HASTINGS
Technology Metals Limited

APPENDIX 5-9

Tailings Storage Facility Geotechnical Assessment

ATC Williams

REPORT

Hastings Technology Metals

Yangibana Project, Gascoyne Region, WA

Geotechnical Investigation for Tailings Storage Facilities and Associated Infrastructure

January, 2017

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CONDITIONS OF INVESTIGATION AND REPORT

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Geotechnical Investigation

1. Geotechnical site investigation necessarily involves the investigation of the subsurface conditions at a site at a few isolated locations, and the interpretation and extrapolation of those conditions to elsewhere on the site not so investigated. This procedure has been adopted at the site that is the subject of this report and due care and skill has been applied in carrying out and reporting on the work. Thus the findings, conclusions and comments contained in this report represent professional estimates and opinions and are not to be read as facts unless the context makes it clear to the contrary. In general, statements of fact are confined to statements as to what was done and/or what was observed. Other statements have been based on professional judgement.

2. The scope of the work has been planned in the absence of any fore-knowledge of the site other than that stated in the report. Unless otherwise stated we consider that the number of locations investigated and the depths to which they have been investigated are reasonable bearing in mind the scale and nature of the project, and the defined purpose for which the investigation was undertaken.

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1 INTRODUCTION

Hastings Technology Metals are currently preparing a feasibility study for the Yangibana Rare Earths Project in the Gascoyne region of Western Australia.

ATC Williams has been engaged by Hastings Technology Metals to complete geotechnical investigations for the proposed mine infrastructure at the Yangibana Rare Earths Project. The geotechnical investigation will provide information for infrastructure design and the submission of a mining proposal. The objectives of the geotechnical investigation are to:

- Undertake field investigations and laboratory testing of soil and rock samples to an extent sufficient to provide data and relevant geotechnical parameters for design of the mine infrastructure,
- Assess the availability and suitability of site won soil and rock materials for earthworks construction and for use as concrete aggregate if appropriate,
- Provide recommendations for design of structural foundations at the plant site, administration area, camp site and potential culverts or bridge crossings at creek locations,
- Provide recommendations and geotechnical parameters for design of the TSF and evaporation pond containment embankments,
- Provide recommendations for pavement design including preliminary assessment of sub base and base course requirements,
- Identify the depth to groundwater beneath the proposed TSF areas and obtain baseline groundwater samples for water quality analysis.

The geotechnical investigation was carried out in two stages.

The first stage was completed between 23rd October 2016 and 6th November 2016. The fieldwork comprised diamond core and RC drilling at the proposed plant site and Tailings Storage Facility (TSF) locations. The second stage was completed between 8th November 2016 and 22nd November 2016 which comprised test pit excavation at the proposed primary mine infrastructure locations.

Terms of reference for this investigation were provided in ATC Williams proposal 112391.11P01 Rev2 dated 12th October 2016. Authorisation to proceed was received from Andy Border of Hastings Technology Metals Ltd.

This document reports the geotechnical investigations undertaken at the proposed TSF sites only. The TSF sites comprise;

- TSF 1 – A central thickened discharge type TSF to store “rougher” flotation tailings. Bleed water and incidental run off will be stored in an appurtenant water storage pond,
- TSF 2 – A paddock type TSF to store “cleaner” flotation tailings,
- TSF 3 – A paddock type TSF to store Hydrometallurgy plant tailings,
- An evaporation pond to store and evaporate hydrometallurgy plant waste water.

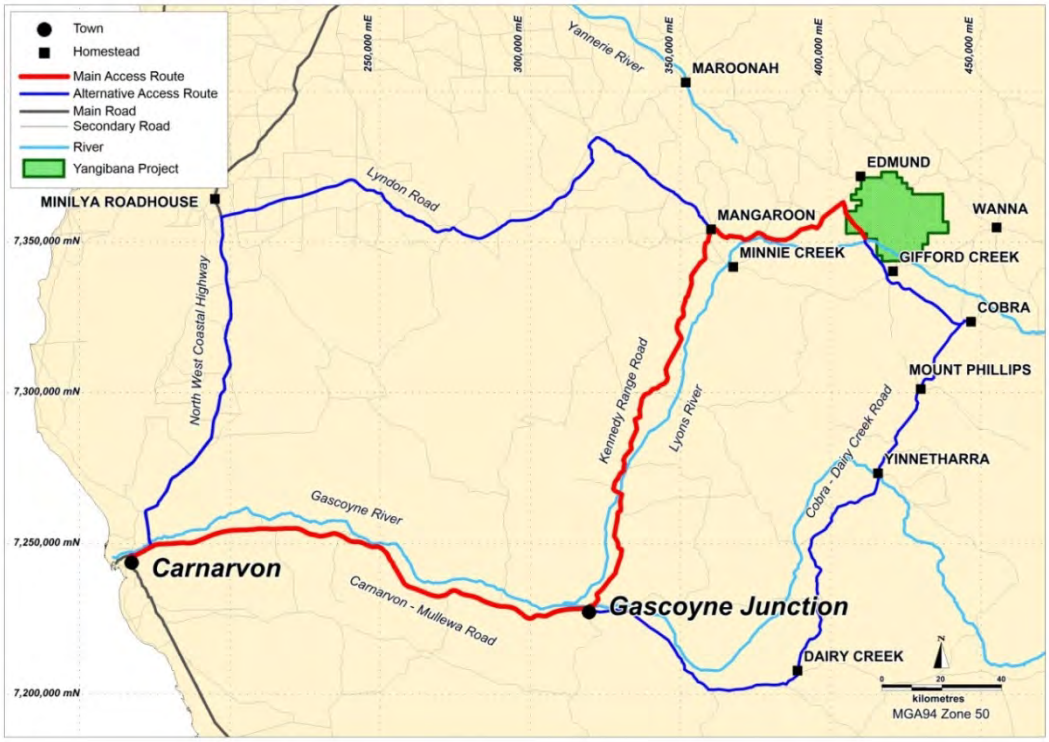
The findings of the investigations undertaken at the proposed plant and primary mine infrastructure locations will be provided in a separate report.

2 PROJECT BACKGROUND

2.1 Site Location

Yangibana is located in the Gascoyne region of Western Australia, approximately 270 km northeast of Carnarvon. Error! Reference source not found. **Figure 1** shows the site location and **Drawing 001** shows the general mine site layout.

Figure 1: Yangibana Project Location



2.2 Geological Setting

The dominant lithologies in the tenement area are the Pimbyana Granite and the Yangibana Granite of Proterozoic age (*c 1860 ma*). Rafts of meta-sedimentary rocks including sandstones, tillites, calc-silicates and schists occasionally occur within the site area.

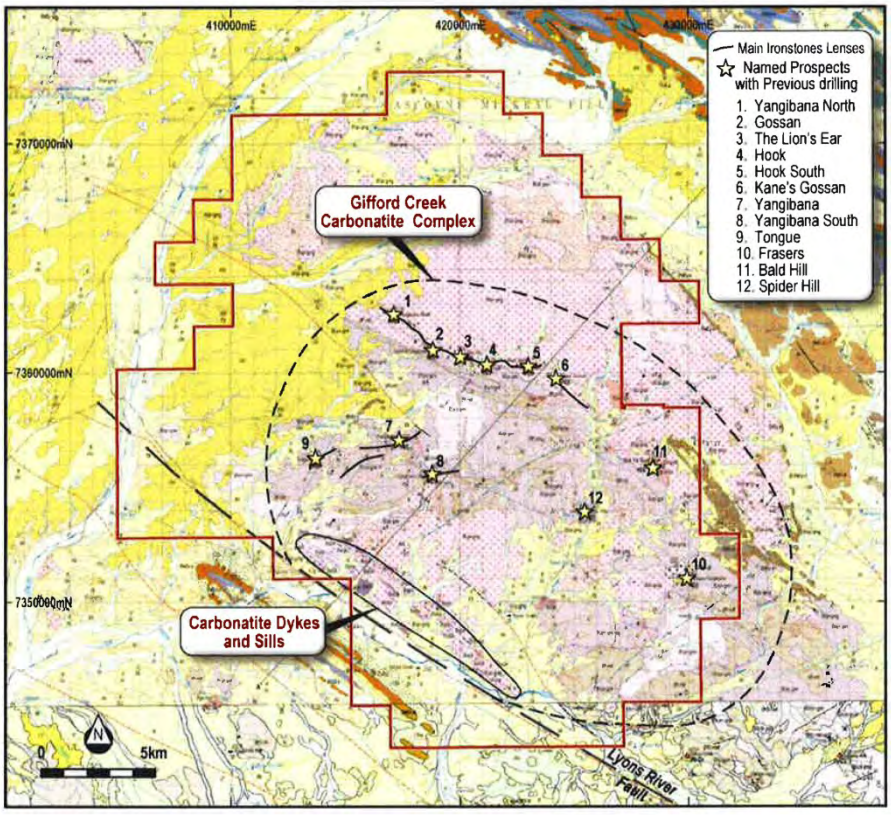
The granites are very well exposed and form extensive low rugged hills covered in boulders with numerous smooth, rounded outcrops of low relief.

The orebody is hosted in the Gifford Creek Carbonatite complex, formed by intrusion of ferrocarbonatite sills into the granitic units. The dominant trend is north west, parallel to the Lyons River fault which is located to the south of the proposed mining area. The sills dip towards the fault.

The near surface expression of the hydrothermally altered (fenitised) ferrocarbonatite dykes is represented by sinuous veins of iron oxides (ironstones) primarily of magnetite composition containing significant amounts of rare earth elements.

The geological setting is illustrated in **Figure 2**.

Figure 2: Yangibana Geology



Localised shallow deposits of unconsolidated silt, sand and gravel are present in the creeks crossing the site area and calcrete deposits are locally present adjacent to the alluvial channels.

To the north and east of the exposed granite complex and locally adjacent to creeklines, sandy and clayey distal sheetwash and slope deposits are inferred. To the west, first generation alluvial units of ferruginised and dissected sand and gravel are indicated.

2.3 Topography

The site topography comprises gently undulating grassland and rocky outcrop with concentrations of trees in creek beds and in isolated locations elsewhere.

Localised ridges with relief typically of less than 10 m are present along the proposed access and haul road alignments. Prominent hills have maximum relief of between 15 m (Spider Hill) and 30 m (Bald Hill). The Lyons River is the principal watercourse, flowing from east to west immediately south of the proposed camp site. Fraser Creek forms a major north to south flowing tributary passing through the mining area.

Fairly broad valleys are present in most of the study area, typically sloping at around 0.7% to 0.5% towards the west or south west.

2.4 Climate

The local area has an arid climate. It is generally warm all year round. The dry season lasts approximately nine months from April to December. Peak wet season rainfall generally occurs in February.

The nearest weather station recording a full suite of climate data is Mount Phillips station (station number 007058) located approximately 60 km south of the site. Average maximum daily temperatures range from 9 °C in July to 40°C in January.

Wanna station (station number 007028) is the closest station recording rainfall data, approximately 20 km south of the site. The mean annual rainfall is about 230 mm, but the area has experienced rainfalls up to 550 mm at average intervals of about 15 -20 years.

2.5 Mining

Open pit, drill and blast mining methods are proposed for approximately 4 pits, commencing with the Bald Hill pit and Frasers pit in the eastern mineralisation belt and continuing with the Yangibana and Yangibana West pits in the western mineralisation area. The preferred plant site location is situated approximately 2 km to the south of the Bald Hill pit.

The depth of significant weathering is very shallow across most of the mine tenement area; although, approximately 25 m of extremely to highly weathered saprolitic material has been identified at Bald Hill.

Mining rate of ore is approximately 1 Mtpa for a period of 7 to 8 years is envisaged.

Waste rock dumps formed primarily of slightly weathered to fresh granite will be located on the northern footwall side of the pits. The saprolitic material at Bald Hill may be stockpiled separately and may be used as low permeability material for dam construction and ultimately for mine rehabilitation purposes.

2.6 Processing

The generalised processing route for the Yangibana ore is summarised in **Figure 3**.

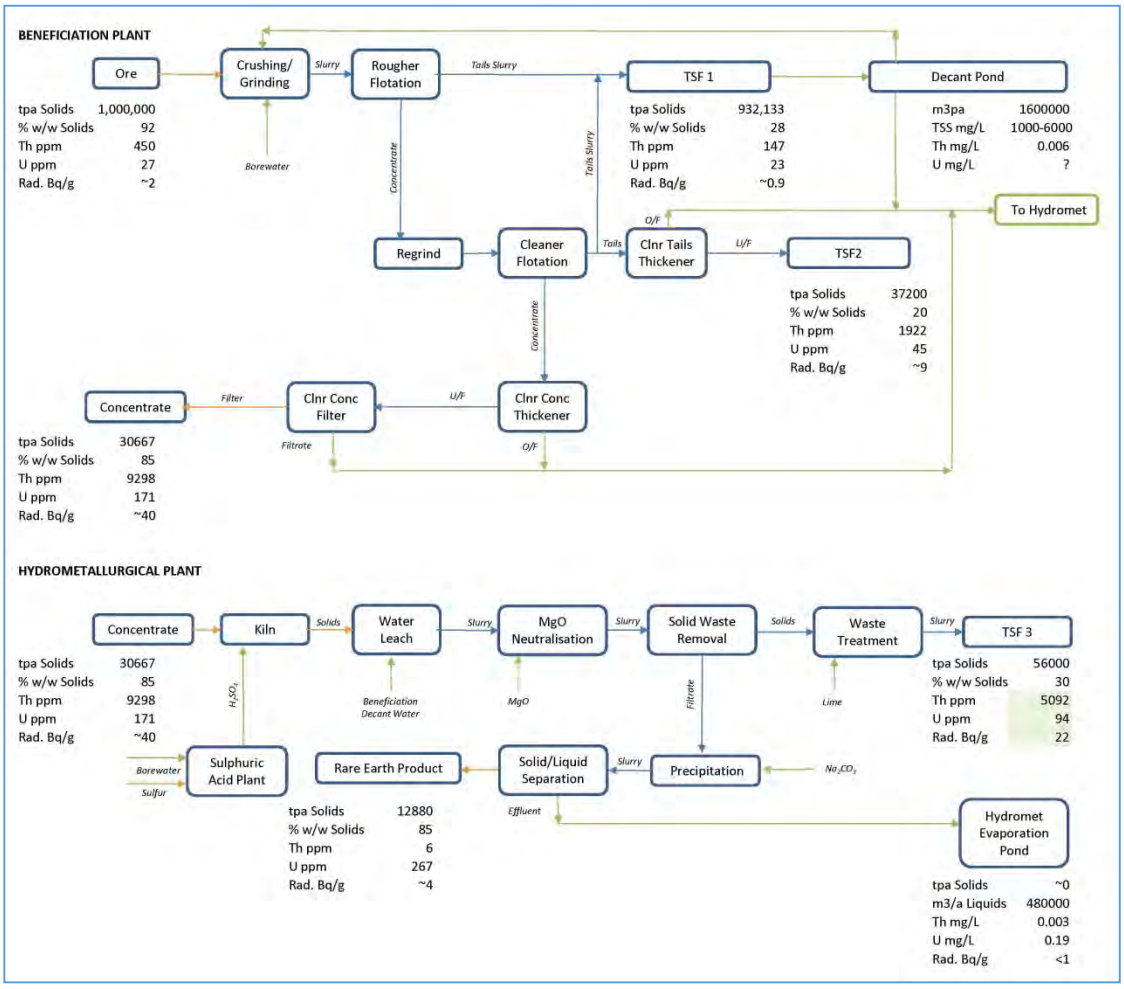
Three tailings streams are expected from the proposed processing route as follows:

- Rougher and Cleaner tailings from the beneficiation plant, and
- Tailings from the hydrometallurgical plant.

The tailings from the beneficiation plant rougher flotation cells are expected to comprise 93% of the slurried waste materials and are expected to be benign with relatively low levels of radioactive nuclides (approx. 1 Bq/g activity concentration). A large tailings storage facility (TSF 1) is proposed for storage of these materials, which will be thickened to a solids concentration of approximately 60% prior to discharge.

The tailing from the beneficiation plant cleaner flotation cells and the hydrometallurgical processing plant will comprise the remainder of the slurried waste materials and will contain concentrated levels of radionuclides. Two separate tailings storage facilities comprising HDPE lined paddock type facilities are proposed to store these materials (TSF 2 and TSF 3).

Figure 3: Proposed Processing Route Yangibana Project



2.7 Water Supply

Groundwater was encountered during exploration drilling, where the mineralised zone was found to be highly permeable forming a confined aquifer within the granitic host rocks. It is expected that the mine water supply will be sourced from dewatering of the orebody, supplemented by decant water return from the TSF and collection of wet season rainfall run-off. Additional water supply may be developed from compartmentalised sections of the mineralised zone along the strike of the orebody.

As part of the feasibility study, hydrogeological investigation has been undertaken at the Bald Hill, Frasers and Yangibana pit locations by Groundwater Resource Management (GRM).

3 GEOTECHNICAL FIELD INVESTIGATION

3.1 General

The locations of the boreholes were accessible using existing exploration roads/tracks. Most of the test pits were in locations without tracks/access. The excavator was used to clear paths to the locations. All clearing was undertaken under a DMP approved Program of Works.

The fieldwork and logging was carried out by an experienced ATCW Engineer who logged and sampled the test holes.

The test pit logs and photographs are presented in **Appendix A** and **Appendix B** respectively.

The borehole logs and core photographs for the TSF 1 site are presented in **Appendix C** and **Appendix D** respectively.

In-situ permeability testing data sheets from the boreholes are presented in **Appendix E**.

3.2 Tailing Storage Facility

The following field work was conducted at the proposed TSF site locations:

- Four (4) HQ diamond drill boreholes to depths between 11.0 m and 55.5 m bgl;
- One (1) RC dill hole to a depth of 66.0 m bgl (CTBH-2);
- Piezometer installation in the RC borehole to measure groundwater table depth and fluctuation;
- Six (6) down hole packer tests performed in boreholes CTBH-1 and CTBH-3;
- Six (6) falling head permeability tests to depths between 0.99 m and 6.6 m bgl.
- Forty (40) test pits excavated to depths between 0.35 m to 2.1 m bgl;

A summary of borehole and test pit information is presented in **Table 1**Error! Reference source not found. and **Table 2**Error! Reference source not found. respectively.

Table 1: TSF borehole details

Hole ID	Type	Proposed Infrastruc-ture	Easting MGA94	Northing MGA94	Dip	Depth (m) bgl	Date Start	Date Finish
CTBH1	Diamond Drill	TSF 1 -RWP	426,455	7,352,168	-90	40.5	27/10/16	28/10/16
CTBH2	Reverse Circulation	TSF 1	426,837	7,352,238	-90	66	6/11/16	7/11/16
CTBH3	Diamond Drill	TSF 1	427,497	7,352,254	-90	55.5	29/10/16	31/10/16
CTBH4	Diamond Drill	TSF 1	426,933	7,351,878	-90	11	1/11/16	1/11/16
CTBH5	Diamond Drill	TSF 1	427,005	7,352,740	-90	12.5	26/10/16	26/10/16

Table 2: TSF test pit details

Hole ID	Proposed Infrastructure	Depth (m) bgl	Easting MGA94	Northing MGA94	Equipment Used
CTTP-01	RWP	1.1	426,745	7,351,678	13 T Excavator
CTTP-02	RWP	1.4	426,770	7,351,944	13 T Excavator
CTTP-03	RWP	0.5	426,456	7,352,106	13 T Excavator
CTTP-04	RWP	0.45	426,541	7,352,232	13 T Excavator
CTTP-05	RWP	0.6	426,429	7,352,188	13 T Excavator
CTTP-06	RWP	0.5	426,481	7,352,294	13 T Excavator
CTTP-07A	RWP	0.45	426,556	7,352,388	13 T Excavator
CTTP-07B	RWP	0.4	426,558	7,352,400	13 T Excavator
CTTP-08	RWP	0.5	426,655	7,352,511	13 T Excavator
CTTP-09	RWP	1.8	426,780	7,352,644	13 T Excavator
CTTP-10	RWP	1	426,915	7,352,721	13 T Excavator
CTTP-11	RWP	0.5	426,737	7,352,424	13 T Excavator
CTTP-12	RWP	0.45	426,710	7,352,246	13 T Excavator
CTTP-13	TSF 1	0.4	426,939	7,352,559	13 T Excavator
CTTP-14	TSF 1	1.7	426,886	7,352,068	13 T Excavator
CTTP-15	TSF 1	0.45	427,119	7,352,277	13 T Excavator
CTTP-16	TSF 1	1.3	427,076	7,352,117	13 T Excavator
CTTP-17	TSF 1	0.5	427,327	7,352,439	13 T Excavator
CTTP-18	TSF 1	1.3	427,620	7,352,852	13 T Excavator
CTTP-19	TSF 1	1.7	427,728	7,352,493	13 T Excavator
CTTP-20	TSF 1	0.9	427,726	7,352,139	13 T Excavator
CTTP-21	TSF 1	2.1	427,827	7,351,945	13 T Excavator
CTTP-22	TSF2/TSF3	1	428,104	7,352,653	13 T Excavator
CTTP-23	TSF2/TSF3	1.9	428,359	7,352,657	13 T Excavator
CTTP-24	TSF2/TSF3	1.1	428,232	7,352,526	13 T Excavator
CTTP-25	TSF2/TSF3	1	428,078	7,352,398	13 T Excavator
CTTP-26	TSF2/TSF3	0.5	428,365	7,352,384	13 T Excavator
CTTP-27	TSF2/TSF3	1.5	428,214	7,352,236	13 T Excavator
CTTP-28	TSF2/TSF3	1.1	428,054	7,352,074	13 T Excavator
CTTP-29	TSF2/TSF3	0.55	428,365	7,352,074	13 T Excavator
CTTP-30	Evap Pond	1.6	428,519	7,352,823	13 T Excavator
CTTP-31	Evap Pond	0.35	428,872	7,352,890	13 T Excavator
CTTP-32	-	0.7	429,267	7,352,700	13 T Excavator
CTTP-33	Evap Pond	2	428,704	7,352,599	13 T Excavator
CTTP-34	Evap Pond	0.7	428,550	7,352,350	13 T Excavator
CTTP-35	Evap Pond	0.4	428,866	7,352,236	13 T Excavator
CTTP-36	Evap Pond	0.4	428,497	7,352,014	13 T Excavator
CTTP-37	Evap Pond	0.4	428,882	7,351,981	13 T Excavator
CTTP-38	RWP	1.1	426,615	7,351,938	13 T Excavator
CTTP-39	TSF 1	0.35	427,399	7,351,763	13 T Excavator

Drawing 002 shows the locations of the boreholes and test pits completed at the TSF sites.

4 LABORATORY TESTING

Following the fieldwork, select soil samples recovered from both the test pits and boreholes were submitted to a NATA accredited soils laboratory for a range of testing. Point load Index tests were completed by ATCW. The test samples were chosen to determine the design parameters of each material unit encountered at the site. **Table 3**Error! Reference source not found. summarises the types and quantities of tests undertaken.

Table 3: Laboratory Testing Program

Test	Standard Used	Test Output	Quantity
PSD: Sieve Only	AS 1289 3.6.1	PSD Chart	12
Atterberg Limits	AS 1289 3.3.2	PI, LL, PL	6
In-situ Moisture Content	AS 1289 2.1.1	% Moisture	8
Modified Compaction	AS 1289 5.2.1	Moisture density curve	4
Emerson test	AS1289 3.8.1	Dispersion numbers	2
CU triaxial 92% MMDD - Multi-Stage	AS 1289 6.4.2	Friction angle and cohesion	2
Point Load Index	AS4133.4.1	Point Load Index, Is_{50}	8

The soils laboratory test certificates are presented in **Appendix F**.

The results of point load tests on rock core are given in **Appendix G.**

5 RESULTS OF INVESTIGATION

5.1 Subsurface Conditions

5.1.1 Boreholes

Boreholes were drilled at the TSF 1 site to termination depths between 11 m and 66 m. Each borehole terminated in Granite rock.

Superficial soils were less than 1.15 m thick and comprised dense to very dense, finer to coarse clayey sand with gravel or very stiff, red brown, medium to high plasticity clay. Superficial soils were not encountered in CTBH-2.

Extremely to moderately weathered granite with low to medium strength was encountered beneath the shallow superficial soils to depths between 3.4 m and 9.5 m below which slightly weathered to fresh rock of high to very high strength was proven to the termination depths of the boreholes. The granite was generally pale grey and porphyrytic with minor black crystals of mafic minerals.

Joints in the rock mass were tight and rough with localised pale brown staining predominantly in the upper weathered zones. Joint spacing decreased significantly with depth in the slightly weathered and fresh rock mass.

5.1.2 Test Pits

Six types of soil /rock were encountered during the test pit investigation and are summarised in **Table 4**Error! Reference source not found.. The table also gives the depths to which the soil/rock was encountered. Descriptions of the soil types and rock are given below.

Silty Sand (SM)

Superficial dry silty sand was encountered between 0.0 m and 0.3 m bgl in CTTP-20 and CTTP-21. The soil was medium dense, fine and medium, pale brown/brown, with trace clay.

Clayey Sand (SC)

Fine to coarse or fine and medium clayey sand was encountered between 0.0 m and 2.1 m bgl in most test pits. The soil was generally red brown, with minor gravel content. In situ moisture condition varied from dry to moist. The material was generally dense to very dense.

The clayey sand was generally underlain by sandy gravel or weathered granite.

Sand (SP)

Pale brown, fine to coarse, medium dense sand with silt was encountered between 0.0 m and 0.6 m depth in three test pits (CTTP-07B, CTTP-32 and CTTP-34). The sand was dry, red brown or grey mottled red brown, with trace clay and rootlets.

The sand was underlain by slightly weathered granite.

Clayey Gravel (GC)

Clayey gravel was locally encountered between 0.0 m and 1.55 m bgl, typically below the clayey sand layer and underlain by sandy gravel / extremely weathered granite material. The soil was generally very dense, fine to coarse, red brown or grey brown with cobbles and variable moisture content.

Sandy Gravel (GWS)

Sandy gravel was encountered between 0.0 m and 1.9 m bgl in most of the test pits directly above highly weathered granite. The material was generally very dense, fine to coarse, pale brown and grey, purple brown or red brown, with clay, trace cobbles and dry.

Granite

All but two of the test pits encountered refusal on granite. The granite was generally highly to moderately weathered, grey and white with yellow brown or red brown discoloration and of low to medium strength. The rock mass was typically encountered between 0.3 m and 2.0 m bgl.

Table 4: Summary of Test Pit Subsurface Conditions

Hole ID	Proposed Infrastructure	SM	SC	SW	GC	GWS	Granite
CTTP-01	RWP		0.80			1.00	> 1.10
CTTP-02	RWP		0.50			0.50	> 1.40
CTTP-03	RWP		0.40				> 0.50
CTTP-04	RWP		0.35				> 0.45
CTTP-05	RWP		0.50				> 0.60
CTTP-06	RWP				0.30		> 0.50
CTTP-07A	RWP				0.30		> 0.45
CTTP-07B	RWP			0.30			> 0.40
CTTP-08	RWP				0.35		> 0.50
CTTP-09	RWP		1.30				> 1.80
CTTP-10	RWP		0.70				> 1.00
CTTP-11	RWP		0.20				> 0.50
CTTP-12	RWP					0.35	> 0.50
CTTP-13	TSF 1		0.30				> 0.40
CTTP-14	TSF 1		0.70			0.15	> 1.70
CTTP-15	TSF 1		0.30				> 0.45
CTTP-16	TSF 1		0.70			1.10	> 1.30
CTTP-17	TSF 1		0.35				> 0.50
CTTP-18	TSF 1		0.50		0.90		> 1.30
CTTP-19	TSF 1		0.70		1.55		> 1.70
CTTP-20	TSF 1	0.30	0.60				> 0.90
CTTP-21	TSF 1	0.10	2.10				
CTTP-22	TSF2/TSF3		0.40		0.90		> 1.00
CTTP-23	TSF2/TSF3		1.20			1.80	> 1.90
CTTP-24	TSF2/TSF3		1.10				
CTTP-25	TSF2/TSF3		0.40		0.90		> 1.00
CTTP-26	TSF2/TSF3					0.40	> 0.50
CTTP-27	TSF2/TSF3		1.40				> 1.50
CTTP-28	TSF2/TSF3		0.50		1.10		> 1.20
CTTP-29	TSF2/TSF3		0.50				> 0.55
CTTP-30	Evap Pond		0.70			1.40	> 1.60
CTTP-31	Evap Pond		0.30				> 0.35
CTTP-32	-		0.30	0.60			> 0.70
CTTP-33	Evap Pond		0.80		1.20	1.90	> 2.00
CTTP-34	Evap Pond			0.20		0.60	> 0.70
CTTP-35	Evap Pond		0.30				> 0.40
CTTP-36	Evap Pond		0.35				> 0.40
CTTP-37	Evap Pond		0.25				> 0.40
CTTP-38	RWP		0.50			0.80	> 1.10
CTTP-39	TSF 1		0.30				> 0.35

5.2 Groundwater

Groundwater was not encountered in any of the test pits. The majority of the boreholes drilled at the TSF site did not intersect groundwater, with the exception of CTBH-2 located at the proposed TSF 1 perimeter embankment where groundwater was intersected within the granite at a depth of 54.0 m during drilling.

The presence of perched groundwater was inferred adjacent to Fraser Creek in CTBH-01 at approximately 7.5 m depth, on the basis of three return water level monitoring visits, performed during a five day period after drilling. It is possible; however that this represents residual drilling fluid and further water level readings are required to assess this.

CTBH-2 was instrumented with a slotted standpipe and was subsequently sampled and tested for water quality. The water quality results are comparable to the water quality results obtained for Bald Hill pit and from eight local pastoral bores with slightly higher manganese levels and higher total suspended solids. For the analytes tested, water quality is generally comparable to that of drinking water (Australian Drinking Water Guidelines). The relevant test results are included in **Appendix F**.

To facilitate TSF design ATCW have conducted laboratory testing of flotation tailings generated during metallurgical testwork. The associated tailings decant water quality was also analysed and the results are provided in **Appendix F**.

Comparison of the results indicate that the decant water has slightly elevated Aluminium, Manganese and Zinc but at concentrations within the drinking water guideline criteria. Dissolved Iron and Molybdenum concentrations in the decant water are marginally above the drinking water guidelines. Calcium and magnesium concentrations in the tailings decant water were considerably lower than the CTBH-2 groundwater sample. Trace Thorium was present in the decant water (0.006 mg/l); however Uranium concentration was lower in the decant water than in most of the pastoral bores and CTBH-2.

5.3 In-situ Permeability Testing

In-situ measurements of permeability were recorded at the TSF site.

Permeability test data sheets for falling head and packer testing in the boreholes are presented in **Appendix E**.

Table 5 Error! Reference source not found. summarizes the falling head test results conducted at the TSF site.

Table 5: Falling head in-situ permeability tests results

Borehole ID	Proposed Infrastructure	Depth (m bgl)	Permeability, k (m/s)	Material
CTBH-01	RWP	0.00 m to 6.60 m	1.44×10^{-06}	HW Granite
CTBH-01	RWP	0.00 m to 1.50 m	1.19×10^{-07}	Clay / EW Granite
CTBH-02	TSF 1	0.00 m to 1.60 m	6.56×10^{-07}	EW/MW Granite
CTBH-02	TSF 1	0.00 m to 5.60 m	1.33×10^{-07}	EW/MW Granite
CTBH-03	TSF 1	0.00 m to 0.90 m	6.31×10^{-07}	Clay / Clayey Sand
CTBH-03	TSF 1	0.00 m to 6.55 m	7.91×10^{-08}	Clayey Sand / EW/MW Granite
CTBH-04	TSF 1	0.00 m to 10.7 m	1.12×10^{-06}	HW/SW Granite

CTBH-05	TSF 1	0.00 m to 11.85 m	1.65 x 10^{-06}	HW/SW Granite

The results of the in-situ packer testing performed in boreholes CTBH-01 & CTBH-03 are summarised below in **Table 6**. Permeability values have been interpreted from the Ludgeon test results.

Table 6: Packer Test Results

Borehole ID	Proposed Infrastructure	Test Type	Test Interval (m bgl)	Permeability, k (m/s)	Lugeon Value	Material
CTBH-01	RWP	Falling Head	9.1 – 21.5	1.01 x 10^{-07}	-	SW Granite
CTBH-01	RWP	Falling Head	22.6 – 36.5	2.55 x 10^{-07}	-	Fresh Granite
CTBH-01	RWP	Constant Head	22.6 – 36.5	3.73 x 10^{-06}	-	Fresh Granite
CTBH-03	TSF 1	Constant Head	9.5 – 21.5	3.49 x 10^{-06}	-	SW Granite
CTBH-03	TSF 1	Lugeon	9.5 – 55.5	3.95 x 10^{-08}	0.3	Fresh Granite
CTBH-03	TSF 1	Lugeon	26.6 – 39.2	6.38 x 10^{-09}	0.049	MW/SW Granite

5.4 Laboratory Test Results

5.4.1 Soil testing

The laboratory tests were undertaken by SGS Australia soil laboratory. The test certificates available at the time of writing are provided in **Appendix F**.

The results for classification tests are summarized in **Table 7**Error! Reference source not found..

Table 7: Laboratory Classification Test Results

Test pit ID	Proposed Infrastructure	Depth (m bgl)	PSD			Atterberg Limits				MC (%)	Emer-son Class No.	USCS
			Gravel (%)	Sand (%)	Fines (%)	LL	PL	PI	LS			
CTTP-01	RWP	0.5 - 0.8	16	64	20	38	22	16	7	7.8	-	SC
CTTP-03	RWP	0.1 - 0.4	15	51	17	-	-	-	-	9.8	-	SC
CTTP-07A	RWP	0.1 - 0.3	33	46	21	-	-	-	-	-	-	SC
CTTP-09	RWP	1 - 1.2	TBC	TBC	TBC	9.5	49	25	24	8.0	4	TBC
CTTP-16	TSF 1	0.4 - 0.6	12	55	33	TBC	TBC	TBC	TBC	6.8	-	SC
CTTP-18	TSF 1	0.6 - 0.8	26	42	32	59	27	32	14	12.2	-	SC
CTTP-19	TSF 1	1.2 - 1.4	37	46	17	-	-	-	-	8.0	-	SC
CTTP-21	TSF2/TSF3	1.5 - 1.7	26	51	23	-	-	-	-	8.0	-	SC
CTTP-24	TSF2/TSF3	0.8 - 1.1	21	53	26	36	18	18	11	-	-	SC
CTTP-27	TSF2/TSF3	0.8 - 1	53	36	11	TBC	TBC	TBC	TBC	5.4	TBC	GWS
CTTP-30	Evap Pond	0.5 - 0.7	18	60	22	-	-	-	-	-	-	SC

Test pit ID	Proposed Infrastructure	Depth (m bgl)	PSD			Atterberg Limits				MC (%)	Emer-son Class No.	USCS
			Gravel (%)	Sand (%)	Fines (%)	LL	PL	PI	LS			
CTTP-30	Evap Pond	1 - 1.2	44	47	9	-	-	-	-	-	-	SP

The modified compaction test results are presented in **Table 8**Error! Reference source not found..

Table 8: Modified Compaction test results

Test pit ID	Proposed Infrastructure	Depth	MMDD (t/m3)	OMC (%)	USCS
CTTP-03	RWP	0.1 - 0.4	TBC	TBC	SC
CTTP-19	TSF 1	1.2 - 1.4	TBC	TBC	SC
CTTP-21	TSF 1	1.5 - 1.7	TBC	TBC	SC
CTTP-27	TSF 2/TSF 3	0.8 - 1	TBC	TBC	GWS

Laboratory results for permeability and tri-axial testing are presented in **Table 9**.

Table 9: Laboratory Permeability and Tri-axial test results

Test pit ID	Proposed Infrastructure	Depth	Permeability (m/s)	Friction Angle (ϕ°)	Cohesion (KPa)
CTTP-03	RWP	0.1 - 0.4	TBC	TBC	TBC
CTTP-27	TSF 2/TSF 3	0.8 - 1	TBC	TBC	TBC

5.4.2 Rock strength testing

Point load testing was conducted on rock core samples by ATCW in accordance with AS 4133.4.1. **Table 10** summarises the test results.

Table 10: Point Load test results

Borehole ID	Proposed Infrastructure	Depth	I_s50 (MPa)	Strength Class (AS 1726-1993)
CTBH-01	RWP	2.80-3.00	3.25	VH
CTBH-01	RWP	5.00-5.25	0.76	M
CTBH-01	RWP	17.00-17.25	4.03	VH
CTBH-01	RWP	29.60-29.90	9.91	VH
CTBH-04	TSF 1	2.50-2.70	4.87	VH
CTBH-04	TSF 1	8.70-8.94	5.07	VH
CTBH-05	TSF 1	2.00-2.20	1.88	H
CTBH-05	TSF 1	8.50-8.65	4.45	VH

6 ANALYSIS, CONCLUSIONS AND RECOMENDATIONS

6.1 TSF sites

6.1.1 Site preparation and construction considerations

Prior to bulk earthworks and embankment construction, the impoundment and embankment footprint should be cleared, grubbed and stripped of topsoil. The topsoil should be stockpiled for subsequent use in rehabilitation of the TSF site infrastructure.

The TSF embankments will be constructed primarily from pre-strip mine waste rock materials with a low permeability upstream zone being formed from clayey materials excavated from the vicinity of TSF 1 and RWP. Foundation preparation will include excavation of a cut off trench through the superficial materials and backfilling with compacted clayey material to minimise potential for lateral seepage beneath embankments.

Excavation conditions in the vicinity of the TSF 1 and RWP are expected to be variable. The superficial clayey sand, clayey gravel and sandy gravel materials will excavate easily; but ripping may be required to excavate indurated near surface weathered granite material.

The in-situ moisture content of the clayey borrow materials is generally expected to be lower than optimum moisture content at the time of construction; consequently moisture conditioning by adding water during construction is anticipated to optimise compaction.

6.1.2 Foundations

Foundation conditions under the embankments are anticipated to comprise dense superficial soils and weathered rock at shallow depth. The rock mass is considered to have sufficient strength to support embankment loading without undue consolidation and settlement.

6.1.3 Embankment construction materials

In areas where surface granite was not present, clayey gravel and clayey sand materials typically less than 0.7 m thick were identified in the TSF 1 impoundment area and are considered suitable for low permeability construction material. Clayey/silty fines content typically ranged from 9% to 33%.

Potential sources of clayey sand materials were also identified in other areas as shown in **Drawing 003**. The depth of the material identified at test pit locations typically ranged between 1.5 m and 2.0 m bgl.

The clayey materials in the vicinity of the TSF have moderate dispersion potential, inhibited to some extent by the presence of calcium carbonate (Emerson class 4). Dispersion by erosion will be minimised by the rapid accumulation of tailings against the upstream face of the low permeability zone.

6.1.4 Seepage control measures

Detailed seepage analyses will be completed as part of the TSF design; however, the in situ permeability values obtained during the investigation provide an indication of relative seepage potential. Permeability values greater than 10^{-5} m/s indicate potential for rapid to moderate seepage, between 10^{-5} m/s and 10^{-7} m/s indicate potential for moderate to slow seepage and values less than 10^{-7} m/s indicate very low seepage potential.

Falling head in-situ permeability tests conducted in the TSF 1 area between 0.0 m and 11.9 m depth indicate relatively low permeability in the superficial soils and weathered rock (1.44×10^{-6} m/s to 7.91×10^{-8} m/s). In-situ permeability of between 3.73×10^{-6} m/s and 6.38×10^{-9} m/s was obtained from down borehole packer tests, performed in moderately to freshly weathered granite bedrock underlying the site.

TSF 1 will store inert tailings material with an expected activity concentration of less than 1 Bq/g and the decant water quality is expected to be similar to that of the groundwater. As groundwater is expected to lie at a depth of approximately 54 m and the material between the water table and the TSF predominantly comprises massive slightly weathered to fresh granite of very low permeability, vertical seepage rates will be very slow and it is unlikely that a hydraulic connection and fully saturated conditions between the decant water pond and groundwater will be established.

The tailings stored in TSF 2 and TSF 3 will have activity concentrations in excess of 1 Bq/g and will therefore require appropriate containment measures for long term storage. The design of these facilities will incorporate a composite liner on the upstream embankment faces and across the floor of the impoundment. The liner is likely to include a combination of HDPE, compacted clay and sand drainage layers as required to satisfy landform closure criteria.

The evaporation pond will store waste process water from the hydrometallurgy plant. Periodic transfer of decant water from TSF 2 and TSF 3 may be required to provide a continuous water cover during operation and the pond will have a similar composite liner.

Lateral seepage from TSF 2, TSF 3 and the evaporation pond will be minimised by the provision of a composite liner on the upstream embankment faces and also by provision of a cut off trench on the upstream side of the embankments. A cut off trench will also be incorporated beneath the TSF 1 and water storage pond perimeter embankments.

The design of TSF 1 allows for transfer of bleed water and incidental run off from the tailings surface to an external storage pond area, consequently a decant pond will not be maintained on the tailings surface. Decant recovery from the storage pond will limit the operational pond size. To reduce potential for vertical seepage following significant rainfall events, at least 300 mm of the clayey in-situ soils in the base of the pond impoundment area should be proof compacted during the initial TSF 1 construction stage.

7 CLOSURE

Your attention is drawn to the “Conditions of Investigation” which appear after the document history and status page of this report.

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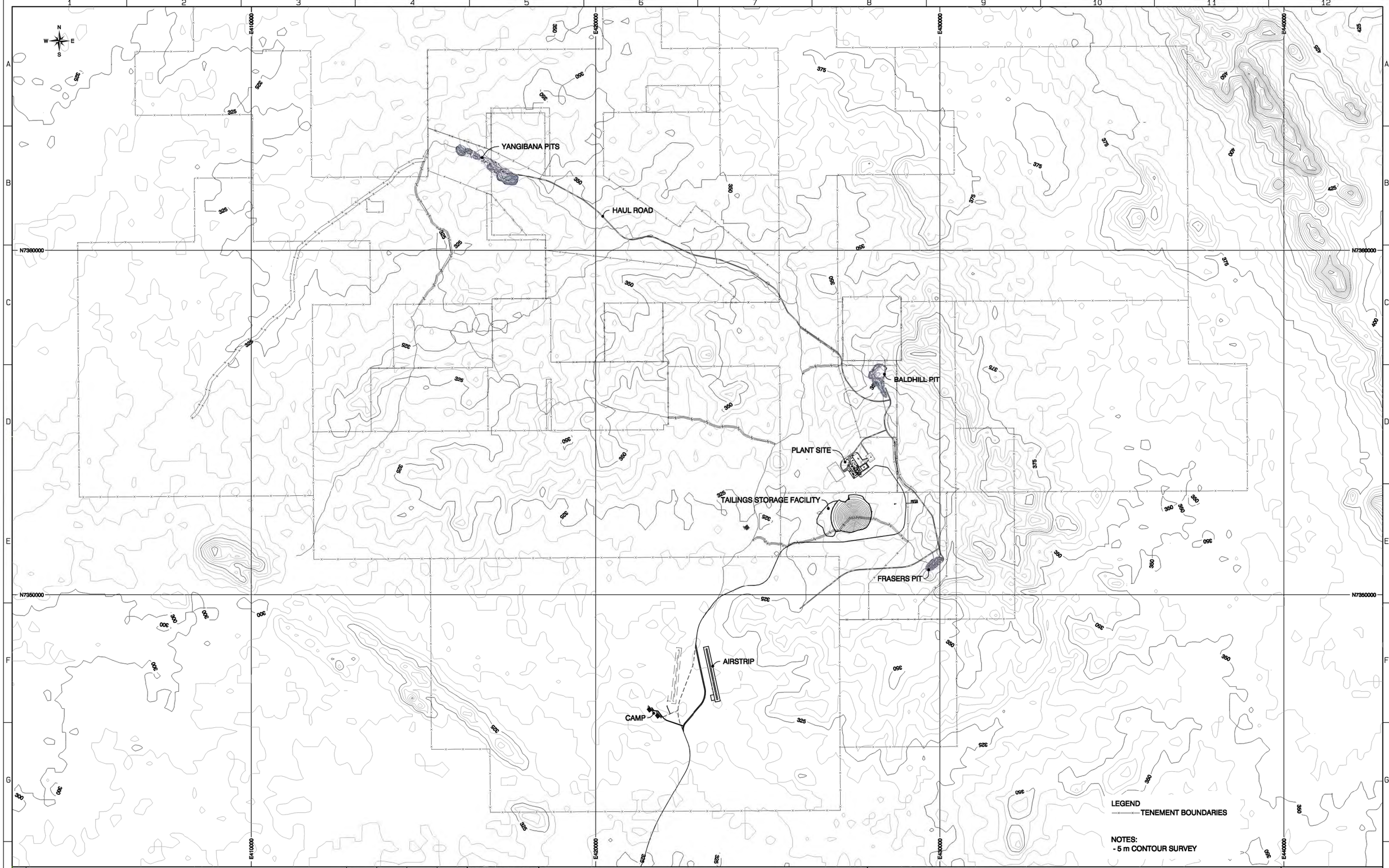
DRAWINGS



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HASTINGS TECHNOLOGY METALS LIMITED
YANGIBANA RARE EARTH PROJECT

GEOTECHNICAL INVESTIGATION
GENERAL SITE LAYOUT

DRAWING 1

CLIENT No.
CAD REF.
REV. A | SHT SIZE A3
SHEET 1 OF 1

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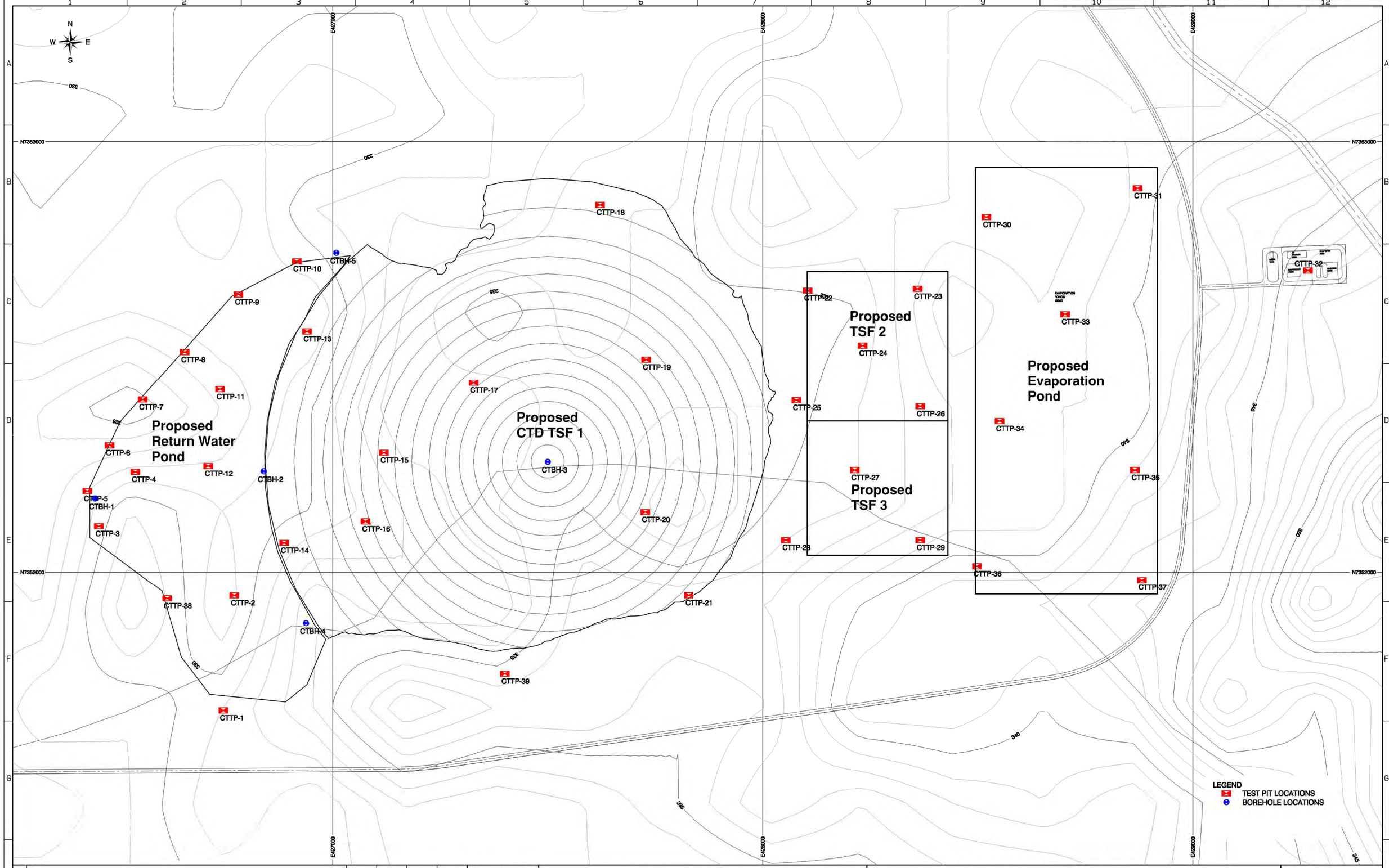

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HASTINGS TECHNOLOGY METALS LIMITED
YANGIBANA RARE EARTH PROJECT

GEOTECHNICAL INVESTIGATION
TSF BOREHOLE AND TEST PIT LOCATIONS

DRAWING 2

CLIENT No.

CAD REF.

REV. A | SHT SIZE A3

SHEET 1 OF 1

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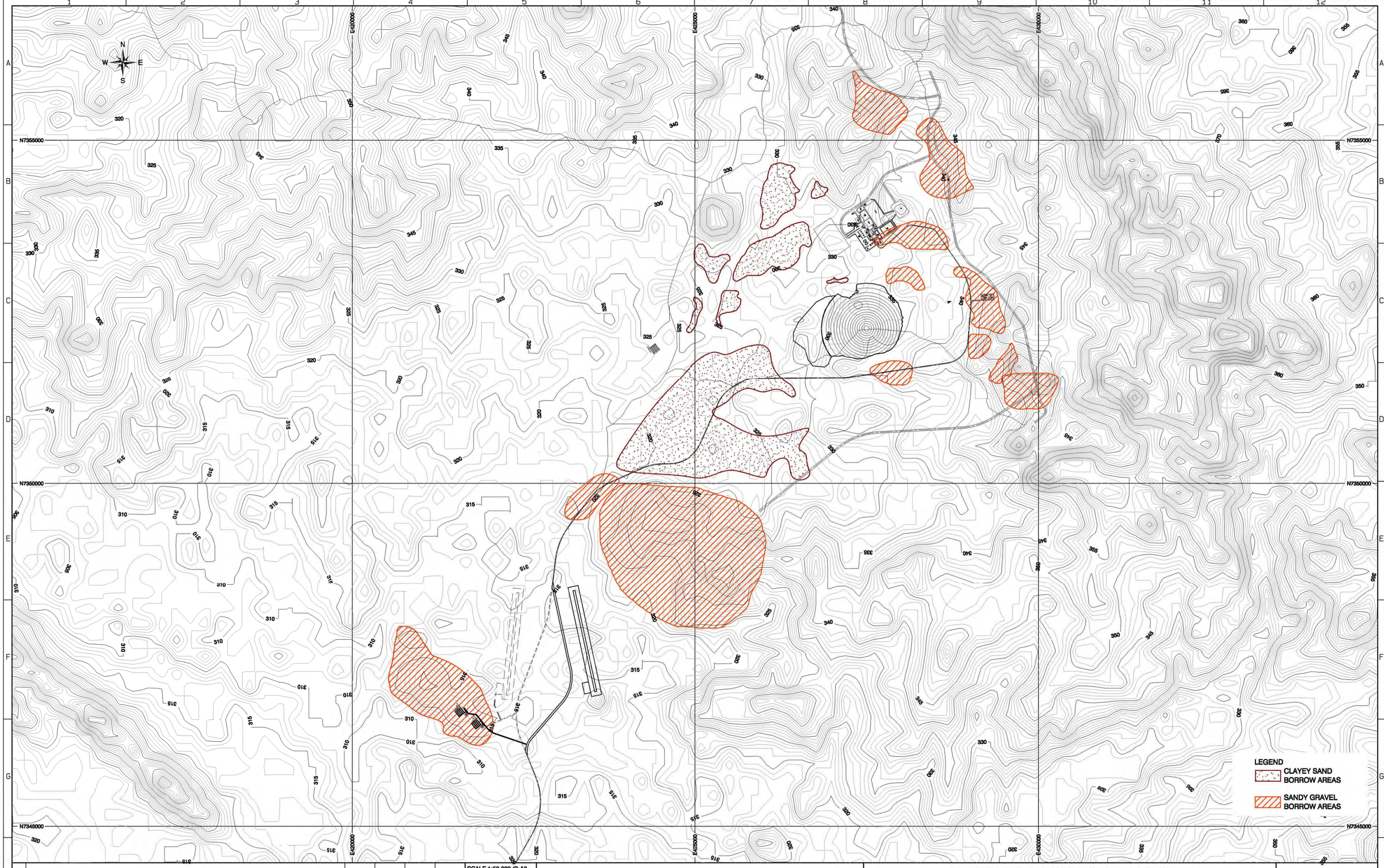

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YANGIBANA RARE EARTH PROJECT

GEOTECHNICAL INVESTIGATION
BORROW MATERIAL LOCATIONS

DRAWING 3

CLIENT No.
CAD REF.
REV. A
SHT SIZE A3
SHEET 1 OF 1

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APPENDICES

APPENDIX A

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FIGURE
TEST PIT NUMBER CTTP-01
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 426745E 7351678N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 4 8 12 16 20)
					SC	**CLAYEY SAND** fine to coarse, red brown, with gravel, moist			
			0.5				BS		
					GWS	**SANDY GRAVEL** fine to coarse, grey, with trace clay, moist			
			1.0			**GRANITE** Highly weathered to moderately weathered, grey and white, low to medium strength			
						Test pit CTTP-01 terminated at 1.1m			
			1.5						
			2.0						
			2.5						

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FIGURE
TEST PIT NUMBER CTTP-02
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 426770E 7351944N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 4 8 12 16 20)
			0.5		SC	**CLAYEY SAND** Dense to very dense, fine to coarse, red brown, with gravel, moist			
			1.0		GWS	**SANDY GRAVEL** Very dense, fine to coarse, red brown, with clay, moist			
						GRANITE Highly weathered, grey and white, very low to low strength			
			1.5			Test pit CTTP-02 terminated at 1.4m			
			2.0						
			2.5						

MPAW/ATC/ATCW BOREHOLE / TEST PIT TESTPIT LOGS.GPJ GINT AUSTRALIA.GDT 30/11/16

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FIGURE
TEST PIT NUMBER CTTP-03
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 426456E 7352106N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 5 10 15 20 25)
					SC	**CLAYEY SAND** Very dense, fine to coarse, red brown, with gravel, moist	BS		
			0.5			**GRANITE** Highly weathered to moderately weathered, grey and white, low to medium strength			
						Test pit CTTP-03 terminated at 0.5m			
			1.0						
			1.5						
			2.0						
			2.5						

MPAW/ATC/ATCW BOREHOLE / TEST PIT TESTPIT LOGS.GPJ GINT AUSTRALIA.GDT 30/11/16

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FIGURE
TEST PIT NUMBER CTTP-04
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 426541E 7352232N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 4 8 12 16 20)
					SC	**CLAYEY SAND** Very dense, fine to coarse, red brown, with gravel, dry			
						GRANITE Highly weathered to moderately weathered, grey and white, low to medium strength			
			0.5			Test pit CTTP-04 terminated at 0.45m			
			1.0						
			1.5						
			2.0						
			2.5						

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FIGURE
TEST PIT NUMBER CTTP-05
SHEET 1 OF 1

CLIENT Hastings Technology Metals

JOB NAME Yangibana Project

JOB NUMBER 112391.11

JOB LOCATION Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 426429E 7352188N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 4 8 12 16 20)
					SC	**CLAYEY SAND** Dense to very dense, fine to coarse, red brown, with gravel, moist			
			0.5			**GRANITE** Highly weathered to moderately weathered, grey and white, low to medium strength			
						Test pit CTTP-05 terminated at 0.6m			
			1.0						
			1.5						
			2.0						
			2.5						

MPAW/ATC/ATCW BOREHOLE / TEST PIT TESTPIT LOGS.GPJ GINT AUSTRALIA.GDT 30/11/16

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FIGURE
TEST PIT NUMBER CTTP-06
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 426481E 7352294N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 4 8 12 16 20)
					GC	**CLAYEY GRAVEL** Very dense, fine to coarse, red brown, with cobbles, moist			
			0.5			**GRANITE** Highly weathered to moderately weathered, grey brown, low to medium strength			
						Test pit CTTP-06 terminated at 0.5m			
			1.0						
			1.5						
			2.0						
			2.5						

MPAW/ATC/ATCW BOREHOLE / TEST PIT TESTPIT LOGS.GPJ GINT AUSTRALIA.GDT 30/11/16

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FIGURE
TEST PIT NUMBER CTTP-07A
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 426556E 7352388N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 5 10 15 20 25)
					GC	**CLAYEY GRAVEL** Very dense, fine to coarse, red brown, with cobbles, moist	BS		
						GRANITE Highly weathered to moderately weathered, grey brown with purple, low to medium strength			
			0.5			Test pit CTTP-07A terminated at 0.45m			
			1.0						
			1.5						
			2.0						
			2.5						

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DRAFT

FIGURE
TEST PIT NUMBER CTTP-07B
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 426558E 7352400N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 3 6 9 12 15)
					SW	**SAND** Medium dense to dense, fine to coarse, pale red brown, with silt, rounded cobbles, dry			
						GRANITE Highly weathered to moderately weathered, grey brown, low to medium strength			
			0.5			Test pit CTTP-07B terminated at 0.4m			
			1.0						
			1.5						
			2.0						
			2.5						

MPAW/ATC/ATCW BOREHOLE / TEST PIT TESTPIT LOGS.GPJ GINT AUSTRALIA.GDT 30/11/16

ATC Williams

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FIGURE
TEST PIT NUMBER CTTP-08
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 426655E 7352511N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 4 8 12 16 20)
					GC	**CLAYEY GRAVEL** Very dense, fine to coarse, red brown, with cobbles, moist			
			0.5			**GRANITE** Highly weathered to moderately weathered, grey and white, low to medium strength			
						Test pit CTTP-08 terminated at 0.5m			
			1.0						
			1.5						
			2.0						
			2.5						

MPAW/ATC/ATCW BOREHOLE / TEST PIT TESTPIT LOGS.GPJ GINT AUSTRALIA.GDT 30/11/16

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DRAFT

FIGURE
TEST PIT NUMBER CTTP-09
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 426780E 7352644N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 5 10 15 20 25)
			0.5		SC	**CLAYEY SAND** Very dense, fine to coarse, red brown, with gravel, trace cobbles, moist			
			1.0				BS		
			1.5			**GRANITE** Highly weathered, dark grey and white, very low strength			
			2.0			Test pit CTTP-09 terminated at 1.8m			
			2.5						

MPAW/ATC/ATCW BOREHOLE / TEST PIT TESTPIT LOGS.GPJ GINT AUSTRALIA.GDT 30/11/16

ATC Williams

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FIGURE
TEST PIT NUMBER CTTP-10
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 426915E 7352721N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 5 10 15 20 25)
			0.5		SC	**CLAYEY SAND** Very dense, fine to coarse, red brown, with gravel, dry	BS		
			1.0			**GRANITE** Highly weathered to moderately weathered, dark grey and white, low to medium strength			
			1.5			Test pit CTTP-10 terminated at 1m			
			2.0						
			2.5						

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FIGURE
TEST PIT NUMBER CTTP-11
SHEET 1 OF 1

CLIENT Hastings Technology Metals

JOB NAME Yangibana Project

JOB NUMBER 112391.11

JOB LOCATION Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 426737E 7352424N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 5 10 15 20 25)
					SC	**CLAYEY SAND** Very dense, fine to coarse, red brown, with gravel, moist			
						GRANITE Highly weathered to moderately weathered, grey and white, low to medium strength			
			0.5			Test pit CTTP-11 terminated at 0.5m			
			1.0						
			1.5						
			2.0						
			2.5						

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FIGURE
TEST PIT NUMBER CTTP-12
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 426710E 7352246N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 4 8 12 16 20)
					GWS	**SANDY GRAVEL** Dense to very dense, fine to coarse, red brown, with clay, moist			
						GRANITE Highly weathered to moderately weathered, grey and white, low to medium strength			
			0.5			Test pit CTTP-12 terminated at 0.45m			
			1.0						
			1.5						
			2.0						
			2.5						

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FIGURE
TEST PIT NUMBER CTTP-13
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 426939E 7352559N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 5 10 15 20 25)
					SC	**CLAYEY SAND** fine to coarse, red brown, with gravel, dry			
						GRANITE Highly weathered to moderately weathered, grey and white, low to medium strength			
			0.5			Test pit CTTP-13 terminated at 0.4m			
			1.0						
			1.5						
			2.0						
			2.5						

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FIGURE
TEST PIT NUMBER CTTP-14
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 426886E 7352068N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 4 8 12 16 20)
			0.5		SC	**CLAYEY SAND** Dense to very dense, fine to coarse, red brown, with gravel, moist			
			1.0		GWS	**SANDY GRAVEL** Very dense, fine to coarse, grey and white, moist			
			1.5			**GRANITE** Highly weathered, pale grey and white, very low to low strength			
			2.0			Test pit CTTP-14 terminated at 1.7m			
			2.5						

MPAW/ATC/ATCW BOREHOLE / TEST PIT TESTPIT LOGS.GPJ GINT AUSTRALIA.GDT 30/11/16

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FIGURE
TEST PIT NUMBER CTTP-15
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 427119E 7352277N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 4 8 12 16 20)
					SC	**CLAYEY SAND** Very dense, fine to coarse, red brown, with gravel, moist			
						GRANITE Highly weathered to moderately weathered, dark grey and white, low to medium strength			
			0.5			Test pit CTTP-15 terminated at 0.45m			
			1.0						
			1.5						
			2.0						
			2.5						

MPAW/ATC/ATCW BOREHOLE / TEST PIT TESTPIT LOGS.GPJ GINT AUSTRALIA.GDT 30/11/16

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FIGURE
TEST PIT NUMBER CTTP-16
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 427076E 7352117N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 5 10 15 20 25)
			0.5		SC	**CLAYEY SAND** Very dense, fine to coarse, red brown, with gravel, dry	BS		
			1.0		GWS	**SANDY GRAVEL** Very dense, fine to coarse, dark grey, with clay, dry			
						GRANITE Highly weathered, dark grey and white, low strength			
			1.5			Test pit CTTP-16 terminated at 1.3m			
			2.0						
			2.5						

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FIGURE
TEST PIT NUMBER CTTP-17
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 427327E 7352439N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 4 8 12 16 20)
					SC	**CLAYEY SAND** Very dense, fine to coarse, red brown, with gravel, moist			
			0.5			**GRANITE** Highly weathered to moderately weathered, grey and white, medium strength			
						Test pit CTTP-17 terminated at 0.5m			
			1.0						
			1.5						
			2.0						
			2.5						

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FIGURE
TEST PIT NUMBER CTTP-18
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 427620E 7352852N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 4 8 12 16 20)
			0.0		SC	**CLAYEY SAND** Dense to very dense, fine to coarse, red brown, with trace gravel, moist	BS		
			0.5		GC	**CLAYEY GRAVEL** Very dense, fine to coarse, red brown, moist	BS		
			1.0			**GRANITE** Highly weathered to moderately weathered, grey and white, low to medium strength			
			1.5			Test pit CTTP-18 terminated at 1.3m			
			2.0						
			2.5						

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FIGURE
TEST PIT NUMBER CTTP-19
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 427728E 7352493N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 5 10 15 20 25)
			0.5		SC	**CLAYEY SAND** Dense to very dense, fine to coarse, red brown, with trace gravel, moist			
			1.0		GC	**CLAYEY GRAVEL** Very dense, fine to coarse, pale brown, with trace cobbles, moist	BS		
			1.5			**GRANITE** Highly weathered to moderately weathered, grey and white, low to medium strength			
						Test pit CTTP-19 terminated at 1.7m			
			2.0						
			2.5						

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FIGURE
TEST PIT NUMBER CTTP-20
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 427726E 7352139N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 5 10 15 20 25)
					SM	**SILTY SAND** Dense, fine and medium, pale brown/brown, with clay, dry			
			0.5		SC	**CLAYEY SAND** Very dense, fine to coarse, red brown, with gravel, dry			
						GRANITE Highly weathered, dark grey white with yellow, low to medium strength			
			1.0			Test pit CTTP-20 terminated at 0.9m			
			1.5						
			2.0						
			2.5						

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FIGURE
TEST PIT NUMBER CTTP-21
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 427827E 7351945N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 5 10 15 20 25)
					SM	**SILTY SAND** Medium dense, fine and medium, pale brown, with clay, dry			
					SC	**CLAYEY SAND** Dense to very dense, fine to coarse, red brown, moist			
			0.5				BS		
						becomes pale brown, with trace gravels			
			1.0						
			1.5				BS		
			2.0						
						Test pit CTTP-21 terminated at 2.1m			
			2.5						

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FIGURE
TEST PIT NUMBER CTTP-22
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 428104E 7352653N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 5 10 15 20 25)
					SC	**CLAYEY SAND** Dense to very dense, fine to coarse, red brown, with gravel, moist			
			0.5		GC	**CLAYEY GRAVEL** Very dense, fine and medium, grey brown, moist			
			1.0			**GRANITE** Highly weathered, dark grey and red brown, low to medium strength			
						Test pit CTTP-22 terminated at 1m			
			1.5						
			2.0						
			2.5						

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FIGURE
TEST PIT NUMBER CTTP-23
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 428359E 7352657N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 5 10 15 20 25)
			0.5		SC	**CLAYEY SAND** Dense to very dense, fine to coarse, red brown, with gravel, dry	BS		
			1.0		GWS	**SANDY GRAVEL** Very dense, fine to coarse, white pale grey, with clay, trace cobbles, dry			
			1.5			**GRANITE** Highly weathered to moderately weathered, yellow brown grey and red, low to medium strength			
			2.0			Test pit CTTP-23 terminated at 1.9m			
			2.5						

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FIGURE
TEST PIT NUMBER CTTP-24
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 428232E 7352526N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 5 10 15 20 25)
			0.0		SC	**CLAYEY SAND** Dense to very dense, fine to coarse, red brown, with gravel, dry			
						becomes grey brown at 0.4 m			
			0.5						
			1.0				BS		
						Test pit CTTP-24 terminated at 1.1m			
			1.5						
			2.0						
			2.5						

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FIGURE
TEST PIT NUMBER CTTP-25
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 428078E 7352398N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 5 10 15 20 25)
					SC	**CLAYEY SAND** Dense to very dense, fine to coarse, red brown, with trace gravel, dry			
			0.5		GC	**CLAYEY GRAVEL** . Very dense, fine to coarse, red brown, with cobbles, dry			
			1.0			**GRANITE** Highly weathered to moderately weathered, white grey with pale red and thin red brown clay infill, low to medium strength Test pit CTTP-25 terminated at 1m			
			1.5						
			2.0						
			2.5						

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FIGURE
TEST PIT NUMBER CTTP-26
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 428365E 7352384N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 5 10 15 20 25)
					GWS	**SANDY GRAVEL** Very dense, fine to coarse, red brown, with cobbles, clay, moist			
			0.5			**GRANITE** Moderately weathered, grey and white, medium strength			
						Test pit CTTP-26 terminated at 0.5m			
			1.0						
			1.5						
			2.0						
			2.5						

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FIGURE
TEST PIT NUMBER CTTP-27
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 428214E 7352236N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 5 10 15 20 25)
			0.0		SC	**CLAYEY SAND** Dense to very dense, fine to coarse, red brown, with gravel, moist			
			0.5				BS		
						becomes dark grey with brown			
			1.0				BS		
			1.5			**GRANITE** Highly weathered, dark grey and white with red and yellow, low strength			
						Test pit CTTP-27 terminated at 1.5m			
			2.0						
			2.5						

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FIGURE
TEST PIT NUMBER CTTP-28
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 428054E 7352074N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 5 10 15 20 25)
			0.5		SC	**CLAYEY SAND** Dense to very dense, fine to coarse, red brown, with trace gravel, dry			
			1.0		GC	**CLAYEY GRAVEL** Very dense, fine to coarse, pale grey/brown, moist			
			1.5			**GRANITE** Highly weathered to moderately weathered, grey and white, low to medium strength Test pit CTTP-28 terminated at 1.1m			
			2.0						
			2.5						

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FIGURE
TEST PIT NUMBER CTTP-29
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 428365E 7352074N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 4 8 12 16 20)
			0.0		SC	**CLAYEY SAND** Dense to very dense, fine to coarse, red brown, with gravel, moist			
			0.5	+		**GRANITE** Moderately weathered, white pale grey, medium strength Test pit CTTP-29 terminated at 0.55m			
			1.0						
			1.5						
			2.0						
			2.5						

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FIGURE
TEST PIT NUMBER CTTP-30
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 428519E 7352823N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 5 10 15 20 25)
			0.5		SC	**CLAYEY SAND** Dense to very dense, fine to coarse, red brown, with gravel, moist	BS		
			1.0		GWS	**SANDY GRAVEL** Very dense, fine to coarse, pale brown/brown, with clay, trace cobbles, moist	BS		
			1.5			**GRANITE** Highly weathered, yellow brown grey with red brown, low to medium strength			
			2.0			Test pit CTTP-30 terminated at 1.6m			
			2.5						

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FIGURE
TEST PIT NUMBER CTTP-31
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 428872E 7352890N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 3 6 9 12 15)
					SC	**CLAYEY SAND** Dense to very dense, fine to coarse, red brown, with gravel, trace cobbles, moist			
				+		**GRANITE** Highly weathered to moderately weathered, grey and white with yellow brown, low to medium strength			
			0.5			Test pit CTTP-31 terminated at 0.35m			
			1.0						
			1.5						
			2.0						
			2.5						

ATC Williams

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FIGURE
TEST PIT NUMBER CTTP-32
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 429267E 7352700N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 4 8 12 16 20)
					SC	**CLAYEY SAND** Dense, fine to coarse, red brown, with gravel, dry			
			0.5		SW	**SAND** Dense to very dense, fine to coarse, grey and red brown, with clay, dry			
						GRANITE Highly weathered to moderately weathered, dark grey brown, low to medium strength			
						Test pit CTTP-32 terminated at 0.7m			
			1.0						
			1.5						
			2.0						
			2.5						

ATC Williams

DRAFT

FIGURE
TEST PIT NUMBER CTTP-33
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 428704E 7352599N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 5 10 15 20 25)
			0.5		SC	**CLAYEY SAND** Dense, fine to coarse, red brown, with gravel, dry			
			1.0		GC	**CLAYEY GRAVEL** Very dense, fine to coarse, red brown, dry			
			1.5		GWS	**SANDY GRAVEL** Very dense, fine to coarse, pale grey brown, with clay, cobbles, boulders, moist			
			2.0			**GRANITE** Highly weathered to moderately weathered, yellow brown red and grey, low to medium strength			
			2.5			Test pit CTTP-33 terminated at 2m			

ATC Williams

DRAFT

FIGURE
TEST PIT NUMBER CTTP-34
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 428550E 7352350N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 5 10 15 20 25)
					SW	**SAND** Dense, fine to coarse, red brown, with silt, clay, rootlets, dry			
					GWS	**SANDY GRAVEL** Very dense, fine to coarse, red brown and grey, with clay, cobbles and boulders, dry			
			0.5			**GRANITE** Highly weathered to moderately weathered, grey and white, medium strength			
						Test pit CTTP-34 terminated at 0.7m			
			1.0						
			1.5						
			2.0						
			2.5						

ATC Williams

DRAFT

FIGURE
TEST PIT NUMBER CTTP-35
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 428866E 7352236N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 4 8 12 16 20)
					SC	**CLAYEY SAND** Dense to very dense, fine to coarse, red brown, with gravel, dry			
						GRANITE Highly weathered to moderately weathered, grey and white, medium strength			
			0.5			Test pit CTTP-35 terminated at 0.4m			
			1.0						
			1.5						
			2.0						
			2.5						

ATC Williams

DRAFT

FIGURE
TEST PIT NUMBER CTTP-36
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 428497E 7352014N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 5 10 15 20 25)
					SC	**CLAYEY SAND** Very dense, fine to coarse, red brown, with gravel, dry			
				+		**GRANITE** Moderately weathered, white pale grey, medium strength			
			0.5			Test pit CTTP-36 terminated at 0.4m			
			1.0						
			1.5						
			2.0						
			2.5						

ATC Williams

DRAFT

FIGURE
TEST PIT NUMBER CTTP-37
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 428882E 7351981N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 4 8 12 16 20)
					SC	**CLAYEY SAND** Very dense, fine to coarse, red brown, with gravel, dry			
						GRANITE Moderately weathered, white pale grey, medium strength			
			0.5			Test pit CTTP-37 terminated at 0.4m			
			1.0						
			1.5						
			2.0						
			2.5						

ATC Williams

DRAFT

FIGURE
TEST PIT NUMBER CTTP-38
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 426615E 7351938N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 4 8 12 16 20)
			0.0		SC	**CLAYEY SAND** Dense to very dense, fine to coarse, red brown, with gravel, moist			
			0.5		GWS	**SANDY GRAVEL** Very dense, fine to coarse, dark grey and white, with clay, moist			
			1.0			**GRANITE** Highly weathered to moderately weathered, grey and white, low to medium strength			
						Test pit CTTP-38 terminated at 1.1m			
			1.5						
			2.0						
			2.5						

MPAW/ATC/ATCW BOREHOLE / TEST PIT TESTPIT LOGS.GPJ GINT AUSTRALIA.GDT 30/11/16

ATC Williams

DRAFT

FIGURE
TEST PIT NUMBER CTTP-39
SHEET 1 OF 1

CLIENT Hastings Technology Metals **JOB NAME** Yangibana Project

JOB NUMBER 112391.11 **JOB LOCATION** Gascoyne Region, Western Australia

DATE 8/11/16 **LOGGED BY** AP **CHECKED** JL **R.L. SURFACE** **DATUM**

EQUIPMENT 13 T Excavator **LOCATION** 427399E 7351763N

REMARKS Groundwater not encountered

Method	Water	RL (m)	Depth (m)	Graphic Log	Classification Symbol	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition	Sample Type	Sample condition	Dynamic Cone Penetrometer No. of blows for depth indicated by bar thickness (0 4 8 12 16 20)
					SC	**CLAYEY SAND** Very dense, fine to coarse, red brown, with gravel, dry			
				+		**GRANITE** Moderately weathered, grey, medium strength			
			0.5			Test pit CTTP-39 terminated at 0.35m			
			1.0						
			1.5						
			2.0						
			2.5						

MPAW/ATC/ATCW BOREHOLE / TEST PIT TESTPIT LOGS.GPJ GINT AUSTRALIA.GDT 30/11/16

APPENDIX B

CTTP-01

CTTP-02

CTTP-03

CTTP-04

CTTP-05

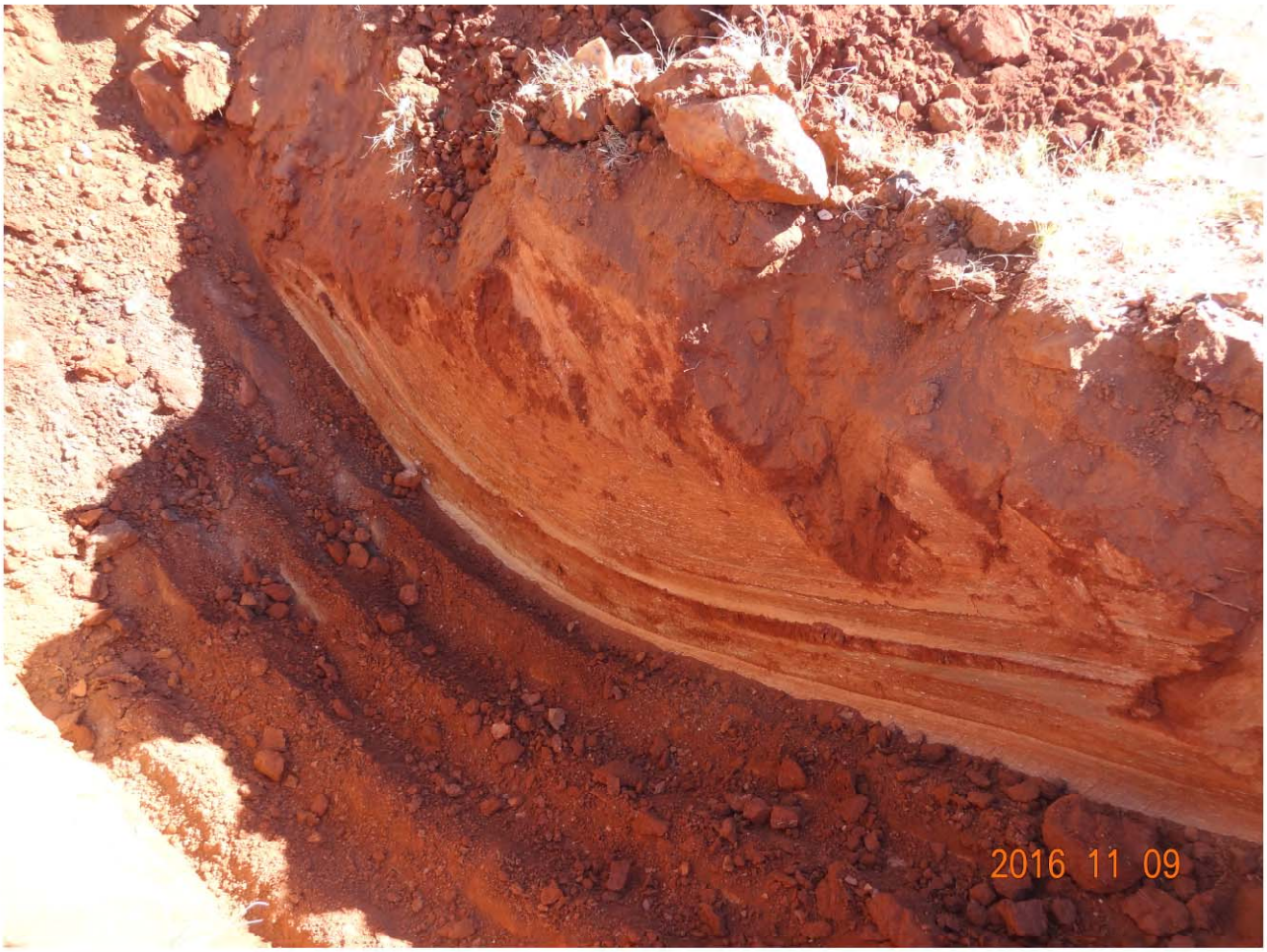
CTTP-06

CTTP-07A

CTTP-07B

CTTP-08

CTTP-09



CTTP-10

CTTP-11

CTTP-12

CTTP-13

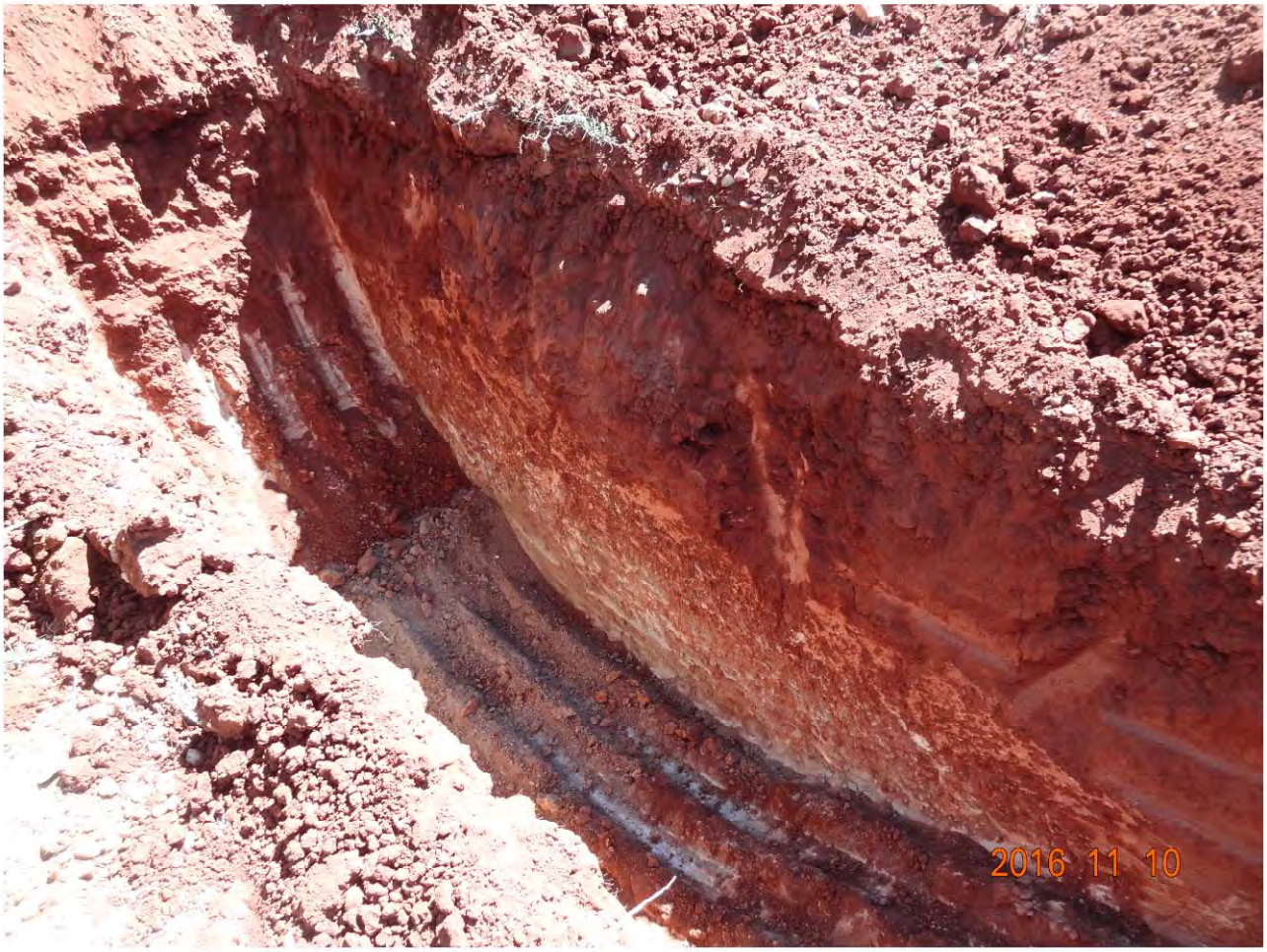
CTTP-14

CTTP-15

CTTP-16

CTTP-17

CTTP-18



CTTP-19

CTTP-20

CTTP-21

CTTP-22

CTTP-23

CTTP-24

CTTP-25

CTTP-26

CTTP-27

CTTP-28

CTTP-29

CTTP-30

CTTP-31

CTTP-32

CTTP-33

CTTP-34

CTTP-33

CTTP-36

CTTP-37

CTTP-38

CTTP-39

APPENDIX C

FIGURE
BOREHOLE NUMBER CTBH-1
SHEET 1 OF 5

ATC Williams

CLIENT Hastings Minerals
JOB NAME Yangibana Rare Earth Project
JOB NUMBER 112391.11
JOB LOCATION Gifford Creek Station WA

DATE STARTED 27/10/16 **COMPLETED**
R.L. SURFACE **DATUM**
LOCATION **INCLINATION** 90° **BEARING** ---
EQUIPMENT **LOGGED BY** CJ **CHECKED BY** JPL

REMARKS Diamond Drill Rig (HQ). Groundwater depth not observed (drilling fluid)

Method	Water	TCR %	RQD %	RL (m)	Depth (m)	Graphic Log	Material Description (Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition; Rock: type, weathering, colour, fabric, estimated strength, structure and bedding)	Weathering	Estimated Strength (EL VL L M H VH EH)	$Is_{(50)}$ MPa (D- diametral A- axial)	Defect Spacing mm (20 60 200 600 2000)	Defect Description
		66					**CLAY** Very stiff, red brown, fissured, with sand					
							GRANITE Extremely weathered, crumbley and weakly cemented, red brown and pale brown, massive	EW				
		92	26		1		**MEGA CRYSTALLINE GRANITE** Highly weathered, pale grey, pink and brown, massive coarse mineral texture, very low to low strength	HW				
					2		becoming moderately weathered, low to medium strength					
		100	60		3		becoming medium to very high strength			D 3.25		main joint set hoizontal to 30 degree dip, mostly planar or irregular with rough surface and minor staining
					4							subordinate joint set 60 - 80 degree dip, undulate or planar with surface staining
							4.33 m - 4.7 m fracture zone	HW/MW				
		100	72		5					D 0.76		
					6							
					7							
		100	83		8		**MEGA CRYSTALLINE GRANITE** Moderately weathered, pale pink and grey, massive coarse mineral texture, medium to very high strength	SW				
					9							
		100	41		10							

MPAW/ATC CORED BOREHOLE YANGIBANA BOREHOLES.GPJ GINT AUSTRALIA.GDT 19/1/17

FIGURE
BOREHOLE NUMBER CTBH-1
SHEET 2 OF 5

ATC Williams

CLIENT Hastings Minerals
JOB NAME Yangibana Rare Earth Project
JOB NUMBER 112391.11
JOB LOCATION Gifford Creek Station WA

DATE STARTED 27/10/16 **COMPLETED**
R.L. SURFACE **DATUM**
LOCATION **INCLINATION** 90° **BEARING** ---
EQUIPMENT **LOGGED BY** CJ **CHECKED BY** JPL

REMARKS Diamond Drill Rig (HQ). Groundwater depth not observed (drilling fluid)

Method	Water	TCR %	RQD %	RL (m)	Depth (m)	Graphic Log	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition. Rock: type, weathering, colour, fabric, estimated strength, structure and bedding	Weathering	Estimated Strength (EL VL L M H VH EH)	$Is_{(50)}$ MPa (D- diametral A- axial)	Defect Spacing mm (20 60 200 600 2000)	Defect Description
		100	41		11							
					12							11.87 m joint 75 deree dip, planar, rough with surface staining
		100	81		13							
					14							
					15			SW				joint surfaces predominantly irregular, rough with oxide staining
		100	57		16							
					17					D 4.03		
					18							17.93 m - 18.91 m fractured zone 30 mm - 80 mm joint spacings
		100	55		19							
					20							

FIGURE
BOREHOLE NUMBER CTBH-1
SHEET 3 OF 5

ATC Williams

CLIENT Hastings Minerals
JOB NAME Yangibana Rare Earth Project
JOB NUMBER 112391.11
JOB LOCATION Gifford Creek Station WA

DATE STARTED 27/10/16 **COMPLETED**
R.L. SURFACE **DATUM**
LOCATION **INCLINATION** 90° **BEARING** ---
EQUIPMENT **LOGGED BY** CJ **CHECKED BY** JPL

REMARKS Diamond Drill Rig (HQ). Groundwater depth not observed (drilling fluid)

Method	Water	TCR %	RQD %	RL (m)	Depth (m)	Graphic Log	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition. Rock: type, weathering, colour, fabric, estimated strength, structure and bedding	Weathering	Estimated Strength (EL VL L M H VH EH)	$Is_{(50)}$ MPa (D- diametral A- axial)	Defect Spacing mm (20 60 200 600 2000)	Defect Description
		100	55		21			SW				
		100	71		22							
		100	75		23		**MEGA CRYSTALLINE GRANITE** Freshly weathered, grey white and pale pink, very high to extremely high strength	FR				
		100	68		24							
		100	100		25							
		100	89		26							
					27							27.0 - 29.3 m no fractures in core run (drilling only)
					28							
					29					D 9.91		
					30							

FIGURE
BOREHOLE NUMBER CTBH-1
SHEET 4 OF 5

ATC Williams

CLIENT Hastings Minerals
JOB NAME Yangibana Rare Earth Project
JOB NUMBER 112391.11
JOB LOCATION Gifford Creek Station WA

DATE STARTED 27/10/16 **COMPLETED**
R.L. SURFACE **DATUM**
LOCATION **INCLINATION** 90° **BEARING** ---
EQUIPMENT **LOGGED BY** CJ **CHECKED BY** JPL

REMARKS Diamond Drill Rig (HQ). Groundwater depth not observed (drilling fluid)

Method	Water	TCR %	RQD %	RL (m)	Depth (m)	Graphic Log	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition. Rock: type, weathering, colour, fabric, estimated strength, structure and bedding	Weathering	Estimated Strength (EL VL L M H VH EH)	$Is_{(50)}$ MPa (D- diametral A- axial)	Defect Spacing mm (20 60 200 600 2000)	Defect Description
		100	89		31							
					32							32.22 m joint 70 degree dip, undulate, rough, clean
					33							
		100	96		34		34.4 m - 34.65 m viens, 65 - 80 degree dip					
					35			FR				
		100	100		36							35.5 m - 36.5 m no fractures in core run (drilling only)
					37							
		100	97		38							38.25 m joint, irregular, rough, tight and clean
					39							
		100	100		40							39.5 m - 40.5 m no fractures in core run (drilling only)

FIGURE
BOREHOLE NUMBER CTBH-1
SHEET 5 OF 5

ATC Williams

CLIENT Hastings Minerals
JOB NAME Yangibana Rare Earth Project
JOB NUMBER 112391.11
JOB LOCATION Gifford Creek Station WA

DATE STARTED 27/10/16 **COMPLETED**
R.L. SURFACE **DATUM**
LOCATION **INCLINATION** 90° **BEARING** ---
EQUIPMENT **LOGGED BY** CJ **CHECKED BY** JPL

REMARKS Diamond Drill Rig (HQ). Groundwater depth not observed (drilling fluid)

Method	Water	TCR %	RQD %	RL (m)	Depth (m)	Graphic Log	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition. Rock: type, weathering, colour, fabric, estimated strength, structure and bedding	Weathering	Estimated Strength (EL VL L M H VH EH)	$Is_{(50)}$ MPa (D- diametral A- axial)	Defect Spacing mm (20 60 200 600 2000)	Defect Description
		100	100					FR				
							CTBH-1 terminated at 40.5m					

41 42 43 44 45 46 47 48 49 50

MPAW/ATC CORED BOREHOLE YANGIBANA BOREHOLES.GPJ GINT AUSTRALIA.GDT 19/1/17

FIGURE
BOREHOLE NUMBER CTBH-2
SHEET 1 OF 7

ATC Williams

CLIENT Hastings Minerals
JOB NAME Yangibana Rare Earth Project
JOB NUMBER 112391.11
JOB LOCATION Gifford Creek Station WA

DATE STARTED 7/11/16 **COMPLETED**
R.L. SURFACE **DATUM**
LOCATION **INCLINATION** 90° **BEARING** ---
EQUIPMENT **LOGGED BY** KF **CHECKED BY** JPL

REMARKS RC Rig (air flush). Groundwater strike at 54 m depth whilst drilling.

Method	Water	TCR %	RQD %	RL (m)	Depth (m)	Graphic Log	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition. Rock: type, weathering, colour, fabric, estimated strength, structure and bedding	Weathering	Estimated Strength (EL VL L M H VH EH)	$Is_{(50)}$ MPa (D- diametral A- axial)	Defect Spacing mm (20 60 200 600 2000)	Defect Description
					1		**GRANITE/SHEARED GRANITE** Extremely / moderately weathered, dark grey and brown					
					2							
					3							
					4		**MEGA CRYSTALLINE GRANITE** Extremely / moderately weathered, grey					
					5							
					6							
					7		**GRANITE/SHEARED GRANITE** Moderately weathered to fresh, dark grey					
					8							
					9							
					10							

ATC Williams

FIGURE
BOREHOLE NUMBER CTBH-2
SHEET 2 OF 7

CLIENT Hastings Minerals
JOB NAME Yangibana Rare Earth Project
JOB NUMBER 112391.11
JOB LOCATION Gifford Creek Station WA

DATE STARTED 7/11/16 **COMPLETED**
R.L. SURFACE
DATUM
LOCATION
INCLINATION 90°
BEARING ---
EQUIPMENT
LOGGED BY KF
CHECKED BY JPL

REMARKS RC Rig (air flush). Groundwater strike at 54 m depth whilst drilling.

Method	Water	TCR %	RQD %	RL (m)	Depth (m)	Graphic Log	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition. Rock: type, weathering, colour, fabric, estimated strength, structure and bedding	Weathering	Estimated Strength: EL VL L M H VH EH	$Is_{(50)}$ MPa: D- diametral A- axial	Defect Spacing mm: 20 60 200 600 2000	Defect Description
					11							
					12		**MEGA CRYSTALLINE GRANITE** Moderately weathered / fresh, grey					
					13							
					14							
					15							
					16		**GRANITE/SHEARED GRANITE** Moderately weathered to fresh, dark grey					
					17							
					18							
					19							
					20							

ATC Williams

FIGURE
BOREHOLE NUMBER CTBH-2
SHEET 3 OF 7

CLIENT Hastings Minerals

JOB NAME Yangibana Rare Earth Project

JOB NUMBER 112391.11

JOB LOCATION Gifford Creek Station WA

DATE STARTED 7/11/16 **COMPLETED**

R.L. SURFACE

DATUM

LOCATION

INCLINATION 90°

BEARING ---

EQUIPMENT

LOGGED BY KF

CHECKED BY JPL

REMARKS RC Rig (air flush). Groundwater strike at 54 m depth whilst drilling.

Method	Water	TCR %	RQD %	RL (m)	Depth (m)	Graphic Log	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition. Rock: type, weathering, colour, fabric, estimated strength, structure and bedding	Weathering	Estimated Strength: EL VL L M H VH EH	$Is_{(50)}$ MPa: D- diametral A- axial	Defect Spacing mm: 20 60 200 600 2000	Defect Description
					21							
					22							
							MEGA CRYSTALLINE GRANITE Moderately weathered /fresh, grey					
					23							
							GRANITE/SHEARED GRANITE Slight weathered to fresh, dark grey					
					24							
					25							
					26							
					27							
					28							
					29							
					30							

ATC Williams

FIGURE
BOREHOLE NUMBER CTBH-2
SHEET 4 OF 7

CLIENT Hastings Minerals
JOB NAME Yangibana Rare Earth Project
JOB NUMBER 112391.11
JOB LOCATION Gifford Creek Station WA

DATE STARTED 7/11/16 **COMPLETED**
R.L. SURFACE **DATUM**
LOCATION **INCLINATION** 90° **BEARING** ---
EQUIPMENT **LOGGED BY** KF **CHECKED BY** JPL

REMARKS RC Rig (air flush). Groundwater strike at 54 m depth whilst drilling.

Method	Water	TCR %	RQD %	RL (m)	Depth (m)	Graphic Log	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition. Rock: type, weathering, colour, fabric, estimated strength, structure and bedding	Weathering	Estimated Strength: EL VL L M H VH EH	$Is_{(50)}$ MPa: D- diametral A- axial	Defect Spacing mm: 20 60 200 600 2000	Defect Description
					31							
					32							
					33							
					34							
					35							
					36							
					37							
					38							
					39							
					40							

ATC Williams

FIGURE
BOREHOLE NUMBER CTBH-2

CLIENT Hastings Minerals

JOB NAME Yangibana Rare Earth Project

JOB NUMBER 112391.11

JOB LOCATION Gifford Creek Station WA

DATE STARTED 7/11/16 **COMPLETED**

R.L. SURFACE

DATUM

LOCATION

INCLINATION 90°

BEARING ---

EQUIPMENT

LOGGED BY KF

CHECKED BY JPL

REMARKS RC Rig (air flush). Groundwater strike at 54 m depth whilst drilling.

Method	Water	TCR %	RQD %	RL (m)	Depth (m)	Graphic Log	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition. Rock: type, weathering, colour, fabric, estimated strength, structure and bedding	Weathering	Estimated Strength: EL VL L M H VH EH	$Is_{(50)}$ MPa: D- diametral A- axial	Defect Spacing mm: 20 60 200 600 2000	Defect Description
					41							
					42							
					43							
					44							
					45							
					46							
					47							
					48							
					49							
					50							

ATC Williams

FIGURE
BOREHOLE NUMBER CTBH-2
SHEET 6 OF 7

CLIENT Hastings Minerals
JOB NAME Yangibana Rare Earth Project
JOB NUMBER 112391.11
JOB LOCATION Gifford Creek Station WA

DATE STARTED 7/11/16 **COMPLETED**
R.L. SURFACE **DATUM**
LOCATION **INCLINATION** 90° **BEARING** ---
EQUIPMENT **LOGGED BY** KF **CHECKED BY** JPL

REMARKS RC Rig (air flush). Groundwater strike at 54 m depth whilst drilling.

Method	Water	TCR %	RQD %	RL (m)	Depth (m)	Graphic Log	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition. Rock: type, weathering, colour, fabric, estimated strength, structure and bedding	Weathering	Estimated Strength (EL VL L M H VH EH)	$Is_{(50)}$ MPa (D- diametral A- axial)	Defect Spacing mm (20 60 200 600 2000)	Defect Description
	▼				51							
					52							
					53							
					54							
					55							
					56		**MEGA CRYSTALLINE GRANITE** Slightly weathered /fresh, dark grey					
					57							
					58							
					59							
					60							

FIGURE
BOREHOLE NUMBER CTBH-2
SHEET 7 OF 7

ATC Williams

CLIENT Hastings Minerals
JOB NAME Yangibana Rare Earth Project
JOB NUMBER 112391.11
JOB LOCATION Gifford Creek Station WA

DATE STARTED 7/11/16 **COMPLETED**
R.L. SURFACE **DATUM**
LOCATION **INCLINATION** 90° **BEARING** ---
EQUIPMENT **LOGGED BY** KF **CHECKED BY** JPL

REMARKS RC Rig (air flush). Groundwater strike at 54 m depth whilst drilling.

Method	Water	TCR %	RQD %	RL (m)	Depth (m)	Graphic Log	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition. Rock: type, weathering, colour, fabric, estimated strength, structure and bedding	Weathering	Estimated Strength: EL VL L M H VH EH	$Is_{(50)}$ MPa: D- diametral A- axial	Defect Spacing mm: 20 60 200 600 2000	Defect Description
					61							
					62							
					63							
					64							
					65							
					66							
							CTBH-2 terminated at 66m					
					67							
					68							
					69							
					70							

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FIGURE
BOREHOLE NUMBER CTBH-3
SHEET 1 OF 6

CLIENT Hastings Minerals

JOB NAME Yangibana Rare Earth Project

JOB NUMBER 112391.11

JOB LOCATION Gifford Creek Station WA

DATE STARTED 29/10/16 **COMPLETED**

R.L. SURFACE

DATUM

LOCATION

INCLINATION 90°

BEARING ---

EQUIPMENT

LOGGED BY CJ

CHECKED BY JPL

REMARKS Diamond Drill Rig (HQ). Groundwater depth not observed (drilling fluid)

Method	Water	TCR %	RQD %	RL (m)	Depth (m)	Graphic Log	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition. Rock: type, weathering, colour, fabric, estimated strength, structure and bedding	Weathering	Estimated Strength (EL VL L M H VH EH)	$Is_{(50)}$ MPa (D- diametral A- axial)	Defect Spacing mm (20 60 200 600 2000)	Defect Description
		75	0		0		**CLAY** Very stiff, medium to high plasticity, red brown, with sand					
					1		**CLAYEY SAND** Dense and weakly cemented, pale red brown, fine to coarse sand trace gravel					
		86	0				**CLAYEY SAND (EXTREMELY WEATHERED GRANITE)** Very dense / dense, green grey and pale grey and black, with gravel	EW				
					2		**MEGA GRANITE** Highly weathered, dark green grey and black, massive, very low to medium strength.	HW				
		100	56		3		**GRANITE** Moderately weathered, dark green grey and pale grey, massive, low to medium strength					joint surfaces predominantly irregular, planar and rough with staining and no infill.
		100	58		4		3.5 m becoming dark grey					
		100	82		5			MW				
					6		5.5 m with irregular foliations					
		94	16		7		7.0 m - 8.1 m highly weathered, grey and green grey, very low / medium strength					
					8		7.38 m - 8.1 m highly weathered, miceaceous rubbley core	HW				7.38 m - 8.1 m highly fractured zone
		100	92		9		**SHEARED GRANITE** Moderately weathered to slightly weathered, dark green grey, white and black, massive, low to medium strength	MW				9.36 m joint 40 degree dip, planar, clay infill
		100	92		10		9.5 m slightly weathered	SW				

MPAW/ATC CORED BOREHOLE YANGIBANA BOREHOLES.GPJ GINT AUSTRALIA.GDT 19/1/17

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FIGURE
BOREHOLE NUMBER CTBH-3
SHEET 2 OF 6

CLIENT Hastings Minerals
JOB NAME Yangibana Rare Earth Project
JOB NUMBER 112391.11
JOB LOCATION Gifford Creek Station WA

DATE STARTED 29/10/16 **COMPLETED**
R.L. SURFACE **DATUM**
LOCATION **INCLINATION** 90° **BEARING** ---
EQUIPMENT **LOGGED BY** CJ **CHECKED BY** JPL

REMARKS Diamond Drill Rig (HQ). Groundwater depth not observed (drilling fluid)

Method	Water	TCR %	RQD %	RL (m)	Depth (m)	Graphic Log	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition. Rock: type, weathering, colour, fabric, estimated strength, structure and bedding	Weathering	Estimated Strength (EL VL L M H VH EH)	$Is_{(50)}$ MPa D- diametral A- axial	Defect Spacing mm (20 60 200 600 2000)	Defect Description
		100	92		11							
					12			SW				
					13		13.1 m dark green grey and white, medium to very high strength					
		100	65		14							
							14.6 m moderately weathered, dark green grey and pale grey,					14.65 m joint 75 degree dip, planar, rough tight
					15			MW/HW				
		100	67		16		15.67 m - 15.80 m modeterately to highly weathered zone					
							becoming slightly to moderately weathered					
					17							
					18			SW/MW				
		100	57		19							
					20							

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FIGURE
BOREHOLE NUMBER CTBH-3
SHEET 3 OF 6

CLIENT Hastings Minerals

JOB NAME Yangibana Rare Earth Project

JOB NUMBER 112391.11

JOB LOCATION Gifford Creek Station WA

DATE STARTED 29/10/16 **COMPLETED**

R.L. SURFACE

DATUM

LOCATION

INCLINATION 90°

BEARING ---

EQUIPMENT

LOGGED BY CJ

CHECKED BY JPL

REMARKS Diamond Drill Rig (HQ). Groundwater depth not observed (drilling fluid)

Method	Water	TCR %	RQD %	RL (m)	Depth (m)	Graphic Log	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition. Rock: type, weathering, colour, fabric, estimated strength, structure and bedding	Weathering	Estimated Strength (EL VL L M H VH EH)	$Is_{(50)}$ MPa (D- diametral A- axial)	Defect Spacing mm (20 60 200 600 2000)	Defect Description
		100	57		21			SW/MW				21.25 - 21.5 m three subhorizontal fractures, irregular, rough
		100	59		22							22.55 m - 22.7 m highly fractured zone, clay infill in joints
		100	76		23		**MEGA GRANITE** Slightly weathered / fresh, pale grey and dark grey and pink crystaline texture, massive, very high to extremely high strength.	SW				
					24		becoming freshly weathered					
		100	95		25							Joints predominantly clean, rough undulating or planar with low dip (0 - 20 degrees).
					26							
					27			FR				
		100	100		28							
					29							
					30							

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DRAFT

FIGURE
BOREHOLE NUMBER CTBH-3
SHEET 4 OF 6

CLIENT Hastings Minerals

JOB NAME Yangibana Rare Earth Project

JOB NUMBER 112391.11

JOB LOCATION Gifford Creek Station WA

DATE STARTED 29/10/16 **COMPLETED**

R.L. SURFACE

DATUM

LOCATION

INCLINATION 90°

BEARING ---

EQUIPMENT

LOGGED BY CJ

CHECKED BY JPL

REMARKS Diamond Drill Rig (HQ). Groundwater depth not observed (drilling fluid)

Method	Water	TCR %	RQD %	RL (m)	Depth (m)	Graphic Log	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition. Rock: type, weathering, colour, fabric, estimated strength, structure and bedding	Weathering	Estimated Strength (EL VL L M H VH EH)	$Is_{(50)}$ MPa (D- diametral A- axial)	Defect Spacing mm (20 60 200 600 2000)	Defect Description
		100	100		31							31.01 m joint clean irregular rough
		100	99		32							
					33							
		100	98		34							
					35			FR				
					36							
		100	99		37							
					38							
					39							
		100	99		40							

ATC Williams

DRAFT

FIGURE
BOREHOLE NUMBER CTBH-3
SHEET 5 OF 6

CLIENT Hastings Minerals

JOB NAME Yangibana Rare Earth Project

JOB NUMBER 112391.11

JOB LOCATION Gifford Creek Station WA

DATE STARTED 29/10/16 **COMPLETED**

R.L. SURFACE

DATUM

LOCATION

INCLINATION 90°

BEARING ---

EQUIPMENT

LOGGED BY CJ

CHECKED BY JPL

REMARKS Diamond Drill Rig (HQ). Groundwater depth not observed (drilling fluid)

Method	Water	TCR %	RQD %	RL (m)	Depth (m)	Graphic Log	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition. Rock: type, weathering, colour, fabric, estimated strength, structure and bedding	Weathering	Estimated Strength (EL VL L M H VH EH)	$Is_{(50)}$ MPa (D- diametral A- axial)	Defect Spacing mm (20 60 200 600 2000)	Defect Description
		100	99		41							40.61 m joint subhorizontal, planar, rough, tight, slight staining 40.7 - 41.33 m set of poorly developed foliations evident (25 degree dip).
					42							only drill fractures evident below 42.3 m.
		100	100		43		43.0 m pale grey, large quartz crystals					
					44							
					45			FR				
		100	100		46		45.4 m - 46.4 m dark grey, poorly developed foliations evident					
					47							
		100	100		48							
					49							
		100	100		50							

MPAW/ATC CORED BOREHOLE YANGIBANA BOREHOLES.GPJ GINT AUSTRALIA.GDT 19/1/17

ATC Williams

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FIGURE
BOREHOLE NUMBER CTBH-3
SHEET 6 OF 6

CLIENT Hastings Minerals
JOB NAME Yangibana Rare Earth Project
JOB NUMBER 112391.11
JOB LOCATION Gifford Creek Station WA

DATE STARTED 29/10/16 **COMPLETED**
R.L. SURFACE **DATUM**
LOCATION **INCLINATION** 90° **BEARING** ---
EQUIPMENT **LOGGED BY** CJ **CHECKED BY** JPL

REMARKS Diamond Drill Rig (HQ). Groundwater depth not observed (drilling fluid)

Method	Water	TCR %	RQD %	RL (m)	Depth (m)	Graphic Log	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition. Rock: type, weathering, colour, fabric, estimated strength, structure and bedding	Weathering	Estimated Strength (EL VL L M H VH EH)	$Is_{(50)}$ MPa (D- diametral A- axial)	Defect Spacing mm (20 60 200 600 2000)	Defect Description
		100	100		51							
					52							
					53			FR				
		100	100		54							
					55							
							CTBH-3 terminated at 55.5m					
					56							
					57							
					58							
					59							
					60							

MPAW/ATC CORED BOREHOLE YANGIBANA BOREHOLES.GPJ GINT AUSTRALIA.GDT 19/1/17

ATC Williams

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FIGURE
BOREHOLE NUMBER CTBH-4
SHEET 1 OF 2

CLIENT Hastings Minerals

JOB NAME Yangibana Rare Earth Project

JOB NUMBER 112391.11

JOB LOCATION Gifford Creek Station WA

DATE STARTED 1/11/16 **COMPLETED**

R.L. SURFACE

DATUM

LOCATION

INCLINATION 90°

BEARING ---

EQUIPMENT

LOGGED BY CJ

CHECKED BY JPL

REMARKS Diamond Drill Rig (HQ). Groundwater depth not observed (drilling fluid)

Method	Water	TCR %	RQD %	RL (m)	Depth (m)	Graphic Log	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition. Rock: type, weathering, colour, fabric, estimated strength, structure and bedding	Weathering	Estimated Strength (EL VL L M H VH EH)	$Is_{(50)}$ MPa (D- diametral A- axial)	Defect Spacing mm (20 60 200 600 2000)	Defect Description
							CLAYEY SAND Medium dense/ dense, fine to coarse, red brown, trace gravel, medium plasticity					
							SILTY GRAVEL (Extremely Weathered Granite) Very dense/weakly cemented, fine to coarse gravel lithorelicts, trace sand	EW				
		100	9		1		**SHEARED GRANITE** Highly weathered, grey and green grey, foliated, very low / low strength	HW				
							1.47 m becoming moderately to highly weathered, green grey and white, medium to high strength					joints predominantly, rough, irregular with surface staining.
					2							2.01 m - 2.52 m fractured zone, fractures irregular, rough, with very thin clay infill (1 mm - 2 mm)
		100	18					HW/MW		D 4.87 A 2.7		
					3							2.8 m - 3.67 m subvertical joint, irregular, rough, stained
							GRANITE Slightly weathered, green grey and white, medium crystalline, massive, very high/ extremely high strength					
		100	71		4							
							4.47 m becoming pale grey and white mega crystalline granite, high to very high strength					4.67 m - 4.83 m joints 30° - 40° dip, irregular, rough
					5							
		100	96									
					6		**SHEARED GRANITE** Slightly weathered, white and dark grey, poorly foliated, high to very high strength					
								SW				
		96	94		7							
					8							
		100	71							D 5.07 A 9.4		joint 70° dip, rough, stained
					9							
		97	81		10							

MPAW/ATC CORED BOREHOLE YANGIBANA BOREHOLES.GPJ GINT AUSTRALIA.GDT 19/1/17

ATC Williams

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FIGURE
BOREHOLE NUMBER CTBH-4
SHEET 2 OF 2

CLIENT Hastings Minerals

JOB NAME Yangibana Rare Earth Project

JOB NUMBER 112391.11

JOB LOCATION Gifford Creek Station WA

DATE STARTED 1/11/16 **COMPLETED**

R.L. SURFACE

DATUM

LOCATION

INCLINATION 90°

BEARING ---

EQUIPMENT

LOGGED BY CJ

CHECKED BY JPL

REMARKS Diamond Drill Rig (HQ). Groundwater depth not observed (drilling fluid)

Method	Water	TCR %	RQD %	RL (m)	Depth (m)	Graphic Log	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition. Rock: type, weathering, colour, fabric, estimated strength, structure and bedding	Weathering	Estimated Strength (EL VL L M H VH EH)	$Is_{(50)}$ MPa (D- diametral A- axial)	Defect Spacing mm (20 60 200 600 2000)	Defect Description
		97	81		11		10.46 m becoming pale grey and medium grained	SW				10.44 m - 10.96 m irregular, rough, 5° - 25 dip
							CTBH-4 terminated at 11m					
					12							
					13							
					14							
					15							
					16							
					17							
					18							
					19							
					20							

ATC Williams

DRAFT

FIGURE
BOREHOLE NUMBER CTBH-5
SHEET 1 OF 2

CLIENT Hastings Minerals

JOB NAME Yangibana Rare Earth Project

JOB NUMBER 112391.11

JOB LOCATION Gifford Creek Station WA

DATE STARTED 26/10/16 **COMPLETED**

R.L. SURFACE

DATUM

LOCATION

INCLINATION 90°

BEARING ---

EQUIPMENT

LOGGED BY CJ

CHECKED BY JPL

REMARKS Diamond Drill Rig (HQ). Groundwater depth not observed (drilling fluid)

Method	Water	TCR %	RQD %	RL (m)	Depth (m)	Graphic Log	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition. Rock: type, weathering, colour, fabric, estimated strength, structure and bedding	Weathering	Estimated Strength (EL VL L M H VH EH)	$Is_{(50)}$ MPa (D- diametral A- axial)	Defect Spacing mm (20 60 200 600 2000)	Defect Description
		37			1		**CLAYEY GRAVEL** Dense/very dense, fine to coarse, brown and grey, medium plasticity.					
		100	83		2		**GRANITE** Moderately weathered, grey and light grey, medium crystaline, massive, medium/ high strength 1.2 m - 2.2 m dark grey and white, high / very high strength			D 1.88 A 2.2		joints irregular, rough, clean or with slight iron oxide staining
		100	77		3		2.2 m - 5.95 m moderately weathered, green grey, massive, medium / high strength	MW				
		100	65		4							
		100	47		5							5.3 m - 5.38 m highly fractured zone
		100	77		6		5.95 m - 6.5 m highly weathered zone, closely fractured, low / medium strength	HW				
		100	77		7		6.5 m moderately weathered, grey, white and crystaline, high/ very high strength	MW				6.54 m - 6.67 m closely fractured zone
		93	81		8		**GRANITE** Slightly weathered, grey and light grey, medium crystalline, massive, medium/ very high strength					
		100	96		9			SW		D 4.45 A 8.65		8.65 m - 8.72 m closely fractured
					10							

ATC Williams

DRAFT

FIGURE
BOREHOLE NUMBER CTBH-5
SHEET 2 OF 2

CLIENT Hastings Minerals

JOB NAME Yangibana Rare Earth Project

JOB NUMBER 112391.11

JOB LOCATION Gifford Creek Station WA

DATE STARTED 26/10/16 **COMPLETED**

R.L. SURFACE

DATUM

LOCATION

INCLINATION 90°

BEARING ---

EQUIPMENT

LOGGED BY CJ

CHECKED BY JPL

REMARKS Diamond Drill Rig (HQ). Groundwater depth not observed (drilling fluid)

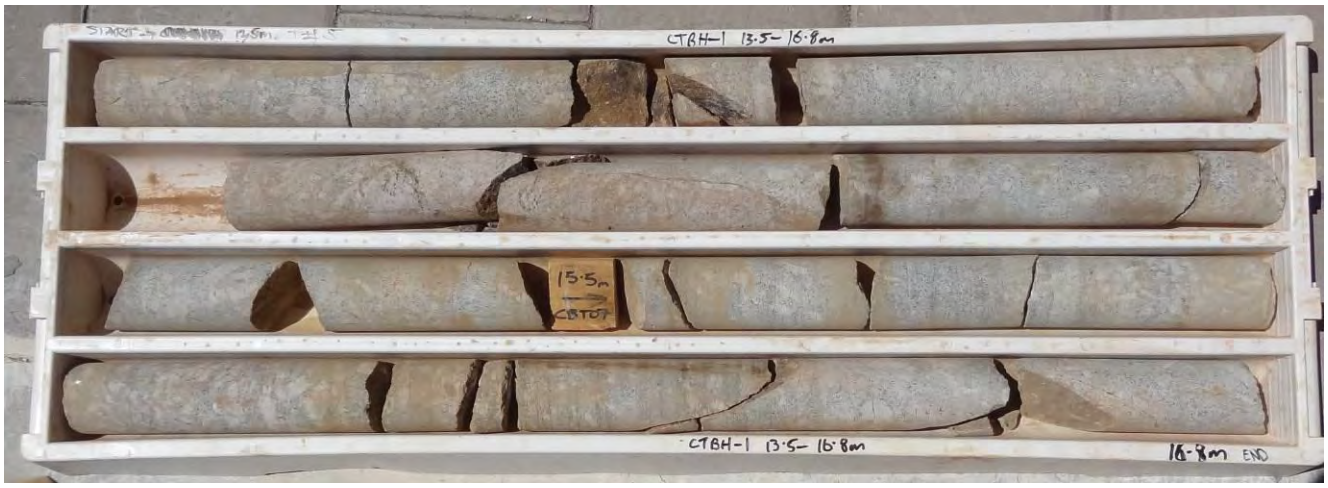
Method	Water	TCR %	RQD %	RL (m)	Depth (m)	Graphic Log	Material Description: Soil: type, USCS symbol, strength, plasticity or particle size, colour, secondary components, moisture condition. Rock: type, weathering, colour, fabric, estimated strength, structure and bedding	Weathering	Estimated Strength (EL VL L M H VH EH)	$Is_{(50)}$ MPa (D- diametral A- axial)	Defect Spacing mm (20 60 200 600 2000)	Defect Description
		100	96					SW				
		95	87		11		**GRANITE** Freshly weathered, green grey and white, medium crystalline, massive, very high/ extremely high strength					
		100	97		12		11.98 m becoming dark grey with pink feldspar crystals	FR				
							CTBH-5 terminated at 12.5m					

13 14 15 16 17 18 19 20

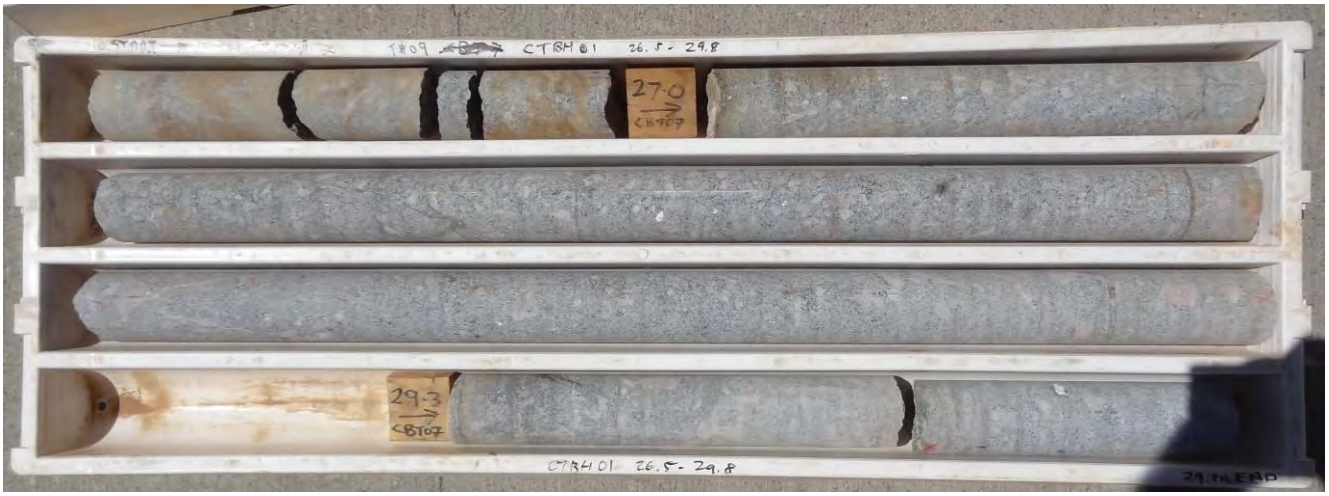
MPAW/ATC CORED BOREHOLE YANGIBANA BOREHOLES.GPJ GINT AUSTRALIA.GDT 19/1/17

APPENDIX D

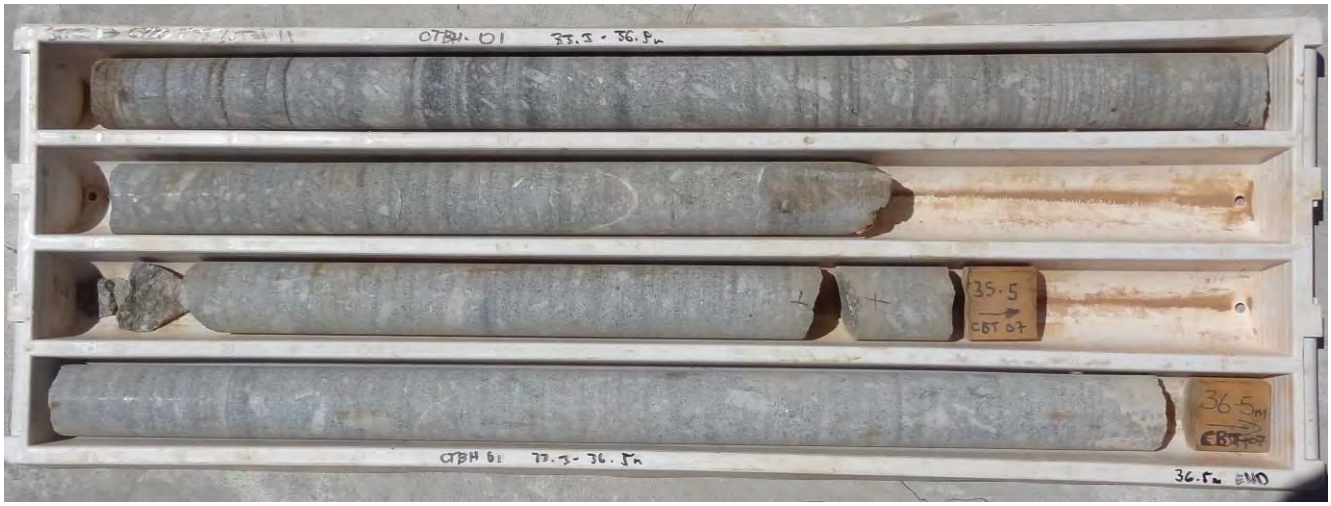
CTBH1 (0.00 - 10.10 m)



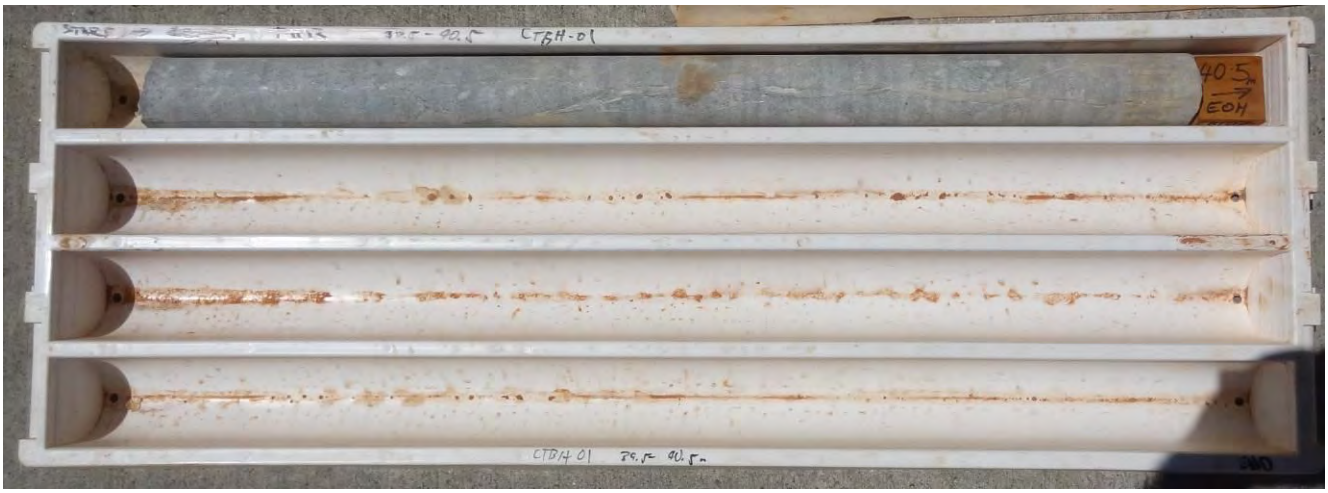
CTBH1 (10.10 - 20.30 m)



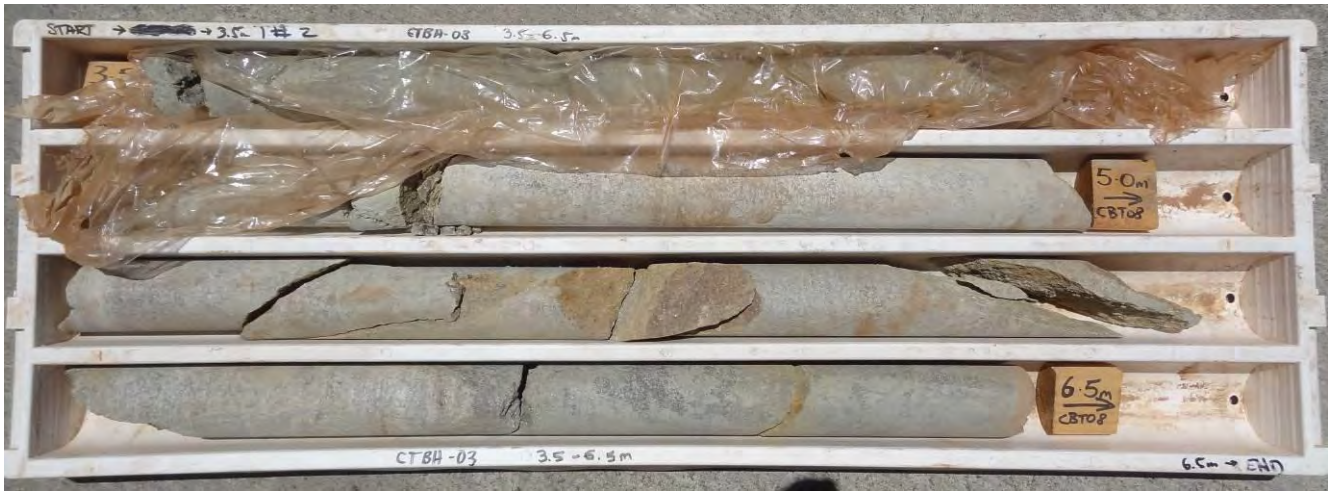
CTBH1 (20.30 - 29.80 m)



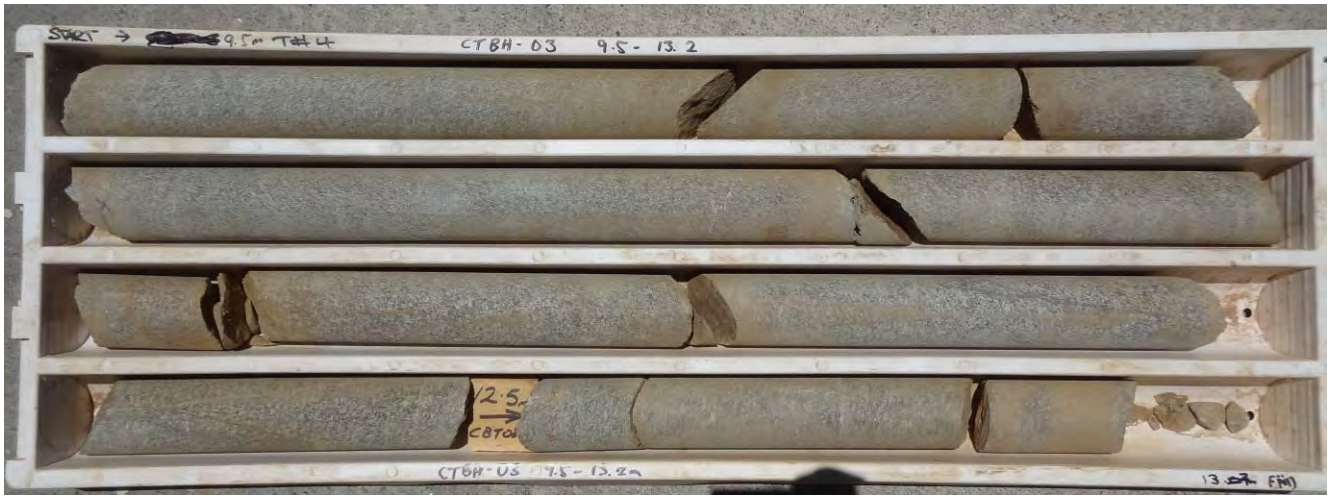
CTBH1 (29.80 - 39.50 m)



CTBH1 (39.50 – 40.50 m)

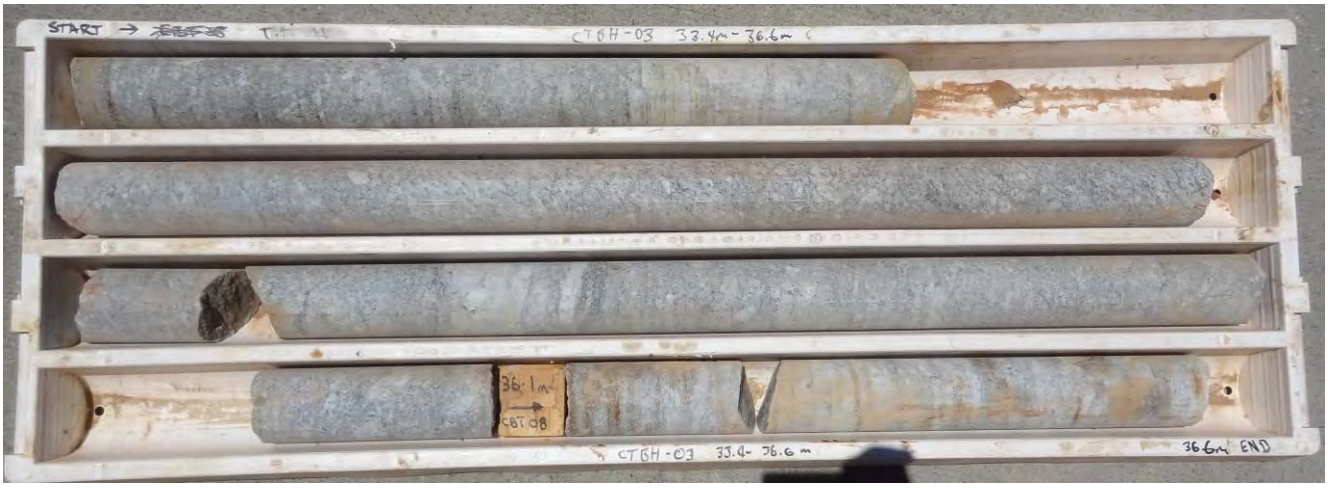


CTBH3 (0.00 – 09.50 m)



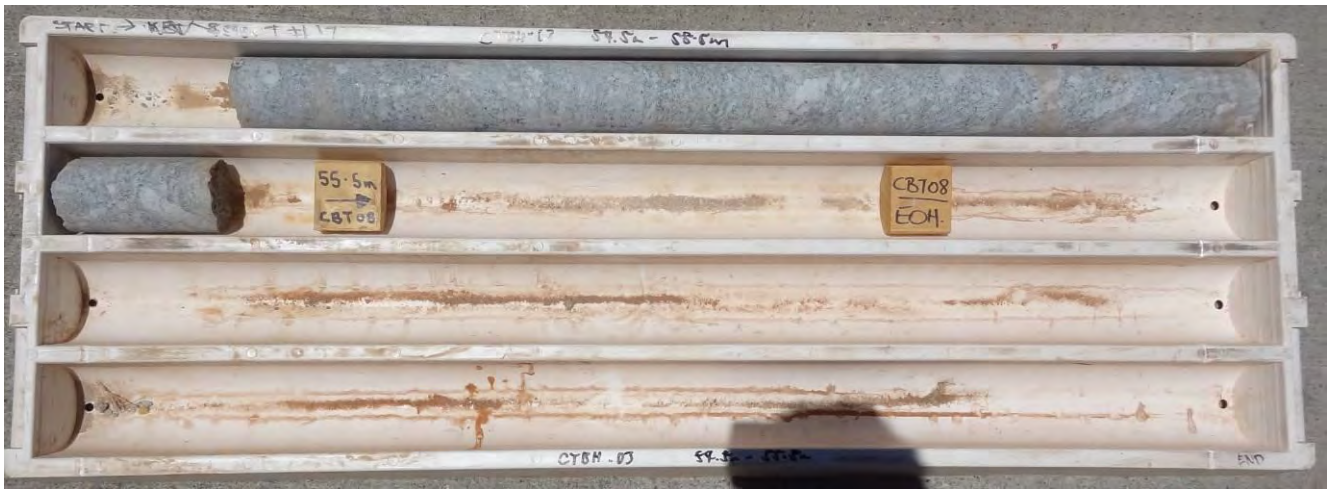
CTBH3 (09.50 – 20.30 m)

CTBH3 (20.30 - 30.50 m)

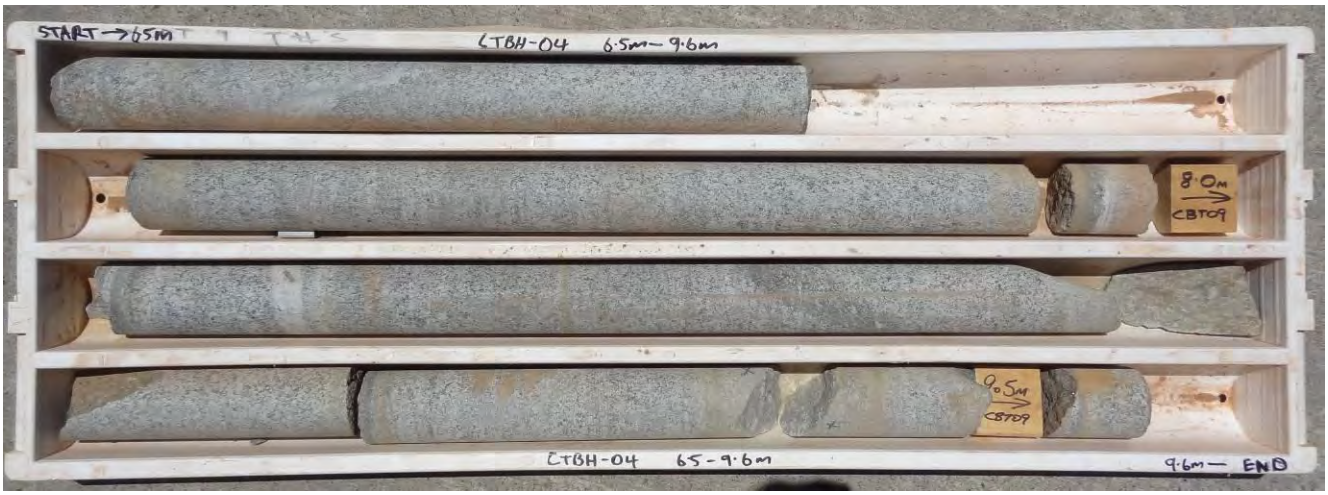


CTBH3 (30.50 – 40.10 m)

CTBH3 (40.10 - 52.60 m)

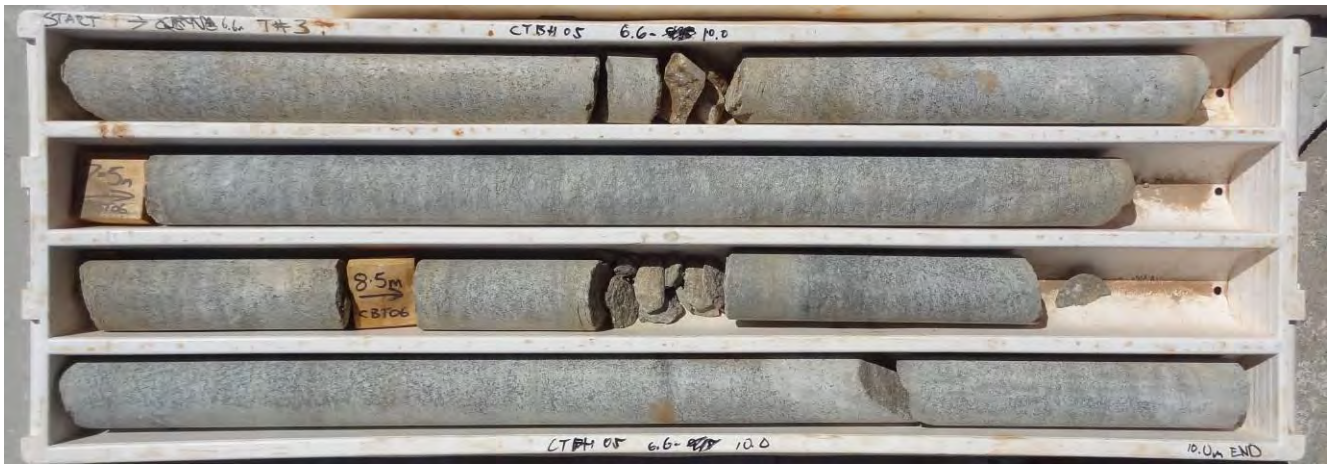


CTBH3 (52.60 - 55.50 m)



CTBH4 (0.00 – 09.60 m)

CTBH4 (09.60 – 11.00 m)



CTBH5 (0.00 – 10.00 m)

CTBH5 (10.00 – 12.50 m)

APPENDIX E

DRAFT

Date:	18/06/2016 to 20/06/2016	BH No.:	CTBH-01
Test By:	AP	Depth (m):	0 to 6.6 6.6
Checked By:	JL		

T (sec)	Depth (m)	H/H_0
0	0.00	1.00
420	0.30	0.95
840	0.62	0.91
1260	0.82	0.88
1680	1.10	0.83
2160	1.30	0.80
3300	1.80	0.73
4740	2.40	0.64
8580	3.50	0.47
10800	4.00	0.39
15780	4.70	0.29
19860	5.10	0.23
26640	5.50	0.17

Casing diameter (D)	0.13	m
Borehole extension below casing (L)	6.6	m
Head at test start (H_0)	6.6	m
Relevant shape factor case	d	
Depth of borehole/Groundwater level	6.6	m

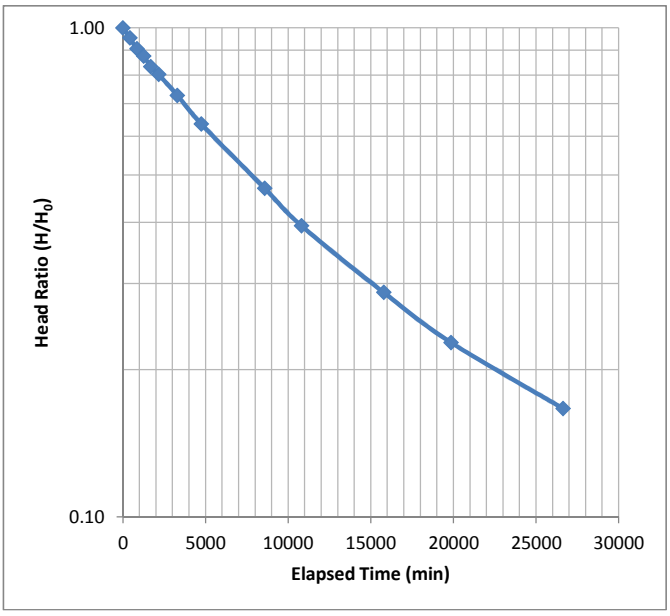
+ Values of shape factor are for use primarily in tests carried out through the open ends boreholes.
+ More accurate results for tests using piesometer tips are obtained by using Fig. 7, especially for values of (L/D)>2.

Shape Factor	8.97494

or

F/D	6.5
Shape Factor	0.84

for tests using piesometer tips



+ From graph or interpolation. Time corresponding to a value of H/H0 of 0.37. (see reference)

Basic time lag (T)	11000	sec

Permeability	1.44E-06	m/sec

HASTINGS TECHNOLOGY METALS
YANGIBANA - GEOTECHNICAL INVESTIGATION

PERMEABILITY TESTING

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Job No: 112391.11
Date: 30/11/2016

FIGURE 1

DRAFT

Date:	18/06/2016 to 20/06/2016	BH No.:	CTBH-01
Test By:	AP	Depth (m):	0 to 1.5 1.5
Checked By:	JL		

T (sec)	Depth (m)	H/H_0
0	0.00	1.00
360	0.07	0.95
780	0.11	0.93
1200	0.14	0.91
2820	0.25	0.83
4260	0.28	0.81
8100	0.32	0.79
10320	0.35	0.77
15180	0.40	0.73
19380	0.44	0.71
26160	0.49	0.67
40000	0.58	0.61
80000	0.75	0.50
120000	0.87	0.42
150000	0.94	0.37

Casing diameter (D)	0.13	m
Borehole extension below casing (L)	1.5	m
Head at test start (H_0)	1.5	m
Relevant shape factor case	d	
Depth of borehole/Groundwater level	1.5	m

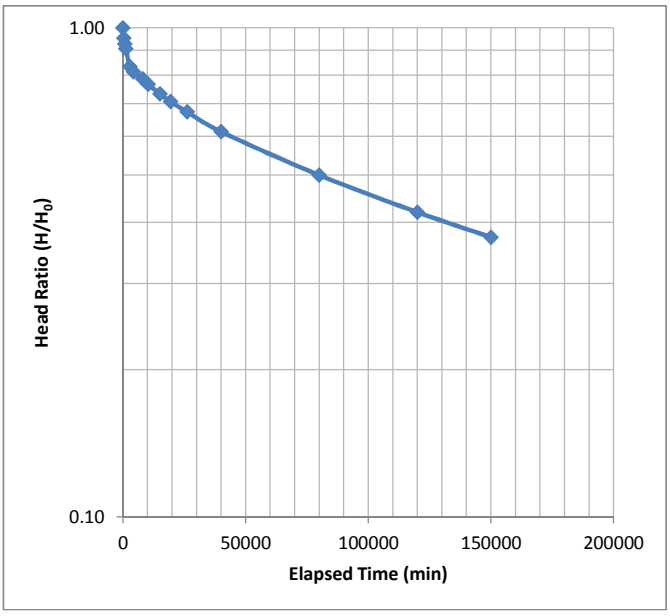
+ Values of shape factor are for use primarily in tests carried out through the open ends boreholes.
+ More accurate results for tests using piesometer tips are obtained by using Fig. 7, especially for values of (L/D)>2.

Shape Factor	3.000847

or

F/D	5.7
Shape Factor	0.74

for tests using piesometer tips



+ From graph or interpolation. Time corresponding to a value of H/H0 of 0.37. (see reference)

Basic time lag (T)	150000	sec

Permeability	1.19E-07	m/sec

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Job No: 112391.11
Date: 30/11/2016

FIGURE 2

DRAFT

Date:	18/06/2016 to 20/06/2016	BH No.:	CTBH-02
Test By:	AP	Depth (m):	0 to 1.6 1.6
Checked By:	JL		

T (sec)	Depth (m)	H/H_0
0	0.00	1.00
1200	0.15	0.91
3900	0.31	0.81
5700	0.40	0.75
11880	0.65	0.59
15960	0.77	0.52
22680	0.93	0.42
35000	1.12	0.30

Casing diameter (D)	0.13	m
Borehole extension below casing (L)	1.6	m
Head at test start (H_0)	1.6	m
Relevant shape factor case	d	
Depth of borehole/Groundwater level	1.6	m

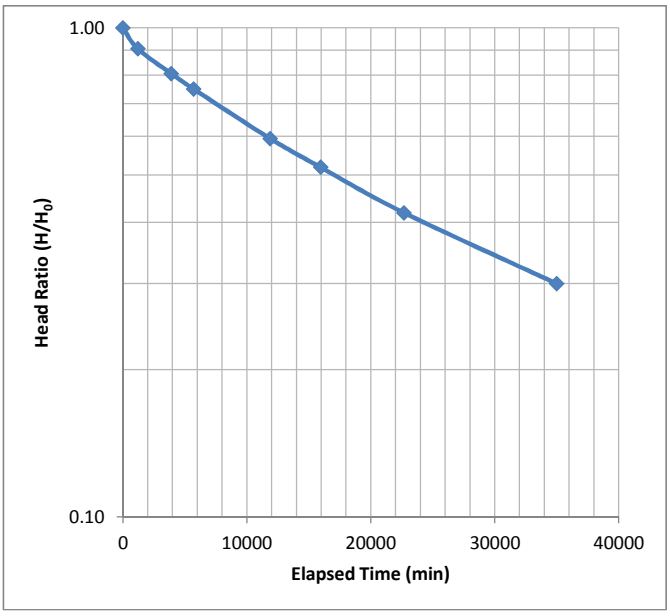
+ Values of shape factor are for use primarily in tests carried out through the open ends boreholes.
+ More accurate results for tests using piesometer tips are obtained by using Fig. 7, especially for values of (L/D)>2.

Shape Factor	3.136674

or

F/D	5.8
Shape Factor	0.75

for tests using piesometer tips



+ From graph or interpolation. Time corresponding to a value of H/H0 of 0.37. (see reference)

Basic time lag (T)	27000	sec

Permeability	6.56E-07	m/sec

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Date: 30/11/2016

FIGURE 3

DRAFT

Date:	18/06/2016 to 20/06/2016	BH No.:	CTBH-02
Test By:	AP	Depth (m):	0 to 5.6 5.6
Checked By:	JL		

T (sec)	Depth (m)	H/H_0
0	0.00	1.00
1200	0.22	0.96
3900	0.46	0.92
5700	0.65	0.88
11880	1.10	0.80
15960	1.31	0.77
22680	1.60	0.71
50000	2.40	0.57
100000	3.30	0.41
120000	3.55	0.37

Casing diameter (D)	0.13	m
Borehole extension below casing (L)	5.6	m
Head at test start (H_0)	5.6	m
Relevant shape factor case	d	
Depth of borehole/Groundwater level	5.6	m

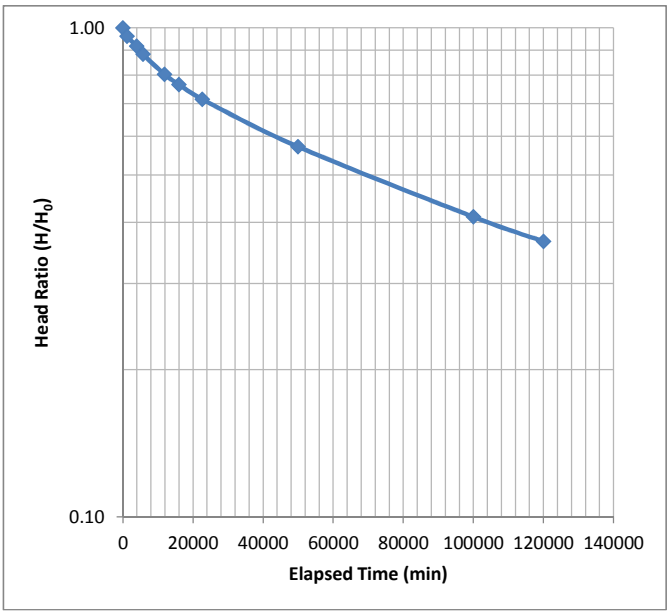
+ Values of shape factor are for use primarily in tests carried out through the open ends boreholes.
+ More accurate results for tests using piesometer tips are obtained by using Fig. 7, especially for values of (L/D)>2.

Shape Factor	7.895806

or

F/D	6.4
Shape Factor	0.83

for tests using piesometer tips



+ From graph or interpolation. Time corresponding to a value of H/H0 of 0.37. (see reference)

Basic time lag (T)	120000	sec

Permeability	1.33E-07	m/sec

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FIGURE 4

DRAFT

Date:	18/06/2016 to 20/06/2016	BH No.:	CTBH-03
Test By:	AP	Depth (m):	0 to 6.55 6.55
Checked By:	JL		

T (sec)	Depth (m)	H/H_0
0	0.00	1.00
1500	0.30	0.95
3540	0.80	0.88
7500	1.30	0.80
9240	1.42	0.78
12840	1.63	0.75
19620	1.88	0.71
30000	2.20	0.66
50000	2.60	0.60
100000	3.30	0.50
150000	3.80	0.42
200000	4.10	0.37

Casing diameter (D)	0.13	m
Borehole extension below casing (L)	6.55	m
Head at test start (H_0)	6.55	m
Relevant shape factor case	d	
Depth of borehole/Groundwater level	6.55	m

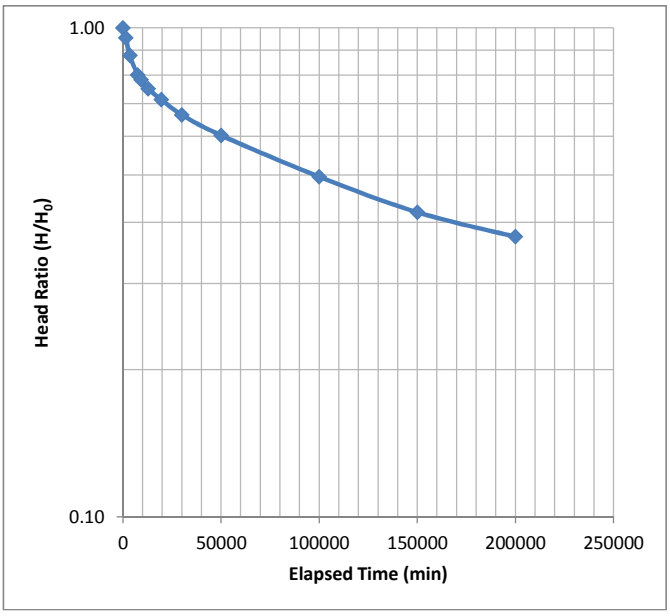
+ Values of shape factor are for use primarily in tests carried out through the open ends boreholes.
+ More accurate results for tests using piesometer tips are obtained by using Fig. 7, especially for values of (L/D)>2.

Shape Factor	8.921629

or

F/D	6.5
Shape Factor	0.84

for tests using piesometer tips



+ From graph or interpolation. Time corresponding to a value of H/H0 of 0.37. (see reference)

Basic time lag (T)	200000	sec

Permeability	7.91E-08	m/sec

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FIGURE 5

DRAFT

Date:	18/06/2016 to 20/06/2016	BH No.:	CTBH-03
Test By:	AP	Depth (m):	0 to 0.9 0.9
Checked By:	JL		

T (sec)	Depth (m)	H/H_0
0	0.00	1.00
1500	0.05	0.94
3540	0.10	0.89
7500	0.18	0.80
9240	0.22	0.76
12840	0.29	0.68
19620	0.42	0.53
30000	0.57	0.37

Casing diameter (D)	0.13	m
Borehole extension below casing (L)	0.9	m
Head at test start (H_0)	0.9	m
Relevant shape factor case	d	
Depth of borehole/Groundwater level	0.9	m

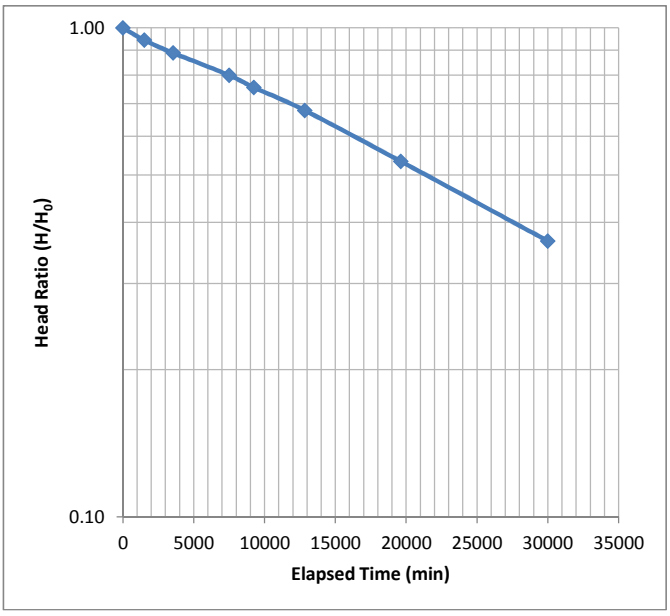
+ Values of shape factor are for use primarily in tests carried out through the open ends boreholes.
+ More accurate results for tests using piesometer tips are obtained by using Fig. 7, especially for values of (L/D)>2.

Shape Factor	2.14754

or

F/D	5.4
Shape Factor	0.70

for tests using piesometer tips



+ From graph or interpolation. Time corresponding to a value of H/H0 of 0.37. (see reference)

Basic time lag (T)	30000	sec

Permeability	6.31E-07	m/sec

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FIGURE 6

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FIGURE

Job No: 112391.11

Date: 2/11/16

BOREHOLE PERMEABILITY TEST - PORCHET METHOD

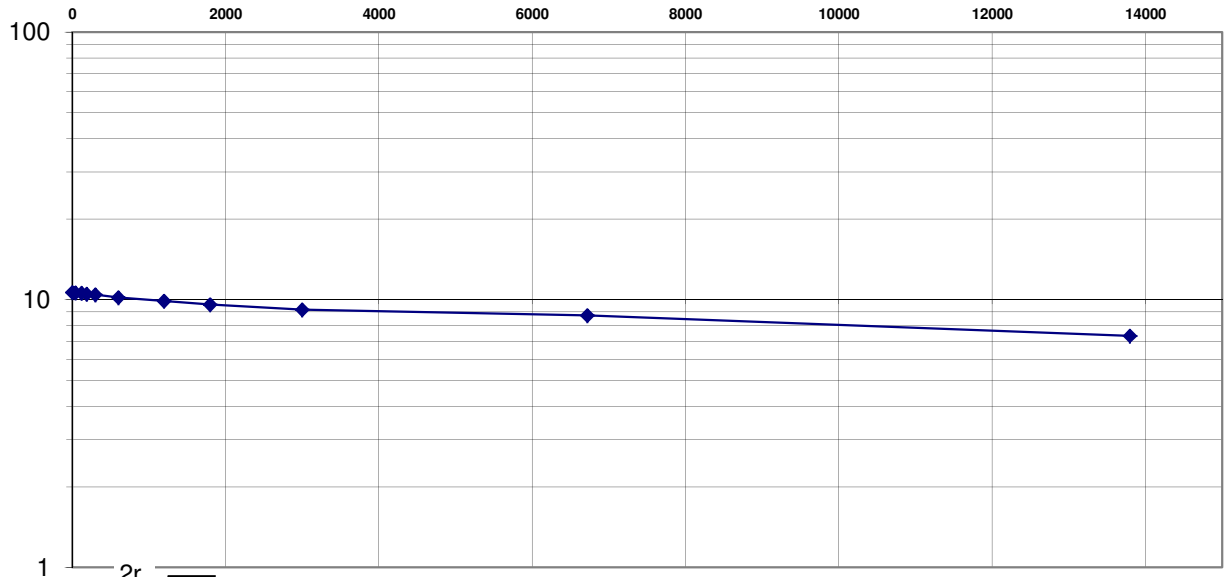
TESTED BY: CJ

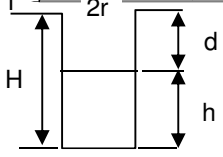
PROJECT: Yangibana Rare Earth Project

HOLE NO: CTBH-4 **Depth: (m)** 10.70 **Radius:(m)** 0.1

Water: (m) 60

Test One					Test One (Continued)				
t hr:min:sec	t sec	d m	h m	h + r/2 m	t hr:min:sec	t sec	d m	h m	h + r/2 m
N/A	0	0.09	10.61	10.66					
N/A	42	0.13	10.57	10.62					
N/A	120	0.145	10.555	10.605					
N/A	190	0.25	10.45	10.5					
N/A	300	0.31	10.39	10.44					
N/A	600	0.56	10.14	10.19					
N/A	1200	0.855	9.845	9.895					
N/A	1800	1.155	9.545	9.595					
N/A	3000	1.58	9.12	9.17					
N/A	6720	2.02	8.68	8.73					
N/A	13800	3.42	7.28	7.33					





$$K = \frac{1.15 \times r}{t_2 - t_1} \quad \text{Log}_{10}\left[\frac{h_{t1} + r/2}{h_{t2} + r/2}\right]$$

	t1	t2	Permeability
1	1800	13800	1.12E-06
			#DIV/0!
2			#DIV/0!
			#DIV/0!

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FIGURE

Job No: 112391.11

Date: 2/11/16

BOREHOLE PERMEABILITY TEST - PORCHET METHOD

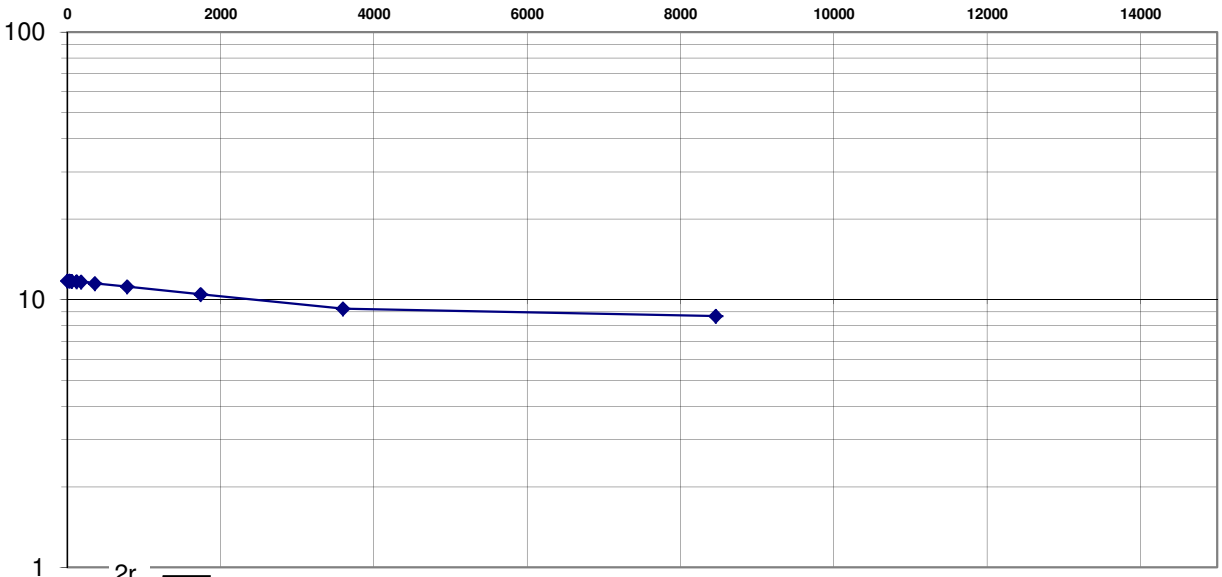
TESTED BY: CJ

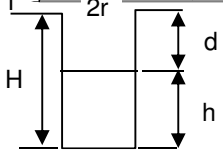
PROJECT: Yangibana Rare Earth Project

HOLE NO: CTBH-5 **Depth: (m)** 11.85 **Radius:(m)** 0.1

Water: (m) 60

Test One					Test One (Continued)				
t hr:min:sec	t sec	d m	h m	h + r/2 m	t hr:min:sec	t sec	d m	h m	h + r/2 m
N/A	0	0.14	11.71	11.76					
N/A	30	0.155	11.695	11.745					
N/A	60	0.165	11.685	11.735					
N/A	120	0.205	11.645	11.695					
N/A	180	0.25	11.6	11.65					
N/A	360	0.385	11.465	11.515					
N/A	780	0.71	11.14	11.19					
N/A	1740	1.42	10.43	10.48					
N/A	3600	2.635	9.215	9.265					
N/A	8460	3.22	8.63	8.68					





$$K = \frac{1.15 \times r}{t_2 - t_1} \quad \text{Log}_{10}\left[\frac{h_{t1} + r/2}{h_{t2} + r/2}\right]$$

	t1	t2	Permeability
1	780	8460	1.65E-06
			#DIV/0!
2			#DIV/0!
			#DIV/0!

DRAFT

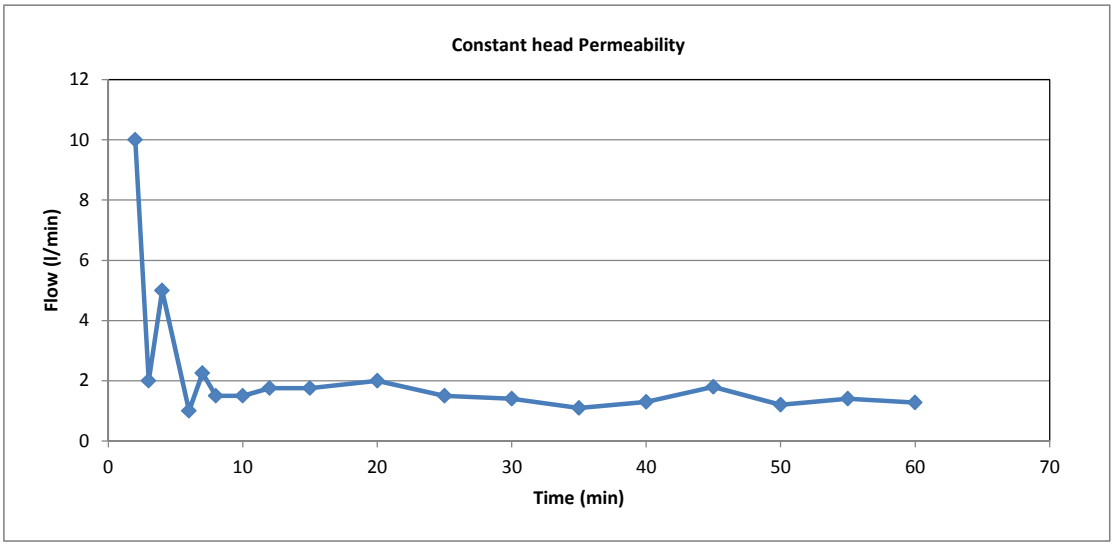
Borehole CTBH-01 **Date** 28/10/2016

t (min)	Flow (l/min)	Water Meter (L)
0		9400
1	10	9410
2	2	9412
3	5	9417
4	1	9418
6	2.25	9422.5
7	1.5	9424
8	1.5	9425.5
10	1.75	9429
12	1.75	9432.5
15	2	9438.5
20	1.5	9446
25	1.4	9453
30	1.1	9458.5
35	1.3	9465
40	1.8	9474
45	1.2	9480
50	1.4	9487
55	1.28	9493.4
60	1.42	9500.5

Datum (m)*	0.7
Casing diameter (m)	0.096
Depth to top of packer (m)	21.4
Packer Length (m)	1.2
Depth of borehole (m)	36.5
Test Zone Length	13.9
Hc = Constant Head (m)	8.2
Shape Factor Case (1 - 7)	3
Groundwater depth (m)	7.5

q = constant flow rate (m^3/s) 10 - 60 min period 1.98611E-05 m^3/s

K = **9.17E-06** m/s



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YANGIBANA RARE EARTH PROJECT

CONSTANT HEAD PERMEABILITY TEST

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Job No: 112391.11

Date: 19/01/2017

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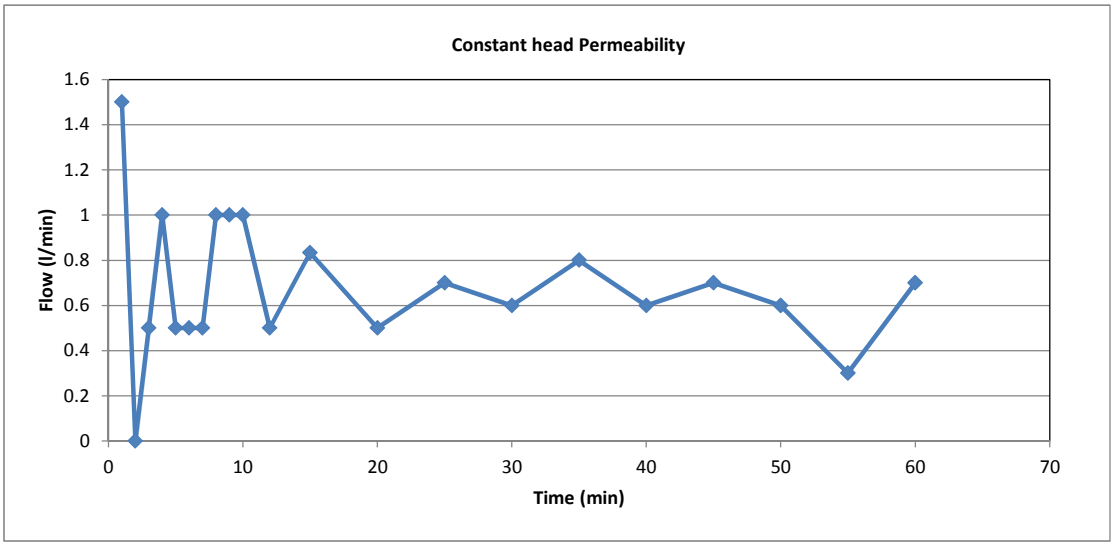
Borehole CTBH-03 **Date** 28/10/2016

t (min)	Flow (l/min)	Water Meter (L)
0		9547
1	1.5	9548.5
2	0	9548.5
3	0.5	9549
4	1	9550
5	0.5	9550.5
6	0.5	9551
7	0.5	9551.5
8	1	9552.5
9	1	9553.5
10	1	9554.5
12	0.5	9555.5
15	0.8	9558
20	0.5	9560.5
25	0.7	9564
30	0.6	9567
35	0.8	9571
40	0.6	9574
45	0.7	9577.5
50	0.6	9580.5
55	0.3	9582
60	0.7	9585.5

Datum (m)*	1.5
Casing diameter (m)	0.096
Depth to top of packer (m)	21.4
Packer length	1
Depth of borehole (m)	21.5
Test Zone Length (m)	12
Hc = Constant Head (m)	11
Shape Factor Case (1 - 7)	3
Groundwater depth (m)	>60

q = constant flow rate (m^3/s) period 3 to 60 mins 1.01389E-05 m^3/s

K = **3.49E-06** m/s



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Date: 19/01/2017

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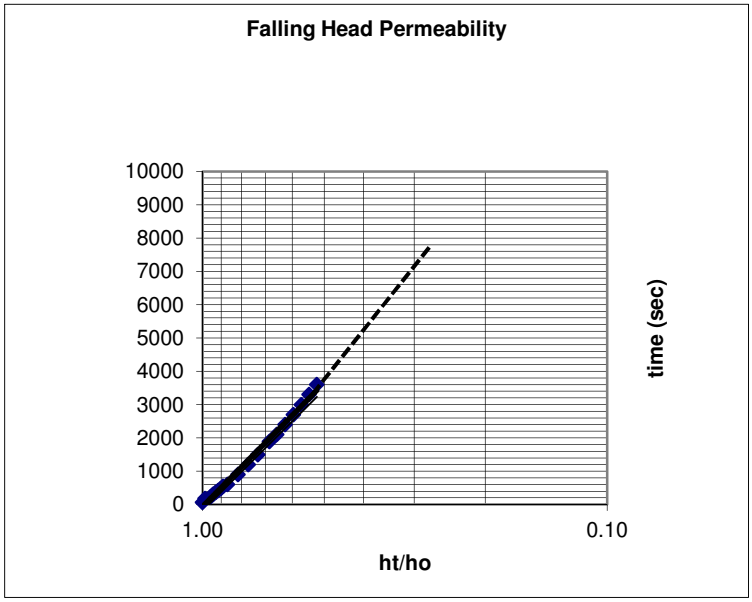
Borehole CTBH-1 **Date** 27/10/2016

t (sec)	Depth (m)	ht/ho
60	0	1.000
180	0.12	0.985
240	0.37	0.955
300	0.48	0.941
360	0.59	0.928
420	0.7	0.915
480	0.8	0.902
540	0.9	0.890
600	1.08	0.868
900	1.5	0.817
1200	1.88	0.771
1500	2.21	0.730
1890	2.59	0.684
2100	2.82	0.656
2400	3.07	0.626
2700	3.31	0.596
3000	3.53	0.570
3300	3.73	0.545
3600	3.92	0.522

Datum (m)*	0
Standing Water Level (m)	8.2
Borehole diameter (m)	0.096
Casing diameter (m)	0.078
Test Section diameter (m)	0.1
Depth of borehole (m)	22.2
Depth of casing (m)	9.8
Test Zone Length	12.4
h0 = Head at test start (m)	8.2
Shape Factor Case (1 - 7)	4

*All measurements below datum +0.7 m AGL
Base of bottom packer at 9.8 m below datum

Stratum Description:	
0.0 - 0.2	Residual Clay
0.2 - 0.8	Extremely weathered granite
0.8 - 7.4	Highly - moderately weathered granite
7.4 - 40.5	Slightly to freshly weathered granite



A = cross section area 0.007854 m^2
F = Shape Factor 14.131182 m
Either **T = Basic time lag (ht/ho = 0.37)** 5500 s
Or **t1 =** **t2 =**

K = **1.01E-07** m/s

YANGIBANA RARE EARTH PROJECT - FALLING HEAD PERMEABILITY TEST | **Job No: 112391.11**

Date: 27.01.17

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DRAFT

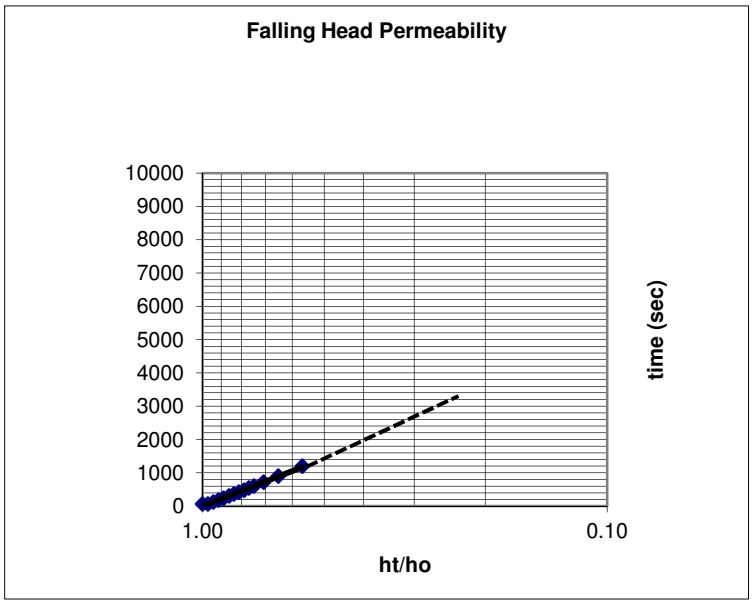
Borehole CTBH-1 **Date** 28/10/2016

t (sec)	Depth (m)	ht/ho
60	0	1.000
60	0.25	0.970
120	0.49	0.940
180	0.71	0.913
240	0.92	0.888
300	1.14	0.861
360	1.33	0.838
420	1.53	0.813
480	1.72	0.790
540	1.9	0.768
600	2.08	0.746
720	2.41	0.706
900	2.87	0.650
1200	3.55	0.567

Datum (m)*	0
Standing Water Level (m)	8.2
Borehole diameter (m)	0.096
Casing diameter (m)	0.078
Test Section diameter (m)	0.1
Depth of borehole (m)	37.2
Depth of casing (m)	22.8
Test Zone Length	14.4
h0 = Head at test start (m)	8.2
Shape Factor Case (1 - 7)	4

*All measurements below datum +0.7 m AGL
Base of bottom packer at 23.3 m below dataum

Stratum Description:	
0.0 - 0.2	Residual Clay
0.2 - 0.8	Extremely weathered granite
0.8 - 7.4	Highly - moderately weathered granite
7.4 - 40.5	Slightly to freshly weathered granite



A = cross section area 0.007854 m^2
F = Shape Factor 10.451639 m
Either **T = Basic time lag (ht/ho = 0.37)** 2950 s
Or **t1 =** **t2 =**

K = **2.55E-07** m/s

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Date: 27.01.17

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Job No: 112391.11

Date: 2/11/16

BOREHOLE PERMEABILITY TEST - LUGEON METHOD

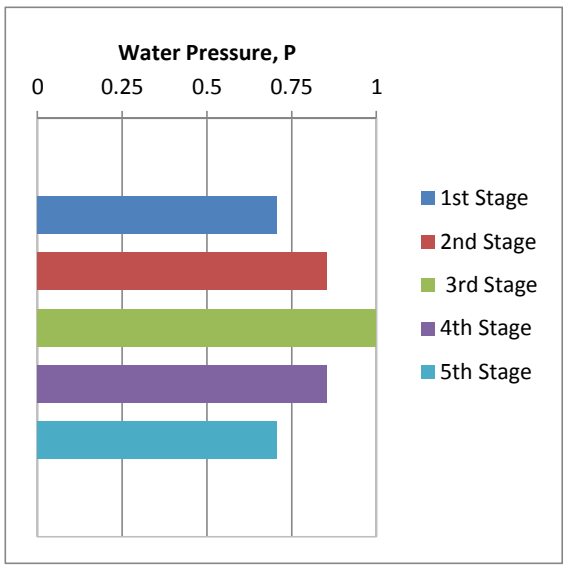
TESTED BY: CJ

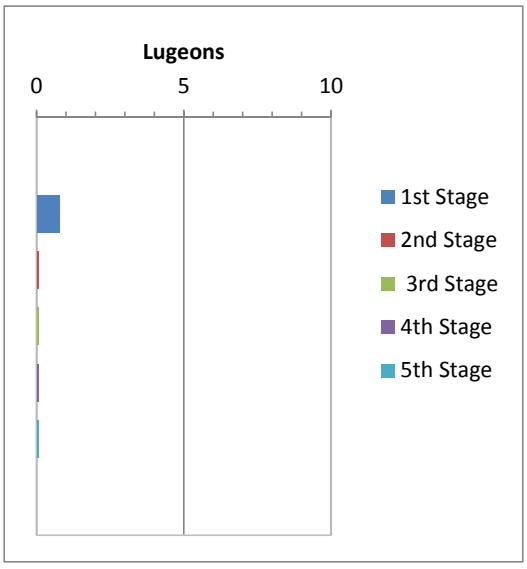
PROJECT: Yangibana Rare Earth Project

HOLE NO: CTBH-3 **Water Depth: (m)** >60 m **Hole Depth: (m)** 55.50

Depth Interval Top (m)	Base (m)	Pressure kPa	Ht kPa	Time (min)	Loss Litres	Q (l/min)	l/min/m	Lugeon Value	Stage Pmax
26.5	39.2	150	481.5	10	47	4.7	0.370	**0.769**	**0.71**
26.5	39.2	250	581.5	10	5	0.5	0.039	**0.068**	**0.85**
26.5	39.2	350	681.5	10	6	0.6	0.047	**0.069**	**1.00**
26.5	39.2	250	581.5	10	5	0.5	0.039	**0.068**	**0.85**
26.5	39.2	150	481.5	10	3	0.3	0.024	**0.049**	**0.71**

Hm 0.3
H 32.85





Lugeon Pattern	**Void Filling**	**Conductivity Classification**	**Very Low**
Representitive Lugeon Value	**0.049**	**Rock Discontinuity Conditior**	**Very Tight**
Permeability (m/s)	**6.38E-09**		

DRAFT

ATC Williams Pty Ltd
1141 Hay Street, West Perth WA 6005
T +61 8 9213 1600 F +61 8 9486 7441
perth@atcwilliams.com.au

Job No: 112391.11

Date: 2/11/16

BOREHOLE PERMEABILITY TEST - LUGEON METHOD

TESTED BY: CJ

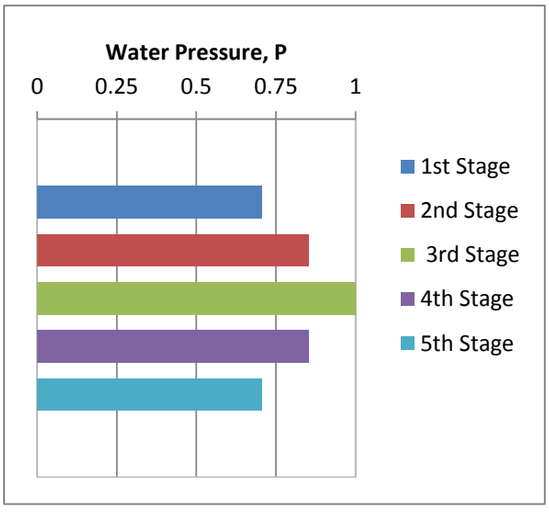
PROJECT: Yangibana Rare Earth Project

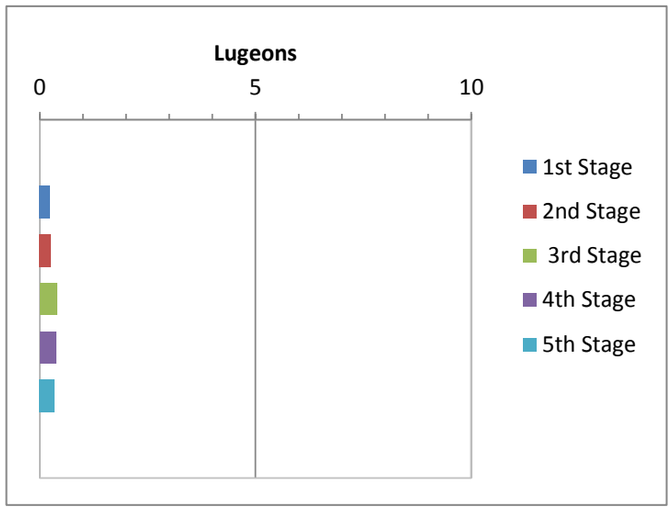
HOLE NO: CTBH-3

Hole Depth: (m) 55.50
Water Depth: (m) >60 m

Depth Interval Top (m)	Base (m)	Pressure kPa	Ht kPa	Time (min)	Loss Litres	Q (l/min)	l/min/m	Lugeon Value	Stage Pmax
9.5	55.5	150	478	10	52	5.2	0.113	**0.236**	**0.71**
9.5	55.5	250	578	10	69	6.9	0.150	**0.260**	**0.85**
9.5	55.5	350	678	10	126	12.6	0.274	**0.404**	**1.00**
9.5	55.5	250	578	10	98	9.8	0.213	**0.369**	**0.85**
9.5	55.5	150	478	10	77	7.7	0.167	**0.350**	**0.71**

Hm 0.3
H 32.5





Lugeon Pattern Dilation
Representitive Lugeon Value 0.30
Permeability (m/s) 3.95E-08

Conductivity Classification Very Low
Rock Discontinuity Condition Very Tight

APPENDIX F

TEST CERTIFICATE

au.ind.admin@sgs.com
ABN: 44 000 964 278
ph: 1300 781 744
fx: +61 (0)8 9378 0199

SGS Australia Pty Ltd
PO Box 486 Bassendean WA 6934
5 Yelland Way
Bassendean WA 6054

Client:	ATC Williams Pty Ltd	Client Job No:	112391.11
Project:	Yangibana Rare Earth	Order No:	
Location:	Gascoyne Region, WA	Tested Date:	8/12/2016
SGS Job Number:	16-01-2448	Sample No:	16-MT-9932
Lab:	Bassendean	Sample ID:	CTTP-01 (0.5m - 0.8m)

MOISTURE CONTENT

Test Method: AS1289.2.1.1 - Convection Oven

Moisture Content (%)	**7.8**

Note: Sample supplied by client.

Authorised Signatory: (Samantha McDonald) Date: 12/12/2016

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ABN: 44 000 964 278
ph: 1300 781 744
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TEST CERTIFICATE

SGS Australia Pty Ltd
PO Box 486 Bassendean WA 6934
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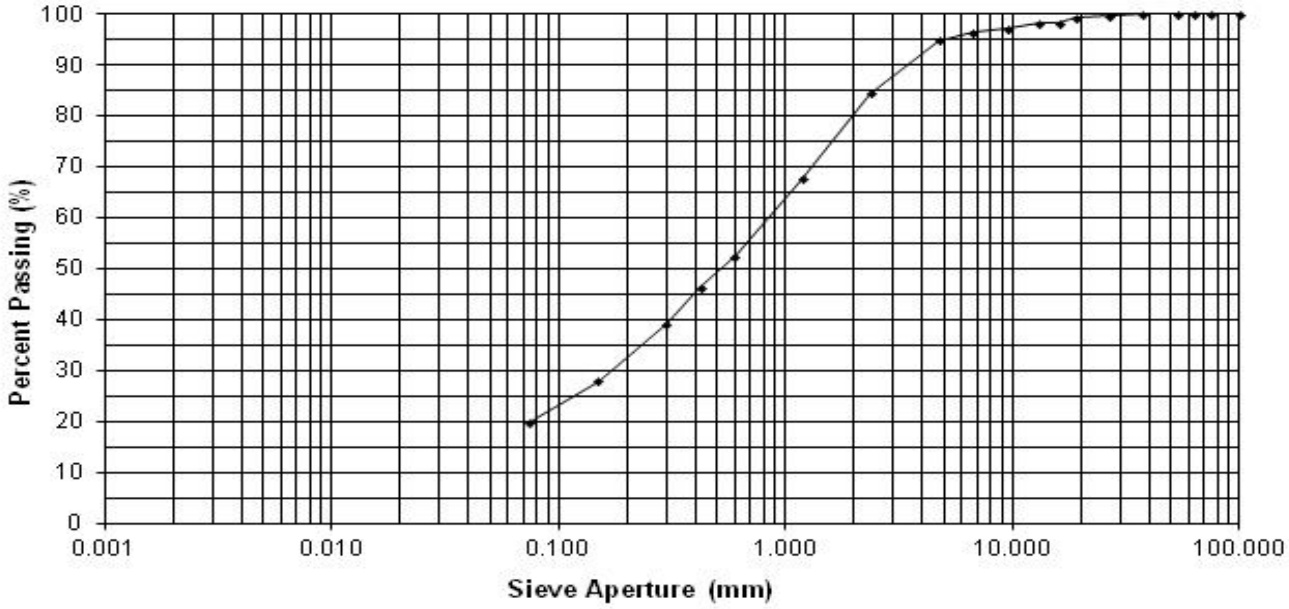
Bassendean WA 6054

Client:	ATC Williams Pty Ltd	Client Job No:	112391.11
Project:	Yangibana Rare Earth	Order No:	
Location:	Gascoyne Region, WA	Tested Date:	14/12/2016
SGS Job Number:	16-01-2448	Sample No:	16-MT-9932
Lab:	Bassendean	Sample ID:	CTTP-01 (0.5m - 0.8m)

Particle Size Distribution of a Soil

AS1289.3.6.1



Sieve Size (mm)	% Passing	Sieve Size (mm)	% Passing
100	100	9.5	97
75	100	6.7	97
63	100	4.75	95
53	100	2.36	84
37.5	100	1.18	68
26.5	100	0.6	52
19.0	99	0.425	46
16.0	98	0.300	39
13.2	98	0.150	28
		0.075	20

Date Sampled: Unknown

Note: Sample supplied by client.

Authorised Signatory: (Benjamin Brumpton) Date: 10/01/2017

TEST CERTIFICATE

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ABN: 44 000 964 278
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SGS Australia Pty Ltd
PO Box 486 Bassendean WA 6934
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Bassendean WA 6054

Client:	ATC Williams Pty Ltd	Client Job No:	112391.11
Project:	Yangibana Rare Earth	Order No:	
Location:	Gascoyne Region, WA	Tested Date:	13/01/2017
SGS Job Number:	16-01-2448	Sample No:	16-MT-9932
Lab:	Bassendean	Sample ID:	CTTP-01 (0.5m - 0.8m)

Atterberg Limits (1 Point Casagrande) with Linear Shrinkage

AS 1289.3.1.2(Liquid Limit), 3.2.1(Liquid Limit), 3.3.1(Plasicity Index), 3.4.1(Linear Shrinkage)

Liquid Limit (%):	**38**
Plastic Limit (%):	**22**
Plastic Index (%):	**16**
Linear Shrinkage (%):	**7.0**
Nature of shrinkage:	Cracked
Length of Mould (mm):	250
History of Sample:	Air Dried
Method of Preparation:	Dry Sieved

Note: Sample supplied by client.

Authorised Signatory: (Samantha McDonald) Date: 18/01/2017

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PO Box 486 Bassendean WA 6934
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Bassendean WA 6054

Client:	ATC Williams Pty Ltd	Client Job No:	112391.11
Project:	Yangibana Rare Earth	Order No:	
Location:	Gascoyne Region, WA	Tested Date:	14/12/2016
SGS Job Number:	16-01-2448	Sample No:	16-MT-9933
Lab:	Bassendean	Sample ID:	CTTP-03 (0.1m - 0.4m)

MOISTURE CONTENT

Test Method: AS1289.2.1.1 - Convection Oven

Moisture Content (%)	**9.8**

Note: Sample supplied by client.

Authorised Signatory: (Samantha McDonald) Date: 18/01/2017

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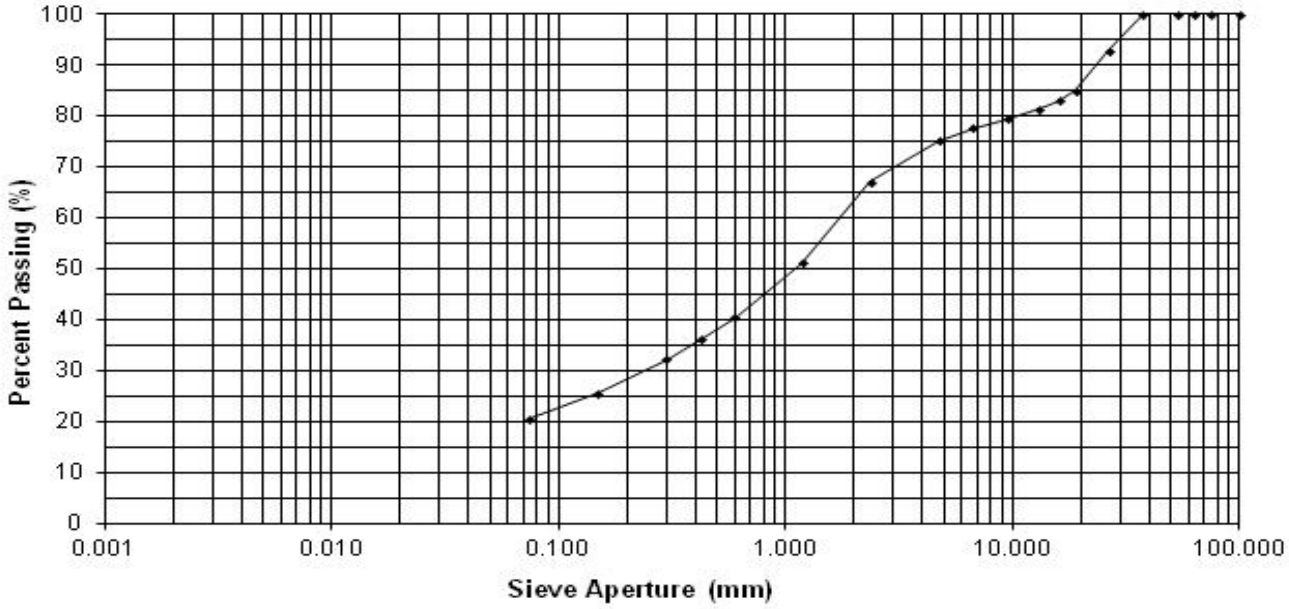
Bassendean WA 6054

Client:	ATC Williams Pty Ltd	Client Job No:	112391.11
Project:	Yangibana Rare Earth	Order No:	
Location:	Gascoyne Region, WA	Tested Date:	9/12/2016
SGS Job Number:	16-01-2448	Sample No:	16-MT-9934
Lab:	Bassendean	Sample ID:	CTTP-07A (0.1m - 0.3m)

Particle Size Distribution of a Soil

AS1289.3.6.1



Sieve Size (mm)	% Passing	Sieve Size (mm)	% Passing
100	100	9.5	79
75	100	6.7	78
63	100	4.75	75
53	100	2.36	67
37.5	100	1.18	51
26.5	93	0.6	40
19.0	85	0.425	36
16.0	83	0.300	32
13.2	81	0.150	25
		0.075	21

Date Sampled: Unknown

Note: Sample supplied by client.

Authorised Signatory: (Benjamin Brumpton) Date: 10/01/2017

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Bassendean WA 6054

Client:	ATC Williams Pty Ltd	Client Job No:	112391.11
Project:	Yangibana Rare Earth	Order No:	
Location:	Gascoyne Region, WA	Tested Date:	8/12/2016
SGS Job Number:	16-01-2448	Sample No:	16-MT-9935
Lab:	Bassendean	Sample ID:	CTTP-09 (1.0m - 1.2m)

MOISTURE CONTENT

Test Method: AS1289.2.1.1 - Convection Oven

Moisture Content (%)	**8.0**

Note: Sample supplied by client.

Authorised Signatory: (Samantha McDonald) Date: 12/12/2016

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Client:	ATC Williams Pty Ltd	Client Job No:	112391.11
Project:	Yangibana Rare Earth	Order No:	
Location:	Gascoyne Region, WA	Tested Date:	13/01/2017
SGS Job Number:	16-01-2448	Sample No:	16-MT-9935
Lab:	Bassendean	Sample ID:	CTTP-09 (1.0m - 1.2m)

Atterberg Limits (1 Point Casagrande) with Linear Shrinkage

AS 1289.3.1.2(Liquid Limit), 3.2.1(Liquid Limit), 3.3.1(Plasicity Index), 3.4.1(Linear Shrinkage)

Liquid Limit (%):	**49**
Plastic Limit (%):	**25**
Plastic Index (%):	**24**
Linear Shrinkage (%):	**9.5**
Nature of shrinkage:	Flat
Length of Mould (mm):	250
History of Sample:	Air Dried
Method of Preparation:	Dry Sieved

Note: Sample supplied by client.

Authorised Signatory: (Samantha McDonald) Date: 18/01/2017

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Bassendean WA 6054

Client:	ATC Williams Pty Ltd	Client Job No:	112391.11
Project:	Yangibana Rare Earth	Order No:	
Location:	Gascoyne Region, WA	Tested Date:	13/12/2016
SGS Job Number:	16-01-2448	Sample No:	16-MT-9935
Lab:	Bassendean	Sample ID:	CTTP-09 (1.0m - 1.2m)

Determination of Emerson Class Number

AS1289.3.8.1

Emserson Class Number: **4**

Note: Sample supplied by client.

Authorised Signatory: (Qader Yazdari) Date: 15/12/2016

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Bassendean WA 6054

Client:	ATC Williams Pty Ltd	Client Job No:	112391.11
Project:	Yangibana Rare Earth	Order No:	
Location:	Gascoyne Region, WA	Tested Date:	8/12/2016
SGS Job Number:	16-01-2448	Sample No:	16-MT-9936
Lab:	Bassendean	Sample ID:	CTTP-16 (0.4m - 0.6m)

MOISTURE CONTENT

Test Method: AS1289.2.1.1 - Convection Oven

Moisture Content (%)	**6.8**

Note: Sample supplied by client.

Authorised Signatory: (Samantha McDonald) Date: 12/12/2016

TEST CERTIFICATE

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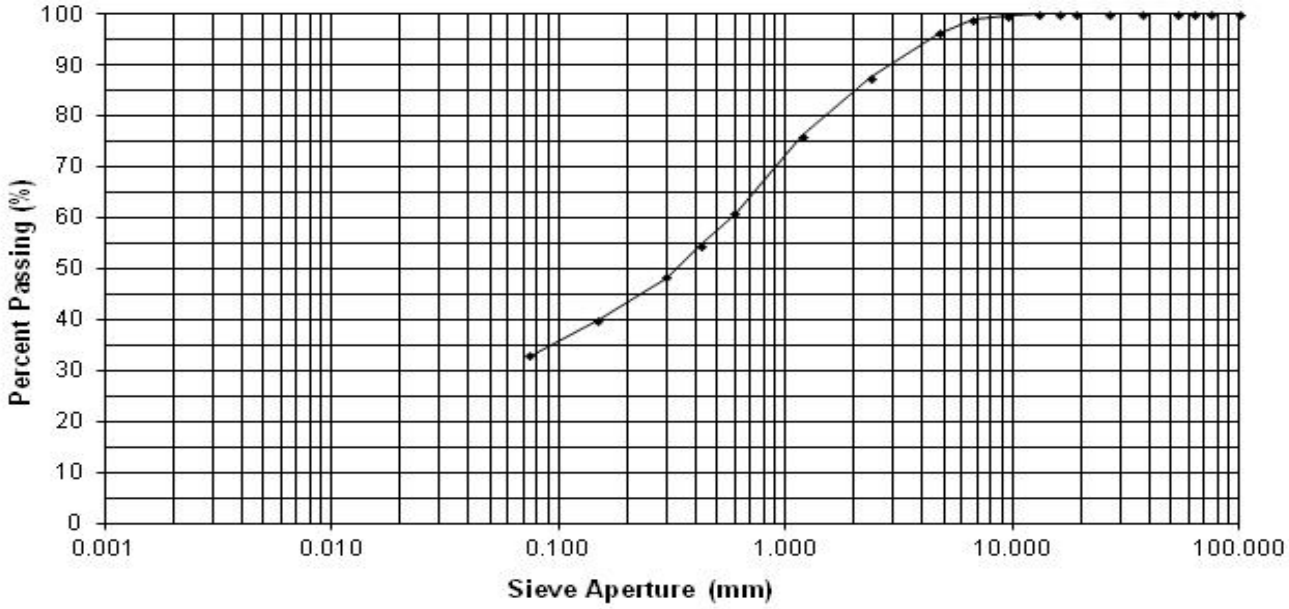
SGS Australia Pty Ltd
PO Box 486 Bassendean WA 6934
5 Yelland Way
Bassendean WA 6054

Client:	ATC Williams Pty Ltd	Client Job No:	112391.11
Project:	Yangibana Rare Earth	Order No:	
Location:	Gascoyne Region, WA	Tested Date:	14/12/2016
SGS Job Number:	16-01-2448	Sample No:	16-MT-9936
Lab:	Bassendean	Sample ID:	CTTP-16 (0.4m - 0.6m)

Particle Size Distribution of a Soil

AS1289.3.6.1



Sieve Size (mm)	% Passing	Sieve Size (mm)	% Passing
100	100	9.5	100
75	100	6.7	99
63	100	4.75	96
53	100	2.36	88
37.5	100	1.18	76
26.5	100	0.6	61
19.0	100	0.425	55
16.0	100	0.300	48
13.2	100	0.150	40
		0.075	33

Date Sampled: Unknown

Note: Sample supplied by client.

Authorised Signatory: (Benjamin Brumpton) Date: 10/01/2017

TEST CERTIFICATE

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ABN: 44 000 964 278
ph: 1300 781 744
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SGS Australia Pty Ltd
PO Box 486 Bassendean WA 6934
5 Yelland Way
Bassendean WA 6054

Client:	ATC Williams Pty Ltd	Client Job No:	112391.11
Project:	Yangibana Rare Earth	Order No:	
Location:	Gascoyne Region, WA	Tested Date:	9/12/2016
SGS Job Number:	16-01-2448	Sample No:	16-MT-9937
Lab:	Bassendean	Sample ID:	CTTP-18 (0.6m - 0.8m)

MOISTURE CONTENT

Test Method: AS1289.2.1.1 - Convection Oven

Moisture Content (%)	**12.2**

Note: Sample supplied by client.

Authorised Signatory: (Samantha McDonald) Date: 12/12/2016

TEST CERTIFICATE

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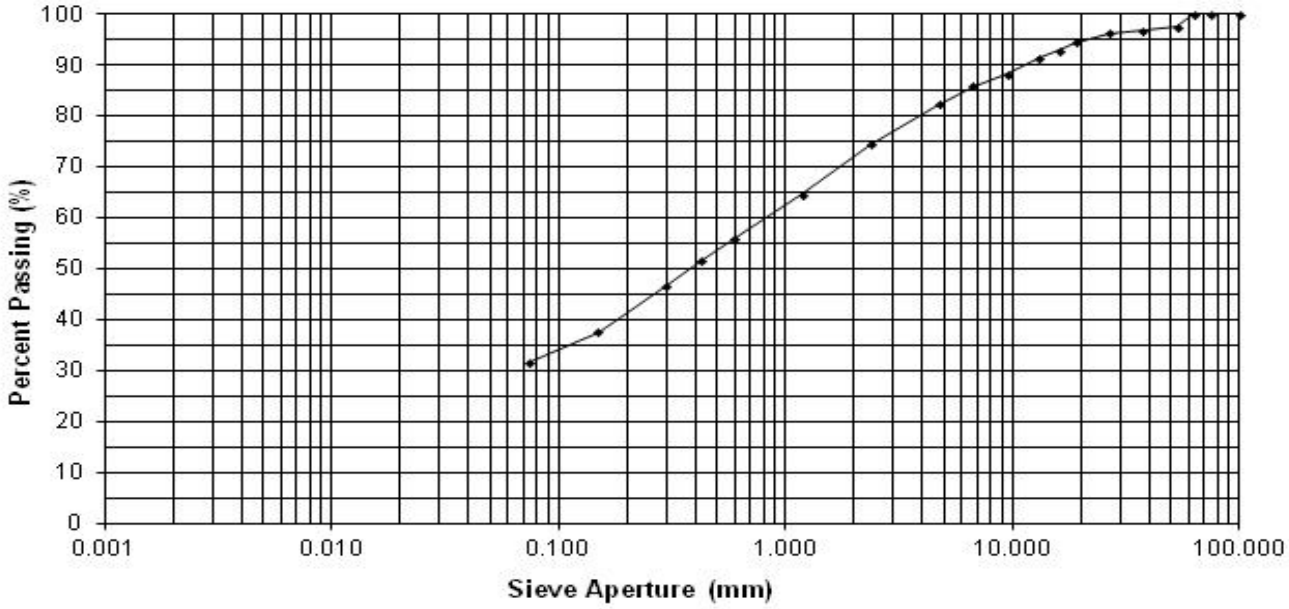
SGS Australia Pty Ltd
PO Box 486 Bassendean WA 6934
5 Yelland Way
Bassendean WA 6054

Client:	ATC Williams Pty Ltd	Client Job No:	112391.11
Project:	Yangibana Rare Earth	Order No:	
Location:	Gascoyne Region, WA	Tested Date:	14/12/2016
SGS Job Number:	16-01-2448	Sample No:	16-MT-9937
Lab:	Bassendean	Sample ID:	CTTP-18 (0.6m - 0.8m)

Particle Size Distribution of a Soil

AS1289.3.6.1



Sieve Size (mm)	% Passing	Sieve Size (mm)	% Passing
100	100	9.5	88
75	100	6.7	86
63	100	4.75	82
53	98	2.36	74
37.5	97	1.18	65
26.5	96	0.6	56
19.0	95	0.425	51
16.0	93	0.300	47
13.2	92	0.150	38
		0.075	32

Date Sampled: Unknown

Note: Sample supplied by client.

Authorised Signatory: (Benjamin Brumpton) Date: 10/01/2017

au.ind.admin@sgs.com
ABN: 44 000 964 278
ph: 1300 781 744
fx: +61 (0)8 9378 0199

TEST CERTIFICATE

SGS Australia Pty Ltd
PO Box 486 Bassendean WA 6934
5 Yelland Way
Bassendean WA 6054

Client:	ATC Williams Pty Ltd	Client Job No:	112391.11
Project:	Yangibana Rare Earth	Order No:	
Location:	Gascoyne Region, WA	Tested Date:	13/01/2017
SGS Job Number:	16-01-2448	Sample No:	16-MT-9937
Lab:	Bassendean	Sample ID:	CTTP-18 (0.6m - 0.8m)

Atterberg Limits (1 Point Casagrande) with Linear Shrinkage

AS 1289.3.1.2(Liquid Limit), 3.2.1(Liquid Limit), 3.3.1(Plasicity Index), 3.4.1(Linear Shrinkage)

Liquid Limit (%):	**59**
Plastic Limit (%):	**27**
Plastic Index (%):	**32**
Linear Shrinkage (%):	**14.0**
Nature of shrinkage:	Cracked
Length of Mould (mm):	250
History of Sample:	Air Dried
Method of Preparation:	Dry Sieved

Note: Sample supplied by client.

Authorised Signatory: (Samantha McDonald) Date: 18/01/2017

TEST CERTIFICATE

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ABN: 44 000 964 278
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Bassendean WA 6054

Client:	ATC Williams Pty Ltd	Client Job No:	112391.11
Project:	Yangibana Rare Earth	Order No:	
Location:	Gascoyne Region, WA	Tested Date:	8/12/2016
SGS Job Number:	16-01-2448	Sample No:	16-MT-9938
Lab:	Bassendean	Sample ID:	CTTP-19 (1.2m - 1.4m)

MOISTURE CONTENT

Test Method: AS1289.2.1.1 - Convection Oven

Moisture Content (%)	**8.0**

Note: Sample supplied by client.

Authorised Signatory: (Samantha McDonald) Date: 20/12/2016

TEST CERTIFICATE

au.ind.admin@sgs.com
ABN: 44 000 964 278
ph: 1300 781 744
fx: +61 (0)8 9378 0199

SGS Australia Pty Ltd
PO Box 486 Bassendean WA 6934
5 Yelland Way
Bassendean WA 6054

Client:	ATC Williams Pty Ltd	Client Job No:	112391.11
Project:	Yangibana Rare Earth	Order No:	
Location:	Gascoyne Region, WA	Tested Date:	8/12/2016
SGS Job Number:	16-01-2448	Sample No:	16-MT-9939
Lab:	Bassendean	Sample ID:	CTTP-21 (1.5m - 1.7m)

MOISTURE CONTENT

Test Method: AS1289.2.1.1 - Convection Oven

Moisture Content (%)	**8.0**

Note: Sample supplied by client.

Authorised Signatory: (Samantha McDonald) Date: 12/12/2016

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ph: 1300 781 744
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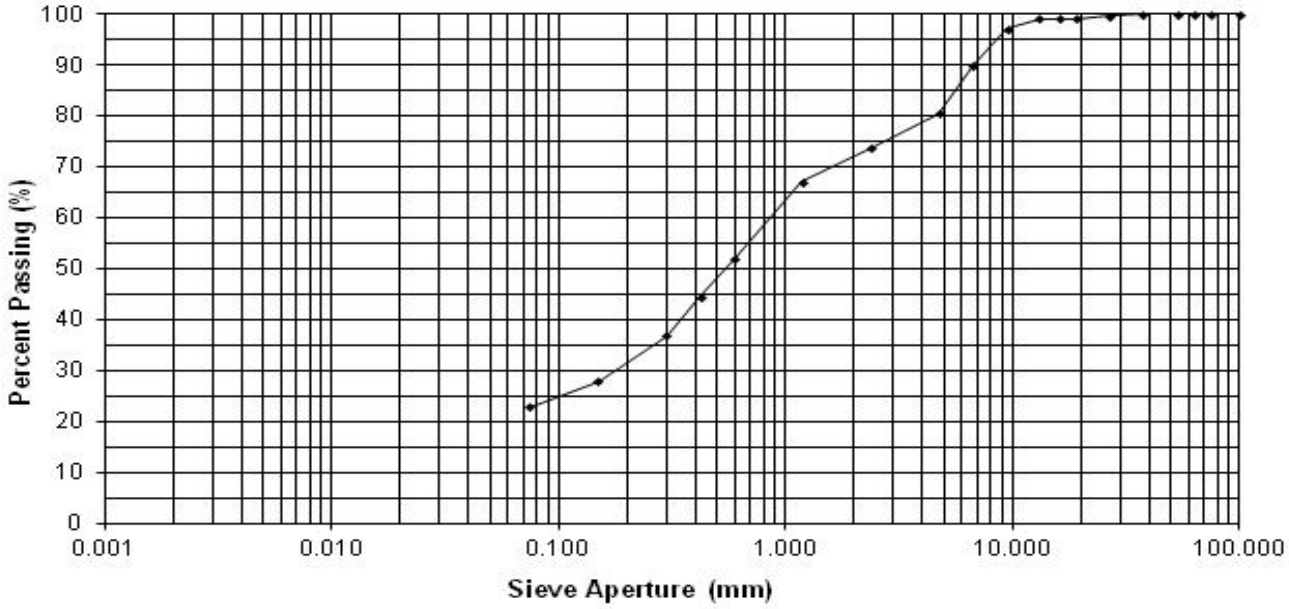
TEST CERTIFICATE

SGS Australia Pty Ltd
PO Box 486 Bassendean WA 6934
5 Yelland Way
Bassendean WA 6054

Client:	ATC Williams Pty Ltd	Client Job No:	112391.11
Project:	Yangibana Rare Earth	Order No:	
Location:	Gascoyne Region, WA	Tested Date:	16/12/2016
SGS Job Number:	16-01-2448	Sample No:	16-MT-9939
Lab:	Bassendean	Sample ID:	CTTP-21 (1.5m - 1.7m)

Particle Size Distribution of a Soil

AS1289.3.6.1



Sieve Size (mm)	% Passing	Sieve Size (mm)	% Passing
100	100	9.5	97
75	100	6.7	90
63	100	4.75	80
53	100	2.36	74
37.5	100	1.18	67
26.5	100	0.6	52
19.0	99	0.425	45
16.0	99	0.300	37
13.2	99	0.150	28
		0.075	23

Note: Sample supplied by client.

Authorised Signatory: (Samantha McDonald) Date: 18/01/2017

TEST CERTIFICATE

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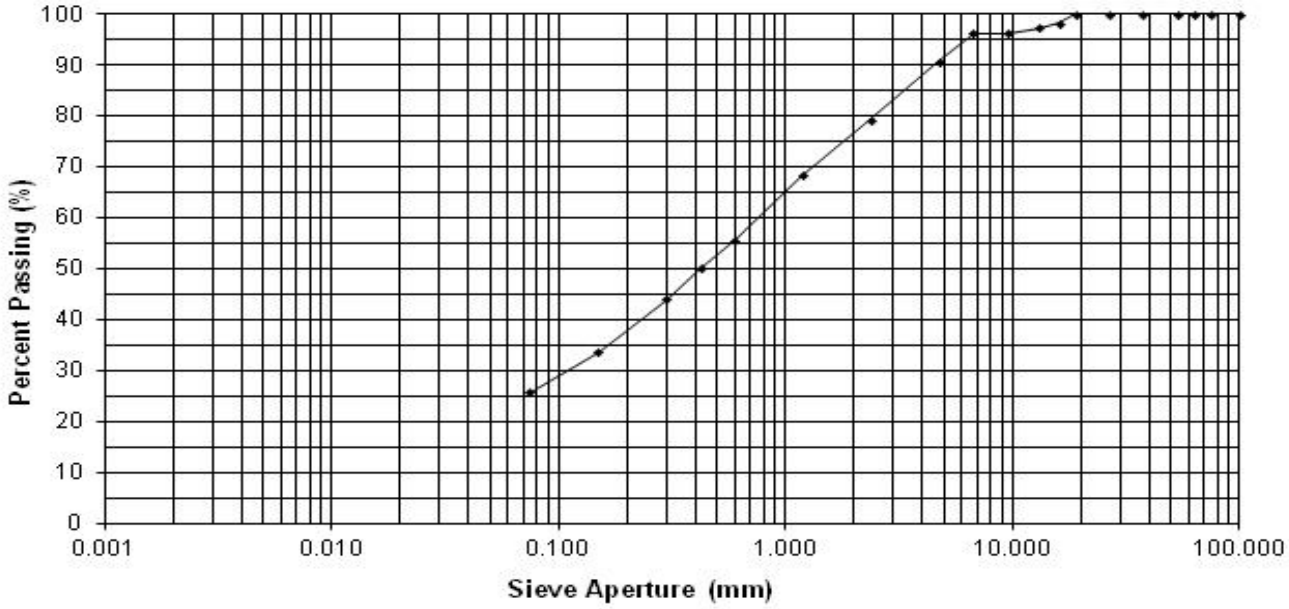
SGS Australia Pty Ltd
PO Box 486 Bassendean WA 6934
5 Yelland Way
Bassendean WA 6054

Client:	ATC Williams Pty Ltd	Client Job No:	112391.11
Project:	Yangibana Rare Earth	Order No:	
Location:	Gascoyne Region, WA	Tested Date:	14/12/2016
SGS Job Number:	16-01-2448	Sample No:	16-MT-9940
Lab:	Bassendean	Sample ID:	CTTP-24 (0.8m - 1.1m)

Particle Size Distribution of a Soil

AS1289.3.6.1



Sieve Size (mm)	% Passing	Sieve Size (mm)	% Passing
100	100	9.5	96
75	100	6.7	96
63	100	4.75	91
53	100	2.36	79
37.5	100	1.18	68
26.5	100	0.6	56
19.0	100	0.425	50
16.0	98	0.300	44
13.2	97	0.150	34
		0.075	26

Note: Sample supplied by client.

Authorised Signatory: (Samantha McDonald) Date: 18/01/2017

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PO Box 486 Bassendean WA 6934
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Bassendean WA 6054

Client:	ATC Williams Pty Ltd	Client Job No:	112391.11
Project:	Yangibana Rare Earth	Order No:	
Location:	Gascoyne Region, WA	Tested Date:	13/01/2017
SGS Job Number:	16-01-2448	Sample No:	16-MT-9940
Lab:	Bassendean	Sample ID:	CTTP-24 (0.8m - 1.1m)

Atterberg Limits (1 Point Casagrande) with Linear Shrinkage

AS 1289.3.1.2(Liquid Limit), 3.2.1(Liquid Limit), 3.3.1(Plasicity Index), 3.4.1(Linear Shrinkage)

Liquid Limit (%):	**36**
Plastic Limit (%):	**18**
Plastic Index (%):	**18**
Linear Shrinkage (%):	**11.0**
Nature of shrinkage:	Cracked
Length of Mould (mm):	250
History of Sample:	Air Dried
Method of Preparation:	Dry Sieved

Note: Sample supplied by client.

Authorised Signatory: (Samantha McDonald) Date: 18/01/2017

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Bassendean WA 6054

Client:	ATC Williams Pty Ltd	Client Job No:	112391.11
Project:	Yangibana Rare Earth	Order No:	
Location:	Gascoyne Region, WA	Tested Date:	14/12/2016
SGS Job Number:	16-01-2448	Sample No:	16-MT-9941
Lab:	Bassendean	Sample ID:	CTTP-27 (0.8m - 1.0m)

MOISTURE CONTENT

Test Method: AS1289.2.1.1 - Convection Oven

Moisture Content (%)	**5.7**

Note: Sample supplied by client.

Authorised Signatory: (Samantha McDonald) Date: 20/12/2016

TEST CERTIFICATE

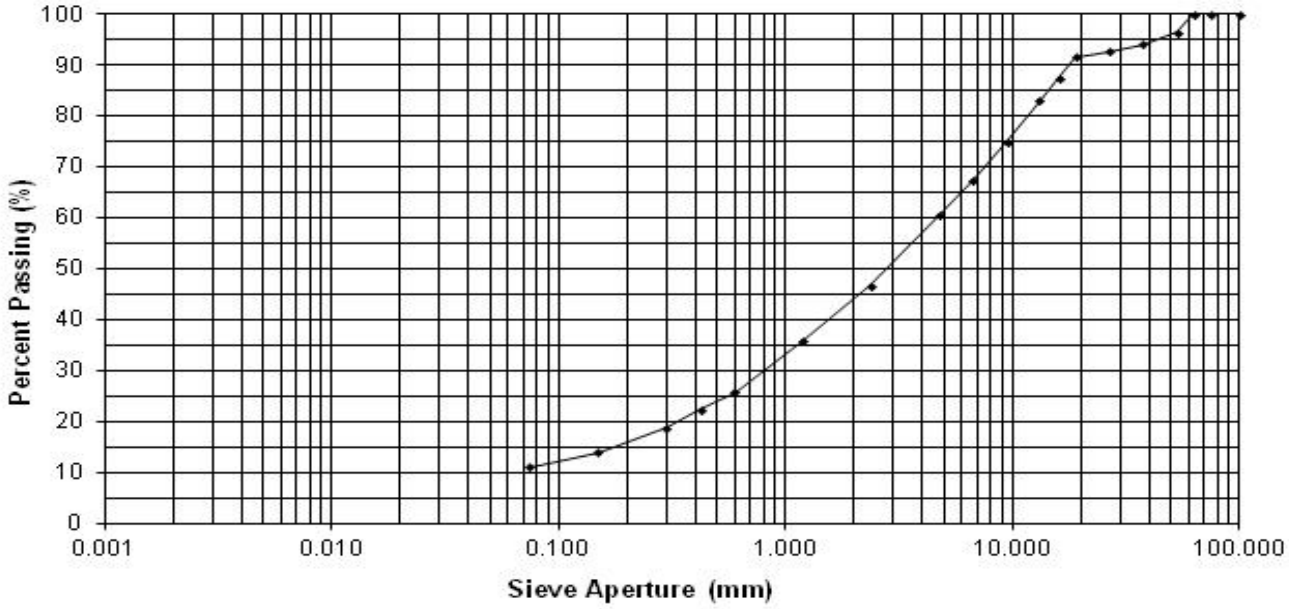
au.ind.admin@sgs.com
ABN: 44 000 964 278
ph: 1300 781 744
fx: +61 (0)8 9378 0199

SGS Australia Pty Ltd
PO Box 486 Bassendean WA 6934
5 Yelland Way
Bassendean WA 6054

Client:	ATC Williams Pty Ltd	Client Job No:	112391.11
Project:	Yangibana Rare Earth	Order No:	
Location:	Gascoyne Region, WA	Tested Date:	14/12/2016
SGS Job Number:	16-01-2448	Sample No:	16-MT-9941
Lab:	Bassendean	Sample ID:	CTTP-27 (0.8m - 1.0m)

Particle Size Distribution of a Soil

AS1289.3.6.1



Sieve Size (mm)	% Passing	Sieve Size (mm)	% Passing
100	100	9.5	75
75	100	6.7	67
63	100	4.75	60
53	97	2.36	47
37.5	94	1.18	36
26.5	93	0.6	26
19.0	92	0.425	22
16.0	88	0.300	19
13.2	83	0.150	14
		0.075	11

Note: Sample supplied by client.

Authorised Signatory: (Benjamin Brumpton) Date: 11/01/2017

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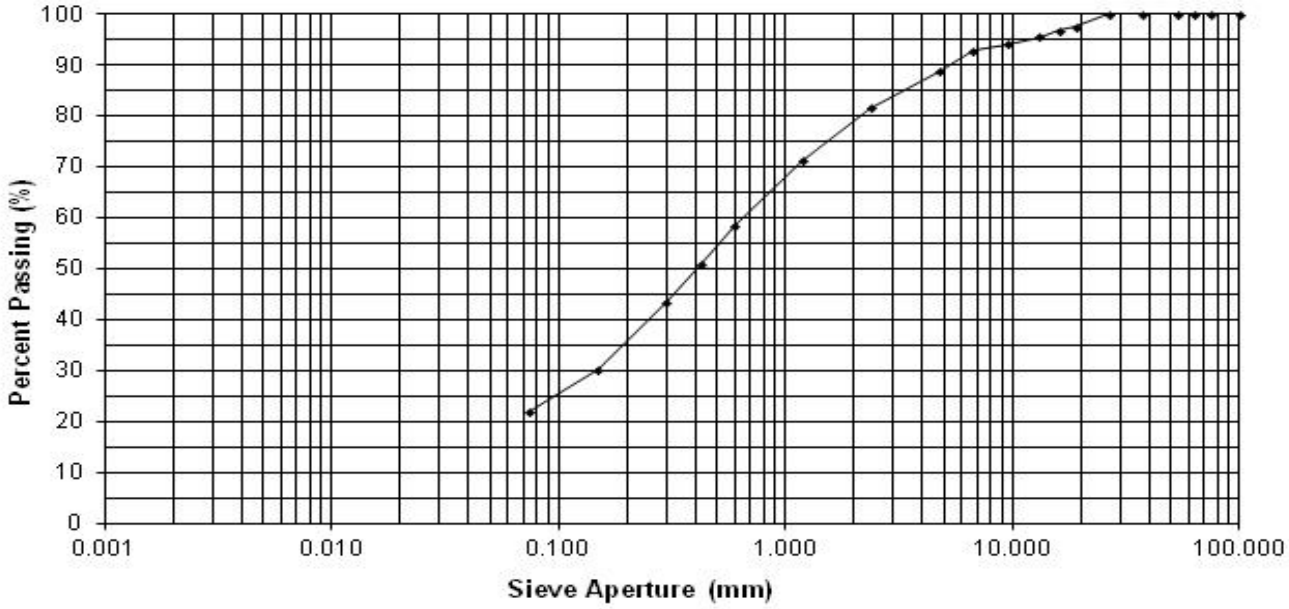
TEST CERTIFICATE

SGS Australia Pty Ltd
PO Box 486 Bassendean WA 6934
5 Yelland Way
Bassendean WA 6054

Client:	ATC Williams Pty Ltd	Client Job No:	112391.11
Project:	Yangibana Rare Earth	Order No:	
Location:	Gascoyne Region, WA	Tested Date:	9/12/2016
SGS Job Number:	16-01-2448	Sample No:	16-MT-9942
Lab:	Bassendean	Sample ID:	CTTP-30 (0.5m - 0.7m)

Particle Size Distribution of a Soil

AS1289.3.6.1



Sieve Size (mm)	% Passing	Sieve Size (mm)	% Passing
100	100	9.5	94
75	100	6.7	93
63	100	4.75	89
53	100	2.36	82
37.5	100	1.18	71
26.5	100	0.6	59
19.0	98	0.425	51
16.0	97	0.300	43
13.2	96	0.150	30
		0.075	22

Date Sampled: Unknown

Note: Sample supplied by client.

Authorised Signatory: (Benjamin Brumpton) Date: 10/01/2017

TEST CERTIFICATE

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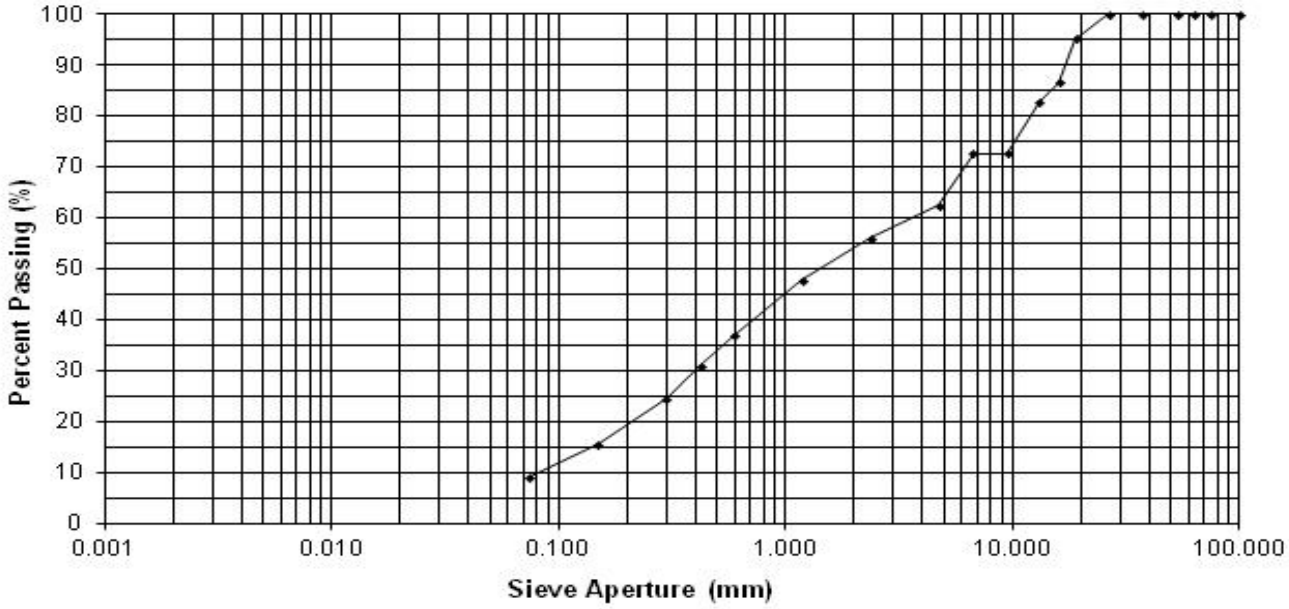
ABN: 44 000 964 278
ph: 1300 781 744
fx: +61 (0)8 9378 0199

SGS Australia Pty Ltd
PO Box 486 Bassendean WA 6934
5 Yelland Way
Bassendean WA 6054

Client:	ATC Williams Pty Ltd	Client Job No:	112391.11
Project:	Yangibana Rare Earth	Order No:	
Location:	Gascoyne Region, WA	Tested Date:	9/12/2016
SGS Job Number:	16-01-2448	Sample No:	16-MT-9943
Lab:	Bassendean	Sample ID:	CTTP-30 (1.0m - 1.2m)

Particle Size Distribution of a Soil

AS1289.3.6.1



Sieve Size (mm)	% Passing	Sieve Size (mm)	% Passing
100	100	9.5	73
75	100	6.7	73
63	100	4.75	62
53	100	2.36	56
37.5	100	1.18	48
26.5	100	0.6	37
19.0	95	0.425	31
16.0	87	0.300	24
13.2	83	0.150	16
		0.075	9

Note: Sample supplied by client.

Authorised Signatory: (Samantha McDonald) Date: 18/01/2017

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS		LABORATORY DETAILS	
Contact	Kathy McDougall	Manager	Ros Ma
Client	Groundwater Resource Management	Laboratory	SGS Perth Environmental
Address	PO Box 8110 Fremantle High Street, Fremantle, WA, 6160 23 Parry Street Fremantle 6160 KARDINYA WA	Address	28 Reid Rd Perth Airport WA 6105
Telephone	9433 2222	Telephone	(08) 9373 3500
Facsimile	9433 2322	Facsimile	(08) 9373 3556
Email	kathy@g-r-m.com.au	Email	au.environmental.perth@sgs.com
Project	**Yangibana**	SGS Reference	**PE112999 R0**
Order Number	**J160014**	Date Received	22 Dec 2016
Samples	1	Date Reported	09 Jan 2017

COMMENTS

Accredited for compliance with ISO/IEC 17025. NATA accredited laboratory 2562(898/20210).

Metals: Over range on ICPMS Method AN318 was taken from ICPOES Method AN320.

SIGNATORIES

Donald Smith
Chemist

Michael McKay
Inorganics and ARD Supervisor

Ohmar David
Metals Chemist

Tommy Cheng
ICP Chemist

Parameter	Units	LOR	Sample Number: PE112999.001 Sample Matrix: Water Sample Name: BHCTD02
pH in water Method: AN101 Tested: 23/12/2016			
pH**	pH Units	-	**7.9**
Conductivity and TDS by Calculation - Water Method: AN106 Tested: 23/12/2016			
Conductivity @ 25 C	µS/cm	2	**1800**
Total Dissolved Solids (by calculation)	mg/L	2	**1100**
Total and Volatile Suspended Solids (TSS / VSS) Method: AN114 Tested: 6/1/2017			
Total Suspended Solids Dried at 103-105°C	mg/L	5	**310**
Sulphate in water Method: AN275 Tested: 29/12/2016			
Sulphate, SO4	mg/L	1	**130**
Metals in Water (Dissolved) by ICPOES Method: AN320/AN321 Tested: 29/12/2016			
Calcium, Ca	mg/L	0.2	**76**
Magnesium, Mg	mg/L	0.1	**53**
Potassium, K	mg/L	0.1	**12**
Sodium, Na	mg/L	0.5	**250**
Trace Metals (Dissolved) in Water by ICPMS Method: AN318 Tested: 28/12/2016			
Aluminium, Al	µg/L	5	<5
Antimony, Sb	µg/L	1	<1
Arsenic, As	µg/L	1	<1
Barium, Ba	µg/L	1	**68**
Beryllium, Be	µg/L	1	<1
Boron, B	µg/L	5	**700**
Cadmium, Cd	µg/L	0.1	<0.1
Chromium, Cr	µg/L	1	<1
Cobalt, Co	µg/L	1	**1**
Copper, Cu	µg/L	1	<1
Iron, Fe	µg/L	5	**11**
Lead, Pb	µg/L	1	<1
Manganese, Mn	µg/L	1	**230**
Molybdenum, Mo	µg/L	1	**16**
Nickel, Ni	µg/L	1	**2**
Selenium, Se	µg/L	1	<1
Strontium, Sr	µg/L	1	**640**
Thorium, Th	µg/L	1	<1
Uranium, U	µg/L	1	**18**
Vanadium, V	µg/L	1	**2**
Zinc, Zn	µg/L	5	**10**

			Sample Number	PE112999.001
			Sample Matrix	Water
			Sample Name	BHCTD02
Parameter		Units	LOR	
Mercury (dissolved) in Water	**Method: AN311(Perth)/AN312**	**Tested: 29/12/2016**		
Mercury		mg/L	0.00005	<0.00005

QC SUMMARY

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Conductivity and TDS by Calculation - Water **Method: ME-(AU)-[ENV]AN106**

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Conductivity @ 25 C	LB126450	µS/cm	2	<2	0 - 1%	96 - 102%
Total Dissolved Solids (by calculation)	LB126450	mg/L	2	<2		NA

Mercury (dissolved) in Water **Method: ME-(AU)-[ENV]AN311(Perth)/AN312**

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Mercury	LB126442	mg/L	0.00005	<0.00005	0%	102 - 113%	104 - 106%

Metals in Water (Dissolved) by ICPOES **Method: ME-(AU)-[ENV]AN320/AN321**

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Calcium, Ca	LB126432	mg/L	0.2	<0.2	0%	98%	88%
Magnesium, Mg	LB126432	mg/L	0.1	<0.1	0%	102%	92%
Potassium, K	LB126432	mg/L	0.1	<0.1	3%	104%	90%
Sodium, Na	LB126432	mg/L	0.5	<0.5	1%	109%	88%

pH in water **Method: ME-(AU)-[ENV]AN101**

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
pH**	LB126450	pH Units	-	6.1 - 6.2	0%	101%

Sulphate in water **Method: ME-(AU)-[ENV]AN275**

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Sulphate, SO4	LB126429	mg/L	1	<1	0 - 1%	103%	83 - 92%

Total and Volatile Suspended Solids (TSS / VSS) **Method: ME-(AU)-[ENV]AN114**

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Suspended Solids Dried at 103-105°C	LB126623	mg/L	5	<5	2 - 19%	92%

QC SUMMARY

MB blank results are compared to the Limit of Reporting
LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.
DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Trace Metals (Dissolved) in Water by ICPMS **Method: ME-(AU)-[ENV]AN318**

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Aluminium, Al	LB126410	µg/L	5	<5	0%	80%	105%
Antimony, Sb	LB126410	µg/L	1	<1	0%	112%	
Arsenic, As	LB126410	µg/L	1	<1	0%	103%	
Barium, Ba	LB126410	µg/L	1	<1	1%	99%	
Beryllium, Be	LB126410	µg/L	1	<1	0%	109%	
Boron, B	LB126410	µg/L	5	<5	1%	89%	
Cadmium, Cd	LB126410	µg/L	0.1	<0.1	0%	116%	
Chromium, Cr	LB126410	µg/L	1	<1	0%	102%	
Cobalt, Co	LB126410	µg/L	1	<1	6%	99%	
Copper, Cu	LB126410	µg/L	1	<1	0%	106%	
Iron, Fe	LB126410	µg/L	5	<5	1%	110%	112%
Lead, Pb	LB126410	µg/L	1	<1	0%	108%	
Manganese, Mn	LB126410	µg/L	1	<1	0%	101%	103%
Molybdenum, Mo	LB126410	µg/L	1	<1	0%	106%	
Nickel, Ni	LB126410	µg/L	1	<1	7%	100%	
Selenium, Se	LB126410	µg/L	1	<1	0%	113%	80%
Strontium, Sr	LB126410	µg/L	1	<1	0%	117%	
Thorium, Th	LB126410	µg/L	1	<1	0%	84%	
Uranium, U	LB126410	µg/L	1	<1	1%	104%	
Vanadium, V	LB126410	µg/L	1	<1	1%	104%	
Zinc, Zn	LB126410	µg/L	5	<5	1%	114%	

METHOD SUMMARY

METHOD	METHODOLOGY SUMMARY
AN101	pH in Soil Sludge Sediment and Water: pH is measured electrometrically using a combination electrode (glass plus reference electrode) and is calibrated against 3 buffers purchased commercially. For soils, an extract with water is made at a ratio of 1:5 and the pH determined and reported on the extract. Reference APHA 4500-H+.
AN106	Conductivity and TDS by Calculation: Conductivity is measured by meter with temperature compensation and is calibrated against a standard solution of potassium chloride. Conductivity is generally reported as µmhos/cm or µS/cm @ 25°C. For soils, an extract with water is made at a ratio of 1:5 and the EC determined and reported on the extract, or calculated back to the as-received sample. Total Dissolved Salts can be estimated from conductivity using a conversion factor, which for natural waters, is in the range 0.55 to 0.75. SGS use 0.6. Reference APHA 2510 B.
AN114	Total Suspended and Volatile Suspended Solids: The sample is homogenised by shaking and a known volume is filtered through a pre-weighed GF/C filter paper and washed well with deionised water. The filter paper is dried and reweighed. The TSS is the residue retained by the filter per unit volume of sample. Reference APHA 2540 D. Internal Reference AN114
AN275	sulfate by Aquakem DA: sulfate is precipitated in an acidic medium with barium chloride. The resulting turbidity is measured photometrically at 405nm and compared with standard calibration solutions to determine the sulfate concentration in the sample. Reference APHA 4500-SO42-. Internal reference AN275.
AN311(Perth)/AN312	Mercury by Cold Vapour AAS in Waters: Mercury ions are reduced by stannous chloride reagent in acidic solution to elemental mercury. This mercury vapour is purged by nitrogen into a cold cell in an atomic absorption spectrometer or mercury analyser. Quantification is made by comparing absorbances to those of the calibration standards. Reference APHA 3112/3500.
AN318	Determination of elements at trace level in waters by ICP-MS technique, in accordance with USEPA 6020A.
AN320/AN321	Metals by ICP-OES: Samples are preserved with 10% nitric acid for a wide range of metals and some non-metals. This solution is measured by Inductively Coupled Plasma. Solutions are aspirated into an argon plasma at 8000-10000K and emit characteristic energy or light as a result of electron transitions through unique energy levels. The emitted light is focused onto a diffraction grating where it is separated into components .
AN320/AN321	Photomultipliers or CCDs are used to measure the light intensity at specific wavelengths. This intensity is directly proportional to concentration. Corrections are required to compensate for spectral overlap between elements. Reference APHA 3120 B.

FOOTNOTES

IS	Insufficient sample for analysis.	LOR	Limit of Reporting
LNR	Sample listed, but not received.	↑↓	Raised or Lowered Limit of Reporting
*	NATA accreditation does not cover the performance of this service.	QFH	QC result is above the upper tolerance
		QFL	QC result is below the lower tolerance
**	Indicative data, theoretical holding time exceeded.	-	The sample was not analysed for this analyte
		NVL	Not Validated

Samples analysed as received.
Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calcuated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the " Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.
Note that in terms of units of radioactivity:

a. 1 Bq is equivalent to 27 pCi
b. 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here : http://www.sgs.com.au/~/media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf

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Analytical Reference Laboratory

LABORATORY REPORT

Job Number: 15-4218
Revision: 00
Date: 19 June 2015

ADDRESS: **ATC Williams Pty Ltd**
Unit 1A, 21 Teddington Road
BURSWOOD WA 6100

ATTENTION: John Leavy

DATE RECEIVED: 10/06/2015

YOUR REFERENCE: ATCW290515

PURCHASE ORDER: 112391

APPROVALS:

Douglas Todd
Laboratory Manager

Sam Becker
Inorganic Supervisor

REPORT COMMENTS:

Samples are analysed on an as received basis unless otherwise noted.
NATA accreditation for alkalinity is held to pH 8.3 and 4.5, not pH 9.5
NATA accreditation for acidity is held to pH 8.3, not pH 9.5

METHOD REFERENCES:

ARL No. 29/402/403	Metals in Water by AAS/ICPOES/ICPMS
ARL No. 029	Metals in Water by AAS
ARL No. 040	Arsenic by Hydride Atomic Absorption
ARL No. 315	Reactive Silica in Water by Discrete Analyser
ARL No. 014	pH in Water
ARL No. 017	Total Dissolved Solids (At 105^{o}C)
ARL No. 016	Total Suspended Solids
ARL No. 037	Alkalinity in Water
ARL No. 021	Acidity in Water
ARL No. 308	Total Phosphorus in Water by Discrete Analyser
ARL No. 301	Sulphate in Water by Discrete Analyser
ARL No. 305	Chloride in Water by Discrete Analyser
ARL No. 321	Fluoride in Water by Discrete Analyser
ARL No. 313/319	NOx in Water by Discrete Analyser

NATA
WORLD RECOGNISED ACCREDITATION
Accredited for compliance with ISO/IEC 17025
NATA Accreditation No. 2377

Analytical Reference Laboratory (WA) Pty. Ltd.
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www.arlwa.com.au ABN: 91 050 159 898

LABORATORY REPORT

ATC Williams Pty Ltd

ARL Job No: 15-4218 *Revision: 00* *Date:* 19 June 2015

Metals in Water Sample No: Sample Description:	LOR	UNITS	15-4218-1 Edmund HST	15-4218-2 Minga Well	15-4218-3 Contessi Bore	15-4218-4 Edmund Well	15-4218-5 YGBWBI
Aluminium - Total	0.1	mg/L	<0.1	<0.1	<0.1	0.2	0.2
Iron - Total	0.01	mg/L	0.15	0.07	0.03	0.22	0.34
Sulphur - Dissolved	0.05	mg/L	96	38	17	110	25
Calcium - Dissolved	0.1	mg/L	66	39	30	79	61
Magnesium - Dissolved	0.1	mg/L	90	58	48	100	38
Sodium - Dissolved	0.1	mg/L	280	150	70	610	150
Aluminium - Dissolved	0.1	mg/L	<0.1	<0.1	<0.1	<0.1	<0.1
Barium - Dissolved	0.01	mg/L	0.02	0.04	0.16	0.04	0.23
Beryllium - Dissolved	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Boron - Dissolved	0.01	mg/L	1.0	0.50	0.26	1.4	0.36
Chromium - Dissolved	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium - Dissolved	0.002	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Cobalt - Dissolved	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Copper - Dissolved	0.01	mg/L	<0.01	<0.01	0.02	0.04	<0.01
Iron - Dissolved	0.01	mg/L	0.07	<0.01	<0.01	<0.01	<0.01
Lead - Dissolved	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Manganese - Dissolved	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	0.07
Molybdenum - Dissolved	0.01	mg/L	<0.01	0.01	0.01	0.01	0.03
Nickel - Dissolved	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Silver - Dissolved	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Strontium - Dissolved	0.01	mg/L	0.76	0.41	0.30	1.1	0.52
Tin - Dissolved	0.01	mg/L	<0.01	<0.01	0.02	<0.01	<0.01
Titanium - Dissolved	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Vanadium - Dissolved	0.01	mg/L	0.04	0.05	<0.01	0.03	<0.01
Zinc - Dissolved	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Antimony - Dissolved	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic - Dissolved	0.001	mg/L	0.003	0.002	<0.001	<0.001	<0.001
Selenium - Dissolved	0.001	mg/L	0.007	0.003	<0.001	0.003	0.005
Silicon - Dissolved	0.1	mg/L	32	36	30	23	24
Thorium - Dissolved	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium - Dissolved	0.001	mg/L	0.004	0.004	0.020	0.038	0.016

Analytical Reference Laboratory (WA) Pty. Ltd.
46-48 Banksia Road, Welshpool, Western Australia 6106 Telephone: 08 6253 4444 Facsimile: 08 6253 4440
www.arlwa.com.au ABN: 91 050 159 898

LABORATORY REPORT

ATC Williams Pty Ltd

ARL Job No: 15-4218 *Revision: 00* *Date:* 19 June 2015

Metals in Water Sample No: Sample Description:	LOR	UNITS	15-4218-6 RCO81	15-4218-7 Frasers Well	15-4218-8 Yangibana Bore	15-4218-9 Woodsys Bore	15-4218-10 Red Hill 2
Aluminium - Total	0.1	mg/L	1.8	<0.1	<0.1	<0.1	0.9
Iron - Total	0.01	mg/L	2.3	0.02	0.02	<0.01	1.5
Sulphur - Dissolved	0.05	mg/L	35	52	60	79	250
Calcium - Dissolved	0.1	mg/L	60	47	120	110	250
Magnesium - Dissolved	0.1	mg/L	43	40	75	110	130
Sodium - Dissolved	0.1	mg/L	340	550	350	380	620
Aluminium - Dissolved	0.1	mg/L	0.8	<0.1	<0.1	<0.1	<0.1
Barium - Dissolved	0.01	mg/L	0.08	0.04	0.03	0.03	0.07
Beryllium - Dissolved	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Boron - Dissolved	0.01	mg/L	0.61	0.83	0.55	0.80	2.1
Chromium - Dissolved	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Cadmium - Dissolved	0.002	mg/L	<0.002	<0.002	<0.002	<0.002	<0.002
Cobalt - Dissolved	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Copper - Dissolved	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Iron - Dissolved	0.01	mg/L	0.26	<0.01	<0.01	<0.01	0.19
Lead - Dissolved	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Manganese - Dissolved	0.01	mg/L	0.01	<0.01	<0.01	<0.01	0.87
Molybdenum - Dissolved	0.01	mg/L	0.02	0.02	<0.01	<0.01	0.01
Nickel - Dissolved	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Silver - Dissolved	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Strontium - Dissolved	0.01	mg/L	0.58	0.52	0.92	0.82	2.2
Tin - Dissolved	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Titanium - Dissolved	0.01	mg/L	0.02	<0.01	<0.01	<0.01	<0.01
Vanadium - Dissolved	0.01	mg/L	<0.01	<0.01	<0.01	0.01	<0.01
Zinc - Dissolved	0.01	mg/L	<0.01	<0.01	<0.01	<0.01	<0.01
Antimony - Dissolved	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Arsenic - Dissolved	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	0.004
Selenium - Dissolved	0.001	mg/L	0.008	0.005	0.005	0.003	<0.001
Silicon - Dissolved	0.1	mg/L	20	24	23	26	31
Thorium - Dissolved	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001
Uranium - Dissolved	0.001	mg/L	0.014	0.025	0.029	0.009	0.079

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LABORATORY REPORT

ATC Williams Pty Ltd

ARL Job No: 15-4218 *Revision: 00* *Date:* 19 June 2015

Metals in Water Sample No: Sample Description:	LOR	UNITS	15-4218-11 Dup 1
Aluminium - Total	0.1	mg/L	<0.1
Iron - Total	0.01	mg/L	0.13
Sulphur - Dissolved	0.05	mg/L	110
Calcium - Dissolved	0.1	mg/L	68
Magnesium - Dissolved	0.1	mg/L	93
Sodium - Dissolved	0.1	mg/L	210
Aluminium - Dissolved	0.1	mg/L	<0.1
Barium - Dissolved	0.01	mg/L	0.02
Beryllium - Dissolved	0.01	mg/L	<0.01
Boron - Dissolved	0.01	mg/L	0.91
Chromium - Dissolved	0.01	mg/L	<0.01
Cadmium - Dissolved	0.002	mg/L	<0.002
Cobalt - Dissolved	0.01	mg/L	<0.01
Copper - Dissolved	0.01	mg/L	<0.01
Iron - Dissolved	0.01	mg/L	0.06
Lead - Dissolved	0.01	mg/L	<0.01
Manganese - Dissolved	0.01	mg/L	<0.01
Molybdenum - Dissolved	0.01	mg/L	<0.01
Nickel - Dissolved	0.01	mg/L	<0.01
Silver - Dissolved	0.01	mg/L	<0.01
Strontium - Dissolved	0.01	mg/L	0.71
Tin - Dissolved	0.01	mg/L	<0.01
Titanium - Dissolved	0.01	mg/L	<0.01
Vanadium - Dissolved	0.01	mg/L	0.04
Zinc - Dissolved	0.01	mg/L	<0.01
Antimony - Dissolved	0.001	mg/L	<0.001
Arsenic - Dissolved	0.001	mg/L	0.003
Selenium - Dissolved	0.001	mg/L	0.005
Silicon - Dissolved	0.1	mg/L	33
Thorium - Dissolved	0.001	mg/L	<0.001
Uranium - Dissolved	0.001	mg/L	0.004

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LABORATORY REPORT

ATC Williams Pty Ltd

ARL Job No: 15-4218 *Revision: 00* *Date:* 19 June 2015

Physical Parameters Sample No: Sample Description:	LOR	UNITS	15-4218-1 Edmund HST	15-4218-2 Minga Well	15-4218-3 Contessi Bore	15-4218-4 Edmund Well	15-4218-5 YGBWBI
pH	0.1	pH units	8.6	8.2	8.5	7.9	7.8
Total Dissolved Solids	5	mg/L	1,400	920	600	2,200	870
Total Suspended Solids	5	mg/L	<5	<5	7	17	5
Alkalinity	5	mgCaCO3/L	300	520	360	430	300
Alkalinity to pH9.5	5	mgCaCO3/L	<5	<5	<5	<5	<5
Acidity to pH9.5	5	mgCaCO3/L	82	120	77	130	95

Physical Parameters Sample No: Sample Description:	LOR	UNITS	15-4218-6 RCO81	15-4218-7 Frasers Well	15-4218-8 Yangibana Bore	15-4218-9 Woodsys Bore	15-4218-10 Red Hill 2
pH	0.1	pH units	7.4	8.0	7.5	7.7	7.2
Total Dissolved Solids	5	mg/L	1,300	1,600	1,600	1,800	2,800
Total Suspended Solids	5	mg/L	84	<5	<5	<5	76
Alkalinity	5	mgCaCO3/L	370	410	360	440	440
Alkalinity to pH9.5	5	mgCaCO3/L	<5	<5	<5	<5	<5
Acidity to pH9.5	5	mgCaCO3/L	110	93	120	140	200

Physical Parameters Sample No: Sample Description:	LOR	UNITS	15-4218-11 Dup 1
pH	0.1	pH units	8.6
Total Dissolved Solids	5	mg/L	1,400
Total Suspended Solids	5	mg/L	7
Alkalinity	5	mgCaCO3/L	640
Alkalinity to pH9.5	5	mgCaCO3/L	<5
Acidity to pH9.5	5	mgCaCO3/L	82

Total Phosphorus in Water Sample No: Sample Description:	LOR	UNITS	15-4218-1 Edmund HST	15-4218-2 Minga Well	15-4218-3 Contessi Bore	15-4218-4 Edmund Well	15-4218-5 YGBWBI
Total Phosphorus	0.01	mg/L	0.09	0.12	0.06	0.07	0.13

Total Phosphorus in Water Sample No: Sample Description:	LOR	UNITS	15-4218-6 RCO81	15-4218-7 Frasers Well	15-4218-8 Yangibana Bore	15-4218-9 Woodsys Bore	15-4218-10 Red Hill 2
Total Phosphorus	0.01	mg/L	0.11	0.14	0.04	0.12	0.39

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LABORATORY REPORT

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ARL Job No: 15-4218 *Revision: 00* *Date:* 19 June 2015

Total Phosphorus in Water Sample No: Sample Description:	LOR	UNITS	15-4218-11 Dup 1
Total Phosphorus	0.01	mg/L	0.11

Ions by Discrete Analyser Sample No: Sample Description:	LOR	UNITS	15-4218-1 Edmund HST	15-4218-2 Minga Well	15-4218-3 Contessi Bore	15-4218-4 Edmund Well	15-4218-5 YGBWBI
Sulphate	1	mg/L	330	110	45	320	73
Chloride	5	mg/L	270	110	95	810	240
Fluoride	0.1	mg/L	1.4	2.3	2.5	2.9	2.1
Nitrate-N	0.01	mg/L	9.0	6.5	0.05	17	11

Ions by Discrete Analyser Sample No: Sample Description:	LOR	UNITS	15-4218-6 RCO81	15-4218-7 Frasers Well	15-4218-8 Yangibana Bore	15-4218-9 Woodsys Bore	15-4218-10 Red Hill 2
Sulphate	1	mg/L	100	160	180	250	830
Chloride	5	mg/L	410	570	530	590	710
Fluoride	0.1	mg/L	3.0	3.0	2.2	1.3	4.0
Nitrate-N	0.01	mg/L	21	12	18	13	<0.01

Ions by Discrete Analyser Sample No: Sample Description:	LOR	UNITS	15-4218-11 Dup 1
Sulphate	1	mg/L	350
Chloride	5	mg/L	310
Fluoride	0.1	mg/L	1.4
Nitrate-N	0.01	mg/L	9.0

Misc. Inorganics in Water Sample No: Sample Description:	LOR	UNITS	15-4218-1 Edmund HST	15-4218-2 Minga Well	15-4218-3 Contessi Bore	15-4218-4 Edmund Well	15-4218-5 YGBWBI
Hardness	5	mg $CaCO_3$/L	530	340	270	610	310

Misc. Inorganics in Water Sample No: Sample Description:	LOR	UNITS	15-4218-6 RCO81	15-4218-7 Frasers Well	15-4218-8 Yangibana Bore	15-4218-9 Woodsys Bore	15-4218-10 Red Hill 2
Hardness	5	mg $CaCO_3$/L	330	280	610	730	1,200

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ATC Williams Pty Ltd

ARL Job No: 15-4218 *Revision: 00* *Date:* 19 June 2015

Misc. Inorganics in Water Sample No: Sample Description:	LOR	UNITS	15-4218-11 Dup 1
Hardness	5	mg $CaCO_3$/L	550

Result Definitions

LOR Limit of Reporting
[NT] Not Tested
[ND] Not Detected at indicated Limit of Reporting
[NR] Analysis Not Requested
(SS) Surrogate Standard Compound - Used for QC purposes. Acceptance Criteria is 60-120%.

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ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EM1611114**	Page	: 1 of 6
Client	: **ATC WILLIAMS P/L**	Laboratory	: Environmental Division Melbourne
Contact	: JOHN LEAVY	Contact	:
Address	: 1141 HAY STREET WEST PERTH W.A. 6005	Address	: 4 Westall Rd Springvale VIC Australia 3171
Telephone	: +61 07 3352 7222	Telephone	: +61-3-8549 9600
Project	: 112391.03	Date Samples Received	: 21-Sep-2016 15:55
Order number	: ----	Date Analysis Commenced	: 28-Sep-2016
C-O-C number	: ----	Issue Date	: 11-Oct-2016 12:33
Sampler	: ----		
Site	: ----		
Quote number	: ----		
No. of samples received	: 2		
No. of samples analysed	: 2		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Ben Felgendrejeris		Brisbane Acid Sulphate Soils, Stafford, QLD
Chris Lemaitre	Non-Metals Team Leader	Melbourne Inorganics, Springvale, VIC
Dilani Fernando	Senior Inorganic Chemist	Melbourne Inorganics, Springvale, VIC
Herman Lin	Laboratory Manager	Melbourne Inorganics, Springvale, VIC
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Titus Vimalasiri	Metals Teamleader	Radionuclides, Fyshwick, ACT

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- EG035T: Mercury result for EM1611114 #2 has been confirmed by re-preparation and re-analysis.
- TDS by method EA-015 may bias high for EM1611114 #2 due to the presence of fine particulate matter, which may pass through the prescribed GF/C paper.
- Sample was filtered through a 0.45um filter prior to the dissolved metals analysis.
- ASS: EA013 (ANC) Fizz Rating: 0- None; 1- Slight; 2- Moderate; 3- Strong; 4- Very Strong; 5- Lime.
- ED007 and ED008: When Exchangeable Al is reported from these methods, it should be noted that Rayment & Lyons (2011) suggests Exchange Acidity by 1M KCl - Method 15G1 (ED005) is a more suitable method for the determination of exchange acidity (H+ + Al3+).

Analytical Results

Sub-Matrix: SLUDGE (Matrix: SOIL)				Client sample ID	19516	----	----	----	----
				Client sampling date / time	[21-Sep-2016]	----	----	----	----
Compound	CAS Number	LOR	Unit		EM1611114-001	--------	--------	--------	--------
					Result	----	----	----	----
EA009: Nett Acid Production Potential									
Net Acid Production Potential	----	0.5	kg H2SO4/t		**2.3**	----	----	----	----
EA011: Net Acid Generation									
pH (OX)	----	0.1	pH Unit		**8.0**	----	----	----	----
NAG (pH 4.5)	----	0.1	kg H2SO4/t		<0.1	----	----	----	----
NAG (pH 7.0)	----	0.1	kg H2SO4/t		<0.1	----	----	----	----
EA013: Acid Neutralising Capacity									
ANC as H2SO4	----	0.5	kg H2SO4 equiv./t		**1.1**	----	----	----	----
ANC as CaCO3	----	0.1	% CaCO3		**0.1**	----	----	----	----
Fizz Rating	----	0	Fizz Unit		**0**	----	----	----	----
EA055: Moisture Content									
Moisture Content (dried @ 103°C)	----	1	%		**16.2**	----	----	----	----
ED007: Exchangeable Cations									
Exchangeable Calcium	----	0.1	meq/100g		**1.0**	----	----	----	----
Exchangeable Magnesium	----	0.1	meq/100g		**0.3**	----	----	----	----
Exchangeable Potassium	----	0.1	meq/100g		<0.1	----	----	----	----
Exchangeable Sodium	----	0.1	meq/100g		**1.3**	----	----	----	----
Cation Exchange Capacity	----	0.1	meq/100g		**2.8**	----	----	----	----
ED040N: Sulfate - Calcium Phosphate Soluble (NEPM)									
Sulfate as SO4 2-	14808-79-8	50	mg/kg		<50	----	----	----	----
ED042T: Total Sulfur by LECO									
Sulfur - Total as S (LECO)	----	0.01	%		**0.11**	----	----	----	----
ED093S: Soluble Major Cations									
Calcium	7440-70-2	10	mg/kg		<10	----	----	----	----
Magnesium	7439-95-4	10	mg/kg		<10	----	----	----	----
Sodium	7440-23-5	10	mg/kg		**140**	----	----	----	----
EG005T: Total Metals by ICP-AES									
Aluminium	7429-90-5	50	mg/kg		**3350**	----	----	----	----
Antimony	7440-36-0	5	mg/kg		<5	----	----	----	----
Arsenic	7440-38-2	5	mg/kg		<5	----	----	----	----
Barium	7440-39-3	10	mg/kg		**300**	----	----	----	----
Beryllium	7440-41-7	1	mg/kg		**7**	----	----	----	----
Boron	7440-42-8	50	mg/kg		<50	----	----	----	----
Cadmium	7440-43-9	1	mg/kg		<1	----	----	----	----

Analytical Results

Sub-Matrix: SLUDGE (Matrix: SOIL)				Client sample ID	19516	----	----	----	----
				Client sampling date / time	[21-Sep-2016]	----	----	----	----
Compound	CAS Number	LOR	Unit		EM1611114-001	--------	--------	--------	--------
					Result	----	----	----	----
EG005T: Total Metals by ICP-AES - Continued									
Chromium	7440-47-3	2	mg/kg		**334**	----	----	----	----
Cobalt	7440-48-4	2	mg/kg		**12**	----	----	----	----
Copper	7440-50-8	5	mg/kg		**46**	----	----	----	----
Iron	7439-89-6	50	mg/kg		**112000**	----	----	----	----
Lead	7439-92-1	5	mg/kg		**144**	----	----	----	----
Manganese	7439-96-5	5	mg/kg		**953**	----	----	----	----
Molybdenum	7439-98-7	2	mg/kg		**13**	----	----	----	----
Nickel	7440-02-0	2	mg/kg		**156**	----	----	----	----
Selenium	7782-49-2	5	mg/kg		<5	----	----	----	----
Strontium	7440-24-6	2	mg/kg		**19**	----	----	----	----
Vanadium	7440-62-2	5	mg/kg		**34**	----	----	----	----
Zinc	7440-66-6	5	mg/kg		**149**	----	----	----	----
EG020T: Total Metals by ICP-MS									
Thorium	7440-29-1	0.1	mg/kg		**41.4**	----	----	----	----
Uranium	7440-61-1	0.1	mg/kg		**10.6**	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.1	mg/kg		<0.1	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	19616	----	----	----	----
				Client sampling date / time	[21-Sep-2016]	----	----	----	----
Compound	CAS Number	LOR	Unit		EM1611114-002	--------	--------	--------	--------
					Result	----	----	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C									
Total Dissolved Solids @180°C	----	10	mg/L		**4690**	----	----	----	----
EA025: Total Suspended Solids dried at 104 ± 2°C									
Suspended Solids (SS)	----	5	mg/L		**584**	----	----	----	----
EA251: Radium 226 and Radium 228 Activity									
Radium 226	----	0.05	Bq/L		**0.34**	----	----	----	----
Radium 228	----	0.08	Bq/L		**0.82**	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA									
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L		**108**	----	----	----	----
ED093F: Dissolved Major Cations									
Calcium	7440-70-2	1	mg/L		**3**	----	----	----	----
Magnesium	7439-95-4	1	mg/L		**1**	----	----	----	----
Sodium	7440-23-5	1	mg/L		**291**	----	----	----	----
Potassium	7440-09-7	1	mg/L		**6**	----	----	----	----
EG020F: Dissolved Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		**0.03**	----	----	----	----
Antimony	7440-36-0	0.001	mg/L		**0.002**	----	----	----	----
Molybdenum	7439-98-7	0.001	mg/L		**0.180**	----	----	----	----
Strontium	7440-24-6	0.001	mg/L		**0.032**	----	----	----	----
Thorium	7440-29-1	0.001	mg/L		<0.001	----	----	----	----
Uranium	7440-61-1	0.001	mg/L		**0.022**	----	----	----	----
Iron	7439-89-6	0.05	mg/L		**0.92**	----	----	----	----
EG020T: Total Metals by ICP-MS									
Aluminium	7429-90-5	0.01	mg/L		**34.3**	----	----	----	----
Arsenic	7440-38-2	0.001	mg/L		**0.045**	----	----	----	----
Boron	7440-42-8	0.05	mg/L		**0.12**	----	----	----	----
Barium	7440-39-3	0.001	mg/L		**6.07**	----	----	----	----
Beryllium	7440-41-7	0.001	mg/L		**0.033**	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L		**0.0018**	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L		**0.081**	----	----	----	----
Chromium	7440-47-3	0.001	mg/L		**0.107**	----	----	----	----
Copper	7440-50-8	0.001	mg/L		**0.229**	----	----	----	----
Manganese	7439-96-5	0.001	mg/L		**14.0**	----	----	----	----
Nickel	7440-02-0	0.001	mg/L		**0.151**	----	----	----	----
Lead	7439-92-1	0.001	mg/L		**1.42**	----	----	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)				Client sample ID	**19616**	----	----	----	----
				Client sampling date / time	[21-Sep-2016]	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*		**EM1611114-002**	--------	--------	--------	--------
					Result	----	----	----	----
EG020T: Total Metals by ICP-MS - Continued									
Selenium	7782-49-2	0.01	mg/L		**0.10**	----	----	----	----
Vanadium	7440-62-2	0.01	mg/L		**0.20**	----	----	----	----
Zinc	7440-66-6	0.005	mg/L		**0.732**	----	----	----	----
Iron	7439-89-6	0.05	mg/L		**95.1**	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		**0.0001**	----	----	----	----

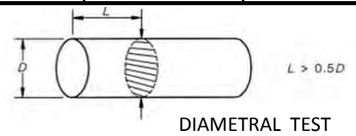
APPENDIX G

Point Load Index Calculations
as per AS 4133.4.1 - 2007

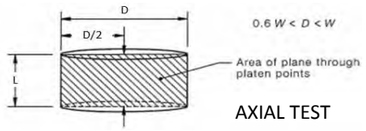
Borehole	Top Depth (m)	Bottom Depth (m)	Rock Description	Moisture Condition	D (mm)	W (mm)	L (mm)	P (kN)	Test type	D_e (mm)	I_s (MPa)	I_{s50} (MPa)	Strength Class to AS1726-1993	Remarks/Comments
CTBH-04	2.50	2.70	GRANITE	INSITU	53.2		200.0	13.40	DIAMETRAL	53.2	4.73	**4.87**	VH	
CTBH-04	8.70	8.94	GRANITE	INSITU	58.9		240.0	16.33	DIAMETRAL	58.9	4.72	**5.07**	VH	
PLBH-01	5.60	5.74	GRANITE	INSITU	60.0		140.0	0.62	DIAMETRAL	60.0	0.17	**0.19**	L	
PLBH-01	14.30	14.40	GRANITE	INSITU	60.0		100.0	0.39	DIAMETRAL	60.0	0.11	**0.12**	L	
PLBH-01	20.90	21.10	GRANITE	INSITU	60.1		200.0	0.23	DIAMETRAL	60.1	0.06	**0.07**	VL	
PLBH-01	23.60	23.82	GRANITE	INSITU	60.0		220.0	0.28	DIAMETRAL	60.0	0.08	**0.08**	VL	
CTBH-01	2.80	3.00	GRANITE	INSITU	60.4		200.0	10.90	DIAMETRAL	60.4	2.99	**3.25**	VH	
CTBH-01	5.00	5.25	GRANITE	INSITU	60.3		250.0	2.53	DIAMETRAL	60.3	0.70	**0.76**	M	
CTBH-01	17.00	17.25	GRANITE	INSITU	60.4		250.0	13.51	DIAMETRAL	60.4	3.70	**4.03**	VH	
CTBH-01	29.60	29.90	GRANITE	INSITU	57.2		300.0	30.52	DIAMETRAL	57.2	9.33	**9.91**	VH	
PLBH-05	4.00	4.20	GRANITE	INSITU	59.7		200.0	16.18	DIAMETRAL	59.7	4.54	**4.92**	VH	
CTBH-05	2.00	2.20	GRANITE	INSITU	59.7		200.0	6.19	DIAMETRAL	59.7	1.74	**1.88**	H	
CTBH-05	8.50	8.65	GRANITE	INSITU	59.9		150.0	14.72	DIAMETRAL	59.9	4.11	**4.45**	VH	
PLBH-02	7.65	7.78	GRANITE	INSITU	55.8		125.0	25.28	DIAMETRAL	55.8	8.12	**8.53**	VH	
PLBH-03	2.20	2.30	GRANITE	INSITU	55.2		100.0	1.51	DIAMETRAL	55.2	0.50	**0.52**	M	
PLBH-03	7.70	7.80	GRANITE	INSITU	58.0		100.0	0.34	DIAMETRAL	58.0	0.10	**0.11**	L	
PLBH-04	2.40	2.51	GRANITE	INSITU	57.2		110.0	5.69	DIAMETRAL	57.2	1.74	**1.85**	H	
PLBH-04	4.40	4.52	GRANITE	INSITU	57.0		120.0	5.13	DIAMETRAL	57.0	1.58	**1.67**	H	

Legend:

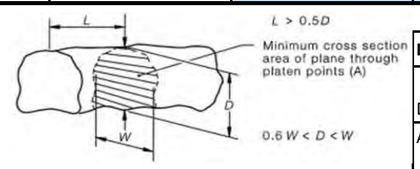
W- Width(Only use for **irregular/block** tests)
L - Length of sample
D - Diameter of sample (Distance between contact points after breaking)
D_e - Equivalent Core Diameter
(axial, block & irregular lump tests) = (4A/p)0.5
A - Minimum Cross-Sectional Area at Loading Points
P - Load at Failure
I_s - Uncorrected Point Load Strength
$I_{s(50)}$ - Point Load Strength Index



DIAMETRAL TEST



AXIAL TEST



OTHER SHAPES TEST

Loading	D_e	
Diametral	$D_e = D$	
Axial	$D_e = \sqrt{\frac{4A}{\pi}}$	$A = D \times L$
Other shapes		$A = D \times W$

$$I_s = \frac{P \times 1000}{D_e^2} \qquad I_{s(50)} = I_s \times \left(\frac{D_e}{50}\right)^{0.45}$$

Strength Class	$I_{s(50)}$ Range (MPa)
EL	≤ 0.03
VL	>0.03 ≤ 0.1
L	>0.1 ≤ 0.3
M	>0.3 ≤ 1.0
H	>1 ≤ 3
VH	>3 ≤ 10
EH	>10

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HASTINGS TECHNOLOGY METALS LIMITED

YANGIBANA RARE EARTH PROJECT

Date:	7/12/2016	112391.11	FIGURE ##