a.s.miner
Geotechnical
Consulting Engineers
50 Calder Street, Manifold Heights, VICTORIA 3218
Tel : 03.52294568 Mobile : 0438.294568
ABN 72 856 478 451
Email: aminer@pipeline.com.au

Corangamite Catchment Management Authority and the City of Greater Geelong

A.S. Miner Geotechnical

Case Study for Erosion and Landslides.

The Dell Clifton Springs

Report No: 356.3/28/06

Prepared for Troy Clarkson

Department of Primary Industries

PO Box 103

Geelong, VIC 3220

and

Leigh Dennis

Corangamite Catchment Management Authority

64 Dennis Street

Colac, VIC 3250

1. Site Description

1.1 Site I.D.

356.3/28

1.2 Site address

The Dell Clifton Springs

1.3 Brief site description

The Dell is a natural amphitheatre on the northern coastline of the Bellarine peninsula. The steep coastal cliffs are structurally controlled by the Curlewis Monocline and the upper plateau is generally flat before falling some 25 to 30 m to the coast. The Dell comprises a large basal landslide which generally comprises much of the gentle lower slopes. A number of medium to small slides are located around the steep amphitheatre flanks. Much smaller earth flows are also common at the site

1.4 Map datum/ Map projection/ Zone

AMG Zone 55 (AGD 66)

1.5 Easting

E 286420

1.6 Northing

N5774239

1.7 Municipality

The City of Greater Geelong

1.8 CCMA landscape zone

Bellarine

1.9 Previous ID

WF3002

1.10 Previous Data Source

Warren Feltham (2005) CCMA landslide and Erosion Database. Version 2 The University of Ballarat. Geology Department July 2005. Contained in an MapInfo Table entitled “SW_erosion_landslides”

2. Hazard Description

2.1 Soil degradation type

Landslides

2.2 Soil degradation sub-class

The Dell is a landslide complex comprising slides and flows developed in weathered older volcanics and tertiary clays

2.3 Description of hazard present on site or threatening site from above or below

The large basal landslide extends form the rim of the natural amphitheatre to beyond the coast. A series of smaller parasitic slides are located around the steeper rim and these have a limited potential to travel onto the sloeps below except for the slide on the access road. This is composed of road fill material and can dilate and travel significant distances onto the middle carpark below.

2.4 Dimensions of Hazard (width, length and depth if appropriate)

160 m (L) x 100 m (W) x 10 m (D)

2.5 Extent of Hazard (spatial area and volume if appropriate)

Total Area = 1.95 hectare with a volume = approximately 160000m3

2.6 Magnitude of hazard (travel distance or rate of occurrence)

Travel rates are generally very slow and of the order of 15 to 20 mm per annum although much accelerated rates have been noted in the past.

2.7 List previous reports or studies relevant to this site

- Parsons Brinkerhoff 2003. The Dell, Clifton Springs Investigation and Monitoring of a Slow Moving Landslide – Interim Report (Aug 2003)
- Parsons Brinkerhoff 2003. The Dell, Groundwater Quality Assessment (Sep 2003)
- Parsons Brinkerhoff 2003. The Dell, Clifton Springs, Monitoring Report November 2003 (Dec 2003).
- GHD 2004. The Dell, Clifton Springs, Monitoring 2003/2004 Report (July 2004).
- GHD 2004. The Dell, Clifton Springs, Monthly Inspection and Reporting for August 2004. Report (August 2004)
- A.S.Miner Geotechnical 2005. The Dell, Clifton Springs, Quarterly Monitoring and Reporting-January 2005 (20 January 2005).
- A.S.Miner Geotechnical 2005. The Dell, Clifton Springs, Site inspection and Monitoring Report Following Heavy Rainfall Event (22 February 2005).

- A.S.Miner Geotechnical 2005. The Dell, Clifton Springs, Limited Monitoring and Reporting-June 2005 (30 July 2005).
- Garrard A., Miner T. and Macdiarmid C., 2003. Investigation and Monitoring of a Slow Moving Landslide. *Australian Geomechanics* Vol 38 No1 (Mar 2003)
- Parsons Brinkerhoff 2003. The Dell, Clifton Springs Status Report (Nov 2003)
- Parsons Brinkerhoff 2004. Addendum to PB report M03458: The Dell Clifton Springs Status Report, 5 November 2003. (February 2004)
- GHD 2004. The Dell Clifton Springs, 2003/2004 Overview Report (July 2004)
- John Leonard Consulting Services 2003. Hydrogeological Peer Review The Dell, Clifton Springs (June 2003).
- Foundation QA Pty Ltd 2003. The Dell, Clifton Springs Interim Geotechnical Review (July 2003).
- Parsons Brinkerhoff 2003. The Dell, Clifton Springs Investigation and Monitoring of a Slow Moving Landslide – Interim Report Chapter 6 Preliminary Stability Analyses. (Aug 2003).
- Dahlhaus Environmental Geology 2003. The Dell, Clifton Springs 3 Dimensional Geological Model (Sep 2003)
- Parsons Brinkerhoff 2004. Memorandum. Water Levels used in Slope/W Analysis (February 2004)
- Coffey 2006. Landslide Risk Assessment The Dell Clifton Springs. January 2006

2.8 Custodian of previous reports and studies

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3. The Event Has Already Occurred

3.1 Date of first occurrence

April 2001

3.2 Date of most recent re-activation or acceleration

Accelerations in movement in July 2002 and June 2003

3.3 Actual or postulated trigger event including magnitude and duration

Heavy rainfall event in April 2001, 138 mm (Another reactivation at the site occurred in February 2005 when 150 mm fell continuously over 36 hrs)

3.4 Frequency of Trigger Event if known

The April 2001 event has been reported to be of the order of 1 in 125 year event (The heavy rainfall event in February 2005 is in excess of a 1In 100 year event as per the BoM IFD curve for Clifton Springs. This event is estimated to have a 1 in 200 year recurrence interval as per the CRC Forge method developed by Monash University's Centre for Hydrology)

3.5 What damage or impact occurred?

Damage to the lower concrete retaining wall and ongoing disruption to the main access road. Ongoing concerns resulted in the demolition of the swimming pool located 25 m form the edge.

3.6 Was there a risk of injury or loss of life?

No

3.7 How important was it?

Extremely important as this was a major public use area and one of the few spots where the coast could be readily accessed.

3.8 What asset classes were impacted?

Infrastructure

People and Community

3.9 What asset sub classes were impacted?

Building, roads and public recreation area.

3.10 What are the asset values?

3.11 How severely were assets impacted?

Assets were severely effected to the point where the facility was closed to the public from July 2002 to December 2006.

3.12 Estimated cost of impact (including qualitative and quantitative costs for loss of asset, investigations, remedial works, cultural, business and environment)

3.12.1 $ Cost of loss of asset

Swimming pool estimated cost $150,000

3.12.2 $ Cost of any investigation prior to failure of occurrence

Investigation costs could be of the order of $250,000

3.12.3 $ Cost of prior remediation works

Remedial works including pumping of the order of $200,000

3.12.4 $ Cost of any prior monitoring or maintenance

Ongoing monitoring and inspections $200,000

3.12.5 Disruption to business (qual)

No major disruption to business although the operation fo the golf club and its associated gaming facility was under threat early in the investigation

3.12.6 Social and cultural impact (qual)

Extremely significant impact on the community with the loss of a major public recreation facility

3.12.7 Impact on environment (qual)

No major impacts to the environment except for increased discharge to the bay of groundwater from pumping operations.

4. Remediation Has Already Been Undertaken

4.1 What remediation option was used?

Sealing of tension crack, removal of leaking stormwater system and swimming pool, installation of a series of active groundwater relief wells.

4.2 How was the site initially assessed?

Geotechnical consultants

4.3 How was the remediation designed and by Who?

Geotechnical consultants

4.4 Did it require specialist equipment or subcontractors?

Yes – specialist groundwater drillers were required to install relief wells

4.5 How effective has the remediation been?

Reduction in groundwater pressures have been extremely effective in slowing rates of movement and maintaining reduced pore pressures at the site even through increased rainfall periods.

4.6 How was the effectiveness judged?

Ongoing detailed monitoring of groundwater levels, subsurface monitoring using inclinometers and surface movements using traditional surveying techniques.

4.7 Would other treatments worked here?

Possibly major earthworks may have been effective but the key to the site appears to be high groundwater pressures which can only be controlled through effective drainage programs.

4.8 Was it early intervention or reactive?

The initial works were in response to accelerated movements but the groundwater pumping system most probably prevented rapid catastrophic failure at the site

4.9 What was the cost of remediation (including design, construction and implementation)?

4.9.1 Investigation costs

Approx $200,000

4.9.2 Design costs

Approx $50,000

4.9.3 Construction and implementation costs

Approximately $200,000

4.10 How was the remediation funded?

Through CoGG emergency funds and ongoing business cases.

5. Ongoing Review and Monitoring Requirements

5.1 What is the likely ongoing monitoring and review strategy?

Ongoing monitoring is a critical part of the management strategy and detailed monitoring programs have been planned every 6 months. In addition the establishment of a real time monitoring station provides near real time access to some monitoring results.

5.2 What is the nature of future monitoring and maintenance?

This will continue as planned for the foreseeable future

5.3 What are the likely costs of monitoring and maintenance?

Ongoing budget for monitoring and maintenance could be of the order of $50,000 to $100000 per annum

Photos

Photos

Photos

Sketches and Drawings