

1981/1. Investigation of an urban allotment, Braddons Lookout Road, Leith

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Abstract

An investigation of an urban allotment at Leith was undertaken to assess the effect of development on the stability of the slope. Unstable slopes are a feature of the area. Trenching has shown that the land is underlain by basaltic materials of Tertiary age. A house site on stable ground exists at the top of the lot, but there is the potential for shallow earth slides to develop on the steeper slope segments. Recommendations are made for the dispersal of household effluents in an area which will not induce instability.

INTRODUCTION

The Department of Mines has undertaken a geological investigation on land owned by Mr T. McCarthy at Lot 20, Braddons Lookout Road, Leith [DQ375425]. An initial assessment, based on the existing provisional zone map indicated that the land should be regarded as being of doubtful stability. The Department recommended that Mr McCarthy should not proceed with building on his land until a more thorough site investigation had been undertaken.

The investigation involved reconnaissance geological mapping and trenching by backhoe. This report describes the results of the investigation which was carried out on 5 December 1980.

RESULTS OF INVESTIGATION

Surface conditions

According to the regional geological map (Burns, 1963) the land at Lot 20, Braddons Lookout Road, Leith is underlain by basalt of Tertiary age. The surface soil is mainly red brown clay (CH). Scattered fragments of ferruginous cemented quartz particles were noted towards the top of the lot. They could be traced for several tens of metres along slope to the north where they became more abundant. These materials are considered to be sediments of Tertiary age and have been found elsewhere along the north-west coast and are known to occur between basalt flows.

Subsurface conditions

The trenching programme has confirmed that the land is underlain by basaltic materials and their weathering products. The weathering sequence is variable, with the indication that a more deeply weathered profile exists higher up the slope. Tertiary sediments were not encountered in either of the two trenches.

Detailed descriptions of materials encountered in the trenches are appended. Their locations are shown on Figure 1.

Morphology

The morphological history of the Forth-Leith area is complex. However, one process which has affected residential development in this area is landslide activity. There are two readily distinguished periods of slope movement; an older phase, which took place on a large scale perhaps some several thousand years ago, and which has a more complex form than

the recent active slides which are known to develop in basaltic soils on slopes as low as 14°.

Section AB (fig. 1) shows the presence of a probable old landslide, recognised on surface evidence by the reverse sloping segment and by the easterly dipping attitude of the basaltic materials exposed in the 2-3 m deep road cut along Russel Street opposite the existing house. This feature is considered to be currently dormant under the present climatic conditions and land use.

The slopes on McCarthy's land range from 6°-26°. Three basic slope segments have been recognised; an upper slope segment of less than 14° extending for 30 m downslope from Braddons Lookout Road; a steeper middle segment to a maximum of 26°; and a 15°-17° lower slope segment that occupies the bottom 15 m of land above the lower boundary fence (fig. 1). The slopes are simple, with no pronounced microrelief and there are currently no signs of active movement on the lot.

DISCUSSION

Landslide activity in the Forth-Leith area has been recognised for many years. With the advent of increasing urban development in this region over the past few years the Department of Mines produced a provisional landslide zone map in 1974. The land under consideration was zoned as an "A" landslide area on which very limited building was recommended. The attitude of the Department now, in relation to the 1974 provisional plan, has changed only in so much as to update the "A" and "B" terminology originally used. The land would now be classified as being of doubtful stability and should be the subject of a more thorough investigation prior to development.

The results of the investigation have indicated that, in the opinion of this Department, the site can be safely developed subject to several conditions being imposed.

Experience has indicated that those slopes which are steeper than about 14° and which are underlain by basaltic soils are the most prone to instability. Evidence supporting this can be borne out by observing the numerous shallow earth slides (about one metre in depth) which have developed on similar slopes along the north-west coastal region, including several which are currently active further along the slope towards the township of Forth. Thus the possibility that shallow seated soil movements may develop on the steeper middle slope segment at some future date cannot be entirely eliminated.

The factors most commonly attributed to inducing failure in these situations include periods of intense or prolonged rainfall; groundwater seepages; and saturation of soil brought about by the concentrated disposal of sullage and septic effluents and by stormwater dispersal in the area of discharge. Hence, with proper site planning, it is possible to reduce the potential for instability to develop by making adequate provisions for the disposal of the effluents and stormwater.

CONCLUSIONS

The site is underlain by basaltic materials of Tertiary age. The upper slope segment extending for 30 m downslope from Braddons Lookout Road is less than 14° and is a suitable area for a proposed house site.

There is a potential for shallow earth slides to develop on the steeper middle slope segment. The likelihood of failure on this segment

would be greatly increased if household effluents and stormwater were allowed to be dispersed onto this slope.

It is considered that the household effluents and stormwater could be safely dispersed without creating instability problems in the area that occupies the bottom 15 m of land above the lower boundary fence.

RECOMMENDATIONS

To minimise the potential risk attached to building on this site, it is recommended that the house be constructed at the top of the lot and within 30 m of the boundary fence fronting onto Braddons Lookout Road. Development should be in strict accordance with existing building codes.

The stormwater and household effluents should not be dispersed onto the steeper middle slope segment. Instead the planting of trees and shrubs should be encouraged as an aid to stabilising the soil and to help prevent saturated soil conditions occurring.

Household effluents should be piped to the bottom of the lot and dispersed over as large an area as possible. It would be preferable if this pipe were located on the surface so that any fracture or leakage would be more easily detected.

REFERENCE

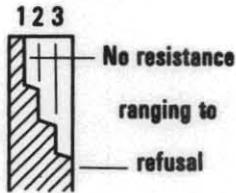
BURNS, K.L. 1963. One mile geological map series. K/55-6-29 Devonport. Department of Mines, Tasmania.

[9 January 1981]

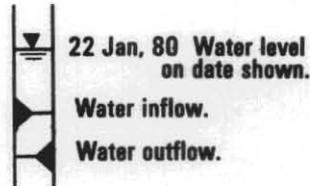
EXPLANATION SHEET FOR ENGINEERING LOGS

Borehole and excavation log

Penetration



Water



Notes - samples and tests

- U50 Undistributed sample 50mm diameter.
- D Disturbed sample.
- N Standard penetrometer blow count for 300mm.
- N* SPT + sample.

Material classification

Based on Unified Soil Classification System. In Graphic Log materials are represented by clear contrasting symbols consistent for each project.

Moisture content

- D Dry, looks and feel dry.
 - M Moist, no free water on hand when remoulding.
 - W Wet, free water on hand when remoulding.
 - LL Liquid limit.
 - PL Plastic limit.
 - PI Plasticity Index.
- eg. $M > PL$ - Moist, moisture content greater than the plastic limit.

Consistency

- | | | hand penetrometer (kPa) |
|-----|-------------|-------------------------|
| VS | Very soft. | < 25 |
| S | Soft. | 25 - 50 |
| F | Firm. | 50 - 100 |
| St | Stiff. | 100 - 200 |
| VSt | Very stiff. | 200 - 400 |
| H | Hard. | > 400 |
| Fb | Friable. | |

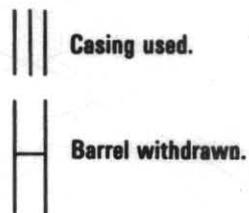
Notes: X on log is test result
— is range of results.

Density index

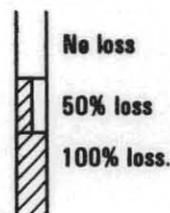
- | | | % |
|----|---------------|----------|
| VL | Very loose. | 0 - 15 |
| L | Loose. | 15 - 35 |
| MD | Medium dense. | 35 - 65 |
| D | Dense. | 65 - 85 |
| VD | Very Dense | 85 - 100 |

Cored borehole log

Case - lift



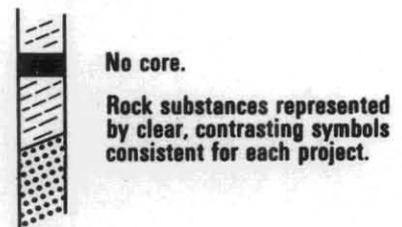
Fluid loss



Lugeons

Lugeon units (μL) are a measure of rock mass permeability. For a 48 to 74mm diameter borehole 1 Lugeon is defined as a rate of loss of 1 litre per metre per minute. 1 Lugeon is roughly equivalent to a permeability of 1×10^{-4} mm/sec.

Graphic log



Weathering

- Fr Fresh.
- SW Slightly weathered.
- HW Highly weathered.
- EW Extremely weathered.

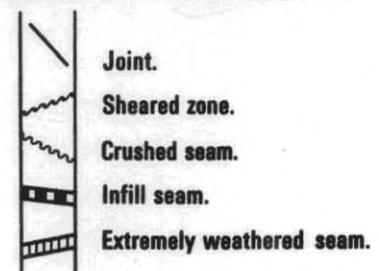
Strength

- | | | point load strength index $I_{5(50)}$ (MPa) |
|----|-----------------|---|
| EL | Extremely low. | < 0.03 |
| VL | Very low. | 0.03 - 0.1 |
| L | Low. | 0.1 - 0.3 |
| M | Medium. | 0.3 - 1 |
| H | High | 1 - 3 |
| VH | Very high. | 3 - 10 |
| EH | Extremely high. | > 10 |

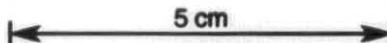
Note: X on log is test result.

Significant defects

Significant defects shown graphically.



ENGINEERING LOG - EXCAVATION



5/7

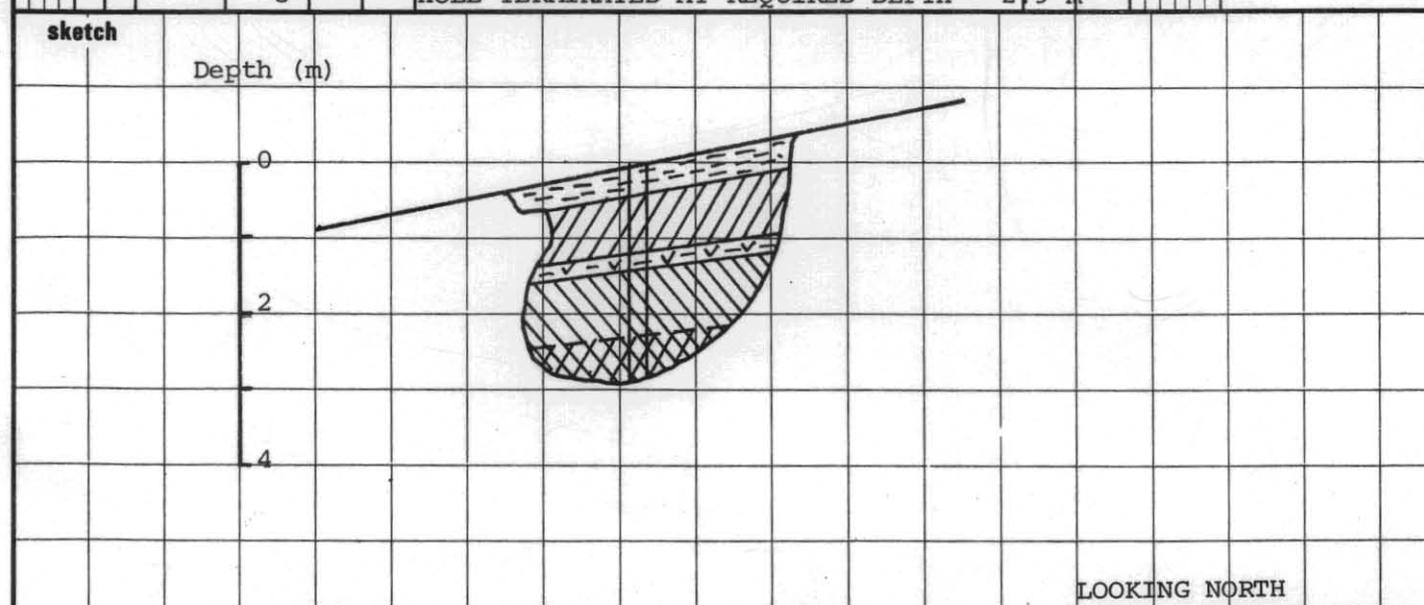
excavation no. 1
sheet 1 of 1

project T. McCarthy site investigation location Leith

co-ordinates DQ375425 Refer figure 1 exposure type Backhoe pit equipment John Deere 400A pit commenced 5/12/80 pit completed 5/12/80

R.L. excavation dimensions 3.2 m x 0.8 m x 2.9 m deep operator Lyell Ashdown logged by R.C. Donaldson checked by A.T. Moon

penetration	support	water	notes samples, tests	metres R.L. depth	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour secondary and minor components	moisture condition	consistency	density index	hand penetrometer kPa	structure, geology
1 2 3											25 50 100 200 400	
						CH	CLAY: high plasticity, brown-red, some sand fine to medium, roots and root fibres.	D	St-V. St. (Fr)		*	TOPSOIL
				1		CH	CLAY: high plasticity, red, trace fine sand	M < PL	H			* Iron-enriched subsoil
	NONE	NONE				CH	CLAY: high plasticity, grey and yellow-brown, trace fine sand. 20% HW BASALT: grey, low strength	M < PL	V. St. H		**	WEATHERED CAP ROCK?
				2		CH	CLAY: high plasticity, mottled yellow and red-brown, trace fine sand.	PL	H			* RESIDUAL CLAY
							Similar to above with pockets of grey and yellow-brown clay (CH) as exposed between 1.1 m and 1.25 m, and some E.W. BASALT: mottled grey and yellow-brown, extremely low strength. Remoulds to CH clay.					* GRADING INTO EXTREMELY WEATHERED BASALT
				3			HOLE TERMINATED AT REQUIRED DEPTH - 2.9 m					



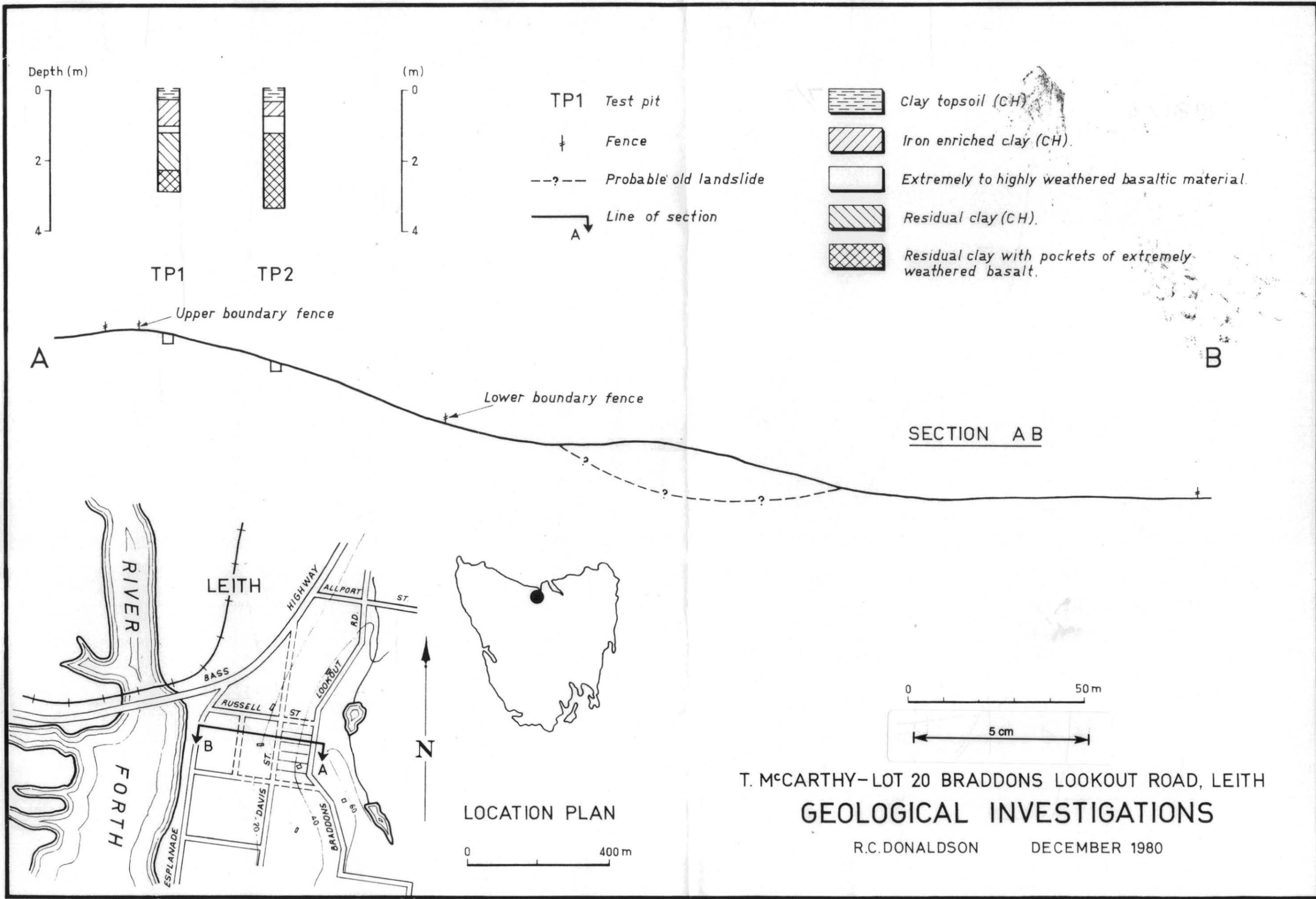


FIGURE 1