UNPUBLISHED REPORT 1962/03

Second report on the Parklands landslide

by K. L. Burns and R. D. Gee

Introduction

Investigations have continued with further studies of matters outlined in the first report (see Unpublished Report 1962/02). Acknowledgement is made of the assistance given by the Burnie Council through Mr J. Frew.

Further developments

The initial surface of failure is now largely inactive. The movement is occurring on a new surface to the north, which joins the old surface in the southwest corner of the heel.

The PMG cable broke on the night of 22 August. On 23 August a trench was dug, about two feet deep, partway across the slide. On Friday the cable had been located on the surface. The rate of movement accelerated in this period.

Heavy rain on 25 August saturated the slide. One vehicle overturned on the highway after striking the toe. On 26 August water was flowing freely into the slip from the surface, from underground channels opening into the heel, and the toe was saturated due to ponding of stormwater on the highway.

Emergency actions taken to date consist simply of measures designed to maintain services and highway traffic, except for a drain in Bay Street which was opened for inspection. Nothing has been done to drains in Buttons Street, the private road. The drains are choked and overflowing along their lengths.

Details of the landslide

A preliminary investigation has been made of the mechanics of the slide. Because of limited staff and other resources, the results are only tentative, but will serve as a guide.

The slide is in soft brown clay derived from dolerite. The heavily striated heel dips around 65 degrees. Using this figure and survey data, a section of the slide has been constructed. This shows that the total weight is of the order of 1200 tons. The base of the slide is about five feet below highway level, close to the top of the bedrock. There is only a small moment opposing movement, so that the shearing strength of the clay is the only factor preventing collapse.

Using a number of centres of rotation with the same extreme points, the equilibrium values (zero) of the expression CL-T-NtanP has been computed graphically. C is the cohesion, P the angle of shear, L the length of the sliding arc, and T, N the total resolved weight acting tangentially, normally, to the slide surface. The weight is assumed to be 110 lbs per cubic foot. Equilibrium values of C and P are tabled.

		Centre				
P°	*1*	*2*	*3*	*4*	*5*	*units*
0	440.1	451.9	417.7	419.3	441.4	(lbs/sq. ft)
1	417.3	430.4	409.2	400.7	397.6	
2	394 4	408.9	400.6	382.5	379.4	
3	372.0	387.6	391.9	363.8	361.5	
4	349.3	366.0	383.3	345.3	343.5	
5	326.6	344.5	374.6	325.3	325.5	
10	211.8	235.2	331.1	232.8	234.1	
15	93.4	122.8	286.1	135.9	140.1	
20		5.0	238.9	34.4	41.3	
30			134.2			
40			57.0			
L	74.5	70.6	68.5	65.3	64.9	feet
T	32780	31900	28600	27390	26950	lbs
N	96360	86680	72160	69080	66660	lbs

The centre 3 is that obtained from survey, and is the most likely except when P is very low. These figures yield P as 5 degrees, C as 375 lbs per square foot for the equilibrium shearing strength on the slide. These values are reasonable for soft clay, and are adopted as a guide. It is desirable that a more precise estimation be made, and that the order of this result be confirmed, but further work on these lines is beyond present resources.

Feasibility of a retaining wall

Assuming a 10 percent drop in cohesion from equilibrium values, and zero angle of friction, the tangential component of weight is 2860 lbs across a slice one foot wide at the centre of the slide. The retaining wall has to support about 1½ tons per linear foot of wall at the centre, averaging perhaps ½ ton overall. The length required is 150 feet, and the minimum height is 8 feet. There is sound bedrock at shallow depth, so such a wall is feasible.

There are practical difficulties with a wall of this nature. First, the cost is high in proportion to the value of property immediately threatened. Second, there may be drainage problems as the clays are probably fairly impermeable, and slow draining.

Third, there are construction difficulties. To excavate for the footing requires cutting into the toe of the landslide, a risky proceeding, or into the highway. Piecemeal methods of construction are possible, but would be expensive.

The most certain method of stabilising the slide, and protecting the rest of the embankment against failure, is to build a retaining wall well out, with suitable fill back to the present embankment. Such a wall is a feasible proposition, but is entirely incompatible with the needs of the highway.

Drainage problems

The water table is very high in this general area. Water is entering the talus slope from the back hillside, partly as runoff over impervious rocks, and partly by conduction through low channels in the basalt. The highest inlet is about 120 foot above sewerage datum. The bank uphill of the Bay Street extension is saturated to ground level and weeping onto the road. Underground water is emerging in the back yard at No. 42 Buttons Street. Investigations show the source is not leaking drains. The ground immediately west of the westernmost house in Buttons Street is saturated, with a small creek running out of a french drain and the embankment. This creek causes perennial problems at highway level, and not infrequently, floods. Water under pressure, presumably conducted down the sewerage line, is emerging through gravel at no. 44 Buttons Street.

There are serious groundwater problems in this whole area, which have been considerably aggravated by neglect. French drains in backyards simply deliver water underground to the front boundaries. It is suspected that at highway level the periodic flooding of low ground, both here and further west, is due to the bad situation, or lack of, highway drainage. It is noted that most of the slip surface on the landslide lies about *5* feet below the highway.

The first stage of a hydrological investigation, geological mapping, has been initiated. The flow path of underground water is shown generally on the accompanying section, but the paths in plan are a matter for investigation. It is likely that a principal resurgence is located in the hollow at the western end of Buttons Street. A rise in water table due to abundant winter supplies, and restriction of outlets at highway level, would lead to high pressures under the embankment. This explains the long history of landsliding, and seasonal control.

If such groundwater conditions are present, which is highly probable, the only effective drainage is by means of an adit driven under the embankment at sea level, below highway level.

Recommendations

Interim recommendations of the first report are confirmed. Restated, these are:

1. Provisions must be made to keep stormwater out of the present slide, and off the whole Buttons Street embankment.
2. No material should be removed from the toe of the present slide. Preferably, the southern highway lane should be closed.
3. Parking and heavy traffic must be barred from the full length of Buttons Street.

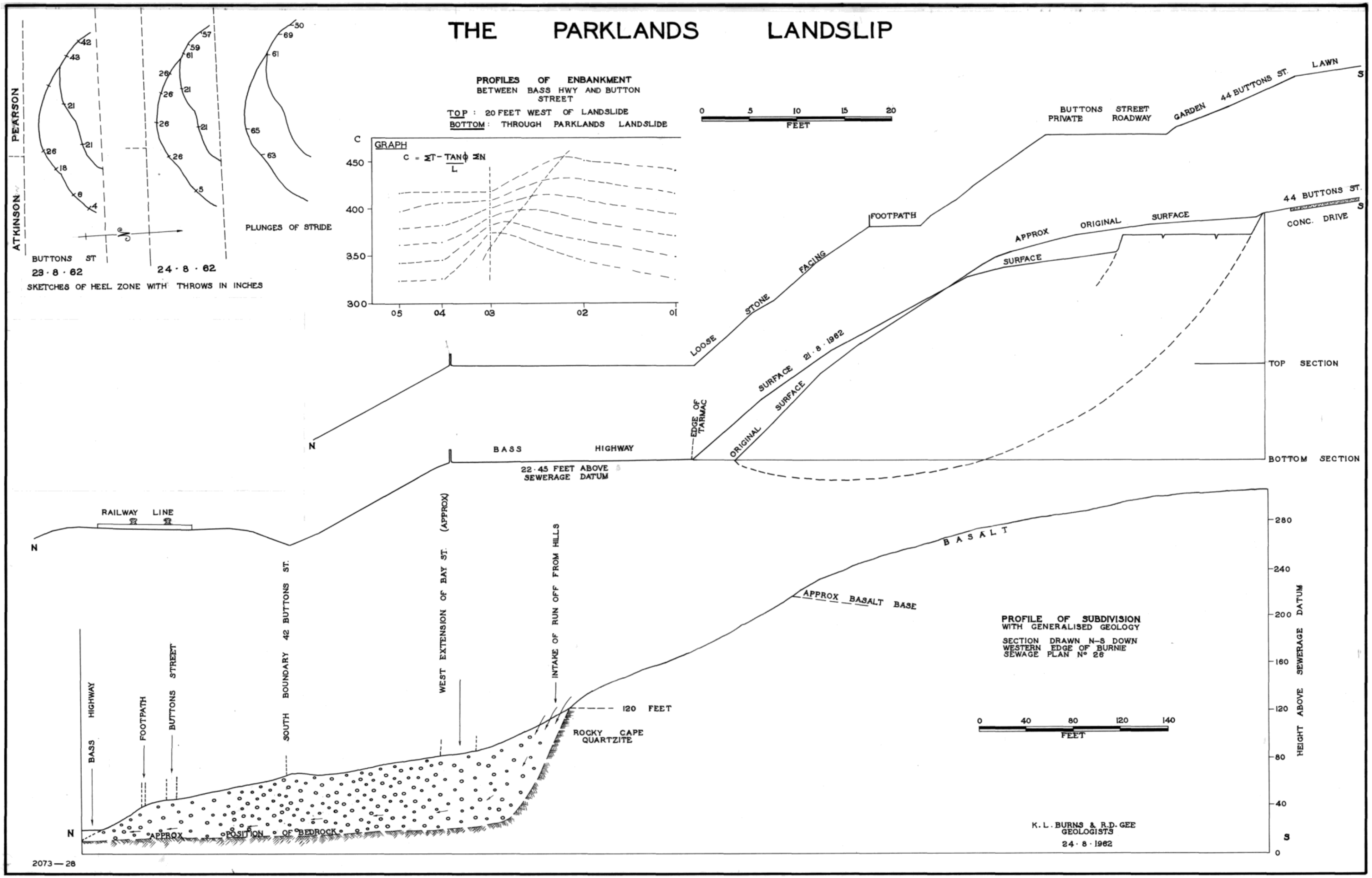
Further work has indicated the advisability of other emergency procedures, which are:

4. Drainage must be provided for the toe of the landslide
5. The whole embankment is potentially unstable. If more slides occur, they are likely to be alongside the present one, rather than behind. The present slide is tending to expand laterally. This decreases the risk to property, but increases the risk of a major highway blockage. It is recommended that this possibility be drawn to the attention of the appropriate authority.

There are a number or inter-related factors to be considered in providing either short or long term solutions to the landslide problem. The cost of a retaining wall must be balanced against drainage measures which will probably not be effective on a short term basis; but which when effective may make a large wall unnecessary. Construction of a retaining wall is costly, and incompatible with highway requirements. Deep drainage of the embankment is costly. As the interests of various bodies must be evaluated no specific recommendations can be made on these matters.

Groundwater conditions are an essential, and largely unknown, aspect of this problem. It is recommended that a hydrological investigation be made to determine general groundwater levels in the area, and the positions of intake and outlets. A number of drill holes, averaging 50 feet long, will probably be a necessary part of such an investigation.

[27 August 1962]


THE PARKLANDS LANDSLIP
PEARSON
ATKINSON
BUTTONS ST
23 · 8 · 62
24 · 8 · 62
SKETCHES OF HEEL ZONE WITH THROWS IN INCHES
PLUNGES OF STRIDE
PROFILES OF ENBANKMENT
BETWEEN BASS HWY AND BUTTON STREET
TOP : 20 FEET WEST OF LANDSLIDE
BOTTOM : THROUGH PARKLANDS LANDSLIDE
GRAPH
C = ΣT − TANφ ΣN / L
FEET
BUTTONS STREET PRIVATE ROADWAY
GARDEN
44 BUTTONS ST.
LAWN
FOOTPATH
LOOSE STONE FACING
APPROX ORIGINAL SURFACE
SURFACE
CONC. DRIVE
SURFACE 21 · 8 · 1962
ORIGINAL SURFACE
EDGE OF TARMAC
TOP SECTION
BOTTOM SECTION
BASS HIGHWAY
22·45 FEET ABOVE SEWERAGE DATUM
RAILWAY LINE
WEST EXTENSION OF BAY ST. (APPROX)
SOUTH BOUNDARY 42 BUTTONS ST.
INTAKE OF RUN OFF FROM HILLS
BASS HIGHWAY
FOOTPATH
BUTTONS STREET
120 FEET
ROCKY CAPE QUARTZITE
APPROX POSITION OF BEDROCK
BASALT
APPROX BASALT BASE
PROFILE OF SUBDIVISION
WITH GENERALISED GEOLOGY
SECTION DRAWN N–S DOWN WESTERN EDGE OF BURNIE SEWAGE PLAN No 26
HEIGHT ABOVE SEWERAGE DATUM
K. L. BURNS & R.D. GEE
GEOLOGISTS
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