DATE 17-Dec-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
BOREHOLE WATER PRESSURE TEST

BOREHOLE No: **DDH 1**
Test 6 of 11

PROJECT: TILLEGRA DAM SITE LOCATION: RIGHT ABUTMENT SPILLWAY	RL (m) BEARING 090° INCLINATION 60°	SECTION DEPTH (m) From 32.20 to 38.70 LENGTH OF SECTION (m) 6.50
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 7.8	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 400 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 140, 300, 400	GROUNDWATER DEPTH (m) - DATE	TIME AT START 8.00 TIME AT FINISH 9.45 TOTAL TEST TIME(hrs) 1.75

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	140	132.0	192.5	60.5	12.1	1.86	13.3
5	140	192.5	252.0	59.5	11.9	1.83	13.1
5	300	262.0	347.0	85.0	17.0	2.62	8.7
5	300	347.0	434.0	87.0	17.4	2.68	8.9
5	400	446.0	544.0	98.0	19.6	3.02	7.5
5	400	544.0	643.0	99.0	19.8	3.05	7.6
5	300	658.0	745.0	87.0	17.4	2.68	8.9
5	300	745.0	833.0	88.0	17.6	2.71	9.0
5	140	840.0	910.0	70.0	14.0	2.15	15.4
5	140	910.0	980.0	70.0	14.0	2.15	15.4



COMMENTS

REPRESENTATIVE LUGEON VALUE: **8**

FLOW TYPE: TURBULENT

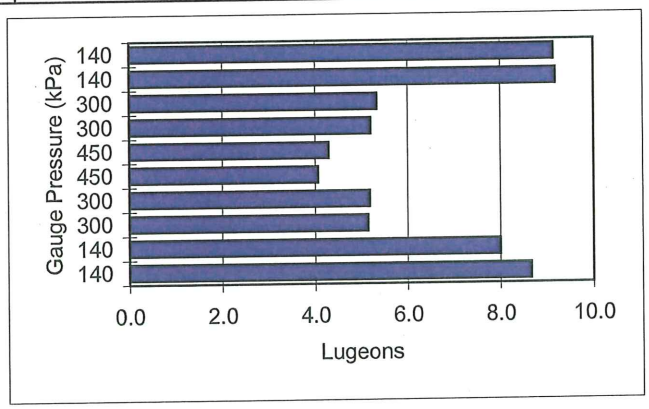
SITE SUPERVISOR M.ASHOVER DATE 18-Dec-07

JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: DDH 1 Test 7 of 11

PROJECT: TILLEGRA DAM SITE LOCATION: RIGHT ABUTMENT SPILLWAY	RL (m) BEARING 090° INCLINATION 60°	SECTION DEPTH (m) From 38.20 to 41.70 LENGTH OF SECTION (m) 3.50
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 7.8	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 1000 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 140, 300, 450	GROUNDWATER DEPTH (m) - DATE	TIME AT START 10.45 TIME AT FINISH 12.15 TOTAL TEST TIME(hrs) 1.50

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	140	2.0	23.2	21.2	4.2	1.21	8.7
5	140	23.2	42.8	19.6	3.9	1.12	8.0
5	300	56.0	83.0	27.0	5.4	1.54	5.1
5	300	83.0	110.2	27.2	5.4	1.55	5.2
5	450	119.0	151.0	32.0	6.4	1.83	4.1
5	450	151.0	184.8	33.8	6.8	1.93	4.3
5	300	193.0	220.3	27.3	5.5	1.56	5.2
5	300	220.3	248.3	28.0	5.6	1.60	5.3
5	140	253.0	275.5	22.5	4.5	1.29	9.2
5	140	275.5	297.9	22.4	4.5	1.28	9.1

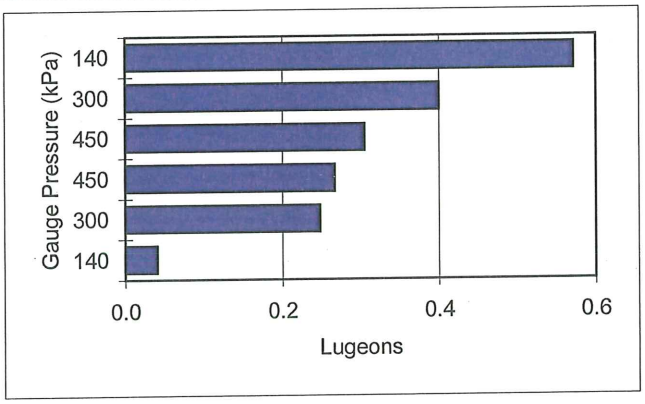


COMMENTS	REPRESENTATIVE LUGEON VALUE: 5 FLOW TYPE: TURBULENT
SITE SUPERVISOR M.ASHOVER DATE 18-Dec-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: **DDH 1** Test 8 of 11

PROJECT: TILLEGRA DAM SITE LOCATION: RIGHT ABUTMENT SPILLWAY	RL (m) BEARING 090° INCLINATION 60°	SECTION DEPTH (m) From 41.20 to 44.70 LENGTH OF SECTION (m) 3.50
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 7.8	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 1000 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 140, 300, 450	GROUNDWATER DEPTH (m) - DATE	TIME AT START 13.30 TIME AT FINISH 14.30 TOTAL TEST TIME(hrs) 1.00

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	140	0.1	0.2	0.1	0.0	0.01	0.0
5	300	0.4	1.7	1.3	0.3	0.07	0.2
5	450	2.0	4.1	2.1	0.4	0.12	0.3
5	450	4.1	6.5	2.4	0.5	0.14	0.3
5	300	6.6	8.7	2.1	0.4	0.12	0.4
5	140	8.9	10.3	1.4	0.3	0.08	0.6

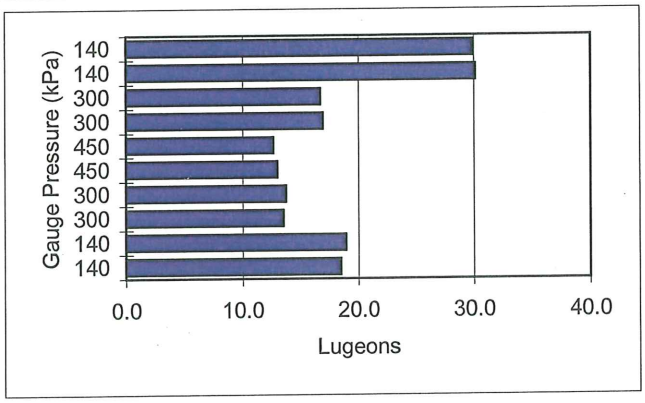


COMMENTS	REPRESENTATIVE LUGEON VALUE: **< 1** FLOW TYPE: LAMINAR
SITE SUPERVISOR M.ASHOVER DATE 18-Dec-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: **DDH 1** Test 9 of 11

PROJECT: TILLEGRA DAM SITE LOCATION: RIGHT ABUTMENT SPILLWAY	RL (m) BEARING 090° INCLINATION 60°	SECTION DEPTH (m) From 44.20 to 50.70 LENGTH OF SECTION (m) 6.50
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 7.8	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 1000 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 140, 300, 450	GROUNDWATER DEPTH (m) - DATE	TIME AT START 7.30 TIME AT FINISH 9.00 TOTAL TEST TIME(hrs) 1.50

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	140	22.0	106.0	84.0	16.8	2.58	18.5
5	140	106.0	192.0	86.0	17.2	2.65	18.9
5	300	210.0	342.0	132.0	26.4	4.06	13.5
5	300	342.0	476.0	134.0	26.8	4.12	13.7
5	450	510.0	700.0	190.0	38.0	5.85	13.0
5	450	700.0	885.0	185.0	37.0	5.69	12.6
5	300	912.0	1077.0	165.0	33.0	5.08	16.9
5	300	77.0	240.0	163.0	32.6	5.02	16.7
5	140	265.0	402.0	137.0	27.4	4.22	30.1
5	140	402.0	538.0	136.0	27.2	4.18	29.9



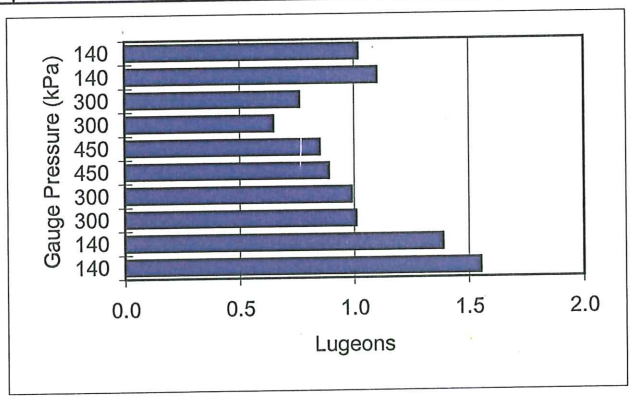
COMMENTS	REPRESENTATIVE LUGEON VALUE: **30** FLOW TYPE: WASHOUT (Tubulent Flow)
SITE SUPERVISOR M.ASHOVER DATE 19-Dec-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
BOREHOLE WATER PRESSURE TEST

BOREHOLE No: **DDH 1**
Test 10 of 11

PROJECT: TILLEGRA DAM SITE LOCATION: RIGHT ABUTMENT SPILLWAY	RL (m) BEARING 090° INCLINATION 60°	SECTION DEPTH (m) From 50.20 to 53.70 LENGTH OF SECTION (m) 3.50
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 7.8	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 1000 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 140, 300, 450	GROUNDWATER DEPTH (m) - DATE	TIME AT START 10.15 TIME AT FINISH 11.45 TOTAL TEST TIME(hrs) 1.50

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	140	1.4	5.2	3.8	0.8	0.22	1.6
5	140	6.7	10.1	3.4	0.7	0.19	1.4
5	300	13.3	18.6	5.3	1.1	0.30	1.0
5	300	20.1	25.3	5.2	1.0	0.30	1.0
5	450	28.0	35.0	7.0	1.4	0.40	0.9
5	450	36.1	42.8	6.7	1.3	0.38	0.9
5	300	46.0	49.4	3.4	0.7	0.19	0.6
5	300	50.9	54.9	4.0	0.8	0.23	0.8
5	140	58.5	61.2	2.7	0.5	0.15	1.1
5	140	61.2	63.7	2.5	0.5	0.14	1.0

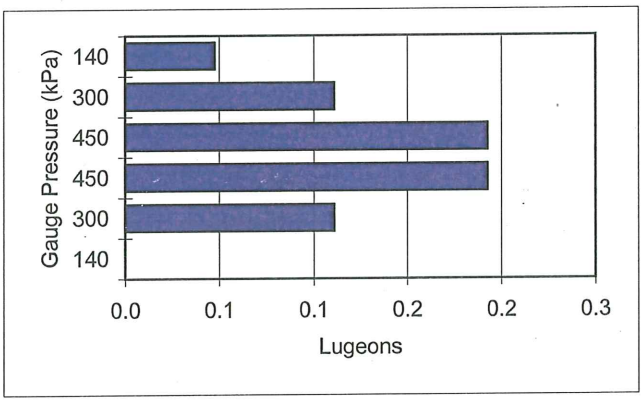


COMMENTS	REPRESENTATIVE LUGEON VALUE: **1.0** FLOW TYPE: LAMINAR
SITE SUPERVISOR M.ASHOVER DATE 19-Dec-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: **DDH 1** Test 11 of 11

PROJECT: TILLEGRA DAM SITE LOCATION: RIGHT ABUTMENT SPILLWAY	RL (m) BEARING 090° INCLINATION 60°	SECTION DEPTH (m) From 53.50 to 56.50 LENGTH OF SECTION (m) 3.00
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 7.8	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 1000 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 140, 300, 450	GROUNDWATER DEPTH (m) - DATE	TIME AT START 12.45 TIME AT FINISH 14.00 TOTAL TEST TIME(hrs) 1.25

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	140	0.3	0.3	0.0	0.0	0.00	0.0
5	300	0.5	1.0	0.5	0.1	0.03	0.1
5	450	2.7	4.0	1.3	0.3	0.09	0.2
5	450	5.0	6.3	1.3	0.3	0.09	0.2
5	300	7.4	7.9	0.5	0.1	0.03	0.1
5	140	8.0	8.1	0.1	0.0	0.01	0.0

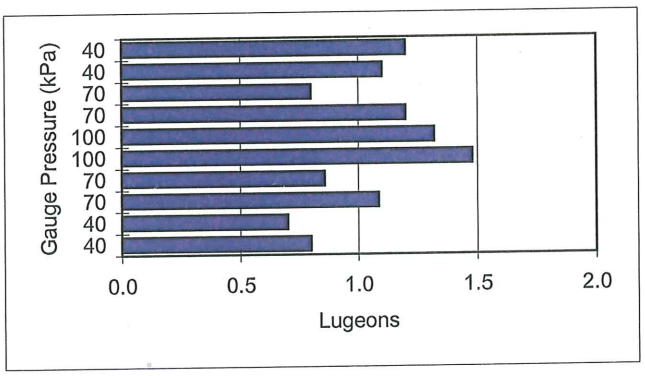


COMMENTS	REPRESENTATIVE LUGEON VALUE: **< 1** FLOW TYPE: LAMINAR
SITE SUPERVISOR M.ASHOVER DATE 19-Dec-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: **DDH 3** Test 1 of 11

PROJECT: TILLEGRA DAM SITE LOCATION: MID RIGHT ABUTMENT C/L	RL (m) BEARING 070° INCLINATION 60°	SECTION DEPTH (m) From 3.83 to 8.83 LENGTH OF SECTION (m) 5.00
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 2.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 250 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 40, 70, 100	GROUNDWATER DEPTH (m) - DATE	TIME AT START 7.30 TIME AT FINISH 9.00 TOTAL TEST TIME(hrs) 1.50

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	40	0.4	1.2	0.8	0.2	0.03	0.8
5	40	1.2	1.9	0.7	0.1	0.03	0.7
5	70	3.4	5.3	1.9	0.4	0.08	1.1
5	70	5.3	6.8	1.5	0.3	0.06	0.9
5	100	7.5	11.2	3.7	0.7	0.15	1.5
5	100	11.2	14.5	3.3	0.7	0.13	1.3
5	70	15.1	17.2	2.1	0.4	0.08	1.2
5	70	17.2	18.6	1.4	0.3	0.06	0.8
5	40	20.5	21.6	1.1	0.2	0.04	1.1
5	40	21.6	22.8	1.2	0.2	0.05	1.2

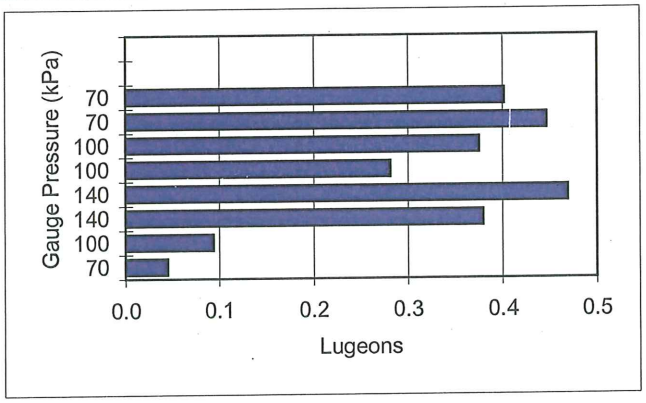


COMMENTS	REPRESENTATIVE LUGEON VALUE: **1.0** FLOW TYPE: LAMINAR
SITE SUPERVISOR M.ASHOVER DATE 13-Jan-08	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: **DDH 3** Test 2 of 11

PROJECT: TILLEGRA DAM SITE LOCATION: MID RIGHT ABUTMENT C/L	RL (m) BEARING 070° INCLINATION 60°	SECTION DEPTH (m) From 8.33 to 14.73 LENGTH OF SECTION (m) 6.40
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 2.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 250 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 70, 100, 140	GROUNDWATER DEPTH (m) - DATE	TIME AT START 13.30 TIME AT FINISH 14.45 TOTAL TEST TIME(hrs) 1.25

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	70	23.6	23.7	0.1	0.0	0.00	0.0
5	100	26.2	26.5	0.3	0.1	0.01	0.1
5	140	28.2	29.9	1.7	0.3	0.05	0.4
5	140	29.9	32.0	2.1	0.4	0.07	0.5
5	100	33.5	34.4	0.9	0.2	0.03	0.3
5	100	34.4	35.6	1.2	0.2	0.04	0.4
5	70	36.0	37.0	1.0	0.2	0.03	0.4
5	70	37.0	37.9	0.9	0.2	0.03	0.4

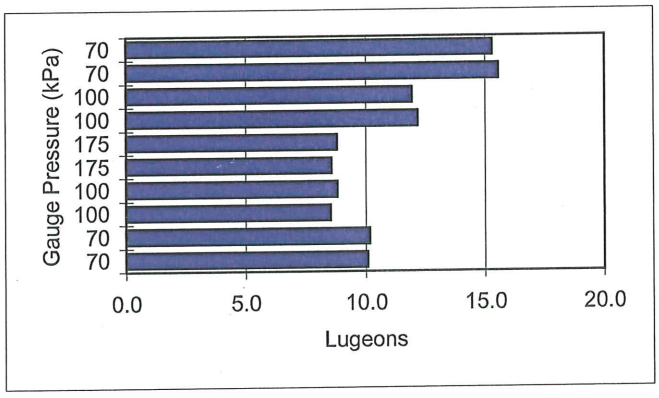


COMMENTS	REPRESENTATIVE LUGEON VALUE: < 1 FLOW TYPE: LAMINAR
SITE SUPERVISOR M.ASHOVER DATE 13-Jan-08	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: **DDH 3** Test 3 of 11

PROJECT: TILLEGRA DAM SITE LOCATION: MID RIGHT ABUTMENT C/L	RL (m) BEARING 070° INCLINATION 60°	SECTION DEPTH (m) From 14.33 to 17.73 LENGTH OF SECTION (m) 3.40
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 2.5	FLOW METER TYPE DIGITAL PUMP TYPE PISTON	PRESSURE GAUGE CAPACITY (kPa) 250 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 70, 100, 175	GROUNDWATER DEPTH (m) - DATE	TIME AT START 7.30 TIME AT FINISH 9.45 TOTAL TEST TIME(hrs) 2.25

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	70	7.5	19.5	12.0	2.4	0.71	10.1
5	70	19.5	31.6	12.1	2.4	0.71	10.2
5	100	35.0	49.5	14.5	2.9	0.85	8.5
5	100	49.5	64.5	15.0	3.0	0.88	8.8
5	175	70.0	95.5	25.5	5.1	1.50	8.6
5	175	95.5	121.7	26.2	5.2	1.54	8.8
5	100	126.0	146.7	20.7	4.1	1.22	12.2
5	100	146.7	167.0	20.3	4.1	1.19	11.9
5	70	170.0	188.5	18.5	3.7	1.09	15.5
5	70	188.5	206.7	18.2	3.6	1.07	15.3



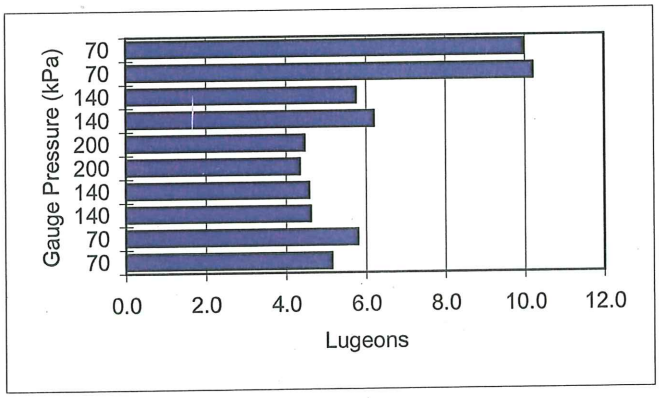
COMMENTS	REPRESENTATIVE LUGEON VALUE: **15** FLOW TYPE: WASHOUT (Turbulent Flow)
SITE SUPERVISOR M.ASHOVER DATE 14-Jan-08	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
BOREHOLE WATER PRESSURE TEST

BOREHOLE No: **DDH 3**
Test 4 of 11

PROJECT: TILLEGRA DAM SITE LOCATION: MID RIGHT ABUTMENT C/L	RL (m) BEARING 070° INCLINATION 60°	SECTION DEPTH (m) From 17.30 to 20.80 LENGTH OF SECTION (m) 3.50
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 2.5	FLOW METER TYPE DIGITAL PUMP TYPE PISTON	PRESSURE GAUGE CAPACITY (kPa) 250 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 70, 140, 200	GROUNDWATER DEPTH (m) - DATE	TIME AT START 7.30 TIME AT FINISH 9.45 TOTAL TEST TIME(hrs) 2.25

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	70	0.4	6.7	6.3	1.3	0.36	5.1
5	70	8.3	15.4	7.1	1.4	0.41	5.8
5	140	17.0	28.3	11.3	2.3	0.65	4.6
5	140	28.3	39.5	11.2	2.2	0.64	4.6
5	200	41.0	56.2	15.2	3.0	0.87	4.3
5	200	56.2	71.8	15.6	3.1	0.89	4.5
5	140	74.5	89.7	15.2	3.0	0.87	6.2
5	140	89.7	103.8	14.1	2.8	0.81	5.8
5	70	106.5	119.0	12.5	2.5	0.71	10.2
5	70	119.0	131.2	12.2	2.4	0.70	10.0



COMMENTS

REPRESENTATIVE LUGEON VALUE: **10**

FLOW TYPE: WASHOUT (Turbulent Flow)

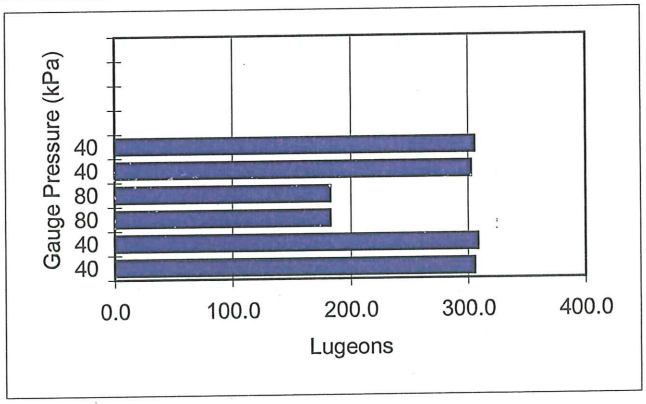
SITE SUPERVISOR M.ASHOVER DATE 14-Jan-08

JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: **DDH 3** Test 5 of 11

PROJECT: TILLEGRA DAM SITE LOCATION: MID RIGHT ABUTMENT C/L	RL (m) BEARING 070° INCLINATION 60°	SECTION DEPTH (m) From 20.30 to 23.80 LENGTH OF SECTION (m) 3.50
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 2.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 250 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 70, 140, 200	GROUNDWATER DEPTH (m) - DATE	TIME AT START 14.45 TIME AT FINISH 15.45 TOTAL TEST TIME(hrs) 1.00

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
2.5	40	286.0	393.0	107.0	42.8	12.23	305.7
2.5	40	393.0	501.0	108.0	43.2	12.34	308.6
2.5	80	517.0	645.0	128.0	51.2	14.63	182.9
2.5	80	645.0	773.0	128.0	51.2	14.63	182.9
2.5	40	790.0	896.0	106.0	42.4	12.11	302.9
2.5	40	896.0	1003.0	107.0	42.8	12.23	305.7

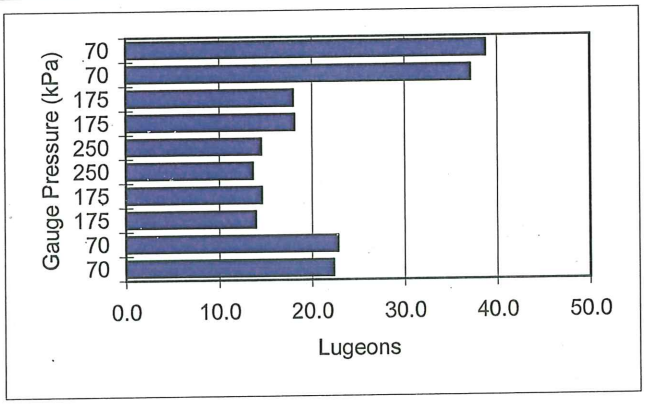


COMMENTS **100% DRILL WATER LOSS AT 21.4m.** **Maximum test pressure achieved was 80kPa.**	REPRESENTATIVE LUGEON VALUE: **> 100** FLOW TYPE: TURBULENT
SITE SUPERVISOR M.ASHOVER DATE 14-Jan-08	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: DDH 3 Test 6 of 11

PROJECT: TILLEGRA DAM SITE LOCATION: MID RIGHT ABUTMENT C/L	RL (m) BEARING 070° INCLINATION 60°	SECTION DEPTH (m) From 23.30 to 26.80 LENGTH OF SECTION (m) 3.50
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 2.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 250 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 70, 175, 250	GROUNDWATER DEPTH (m) - DATE	TIME AT START 16.00 TIME AT FINISH 17.45 TOTAL TEST TIME(hrs) 1.75

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	70	5.0	32.3	27.3	5.5	1.56	22.3
5	70	32.3	60.2	27.9	5.6	1.59	22.8
5	175	68.0	110.6	42.6	8.5	2.43	13.9
5	175	110.6	155.2	44.6	8.9	2.55	14.6
5	250	165.0	224.5	59.5	11.9	3.40	13.6
5	250	224.5	288.0	63.5	12.7	3.63	14.5
5	175	298.0	353.5	55.5	11.1	3.17	18.1
5	175	353.5	408.5	55.0	11.0	3.14	18.0
5	70	417.0	462.5	45.5	9.1	2.60	37.1
5	70	462.5	510.0	47.5	9.5	2.71	38.8



COMMENTS	REPRESENTATIVE LUGEON VALUE: 38 FLOW TYPE: WASHOUT (Turbulent Flow)
SITE SUPERVISOR M.ASHOVER DATE 21-Jan-08	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: **DDH 3** Test 7 of 11

PROJECT: TILLEGRA DAM SITE LOCATION: MID RIGHT ABUTMENT C/L	RL (m) BEARING 070° INCLINATION 60°	SECTION DEPTH (m) From 26.30 to 29.52 LENGTH OF SECTION (m) 3.22
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 2.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 400 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 100, 200, 300	GROUNDWATER DEPTH (m) - DATE	TIME AT START 11.00 TIME AT FINISH 12.00 TOTAL TEST TIME(hrs) 1.00

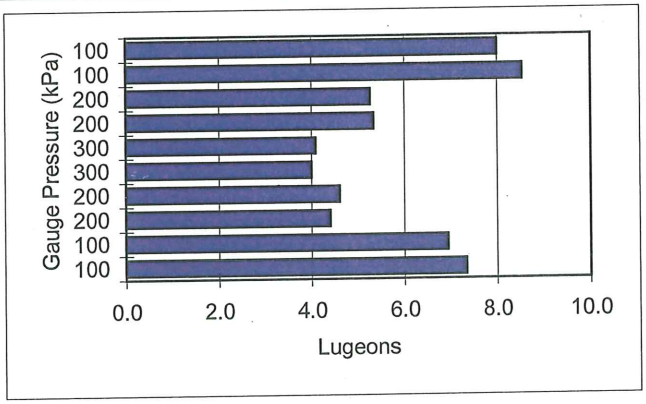
TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)

COMMENTS **Pumped at maximum capacity (50litres/min) for 20 min. Zero test pressure achieved.**	REPRESENTATIVE LUGEON VALUE: **> 100** FLOW TYPE: N/A
SITE SUPERVISOR M.ASHOVER DATE 22-Jan-08	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: DDH 3 Test 8 of 11

PROJECT: TILLEGRA DAM SITE LOCATION: MID RIGHT ABUTMENT C/L	RL (m) BEARING 070° INCLINATION 60°	SECTION DEPTH (m) From 29.83 to 32.83 LENGTH OF SECTION (m) 3.00
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 2.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 400 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 100, 200, 300	GROUNDWATER DEPTH (m) - DATE	TIME AT START 14.45 TIME AT FINISH 16.15 TOTAL TEST TIME(hrs) 1.50

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	100	121.0	132.0	11.0	2.2	0.73	7.3
5	100	132.0	142.4	10.4	2.1	0.69	6.9
5	200	144.0	157.2	13.2	2.6	0.88	4.4
5	200	157.2	171.0	13.8	2.8	0.92	4.6
5	300	173.0	191.0	18.0	3.6	1.20	4.0
5	300	191.0	209.4	18.4	3.7	1.23	4.1
5	200	212.0	228.0	16.0	3.2	1.07	5.3
5	200	228.0	243.8	15.8	3.2	1.05	5.3
5	100	246.0	258.8	12.8	2.6	0.85	8.5
5	100	258.8	270.8	12.0	2.4	0.80	8.0

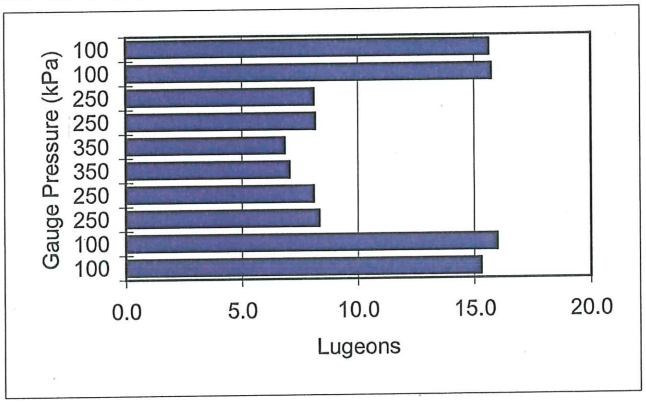


COMMENTS	REPRESENTATIVE LUGEON VALUE: 8 FLOW TYPE: SLIGHT WASHOUT
SITE SUPERVISOR M.ASHOVER DATE 22-Jan-08	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: DDH 3 Test 9 of 11

PROJECT: TILLEGRA DAM SITE LOCATION: MID RIGHT ABUTMENT C/L	RL (m) BEARING 070° INCLINATION 60°	SECTION DEPTH (m) From 32.30 to 35.83 LENGTH OF SECTION (m) 3.53
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 2.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 400 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 100, 250, 350	GROUNDWATER DEPTH (m) - DATE	TIME AT START 8.15 TIME AT FINISH 9.45 TOTAL TEST TIME(hrs) 1.50

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	100	9.0	36.0	27.0	5.4	1.53	15.3
5	100	36.0	64.2	28.2	5.6	1.60	16.0
5	250	100.0	136.8	36.8	7.4	2.08	8.3
5	250	136.8	172.5	35.7	7.1	2.02	8.1
5	350	183.0	226.6	43.6	8.7	2.47	7.1
5	350	226.6	269.0	42.4	8.5	2.40	6.9
5	250	278.0	314.0	36.0	7.2	2.04	8.2
5	250	314.0	349.8	35.8	7.2	2.03	8.1
5	100	356.0	383.8	27.8	5.6	1.58	15.8
5	100	383.8	411.4	27.6	5.5	1.56	15.6



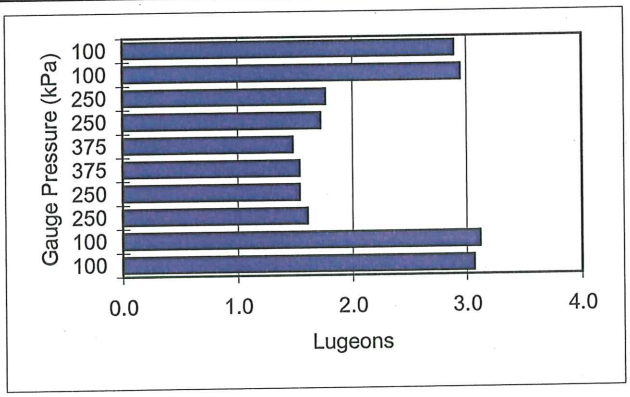
COMMENTS	REPRESENTATIVE LUGEON VALUE: 7 FLOW TYPE: TURBULENT
SITE SUPERVISOR M.ASHOVER DATE 23-Jan-08	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
BOREHOLE WATER PRESSURE TEST

BOREHOLE No: **DDH 3**
Test 10 of 11

PROJECT: TILLEGRA DAM SITE LOCATION: MID RIGHT ABUTMENT C/L	RL (m) BEARING 070° INCLINATION 60°	SECTION DEPTH (m) From 35.30 to 38.83 LENGTH OF SECTION (m) 3.53
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 2.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 400 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 100, 250, 375	GROUNDWATER DEPTH (m) - DATE	TIME AT START 11.25 TIME AT FINISH 12.55 TOTAL TEST TIME(hrs) 1.50

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	100	113.0	118.4	5.4	1.1	0.31	3.1
5	100	118.4	123.9	5.5	1.1	0.31	3.1
5	250	125.0	132.1	7.1	1.4	0.40	1.6
5	250	132.1	138.9	6.8	1.4	0.39	1.5
5	375	140.5	150.7	10.2	2.0	0.58	1.5
5	375	150.7	160.5	9.8	2.0	0.56	1.5
5	250	162.0	169.6	7.6	1.5	0.43	1.7
5	250	169.6	177.4	7.8	1.6	0.44	1.8
5	100	179.0	184.2	5.2	1.0	0.29	2.9
5	100	184.2	189.3	5.1	1.0	0.29	2.9



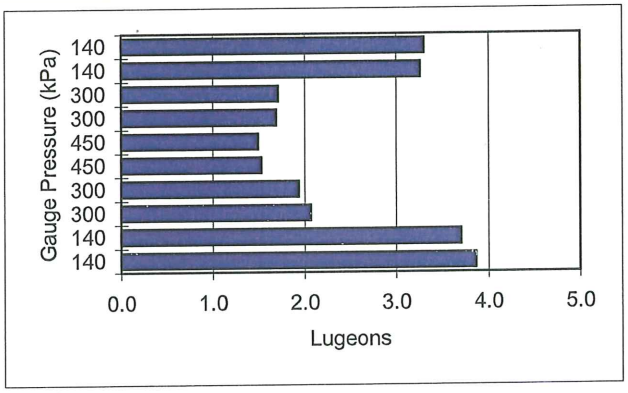
COMMENTS	REPRESENTATIVE LUGEON VALUE: 1.5 FLOW TYPE: TURBULENT
SITE SUPERVISOR M.ASHOVER DATE 23-Jan-08	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
BOREHOLE WATER PRESSURE TEST

BOREHOLE No: **DDH 3**
Test 11 of 11

PROJECT: TILLEGRA DAM SITE LOCATION: MID RIGHT ABUTMENT C/L	RL (m) BEARING 070° INCLINATION 60°	SECTION DEPTH (m) From 38.30 to 41.85 LENGTH OF SECTION (m) 3.55
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 2.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 1000 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 140, 300, 450	GROUNDWATER DEPTH (m) - DATE	TIME AT START 14.15 TIME AT FINISH 15.45 TOTAL TEST TIME(hrs) 1.50

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	140	1.0	10.6	9.6	1.9	0.54	3.9
5	140	10.6	19.8	9.2	1.8	0.52	3.7
5	300	21.5	32.5	11.0	2.2	0.62	2.1
5	300	32.5	42.8	10.3	2.1	0.58	1.9
5	450	44.5	56.7	12.2	2.4	0.69	1.5
5	450	56.7	68.6	11.9	2.4	0.67	1.5
5	300	70.0	79.0	9.0	1.8	0.51	1.7
5	300	79.0	88.1	9.1	1.8	0.51	1.7
5	140	89.3	97.4	8.1	1.6	0.46	3.3
5	140	97.4	105.6	8.2	1.6	0.46	3.3

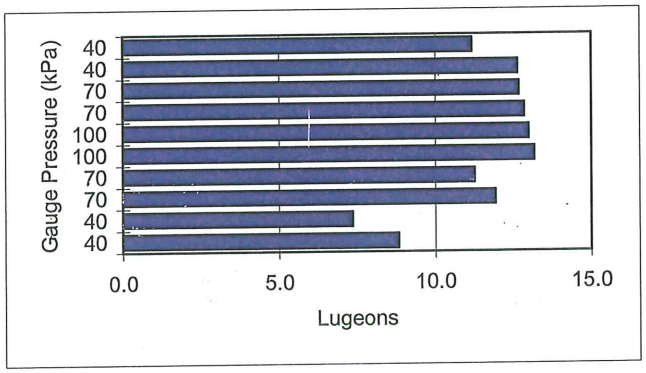


COMMENTS	REPRESENTATIVE LUGEON VALUE: **1.5** FLOW TYPE: TURBULENT
SITE SUPERVISOR M.ASHOVER DATE 23-Jan-08	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: **DDH 4** Test 1 of 8

PROJECT: TILLEGRA DAM SITE LOCATION: DIVERSION UPSTREAM PORTAL	RL (m) BEARING 085° INCLINATION 60°	SECTION DEPTH (m) From 3.80 to 7.20 LENGTH OF SECTION (m) 3.40
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 2.6	FLOW METER TYPE ANALOG PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 250 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 40, 70, 100	GROUNDWATER DEPTH (m) - DATE	TIME AT START 7.30 TIME AT FINISH 9.15 TOTAL TEST TIME(hrs) 1.75

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	40	113842.0	113848.0	6.0	1.2	0.35	8.8
5	40	113848.0	113853.0	5.0	1.0	0.29	7.4
5	70	113857.0	113871.2	14.2	2.8	0.84	11.9
5	70	113871.7	113885.1	13.4	2.7	0.79	11.3
5	100	113890.0	113912.4	22.4	4.5	1.32	13.2
5	100	113912.9	113935.0	22.1	4.4	1.30	13.0
5	70	113940.0	113955.3	15.3	3.1	0.90	12.9
5	70	113955.7	113970.8	15.1	3.0	0.89	12.7
5	40	113974.0	113982.6	8.6	1.7	0.51	12.6
5	40	113982.6	113990.2	7.6	1.5	0.45	11.2



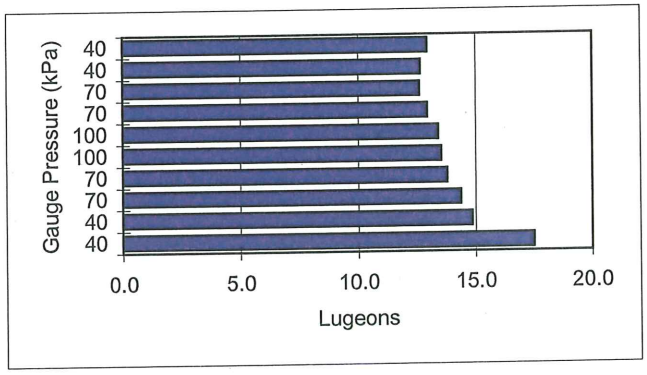
COMMENTS	REPRESENTATIVE LUGEON VALUE: **12** FLOW TYPE: LAMINAR
SITE SUPERVISOR M.ASHOVER DATE 9-Jan-08	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
BOREHOLE WATER PRESSURE TEST

BOREHOLE No: **DDH 4**
Test 2 of 8

PROJECT: TILLEGRA DAM SITE LOCATION: DIVERSION UPSTREAM PORTAL	RL (m) BEARING 085° INCLINATION 60°	SECTION DEPTH (m) From 6.80 to 10.20 LENGTH OF SECTION (m) 3.40
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 2.6	FLOW METER TYPE ANALOG PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 250 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 40, 70, 100	GROUNDWATER DEPTH (m) - DATE	TIME AT START 10.45 TIME AT FINISH 12.15 TOTAL TEST TIME(hrs) 1.50

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	40	25.1	37.0	11.9	2.4	0.70	17.5
5	40	37.0	47.1	10.1	2.0	0.59	14.9
5	70	51.0	68.1	17.1	3.4	1.01	14.4
5	70	68.6	85.0	16.4	3.3	0.96	13.8
5	100	89.0	112.0	23.0	4.6	1.35	13.5
5	100	112.5	135.3	22.8	4.6	1.34	13.4
5	70	139.0	154.4	15.4	3.1	0.91	12.9
5	70	154.9	169.9	15.0	3.0	0.88	12.6
5	40	173.0	181.6	8.6	1.7	0.51	12.6
5	40	181.6	190.4	8.8	1.8	0.52	12.9



COMMENTS

REPRESENTATIVE LUGEON VALUE: **13**

FLOW TYPE: LAMINAR

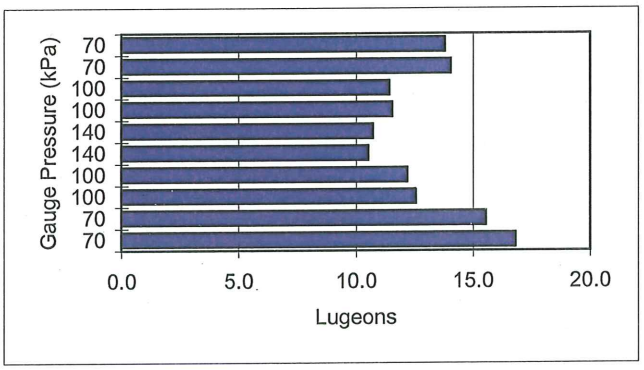
SITE SUPERVISOR M.ASHOVER DATE 9-Jan-08

JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: **DDH 4** Test 3 of 8

PROJECT: TILLEGRA DAM SITE LOCATION: DIVERSION UPSTREAM PORTAL		RL (m) BEARING 085° INCLINATION 60°		SECTION DEPTH (m) From 9.80 to 13.20 LENGTH OF SECTION (m) 3.40	
DRILLING/CORE TYPE BOREHOLE DIAMETER (mm) CASING DIAMETER (mm) CASING DEPTH (m)	HQ3 96 110 2.6	FLOW METER TYPE ANALOG PUMP TYPE MONO		PRESSURE GAUGE CAPACITY (kPa) PACKER TYPE SEALING LENGTH (m)	 250 HQW 1.0
PRESSURE RANGE (kPa) 70, 100, 140		GROUNDWATER DEPTH (m) - DATE		TIME AT START TIME AT FINISH TOTAL TEST TIME(hrs)	13.15 15.00 1.75

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	70	249.0	269.0	20.0	4.0	1.18	16.8
5	70	269.0	287.5	18.5	3.7	1.09	15.5
5	100	294.2	315.5	21.3	4.3	1.25	12.5
5	100	315.5	336.2	20.7	4.1	1.22	12.2
5	140	346.0	371.0	25.0	5.0	1.47	10.5
5	140	371.0	396.5	25.5	5.1	1.50	10.7
5	100	400.0	419.6	19.6	3.9	1.15	11.5
5	100	419.6	439.0	19.4	3.9	1.14	11.4
5	70	447.0	463.7	16.7	3.3	0.98	14.0
5	70	463.7	480.1	16.4	3.3	0.96	13.8

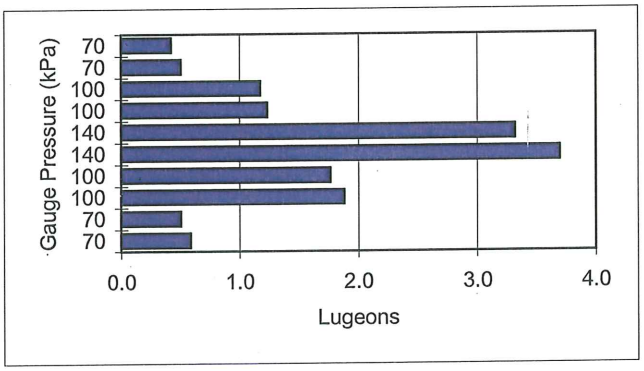


COMMENTS	REPRESENTATIVE LUGEON VALUE: **11** FLOW TYPE: TURBULENT
SITE SUPERVISOR M.ASHOVER DATE 9-Jan-08	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: **DDH 4** Test 4 of 8

PROJECT: TILLEGRA DAM SITE LOCATION: DIVERSION UPSTREAM PORTAL	RL (m) BEARING 085° INCLINATION 60°	SECTION DEPTH (m) From 12.80 to 16.20 LENGTH OF SECTION (m) 3.40
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 2.6	FLOW METER TYPE ANALOG PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 250 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 70, 100, 140	GROUNDWATER DEPTH (m) - DATE	TIME AT START 15.45 TIME AT FINISH 17.15 TOTAL TEST TIME(hrs) 1.50

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	70	521.0	521.7	0.7	0.1	0.04	0.6
5	70	521.7	522.3	0.6	0.1	0.04	0.5
5	100	525.5	528.7	3.2	0.6	0.19	1.9
5	100	528.7	531.7	3.0	0.6	0.18	1.8
5	140	535.1	543.9	8.8	1.8	0.52	3.7
5	140	543.9	551.8	7.9	1.6	0.46	3.3
5	100	553.5	555.6	2.1	0.4	0.12	1.2
5	100	555.6	557.6	2.0	0.4	0.12	1.2
5	70	558.1	558.7	0.6	0.1	0.04	0.5
5	70	558.7	559.2	0.5	0.1	0.03	0.4



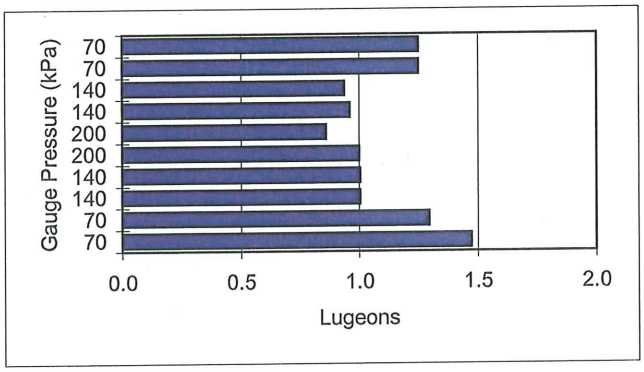
COMMENTS	REPRESENTATIVE LUGEON VALUE: **4** FLOW TYPE: DILATION
SITE SUPERVISOR M.ASHOVER DATE 9-Jan-08	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
BOREHOLE WATER PRESSURE TEST

BOREHOLE No: **DDH 4**
Test 5 of 8

PROJECT: TILLEGRA DAM SITE LOCATION: DIVERSION UPSTREAM PORTAL	RL (m) BEARING 085° INCLINATION 60°	SECTION DEPTH (m) From 15.80 to 22.20 LENGTH OF SECTION (m) 6.40
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 2.6	FLOW METER TYPE ANALOG PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 250 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 70, 140, 200	GROUNDWATER DEPTH (m) - DATE	TIME AT START 10.15 TIME AT FINISH 11.45 TOTAL TEST TIME(hrs) 1.50

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	70	340.0	343.3	3.3	0.7	0.10	1.5
5	70	343.3	346.2	2.9	0.6	0.09	1.3
5	140	348.0	352.5	4.5	0.9	0.14	1.0
5	140	352.5	357.0	4.5	0.9	0.14	1.0
5	200	358.0	364.4	6.4	1.3	0.20	1.0
5	200	364.4	369.9	5.5	1.1	0.17	0.9
5	140	371.5	375.8	4.3	0.9	0.13	1.0
5	140	375.8	380.0	4.2	0.8	0.13	0.9
5	70	380.5	383.3	2.8	0.6	0.09	1.3
5	70	383.5	386.3	2.8	0.6	0.09	1.3



COMMENTS	REPRESENTATIVE LUGEON VALUE: **1.0** FLOW TYPE: LAMINAR
SITE SUPERVISOR M.ASHOVER DATE 10-Jan-08	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: **DDH 4** Test 6 of 8

PROJECT: TILLEGRA DAM SITE LOCATION: DIVERSION UPSTREAM PORTAL	RL (m) BEARING 085° INCLINATION 60°	SECTION DEPTH (m) From 21.80 to 28.20 LENGTH OF SECTION (m) 6.40
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 2.6	FLOW METER TYPE ANALOG PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 400 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 100, 200, 300	GROUNDWATER DEPTH (m) - DATE	TIME AT START 13.30 TIME AT FINISH 14.45 TOTAL TEST TIME(hrs) 1.25

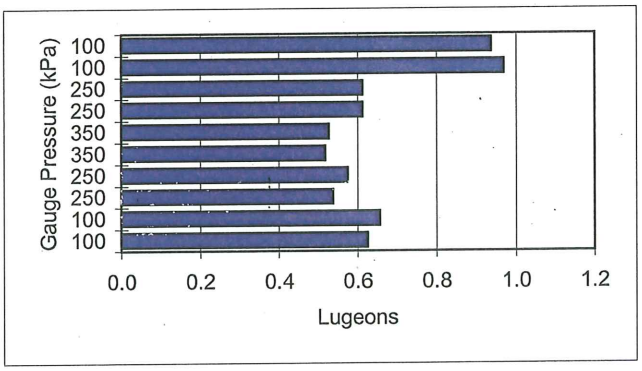
TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	100	929.0	929.0	0.0	0.0	0.00	0.0
5	200	929.0	929.0	0.0	0.0	0.00	0.0
5	300	929.1	929.1	0.0	0.0	0.00	0.0
5	300	929.5	929.5	0.0	0.0	0.00	0.0

COMMENTS	REPRESENTATIVE LUGEON VALUE: **0** FLOW TYPE: N/A
SITE SUPERVISOR M.ASHOVER DATE 10-Jan-08	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: DDH 4 Test 7 of 8

PROJECT: TILLEGRA DAM SITE LOCATION: DIVERSION UPSTREAM PORTAL		RL (m) BEARING 085° INCLINATION 60°		SECTION DEPTH (m) From 27.80 to 34.20 LENGTH OF SECTION (m) 6.40	
DRILLING/CORE TYPE BOREHOLE DIAMETER (mm) CASING DIAMETER (mm) CASING DEPTH (m)	HQ3 96 110 2.6	FLOW METER TYPE ANALOG PUMP TYPE MONO		PRESSURE GAUGE CAPACITY (kPa) PACKER TYPE SEALING LENGTH (m)	400 HQW 1.0
PRESSURE RANGE (kPa) 100, 250, 350		GROUNDWATER DEPTH (m) - DATE		TIME AT START TIME AT FINISH TOTAL TEST TIME(hrs)	7.30 9.30 2.00

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	100	41.5	43.5	2.0	0.4	0.06	0.6
5	100	43.5	45.6	2.1	0.4	0.07	0.7
5	250	46.6	50.9	4.3	0.9	0.13	0.5
5	250	50.9	55.5	4.6	0.9	0.14	0.6
5	350	56.3	62.1	5.8	1.2	0.18	0.5
5	350	62.1	68.0	5.9	1.2	0.18	0.5
5	250	68.8	73.7	4.9	1.0	0.15	0.6
5	250	73.7	78.6	4.9	1.0	0.15	0.6
5	100	79.3	82.4	3.1	0.6	0.10	1.0
5	100	82.4	85.4	3.0	0.6	0.09	0.9



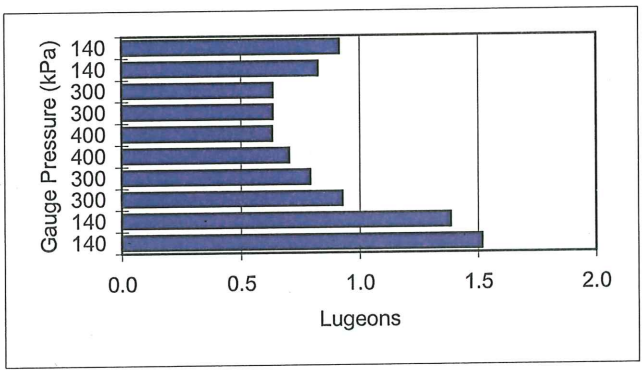
COMMENTS	REPRESENTATIVE LUGEON VALUE: < 1 FLOW TYPE: LAMINAR
SITE SUPERVISOR M.ASHOVER DATE 11-Jan-08	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
BOREHOLE WATER PRESSURE TEST

BOREHOLE No: **DDH 4**
Test 8 of 8

PROJECT: TILLEGRA DAM SITE LOCATION: DIVERSION UPSTREAM PORTAL	RL (m) BEARING 085° INCLINATION 60°	SECTION DEPTH (m) From 33.80 to 40.20 LENGTH OF SECTION (m) 6.40
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 2.6	FLOW METER TYPE ANALOG PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 400 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 140, 300, 400	GROUNDWATER DEPTH (m) - DATE	TIME AT START 11.15 TIME AT FINISH 12.45 TOTAL TEST TIME(hrs) 1.50

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	140	2.3	9.1	6.8	1.4	0.21	1.5
5	140	9.1	15.3	6.2	1.2	0.19	1.4
5	300	18.0	26.9	8.9	1.8	0.28	0.9
5	300	26.9	34.5	7.6	1.5	0.24	0.8
5	400	35.7	44.7	9.0	1.8	0.28	0.7
5	400	44.7	52.8	8.1	1.6	0.25	0.6
5	300	53.6	59.7	6.1	1.2	0.19	0.6
5	300	59.7	65.8	6.1	1.2	0.19	0.6
5	140	66.3	70.0	3.7	0.7	0.12	0.8
5	140	70.0	74.1	4.1	0.8	0.13	0.9

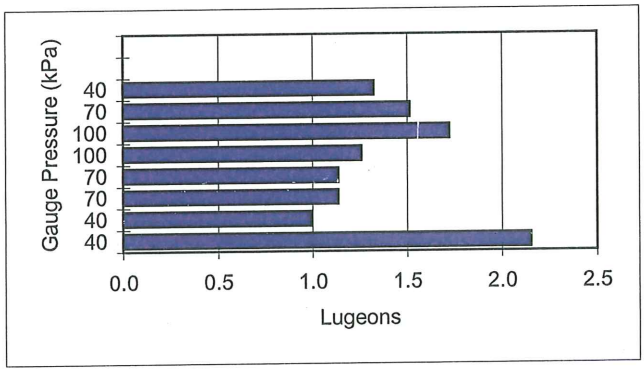


COMMENTS	REPRESENTATIVE LUGEON VALUE: **< 1** FLOW TYPE: LAMINAR
SITE SUPERVISOR M.ASHOVER DATE 11-Jan-08	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: **DDH 5** Test 1 of 9

PROJECT: TILLEGRA DAM SITE LOCATION: UPSTREAM TOE	RL (m) BEARING 085° INCLINATION 60°	SECTION DEPTH (m) From 3.80 to 6.82 LENGTH OF SECTION (m) 3.02
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 1.7	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 100 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 40, 70, 100	GROUNDWATER DEPTH (m) - DATE	TIME AT START 8.45 TIME AT FINISH 10.30 TOTAL TEST TIME(hrs) 1.75

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	40	528.5	529.8	1.3	0.3	0.09	2.2
5	40	529.8	530.4	0.6	0.1	0.04	1.0
5	70	531.0	532.2	1.2	0.2	0.08	1.1
5	70	532.2	533.4	1.2	0.2	0.08	1.1
5	100	533.8	535.7	1.9	0.4	0.13	1.3
5	100	535.7	538.3	2.6	0.5	0.17	1.7
5	70	538.5	540.1	1.6	0.3	0.11	1.5
5	40	540.2	541.0	0.8	0.2	0.05	1.3



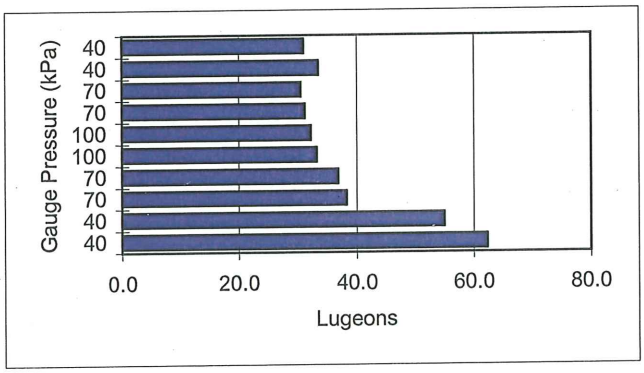
COMMENTS	REPRESENTATIVE LUGEON VALUE: **1.5** FLOW TYPE: LAMINAR
SITE SUPERVISOR M.ASHOVER DATE 5-Dec-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
BOREHOLE WATER PRESSURE TEST

BOREHOLE No: **DDH 5**
Test 2 of 9

PROJECT: TILLEGRA DAM SITE LOCATION: UPSTREAM TOE	RL (m) BEARING 085° INCLINATION 60°	SECTION DEPTH (m) From 6.80 to 10.83 LENGTH OF SECTION (m) 4.03
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 1.7	FLOW METER TYPE DIGITAL PUMP TYPE PISTON	PRESSURE GAUGE CAPACITY (kPa) 250 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 40, 70, 100	GROUNDWATER DEPTH (m) - DATE	TIME AT START 14.00 TIME AT FINISH 15.30 TOTAL TEST TIME(hrs) 1.50

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	40	11.0	61.2	50.2	10.0	2.49	62.3
5	40	61.2	105.5	44.3	8.9	2.20	55.0
5	70	140.0	194.0	54.0	10.8	2.68	38.3
5	70	194.0	246.0	52.0	10.4	2.58	36.9
5	100	251.0	318.0	67.0	13.4	3.33	33.3
5	100	318.0	383.0	65.0	13.0	3.23	32.3
5	70	390.0	434.0	44.0	8.8	2.18	31.2
5	70	434.0	477.0	43.0	8.6	2.13	30.5
5	40	480.0	507.0	27.0	5.4	1.34	33.5
5	40	507.0	532.0	25.0	5.0	1.24	31.0



COMMENTS

REPRESENTATIVE LUGEON VALUE: **32**

FLOW TYPE: LAMINAR

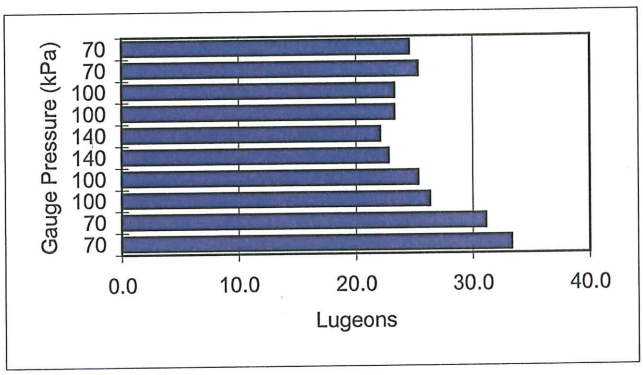
SITE SUPERVISOR M.ASHOVER DATE 5-Dec-07

JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: **DDH 5** Test 3 of 9

PROJECT: TILLEGRA DAM SITE LOCATION: UPSTREAM TOE		RL (m) BEARING INCLINATION	 085° 60°	SECTION DEPTH (m) From 10.80 to 14.75 LENGTH OF SECTION (m)	 3.95
DRILLING/CORE TYPE BOREHOLE DIAMETER (mm) CASING DIAMETER (mm) CASING DEPTH (m)	HQ3 96 110 1.7	FLOW METER TYPE DIGITAL PUMP TYPE PISTON		PRESSURE GAUGE CAPACITY (kPa) PACKER TYPE SEALING LENGTH (m)	 250 HQW 1.0
PRESSURE RANGE (kPa) 70, 100, 140		GROUNDWATER DEPTH (m) DATE	 - 	TIME AT START TIME AT FINISH TOTAL TEST TIME(hrs)	7.45 9.15 1.50

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	70	3.0	49.0	46.0	9.2	2.33	33.3
5	70	49.0	92.0	43.0	8.6	2.18	31.1
5	100	97.0	149.0	52.0	10.4	2.63	26.3
5	100	149.0	199.0	50.0	10.0	2.53	25.3
5	140	205.0	268.0	63.0	12.6	3.19	22.8
5	140	268.0	329.0	61.0	12.2	3.09	22.1
5	100	334.0	380.0	46.0	9.2	2.33	23.3
5	100	380.0	426.0	46.0	9.2	2.33	23.3
5	70	429.0	464.0	35.0	7.0	1.77	25.3
5	70	464.0	498.0	34.0	6.8	1.72	24.6



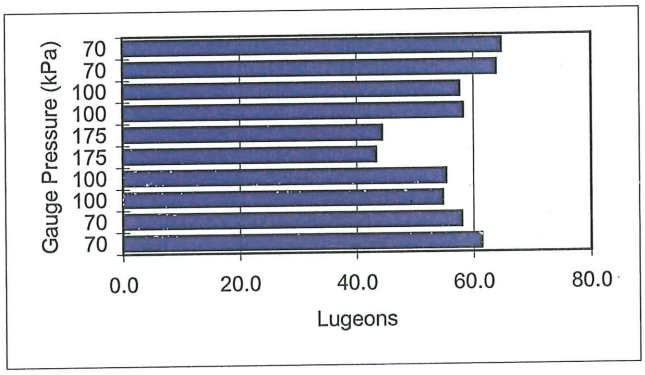
COMMENTS	REPRESENTATIVE LUGEON VALUE: **24** FLOW TYPE: LAMINAR
SITE SUPERVISOR M.ASHOVER DATE 6-Dec-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
BOREHOLE WATER PRESSURE TEST

BOREHOLE No: **DDH 5**
Test 4 of 9

PROJECT: TILLEGRA DAM SITE LOCATION: UPSTREAM TOE	RL (m) BEARING 085° INCLINATION 60°	SECTION DEPTH (m) From 14.35 to 17.75 LENGTH OF SECTION (m) 3.40
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 1.7	FLOW METER TYPE DIGITAL PUMP TYPE PISTON	PRESSURE GAUGE CAPACITY (kPa) 250 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 70, 100, 175	GROUNDWATER DEPTH (m) - DATE	TIME AT START 11.15 TIME AT FINISH 13.00 TOTAL TEST TIME(hrs) 1.75

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	70	40.0	113.0	73.0	14.6	4.29	61.3
5	70	113.0	182.0	69.0	13.8	4.06	58.0
5	100	198.0	291.0	93.0	18.6	5.47	54.7
5	100	291.0	385.0	94.0	18.8	5.53	55.3
5	175	404.0	533.0	129.0	25.8	7.59	43.4
5	175	533.0	665.0	132.0	26.4	7.76	44.4
5	100	681.0	780.0	99.0	19.8	5.82	58.2
5	100	780.0	878.0	98.0	19.6	5.76	57.6
5	70	888.0	964.0	76.0	15.2	4.47	63.9
5	70	964.0	1041.0	77.0	15.4	4.53	64.7



COMMENTS

REPRESENTATIVE LUGEON VALUE: **44**

FLOW TYPE: TURBULENT

SITE SUPERVISOR M.ASHOVER DATE 6-Dec-07

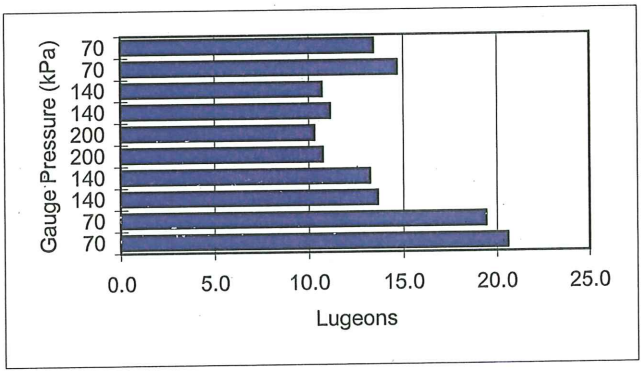
JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
BOREHOLE WATER PRESSURE TEST

BOREHOLE No: **DDH 5**
Test 5 of 9

PROJECT: TILLEGRA DAM SITE LOCATION: UPSTREAM TOE	RL (m) BEARING 085° INCLINATION 60°	SECTION DEPTH (m) From 17.35 to 20.75 LENGTH OF SECTION (m) 3.40
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 1.7	FLOW METER TYPE DIGITAL PUMP TYPE PISTON	PRESSURE GAUGE CAPACITY (kPa) 250 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 70, 140, 200	GROUNDWATER DEPTH (m) - DATE	TIME AT START 15.00 TIME AT FINISH 16.30 TOTAL TEST TIME(hrs) 1.50

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	70	7.0	31.5	24.5	4.9	1.44	20.6
5	70	31.5	54.6	23.1	4.6	1.36	19.4
5	140	60.0	92.5	32.5	6.5	1.91	13.7
5	140	92.5	124.0	31.5	6.3	1.85	13.2
5	200	187.0	223.5	36.5	7.3	2.15	10.7
5	200	223.5	258.5	35.0	7.0	2.06	10.3
5	140	264.0	290.5	26.5	5.3	1.56	11.1
5	140	290.5	316.0	25.5	5.1	1.50	10.7
5	70	322.0	339.5	17.5	3.5	1.03	14.7
5	70	339.5	355.5	16.0	3.2	0.94	13.4



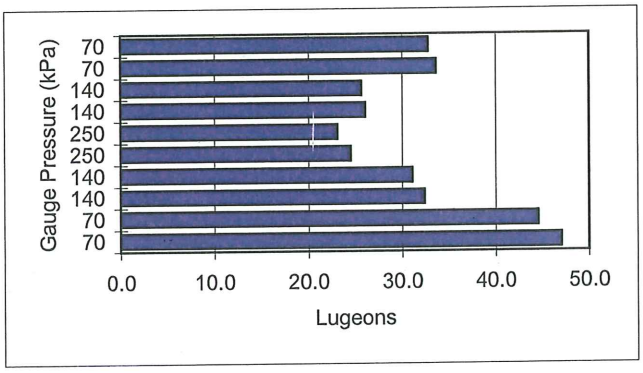
COMMENTS	REPRESENTATIVE LUGEON VALUE: **12** FLOW TYPE: LAMINAR
SITE SUPERVISOR M.ASHOVER DATE 6-Dec-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
BOREHOLE WATER PRESSURE TEST

BOREHOLE No: **DDH 5**
Test 6 of 9

PROJECT: TILLEGRA DAM SITE LOCATION: UPSTREAM TOE	RL (m) BEARING 085° INCLINATION 60°	SECTION DEPTH (m) From 20.35 to 23.75 LENGTH OF SECTION (m) 3.40
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 1.7	FLOW METER TYPE DIGITAL PUMP TYPE PISTON	PRESSURE GAUGE CAPACITY (kPa) 400 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 70, 140, 250	GROUNDWATER DEPTH (m) - DATE	TIME AT START 8.45 TIME AT FINISH 10.15 TOTAL TEST TIME(hrs) 1.50

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	70	7.0	63.0	56.0	11.2	3.29	47.1
5	70	63.0	116.0	53.0	10.6	3.12	44.5
5	140	127.0	204.0	77.0	15.4	4.53	32.4
5	140	204.0	278.0	74.0	14.8	4.35	31.1
5	250	300.0	404.0	104.0	20.8	6.12	24.5
5	250	404.0	502.0	98.0	19.6	5.76	23.1
5	140	512.0	574.0	62.0	12.4	3.65	26.1
5	140	574.0	635.0	61.0	12.2	3.59	25.6
5	70	647.0	687.0	40.0	8.0	2.35	33.6
5	70	687.0	726.0	39.0	7.8	2.29	32.8



COMMENTS

REPRESENTATIVE LUGEON VALUE: **25**

FLOW TYPE: TURBULENT

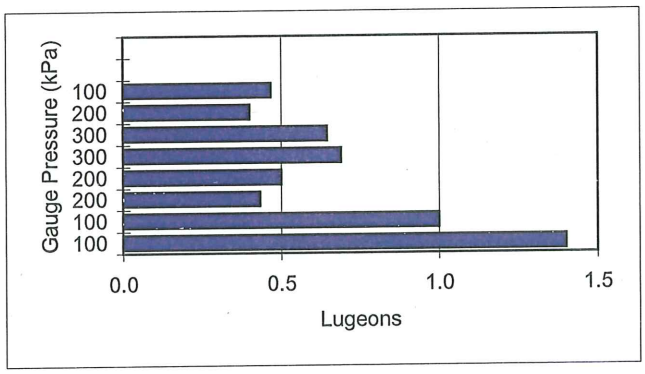
SITE SUPERVISOR M.ASHOVER DATE 7-Dec-07

JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: **DDH 5** Test 7 of 9

PROJECT: TILLEGRA DAM SITE LOCATION: UPSTREAM TOE	RL (m) BEARING 085° INCLINATION 60°	SECTION DEPTH (m) From 23.75 to 26.75 LENGTH OF SECTION (m) 3.00
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 1.7	FLOW METER TYPE DIGITAL PUMP TYPE PISTON	PRESSURE GAUGE CAPACITY (kPa) 400 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 100, 200, 300	GROUNDWATER DEPTH (m) - DATE	TIME AT START 11.45 TIME AT FINISH 13.15 TOTAL TEST TIME(hrs) 1.50

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	100	0.3	2.4	2.1	0.4	0.14	1.4
5	100	7.5	9.0	1.5	0.3	0.10	1.0
5	200	9.2	10.5	1.3	0.3	0.09	0.4
5	200	10.5	12.0	1.5	0.3	0.10	0.5
5	300	14.5	17.6	3.1	0.6	0.21	0.7
5	300	17.6	20.5	2.9	0.6	0.19	0.6
5	200	21.0	22.2	1.2	0.2	0.08	0.4
5	100	22.5	23.2	0.7	0.1	0.05	0.5

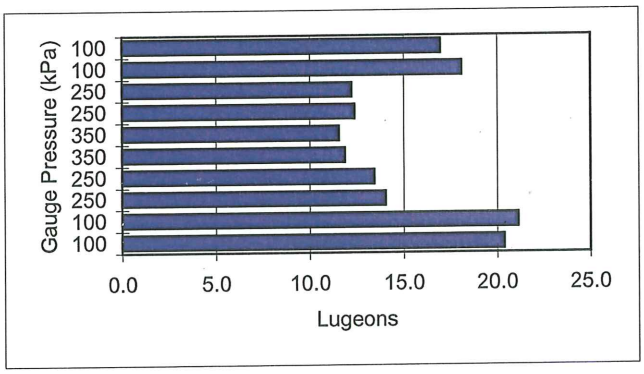


COMMENTS	REPRESENTATIVE LUGEON VALUE: < 1 FLOW TYPE: LAMINAR
SITE SUPERVISOR M.ASHOVER DATE 7-Dec-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: **DDH 5** Test 8 of 9

PROJECT: TILLEGRA DAM SITE LOCATION: UPSTREAM TOE	RL (m) BEARING 085° INCLINATION 60°	SECTION DEPTH (m) From 26.35 to 31.65 LENGTH OF SECTION (m) 5.30
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 1.7	FLOW METER TYPE DIGITAL PUMP TYPE PISTON	PRESSURE GAUGE CAPACITY (kPa) 400 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 100, 250, 350	GROUNDWATER DEPTH (m) - DATE	TIME AT START 16.30 TIME AT FINISH 18.00 TOTAL TEST TIME(hrs) 1.50

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	100	15.0	69.0	54.0	10.8	2.04	20.4
5	100	69.0	125.0	56.0	11.2	2.11	21.1
5	250	135.0	228.0	93.0	18.6	3.51	14.0
5	250	228.0	317.0	89.0	17.8	3.36	13.4
5	350	326.0	436.0	110.0	22.0	4.15	11.9
5	350	436.0	543.0	107.0	21.4	4.04	11.5
5	250	554.0	636.0	82.0	16.4	3.09	12.4
5	250	636.0	717.0	81.0	16.2	3.06	12.2
5	100	725.0	773.0	48.0	9.6	1.81	18.1
5	100	773.0	818.0	45.0	9.0	1.70	17.0

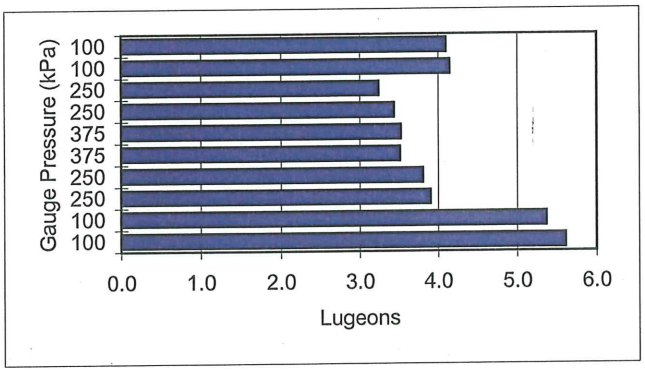


COMMENTS	REPRESENTATIVE LUGEON VALUE: **12** FLOW TYPE: TURBULENT
SITE SUPERVISOR M.ASHOVER DATE 7-Dec-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: **DDH 5** Test 9 of 9

PROJECT: TILLEGRA DAM SITE LOCATION: UPSTREAM TOE	RL (m) BEARING 085° INCLINATION 60°	SECTION DEPTH (m) From 31.65 to 35.75 LENGTH OF SECTION (m) 4.10
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 1.7	FLOW METER TYPE DIGITAL PUMP TYPE PISTON	PRESSURE GAUGE CAPACITY (kPa) 400 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 100, 250, 375	GROUNDWATER DEPTH (m) - DATE	TIME AT START 11.00 TIME AT FINISH 12.30 TOTAL TEST TIME(hrs) 1.50

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	100	2.0	13.5	11.5	2.3	0.56	5.6
5	100	13.5	24.5	11.0	2.2	0.54	5.4
5	250	28.5	48.5	20.0	4.0	0.98	3.9
5	250	48.5	68.0	19.5	3.9	0.95	3.8
5	375	76.0	103.0	27.0	5.4	1.32	3.5
5	375	103.0	130.1	27.1	5.4	1.32	3.5
5	250	137.0	154.6	17.6	3.5	0.86	3.4
5	250	154.6	171.2	16.6	3.3	0.81	3.2
5	100	173.0	181.5	8.5	1.7	0.41	4.1
5	100	181.5	189.9	8.4	1.7	0.41	4.1



COMMENTS	REPRESENTATIVE LUGEON VALUE: **4** FLOW TYPE: LAMINAR
SITE SUPERVISOR M.ASHOVER DATE 8-Dec-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
BOREHOLE WATER PRESSURE TEST

BOREHOLE No: **DDH 6**
Test 1 of 9

PROJECT: TILLEGRA DAM SITE LOCATION: MIDDLE LEFT ABUTMENT	RL (m) BEARING 090° INCLINATION 60°	SECTION DEPTH (m) From 3.80 to 7.25 LENGTH OF SECTION (m) 3.45
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 1.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 100 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 40, 70, 100	GROUNDWATER DEPTH (m) - DATE	TIME AT START 12.45 TIME AT FINISH 14.15 TOTAL TEST TIME(hrs) 1.50

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	40	0.3	0.7	0.4	0.1	0.02	0.6
5	70	0.8	0.8	0.0	0.0	0.00	0.0
5	100	1.1	1.2	0.1	0.0	0.01	0.1
5	100	1.2	1.3	0.1	0.0	0.01	0.1

COMMENTS	REPRESENTATIVE LUGEON VALUE: < 1 FLOW TYPE: N/A
SITE SUPERVISOR M.ASHOVER DATE 26-Nov-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
BOREHOLE WATER PRESSURE TEST

BOREHOLE No: **DDH 6**
Test 2 of 9

PROJECT: TILLEGRA DAM SITE LOCATION: MIDDLE LEFT ABUTMENT	RL (m) BEARING 090° INCLINATION 60°	SECTION DEPTH (m) From 6.80 to 10.25 LENGTH OF SECTION (m) 3.45
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 1.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 100 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 40, 70, 100	GROUNDWATER DEPTH (m) - DATE	TIME AT START 15.20 TIME AT FINISH 16.05 TOTAL TEST TIME(hrs) 0.75

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	40	7.3	7.3	0.0	0.0	0.00	0.0
5	70	7.7	7.7	0.0	0.0	0.00	0.0
5	100	8.1	8.1	0.0	0.0	0.00	0.0
5	100	8.3	8.3	0.0	0.0	0.00	0.0

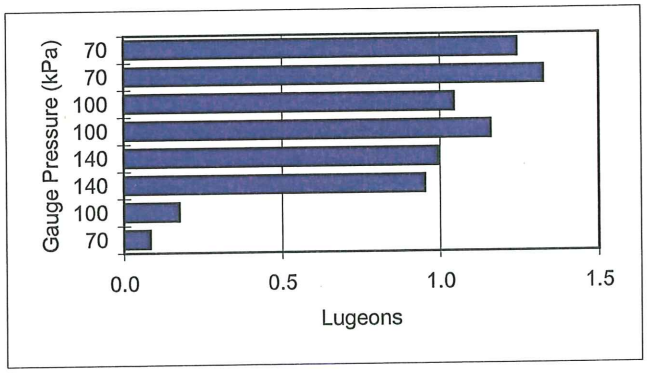
COMMENTS	REPRESENTATIVE LUGEON VALUE: **0** FLOW TYPE: N/A
SITE SUPERVISOR M.ASHOVER DATE 26-Nov-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
BOREHOLE WATER PRESSURE TEST

BOREHOLE No: **DDH 6**
Test 3 of 9

PROJECT: TILLEGRA DAM SITE		RL (m)		SECTION DEPTH (m)	
		BEARING	090°	From 9.80	to 13.25
LOCATION: MIDDLE LEFT ABUTMENT		INCLINATION	60°	LENGTH OF SECTION (m)	3.45
DRILLING/CORE TYPE	HQ3	FLOW METER TYPE		PRESSURE GAUGE	
BOREHOLE DIAMETER (mm)	96	DIGITAL		CAPACITY (kPa)	250
CASING DIAMETER (mm)	110	PUMP TYPE		PACKER TYPE	HQW
CASING DEPTH (m)	1.5	MONO		SEALING LENGTH (m)	1.0
PRESSURE RANGE (kPa)		GROUNDWATER		TIME AT START	7.45
		DEPTH (m)	-	TIME AT FINISH	9.30
70, 100, 140		DATE		TOTAL TEST TIME(hrs)	1.75

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	70	7.4	7.5	0.1	0.0	0.01	0.1
5	100	7.5	7.8	0.3	0.1	0.02	0.2
5	140	7.7	10.0	2.3	0.5	0.13	1.0
5	140	10.0	12.4	2.4	0.5	0.14	1.0
5	100	13.0	15.0	2.0	0.4	0.12	1.2
5	100	15.0	16.8	1.8	0.4	0.10	1.0
5	70	17.0	18.6	1.6	0.3	0.09	1.3
5	70	18.6	20.1	1.5	0.3	0.09	1.2



COMMENTS

REPRESENTATIVE LUGEON VALUE: **1.0**

FLOW TYPE: LAMINAR

SITE SUPERVISOR M.ASHOVER DATE 27-Nov-07

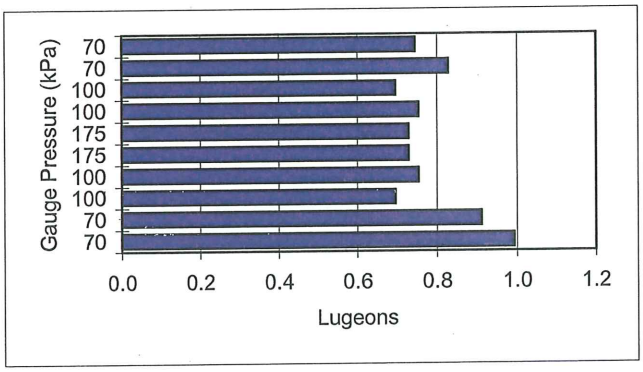
JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
BOREHOLE WATER PRESSURE TEST

BOREHOLE No: **DDH 6**
Test 4 of 9

PROJECT: TILLEGRA DAM SITE LOCATION: MIDDLE LEFT ABUTMENT	RL (m) BEARING 090° INCLINATION 60°	SECTION DEPTH (m) From 12.80 to 16.25 LENGTH OF SECTION (m) 3.45
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 1.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 250 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 70, 100, 175	GROUNDWATER DEPTH (m) - DATE	TIME AT START 11.00 TIME AT FINISH 12.15 TOTAL TEST TIME(hrs) 1.25

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	70	68.5	69.7	1.2	0.2	0.07	1.0
5	70	69.7	70.8	1.1	0.2	0.06	0.9
5	100	71.4	72.6	1.2	0.2	0.07	0.7
5	100	72.6	73.9	1.3	0.3	0.08	0.8
5	175	74.5	76.7	2.2	0.4	0.13	0.7
5	175	76.7	78.9	2.2	0.4	0.13	0.7
5	100	79.1	80.4	1.3	0.3	0.08	0.8
5	100	80.4	81.6	1.2	0.2	0.07	0.7
5	70	82.0	83.0	1.0	0.2	0.06	0.8
5	70	83.0	83.9	0.9	0.2	0.05	0.7



COMMENTS

REPRESENTATIVE LUGEON VALUE: < 1

FLOW TYPE: LAMINAR

SITE SUPERVISOR M.ASHOVER DATE 27-Nov-07

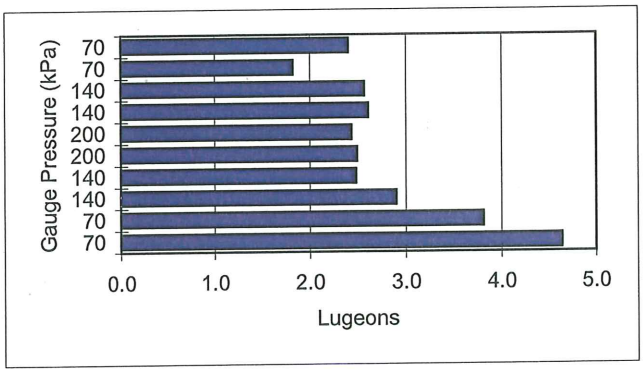
JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
BOREHOLE WATER PRESSURE TEST

BOREHOLE No: **DDH 6**
Test 5 of 9

PROJECT: TILLEGRA DAM SITE LOCATION: MIDDLE LEFT ABUTMENT	RL (m) BEARING 090° INCLINATION 60°	SECTION DEPTH (m) From 15.80 to 19.25 LENGTH OF SECTION (m) 3.45
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 1.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 250 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 70, 140, 200	GROUNDWATER DEPTH (m) - DATE	TIME AT START 13.30 TIME AT FINISH 15.00 TOTAL TEST TIME(hrs) 1.50

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	70	117.8	123.4	5.6	1.1	0.32	4.6
5	70	123.4	128.0	4.6	0.9	0.27	3.8
5	140	130.5	137.5	7.0	1.4	0.41	2.9
5	140	137.5	143.5	6.0	1.2	0.35	2.5
5	200	145.6	154.2	8.6	1.7	0.50	2.5
5	200	154.2	162.6	8.4	1.7	0.49	2.4
5	140	163.7	170.0	6.3	1.3	0.37	2.6
5	140	170.0	176.2	6.2	1.2	0.36	2.6
5	70	176.8	179.0	2.2	0.4	0.13	1.8
5	70	179.0	181.9	2.9	0.6	0.17	2.4



COMMENTS

REPRESENTATIVE
LUGEON VALUE: **3**

FLOW TYPE: LAMINAR

SITE SUPERVISOR M.ASHOVER DATE 27-Nov-07

JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
BOREHOLE WATER PRESSURE TEST

BOREHOLE No: **DDH 6**
Test 6 of 9

PROJECT: TILLEGRA DAM SITE LOCATION: MIDDLE LEFT ABUTMENT	RL (m) BEARING 090° INCLINATION 60°	SECTION DEPTH (m) From 18.80 to 25.25 LENGTH OF SECTION (m) 6.45
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 1.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 400 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 100, 200, 300	GROUNDWATER DEPTH (m) - DATE	TIME AT START 8.00 TIME AT FINISH 9.15 TOTAL TEST TIME(hrs) 1.25

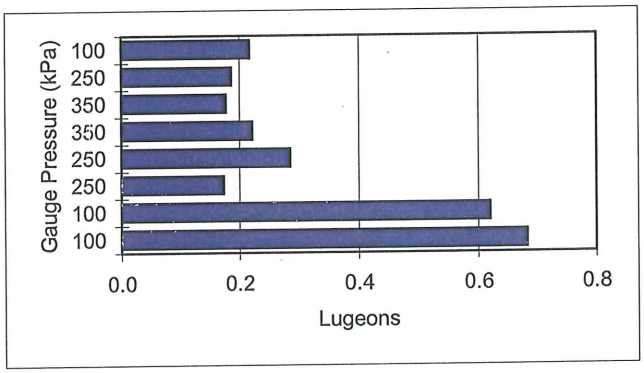
TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	100	0.1	0.1	0.0	0.0	0.00	0.0
5	200	0.4	0.4	0.0	0.0	0.00	0.0
5	300	0.5	0.7	0.2	0.0	0.01	0.0
5	300	0.7	1.0	0.3	0.1	0.01	0.0

COMMENTS	REPRESENTATIVE LUGEON VALUE: < 1 FLOW TYPE: N/A
SITE SUPERVISOR M.ASHOVER DATE 28-Nov-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: DDH 6 Test 7 of 9

PROJECT: TILLEGRA DAM SITE LOCATION: MIDDLE LEFT ABUTMENT	RL (m) BEARING 090° INCLINATION 60°	SECTION DEPTH (m) From 24.80 to 31.25 LENGTH OF SECTION (m) 6.45
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 1.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 400 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 100, 250, 350	GROUNDWATER DEPTH (m) - DATE	TIME AT START 11.00 TIME AT FINISH 12.30 TOTAL TEST TIME(hrs) 1.50

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	100	0.5	2.7	2.2	0.4	0.07	0.7
5	100	2.7	4.7	2.0	0.4	0.06	0.6
5	250	5.5	6.9	1.4	0.3	0.04	0.2
5	250	6.9	9.2	2.3	0.5	0.07	0.3
5	350	9.5	12.0	2.5	0.5	0.08	0.2
5	350	12.0	14.0	2.0	0.4	0.06	0.2
5	250	14.4	15.9	1.5	0.3	0.05	0.2
5	100	16.2	16.9	0.7	0.1	0.02	0.2



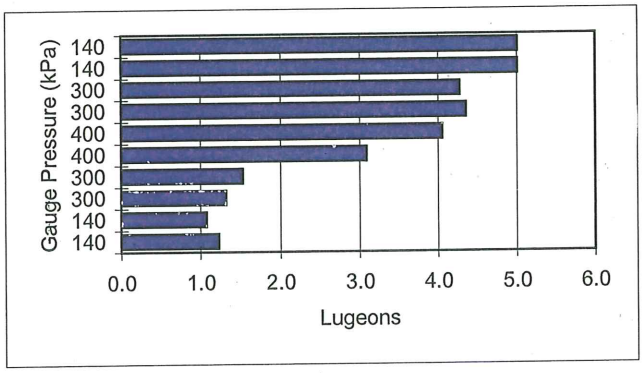
COMMENTS	REPRESENTATIVE LUGEON VALUE: < 1 FLOW TYPE: LAMINAR
SITE SUPERVISOR M.ASHOVER DATE 28-Nov-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
BOREHOLE WATER PRESSURE TEST

BOREHOLE No: **DDH 6**
Test 8 of 9

PROJECT: TILLEGRA DAM SITE LOCATION: MIDDLE LEFT ABUTMENT	RL (m) BEARING 090° INCLINATION 60°	SECTION DEPTH (m) From 30.80 to 39.07 LENGTH OF SECTION (m) 8.27
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 1.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 400 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 140, 300, 400	GROUNDWATER DEPTH (m) - DATE	TIME AT START 13.00 TIME AT FINISH 14.45 TOTAL TEST TIME(hrs) 1.75

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	140	61.3	68.4	7.1	1.4	0.17	1.2
5	140	68.4	74.6	6.2	1.2	0.15	1.1
5	300	80.0	96.4	16.4	3.3	0.40	1.3
5	300	96.4	115.4	19.0	3.8	0.46	1.5
5	400	124.0	175.0	51.0	10.2	1.23	3.1
5	400	175.0	242.0	67.0	13.4	1.62	4.1
5	300	256.0	310.0	54.0	10.8	1.31	4.4
5	300	310.0	363.0	53.0	10.6	1.28	4.3
5	140	371.0	400.0	29.0	5.8	0.70	5.0
5	140	400.0	429.0	29.0	5.8	0.70	5.0



COMMENTS

REPRESENTATIVE
LUGEON VALUE: **5**
FLOW TYPE: WASHOUT

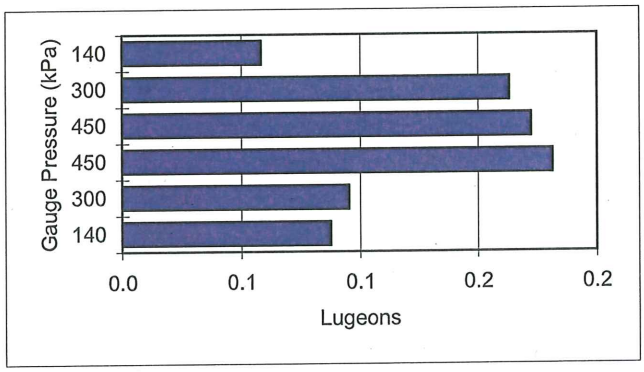
SITE SUPERVISOR MASHOVER DATE 3-Dec-07

JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: DDH 6 Test 9 of 9

PROJECT: TILLEGRA DAM SITE LOCATION: MIDDLE LEFT ABUTMENT	RL (m) BEARING 090° INCLINATION 60°	SECTION DEPTH (m) From 38.35 to 43.25 LENGTH OF SECTION (m) 4.90
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 1.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 1000 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 140, 300, 450	GROUNDWATER DEPTH (m) - DATE	TIME AT START 16.00 TIME AT FINISH 17.45 TOTAL TEST TIME(hrs) 1.75

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	140	495.4	495.7	0.3	0.1	0.01	0.1
5	300	495.8	496.5	0.7	0.1	0.03	0.1
5	450	496.8	498.8	2.0	0.4	0.08	0.2
5	450	498.8	500.7	1.9	0.4	0.08	0.2
5	300	500.8	502.0	1.2	0.2	0.05	0.2
5	140	502.3	502.5	0.2	0.0	0.01	0.1



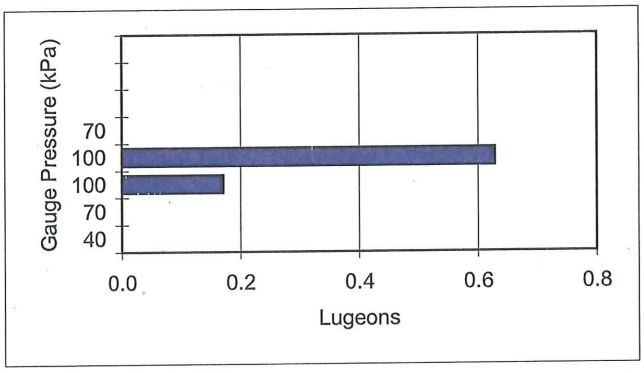
COMMENTS	REPRESENTATIVE LUGEON VALUE: < 1 FLOW TYPE: LAMINAR
SITE SUPERVISOR M.ASHOVER DATE 3-Dec-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
BOREHOLE WATER PRESSURE TEST

BOREHOLE No: **DDH 7**
Test 1 of 9

PROJECT: TILLEGRA DAM SITE LOCATION: UPPER LEFT ABUTMENT	RL (m) BEARING 060° INCLINATION 60°	SECTION DEPTH (m) From 6.80 to 10.30 LENGTH OF SECTION (m) 3.50
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 1.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 250 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 40, 70, 100	GROUNDWATER DEPTH (m) - DATE	TIME AT START 9.30 TIME AT FINISH 10.45 TOTAL TEST TIME(hrs) 1.25

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	40	25.5	25.5	0.0	0.0	0.00	0.0
5	70	25.7	25.7	0.0	0.0	0.00	0.0
5	100	26.2	26.5	0.3	0.1	0.02	0.2
5	100	26.5	27.6	1.1	0.2	0.06	0.6
5	70	27.7	27.7	0.0	0.0	0.00	0.0



COMMENTS	REPRESENTATIVE LUGEON VALUE: < 1 FLOW TYPE: N/A
SITE SUPERVISOR M.ASHOVER DATE 23-Nov-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
BOREHOLE WATER PRESSURE TEST

BOREHOLE No: **DDH 7**
Test 2 of 9

PROJECT: TILLEGRA DAM SITE LOCATION: UPPER LEFT ABUTMENT	RL (m) BEARING 060° INCLINATION 60°	SECTION DEPTH (m) From 9.80 to 13.30 LENGTH OF SECTION (m) 3.50
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 1.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 250 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 70, 100, 140	GROUNDWATER DEPTH (m) - DATE	TIME AT START 11.30 TIME AT FINISH 12.30 TOTAL TEST TIME(hrs) 1.00

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	70	21.2	21.2	0.0	0.0	0.00	0.0
5	100	21.6	21.6	0.0	0.0	0.00	0.0
5	140	22.0	22.0	0.0	0.0	0.00	0.0
5	140	22.0	22.0	0.0	0.0	0.00	0.0

COMMENTS

REPRESENTATIVE
LUGEON VALUE: **0**
FLOW TYPE: N/A

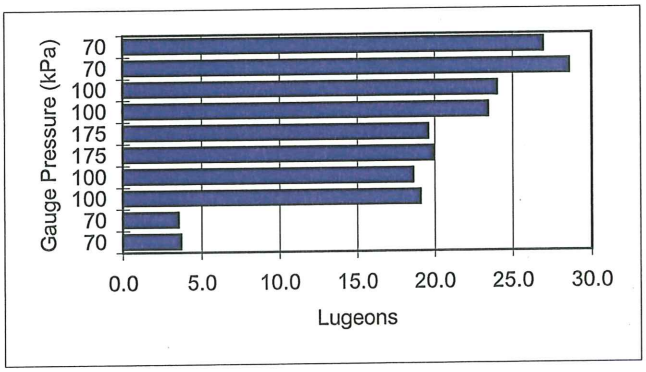
SITE SUPERVISOR M.ASHOVER DATE 23-Nov-07

JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: DDH 7 Test 3 of 9

PROJECT: TILLEGRA DAM SITE LOCATION: UPPER LEFT ABUTMENT	RL (m) BEARING 060° INCLINATION 60°	SECTION DEPTH (m) From 12.80 to 16.30 LENGTH OF SECTION (m) 3.50
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 1.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 250 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 70, 100, 175	GROUNDWATER DEPTH (m) - DATE	TIME AT START 13.15 TIME AT FINISH 14.45 TOTAL TEST TIME(hrs) 1.50

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	70	82.0	86.5	4.5	0.9	0.26	3.7
5	70	86.5	90.8	4.3	0.9	0.25	3.5
5	100	91.0	124.4	33.4	6.7	1.91	19.1
5	100	124.4	157.0	32.6	6.5	1.86	18.6
5	175	170.0	231.0	61.0	12.2	3.49	19.9
5	175	231.0	291.0	60.0	12.0	3.43	19.6
5	100	299.0	340.0	41.0	8.2	2.34	23.4
5	100	340.0	382.0	42.0	8.4	2.40	24.0
5	70	387.0	422.0	35.0	7.0	2.00	28.6
5	70	422.0	455.0	33.0	6.6	1.89	26.9

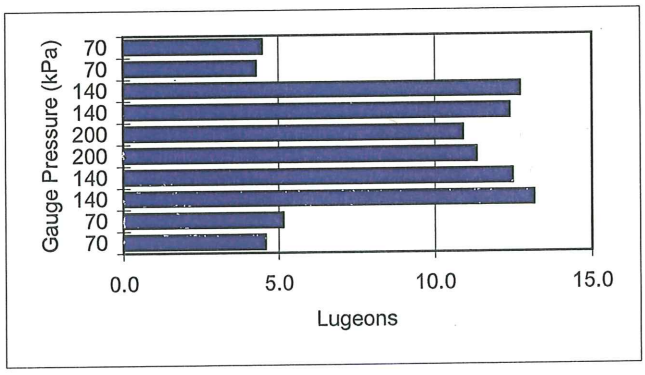


COMMENTS	REPRESENTATIVE LUGEON VALUE: 28 FLOW TYPE: WASHOUT
SITE SUPERVISOR M.ASHOVER DATE 23-Nov-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: DDH 7 Test 4 of 9

PROJECT: TILLEGRA DAM SITE LOCATION: UPPER LEFT ABUTMENT		RL (m) BEARING INCLINATION	 060° 60°	SECTION DEPTH (m) From 16.30 to LENGTH OF SECTION (m)	 19.30 3.00
DRILLING/CORE TYPE BOREHOLE DIAMETER (mm) CASING DIAMETER (mm) CASING DEPTH (m)	HQ3 96 110 1.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO		PRESSURE GAUGE CAPACITY (kPa) PACKER TYPE SEALING LENGTH (m)	 250 HQW 1.0
PRESSURE RANGE (kPa) 70, 140, 200		GROUNDWATER DEPTH (m) DATE	 - 	TIME AT START TIME AT FINISH TOTAL TEST TIME(hrs)	9.00 10.45 1.75

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	70	54.3	59.1	4.8	1.0	0.32	4.6
5	70	59.1	64.5	5.4	1.1	0.36	5.1
5	140	4.6	32.2	27.6	5.5	1.84	13.1
5	140	32.2	58.4	26.2	5.2	1.75	12.5
5	200	63.0	97.0	34.0	6.8	2.27	11.3
5	200	97.0	129.7	32.7	6.5	2.18	10.9
5	140	134.0	160.0	26.0	5.2	1.73	12.4
5	140	160.0	186.7	26.7	5.3	1.78	12.7
5	70	190.0	194.5	4.5	0.9	0.30	4.3
5	70	194.5	199.2	4.7	0.9	0.31	4.5



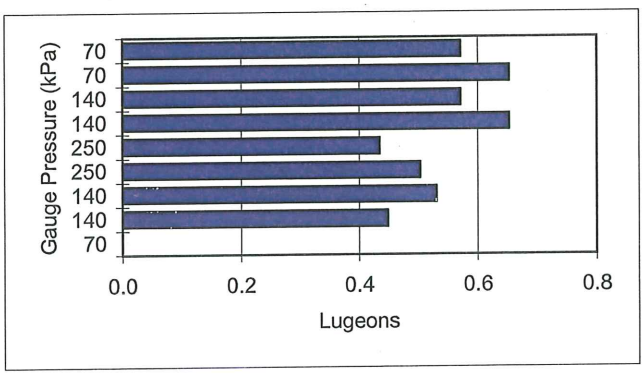
COMMENTS	REPRESENTATIVE LUGEON VALUE: 12 FLOW TYPE: DILATION (Turbulent Flow)
SITE SUPERVISOR M.ASHOVER DATE 24-Nov-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
BOREHOLE WATER PRESSURE TEST

BOREHOLE No: **DDH 7**
Test 5 of 9

PROJECT: TILLEGRA DAM SITE LOCATION: UPPER LEFT ABUTMENT	RL (m) BEARING 060° INCLINATION 60°	SECTION DEPTH (m) From 18.80 to 22.30 LENGTH OF SECTION (m) 3.50
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 1.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 250 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 70, 140, 250	GROUNDWATER DEPTH (m) - DATE	TIME AT START 11.55 TIME AT FINISH 13.10 TOTAL TEST TIME(hrs) 1.25

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	70	1.4	1.4	0.0	0.0	0.00	0.0
5	140	1.6	2.7	1.1	0.2	0.06	0.4
5	140	2.7	4.0	1.3	0.3	0.07	0.5
5	250	4.3	6.5	2.2	0.4	0.13	0.5
5	250	6.5	8.4	1.9	0.4	0.11	0.4
5	140	8.6	10.2	1.6	0.3	0.09	0.7
5	140	10.2	11.6	1.4	0.3	0.08	0.6
5	70	11.8	12.6	0.8	0.2	0.05	0.7
5	70	12.6	13.3	0.7	0.1	0.04	0.6



COMMENTS

REPRESENTATIVE LUGEON VALUE: < 1

FLOW TYPE: LAMINAR

SITE SUPERVISOR M.ASHOVER DATE 24-Nov-07

JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: **DDH 7** Test 6 of 9

PROJECT: TILLEGRA DAM SITE LOCATION: UPPER LEFT ABUTMENT		RL (m) BEARING INCLINATION	 060° 60°	SECTION DEPTH (m) From 21.80 to 25.30 LENGTH OF SECTION (m)	3.50
DRILLING/CORE TYPE BOREHOLE DIAMETER (mm) CASING DIAMETER (mm) CASING DEPTH (m)	HQ3 96 110 1.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO		PRESSURE GAUGE CAPACITY (kPa) PACKER TYPE SEALING LENGTH (m)	 250 HQW 1.0
PRESSURE RANGE (kPa) 70, 175, 250		GROUNDWATER DEPTH (m) DATE	 - 	TIME AT START TIME AT FINISH TOTAL TEST TIME(hrs)	14.20 15.20 1.00

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	70	1.0	1.0	0.0	0.0	0.00	0.0
5	175	1.4	1.4	0.0	0.0	0.00	0.0
5	250	4.3	4.5	0.2	0.0	0.01	0.0
5	250	4.5	4.8	0.3	0.1	0.02	0.1

COMMENTS	REPRESENTATIVE LUGEON VALUE: **< 1** FLOW TYPE: N/A
SITE SUPERVISOR M.ASHOVER DATE 24-Nov-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
BOREHOLE WATER PRESSURE TEST

BOREHOLE No: **DDH 7**
Test 7 of 9

PROJECT: TILLEGRA DAM SITE LOCATION: UPPER LEFT ABUTMENT	RL (m) BEARING 060° INCLINATION 60°	SECTION DEPTH (m) From 24.80 to 28.30 LENGTH OF SECTION (m) 3.50
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 1.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 400 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 100, 200, 300	GROUNDWATER DEPTH (m) - DATE	TIME AT START 8.00 TIME AT FINISH 9.30 TOTAL TEST TIME(hrs) 1.50

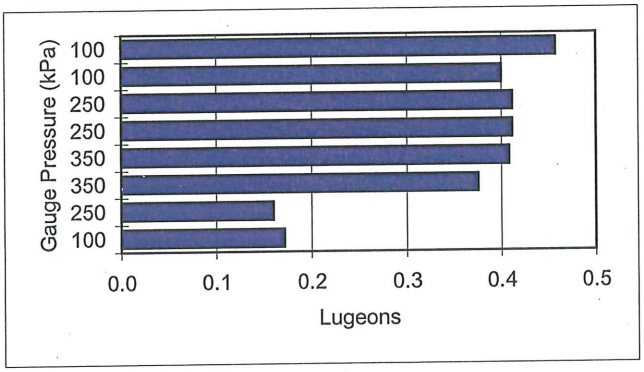
TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	100	48.6	48.6	0.0	0.0	0.00	0.0
5	200	49.0	49.0	0.0	0.0	0.00	0.0
5	300	49.4	49.7	0.3	0.1	0.02	0.1
5	300	49.7	50.1	0.4	0.1	0.02	0.1
5	200	53.6	53.6	0.0	0.0	0.00	0.0
5	100	55.2	55.2	0.0	0.0	0.00	0.0

COMMENTS	REPRESENTATIVE LUGEON VALUE: **< 1** FLOW TYPE: N/A
SITE SUPERVISOR M.ASHOVER DATE 25-Nov-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: **DDH 7** Test 8 of 9

PROJECT: TILLEGRA DAM SITE LOCATION: UPPER LEFT ABUTMENT	RL (m) BEARING 060° INCLINATION 60°	SECTION DEPTH (m) From 27.80 to 31.30 LENGTH OF SECTION (m) 3.50
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 1.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 400 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 100, 250, 350	GROUNDWATER DEPTH (m) - DATE	TIME AT START 12.00 TIME AT FINISH 13.15 TOTAL TEST TIME(hrs) 1.25

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	100	42.9	43.2	0.3	0.1	0.02	0.2
5	250	43.3	44.0	0.7	0.1	0.04	0.2
5	350	44.4	46.7	2.3	0.5	0.13	0.4
5	350	46.7	49.2	2.5	0.5	0.14	0.4
5	250	49.4	51.2	1.8	0.4	0.10	0.4
5	250	51.2	53.0	1.8	0.4	0.10	0.4
5	100	53.2	53.9	0.7	0.1	0.04	0.4
5	100	53.9	54.7	0.8	0.2	0.05	0.5



COMMENTS	REPRESENTATIVE LUGEON VALUE: < 1 FLOW TYPE: LAMINAR
SITE SUPERVISOR M.ASHOVER DATE 25-Nov-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
BOREHOLE WATER PRESSURE TEST

BOREHOLE No: **DDH 7**
Test 9 of 9

PROJECT: TILLEGRA DAM SITE LOCATION: UPPER LEFT ABUTMENT	RL (m) BEARING 060° INCLINATION 60°	SECTION DEPTH (m) From 30.80 to 34.30 LENGTH OF SECTION (m) 3.50
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 1.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 400 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 140, 250, 375	GROUNDWATER DEPTH (m) - DATE	TIME AT START 14.15 TIME AT FINISH 15.00 TOTAL TEST TIME(hrs) 0.75

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	140	0.0	0.0	0.0	0.0	0.00	0.0
5	250	0.0	0.0	0.0	0.0	0.00	0.0
5	375	0.2	0.2	0.0	0.0	0.00	0.0
5	375	0.5	0.5	0.0	0.0	0.00	0.0

COMMENTS

REPRESENTATIVE LUGEON VALUE: **0**

FLOW TYPE: N/A

SITE SUPERVISOR M.ASHOVER DATE 25-Nov-07

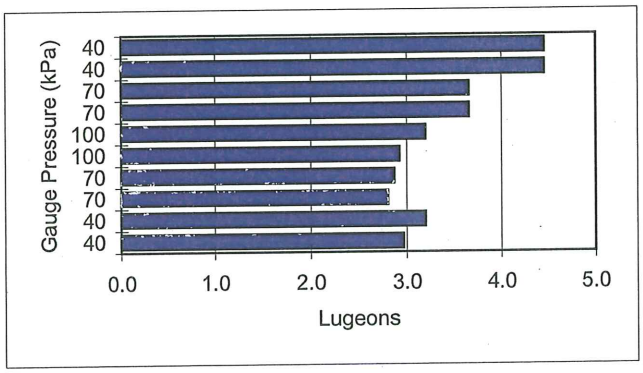
JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
BOREHOLE WATER PRESSURE TEST

BOREHOLE No: **DDH 8**
Test 1 of 13

PROJECT: TILLEGRA DAM SITE		RL (m)		SECTION DEPTH (m)	
		BEARING	050°	From 3.80 to	8.18
LOCATION: LEFT ABUTMENT ALT. SPILLWAY		INCLINATION	60°	LENGTH OF SECTION (m)	4.38
DRILLING/CORE TYPE	HQ3	FLOW METER TYPE		PRESSURE GAUGE	
BOREHOLE DIAMETER (mm)	96	DIGITAL		CAPACITY (kPa)	250
CASING DIAMETER (mm)	110	PUMP TYPE		PACKER TYPE	HQW
CASING DEPTH (m)	1.5	MONO		SEALING LENGTH (m)	1.0
PRESSURE RANGE (kPa)		GROUNDWATER		TIME AT START	9.00
		DEPTH (m)	-	TIME AT FINISH	11.00
40, 70, 100		DATE		TOTAL TEST TIME(hrs)	2.00

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	40	1.0	3.6	2.6	0.5	0.12	3.0
5	40	3.6	6.4	2.8	0.6	0.13	3.2
5	70	7.9	12.2	4.3	0.9	0.20	2.8
5	70	12.2	16.6	4.4	0.9	0.20	2.9
5	100	18.2	24.6	6.4	1.3	0.29	2.9
5	100	24.6	31.6	7.0	1.4	0.32	3.2
5	70	33.0	38.6	5.6	1.1	0.26	3.7
5	70	38.6	44.2	5.6	1.1	0.26	3.7
5	40	44.8	48.7	3.9	0.8	0.18	4.5
5	40	48.7	52.6	3.9	0.8	0.18	4.5



COMMENTS

REPRESENTATIVE
LUGEON VALUE: **5**

FLOW TYPE: SLIGHT WASHOUT

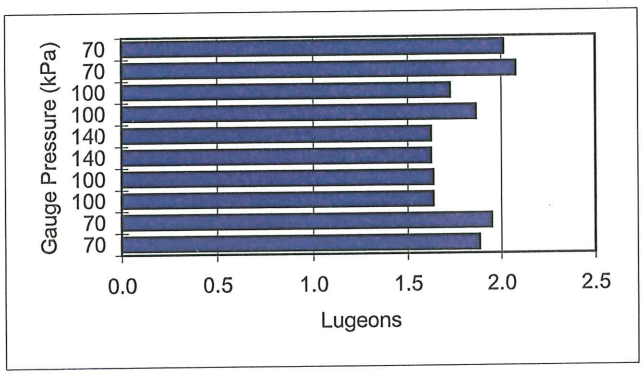
SITE SUPERVISOR M.ASHOVER DATE 16-Nov-07

JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: **DDH 8** Test 2 of 13

PROJECT: TILLEGRA DAM SITE LOCATION: LEFT ABUTMENT ALT. SPILLWAY	RL (m) BEARING 050° INCLINATION 60°	SECTION DEPTH (m) From 8.10 to 12.50 LENGTH OF SECTION (m) 4.40
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 1.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 250 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 70, 100, 140	GROUNDWATER DEPTH (m) - DATE	TIME AT START 12.30 TIME AT FINISH 14.30 TOTAL TEST TIME(hrs) 2.00

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	70	1.3	4.2	2.9	0.6	0.13	1.9
5	70	4.2	7.2	3.0	0.6	0.14	1.9
5	100	7.8	11.4	3.6	0.7	0.16	1.6
5	100	11.4	15.0	3.6	0.7	0.16	1.6
5	140	16.4	21.4	5.0	1.0	0.23	1.6
5	140	21.4	26.4	5.0	1.0	0.23	1.6
5	100	27.3	31.4	4.1	0.8	0.19	1.9
5	100	31.4	35.2	3.8	0.8	0.17	1.7
5	70	35.6	38.8	3.2	0.6	0.15	2.1
5	70	38.8	41.9	3.1	0.6	0.14	2.0



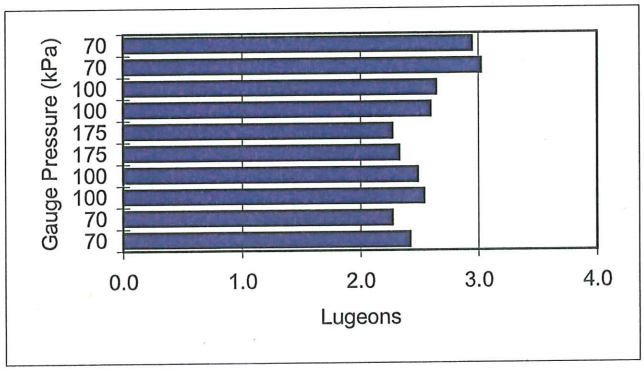
COMMENTS	REPRESENTATIVE LUGEON VALUE: **1.8** FLOW TYPE: LAMINAR
SITE SUPERVISOR M.ASHOVER DATE 16-Nov-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
BOREHOLE WATER PRESSURE TEST

BOREHOLE No: **DDH 8**
Test 3 of 13

PROJECT: TILLEGRA DAM SITE		RL (m)		SECTION DEPTH (m)	
		BEARING	050°	From 12.45 to	16.23
LOCATION: LEFT ABUTMENT ALT. SPILLWAY		INCLINATION	60°	LENGTH OF SECTION (m)	3.78
DRILLING/CORE TYPE	HQ3	FLOW METER TYPE		PRESSURE GAUGE	
BOREHOLE DIAMETER (mm)	96	DIGITAL		CAPACITY (kPa)	250
CASING DIAMETER (mm)	110	PUMP TYPE		PACKER TYPE	HQW
CASING DEPTH (m)	1.5	MONO		SEALING LENGTH (m)	1.0
PRESSURE RANGE (kPa)		GROUNDWATER		TIME AT START	12.00
		DEPTH (m)	-	TIME AT FINISH	13.30
70, 100, 175		DATE		TOTAL TEST TIME(hrs)	1.50

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	70	1.0	4.2	3.2	0.6	0.17	2.4
5	70	4.2	7.2	3.0	0.6	0.16	2.3
5	100	8.2	13.0	4.8	1.0	0.25	2.5
5	100	13.0	17.7	4.7	0.9	0.25	2.5
5	175	19.2	26.9	7.7	1.5	0.41	2.3
5	175	26.9	34.4	7.5	1.5	0.40	2.3
5	100	35.3	40.2	4.9	1.0	0.26	2.6
5	100	0.2	5.2	5.0	1.0	0.26	2.6
5	70	6.0	10.0	4.0	0.8	0.21	3.0
5	70	10.0	13.9	3.9	0.8	0.21	2.9



COMMENTS

REPRESENTATIVE
LUGEON VALUE: **2.5**

FLOW TYPE: LAMINAR

SITE SUPERVISOR M.ASHOVER DATE 19-Nov-07

JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
BOREHOLE WATER PRESSURE TEST

BOREHOLE No: **DDH 8**
Test 4 of 13

PROJECT: TILLEGRA DAM SITE LOCATION: LEFT ABUTMENT ALT. SPILLWAY	RL (m) BEARING 050° INCLINATION 60°	SECTION DEPTH (m) From 15.75 to 19.23 LENGTH OF SECTION (m) 3.48
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 1.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 250 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 70, 140, 200	GROUNDWATER DEPTH (m) - DATE	TIME AT START 14.30 TIME AT FINISH 15.30 TOTAL TEST TIME(hrs) 1.00

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	70	0.2	0.2	0.0	0.0	0.00	0.0
5	140	0.7	0.7	0.0	0.0	0.00	0.0
5	200	1.0	1.0	0.0	0.0	0.00	0.0
5	200	1.0	1.0	0.0	0.0	0.00	0.0

COMMENTS	REPRESENTATIVE LUGEON VALUE: **0** FLOW TYPE: N/A
SITE SUPERVISOR M.ASHOVER DATE 19-Nov-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING
BOREHOLE WATER PRESSURE TEST

BOREHOLE No: **DDH 8**
Test 5 of 13

PROJECT: TILLEGRA DAM SITE LOCATION: LEFT ABUTMENT ALT. SPILLWAY	RL (m) BEARING 050° INCLINATION 60°	SECTION DEPTH (m) From 18.75 to 25.23 LENGTH OF SECTION (m) 6.48
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 1.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 400 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 100, 200, 300	GROUNDWATER DEPTH (m) - DATE	TIME AT START 7.30 TIME AT FINISH 9.30 TOTAL TEST TIME(hrs) 2.00

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	100	8.9	9.0	0.1	0.0	0.00	0.0
5	200	34.0	34.2	0.2	0.0	0.01	0.0
5	300	34.4	34.6	0.2	0.0	0.01	0.0
5	300	34.6	34.8	0.2	0.0	0.01	0.0

COMMENTS

REPRESENTATIVE LUGEON VALUE: **0**

FLOW TYPE: N/A

SITE SUPERVISOR M.ASHOVER DATE 20-Nov-07

JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: **DDH 8** Test 6 of 13

PROJECT: TILLEGRA DAM SITE LOCATION: LEFT ABUTMENT ALT. SPILLWAY	RL (m) BEARING 050° INCLINATION 60°	SECTION DEPTH (m) From 24.75 to 28.23 LENGTH OF SECTION (m) 3.48
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 1.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO/PISTON	PRESSURE GAUGE CAPACITY (kPa) 400 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 100, 250, 350	GROUNDWATER DEPTH (m) - DATE	TIME AT START 10.30 TIME AT FINISH 11.15 TOTAL TEST TIME(hrs) 0.75

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)

COMMENTS **Pumped at maximum capacity (55litres/min) for 15 min. Zero test pressure achieved.** **100% DRILL WATER LOSS AT 27.65m.**	REPRESENTATIVE LUGEON VALUE: **> 100** FLOW TYPE: N/A
SITE SUPERVISOR M.ASHOVER DATE 20-Nov-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: **DDH 8** Test 7 of 13

PROJECT: TILLEGRA DAM SITE LOCATION: LEFT ABUTMENT ALT. SPILLWAY	RL (m) BEARING 050° INCLINATION 60°	SECTION DEPTH (m) From 28.23 to 31.23 LENGTH OF SECTION (m) 3.00
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 1.5	FLOW METER TYPE DIGITAL PUMP TYPE PISTON	PRESSURE GAUGE CAPACITY (kPa) 400 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 100, 250, 350	GROUNDWATER DEPTH (m) - DATE	TIME AT START 12.50 TIME AT FINISH 13.50 TOTAL TEST TIME(hrs) 1.00

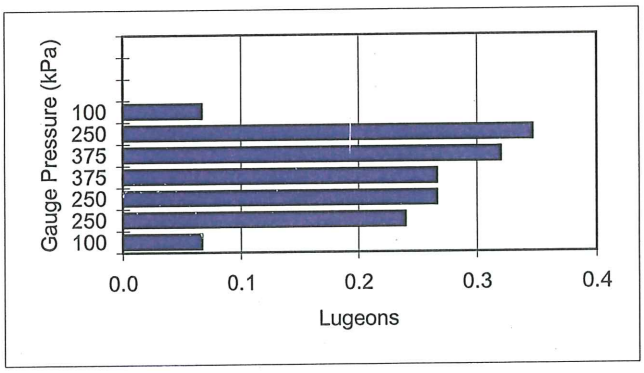
TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)

COMMENTS **Pumped at maximum capacity (55litres/min) for 15 min. Zero test pressure achieved.**	REPRESENTATIVE LUGEON VALUE: **> 100** FLOW TYPE: N/A
SITE SUPERVISOR M.ASHOVER DATE 20-Nov-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: DDH 8 Test 8 of 13

PROJECT: TILLEGRA DAM SITE LOCATION: LEFT ABUTMENT ALT. SPILLWAY		RL (m) BEARING 050° INCLINATION 60°		SECTION DEPTH (m) From 31.23 to 34.23 LENGTH OF SECTION (m) 3.00	
DRILLING/CORE TYPE BOREHOLE DIAMETER (mm) CASING DIAMETER (mm) CASING DEPTH (m)	HQ3 96 110 1.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO		PRESSURE GAUGE CAPACITY (kPa) PACKER TYPE SEALING LENGTH (m)	400 HQW 1.0
PRESSURE RANGE (kPa) 100, 250, 375		GROUNDWATER DEPTH (m) - DATE		TIME AT START TIME AT FINISH TOTAL TEST TIME(hrs)	15.25 16.40 1.25

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	100	125.0	125.1	0.1	0.0	0.01	0.1
5	250	125.4	126.3	0.9	0.2	0.06	0.2
5	250	126.3	127.3	1.0	0.2	0.07	0.3
5	375	127.7	129.2	1.5	0.3	0.10	0.3
5	375	129.2	131.0	1.8	0.4	0.12	0.3
5	250	131.2	132.5	1.3	0.3	0.09	0.3
5	100	132.7	132.8	0.1	0.0	0.01	0.1

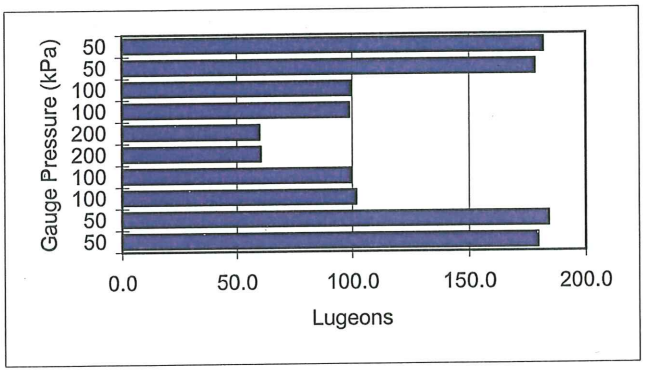


COMMENTS	REPRESENTATIVE LUGEON VALUE: < 1 FLOW TYPE: LAMINAR
SITE SUPERVISOR M.ASHOVER DATE 20-Nov-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: **DDH 8** Test 9 of 13

PROJECT: TILLEGRA DAM SITE LOCATION: LEFT ABUTMENT ALT. SPILLWAY		RL (m) BEARING INCLINATION	 050° 60°	SECTION DEPTH (m) From 33.75 to LENGTH OF SECTION (m)	 37.23 3.48
DRILLING/CORE TYPE BOREHOLE DIAMETER (mm) CASING DIAMETER (mm) CASING DEPTH (m)	HQ3 96 110 1.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO		PRESSURE GAUGE CAPACITY (kPa) PACKER TYPE SEALING LENGTH (m)	 400 HQW 1.0
PRESSURE RANGE (kPa) 140, 300, 400		GROUNDWATER DEPTH (m) DATE	 - 	TIME AT START TIME AT FINISH TOTAL TEST TIME(hrs)	7.30 9.00 1.50

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	50	430.0	586.0	156.0	31.2	8.97	179.3
5	50	610.0	770.0	160.0	32.0	9.20	183.9
5	100	805.0	982.0	177.0	35.4	10.17	101.7
5	100	982.0	1155.0	173.0	34.6	9.94	99.4
5	200	1180.0	1390.0	210.0	42.0	12.07	60.3
5	200	1390.0	1598.0	208.0	41.6	11.95	59.8
5	100	1620.0	1792.0	172.0	34.4	9.89	98.9
5	100	1792.0	1965.0	173.0	34.6	9.94	99.4
5	50	1980.0	2135.0	155.0	31.0	8.91	178.2
5	50	2135.0	2293.0	158.0	31.6	9.08	181.6

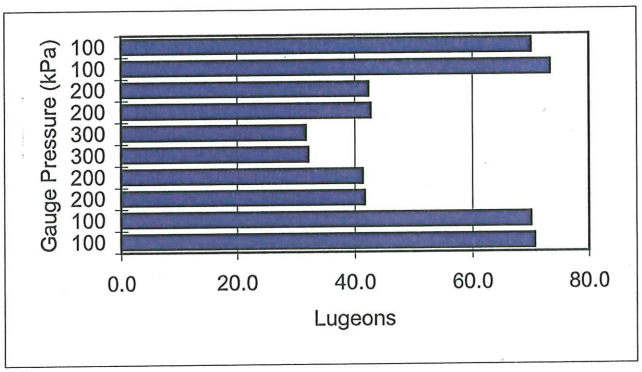


COMMENTS	REPRESENTATIVE
Maximum achievable pressure was 200kPa.	LUGEON VALUE: **60** FLOW TYPE: TURBULENT
SITE SUPERVISOR M.ASHOVER DATE 21-Nov-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: **DDH 8** Test 10 of 13

PROJECT: TILLEGRA DAM SITE LOCATION: LEFT ABUTMENT ALT. SPILLWAY		RL (m) BEARING 050° INCLINATION 60°		SECTION DEPTH (m) From 37.23 to 40.23 LENGTH OF SECTION (m) 3.00	
DRILLING/CORE TYPE BOREHOLE DIAMETER (mm) CASING DIAMETER (mm) CASING DEPTH (m)	HQ3 96 110 1.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO		PRESSURE GAUGE CAPACITY (kPa) PACKER TYPE SEALING LENGTH (m)	400 HQW 1.0
PRESSURE RANGE (kPa) 140, 300, 400		GROUNDWATER DEPTH (m) - DATE		TIME AT START TIME AT FINISH TOTAL TEST TIME(hrs)	10.00 11.30 1.50

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	100	250.0	356.0	106.0	21.2	7.07	70.7
5	100	356.0	461.0	105.0	21.0	7.00	70.0
5	200	480.0	605.0	125.0	25.0	8.33	41.7
5	200	605.0	729.0	124.0	24.8	8.27	41.3
5	300	750.0	895.0	145.0	29.0	9.67	32.2
5	300	895.0	1038.0	143.0	28.6	9.53	31.8
5	200	1054.0	1182.0	128.0	25.6	8.53	42.7
5	200	1182.0	1309.0	127.0	25.4	8.47	42.3
5	100	1320.0	1430.0	110.0	22.0	7.33	73.3
5	100	1430.0	1535.0	105.0	21.0	7.00	70.0

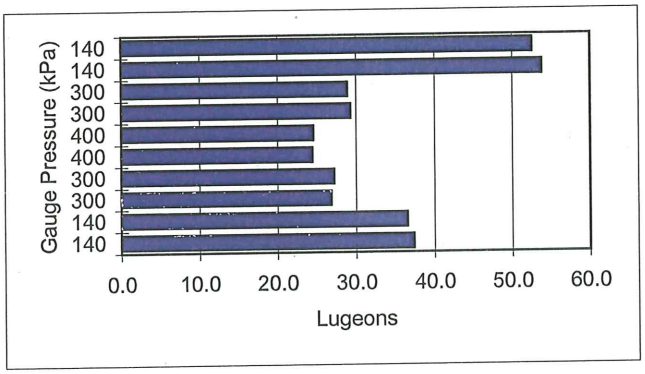


COMMENTS	REPRESENTATIVE
Maximum achievable pressure was 300kPa.	LUGEON VALUE: **32** FLOW TYPE: TURBULENT
SITE SUPERVISOR M.ASHOVER DATE 21-Nov-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: **DDH 8** Test 11 of 13

PROJECT: TILLEGRA DAM SITE LOCATION: LEFT ABUTMENT ALT. SPILLWAY	RL (m) BEARING 050° INCLINATION 60°	SECTION DEPTH (m) From 39.75 to 43.23 LENGTH OF SECTION (m) 3.48
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 1.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 400 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 140, 300, 400	GROUNDWATER DEPTH (m) - DATE	TIME AT START 12.30 TIME AT FINISH 14.00 TOTAL TEST TIME(hrs) 1.50

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	140	192.0	283.0	91.0	18.2	5.23	37.4
5	140	283.0	372.0	89.0	17.8	5.11	36.5
5	300	445.0	585.0	140.0	28.0	8.05	26.8
5	300	585.0	727.0	142.0	28.4	8.16	27.2
5	400	812.0	982.0	170.0	34.0	9.77	24.4
5	400	982.0	1153.0	171.0	34.2	9.83	24.6
5	300	1193.0	1346.0	153.0	30.6	8.79	29.3
5	300	1346.0	1497.0	151.0	30.2	8.68	28.9
5	140	1644.0	1775.0	131.0	26.2	7.53	53.8
5	140	1775.0	1903.0	128.0	25.6	7.36	52.5

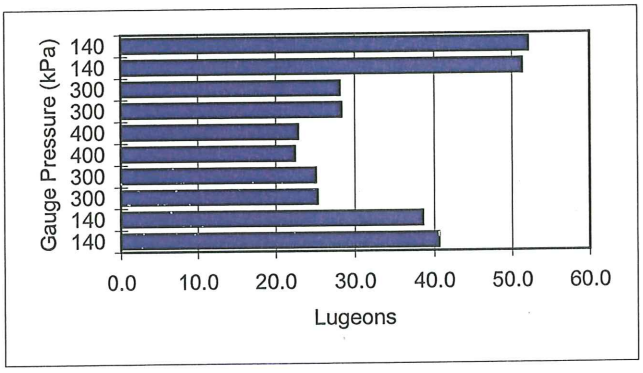


COMMENTS	REPRESENTATIVE LUGEON VALUE: **54** FLOW TYPE: WASHOUT (Turbulent Flow)
SITE SUPERVISOR M.ASHOVER DATE 21-Nov-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: **DDH 8** Test 12 of 13

PROJECT: TILLEGRA DAM SITE LOCATION: LEFT ABUTMENT ALT. SPILLWAY	RL (m) BEARING 050° INCLINATION 60°	SECTION DEPTH (m) From 42.75 to 46.23 LENGTH OF SECTION (m) 3.48
DRILLING/CORE TYPE HQ3 BOREHOLE DIAMETER (mm) 96 CASING DIAMETER (mm) 110 CASING DEPTH (m) 1.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO	PRESSURE GAUGE CAPACITY (kPa) 400 PACKER TYPE HQW SEALING LENGTH (m) 1.0
PRESSURE RANGE (kPa) 140, 300, 400	GROUNDWATER DEPTH (m) - DATE	TIME AT START TIME AT FINISH TOTAL TEST TIME(hrs)

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	140	196.0	295.0	99.0	19.8	5.69	40.6
5	140	295.0	389.0	94.0	18.8	5.40	38.6
5	300	410.0	542.0	132.0	26.4	7.59	25.3
5	300	542.0	673.0	131.0	26.2	7.53	25.1
5	400	690.0	846.0	156.0	31.2	8.97	22.4
5	400	846.0	1005.0	159.0	31.8	9.14	22.8
5	300	1046.0	1194.0	148.0	29.6	8.51	28.4
5	300	1194.0	1341.0	147.0	29.4	8.45	28.2
5	140	1363.0	1488.0	125.0	25.0	7.18	51.3
5	140	1488.0	1615.0	127.0	25.4	7.30	52.1

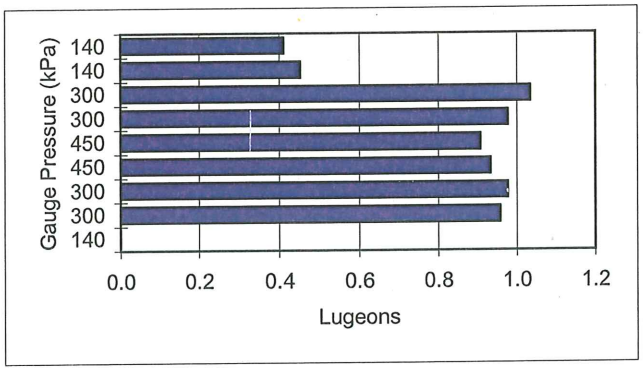


COMMENTS	REPRESENTATIVE LUGEON VALUE: **50** FLOW TYPE: WASHOUT (Turbulent Flow)
SITE SUPERVISOR M.ASHOVER DATE 21-Nov-07	JOB/REPORT No. GN31A

GEOTECHNICAL & ENVIRONMENTAL ENGINEERING BOREHOLE WATER PRESSURE TEST	BOREHOLE No: **DDH 8** Test 13 of 13

PROJECT: TILLEGRA DAM SITE LOCATION: LEFT ABUTMENT ALT. SPILLWAY		RL (m) BEARING 050° INCLINATION 60°		SECTION DEPTH (m) From 45.75 to 49.23 LENGTH OF SECTION (m) 3.48	
DRILLING/CORE TYPE BOREHOLE DIAMETER (mm) CASING DIAMETER (mm) CASING DEPTH (m)	HQ3 96 110 1.5	FLOW METER TYPE DIGITAL PUMP TYPE MONO		PRESSURE GAUGE CAPACITY (kPa) PACKER TYPE SEALING LENGTH (m)	1000 HQW 1.0
PRESSURE RANGE (kPa) 140, 300, 450		GROUNDWATER DEPTH (m) - DATE		TIME AT START TIME AT FINISH TOTAL TEST TIME(hrs)	

TIME (min)	PRESSURE (kPa)	FLOW METER READING START (l)	FLOW METER READING END (l)	LITRES	l/min	l/min/m	LUGEONS (L)
5	140	141.7	141.7	0.0	0.0	0.00	0.0
5	300	142.0	147.0	5.0	1.0	0.29	1.0
5	300	147.0	152.1	5.1	1.0	0.29	1.0
5	450	152.8	160.1	7.3	1.5	0.42	0.9
5	450	160.1	167.2	7.1	1.4	0.41	0.9
5	300	167.9	173.0	5.1	1.0	0.29	1.0
5	300	173.0	178.4	5.4	1.1	0.31	1.0
5	140	178.8	179.9	1.1	0.2	0.06	0.5
5	140	179.9	180.9	1.0	0.2	0.06	0.4



COMMENTS	REPRESENTATIVE LUGEON VALUE: **1.0** FLOW TYPE: LAMINAR
SITE SUPERVISOR M.ASHOVER DATE 22-Nov-07	JOB/REPORT No. GN31A

APPENDIX F

Petrographic Analyses

by Dr. B.J. Franklin

Dr Brenda J. Franklin BSc(Hons)(Syd), MSc, PhD(NSW), FAIG, FGAA, FGSAust

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PETROGRAPHIC ANALYSIS OF ROCK SAMPLES FROM CHICHESTER DAM QUARRY AND TILLEGRA DAM SITE

Report to:
Mr John Young,
Senior Engineering Geologist
Geotechnical & Environmental
NSW Department of Commerce,
Level 13, McKell Building,
2-24 Rawson Place, Sydney, NSW 2000 October 29, 2007

INTRODUCTION

The author was requested by Mr John Young to provide petrographic analyses of samples from the Chichester Dam Quarry and Tillegra Dam Site in north-eastern NSW for the purpose of identifying and classifying the rock types. The samples are labelled:

1. Chichester Dam Quarry Shale
2. Chichester Dam Quarry Sandstone
3. Tillegra Dam Site Sandstone
4. Tillegra Dam Site Tuff

PROCEDURE

The petrographic analyses were made using 'standard' procedure, *viz:*

1. Macroscopic Description - Hand Specimen
2. Microscopic Description - Thin Section
   (a) Texture
   (b) Mineralogy (including volume percent estimation and mineral descriptions).
3. Rock Name (using appropriate classification)

METHOD OF ANALYSIS

The samples were first examined in bright daylight using both a hand lens and a stereomicroscope with magnifications of up to 20x in order to determine macroscopic properties.

The samples were petrographically examined by means of microscopic techniques using rock thin sections The usual procedure for thin sectioning is as follows: A

sample is sliced and smoothed to a flat surface, mounted onto a glass plate and cut and ground to 0.03mm (30 micron) in thickness. At this thickness most minerals are transparent to light. Such test specimens are known as *rock thin sections*.

The thin sections were examined using a doubly polarising *Zeiss Photomicroscope* under magnifications from 40x to 200x.

PETROGRAPHIC ANALYSIS
SAMPLE NO 1. CHICHESTER QUARRY SHALE

MACROSCOPIC DESCRIPTION - HAND SPECIMEN
A dark grey, laminated shale, which is fresh to slightly weathered with prominent lighter-coloured irregular bands or laminae. These are often discontinuous and/or lensoid in shape and may be quite irregular along the margins. The lighter coloured bands range from 2 up to 8 mm in width, and are usually spaced between 5 and 20 mm apart. They appear to be more quartzose than the rest of the rock and are slightly coarser-grained (silt-sized). The laminae are often iron-stained.

A few small, discontinuous dark - almost black - irregular to lensoid laminae also occur. These are possibly carbonaceous. They range from 0.5 up to 2 mm in width.

MICROSCOPIC DESCRIPTION - THIN SECTION
Texture

Grainsize: In the main body of the rock, most grains range from < 0.01 to <0.05 mm in diameter. A few grains reach 0.1 mm. In the lighter quartzose bands, grainsize is up to 0.15 mm.

Roundness: Angular

Sphericity: Low to medium

Sorting: Poor

Porosity: Low < 1%

There is a strong preferred dimensional and crystallographic orientation of the minerals in the rock.

Mineralogy of main body of the shale

(a) Volume percent (estimate only)

quartz	20
clay/illite and fine mica	45
carbonaceous matter	30
iron oxides/hydroxides	5

(b) Individual mineral constituents

Tiny *quartz* grains (and possibly a little *feldspar*) are scattered through the rock. The quartz is angular and clear and unaltered.

The bulk of the rock is made of iron-stained *clays/illite/fine white mica/carbonaceous material* in the form of pellets and aggregates and wavy laminae.

Red brown *iron oxides/hydroxides* occur in discrete irregular granules and elongated to lenticular irregular grains.

Variations

The lighter-coloured bands are slightly coarser grained than the main body of the shale and contain a higher percentage of tiny angular quartz grains (up to 50%)

The very dark-coloured bands consist almost entirely of carbonaceous material, occurring in fine wispy stringers and wavy laminae.

NAME
Laminated carbonaceous shale

PETROGRAPHIC ANALYSIS

SAMPLE NO: 2. CHICHESTER QUARRY SANDSTONE

MACROSCOPIC DESCRIPTION - HAND SPECIMEN

The sample is fresh and unweathered. It is massive with no discernible bedding features and no obvious fractures or zones of weakness. A fine- to medium-grained, grey, lithic sandstone, which contains abundant whitish to grey quartz crystals, often with well-developed crystal faces (visible vitreous lustre) and usually between 0.5 and 1.5 mm in diameter.

Additionally, numerous lithic fragments are present. These may be slightly coarser than the quartz grains, reaching 2.5 mm in diameter. They are fine-grained and range from light to dark grey in colour.

The crystal and lithic fragments are set in a grey aphanitic matrix.

MICROSCOPIC DESCRIPTION - THIN SECTION

Texture

Grainsize: Mineral and lithic fragments from <0.05 to 1.5 mm; A few lithic fragments reach 2.5 mm

Roundness: Mostly angular to subangular

Sphericity: Moderate to low

Sorting: Very poor

Porosity: Low (<1%)

Mineralogy

(a) Volume percent (estimate only)

Mineral and Lithic Fragments (90%)

quartz	33
feldspar	2
altered mica/Fe/Mg minerals	5
lithics (volcanics)	30
lithics (fine siliceous	20

Matrix/Cement (10%)

Clay/illite, chlorite, quartz, iron oxides/hydroxides, epidote

(b) Individual mineral constituents

Mineral and Lithic Fragments (90%)

Quartz occurs in small angular to subangular fragments. The grains are clear and unaltered, but may be fractured. The quartz type is usually volcanic. The grains are all separate. There is no observable secondary quartz overgrowth present in the rock.

Feldspar occurs in small subhedral to broken grains, which are lightly altered to iron-stained *clays* and *sericite*. Multiple twinning is still discernible in some grains. It is likely that both feldspars are present.

Fragments of *mica* and probable *ferromagnesian minerals (?amphibole and/or pyroxene)* altered to a pale green *chlorite* and *iron oxide* occur in small grains scattered throughout the rock..

Lithic (rock) fragments are of several types.

1. *Intermediate* to *felsic volcanic* fragments. The outlines of original quartz, feldspar, both alkali and plagioclase and ferromagnesian minerals and their alteration products can be seen.

2. Fine *siliceous* fragments consist of micro- to cryptocrystalline fragments of siliceous/clay-rich material. These include (a) parts of the *glassy/cryptocrystalline silica groundmass of volcanic rocks,* (b) *siliceous shales/siltstones* and (c) fine microcrystalline *quartzites*.

Matrix/Cement (10%)
The matrix is subordinate and consists of crystalline and amorphous *clay minerals/illite/sericite*, pale green *chlorite,* which often coats individual fragments, fine *quartz* and iron oxides/hydroxides *(limonite/goethite/hematite)*. The minerals occur as intergranular material filling and cementing spaces between the fragments. A few tiny grains of *epidote* are also present in the matrix.

NAME
Volcaniclastic lithic sandstone

PETROGRAPHIC ANALYSIS

SAMPLE NO: 3. TILLEGRA DAM SITE SANDSTONE

MACROSCOPIC DESCRIPTION - HAND SPECIMEN

The sample is fresh and unweathered. It is massive with no discernible bedding features and no obvious fractures or zones of weakness. A medium-grained, grey, lithic sandstone, which contains whitish to grey quartz crystals, often with well-developed crystal faces (visible vitreous lustre) and usually between 0.5 and 1.5 mm in diameter.

Additionally, numerous lithic fragments are present. These are often larger than the quartz grains, reaching 3.5 mm in diameter. They are fine-grained and range from whitish grey and yellow to dark grey in colour.

The crystal and lithic fragments are set in a grey aphanitic matrix.

MICROSCOPIC DESCRIPTION - THIN SECTION

Texture

Grainsize: Mineral fragments from <0.05 to 1.5 mm; Lithic fragments from 0.5 to >3.0 mm

Roundness: Mostly angular to subangular

Sphericity: Moderate to low

Sorting: Very poor

Porosity: Low (<1%)

Mineralogy

(a) Quantitative volume percent (modal analysis) determined by point count

Mineral and Lithic Fragments (90%)

quartz	25
altered mica/Fe/Mg minerals	5
lithics (volcanics)	40
lithics (fine siliceous)	20

Matrix/Cement (10%)

Clay/illite, chlorite, quartz, iron oxides/hydroxides

(b) Individual mineral constituents

Mineral and Lithic Fragments (90%)

Quartz occurs in small angular to subangular fragments. The grains are clear and unaltered, but may be fractured. The quartz type is usually volcanic. The grains are all separate. There is no observable secondary quartz overgrowth present in the rock.

Fragments of *mica* and probable *ferromagnesian minerals (?amphibole and/or pyroxene)* altered to a pale green *chlorite* and *iron oxide* occur in small grains scattered throughout the rock..

Lithic (rock) fragments are of several types.

1. *Intermediate* to *felsic volcanic* fragments. The outlines of original quartz, feldspar, both alkali and plagioclase and ferromagnesian minerals and their alteration products can be seen.
2. Fine *siliceous* fragments consist of micro- to cryptocrystalline fragments of siliceous/clay-rich material. These include (a) parts of the *glassy/cryptocrystalline silica groundmass of volcanic rocks,* (b) *siliceous shales/siltstones* and (c) fine microcrystalline *quartzites,* which are often *micaceous.*

Matrix/Cement (10%)

The matrix is subordinate and consists of crystalline and amorphous *clay minerals/illite/sericite*, pale green *chlorite,* which often coats individual fragments, fine *quartz* and iron oxides/hydroxides *(limonite/goethite/hematite).* The minerals occur as intergranular material filling and cementing spaces between the fragments.

NAME
Volcaniclastic lithic sandstone (?tuff)

NOTE: As there has only been minimal (if any) reworking of the sedimentary detrital fragments in this rock, it is virtually impossible, on the scale of the hand specimen provided to be sure whether this sample is best described as a 'volcaniclastic sandstone' or a 'tuff'. Macroscale observations in the field, of any pyroclastic features would be needed to positively confirm this.

PETROGRAPHIC ANALYSIS

SAMPLE NO: 4. TILLEGRA DAM SITE TUFF

MACROSCOPIC DESCRIPTION - HAND SPECIMEN

The sample is fresh and unweathered. It is massive with no discernible bedding features and no obvious fractures or zones of weakness. A medium-grained, grey, lithic sandstone, which contains whitish to grey quartz crystals, often with well-developed crystal faces (visible vitreous lustre) and usually between 0.5 and 1.5 mm in diameter.

Additionally, numerous lithic fragments are present. These are often larger than the quartz grains, reaching over 4 mm in diameter. They are fine-grained and range from whitish grey and yellow to dark grey in colour.

The crystal and lithic fragments are set in a light brownish grey aphanitic matrix.

MICROSCOPIC DESCRIPTION - THIN SECTION

Texture

Grainsize: Mineral fragments from <0.05 to 1.5 mm; Lithic fragments from 0.5 to >4.0 mm

Roundness: Mostly angular to subangular

Sphericity: Moderate to low

Sorting: Very poor

Porosity: Low (<2%)

Mineralogy

(a) Quantitative volume percent (modal analysis) determined by point count

Mineral and Lithic Fragments (90%)

quartz	15
altered mica/Fe/Mg minerals	5
lithics (volcanics)	50
lithics (fine siliceous)	20

Matrix/Cement (10%)

Clay/illite, chlorite, quartz, iron oxides/hydroxides

(b) Individual mineral constituents

Mineral and Lithic Fragments (90%)

Quartz occurs in small angular to subangular fragments. The grains are clear and unaltered, but may be fractured. The quartz type is usually volcanic. The grains are all separate. There is no observable secondary quartz overgrowth present in the rock.

Mica and probable *ferromagnesian minerals (?amphibole and/or pyroxene)* altered to *chlorite* and *iron oxide* occur in small grains scattered throughout the rock..

Lithic (rock) fragments are of several types.

1. *Intermediate* to *felsic volcanic* fragments. The outlines of original quartz, feldspar, both alkali and plagioclase and ferromagnesian minerals and their alteration products can be seen.
2. Fine *siliceous* fragments consist of micro- to cryptocrystalline fragments of siliceous/clay-rich material. These include (a) parts of the *glassy/cryptocrystalline silica groundmass of volcanic rocks,* (b) *siliceous shales/siltstones* and (c) fine microcrystalline *quartzites,* which are often *micaceous.*

Matrix/Cement (10%)
The matrix is subordinate and consists of crystalline and amorphous *clay minerals/illite/sericite*, pale green *chlorite,* which often coats individual fragments, fine *quartz* and iron oxides/hydroxides *(limonite/goethite/hematite).* The minerals occur as intergranular material filling and cementing spaces between the fragments.

NAME Volcaniclastic lithic sandstone

NOTE: As there has only been minimal (if any) reworking of the sedimentary detrital fragments in this rock, it is virtually impossible, on the scale of the hand specimen provided to be sure whether this sample is best described as a 'volcaniclastic sandstone' or a 'tuff'. Macroscale observations in the field, of any pyroclastic features would be needed to positively confirm this.

Brenda J. Franklin
29 October, 2007

Dr Brenda J. Franklin BSc(Hons)(Syd), MSc, PhD(NSW), FAIG, FGAA, FGSAust

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PETROGRAPHIC ANALYSIS OF ROCK SAMPLES FROM THE TILLEGRA DAM SITE

Report to:
Mr John Young,
Senior Engineering Geologist,
Geotechnical & Environmental,
NSW Department of Commerce,
Level 13, McKell Building,
2-24 Rawson Place, Sydney, NSW 2000

April 10, 2008

INTRODUCTION

The author was requested by Mr John Young to provide petrographic analyses of 5 samples from the Tillegra Dam Site in the Upper hunter area of NSW for the purpose of identifying and classifying the rock types. The samples are labelled:

1. DDH9 30.20m
2. DDH9 40.26m
3. DDH9 49.95m
4. DDH2 Gravel
5. DDH2 Gravel

PROCEDURE

The petrographic analyses were made using 'standard' procedure, *viz:*

1. Macroscopic Description - Hand Specimen
2. Microscopic Description - Thin Section
   (a) Texture
   (b) Mineralogy (including volume percent estimation and mineral descriptions).
3. Rock Name (using appropriate classification)

METHOD OF ANALYSIS

The samples were first examined in bright daylight using both a hand lens and a stereomicroscope with magnifications of up to 20x in order to determine macroscopic properties.

The samples were petrographically examined by means of microscopic techniques using rock thin sections The usual procedure for thin sectioning is as follows: A sample is sliced and smoothed to a flat surface, mounted onto a glass plate and cut and ground to 0.03mm (30 micron) in thickness. At this thickness most minerals are transparent to light. Such test specimens are known as *rock thin sections*.

The thin sections were examined using a doubly polarising *Zeiss Photomicroscope* under magnifications from 40x to 200x.

A photo was taken of each hand specimen to illustrate macroscopic properties.

Microphotographs were taken to illustrate relevant features in the thin sections

MICROPHOTOGRAPHS - EXPLANATORY NOTES:

Traditional micropetrography of rocks uses a doubly polarising transmitted light microscope, which passes white light through sections of rock cut to a standard thickness of 0.03mm, at which thickness most minerals become transparent or translucent. In all the photomicrographs the scale is given as a field of view, *which is the total distance across the width of the photograph*.

plane polarised light
The photo is taken under plane or singly polarised light and the colours are actual mineral colours as seen with the eye.
Mineral properties such as - *mineral shape (habit)* and *form, size, refractive index, relief, number of cleavages, degree of alteration* and *colour* are seen in plane polarised light.

crossed polars
The photo is taken through two pieces of polarising filter set at right angles (crossed polars or doubly polarised light) and the colours seen are colours caused by interference of the different wavelengths of white light within the crystal structure of each mineral. Doubly polarised light reveals internal structures and properties not visible in singly polarised light such as - *double refraction, twinning, extinction angle, crystal system* and *dispersion*.

PETROGRAPHIC ANALYSIS

SAMPLE NO: 1. TILLEGRA DAM DDD9 – 30.20m

MACROSCOPIC DESCRIPTION - HAND SPECIMEN

The sample is fresh and unweathered, with no visible fractures or other zones of weakness. The sample is massive over much of the scale of the hand specimen, but contains a zone of fine, dark, irregular laminations at one end of the sample (see lower end of **Photo 1(a)** below). These are probably carbonaceous in nature.

A fine- to medium-grained, grey siltstone, which contains abundant tiny, whitish to grey quartz crystals, fine lithic fragments and some bronze micas. The fragments are usually <0.05 mm in diameter.

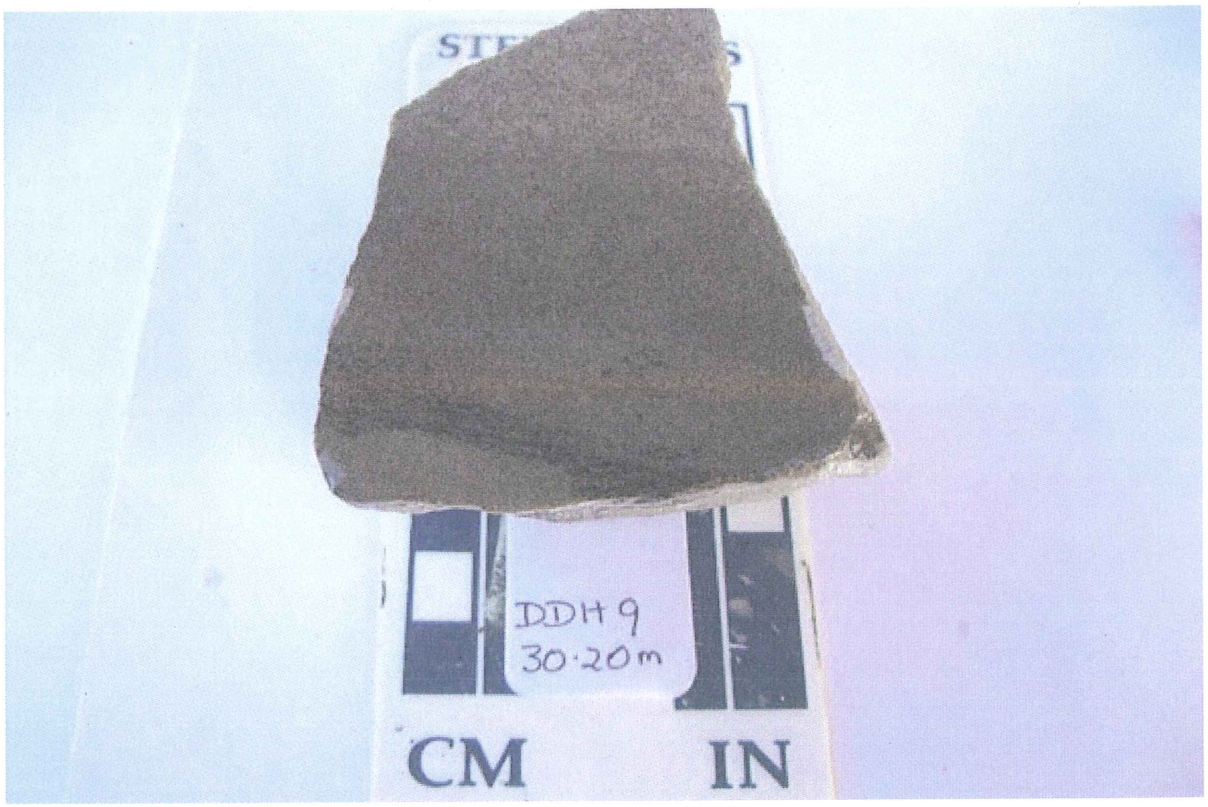

Photo 1(a): Sample 1. Tillegra Dam. DDH9 – 30.20m. Macroscopic view of the sample, illustrating the grey, massive siltstone with a zone of irregular, fine, dark grey to black, probably carbonaceous laminations (arrowed) at the base of the sample.

MICROSCOPIC DESCRIPTION - THIN SECTION

Texture

Grainsize: Mineral and lithic fragments from <0.01 to 0.1 mm; A few lithic fragments reach 0.25 mm

Roundness: Mostly angular to subangular

Sphericity: Moderate to low

Sorting: Very poor

Porosity: Low (<1%)

Mineralogy

(a) Volume percent (estimate only)

Mineral and Lithic Fragments (90%)

quartz	45
feldspar	10
altered mica	5
lithics	30

Matrix/Cement (10%)

Clay/illite, chlorite, quartz, iron oxides/hydroxides

(b) Individual mineral constituents

Mineral and Lithic Fragments (90%)

Quartz occurs in small angular to subangular fragments. The grains are clear and unaltered, but may be fractured. The quartz type is usually volcanic. The grains are all separate. There is no observable secondary quartz overgrowth present in the rock.

Feldspar occurs in small subhedral to broken grains, which are lightly altered to iron-stained *clays* and *sericite*. Multiple twinning is still discernible in some grains.

Fragments of *mica,* altered to a pale green *chlorite* and *iron oxide* occur in small grains scattered throughout the rock..

Lithic (rock) fragments are all very small and altered and it is very difficult to identify specific rock types at this grainsize. However, fine *siliceous* fragments, consisting of micro- to cryptocrystalline fragments of siliceous/clay-rich material can be identified.

Matrix/Cement (10%)

The matrix is subordinate and consists of crystalline and amorphous *clay minerals/illite/sericite* and pale green *chlorite*

NAME

Siliceous siltstone

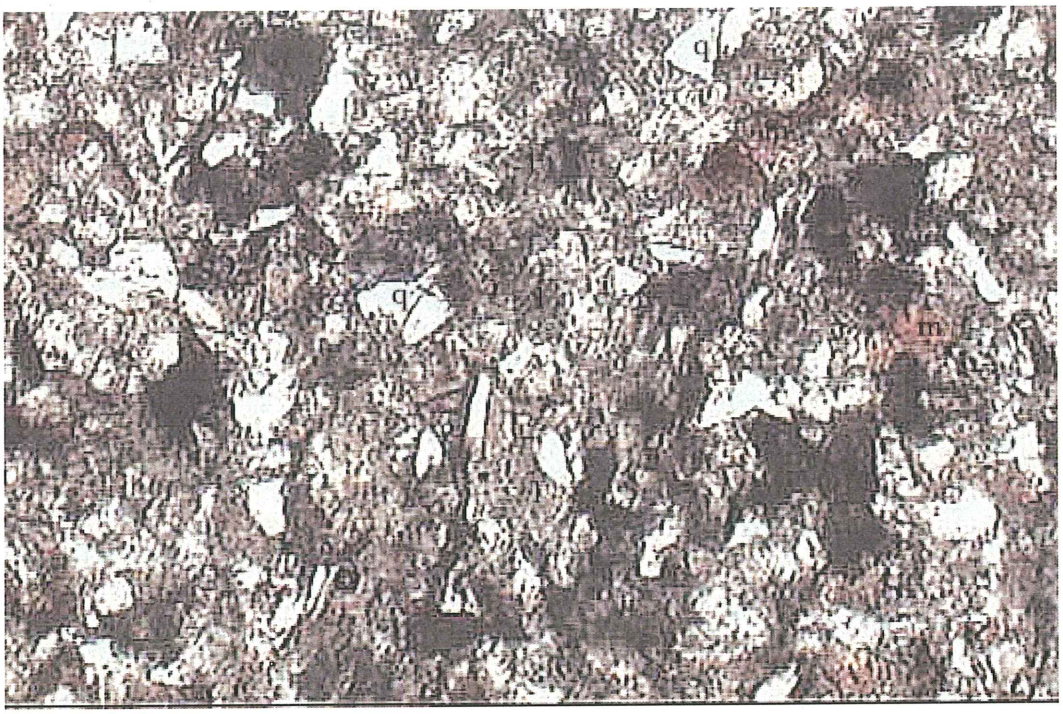

Photo 1(b): Sample 1. Tillegra Dam. DDH9 – 30.20m. High magnification view of the siliceous siltstone, showing angular clear, angular quartz grains **(q)**, brownish altered micas **(m)** and altered lithic fragments **(l)**.
plane polarised light *field of view across photograph = 1.3 mm*

Photo 1(c): Sample 1. Tillegra Dam. DDH9 – 30.20m. Same view as above, highlighting the clear quartz, and the altered nature of the lithic fragments
crossed polars

PETROGRAPHIC ANALYSIS

SAMPLE NO: 2. TILLEGRA DAM. DDH9 - 40.26m

MACROSCOPIC DESCRIPTION - HAND SPECIMEN

The sample is fresh and unweathered. It is massive with no discernible bedding features and no visible fractures or zones of weakness.

A light grey, medium-grained, grey, quartz lithic sandstone, which contains whitish to grey quartz crystals, often with well-developed crystal faces (visible vitreous lustre) and usually between 0.5 and 1.5 mm in diameter.

Additionally, angular lithic fragments are present (see **Photo 2(a)** below). These are a little larger than the quartz grains, reaching 2.0 mm in diameter. They are fine-grained and range from whitish grey and yellow to dark grey in colour.

The crystal and lithic fragments are set in a grey aphanitic matrix.

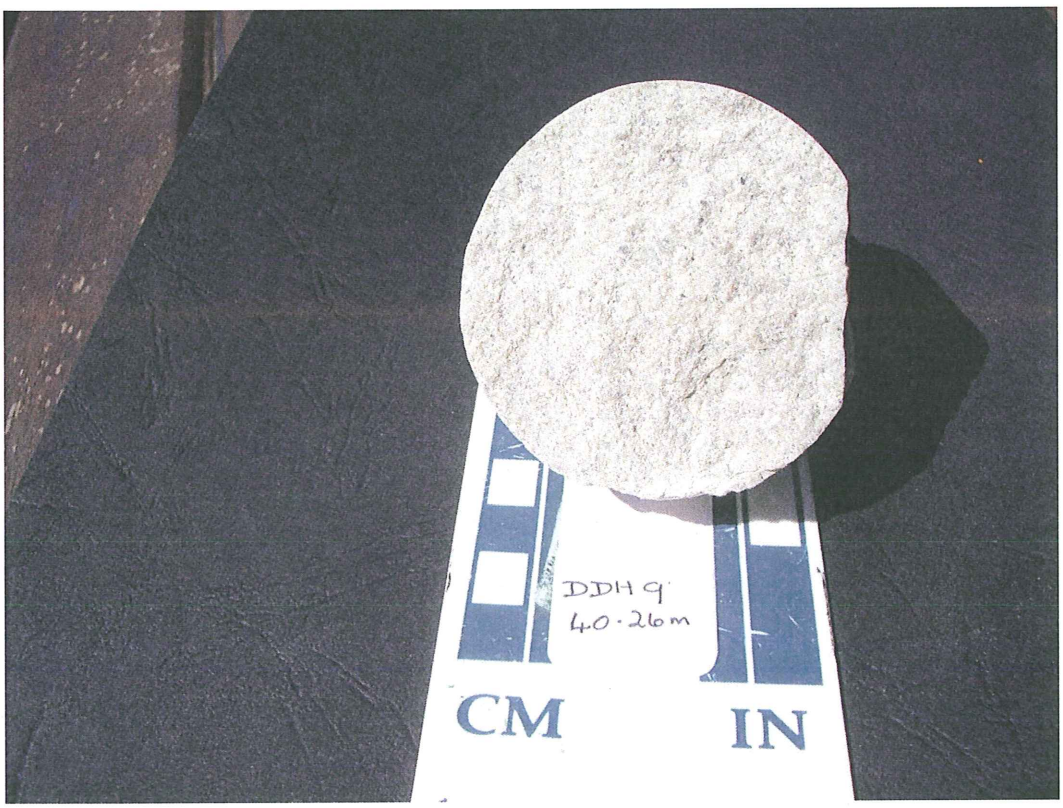

Photo 2(a): Sample 2. Tillegra Dam. DDH9 – 40.26m. Macroscopic view of the sample, illustrating the massive, light-grey quartz lithic sandstone. The small dark 'spots' in the stone are some of the dark grey lithic fragments.

MICROSCOPIC DESCRIPTION - THIN SECTION

Texture

Grainsize: Mineral fragments from <0.05 to 1.5 mm; Lithic fragments from 0.5 to >2.0 mm

Roundness: Mostly angular to subangular

Sphericity: Moderate to low

Sorting: Very poor

Porosity: Low (<1%)

Mineralogy

(a) Quantitative volume percent (modal analysis) determined by point count

Mineral and Lithic Fragments (90%)

quartz	35
Plagioclase	15
altered mica/Fe/Mg mins	5
lithics (volcanics)	15
lithics (fine siliceous)	20

Matrix/Cement (10%)

Clay/illite, chlorite, quartz, calcite, iron oxides/hydroxides

(b) Individual mineral constituents

Mineral and Lithic Fragments (90%)

Quartz occurs in small angular to subangular fragments. The grains are clear and unaltered, but may be fractured. The quartz type is usually volcanic. The grains are all separate. There is no observable secondary quartz overgrowth present in the rock.

Plagioclase feldspar occurs in small subhedral to broken grains, which are lightly altered to iron-stained *clays* and *sericite*. Multiple twinning is still discernible in many grains.

Fragments of partly altered *mica* and probable *ferromagnesian minerals (?amphibole and/or pyroxene)* altered to a pale green *chlorite* and *iron oxide* occur in small grains scattered throughout the rock.

Lithic (rock) fragments are of several types.

1. *Intermediate* to *felsic volcanic* fragments. The outlines of original quartz, feldspar, both alkali and plagioclase and ferromagnesian minerals and their alteration products can be seen.
2. Fine *siliceous* fragments consist of micro- to cryptocrystalline fragments of siliceous/clay-rich material. These include (a) parts of the *glassy/cryptocrystalline silica groundmass of volcanic rocks,* (b) *siliceous shales/siltstones* and (c) fine microcrystalline *quartzites,* which are often *micaceous.*

Matrix/Cement (10%)

The matrix is subordinate and consists of crystalline and amorphous *clay minerals/illite/sericite*, pale green *chlorite,* which often coats individual fragments, fine *quartz*, shredded stringers of *calcite* and iron oxides/hydroxides *(limonite/goethite/hematite).* The minerals occur as intergranular material filling and cementing spaces between the fragments.

NAME

Volcaniclastic quartz lithic sandstone

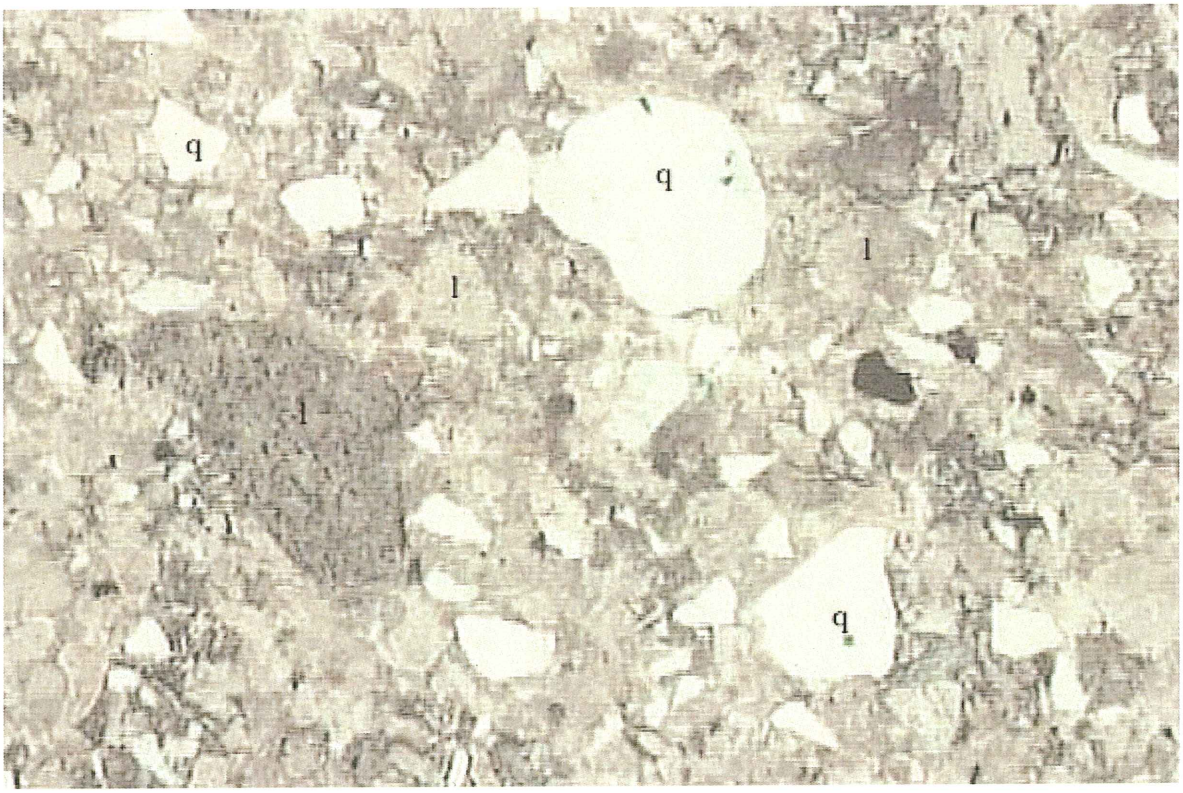

Photo 2(b): Sample 2. Tillegra Dam. DDH9 – 40.26m. General view of the sample, showing numerous clear, angular quartz grains **(q)** and altered lithic fragments **(l)**, set in a fine matrix.
plane polarised light *field of view across photograph = 6 mm*

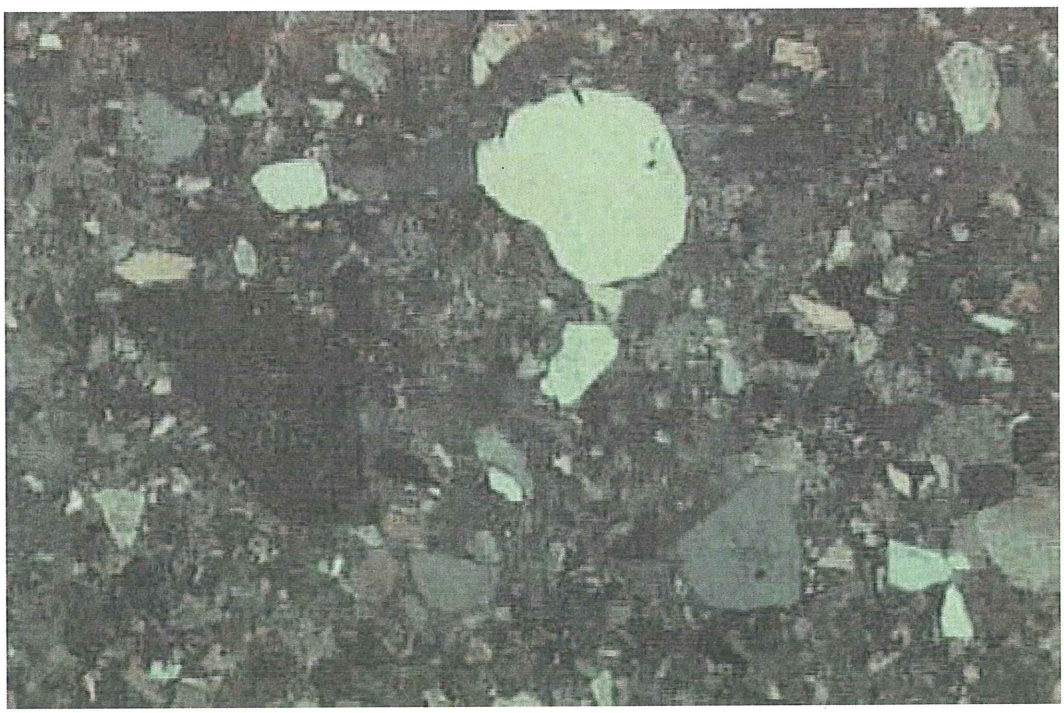

Photo 2(c): Sample 2. Tillegra Dam. DDH9 – 40.26m. Same view as above, highlighting the clear, unaltered nature of the quartz and the altered lithics.
crossed polars

PETROGRAPHIC ANALYSIS

SAMPLE NO: 3. TILLEGRA DAM DDH9 - 49.95m

MACROSCOPIC DESCRIPTION - HAND SPECIMEN

The sample is fresh and unweathered. It is massive with no discernible bedding features and no visible fractures or zones of weakness.

A fine- to medium-grained, light grey, quartz lithic sandstone, which contains abundant whitish to grey quartz crystals, often with well-developed crystal faces (visible vitreous lustre) and usually between 0.5 and 1.5 mm in diameter.

Additionally, numerous whitish angular feldspar crystal fragments and lithic fragments are present. These may be coarser than the quartz grains, reaching 4.5 mm in diameter. The lithics are fine-grained and range from light to dark grey in colour (see **Photo 3(a)** below).

The crystal and lithic fragments are set in a grey aphanitic matrix.

Photo 3(a): Sample 3. Tillegra Dam. DDH9 – 49.95m. Macroscopic view of the sample, illustrating the medium-grained light grey quartz lithic sandstone. Both light and dark grey angular lithic fragments can be seen in the photo.

MICROSCOPIC DESCRIPTION - THIN SECTION

Texture

Grainsize: Mineral and lithic fragments from <0.5 to 1.5 mm; A few lithic fragments reach 4.5 mm

Roundness: Mostly angular to subangular

Sphericity: Moderate to low

Sorting: Very poor

Porosity: Low (<1%)

Mineralogy

(a) Volume percent (estimate only)

Mineral and Lithic Fragments (90%)

quartz	40
feldspar	5
altered mica/Fe/Mg mins	5
lithics (volcanics)	20
lithics (fine siliceous	20

Matrix/Cement (10%)

Clay/illite, chlorite, calcite, quartz, iron oxides/hydroxides

(b) Individual mineral constituents

Mineral and Lithic Fragments (90%)

Quartz occurs in small angular to subangular fragments. The grains are clear and unaltered, but may be fractured. The quartz type is usually volcanic. The grains are all separate. There is no observable secondary quartz overgrowth present in the rock.

Feldspar occurs in small subhedral to broken grains, which are lightly altered to iron-stained *clays* and *sericite*. Multiple twinning is still discernible in some grains.

Fragments of *mica* and probable *ferromagnesian minerals (?amphibole and/or pyroxene)* altered to a pale green *chlorite* and *iron oxide* occur in small grains scattered throughout the rock..

Lithic (rock) fragments are of several types.

1. *Intermediate* to *felsic volcanic* fragments. The outlines of original quartz, feldspar, both alkali and plagioclase and ferromagnesian minerals and their alteration products can be seen.
2. Fine *siliceous* fragments consist of micro- to cryptocrystalline fragments of siliceous/clay-rich material. These include (a) parts of the *glassy/cryptocrystalline silica groundmass of volcanic rocks,* (b) *siliceous shales/siltstones* and (c) fine microcrystalline *quartzites*.

Matrix/Cement (10%)

The matrix is subordinate and consists of crystalline and amorphous *clay minerals/illite/sericite*, pale green *chlorite* and shredded *calcite,* which often coats individual fragments, fine *quartz* and iron oxides/hydroxides *(limonite/goethite/hematite).* The minerals occur as intergranular material filling and cementing spaces between the fragments.

NAME

Volcaniclastic lithic sandstone

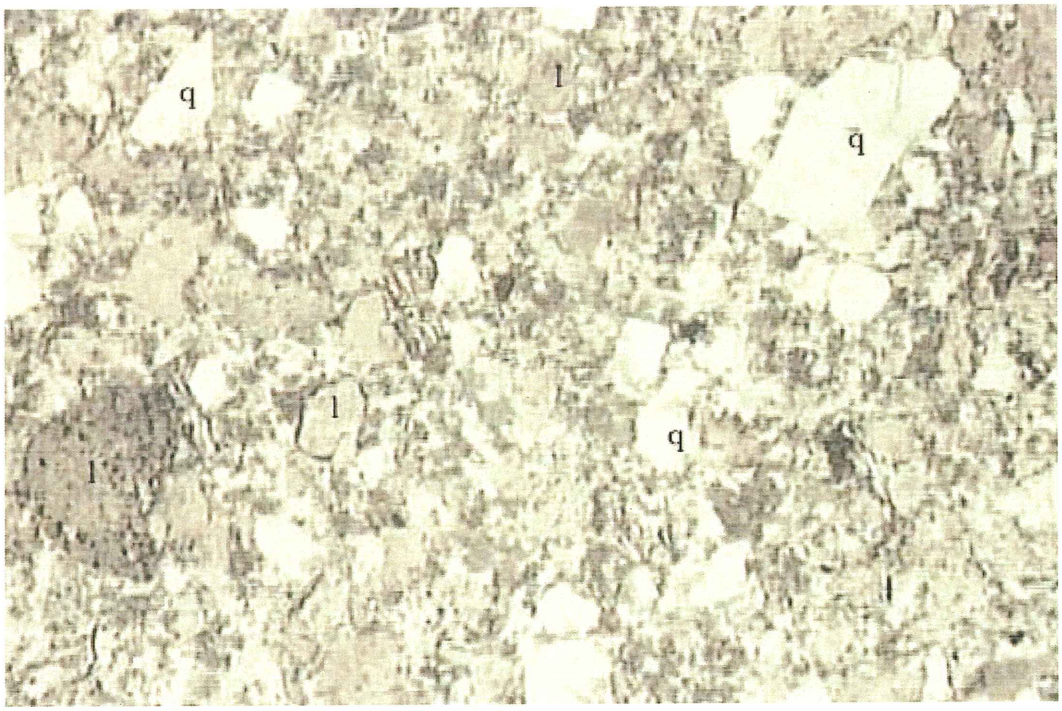

Photo 3(b): Sample 3. Tillegra Dam. DDH9 – 49.95m. General view of the sample, showing numerous clear, angular quartz grains **(q)** and altered lithic fragments **(l)**, set in a fine matrix.
plane polarised light *field of view across photograph = 6 mm*

Photo 3(c): Sample 3. Tillegra Dam. DDH9 – 49.95m. Same view as above, highlighting the clear, unaltered nature of the quartz and the altered lithics.
crossed polars

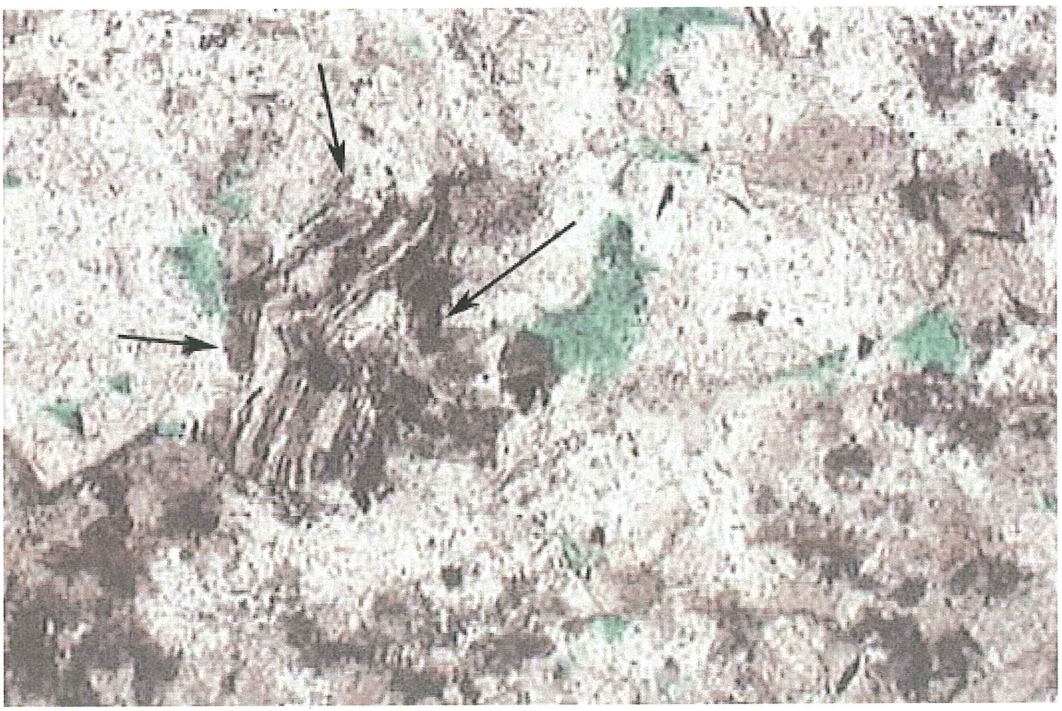

Photo 3(d): Sample 3. Tillegra Dam. DDH9 – 49.95m. High magnification view of the sample, illustrating a partly altered mica flake (arrowed), the alteration occurring preferentially in zones parallel to cleavage traces.
plane polarised light *field of view across photograph = 1.3 mm*

PETROGRAPHIC ANALYSIS

SAMPLES NOS 4 and 5: DDH2 River Gravels.
Both of the gravel samples are identical and their descriptions have been combined.

MACROSCOPIC DESCRIPTION - HAND SPECIMEN
Both samples are extremely hard and difficult to break with a hammer. The samples are both water worn and have a light yellow to cream coloured 'crust or rind' on the outside surfaces. Small (< 1mm) rectangular, Fe-stained phenocrysts occur within the surface crust. There are also numerous tiny holes or voids where crystals have been weathered out.

The inside surfaces of the rocks consist of a very fine-grained, black aphanitic material in which are scattered a small amount of lightly Fe-stained phenocrysts (a ferromagnesian mineral). In bright sunlight, on a freshly broken rock face, tiny needles of a transparent mineral (plagioclase feldspar) can just be discerned with a hand lens.

Both the yellow weathering crust and the texture and mineralogy of the rocks indicate that they are basalts.

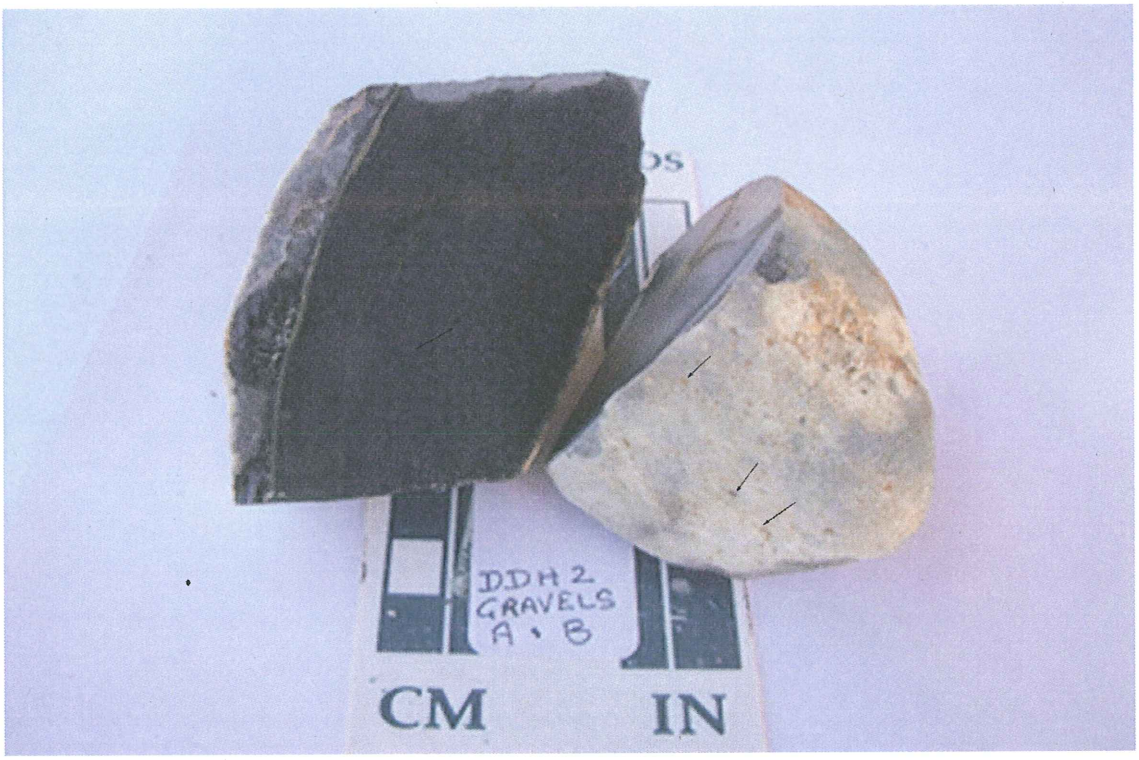

Photo 4(a): Samples 4 and 5. Tillegra Dam DDH2 Gravels
Macroscopic view of both gravel samples illustrating both the cream-coloured yellow weathering 'crust' and water worn nature of the outer surfaces of the samples and the fine-grained black aphanitic fresh rock. Arrows indicate possible ferromagnesian phenocrysts.

MACROSCOPIC DESCRIPTION – THIN SECTION

Texture

Fine-grained, porphyritic, intergranular and intersertal. The groundmass of Sample 5 is partly glassy. Phenocrysts are usually <1 mm in diameter.

Mineralogy	**Volume percent range (estimate)**	
Sample	**4**	**5**
Phenocrysts	*10*	*20*
olivine	7	10
ti-augite	3	3
plagioclase	n.d.	7
Groundmass	*90*	*80*
Plagioclase, Augite		
Fe-Ti oxides, Chlorite, Carbonate		
Alkali feldspar, Basic volcanic glass		

n.d. = not detected;

Individual mineral descriptions

Phenocrysts

Olivine occurs in single well-formed grains - euhedral to subhedral – in both samples. The mineral is mainly fresh. Some grains are partly altered and fractured with the fractures filled with a green-brown alteration product *iddingsite.*

Augite (ti-augite) occurs in small to medium brown to pinkish-purple crystals, which are well-formed and clear and unaltered.

Plagioclase feldspar occurs in elongated laths as phenocrysts up to 1 mm in length in Sample 5. The plagioclase is calcic - *labradorite* in composition.

Accessory minerals include *magnetite, ti-magnetite, ilmenite* and *apatite* scattered randomly through the fabric of the rock.

Groundmass

Both samples contain:

- Plagioclase laths in small needles up to 0.1 mm in length
- Ti-augite in small anhedral grains
- Fe-Ti oxides (magnetite, ti-magnetite and ilmenite) in small scattered grains.
- Chlorite in green shapeless masses
- Calcite in small shredded grains.

In addition, Sample 4 contains a small amount of *alkali feldspar* in the interstices of the rock. The mineral is shapeless and has been the last mineral to crystallise. Sample 5 contains *basic volcanic glass* in the interstices.

NAME

Alkali olivine basalt

(**Note:** Although the author does not know the provenance of the two gravel samples, their mineralogy and texture indicate that they most probably belong to the Tertiary alkali basalt suite of south-eastern NSW).

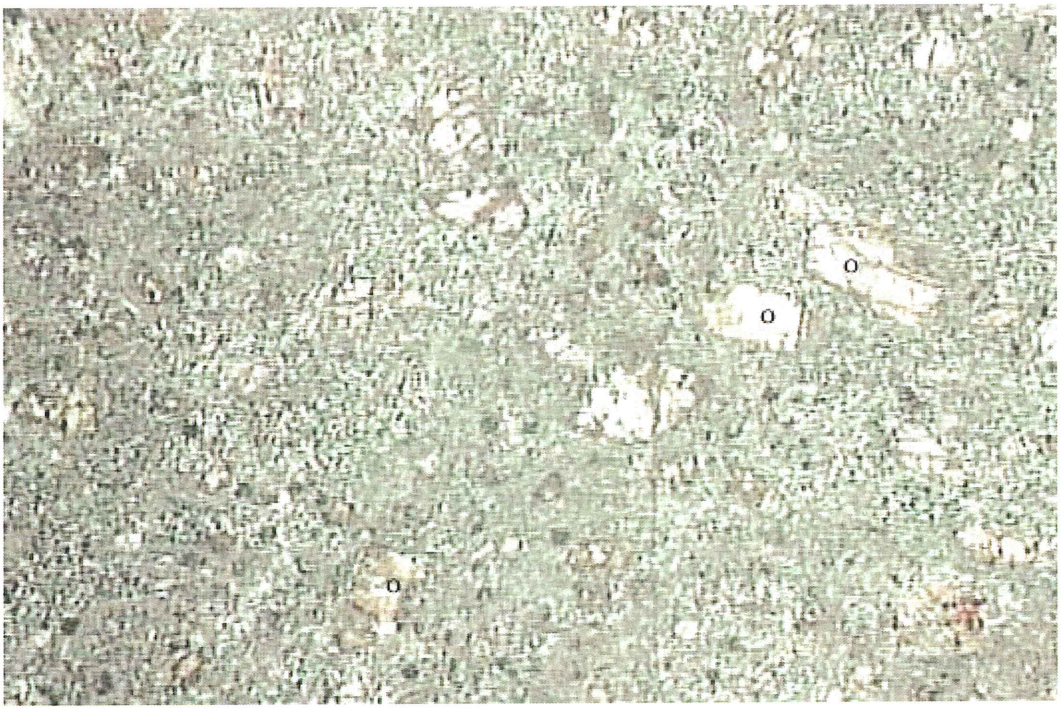

Photo 4(b): Sample 4. Tillegra Dam. DDH2 Gravels. General view of Sample 4, illustrating the porphyritic nature of the rock with olivine **(o)** phenocrysts set in a fine groundmass in which tiny colourless plagioclase needles are discernible.
plane polarised light *field of view across photograph = 6 mm*

Photo 4(c): Sample 4. Tillegra Dam. DDH2 Gravels. Same view as above, highlighting the shape of the phenocrysts and the fine nature of the groundmass.
crossed polars

Photo 4(d): Sample 4. Tillegra Dam. DDH2 Gravels. High magnification view of Sample 4, highlighting the partly altered olivine phenocrysts, with iddingsite filled fractures and the intergranular groundmass.
plane polarised light *field of view across photograph = 1.3 mm*

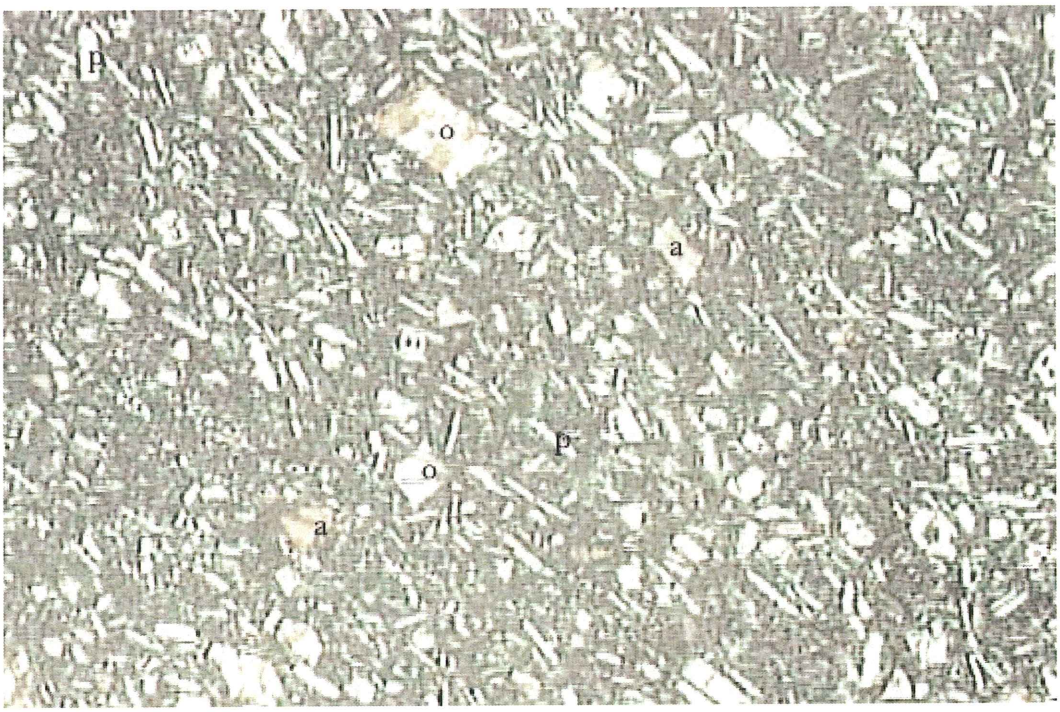

Photo 4(e): Sample 5. Tillegra Dam. DDH2 Gravels. General view of Sample 5, illustrating the porphyritic nature of the rock with olivine **(o)**, titanaugite **(a)** and plagioclase **(p)** phenocrysts set in a very fine groundmass.
plane polarised light *field of view across photograph = 6 mm*

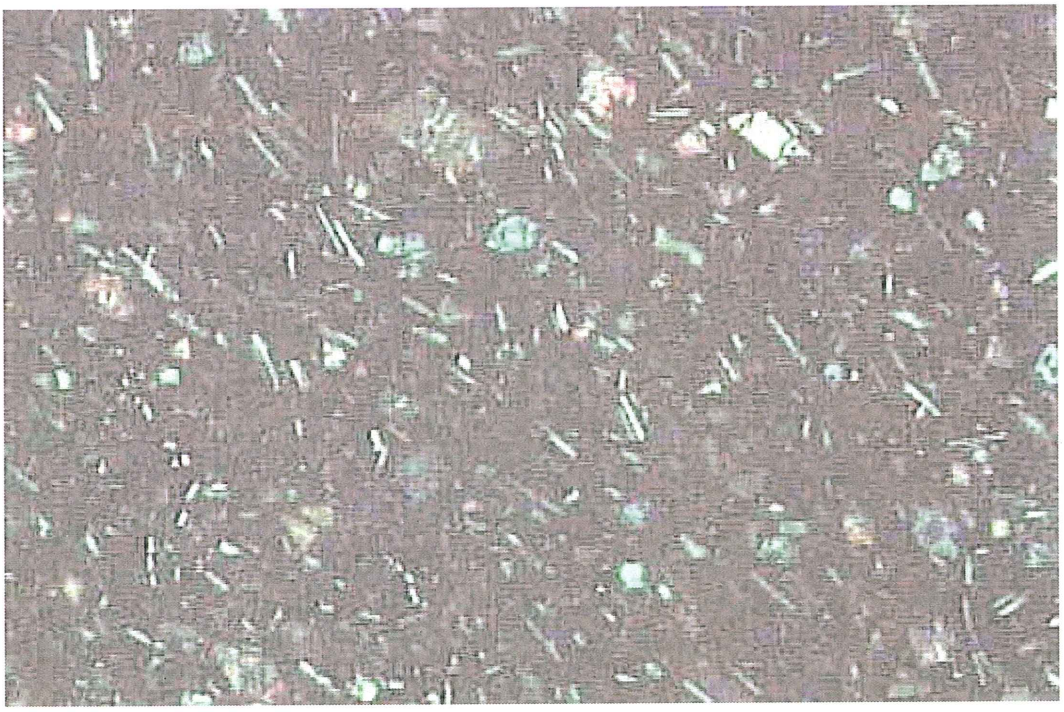

Photo 4(f): Sample 5. Tillegra Dam. DDH2 Gravels. Same view as above, highlighting the shapes of the different phenocrysts and the fine, partly glassy nature of the groundmass.
crossed polars

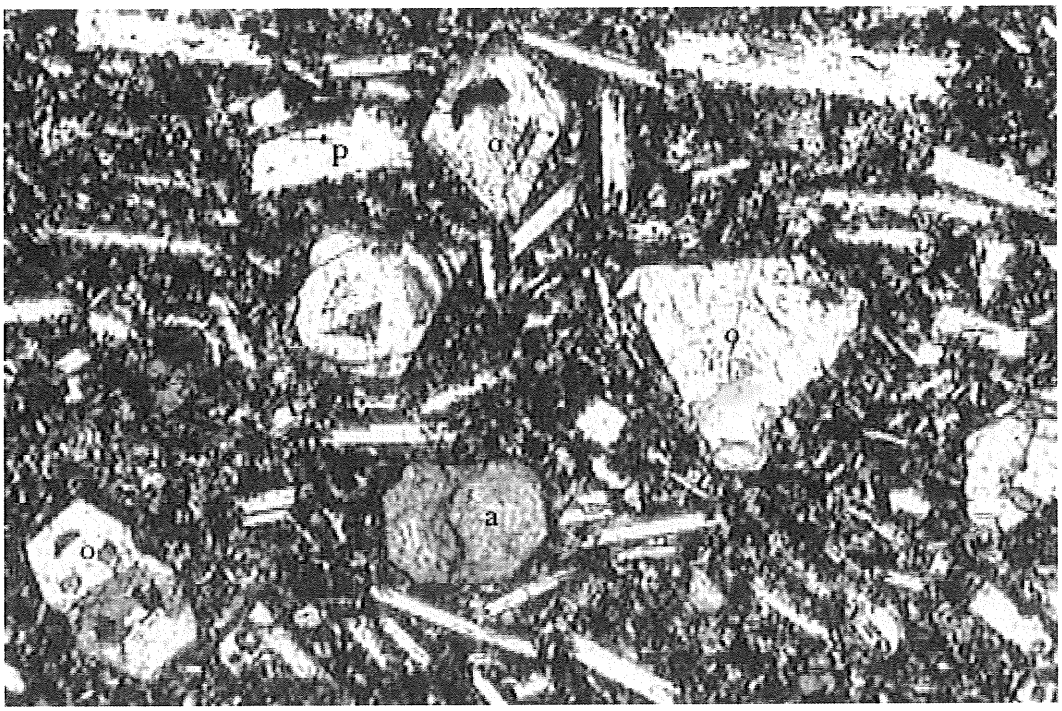

Photo 4(g): Sample 5. Tillegra Dam. DDH2 Gravels. High magnification view of Sample 5, highlighting the various phenocryst types – olivine **(o),** titanaugite **(a)** and plagioclase **(p**) and the fine, glassy groundmass.
plane polarised light *field of view across photograph = 1.3 mm*

Brenda J. Franklin
April 10, 2008 08JY2

APPENDIX G

Aggregate Test Results

Boral Resources (NSW) Pty Ltd

Australian Construction Materials

BORAL

MATERIALS TECHNICAL SERVICES
BORAL RESOURCES (NSW) PTY LTD
ABN 51 000 756 507
Unit 4, 3-5 Gibbon Road
Baulkham Hills NSW 2153 Australia
PO Box 400, Winston Hills NSW 2153
Telephone 61 2 9624 9900
Facsimile 61 2 9624 9999

CLIENT: NSW Department of Commerce

FILE NO: 98/08

PROJECT: Quality Control – Testing of Rock Cores ex Tillegra Dam Site and River Gravel ex Williams River

TEST PROCEDURE: AS1141 – Sampling and Testing Aggregates

Laboratory Sample No:		80441	80442
Date Received:		4.4.08	
Sample Description:		Rock Cores 27.38m-39.30m	River Gravel
Test Method	**Test**	**Results**	
AS1141.21	Aggregate Crushing Value (%)	11.0	8.7
	Fraction tested (mm)	-13.2+9.5	-13.2+9.5
AS1141.23	Los Angeles Value		
	Grading 'B' (% Loss)	15	10
AS1141.24	Sodium Sulphate Soundness		
	Fraction tested:		
	-37.5+26.5mm (% Loss)	Nil	0.1
	-26.5+19.0mm (% Loss)	0.1	1.0
	-19.0+13.2mm (% Loss)	0.1	Nil
	-13.2+9.5mm (% Loss)	0.2	0.2
	-9.5+4.75mm (% Loss)	0.1	0.1

Sample submitted by client.

J. Young, QC File, File, Ref: 4479.Rep

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Approved Signatory _____ Richard Bawer

Date 15.4.08 *Serial No.* 68812

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Australian Construction Materials

BORAL

MATERIALS TECHNICAL SERVICES
BORAL RESOURCES (NSW) PTY LTD
ABN 51 000 756 507
Unit 4, 3-5 Gibbon Road
Baulkham Hills NSW 2153 Australia
PO Box 400, Winston Hills NSW 2153
Telephone 61 2 9624 9900
Facsimile 61 2 9624 9999

Test Report

CLIENT: NSW DEPARTMENT OF COMMERCE

FILE NO: 98/08

PROJECT: Testing of Rock Cores for AAR T363

DATE REC'D: Apr. 2008

TEST METHOD:
Accelerated Mortar Bar Test for AAR Assessment - RTA T363

LAB SAMPLE NO:	MATERIAL	DESCRIPTION
80441	Rock Cores	Ex. Tillegra Dam Site
ID # 40140	GP Cement	SL Berrima

Results:

Age (days)	Expansion % (Ave. of 3 specimens)
3	0.03
7	0.07
10	0.10
14	0.15
17	0.19
21	0.23

Aggregate reactivity classification:

% Expansion at 21 Days		Aggregate Reactivity Classification
Coarse Aggregate	Fine Aggregate	
<0.10	<0.15	Non Reactive
≥0.10, <0.4	≥0.15, <0.45	Having Potential for Slow/Mild AAR
≥0.40	≥0.45	Having Potential for Substantial AAR

John Young, Q. C. File, Mat. File, File

Muans Abdulnebe

Approved Signatory _____

Date 9-05-08 *Serial No.* 68813

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Australian Construction Materials

BORAL

MATERIALS TECHNICAL SERVICES
BORAL RESOURCES (NSW) PTY LTD
ABN 51 000 756 507
Unit 4, 3-5 Gibbon Road
Baulkham Hills NSW 2153 Australia
PO Box 400, Winston Hills NSW 2153
Telephone 61 2 9624 9900
Facsimile 61 2 9624 9999

Test Report

CLIENT: NSW DEPARTMENT OF COMMERCE

FILE NO: 98/08

PROJECT: Testing of River Gravel for AAR T363

DATE REC'D: Apr. 2008

TEST METHOD:
Accelerated Mortar Bar Test for AAR Assessment - RTA T363

LAB SAMPLE NO:	MATERIAL	DESCRIPTION
80442	River Gravel	Ex. Williams River
ID # 40140	GP Cement	SL Berrima

Results:

Age (days)	Expansion % (Ave. of 3 specimens)
3	0.01
7	0.02
10	0.03
14	0.04
17	0.06
21	0.07

Aggregate reactivity classification:

% Expansion at 21 Days		Aggregate Reactivity Classification
Coarse Aggregate	Fine Aggregate	
<0.10	<0.15	Non Reactive
≥0.10, <0.4	≥0.15, <0.45	Having Potential for Slow/Mild AAR
≥0.40	≥0.45	Having Potential for Substantial AAR

John Young, Q. C. File, Mat. File, File

Muans Abdulnebe

Approved Signatory _____

Date 9-05-08 *Serial No.* 68814

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APPENDIX H

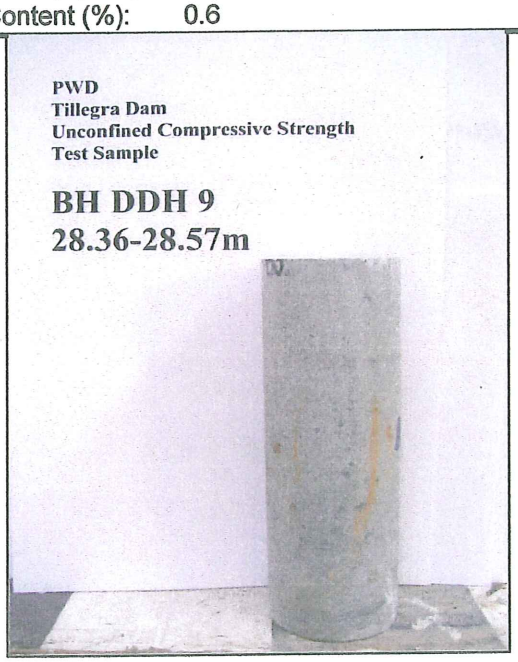
Unconfined Compressive Strength Results (DDH9)

Australian Soil Testing Pty Ltd

AUSTRALIAN SOIL TESTING PTY LTD. A.B.N. 79 003 493 623
24 Bermill Street, Rockdale, NSW, 2216 P.O. Box 2014, Rockdale D.C. NSW 2216
Tel: 9597 5599, 9597 3286 Fax: 9597 3442 Email: austst@bigpond.com

COMPRESSIVE STRENGTH
REPORT CERTIFICATE
AS 4133.4.2

CLIENT:	**PWD**	**JOB NO. :**	003-098
PROJECT:	**Tillegra Dam**	**LAB NO. :**	47268
LOCATION:	**Tillegra Dam**	**Date Tested:**	22.05.08
Sample Id:	BH DDH 9	**Test Type:**	Compressive Str.
Sample No:	-	**Sample Type:**	PQ3 Core
Initial Specimen:		**Rock Type**	
Length/ Diameter Ratio:	2.9		
Bulk Dry Density (t/m^3):	2.64	**Depth (m):**	28.36-28.57m
Moisture Content (%):	0.6		



UNIAXIAL COMPRESSIVE STRENGTH
U.C.S. (MPa) = 137.9

Notes on testing: Specimen tested at the moisture condition as received.

Specimen supplied by client.

Bulk density value was determined by vernier calliper method.

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Signed: .....
Title: Manager

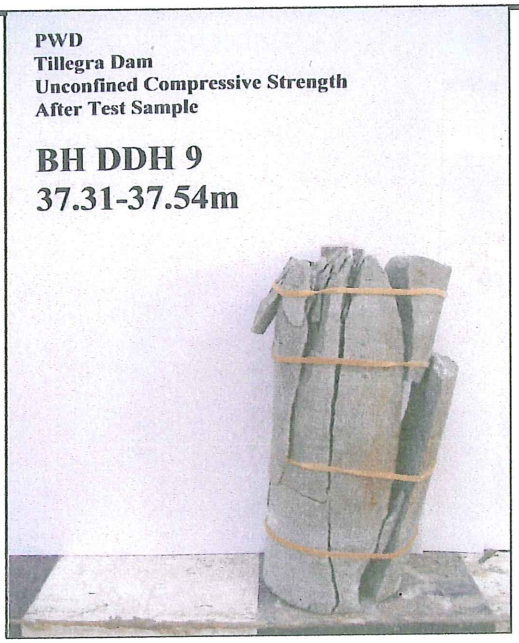
Name: C Stubbs
Date: 9/6/08

AUSTRALIAN SOIL TESTING PTY LTD. A.B.N. 79 003 493 623
24 Bermill Street, Rockdale, NSW, 2216 P.O. Box 2014, Rockdale D.C. NSW 2216
Tel: 9597 5599, 9597 3286 Fax: 9597 3442 Email: austst@bigpond.com

COMPRESSIVE STRENGTH REPORT CERTIFICATE

AS 4133.4.2

CLIENT:	**PWD**	**JOB NO. :**	003-098
PROJECT:	**Tillegra Dam**	**LAB NO. :**	47269
LOCATION:	**Tillegra Dam**	**Date Tested:**	22.05.08
Sample Id:	BH DDH 9	**Test Type:**	Compressive Str.
Sample No:	-	**Sample Type:**	PQ3 Core
Initial Specimen:		**Rock Type**	0
Length/ Diameter Ratio:	2.7		0
Bulk Dry Density (t/m^3):	2.67	**Depth (m):**	37.31-37.54m
Moisture Content (%):	0.3		



UNIAXIAL COMPRESSIVE STRENGTH
U.C.S. (MPa) = 86.9

Notes on testing: Specimen tested at the moisture condition as received.

Specimen supplied by client.

Bulk density value was determined by vernier calliper method.

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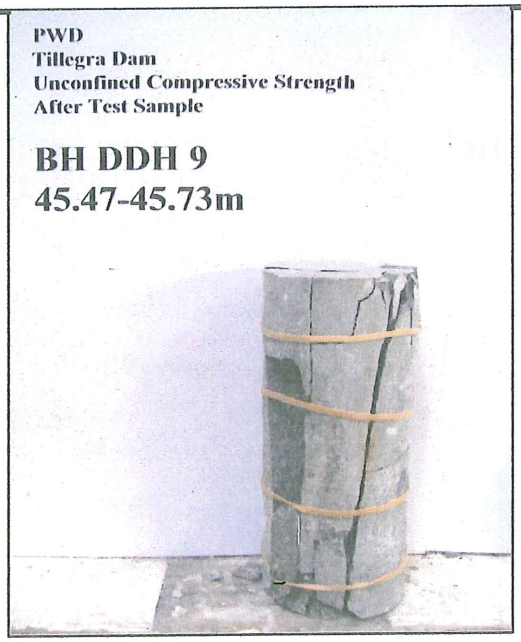
Signed: .....
Title: Manager

Name: Austin Lee
Date: 5/6/08

AUSTRALIAN SOIL TESTING PTY LTD. A.B.N. 79 003 493 623
24 Bermill Street, Rockdale, NSW, 2216 P.O. Box 2014, Rockdale D.C. NSW 2216
Tel: 9597 5599, 9597 3286 Fax: 9597 3442 Email: austst@bigpond.com

COMPRESSIVE STRENGTH
REPORT CERTIFICATE
AS 4133.4.2

CLIENT:	**PWD**	**JOB NO. :**	003-098
PROJECT:	**Tillegra Dam**	**LAB NO. :**	47270
LOCATION:	**Tillegra Dam**	**Date Tested:**	22.05.08
Sample Id:	BH DDH 9	**Test Type:**	Compressive Str.
Sample No:	-	**Sample Type:**	PQ3 Core
Initial Specimen:		**Rock Type**	
Length/ Diameter Ratio:	2.8		
Bulk Dry Density (t/m^3):	2.64	**Depth (m):**	45.47-45.73m
Moisture Content (%):	0.6		



UNIAXIAL COMPRESSIVE STRENGTH
U.C.S. (MPa) = 66.9

Notes on testing: Specimen tested at the moisture condition as received.

Specimen supplied by client.

Bulk density value was determined by vernier calliper method.

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Signed: .....
Title: Manager

Name: C Hobbs
Date: 9/6/08

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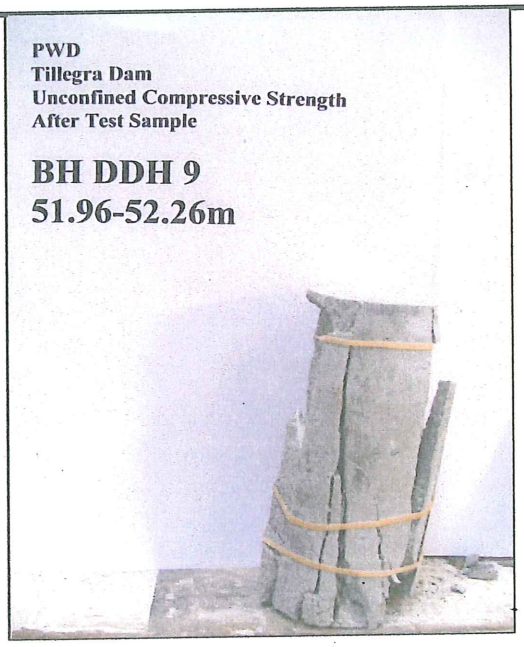
24 Bermill Street, Rockdale, NSW, 2216 P.O. Box 2014, Rockdale D.C. NSW 2216
Tel: 9597 5599, 9597 3286 Fax: 9597 3442 Email: austst@bigpond.com

COMPRESSIVE STRENGTH REPORT CERTIFICATE

AS 4133.4.2

CLIENT:	**PWD**	**JOB NO. :**	003-098
PROJECT:	**Tillegra Dam**	**LAB NO. :**	47271
LOCATION:	**Tillegra Dam**	**Date Tested:**	22.05.08
Sample Id:	BH DDH 9	**Test Type:**	Compressive Str.
Sample No:	-	**Sample Type:**	PQ3 Core
Initial Specimen:		**Rock Type**	
Length/ Diameter Ratio:	2.6		
Bulk Dry Density (t/m^3):	2.69	**Depth (m):**	51.96-52.26m
Moisture Content (%):	0.7		



UNIAXIAL COMPRESSIVE STRENGTH

U.C.S. (MPa) = 68.0

Notes on testing: Specimen tested at the moisture condition as received.

Specimen supplied by client.

Bulk density value was determined by vernier calliper method.

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Signed: ..... Name: .....

Title: Manager ..... Date: 9/6/08 .....

AUSTRALIAN SOIL TESTING PTY LTD. A.B.N. 79 003 493 623
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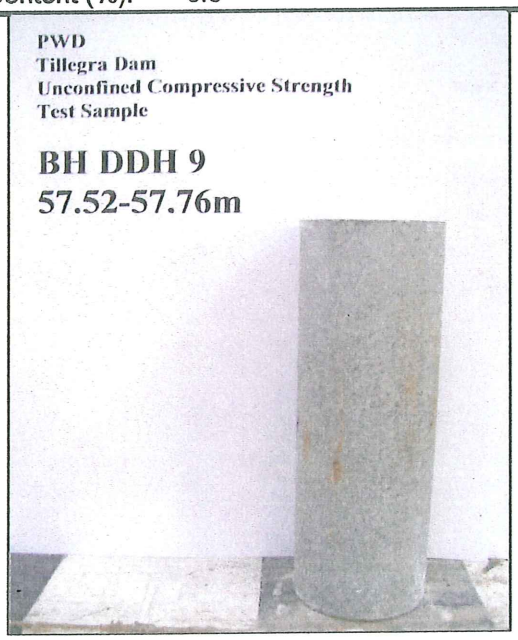
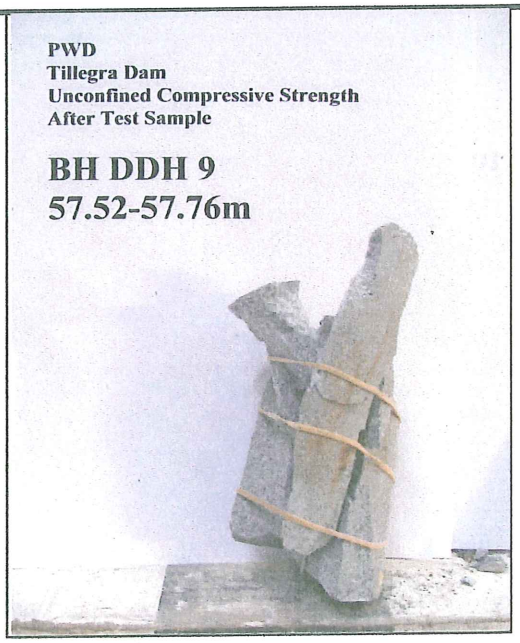
COMPRESSIVE STRENGTH REPORT CERTIFICATE

AS 4133.4.2

CLIENT:	**PWD**	**JOB NO. :**	003-098
PROJECT:	**Tillegra Dam**	**LAB NO. :**	47272
LOCATION:	**Tillegra Dam**	**Date Tested:**	22.05.08
Sample Id:	BH DDH 9	**Test Type:**	Compressive Str.
Sample No:	-	**Sample Type:**	PQ3 Core
Initial Specimen:		**Rock Type**	0
Length/ Diameter Ratio:	2.8		0
Bulk Dry Density (t/m^3):	2.68	**Depth (m):**	57.52-57.76m
Moisture Content (%):	0.6		





UNIAXIAL COMPRESSIVE STRENGTH
U.C.S. (MPa) = 144.6

Notes on testing: Specimen tested at the moisture condition as received.

Specimen supplied by client.

Bulk density value was determined by vernier calliper method.

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Signed: .....

Title: Manager

Name: C.S.T.A. 66

Date: 5/6/08