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1979/53. Notes on the Aerodrome Hill landslip area

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Abstract

An extensive landslip area occurs in Tertiary clay, sand and gravel on the steep slopes bordering Georges Bay at St Helens. These slips have been active for at least the last ten years and have been aggravated by the removal of natural vegetation, the introduction of water into the slope face and by marine erosion. Natural rainfall may also be a contributory factor, with above average rainfall in the last five years. Improved drainage, re-vegetation of slopes and some foreshore protection are recommended.

INTRODUCTION

At a request from Scott and Furphy Engineers Pty Ltd and the Portland Municipal Council, a landslip area at Aerodrome Hill, St Helens (fig. 1), has been inspected. This is a preliminary report on the above problem. Over the past three years considerable landslip movement has occurred in the area and the Portland Council has become concerned at the effect on development of the region and requested information on remedial measures to improve the stability of the region. The landslip problem dates back to at least 1970, when Jennings (1973) and Mortimore (1970) reported on instability problems. Recommendations were made at that time and have either been unheeded or forgotten due to changes of Council members. Many of the recommendations made by Jennings have either been reinforced or added to in this report. These early reports were concerned with a landslip on Treloggens Track and embankment failures adjacent to St Helens Point Road near the aerodrome. The Treloggens Track landslip has been periodically active and has affected the foundations of one holiday home and necessitated the removal of another; the track has had to be periodically repaired.

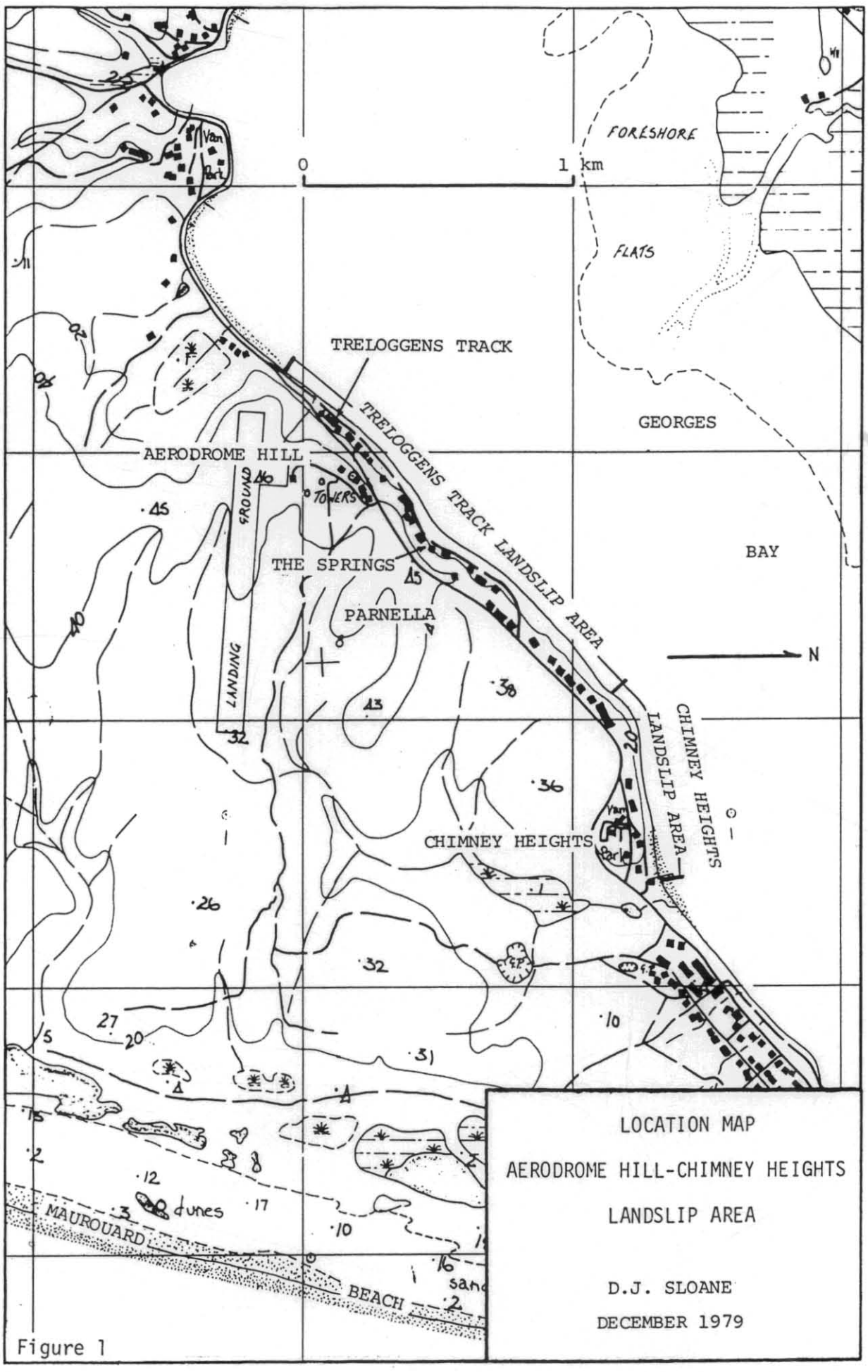
The area has been mapped at an approximate scale of 1:750 from oblique aerial photographs. A draft landslip zone map has been prepared, but is to be altered as survey control of the area has now become available.

Further work involving drilling and sampling is proposed and a more detailed report will be prepared.

TOPOGRAPHY

St Helens Point Road is located along the watershed of a gently undulating plateau which rises to about 46 m above sea level at Parnella and slopes gently towards the north-east, to a relict shoreline behind Maurouard Beach. From the watershed along or close to St Helens Point Road, the area slopes steeply to Georges Bay, with regional slopes generally between 20° and 35°.

Surface drainage is largely towards the north-east. No permanent streams are apparent, but broad shallow depressions carry runoff to Jacks and Windmill Lagoons behind Maurouard Beach and towards a lagoon which drains into Georges Bay near Stieglitz. The streams are ephemeral and are considered to be relict drainage features inherited from more pluvial climatic conditions which probably occurred towards the end of the Last Glacial period. Another explanation for the lack of well defined channels is related to the high infiltration capacity of the coarse, granite-derived Tertiary gravel exposed at the ground surface.


5 cm
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FORESHORE
FLATS
TRELOGGENS TRACK
TRELOGGENS TRACK LANDSLIP AREA
GEORGES
BAY
AERODROME HILL
GROUND
TOWERS
THE SPRINGS
PARNELLA
LANDING
N
CHIMNEY HEIGHTS
LANDSLIP AREA
CHIMNEY HEIGHTS
dunes
MAUROUARD
BEACH
LOCATION MAP
AERODROME HILL-CHIMNEY HEIGHTS
LANDSLIP AREA
D.J. SLOANE
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Figure 1

The vegetation of the area varies from a mosaic of open heath and tussock sedgeland near the coast to dry schlerophyll tall open forest around Parnella and Aerodrome Hill.

GEOLOGY

The Parnella-Aerodrome Hill area is underlain by Tertiary sediments. These sediments consist of sand, gravel, and clay with the coarser sediments largely derived from granite. Gravel and sand horizons which crop out along the steep slopes bordering Georges Bay are generally laterally inconsistent, lensing and interdigitating with clayey sediments. The upper part of the sequence in the Chimney Heights area consists of gravel and sandy gravel to a depth of 5 to 6 m. The base of this unit is subhorizontal and undulatory. The upper part of the gravel is well cemented with iron oxides, a result of soil profile development which extends to a depth of 3 to 4 m where fully preserved. This cemented gravel forms a resistant cap at the sharp break of slope between the steeply sloping area adjacent to Georges Bay and the Parnella-Aerodrome Hill plateau. Below the upper gravel horizon is yellow-brown clay, sometimes containing sand and gravel lenses. In one area a second large gravel horizon is present at a height of about 10 to 15 m above sea level. The lateral extent of this gravel horizon is not known due to poor exposures along Georges Bay. The lower section at Chimney Heights has abundant gravel with a clayey matrix, gravel lenses and clay lenses. Large scale current bedding and clay ball inclusions also occur. Towards the southern end of the Georges Bay hillslope, a grey clay is exposed at or about sea level. This clay contains the clay mineral montmorillonite.

Slopes are mantled by thin veneers of slope deposits derived from the unconsolidated Tertiary sediments. The geology of the hill slope region is also reflected in the slope facets.

HYDROLOGY

Approximately 75% of the rainfall on the Parnella-Aerodrome Hill region is lost by evapotranspiration or surface runoff, with about 25% infiltrating through the gravelly soil to reach the watertable or the impermeable clay layer at the base of the upper gravel. The water is then diverted, depending on the regional slope of the watertable or the slope of the clay-gravel interface. The direction in which the water moves is unknown, but some seeps out at the ground surface along the steeply sloping area adjacent to Georges Bay. This water is immediately obvious where landslip failure has exposed the clay-gravel interface and the water can be seen issuing from the cliff face. Other evidence is apparent in swampy regions or where vegetation indicates moist conditions at shallow depth. The upper clay-gravel interface seems to be the main origin for seepages but some evidence suggests that a large gravel horizon 10 m above sea level is also acting as an aquifer in localised areas. This natural drainage is complicated by surface drainage from houses, from road table drains and from pathways constructed to provide access from houses to the waterfront. Stormwater and septic tank drainage from houses also permeates into the hillslope as most of the French drain dispersal systems are located close to the top of the hillslope. Table drains from St Helens Point Road are drained down the hillslope to Georges Bay. In some areas these are in poor repair, are unlined, or do not continue to the waters edge. All unlined drains in the area are likely to contribute to increased infiltration into the upper gravel and thence to the hillslope region. Water from some of the road drains, and also by diversion from the hillslope pathways, passes directly into headscarp or sidescarp regions of landslip failures.

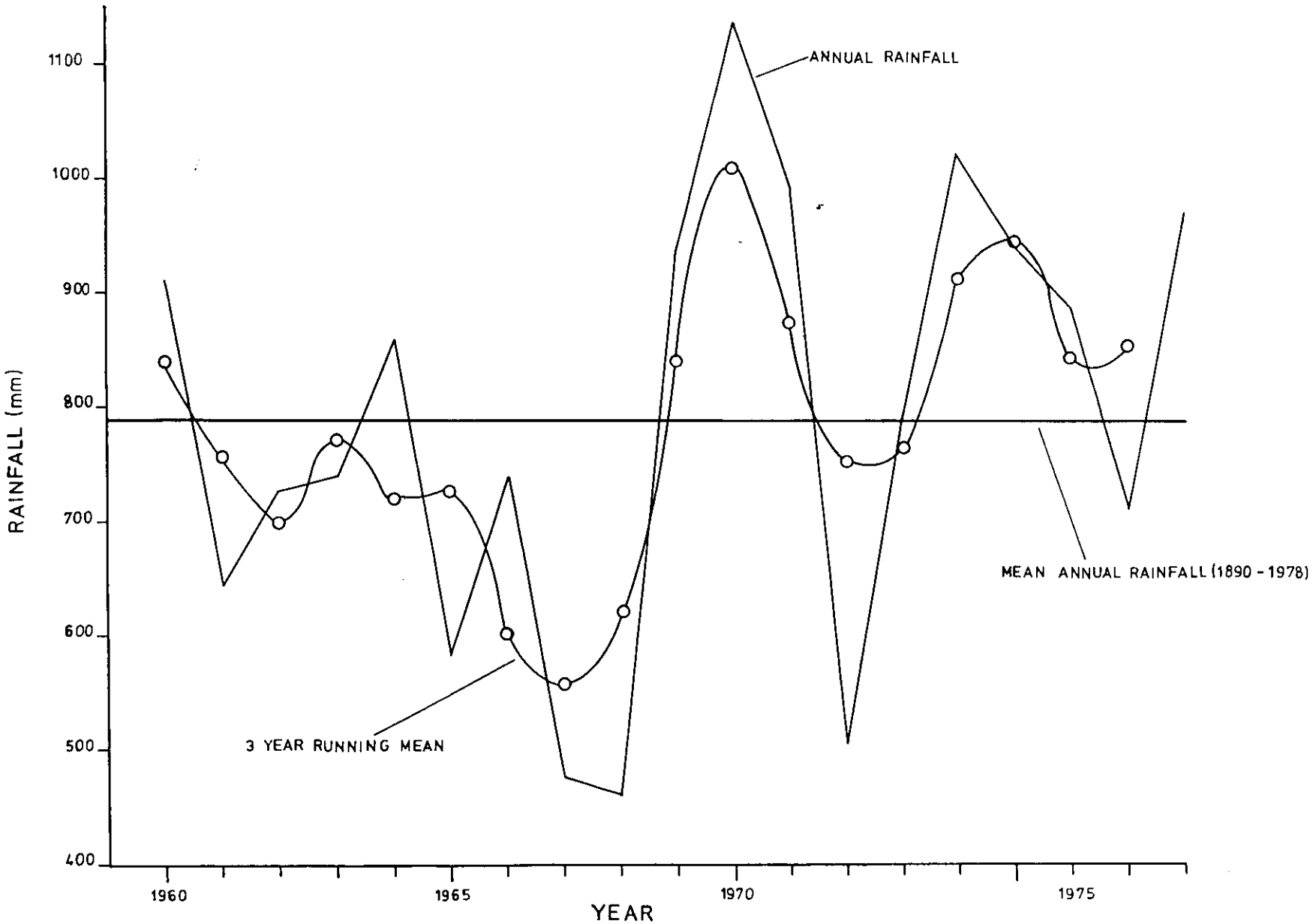

Figure 2. *Twenty-year rainfall record, St Helens*

For eight of the past ten years, total yearly rainfall has been equal to or greater than the mean rainfall for the period 1890-1978 (fig. 2). There has been a noticeable peak over the last five years. Of the preceding ten years (1959-1969), seven have been below average. This suggests that the heavier rainfall over the past ten years, and especially the last five years, must contribute to the landslip problem to a considerable extent.

THE LANDSLIP PHENOMENON

The landslip zone can be divided into two distinct areas (fig. 1).

The first, or Treloggens Track area, is characterised by some minor recent slip activity and failures of the semi-rotational slump movement type. One large landslip affecting Treloggens Track and two adjacent holiday homes has been periodically active for at least the last ten years. When Jennings and Mortimore inspected this landslip in 1970, it had just reached the foreshore edge of Treloggens Track with a tension crack on the opposite side of the road. The base of the landslip is apparently located on the grey clay exposed at sea level. The toe of the landslip encroaches onto the beach in a distinct bulge, subsequently eroded by wave action. Numerous tension cracks and well defined near-vertical arcuate head scarps and side scarps are prominent features. There is evidence of a much older headscarp located to the rear of the foundations of the holiday home which has been removed. Renewed activity of this old scarp was shown by a 50 mm vertical displacement tension crack in this region during mid-1979. It therefore appears that the well defined and currently active slip involves parasitic failure of the toe of this much older landslip. Another similar large slip has occurred in a section of bush near the northern end of Treloggens Track. Further north, the landslips are not as distinct and arcuate in nature but numerous tension cracks are present towards the foot of the steeply sloping region. The area known as The Springs is considered to be a very large old landslip. This feature is recognised by the disruption of the general hillslope by a large 'amphitheatre' embayment. The area within the embayment is low lying, of shallow slope and swampy. The large seepage area probably originated from exposure of an aquifer in the old headscarp region. This old landslip could have originated some 5000 years ago towards the end of the Last Glacial period. Some small old slip blocks occur further to the north. In one case, a slip block has a large eucalypt growing on it, but leaning at a steep angle towards the slope, a result of the old rotational movement. Adjacent to this area is a section of the Crown Reservation which has retained its natural vegetation. This area shows no sign of movement, with a good interlocking root mat exposed at high water mark. Adjacent to the north of this stable area is a very large landslip, partly rotational and partly slab and mudflow in type. There appears to be an upper and a mid-slope gravel aquifer at this slip. This large landslip approximately marks the boundary between the two landslip areas. The Treloggens Track area shows little foreshore erosion. Only one area shows foreshore cliffed erosion and this occurs at the southern end of The Springs where the side-scarp of the old landslip intersects the regional south-west facing slope.

The northern or Chimney Heights landslip area is a more recent and obvious failure area, with common bare cliffs, mudflows, debris slides and planar slab failures exposing the clay and gravel in the slope face. The majority of the failures seem to have become more obvious during the last three years and several headscarps have extended into the adjacent building allotments. Marine erosion is a contributing factor to slope failure. The base of the slope has been undercut by wave erosion resulting in near vertical clayey gravel cliffs. These cliffs have been deeply gullied by runoff and mudflows from the overlying clay. The main aquifer occurs at

the base of the upper gravel and can be clearly seen where exposed in the headscarps of the numerous arcuate slips. Water issuing from the aquifer saturates the clay which appears to be both dispersive and highly plastic in nature. Due to the oversteepening of the slope foot, the removal of vegetation, the introduction of water from septic tanks and stormwater drainage and natural aquifers, the clay horizon has become saturated at the slope face and frequently fails, carrying large vegetated slabs of the gravelly slope mantle veneer downslope. Mudflows have also resulted and appear to be extremely active after periods of heavy rainfall. The clay becomes cracked when dry and subsequent wetting allows the water to penetrate and allows the cracked blocks to be more easily removed. The removal of vegetation is undoubtedly a contributing factor to failure in this region. Many allotments along St Helens Point Road have been cleared of trees and most of the foreshore reservation in this area has been cleared to provide uninterrupted views for the holiday home owners.

CONCLUSIONS

Several factors are responsible for slope failure in the Aerodrome Hill area at St.Helens. These are steep slopes, underlying clay with adverse physical properties, marine erosion, the removal of natural vegetation and the introduction of water into the slope face by natural aquifers and man made alterations to the natural drainage.

Marine erosion is undoubtedly a contributing factor to failures which have occurred in the Chimney Heights area. Some foreshore protection has been attempted in this area by dragging fallen trees parallel to the shoreline at the base of the cliff. This has certainly improved the situation in some areas. It must be understood, however, that foreshore protection will not stop the landslip problem, as landslips are occurring where erosion is not present.

Water in the slope face originates from natural gravel aquifers and from alteration to the natural drainage by road culverts and foreshore drains, from paths along the foreshore and from houses in the form of septic tank, stormwater and surface drainage.

It is also considered that natural rainfall is a major contributing factor. Above average rainfall over the preceding five year period has contributed to higher water table conditions and subsequent aquifer seepage at the slope face. These rainfall figures will be examined in greater detail at a later date, as the intensity and time of year that rainfall occurs will tend to accentuate or reduce the initial opinion based only on annual rainfall figures.

The removal of vegetation from the Crown Reservation along the foreshore and house allotments has definitely contributed to landslip failure by the loss of root binding support and the introduction of water normally taken up by plant transpiration and evaporation.

RECOMMENDATIONS

It is recommended that the following measures be adopted to improve the stability of the region. These suggestions are ranked in order of increasing importance:

Improved drainage

The sealing of road culverts to reduce infiltration. The repair and upgrading of drainage from St Helens Point Road to the Georges Bay foreshore.

These drains should be continuous to the foreshore and should be of such construction that they may be easily maintained and repaired if further landslip movement causes damage. The piping of stormwater from any new buildings along St Helens Point Road, either to the foreshore or well away towards Maurourard Beach. Encouragement should be given to the owners of existing houses to pipe stormwater to the foreshore. Sullage or sewerage systems should be introduced to any new subdivisions in this region. If these measures are adopted and the area becomes fully developed, approximately 20 to 25% of the natural rainfall which would normally fall on the area will be intercepted by the roofs of buildings and roads and diverted from the area.

Vegetation

The planting of trees in areas of instability. Species of eucalypt, oak, willow and pine are suitable, but the advice of the Department of Agriculture or the Forestry Commission should be sought. Obviously deep rooting and quick growing species are desirable, but these must be able to withstand swampy conditions. In other areas all trees should remain wherever possible. The removal of trees is controlled by Part IV, Division 5, Section 45 of the Tasmanian Building Regulations, 1978, and will consequently apply in the landslip B areas between St Helens Point Road and the foreshore.

Marine erosion

Some foreshore protection is desirable, but the cost of such protection should be considered in view of the opinion that foreshore erosion is a contributing but not a major factor relating to instability. The present practice of using fallen trees for wave energy dissipation at the foot of the hillslope could be continued.

FUTURE WORK

The landslip problem has necessitated the introduction of landslip zoning to the area. This zoning is an attempt to make people aware of the problem and to control the continuing development of the region to ensure that sensible practices are adopted in this area of obvious instability.

Further work is proposed in 1980. Drilling for stratigraphic purposes and aquifer location will be conducted, although aquifer location could prove difficult. Sampling is required to provide information on the composition and physical properties of the clay. Sampling of seepages may provide information on the origin of the water. Stability and back analysis will be conducted to aid in identifying threshold slope angles. Periodic surveying will be conducted to ascertain areas where retreat of the cliff face is occurring and calculations will be made on the rate of retreat.

REFERENCES

JENNINGS, I.B. 1973. Landslips on the northern slopes of Aerodrome Hill, St Helens. *Tech.Rep.Dep.Mines Tasm.* 15:87-90.

MORTIMORE, I.R. 1970. *Landslips below Treloggens Track, Lower Aerodrome Hill, St Helens.* (Unpublished Report to Portland Council).

[10 December 1979]

Areas of instability where vegetation has been partly removed. The central region still retains the natural vegetation and stability.