APPENDIX F

CUT-OFF WALLS

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PRELIMINARY CONCEPT REPORT - GROUNDWATER CUT-OFF BY CURTAIN GROUTING

Spinifex Ridge Mine Site, Pilbara, WA
Aquaterra

GEOTHERD08311AA-AB
31 May 2007

Coffey Geotechnics Pty Ltd ABN 93 056 929 483
24 Hasler Road Herdsman WA 6017 Australia

coffey geotechnics
SPECIALISTS MANAGING THE EARTH

31 May 2007

Aquaterra
Suite 4, 125 Melville Parade
COMO WA

Attention: Mr Stan Blanks

Dear Sir

RE: SPINIFEX RIDGE MINE SITE, PILBARA, WA

PRELIMINARY CONCEPT REPORT - GROUNDWATER CUT-OFF BY CURTAIN GROUTING

1 INTRODUCTION

This report describes preliminary geotechnical studies on potential curtain grouting solutions undertaken by Coffey Geotechnics Pty Ltd (Coffey) as part of a preliminary assessment of the feasibility of forming an in ground barrier to prevent groundwater flow though selected formations at the Spinifex Ridge mine site, 170km south east of Port Hedland, WA. It is understood that construction of an open pit copper / molybdenum mine is proposed at the site and there is a potential for dewatering of the mine to cause an existing permanent natural pond at nearby Coppin's Gap to dry out. The feasibility of forming a grout curtain, to restrict groundwater flow between the pond and the pit, is being explored by Aquaterra as one of a number of options to prevent the pond from drying out during and after operation of the mine.

This work was commissioned by Mr Stan Blanks of Aquaterra Pty Ltd on 10 April 2007 (Cost Code 689D6). This report is prepared and is to be read subject to the terms and conditions contained in our proposal dated 10 April 2007. Our advice is based on the information stated and on the assumptions expressed herein. Should that information or the assumptions be incorrect then Coffey Geotechnics Pty Ltd shall accept no liability in respect of the advice whether under law of contract, tort or otherwise.

2 BACKGROUND INFORMATION

It is understood that the Spinifex Ridge Mine is proposed to be an approximately 400 m deep by 800 m wide open cut pit, to target an ore body of copper and molybdenum. The ore body is intruded in a steeply dipping sequence of metafelsic and metabasalt igneous rocks.

The pit is located to the south of a ridge of Banded Iron Formation and over the path of an existing seasonal creek which meanders to the north east, towards the ridge. Where it cuts through the ridge at Coppin's Gap, a permanent waterhole incised in the BIF ridge. It is understood that the waterhole has significant heritage and environmental value and therefore the mine approval is contingent upon maintaining the pond in its natural conditions.

The creek feature is understood to have surface flows, typically only after high rainfall events such as cyclones, and for the majority of the time the flow is subterranean. It has been postulated by Aquaterra that mounding of the subterranean groundwater flows at the BIF ridge keeps the pond recharged through the dry season. There is some concern that dewatering for the new pit could cut-off and reverse the groundwater flows to such an extent that the pond at Coppin's Gap is no longer recharged and so may seasonally dry out.

3 OBJECTIVES

The objectives of this geotechnical study were to review the available geotechnical and geological information relating to the site to assess the following:

- Whether a curtain grouting concept is feasible;
- Type(s) of grouting that might be required to form a grout cut-off; and
- Approximate order of cost for constructing a curtain grout cut-off.

It is understood that the grouting option is currently in a conceptual / pre-feasibility phase and that detailed geotechnical and hydrogeological site investigation and testing would be required to confirm any recommendations made at this stage.

4 SCOPE OF WORKS

Coffey's scope of works, for this preliminary concept study, is to:

- Review the geological information provided by Aquaterra;
- Comment on the likely feasibility of forming grout cut-offs through the identified geological units and the type of grouting that may be necessary;
- Comment on typical investigation requirements to further develop the concept;
- Obtain order of magnitude costing, from a grouting contractor, for a typical grouting concept;
- Prepare a short report summarising the findings. We will provide one hard copy and one electronic copy (pdf).

5 INFORMATION SUPPLIED BY OTHERS

Aquaterra provided the following information:

- Geological map of the site;
- Contour map of the site;
- Geological cross section in the vicinity of the mine;
- Typical core photographs from the site; and
- General photographs of the site.

6 GROUND CONDITIONS

6.1 Geology

The information provided by Aquaterra indicates that the ground conditions comprise a steeply dipping sequence of banded iron formation, ultra-mafic, meta-basalt, meta-felsic and felsic porphyry rock units. Surface weathering of the ultra-mafic unit has formed a layer of calcrete that is present in the existing creek bed.

A plan of the surface geology, provided by Aquaterra, is included as Figure 1. A topographic plan is included as Figure 2 and a cross section of the inferred geology through the proposed pit is included as Figure 3.

6.2 Groundwater Flow

Aquaterra indicated that the majority of the groundwater flow between the pit and the pond at Coppin's Gap is, at this stage, believed to be via two paths, namely:

1. Through the surficial layer of calcrete that could be present to depths of up to nominally 12m in the existing creek bed where it traverses the ultramafic unit.
2. Through the meta-felsic unit which is deeply jointed and weathered.

On this basis these two separate units have been identified for the grouting works at this stage.

6.3 MetaFelsic

Typical core photographs from the felsic rock unit, provided by Aquaterra, are shown on Figures 4 to 6.

Figure 4 shows typical photographs of the weathered meta-felsics that are the target of the proposed grouting. From the photographs, the weathered metafelsic appears to be predominantly weak rock with variable clay content and variable fracturing. It is difficult to distinguish drilling induced fractures from insitu fractures. Based on the core photos it appears as though it was difficult to drill and (based on the short core runs and crumbled zones at the end of most runs) appears to have blocked off in the drill bit at frequent intervals.

There is obvious iron rich staining in some zones which could indicate zones of higher water flow. The weathering is most severe in the upper 20m to 27m depth.

Below about 20m to 27m depth the amount of weathering reduces and the rock strength increases. Figure 5 shows typical photos of core from the depth zone from 27m to 50m. There appears to be at least 3 major joint sub-orthogonal joint sets, with a joint spacing of more than 5 fractures per metre. The joints commonly have iron staining and mostly little more than a veneer of weathering. Many of the joints appear to be relatively tight. There are some highly fractured (sheared) zones where the core was recovered as gravels, most notably around 44m to 52m depth.

Figure 6 shows typical photographs of the fresh felsic from nominally 60m depth. It is understood that the fresh felsic is not the target of the proposed grouting. Based on the core photographs, this material appears to be comprised of competent fresh rock with a fracture spacing of typically 2 to 5 open joints per metre. There appears to be a primary joint set and at least one secondary joint set that is orthogonal to the primary set. The visible joint surfaces appear clean and unweathered, which probably indicates that they are tight insitu and therefore of low permeability.

6.4 Calcrete

A photograph of typical calcrete exposed in the creek bed is included on Figure 7. From the photograph the calcrete appears to be highly fractured and weathered, with soil infill in the fractures. The ultramafic unit is understood to be present beneath the calcrete at that location.

7 PERMEABILITY PARAMETERS

Aquaterra indicated that the horizontal Hydraulic Conductivity (k_h) of the two units, identified for potential grouting works, is assessed as:

- 1 to 10m/day ($1.2x10^{-5}$m/sec to $1.2x10^{-4}$m/sec) for the calcrete and
- 0.1 to 5m/day ($1.2x10^{-6}$m/sec to $5.8x10^{-5}$m/sec) for the weathered felsic rock,

It should be noted that these are the overall average hydraulic conductivity values for the units. As can be seen from the sample photographs of the felsic unit (Figures 4 to 6), the local hydraulic conductivity is probably much higher in some zones and lower in others.

Assessment of the permeability of rock for foundation grouting is mostly based upon Lugeon values. The Lugeon value of the rock is normally determined by packer testing, where a Lugeon is a water flow of 1 litre per minute per metre of borehole, under a pressure of 1000kPa (10 bar). In the absence of such tests, Fell *et al* (1992) indicates that in a 75mm diameter borehole one Lugeon is approximately equivalent to a hydraulic conductivity of $1.3x10^{-7}$m/sec, thus the estimated Lugeon values for the two units are:

- 89 to 890 Lugeons for the calcrete, and
- 9 to 445 Lugeons for the weathered felsic unit.

8 CURTAIN GROUTING CONCEPT

A curtain grouting option is being considered to restrict the groundwater flow in the calcrete and weathered felsic units. Curtain grouting involves progressively drilling a single or possibly multiple rows of closely spaced boreholes in sequence and pumping grout into the holes to meet a pre-determined closure criterion.

The grout restricts groundwater flow by permeating and hardening in the existing natural fractures in the rock mass, forming a narrow barrier or “curtain” of overall lower permeability than the surrounding rock mass. The curtain created by the row of grout injected holes would typically be constructed as a linear feature, perpendicular to the groundwater flow direction.

Aquaterra advised that to cut off groundwater flow through the two major water bearing strata, two separate grout curtains could be required. A preliminary estimate of the extent of the grout curtains required is as follows:

- A curtain approximately 200m long, extending from the ground surface level, nominally 12m deep would be required to restrict groundwater flow through a layer of calcrete, across the existing creek bed;
- A curtain approximately 300m long, extending from the ground surface to depths of between 60m and 80m (inclined) would be required to restrict groundwater flow through the weathered meta-felsic unit.

8.1 Conceptual Design

The type and amount of grouting required to form the grout curtains, and likely effectiveness of the grout curtains depends primarily on the following rock mass features:

- fracture spacing,
- aperture of the fractures,
- continuity and intersection of the fractures,
- roughness of the fracture surfaces.

The Lugeon test is typically used to assess the combined effect of these parameters on the permeability of the rock mass, however the results need to be considered in relation to the individual properties listed above.

In simplistic terms, for equivalent permeabilities, it is easier to grout a profile with fewer fractures and larger apertures than one with lots of closely spaced, but tight fractures. Based on the core photographs provided for the felsic unit, it appears as though there may be many joints (>5/m) with tight apertures rather than few open fractures.

Details of the grouting scheme that need to be considered include:

- Site preparation,
- Type of grout,
- Hole spacing,
- Grouting methodology,
- Closure criteria,
- Number of rows of holes.

Based on the limited information available for this study, these details are discussed in the following sub-sections.

8.1.1 Site Preparation

Before grouting can commence it may be necessary to clear away any highly permeable overburden material that could mask any surface grout seepage and make grouting closure of the upper stage of grouting more difficult. Based on the photograph of the typical calcrete creek bed provided by Aquaterra (Figure 7), it is likely that there will be a requirement to doze a trench along the alignment of the grout curtain in order to remove loose surface gravels and boulders and allow for clean access and observation of the calcrete surface. Similar works may also be required at the surface of the felsic unit for its grout curtain.

8.1.2 Type of Grout

The grout type that will be required depends largely on the aperture of the fractures that need to be grouted. Cement based grouts are typically used for grouting of fractured rock. The smaller the fracture openings, the finer the cement needs to be to be able to penetrate into the fractures. The cement type required for this project could be ordinary Portland General Purpose (GP) cement or sulphate resisting (SR) cement which is ground slightly finer than GP cement and so can penetrate into finer fractures. Microfine cement may be required if a very low permeability is targeted, however this cement is significantly more expensive than ordinary Portland cement. Note it is possible to mill finer cement on site if appropriate equipment is available.

At this stage allowance for GP and SR type cement is suggested, unless a particularly stringent closure criteria is considered appropriate, in which case, given the closely jointed nature of the rock, some or all of the grouting work may need to be carried out using microfine cement.

8.1.3 Hole Spacing

Curtain grouting is normally carried out with a staged approach. Primary holes are first drilled and grouted along a predetermined spacing (usually 6m to 12m spacing), then if required, subsequent secondary, tertiary and quaternary stages are drilled and grouted, each time halving the distance between the holes. For example, secondary holes are drilled mid way between the primary holes and tertiary holes are drilled midway between the primary and secondary holes. The absolute minimum requirement would be to drill and grout primary holes, then drill test and grout secondary holes.

At this stage, an allowance for Primary, Secondary and Tertiary holes, with a final spacing of nominally 1.5m in the felsic unit and 2.5m in the calcrete unit is suggested. The holes would be drilled vertically in the calcrete and may need to be inclined in the felsic unit, so that they intersect the full length of the unit.

8.1.4 Grouting Methodology

There are two main options for grouting in each hole, namely down stage grouting and upstage grouting.

In the down stage method, the holes for the calcrete unit would be drilled in two stages (0 to 6m and 6 to 12m) and the holes in the felsic unit would be drilled in 4 to 5 stages (the length of each stage increasing with depth from about 8m to 20m). The procedure for each stage is drill, then flush, then water test, the grout, then wash out the grout in the hole, ready for drilling the next stage. There would typically be at least 24hrs between stages. Down stage grouting is the preferred, but more expensive, method of grouting because it allows for progressive grouting and confirmation of the required hole depths based on the grout takes and water test results (i.e. closure criteria). It also allows for better sealing in the top stage, is less likely to have problems with hole stability and allows for higher pressures to be used in the lower stages. A packer may or may not be required at the top of each stage level. The main disadvantage of this method is that separate drill set-ups and grout hook-ups are required for each stage and so the work takes longer and is more costly.

In the up stage method, the holes would be drilled to the full nominated depth first, then grouted progressively from the bottom up, using a packer to isolate each grouting stage. The main advantage of this method is that it is cheaper and quicker because the holes only have to be drilled once. The main disadvantages of this method are that it requires the holes to be stable and there can be some problems with sealing of the packer in fractured ground.

At this stage it is recommended that allowance is made for up stage grouting for the holes across the calcrete unit which should be relatively straightforward, however it must be noted that Coffey has not been provided with any core photographs of the calcrete unit, so the extent of fracturing and the likely hole stability is unknown.

For the felsic unit, down stage grouting is recommended at least for the primary holes. Up stage grouting may be possible for some sections of the subsequent secondary and tertiary holes, unless there are problems with hole stability that preclude the use of up stage methods entirely.

8.1.5 Closure Criteria

The closure criterion defines how intensive the grouting needs to be to achieve the desired groundwater cut-off effect. Closure criteria normally involve a water test criteria (Lugeons) and a grout take criteria, where by, once the grout takes and / or water test results drop below the closure values then the grouting is ceased. At this stage there is not enough information available to be able to comment on appropriate grout takes, however some guidance can be given on water test (Lugeon) criteria that might need to be adopted.

Houlsby (1990) suggests that where water is precious or worth the cost of intensive grouting, then the closure criteria for grouting expressed in terms of Lugeons should be in the range of 1 to 3 Lugeons (approximately 1.3×10^{-7} to 3.9×10^{-7}m/sec equivalent permeability). However, given the relatively closely spaced jointing observed in the borehole photographs, it is possible that such a low closure criteria might be very difficult to achieve using conventional cement grout, and the more expensive microfine cement grout (possibly including dispersants) may be required to achieve such low closure criteria.

If it can achieve the desired objectives at Coppin's Gap, then a more realistic closure criterion of around 8 to 10 Lugeons would be preferred. A water test result of 8 Lugeons is roughly equivalent to a permeability of 1×10^{-6}m/sec and is likely to be about the best that can be achieved at the site, with a well controlled grouting program, using type GP and / or SR cement grout.

8.1.6 Number of Rows of Holes

Given that the Spinifex Ridge mine is to be mined over a number of years, there is an opportunity to carry out the grouting works over a number of years, whilst monitoring the effectiveness, via piezometers installed on either side of the curtain, to determine whether further grouting is required. If an initial row of holes does not achieve sufficient reduction in flow, then a second row of holes could be drilled the following year, and so on until the desired flow reduction is achieved.

To estimate the potential for a grout curtain to achieve the desired effects at Coppin's Gap, it is understood that Aquaterra is developing a regional groundwater model, using a computer package such as MODFLOW. In such a model, the grout curtain could be modelled by including a zone of low permeability material and varying its width (in the direction of flow) to determine the effect on restricting flows from Coppin's Gap.

It is difficult to determine the appropriate hydraulic conductivity to adopt for the grouted rock mass, however ICOLD (1985) suggests that a well constructed grout curtain would have a hydraulic conductivity of about $1x10^{-6}$m/sec.

The width of the low permeability zone depends on the penetration distance of the grout from the boreholes. Based on Table 12.7 of Fell *et al* (1992), a penetration distance of about 2m to 4m in the felsic unit and 4m or more for the calcrete unit might be possible. Therefore, for the groundwater modelling, it is suggested that the width of the wall be taken as 2.5m per row of holes in the felsic unit and 3.5m per row of holes in the calcrete unit. At this stage it is recommended that the number of rows of holes is determined theoretically by first trialling one row, then two rows, and increasing the number of rows (or overall width) of the low permeability material until the desired effects at Coppin's Gap are achieved. In the absence of such analyses, it is suggested that allowance be made for at least two rows on each wall at this stage.

8.2 Preliminary Cost Estimate

It is very difficult to estimate the cost of grouting works as the grout takes and the number of grouting stages are so difficult to estimate. The mining company needs to be aware of this difficulty and understand that grouting contracts need to be let on a unit rates basis and that the overall costs are very difficult to predict.

Coffey approached a WA based grouting contractor for an order of magnitude cost estimate, who indicated that the grouting works as described in this report, including SR cement, predominantly up stage grouting and up to 2 rows of holes could cost of the order of $3million if constructed in one mobilisation.

Aquaterra indicated that the mine may prefer to spread the capital costs over a number of years, constructing the grout curtain across the calcrete unit in years 1 to 3 and the felsic unit, say in years 3 to 5. With this approach, and given the uncertainty of the operation it is suggested that allowance might need to be made for an average of say $1million per year for 6 years (2007 costs). Further work needs to be done to confirm these order of magnitude costs after Aquaterra has completed the groundwater modelling and a better idea of the required effective width of a cut-off wall is estimated.

9 ALTERNATIVE CONCEPT FOR CALCRETE CUT-OFF

Given the calcrete unit is expected to be relatively shallow, it may be worthwhile comparing the cost and benefits of constructing a slurry cut-off wall as an alternative to grouting. This may be a feasible option depending on the excavatability of the rock and the actual depth required. The concept is for a narrow trench filled with a bentonite slurry, bentonite/soil mix, grout or concrete mix (depending on the permeability required) and would be excavated by a long reach excavator or a possibly by a combination of rotary drilling or percussion tools, followed by excavation of spoil with a clamshell bucket grab.

The resulting cut-off wall, could have an order of magnitude or lower permeability than a grout curtain and a more defined and uniform width.

10 SITE INVESTIGATION REQUIREMENTS

A detailed site investigation will be required to enable design and reasonable costing of the grout curtains. The investigation will need to incorporate the following:

- Cored angled boreholes with full joint orientations;
- Mapping of borehole defects with an acoustic televiewer or similar device;
- Comprehensive Lugeon Water tests in the cored boreholes;

Since the drilling muds used for coring are likely to block up cracks in the rock mass, it is likely that separately drilled holes will be required for the defect mapping and water testing. These may need to be drilled in addition to the cored boreholes, using a down stage method of progressive drilling, mapping, isolation of the test section with a packer, and water testing. RC or RAB drilling methods that don't involve drilling muds may be suitable for this testing.

At this stage it is suggested that a borehole spacing of about 20m along the alignment of each proposed grout curtain is suggested for detailed design. Additional holes may be required to help identify the best position for the grout curtains, if sufficient data is not already available for this purpose.

11 REFERENCES

The following references were used in preparing this report:

Houlsby, A. C. (1990) Construction and Design of Cement Grouting: a Guide to Grouting in Rock Foundations, A Wiley-Interscience Publication.

Fell R, MacGregor P, Stapledon D (1992) Geotechnical Engineering of Embankment Dams. A.A. Balkema, Rotterdam.

ICOLD (1985) Filling Materials for Watertight Cutoff Walls. International Commission on Large Dams, Bulletin 51.

12 CLOSURE

We trust the information contained in this report meets your present requirements. Further important information regarding your Coffey report is attached. Should you require further information or clarification of any details, please do not hesitate to contact this office.

For and on behalf of Coffey Geotechnics Pty Ltd

Darren Beaumont

Principal

Encl: Important Information about your Coffey Report

Figure 1 – Inferred Surface Geology Plan

Figure 2 – Topographic Plan

Figure 3 – Geological Section

Figure 4 – Photographs of Typical Slightly Weathered Metafelsics

Figure 5 – Photographs of Typical Weathered Metafelsics

Figure 6 – Photographs of Typical Fresh Felsics

Figure 7 – Photograph of Typical Calcrete Outcrop In A Creek Bed

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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.

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.

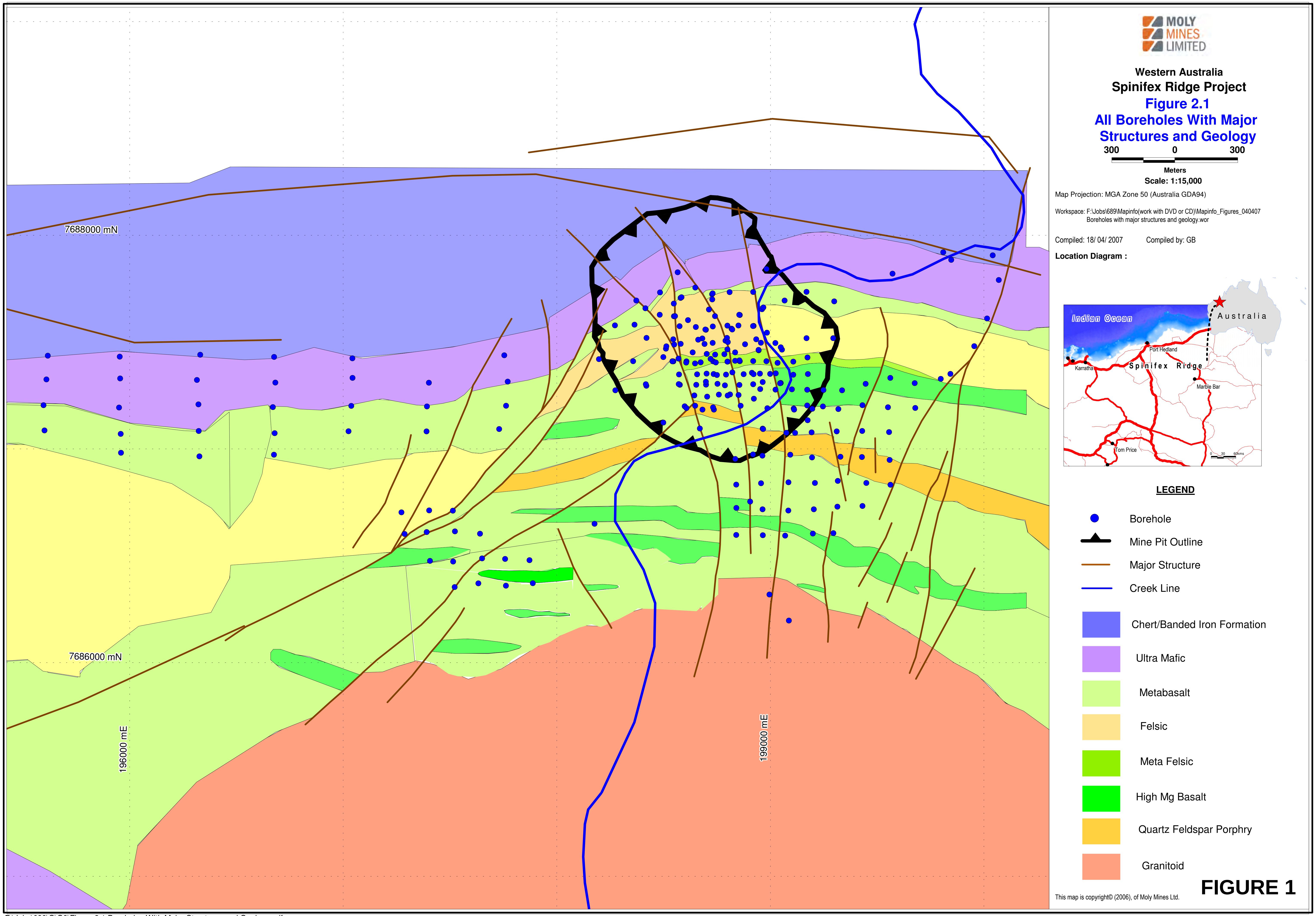
Rely on Coffey for additional assistance

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.

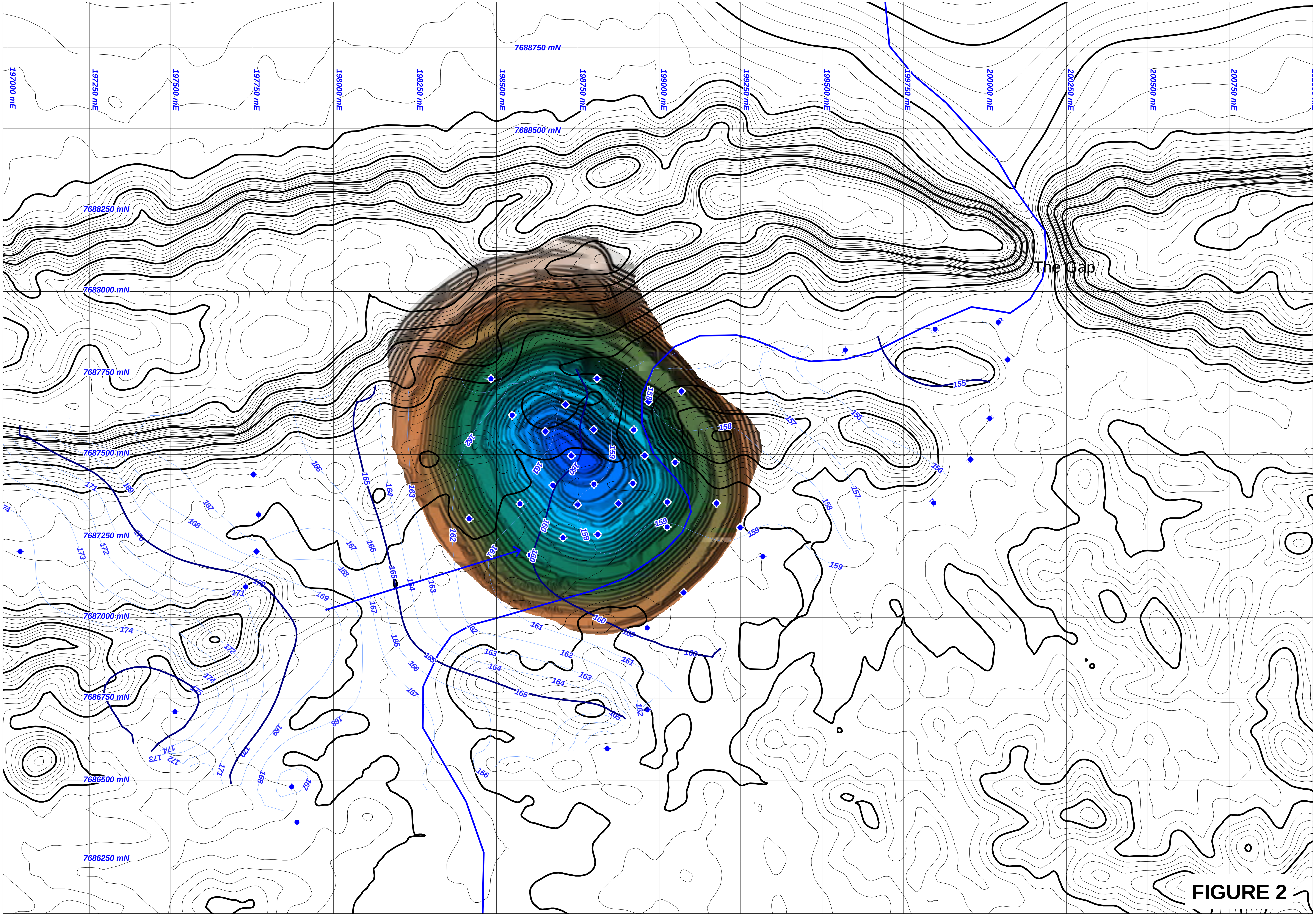
Responsibility

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.



F:\Jobs\689\G\G3\Figure.2.1.Boreholes With Major Structures and Geology.pdf



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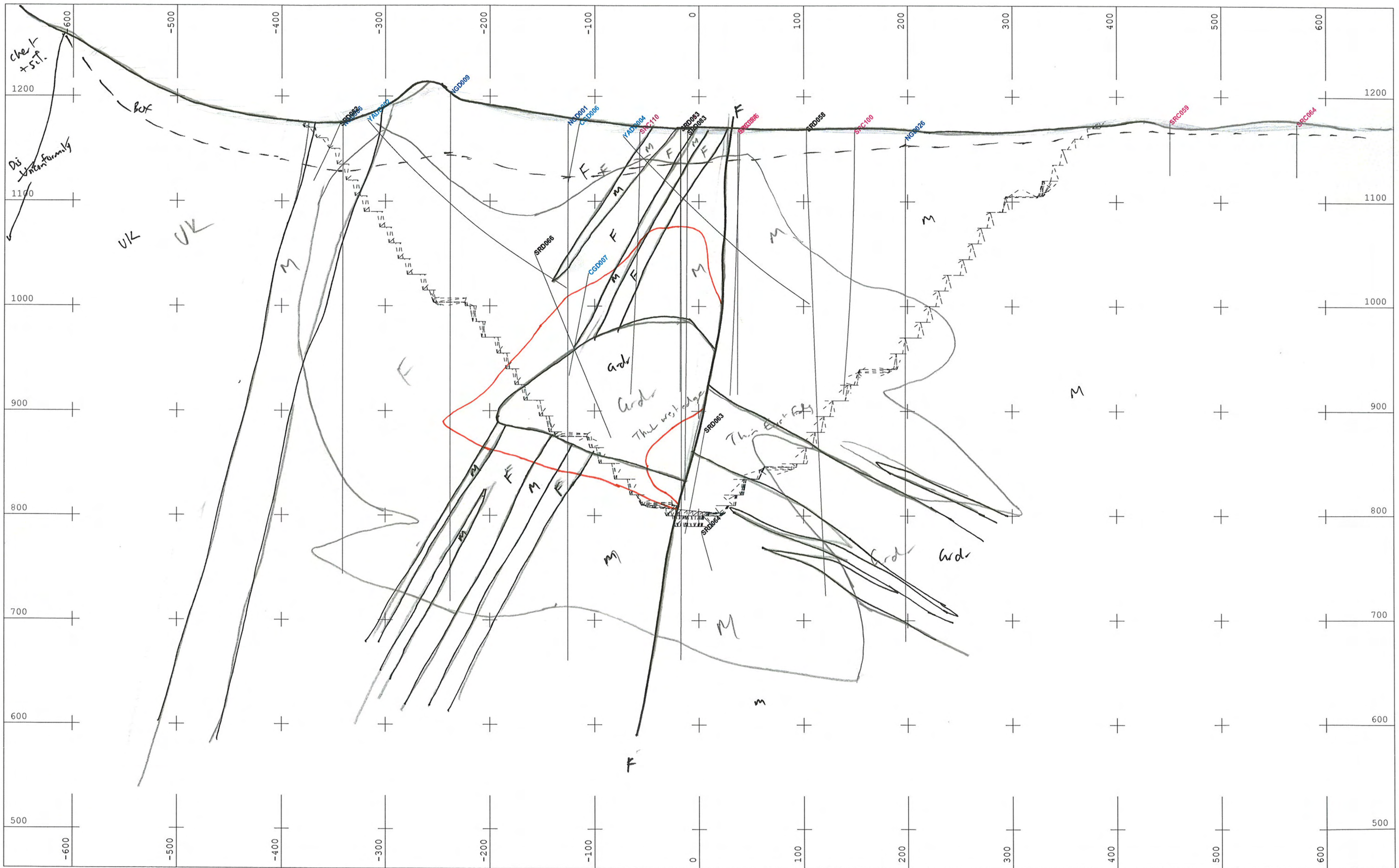
The Gap

FIGURE 2



Plotted with MICROMINE Resources Software
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Fax +61 8 9423 9001
www.micromine.com.au

Notes:
RHS - Moly assays
Hatching Grades
<200
200 - 400
400 - 600
600 - 800
800 - 1000
>1000

Notes:
Green - mafic, dolerite, basalt
Orange - felsic, dacite, rhyodacite

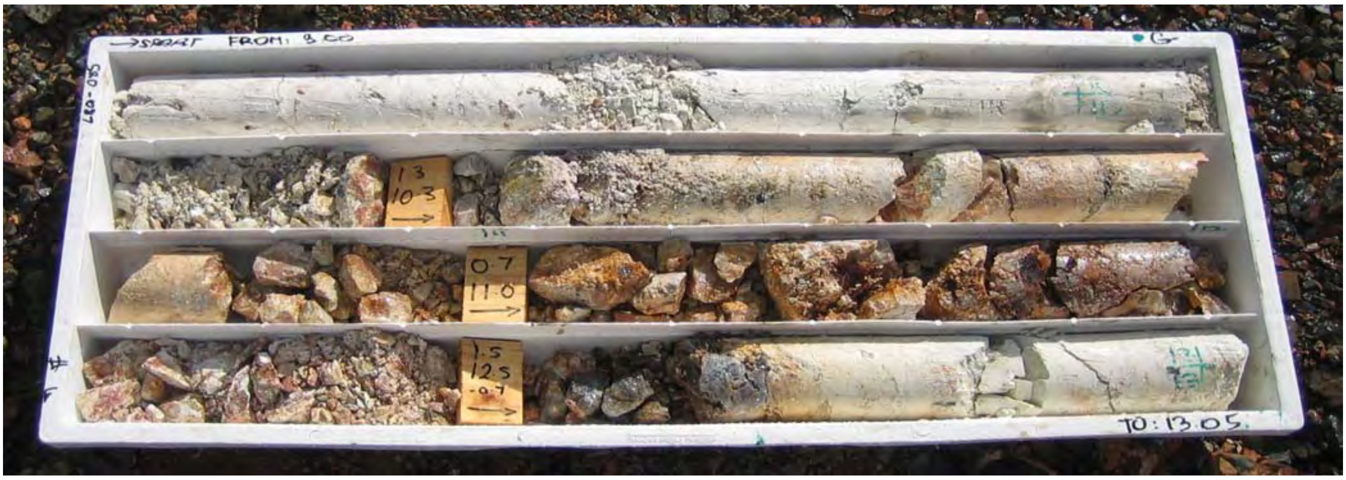
Scale	DATE	SHEET
1:3500	12/10/2005	1 of 1
	REF No. 1	FILE VIZEX

0 100m

Moly Mines Limited
Spinifex Ridge Project

FIGURE 3

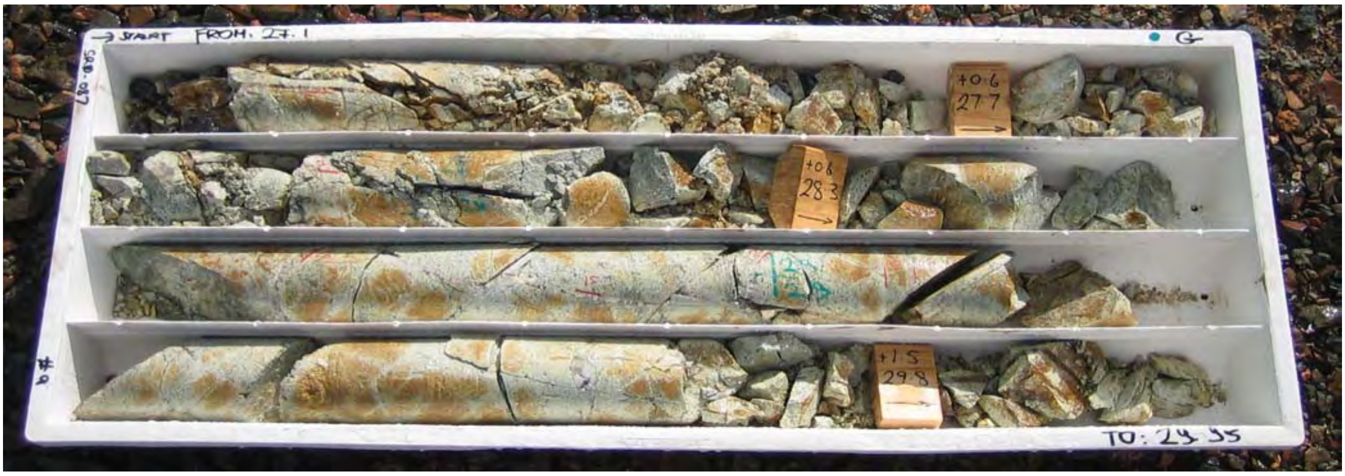
Borehole SRD-087, Tray 002 - 3.25m - 6.10m



Borehole SRD-087, Tray 002 - 8.00m - 13.05m

Borehole SRD-087, Tray 006 - 16.20m - 20.50m

drawn	DCB	coffey geotechnics SPECIALISTS MANAGING THE EARTH	client:	Aquaterra
approved	MAW		project:	Spinifex Ridge Mine Site Groundwater Cut-Off Study
date	31-May-07			
scale	N.T.S		title:	**Photographs of Typical Weathered Metafelsics**
original size	A4		project no: GEOTHERD08311AA	figure no: FIGURE 4

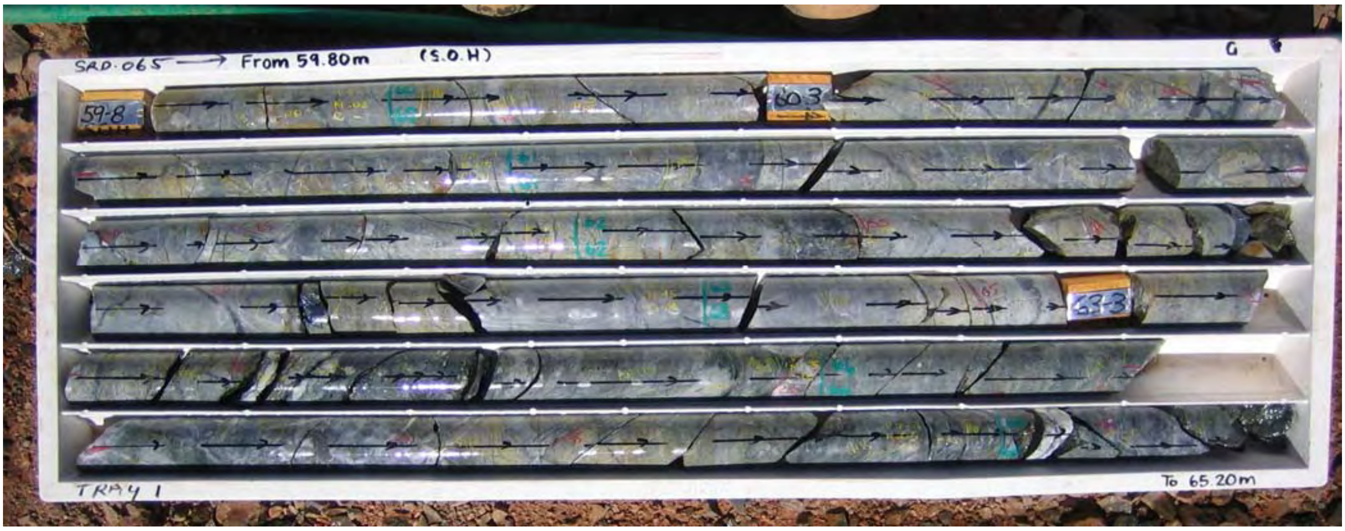


Borehole SRD-087, Tray 009 - 27.10m - 29.95m

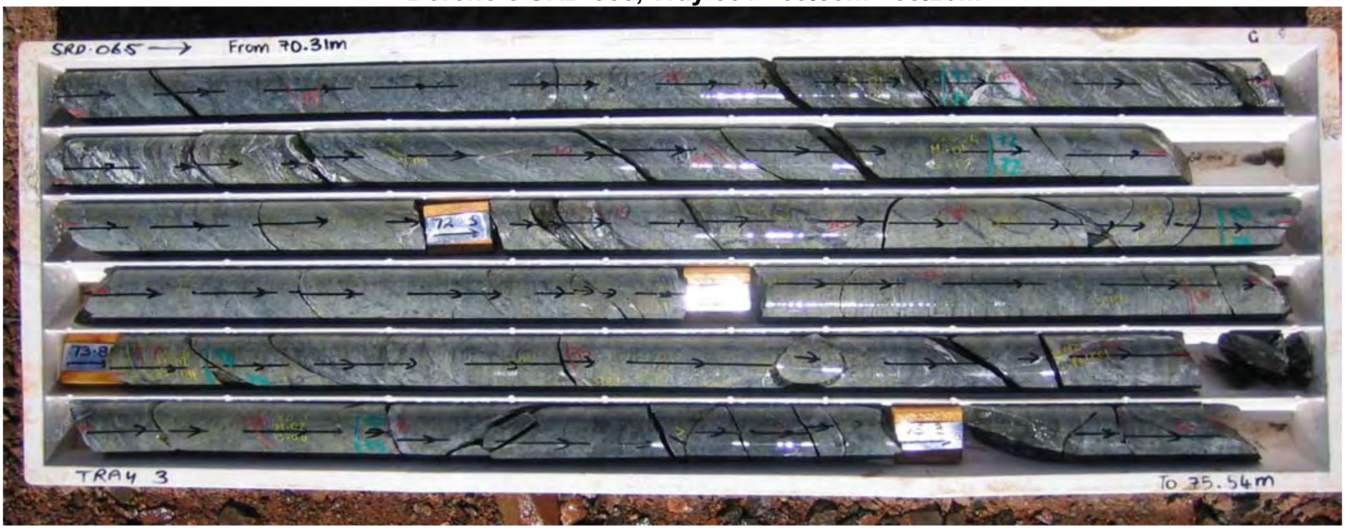
Borehole SRD-087, Tray 011 - 33.30m - 36.40m

Borehole SRD-087, Tray 013 - 39.20m - 42.00m

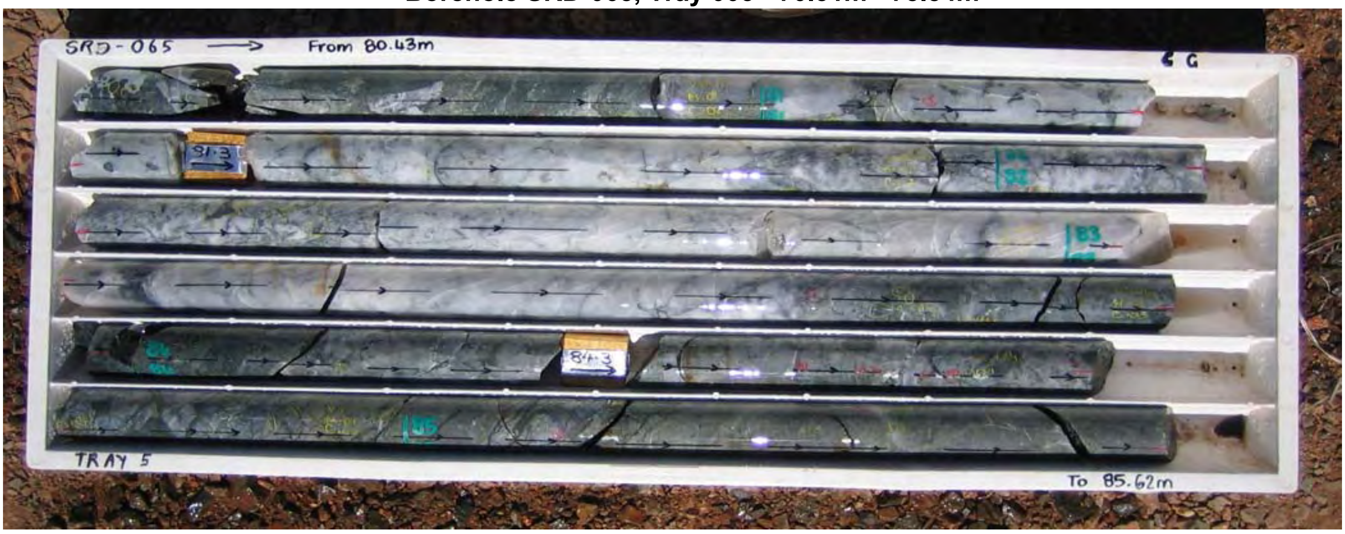
drawn	DCB	coffey geotechnics SPECIALISTS MANAGING THE EARTH	client:	Aquaterra
approved	MAW		project:	Spinifex Ridge Mine Site Groundwater Cut-Off Study
date	31-May-07			
scale	N.T.S		title:	**Photographs of Typical Slightly Weathered Metafelsics**
original size	A4		project no: GEOTHERD08311AA	figure no: FIGURE 5



Borehole SRD-065, Tray 001 - 59.80m - 65.20m



Borehole SRD-065, Tray 003 - 70.31m - 75.54m



Borehole SRD-087, Tray 05 - 80.43m - 85.62m

drawn	DCB	coffey geotechnics SPECIALISTS MANAGING THE EARTH	client:	Aquaterra	
approved	MAW		project:	Spinifex Ridge Mine Site Groundwater Cut-Off Study	
date	31-May-07				
scale	N.T.S		title:	**Photographs of Typical Fresh Felsics**	
original size	A4		project no: GEOTHERD08311AA	figure no:	FIGURE 6

Calcrete Exposed in Creek Bed, SRWB06C

drawn	DCB	coffey geotechnics SPECIALISTS MANAGING THE EARTH	client:	Aquaterra
approved	MAw		project:	Spinifex Ridge Mine Site Groundwater Cut-Off Study
date	31-May-07			
scale	N.T.S		title:	**Photographs of Typical Calcrete outcrop in a creek bed**
original size	A4		project no: GEOTHERD08311AA	figure no: FIGURE 7

APPENDIX G

GROUNDWATER LICENSES

Department of Water
Government of Western Australia

RECEIVED
13 JUL 2006

NWK3206

Jason Rechichi

9144 0250

Trevor Naughton
Manager Environment
Moly Metals Australia Pty Ltd
189 Hay Street, Subiaco
Western Australia 6008

Dear Trevor

ISSUE OF A *LICENCE TO CONSTRUCT OR ALTER WELL CAW161199(1)*
PROPERTY :M45/1095, M45/1096 & M45/1097 – Spinifex Ridge

I refer to the application received by the Department of Water on the 28 June 2006 for approval to construct five test bores so as to determine aquifer properties around the proposed mine site.

Please find enclosed your Licence, authorising you to Construct or Alter a Well, subject to certain terms, conditions or restrictions.

It is important that you read the conditions of your licence carefully. If you do not understand your licence, please contact the Commission as soon as possible, as there are penalties for failing to comply with all of your licence conditions. Under Section 26GI of the *Rights in Water and Irrigation Act 1914*, you have a right to apply to the State Administrative Tribunal for a review of the decision to Issue a *Licence to Construct or Alter a Well*. You have 28 days from the date you received this letter to request that the decision be reviewed.

For further information please contact the State Administrative Tribunal:

State Administrative Tribunal
12 St Georges Terrace
PERTH WA 6000

GPO Box U1991
PERTH WA 6845

Telephone: (08) 9219 3111
Toll-free: 1300 306 017
Facsimile: (08) 9202 1180
www.sat.justice.wa.gov.au

Under section 21 of the *State Administrative Tribunal Act 2004*, you have a right to request a written statement of reasons for the decision to Issue a *Licence to Construct or Alter a Well.* This request must be made, in writing, to the Department of Water within 28 days after the day on which you received this letter.

Within one month of completing the well, you are required to submit **Form L – Particulars of Completed Borehole** to the Department of Water Office in Karratha. A penalty of $150 applies for failure to submit this Form.

If the water from this well is being improperly used, is being wasted or is having a harmful effect, the Department may direct the closing of this well.

Compliance with the terms, conditions or restrictions of this licence does not absolve the licensee from responsibility for compliance with the requirements of all Commonwealth and State legislation.

If you have any questions, please contact the Pilbara Regional Office on Phone Number (08)9144 2000.

Yours sincerely

Jason Rechichi

6 July 2006

File No: NWK3206

Water and Rivers Commission
Government of Western Australia

Instrument No. CAW161199(1)

LICENCE TO CONSTRUCT OR ALTER WELL

Granted by the Commission under section 26D of the Rights in Water and Irrigation Act 1914

Licensee(s)	Moly Mines Limited	
Description of Water Resource	Pilbara Pilbara - Fractured Rock	
Location of Well(s)	M45/1095, M45/1096, M45/1097 - Spinifex Ridge	
Authorised Activities	**Activity**	**Location of Activity**
	Construct 5 non-artesian well(s).	M45/1095, M45/1096, M45/1097 - Spinifex Ridge
Duration of Licence	From 6 July 2006 to 31 December 2007	

This Licence is subject to the following terms, conditions and restrictions:

1 That water discharged during the pump test, is to be disposed of in such a manner as to cause no undesirable environmental impact

2 The well must be constructed by a driller having a current class 1 water well drillers certificate issued by the Western Australian branch of the Australian Drilling Industry Association or other certification approved by the Water and Rivers Commission as equivalent.

3 The licensee is required to provide to the Water and Rivers Commission a completed ' Particulars of Completed Bore Hole Form ' on completion of the approved drilling programme.

4 That no well shall be sunk within 400 metres of an existing well without the written permission of the owner of that well.

End of terms, conditions and restrictions

This Licence is granted subject to the Rights in Water and Irrigation Regulations 2000.