11 February 2013 Document Ref. 2013-0007AC

Opal Vale Pty Ltd
c/- Instant Waste
PO Box 419
Morley Business Centre
Morley, WA, 6943

Attention: Mr Sam Mangione

RE: GEOTECHNICAL SITE INSPECTION AND REVIEW OF STABILITY ANALYSIS, OPAL VALE LANDFILL, CHITTY ROAD, TOODYAY, WA

1 INTRODUCTION

CMW Geosciences Pty Ltd (CMW) was authorised by Instant Waste (Sam Mangione) to undertake a site inspection to assess the stability of the exposed pit wall materials at the proposed Opal Vale Landfill site, located at Chitty Road, Toodyay, WA. In addition to this work, CMW were also required to further investigate the calculation of seismic risk by referencing both AS4678-2002 and AS1170.4-2007.

Our engagement was to satisfy conditions of a Conferral of Expert Witnesses for the State Administration Tribunal in the matter of Opal Vale Pty Ltd and the Shire of Toodyay and this report must be read in conjunction with our earlier report dated 16 August 2012, Ref. 2013-007AC.

2 SITE INSPECTION

The existing clay pit has been predominantly cut through the crest of a ridge which runs in an approximately south-east to north-west direction.

The majority of the pit walls have been reworked to reduce slope angles and during the time of our inspection were typically covered with track compacted fill materials (Plate 1). Large quantities of fill has been placed in the eastern portion of the site covering the near vertical cut slopes, which are visible in the aerial photograph provided (Figure 1 and Plate 2). However, two steep cut slopes in the northern portion of the site (marked on Figure 1 as Exposure 1 and 2) exposed the subsurface profiles which were logged during our time onsite.

Our inspection involved a site walkover and classification of the exposed pit materials plus the assessment of the schistosity and defect orientation exposed in the cut slopes. As mentioned above, the majority of the pit slopes have been reworked, therefore our assessment was limited to only two areas of the clay pit (Exposure 1 and Exposure 2).

3 EXPOSED GEOLOGY

A discussion of the published geological information is presented in our earlier report dated 16 August 2012. However, based on our limited inspection (only two areas) including portions of the clay pit floor, the subsurface geology can be generalised as follows:

Table 1: Geological Profile Logged at Exposures 1 and 2

MATERIAL	NOMINAL THICKNESS (m)	DESCRIPTION
FILL / CLAYEY SANDY GRAVEL (GC)	0 – 3**	Red brown, fine to coarse grained, of angular quartzite and rounded laterite.
SILTY SAND (SM)	0 – 0.5**	Pale brown, fine to coarse grained, trace gravel, very weakly cemented.
SANDY CLAYEY SILT (ML/CL)	1 – 2	Mottled pale grey and orange brown, low to medium plasticity, with gravel of rounded laterite and angular quartzite, variable very weak iron cementation; Stiff to Very hard.
Extremely Weathered PHYLITE / SCHIST	Lithology logged to the base of the pit	Pale grey with some orange mottles, fine grained, extremely low to very low strength, extremely to highly weathered; schistosity typically sub horizontal, extremely closely spaced, wavy, rough, clean, closed; Defects typically joints, sub vertical, closely to widely spaced, planar, very rough, typically clean, some with iron staining, closed to open up to 15mm, occasional quartz veins.
Note: ** Layer is surficial and not continuous		

In addition, based on the geological references for the area, other units are likely to exists although were not logged during our time onsite.

4 ASSESMENT OF PIT SLOPE STABILITY

4.1 General

The reworked slopes which comprise the majority of the pit have not been considered for assessment in this report. However, the pit walls that are exposed have been subject to instability especially in the location of Exposure 2 and these areas are the focus of the following information.

As described in Table 1, these slopes typically comprised a surficial layer of sandy clayey silt overlying an extremely low to very low strength, highly to extremely weathered schist. CMW's previous analysis (Ref: 2013-0007AB) modelled the insitu materials as a hard residual soil which was based on a desktop review of existing information but did not include a site visit. The typically extremely low strength material that is exposed confirms that the material will technically behave as a soil (defined in AS1726-1993, section A2.6, as a material which can be broken down by hand in either water or air) and therefore the failure mechanisms analysed in our previous report is still valid. However, defects and weaker planes (schistosity) in the exposed materials were observed during our site visit. Preliminary assessments of the slopes for potential rock type slope failures are therefore required and are presented below.

4.2 Exposure 1

The materials encountered at Exposure 1 are presented in Figure 2 which shows that the underlying lithology contains planes of weakness that comprise the following:

- *Sub-horizontal Schistosity*: typically extremely closely spaced, wavy, rough, clean and closed; and
- *Sub-vertical Defects*: typically joints, sub vertical, closely to widely spaced, planar, very rough, clean, with some iron staining, closed.

A stereographic projection of the dominant defects measured in the field is presented in Figure 1. Based on our interpretation of the stereograph and the observed quality of the defects, the following can be concluded about the potential for rock slope type failures at the location of Exposure 1:

- Although the orientation of the schistosity would kinematically allow for planar failures, it is judged that the roughness and waviness (Plate 3) of the schistosity would generate too much friction for a planar failure to occur. In other words, we would anticipate that the friction angle of the schistosity is larger than the dip angle (typically measured at approximately 15 to 30 degrees). In addition, there is no evidence of planar failure at this location;
- Some defects intersect the schistosity at an orientation to the face that could allow for wedge type failures. However, it is considered that the dip of such wedge type failures is less than the friction angle of any weak planes and therefore will not be activated;
- Two of the sub vertical defects have similar dip directions to the slope which indicates a potential for toppling failure, although basal release is required through planar failure mechanisms.

4.3 Exposure 2

The materials encountered in Exposure 2 are presented in Figure 3 which shows that the lithology has a sub-horizontal schistosity and sub-vertical jointing similar to that of Exposure 1. However, unlike Exposure 1, several of the defects were found to have partings of up to 15mm which is probably due to stress release from the removal of clay during previous land use. These partings became tighter with depth.

A stereographic projection of the dominant defects measured in the field is presented in Figure 1. Based on our interpretation of the stereograph and the observed quality of the defects, the following can be concluded about the potential for rock slope type failures at the location of Exposure 2:

- Although the orientation of the schistosity would allow for planar failures, as described above, the roughness and waviness (Plate 3) of the schistosity would generate too much friction for a planar failure to occur;
- Some defects intersect the schistosity at an orientation to the face that will allow for wedge type failures to occur. The likelihood of wedge type failures was confirmed on site by the presence of open sub vertical joints and the presence of some boulders at the base of the slope (Plate 4, Figure 3); and
- The dip direction of the defects in comparison to the face indicates that there is not potential for toppling failure at this location.

4.4 Proposed Slope

We have assessed the possibility of slope failures along defect planes following the recontouring of the slope to proposed angles of 1V:3H (18 degrees). Based on the dip angles of the measured discontinuities, it is unlikely that kinematic failure can occur from a slope face angle of 18 degrees, considering the condition of the defects and assumed friction angles.

5 SEISMIC VELOCITY

In CMW's previous stability analyses, a horizontal design response spectrum of 0.23m/s^2 was calculated using AS1170.4 (2007) *Structural Design Actions Part 4: Earthquake actions in Australia*. It was requested during the Conferral of Expert Witnesses for the State Administration Tribunal that the horizontal design response spectrum be compared to that calculated using AS4768 (2002) *Earth Retaining structures*. We have therefore reassessed the proposed slope with a seismic horizontal coefficient of acceleration of 0.065m/s^2 that was calculated from AS4768 (2002) which produced a factor of safety for the proposed slope case in excess of 1.5, which is satisfactory. CMW maintain that AS1170.4 is the appropriate code for the proposed landfill which also provided a more conservative coefficient of ground acceleration.

6 CONCLUSION

Based on our site inspection, defects and schistosity was identified at two exposures and further analysis was therefore completed to assess the effect of these discontinuities have on slope instability. It was concluded that it is kinematically possible for toppling type failures at Exposure 1 and for wedge type failures at Exposure 2.

However, once the slopes are recontoured to 18 degrees then we maintain they should be stable against general slip failures through the insitu material, (even under seismic loading with the parameters used) and against rock slope type failures along existing discontinuities.

As mentioned in our previous report, site specific geotechnical investigations should be undertaken to confirm our findings with consideration given to relevant laboratory testing. As discussed previously, there are a number of variables that influence shear strength parameters and our research into these correlations must be validated.

7 CLOSURE

Should you require any further information or clarification regarding our proposal, please do not hesitate to contact the undersigned.

For and on behalf of

CMW Geosciences Pty Ltd

Tyrone Mardesic

Project Geotechnical Engineer

Reviewed by:

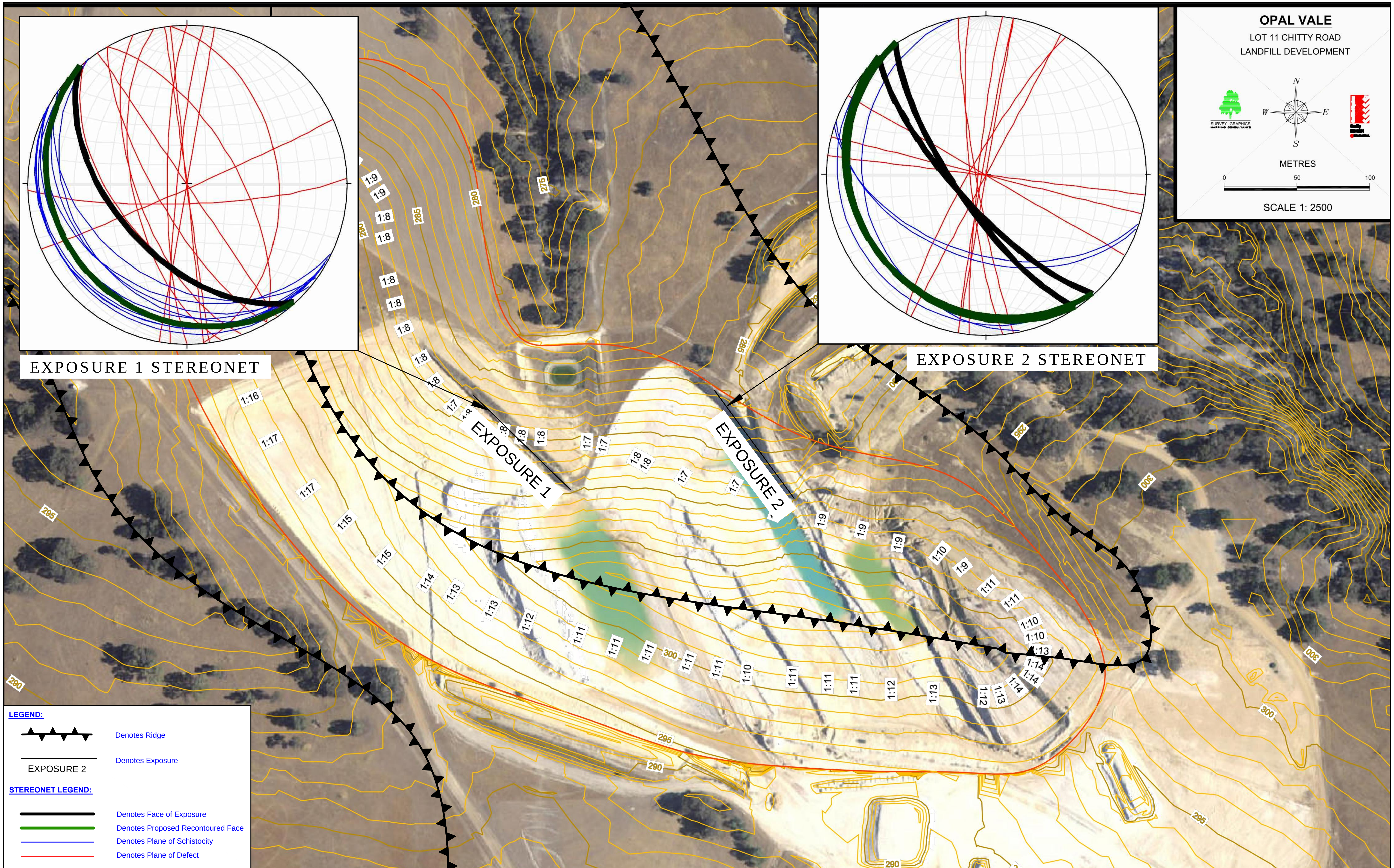
Phil Chapman

Managing Director / Principal

Distribution: 1 copy to Opal Vale Landfill (electronic)

Original held by CMW Geosciences Pty Ltd

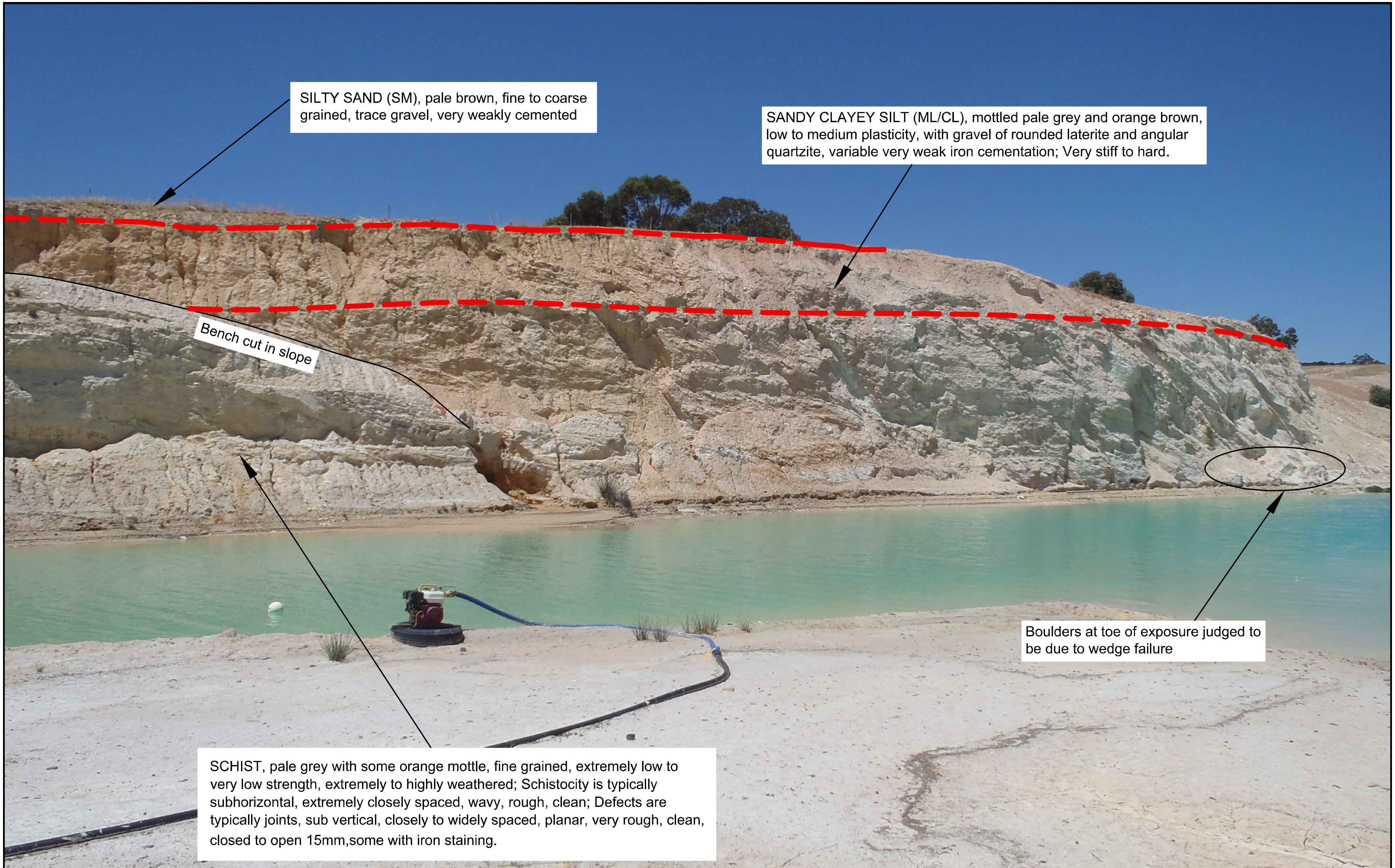
FIGURES



CMW Geosciences Pty Ltd
Chapman Morton Woodward

CLIENT: OPAL VALE PTY LTD	DRAWN: TM	DATE: 08/02/13	
	CHECKED: PDM	DATE: 08/02/13	
PROJECT: OPAL VALE LANDFILL PROJECT	PROJECT No. 2013-0007	FIGURE No. 01	
	SCALE: 1:2500 (0 25 50 75 100 125 Metres)		
TITLE: GEOTECHNICAL SITE PLAN	REVISION: A	DATE: 08/02/12	A3

CMW Geosciences Pty Ltd Chapman Morton Woodward	CLIENT: OPAL VALE PTY LTD	DRAWN:	TM	DATE:	08/02/13
		CHECKED:	PDM	DATE:	08/02/13
	PROJECT: OPAL VALE LANDFILL PROJECT	PROJECT No.	2013-0007	FIGURE No.	02
		SCALE:	NTS		
	TITLE: EXPOSURE 1	REVISION:	A	DATE:	08/02/13 A4



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PROJECT:	OPAL VALE LANDFILL PROJECT	CHECKED: PDC	DATE: 08/02/13
		PROJECT No. 2013-0007	FIGURE No. 03
		SCALE: NTS	
TITLE:	EXPOSURE 2	REVISION: A	DATE: 08/02/13 A4

PLATES

PLATE 1 - Site Photo

PLATE 2 - Site Photo

PLATE 3 – Typical Rock Schistocity

PLATE 4 – Open Jointing and Slope Debris at Base of Slope Observed in Exposure 2