

1981/42. Preliminary geological investigations at a proposed sanitary landfill site near Prospect.

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*Abstract*

Geological mapping and test pit logging has established the surface and near-surface geology of a 32 ha proposed landfill site near Prospect. The site, in a gently undulating shallow valley, is underlain by Tertiary sediments and bounded on all sides by Jurassic dolerite.

Well-defined soil profiles have developed on both rock types. The B horizon of each consists of 0.5-2.0 m of unfractured, impermeable clay. This material overlies almost all of the proposed site and will probably prevent leachate pollution of the underlying confined groundwater.

Provided certain recommendations are followed regarding excavations, filling, and drainage, the site is considered geologically suitable as a landfill area. Nevertheless, a groundwater quality monitoring programme using piezometers or observation bores at selected sites should be started before operations commence. Such a sampling programme would continue indefinitely and should be considered a normal and necessary part of site management.

INTRODUCTION

Geological conditions at a proposed refuse disposal site [EQ117073] at Prospect (fig. 1) have been investigated at the request of the St Leonards Municipal Council. The site, about one kilometre east of Prospect Vale, is under consideration by the Beaconsfield, Lilydale, St Leonards, Westbury Municipal and Launceston City Councils as a major disposal site for the Launceston metropolitan area.

The locality has been inspected by the Department of the Environment which required that the nature of the soil profiles of the site be studied by test pits. A necessary condition is that operation of the site causes no deleterious effect on watercourses draining the area.

METHOD OF INVESTIGATION

In this preliminary survey, the site was mapped in detail and thirty-four backhoe test pits were dug to determine the near-surface geology of the area. This assists in assessing the various geological factors which need to be considered in determining the suitability of landfill sites generally:

- the general geology of the area
- the detailed geology of the site
- nature of, and depth to, weathered rock
- occurrence of groundwater
- potential for groundwater and surface water pollution by landfill leachate
- ease of excavation
- availability of suitable cover materials

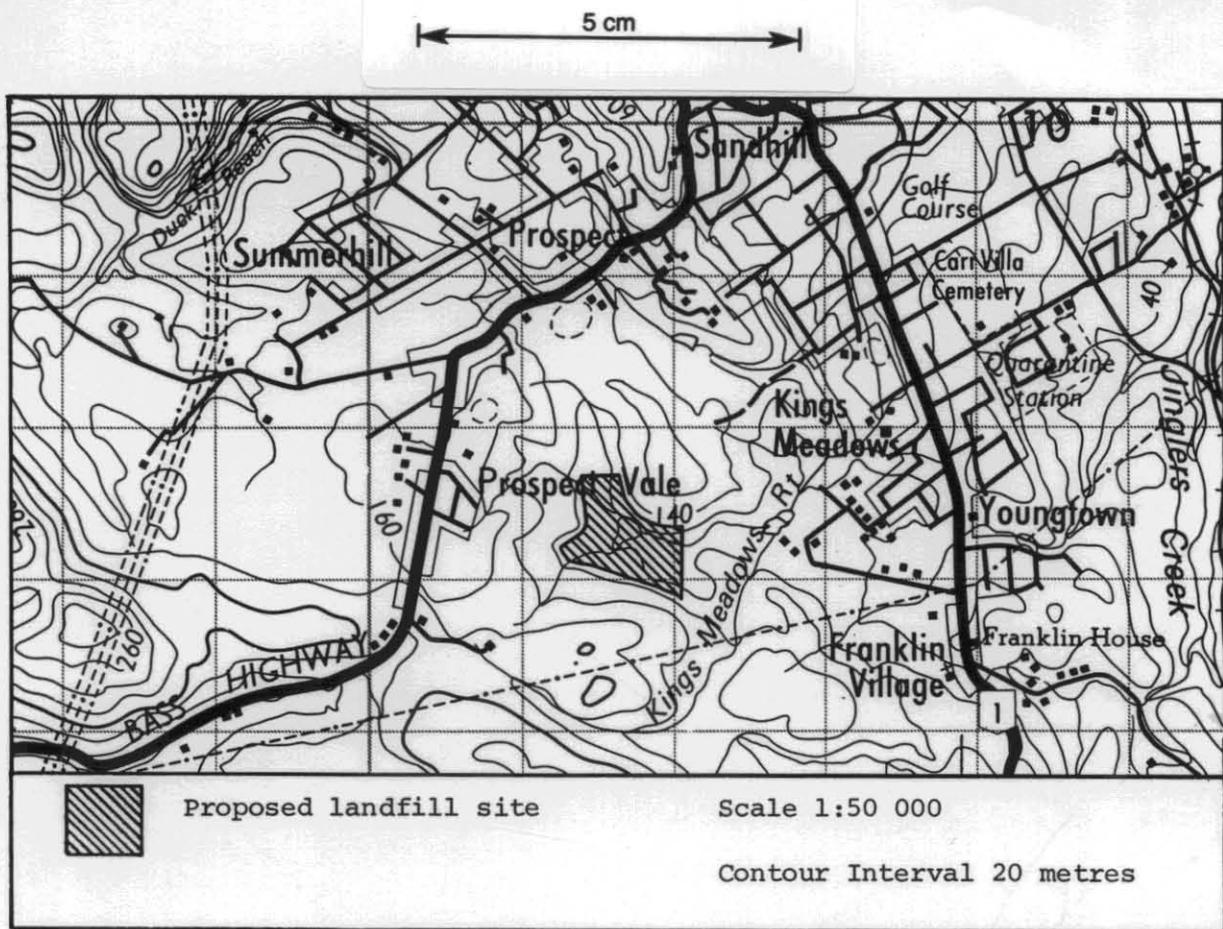


Figure 1. Location of proposed landfill

METHOD OF LANDFILL OPERATION

The locality is to be used as a sanitary landfill site. In this operation, refuse is initially dumped and compacted (ideally on impermeable soil) and covered daily with permeable fill. Successive horizontal layers of refuse are similarly compacted and covered. Leachate percolating vertically down through the fill is collected in drains and discharged beneath the site to a leachate treatment lagoon. After treatment, the remaining water is discharged to natural water courses or municipal drains.

The main concern, therefore, in assessing the geological suitability of the site is to determine whether impermeable material exists so that leachate cannot enter the groundwater system and bypass the drainage and treatment pond.

On completion, the site will cover about 32 ha, with a horizontal finished surface at an elevation of 135 m AMSL. This will necessitate two steep faces; one 300 m long and 10-12 m high facing north, the other 500 m long, about 25 m high, facing east.

PRESENT TOPOGRAPHY AND DRAINAGE

The proposed site (fig. 2) occupies a shallow undulating valley near the confluence of two small unnamed and east-flowing tributaries of Kings Meadows Rivulet. Below the confluence the water course is clearly defined; above it, the land is marshy, waterlogged in places, and poorly drained, with the marshy area separated by low east-trending spurs and hills covered with sandy silt topsoil. The more southerly of the two creeks drains higher land near the Bass Highway south of Prospect Vale, and is presently polluted with what appears to be organic wastes.

## BEDROCK GEOLOGY

### *General*

In a regional sense, the Prospect area is part of an uplifted dolerite horst structure lying adjacent to the downfaulted NW-SE trending Launceston Tertiary Basin.

In Tertiary times, the basin was flooded and infilled with lake deposits (the Launceston Beds), a thick but variable and complex sequence of sand, gravel, and clay (and their combinations). In places, sedimentation overlapped the margins of the basin, so that material was deposited on a surface of probably high relief.

At the proposed site the main rock types are Jurassic dolerite and Tertiary sediments of the Launceston Beds, and it is to be expected that the sediments will be very variable in lithology and thickness, changing rapidly both vertically and horizontally over short distances. This occurred in excavations for the nearby Southern Outlet Road and Prospect Bypass, where the Launceston Beds consist of interbedded and lensing horizons of clay, sandy clay, sand, gravelly clay, and gravel. Correlation was difficult between boreholes less than 20 m apart, and the sediments change in thickness abruptly over similar distances.

### *Geology of the proposed site*

Although Jurassic dolerite and Tertiary sediments are the main rock types at the site, neither crops out and both are covered by either talus and scree, residual soil, or swamp deposits. The geology of the site is shown in Figure 2, which also shows the boundaries of the finished landfill and leachate pond, and the locations of test pits and geological section lines.

Dolerite presumably underlies the proposed site at depth, as it occurs on the hills on all sides. The Tertiary sediments occupy the floor and low hills in the valley, but their thickness is not known. The northern contact (fig. 3) between dolerite and sediments probably dips south and corresponds approximately with the northern watercourse. The southern contact probably dips north near the 130 m contour line along the boundary of the finished landfill site. However, it is obscured by dolerite scree which extends down hill, covering in part the Tertiary sediments, to about the 120 m contour.

The Tertiary sediments, which are partly overlain by a veneer of swamp deposits no more than one metre thick, are identified in the field by their thin capping of pale, leached soil - mainly greyish fine sand or silty sand with occasional white quartzite pebbles.

Both the dolerite and sediments have developed well-defined soil profiles to depths of about three metres in places, and these soils are the main geological factor controlling the suitability of the site.

## SOIL FORMATION AT THE PROPOSED SITE

### *General comments*

It is important to understand the basic process of soil formation and to be able to recognise the various soils in the field. For example, soils developed on dolerite and sediments at this site both contain an impermeable

horizon which will effectively prevent groundwater pollution in the underlying rock. This clay will need to be located and recognised during excavations.

Soil is weathered mineral and organic matter found in *genetically related horizons* in response to subaerial processes. The sequence of horizons down to and including the parent material is the *soil profile*. The soil profile consists of two parts; the *solum* (the altered horizon) and the *weathered parent material* (not sorted into horizons).

In descriptive terminology, the soil horizons are designated by letters (e.g. O, A, B, C), and in most cases the letters relate to the movement of constituents through the profile, thus stressing the genetic relationship between horizons.

The most important distinction is between horizons which have lost constituents, and those that have gained constituents, mainly by leaching. The former are called *eluvial* (washed out of) and the latter *illuvial* (washed into). The letter A is used to designate eluvial horizons, and B is used for illuvial horizons. Since clay, iron, lime, and humus are the most commonly eluviated (and subsequently illuviated) constituents, the A and B horizons may be subdivided on the basis of properties reflecting their movements.

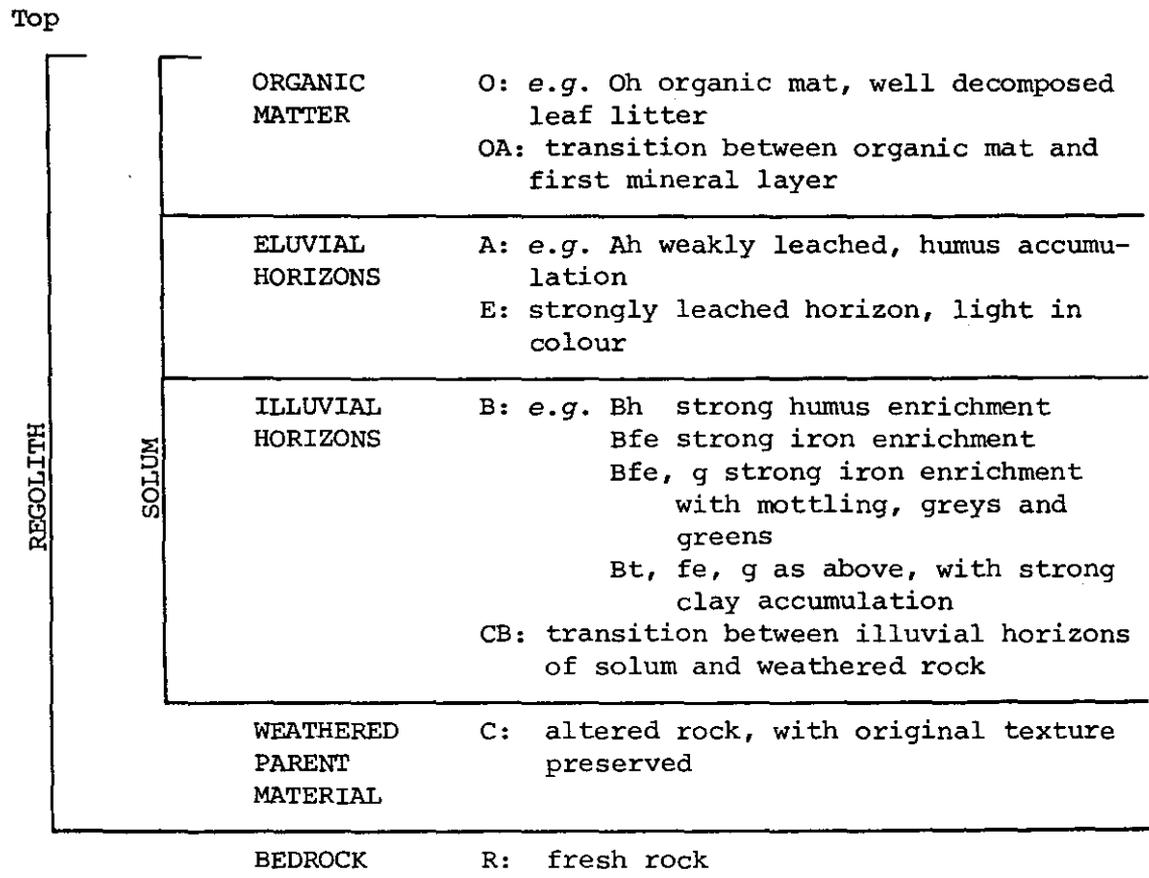
From the top to bottom of a soil profile, the following symbols are commonly used, and have been used in this report and appendix:

<i>Horizon</i>	<i>Description</i>
O	- consists of organic matter. Often absent.
A	- eluvial horizons, mainly of mineral matter mixed with some humified organic matter
E	- strongly eluviated horizons depleted in organic matter, iron, lime, and clay. Usually pale coloured and high in quartz.
B	- illuvial horizons, characterised by concentrations of clay, iron, and organic matter (alone or in combination). Also some lime, but if high in lime, letter K is used.
G	- bluish, greenish, or greyish illuvial horizons, usually high in clay and iron, formed under reducing conditions with impeded aeration - these are <i>gleyed</i> horizons.
CB, BC	- transition horizon between the illuviated B horizon above and the C horizon or weathered parent material below.
C	- weathered parent material lacking soil properties and looking more like fresh parent material.
R	- bedrock

In this report the following suffixes are used to describe some features of an horizon:

- h - humus - well decomposed organic matter, accumulates under free drainage and aeration. Can be used with O, A, or B horizons, e.g. Ah, Bh.
- fe - illuvial accumulation of iron, usually applied to B, CB horizons.
- r - concretionary or gravelly layers.
- t - for illuvial accumulation of clay, usually applied to B horizons.
- g - gleying, strong mottling reflecting variation in oxidation and reduction as a result of periodic wetting.

This classification is diagrammatically illustrated below.



The colour of soil horizons is an important and often diagnostic property, and is related primarily to the presence of humic material, and the mobile iron oxides in various hydration states. Thus, in profiles where iron is being illuviated, reddish colours occur in the upper B horizon, with a tendency for yellow (more hydrated) iron oxides in the lower B horizons, indicating wetter conditions at that level. Red and yellow mottling indicates periodic moisture fluctuations.

Prolonged wetting produces drab greys and yellows, and even blues and greens (from the ferrous instead of the ferric iron oxides) of the gleyed levels.

Black colours are produced by humic matter, or manganese oxides, which may mask other colours.

All of these effects occur in soils at the site, and are easily recognisable in excavations.

*Soils developed on Tertiary sediments at the site*

These soils are characterised by a virtual absence of the O horizon, minor development of the A horizon, and marked E and B horizons. In the field, a strongly eluviated pale E surface horizon about 0.3-0.5 m thick consisting of stiff silt, sandy silt, or silty sand changes abruptly to a very stiff, impermeable, strongly coloured and often mottled clay B horizon. The clay is at least one metre and up to two metres thick in places and usually grades vertically downwards to sandy clay (interpreted as the CB horizon). Often the B horizon contains irregular concretionary limonite bands and patches, and small granular limonite is sporadically interspersed throughout it. The clay is massive or uniform, unfractured, and virtually impermeable. As the clay occurs wherever the Tertiary sediments appear, it underlies most of the proposed site and is an effective barrier to downward migration of leachate. Conversely, the clay acts as an upper confining layer for confined groundwater occurring in the underlying, more permeable Tertiary sediments.

This B horizon on the Tertiary sediments should not be penetrated during preparatory excavations and clearing at the site. Nor should refuse be dumped immediately on the existing land surface. The eluviated pale silty sand surface layer, although relatively impermeable, is considerably more permeable than the underlying clay and unless removed it may transmit leachate from the site. The whole area should therefore be stripped of this silty horizon before covering with refuse. The silty material would also form a suitable cover fill.

*Soils developed on Jurassic dolerite at the site*

These soils are similar to those on Tertiary sediments in that they exhibit distinct, easily recognisable soil horizons.

Areas of doleritic soils on the site invariably have scattered dolerite boulders littered about the surface. Similar boulders and cobbles occur in the uppermost A and E horizons, which are usually strongly to moderately leached (eluviated) dark brown silt and gravelly silt. The silts change abruptly at between 0.3-0.6 m to very stiff mottled brown and yellowish-brown clay, often with limonitic fragments and granules, and occasionally with extremely to highly weathered dolerite cobbles and boulders. Like the soils on Tertiary sediments, this clay (about 0.5 to 1.0 m thick) grades to weathered bedrock, but the clay on the dolerite is paler in colour and usually of lower plasticity. Its gradation through the CB horizon to weathered bedrock is usually more distinctive, since the extremely weathered dolerite in the CB and C horizons retains a characteristic dolerite texture.

The CB and C horizons in both the dolerite and sediments are relatively permeable compared to the overlying clayey B horizon, and they usually exhibit irregular fractures and weathering seams sealed with highly plastic grey-blue clay. Some of these seams yield water in excavations, and this was particularly noticeable in the Tertiary sediments.

It will be necessary to remove the top half metre or so (the A and E horizons) of the dolerite soil to provide an impermeable base to the site. Again, the underlying B horizon should be exposed and not penetrated. The material removed would act as a suitable cover for refuse.

*Marshy soils*

The thin marshy deposits are less than one metre thick and consist largely of brown-black organic clay and silt.

Since it is likely that the two watercourses will either be piped beneath or diverted around the site, it will probably not be necessary to remove the marsh deposits before tip operations start; the marshes would in this manner receive leachate from above, but since they are topographically the lowest unit in the area drainage from them would eventually be collected in the leachate pond.

*Geological cross sections showing soil profiles*

All test pits are described in detail in Appendix 1 and the information has been used to construct the five cross-sections in Figure 3.

The sections mainly describe the various soil horizons already mentioned, but they also indicate the extent of Jurassic dolerite scree (note that this material overlies Tertiary sediments on the site's southern boundary), and the inferred positions of dolerite/Tertiary sediment contacts.

OCCURRENCE AND MOVEMENT OF GROUNDWATER AT THIS SITE

*Occurrence*

Both the dolerite and Tertiary sediments contain groundwater, and in each case the water is apparently confined beneath the clay (B) soil horizon.

Water issued from fissures in the CB horizons of test pits 1, 2, 3, 6, 7, 11, 15, 19, 20, 22, 32, and 33. After leaving the levels to stabilise, the final water levels were surveyed to indicate the potentiometric head of the confined groundwater (the absence of free water in some holes may only be apparent, and is probably the result of backhoe operations sealing water-bearing fissures and other defects. Note that most of the dolerite holes on the hillsides were dry). Confined water is assumed to exist continuously throughout the locality, although the test pits in dolerite were too shallow to intersect the potentiometric surface.

Figure 4 is a potentiometric contour map of the site. The contours (approximate, and in places inferred) indicate the level to which water would rise in bores or pits intersecting the groundwater body. Generally, the shape of this surface is a subdued replica of the land surface, so that the topographic and potentiometric contours have the same form. Swamps and marshes occur where the potentiometric surface coincides with or is approximately equal to the natural land surface.

*Movement*

It is apparent from Figure 4 that groundwater movement is towards the existing watercourses and that groundwater is therefore contributing to, and possibly causing, the marshy conditions along them. This conclusion is supported by the similarity of the surface water and groundwater salinities measured on site (of the order of 4000-6000 µS/cm, typical of Tertiary sediments).

Unconfined groundwater thus occurs in the marshes, and it is likely that the impermeable B horizon clay has not developed in at least parts of

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these areas. Access to the marsh was difficult by backhoe, but the results from test pit 19 support this. The possible absence of this confining layer beneath the swamps has implications for groundwater pollution (see below).

#### EASE OF EXCAVATION OF MATERIALS

Most of the site is underlain by materials readily excavable by backhoe or larger plant. However, the MF40 backhoe met refusal in extremely weathered dolerite in holes 4, 5, 21, and 31 and was close to refusal in similar material in holes 12, 13, and 14. Tertiary sediments are more easily excavable, but the MF40 (with 600 and 450 mm buckets) was close to refusal in weakly cemented sandstone in holes 16, 24, 25, 26, 27, and 28, and met refusal in a cemented ironstone horizon in hole 17.

Excavations for open drains will, of necessity, be dug near the perimeter of the landfill site, on slopes where dolerite cobbles and boulders occur. Generally these will be no problem, although in some isolated areas above about the 130 m level, large boulders (possibly *in situ*) may need blasting. However in most cases where boulders occur, weathered, excavable material exists beneath them.

#### AVAILABILITY OF FILL AT THE SITE

Regulations require that the refuse be covered daily with suitable fill. Some of this will be contributed by contractors in the normal course of operations, but it would be useful to obtain as much fill as possible from the site itself.

There are two possible on-site sources of fill:

- (a) the silty sand and sandy silt A soil horizon developed on the Tertiary sediments. This material, on average 0.3 m thick, occurs everywhere on the areas marked 'Tertiary' in Figure 2. Reserves are estimated at about 40 000 m<sup>3</sup> if the area inside the landfill limits were stripped.
- (b) An east-trending spur of Tertiary sediments occurring within the landfill limits (holes 23, 24, 25, and 26 were sited on this).

This spur is believed to be composed of Tertiary material, at least down to about the 180 m contour. Its surface layer consists of the sandy silt already discussed. Beneath this is a B horizon of stiff plastic clay which will be unsuitable as fill but could be stockpiled and used as an impermeable liner in open drains and leachate ponds. Underlying the B horizon are the CB and C horizons and unweathered Tertiary sediments. The stratigraphy of the sediments is unknown, but they probably consist of stiff sandy clay and clayey sand, and weakly cemented sandstone. Most of this should be rippable or excavable, and suitable as fill. If the material from this spur is considered a necessary requirement for filling operations, it would be wise to drill and core one exploratory hole to establish the stratigraphy of the sediments.

The potentiometric surface will be exposed during excavation of this spur, and this (together with the possible occurrence of clay in the sequence) may cause problems. To prevent leachate infiltration, this exposed excavated level will need to be adequately covered with impermeable, compacted clay before covering with refuse.

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CONCLUSIONS, DISCUSSION, AND RECOMMENDATIONS

*Potential for groundwater pollution*

This is potentially a major constraint on operations. However, infiltration of leachate to the underlying Tertiary sediments is considered unlikely and will be minimised if:

- (a) the silty sand A horizon is stripped and refuse dumped on the underlying impermeable clay B horizon.
- (b) this B horizon is not penetrated in excavations.
- (c) an adequate drainage system is installed.

Since parts of the area are forested with mature eucalypts which will need to be removed, the possibility exists for vertical leachate infiltration through root openings as the root system rots in the ground (many large roots, if left, will eventually provide open passages through the impermeable layer). To prevent this, it may be necessary to burn and grub out stumps and then pack the resulting holes with compacted clay. This step is not a definite recommendation and may only need to be implemented in certain obvious cases.

*Provision for adequate drainage*

The proposed system of open drains drawn up by the Council and shown on Figure 4 are considered adequate. The drains should be excavated to the B soil horizon, or lined with impermeable clay if this is impracticable.

However, consideration should be given to altering the system of stormwater pipes. The Hobart City Council's experience at the McRobies Gully landfill site in Hobart has shown that the provision of large diameter strengthened concrete pipes (to withstand overburden pressures)\* is a major and possibly unnecessary expense (present costs are about \$1000/metre).

An alternative suggestion is to divert all the water from the two watercourses into the system of open drains. For example, in the initial stages of filling, the open drain 'A' on Figure 4 could be extended to A to divert the creek. On completion, the open drain 'B' could similarly be extended to B. This would eliminate the need for the adjacent stormwater pipe. In this way, all natural drainage would be diverted around the site.

Under either system of stormwater drainage, ponding of possibly polluted water will still occur behind the rising face of the landfill because of; (a) the small amounts of natural runoff from adjacent fill and undrained areas, and (b) the probable groundwater seepage to the marshes, especially after wet periods. It would be judicious to assume, however unlikely, that some of this groundwater will also be polluted. It is recommended, therefore, that this marshy area be drained by a small diameter (perhaps 300-400 mm) pipe beneath the site to discharge to the leachate pond.

Under this system; (a) all unpolluted surface drainage will bypass the site altogether, (b) possibly polluted water dammed behind the fill will

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\* Another disadvantage of large stormwater drains is their tendency to crack. This has occurred at McRobies Gully where it is now necessary to top off leachate in times of low flow to the leachate pond.

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discharge to the leachate pond, and (c) seepage of leachate from the face of the landfill will discharge to the proposed french drain and leachate pond.

#### *The leachate pond*

Test pits 33 and 34 indicate that impermeable clay (B horizon) developed on both dolerite and Tertiary sediments underlies about 0.5 m of clayey and sandy silt. This top horizon should be removed and the underlying clay not penetrated, as the sediments beneath are saturated and more permeable.

Provided these precautions are undertaken, no problems are envisaged. If the pond needs to be deeper than the two or three metres geologically permitted, consideration should be given to moving the site further downstream (and thus also trapping any shallow groundwater now moving eastwards through the south-west corner of the site and not able to be diverted to drains), or excavating deeper and lining the floor with clay, concrete or other suitable material (deep excavations here may expose the contact between the dolerite and Tertiary sediments).

#### *General recommendations*

- (a) The site is considered feasible from a geological viewpoint. The likelihood of groundwater pollution is minimal provided the precautions mentioned above are followed.
- (b) A systematic sampling procedure should be adopted to determine variations in surface water qualities before the site is used, and water and leachate qualities should be monitored on a frequent, regular basis. Initially, sampling should be done perhaps monthly, but only pollutant indicators may need to be determined.
- (c) The presence or absence of an impermeable clay B horizon should be established beneath the marshes. If this is absent, consideration should be given to stripping the marshy soil (if necessary) and covering with compacted clay. This aspect is not considered a restraint on operations and can be investigated as filling progresses.
- (d) Consideration should be given to monitoring groundwater qualities on a long term basis. This would involve the installation of properly designed piezometers or observation bores at selected sites, and to determine background levels this would need to be done some time before operations begin. In the unlikely event of groundwater pollution, properly located piezometers would detect pollutants early enough so that damage is minimal and remedial measures most effective.
- (e) Depending on the availability of fill from outside the site, it would be useful to drill the spur of Tertiary sediments to establish the sequence of material beneath the soil profile. One cored diamond hole is envisaged.

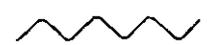
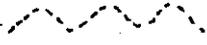
[24 August 1981]

APPENDIX 1

Engineering geology logs of backhoe test pits

The logs should be read in conjunction with the accompanying 'Explanation sheet for engineering logs'. Additional explanations for abbreviations not included on the printed sheet are defined below:

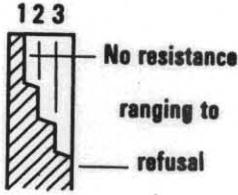
- Colour* most descriptive colours in the 'materials' column are followed by a classification code. In such cases, both the colour name and its corresponding code are from the 'Revised Standard Soil Colour Charts, 1967'. Where no code follows a colour, the colour has been visually estimated.
- Grain size* VF, F, M, C refer to sand in the very fine, fine, medium, and coarse grained size ranges. Field estimated.
- Sorting* WS, MS, PS describe well-sorted, moderately-sorted, and poorly-sorted granular material (mainly sand range). Field estimated.
- Soil description* O, A, E, B, CB, C and their various suffixes refer to various soil horizons, already described in the report. Pedal and apedal refer to soil structure. Pedal indicates the soil has a tendency to fracture along regularly spaced surfaces of weakness to produce regular soil units called peds. Apedal soils are massive and uniform. Boundaries between soil horizons are indicated in the structure column, and may be;

- regular and sharp 
- regular and gradational 
- irregular and sharp 
- irregular and gradational 

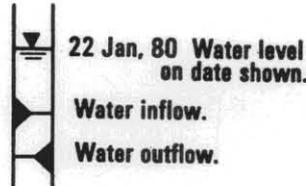
# EXPLANATION SHEET FOR ENGINEERING LOGS

## 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.    |                         |

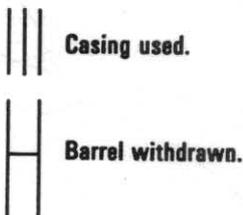
Notes: X on log is test result  
— is range of results.

### Density index

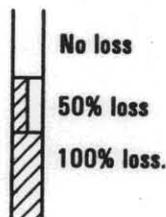
- |    |               | %        |
|----|---------------|----------|
| VL | Very loose.   | 0 - 15   |
| L  | Loose.        | 15 - 35  |
| MD | Medium dense. | 35 - 65  |
| D  | Dense.        | 65 - 85  |
| VD | Very Dense    | 85 - 100 |

## Cored borehole log

### Case - lift



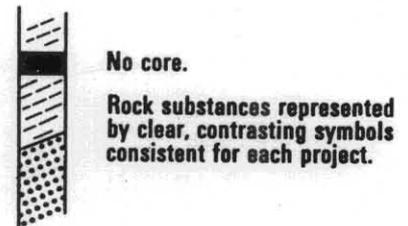
### Fluid loss



### Lugeons

Lugeon units ( $\mu L$ ) 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  $1 \times 10^{-4}$  mm/sec.

### Graphic log



### Weathering

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

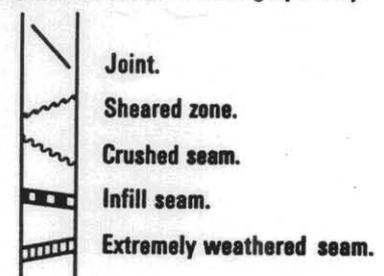
### Strength

- |    |                 | point load strength index $I_s (50)$ (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.

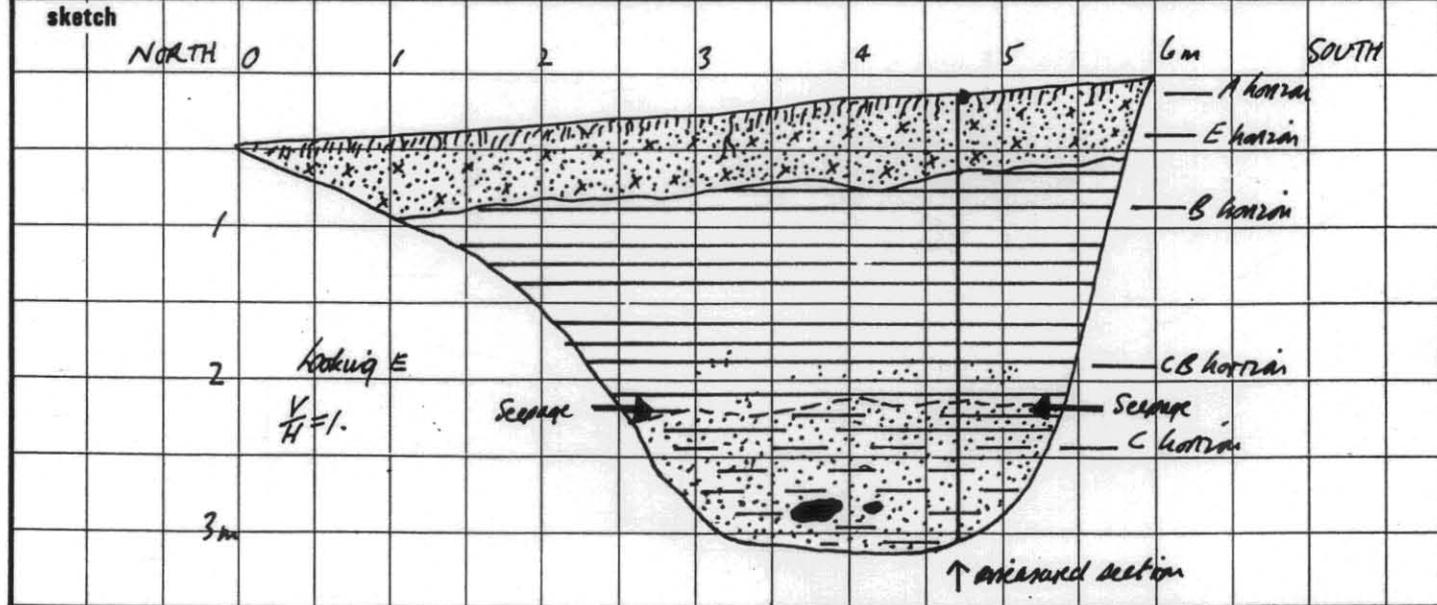


# ENGINEERING LOG - EXCAVATION

excavation no. 1 / 13  
sheet 1 of 1 / 49

project **PROSPECT TIP** location \_\_\_\_\_  
 co-ordinates **405678m N** exposure type **Backhoe pit** pit commenced **13.5.81**  
**311914m E** equipment **MF 40; 600mm bucket** pit completed **13.5.81**  
 R.L. **113.4m** operator **T. H. Cooper** logged by **W. Cooper**  
 excavation dimensions **6m x 2.9m x 0.6m** checked by \_\_\_\_\_

penetration 1 2 3	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 penetr- ometer kPa	structure, geology
			0	SM	Silty SAND, dark brown (10YR 3/3) grading to dull yellowish brown (10YR 5/3), F-VF, MS-PS, with trace fine roots, charcoal, angular limonite fragments (up to 25mm). Apedal.	M	L		A and E horizons
			1	CH	CLAY, in places sandy CLAY, yellowish brown (10YR 5/6) with mottles and streaks of yellowish brown (2.5Y 5/4). Trace sand, and taraxacum base patches of grey blue clayey sand. Trace charcoal, and limonite fragments (up to 20mm). High plasticity, apedal.	M < PI	VSt to St		B horizon grading to CB horizon
			2	SC to CH	Sandy CLAY, grading at 2.1m to clayey sand, with patches of sandy clay (grey blue streaked with orange brown). Some irregular patches of loose angular limonite (up to 200mm). Occasional patches of slightly clayey sand 2.7-2.8m, PS, with trace dark minerals.	W	VSt to L		C horizon
			3		Hole stopped at required depth, 2.9m				Soil profile developed on weakly cemented Tertiary sediments (probably mainly sandstone)



# ENGINEERING LOG - EXCAVATION

project **PROSPECT TIP** location **5m south of creek bed.**

co-ordinates **4056954N**  
**311924mE**

R.L. **111.5m**

excavation dimensions **6.2 x 2.8m x 0.6m**

exposure type **Backhoe pit**

equipment **MFAO; 600mm bucket**

operator **T.H. Cooper**

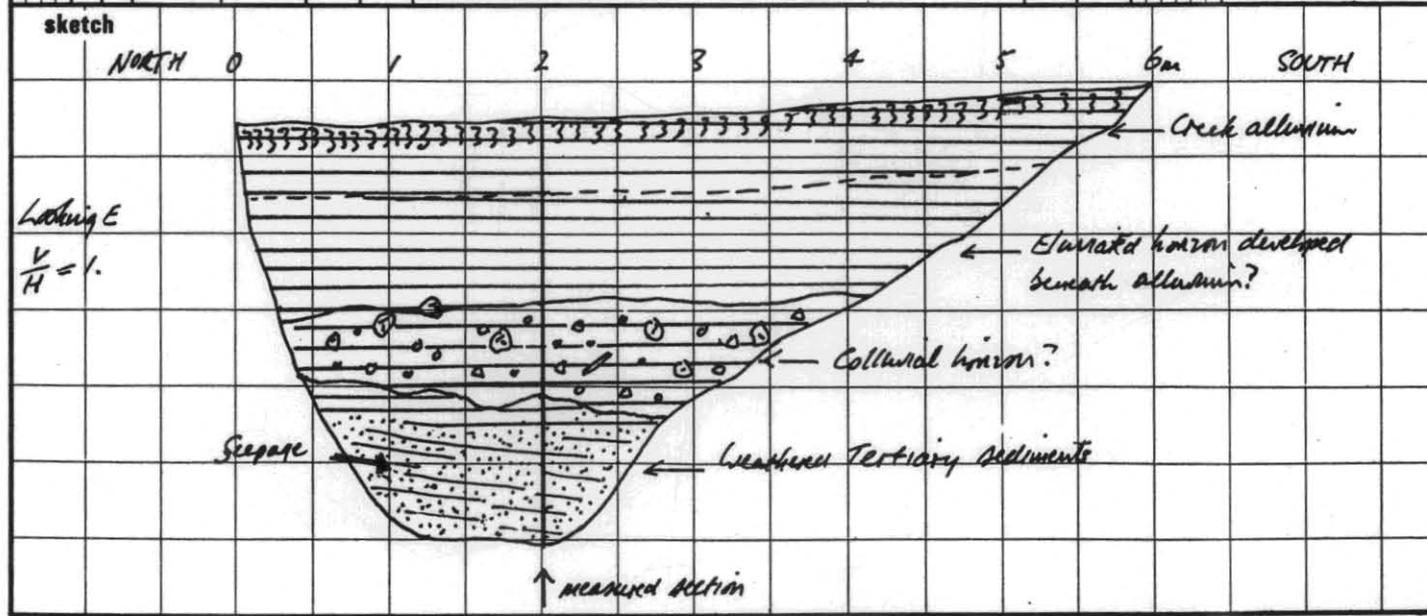
pit commenced **13.5.81**

pit completed **13.5.81**

logged by **W. Cooper**

checked by

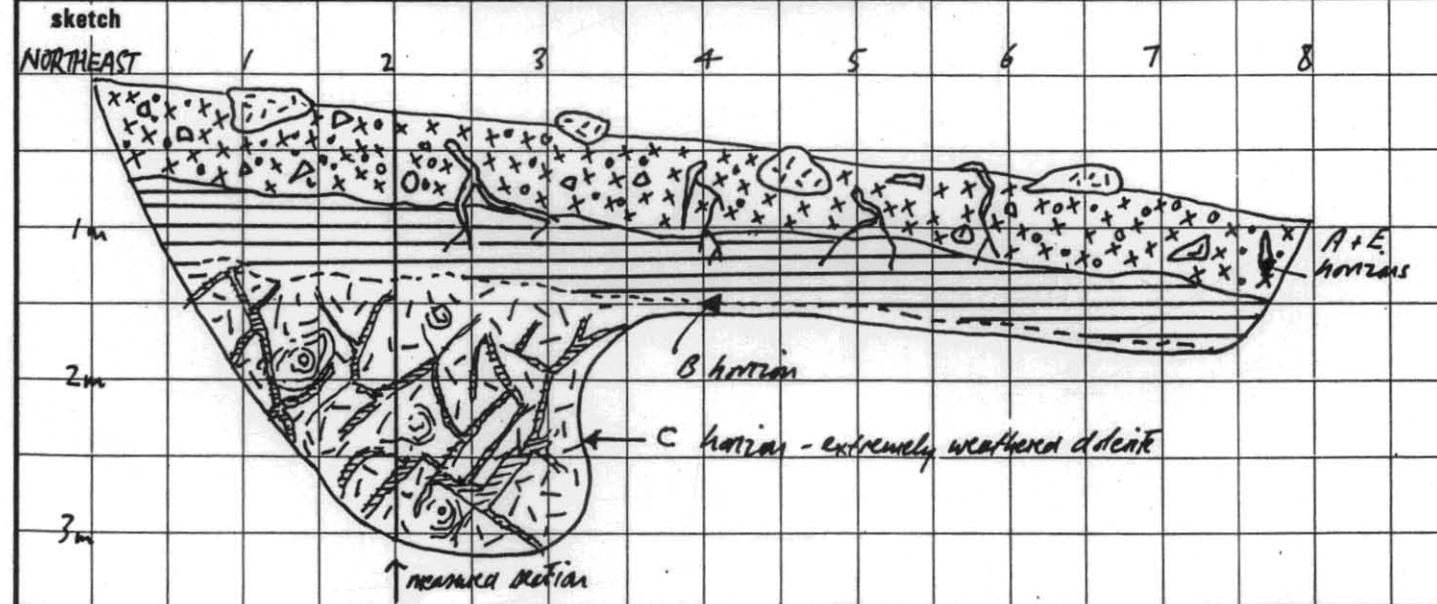
penetration	support	water	notes samples, tests	metres R.L. depth	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour secondary and minor components	moisture condition	consistency density index	hand penetrometer kPa	structure, geology
1 2 3										25 50 100 200 400	
				1		CH	CLAY, brownish black (10A12/3), mottled with yellowish brown. Pedal 0-0.2m; many fine roots. Trace limonite fragments (up to 5mm); compact, massive + apedal in places. High plasticity; peds 0-0.2 large, with open fractures.	M < PI	L to VSt		Alluvium
				1		CH	CLAY, mottled olive brown (2.5Y4/3) - greyish blue (5Y4/2) brown (10A4/6) and grey-blue. High plasticity, apedal, trace black MnO <sub>2</sub> ? patches, fine sand, and limonite fragments (up to 5mm)	M > PI	VSt		Eluviated horizon in alluvium?
				2		GC	Gravelly CLAY and clayey GRAVEL; mottled as above, partly rooted, high plasticity; matrix, with pebbles and cobbles of angular-sub rounded coarse grained dolerite (up to 100mm), and platy, low sphericity limonite fragments (up to 100mm but generally < 5mm), and occasional lenses and patches of clayey sand. Finer gravel mainly limonitic. Horizon dips S.				Weathered Tertiary sediments
				3		CH to SC	CLAY, sandy CLAY and clayey SAND. Clay 2.6-2.7. Between 1.8-2.1m, mainly grey-blue mottled as above. Below 2.1m, mainly lenses (dip 10-20° to 180° apparent) of alternating grey-blue sandy clay, grey clay and yellowish brown (10A5/8) clayey F sand, with some irregular small limonite patches. Clay high plasticity. Hole stopped at required depth, 2.8m.				



# ENGINEERING LOG - EXCAVATION

project <b>PROSPECT TIP</b>	location
co-ordinates <b>405724m N 311928m E</b>	exposure type <b>Backhoe pit</b>
R.L. <b>113.4m</b>	equipment <b>MF 40; 600mm bucket</b>
excavation dimensions <b>8m x 2.7m x 0.6m</b>	operator <b>T.H. Cooper</b>
	pit commenced <b>13.5.81</b>
	pit completed <b>13.5.81</b>
	logged by <b>W. Cooper</b>
	checked by

penetration 1 2 3	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 penetr- ometer kPa	structure, geology
		Water conductivity = 6500 µS/cm	1		ML to GM	<b>SILT and gravelly SILT</b> , dark brown (10YR3/4) 0-0.1 dual yellow orange (10YR6/3) 0.1-0.3m; pedal; pede have high dry strength; many roots; in places up to 15% fine gravelly limonite (and occasional platy limonite up to 50mm). Some angular medium - coarse grained slightly weathered dolerite cobbles (up to 200mm), occasional boulders on surface (up to 600mm)	D to M	Fb to VSt		A and E horizons
		Seepage est. 10L/hr.	2		CL to CH	<b>CLAY</b> , mainly brown (7.5Y4/4), mottled and streaked in places with greyish blue (5Y5/2); in places flecked with fine cream spots (dolerite texture?). Occasional large roots and patches of limonite fragments	M to PI	VSt to Sf	> 450	B horizon
			3		DL	<b>DOLERITE</b> , extremely weathered, mottled and streaked as above, with relic texture. Medium - coarse grained irregularly fractured with sub-horizontal and sub-vertical weathering seams of grey-blue high plasticity clay. Seams also marked by fine roots and MnO <sub>2</sub> ? staining. Occasional harder mottled yellowish brown (10YR5/8) brown and greyish blue extremely weathered dolerite cores. Some clay seams sheared, and some show minor depressions.	> PI in seam	Sf on seams		C horizon
<p>Soil profile developed on Jurassic dolerite</p> <p>Hole stopped at required depth, 2.7m, in extremely weathered Jurassic dolerite</p>										



# ENGINEERING LOG - EXCAVATION

project **PROSPECT TIP** location

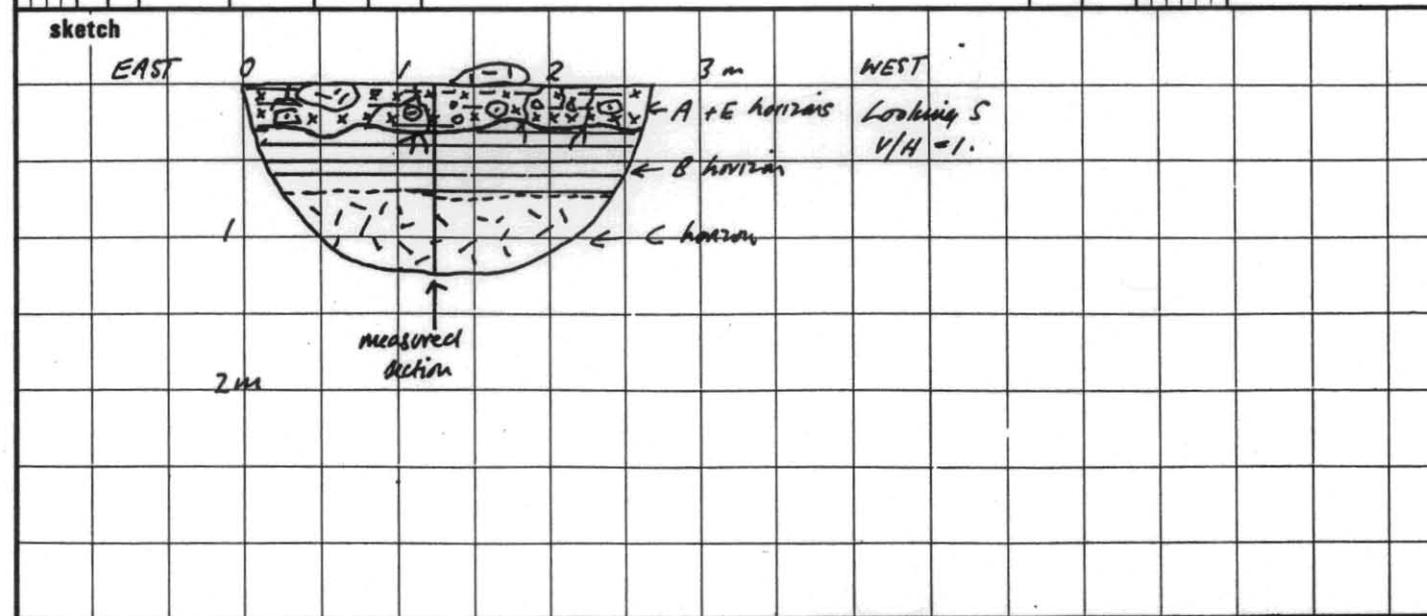
co-ordinates **405760mN**  
**311924mE** exposure type **Backhoe pit**

R.L. **118.0m** equipment **MF 40** pit commenced **13.5.81**

excavation dimensions **2.7m x 1.2m x 0.6m** operator **T.H. Cooper** pit completed **13.5.81**

logged by **W. Conner**  
checked by

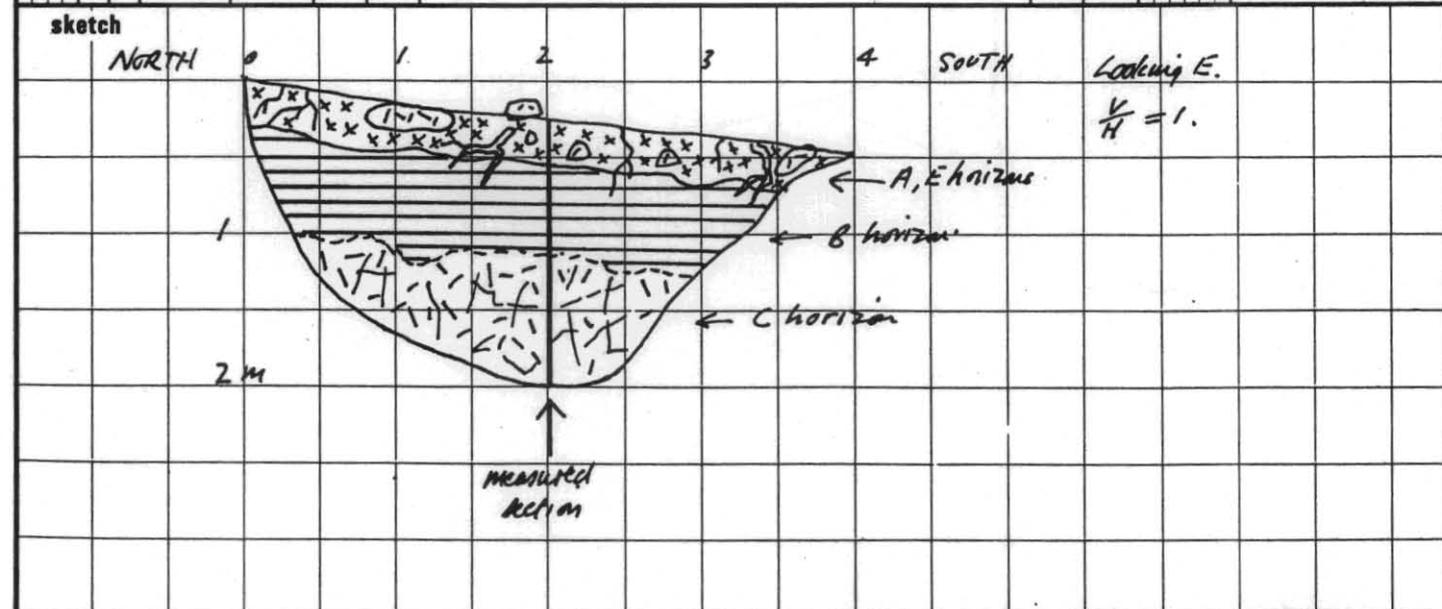
penetration	support	water	notes samples, tests	metres R.L. depth	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour secondary and minor components	moisture condition	consistency density index	hand penetrometer kPa	structure, geology
1 2 3										25 50 100 200 400	
		NOT ENCOUNTERED		1		ML + CL	SILT and clayey SILT, dark brown (10YR3/4) grading to dull yellow brown (10YR5/4), with many root fibres and roots. Trace fine limonite gravel and charcoal. Some angular to sub-angular coarse grained detrital cobbles (up to 100mm), and occasional boulders (up to 1m). Pit adjacent to detrital in situ? Pedal.	M-D M PI D M	L VST	7450	A horizon B horizon C horizon
				2		CH CL	CLAY, yellowish brown (10YR5/6), flecked with fine cream spots, and in places possibly a detrital texture. Trace root fibres and limonite and MnO <sub>2</sub> ? patches				Soil profile developed on detrital
							DOLERITE, extremely weathered, to highly weathered at base; textured medium - coarse grained, mottled olive brown and greyish blue; breaks into small irregular weakly cemented irregular blocks along thin fractures				
							Backhoe refusal in highly weathered detrital at 1.2m				



# ENGINEERING LOG - EXCAVATION

project <b>PROSPECT TIP</b>	location
co-ordinates <b>405824m N 311924m E</b>	exposure type <b>Backhoe pit</b>
R.L. <b>128.5m</b>	equipment <b>MF40; 600mm bucket</b>
excavation dimensions <b>4m x 1.7m x 0.6m</b>	operator <b>T. A. Cooper</b>
	pit commenced <b>13.5.81</b> pit completed <b>13.5.81</b> logged by <b>W. Crower</b> checked by

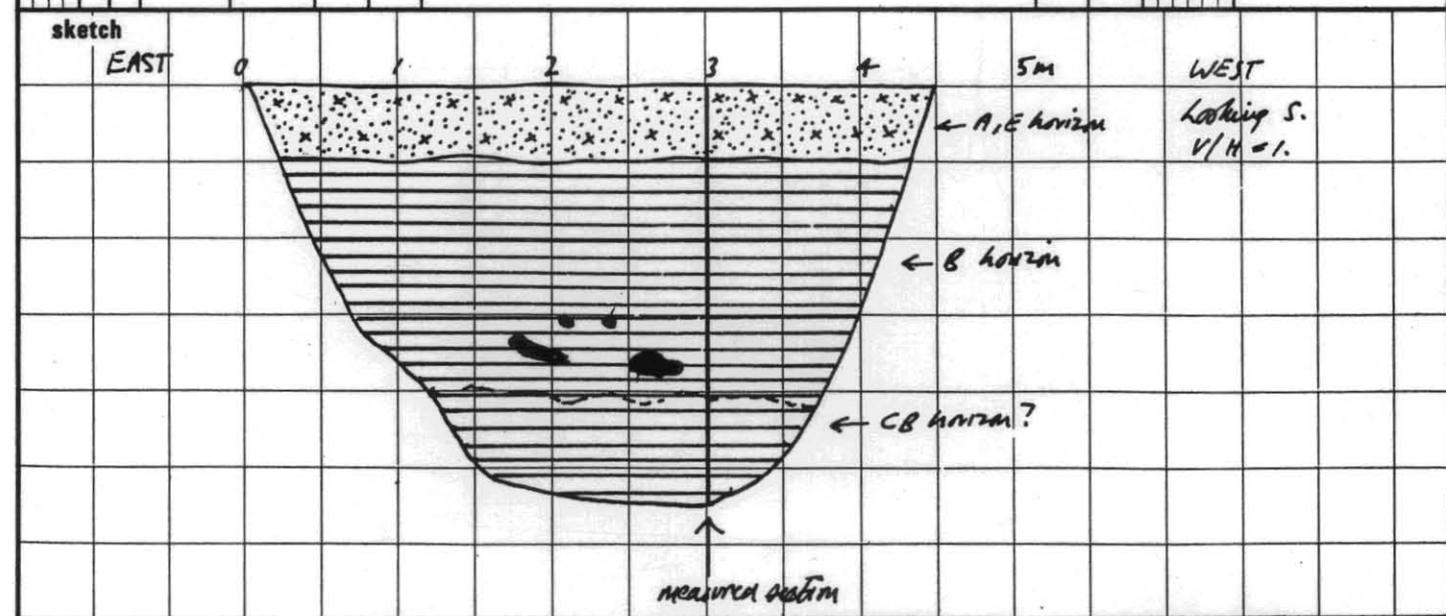
penetration 1 2 3	support water	notes samples, tests	metres R.L. depth	graphic log classification symbol	material soil type: plasticity or particle characteristics, colour secondary and minor components	moisture condition	consistency density index	hand penetr- ometer kPa	structure, geology
	NOT ENCOUNTERED		0	ML	SILT, dark brown (10YR 3/3) grading to brown (10YR 4/4); many roots and fibres; trace charcoal. Occasional angular slightly weathered d drite boulder (up to 300mm)	M-D	F-S		A, E horizons
			1	CH	CLAY, dark brown (10YR 3/4) flecked with very fine cream sand sized fragments. Trace fine roots and fine limonite gravel. High plasticity	M	H	>450	B horizon
			2		DOLERITE, extremely-highly weathered, yellowish brown (10YR 5/8), medium-coarse grained; irregularly fractured; fractures thin, closed; clay lined in places  Backhoe refusal at 1.7m in extremely-highly weathered d drite				Soil profile developed on d drite



# ENGINEERING LOG - EXCAVATION

project <b>PROSPECT TIP</b>	location
co-ordinates <b>405626m N 311927m E</b>	exposure type <b>Backhoe pit</b>
R.L. <b>115.4m</b>	equipment <b>MF 40, 600mm bucket</b>
excavation dimensions <b>4.5m x 2.7m x 0.6m</b>	operator <b>T. H. Cooper</b>
	pit commenced <b>13.5.81</b>
	pit completed <b>13.5.81</b>
	logged by <b>W. Corner</b>
	checked by

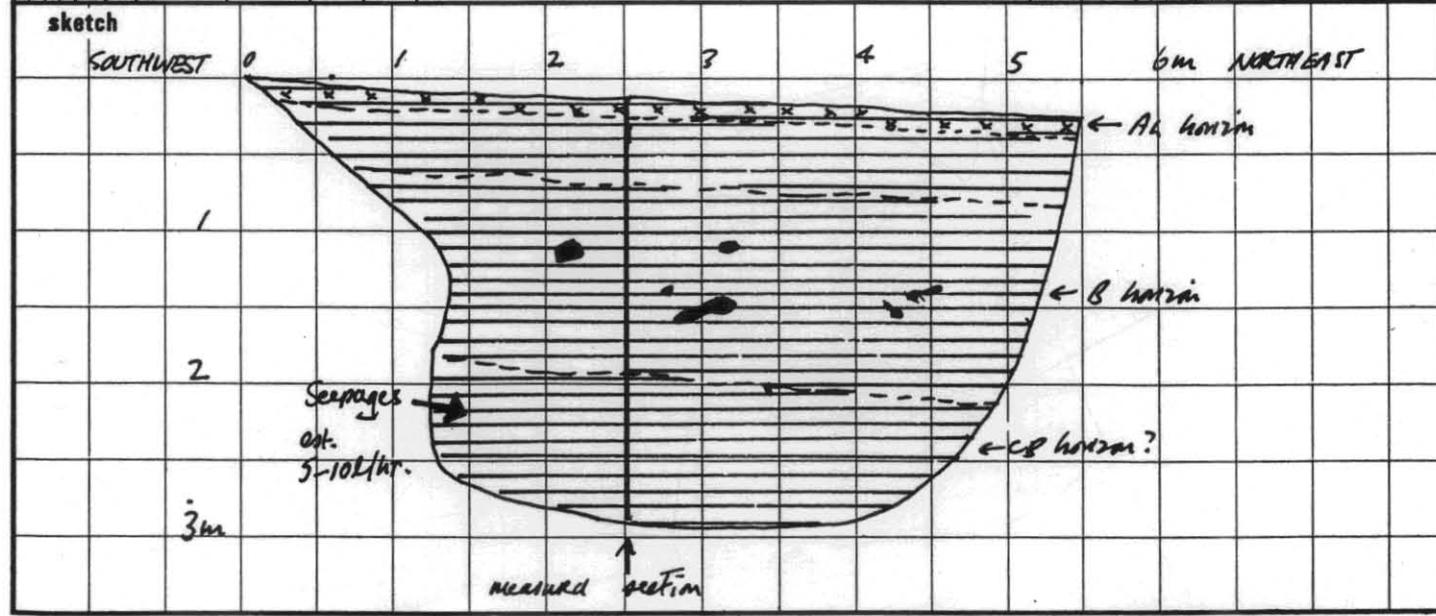
penetration 1 2 3	support water	notes samples, tests	metres R.L. depth	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour secondary and minor components	moisture condition	consistency density index	hand penetr- ometer kPa	structure, geology
			0-0.1m	SP to SM		Silty SAND, dark brown (10YR 3/3) 0-0.1m, grading to greyish yellow brown and below 0.3m light brownish grey (7.5YR 7/1). Mottled brown (10YR 4/4) and 10YR 4/6 between 0.4-0.5m. Sand VF-F, MS; upper parts trace organics with many fine roots. Below 0.1m weakly consolidated. Apedal	M to MD	L to MD		A+E horizons
			0.4-0.5m				M to PI	H, Vst	> 450	B horizon
		Seepage est. at 20 L/hr.	1.8-2.6m	CH		CLAY, mottled, streaked greyish blue, yellowish brown (10YR 5/6), dark greyish yellow (2.5Y 5/2); occasional irregular patches of ferruginous bright brown (7.5YR 5/8) in places friable clayey sand and sandy clay. Clay generally has trace F sand; some irregular fracture surfaces with many root fibres, and occasional irregular aggregates of limonitic material (up to 300µm). Below 1.8m, mainly grey-blue high plasticity clay with large irregular patches of red (10R 4/6) clay. Patches of sandy clay at 2.6m.	M to PI			C horizon?
			2.7m			Hole stopped at required depth, 2.7m				Silt profile developed on Tertiary sediments



# ENGINEERING LOG - EXCAVATION

project <i>PROSPECT TIP</i>	location
co-ordinates <i>405562mN 311931mE</i>	exposure type <i>Backhoe pit</i>
R.L. <i>113.3m</i>	equipment <i>MF 40, 600mm bucket</i>
excavation dimensions <i>5.5m x 2.7m x 0.6m</i>	operator <i>T. H. Cooper</i>
	pit commenced <i>13.5.81</i> pit completed <i>13.5.81</i> logged by <i>W. Cooper</i> checked by

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		
				FKK	CL to CH	<i>Silty CHAY, brownish black (104R213), many root fibres, moderate plasticity, grading at 0.2m to CHAY, mottled brownish black (104R212) and bright yellowish brown (104R618). Pedal; peds irregular, up to 50mm. Some limonite fragments (&lt; 2mm) and trace limonite up to 20mm.</i>	W M PI	Fb H		Ah horizon B horizon
		D	1		CH	<i>CLAY, mainly olive brown (2.5Y4/6) with grey (5Y5/1) and yellowish brown (104R5/6). High plasticity; trace fine sand; occasional irregular patches of fragmented <del>concretionary</del> limonite (up to 100mm) near 1m. 1.5-1.9m some sandy clay-clayey sand patches with seepages. Apedal</i>	M L V PI	Vst		B horizon
		D	2		CH	<i>CLAY, yellow orange (104R7/8) and grey; high plasticity; apedal</i>	Variable M PI	St		CB horizon?
		D	3		CH	<i>Hole stopped at required depth, 2.7m in Tertiary sediments</i>				Soil profile developed on Tertiary sediments

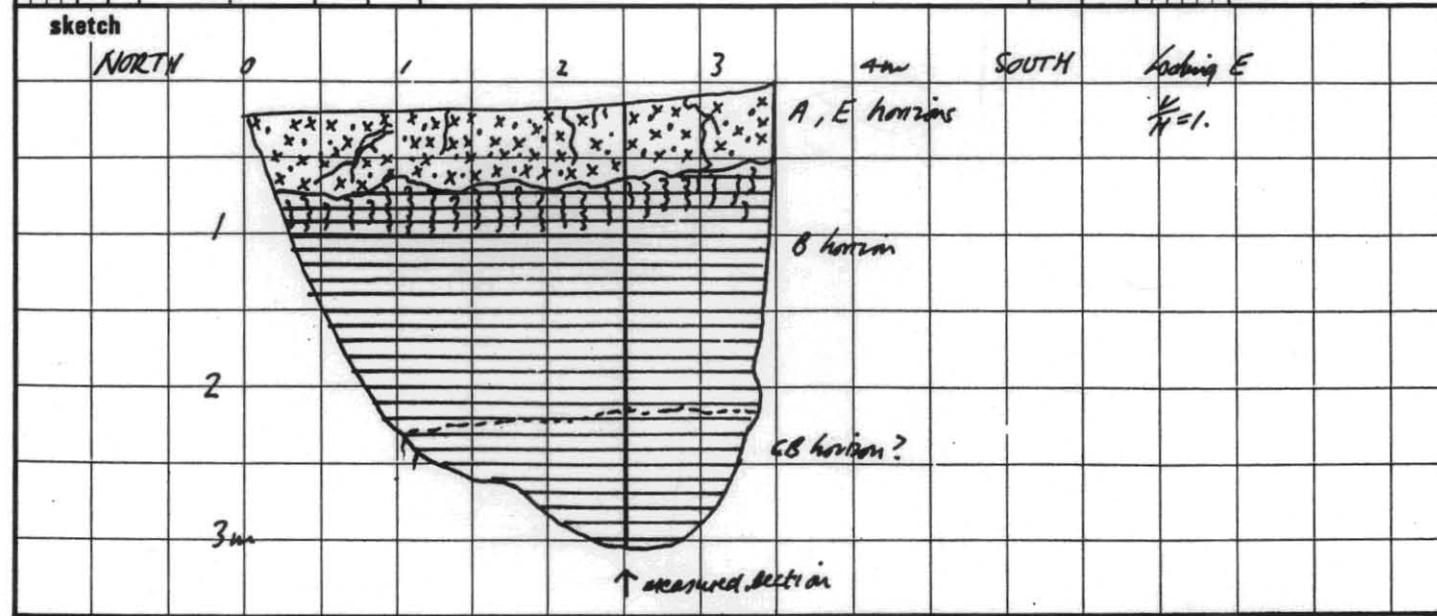


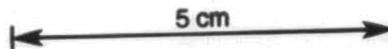
# ENGINEERING LOG - EXCAVATION

project **PROSPECT TIP** location

co-ordinates **4055134N  
311934E** exposure type **Backhoe pit** pit commenced **14.5.81**  
R.L. **115.2m** equipment **MF 40; 400mm bucket** pit completed **14.5.81**  
excavation dimensions **3.5m x 2.9m x 0.9m** operator **K. Bradford** logged by **W. Corner**  
checked by

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	
				1	xxx xxx xxx	ML	Silt, brown (10YR4/4) flecked with orange brown; grades to dull yellow orange (10YR7/2) at 0.2m. Many root fibres and trace fine limonite gravel. Apedal.	D	H, St	> 450	A, E horizon
				2		CH	CLAY, mottled brown (10YR4/6), dark brown (10YR3/3) High plasticity; pedal at top; mottled irregular, with many root fibres on ped surfaces. Trace fine sand in places, and some irregular grey-blue extremely weathered clay clumps. Below 1.2m, clay also with fine brown (2.5Y4/6) streaks. Below 2m mainly grey-blue CH clay with pockets and patches of (2.5Y6/4) dull yellow and bright yellowish brown (10YR6/8) flecked with brownish black. Trace silty clay? in places.	M ≥ PI	St to VSt	> 450	B horizon  CB horizon?
				3			Hide stopped at required depth, 2.9m				Soil profile developed on Tertiary sediments





# ENGINEERING LOG - EXCAVATION

excavation no. **9**  
sheet 1 of 1

2/49

project **PROSPECT TIP** location

co-ordinates **405466 m N**  
**311936 m E**

R.L. **118.5m**

excavation dimensions **4.7m x 2.9m x (0.4-0.9m)**

exposure type **Backhoe pit**

equipment **MF 40; 400mm bucket**

operator **K. Bradford**

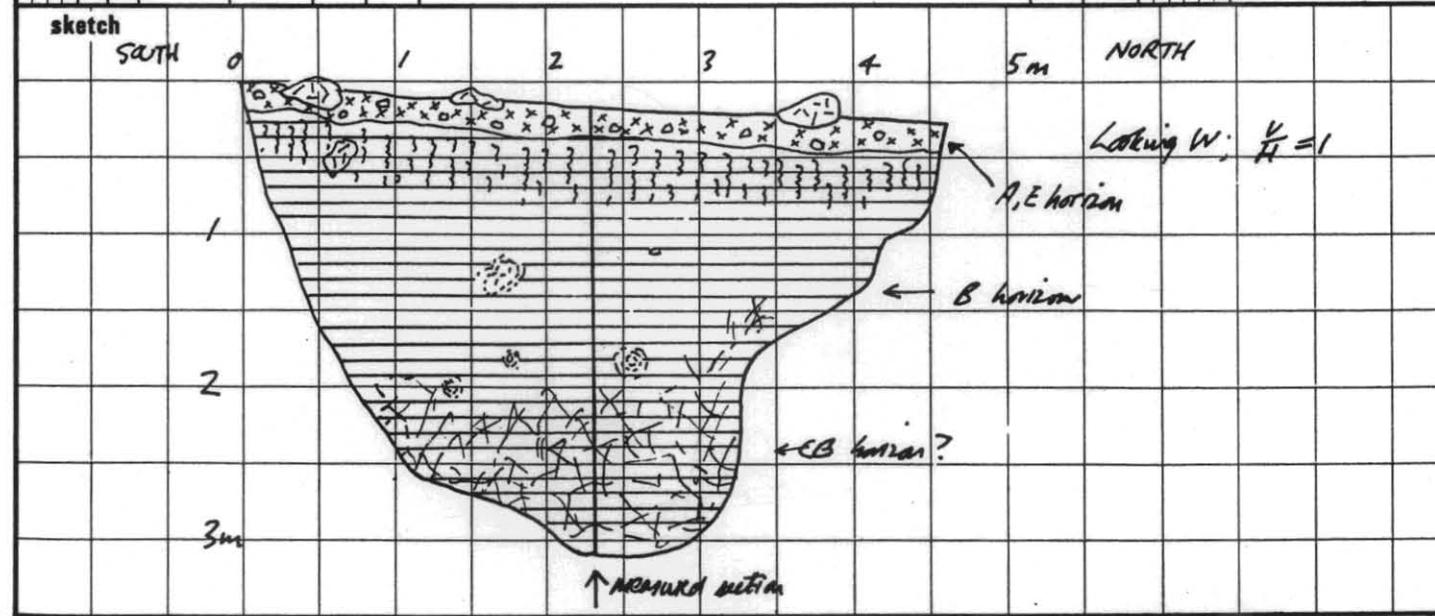
pit commenced **14.5.81**

pit completed **14.5.81**

logged by **W. Connor**

checked by

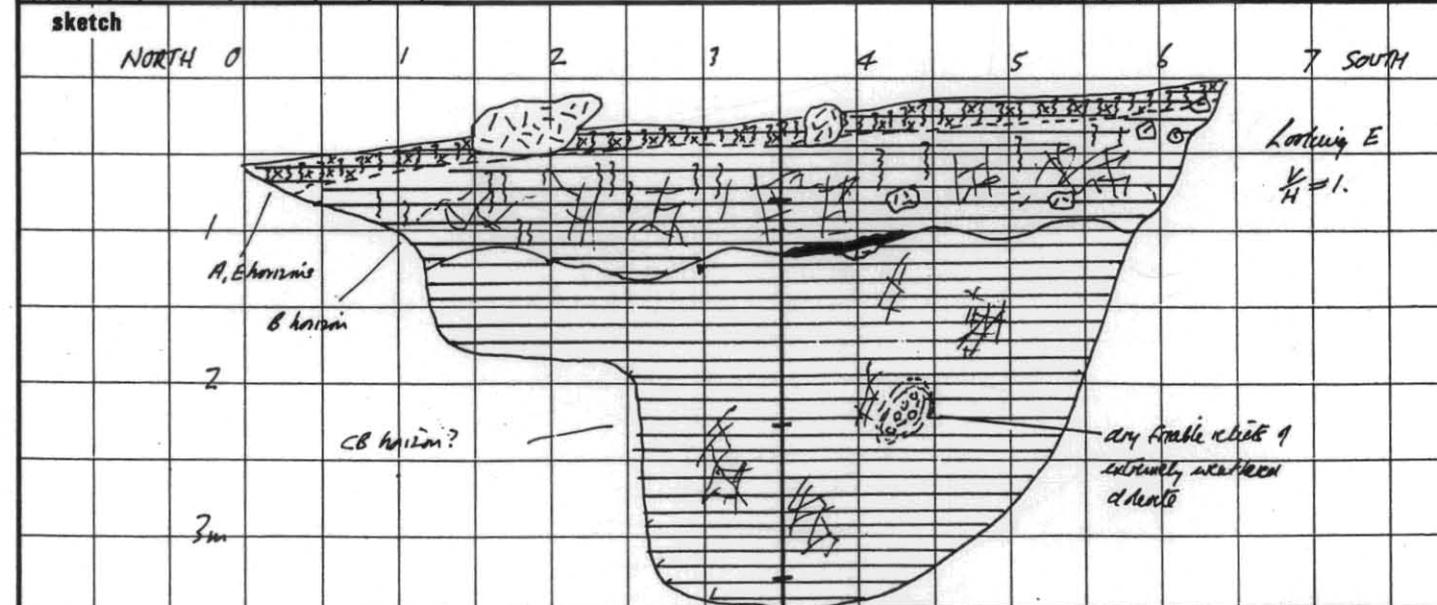
penetration 1 2 3	support water	notes samples, tests	metres R.L. depth	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour secondary and minor components	moisture condition	consistency density index	hand penetr- ometer kPa	structure, geology
			1		ML	SILT, dark brown (10YR3/5); many roots and root fibres, trace VF sand, area grading to greyish yellow brown (10YR5/2). Sparingly silt with limonite fragments. Occasional slightly weathered cobbles and bands of debris (up to 60mm)	D	FB		A, E horizon
			2		CH + CL	CLAY, brown (10YR4/4) and dull yellowish brown (10YR5/4); high plasticity, irregularly fractured in places. Occasional slightly - extremely weathered medium grained cobbles & debris (up to 75mm). Irregularly pedal to 1m, with many root fibres, with trace fine limonitic gravel and lime patches. Below 1.5m, mainly yellowish brown (10YR5/6) and (2.5Y5/4). Below 1.2-1.5m, clay irregularly fractured, blocky; fractures closely spaced, thin.	M < PI	VSP to H		B horizon
			3			Hide stopped at required depth, 2.9m				CB horizon?
										Soil profile developed on Jurassic dolerite



# ENGINEERING LOG - EXCAVATION

project <b>PROSPECT TIP</b>	location
co-ordinates <b>405420m N 311937m E</b>	exposure type <b>Backhoe pit</b> equipment <b>MF40, 400mm bucket</b>
R.L. <b>124.1m</b> excavation dimensions <b>6.4m x 3.2m x 0.8m</b>	operator <b>K. Bradford</b> pit commenced <b>14.5.81</b> pit completed <b>14.5.81</b> logged by <b>W. Crocker</b> checked by

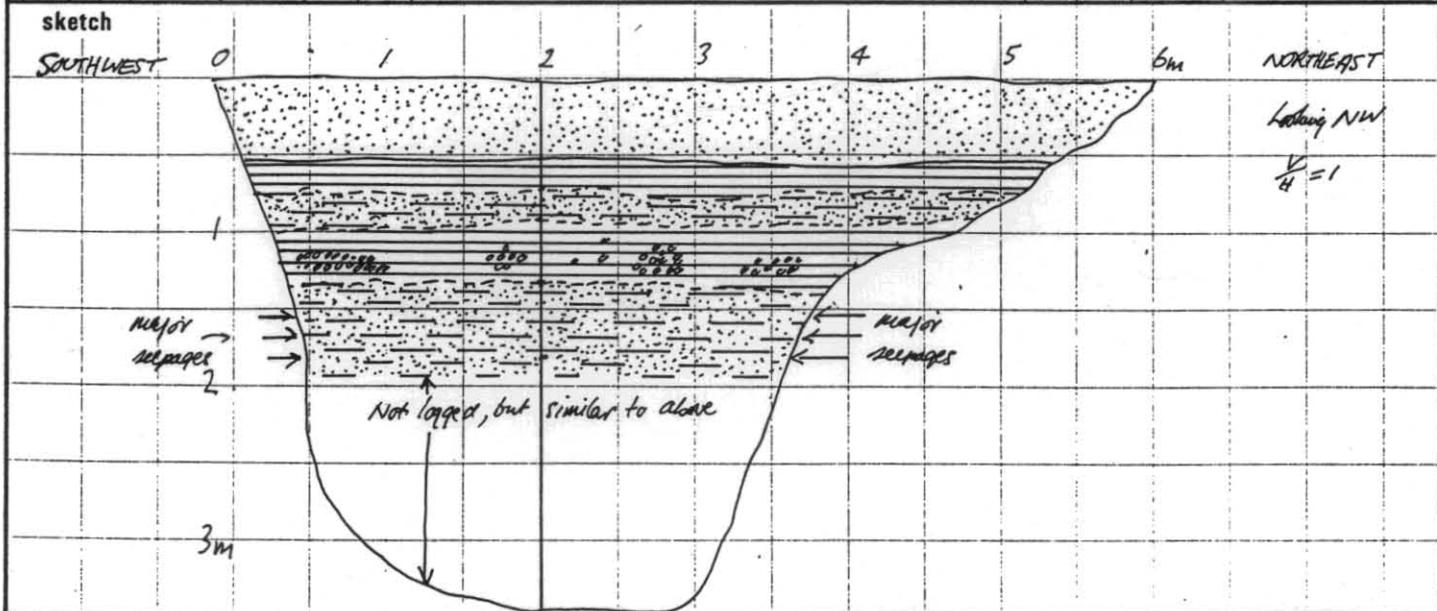
penetration 1 2 3	support water	notes samples, tests	metres R.L. depth	graphic log classification symbol	material soil type: plasticity or particle characteristics, colour secondary and minor components	moisture condition	consistency density index	hand penetr- ometer kPa	structure, geology
			1	CL	Silty CLAY, dark brown (7.5YR7/3), with many roots and root fibres, in places brownish black (7.5YR2/2); pedal, with pedis up to 40mm irregular. Trace of charcoal and fine limonite gravel. Occasional subangular to subrounded medium grained detritic cobbles and boulders mainly < 30mm but up to 1m.	D	FB		A, E horizon
			2	CH to GC	CLAY, brown (10YR4/4), flecked in places with trace of VF-F sand, and occasional slightly weathered medium grained detritic cobbles (up to 30mm). Pedal in places; occasional roots. Near base, yellowish brown (10YR5/8) and cream clayey gravel and gravelly clay with fine limonite fragments and blue staining. Occasional cream lime aggregates (possibly extremely weathered detritic).	M < PI	H		B horizon
			3	CH	CLAY, yellowish grey (2.5Y5/1) with occasional cream patches as above, with irregular streaks and patches of yellowish brown (10YR5/6) and dull yellowish brown (10YR5/4). Generally massive, apedal, in places irregularly fractured with some root fibres on fracture surfaces. Occasional irregular patches of white brown extremely weathered, textured detritic.	M ~ PI	VSt to H	7450 to base	B horizon ↓ CB horizon?
					Hole stopped at required depth, 3.2m.				Soil profile developed on Jurassic detritic



# ENGINEERING LOG - EXCAVATION

project <i>PROSPECT TIP</i>	location
co-ordinates <i>405747mN 311936mE</i>	exposure type <i>Backhoe pit</i>
R.L. <i>112.7m</i>	equipment <i>MF40, 400mm bucket</i>
excavation dimensions <i>6m x 3.4m x 0.9m</i>	operator <i>K. Bradford</i>
	pit commenced <i>14.5.81</i> pit completed <i>14.5.81</i> logged by <i>W. Corner</i> checked by

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		
			Seepage est. 450 l/hr 1.5-1.8m	1	SP		SAND, brown (10YR4/14), F, WS, with sub-angular to sub-rounded quartz, quartzite and trace rock fragments; grades to yellowish brown (2.5Y5/4) with trace fines increasing near 0.5m. In places, yellowish brown (10YR5/8) with occasional small patches of greyish yellow brown (10YR6/4) clay.	M	L			Possibly washed from adjacent road. B horizon? CB horizon CB horizon?	
				2	CH		CLAY, mottled and streaked brownish grey (10YR4/1) and brown (10YR4/6), high plasticity, with trace sand, root fibres and wood fragments.	M > PI	St				
				3	CH to CL	NOT LOGGED.	Clayey SAND, mainly yellowish brown (10YR5/8) with grey clayey sand in sub-vertical irregular sealed fractures. Trace limonite fragments up to 10mm.	M	St to Vst				
							CLAY, in places gravelly CLAY, mainly grey blue and yellowish brown (10YR5/8); low-high plasticity. Gravelly clay consists of detrital and limonite fragments in sandy clay matrix. Trace roots. between 1.1-1.3m, mainly grey-blue CH clay.						
							Clayey SAND and SAND, yellowish brown, in interbedded lenses and patches; compacted in places in orange limonite zones. Sand slumping in places, especially 1.5-1.7m.						
							Hole continued to backhoe limit (3.4m) but not logged below 1.8m due to slumping and rapid seepage estimated at 450 l/hr. By inspection 1.8-3.4m consists of similar material to interval 1.3-1.8m.						Soil profile developed on Tertiary sediments



# ENGINEERING LOG - EXCAVATION

project **PROSPECT TIP** location

co-ordinates **405797m N**  
**311834m E**

R.L. **118.1m**

excavation dimensions **3.3m x 1.8m x 0.5m**

exposure type **Backhoe pit**

equipment **MF 40; 400mm bucket**

operator **K. Bradford**

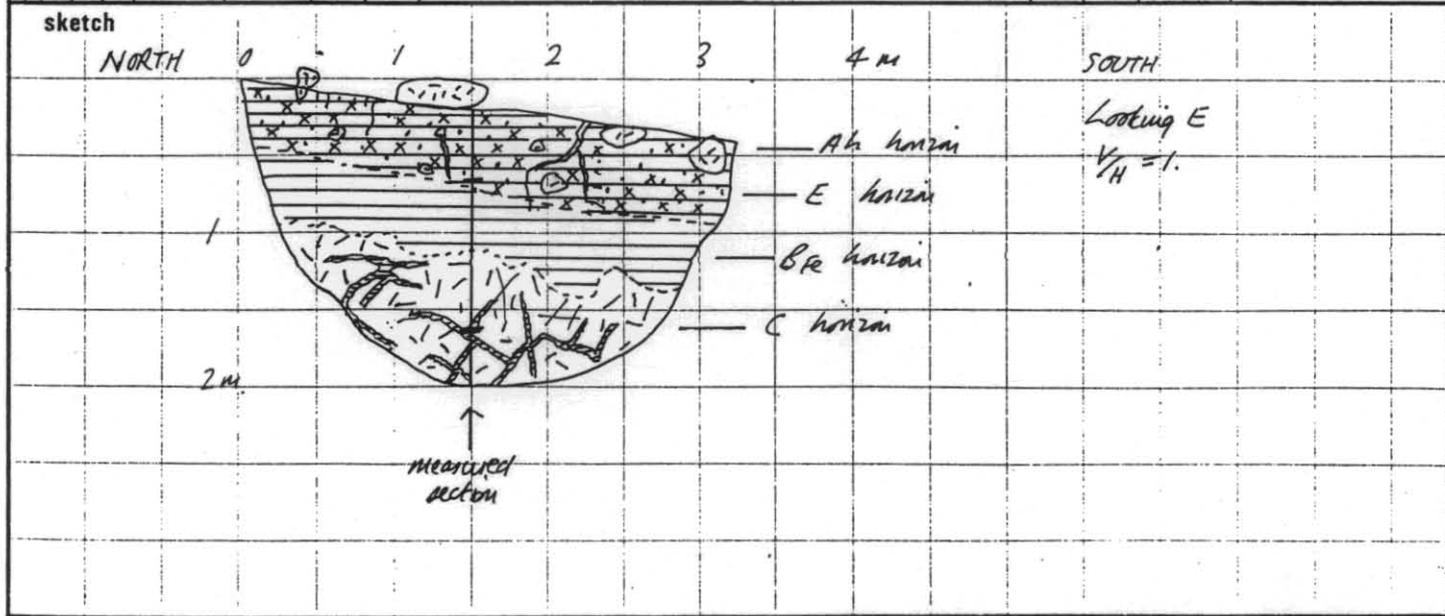
pit commenced **14.5.81**

pit completed **14.5.81**

logged by **W. Cramer**

checked by

penetration	support	water	notes samples, tests	metres		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
				R.L.	depth							
1 2 3												
							ML CL	Silty CLAY, brownish black (104R213) grading to brown (104R4/4). Pedal; trace roots, root fibres, charcoal and fine lamarkite gravel. Occasional rounded-sub angular slightly weathered dderik rubble and boulders (up to 600mm)	D to M M to H	F6 to H		A + E horizons
							CH	CLAY, brown (104R4/6) with mottles and patches of dark brown (104R3/4), flecked with fine cream spots. High plasticity, pedal in places but generally apedal	M to H D to M	H		B horizon
								DOLERITE, extremely weathered; mainly yellowish brown (104R5/8) and greyish blue (54S13); textured in places medium-coarse grained. Some irregular closed fractures stained with MnO <sub>2</sub> ? and occasional extremely weathered seams of light yellow (54S13) high plasticity clay. Trace root fibres				C horizon
								Hole stopped at 1.8m (near refusal) in extremely weathered dderik.				Soil profile developed on Jurassic dderik



# ENGINEERING LOG - EXCAVATION

project **PROSPECT TIP** location

co-ordinates **405860m N**  
**311830m E**

R.L. **127.7m**

excavation dimensions  
**3.1m x 1.4m x 0.5m**

exposure type **Backhoe pit**

equipment **MF 40, 400mm bucket**

operator **K. Bradford**

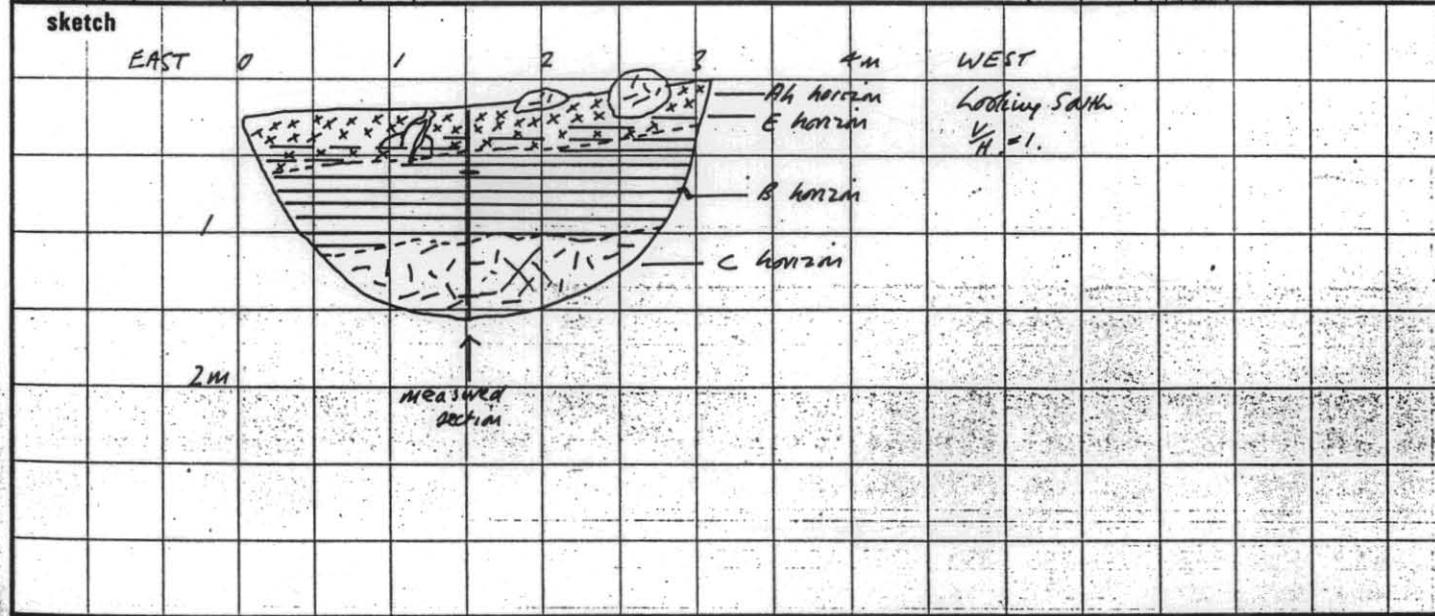
pit commenced **14.5.81**

pit completed **14.5.81**

logged by **W. Currier**

checked by

penetration 1 2 3	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 penetr- ometer kPa	structure, geology
					ML	SILT, dark brown (10YR3/4) grading to clayey SILT, dull yellowish brown (10YR5/4) at 0.2m, flecked in places with orange and black; many root fibres and trace fine - very fine limonite gravel. Occasional slightly weathered dentin cobbles and boulders (up to 60mm)	D	Fb/f		Ah, E horizons
	NOT ENCOUNTERED	D					M	H		B horizon
		D	1		CH	CLAY, dark brown (10YR3/4) flecked with cream spots, and mottled in places with greyish yellow brown (10YR4/2). High plasticity, apedal, trace roots		H		C horizon
			2			DOLERITE, extremely to highly weathered, mottled yellowish brown (10YR5/8) and dull yellowish brown (10YR4/8) and greyish yellow with minor bright reddish brown (5YR5/8); medium - coarse grained texture. occasional patches of high plasticity clay and MnO <sub>2</sub> staining				
						Hole stopped in highly weathered dentin, near refusal, at 1.4m				



# ENGINEERING LOG - EXCAVATION

project *PROSPECT TIP*

location

co-ordinates *405775m N  
311832m E*

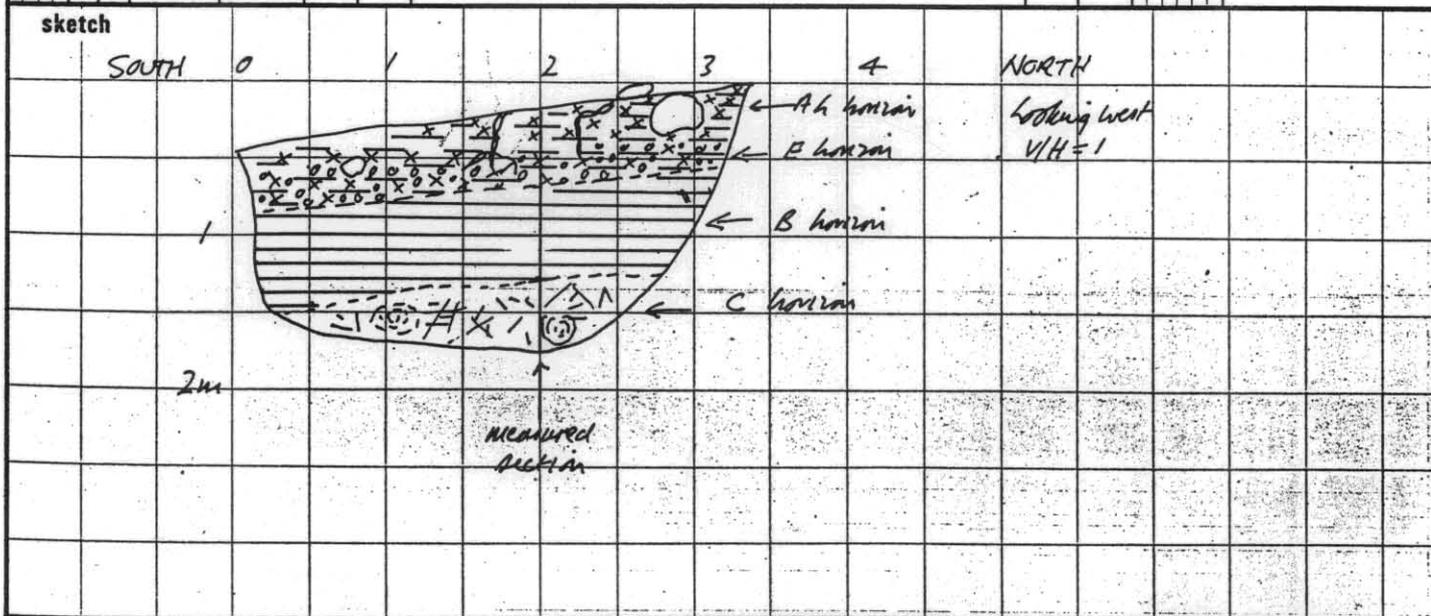
exposure type *Backhoe pit*  
equipment *MF 40, 400mm bucket*

pit commenced *14.5.81*  
pit completed *14.5.81*  
logged by *W. Garner*  
checked by

R.L. *115.9m*  
excavation dimensions  
*3.4m x 1.6m x 0.5m*

operator *K. Bradford*

penetration 1 2 3	support water	notes samples, tests	metres R.L. depth	graphic log classification symbol	material soil type: plasticity or particle characteristics, colour secondary and mindr components	moisture condition	consistency density index	hand penetr- ometer kPa 25 50 100 200 400	structure, geology
	<i>NOT ENCOUNTERED</i>		1	<i>ML to CL</i>	<i>Clayey SILT dark brown (104R3/4) 0-0.2m; with many roots and root fibres. Grades 0.4-0.5m to dull yellowish brown (104R5/3) mottled with dark brown (104R3/3); in places gravelly clayey silt dull yellow orange (104R6/3) and yellowish brown (104R5/6) with fine limonite fragments (up to 5mm). Some slightly weathered chert cobbles (up to 200mm)</i>	<i>D</i>	<i>Fb to H</i>		<i>Ah, E horizons</i>
			2	<i>CH</i>	<i>CLAY, brown (104R4/4) flecked with reddish brown (54R4/8) and cream; high plasticity. Trace limonite fragments and occasional patches of dark greyish yellow (2.54/12). Pedal, irregular peds lined with trace root fibres and MnO<sub>2</sub>?  DOLOMITE, extremely weathered; clay in places; textured; clotted as above in places with occasional more compact highly weathered dolomite patches  The stopped very rapid at 1.6m in extremely weathered dolomite</i>	<i>M PI M</i>	<i>H</i>		<i>Soil profile developed on Jurassic dolomite</i>



# ENGINEERING LOG - EXCAVATION

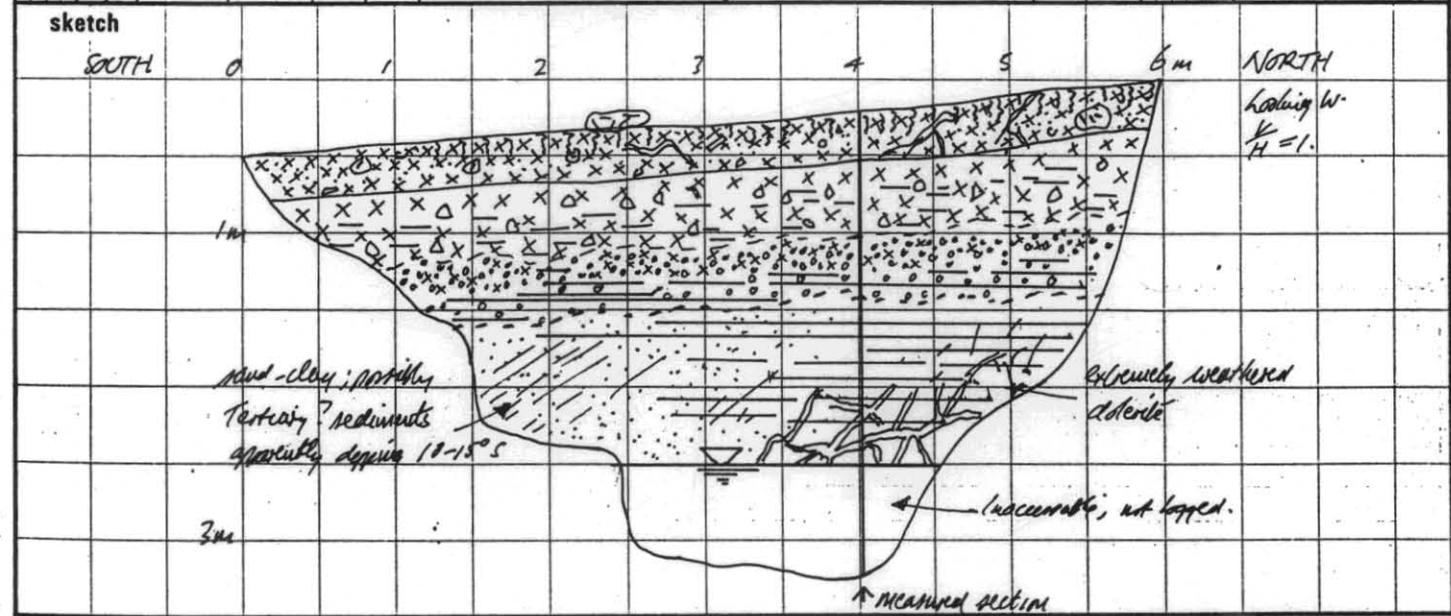
project **PROSPECT TIP** location \_\_\_\_\_

co-ordinates **405762m N**  
**311873m E** exposure type **Backhoe pit** pit commenced **15.5.81**

R.L. **114.4m** equipment **MF 40, 400mm bucket** pit completed **15.5.81**

excavation dimensions **6m x 3m x 0.9m.** operator **K. Bradford.** logged by **W. Corner 16.5.81**  
checked by \_\_\_\_\_

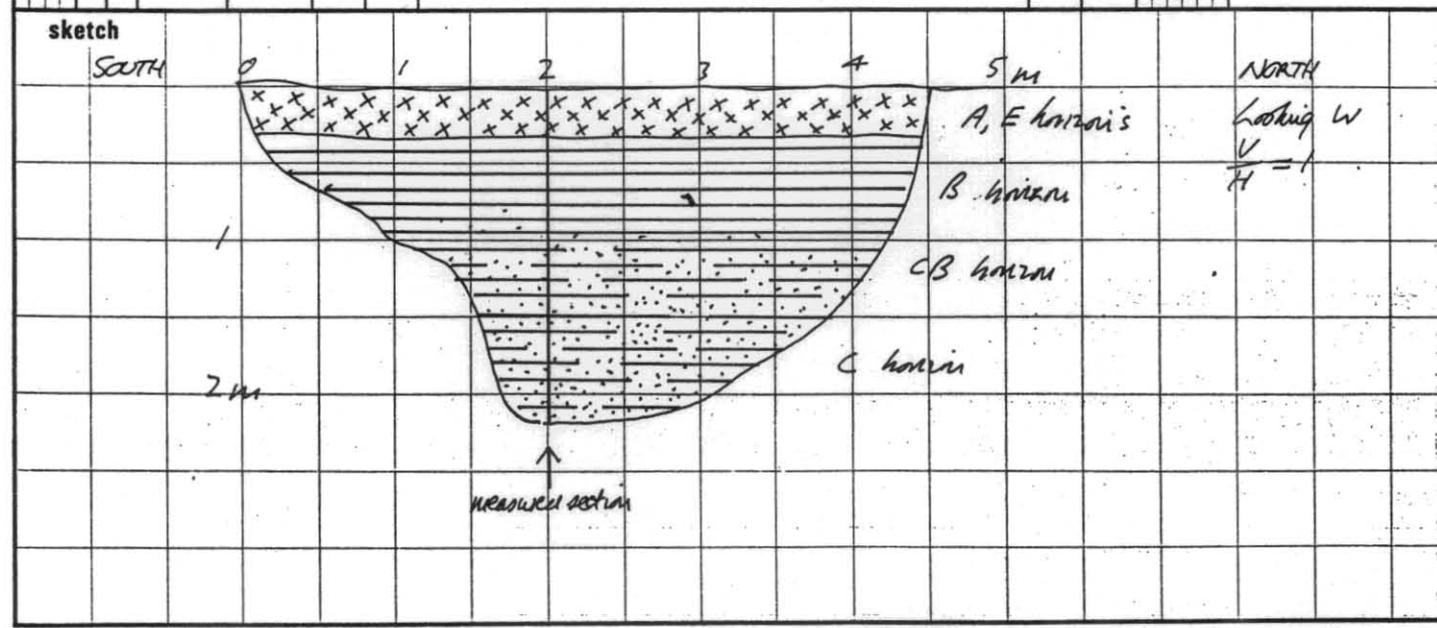
penetration 1 2 3	support water	notes samples, tests	metres R.L. depth	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour secondary and minor components	moisture condition	consistency density index	hand penetr- ometer kPa 25 50 100 200 400	structure, geology
			0		ML	SILT, dark brown (104R3/3), with trace fines, roots and many fibres. Occasional subangular, subrounded dolerite boulders generally < 100mm but up to 30mm.	D	FB		A+E horizons
			1		ML CL	SILT and clayey SILT, dull yellow orange (104R6/3) flecked with trace limonite fragments in places. Trace small roots; in places, locally encased in limonite to give pebbly & gravelly silt with fragments to 10mm. Occasional subangular - subrounded dolerite cobbles up to 100mm, rarely to 200mm, usually in clayey silt patches.	D to M	H		E horizon
		Seepage estimated 10-20L/hr	2		SM SC	Gravelly SILT, gravelly CLAY (1-1.2m). 0.8-1m, brown (104R4/6), yellowish brown (104R5/8) and brown (104R4/4). Between 1-1.2m, silty fine sand matrix with angular dolerite fragments (up to 30mm) and limonite grains (up to 10mm). Grades to gravelly clay below.	M < P1	Vsf		E horizon
			3		CH SC CL	CLAY, and sandy CLAY, brown (104R4/6), olive brown (2.544/3), yellowish brown (104R5/8) and grey (1046/1), massive, textured in places. Mainly in situ extremely weathered dolerite with irregular seams of grey (1046/1) high plasticity clay.	> P1	St		B, CB and C horizons.
			4			Hide stopped at required depth, 3.0m. Lower extremely weathered dolerite at base grade laterally south to sand and sandy clay interpreted as Tertiary sediments. Test pit possibly sited on dolerite bedrock boundary.				Soil profile developed on Tertiary dolerite



# ENGINEERING LOG - EXCAVATION

project *PROSPECT TIP* location \_\_\_\_\_  
 co-ordinates *405634mN*  
*311834mE* exposure type *Backhoe pit*  
 equipment *MF40; 600mm bucket* pit commenced *15.5.81*  
 R.L. *118.5m* pit completed *15.5.81*  
 excavation dimensions *4.5m x 2.2m x 0.6m* operator *T. Cooper* logged by *W. Corner*  
 checked by \_\_\_\_\_

penetration 1 2 3	support water	notes samples, tests	metres		graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour secondary and minor components	moisture condition	consistency density index	hand penetr- ometer kPa	structure, geology
			R.L.	depth							
				1	GM, ML, SM	<i>SILT and sandy SILT (in places gravelly), dull yellow orange (10YR6/3) grading to dull yellowish brown (10YR5/4); mainly mixture of silt and quartz sand with local enrichment of limonite fragments (up to 25mm). Some root fibres</i>	<i>D</i>	<i>D</i> <i>VS</i>		<i>A, E horizon</i>	
				2	CH to CL+ SC	<i>CLAY, brown (7.5YR4/6), yellowish brown (10YR5/6) and (2.5Y5/4) and minor dark reddish brown (2.5YR3/6), high plasticity, trace VF-F sand, grades at about 0.8m to sandy clay/clayey sand mottled as above in places, with greyish blue (5Y6/2). trace roots and limonite grains</i>	<i>M</i> <i>Z</i> <i>PI</i>	<i>H</i>		<i>B, Fe, g horizon</i> <i>grading through</i> <i>CB horizon</i> <i>to</i> <i>C horizon</i>	
				3		<i>The stopped close to backhoe refusal at 2.2m.</i>				<i>Soil profile</i> <i>developed</i> <i>on</i> <i>Tertiary</i> <i>sediments</i>	

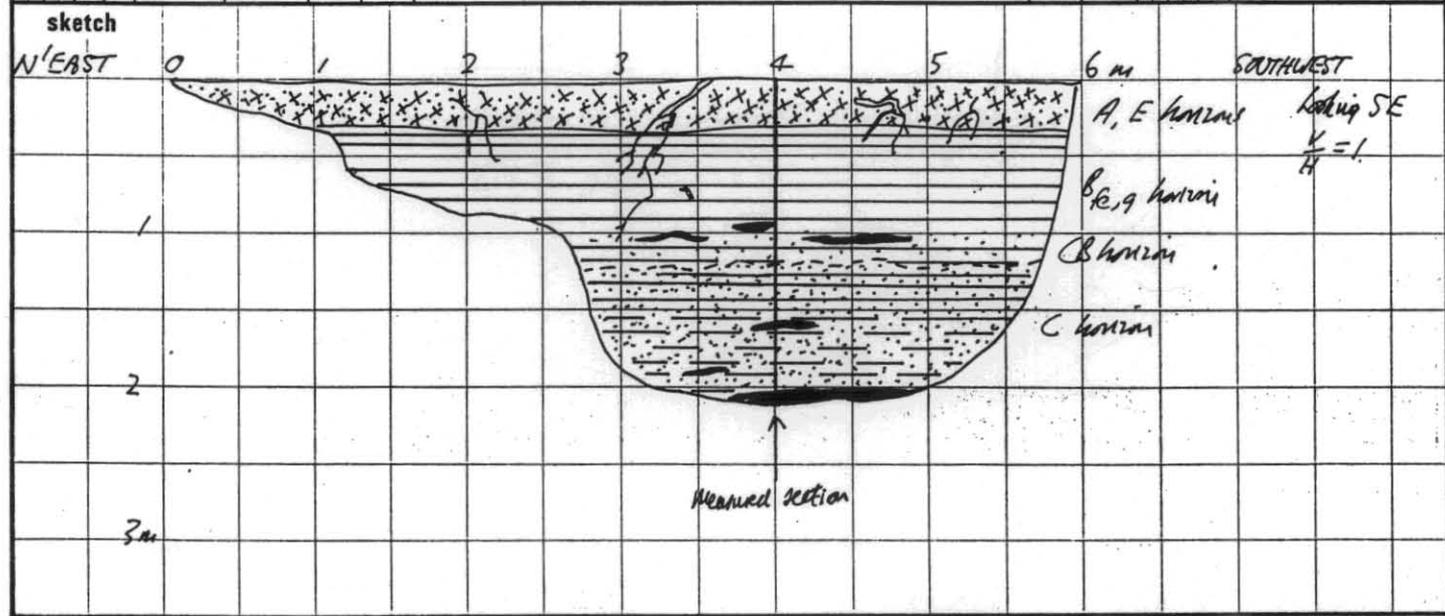


# ENGINEERING LOG - EXCAVATION

project *PROSPECT TIP* location \_\_\_\_\_

co-ordinates *405543m N* exposure type *Backhoe pit* pit commenced *15.5.81*  
*311815 m E* equipment *MFAO, 600mm bucket* pit completed *15.5.81*  
 R.L. *118.6m* operator *T. Cooper* logged by *W. Gomer*  
 excavation dimensions *6.0m x 2.1m x 0.6m* checked by \_\_\_\_\_

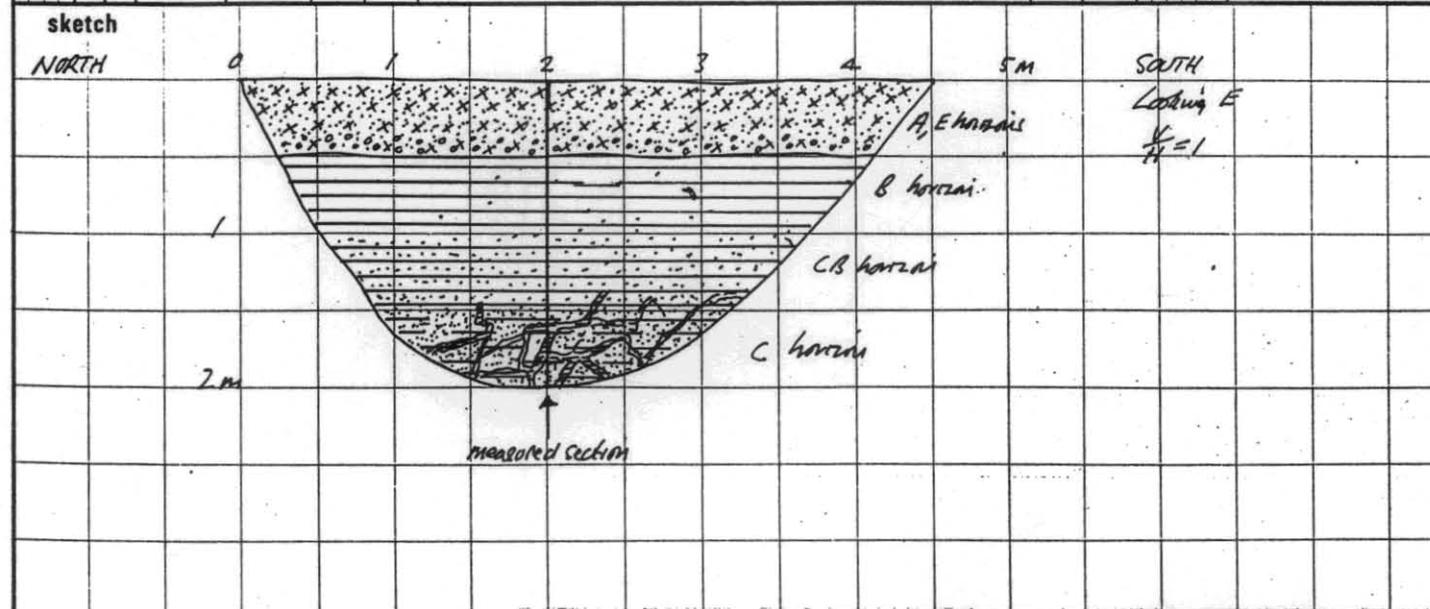
penetration 1 2 3	support water	notes samples, tests	metres R.L. depth	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour secondary and minor components	moisture condition	consistency density index	hand penetr- ometer kPa	structure, geology
					ML to SM	SILT, mainly dual yellow orange (10YR7/2) and dual yellowish brown (10YR 5/3) mottled with 10YR 6/4 (dual yell. orange). Trace F sand and limonite gravel (up to 5mm). Many roots and fibres.	D	FB/ H		A, E horizon
		D	1		CH	CLAY, dark brown (10YR3/4) and brown (10YR4/6), with fine small red flecks. High plasticity, trace limonite fragments (up to 40mm) and occasional irregular limonite bands and horizons. Trace roots and fibres. Trace sand, increasing with depth.	M	H	>450	B <sub>fe</sub> , g. horizon grading to C <sub>B</sub> horizon
		D	2		SC	Sandy clay, clay as above, grading at 1.4m to clayey sand, mainly greyish blue (5Y6/2) and blue brown (2.5Y4/6). Sand fractions sub-angular to angular, F, medium sphericity, with trace heavy black minerals. occasional roots. local lensed (up to 100mm thick) of yellowish brown (10YR5/8) and dark reddish brown (2.5YR3/6) concretionary limonite (up to 0.8m in length) below 1.5m; very hard.	M	H- VD		C horizon
			3			Backhoe refusal in hard concretionary limonite lens at 2.1m.				Soil profile developed on Tertiary sediments



# ENGINEERING LOG - EXCAVATION

project <b>PROSPECT TIP</b>	location
co-ordinates <b>405639m N 311750m E</b>	exposure type <b>Backhoe pit</b>
R.L. <b>119.1m</b>	equipment <b>M.F. 40; 60cm bucket</b>
excavation dimensions <b>4.2m x 2.0m x 0.6m</b>	operator <b>T.H. Cooper</b>
	pit commenced <b>15.5.81</b> pit completed <b>15.5.81</b> logged by <b>W. Cooper</b> checked by

penetration 1 2 3	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 penetr- ometer kPa	structure, geology
	NONE ENCOUNTERED	NO SAMPLES TAKEN		SM to GM + SW		Sandy SILT, black, organic, many fine roots 0-0.1m; 0.1-0.5m, brownish black (10YR 2/3). Sand fraction F, angular-subangular low-medium sphericity quartzite with trace very fine dark minerals. locally grades to silty F sand and below 0.4m to gravelly silt with sub-rounded slightly weathered clastic, 20-30% (up to 20mm) in silt/sand matrix. Occasional limonite fragments (up to 75mm)	M to D	L to D		A, E horizons
			1	CH to CL + SC		CLAY, brown (10YR 4/6) and dark brown (2.5Y 4/3) and small patches of dark red (10R 3/6); trace fine roots; grading at 1m to sandy clay and below 1.6m to clayey sand Below 1m, mottled and patchy grey (5Y 6/1) and dark reddish brown (5YR 7/6) with minor bright yellowish brown (10YR 5/8). Some irregular EW seams (up to 75mm wide) sealed with dark greyish yellow (2.5Y 4/2) high plasticity clay common below 1.5m. At 1.9m, mainly grey (5Y 6/1) and bright yellowish brown (10YR 5/8) clayey sand.	M < PI	H	7450	B <sub>fe</sub> horizon grading through CB horizon to C horizon
			2			Hole stopped at required depth, 2.0m				Soil profile developed on Tertiary sediments



# ENGINEERING LOG - EXCAVATION

project **PROSPECT TIP** location

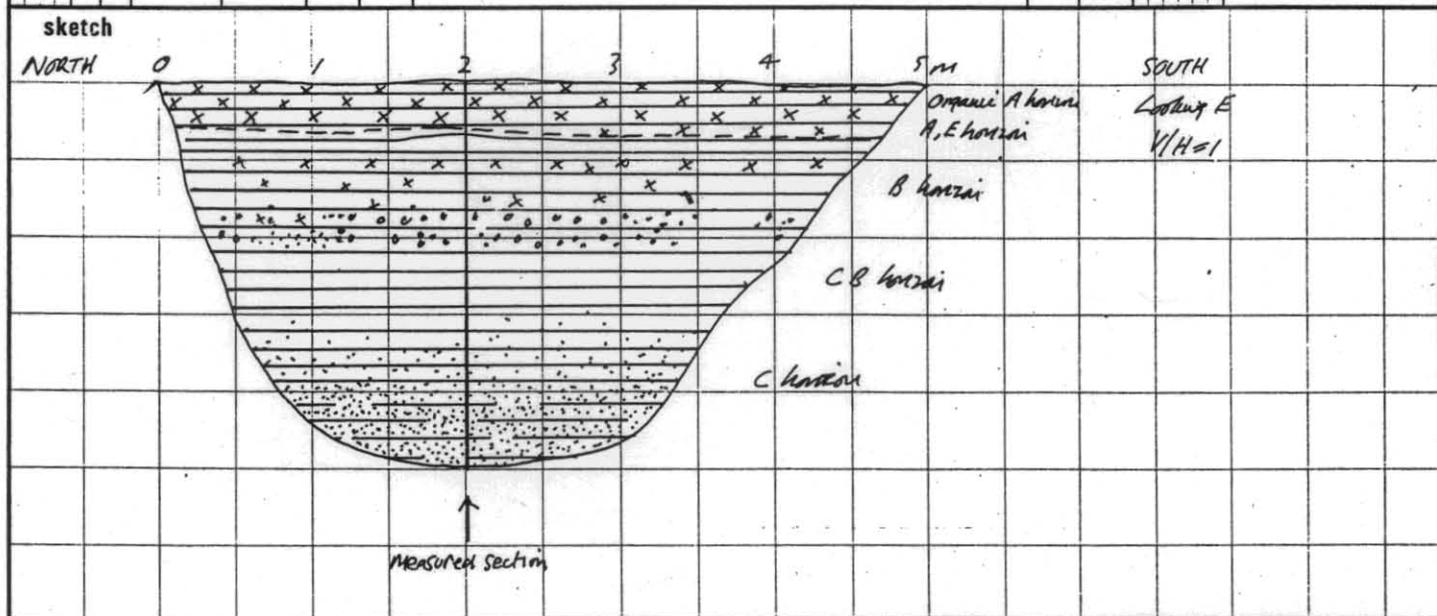
co-ordinates **405706mN**  
**311753mE** exposure type **Backhoe pit** pit commenced **15.5.81**

R.L. **113.8m** equipment **MFA0; 600mm bucket** pit completed **15.5.81**

excavation dimensions **5.0m x 2.5m x (0.6-1.6m)** operator **T. H. Cooper** logged by **W. Cooper**

checked by

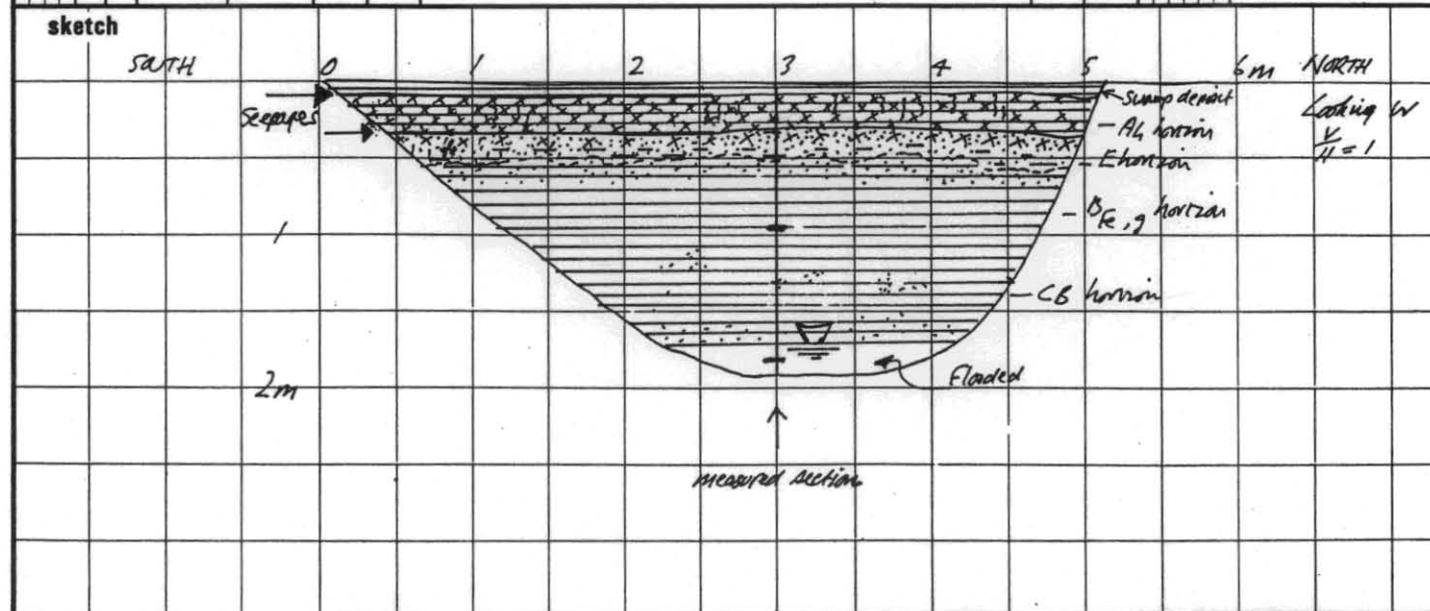
penetration 1 2 3	support water	notes samples, tests	metres R.L. depth	graphic log classification symbol	material soil type: plasticity or particle characteristics, colour secondary and minor components	moisture condition	consistency density index	hand penetr- ometer kPa	structure, geology
		minor seepage		OL, CL, CH	Silty CLAY, brownish black (10YR2/3), with roots and many root fibres, trace charcoal; grading at 0.2m to brownish black (10YR2/2)	W	F to S		Organic A, E horizons
		NO samples taken.	1	CH	Silty CLAY, greyish yellow brown (10YR5/2), some root fibres, grading rapidly to CLAY, mottled yellowish grey (2.5Y4/1) and yellowish brown (2.5Y4/1). High plasticity, with trace limonite gravel. [Below 0.8m, locally grades to gravelly clay]. Below 1m, mottled grey-blue and olive brown (2.5Y4/6) CLAY, GRAVELLY CLAY and sandy CLAY. Sand % increases with depth. Also mottled yellowish brown (10YR5/8) and grey blue below 1.3m.	M	S		B, CB horizons
		Seepages est. 200 l/hr.	2	CL, GC + SC	Between 0.8-1.3m, gravelly clay contains sub-rounded limonite and ferruginous sandstone (up to 25mm, but generally less than 20mm)	> PI	grading to St + VSt		C horizon
			3		pipe stopped at required depth, 2.5m.				



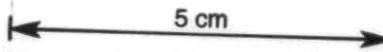
# ENGINEERING LOG - EXCAVATION

project <b>PROSPECT TIP</b>	location
co-ordinates <b>405819mN</b> <b>311720mE</b>	exposure type <b>Backhoe pit</b>
R.L. <b>115.1m</b>	equipment <b>MF40, 600mm bucket</b>
excavation dimensions <b>5.2m x 1.9m x 0.6m</b>	operator <b>T.H. Corner</b>
	pit commenced <b>25.5.81</b>
	pit completed <b>25.5.81</b>
	logged by <b>W. Corner</b>
	checked by

penetration 1 2 3	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 penetr- ometer kPa	structure, geology mark deposit
		Seepage estimated at 100L/hr.	1	CH CL OL	CLAY, dull yellow orange (10YR 7/4) streaked and mottled with olive yellow (5Y 6/3). High plasticity, many fine roots. Apedal.	W	S		Ah horizon
		D	1	OL	Clayey SILT, brownish black (7.5YR 2/2), mottled in places with yellowish brown (10YR 5/8); locally pedal, with irregular peds (up to 10mm). Organic, low plasticity, with many fine roots, and trace charcoal and fine angular quartzite gravel.		MD		E horizon
		D	2	SM	Silty SAND grading to clayey sand, mottled greyish yellow brown (10YR 4/2) and brown (7.5YR 4/6), with trace limonite gravel (up to 5mm)		F		B <sub>h</sub> , g horizon grading to CB horizon
			3	CH CL	Sandy CLAY, mottled grey-blue, yellowish brown (10YR 5/8), with trace limonite gravel; grading at 0.7m to CLAY, mottled as above, with grey (N5/0), trace fine sand and occasional yellowish brown friable sand patches. Locally pedal with poorly developed peds (up to 10mm) and some fine roots. Becomes sandier with depth, grading locally to clayey sand below 1.5m.				Soil profile developed on Tertiary sediments.
					Site stopped at required depth, 1.9m.				







# ENGINEERING LOG - EXCAVATION

project **PROSPECT TIP** location \_\_\_\_\_

co-ordinates **405907mN**  
**311616mE**

R.L. **118.9m**

excavation dimensions  
**6m x 0.6m x 2.6m**

exposure type **Backhoe pit**

equipment **MF 40, 600mm bucket**

operator **T. H. Cooper**

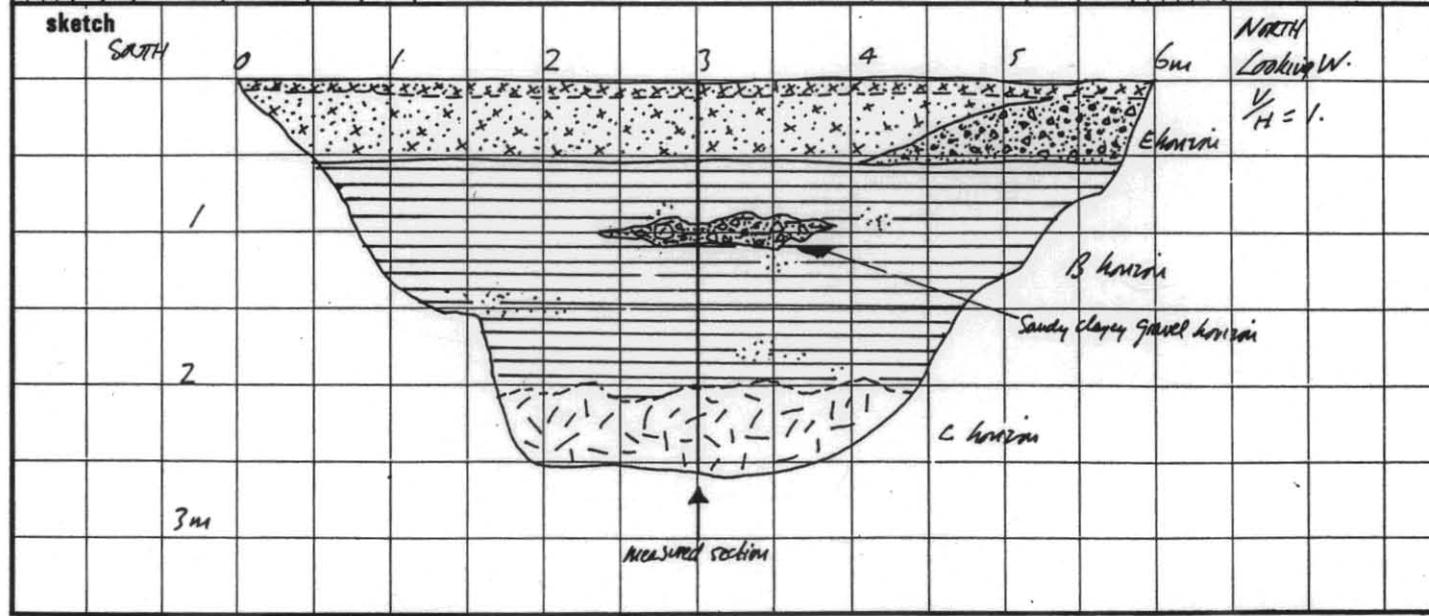
pit commenced **25.5.81**

pit completed **25.5.81**

logged by **W. Corner**

checked by \_\_\_\_\_

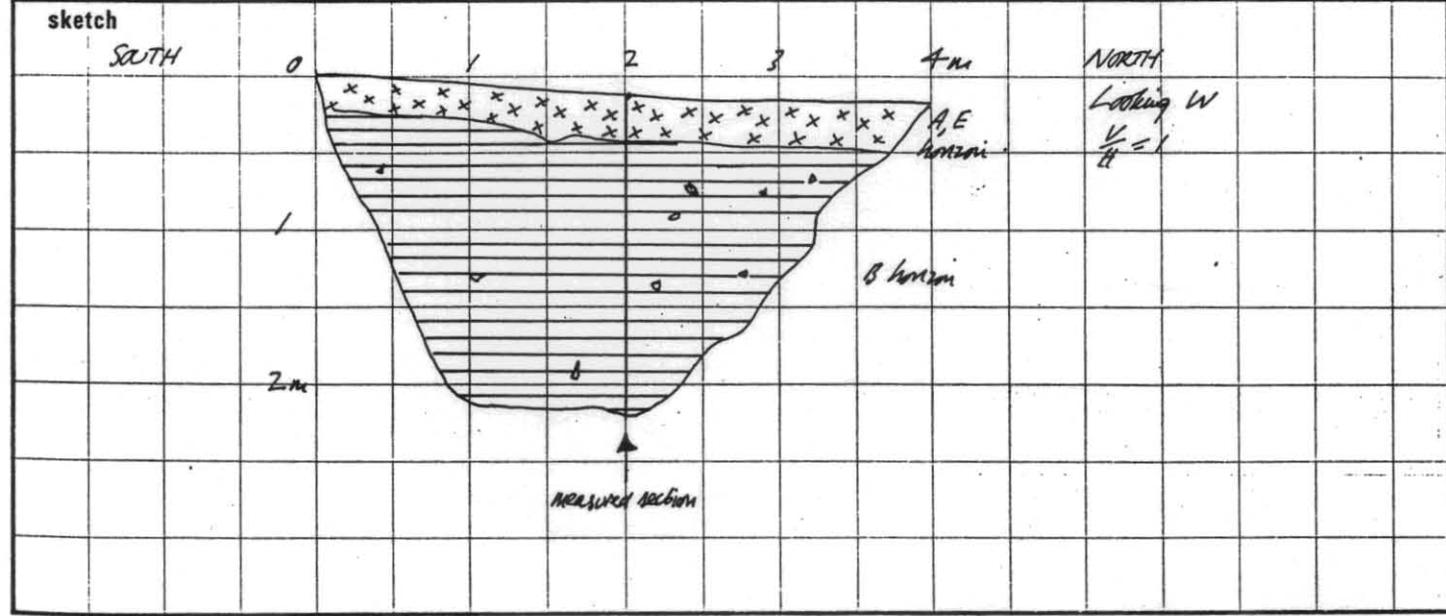
penetration	support	water	notes samples, tests	metres R.L. depth	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour secondary and minor components	moisture condition	consistency density index	hand penetrometer kPa	structure, geology
1 2 3										25 50 100 200 400	
			See page 1 est. 360l/hr.	1		SM	SILT, dull yellowish brown (10YR5/3), with trace fine sand; pedat; mottled locally with yellowish brown (10YR5/8); peds irregular (up to 20mm). Many fine roots.	D	FJ		Ah, E horizon
		2			CH, CL, SC in Mass	Silty SAND - sandy SILT; clay as above; some large roots; sand angular, quartzite & ls spherulites, trace limonite granules (up to 15mm), fine quartzite gravel, At N end of section this unit carries wedge shaped sandy gravel (>50% ironstone fragments up to 20mm)	M < PI above 1m; M > PI 1.6-2.0m	VST		450	B horizon
		3			CLAY	CLAY, mottled bright brown (7.5YR5/8), brownish grey (7.5YR4/1) and yellowish brown (10YR5/8) with local pockets of yellowish brown (10YR5/8) sandy clay and clayey sand. Many irregular fractures sealed with brownish grey (7.5YR4/1) high plasticity clay. Trace fine roots. Probably pedat above 1m, peds irregular (up to 10mm). 1-1.2m horizon of gravelly clay with irregular boundary, and clay gravelly in places between 1.2-1.6m. In this zone, matrix yellowish brown (10YR5/8) sandy clay; gravel fragmented ironstone and highly weathered adarite, both angular up to 50mm. Below 1.2m, clay mottled olive grey (5G4/1) with minor brown (10YR4/6); gleyed. Trace MnO <sub>2</sub> patches. Clay high plasticity.	W	soft		370-400	C horizon
							BOLEHITE, mottled grey blue and olive grey, coarse grained, highly weathered, massive. Trace roots. Hole stopped at required depth, 2.6m.				



# ENGINEERING LOG - EXCAVATION

project <b>PROSPECT TIP</b>	location
co-ordinates <b>405728mN 711440mE</b>	exposure type <b>backhoe pit</b>
R.L. <b>131.4m</b>	equipment <b>MF 40, 600mm bucket</b>
excavation dimensions <b>4.3x0.6x2.1m</b>	operator <b>T. H. Cooper</b>
	pit commenced <b>25.5.81</b> pit completed <b>25.5.81</b> logged by <b>W. Corner</b> checked by

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														
				1			XXX XXX XXX	ML	SILT, brownish black grading rapidly to dull yellowish brown (10YR5/3); some ironstone fragments on surface; many fine roots. Pedal 0-1m; peds irregular. Below 0.1m, apedal, massive. Trace fine sand.	D	FbH			A <sub>h</sub> , E horizon
				2				CH	CLAY, brown (10YR4/6) pedal 0.3-0.4m, olds up to 40mm, irregular; trace fine roots and limonite fragments. High plasticity but local granular clay patches with ironstone fragments. Below 1m, mottled dull yellow (5Y6/7) and yellowish brown (10YR5/8), and below 1.6m also streaked with reddish brown (2.5YR4/6)	M	Vst		B horizon	
				3					Hole stopped at required depth, 2.1m					

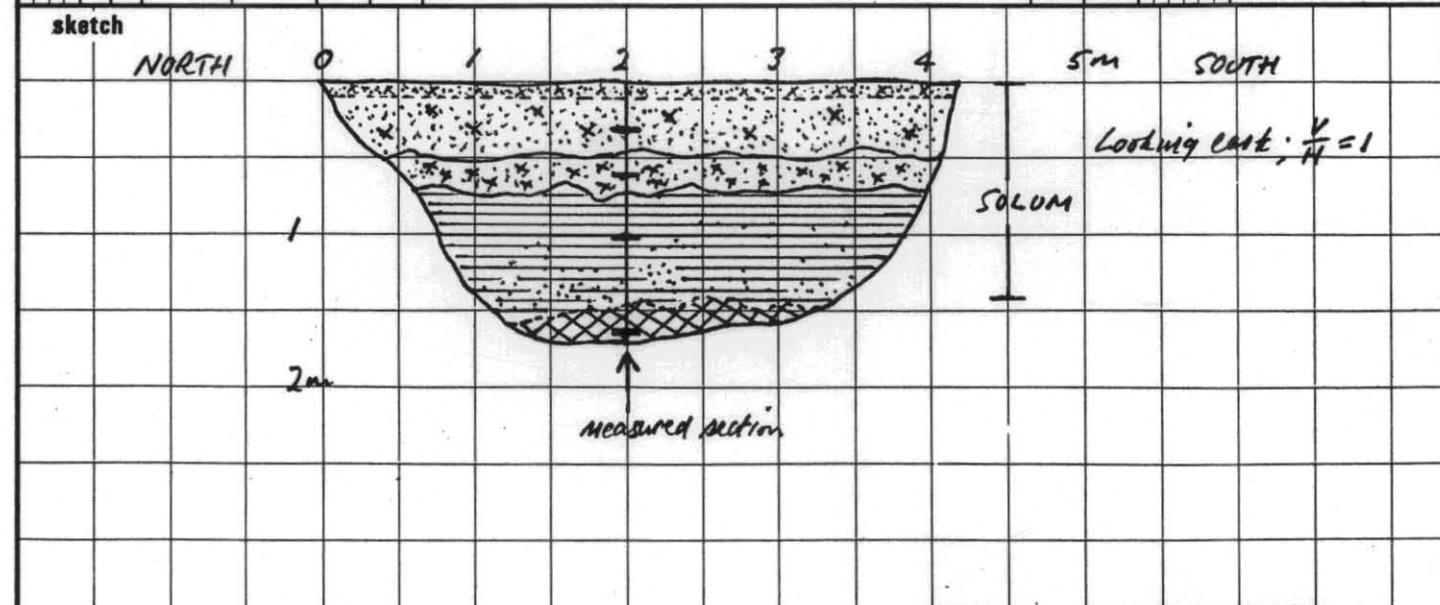


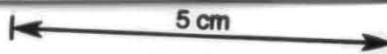
# ENGINEERING LOG - EXCAVATION

project **PROSPECT TIP** location

co-ordinates 405742m N  
311513m E exposure type **Backhoe pit** pit commenced 26.5.81  
equipment **M=40; 600mm bucket** pit completed 26.5.81  
R.L. 126.5m operator **T.H. Cooper** logged by **W. Cramer**  
excavation dimensions **4.3m x 1.7m x 0.6m** checked by

penetration 1 2 3	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 penetr- ometer kPa	structure, geology
	NOT ENCOUNTERED	D			SP	Silty SAND, greyish yellow brown (10YR 5/2), F, WS, with roots and many root fibres; thin black organic surface layer	D	L		Ah horizon
		D			ML			H		E horizon
		D	1		SP	SAND, bright yellowish brown (10YR 6/6), VF-F, WS, apedal, with roots, root fibres and trace charcoal; occasional limonite fragments (up to 15mm tr. fines)	M	SI		B Fe, g horizon
		D			ML to SM	As above, but compact, trace clay; mottled at base with yellowish brown (10YR 5/8). In places grades to silty sand and sandy silt.				C horizon
			2		SC to CL	Clayey SAND and sandy CLAY, mottled yellowish brown (10YR 5/6) and dull yellow (2.5Y 6/4); some small black patches; apedal, low plasticity; occasional high plasticity clay (CH) in sealed fractures. Sand increases towards base.				
						SANDSTONE, yellowish brown (10YR 5/8) with patches of grey-blue and streaks of red; weakly consolidated, F, WS, with trace fines. Fractures irregularly to blocky lumps				
						Backhoe refusal at 1.7m in weakly consolidated Tertiary sandstone				

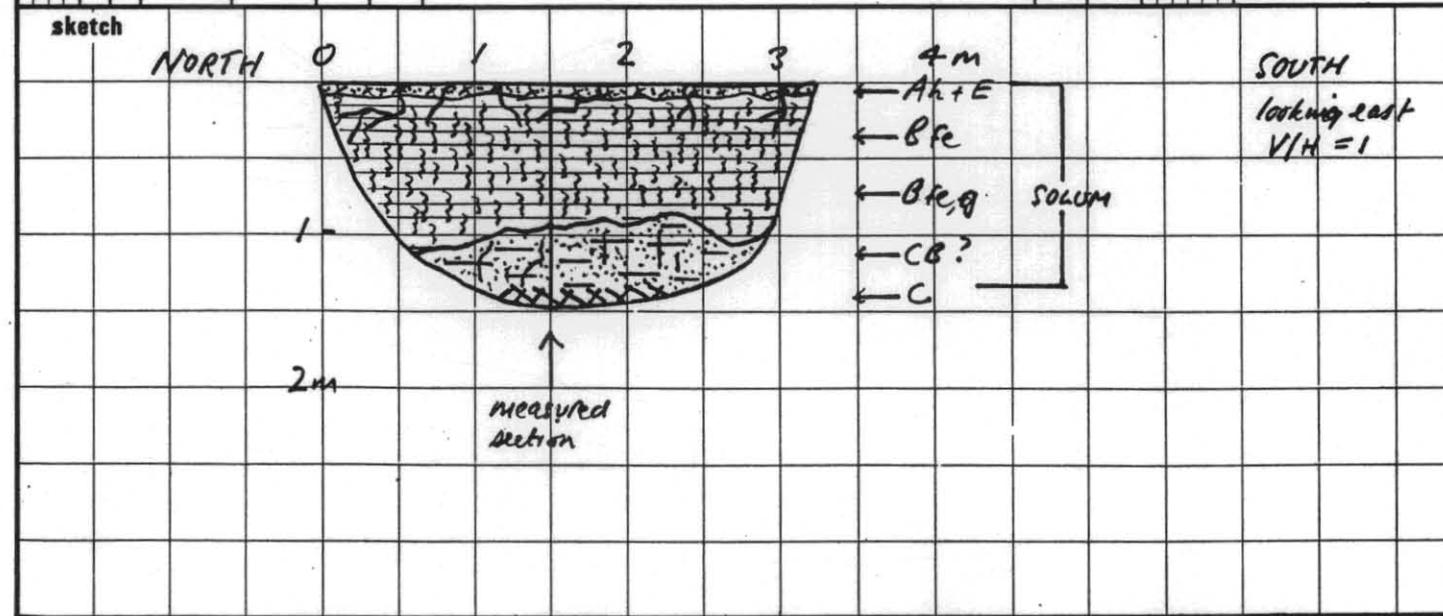




# ENGINEERING LOG - EXCAVATION

project <b>PROSPECT TIP</b>	location
co-ordinates 405738mN 311592mE R.L. 122.1m excavation dimensions 3.3m x 1.5m x 0.6m	exposure type <b>Backhoe pit</b> equipment <b>MF 40; 600mm bucket</b> operator <b>T. H. Cooper</b>
	pit commenced <b>26.5.81</b> pit completed <b>26.5.81</b> logged by <b>W. Cromer</b> checked by

penetration	support	water	notes samples, tests	metres	R.L.	depth	graphic log	classification symbol	material	moisture condition	consistency	density index	hand penetrometer kPa	structure, geology
1 2 3									soil type: plasticity or particle characteristics, colour secondary and minor components				50 100 200 300 400	Al and E horizons
			NOT ENCOUNTERED			1		SM + ML CH	Sandy SILT, greyish yellow brown (10YR 4/2) grading to 10YR 6/2; fragmented in places, possibly pedall; in places compact; many roots and root fibres  CLAY, brown (10YR 4/6), with trace F sand in places, and roots and root fibres; Pedal; prismatic peds up to 75mm. High plasticity. Below 0.7m mottled and streaked yellowish brown (2.5Y 5/4) and olive brown (2.5Y 4/6) and brown (10YR 4/6) Ped surfaces marked by root fibres	D M L PI	VST to H			Bfe horizon Bfe g CB and C horizons
						2			SAND and clayey SAND, yellowish brown (10YR 5/8) streaked with bright reddish brown (5YR 5/8), and light yellow (2.5Y 7/3) high plasticity clay in irregular subvertical and sub horizontal fractures. Sub horizontal bedding? indicated by grain size variation (VF-M). weakly consolidated towards base, and grades to weakly consolidated and possibly EW sandstone at 1.5m  Near backhoe refusal on EW? Tertiary sandstone at 1.5m	M	H			Soil profile developed on weakly cemented Tertiary sandstone



# ENGINEERING LOG - EXCAVATION

project **PROSPECT TIP** location

co-ordinates 405742m N  
311662m E

R.L. 118.6m

excavation dimensions 5.2m x 1.9m x 0.6m

exposure type *Backhoe pit*

equipment *MF 40, 600mm bucket*

operator *T. H. Cooper*

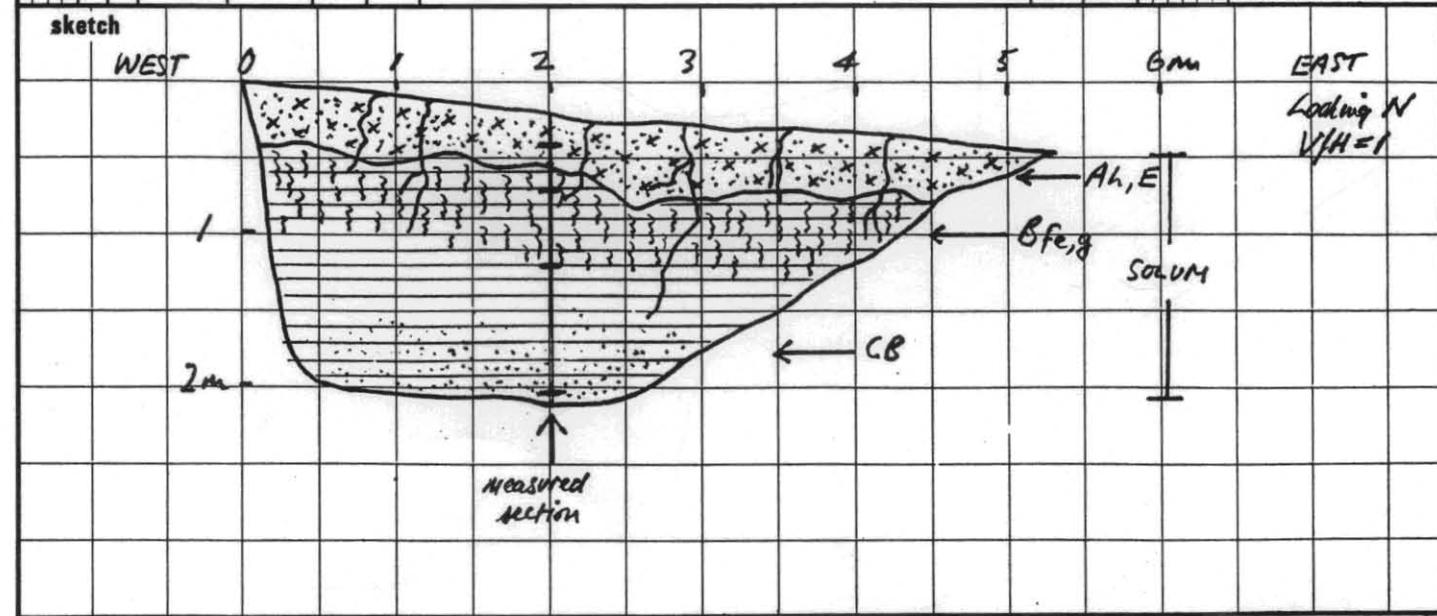
pit commenced 26.5.81

pit completed 26.5.81

logged by *W. Cromer*

checked by

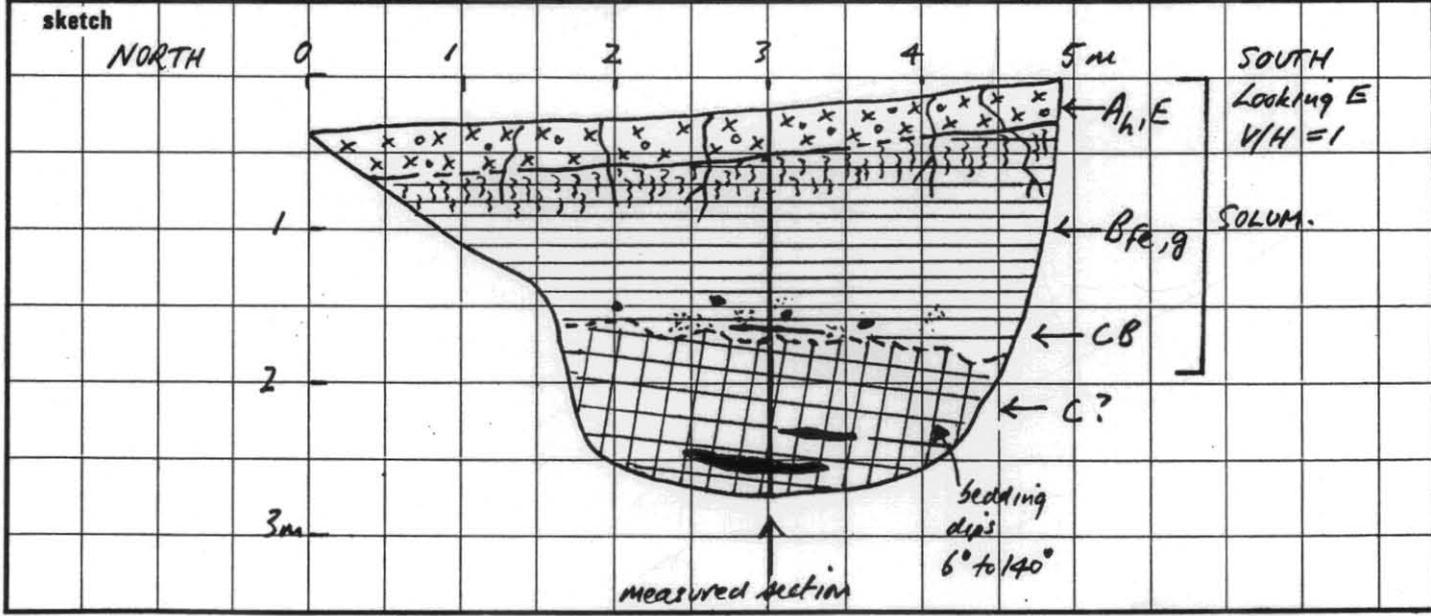
penetration	support	water	notes samples, tests	metres R.L. depth	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour secondary and minor components	moisture condition	consistency density index	hand penetrometer kPa	structure, geology
1 2 3										25 50 100 200 400	
			D			SM to ML	<i>Sandy SILT, brownish grey (7.5YR 5/1) grading to 7.5YR 6/1; sand F; very thin organic horizon; many roots and root fibres, trace charcoal; A pedol, trace fine limonite gravel</i>	D	F <sub>2</sub> H		Ah and E horizon
			D					M	H		B <sub>f</sub> e, g horizon
			D	1		CH, CL + SC	<i>CLAY, mainly yellowish brown (10YR 5/6) mottled with yellowish brown (2.5Y 5/4); trace F sand; Pedal; peds roughly prismatic-irregular, up to 75mm; secondary peds up to 20mm often with brownish black (7.5YR 7/2) clay skins. Pedalinity decreases with depth, and is absent below 1m. Many roots and root fibres. Sand content increases with depth and below 1.3m grades to sandy clay.</i>			>450	CB horizon
			D	2			<i>Near backhoe refusal in hard sandy clay at 1.9m</i>				Soil profile developed on Tertiary sandstone (weakly consolidated)



# ENGINEERING LOG - EXCAVATION

project <b>PROSPECT TIP</b>	location
co-ordinates 405527m N 311745m E R.L. 122.2m excavation dimensions 4.9m x 2.6m x 0.6m	exposure type <b>Backhoe pit</b> equipment <b>MF 40; 600mm bucket</b> operator <b>T. H. Cooper</b>
	pit commenced <b>26.5.81</b> pit completed <b>26.5.81</b> logged by <b>W. Cromer</b> checked by

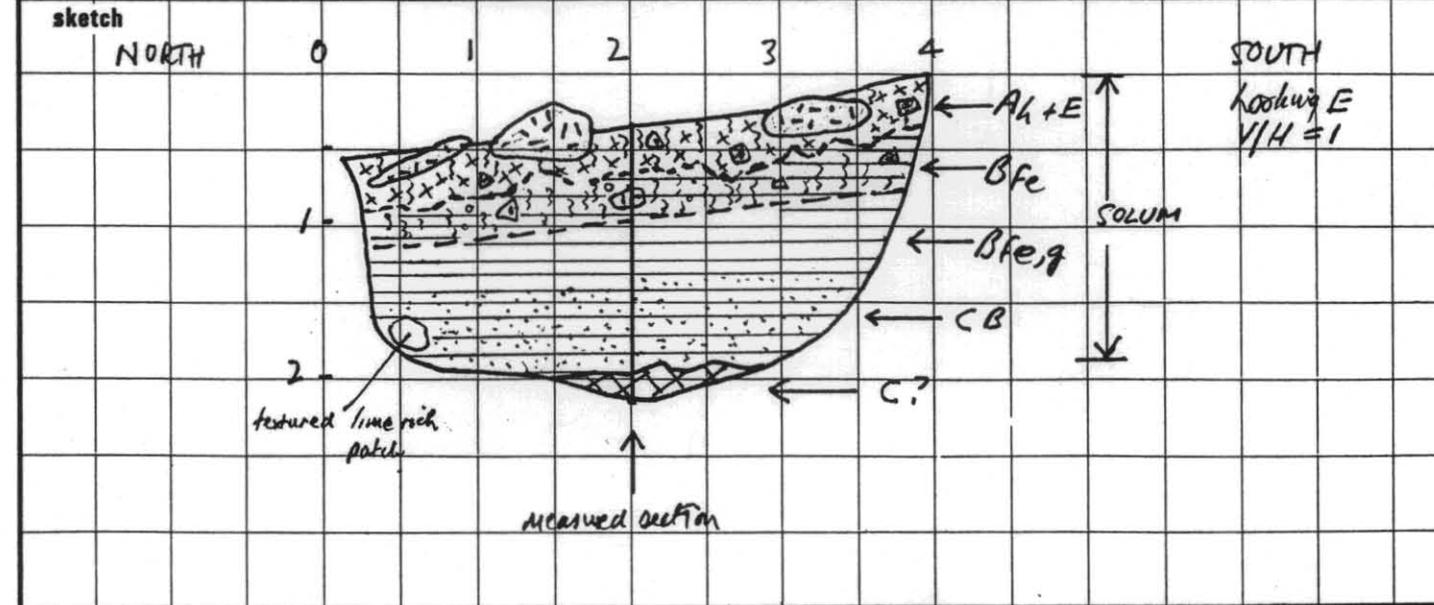
penetration	support	water	notes samples, tests	metres R.L. depth	graphic log	classification symbol	material soil type: plasticity or particle characteristics, colour secondary and minor components	moisture condition	consistency density index	hand penetrometer kPa	structure, geology	
1 2 3										25 50 100 200 400		
				D		ML	<b>SILT</b> , dark brown (10YR 3/4) grading through greyish yellow brown (10YR 4/2) to 10YR 6/2; trace charcoal (0.2-0.3m), root fibres, and trace fine limonite gravel and fine sand. Occasional concretionary (limonite) up to 75mm but generally < 10mm.	D M K PI	Fb/H H		A <sub>h</sub> +E horizon B <sub>fe, g</sub> horizon CB horizon C? horizon	
				D		CH, CL, SC	<b>CLAY</b> , mottled brown (10YR 4/6) and 10YR 4/4, high plasticity; trace fine sand and root fibres. Pedal; peds irregular - prismatic up to 50mm; Apedal below 0.6m. Mottled also with olive brown (2.5YR 4/6) and yellowish brown (10YR 5/8) below 0.6m. Some patches of yellowish brown sandy clay; sand increases below 1.2m. Below 1.2m, irregular limonite patches and at 1.5m hard thin limonite banding.	M				
				D			<b>SANDSTONE</b> , yellowish brown (10YR 5/8) and grey-blue in alternating weakly cemented beds. Beds dip 6° to 140°. Some beds clayey friable mudstone. Some hard irregular limonite horizons especially at 2.0 and 2.4m. Sandstone F-VF, WS.					Soil profile developed on weakly cemented Tertiary sandstone
							Near backhoe refusal at 2.5m in weakly cemented Tertiary sandstone.					



# ENGINEERING LOG - EXCAVATION

project <b>PROSPECT TIP</b>	location
co-ordinates 405438m N 311744m E	exposure type <b>Backhoe pit</b>
R.L. 133.3m	equipment <b>MF40; 600mm bucket</b>
excavation dimensions 3.8m x 1.8m x 0.6m	operator <b>T. H. Cooper</b>
	pit commenced <b>26.5.81</b> pit completed <b>26.5.81</b> logged by <b>W. Crower</b> checked by

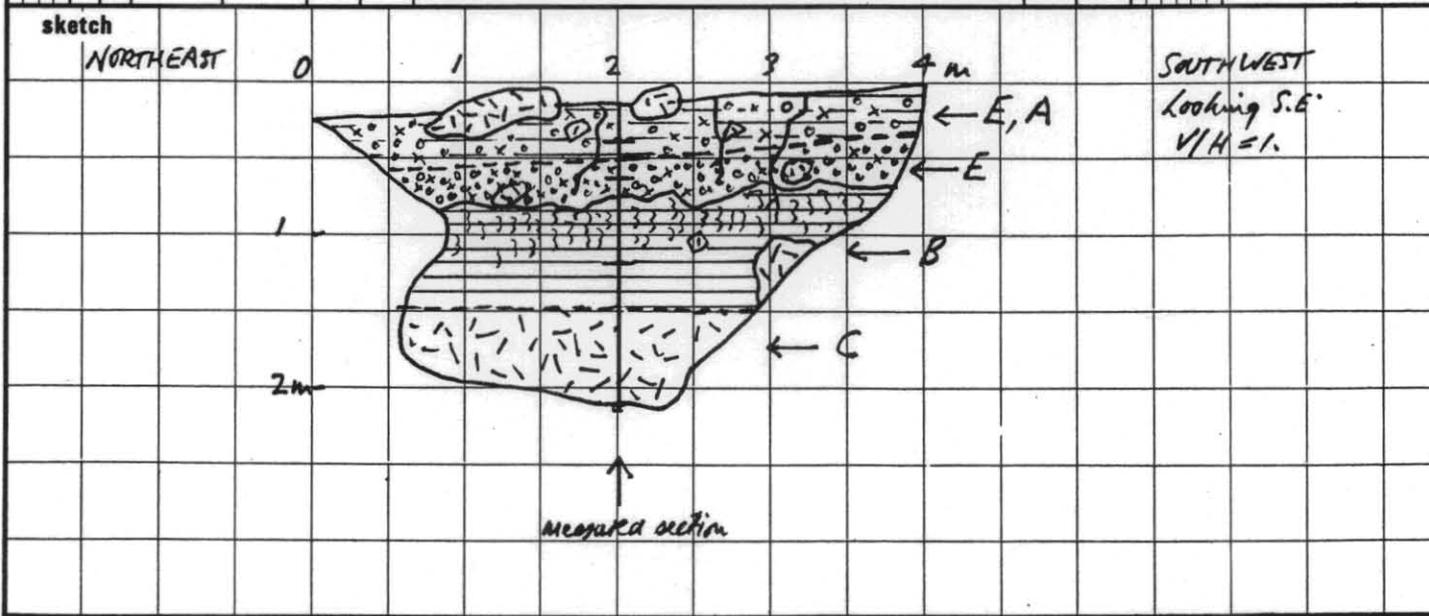
penetration	support	water	notes samples, tests	metres	graphic log	classification symbol	material	moisture condition	consistency	density index	hand penetrometer kPa	structure, geology
1 2 3				R.L. depth			soil type: plasticity or particle characteristics, colour secondary and minor components				25 50 100 200 400	colluvial?
						ML to CL	<b>SILT</b> , brown (10YR 4/4), pedol; peds irregular (approx. 20mm); many fine roots, trace fines near 0.3m; some moderately slightly to highly weathered siderite cobbles and boulders occasionally up to 1metre	D	Fb	USC		Ah, E? colluvial? Bfe? Bfe and CB? C?
				1		CL to CH	<b>CLAY</b> , mainly brown (10YR 4/6) flecked with fine cream spots; moderate plasticity, with occasional angular slightly - highly weathered medium grained siderite cobbles (up to 100mm); fragmented, possibly pedol, with blocks up to 75mm. Trace root fibres and limonite gravel. Locally grades to gravelly clay	M	H			
			Backhoe near refusal on weakly cemented sandstone at 1.8m	2		CH	<b>CLAY</b> , brown (10YR 4/4); fractured, possibly pedol 0.6 - 0.8m. Some patches of dark brown (10YR 3/3) below 1m. Grades at 1m to streaky olive brown (2.5Y 4/4 and 2.5Y 4/6) and grey (5Y 5/1) clayey sand and sandy clay. Occasional irregular cream-white mottled and textured lime-rich patches up to 20mm. Fractured, possibly pedol 1.2 - 1.6m.	M-D				Colluvial weathered + leached siderite soil profile overlying soil profile developed on weakly cemented Tertiary sandstone
				3		CL SC	<b>SANDSTONE</b> bright yellowish brown (10YR 6/8) streaked with grey-blue; angular - sub angular med - spheric quartz. Friable, weakly cemented. Trace silt.					



# ENGINEERING LOG - EXCAVATION

project <b>PROSPECT TIP</b>	location
co-ordinates <b>405458mN 311587mE</b>	exposure type <b>Backhoe pit</b>
R.L. <b>132.6m</b>	equipment <b>MF40; 600mm bucket</b>
excavation dimensions <b>4.0m x 2.0m x 0.6m</b>	operator <b>T.H. Cooper</b>
	pit commenced <b>26.5.81</b> pit completed <b>26.5.81</b> logged by <b>W. Crower</b> checked by

penetration	support	water	notes samples, tests	metres	graphic log	classification symbol	material	moisture condition	consistency density index	hand penetrometer kPa	structure, geology
1 2 3				R.L. depth			soil type: plasticity or particle characteristics, colour secondary and minor components			25 50 100 200 400	
			NOT ENCOUNTERED			GM	Gravelly silty CLAY, dull yellowish brown (10YR 4/3) and brown (10YR 4/4). Pedal; peds irregular; some fine roots. Friable 0-0.2m, slightly harder 0.2-0.3m; gravel fraction is fine limonite fragments (up to 5mm); trace charcoal. Occasional slightly - highly weathered dolerite pebbles, cobbles and boulders; largest ones on surface and up to 2 metres	D	Fb		A, E horizons
				1				M	H		E Horizon
								K			B horizon
								PI			
				2				M			C horizon
						GM	Silty GRAVEL, greyish yellow brown (10YR 6/2) mottled with yellowish brown (10YR 5/8) in places; grades locally to gravelly silt or silt; gravel is rounded limonite up to 5mm, with occasional slightly - highly weathered dolerite cobbles and boulders generally < 200mm; rarely > 600mm. Apedal; trace fine roots.				Colluvium?
						CH	CLAY, mainly brown (10YR 4/4) with patches of black staining and red (10R 4/8). Possibly pedal, fractured; trace fine roots; high plasticity. Occasional highly weathered dolerite cobbles up to 50mm; rarely > 200mm				and soil profile developed an extremely weathered staurosite dolerite
							DOLOERITE, extremely weathered; mottled yellowish brown (10YR 5/8) and dull yellow (2.5Y 6/3), medium grained; trace fine roots an irregular. sealed extremely weathered yellowish brown infill seam				



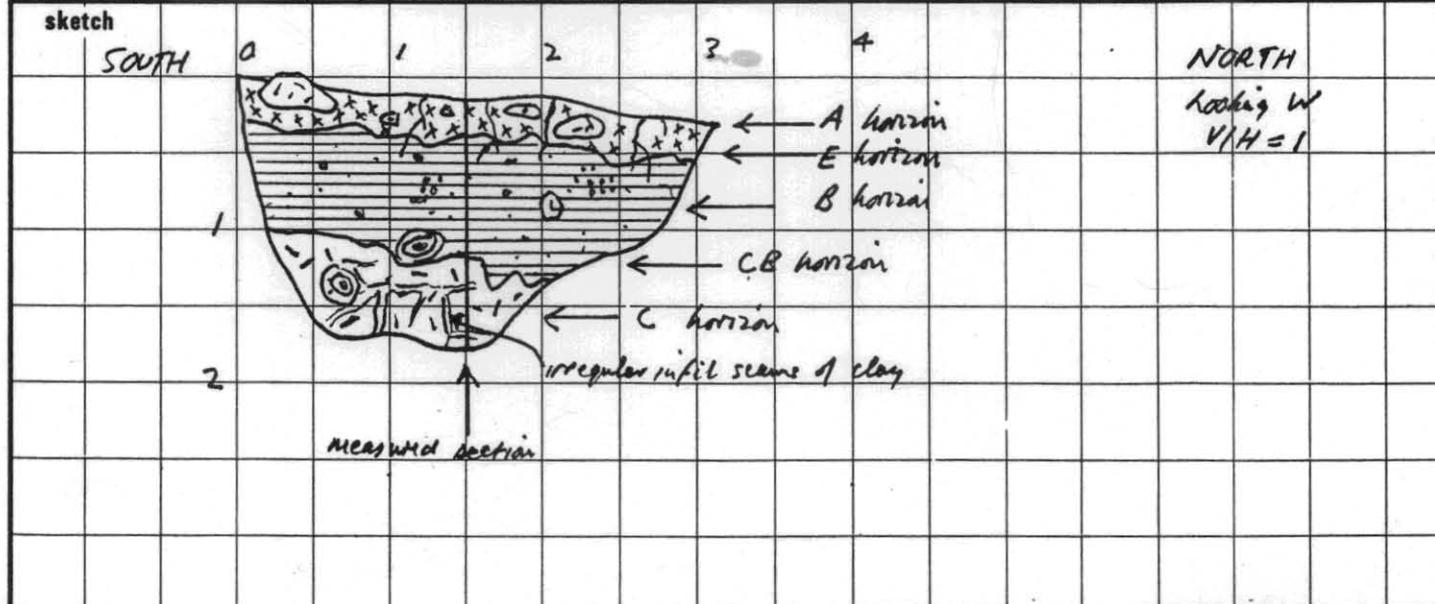


# ENGINEERING LOG - EXCAVATION

project **PROSPECT TIP** location

co-ordinates **405547m N**  
**311412** exposure type **Backhoe pit** pit commenced **27.5.81**  
R.L. **125.5m** equipment **MF40** pit completed **27.5.81**  
excavation dimensions operator **T.H. Cooper** logged by **W. Corner**  
**3.1m x 1.6m x 0.6m** checked by

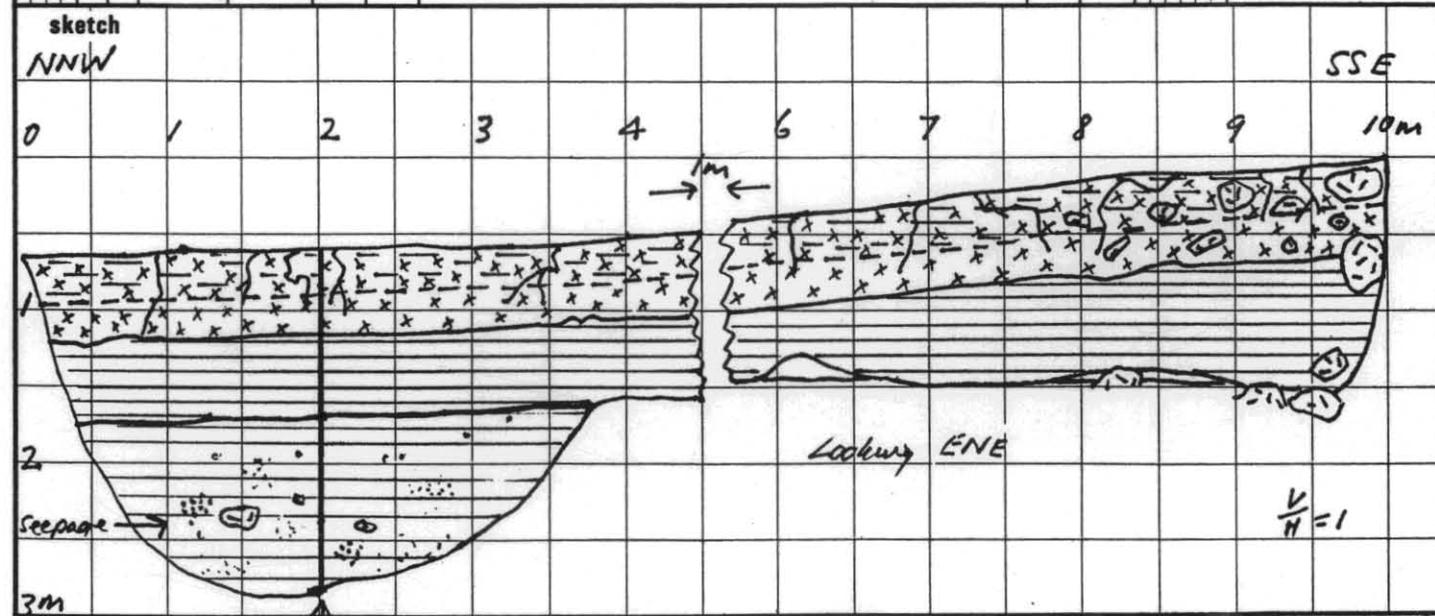
penetration 1 2 3	support water	notes samples, tests	metres R.L. depth	graphic log classification symbol	material soil type: plasticity or particle characteristics, colour secondary and minor components	moisture condition	consistency density index	hand penetr- ometer kPa	structure, geology
	NOT ENCOUNTERED		1	ML	SILT, dark brown (10YR 3/3), granular, friable, many fine roots and trace limonite gravel, grading at 0.1m to hard compact dull yellowish brown (10YR 5/4) silt. Occasional slightly weathered dolerite cobbles and boulder (up to 500mm)	D M L PI M	Fb/A H		A+E horizons B, CB horizons C horizon
			2	CH	CLAY, mainly brown (10YR 4/6) flecked with small cream spots; trace sand and fine limonite gravel. Grades locally to gravelly clay. Many root fibres; irregularly fractured and blocky. Occasional slightly weathered dolerite cobbles up to 200mm. Clay pedol in places, beds irregular. Towards base, grades to olive brown (2.5Y 4/3) and yellowish brown (10YR 5/8). Trace charcoal and MnO <sub>2</sub> staining. Possibly relic dolerite texture near base.				Soil profile developed on Jurassic dolerite
			3		DOLERITE, mainly extremely weathered, textured, friable, mottled yellowish brown (10YR 5/8) and yellowish brown, occasional slightly weathered harder rock, and common irregular infill seams of olive brown high plasticity clay. Occasional lime patches.				
					Backhoe refusal at 1.6m in slightly - extremely weathered dolerite.				



ENGINEERING LOG - EXCAVATION

project <b>PROSPECT TIP</b>	location
co-ordinates <b>405528m N 311733m E</b>	exposure type <b>Bachhoe pit</b>
R.L. <b>129.9m</b>	equipment <b>MF 40, 600mm bucket</b>
excavation dimensions <b>10m x 2.2m x 0.6m</b>	operator <b>T. H. Cooper</b>
	pit commenced <b>27.5.81</b>
	pit completed <b>27.5.81</b>
	logged by <b>W. Crower</b>
	checked by

penetration 1 2 3	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 penetr- ometer kPa	structure, geology
			1	ML MC to SC	Clayey SILT, brownish black (10YR 3/2), granular with lumps up to 15mm, many roots and root fibres, trace charcoal. Thin organic layer	D	FB H		O, Ah horizons E horizon
			2	SC CH	SILT, locally gravelly silt, dull yellow orange (10YR 6/7) grading to brown (10YR 4/4), apedal. trace limonite fragments (to 10mm), root fibres and VF-F sand	F -H	<PI M >PI	*	B <sub>fc</sub> , g horizon CB? horizon
		Est. 50 l/hr.	3		CLAY, brown (7.5YR 4/6), mottled in places with greyish yellow brown (10YR 4/2); apedal, trace roots, F sand and fragmentary limonite gravel	M >PI	F to H		Soil profile developed on Jurassic dolomite
					CLAY, dark greenish grey (5G 4/1) mottled with dark olive brown (2.5Y 3/3); apedal. Occasional yellowish brown (10YR 5/8) patches. In places, grey-blue clayey sand, and gravelly clay with angular-rounded limonite granules (up to 10mm). Some slightly weathered dolomite boulders up to 200mm especially near 1.8m. Seepage estimated at 50 l/hours from yellowish brown clayey limonite patches				
					Hole stopped at required depth, 2.2m				

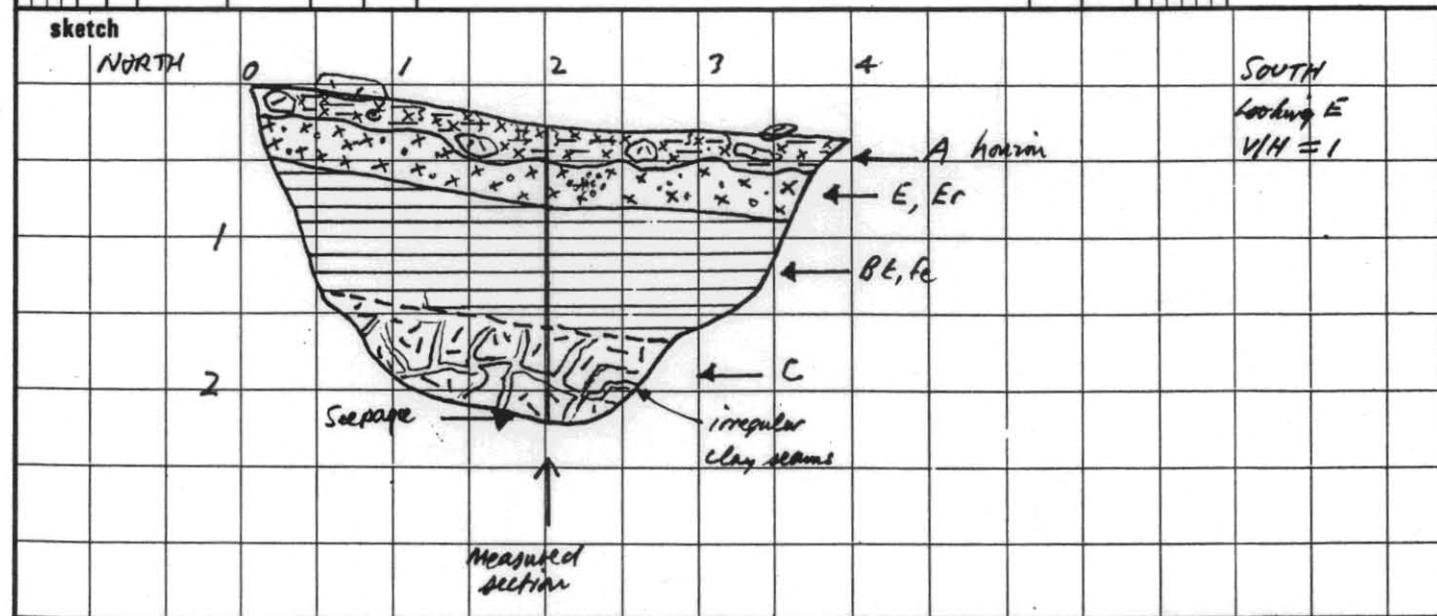


measured section

# ENGINEERING LOG - EXCAVATION

project <b>PROSPECT TIP</b>	location
co-ordinates <b>405690m N 311995m E</b>	exposure type <b>Backhoe pit</b>
R.L. <b>111.9m</b>	equipment <b>MF 40, 600mm bucket</b>
excavation dimensions <b>3.6m x 1.9m x 0.6m</b>	operator <b>T. H. Cooper</b>
	pit commenced <b>27.5.81</b>
	pit completed <b>27.5.81</b>
	logged by <b>W. Cooper</b>
	checked by

penetration 1 2 3	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 penetr- ometer kPa 25 50 100 200 400	structure, geology
					ML	Clayey SILT, dark brown (10YR 7/3); pedal, primary peds to 50mm, secondary to 10mm. Many fine roots, occasional angular slightly weathered dolerite cobbles (up to 300mm)	D	Fb		A horizon
					ML to GM	SILT, in places gravelly silt, dull yellowish brown (10YR 5/3), mottled in places with yellowish brown (10YR 5/6). Gravel is well graded limonite (up to 10mm) - Pedal (or fractured) in places. Trace roots and occasional angular slightly weathered dolerite cobbles (up to 75mm)	<PI	H		Er horizon
		Est. 50L/hr.	2		CH	CLAY, mottled dark brown (10YR 7/4) and dark reddish brown (2.5YR 3/4), high plasticity, trace root fibres, sand and limonite gravel. Apedal	M			BE, Fe horizon
			3			DOLERITE, extremely weathered, textured, mottled yellowish brown (10YR 5/8), cream and grayish blue (5Y 5/3). Some grey-blue irregular sub-horizontal + sub-vertical extremely weathered clay seams. Occasional patches of yellowish brown (10YR 5/8) extremely weathered dolerite with iron-stained sealed thin fractures. Seepage at 1.9m				C horizon

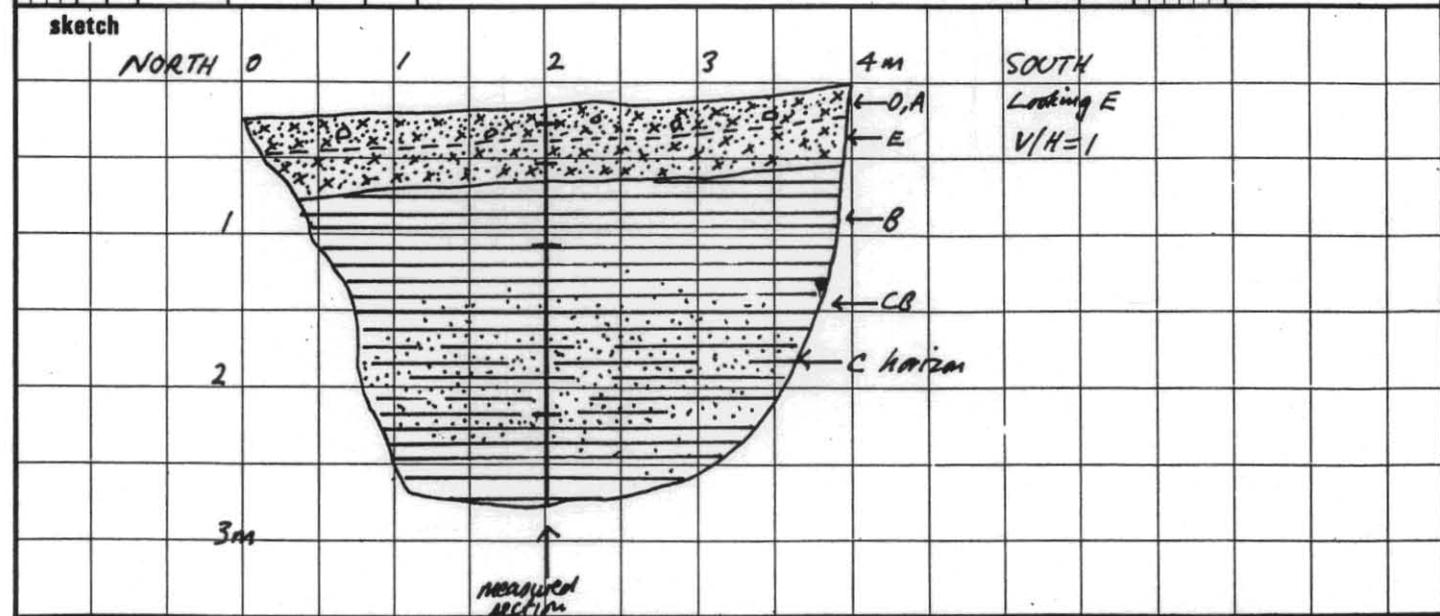


ENGINEERING LOG - EXCAVATION

project **PROSPECT TIP** location

co-ordinates 405640m N  
311993m E exposure type **Backhoe pit** pit commenced 27.5.81  
equipment **M/F 40; 600mm bucket** pit completed 27.5.81  
R.L. 112.6m operator **T. H. Cooper** logged by **W. Corner**  
excavation dimensions 4.0m x 2.6m x 0.6m checked by

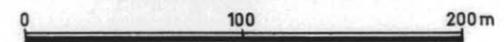
penetration 1 2 3	support water	notes samples, tests	metres R.L. depth	graphic log classification symbol	material soil type: plasticity or particle characteristics, colour secondary and minor components	moisture condition	consistency density index	hand penetr- ometer kPa	structure, geology
				OL- ML	Sandy SILT, organic, brownish, black (10YR2/2), apedal, many fine roots, grading to mottled dark brown (10YR3/3) and yellowish brown (10YR5/8), trace charcoal, angular slightly weathered dolomite (up to 50mm). Sand fraction VF	M	Fb/MD		O, A horizons
						D	H		E horizon
			1			M	VSt to PI		B horizon
					Sandy SILT, mainly dull yellow (2.5Y6/3) mottled with yellowish brown (10YR5/8). Trace angular limonite fragments. Apedal.				CB horizon
		Seepage est. 10L/hr. ↓	2	CH, CL, SC	CLAY, mottled yellowish brown (10YR5/8) and brown (10YR4/4); apedal; trace sand. Below 1m mainly grey (5Y5/1) with mottles and patches of olive brown (2.5Y4/6). Sand increases with depth, grading to sandy clay and clayey sand 1.5-2.2m. Below 2.2m, greenish grey (10G4/1) and bright yellowish brown (2.5Y6/8) high plasticity clay. Some irregular hard dark reddish brown (2.5YR3/6) patches at 2.6m. No obvious seams. Minor seepages at 2m.  Hole stopped at required depth, 2.6m.			C horizon	
			3						Soil profile developed on Tertiary sediments - probably interbedded sands and (weakly cemented) and clay.



# GEOLOGY

## PROPOSED PROSPECT LANDFILL SITE

W.C. CROMER 1981



CONTOUR INTERVAL 2m.

- QUATERNARY
  - MARSH AND CREEK DEPOSITS
  - DOLERITE SCREE AND TALUS
- TERTIARY
  - SILTY SAND SOIL DEVELOPED ON TERTIARY SEDIMENTS WITH AREAS OF FERRUGINOUS SANDSTONE INDICATED
- LIMIT OF FINISHED LANDFILL SITE
- APPROXIMATE GEOLOGICAL BOUNDARY
- INFERRED GEOLOGICAL BOUNDARY
- LOCATION NUMBER OF BACKHOE TEST PIT
- H.E.C. POWER POLE
- NUMBERED SECTION LINE. REFER FIG. 3

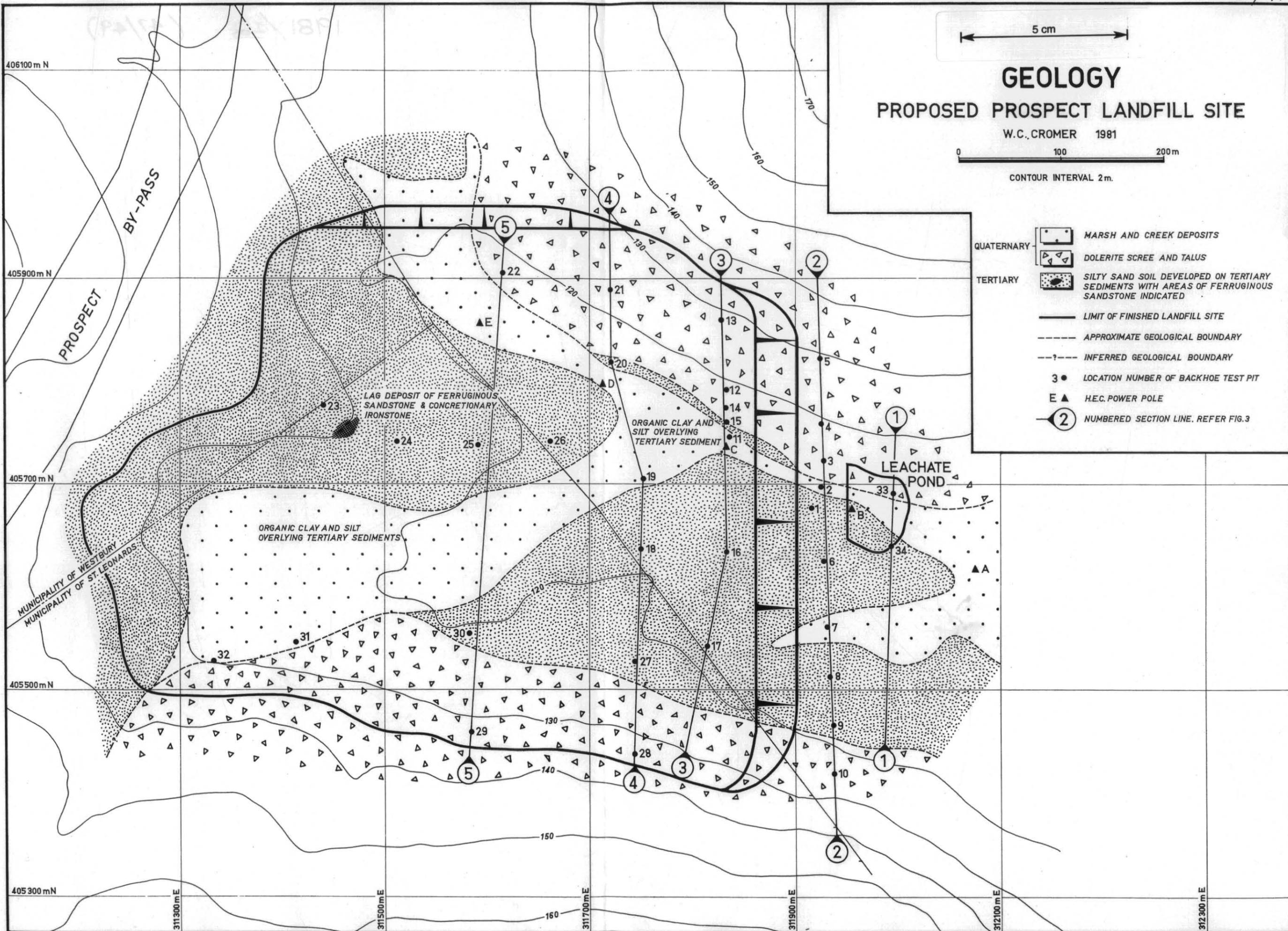
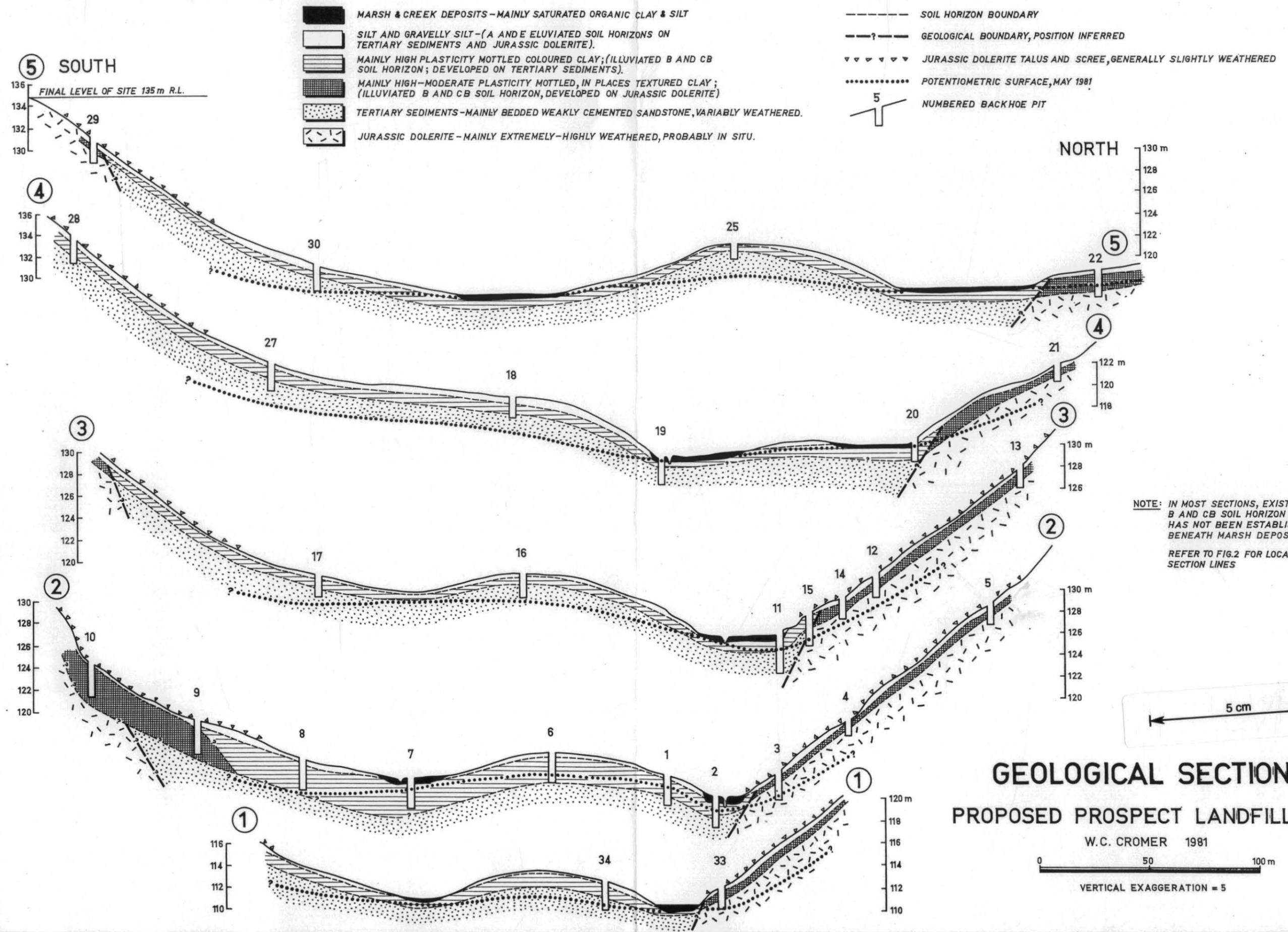


FIGURE 2



- MARSH & CREEK DEPOSITS - MAINLY SATURATED ORGANIC CLAY & SILT
- SILT AND GRAVELLY SILT - (A AND E ELUVIATED SOIL HORIZONS ON TERTIARY SEDIMENTS AND JURASSIC DOLERITE).
- MAINLY HIGH PLASTICITY MOTTLED COLOURED CLAY; (ILLUVIATED B AND CB SOIL HORIZON; DEVELOPED ON TERTIARY SEDIMENTS).
- MAINLY HIGH-MODERATE PLASTICITY MOTTLED, IN PLACES TEXTURED CLAY; (ILLUVIATED B AND CB SOIL HORIZON, DEVELOPED ON JURASSIC DOLERITE)
- TERTIARY SEDIMENTS - MAINLY BEDDED WEAKLY CEMENTED SANDSTONE, VARIABLY WEATHERED.
- JURASSIC DOLERITE - MAINLY EXTREMELY-HIGHLY WEATHERED, PROBABLY IN SITU.

- SOIL HORIZON BOUNDARY
- GEOLOGICAL BOUNDARY, POSITION INFERRED
- JURASSIC DOLERITE TALUS AND SCREE, GENERALLY SLIGHTLY WEATHERED
- POTENTIOMETRIC SURFACE, MAY 1981
- 5 NUMBERED BACKHOE PIT

NOTE: IN MOST SECTIONS, EXISTENCE OF B AND CB SOIL HORIZON (CLAY) HAS NOT BEEN ESTABLISHED BENEATH MARSH DEPOSITS.  
REFER TO FIG.2 FOR LOCATION OF SECTION LINES

**GEOLOGICAL SECTIONS**  
**PROPOSED PROSPECT LANDFILL SITE**  
 W.C. CROMER 1981  
 0 50 100 m  
 VERTICAL EXAGGERATION = 5

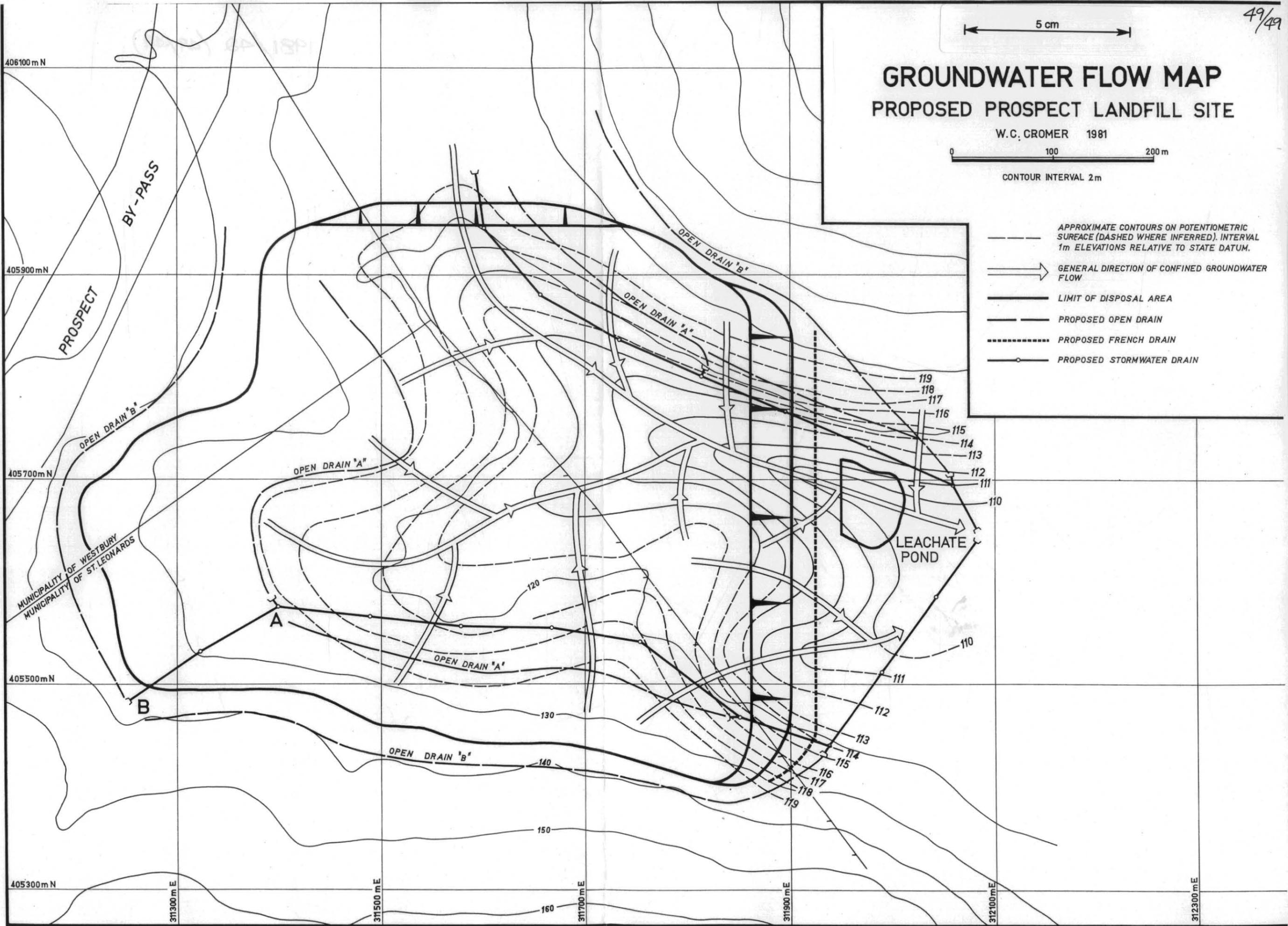


FIGURE 4