

26 August 2022

My Ref: BG-296-220826-Rpt26-DRAFT

Glenorchy City Council

Attention: Mr Patrick Marshal

Dear Sir

REVIEW OF LANDSLIDES FOR GCC
REPORT 26 – 28 August 2022

1 INTRODUCTION

At the request of Mr Patrick Marshal of Glenorchy City Council (GCC) various aspects of the Rosetta Landslide and the Casuarina Landslide are being regularly reviewed. This is the twenty sixth review report by Baynes Geologic.

This report presents the findings of a site inspection carried out on 6 June 2022. The purpose of the site inspection was to close out a number of outstanding comments from previous reports.

This report concludes that small localized movements of parts of the Rosetta landslide are probably continuing to develop and require further consideration and review on site. Overall landslide movements are probably not occurring.

This report also concludes that there are probably small localized movements of parts of the Casuarina landslide occurring but that overall landslide movements are not occurring. Movement at the toe of the landslide appears to be causing cracking of a nearby sewer and remedial action is recommended.

2 DATA FOR REVIEW

The data to be reviewed was originally attached to emails dated 23 August 2022 from Mr Dan Egodawatte and included:

- Rosetta Landslip Surveys 1990 – JUN2022
- Casuarina Monitoring – JUL 2015 – JULY 2022

3 COMMENTS ON MONITORING DATA- ROSETTA

The most useful monitoring data to understand the behavior of the landslide is provided by nine monitoring points and the water levels in three piezometers installed in boreholes and three boreholes in which pumps have been installed, the locations of these are shown on Figure 1.

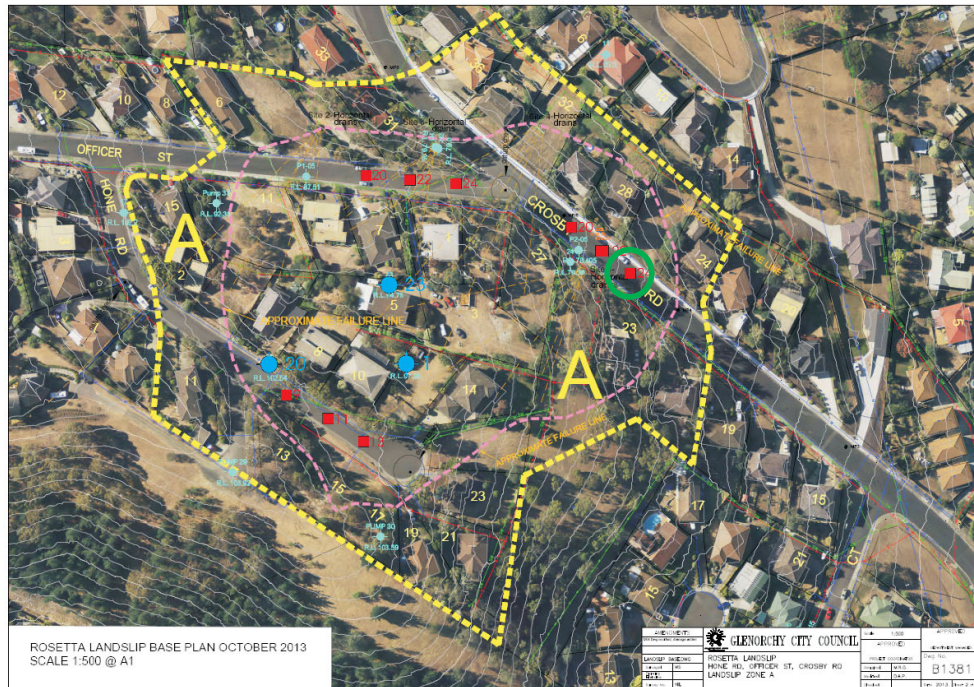


Figure 1 Critical survey monitoring points (in red) and groundwater monitoring boreholes (in blue). Point 24 circled in green.

The accuracy of the surveys is theoretically in the range of +/- 3 mm for the horizontal co-ordinates and +/- 1mm for the vertical co-ordinates (the level). It is possible that variations associated with setting up the instrument, operator error or the stability of the base station could be greater than this error, as systematic variations in the precise position of the survey points of up to 5 to 10 mm appear to occur regularly. The effects of swelling and shrinkage of clay rich soils during wet and dry periods and settlement associate with the long term consolidation of the landslide mass may also be contributing to the error.

Although the individual movement vectors deduced from the quarterly surveys are not in themselves useful to detect landslide movements, it is suggested that the overall trends that may be deduced from decades of monitoring do provide some insights as to what is happening to this landslide and these are discussed below.

Points 9, 11 & 13 Hone Road

The last survey was in May 2022. There continues to appear to be a long-term trend of settlement or slight landslide downwards movement of between 15 and 20 mm over the last 10 years in this area, with little in the way of lateral movements, which is consistent with the location of these monitoring points within the upper part of landslide, where downward movements would be anticipated. There is no significant movement of the landslide. Comment remains unchanged.

Points 20, 22 & 24 Officer Street

The last survey was in May 2022. There appears to be a long term trend of settlement and lateral displacement of between 10 and 15 mm over the last 10 years in this area with survey point 24 showing possibly 15 to 25 mm settlement over the same period. There is no significant movement of the landslide but these slight ongoing movements that affect Officer Street, particularly those movements around point 24, continue to require careful consideration and are discussed below in Section 4.

Points 20, 22 & 24 Crosby Road

The last survey was in May 2022. The three monitoring points may have settled by between about 5 to 10 mm over the last 10 years. There is no significant movement of the landslide. Comment remains unchanged.

Boreholes 1, 20 & 23

Groundwater levels continue to be below levels at which immediate actions are required, which indicates that the pumping and the gravity drainage is being successful in maintaining lower groundwater levels.

4 SITE WALK OVER - ROSETTA

Some observations

A thorough walk-over survey was carried out at the Rosetta Landslide. Nothing untoward was observed apart from some cracks that needed sealing and some seepage – see Figures 2, 3 and 4 below.

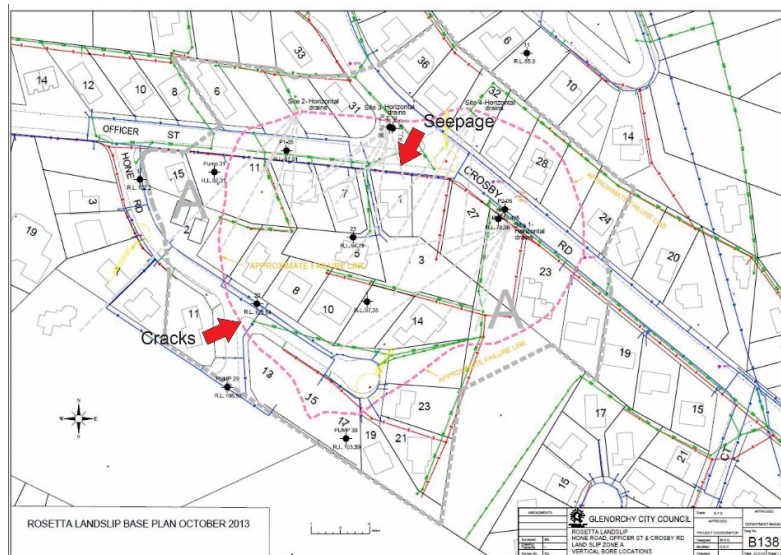


Figure 2 – location of some observations



Figure 3 – cracks continuing to open up in the kerb in the cul-de-sac above Hone Rd - see Figure 2 for location.



Figure 4 – seepage in the gutter below No 1 Officer Street – see Figure 2 for location.

It is recommended that:

1. All significant open cracks in paving and asphalt should be sealed with bitumen during the next maintenance campaign.
2. The source of the seepage in Figure 4 should be investigated – perhaps with a camera inspection of the drain. The aim should be to establish the source of the water seepage and if it is due to an identifiable leak then steps should be taken to prevent further leakage.

Point 24 Officer Street

The slight ongoing movements that affect Officer Street, particularly those movements around Point 24 (circled in green in Figure 1) have been of minor

concern for some time. Site inspection suggests that these movements result from the proximity to the toe of the landslide and the seepage in the gutter, where further movements are more likely. The observed movements should continue to be monitored and may be reduced by dealing with the seepage issue.

Pumps in Boreholes 29, 30 & 31

Pumps 29 and 30 appear to be working effectively and water levels in the pump boreholes are generally below the prescribed levels. However, pump 31 continues to have maintenance/availability issues and water levels continue to periodically rise above alert levels. These problems should be sorted out as a matter of priority.

The possibility of increasing the prescribed levels (RL) that cause operation of the pumps to reduce the amount of work the pumps are doing and ultimately dispensing with the pumps was considered.

Review of the information relating to groundwater levels from the time the pumps were installed suggest that the likely hydrogeological conditions are as presented in Figure 5 and summarized in the Table below.

Bore	Collar Level RL	Original depth of borehole	Initial depth to water	Initial standing water level RL	Depth to top of pump	Depth to bottom senso	Depth/RL to top sensor	Depth to alert level as of 8/22	Depth of likely highest water level recorded	RL of likely highest water level recorded
29	108.9	56.5	35	73.9	54	54	49/59.9	32	28.9	80.0
30	103.4	42.0	34	69.4	40.5	40.5	37/66.4	30	23.8	79.6
31	92.2	47.5	20	72.2	45	45	40/52.2	18	5.6	86.6

Although there are several boreholes, installed piezometers and around 30 years of records, there is limited detailed understanding regarding the geological and groundwater conditions within the landslide. The following tentative interpretation is suggested:

- There is an upper perched water table within the landslide mass above a less permeable clay rich basal shear plane in the Tertiary sediments
- There is a lower water table within the Permian sandstones and Jurassic dolerites possible connected to the lower parts of the Tertiary sediments
- There is a flow of groundwater from a recharge area to the north-west (in the upper parts of Officer Street) into the landslide area which results in the higher groundwater levels in pump 31.

This suggests that if pumps 29 and 30 were to be switched off a water level rise to around RL 80 is likely and this could reduce the volume of drained ground below the landslide and thus reduce the capacity of the area to safely absorb rainfall events. If pump 31 were to be switched off this would have a similar effect and in addition a water level rise to, say, above RL 86.6 could significantly affect the stability of the landslide. This action is therefore not recommended.

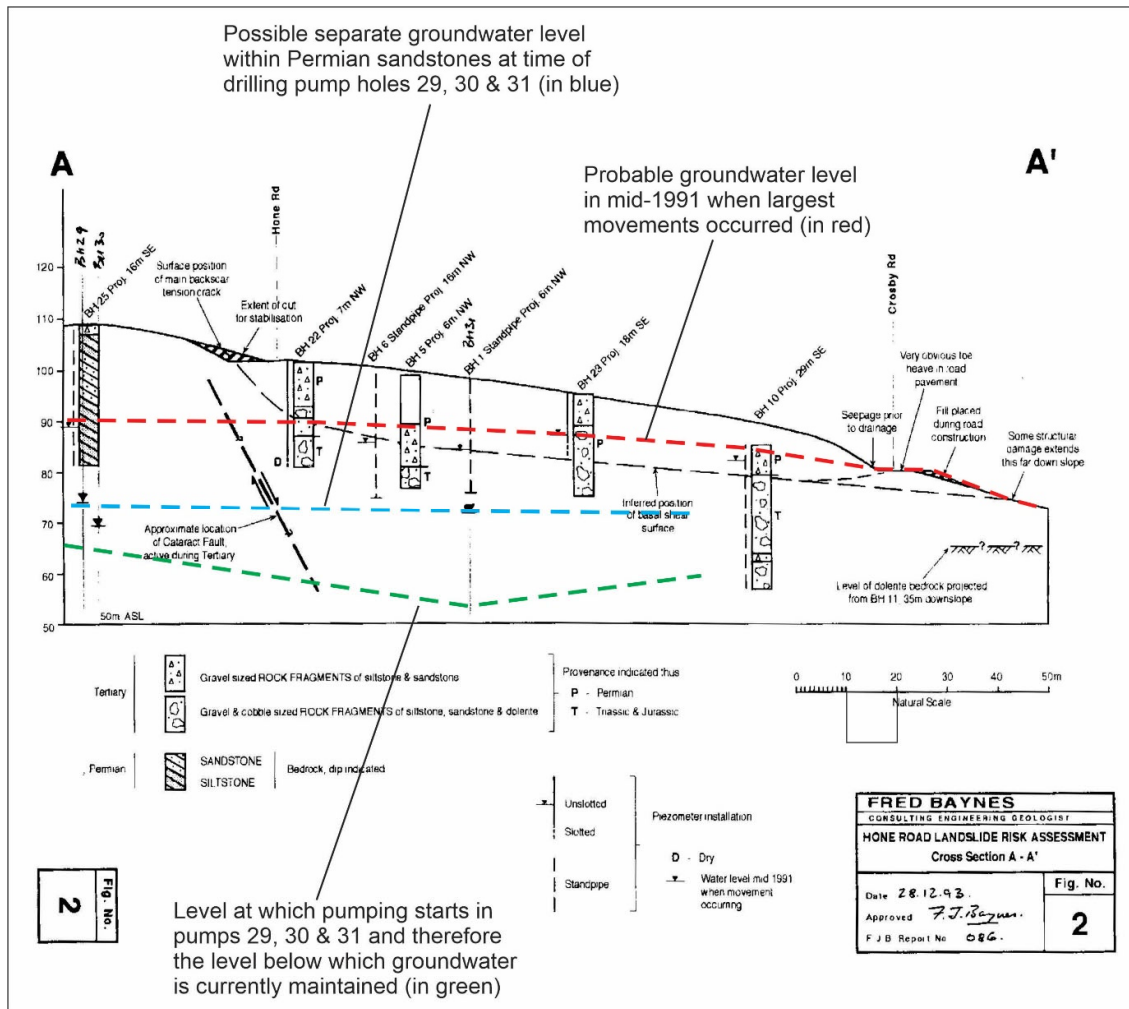


Figure 5 Interpreted groundwater conditions before and after drainage

Accordingly, it is suggested that at this time there are probably two reasonable courses of action, either:

- 1 Pumps 29, 30 and 31 and their associated top and bottom sensors should be maintained at their present levels and continue to be operated for the foreseeable future, or,
- 2 As for 1 but with the top sensor for pump 31 raised to 30 m below the collar level (i.e. at RL 62.2) so that pump 31 does slightly less work.

Horizontal Drains

Four arrays of horizontal drains were installed to drain and stabilize the landslide. Arrays 1, 2 and 3 are all dry with intermittent flows from two pipes in array 4.

Water Usage

The reporting of average daily water usage, which is information that is considered to be beneficial to understanding the stability of the Rosetta landslide, has been

modified. An alert system is in place as of Dec 2021 whereby when properties have a water usage that exceeds 0.7kL/day over 3 consecutive quarters, the GCC Landslip Co-ordinator will alert the Taswater team to investigate further on any potential impacts. It is understood that Taswater have investigated the properties which GCC identified as having excessive water usage and have confirmed that there are no leaks nor defects. This has yet to be reported by Taswater.

5 COMMENTS ON MONITORING DATA - CASUARINA

The last survey was in April 2022. There are movements of several millimetres both laterally and vertically, which probably reflect seasonal variations in moisture content of clay soils. There are no significant movements of the landslide apart from Control Point 2 which appears to be showing a displacement of up to 35 mm. When this control point was inspected it was found to be in a relatively active part (the toe) of the landslide adjacent to a sewer main (location indicated in Figure 6). Review of recent crack monitoring of the main indicated that cracks up to 20 mm were observed in the sewer during a recent camera inspection (Taswater Infrastructure Displacement map for Casuarina Crescent 26/5/2021). It appears that leakage from the sewer and landslide movements may be interrelated, with movement causing cracking and leakage accentuating movement.

It is recommended that the matter be drawn to attention of Taswater and that the leaks should be repaired, as further leakage has the potential to reactivate the landslide and possibly cause property damage and environmental impacts due to the release of sewage onto the foreshore.



Figure 6 – location of Point 2 close to cracked mains sewer, circled in red

5 COMMENTS ON THE LANDSLIDE MANUAL

The Landslide Manual (which summarizes details of the landslides and the management plans for both the Rosetta Landslide and the Casuarina Landslide) was

issued in May 2014, updated in early 2015 and revised in August 2020. This document was reviewed and a draft revision prepared during the site visit and submitted to GCC for finalization on 7 June. It is understood that this document is about to be finalized

6 OVERVIEW

1. This report concludes that there are probably small localized movements of parts of the Rosetta landslide that are continuing to develop, although overall landslide movements are probably not occurring.
2. This report concludes that that there are probably small localized movements of parts of the Casuarina landslide occurring but that overall landslide movements of are not occurring. However Point 2 appears to be moving and it is recommended that the matter be drawn to attention of Taswater and that the leaks should be repaired.
3. The existing monitoring system is excellent and monitoring according to the plan should continue.
4. A schedule of the status of all properties and all infrastructure in the A zone at Rosetta should be created to develop a long term strategy to manage the future of each property most effectively, with consideration of long term aims such as selective demolition of isolated houses, removal of services that could leak, minimization of maintenance of cleared areas, reducing costs of landslide management, working out how this might interface with the Open Spaces Plan etc. It is understood that GCC's policy in regard to this matter is starting to develop and it is possible that this could be documented within the Landslide Manual.
5. A review of the management plan (the Landslide Manual) has been completed.

7 CLOSURE

The findings of both geotechnical and engineering geological reports are based on observation, interpretation and opinion derived from limited site investigations. The inherent uncertainty in the findings must be recognized. It will be essential to review and perhaps revise the findings of this report if the nature of the project changes, or if the use of the report, or the conditions encountered, differ from those anticipated.

Yours faithfully

Fred Baynes
Director, Baynes Geologic Pty Ltd