



Department of Agriculture
Government of Western Australia



SOIL GROUPS OF WESTERN AUSTRALIA

**A simple guide to the main soils of
Western Australia**

Compiled by Noel Schoknecht

Edition 3

June 2002



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This report updates and expands on Technical Report 193
(Soil Groups of Western Australia, Edition 2)

June 2002

**Natural Resources Assessment Group
Department of Agriculture, Western Australia
3 Baron-Hay Court, South Perth 6151
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Introduction

This publication provides a simple, standardised and easy-to-understand way to recognise the most common soils in Western Australia.

It is designed to:

- Provide a standard way of giving common names to the main soils of the State
- Provide a simple method to identify them
- Assist with the communication of soils information at a general level.

Common names for soils are often based on location, geology, native vegetation or other descriptors. Although these factors are often relevant and related to soil type, they may be used inconsistently throughout the State and can be confusing. Soil Groups are a substitute for these locally used common names and aid the communication of soil information at a simple generic level.

The majority of the State's soils can be allocated to one of the 60 Soil Groups defined. A few of the soils that occur in the diverse landscapes of Western Australia are not catered for at the Soil Group level. These can usually be placed within the Soil Supergroups – a higher level in the Soil Group hierarchy, or as a last resort in the 'no suitable Group' category. Soil Groups also include some land units that may not be soils but cover an area in the landscape, e.g. bare rock, disturbed land and water.

The main characteristics of each Soil Group are described and the major distributions noted. An indication is given of typical values for the soil attributes considered important for land use decision making (after van Gool and Moore 1999). Local Soil Group variants can have widely different properties, hence Soil Group attributes are only suitable for very broad regional or statewide overviews. This report also gives guidance to assigning qualifiers to the Soil Groups to allow them to be used to build land units relevant to land management.

Soil Groups were developed to assist with the communication of information collected in land resource and rangeland mapping programs, especially in areas where detailed soil information is limited or incomplete. They can be used to generate regional or State-wide distribution maps of soils or soil properties.

The technical name used for soil types in the Department of Agriculture, Western Australia is the soil series (Purdie 1993). These are based on the Australian Soil Classification system (Isbell 1996), which has been adopted as the official soil classification system for Australia, replacing a previous classification by Northcote (1979).

Planning at a semi-detailed to detailed level should refer to the more detailed information which is available in Land Resource Series and Land System reports, and from the digital databases that cover all the land resource mapping of the State. Also available for detailed planning are land units which combine soil series and landform information to provide estimates of qualities useful for assessing land capability or land degradation.

Further enquiries should be directed to:
Noel Schoknecht, Natural Resources Assessment
Department of Agriculture, Western Australia
Phone (08) 9368 3707, Fax (08) 9368 3939
Email: nschoknecht@agric.wa.gov.au

External website: www.agric.wa.gov.au/progserv/natural/assess/Index.htm
Internal site for Dept. of Agriculture staff: agweb/progserv/natural/assess/Index.htm

Criteria used to define Soil Supergroups and Soil Groups

The primary aim of the Soil Groups is to define the main soils of the State in terms that are easy to recognise in the field, and can be done with limited soil classification experience.

The soils are named and described at two levels, Soil Supergroups and Soil Groups.

1. Soil Supergroups

Thirteen Soil Supergroups are defined using three primary criteria:

- **texture or permeability profile**
- **coarse fragments** (*presence and nature*) and
- **water regime**

The summary descriptions and properties of the Supergroups are given in pages 20 and 21. The criteria are defined in pages 6-9.

2. Soil Groups

Sixty Soil Groups are defined by further divisions of the Soil Supergroups based on one or more of the following secondary and tertiary criteria:

- **calcareous layer** (*presence of carbonates*)
- **colour**
- **depth of horizons/profile**
- **pH** (*acidity/alkalinity*)
- **structure**

The descriptions and properties of the Soil Groups are given in pages 22 to 78, listed alphabetically with each Soil Supergroup. The criteria are defined in pages 6-9.

Describing soils in the field

Soil description is best conducted on an exposed profile such as a pit or road cutting, but alternatively using a soil auger or coring device. In the field the soil profile is divided into layers (horizons) based on one or more of the properties listed above. The properties, depths and arrangement of the layers are used to assign the soil to a Soil Supergroup or Soil Group. For the *texture or permeability* criterion it is important to estimate how quickly the texture or permeability changes occur between layers down the profile (*over* indicates a rapid change whereas *grading* which indicates a gradual change).

Definitions of criteria

Calcareous layer

Soil layer high in carbonates that causes visible effervescence in weak hydrochloric acid (1M HCl). Note: *Spirits of salts diluted with water (1 part spirits of salts to 5 parts water) can be used to create weak hydrochloric acid.*

Coarse fragments (presence and nature)

Particles coarser than 2 mm in the soil matrix.

Stony or rocky - A soil layer which contains more than 50% of coarse fragments >20 mm in size (coarse gravels, cobbles, stones or boulders).

Gravelly - A soil layer which contains more than 20% of ironstone gravel, including hard ironstone segregations.

Colour

Colour is a tertiary criterion for the definition of many Soil Groups. It is intended to be the predominant colour of the profile (up to 80 cm) in non-duplex soils, or the dominant colour of the surface layers down to the texture or permeability contrast layer in duplex soils.

Colours that are one colour 'chip' outside the designated colour boundaries are incorporated in the dominant colour where considered appropriate to maintain the 'theme' for a dominant soil. For example, a Grey deep sandy duplex could include topsoils with a black colour (10YR3/2) if the majority of the soils in a particular area have grey topsoils.

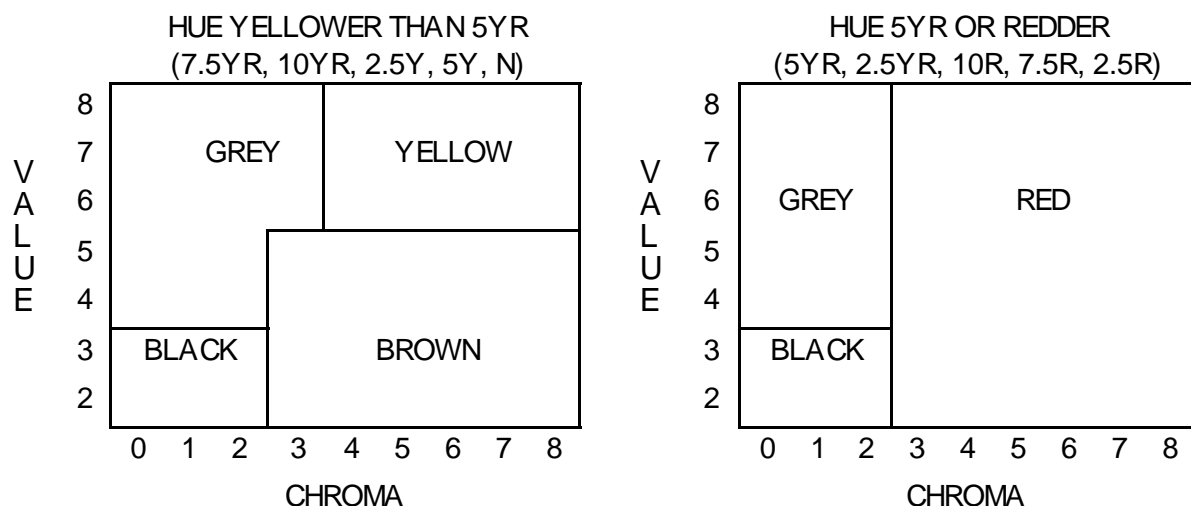
Specifically:

Shallow sands and loams - dominant soil colour from surface to hard layer. (The colour within or at 30 cm is used as a guide in the key.)

Deep sands, Sandy earths, Loamy earths and Non-cracking clays - dominant soil colour from surface to 80 cm. (The colour at 30 cm is used as a guide in the key.)

Duplex soils - dominant colour of the soil layers above the texture or permeability contrast layer.

A simplified colour chart is used (Isbell 1996) and only five colours are recognised: black, grey, yellow, brown and red. These are related to the Munsell hue, value and chroma from the following table. The colour is determined on the moist soil.



Cracking

Soils which exhibit strong vertical cracking at the surface when dry. Cracks usually exceed 5 mm in width, and extend at least 10 cm beneath the surface.

Depth of horizons/profile*Shallow*

- Texture or permeability contrast soils (duplexes): <30 cm of topsoil over heavier subsoil
- All other soils: ≤80 cm of sands, loams, clays or gravels over rock, hardpans or cemented gravels (ferricrete).

Deep

- Texture or permeability contrast soils (duplexes): 30-80 cm of topsoil over heavier subsoil.
- All other soils: >80 cm of sands, loams, clays or gravels.

Duplex soil

A duplex soil is defined as a soil with a texture or permeability contrast layer within the top 80 cm of the profile.

Duricrust

See ferricrete

Ferricrete

Indurated iron oxide rich layer occurring as cemented ironstone gravels or massive sheets. Also referred to as laterite, duricrust or ferricrete.

Laterite

See ferricrete

Permeability contrast layer

A permeability contrast layer is any layer that impedes soil drainage and occurs over a vertical distance of less than 5 cm. Typically the permeability contrast is due to a rapid increase in texture (texture contrast layer), such as in the duplex soils of the Factual Key (Northcote 1979) or the texture contrast soils of the Australian Soil Classification (Isbell 1993). It may also include a permeability contrast due to reticulite. The permeability contrast layer as used in this publication does not include non-soil permeability contrast layers such as rock or permanently cemented layers.

pH (acidity/alkalinity) pH values taken as a guide only

	pH_{CaCl2}	pH_{water}
<i>strongly acid</i>	<4.5	<5.5
<i>acid</i>	4.5-<5.5	5.5-<6.5
<i>neutral</i>	5.5-<7.0	6.5-<8.0
<i>alkaline</i>	>7.0	>8.0

Red-brown hardpan

An earthy pan which is normally reddish brown to red in colour with a dense yet porous appearance. It is one of a variable Group of silica pans (duripans) that commonly occur in arid climates, and is very common in the Gascoyne, Murchison, Goldfields and northern parts of South-west Western Australia.

Reticulite

A reddish, yellowish, grey and white mottled horizon common in the wheatbelt below surface gravels. The mottling has a reticulate (net-like) pattern. It has a 'gritty' field texture of sandy loam to sandy clay loam, but until textured often looks like a clayey horizon. Clay content usually increases with depth. When moist it is usually hard and brittle and can be augered or hand cut with a spade, however it often hardens further on drying. Some ironstone gravel may be present but this feature is not diagnostic.

Structure

The presence of soil aggregates or 'peds' in the profile

Massive - no visible structure

Pedal - structure or 'peds' evident throughout profile

Self-mulching (surface) - fine, highly pedal, surface structure

Subsoil

Layer/s of a soil below the topsoil which are usually higher in clay and lower in organic matter than the topsoil. Often called the B horizon/s of a profile.

Texture group

Texture of the fine earth fraction (<2 mm). Three categories are recognised:

Sand - fine, medium and coarse sand, loamy sand and clayey sand

Loam - sandy loam, loam, silty loam, sandy clay loam and clay loam

Clay - light, medium and heavy clay, sandy and silty clay

A guide to determining the field texture is given on page 9.

Texture contrast

A significant increase in texture over a vertical distance of less than 5 cm (referred to by the term *over*). This is commonly a sand over a sandy clay loam to clay, or a loam over a clay. The texture contrast term used in this report is equivalent to the *clear or abrupt textural B horizon* defined in the Australian Soil Classification (Isbell 1996, p. 112)

The term *grading to* indicates a gradual increase in texture over more than 5 cm.

Topsoil

Surface layer/s of a soil which are usually higher in organic matter (at least at the surface) and lower in clay than the lower layers (subsoil). Often called the A horizon/s of a profile.

Water regime

Wet or waterlogged soils - Soils which are seasonally wet within 80 cm of the surface for more than 3-4 months and usually the major part of the year.

Other definitions from *Australian Soil and Land Survey Field Handbook* (McDonald et al. 1990).

Soil field texture guide

The texture of a soil reflects the size distribution of mineral particles finer than 2 mm. If it is gravelly, remove the gravel by sieving.



Take a sample of soil that will sit comfortably in the palm of your hand from the layer of soil to be textured.



Form a *bolus* (ball) of soil by moistening the sample with water and kneading it. Knead the soil for 1-2 minutes while adding more water or soil until it just fails to stick to the fingers. The soil is now ready for shearing (ribboning). Note how the bolus feels when kneading it.

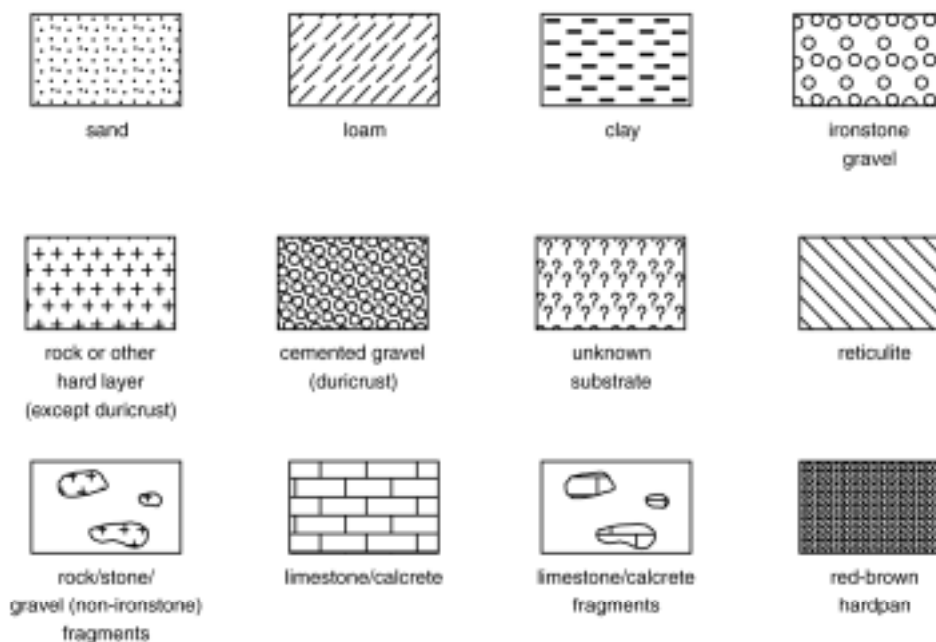


Press out the soil between the thumb and forefinger to form a ribbon. The ribbon should only be 2-3 mm thick.

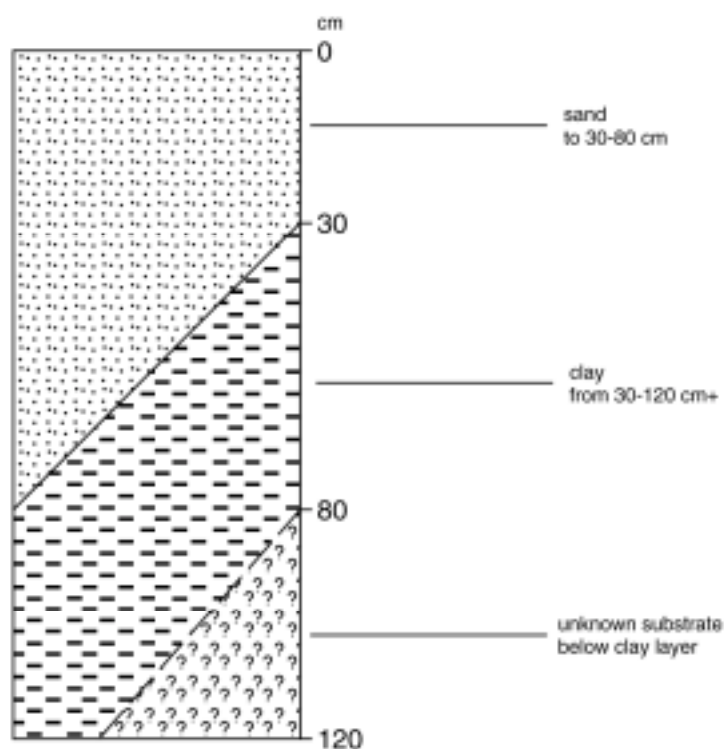
The behaviour of the bolus and of the ribbon determines the field texture. Do not decide texture solely on the length of the ribbon.

Texture Group	Subgroup	Behaviour of bolus and ribbon
CLAY	All clays	Plastic bolus like putty, smooth to touch, becomes stiffer as clay increases, forms ribbon of 50-75 mm or more.
LOAM	Clay loam	Coherent plastic bolus, smooth to manipulate, forms ribbon of 40-50 mm.
	Sandy clay loam	Coherent bolus, feels sandy, forms ribbon of 25-40 mm.
	Loam	Coherent bolus, feels smooth and spongy, forms ribbon of about 25 mm.
	Sandy loam	Weakly coherent bolus, feels sandy, ribbon of 15-25 mm. Sand grains may be visible.
SAND	Clayey sand	Clay stain on fingers, very slightly coherent bolus, ribbon of 5-15 mm.
	Loamy sand	Very slightly coherent bolus, dark staining of fingers, minimal ribbon of about 5 mm.
	Sand	Cannot form a bolus, non-coherent.

Key to stylised profile diagrams



Example - Grey deep sandy duplex (soil group 403)





Broad geographic regions used to describe the distribution of Soil Groups

Key to WA Soil Groups

1. SUPERGROUPS LEVEL

A	Wet or waterlogged at <80 cm for the major part of the year. (Does not include soils that have a temporary perched watertable e.g. wet surface or subsurface layer, such as an A ₂ over a dry clay). WET OR WATERLOGGED SOILS (p. 13)
B	Rocky or stony or coarse gravelly (>50%, >20 mm) throughout. Does not include ironstone gravels or ferricrete. ROCKY OR STONY SOILS (p. 13)
C	Ironstone gravel layer (>20% and >20 cm thick) or ferricrete starts within top 15 cm, & ironstone gravels a dominant feature of the profile. IRONSTONE GRAVELLY SOILS (p. 14)
D	Sandy topsoil (dominant topsoil texture is sandy and topsoil at least 3 cm thick. A thin loamy surface may be present). <ol style="list-style-type: none"> 1. Sand over a texture contrast layer or <i>reticulite</i> permeability contrast layer (either layer at least 10 cm thick) at ≤80 cm. SANDY DUPLEXES (p. 15) 2. Sand grading to loam by 80 cm. May be clayey at depth. SANDY EARTHS (p. 16) 3. Sand, ≤80 cm deep, over rock, hardpan or other permanently cemented layer. SHALLOW SANDS (p. 16) 4. Sand > 80 cm deep. DEEP SANDS (p. 17)
E	Loamy topsoil (dominant topsoil texture is loamy and topsoil at least 3 cm thick. A thin sandy surface may be present). <ol style="list-style-type: none"> 1. Loam over texture contrast layer (at least 10 cm thick) at ≤80 cm. LOAMY DUPLEXES (p. 18) 2. Loam, ≤80 cm deep, over rock, hardpan or other cemented layer. SHALLOW LOAMS (p. 18) 3. Uniform loam and loam grading to clay loam or clay. LOAMY EARTHS (p. 19)
F	Clayey topsoil (at least 10 cm thick, could have ≤3 cm sand or loam on surface). <ol style="list-style-type: none"> 1. Soils which crack strongly when dry. CRACKING CLAYS (p. 19) 2. Soils which do not crack when dry. NON-CRACKING CLAYS (p. 19)
G.	Other soils. MISCELLANEOUS SOILS (p. 14)

Key to WA Soil Groups

2. Soil Group level

WET OR WATERLOGGED SOILS Supergroup (Distribution map p. 113)

(Soils seasonally wet within 80 cm of the surface for a major part of the year)

- | | |
|---|--|
| • Soils subject to tidal inundation. | Tidal soil (p. 25) |
| • Soils of the salt lakes. | Salt lake soil (p. 23) |
| • Soils that are wet or waterlogged at ≤ 80 cm for a major part of the year and subject to secondary salinity. | Saline wet soil (p. 22) |
| • Non-saline soils that are wet or waterlogged at less than 30 cm for a major part of the year. | Wet soil (p. 26) |
| • Non-saline soils that are wet or waterlogged at 30-80 cm for a major part of the year. | Semi-wet soil (p. 24) |
| • Other wet or waterlogged soils. | (use WET OR WATERLOGGED SOILS Supergroup) (p. 20) |

ROCKY OR STONY SOILS Supergroup

(Distribution map p. 113)

(Soils, generally shallow, with more than 50% of coarse fragments >20 mm in size (coarse gravels, cobbles, stones or boulders) throughout the profile. Soils dominated by ironstone gravels included in *IRONSTONE GRAVELLY SOILS Supergroup*. Includes areas of rock outcrop [all lithologies except ferricrete].)

- | | |
|--|--|
| • Rock outcrop (excluding ferricrete). | Bare rock (p. 27) |
| • Calcareous throughout. | Calcareous stony soil (p. 28) |
| • Not calcareous throughout. | Stony soil (p. 29) |
| • Other rocky or stony soils. | (use ROCKY OR STONY SOILS Supergroup) (p. 20) |

IRONSTONE GRAVELLY SOILS Supergroup*(Distribution map p. 113)*

(Soils that have an ironstone gravel layer (>20% and >20 cm thick) or ferricrete within the top 15 cm, and ironstone gravels are a dominant feature of the profile.)

- Cemented gravels (ferricrete), rock or other hard or permanently cemented layers at ≤80 cm.
..... **Shallow gravel** (p. 33)
- Gravels with a predominantly sandy matrix
(sandy for at least top 30 cm unless texture or permeability contrast layer at <30 cm)
 1. Over texture or permeability contrast layer at <30 cm.
The permeability contrast may be due to either a texture contrast (clay loam to clay) or reticulite (mottled sandy loam to sandy clay loam).
..... refer to **SANDY DUPLEXES Supergroup** (p. 15)
 2. Over a texture or permeability contrast layer at 30-80 cm.
The permeability contrast may be due to either a texture contrast (clay loam to clay) or reticulite (mottled sandy loam to sandy clay loam).
..... **Duplex sandy gravel** (p. 31)
 3. Gravels with predominantly sandy matrix to greater than 80 cm.
..... **Deep sandy gravel** (p. 30)
- Gravels with a predominantly loamy matrix.
 1. Over permeability contrast layer (usually texture contrast) at less than 30 cm.
..... refer to **LOAMY DUPLEXES Supergroup** (p. 18)
 2. No texture or permeability contrast layer within top 30 cm.
..... **Loamy gravel** (p. 32)
- Other ironstone gravelly soils.
..... **(use IRONSTONE GRAVELLY SOILS Supergroup)** (p. 20)

MISCELLANEOUS SOILS Supergroup*(No distribution map)*

(Other soils)

- Areas which are highly disturbed.
..... **Disturbed land** (p. 78)
- Areas of permanent or near permanent water.
..... **Water** (p. 78)
- Other minor soils cannot be described within the main Soil Groups or Soil Supergroups.
..... **No suitable Group** (p. 78)
- Other soils where there is insufficient information or no desire to classify a soil/s to soil Group/s.
..... **Undifferentiated soils** (p. 78)

SANDY DUPLEXES Supergroup*(Distribution map p. 113)*

(Soils with a sandy surface and a texture or permeability contrast at 3 to 80 cm.)

- Texture contrast at 3 to <30 cm (shallow sandy duplexes).
 - 1 Strongly acid in upper part of texture contrast layer.
..... **Acid shallow duplex** (p. 58)
 - 2 Grey is the dominant colour of the topsoil layer/s; alkaline subsoil.
..... **Alkaline grey shallow sandy duplex** (p. 35)
 3. Grey is the dominant colour of the topsoil layer/s; non-alkaline subsoil.
..... **Grey shallow sandy duplex** (p. 37)
 4. Yellow or brown is the dominant colour of the topsoil layer/s.
..... **Yellow/brown shallow sandy duplex** (p. 42)
 5. Red is the dominant colour of the topsoil layer/s.
..... **Red shallow sandy duplex** (p. 39)
 6. Other shallow sandy duplexes.
..... **(use SANDY DUPLEXES Supergroup)** (p. 20)
- Texture contrast at 30 to 80 cm (deep sandy duplexes).
 - 1 Grey is the dominant colour of the topsoil layer/s; alkaline subsoil.
..... **Alkaline grey deep sandy duplex** (p. 34)
 - 2 Grey is the dominant colour of the topsoil layer/s; non-alkaline subsoil.
..... **Grey deep sandy duplex** (p. 36)
 - 3 Yellow or brown is the dominant colour of the topsoil layer/s.
..... **Yellow/brown deep sandy duplex** (p. 41)
 - 4 Red is the dominant colour of the topsoil layer/s.
..... **Red deep sandy duplex** (p. 38)
 - 5 Other deep sandy duplexes.
..... **(use SANDY DUPLEXES Supergroup)** (p. 20)
- *Reticulite* permeability contrast layer at 30 to 80 cm (deep sandy duplexes).
 - 1 Grey to yellow or brown surface layer over *reticulite* (mottled loamy sandy to sandy clay loam) subsoil.
..... **Reticulite deep sandy duplex** (p. 40)
 - 2 Other deep sandy duplexes.
..... **(use SANDY DUPLEXES Supergroup)** (p. 20)

SANDY EARTHS Supergroup*(Distribution map p. 114)*

(Soils with a sandy surface and grading to loam by 80 cm. May be clayey at depth.)

- | | |
|--|--|
| • Yellow <u>and</u> strongly acid within top 30 cm. | Acid yellow sandy earth (p. 53) |
| • Yellow within top 30 cm. | Yellow sandy earth (p. 57) |
| • Brown within top 30 cm. | Brown sandy earth (p. 54) |
| • Red within top 30 cm. | Red sandy earth (p. 56) |
| • White, grey or Munsell value of 7 or greater (pale yellow) within top 30 cm. | Pale sandy earth (p. 55) |
| • Other sandy earth soils. | (use SANDY EARTHS Supergroup) (p. 20) |

SHALLOW SANDS Supergroup*(Distribution map p. 114)*

(Sands less than or equal to 80 cm over rock, hardpan or other cemented layer.)

- | | |
|--|---|
| • Calcareous throughout. | Calcareous shallow sand (p. 43) |
| • White, grey or Munsell value of 7 or greater (pale yellow) within top 30 cm. | Pale shallow sand (p. 44) |
| • Yellow or brown within top 30 cm. | Yellow/brown shallow sand (p. 46) |
| • Red within top 30 cm. | Red shallow sand (p. 45) |
| • Other shallow sands. | (use SHALLOW SANDS Supergroup) (p. 20) |

DEEP SANDS Supergroup*(Distribution map p. 114)*

(Sands greater than 80 cm deep.)

- | |
|---|
| <ul style="list-style-type: none">• Calcareous within top 30 cm of surface, and usually throughout.
..... Calcareous deep sand (p. 48)• Yellow within top 30 cm, ironstone gravel common at depth.
..... Yellow deep sand p. 52)• Brown within top 30 cm.
..... Brown deep sand (p. 47)• Red within top 30 cm.
..... Red deep sand (p. 51)• Gravelly below 15 cm and gravels a dominant feature of the profile, with a minimum gravel layer requirement of 30 cm thick and >20% ironstone gravels starting within the top 80 cm. White, grey or Munsell value of 7 or greater (pale yellow) within top 30 cm. The sandy subsoil matrix may be coloured.
..... Gravelly pale deep sand (p. 49)• White, grey or Munsell value of 7 or greater (pale yellow) within top 30 cm.
..... Pale deep sand (p. 50)• Other deep sands.
..... (use DEEP SANDS Supergroup) (p. 20) |
|---|

LOAMY DUPLEXES Supergroup*(Distribution map p. 114)*

(Soils with a loamy surface and a texture contrast at 3 to 80 cm.)

- Texture at 3 to <30 cm (shallow loamy duplexes).
 - 1 Strongly acid in upper part of texture contrast layer.
..... **Acid shallow duplex** (p. 58)
 - 2 Grey to grey-brown surface layer/s over alkaline subsoil.
..... **Alkaline grey shallow loamy duplex** (p. 59)
 - 3 Grey surface layer/s over non-alkaline subsoil.
..... **Grey shallow loamy duplex** (p. 62)
 - 4 Yellow or brown surface layer/s.
..... **Yellow/brown shallow loamy duplex** (p. 65)
 - 5 Red surface layer/s over alkaline subsoil.
..... **Alkaline red shallow loamy duplex** (p. 60)
 - 5 Red surface layer/s over non-alkaline subsoil
..... **Red shallow loamy duplex** (p. 64)
 - 6 Other loamy duplexes.
..... **(use LOAMY DUPLEXES Supergroup)** (p. 20)
- Texture contrast at 30-80 cm (deep loamy duplexes).
 - 1 Red surface layer/s over alkaline or non-alkaline subsoil.
..... **Red deep loamy duplex** (p. 63)
 - 2 Brown (surface may be grey or black) surface layer/s.
..... **Brown deep loamy duplex** (p. 61)
 - 3 Other loamy duplexes.
..... **(use LOAMY DUPLEXES Supergroup)** (p. 20)

SHALLOW LOAMS Supergroup*(Distribution map p. 115)*

Loam ≤80 cm deep, over rock, hardpan or other cemented layer.

- Calcareous throughout.
..... **Calcareous shallow loam** (p. 66)
- Red surface layer/s with a red-brown hardpan by 50 cm.
(If hardpan at >50 cm refer to **Red loamy earth**).
..... **Red-brown hardpan shallow loam** (p. 68)
- Red surface layer/s over a hard layer.
..... **Red shallow loam** (p. 67)
- Other shallow loams.
..... **(use SHALLOW LOAMS Supergroup)** (p. 20)

LOAMY EARTHS Supergroup*(Distribution map p. 115)*

(Soils with a loamy surface and either loamy throughout or grading to clay by 80 cm.)

- Calcareous within top 30 cm, commonly throughout.
..... **Calcareous loamy earth** (p. 70)
- Yellow within top 30 cm.
..... **Yellow loamy earth** (p. 73)
- Red within top 30 cm, massive or poorly structured, earthy fabric
(may have a red-brown hardpan below 50 cm).
..... **Red loamy earth** (p. 72)
- Red or brown within top 30 cm. Very friable and porous.
Often well structured.
..... **Friable red/brown loamy earth** (p. 71)
- Brown within top 30 cm (may have a grey surface).
..... **Brown loamy earth** (p. 69)
- Other loamy earths.
..... **(use LOAMY EARTHS Supergroup)** (p. 20)

CRACKING CLAYS Supergroup*(Distribution map p.115)*

(Soils that have a clay surface at least 30 cm thick (except possibly for the top 3 cm) and crack strongly when dry.)

- Self-mulching surface (strongly and finely pedal surface).
..... **Self-mulching cracking clay** (p. 75)
- Massive, crusting or coarsely pedal surface.
..... **Hard cracking clay** (p. 74)
- Other cracking clays.
..... **(use CRACKING CLAYS Supergroup)** (p. 20)

NON-CRACKING CLAYS Supergroup*(Distribution map p. 115)*

(Soils that have a clay surface at least 30 cm thick (except possibly for the top 3 cm) and do not crack strongly when dry.)

- Red or brown within top 30 cm
..... **Red/brown non-cracking clay** (p. 77)
- Other colours in within top 30 cm, usually grey, but also yellow or black
..... **Grey non-cracking clay** (p. 76)
- Other non-cracking clays
..... **(use NON-CRACKING CLAYS Supergroup)** (p. 20)