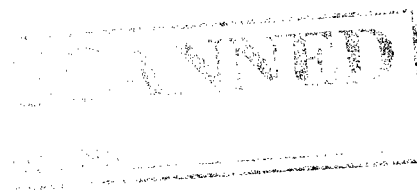


Appendix 3 – Geotechnical Report



GEOTECHNICAL ASSESSMENT & RECOMMENDATIONS
to
ENHANCE SLOPE STABILITY
HIGH WALL EXCAVATION
McKENZIE BLOCK, PUKE COAL LTD

1. Introduction

This report is prepared to provide an Appendix to the Resource Consent Application for earthworks on McKenzie Block, located at No. 1158 Rotowaro Road, Glen Afton. The Assessment of Environmental Effects documentation has been prepared by Puke Coal Consulting Ltd.

Drawings which show the extent of the work proposed are numbered 140502/01 through to 140502/03.

2. Site Background

The Puke Coal project site has had a history of underground mining which commenced in around 1915 and continued for several decades. This was followed in the 1980's with open pit excavations to expose the old workings and retrieve the remains of the coal deposits. A similar process occurred at the same time at several other former underground coal mines in the west Huntly area, with the focus at retrieving coal at the lowest cost, with a primary emphasis on short term land stability, rather than on long term stability of the excavated slopes and soils disposal areas.

The present location of the west highwall forms the western edge of the original (approx. 1980) Downer-operated opencast coal mine which is close to the present location of the highwall. The Construction & Demolition (C & D) Landfill occupies part of the Downer

As part of the initial Downer siteworks, the upper soil and rock required removal to expose the underground coal workings, following which the overburden removal process moved from west to east. The location of the initial overburden stockpile therefore could only be located to the west of the edge of the pit; otherwise it would have involved double-handling.

The consequence of this initial opencast mining operations is a highwall that has over the years been marginally stable, but with the upper soils undergoing creep movement towards the highwall. This creep movement is on account of Fill that has been placed to the west of the excavation face, together with stormwater runoff that flows in an easterly direction towards the highwall.

A demonstration of this creep movement is the boundary fence which is located to the immediate west of the highwall, having possibly moved by as much as 10 metres since its construction, which would have been in the early 1980's.



The purpose of the proposed earthworks is therefore to increase the stability of the highwall by means of better control and disposal of both groundwater and surface water flows, together with the flattening of some of the steeper batter slopes. By this means, the retrieval of coal from the base of the highwall slopes will be at less of a risk of being exposed to rock falls and water-initiated mud flows. The control of surface stormwater runoff is also an essential part of this slope stabilisation work.

3. Proposed Earthworks

The locations of the proposed excavations are shown on the attached Drawing No. 14023-01. It will be noted that the toe of the proposed excavation passes to the immediate west of the Construction & Demolition Landfill and extends into the adjacent property, which has been purchased by Puke Coal Ltd in the past year. Prior to that time, stabilisation of the highwall batter slopes was ineffective as it was not possible to extend the earthworks beyond the western boundary. As a result, slope instability has occurred along parts of the highwall face in this locality over the past several years.

Elsewhere, during the overburden removal process in exposing the coal seams, localised instability of a temporary nature has occurred as the benches have been formed. That type of slip is typically stabilised by lowering of the level of the upper bench

A typical cross section of the proposed slope stabilisation works is presented on Drawing No. 14023-02. It will be noted that a series of toe drains are planned, with the benches each formed with at a minor crossfall towards the inner part of the excavation. A high point in each of the benches is to be formed midway along the excavation face, with the longitudinal gradient set at about 3 degrees so as to provide well-drained benches that will also serve as haul-road routes.

4. Local Geology

The upper, near-surface soils which occur within the upper 5 to 10 metres of ground surface within the neighbouring farm to the west are comprised of past overburden fill soils, which overlie deeply weathered Siltstone of the Mangakotuku Formation. This formation is also termed the Rotowaro Siltstone member.

Under dry conditions this Siltstone formation is able to stand at reasonably steep cut batters, such as 1 vertical on 1 horizontal. An example of which is near the top of the valley sides that run alongside Rotowaro Road to the north of the site where the stream has incised into the valley floor. Steep batter slopes in this siltstone within the project site are also present where only short-term stability is required.

However where surface and subsurface water flows occur, those batters will tend to collapse. As surface water and groundwater flow over and through the upper part of the Siltstone formation, downslope creep of the soil formation occurs, with resulting hummocky ground as observed over the neighbouring property to the west.



At the base of the upper soils, it is likely that a weak zone is present. Also within the rock structure itself, thin layers of clay-rich sediments are present upon which block sliding will develop. Where such layers are identified, the workings should be developed so that they are exposed near the top of a bench batter slope, rather than near the lower part of an excavation face.

Within the deeper siltstone rock, where weathering is less, vertical joints will have also developed as a consequence of stress relief in a horizontal direction when the soil and rock to the east of the escarpment are removed. If the cut slopes are vertical in these materials, there is a tendency for block toppling to occur, although this has not occurred at this mine site.

Some parts of the Mangakotuku/Rotowaro Siltstone formation also have a tendency to slake upon exposure and therefore have a low durability. The slaking itself is the result of the release of residual stresses within the rock as the overburden is removed, both on a large scale and also in smaller stockpiles. This slaking is the result of water adsorption on to clay surfaces with a consequential loss in soil cohesive strength.

The Glen Afton Claystone (Ka) occurs immediately below this formation, with the blocky landslip debris that occurs on the escarpment face likely to be the Pukemiro Sandstone (Kp) formation.

At a deeper level, the Upper Coal Measures Formation (Kh) consist of darker-coloured rock where minor seams of carbonaceous siltstone is interspersed with siltstone and minor coal seams. The coal seams of the Waikato Coal Measures (Renown Coal Seam) occur below this formation, with the underclay being the upper, well-weathered part of the older Newcastle Group Formation.

5. Historic Instability within Upper Soils

Instability of the upper soils within this same area was assessed by Works Consultancy Services Ltd in the period 1992 to 1993. At that time Downer Mining Ltd owned the property, who retained Works to carry out these studies.

Slope stability studies were carried out by Works, with the conclusion that the risk of failure through the Waikato coal measures (ie. the soft rocks that are exposed on the western high wall) is interpreted as being relatively low. But the studies indicated low factors of safety (between 0.88 and 1.09) would occur at times of high groundwater level, which was assumed would be the situation when a “wet winter” occurred.

A “wet winter” actually occurred in June-July of 2010 and thus the instability that developed above the western high wall in late July 2010 was similar to that which had been predicted by Works Consultancy in 1993.

6. Slope Stability within Upper Soils

Where the upper soils are located in areas where overland flow of stormwater is diverted away from the excavations and groundwater flows are not present, the upper soils may be excavated to a slope of 1 vertical on 1.5 horizontal for permanent slopes and 1 on 1 for temporary slopes.



It is noted that in comparison, slope angles in road cuttings within the project site and also along local roads are typically cut at slope angles of up to 1 on 1, but only where there are minimal local stormwater flows present and filling is absent.

7. Rock Slope Stability

Contours of excavation slope angles in the lower escarpment face to the north of the proposed earthworks show slope angles to be in the order of 70 degrees, with overall slope angles varying between 45 degrees (1 on 1) to 63 degrees (2.0 vertical on 1.0 horizontal). The height between benches has typically been up to 40 metres. The cut slopes within the higher areas are less steep at about 35 degrees (or about 1 vertical on 1.5 horizontal).

Within the area to the north, excavations show no obvious instability of the lower rock faces, although there is some risk of rock falls while the coal and underclay soils are being removed. It is therefore concluded that the recent lower excavations that form the lower main escarpment face have been excavated to a stable slope angle. However the escapement height of up to about 40 metres is greater than would normally be acceptable on account of worker safety considerations.

Within the proposed area of earthworks, areas of instability have occurred, which have been the result of a combination of earthfilling, particularly within former gully areas, together with overland flow of stormwater and some groundwater seepages. Therefore, within this location a lower cut slope angle of 45 degrees is recommended with a maximum bench height of 10 metres. This is particularly important for the bottom excavation which directly overlies the coal measures.

It is further recommended that the siltstone level of the lower bench be maintained at about 2 metres above the level of the coal deposit so as to avoid potential contamination of the coal in the event of near-surface instability of the slopes above. This layer would also minimise the risk of the excavator dropping into former workings within the coal deposit.

8. Site Inspections

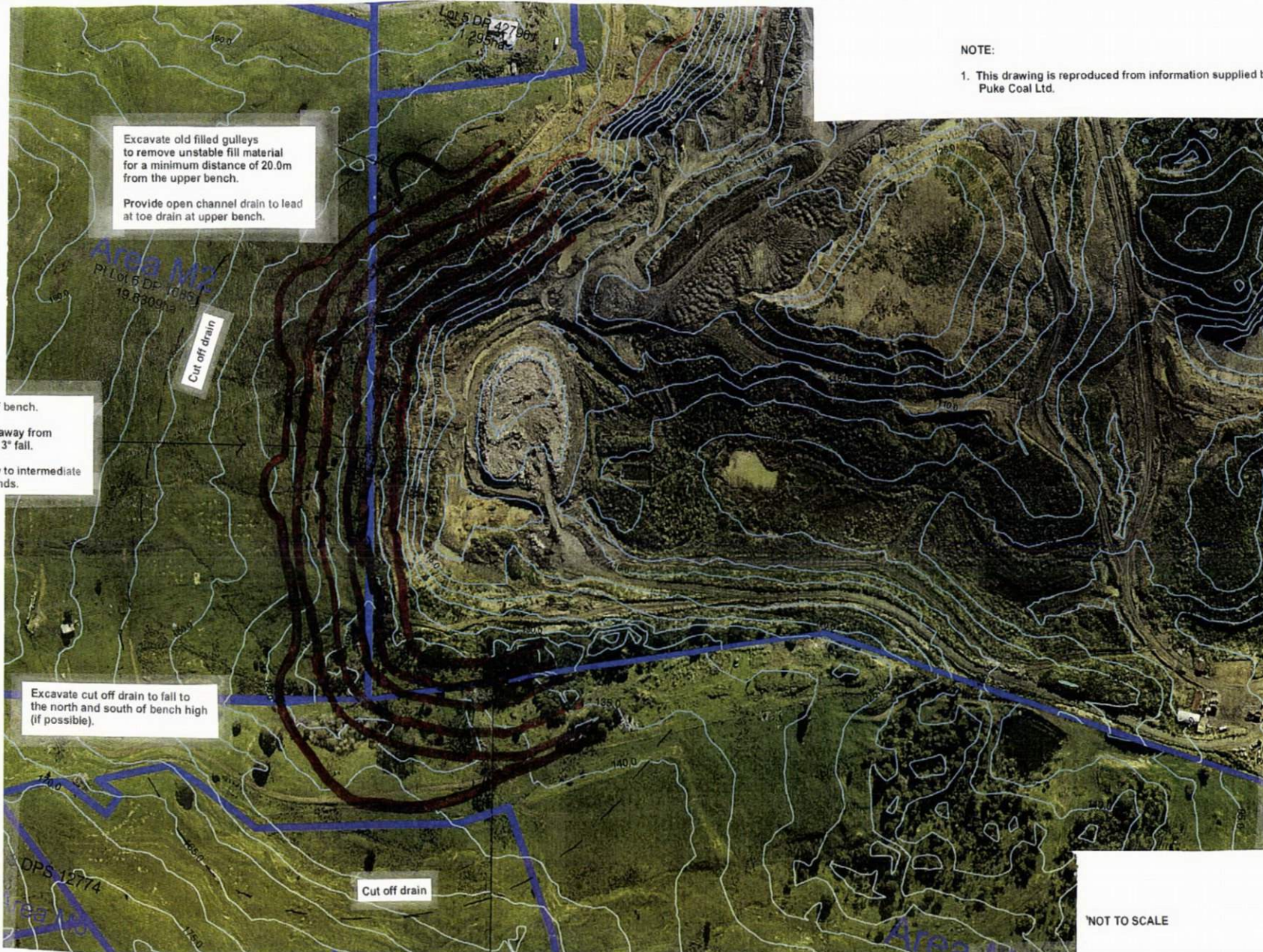
It is recommended that regular site inspections of the area of proposed earthworks are carried out by a geotechnical engineer or engineering geologist from our staff. These inspections are required in order to identify any areas where modifications to our recommendations are found to be necessary as the site soils and rock are exposed during excavations. Some modifications to the intersection and routing of stormwater flows may also be found to be required as the works proceed.

Mark T Mitchell Ltd

Mark T Mitchell

Mark T Mitchell
Director





NOTE:

1. This drawing is reproduced from information supplied by Puke Coal Ltd.



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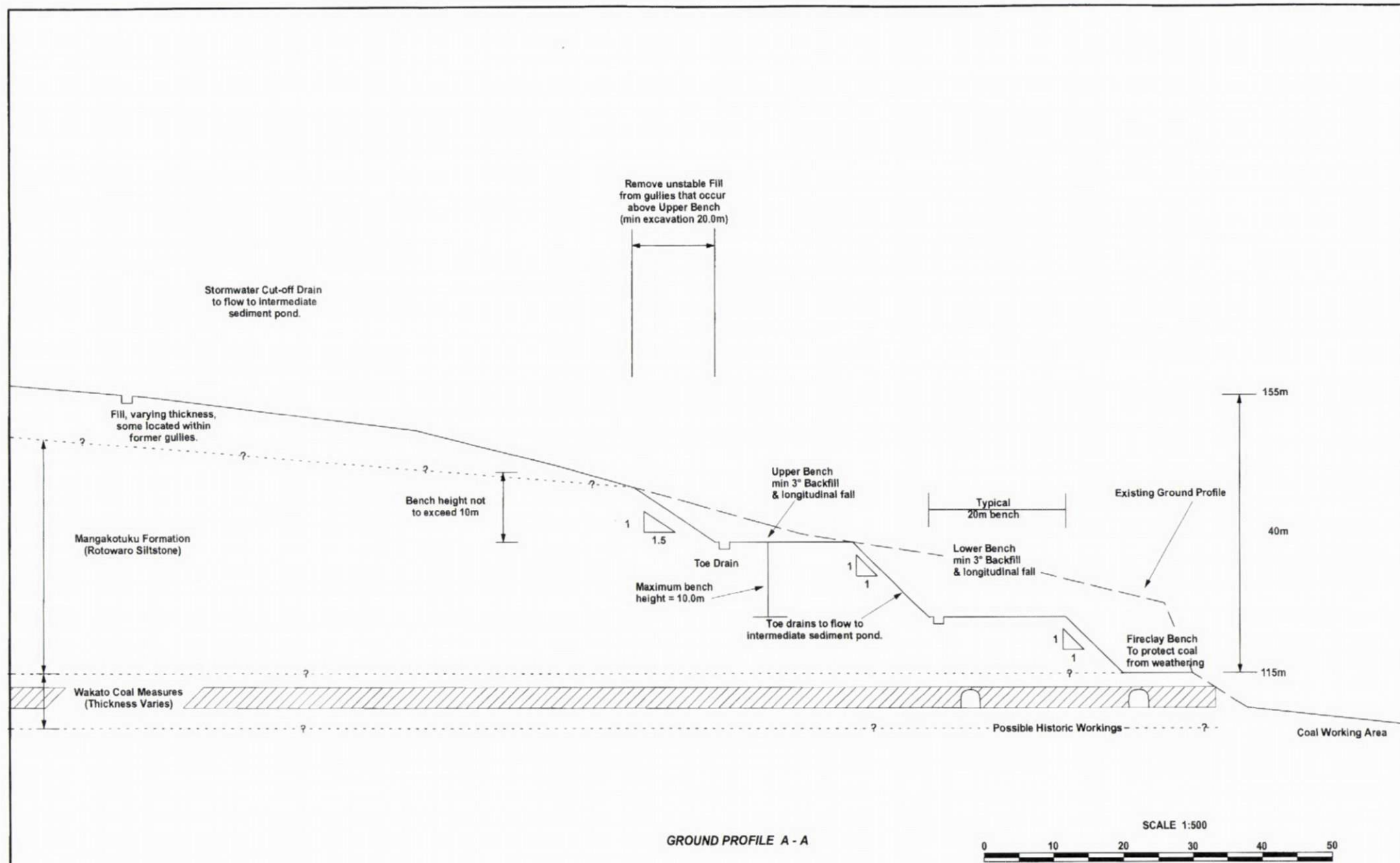
Geotechnical Assessment & Recommendations
Rotowaro Road, Glen Afton

HIGHWALL EXCAVATION PROPOSED SITE PLAN

DRAWING No. 14023-01

DATE July 2014

ISSUE One



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TYPICAL CROSS SECTION

DRAWING No. 14023-02

DATE July 2014

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