SOIL PHYSICAL PERAMETERS

Properties that are important to water holding capacity includes soil depth, bulk density, porosity, field capacity, silting pint and inclusions.

Soil depth

Summarising previous findings, depth varies from less than 1 metre on dry crests and ridges increasing to over 3 metres on lower wetter slopes. More specific depth data was not available due to the lack of resources and time.

Bulk density and porosity

Bulk densities were calculated from core samples taken in the field. These samples were also used to determine field capacity moisture levels. There were 14 sites and 28 cores were taken. See map 5. The emphasis was placed on differentiating between the extreme soil types in the areas i.e. 'wet' and 'dry'. Bulk density figures are given in Table 6, see also fig 9.

There seems to be little difference between the main soil types. However averaging has generalised the individual site data. The latter is important when looking at specific sites.

Firstly, the bulk densities are generally low. For A horizons bulk density was 0.92 gm/cm^3 for 'wet' soils and 0.99 gm/cm^3 for 'dry' soils. For B horizons the bulk density was 1.38 gm/cm^3 for 'wet' soils and 1.32 gm/cm^3 for 'dry' soils. The gley sample has a greater bulk density than the other samples: 1.56 gm/cm^3 (see table 6).

Secondly, the nature of the sampling technique has limitations. Where surface horizons are shallow it is difficult to obtain as intact core sample without also sampling some of the horizon below. For example, for a large proportion of the 'wet' soil areas there is a well developed humus layer grading into the soil (approximately 10 cm thick) which has a bulk density of only 0.75% gm/cm^3. Dry soil areas have only 2-3 cm of humus material of a similar bulk density, grading quickly into mineral horizons.

Table 6: Bulk Density for each soil type. (g/cm^2).

Soil Type:	W	(W)T	(D)T	D	O	G
Horizon						
A	0.936	0.98	0.9*	0.99	0.9*	
A/B	1.2					
B	1.384	1.22	0.92	1.32	1.31*	1.56*

Table 7: porosity for each soil type.

(i) Macro Porosity (% volume)

Soil Type:	W	(W)T	(D)T	D	O	G
Horizon						
A	17.5	11.7	20.8*	12.2	25.2*	
A/B	7.8					
B	6.2	13.4	6.6	11.2	18.9*	7.0*

(ii) Micro Porosity (% volume)

Soil Type:	W	(W)T	(D)T	D	O	G
Horizon						
A	47.2	51.6	45.1*	50.4	40.5	
A/B	47.0					
B	41.6	40.7	59.6	39.0	31.7*	34.1*

(iii) Solids (% volume)

Soil Type:		W	(W)T	(D)T	D	O	G
Horizon							
	A	15.3	36.7	35.0*	37.4	35.0*	
	A/B	45.2					
	B	52.2	46.9	34.9*	49.8	49.5	59.9*

* 1 sample   2 samples

Porosity of the soil is related to bulk density.

The macro porosity of the soil varies for each soil type see fig. 10 and appendix 2. There is a sharp decrease in macro porosity with depth in the 'wet' soil, however there is a high proportion in the upper horizons. The proportion of macro pores in the 'dry' soils is less variable through the profile (see fig. 10 and table 7).

The proportion of solid material is similar for 'wet' and 'dry' soil types (fig 10) and therefore micro-pore proportions vary according to the proportion of macro-pores. Total porosity for 'wet' soil averages 62-65% volume in the upper horizons decreasing to 50% at depth. The porosity of transitional soils is variable depending on the stage of development. For example, well-developed humic a horizons on gently sloping ground (i.e. soils subject to less soil loss) will result in higher porosity in soils subject to the a horizon. This would further be enhanced by a less bulky sub-soil (as in fig. 10) for the 'wet' transitional soil. The open structure enhanced by organic material is exemplified by the high proportion of macro and micro porosities of organic soils, particularly in the upper horizons. In contrast, the gley soil has a higher proportion of solid material throughout it s profiles.

Soil water retention

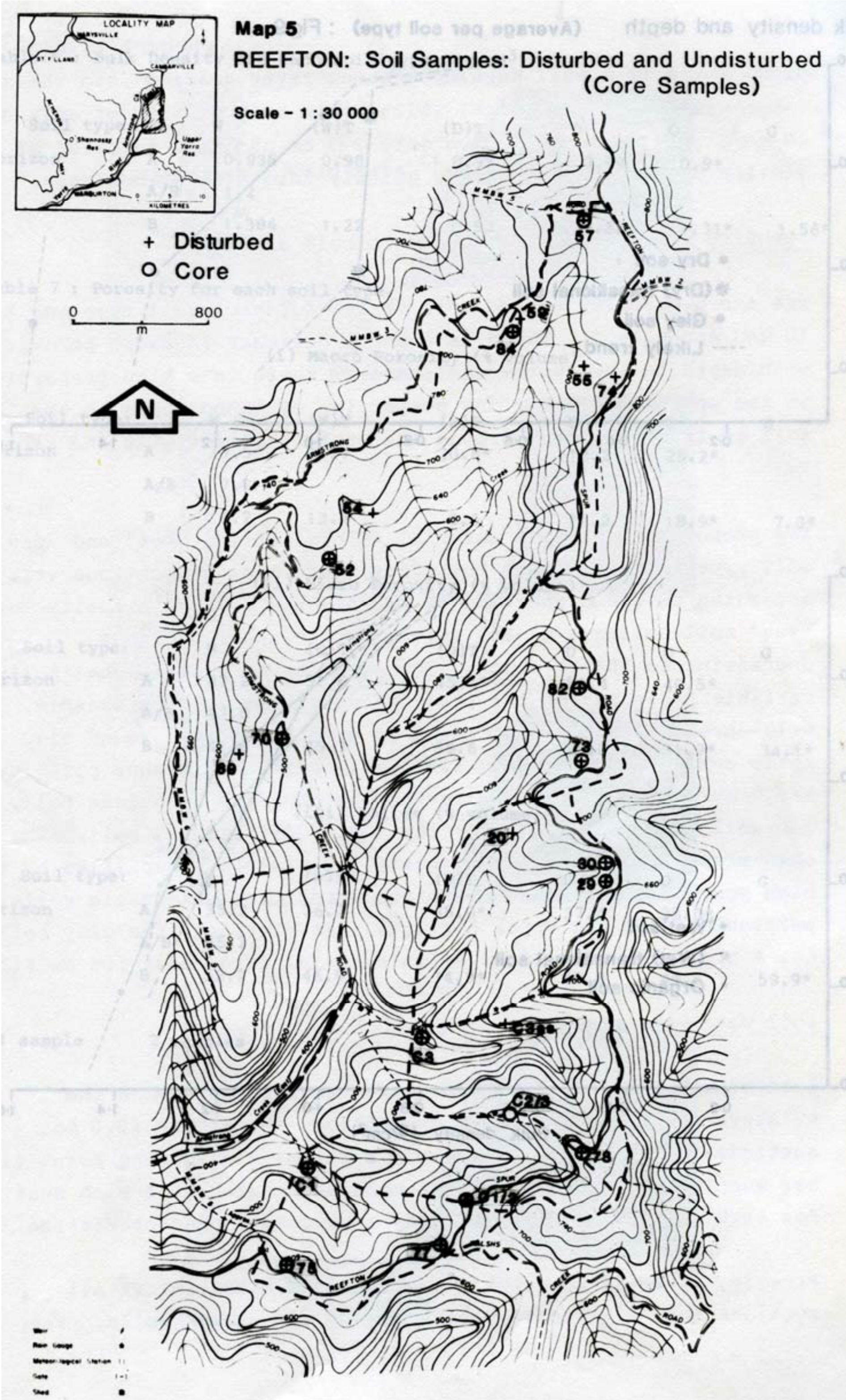
Laboratory analyses of samples were taken to determine the moisture content at 3 stages of suction; saturation (0.0 bar suction), field capacity (0.1 bar suction) and wilting point (15 bar suction). Fig 11 shows the moisture contents of each suction for each soil type which indicate a number of characteristics.

Firstly, there is an overall lower moisture content at all suctions for 'dry' soils when compared with 'wet' soils. The 'dry' transitional soil also has a lower moisture contents at depth as does the gley soil.

Secondly, for the 'dry' soil the moisture contents at the particular suctions increases with depth whereas for the 'wet' soil for low suctions, moisture contents decreases with depth. There is also a similarity between the organic soil examples and that for 'wet' soil, the former indicating a large difference in moisture content between the various suctions.

From these observations, bulk density and porosity are important in determining the differences in water content at various suctions. The characteristics discussed are reflected in the nature of the soils' appearance and hence the terminology to the various soil types. The greater capacity for holding water at depth in 'wet' soils is probably due to the increases clay content and clay mineral type and therefore the extra electrical bonding of water to clay particles.

The clay mineral type is important because some minerals absorb water up to 8 times its own weight (montmorillonite) while others are 2:1 or 1:1 lattice clays, these being the dominant clay mineral types in the study area. The erodibility section discusses cation exchange capacity which gives an indication of mineral type.



Map 5 – Reefton: Soil Samples: Disturbed and Undisturbed (Core samples)

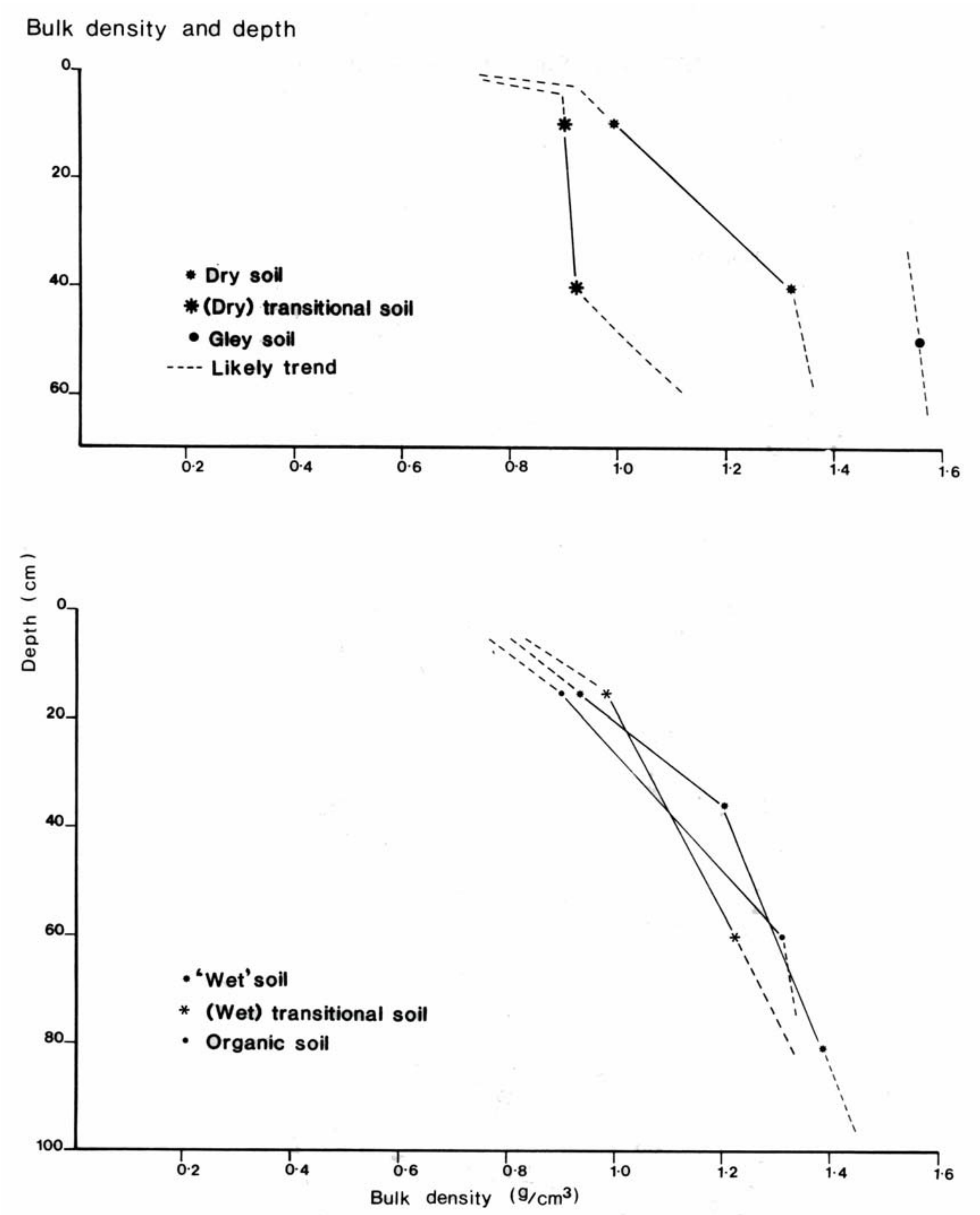


Figure 9 – Bulk Density and Depth (average per soil type)

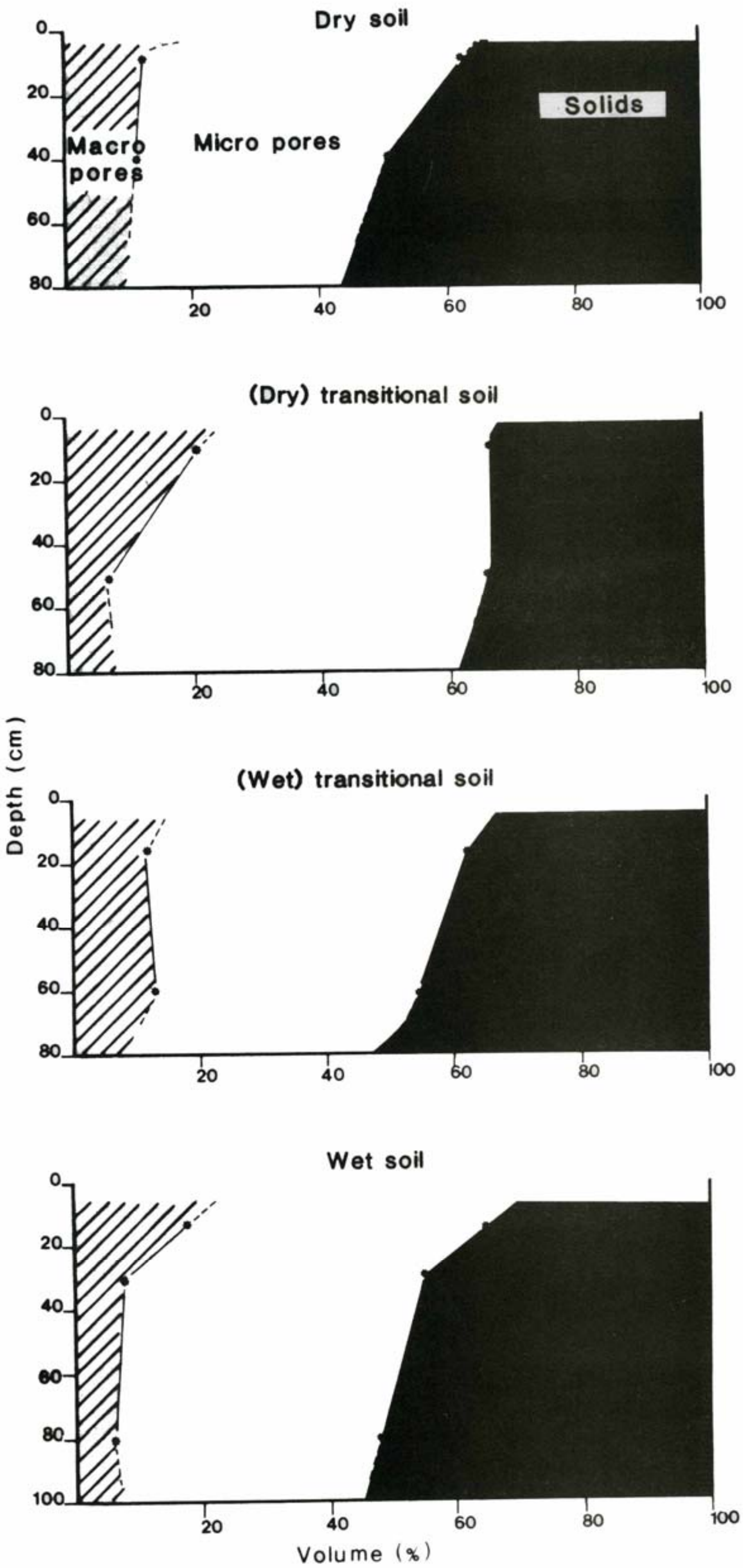


Figure 10 – Porosity

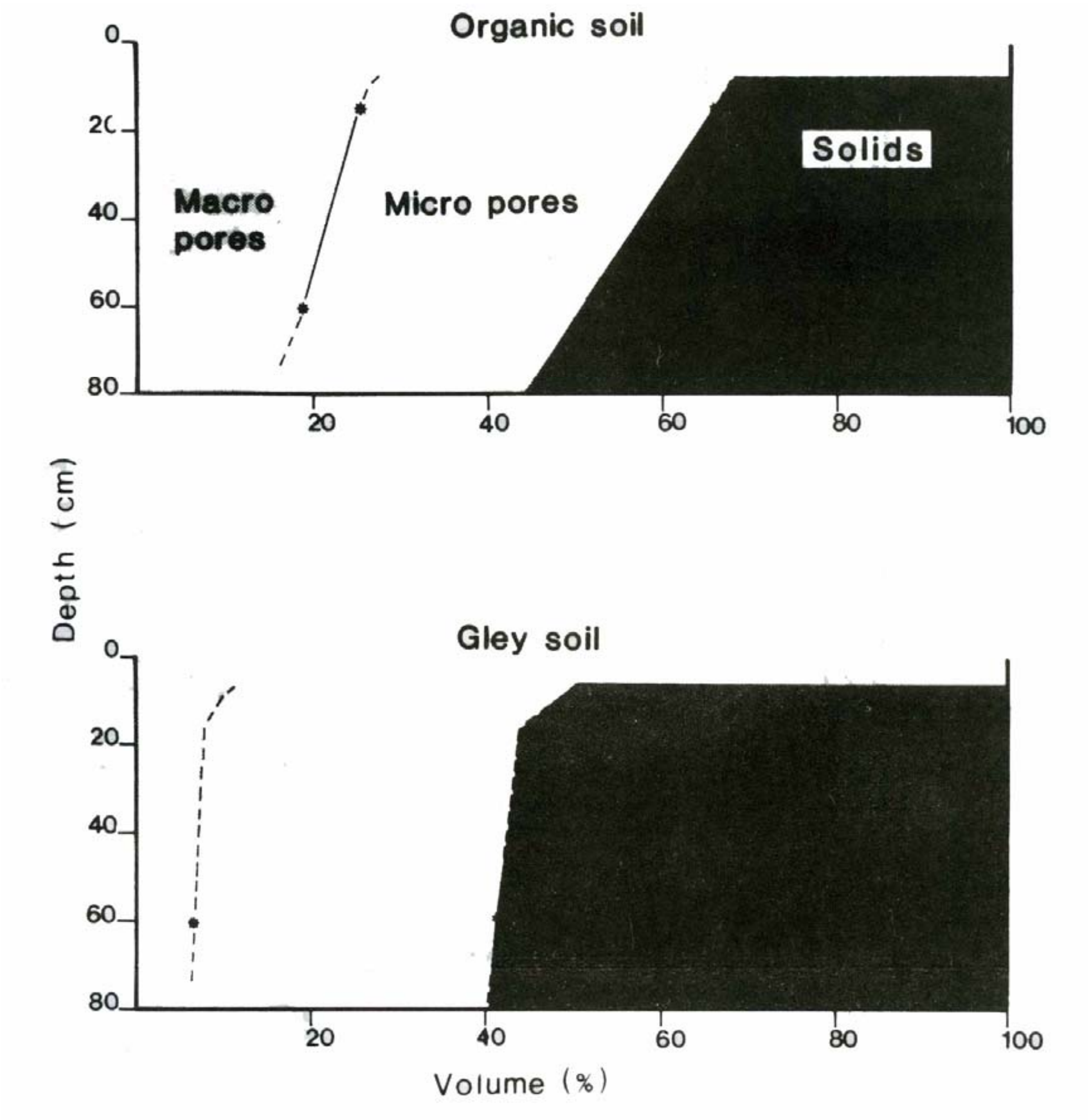


Figure 10 – Porosity

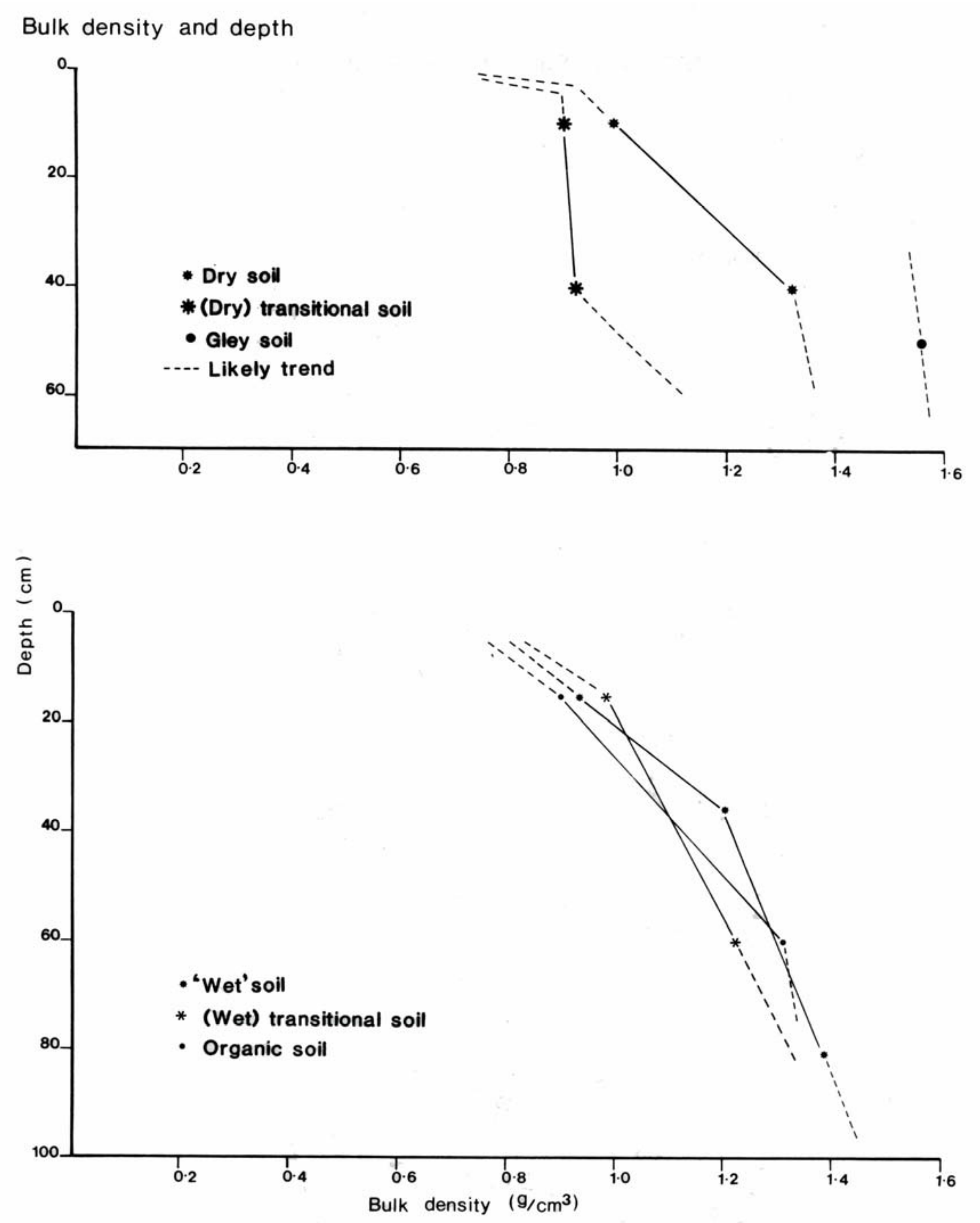


Figure 11 – Water retentivity

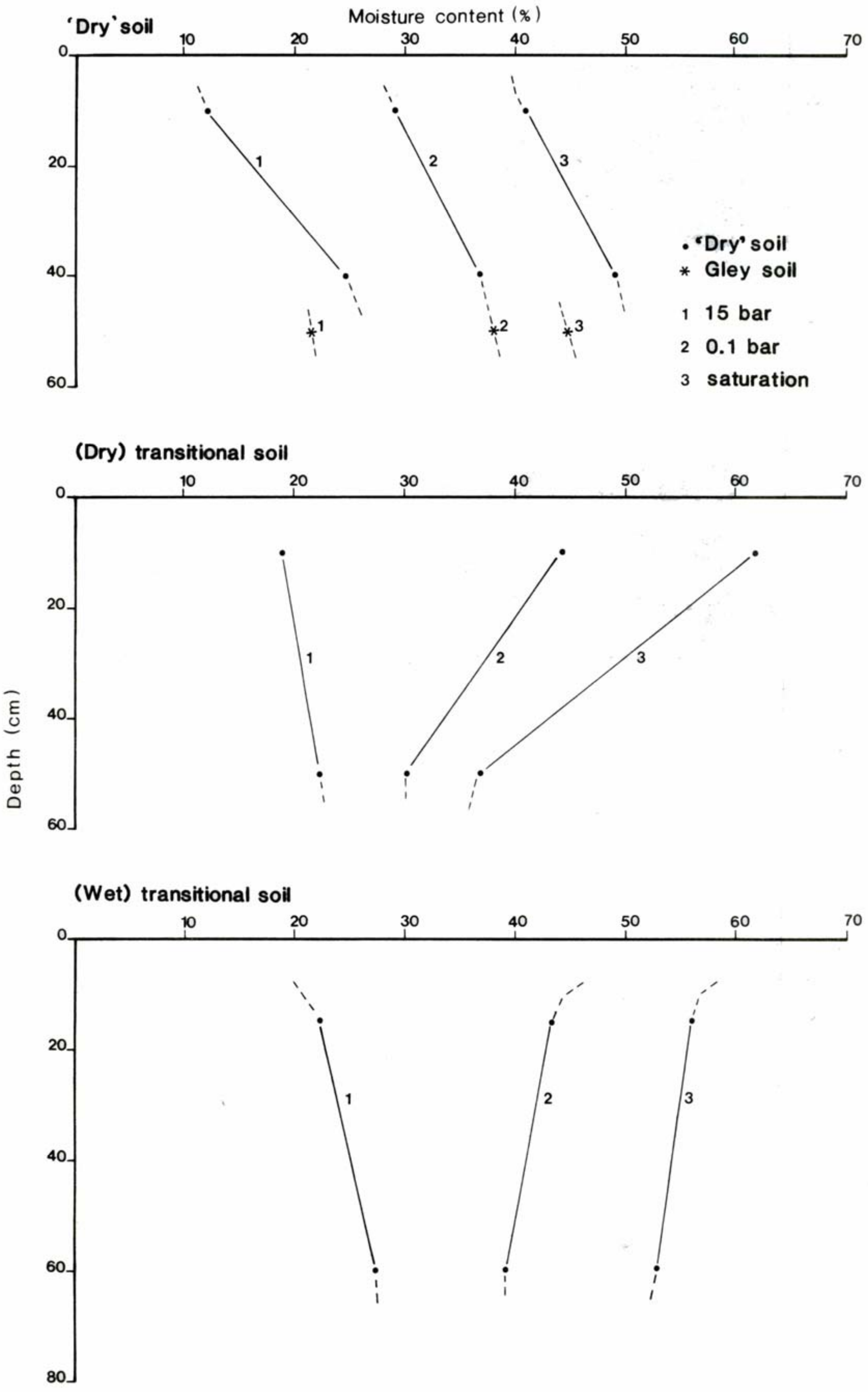


Figure 11 – Water retentivity

Available water capacity (AWC)

The available water capacity is defined as the difference between field capacity and wilting point. The former being the state of which maximum moisture is held in a drained situation i.e. no water movement down the profile and is taken here as 0.1 bar. In these examples the available water capacity is defined as the difference between 0.1 bar and 15 bar suction.

Fig 12 and Table 8 indicate the AWC's for each soil type. There is a much higher AWC for 'wet' soil, particularly the A horizons.

The very high value for the 'dry' transitional soil is only 1 sample and indicates the porosity and high organic content of the surface soil. However the general trend is from organic soil with the highest AWC (31%) to 'dry' soil with 17% AWC. The trend of the B horizons is similar; 'wet' soils have 18% AWC at depth where as the dry soils only have 12%. If calculating total water capacity for the soil, depth of soil must be taken into account. However stoniness is also an important consideration. In 'dry' soils, stoniness of the B horizons is approximately 25-30% of volume and in the 'wet' soils about 305%. Therefore the total water capacity will be reduced by these proportions using the above figures, as it relates to the earth component of the soil complex and do not account for the presence of the stone.

Table 8: Water Retention for each soil type.

(i) Saturation 9% moisture)

Soil Type:	W	(W)T	(D)T	D	O	G
Horizon						
A	61.9	55.1	61.6*	41.1	70.9*	
A/B	54.8					
B	52.5	52.8	36.9	48.0	58.5*	44.8*

(ii) Field Capacity; 0.1 bar tension (% moisture) (0.0 bar tension)

Soil Type:	W	(W)T	(D)T	D	O	G
Horizon						
A	44.1	43.4	44.4*	28.9	45.8*	
A/B	47.1					
B	46.3	39.3	30.2	36.7	39.6	37.7*

(iii) Wilting Point 15 bar tension (% moisture)

Soil Type:	W	(W)T	(D)T	D	O	G
Horizon						
A	18.9	22.2	17.7*	11.9	14.7*	
A/B	25.2					
B	28.1	27.4	22.2	24.4	21.3*	21.3*

(iv) Available Water Capacity (0.1 bar – 15bar) (%moisture)

Soil Type:	W	(W)T	(D)T	D	O	G
Horizon						
A	25.2	21.2	26.7*	17.0	31.1*	16.4*
A/B	21.9					
B	18.2	11.9	8.0	12.3	18.3*	

* 1 sample 2 samples

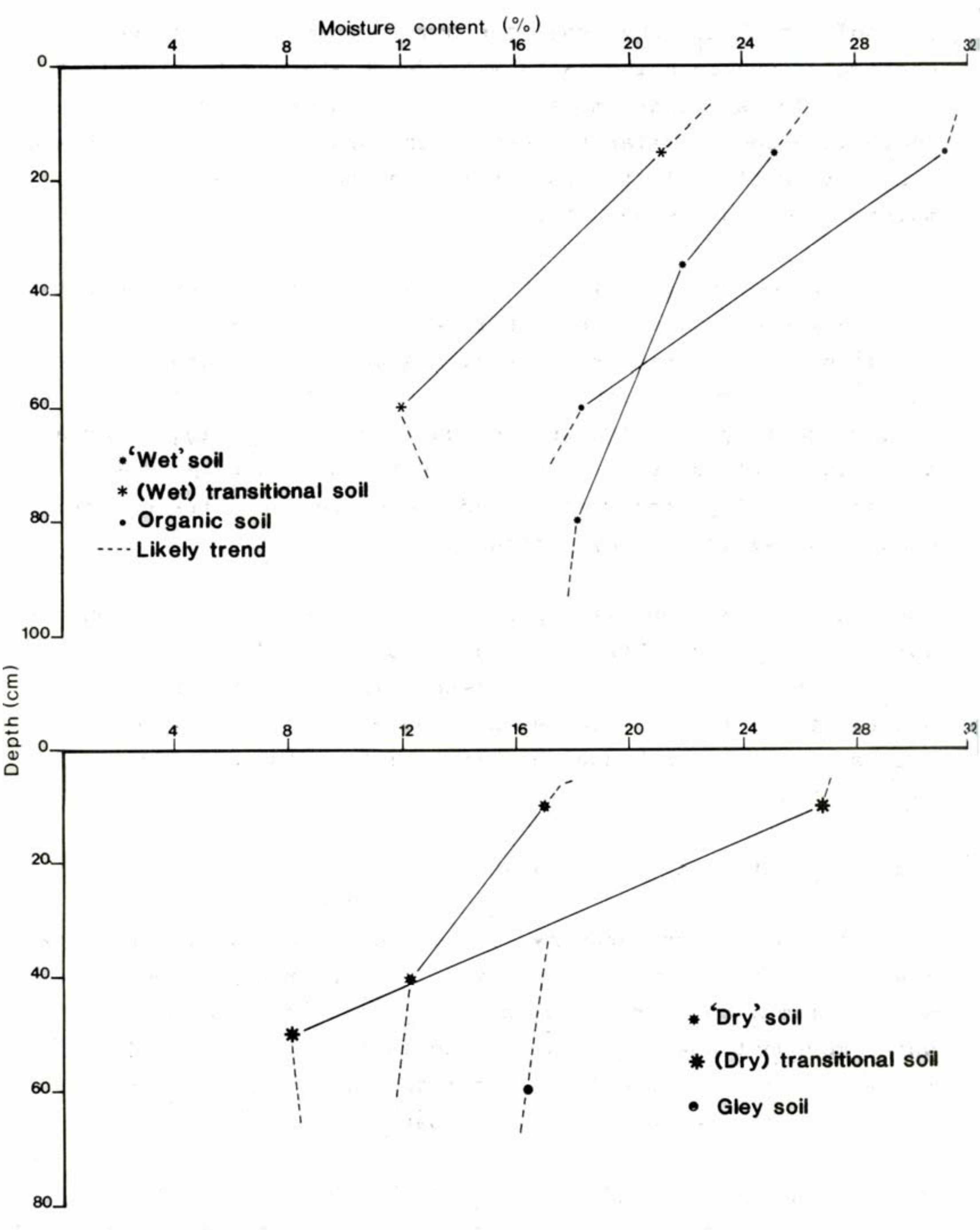


Figure 12 – Available Water Capacity (AWC)