APPENDIX III - METHODS OF SOIL ANALYSIS

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All results are expressed in terms of oven-dry soil passing a 2 mm round-hole sieve, except gravel, which is reported as a percentage of the air-dry field sample.

Particle-size analysis - plummet balance method of Hutton (1956), with sand separation by hand decantation. The I.S.S.S. size fractions were separated: i.e., coarse sand 2-0.2 mm fine sand 0.2-0.02 mm; silt 0.02-0-002 mm and clay <0.002 mm.

Electrolytic conductivity (EC 25^0 C) - a 1:5 soil water suspension was shaken for 1 hour and, after temperature equilibration, conductivity was measured with a dip cell and direct-reading meter. Results are reported as microsiemens per centimetre (µS/per cm).

Soil reaction (pH) - by glass electrode and digital pH meter on the above suspension.

Chloride (Cl^-) - by solid-state chloride electrode and millivoltmeter on the same suspension, calibrated with potassium chloride standards.

Organic carbon (Org. C) - wet-combustion technique of Walkley and Black, described by Piper (1942). No recovery factor has been applied, but the factor 1. 3 C: N was used to calculate carbon: nitrogen ratios.

Total nitrogen (N) – semi-micro Kjeldahl method of Metson (1956).

Free iron oxide (Fe_2O_3) - Haldane (1956). Finely ground soil was extracted with powdered zinc in ammonium chloride-oxalic acid buffer. Ferrous iron in the treated extract was titrated with potassium dichromate.

Hydrochloric acid extract for phosphorus and potassium (P, K) - 4 g soil was refluxed for 4 hours with 20 mL 6M hydrochloric acid, with subsequent filtration and dilution of the filtrate to 200 mL. Phosphorus was determined by a colorimetric method using molybdenum blue (Hutton, personal communication) and potassium by atomic absorption.

Available phosphorus (P avail.) - Colwell (1963). 1 g soil was shaken with 100 mL 0.5 M sodium bicarbonate at pH 8.5 for 16 hours. Phosphorus was determined in the clarified extract by a colorimetric method (molybdenum blue).

Available potassium (K avail.) - 2.5 g soil was shaken for 1 hour with 50 mL 0. 05M hydrochloric acid. After settling overnight to clear, an aliquot was diluted for potassium determination by atomic absorption.

Exchangeable cations - by extraction method of Tucker (1974), also described in Loveday (1974). Synopsis: Soluble ion removal by 10% ethanediol in ethanol. Cation displacement by ammonium chloride in ethanol-water (2:1) at pH 8.5. Cation determinations by atomic absorption. Cation exchange capacity by measurement of ammonium ion displaced from the treated soil by a potassium nitrate-calcium nitrate solution.

Water-holding properties - undisturbed soil cores 73 min diameter and 63 mm high retained in brass sleeves were saturated with water from below, weighed, then allowed to equilibrate at a water tension of 1 m on a ceramic tension plate. After re-weighing, the cores were dried at 105^0 C and weighed again. The soil was then washed through a 2 mm sieve, and gravel on the sieve was dried and weighed. The percentage of gravel by volume was calculated assuming a specific gravity of 2.65. Smaller samples of fine earth were saturated, then equilibrated at 15 atm in a pressure membrane apparatus. These were weighed, dried at 105^0 C and weighed again.

These measurements allowed the calculation of bulk density and percentage by volume of water retained at saturation, field capacity and wilting point, all on a gravel-free basis. Total porosity was derived from the function $100 \times (1 - [\text{bulk density} \div 2.65])$.

Atterberg limits - methods employed were taken from Australian Standard 1289:

Liquid limit	AS 12.89 C1.1
Plastic limit	AS 1289 C2.1
Plasticity index	AS 1289 C3.1
Linear shrinkage	AS 1289 C4.1