APPENDIX 3. LIST OF PRINCIPAL PROFILE FORMS

The principal profile forms listed and summarily defined below (*Uc1.11* etc.) are those shown on 'A Soil Map of Australia' (in *A Description of Australian Soils,* Northcote and others 1975), from which the accompanying folded map 'Australia: Soil Resources' was derived.

Various scientific terms, not all of them used in the main text or on the map, appear here and in Appendix 4. Some are briefly defined (in footnotes) but for full descriptions, including those used for such seemingly everyday terms as *yellow* or *shallow*, see the above-mentioned publication or *A Factual Key for the Recognition of Australian Soils* (Northcote 1971).

U **SOILS WITH UNIFORM TEXTURE PROFILES**

Uc **Sands**

Uc1.1 Loose Calcareous Sands—
.11 whitish
.12 yellow

Uc1.2 Loose Siliceous Sands—
.21 whitish
.22 yellow
.23 red

Uc1.3 Firm Calcareous Sands—
.31 whitish

Uc1.4 Firm Siliceous Sands—
.41 whitish
.42 yellow
.43 red

KS-Uc1.43 as *.43* but ironstone gravelly

Uc2.1 Bleached Sands—
.12 siliceous rock at shallow depth

Uc2.2 Bleached Sands with Colour B Horizon—
.21 grey-brown to reddish brown B horizon

KS-Uc2.21 as *.21* but ironstone gravelly
.22 as *.21* but mottled
.23 gley colours in B horizon

Uc2.3 Bleached Sands with Subsoil Pan—
.33 very dark brown to black pan
.34 light grey-brown pan
.35 upper white pan over lower black pan
.36 upper black pan over lower yellow pan

Uc4.1 Pale Sands without B Horizons—
.11 grey-brown A_2 horizon

KS-Uc4.11 as *.11* but ironstone gravelly
.12 yellow A_2 horizon

KS-Uc4.12 as *.12* but ironstone gravelly

Uc4.2 Pale Sands with Colour B Horizon—
.21 yellow-brown B horizon

KS-Uc4.21 as *.21* but ironstone gravelly
.22 red-brown B horizon

Uc5.1 Loose Brownish Sands—
.11 no cemented layers
.12 carbonate pan in subsoil
.13 earthy pan in subsoil

Uc5.2 Sands with Coherent Earthy Subsoils—
.21 red

KS-Uc5.21 as *.21* but ironstone gravelly
.22 yellow

KS-Uc5.22 as *.22* but ironstone gravelly
.23 yellowish brown

Uc6.1 Shallow Weakly Structured Sandy Soils—
.11 grey-brown
.13 red-brown

Um **Loams**

Um1.1 Loose Calcareous Loams

Um1.2 Loose Siliceous Loams

Um1.3 Firm Shallow Calcareous Loams

Um1.4 Firm Shallow Siliceous Loams—
.41 grey-brown
.42 yellow
.43 red-brown

Um2.1 Shallow Bleached Loams—
.12 siliceous rock at shallow depth

Um4.1 Pale Loams—
.11 grey-brown

Um4.2 Pale Loams with Colour B Horizon—
.21 red-brown
.22 yellow-brown

Um4.3 Pale Loams with Rough-ped B Horizon—
.31 red-brown B horizon

Um4.4 Pale Loams with Smooth-ped B Horizon—
.41 red-brown B horizon
.43 yellow B horizon

Um5.1 Powdery Calcareous Loams—
.11 shallow

Um5.2 Powdery Non-calcareous Loams—
.21 shallow
.22 deep

Um5.3 Earthy Loams underlain by Red-brown Hardpan—
.31 red-brown

Um5.4 Dense Loams—
.41 shallow

Um5.5 Earthy Loams—
.51 shallow
.52 deep

Um5.6 Coherent Calcareous Loams showing Profile Development—
.61 shallow

Um6.1 Friable Loams with Rough-ped B Horizon—
.11 dark B horizon
.12 brown B horizon
.13 red B horizon
.14 grey-brown B horizon

Um6.2 Shallow Friable Loams with Rough-ped Fabric—
.21 dark subsurface soil
.22 grey-brown subsurface soil
.23 brown subsurface soil
.24 red subsurface soil

Um6.3 Friable Loams with Smooth-ped B Horizon—
.33 red B horizon
.34 yellow-brown B horizon

Um7.1 Organic Loams—
.11 A_1 horizon well developed
.12 O horizon well developed

Uf **Non-cracking Clays**

Uf1.4 Development Minimal—
.41 grey, saline

Uf5.2 Subplastic Clays of Low Subsoil Coherence—
.21 red-brown

Uf6.1 Shallow Friable Clays with Rough-ped Fabric—
.12 brown

Uf6.2 Crumbly Clays—
.22 dark

Uf6.3 Shallow Friable Clays with Smooth-ped Fabric—
.31 brown
.32 dark

Uf6.4 Dense Pedal Clays—
.42 dark

Uf6.5 Dense Clays—
.51 grey-brown, saline

Uf6.6 Plastic Clays—
.61 grey and grey-brown, saline
.62 yellow-brown, saline

Uf6.7 Coherent Porous Clays—
.71 brown and red-brown

Ug **Cracking Clays**

Ug5.1 Black, Self-mulching—
.11 highly calcareous subsoil
.12 shallow
.13 moderately deep, brown subsoil
.15 deep, brown subsoil
.16 deep, grey subsoil
.17 underlain by buried soils, saline

Ug5.2 Grey, Self-mulching—
.22 moderately deep
.24 deep, continues grey
.25 deep, brown subsoil
.28 deep, yellow-grey
.29 deep, yellow-grey then brown

Ug5.3 Brown and Red, Self-mulching—
.32 moderately deep, brown
.34 deep, brown
.35 deep, grey subsoil
.37 moderately deep, red
.38 deep, red

Ug5.4 Black, Massive

Ug5.5 Grey, Massive

G **SOILS WITH GRADATIONAL TEXTURE PROFILES**

Gc **Calcareous Earths**

Gc1.1 Apedal, Highly Calcareous—
.11 dark
.12 grey-brown

Gc1.2 Apedal, Calcareous—
.22 brown

Gc2.2 Pedal, Calcareous—
.21 weak clay B horizon above main carbonate zone
.22 no weak clay B horizon above main carbonate zone

Gn **Non-calcareous Earths**

Gn2 Massive Earths

Gn2.1 Red—
.11 acid

KS-Gn2.11 as *.11* but ironstone gravelly
.12 neutral
.13 alkaline
.14 acid with A_2 horizon
.15 neutral with A_2 horizon

Gn2.2 Yellow—
.21 acid
.22 neutral
.24 acid with A_2 horizon
.25 neutral with A_2 horizon

Gn2.3 Yellow, Bleached—
.32 neutral with sporadic bleach
.34 acid with conspicuous bleach

Gn2.4 Brown or Mottled Red—
.42 neutral

Gn2.6 Mottled Yellow—
.61 acid
.62 neutral
.63 alkaline
.64 acid with A_2 horizon

Gn2.7 Mottled Yellow, Bleached—
.74 acid with conspicuous bleach

Gn2.8 Grey—
.81 acid
.82 neutral
.83 alkaline
.84 acid with A_2 horizon

Gn2.9 Grey, Bleached—
.94 acid with conspicuous bleach
.95 neutral with conspicuous bleach

Gn3 Structured Earths with Smooth-ped B Horizons

Gn3.1 Red—
.10 strongly acid
.11 acid
.12 neutral
.13 alkaline
.14 acid with A_2 horizon

Gn3.2 Brown—
.21 acid
.22 neutral
.24 acid with A_2 horizon

Gn3.4 Black—
.42 neutral
.43 alkaline

Gn3.5 Mottled Brown and Red—
.51 acid
.52 neutral
.54 acid with A_2 horizon

Gn3.7 Yellow—
.71 acid
.74 acid with A_2 horizon

Gn3.9 Grey—
.91 acid

Gn3.0 Grey, Bleached—
.04 acid with conspicuous bleach

Gn4 Structured Earths with Rough-ped B Horizons

Gn4.1 Red—
.11 acid
.14 acid with A_2 horizon

Gn4.3 Brown—
.31 acid

Gn4.4 Black—
.41 acid
.42 neutral

D **DUPLEX—SOILS WITH TEXTURE CONTRAST PROFILES**

Dr **Red Duplex Soils**

Dr1 Crusty Red Duplex Soils

Dr1.1 No A_2 Horizon—
.13 alkaline

Dr1.3 Sporadically Bleached A_2 Horizon—
.32 neutral
.33 alkaline

Dr1.4 Bleached A_2 Horizon—
.43 alkaline

Dr2 Hard-setting Red Duplex Soils

Pedal Subsoils

Dr2.1 No A_2 Horizon—
.11 acid
.12 neutral
.13 alkaline

Dr2.2 Unbleached A_2 Horizon—
.21 acid
.22 neutral
.23 alkaline

Dr2.3 Sporadically Bleached A_2 Horizon—
.31 acid
.32 neutral
.33 alkaline

Dr2.4 Bleached A_2 Horizon—
.41 acid
.42 neutral
.43 alkaline

Apedal Subsoils

Dr2.6 Unbleached A_2 Horizon—
.61 acid

Dr2.8 Bleached A_2 Horizon—
.81 acid

Dr3 Hard-setting Mottled Red Duplex Soils, Pedal Subsoils

Dr3.2 Unbleached A_2 Horizon—
.22 neutral

Dr3.4 Bleached A_2 Horizon—
.41 acid

Dr4 Friable Red Duplex Soils, Pedal Subsoils

Dr4.1 No A_2 Horizon—
.12 neutral

Dr4.2 Unbleached A_2 Horizon—
.21 acid

Dr4.4 Bleached A_2 Horizon—
.41 acid

Db **Brown Duplex Soils**

Db1 Hard-setting Brown Duplex Soils, Pedal Subsoils

Db1.1 No A_2 Horizon—
.13 alkaline

Db1.2 Unbleached A_2 Horizon—
.22 neutral

Db1.3 Sporadically Bleached A_2 Horizon—
.33 alkaline

Db1.4 Bleached A_2 Horizon—
.42 neutral

Db3 Friable Brown Duplex Soils, Pedal Subsoils

Db3.1 No A_2 Horizon—
.12 neutral

Dy **Yellow and Yellow-Grey Duplex Soils**

Dy2 Hard-setting Yellow Duplex Soils

Pedal Subsoils

Dy2.2 Unbleached A_2 Horizon—
.21 acid
.22 neutral

Dy2.3 Sporadically Bleached A_2 Horizon—
.33 alkaline

Dy2.4 Bleached A_2 Horizon—
.41 acid
.42 neutral
.43 alkaline

Apedal Subsoils

Dy2.6 Unbleached A_2 Horizon—
.61 acid

KS-Dy2.62 neutral, ironstone gravelly

Dy3 Hard-setting Mottled Yellow Duplex Soils

Pedal Subsoils

Dy3.2 Unbleached A_2 Horizon—
.21 acid
.22 neutral

Dy3.3 Sporadically Bleached A_2 Horizon—
.31 acid
.32 neutral
.33 alkaline

Dy3.4 Bleached A_2 Horizon—
.41 acid
.42 neutral
.43 alkaline

Apedal Subsoils

Dy3.6 Unbleached A_2 Horizon—
.61 acid
.62 neutral

Dy3.8 Bleached A_2 Horizon—
.81 acid
.82 neutral
.83 alkaline

Dy5 Sandy Mottled Yellow Duplex Soils

Pedal Subsoils

Dy5.4 Bleached A_2 Horizon—
.41 acid
.42 neutral
.43 alkaline

Apedal Subsoils

Dy5.6 Unbleached A_2 Horizon—
.61 acid

Dy5.8 Bleached A_2 Horizon—
.81 acid
.82 neutral
.83 alkaline

Dd **Black Duplex Soils**

Dd1 Hard-setting Black Duplex Soils, Pedal Subsoils

Dd1.1 No A_2 Horizon—
.13 alkaline

Dd1.3 Sporadically Bleached A_2 Horizon—
.33 alkaline

Dd2 Hard-setting Mottled Black Duplex Soils, Pedal Subsoils

Dd2.3 Sporadically Bleached A_2 Horizon—
.33 alkaline

Dg **Gley Duplex Soils**

Dg2 Hard-setting Gley Duplex Soils, Pedal Subsoils

Dg2.4 Bleached A_2 Horizon—
.41 acid

Dg4 Friable Gley Duplex Soils, Pedal Subsoils

Dg4.1 No A_2 Horizon—
.11 acid

O **ORGANIC SOILS**

U signifies soils with *Uniform texture profiles*, that is, soils in which there is little change in texture grade between the surface and the subsoil: clay content does not increase significantly with depth.

Uc = sands and sandy loams
Um = loams and clay loams
Uf = clays
Ug = cracking clays

G signifies soils with *Gradational texture profiles*, that is, soils in which texture grades become gradually finer with depth: clay content increases gradually with depth.

Gc = soils that are calcareous in both surface soil and subsoil
Gn = soils that are not calcareous in surface soils

D signifies soils with *Duplex (texture contrast) profiles*, that is, soils in which the texture grade suddenly becomes finer: clay content increases markedly between surface soil and subsoil.

Dr = red clayey subsoils
Db = brown clayey subsoils
Dy = yellow clayey subsoils
Dd = black clayey subsoils
Dg = gley clayey subsoils

O signifies soils rich in fresh or partly decomposed organic matter in at least the top 30 cm of the profile.

KS is prefixed to the notation for soils in which ironstone gravels form the bulk of the soil material.

GLEY refers to the grey, blue-grey, greenish grey and yellow colours produced in the soil by partial oxidation and reduction of iron caused by intermittent waterlogging. The *Dg* soils exhibit these colours particularly clearly in their B horizons, while in the B horizons of some other soils such as *Dy3.4* or *Dy5.4* gley colours, although present, are not as pronounced.

HORIZONS refer to the different soil layers with features produced by soil-forming processes. The surface soil, or A_1 horizon, is the site of the main biological activity, for example fresh organic matter accumulation within the soil. Below this, the subsurface soil, or A_2 horizon, shows decreased biological activity and is the main site of subsurface waterlogging which, when present, is evidenced by whitish (bleached) soil colours. The subsoils, or B horizons, represent a major change within the profile, being mineral soil layers showing concentrations of clay, sesquioxides or modified organic materials and having soil colours, structure and consistence unlike those of the A horizons. (The international convention for denoting horizons with subscript numbers, for example A_1, A_2, is followed here. This should not be confused with the labelling of interpretative map units, for example A1, A2.)

PEDAL refers to the dominating presence of natural soil aggregates (peds) in the soil mass, whereas apedal means that few such peds are present.

APPENDIX 4. THE SOILS OF EACH MAPPING UNIT

Mapping Unit	Factual Key Soil Class/ Profile Form	Properties	Associated Landforms
A1	*Um4.3; Um5.22* on depositional plains of < 15m relief; *Um6.11; Um6.14; Um6.3*	Deep loam soils usually friable, permeable and of good AWC. They have acid, neutral or alkaline SRT. Soil fertility is moderate and continues thus even with intensive use, which requires N and P.	Mainly plains and terraces but also some hill slopes.
A2	*Dr2.2; Dr2.6; Dr3.2; Dr4.1; Dr4.2; Db1.2; Db3.1; Dy2.2; Dy3.2*	Deep duplex soils with soft, friable surface soils in *Dr4* and *Db3* otherwise they are hard-setting; all are friable and of good tilth when moist. Subsoil clays are naturally friable but permeability decreases slightly from *Dr* through *Db* to *Dy*. AWC is good. SRT covers acid, neutral and alkaline ranges. Inherent soil fertility is moderate and continues thus even with intensive use, but some micro-nutrient deficiencies may occur in acid (Mo) and alkaline (Zn) forms, otherwise P and N are the only nutrients required.	Nearly flat plains to steep hill slopes.
Ba1	*Um4.4; Um6.12; Um6.13*	Deep highly structured loams with good AWC and good permeability. They have mainly acid to neutral SRT and moderate to high inherent fertility which declines rapidly with intensive use; responses to Mo, S, Mn and K as well as N and P are likely.	Mainly hill slopes and plateau remnants but also some plains and terraces.
Ba2	*Uf5.2*	Deep highly structured clays with good AWC and good permeability. They have acid SRT and high inherent fertility which declines with intensive use, when N and P become necessary.	Mainly tableland remnants but also some undulating plains.
Ba3	*Gn3.1; Gn3.2; Gn3.4; Gn3.5; Gn3.7; Gn3.9; Gn3.0; Gn4.1; Gn4.3; Gn4.4*	Deep highly structured earths with very good to only moderate AWC. Permeabilities range from very high (*Gn4.1*) through high (*Gn3.1*) to those with slow subsoil drainage (*Gn3.0*). SRT covers acid, neutral and alkaline ranges with the two former being more widespread. Inherent soil fertility is high (*Gn4.1, Gn3.1*) but decreases to low-moderate (*Gn3.0*). With intensive use following clearing, responses to S, Mo and K as well as P and N are common.	Mainly tablelands and their remnants but also hill slopes, plains and terraces.
Bb1	*Um5.52*	Deep massive porous loams that are moderately permeable and have low-moderate AWC and acid to neutral SRT. Inherent fertility is variable and not well known but N and P contents are low to very low.	River deltas and levees.
Bb2	*Um7.1*	Acid organic loam soils with high AWC and very good permeability but very low inherent fertility.	Mountain crests and slopes in alpine and subalpine areas.
Bb3	*Uf6.71*	Similar to Bb1 but the properties of these clays are not well known.	Alluvial plains.
Bb4	*Gn2.1; Gn2.2; Gn2.3; Gn2.4; Gn2.6; Gn2.7; Gn2.8; Gn2.9*	Deep massive earths noticeably porous in their subsoils, which may be hard to very hard when dry but become friable when moist. AWC is low-moderate. Permeabilities range from high in the redder soils *(Gn2.1)* through moderate in the yellower soils (*Gn2.2, .6, .7*) to low with periodic waterlogging in the greyer soils (*Gn2.8, .9*). SRT covers acid, neutral and alkaline ranges with the two former being more widespread. Inherent soil fertility is low to very low and deficiencies of S, Mo, Cu, Zn, B and sometimes Ca and Mg, as well as of N, P and K, are known.	Terraces, levees and fans to large plains and pediments, hill slopes and tableland crests throughout the northern two-thirds of Australia.
Bb5	*Dy2.6; Dy3.6; Dy3.8; Dy5.6*	Duplex soils often containing large amounts of ironstone gravels in their surface soils, which are only moderately permeable while their yellow clay subsoils are distinctly less permeable and restrict water penetration. Thus they are similar to yellow Cd2 soils but require trace elements Zn, Cu and/or Mo as well as large and continuous applications of P before they can be developed. Due to periodic subsurface waterlogging, AWC is lower than it should be due to the loss of water laterally. Acid and neutral forms are most common but some alkaline forms are known.	Undulating to hilly lands derived from dissection of lateritic plateaux.
Bc1	*Uc1.1*	Deep calcareous sands that are highly permeable and excessively drained so that AWC is low. Inherent fertility is very low and deficiencies of Co, Cu, Zn, B, Fe, Mn, as well as N, P and K, have been reported.	Mainly dunes but also some sand sheets around the coastline.
Bc2	*Gc1.1; Gc1.2; Gc2.2*	The calcium carbonate content of these calcareous earths is very variable, ranging from >50% in *Gc1.1* to 15-30% in *Gc1.2* and *Gc2.2*, which are the better soils. They also usually have an ESP < 15% whereas *Gc1.1* soils have an ESP of >15%. *Gc1.2* and *Gc2.2* have moderate AWC and permeability although it may be restricted by subsoils. Drainage problems are more severe in *Gc1.1*. Inherent fertility is low to moderate with Zn, Mn and Fe being important as well as N and P.	Undulating plains, dunes, and some low hilly terrain; mainly in semi-arid to arid areas.
Bd1	*Um1.1; Um1.2*	Young loam soils on saline alluvia and ranging from shallow to deep. Plant growth is restricted by high contents of soluble salts. Inherent fertility is low.	Alluvial plains in the more arid areas.
Bd2	*Uf1.4; Uf6.5; Uf6.6; Ug5.17*	Slowly permeable clay soils which are highly saline, thus greatly limiting plant growth.	Riverine and coastal plains.
Bd3	*Dr1.1; Dr1.3; Dr1.4*	These red duplex soils, although superficially like other *Dr* soils, have much higher soluble salt contents: some surface soils have >0.1% NaCl while subsoils range up to 1% NaCl. Hence permeabilities are low, runoff is high (crusty, dispersible surface soil), and AWC is very low. Inherent fertility is low.	Stony plains, pediments, tablelands and some flood plains in the more arid areas.
Ca1	*Uc1.2* if deep; *Uc1.43* on depositional plains of < 15m relief; *Uc2.2; Uc4.2* if deep; *Uc5.1* if deep	Low AWC and low inherent fertilities restrict the use of these sand soils. The surface sand is often difficult to wet when dry and thus limits water entry. Deficiencies of N, P and K are common to all with Zn, Mn and Cu also in *Uc5.1,* and S, Cu, Mo, Zn and Ca and Mg being likely in the others.	Mainly dunes but also some plains.
Cb1	*Ug5.11-.16; Ug5.2; Ug5.3*	Heavy rains penetrate rapidly down the cracks of dry *Ug* soils, but cracks quickly close and the moist to wet soil has a very low permeability and high runoff. AWC is low to very low. The finer structured forms *Ug5.1, .2* and *.3* generally have a better water acceptance and storage in their surface soils than do the coarser forms *Ug5.4* and *.5*. Subsoil accumulations of soluble salts may be a hazard under irrigation with *Ug5.1* least affected and *Ug5.4* and *.5* most affected. Inherent fertility ranges from high to low. P content varies greatly and in some *Ug5.1* was originally high enough for grain cropping without added P fertiliser. P, N, Zn, Mo, S, Mn, Cu are now being used increasingly on these soils for growing crops.	From plains and undulating terrain in bottom lands to rolling and hilly uplands.
Cb2	*Ug5.4; Ug5.5*		
Cc1	*Dr2.1; Dr2.3; Db1.1; Db1.3; Dy2.3; Dy3.3; Dd1.1; Dd1.3; Dd2.3*	Duplex soils commonly with thin (5–20 cm) surface soils which initially may be difficult to wet due to their hard-setting nature. Once moist, they are moderately permeable. Through drainage is restricted by the dispersible (puddly) subsoil clays, which are sodic (ESP >6) to highly sodic (ESP >15); this restriction increases from *Dr* through *Db* to *Dy* and *Dd*, in which some periodic saturation of the surface soil may occur. AWC is fair but may be improved by amelioration with gypsum. SRT ranges from acid to neutral and alkaline. Inherent fertility is low to moderate and deficiencies of S, Mo, Zn and Cu as well as P and N are likely. Gypsum and/or lime may be necessary to correct for low Ca and high Al contents in some acid forms, especially in *Dy* and *Dd* soils.	From plains, fans and terraces to slopes of hills, plateaux and mountains.
Cd1	*Uc2.3*	Sand soils with hardpans usually in the upper subsoil but also in the lower subsurface soil. The surface soils are highly permeable but the hardpans are only slowly permeable. This results in seasonally perched water in the subsurface sand, which may become fluid. The duration of this perched watertable depends on rainfall incidence and site. Inherent fertility is very low in these strongly leached acid sands. Deficiencies of Ca, Mg, S, Cu, Co, Zn, Mo as well as N, P and K are likely. Correction of these by adding fertilisers achieves best results after amelioration of hardpans and adequate drainage to improve AWC and soil aeration.	Mostly plains and dunes in coastal areas but also wet valleys in some mountain regions.
Cd2	*Dr2.4; Dr2.8; Dr3.4; Dr4.4; Db1.4; Dy2.4; Dy3.4; Dy5.4; Dy5.8*	Duplex soils with surface soils ranging from sand to loam commonly 20 cm or more thick. They have low to moderate permeabilities. Many subsoils are sodic (ESP > 6) to highly sodic (ESP >15) and all are only slowly permeable causing intermittent perched water in the subsurface horizon and partial saturation of the upper subsoil during wet seasons. The severity of this saturation increases from *Dr* through *Db* to *Dy*. The perched water is lost laterally from the soil, that is, it does not penetrate into the deeper subsoil layers, so stored moisture for plant use during dry periods is limited. Thus actual AWC is lower than it would be if amelioration of subsoils by ripping plus addition of gypsum was carried out. SRT ranges from acid to neutral and alkaline forms. Inherent fertility is low to very low (*Dy5.4* and *Dy5.8*), always being poorer in the acid forms. Deficiencies of S, Mo, Cu, Zn as well as N, P and K are known. In acid forms, especially *Dy3.41, Dy5.41, Dy5.81,* contents of all metal cations are often very low while Al may be high. Thus gypsum and/or lime treatments could be beneficial.	From plains, fans and terraces to slopes of hills, plateaux and mountains.
Ce1	*Uf6.42*	Clay soils with gleyed subsoils that are only slowly permeable and, due to this and the poorly drained sites in which they occur, are periodically saturated. SRT is acid to neutral and inherent fertility varies but P contents are low. Drainage is a prime prerequisite for development.	Coastal plains.
Ce2	*Dg2.4; Dg4.1*	Duplex gley soils occurring in poorly drained sites which, coupled with low subsoil permeabilities, causes their periodic saturation. SRT ranges from acid to neutral and alkaline. Inherent fertility is low and the most important nutrients required are P, N, K, Ca, Mo, Zn and Cu but drainage is the prime prerequisite to the use of these soils.	Low-lying parts of plains, fans and lower hill slopes.
Cf1	*Uc1.3; Uc1.4; Uc2.1; Uc5.2; Uc6.1;* also shallow forms of *Uc1.2, Uc4.1, Uc4.2, Uc5.1*	Sand soils mostly permeable but shallow (< 60 cm thick) and with low AWC on this account. Where they overlie deeply fissured rocks the moisture supply is better. Inherent fertility is very variable but is mainly low to moderate.	Mostly hill slopes, crests and ridges but also some plains.
Cf2	*KS-Uc4.1; KS-Uc4.2*	Shallow (< 60 cm thick) sand soils underlain by products of deep lateritic weathering. Where these are hard laterites, the soils react similarly to Cf1. Where the underlying materials are mottled and/or pallid zone clays, they behave similarly to clay subsoils. This results in a moisture and nutrient situation similar to unit Bb5. These two are usually fairly intimately interwoven in a given area.	Dissected lateritic plateaux.

Mapping Unit	Factual Key Soil Class/ Profile Form	Properties	Associated Landforms
Cf3	*Um1.3; Um1.4; Um2.1; Um4.1; Um4.2; Um5.1; Um5.2* if shallow; *Um5.3; Um5.4; Um5.51; Um5.61; Um6.2*	The shallow depth (< 60 cm) and thus low AWC of these loam soils limits their use. Inherent fertility is very variable.	From plains and stony rises to, more commonly, crests and steep slopes of plateaux, hills and ridges.
Cf4	*Uf6.1; Uf6.2; Uf6.3*	Permeable friable clay soils with AWC limited by their shallow depth (< 60 cm). SRT is mainly neutral to alkaline. Inherent fertility is variable; P is usually necessary.	Slopes and crests in rolling to hilly terrain but also on some plains.
Cf5	Largely bare rock	Quaternary basalts with pockets of organic debris in rock crevices.	Broken terrain.
O1	*O*	Organic soils ranging from peaty sand to peat. Their bulk density is low and AWC is very high. The organic material ranges from 30 cm to 3 m or more thick. SRT ranges from acid to neutral and alkaline. Inherent fertility is usually very low in the acid forms but moderate in neutral and alkaline forms. All require P and other nutrients but vary with individual occurrences.	Low-lying, poorly drained sites on tablelands and mountain crests, some hill slopes and coastal plains.

AWC: the Available Water Capacity of the soil This is an estimate of the soil's store of moisture. It is the difference between field capacity (upper limit of available water when the addition of more water is lost by drainage) and wilting point (lower limit of available water when water is so tightly held by the soil that plant roots cannot extract it, causing the plant to wilt).

SRT: Soil Reaction Trends, and refers to the general acidity-alkalinity (pH) changes with depth in the body of the soil. Three main trends are:

Acid when the subsoil has pH values less than 6.5.
Neutral when the subsoil has pH values between 6.5 and 8.0.
Alkaline when the subsoil has pH values higher than 8.0.

NUTRIENT ELEMENTS: the nutrient elements known to be required for plant growth are referred to by their chemical abbreviations as follows: nitrogen N, phosphorus P, potassium K, sulphur S, iron Fe, calcium Ca, magnesium Mg, boron B, manganese Mn, copper Cu, cobalt Co, zinc Zn, and molybdenum Mo. Another element common in some soils is aluminium Al.

ESP: Exchangeable Sodium Percentages. Sodic and highly sodic soils have ESP of 6-14 and 15 or more. Soil permeability is influenced by its sodium ion content which, when high enough, causes soil clay to disperse (break into very tiny particles) and thus block the passage of water through the soil pores. Some of the acid duplex soils included in Cc and Cd may have ESP < 6, but their subsoils are equally impermeable. The reasons for this are not understood but may have something to do with their very low contents of metal ions (Northcote and Skene 1972).

NaCl: sodium chloride or common salt, which is often used as a measure of the salinity of Australian soils (Northcote and Skene 1972).

REFERENCES

Aitchison, G. D., Sprigg, R. C. and Cochrane, G. W. (1954), The soils and geology of Adelaide and suburbs, Bulletin Geological Survey S.A. 32.

Bettenay, E. (1962), 'The salt lake systems and their associated aeolian features in the semi-arid regions of Western Australia', *Journal Soil Science* 13, 10-17.

Carter, E. D. (1958), Fertilizer investigations with special reference to phosphate use on the lateritic soils of Kangaroo Island, Aust. Agrostology Conference 1958, vol. 1, part 1, paper 33.

Chittleborough, D. and Wright, M. (1973), Murray New Town site selection: a preliminary soil and land form survey, Special Bulletin 3.73, Dept of Agriculture, S.A.

Christian, C. S. (1958), The concept of land units and land systems, Proceedings Ninth Pacific Science Congress 1957, vol. 20, 74-81.

Crocker, R. L. (1946), Post Miocene climatic and geologic history and its significance in the genesis of the major soil types of South Australia, Bulletin 193, CSIRO Aust.

FAO/Unesco (1974), *Soil Map of the World*, 1:5 000 000. Vol. I (general legend), Unesco, Paris.

Isbell, R. F. and Smith, G. McL. (1976), Some properties of red, yellow and grey massive earths in North Queensland, Technical Paper 30, Division of Soils, CSIRO Aust.

Jessup, R. W. (1960), 'The stony tableland soils of the south-eastern portion of the Australian arid zone and their evolutionary history', *Journal Soil Science* 11, 188-96.

Northcote, K. H. (1949), 'The horticultural potential, under irrigation, of soils of the highland area, in the mid-Murray River Valley', *Journal Aust. Inst. Agricultural Science* 15, 122-7.

_____(1951), A pedological study of the soils occurring at Coomealla, New South Wales, Bulletin 264, CSIRO Aust.

_____(1971), *A Factual Key for the Recognition of Australian Soils*, 3rd edn, Rellim, Glenside, S.A. The 4th edn (1979), which includes a new section 'Concept of the extended principal profile form', has now been published.

_____and Skene, J. K. M. (1972), Australian soils with saline and sodic properties, Soil Publication 27, CSIRO Aust.

_____and Tucker, B. M. (1948), A soil survey of the Hundred of Seddon and part of the Hundred of MacGillivray, Kangaroo Island, South Australia, Bulletin 233, CSIRO Aust.

_____and others (1960-68), *Atlas of Australian Soils*, sheets 1-10 with explanatory booklets, CSIRO Aust. and Melbourne University Press, Melbourne.

_____and others (1975), *A Description of Australian Soils*, CSIRO Aust.

Prescott, J. A. (1944), A soil map of Australia, Bulletin 177, CSIRO Aust.

Soil Survey Staff, U.S. Dept of Agriculture (1975), *Soil Taxonomy*, Agriculture Handbook 436, Govt Printing Office, Washington.

Stace, H. C. T. and others (1968), *A Handbook of Australian Soils*, Rellim, Glenside, S.A.

Stephens, C. G. (1961), The soil landscapes of Australia, Soil Publication 18, CSIRO Aust.

_____(1963), 'Soils', 2nd edn, in *Atlas of Australian Resources*, Second Series, Dept of National Development, Canberra.

Taylor, J. K. (1953), 'Soils', in *Atlas of Australian Resources*, [First Series], Dept of National Development, Canberra.

Wickham, H. G. and Harris, G. L. (1976), 'Sodium tripolyphosphate prevents seepage in red earth structures—Coffs Harbour', *Journal Soil Conservation Service N.S.W.* 32, 68.

Wopfner, H. and Twidale, C. R. (1967), 'Geomorphological history of the Lake Eyre Basin', *in* Jennings, J. N. and Mabbutt, J. A. eds, *Landform Studies from Australia and New Guinea*, Aust. National Univ. Press, Canberra.