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MEMO

TO:	Justin Robins	COMPANY:	ABM Resources Ltd	
FROM:	SWC Personnel	PROJECT TITLE:	ABM Resources EIS	
DATE:	3 April 2014	PROJECT & DOCUMENT NO:	ABM-001-01-03	008
SUBJECT:	Twin Bonanza Waste Rock Dump Design Assessment Memo			

Introduction

Soilwater Consultants (SWC) were contracted by ABM Resources Limited (ABM) to assess the waste rock dump (WRD) design for the Twin Bonanza Gold Project (TBGP) site based on the SWC proposal dated 24 March 2014 titled "Addressing Regulator Comments on the Twin Bonanza EIS". This memo includes the Task 1 items of the Scope of Work: the results of the desktop stability assessment of the WRD design and the assessment of the likely environmental implications of increased rainwater infiltration into the WRD.

Site Location

The proposed TBGP site is located in the Tanami Desert Region of the Northern Territory, approximately 625 km north-west of Alice Springs and 16 km east of the Northern Territory border with Western Australia.

The proposed site layout is shown in Figure 1 attached, and consists of three open pits, onsite processing facilities and associated tailings facility, two WRDs, concentrate residual dam and required infrastructure including power station, accommodation, workshops and offices. The two WRDs proposed for the TBGP site are shown red in Figure 1.

Life of mine (LOM) is expected to be at least 3 years, with the expectation that further exploration activities will indicate that the LOM could be extended. The total disturbance area within the TBGP area is approximately 255.8 ha.

WRD Design Overview

The general strategy for the proposed design for the WRDs is to result in a land surface that is stable and allows for the establishment of revegetation species, which will further stabilise the landforms. The outer surfaces of the WRDs are planned to be constructed of suitably erosion-resistant materials, with the upper surface and outer embankments made of local sandstone material.[1]

[1] SWC, 2013. *Twin Bonanza Erosion and Sediment Control Plan*. Unpublished report ABM-001-01-03 001 prepared by Soilwater Consultants for ABM Resources Ltd. Perth, Australia. 10 December 2013.

Figure 2 shows a section of the WRD design (provided by ABM) and the idealised model geometry. The proposed WRD design includes batter slopes shaped to a maximum slope angle of 15°, with maximum lift height of 10 m. 10-meter-wide back-sloping berms are included in the design between each lift. The total WRD design height is 20 m.[2]

WRD Stability Overview

Material Parameters

A pre-mine soils assessment was completed by SWC to identify the surficial materials present within the TBGP area and to characterise the physical, chemical and hydraulic properties. The study found the soil profile for the TBGP site was characterised as a shallow sandy loam, with red sandy loam overlying a partially to completely weathered sandstone. A significant gravel fraction was contained within the surface red sandy loam and the underlying sandstone[3].

Five key geological units were identified as part of the geochemical review and will likely be present to some degree in the WRD: sandstone, siltstone, intercalated siltstones and sandstones, intercalated anomalous arsenic and quartz veins[4]. Generally these types of materials are non-plastic and poorly graded with low strength parameters when minimal compaction effort is applied and the material particles are loose. Realistic minimum strength parameters for this type of material are:

- Cohesion of 1 kPa
- Angle of Friction range[5] of 26° to 30°, and
- Unit weight of approximately 1950 kg/m^3.[6]

WRD Design Stability

Factor of safety (FOS) when working with geotechnical stability modelling is an indication of the stability of an idealised structure. Modelling results for idealised structures with FOS greater than or equal to 1 are indicative of a stable condition; alternately a FOS result less than 1 is considered unstable. Generally the higher the FOS the more stable an idealised model is geotechnically.

An idealised WRD design, as shown in Figure 2, was used to create a stability model using SoilVision Slope (SV Slope) and run to establish minimal material parameters that would indicate a stable WRD with the idealised geometry. The results of the model indicated that at minimum expected material strength parameters for sandstone, the WRD design would have a FOS greater than 1.

Risks Associated with Failure

Based on the material characterisation and the WRD design, the potential of the WRD developing stability problems is low and a detailed geotechnical stability analysis is not required.

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[2] SWC, 2013. *Twin Bonanza Erosion and Sediment Control Plan*.

[3] SWC, 2013. *Twin Bonanza Soil Assessment and Erosion Study*. Unpublished report ABM-002-01-01 001 prepared by Soilwater Consultants for ABM Resources Ltd. Perth, Australia. 28 October 2013.

[4] SWC, 2013. *Review of the Tailings and Waste Material Geochemical Characterisation*. Unpublished report ABM-003-01-08 002 prepared by Soilwater Consultants for ABM Resources Ltd. Perth, Australia. 29 November 2013.

[5] Chowdhury, R.. et al. *Geotechnical Slope Analysis*. Taylor & Francis Group, London, UK., 2010, p. 42.

[6] Chowdhury, p.45-46

WRD Seepage Environmental Implications

The waste at the Twin Bonanza site has been characterised as non-acid forming (NAF) and deemed have a low potential to develop Acid Mine Drainage (AMD). However, the assessment indicated that there was some potential for the liberation of arsenic and lead. To mitigate the low risk of low AMD and metals leaching, the proposed WRD design included isolation of low potential AMD and metal leaching material in the centre of the waste dump, with identified NAF material used as the outer embankment walls to limit oxygen and water interaction. The disposal recommendations considered the possible pathways and targets to reduce the impact on the environment.[7]

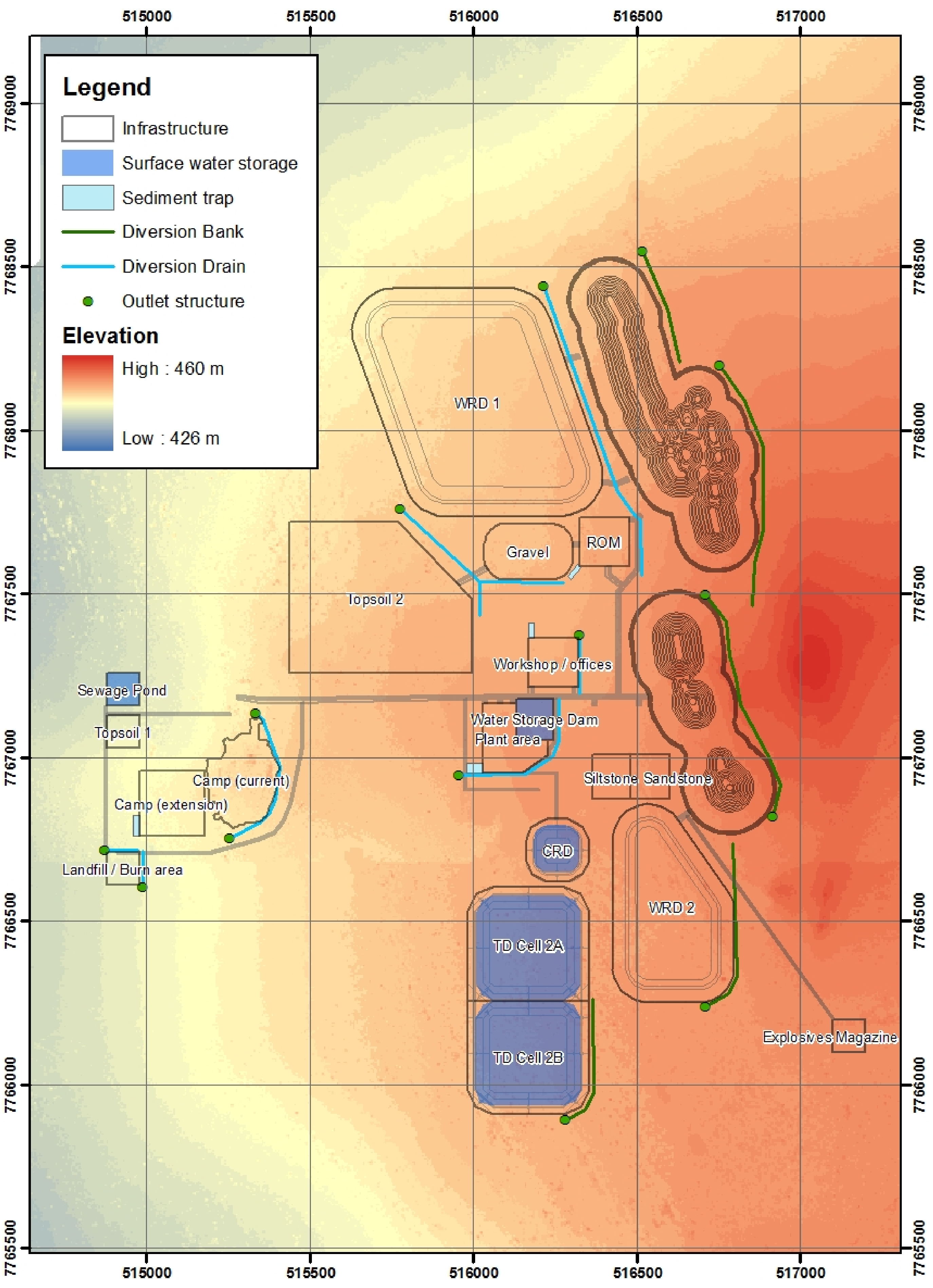
The WRD design includes an inward sloping upper surface and mid-slope in order to trap any rainfall during a 1:100 year 72 hour event that falls on the WRD. These inward sloping surfaces decrease the volume of rainfall runoff down the WRD slopes from the event and therefore decrease erosion. As the waste material was characterised as NAF, the increased volume of rainfall and seepage into the WRD was considered of lower potential environmental impact than erosion of the outer surfaces of the WRD slopes[8].

Based on the water retention properties of the material indicated to be contained within the WRD, the material is expected to hold approximately 300 mm/m of water at field capacity. With the estimated field capacity over the depth of the WRD cover profile, shown in Figure 2, it is estimated that there is sufficient storage capacity within the WRD material to contain infiltration to the WRD resulting in negligible seepage.[9]

[7] SWC, 2013. *Review of the Tailings and Waste Material Geochemical Characterisation.*

[8] SWC, 2013. *Twin Bonanza Erosion and Sediment Control Plan.*

[9] SWC, 2013. *Twin Bonanza Soil Assessment and Erosion Study.*



ABM Resources Ltd	Figure 1: Twin Bonanza Gold Project Proposed Site Layout
ABM Resources EIS	

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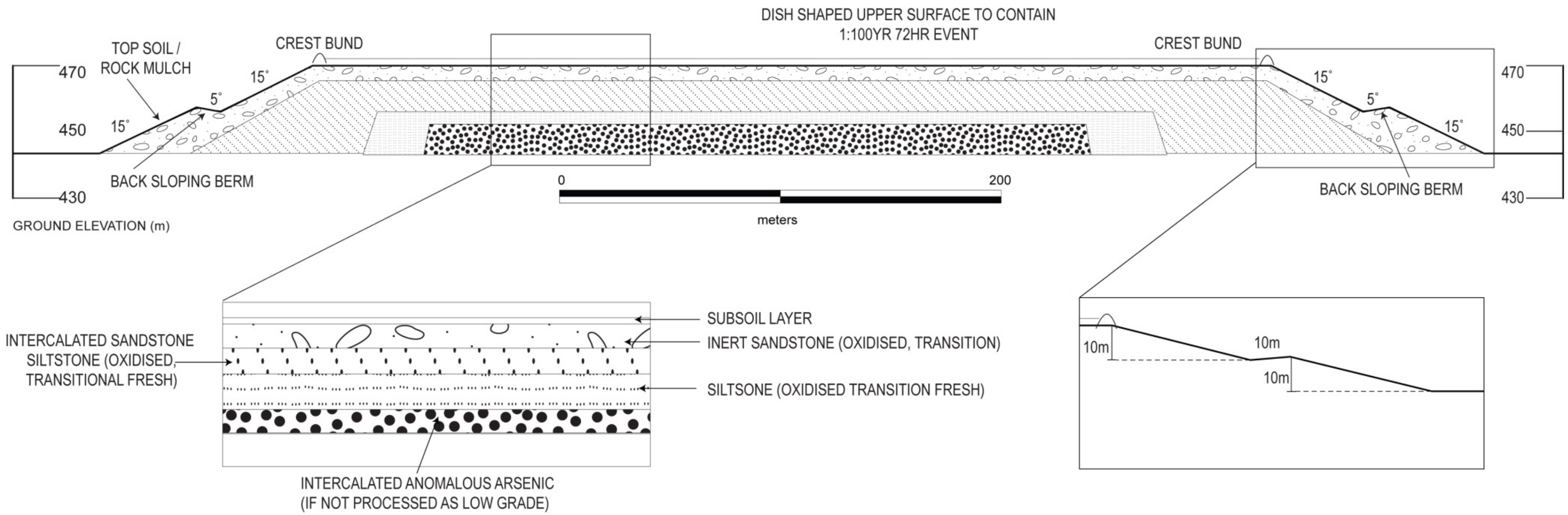

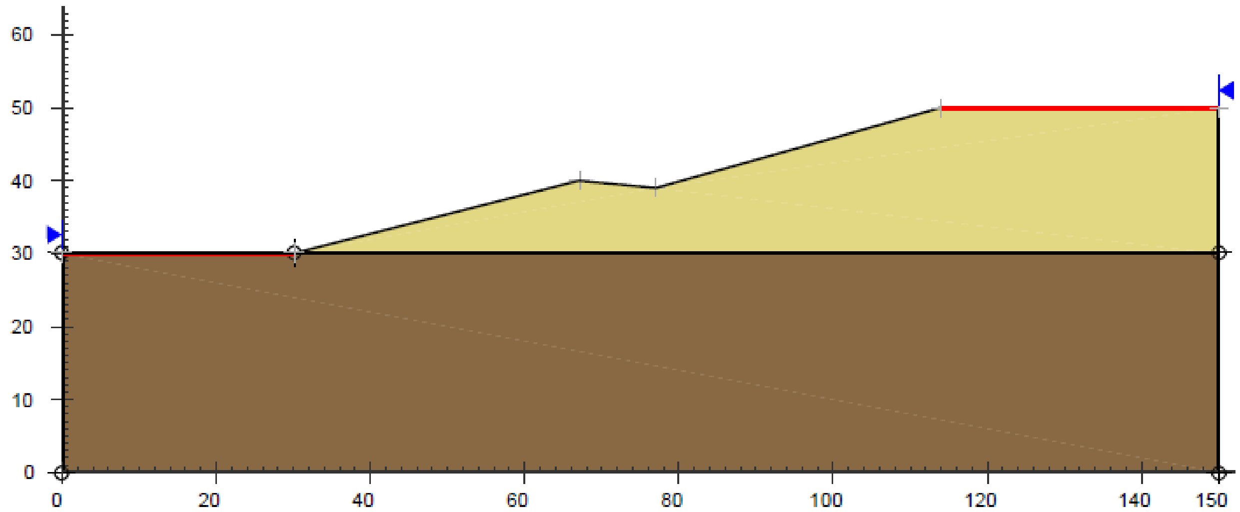

ABM Resources Ltd	Figure 2: Waste Rock Dump Idealised Design Section and Model
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