WATERMARK
COAL PROJECT
ENVIRONMENTAL IMPACT STATEMENT

February 2013

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Geotechnical and Geomorphology Investigation of Grinding Groove Sites

REPORT TO:

HANSEN BAILEY

Geotechnical and Geomorphology Investigation of the WM-GG1-11 and WM-GG3-12 Grinding Groove Sites

WAT3821

Strata Control Technology

Mining Research and Consulting Group
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Report To	Melissa Walker Environmental Scientist Hansen Bailey Environmental Consultants PO Box 473 SINGLETON NSW 2330
Subject	Geotechnical and Geomorphology Investigations of the WM-GG1-11 and WM-GG3-12 Grinding Groove Sites
Report No	WAT3821
Prepared By	Luc Daigle Robert C. Lee
Date	31 July 2012

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Senior Engineering Geologist

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Managing Director

Executive Summary

SCT Operations Pty Ltd (SCT) was commissioned by Hansen Bailey Environmental Consultants, on behalf of Shenhua Watermark Coal Pty Limited to complete a Geotechnical and Geomorphological Impact Assessment of Aboriginal axe grinding grooves associated with the Watermark Coal Project.

Two Aboriginal axe grinding groove sites (WM-GG1-11 and WM-GG3-12) have been identified within the proposed open cut mining area for the Watermark Coal Project. As both WM-GG1-11 and WM-GG3-12 are located within the proposed mining areas, relocation of the sites is a mitigation measure being considered in the EIS. This assessment was conducted in accordance with the Director-General's Requirements for the Environmental Impact Statement in order to provide an evaluation of the effectiveness of relocation as a potential mitigation measure. This is achieved by an evaluation of the geomorphic history of the site and laboratory analysis to determine the rock strength and sub-surface extent.

A 3D photogrammetric survey of WM-GG1-11 and WM-GG3-12 was completed on 23 April 2012. This survey resulted in a detailed imaged record of the sites condition prior to any subsequent activity. Each grinding groove was digitally recorded and rendered as a highly accurate surveyed three-dimensional surface. The processed images are presented within this report. Additionally, these processed digital images are presented with software to view each image as a three-dimensional surface. A 360^0 site photographic tour has also been constructed and is presented which allows a full view of each site and its surrounds, the location of each three dimensional imaged surface and permits the viewer to examine the site in great detail.

The geotechnical field investigation of WM-GG1-11 and WM-GG3-12 was undertaken by Luc Daigle from SCT between 18 and 20 June 2012. This work was overseen by Dr Andrew McLaren and Rochelle Coxon of AECOM, Kyle Prowse of Hansen Bailey, Melanie Layton and Grayson Wolfgang of Shenhua Watermark, under the supervision of the Senior Elders Group.

Soil hand auguring was completed at both WM-GG1-11 and WM-GG3-12 and provides a detailed description of the immediate subsurface deposits within the associated landscape. Three lines of auguring were completed at WM-GG1-11 and two lines of auguring were completed at WM-GG3-12.

A single core from the sandstone bed hosting the grinding grooves at WM-GG1-11 and WM-GG3-12 was collected at each site. These cores were obtained through hand tool drilling methods in the presence of the Senior Elders Groups. These cores were required to determine the geotechnical nature of the grinding grooves hosting rock shelfs. Features such as the thickness of the host slab, bedding separations, rock strength and durability of the rock slabs were determined through examination of the cored samples. Laboratory testing was then completed to establish the rock properties which will be necessary for any future management strategies of the site.

Hand operated equipment was used for completion of these works to minimise any potential impact. All hand augur holes were backfilled with the cuttings and the two cored samples will be replaced back into their core holes in the presence of the Senior Elders Group.

The soil hand auguring demonstrated that distinct soil horizons are present at both WM-GG1-11 and WM-GG3-12. WM-GG1-11 was shown to have very distinct, readily identifiable soil horizons. Of particular interest at WM-GG1-11 was the identification of an earlier surface which predates modern agriculture and indicates a period of greater erosion and water flow than the present surface. This horizon was buried through sedimentation from sheet flow off the surrounding topography.

Soil auguring at WM-GG3-12 found natural soil horizons derived from the weathering of underlying bedrock completely surrounded this site.

The continuity of the bedrock slabs at WM-GG1-11 and WM-GG3-12 was found to consist of highly localised minor channel fills within the Permian aged bedrock. These formed resistant cap stones within the deeply oxidised and weathered profile leaving the sandstone free floating within the soil profiles.

Geotechnical analysis of the cored rock sample shows the sandstone slabs hosting WM-GG1-11 and WM-GG3-12 are low strength but coherent. Their density is approximately 2.25 t/m^3 and both sites exhibit moisture contents of 3% to 6%. Results also indicated the bed thickness was shown to be greater than 30cm on the central portion of the main slabs at both sides.

Because the host slabs are fully surrounded by weathered shale, siltstone and mudstone, they are effectively detached in the soil profile. The smaller slabs hosting grinding groove can be manually excavated and be relocated easily. However, the larger slabs would need to be reduced in size to be relocated.

Long term management strategies such as relocation of the slabs hosting the grinding grooves are plausible. Relocation would require a management plan to determine a procedure that would ensure the safe movement and future conservation of these materials.

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1. Introduction

1.1 Background

SCT Operations Pty Ltd (SCT) was commissioned by Hansen Bailey Environmental Consultants (Hansen Bailey), on behalf of Shenhua Watermark Coal Pty Ltd (Shenhua Watermark) to complete a Geotechnical and Geomorphological Impact Assessment of Aboriginal axe grinding grooves associated with the Watermark Coal Project (the Project).

The purpose of this assessment is to form part of an Environmental Impact Statement (EIS) being prepared by Hansen Bailey to support an application for State Significant Development Consent under Division 4.1 of Part 4 of *the Environmental Planning and Assessment Act 1979* (EP&A Act) for the construction and operation of the Project.

In October 2008, Shenhua Watermark Coal Pty Limited (Shenhua Watermark) was granted Exploration Licence (EL) 7223. Shenhua Watermark is a subsidiary of the Shenhua Corporation.

The Project is located within EL7223, approximately 25km south south-east of the township of Gunnedah and to the immediate west of the village of Breeza, within the Gunnedah Local Government Area (LGA). The Project is approximately 282 km by rail from the export Port of Newcastle. Figure 1 illustrates the regional locality of the Project in relation to the nearest town centres of Breeza.

1.2 Project Overview

Shenhua Watermark is seeking State Significant Development Consent under Division 4.1 of Part 4 of the *Environmental Planning & Assessment Act 1979* (EP&A Act) for the Project.

The Project generally comprises:

- The construction and operation of an open cut mining operation extracting up to 10 Million tonnes per annum (Mtpa) of Run of Mine (ROM) coal for a 30 year period;
- An open cut mining fleet of excavators and shovels, supported by haul trucks, dozers, graders, drill rigs and water carts;
- Progressive rehabilitation of all disturbed areas;
- The construction and operation of a Coal Handling and Preparation Plant (CHPP) with a throughput of 10 Mtpa ROM coal;
- The co-disposal of tailings and coarse reject within the Overburden Emplacement Areas (OEA);

- The construction and operation of a rail spur, rail loop, Kamilaroi Highway rail overpass, associated load out facility and connection to the Werris Creek-Moree Railway Line;
- The construction and operation of a Mine Access Road;
- The construction and operation of administration, workshop and related facilities;
- The construction and operation of ground and surface water management and reticulation infrastructure including pipelines, pumping stations and associated infrastructure for access to water from groundwater aquifers, the Mooki River and private dams to the north-east of the Project Boundary;
- The installation of communications and electricity reticulation infrastructure; and
- A workforce of up to approximately 600 full-time equivalent employees during construction and up to 600 full-time equivalent employees during the operation of the Project.

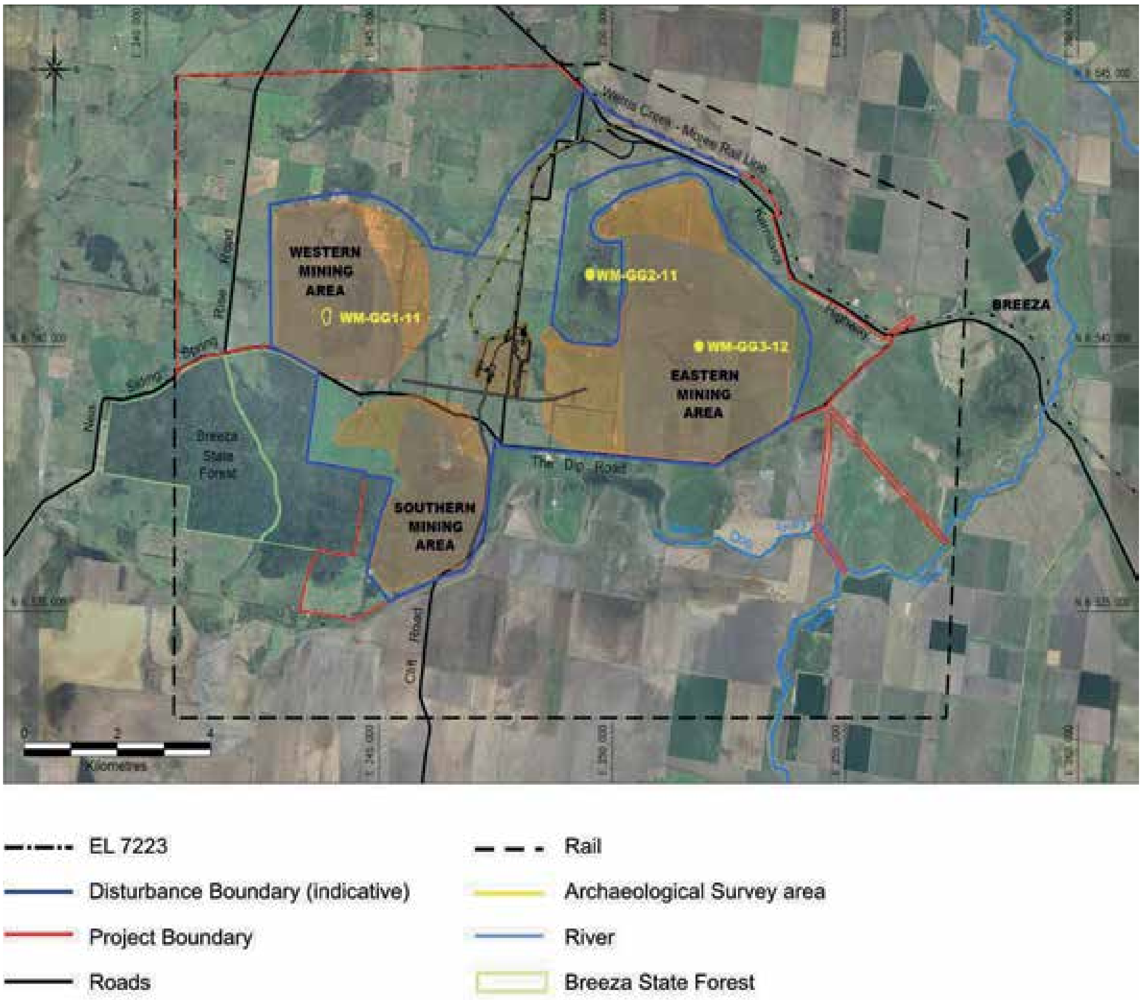

Figure 1: Locality map showing location of sites WM-GG1 - 11 and WM-GG3 - 12.

The conceptual layout of the Project is shown in Figure 1.

1.3 Aboriginal Archaeology & Cultural Heritage Assessments

Key assessments being undertaken for the EIS include an Aboriginal Archaeology Impact Assessment (AECOM, 2012) and an Aboriginal Cultural Heritage Assessment (Connect for Effect, 2012).

These assessments are being undertaken in accordance with the Director-General's Environmental Assessment Requirements (DGRs) for the EIS, NSW Department of Planning and Infrastructure's (DP&I) *Guidelines for Aboriginal Cultural Heritage Impact Assessment and Community Consultation* (2010) and OEHs *Code of Practice for Archaeological Investigation of Aboriginal Objects in New South Wales* (2010).

Archaeological survey of land within the Project Boundary was undertaken in two blocks between March 2011 and April 2012. The first and primary block of survey was conducted over a period of 25 days between March and May 2011. The second block was conducted over a period of 6 days between February and March 2012 with the Senior Elders Group.

Three axe grinding groove sites have been identified within the Project Boundary (see Figure 1). WM-GG1-11 and WM-GG2-11 were identified during the primary survey in 2011 with Aboriginal stakeholders. WM-GG1-11 is located centrally within the proposed Western Mining Area, whilst WM-GG2-11 is located on Mt Watermark, outside of the proposed Disturbance Boundary. WM-GG3-12 was identified as part of the Exploration Due Diligence program in 2012 and recorded during the second block of survey. The site is located centrally within the proposed Eastern Mining Area.

As both WM-GG1-11 and WM-GG3-12 are located within the proposed mining areas, relocation of the site is a mitigation measure being considered in the EIS.

1.4 Assessment Scope and Objectives

This assessment has been prepared in accordance with DGRs for the EIS as issued by the NSW Department of Planning & Infrastructure (DP&I) on 19 April 2012. Table 1 lists the DGRs that are relevant to this assessment and the sections in this report where these DGRs are addressed.

This assessment has also been prepared in consideration of DGRs input from the Office of Environment & Heritage (OEH) and Namoi Catchment Management Authority (Namoi CMA). This is shown in Table 2 below.

Table 1: Director-General's Requirements

Key Issue	Requirement	Report Section Where Addressed
Heritage	An Aboriginal cultural heritage assessment (including cultural and archaeological significance) which must: – Demonstrate effective consultation with Aboriginal communities in determining and assessing impacts, and developing and selecting options and management measures; – Outline any proposed impact mitigation and management measures (including an evaluation of the effectiveness and reliability of measures)	This report outlines the consultation undertaken during the field work (Section 2.5). Further details on effective Aboriginal consultation are provided in the *Aboriginal Archaeology Impact Assessment* (AECOM, 2012) and an *Aboriginal Cultural Heritage Assessment* (Connect for Effect, 2012). This report evaluates the effectiveness of proposed management measures (Section 3 and 4)

Table 2: Agency Comments to DGRs

Key Issue	Requirement	Report Section Where Addressed
Namoi CMA	The EIS should address and consider the potential impacts on Aboriginal archaeology and cultural heritage especially with regard to clearing and potential loss of significant Aboriginal cultural sites. Mitigation measures and safeguards need to be addressed and assessed.	This report evaluates the effectiveness of proposed management measures (Section 3 and 4). Further details on impacts are provided in the *Aboriginal Archaeology Impact Assessment* (AECOM, 2012) and an *Aboriginal Cultural Heritage Assessment* (Connect for Effect, 2012).
OEH	Describe the actions that will be taken to avoid or mitigate impacts or compensate to prevent unavoidable impacts of the project on Aboriginal cultural heritage values. This should include an assessment of the effectiveness and reliability of the measures and any residual impacts after these measures are implemented.	This report evaluates the effectiveness of proposed management measures (Section 3 and 4).
OEH	The EA needs to clearly demonstrate that effective community consultation with Aboriginal communities has been undertaken in determining and assessing impacts, developing options and making final recommendations.	This report outlines the consultation undertaken during the fieldwork (Section 2.5). Further details on the effective Aboriginal consultation is provided in the *Aboriginal Archaeology Impact Assessment* (AECOM, 2012) and an *Aboriginal Cultural Heritage Assessment* (Connect for Effect, 2012)

Therefore, the objectives of this assessment were to:

- Obtain detailed topographic baseline mapping of both sites and immediate environs;
- Obtain detailed three-dimensional baseline photo documentation and imagery of both axe grinding groove sites;
- Undertake bedrock coring and hand auguring to determine the rock strength and sub-surface extent of the host rock within the current geomorphology and evaluate the geomorphology history; and
- Evaluate the effectiveness of relocating WM-GG1-11 and WM-GG3-12 as a mitigation measure for the EIS.

1.5 Document Structure

This document is structured as follows:

- Section 2 describes the methodology implemented to conduct a 3D photogrammetric analysis of the WM-GG1-11 and WM-GG3-12 and a geotechnical and geomorphological assessment;
- Section 3 provides the results of the geotechnical and geomorphological assessment;
- Section 4 provides recommendations for future works and assessment; and
- Section 5 provided conclusions as to the effectiveness of relocating WM-GG1-11 and WM-GG3-12 as a management measure.

2. Methodology

2.1 Surveys Completed and Work Procedures

A photogrammetric survey of WM-GG1-11 and WM-GG3-12 was completed on 23 April 2012 by SCT Senior Engineering Geologist, Luc Daigle and Geologist, Robert Lee.

Hand auguring and bedrock coring was completed at WM-GG1-11 and WM-GG3-12 between 18 and 20 June 2012 by SCT Senior Engineering Geologist, Luc Daigle.

The following details the surveys and work procedures used to complete the field investigation.

2.2 3D Photogrammetric Imaging and Procedure

On 23 April 2012, SCT conducted a photogrammetric survey of WM-GG1-11 and WM-GG3-12. SCT personnel were accompanied by two surveyors from Pegasus Technical and Archaeologist, Rochelle Coxon of AECOM. Each site was photographed and surveyed according to the following procedure.

2.2.1 Terrestrial Photogrammetric Capture Procedure

3D photogrammetric analysis utilises high quality digital images captured with modern digital SLR cameras. By photographing the subject surface with two or more images taken from various vantage points and all having within their view accurately surveyed reference targets, it is then possible to process the images using specific software developed to create a three-dimensional model of the imaged surface. This digital terrain model (DTM) can be viewed from any angle and recreated at any scale. This modelled surface (if adequately referenced by survey data) is accurate to within millimetres and establishes a baseline reference for the subject surface examined at that moment in time.

Image capture is completed with a SLR digital camera mounted on a tri-pod. Each outcrop surface is carefully brushed clean and the reference targets are laid out so that they are within the field of view. The following lists the photographic procedure utilised during image capture:

1. Assess the object or scene that will be captured, take into account the size, shape, and lighting. Calculate the distance the camera stations need to be away from the object/scene and from one another. A desirable distance/base ratio is between 2:1 to 6:1.

2. Control points need to be placed within the image scene. This consists of placing survey targets in the visible area in front of, on top of, or behind the object/scene. Depending on the risk of placing control points near the object/scene the camera stations can act as control points. A minimum of three control points need to be in a pair of images to be successful. Further markers can be placed in the viewing scene as to provide redundancy in control.

3. Once the control points, image markers, camera stations have been placed or marked photo capture can proceed. Notes should be taken at each camera station to assist with processing the data at a later date.

4. Capturing a scene or object involves taking two images from different locations of exactly the same scene. This requires the field person to position the image so that it fully overlaps the last image to complete a single convergent model.

5. Once all pairs have been captured and notes taken all the equipment can be packed up and stored for transportation. Note that control points will not be moved if they have not previously been surveyed in.

2.2.2 Data Processing

Data processing was completed by Robert Lee of SCT to create individual three dimensional models for each outcrop surface examined. Additional 360^0 imaging of each site was collected and a virtual tour of the sites was compiled during the survey.

The images were processed to create three-dimensional models for each surface investigated:

1. Images captured in the field are sorted and matched into their convergent pairs.

2. The pair of images is then opened in 3DM Analyst Lite along with a lens calibration file and a survey file of all control point locations.

3. Control points are located in each pair of images and digitised with their corresponding name found in the survey file.

4. An absolute orientation bundle adjustment is conducted on the pair of images that calculates the camera orientations in relation to the already digitized control points.

5. After a successful absolute orientation has been established, alignment of the pair of images and removal of lens distortion is conducted to create epipolar images.

6. The epipolar images allow for data points or vertices to be located on the pair of images. The vertices are then connected to form triangles that act the 3D surface.

7. Digital terrain models (DTM) are derived from the epipolar images which can then be viewed as a 3D object/scene.

The DTM images created through the data processing have been collated and are presented as hardcopy views in albums contained within this report (Appendix 1). Additionally a diskette is attached to this report (Appendix 2) which contains an instructional guide to installing the DTM viewing software, how to view and manipulate the DTMs, the survey data and panoramic images of sites WM-GG1-11 and WM-GG3-12.

The survey work was completed in a timely manner, with all of the photogrammetric imaging successfully completed on 23 April 2012. Whilst it was an overcast day and there was light rain, the quality of the images nonetheless is very good and unaffected by shadows, thus improving the quality of the survey completed.

The distribution of grinding grooves and location of photogrammetric surveys completed are shown on Figure 2.

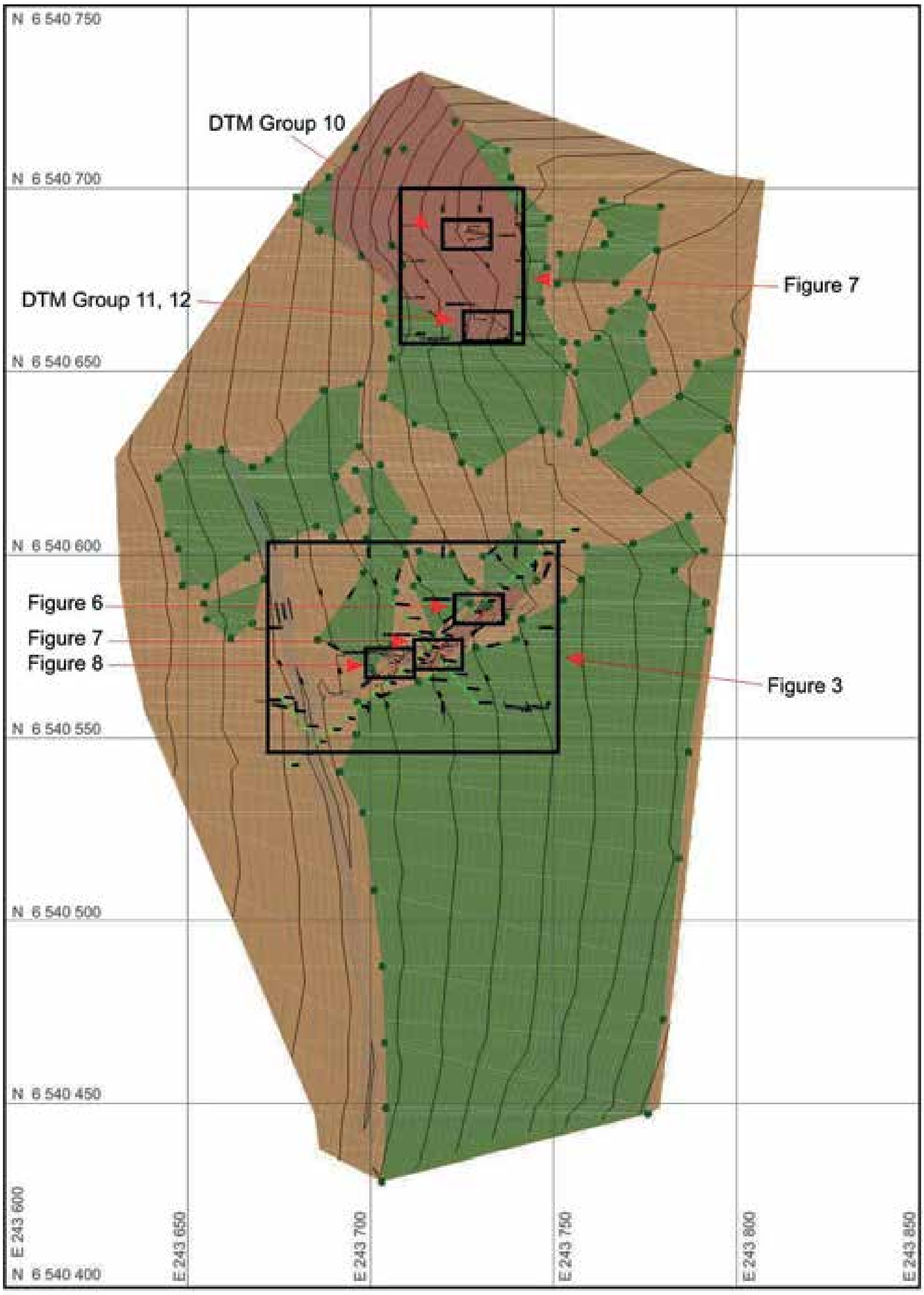

Figure 2: WM-GG1 - 11, location of grinding grooves and DTM layouts.

Within Figure 2 are located groups of imaged DTMs, Figure 3 shows the layouts of DTM 1, 2 and 3, Figure 4 shows the layouts of DTM 4, 5, 6, 7, and 8, Figure 5 shows the layout of DTM 9 and Figure 6 shows the layouts of DTM 10, 11, and 12 and Figure 7 shows the layouts of WM-GG3 DTM 1, 2 and 3.

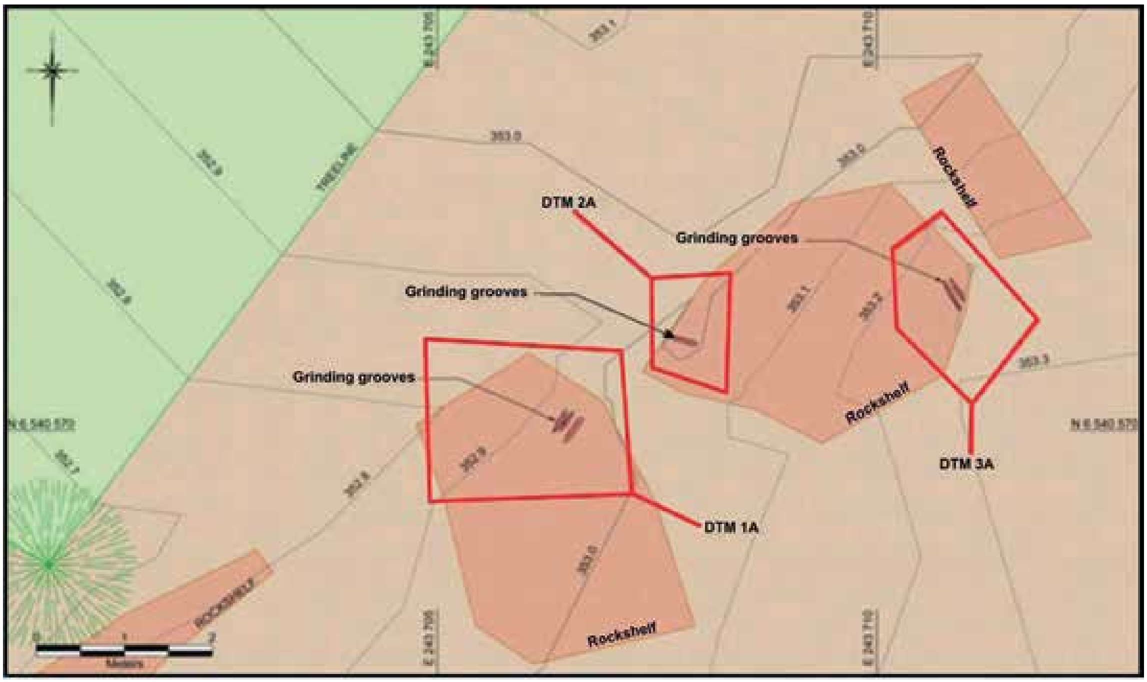

Figure 3: WM-GG1 - 11 DTM groups 1, 2 and 3 ***(Ref. Hansen Bailey cad file 07523A.dwg fig 8)***

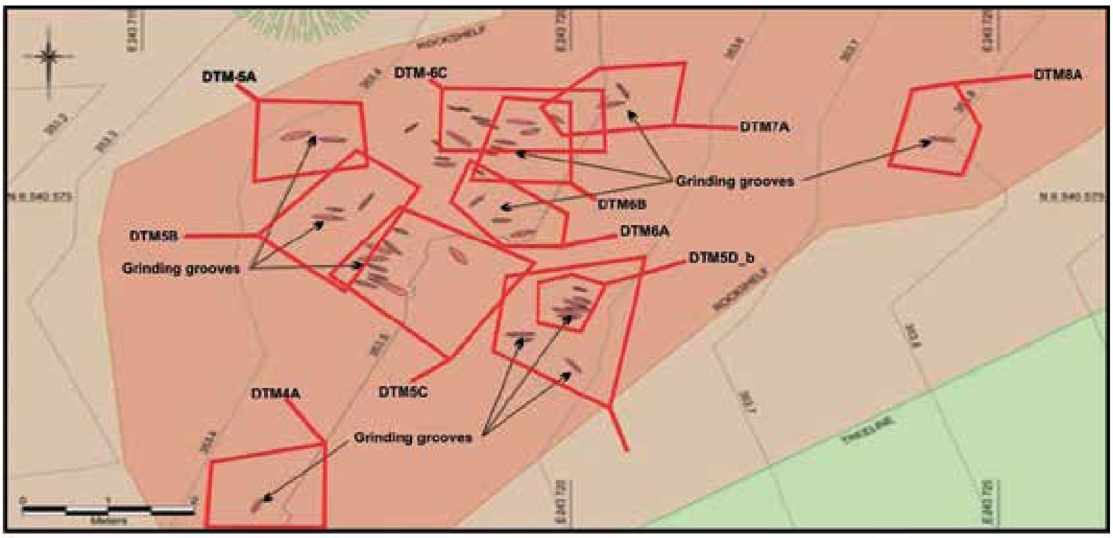

Figure 4: WM-GG1-11 Layouts of DTM 4, 5, 6, 7 and 8 ***(Ref Hansen Bailey cad file 07523A.dwg fig 7)***

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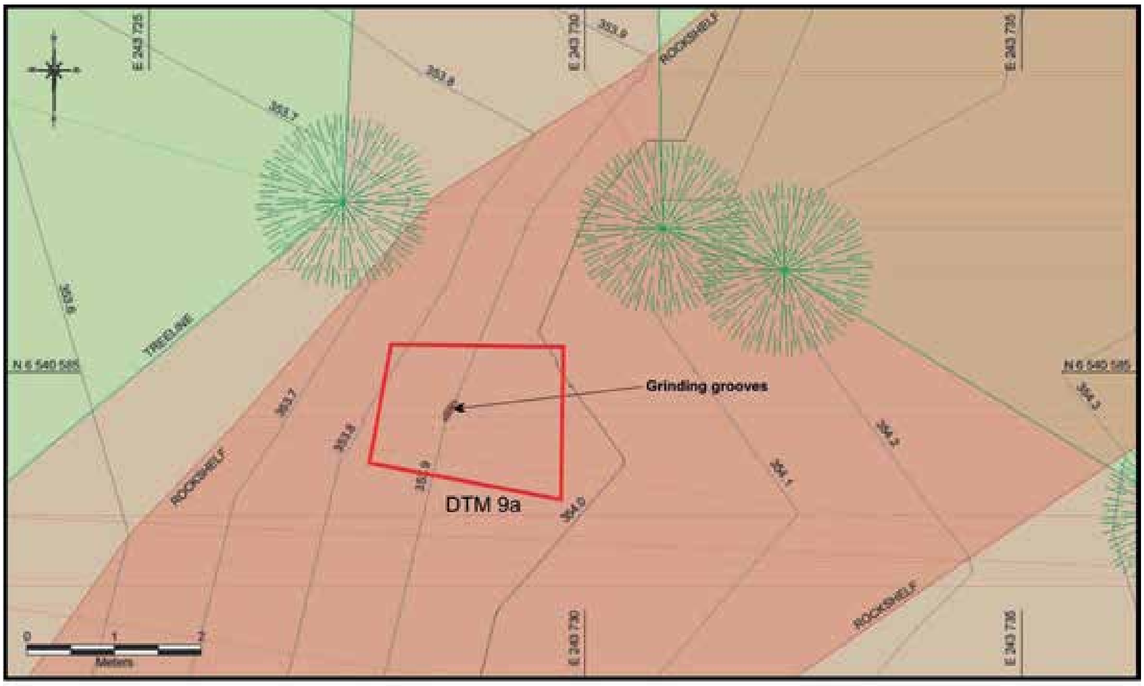

Figure 5: WM-GG1-11 DTM 9a ***(Ref Hansen Bailey cad file 07523A.dwg fig 6)***

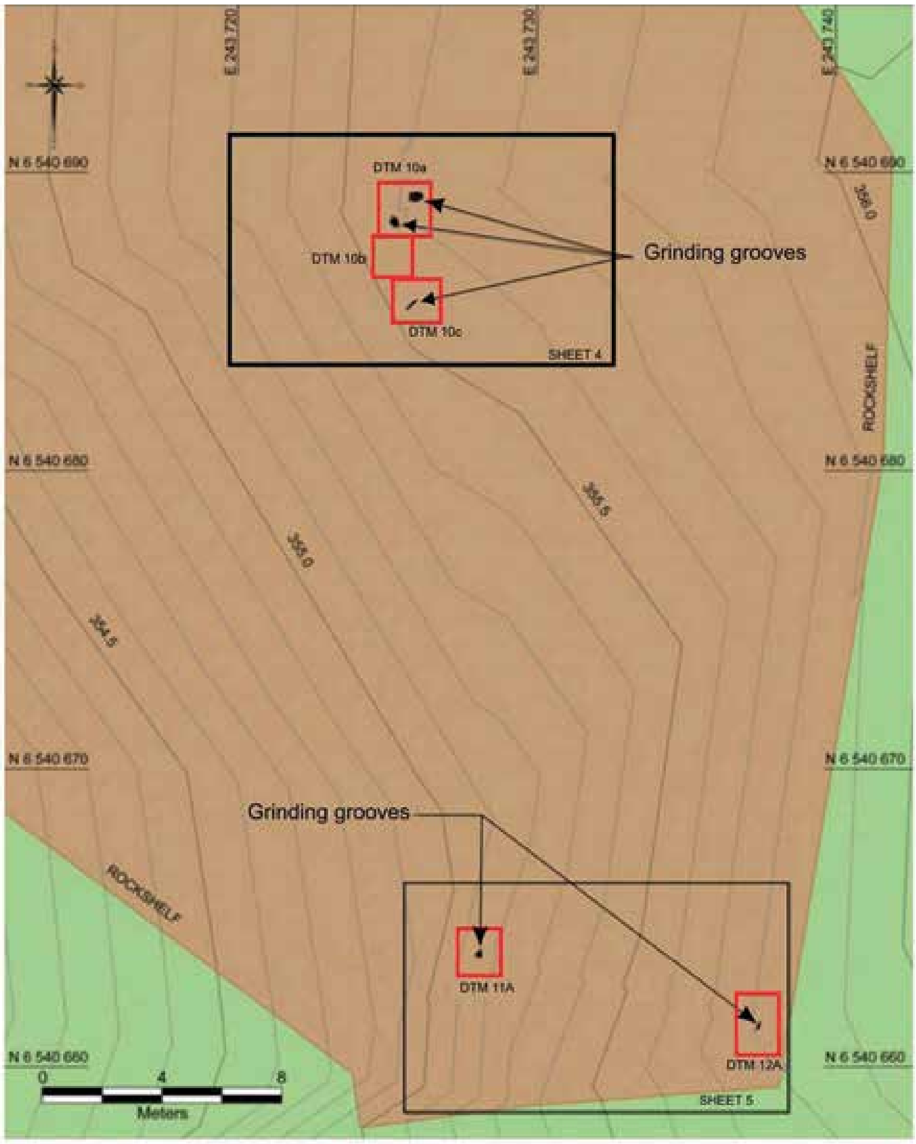

Figure 6: WM-GG1-11 DTM 10, 11and 12 layouts. ***(Ref Hansen Bailey cad file 07523A.dwg fig 2)***

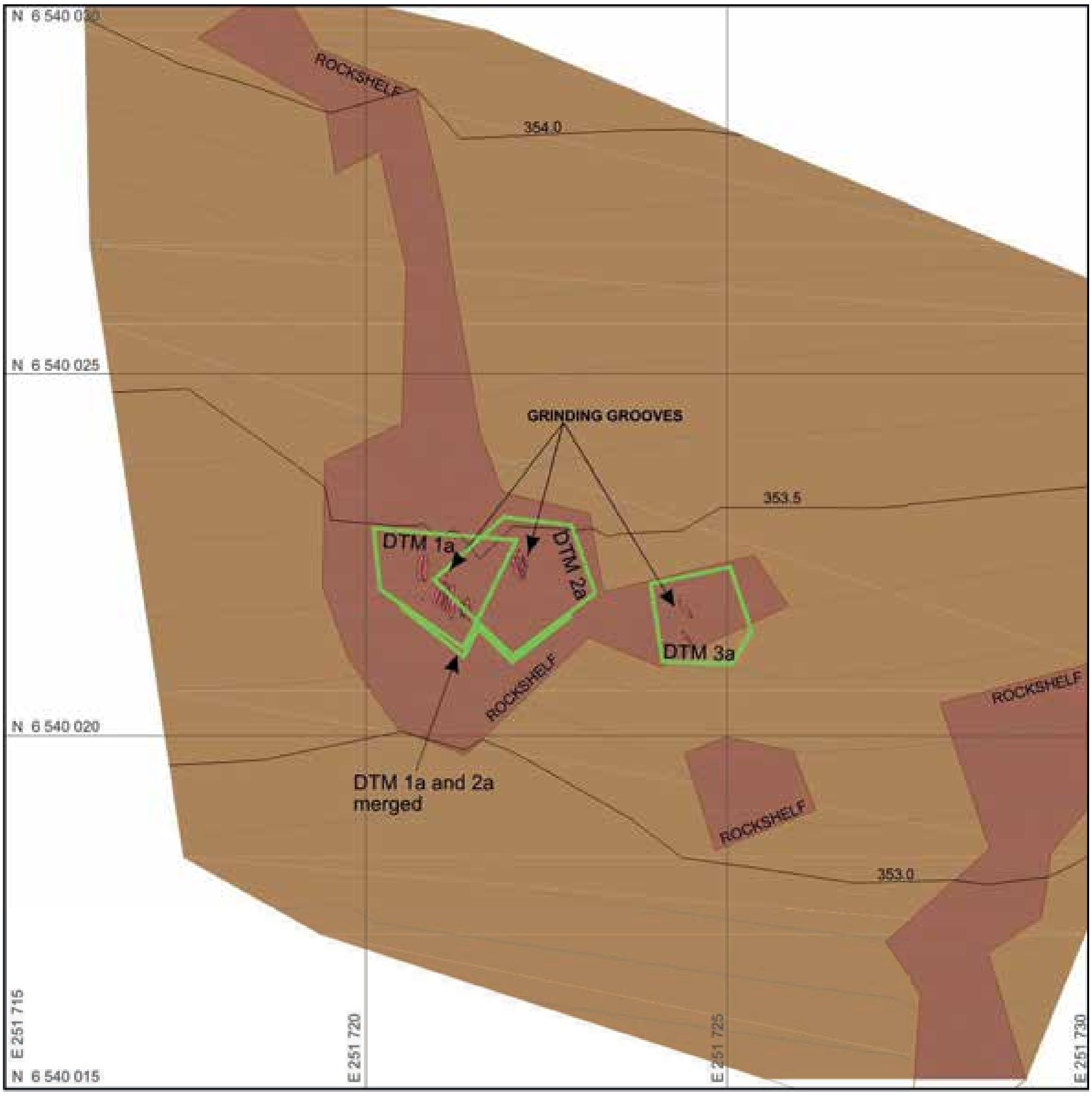

Figure 7: WM-GG3-12 Site 2 - WM-GG3 DTM 1, 2 and 3.

2.3 Hand Augur Surveys

Hand augur surveys were completed at WM-GG1-11 and WM-GG3-12 from 18–20 June 2012 by SCT Senior Engineering Geologist, Luc Daigle. This work was overseen by Dr Andrew McLaren and Rochelle Coxon of AECOM, Kyle Prowse of Hansen Bailey, Melanie Layton and Grayson Wolfgang of Shenhua Watermark, under the supervision of the Senior Elders Group.

The following details the surveys and work procedures used to complete the field investigation.

2.3.1 WM-GG1-11

At site WM-GG1-11, one main North-East – South-West auger line and two tie lines running North-West – South-East were established, as shown Figure 8. The positions of the augur lines were determined in the field by Senior Geotechnical Engineer, Luc Daigle in consultation with AECOM archaeologists and the Senior Elders Group.

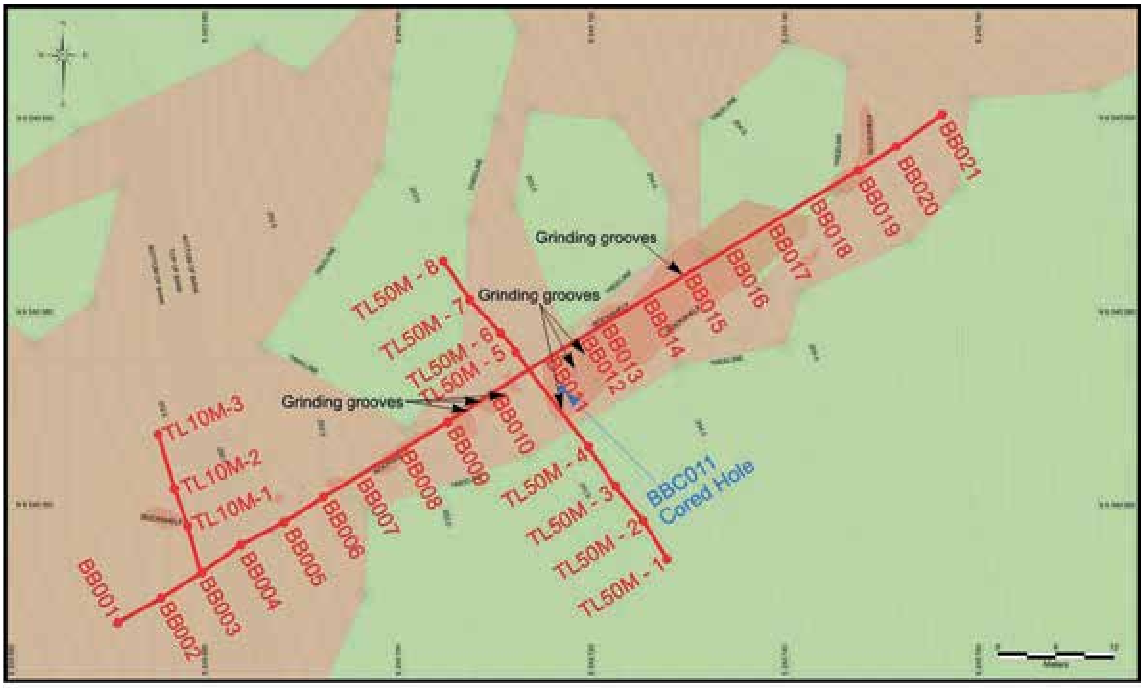

Figure 8: WM-GG1-11 Site showing auger collar RL's.

The process conducted for each augur line was as follows:

1. A 100m long tape was stretched between start and finish points marked with white painted wooden stakes;
2. Hand compass bearings where used to position the pegs. Surveyor pickup of the augur hole was used later to locate the start and finish of each line and pickup the position of each augur hole.

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3. An augur hole was hand dug to the point of refusal every 5 metres along the stretched tape (see Figure 9). In total, 32 augur investigation holes were completed at WM-GG1-11;

4. The material recovered from the augur hole was laid out to keep the order of the sample continuous and in the correct orientation;

5. The characteristics of the sample were then recorded as a log directly into a notebook; and

6. The soil sample was then returned to the hole in the order it was dug.

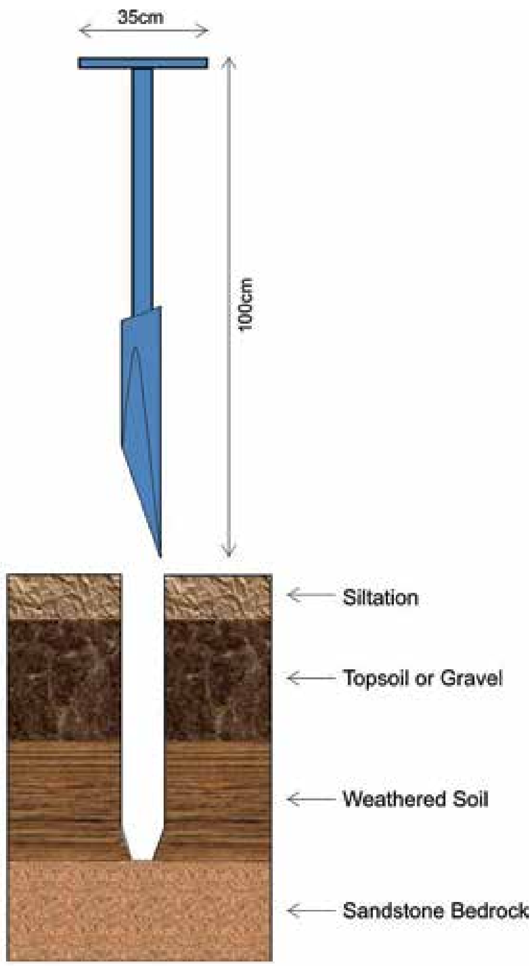

Figure 9: Typical Auger Hole Profile

On completion of the hand auguring, the data collected was digitised by data entry using Prolog software to create a digital strip log for each augur hole (Appendix 4). These digital plots were then converted into AutoCAD files to allow the logs to be combined onto accurate compiled digital plots forming fence diagrams representing each line of augur holes.

2.3.2 WM-GG3-12

At site WM-GG3-12, one main North-South and East-West auger line were established, as shown on Figure 10. These augur lines were determined in the field by Senior Geotechnical Engineer, Luc Daigle in consultation with AECOM archaeologists and the Senior Elders Group.

The process conducted for each augur line was as follows:

1. A 100m long tape was stretched between start and finish points marked with white painted wooden stakes;

2. Hand compass bearings where used to position the pegs. GPS readings will be used to locate the start and finish of each line;

3. An augur hole was hand dug to the point of refusal every 5 metres along the stretched tape (see Figure 9). In total, 17 augur investigation holes were completed at WM-GG3-12;

4. The material recovered from the augur hole was laid out keep the order of the sample continuous and in the correct orientation;

5. The characteristics of the sample were recorded as a log directly into a notebook; and

6. The soil sample was then returned to the hole in the order it was dug.

On completion of the hand auguring, the data collected was digitised by data entry using Prolog software to create a digital strip log for each augur hole (Appendix 4). These digital plots were then converted into AutoCAD files to allow the logs to be combined onto accurate compiled digital plots forming fence diagrams representing each line of augur holes.

2.4 Bedrock Coring

Bedrock coring was completed at WM-GG1-11 and WM-GG3-12 from 18–20 June 2012 by SCT Senior Engineering Geologist, Luc Daigle. This work was overseen by Dr Andrew McLaren and Rochelle Coxon of AECOM, Kyle Prowse of Hansen Bailey, Melanie Layton and Grayson Wolfgang of Shenhua Watermark, under the supervision of the Senior Elders Group.

The following details the surveys and work procedures used to complete the field investigation.

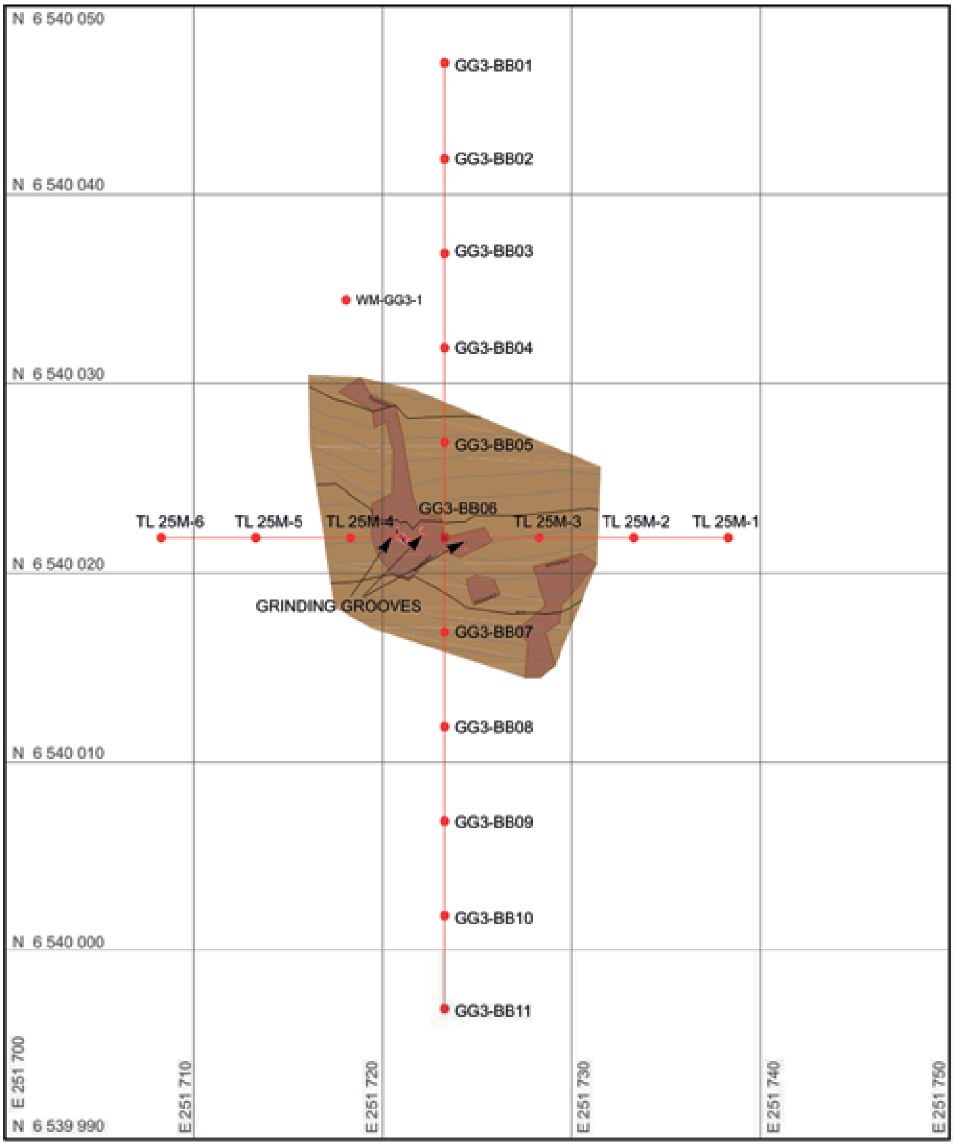

Figure 10: WM-GG3 - 12 location of grinding grooves and augers.

2.4.1 WM-GG1-11

One shallow hand cored hole (BBC011) was completed at WM-GG1-11 (see Figure 8) to determine the geotechnical character and strength of the sandstone hosting the grinding grooves. The coring process was as follows:

1. The proposed core site was selected by SCT Senior Engineering Geologist, Luc Daigle in consultation with an AECOM archaeologist and the Senior Elders and was located away from visible axe grinding grooves;

2. Coring was undertaken using a hand guided electric power drill attached to a small core barrel (100mm diameter) (Figure 11). A small hand portable generator provided electricity to run the drill and water was supplied via gravity feed from a water container. The hole was drilled to a depth of 30cm but only one 18cm long core was subsequently removed from WM-GG1-11 for laboratory testing;

3. On completion of coring, the hole was left open so that the core could be returned to the hole once laboratory testing was completed;

4. The core sample was logged in detail and then wrapped in plastic wrap to prevent moisture loss and keep the sample in its original condition for transport; and

5. Following laboratory analysis, the core sample will be returned to site and reinstated and grouted in its original position.

Samples collected were wrapped in plastic to preserve their moisture content, these were then submitted to Strata Testing Services and subjected to triaxial testing to measure the rocks geotechnical properties, these results of the laboratory analysis was received on 25 June 2012 (Appendix 5).

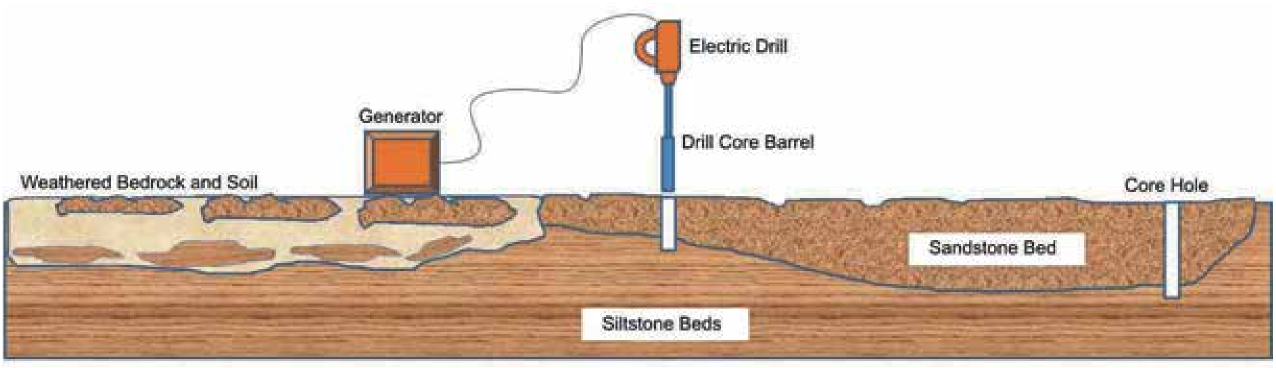

Figure 11: Bedrock Core Sampling

2.4.2 WM-GG3-12

One shallow hand cored hole (WM-GG3-1) was completed at WM-GG3-12 (see Figure 10) to determine the geotechnical character and strength of the sandstone hosting the grinding grooves. The coring process was as follows:

1. The proposed core site was selected by SCT Senior Engineering Geologist, Luc Daigle in consultation with an AECOM archaeologist and the Senior Elders, the sample site was located away from visible axe grinding grooves;

2. Coring was undertaken using a hand guided electric power drill attached to a small core barrel (100mm diameter) (Figure 11). A small hand portable generator provided electricity to run the drill and water was supplied via gravity feed from a water container. The hole was drilled to a depth of 30cm and one 28cm long core was subsequently removed from WM-GG3-12 for laboratory testing;

3. On completion of coring, the hole was left open so that the core could be returned to the hole once laboratory testing was completed;

4. The core sample was logged in detail and then wrapped in plastic wrap to prevent moisture loss and keep the sample in its original condition for transport; and

5. Following laboratory analysis, the core sample will be returned to site and reinstated and grouted in its original position.

Samples collected were wrapped in plastic to preserve their moisture content, these were then submitted to Strata Testing Services and subjected to triaxial testing to measure the rocks geotechnical properties, these results of the laboratory analysis was received on 25 June 2012 (Appendix 5).

2.5 Senior Elders Group Supervision

The geotechnical field investigation (i.e. hand auguring and bedrock coring) of WM-GG1-11 and WM-GG3-12 was conducted in the presence of the Senior Elders Group. Prior to undertaking the work, all Senior Elders were consulted on the purpose of the work and proposed methodology and were provided the opportunity to stop work at any time if they had concerns.

The following Senior Elders were present for the geotechnical field investigation of WM-GG1-11 and WM-GG3-12:

- Gwen Griffen (attended 18 June 2012)
- Dick Talbott (attended 18 June 2012)
- Rhonda Talbott (attended 18 June 2012)
- Lorna Lamb (attended 18 June 2012)

- Lloyd Matthews (attended 18 June 2012)
- Cyril Sampson (attended 18 June 2012)
- Neville Sampson (attended 18 June 2012)
- Hubert Smith (attended 18 June 2012)
- Betty Condran (attended 18 June 2012)
- Rita Long (attended 19 June 2012)
- Sandy Alridge (attended 19 June 2012)
- Hazel Collins (attended 19 June 2012)
- Christine Allen (attended 19 June 2012)
- Patricia Slater (attended 19 June 2012)
- Susan Smith (attended 19 June 2012)
- Marie Saunders (attended 19 June 2012)
- Vicki Wortley (attended 19 June 2012)
- Gordon Matthews (attended 19 June 2012)
- June Field (attended 19 June 2012)
- Janet Wanles (attended 19 June 2012)
- Louise Conlan (attended 19 June 2012)
- Joan Suey (attended 19 June 2012)
- Joyce Dorrington (attended 20 June 2012)
- Shirley Long (attended 20 June 2012)
- Gloria Foley (attended 20 June 2012)
- Delma Jones (attended 20 June 2012)
- Margret Windsor (attended 20 June 2012)
- Pam Silver (attended 20 June 2012)

The following photographs were taken by Kyle Prowse of Hansen Bailey Environmental Consultants during the fieldwork. These photos clearly illustrate the methodologies used at each site and participates present.

Photo 1: Setting up the soil auger grid lines.

Photo 2: Running out the 100m tape at WM GG1 - 11 to establish the baseline.

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Photo 3: Looking Northeast along the baseline with the grinding grooves in view at WM GG1 - 11.

Photo 4: Engineering geologist Luc Daigle measuring the depth of an auger hole at WM GG1 - 11.

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Photo 5: An auger hole being dug at WM GG1 - 11.

Photo 6: Hand augering at WM GG1 - 11. Senior Elders group closely observing the process.

Photo 7: Extended view of the hang augering in process.

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Photo 8: Hand augering at WM GG1 - 11 in hole 1 on the cross line TL50.

Photo 9: Hand coring the outcrop slab at WM GG1 - 11.

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Photo 10: Close up of the drilling at WM GG1 - 11.

Photo 11: Full view of the WM GG1 - 11 bedrock slab being drilled and the Senior Elders group observing the procedure.

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Photo 12: WM GG1 - 11 cored sample extracted from the outcrop slab.

Photo 13: The Senior Elders Group at the WM GG3 - 12 grinding groove site.

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Photo 14: Laying out the tape measure at WM GG3 - 12.

Photo 15: Hand augering at WM GG3 - 12.

Photo 16: Hand augering at WM GG3 - 12.

Photo 17: Examining the auger cuttings

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Photo 18: Bedrock coring at the WM-GG3-12 site.

Photo 19: View of the drill setup to core the bedrock.

Photo 20: Setting up of the drill site at WM-GG3-12.

Photo 21: Core drilling the bedrock at WM GG3 - 12 and the Senior Elders Group.

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3. Results

3.1 Hand Auguring

3.1.1 WM-GG1-11

Plan Sections 1, 2 and 3 shows the hand auguring lines completed at WM-GG1-11.

Hand auguring line BB01 to BB21 covers a length of 100 metres orientated South-West to North-East over the central sandstone slab of WM GG1-11. Correlation of the stratum intersected in these augur holes illustrates the succession of shallow surface deposits present at this site (Plan Section 1). In this section, eight distinct deposits are noted and are as follows based on their succession.

1. Sediment filled bulldozer cut: This is a deposit of recent sediment washed into the shallow excavations created by bulldozer construction for erosion mitigation earthworks. This is the youngest deposit at the site. These earthworks are located throughout the district and were constructed as soil conservation measures during the latter half of the 20th century.

2. Contour bank: This is a deposit of soil which has been formed into a mound by bulldozers for erosion mitigation earthworks. This deposit was formed recently by mechanised farming earthworks. These earthworks are located throughout the district and were constructed as soil conservation measures during the latter half of the 20th century.

3. Soil organic rich mat: This is the organic rich humus layer hosting plant growth and forms the upper most layer of the topsoil. This layer is dark brown to blackish organic rich horizon which helps maintain the moisture and soil integrity. This is found distributed north-east of the contour bank but is not observed south-east of the bank where it appears to have been stripped away by the modern agriculture practices. The areas retaining an organic mat indicates that the age of this layer predate modern mechanized farming methods.

4. Mobilised topsoil: This soil horizon is characterised as a re-deposited sandy to silty soil. The evidence for the mobilisation of this deposit is a basal lag deposit of gravel wash which is readily traced back to bedrock exposures. The age of the mobilisation is indeterminate - it predates modern settlement and represents a period of reduced water flows at termination of a period of higher energy flow represented by the underlying lag deposits.

5. Lag: These are thin deposits of pebble gravel and grit likely washed downslope from sandstone forming a resistant cap to the local topography. The age of the mobilisation of the lag horizon is indeterminate - it predates modern settlement and represents a

period of greater erosion of the site with much higher water flows than represented by the modern environment.

6. Undisturbed deeply weathered bedrock, clay rich: This is a soil horizon formed from deeply weathered fine grained mudstone and siltstone bedrock.

7. Undisturbed deeply weathered bedrock, sand rich: This is a soil horizon formed from deeply weathered sandstone.

8. Sandstone bedrock: This horizon is characterised as competent yet weathered medium to coarse grained sandstone, which is in places very gritty to pebbly.

The hand auguring conducted at WM-GG1-11 shows that the main sandstone outcropping is fully surrounded by clay to silt rich weathered bedrock. A period of higher erosion rates and greater exposure is evidenced by the on-lap of a lag horizon. The age of this horizon is unknown and the subsequent blanketing of this horizon is by a mobilised sand and silt soil derived from the surrounding landform. The lag horizon and mobilised soil horizon predates modern agriculture as evidenced by the preservation of organic humus mat up-hill from the contour bank earth works. Downslope from these works, the soil surface is deflated through intensive agriculture and lacks an organic mat, indicating that where a preserved organic mat is present, it represents a surface that predates modern farming practices.

Hand auguring line BB03 to 10TL15 covers a length of 15 metres orientated North-West to South-East over an interpreted shallow surface drainage. Correlation of the stratum intersected in these augur holes illustrates the succession of shallow surface deposits (Plan Section 2) is consistent with those observed in Plan 1. In this section, four of the deposits identified in Plan 1 are present and demonstrate simular distributions. However, a thickening of the mobilised soil and lag deposits is indicated as the line trends towards augur hole 10TL15.

Hand auguring line 50TL1 to 50TL-8 covers a length of 40 metres oriented North-West to South-East over the main grinding groove sandstone slab and across an indicated modern drainage. Correlation of the stratum intersected in these augur holes (Plan Section 3) is generally consistent with the stratigraphy illustrated in the two previous profiles. The exception here is for a feature noted adjacent to the sandstone slab, where augur hole 50TL5 intersects a thick column of wet organic rich humus fill trending to silt and grit rich. The feature lies within the trace of the drainage line but the low volume flows that would have flowed through the site are not considered sufficient to have eroded a channel to the depth encountered. The remaining sediments are consistent with the other sections and demonstrate that the mobilized soil and lag layer thicken towards the South-West.

The bedrock slab hosting the grinding grooves was found to isolated, thin, free floating blocks of Permian age sandstone to pebble rich grit which represent the remnant trends of a channel. This ancient channel is readily seen to meander over the side of the hill and forms a capping stone on the hill. The surrounding sedimentary rocks are completely oxidized and weathered to form the base of the natural soil profile. Thin lag deposits were observed to shroud the outcrop and represent an earlier exposed surface horizon which has since been buried by a silty sandy soil horizon then covered with an organics rich mat. These deposits all predate European farming which has in places stripped away the organic mat and in other places, disturbed by mechanically formed earthworks. A thick deposit of organic matter in the modern surface drainage line penetrates the stratigraphy and is anomalous. The absolute depth of weathering at this site is unknown but could be easily extrapolated from any nearby exploration boreholes. Typically the base of oxidation in the Hunter and Gunnedah Basin areas ranges from a minimum of 15 to 30 metres depth.

3.1.2 WM-GG3-12

Plan Sections 4 and 5 shows the hand auguring lines completed at WM-GG3-12.

Hand auguring line BB01 to BB11 covers a length of 50 metres orientated north to south over the central sandstone slab. Correlation of the stratum intersected in these augur holes illustrates the succession of shallow surface deposits present at this site (Plan Section 4). In this section, six distinct deposits previously in Section 3.1.1 are Units 3, 4, 5, 6, 7 and 8, another unit has been indentified and is included as Unit 9.

3. Soil organic rich mat: This is the organic rich humus layer hosting plant growth and forms the upper most layer of the topsoil. This layer is characterised by a dark brown to blackish organic rich horizon which helps maintain the moisture and soil integrity. This horizon is found distributed north-east of the contour bank but is not observed south-east of the bank where it appears to have been stripped away by the modern agriculture practices. The areas retaining an organic mat indicate that the age of this layer predates mechanised modern farming methods.

4. Sandy/silty/gritty topsoil: This soil horizon is a sandy to silty soil derived from the weathering of the underlying sedimentary bedrocks. The soil horizon appears to be derived in-situ, and is locally mobilised.

5. Lag: Very limited in extent, these are thin localised deposits of pebble gravel and grit likely washed downslope from sandstone forming a resistant cap to the local topography. The age of the mobilisation of the lag horizon is indeterminate.

6. Undisturbed deeply weathered bedrock, clay rich: This is a soil horizon formed from deeply weathered fine grained mudstone and siltstone bedrock.

7. Undisturbed deeply weathered bedrock, sand rich: This is a soil horizon formed from deeply weathered sandstone.

8. Sandstone bedrock: This is competent yet weathered medium to coarse grained sandstone in places very gritty to pebbly.

9. Leached undisturbed deeply weathered bedrock derived soil horizon: This is a soil horizon formed from deeply weathered mudstone, siltstone and sandstone.

Hand auguring line 25TL1 to 25TL6 covers a length of 30 metres orientated east to west over the central sandstone slab. Correlation of the stratum intersected in these augur holes illustrates the succession of shallow surface deposits present at this site (Plan Section 5). In this section the stratum viewed is consistent with those observed in the Plan Section 4 described above.

No unusual trends were noted at WM-GG3-12 and the deposit is consistent with an undisturbed bedrock derived weathering profile. The sandstone slabs are remnant Permian channels which form resistant capping in the surrounding topography. No modern erosion channels were noted. A consistent organic mat indicated the area has not been disturbed by modern farming practices.

3.2 Bedrock Coring

3.2.1 WM-GG1-11

Sample 1699-01 was obtained from WM-GG1-11. Laboratory analysis of the core indicates that the rock density is 2.166 t/m^3 with a moisture content of 5.9%. The samples were triaxial tested because it was felt a direct UCS test would not be truly representative of the rock strength. The lowest confining pressure used was 1.0MPa and resulted in a maximum intact axial stress of 10.9MPa with Young's Modulus of 2.39GPa. A residual strength of 7.07MPa was noted at a confining pressure of 1MPa.

The sandstone slab at WM-GG1-11 was observed to be very oxidized. Where the sandstone slab was exposed, it was observed to be a graded bed with grit to pebbles forming the base of the bed in places. Bedrock coring at WM-GG1-11 has demonstrated that there are internal cross beds and that these can form partings. The strength of the unit is low but because of its geometry, it readily forms free floating units which can be amenable to separation from the surrounding fully oxidised, deeply weathered siltstone and mudstone.

3.2.2 WM-GG3-12

Sample 1699-02 was obtained from WM-GG3-12. Laboratory analysis of the core indicates that the rock density is 2.276 t/m^3 with a moisture content of 3.9%. The samples were triaxial tested because it was felt a direct UCS test would not be truly representative of the rock strength. The lowest confining pressure used was 1.0MPa and resulted in a maximum intact axial stress of 23.6MPa with Young's Modulus of 3.77GPa. A residual strength of 8.53MPa was noted at a confining pressure of 1MPa.

The sandstone slab at WM-GG3-12 was observed to be very oxidized. Where the sandstone slab was exposed, it was observed to be a coarse grained to gritty bed. Bedrock coring at W-GG3-12 has demonstrated the bed is massive. The strength of the unit is low but because of its geometry, it readily forms free floating units which can be amenable to separation from the surrounding fully oxidised, deeply weathered siltstone and mudstone.

4. Recommendations

The work completed in these surveys documents in detail the surface and immediate sub-surface character of WM-GG1-11 and WM-GG3-12.

The 3D photogrammetric surveys provide a detailed baseline record for each site. Their condition at the time of the survey provides a detailed baseline upon which all future work and recording of the grinding grooves condition can be referenced back to. Any change to the site or condition of the grooves should be documented by subsequent photo analysis.

Using the 3D modelled surface, further examination of each individual grinding groove can be completed. Exact measurements of each individual groove can be made from the digital models; individual groove cross sectional profiles can be plotted at any scale, and even full size hard model reproductions of the outcrop surface can be manufactured.

Inclusion of the virtual tour provides a baseline view of the site prior to any site disturbance. Subsequent site disturbances such as archaeological surveys, trenches or excavations should be photo recorded and added to the tour to demonstrate change to the site over time.

The subsurface investigation through the hand augur survey provided a baseline understanding of the depositional history of the site and potential occupation surfaces. The surveys completed provided a characterisation upon which further analysis can be completed through additional augur holes.

Bedrock coring and strength analysis of the cores demonstrated the slabs hosting the grinding grooves are competent and resistant materials relative to the surrounding bedrock which is completely weathered to their constituent materials. Improved management of the sites can be accomplished through excavation of the edges of the slabs to determine their geometry.

Long term management strategies such as relocation of the slabs hosting the grinding grooves are plausible. Relocation would require a management plan to determine a procedure that would ensure the safe movement and future conservation of these materials.

5. Conclusions

The photogrammetric survey of WM-GG1-11 and WM-GG3-12 was completed by Luc Daigle and Robert Lee of SCT on 23 April 2012, accompanied by Rochelle Coxon of AECOM.

The geotechnical field investigation of WM-GG1-11 and WM-GG3-12 was undertaken by Luc Daigle from SCT Operations Pty Ltd between 18 and 20 June 2012. This work was overseen by Dr Andrew McLaren and Rochelle Coxon of AECOM, Kyle Prowse of Hansen Bailey, Melanie Layton and Grayson Wolfgang of Shenhua Watermark, under the supervision of the Senior Elders Group.

The geotechnical field assessment of WM-GG1-11 and WM-GG3-12 (i.e. hand auguring and bedrock coring) was conducted in order to provide an evaluation of the effectiveness of relocation as a mitigation measure. The geotechnical investigation assisted in this evaluation to determine the rock strength, sub-surface extent and the feasibility of site relocation.

The soil hand auguring demonstrated that distinct horizons are present at both WM-GG1-11 and WM-GG3-12. WM-GG1-11 was shown to have very distinct, readily identifiable soil horizons. Of particular interest at WM-GG1-11 was the identification of an earlier surface which predates modern agriculture and indicates a period of greater erosion and water flow than the present surface. This horizon was buried through sedimentation from sheet flow off the surrounding topography.

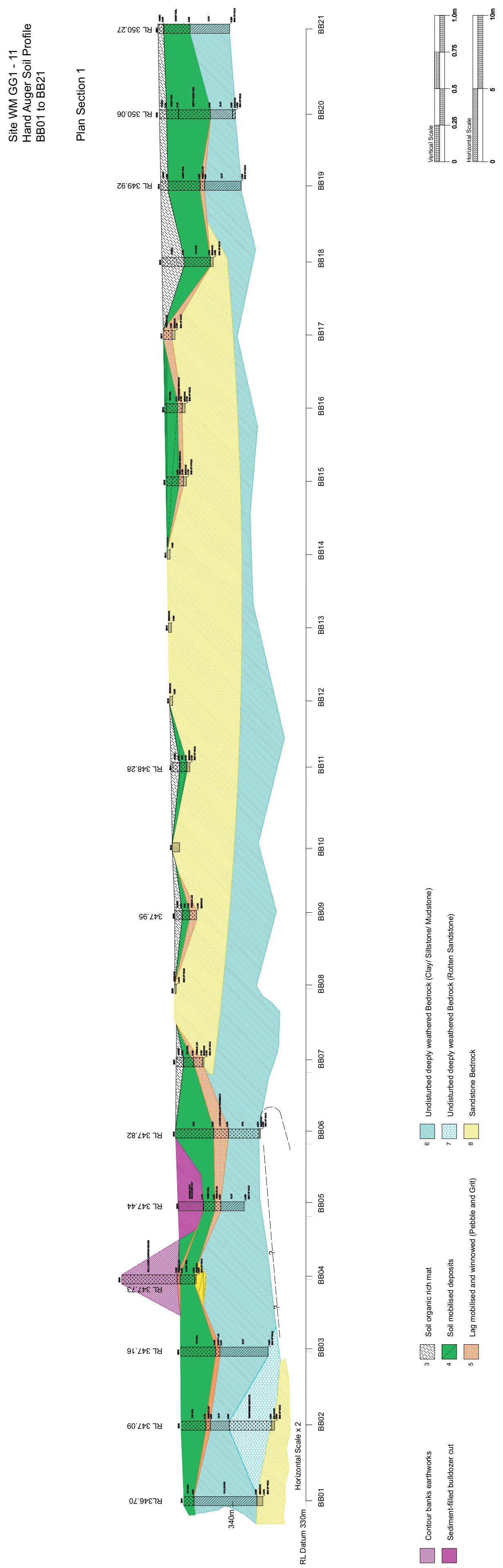
Soil auguring at WM-GG3-12 found natural soil horizons derived from the weathering of underlying bedrock completely surrounded this site.

The continuity of the bedrock slabs at WM-GG1-11 and WM-GG3-12 was demonstrated to consist of highly localised minor channel fills within the Permian aged bedrock. These formed resistant cap stones within the deeply oxidised and weathered profile, leaving the sandstone free floating within the soil profiles.

Geotechnical analysis of the cored rock sample shows the sandstone slabs hosting WM-GG1-11 and WM-GG3-12 are low strength but are coherent. Their density is approximately 2.25t/m^3 and both sites exhibit moisture contents of 3% to 6%. Results also indicated the bed thickness was shown to be greater than 30cm on the central portion of the main slabs at both sites.

Because the host slabs are fully surrounded by weathered shale, siltstone and mudstone, they are effectively detached in the soil profile. The smaller slabs hosting grinding grooves can be manually excavated and be relocated easily. However, the large slabs will need to be reduced in size to be relocated

Long term management strategies such as relocation of the slabs hosting the grinding grooves are plausible. Relocation would require a management plan to determine a procedure that would ensure the safe movement and future conservation of these materials.



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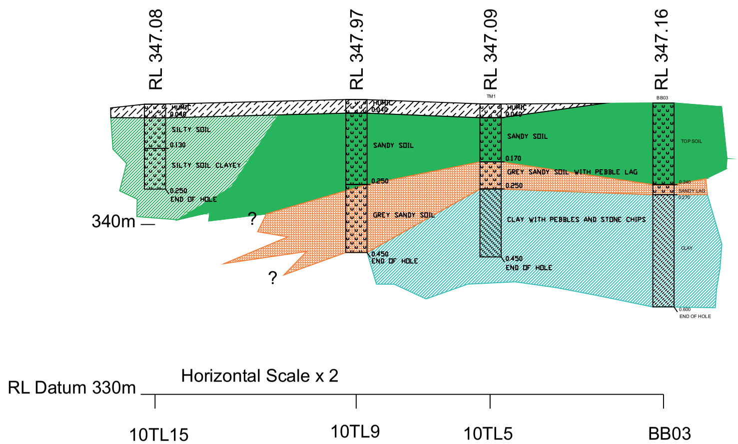
Site WM GG1 - 11
Hand Auger Soil Profile
BB03 to TL15

Plan Section 2



3 Soil organic rich mat

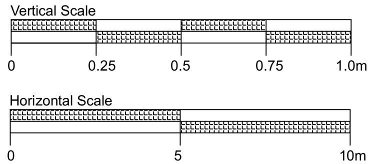
4 Soil mobilised deposits

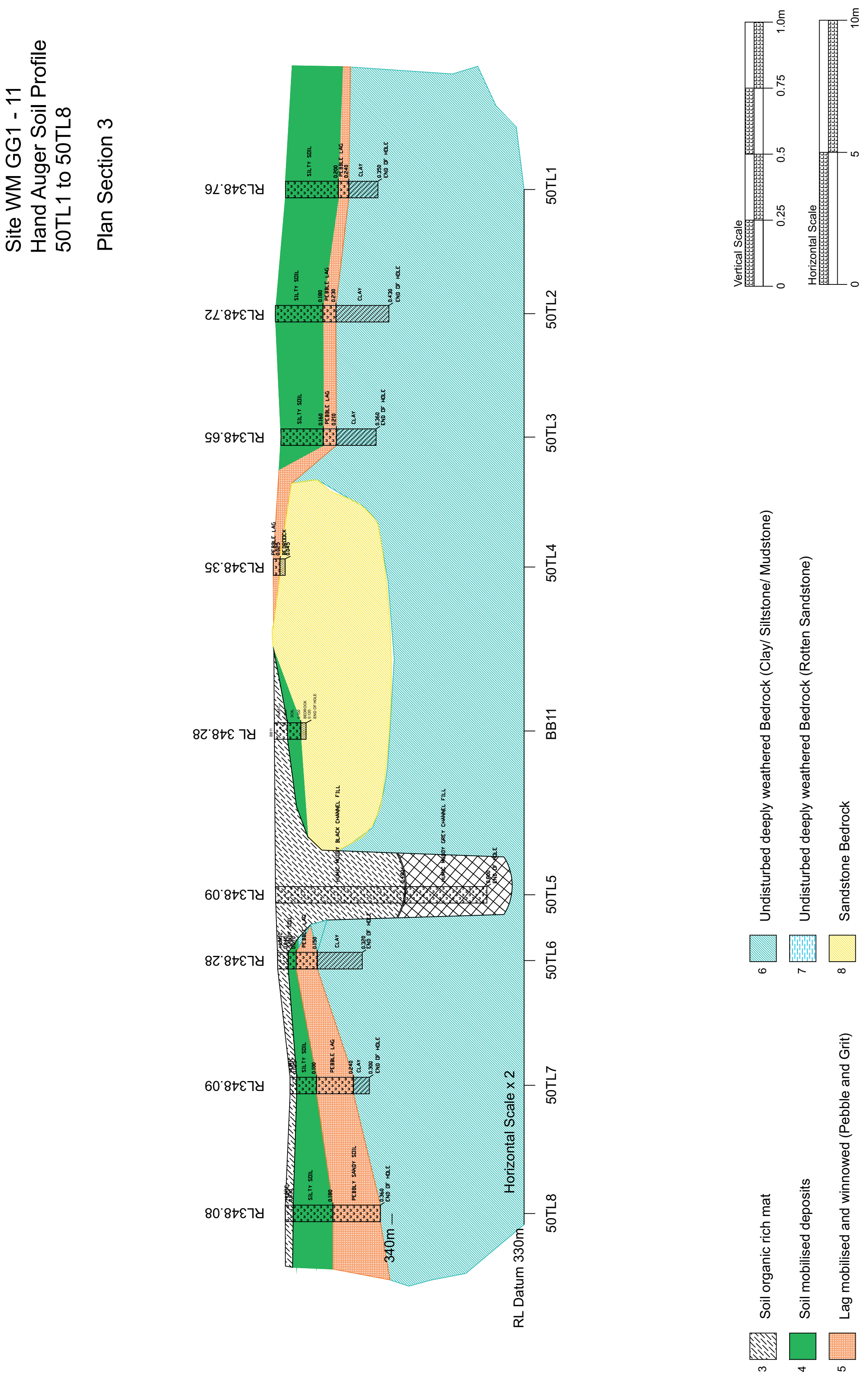
5 Lag mobilised and winnowed (Pebble and Grit)

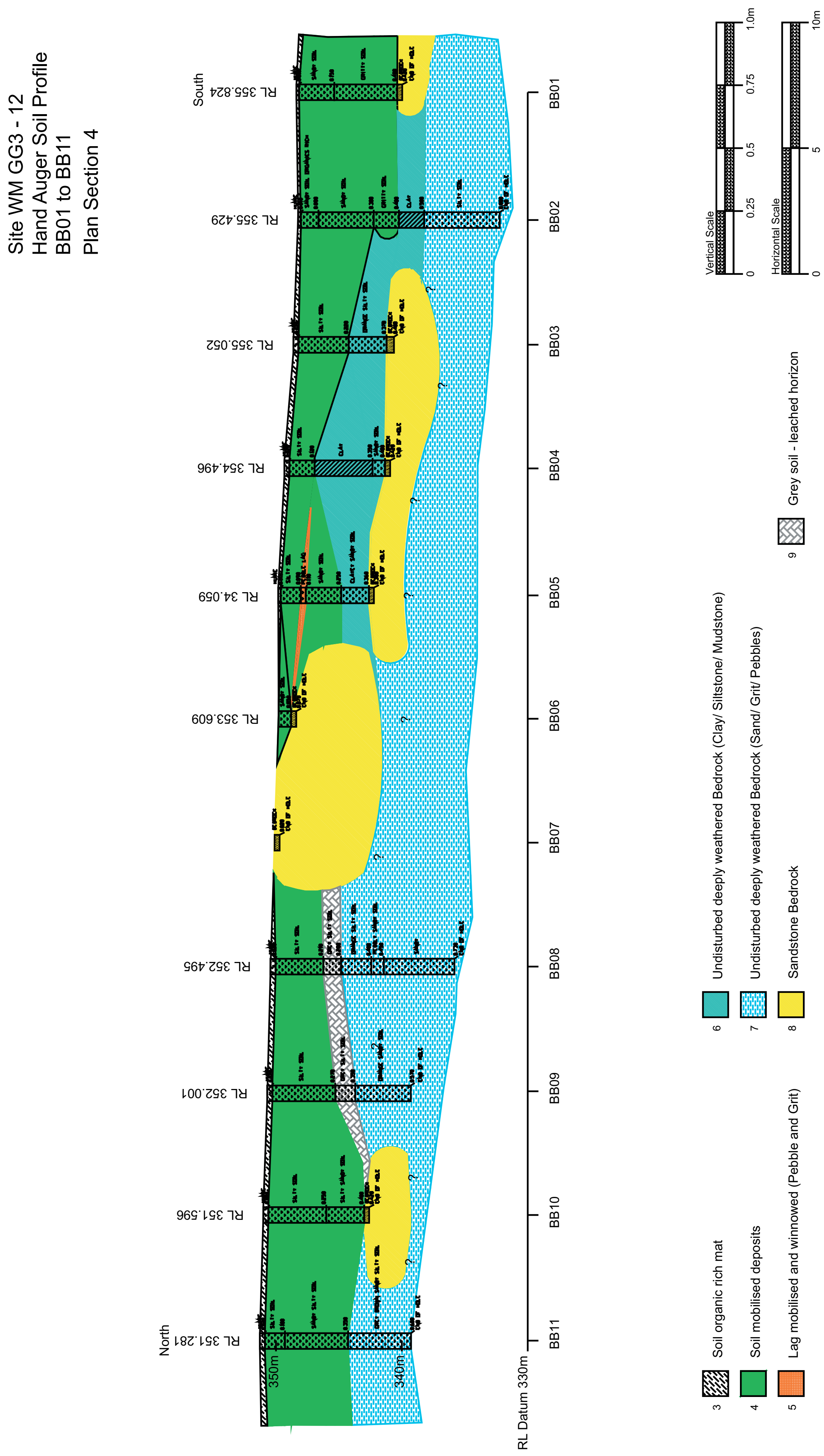
6 Undisturbed deeply weathered Bedrock (Clay/ Siltstone/ Mudstone)

7 Undisturbed deeply weathered Bedrock (Rotten Sandstone)

8 Sandstone Bedrock




Site WM GG1 - 11
Hand Auger Soil Profile
50TL1 to 50TL8
Plan Section 3
RL348.76
RL348.72
RL348.65
RL348.35
RL 348.28
RL348.09
RL348.28
RL348.09
RL348.08
50TL1
50TL2
50TL3
50TL4
BB11
50TL5
50TL6
50TL7
50TL8
Horizontal Scale x 2
340m
RL Datum 330m
SILTY SOIL
PEBBLE LAG
CLAY
END OF HOLE
PEBBLY SANDY SOIL
Vertical Scale
0
0.25
0.5
0.75
1.0m
Horizontal Scale
0
5
10m
3 Soil organic rich mat
4 Soil mobilised deposits
5 Lag mobilised and winnowed (Pebble and Grit)
6 Undisturbed deeply weathered Bedrock (Clay/ Siltstone/ Mudstone)
7 Undisturbed deeply weathered Bedrock (Rotten Sandstone)
8 Sandstone Bedrock



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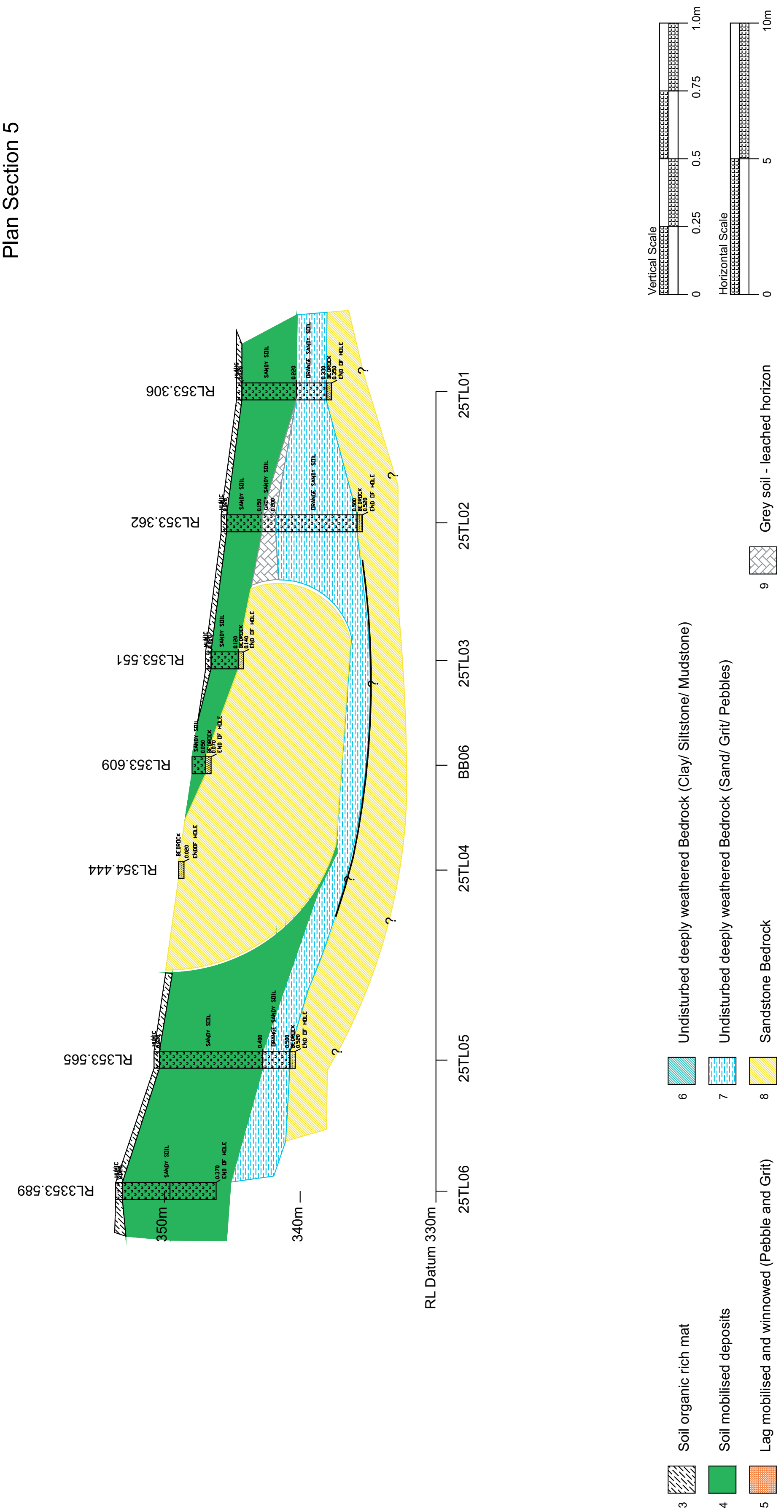
Site WM GG3 - 12
Hand Auger Soil Profile
TL1 to TL6

Plan Section 5

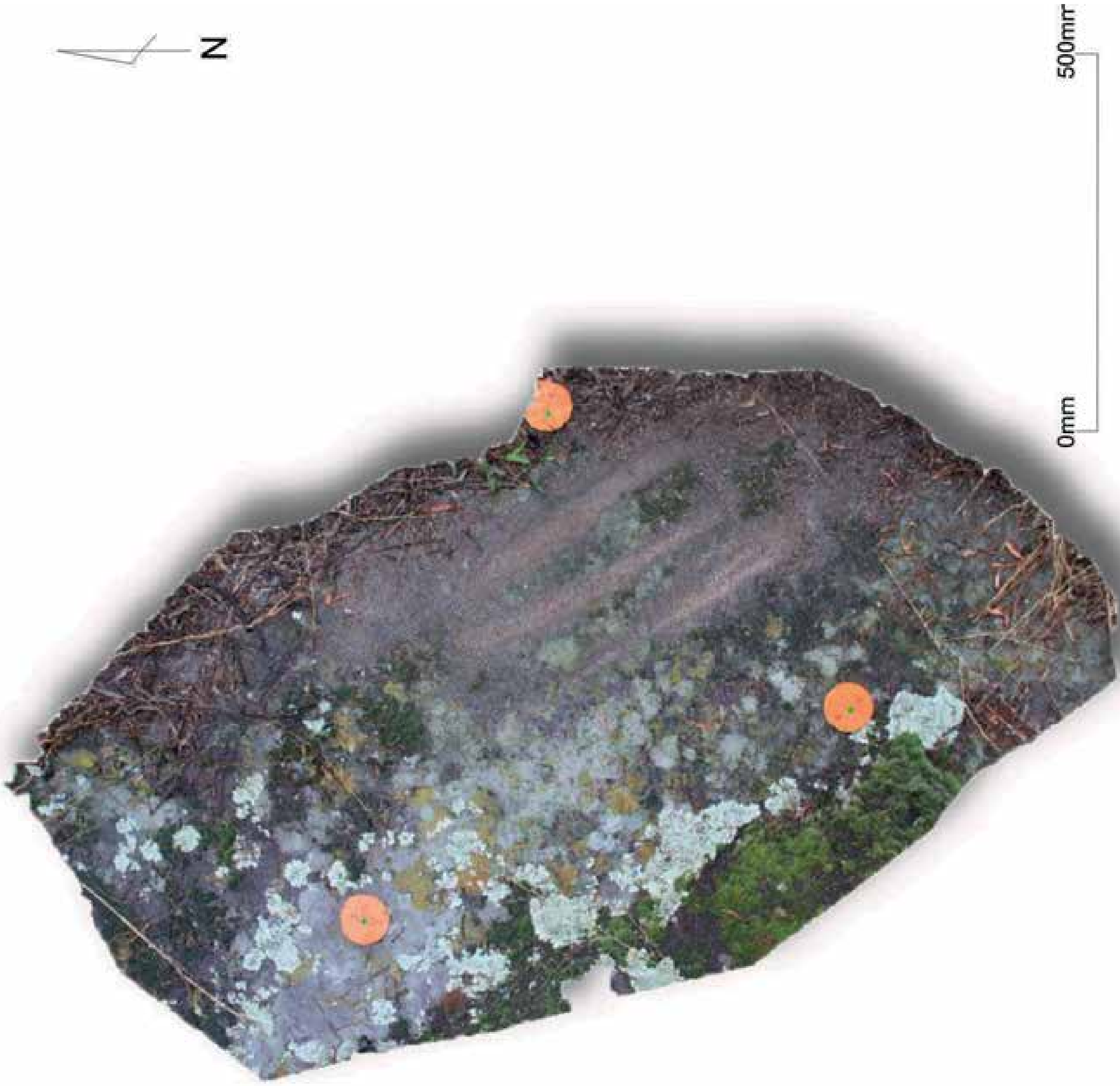


Appendix 1 - WM-GG1-11 and WM-GG3-12 Photo Albums

Album 1 Site 1

Appendix A1.1a: Site 1 - DTM 1a

Appendix A1.2a: Site 1 - DTM 2a



Appendix A1.3a: Site 1 - DTM 3a

Appendix A1.4a: Site 1 - DTM 4a

Appendix A1.5a: Site 1 - DTM 5a

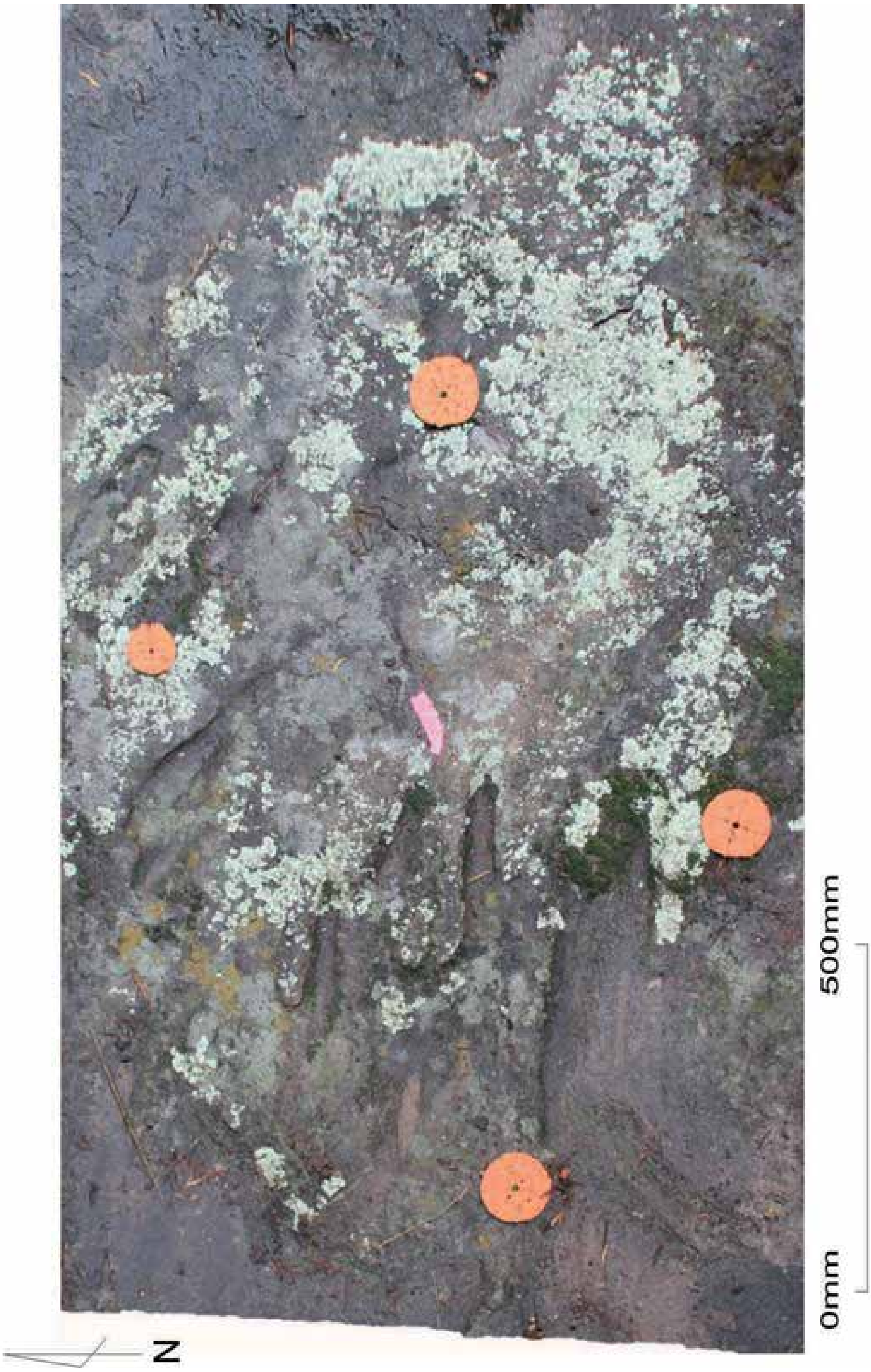
Appendix A1.5b: Site 1 - DTM 5b

Appendix A1.5c: Site 1 - DTM 5c

Appendix A1.5d: Site 1 - DTM 5d - a

Appendix A1.5d: Site 1 - DTM 5d-b

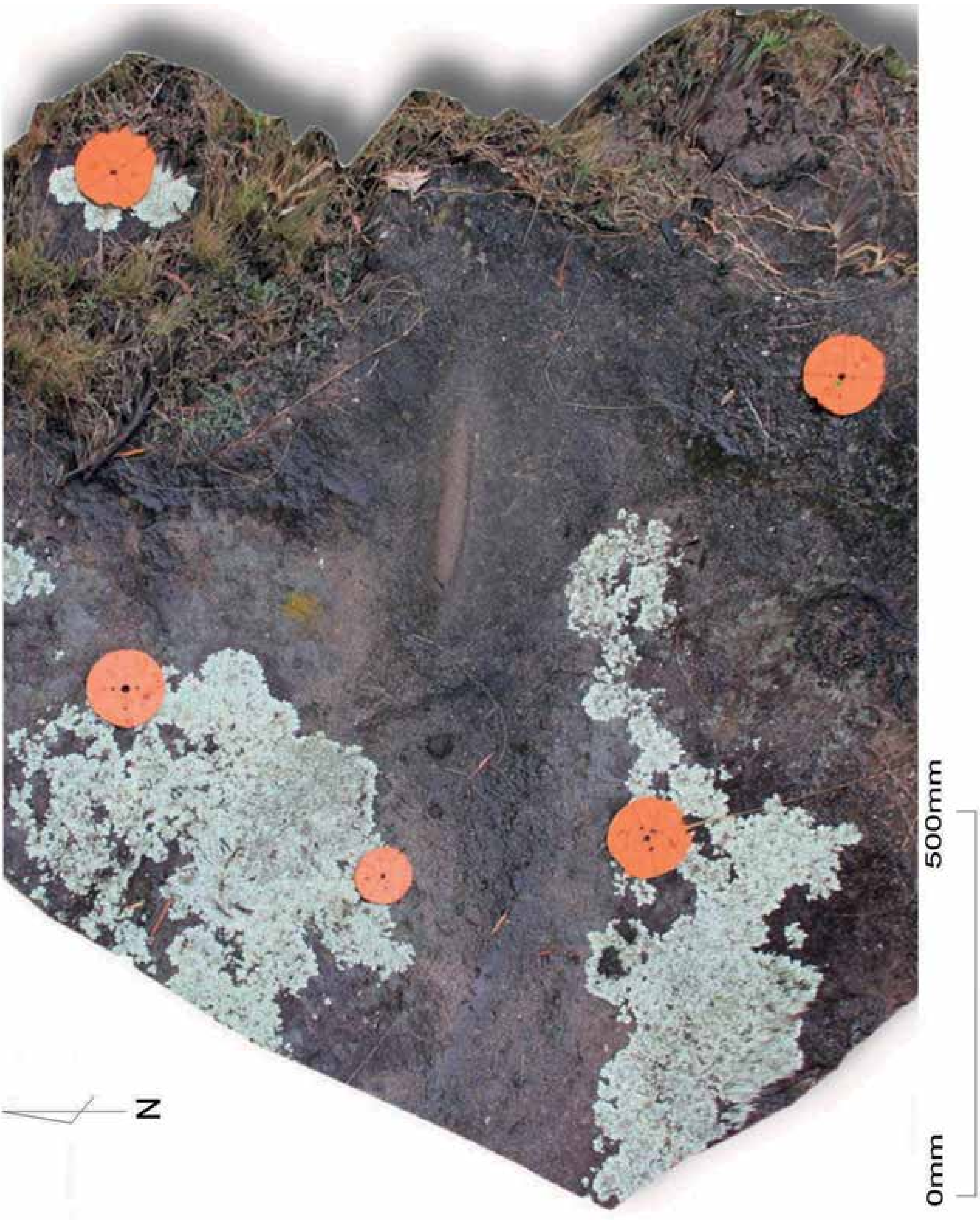
Appendix A1.6a: Site 1 - DTM 6a



Appendix A1.6b: Site 1 - DTM 6b

Appendix A1.6c: Site 1 - DTM 6c

Appendix A1.7a: Site 1 - DTM 7a



Appendix A1.8a: Site 1 - DTM 8a

Appendix A1.9a: Site 1 - DTM 9a

Appendix A1.10a: Site 1 - DTM 10a

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Appendix A1.10b: Site 1 - DTM 10b

Appendix A1.10c: Site 1 - DTM 10c

Appendix A1.11a: Site 1 - DTM 11a

Appendix A1.12a: Site 1 - DTM 12a

Album 2 Site 2

Appendix A1.13a: Site 2 - DTM 1a

Appendix A1.14a: Site 2 - DTM 1a and 2a merged.

Appendix A1.15a: Site 2 - DTM 2a.

Appendix A1.16a: Site 2 - DTM 3a.

Appendix 2 - Diskette of DTM images and Panoramic Virtual Tour

1. Introduction

Hansen Bailey commissioned SCT Operations Pty Ltd to conduct Terrestrial Photogrammetric surveys of two aboriginal grinding groove sites located on Shenhua Watermark Coal Project. Two surveys were conducted on 23 April 2012 with the first conducted at site WM-GG1-11 and the second survey being conducted at site WM-GG3-12.

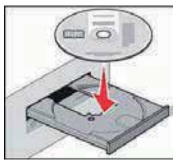
This section presents the steps to follow to navigate the Survey package on the CD supplied and the procedure for the capture of the photogrammetric survey and processing of data.

Also attached to the CD package:

- Instructional guide to installing the DTM viewing software.
- 3DM Viewer 2.4.3 install file.
- A link to download the Viewer install file.
- Instructional guide to viewing and manipulate the DTMs using the software.
- 360^0 spherical virtual walk through tour of both sites.
- Survey data for the photogrammetric survey.
- Map layouts, DTM planviews and DTM location maps.

2. Survey CD Navigation

1. Place the CD supplied into your computer CD drive and wait for the menu to open. This may take a few seconds to load. The menu is seen below (Figure 1).

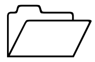


2. To view the walk through tours of each site click on the View Tour button. This will open the tour on your internet browser. Information on using the tour can be found in the left hand corner.

3. It is advised to review the SCT 3DM Viewer Instruction Manual by clicking on the DTM Instructions button at this moment in time. This will explain how to install the 3DM viewer.

4. Install the DTM Viewer by clicking on the Install button which should install a shortcut to your desktop. If the shortcut does not appear navigate through the directory to C:\Program Files\Adam Technology\3DM Viewer 2.4\3DM Viewer.exe (you may create a shortcut to your desktop from here also).

5. Once the Viewer is installed, the DTM files can be opened in the 3DM Viewer program.

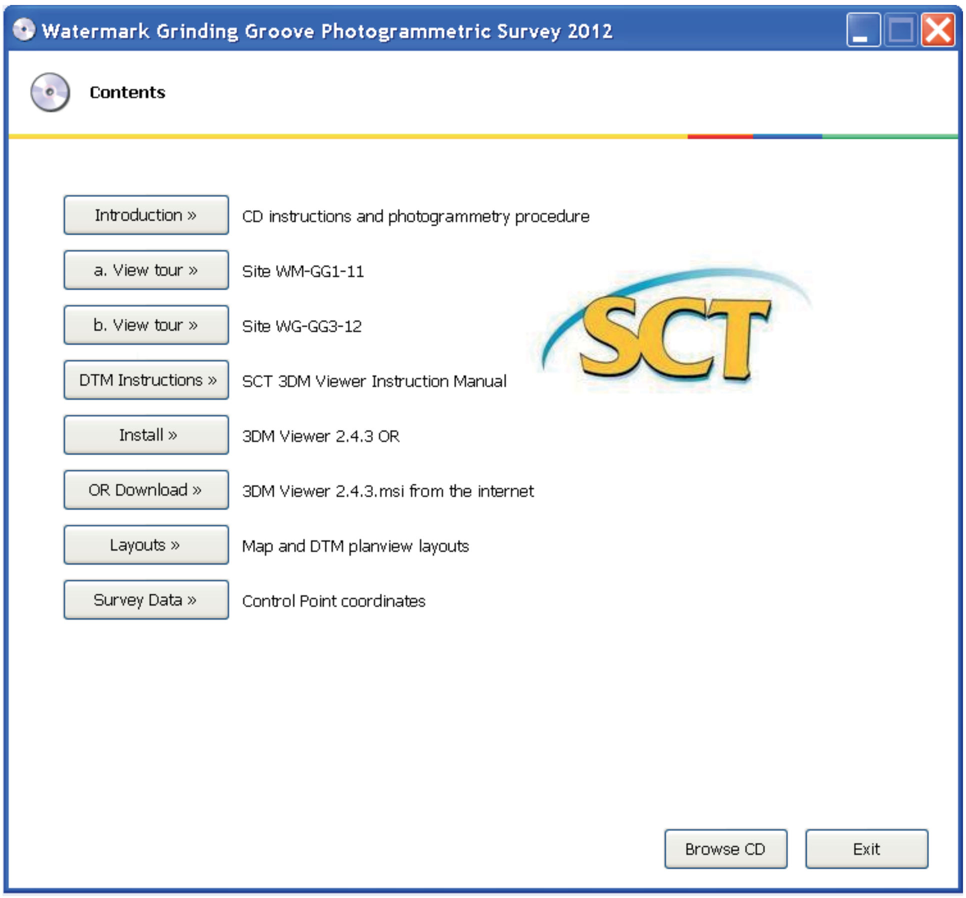


6. To view the map layouts, DTM locations and the DTM planview click on the Layouts button.

7. Survey data of the photogrammetric survey can be viewed by clicking on the Survey Data button.

8. To view all the files on the CD locate the Browse CD button at the bottom right hand corner.

9. To Exit the CD click on the Exit button in the right hand corner.



3. Photogrammetric Procedure for Image Capture and Processing

3.1 Terrestrial Photogrammetric Capture

1. Assess the object or scene that will be captured, take into account the size, shape, and lighting. Calculate the distance the camera stations need to be away from the object/scene and from one another. A desirable distance/base ratio are between 2:1 to 6:1.

2. Control points need to be placed within the image scene. This will consist of placing survey targets in the visible area in front of, on top of, or behind the object/scene. Depending on the risk of placing control points near the object/scene the camera stations can act as control points. A minimum of three control points need to be in a pair of images to be successful Further markers can be placed in the viewing scene as to provide redundancy in control.

3. Once the control points, image markers, camera stations have been placed or marked photo capture can proceed. Notes should be taken at each camera station to assist with processing the data at a later date.

4. Capturing a scene or object involves taking two images from different locations of exactly the same scene. This requires the field person to position the image so that it fully overlaps the last image to complete a single convergent model.

5. Once all pairs have been captured and notes taken all the equipment can be packed up and stored for transportation. Note that control points will not be moved if they have not previously been surveyed in.

3.2 Data Processing

1. Images captured in the field are sorted and matched into their convergent pairs.

2. The pair of images is then opened in 3DM Analyst Lite along with a lens calibration file and a survey file of all control point locations.

3. Control points are located in each pair of images and digitised with their corresponding name found in the survey file.

4. An absolute Orientation Bundle adjustment is conducted on the pair of images that calculates the camera orientations in relation to the already digitized control points.

5. After a successful absolute orientation has been established alignment of the pair of images and removal of lens distortion is conducted to create epipolar images.

6. The epipolar images allow for data points or vertices to be located on the pair of images. The vertices are then connected to form triangles that act the 3D surface.

7. Digital terrain models are derived from the epipolar images which can then be viewed as a 3D object/scene.

Site 1 – WM-GG1-11 Panoramic Images

Appendix A2.1: Site 1 - WM-GG1-11 Panorama 1-4.

Appendix A2.2: Site 1 - WMGG2 Panorama 6-8

APPENDIX 3 - REFERENCE TARGET SURVEY DATA

Site 1: WM-GG1-11 Survey Data

Site	Group	Survey ID	Easting	Northing	RL	Photogrammetric ID
1	1a	2500	243706.1	6540570	352.942	S1-7
1	1a	2501	243706.7	6540570	352.966	S1-6
1	1a	2502	243707	6540570	352.97	S1-5
1	2a	2503	243707.9	6540571	352.999	S2-A
1	2a	2504	243707.9	6540571	352.995	S2-B
1	2a	2505	243708.3	6540571	353.053	S2-C
1	2a	2506	243708.2	6540571	353.025	S2-D
1	3a	2507	243710.4	6540572	353.303	S3-E
1	3a	2508	243710.7	6540571	353.281	S3-F
1	3a	2509	243711.1	6540572	353.293	S3-G
1	3a	2510	243711.1	6540572	353.279	S3-H
1	4a	2511	243714.9	6540573	353.462	S4-1
1	4a	2512	243715.1	6540574	353.444	S4-2
1	4a	2513	243715.6	6540573	353.464	S4-3
1	4a	2514	243715.7	6540574	353.488	S4-4
1	5a	2515	243715.9	6540575	353.431	S5-5
1	5a	2516	243716.3	6540576	353.423	S5-6
1	5a	2517	243717	6540575	353.44	S5-7
1	5b	2518	243717.5	6540575	353.461	S5-B
1	5b	2519	243717.8	6540575	353.493	S5-D
1	5b	2520	243717.2	6540574	353.461	S5-A
1	5c	2519	243717.8	6540575	353.493	S5-D
1	5c	2520	243717.2	6540574	353.461	S5-A
1	5c	2521	243717.6	6540573	353.507	S5-C
1	5c	2522	243718.3	6540574	353.507	S5-E
1	5d_a	2525	243719.4	6540573	353.671	S5-H
1	5d_a	2526	243720.5	6540573	353.6	S5-3
1	5d_a	2527	243719.8	6540574	353.563	S5-2
1	5d_a	2528	243720.4	6540574	353.654	S5-1
1	5d_b	2561	243720.2	6540573	353.592	s6-G
1	5d_b	2564	243719.7	6540573	353.614	s6-D
1	5d_b	2565	243719.8	6540574	353.582	s6-F
1	5d_b	2567	243720.5	6540574	353.59	s6-B
1	6a	2568	243719.1	6540574	353.509	S6-C

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Site	Group	Survey ID	Easting	Northing	RL	Photogrammetric ID
1	6a	2569	243718.6	6540575	353.459	S6-E
1	6a	2570	243719.2	6540575	353.473	S6-2
1	6a	2571	243719.7	6540575	353.498	S6-4
1	6b	2570	243719.2	6540575	353.473	S6-2
1	6b	2571	243719.7	6540575	353.498	S6-4
1	6b	2572	243720.3	6540575	353.588	S6-1
1	6b	2574	243720	6540576	353.532	S6-5
1	6c	2570	243719.2	6540575	353.473	S6-2
1	6c	2575	243718.7	6540576	353.468	S6-A
1	6c	2576	243718.5	6540577	353.448	S6-3
1	6c	2577	243719.3	6540576	353.449	S6-H
1	7a	2571	243719.7	6540575	353.498	S6-4
1	7a	2572	243720.3	6540575	353.588	S6-1
1	7a	2578	243720.6	6540577	353.515	S6-6
1	7a	2579	243721	6540576	353.578	S6-7
1	8a	2594	243723.8	6540576	353.778	S7-7
1	8a	2595	243724.1	6540576	353.812	S7-3
1	8a	2596	243724.8	6540576	353.86	S7-4
1	8a	2597	243724.5	6540575	353.804	S7-1
1	8a	2598	243723.9	6540576	353.792	S7-2
1	9a	2599	243728.4	6540585	354.003	S8-E
1	9a	2600	243728.6	6540585	353.915	S8-C
1	9a	2601	243728.2	6540585	353.942	S8-B
1	9a	2602	243728.6	6540584	353.915	S8-D
1	9a	2603	243728.2	6540584	353.918	S8-A
1	10a	2638	243726.2	6540689	355.645	S10-3
1	10a	2639	243725.5	6540688	355.6	S10-4
1	10a	2641	243725.2	6540689	355.613	S10-2
1	10a	2657	243726.1	6540690	355.635	S10-1
1	10b	2640	243724.4	6540688	355.546	S10-6
1	10b	2642	243723.9	6540687	355.569	S10-F
1	10b	2652	243723.1	6540685	355.374	S10-C
1	10b	2656	243724.9	6540688	355.595	S10-5
1	10c	2652	243723.1	6540685	355.374	S10-C
1	10c	2653	243722.6	6540685	355.363	S10-B
1	10c	2654	243722.7	6540685	355.378	S10-E
1	10c	2651	243723.3	6540685	355.41	S10-G

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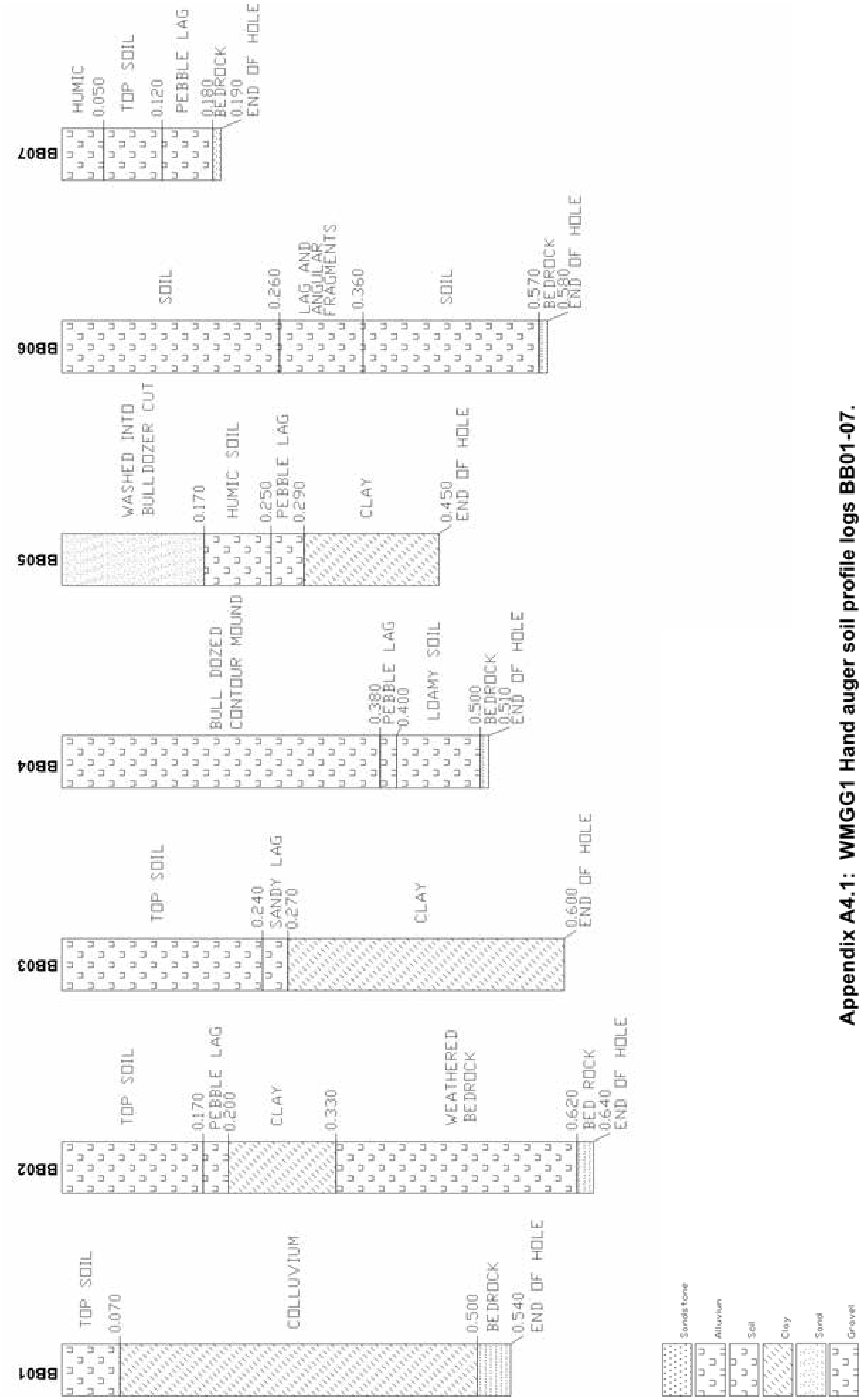
Site	Group	Survey ID	Easting	Northing	RL	Photogrammetric ID
1	11a	2645	243728	6540664	355.134	S11-A
1	11a	2646	243728.9	6540665	355.193	S11-3
1	11a	2659	243728.8	6540664	355.189	S11-2
1	11a	2660	243728.6	6540663	355.171	S11-4
1	12a	2647	243736.9	6540661	355.774	S12-F
1	12a	2648	243736.9	6540662	355.763	S12-D
1	12a	2650	243737.6	6540661	355.843	S12-6

Site 2: WM-GG3-12 Survey Data

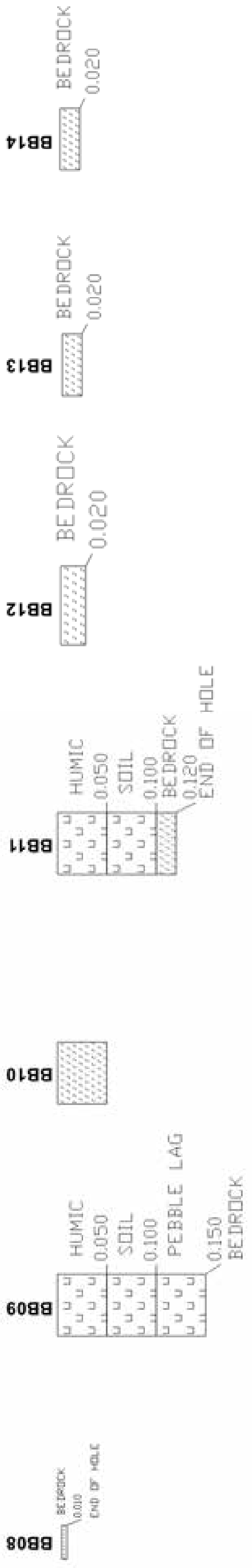
Site	Group	Survey ID	Easting	Northing	RL	Photogrammetric ID
2	1a	6500	823156.5	6537984	343.169	S1-2
2	1a	6501	823157.2	6537983	343.08	S1-4
2	1a	6502	823157.8	6537984	343.235	S1-3
2	1a	6503	823157.1	6537984	343.207	S1-1
2	2a	6502	823157.8	6537984	343.235	S1-3
2	2a	6504	823158.7	6537985	343.216	S1-7
2	2a	6505	823158.5	6537984	343.14	S1-5
2	2a	6506	823159.1	6537984	343.154	S1-6
2	3a	6507	823162.3	6537984	343.158	S1-H
2	3a	6508	823161.5	6537983	343.146	S1-A
2	3a	6509	823161.4	6537983	343.095	S1-D
2	3a	6510	823162.5	6537983	343.078	S1-F

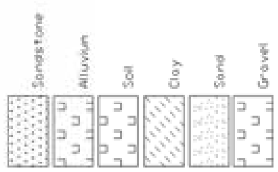
Appendix 4 - WM-GG1-11 and WM-GG3-12 Augur Hole Logs



Appendix A4.1: WMGG1 Hand auger soil profile logs BB01-07.

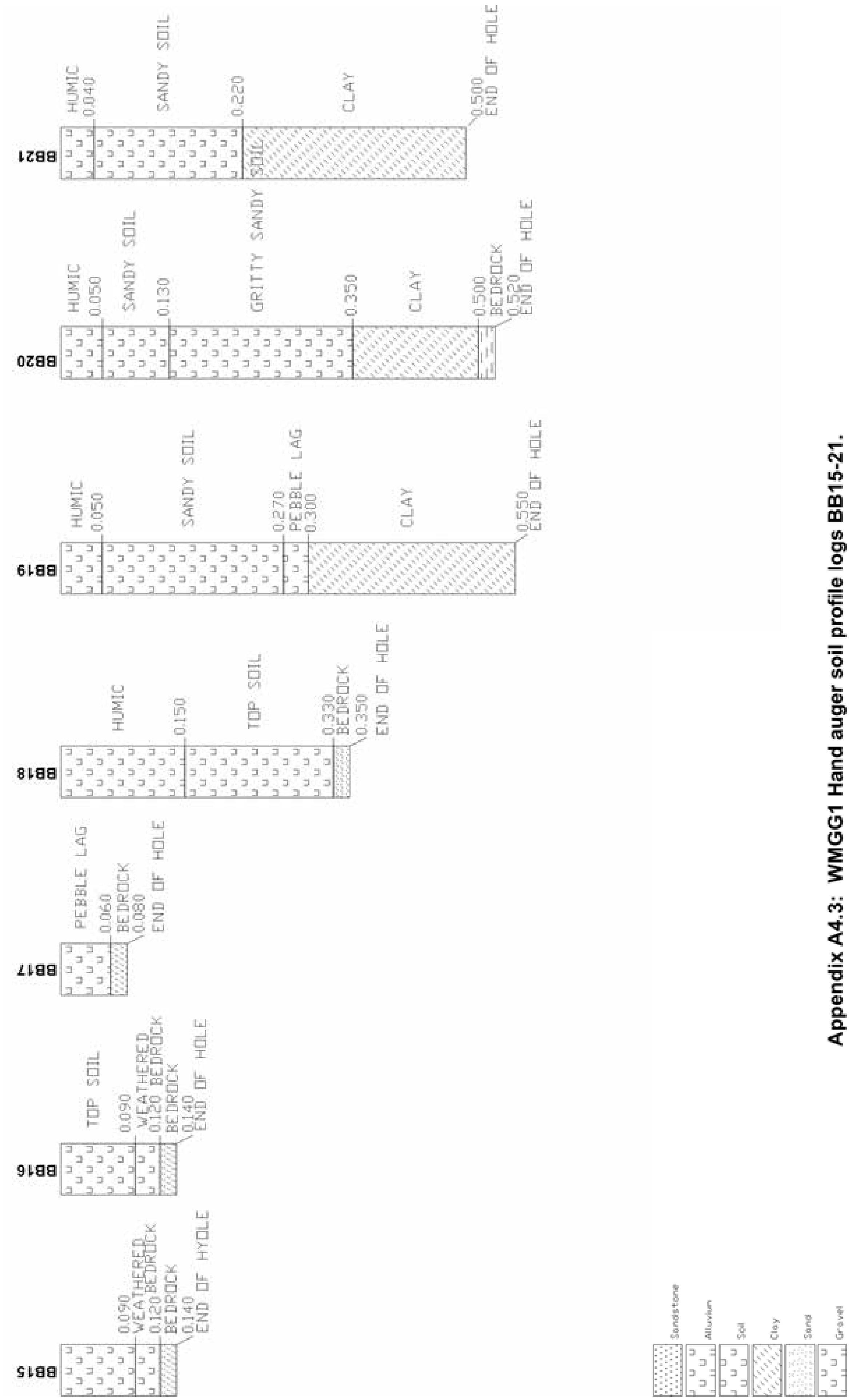
SCT Operations Pty Ltd





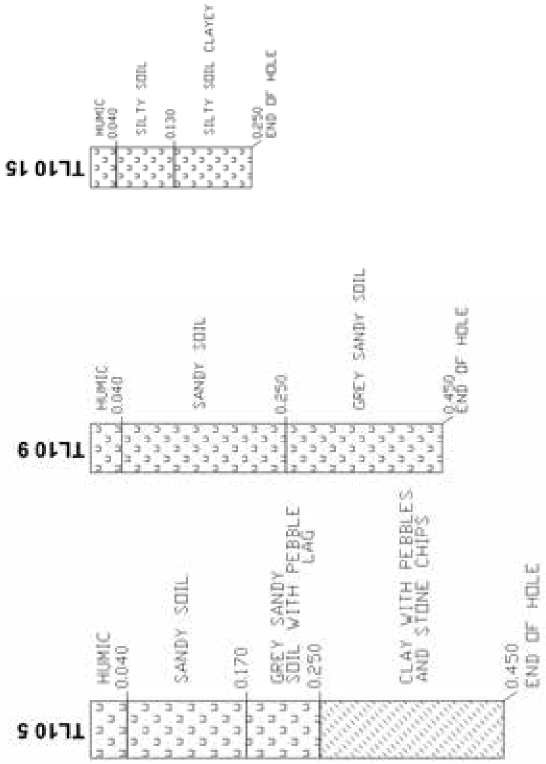
Appendix A4.2: WMGG1 Hand auger soil profile logs BB08-14.

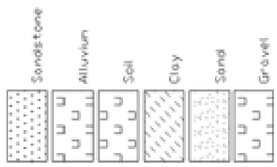
SCT Operations Pty Ltd



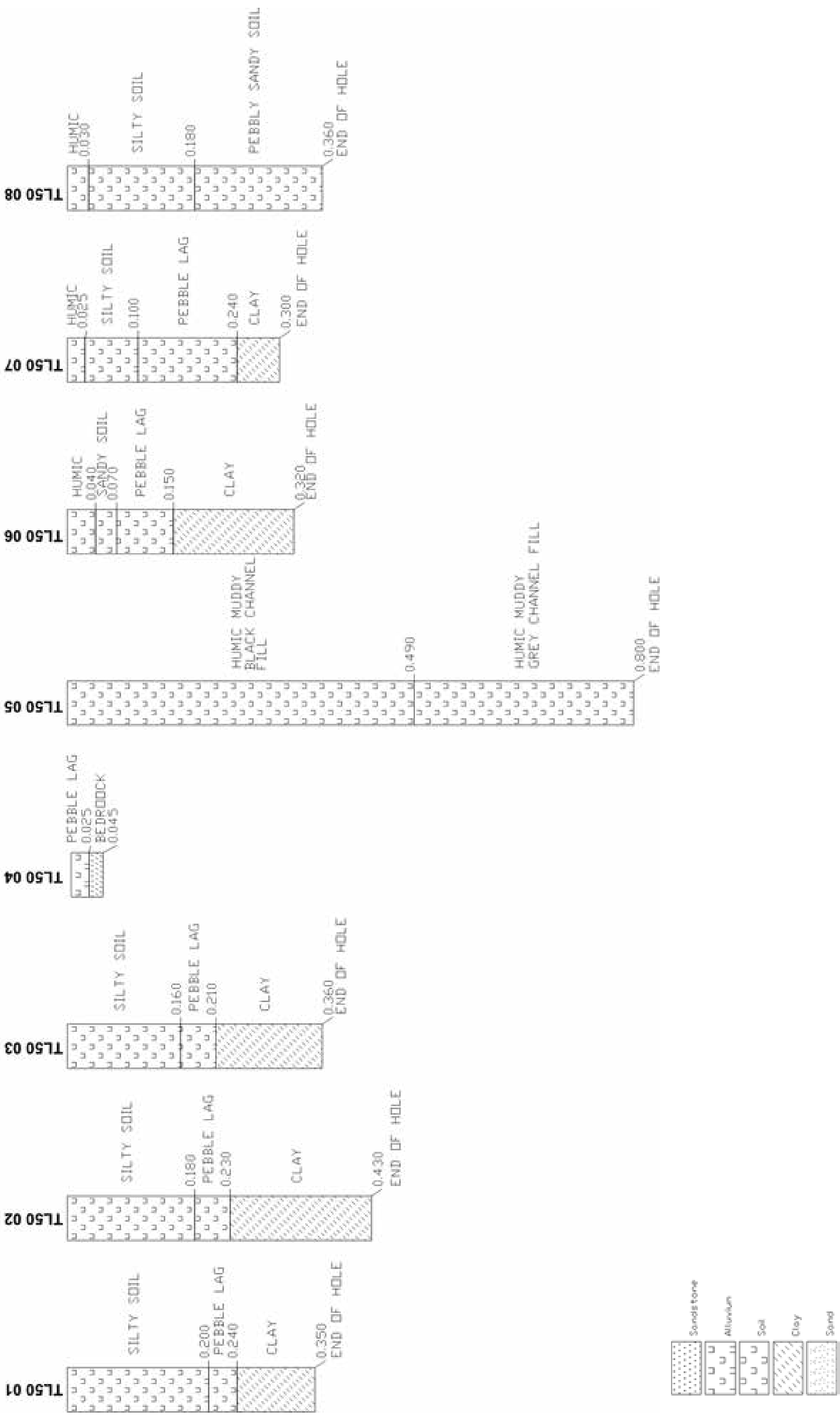
Appendix A4.3: WMGG1 Hand auger soil profile logs BB15-21.

SCT Operations Pty Ltd





Appendix A4.4: WMGG1 Hand auger soil profile logs TL10 5-TL10 15.



Appendix A4.5: WMGG1 Hand auger soil profile logs TL50 01-TL50 08.

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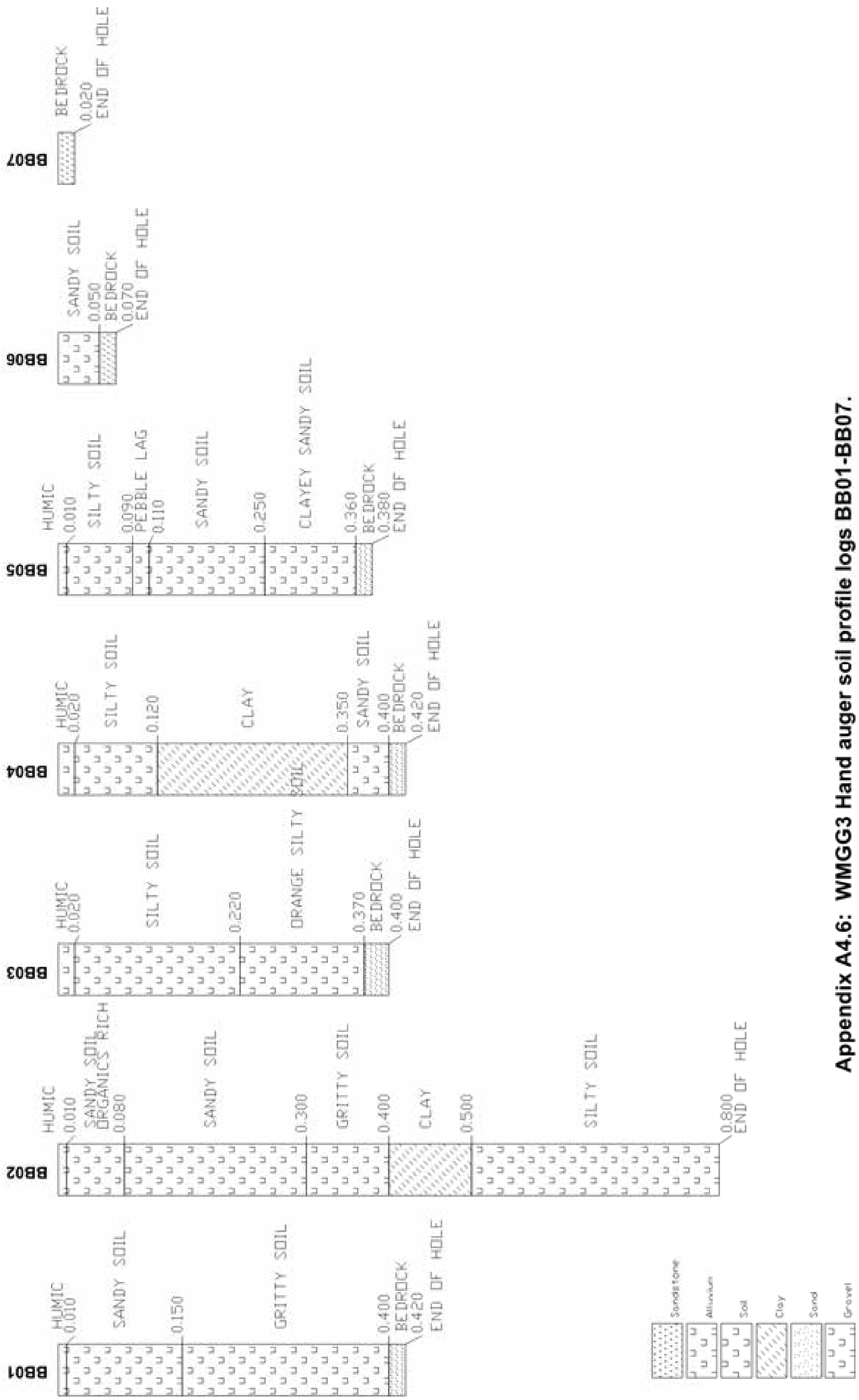
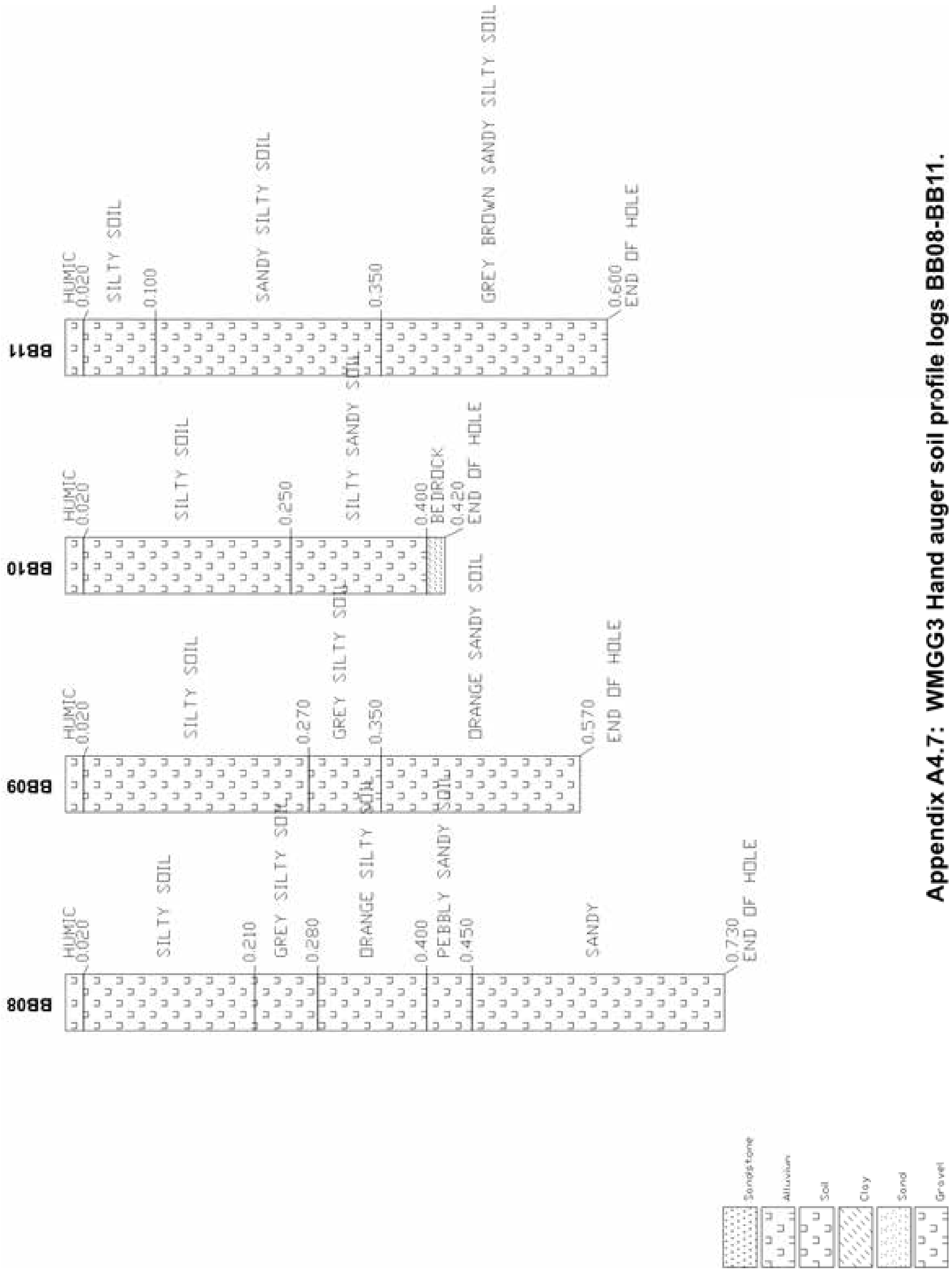


Appendix A4.6: WMGG3 Hand auger soil profile logs BB01-BB07.



Appendix A4.7: WMGG3 Hand auger soil profile logs BB08-BB11.

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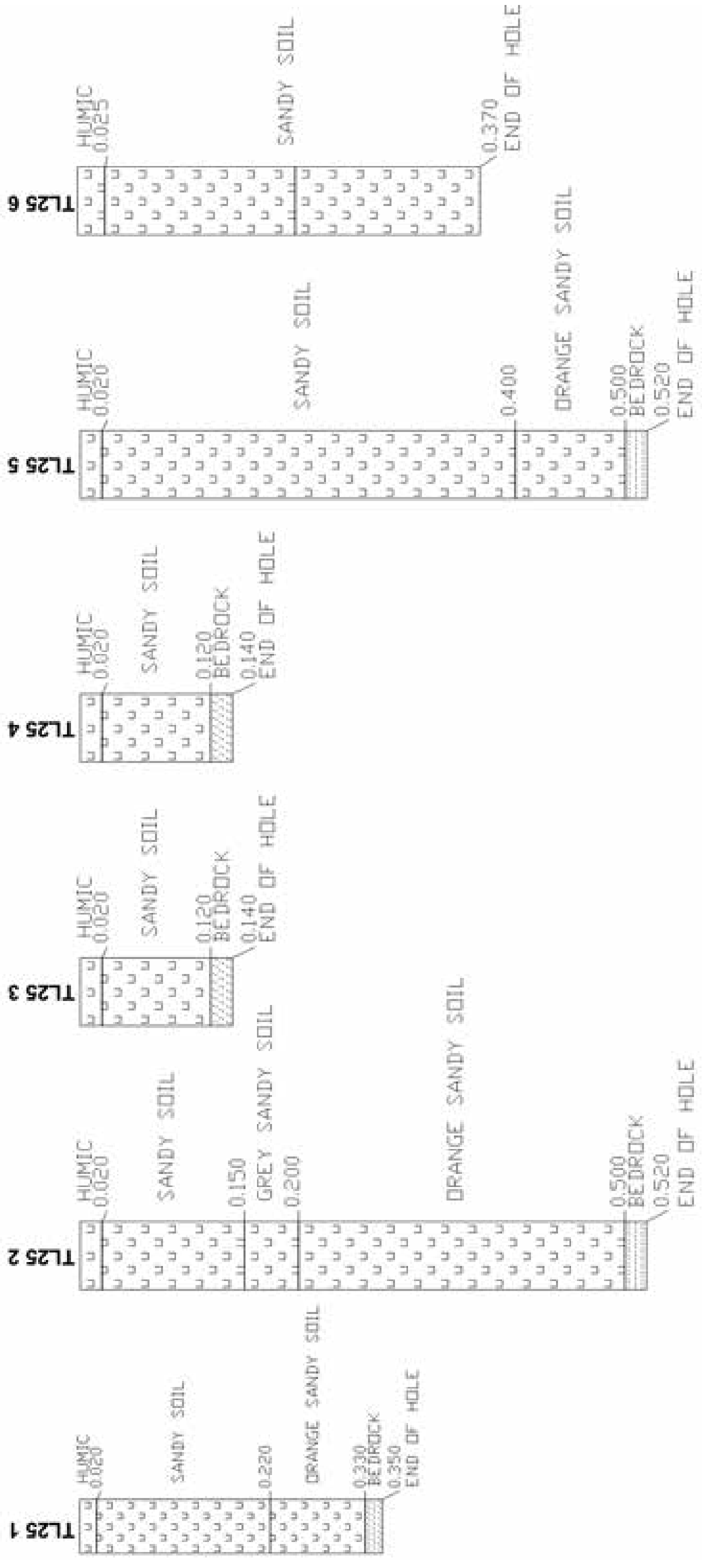

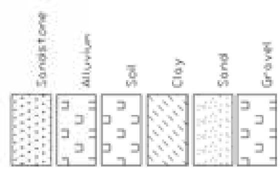

Appendix A4.8: WMGG3 Hand auger soil profile logs TL25 1-TL25 6.

Appendix 5 - Rock Core Laboratory Report

(PDF Format)

STRATA TESTING SERVICES

Strata Testing Services Pty Ltd ACN 100 216 519
2/77 Jardine St, Fairy Meadow, NSW 2519, Australia
PO Box 86, Corrimal, NSW 2518, Australia
Phone: (02) 4284 4666 Fax: (02) 4284 4664

REPORT NUMBER: L1699
REPORT DATE: 25 Jun 2012

GEOTECHNICAL LABORATORY TEST REPORT

Strata Control Technology

131 Kembla St, Wollongong 2500

Watermark

StrataLab 3.7.01 – June 2012

STRATA TESTING SERVICES

Strata Testing Services Pty Ltd ACN 100 216 519
2/77 Jardine St, Fairy Meadow, NSW 2519, Australia
PO Box 86, Corrimal, NSW 2518, Australia
Phone: (02) 4284 4666 Fax: (02) 4284 4664

GEOTECHNICAL LABORATORY TEST REPORT

REPORT NUMBER: 1699–01
REPORT DATE: 25 Jun 2012
PAGE: 1 of 2

TRIAXIAL PROPERTIES

CLIENT: Strata Control Technology
131 Kembla St, Wollongong 2500
Project: Watermark

SAMPLE

Specimen: 1699–01
Rock Type: Not Defined
ID/Mark/Depth: WM–GG–1
Storage: Plastic wrapped, tested as received

TEST

Date: 22 Jun 2012
Method: GTLAB06.02–1999
Test Machine: Avery 7112 E70243 & Celtron LCD50k
Measurement: Displacement Transducer
Duration: 12m 47s

RESULTS

Diameter (mm)	Length (mm)	Density (t/m^3)	Moisture Content (%)
82.6	142.6	2.166	5.9

Intact Strengths

Confining Pressure (MPa)	Maximum Axial Stress (MPa)	Young's Modulus (GPa)
1.0	**10.9**	**2.39**
2.0	**17.8**	**3.80**
4.0	**29.4**	**4.84**

Residual Strengths

Confining Pressure (MPa)	Median Axial Stress (MPa)	Young's Modulus (GPa)
4.0	**20.8**	——
3.0	**16.9**	——
2.0	**12.2**	**2.54**
1.5	**9.69**	
1.0	**7.07**	
0.6	**4.87**	

COMMENTS

Digitally signed by Peter Fulko
Authorised Signatory...............................

StrataLab 3.7.01 – June 2012

Sample ID: WM–GG–1

SCT Operations Pty Ltd

Strata Testing Services Pty Ltd ACN 100 216 519
2/77 Jardine St, Fairy Meadow, NSW 2519, Australia
PO Box 86, Corrimal, NSW 2518, Australia
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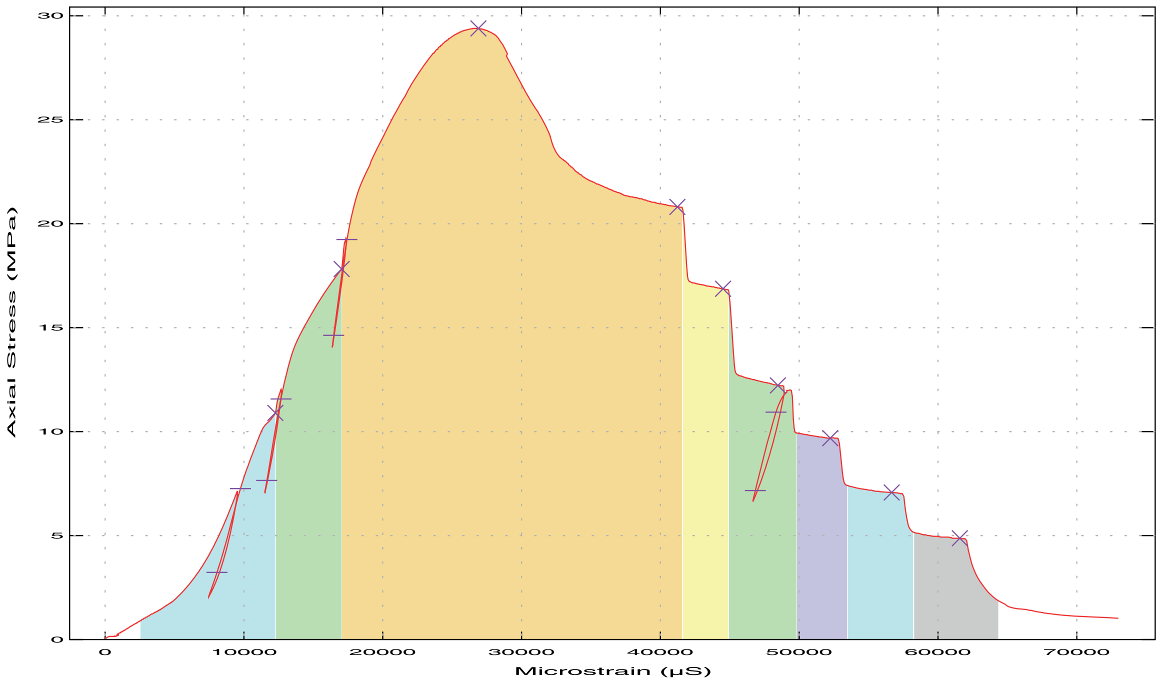
GEOTECHNICAL LABORATORY TEST REPORT

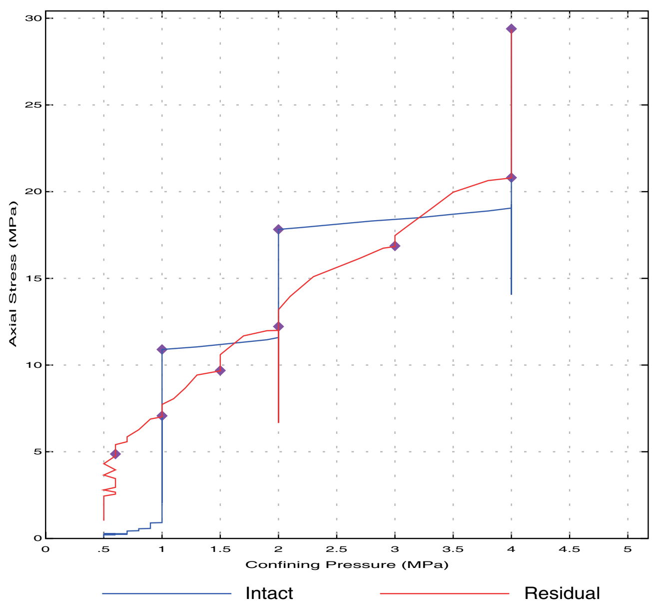
REPORT NUMBER: 1699–01
REPORT DATE: 25 Jun 2012
PAGE: 2 of 2

TRIAXIAL PROPERTIES

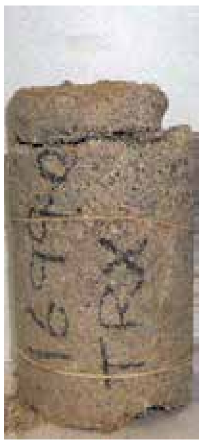
CLIENT: Strata Control Technology
131 Kembla St, Wollongong 2500
Project: Watermark

RESULT PLOTS





Failure Mode



StrataLab 3.7.01 – June 2012

SCT Operations Pty Ltd

Strata Testing Services Pty Ltd ACN 100 216 519
2/77 Jardine St, Fairy Meadow, NSW 2519, Australia
PO Box 86, Corrimal, NSW 2518, Australia
Phone: (02) 4284 4666 Fax: (02) 4284 4664

GEOTECHNICAL LABORATORY TEST REPORT

REPORT NUMBER: 1699–02
REPORT DATE: 25 Jun 2012
PAGE: 1 of 2

TRIAXIAL PROPERTIES

CLIENT: Strata Control Technology
131 Kembla St, Wollongong 2500
Project: Watermark

SAMPLE
Specimen: 1699–02
Rock Type: Not Defined
ID/Mark/Depth: WM–GG–3
Storage: Plastic wrapped, tested as received

TEST
Date: 22 Jun 2012
Method: GTLAB06.02–1999
Test Machine: Avery 7112 E70243 & Celtron LCD50k
Measurement: Displacement Transducer
Duration: 12m 33s

RESULTS

Diameter (mm)	Length (mm)	Density (t/m^3)	Moisture Content (%)
82.5	171.9	2.276	3.9

Intact Strengths

Confining Pressure (MPa)	Maximum Axial Stress (MPa)	Young's Modulus (GPa)
1.0	**23.6**	**3.77**
2.0	**29.6**	**7.75**
4.0	**38.5**	**7.98**

Residual Strengths

Confining Pressure (MPa)	Median Axial Stress (MPa)	Young's Modulus (GPa)
4.0	**23.9**	——
3.0	**19.5**	——
2.0	**14.4**	**4.35**
1.5	**11.5**	
1.0	**8.53**	
0.6	**5.82**	

COMMENTS

Authorised Signatory..............................

StrataLab 3.7.01 – June 2012

Sample ID: WM–GG–3

SCT Operations Pty Ltd

Strata Testing Services Pty Ltd ACN 100 216 519
2/77 Jardine St, Fairy Meadow, NSW 2519, Australia
PO Box 86, Corrimal, NSW 2518, Australia
Phone: (02) 4284 4666 Fax: (02) 4284 4664

GEOTECHNICAL LABORATORY TEST REPORT

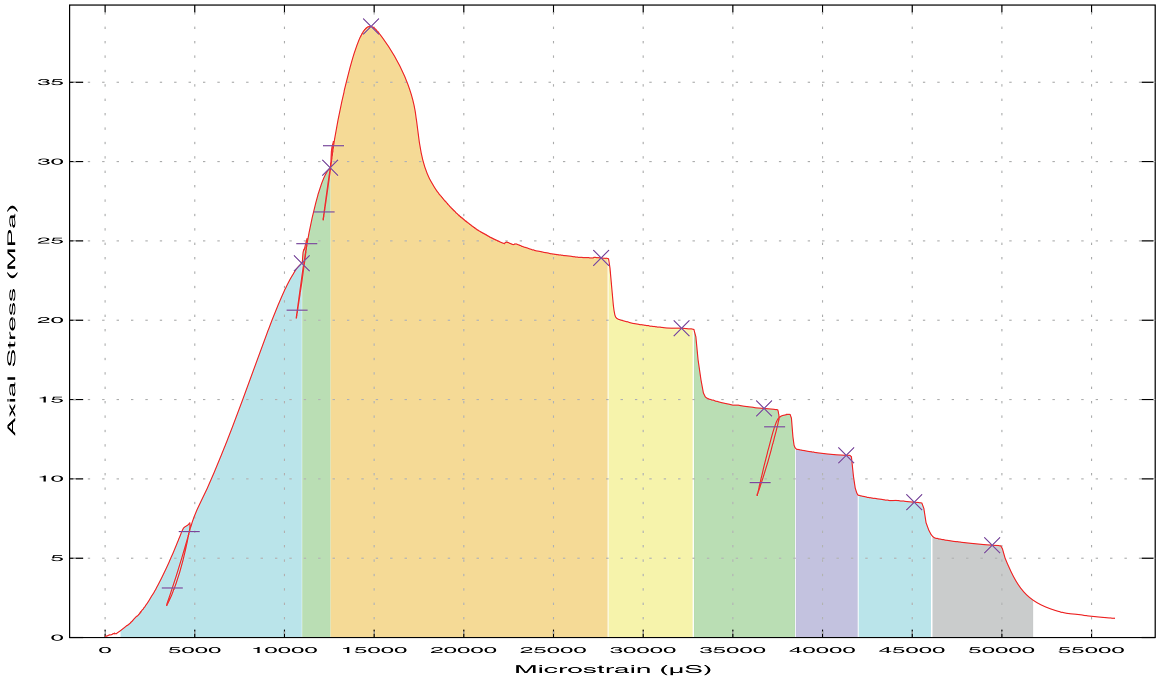
REPORT NUMBER: 1699–02
REPORT DATE: 25 Jun 2012
PAGE: 2 of 2

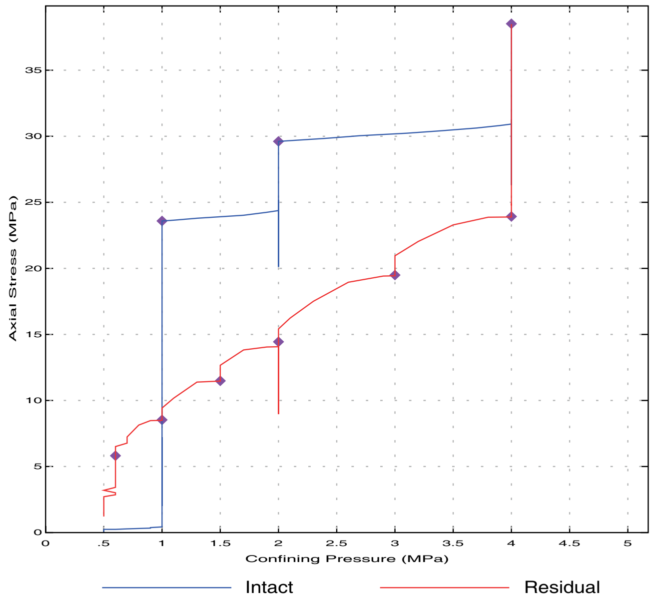
TRIAXIAL PROPERTIES

CLIENT: Strata Control Technology
131 Kembla St, Wollongong 2500

Project: Watermark

RESULT PLOTS





Failure Mode

StrataLab 3.7.01 – June 2012

SCT Operations Pty Ltd