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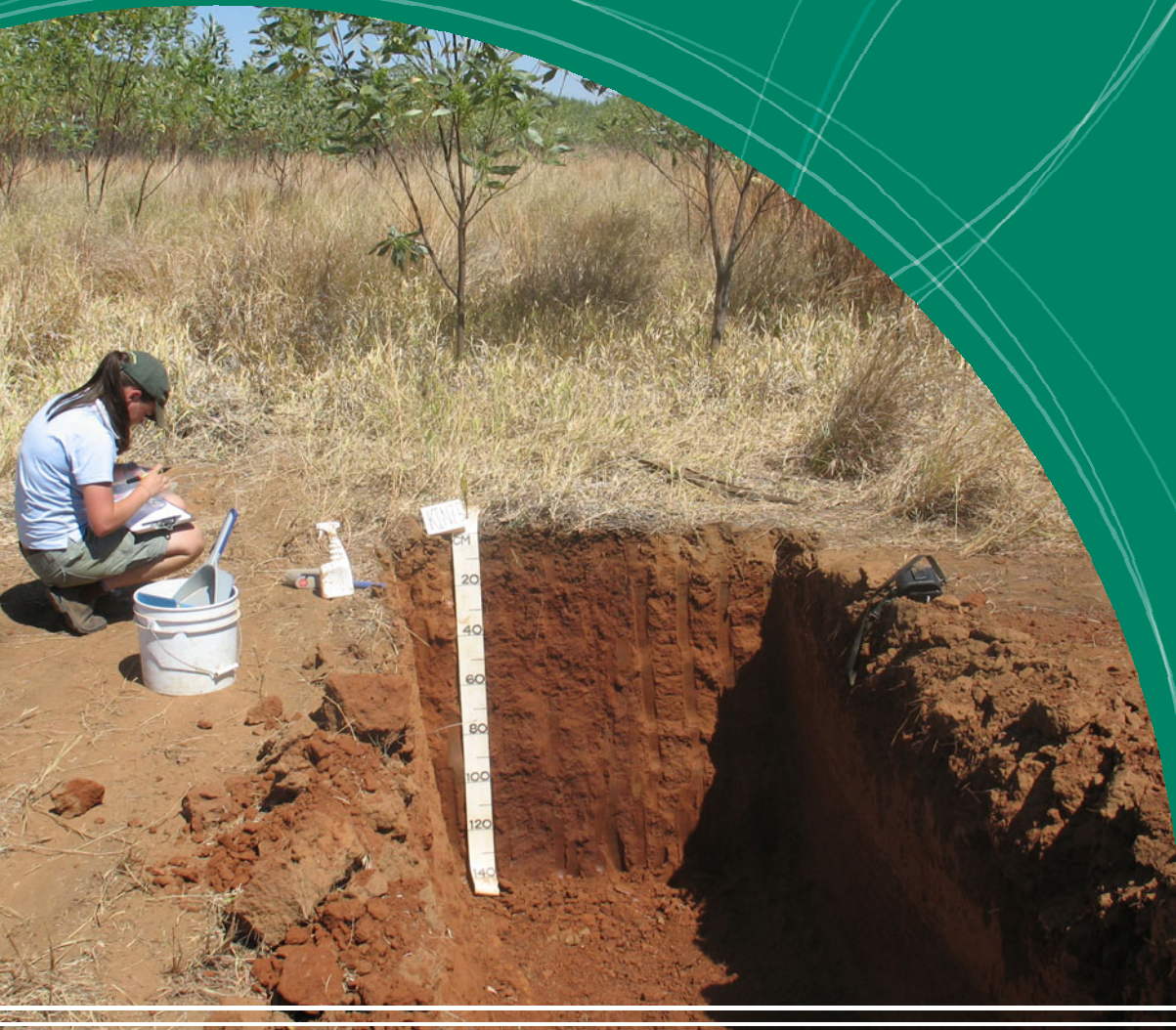
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Soil Groups of Western Australia

Fourth Edition



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SOIL GROUPS OF WESTERN AUSTRALIA

A simple guide to the main
Soils of Western Australia

Fourth Edition

Noel Schoknecht
Shahab Pathan

March 2013



Department of
Agriculture and Food



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Phil Goulding and Gabriela Seredenco organised the diagrams and maps.

Dennis van Gool has populated soil attributes and qualifiers for each Soil Group for the 4th edition.

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Friable red/brown loamy earth (Karri loam) near Pemberton supporting *Eucalyptus diversicolor* (Karri). Source: Reference soils of south-western Australia (McArthur, 2004).

1. 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 state-wide 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 official soil classification system for Australia is the Australian Soil Classification (ASC) (Isbell 2002), replacing a previous national classification by Northcote (1979). For most Soil Groups the typical ASC equivalent/s are provided.

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.

Edition 4 of this publication provides more detail on the attributes of each Soil Group which can be used for soil capability assessments. The full description and attributes of each Soil Group is now provided together as a set of two page factsheets which can be used independently from the rest of the report.

2. HOW SOIL SUPERGROUPS AND SOIL GROUPS ARE DEFINED

2.1 Criteria used

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.

A. 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 Soil Supergroups are given in page 21.

B. 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 Factsheets are given in pages 34 to 146.

2.2 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).

2.3 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.

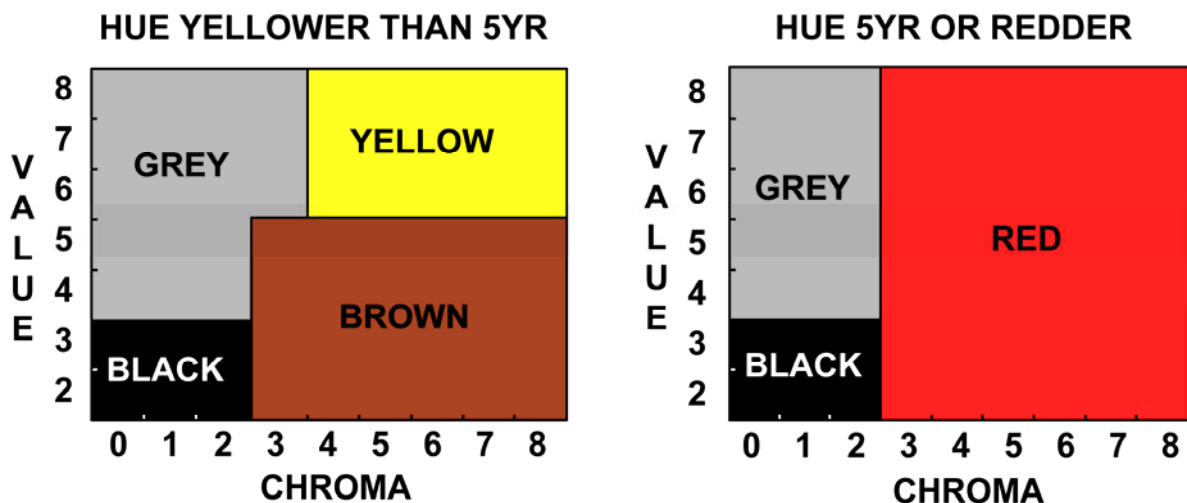
Colour

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 2002) 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/profiles

1. 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).

2. 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 (e.g. a sand over a clay).

Duricrust

See ferricrete

Ferricrete

Indurated iron oxide rich layer occurring as cemented ironstone gravels or massive sheets. Formed in laterite often called ironstone caprock, 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}
• strongly acid	<4.5	<5.5
• acid	4.5-<5.5	5.5-<6.5
• neutral	5.5-<7.0	6.5-<8.0
• alkaline	>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 augured 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 fractions are less than 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 at page 10.

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 2002). 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.

Note: Other definitions are from *Australian Soil and Land Survey Field Handbook* (McDonald *et al.* 2009).

2.4 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.

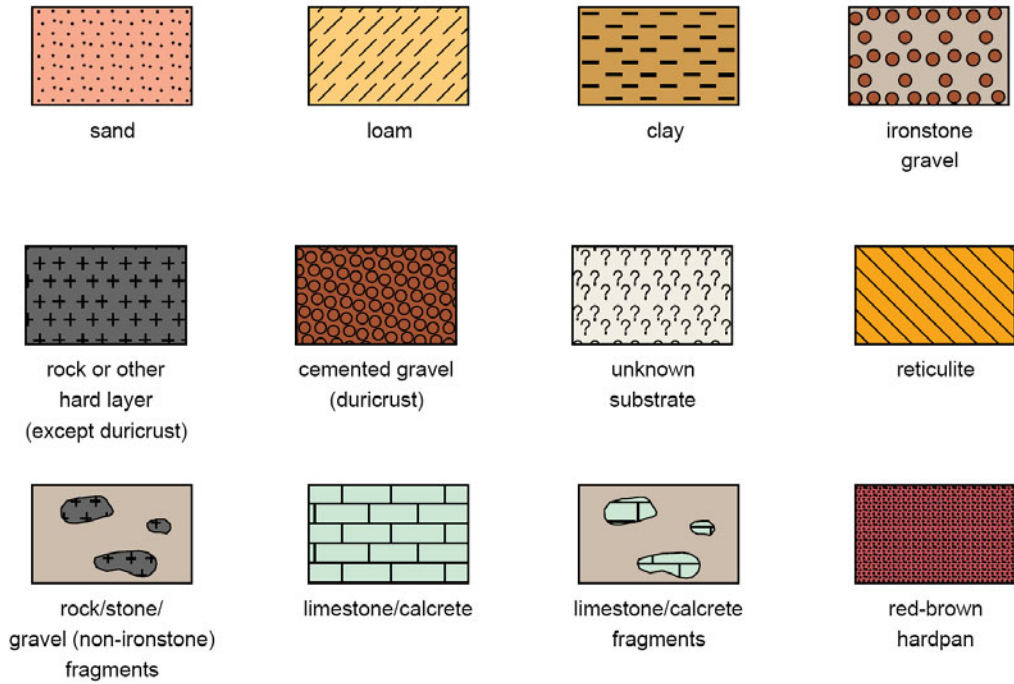


Press out the soil between the thumb and forefinger to form a ribbon. The ribbon should only be 2-3 mm thick.

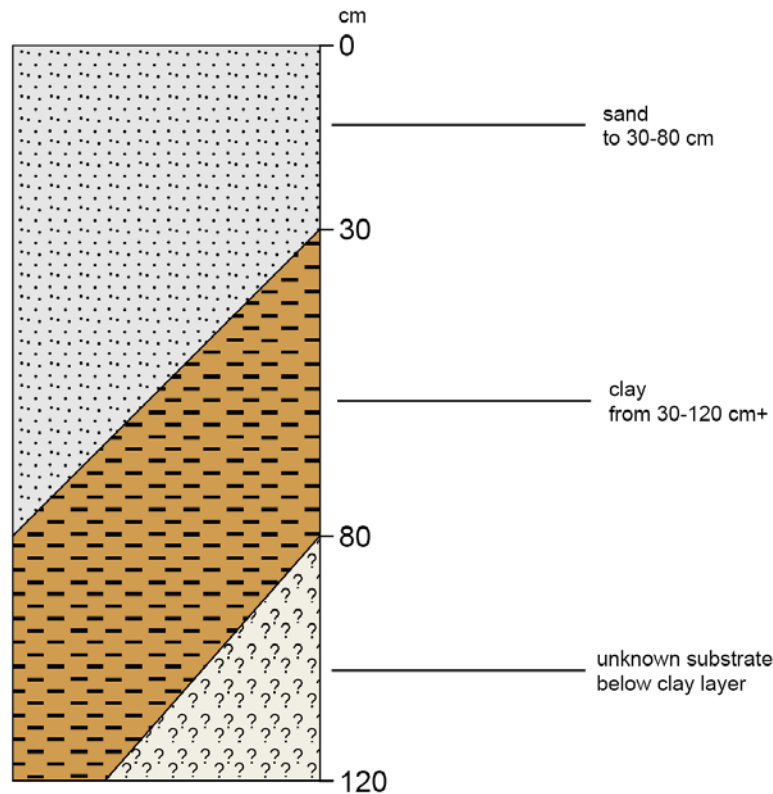
Table 1: The behaviour of the bolus and of the ribbon determines the field texture.
(Use table below to identify your soil's texture. Do not decide texture solely on the length of the ribbon.)

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.

2.5 Key to stylised soil profile diagrams



Example – Grey deep sandy duplex (soil group 403)



Note: Shading has been added to individual Soil Group profile diagrams (page 46-144) to indicate soil colour and the slope in diagram indicates depth range.

2.6 Map of the main regions of Western Australia



Note: Broad geographic regions used to describe the distribution of WA Soil Groups

3. KEY TO WA SOIL SUPERGROUPS AND GROUPS

3.1 Soil Supergroups

- | | |
|--|--|
| <p>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 A₂ over a dry clay).</p> | <p>..... WET OR WATERLOGGED SOILS (p. 14)</p> |
| <p>B. Rocky or stony or coarse gravelly (>50%, >20 mm) throughout. Does not include ironstone gravels or ferricrete.</p> | <p>..... ROCKY OR STONY SOILS (p. 14)</p> |
| <p>C. Ironstone gravel layer (>20% and >20 cm thick) or ferricrete starts within top 15 cm, and ironstone gravels a dominant feature of the profile.</p> | <p>..... IRONSTONE GRAVELLY SOILS (p. 15)</p> |
| <p>D. Sandy topsoil (dominant topsoil texture is sandy and topsoil at least 3 cm thick. A thin loamy surface may be present).</p> | |
| <p>1. Sand over a texture contrast layer or <i>reticulite</i> permeability contrast layer (either layer at least 10 cm thick) at ≤80 cm.</p> | <p>..... SANDY DUPLEXES (p. 16)</p> |
| <p>2. Sand, ≤80 cm deep, over rock, hardpan or other permanently cemented layer.</p> | <p>..... SHALLOW SANDS (p. 17)</p> |
| <p>3. Sand > 80 cm deep.</p> | <p>..... DEEP SANDS (p. 17)</p> |
| <p>4. Sand grading to loam by 80 cm. May be clayey at depth.</p> | <p>..... SANDY EARTHS (p. 18)</p> |
| <p>E. Loamy topsoil (dominant topsoil texture is loamy and topsoil at least 3 cm thick. A thin sandy surface may be present).</p> | |
| <p>1. Loam over texture contrast layer (at least 10 cm thick) at ≤80 cm.</p> | <p>..... LOAMY DUPLEXES (p. 18)</p> |
| <p>2. Loam, ≤80 cm deep, over rock, hardpan or other cemented layer.</p> | <p>..... SHALLOW LOAMS (p. 19)</p> |
| <p>3. Uniform loam and loam grading to clay loam or clay.</p> | <p>..... LOAMY EARTHS (p. 19)</p> |
| <p>F. Clayey topsoil (at least 10 cm thick, could have ≤3 cm sand or loam on surface).</p> | |
| <p>1. Soils which crack strongly when dry.</p> | <p>..... CRACKING CLAYS (p. 20)</p> |
| <p>2. Soils which do not crack when dry.</p> | <p>..... NON-CRACKING CLAYS (p. 20)</p> |
| <p>G. Other soils.</p> | <p>..... MISCELLANEOUS SOILS (p. 20)</p> |

3.2 Soil Groups

WET OR WATERLOGGED SOILS Supergroup

(Distribution map p. 159)

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

- | | |
|---|--|
| • 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. 34) |
| • Soils of the salt lakes. | Salt lake soil (p. 36) |
| • Non-saline soils that are wet or waterlogged at 30-80 cm for a major part of the year. | Semi-wet soil (p. 38) |
| • Soils subject to tidal inundation. | Tidal soil (p. 40) |
| • Non-saline soils that are wet or waterlogged at less than 30 cm for a major part of the year. | Wet soil (p. 42) |
| • Other wet or waterlogged soils. | (use WET OR WATERLOGGED SOILS Supergroup) (p. 21) |

ROCKY OR STONY SOILS Supergroup

(Distribution map p. 159)

(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. 44) |
| • Calcareous throughout. | Calcareous stony soil (p. 46) |
| • Not calcareous throughout. | Stony soil (p. 48) |
| • Other rocky or stony soils. | (use ROCKY OR STONY SOILS Supergroup) (p. 21) |

IRONSTONE GRAVELLY SOILS Supergroup*(Distribution map p. 159)*

(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. 56)
- 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. 16)
 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. 52)
 3. Gravels with predominantly sandy matrix to greater than 80 cm.
..... **Deep sandy gravel** (p. 50)
- 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. 54)
- Other ironstone gravelly soils.
..... **(use IRONSTONE GRAVELLY SOILS Supergroup)** (p. 21)

SANDY DUPLEXES Supergroup*(Distribution map p. 159)*

(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. 106)
 2. Grey is the dominant colour of the topsoil layer/s; alkaline subsoil.
..... **Alkaline grey shallow sandy duplex** (p. 60)
 3. Grey is the dominant colour of the topsoil layer/s; non-alkaline subsoil.
..... **Grey shallow sandy duplex** (p. 64)
 4. Yellow or brown is the dominant colour of the topsoil layer/s.
..... **Yellow/brown shallow sandy duplex** (p. 72)
 5. Red is the dominant colour of the topsoil layer/s.
..... **Red shallow sandy duplex** (p. 68)
 6. Other shallow sandy duplexes.
..... **(use SANDY DUPLEXES Supergroup)** (p. 21)

- 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. 58)
 2. Grey is the dominant colour of the topsoil layer/s; non-alkaline subsoil.
..... **Grey deep sandy duplex** (p. 62)
 3. Yellow or brown is the dominant colour of the topsoil layer/s.
..... **Yellow/brown deep sandy duplex** (p. 70)
 4. Red is the dominant colour of the topsoil layer/s.
..... **Red deep sandy duplex** (p. 66)
 5. Other deep sandy duplexes.
..... **(use SANDY DUPLEXES Supergroup)** (p. 21)

- *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. 74)
 2. Other deep sandy duplexes.
..... **(use SANDY DUPLEXES Supergroup)** (p. 21)

SHALLOW SANDS Supergroup*(Distribution map p. 160)*

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

- | | |
|--|---|
| • Calcareous throughout. | Calcareous shallow sand (p. 76) |
| • White, grey or Munsell value of 7 or greater (pale yellow) within top 30 cm. | Pale shallow sand (p. 78) |
| • Red within top 30 cm. | Red shallow sand (p. 80) |
| • Yellow or brown within top 30 cm. | Yellow/brown shallow sand (p. 82) |
| • Other shallow sands. | (use SHALLOW SANDS Supergroup) (p. 21) |

DEEP SANDS Supergroup*(Distribution map p. 160)*

(Sands greater than 80 cm deep.)

- | | |
|---|--|
| • Calcareous within top 30 cm of surface, and usually throughout. | Calcareous deep sand (p. 86) |
| • Yellow within top 30 cm, ironstone gravel common at depth. | Yellow deep sand p. 94) |
| • Brown within top 30 cm. | Brown deep sand (p. 84) |
| • Red within top 30 cm. | Red deep sand (p. 92) |
| • 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. 88) |
| • White, grey or Munsell value of 7 or greater (pale yellow) within top 30 cm. | Pale deep sand (p. 90) |
| • Other deep sands. | (use DEEP SANDS Supergroup) (p. 21) |

SANDY EARTHS Supergroup*(Distribution map p. 160)*

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

- Yellow and strongly acid within top 30 cm.
..... **Acid yellow sandy earth** (p. 96)
- Yellow within top 30 cm.
..... **Yellow sandy earth** (p. 102)
- Brown within top 30 cm.
..... **Brown sandy earth** (p. 98)
- Red within top 30 cm.
..... **Red sandy earth** (p. 100)
- White, grey or Munsell value of 7 or greater (pale yellow) within top 30 cm.
..... **Pale sandy earth** (p. 104)
- Other sandy earth soils.
..... **(use SANDY EARTHS Supergroup)** (p. 21)

LOAMY DUPLEXES Supergroup*(Distribution map p. 160)*

(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. 106)
 2. Grey to grey-brown surface layer/s over alkaline subsoil.
..... **Alkaline grey shallow loamy duplex** (p. 108)
 3. Grey surface layer/s over non-alkaline subsoil.
..... **Grey shallow loamy duplex** (p. 112)
 4. Yellow or brown surface layer/s.
..... **Yellow/brown shallow loamy duplex** (p. 120)
 5. Red surface layer/s over alkaline subsoil.
..... **Alkaline red shallow loamy duplex** (p. 110)
 6. Red surface layer/s over non-alkaline subsoil
..... **Red shallow loamy duplex** (p. 118)
 7. Other loamy duplexes.
..... **(use LOAMY DUPLEXES Supergroup)** (p. 21)
- 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. 116)
 2. Brown (surface may be grey or black) surface layer/s.
..... **Brown deep loamy duplex** (p. 114)
 3. Other loamy duplexes.
..... **(use LOAMY DUPLEXES Supergroup)** (p. 21)

SHALLOW LOAMS Supergroup*(Distribution map p. 161)*

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

- Calcareous throughout.
..... **Calcareous shallow loam** (p. 122)
- 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. 126)
- Red surface layer/s over a hard layer.
..... **Red shallow loam** (p. 124)
- Other shallow loams.
..... **(use SHALLOW LOAMS Supergroup)** (p. 21)

LOAMY EARTHS Supergroup*(Distribution map p. 161)*

(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. 130)
- Yellow within top 30 cm.
..... **Yellow loamy earth** (p. 136)
- Red within top 30 cm, massive or poorly structured, earthy fabric
(may have a red-brown hardpan below 50 cm).
..... **Red loamy earth** (p. 134)
- Red or brown within top 30 cm. Very friable and porous.
Often well structured.
..... **Friable red/brown loamy earth** (p. 132)
- Brown within top 30 cm (may have a grey surface).
..... **Brown loamy earth** (p. 128)
- Other loamy earths.
..... **(use LOAMY EARTHS Supergroup)** (p. 21)

CRACKING CLAYS Supergroup*(Distribution map p. 161)*

(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. 140)
- Massive, crusting or coarsely pedal surface.
..... **Hard cracking clay** (p. 138)
- Other cracking clays.
..... **(use CRACKING CLAYS Supergroup)** (p. 21)

NON-CRACKING CLAYS Supergroup*(Distribution map p. 161)*

(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. 144)
- Other colours in within top 30 cm, usually grey, but also yellow or black.
..... **Grey non-cracking clay** (p. 142)
- Other non-cracking clays.
..... **(use NON-CRACKING CLAYS Supergroup)** (p. 21)

MISCELLANEOUS SOILS Supergroup

(Other soils)

- Areas which are highly disturbed.
..... **Disturbed land** (p. 146)
- Areas of permanent or near permanent water.
..... **Water** (p. 146)
- Other minor soils cannot be described within the main Soil Groups or Soil Supergroups.
..... **No suitable Group** (p. 146)
- Other soils where there is insufficient information or no desire to classify a soil/s to soil Group/s.
..... **Undifferentiated soils** (p. 146)

Note: *Water, although not a soil, is described as a Soil Group to enable 100% area attribution for all map units in DAFWA's Map Unit Database.*

Electronic soil key: *An Interactive Pathway Key to Identify Western Australian Soils* (Pathan and Schoknecht 2012) including individual Soil Groups factsheet can be accessed on the department website at: www.agric.wa.gov.au/

4. DESCRIPTIONS

4.1 Definitions of the Soil Supergroups

Soil Supergroup	Definition
Wet or waterlogged soils	Soils seasonally wet within 80 cm of the surface for a major part of the year.
Rocky or stony soils	Soils, generally shallow, with >50% of coarse fragments >20 mm in size (coarse gravels, cobbles, stones or boulders) throughout the profile. Include areas of rock outcrop (all lithologies).
Ironstone gravelly soils	Soils that have an ironstone gravel layer (>20% and >20 cm thick) or ferricrete/cemented gravels within the top 15 cm, and ironstone gravels a dominant feature of the profile.
Sandy duplexes	Soils with a sandy surface and a texture contrast or a permeability contrast (reticulite) at 3 to 80 cm.
Sandy earths	Soils with a sandy surface and grading to loam by 80 cm. May be clayey at depth.
Shallow sands	Sands \leq 80 cm over rock, hardpan or other cemented layer.
Deep sands	Sands >80 cm deep.
Loamy duplexes	Soils with a loamy surface and a texture contrast at 3 to 80 cm.
Loamy earths	Soils with a loamy surface and either loamy throughout or grading to clay by 80 cm.
Shallow loams	Loams \leq 80 cm over rock, hardpan or other cemented layer.
Cracking clays	Soils that have a clayey surface at least 30 cm thick and crack strongly when dry.
Non-cracking clays	Soils that have a clayey surface at least 30 cm thick and do not crack strongly when dry.
Miscellaneous soils	Other soils.

4.2 Soil attributes

For each of the soil attributes included in the descriptions of Soil Groups, the reference and range of values is provided below (Table 2). Most are based on the land qualities as defined by van Gool, Tille and Moore (2005).

Profile stones and gravels are from the definitions of McDonald *et al.* (2009). The soil permeability is that of the surface layers based on the classes listed in Purdie (1993). The pH attributes use the ranges in Purdie (1999) that has fewer classes than those used in van Gool, Tille and Moore (2005).

Some of the land qualities of van Gool, Tille and Moore (2005) can be related directly to soil properties (e.g. Water repellence and Surface soil structure decline). However, some land qualities are influenced by the position in the landscape (e.g. Rooting depth, Soil water storage). In these cases, the values provided for Soil Groups assume that there is no shallow watertable, fresh or saline within 1.5 m. The soil attribute Inherent fertility is related to the soil parent material. If the particular Soil Groups subsoil is saline, the limitation for these soils is salinity, not inherent fertility.

In cases where the expected value of an attribute includes any of the available range, the value *variable* is used. In cases where it is not possible to assign a value to an attribute (e.g. soil attributes for Bare rock), the value *not applicable* is used.

Table 2: Soil attributes (dominant values) and references

Attribute	Based on	Range of values
Inherent fertility	van Gool and Tille (in press)	Low, Moderate, High
Permeability (0-50 cm)	Purdie (1993)	Very slow, Slow, Moderately slow, Moderate, Moderately rapid, Rapid, Very rapid
pH 0-10 cm	Purdie (1999)	Strongly acid, Acid, Neutral, Alkaline
pH 50-80 cm	Purdie (1999)	Strongly acid, Acid, Neutral, Alkaline
Profile stones and gravels	McDonald <i>et al.</i> (2009)	Very few, Few, Many, Abundant
Rooting depth	van Gool, Tille and Moore (2005)	Very shallow, Shallow, Moderate, Deep, Very deep
Soil water storage	van Gool, Tille and Moore (2005)	Very low, Low, Moderate, High
Subsurface acidification	van Gool, Tille and Moore (2005)	Low, Moderate, High, Presently Acid
Subsurface compaction	van Gool, Tille and Moore (2005)	Low, Moderate, High
Surface organic carbon	van Gool, Tille and Moore (2005)	Low, Moderate, High
Surface soil structure decline	van Gool, Tille and Moore (2005)	Low, Moderate, High
Water repellence	van Gool, Tille and Moore (2005)	Low, Moderate, High

4.3 Soil Group qualifiers

Each Soil Group includes a range of soil properties. In many circumstances the Soil Group alone may not convey all the information necessary to distinguish local soils or soil properties relevant to land management. An appended qualifier gives flexibility needed in these situations while retaining standardised names.

The extra information provided by Soil Group qualifiers falls into five main categories:

- texture
- structure
- subsurface
- subsoil and
- substrate related

Soil Group qualifiers can be used in two main ways:

1. Ad hoc for adding some descriptive information to a Soil Group

In this option free text can be added to a Soil Group to help describe particular characteristics of a soil. For example, Pale deep sand (over mottled clay by 1.5 m)

2. Structured to determine land units

The Department of Agriculture and Food, Western Australia uses a standard set of Soil Group qualifiers which are applied to individual Soil Groups or combinations of Soil Groups for the purpose of defining land units in combination with landscape position. The methodology for determining land units for the purpose of assigning attributes for land management decision making is described on page 33.

Table 3 describes in detail the standard set of Soil Group qualifiers used by the Department of Agriculture and Food, and the Soil Groups to which they apply. Note that some appear similar but have different meanings and different Soil Group applicability.

Table 4 describes how the qualifiers are assigned to individual Soil Groups or Soil Supergroups. The qualifiers are applied to each Soil Group in a specific order. For a given Soil Group start at the top of the list of qualifiers and, working down the list, select the *first* applicable qualifier, even if other qualifiers down the list are also applicable. The qualifiers are listed in decreasing order of importance for land use, hence it is important that the first, and most important, qualifier is selected.

Table 3: Standard list of Soil Group qualifiers for describing land units
(Ordered by code)

Code	Qualifier name and summary description	Relevant soil groups
ACD	Good acid subsoil: clay loam to clay subsoil above 80 cm is acidic ($\text{pH}_w < 6.0$) and non-sodic and well structured or permeable	404, 405, 407, 501, 505, 506, 508, 541, 543, 544, 545
ACD	Good acid subsoil: subsoil above 80 cm is acidic ($\text{pH}_w < 6.0$) and non-sodic and well structured or permeable	461, 462, 463, 464, 465
ALK	Good alkaline subsoil: clay loam to clay subsoil above 80 cm is alkaline ($\text{pH}_w > 8.0$) and non-sodic and well structured or permeable	402, 405, 406, 407, 408, 502, 503, 505, 506, 507, 508, 541, 542, 543, 544, 545
ALK	Good alkaline subsoil: subsoil above 80 cm is alkaline ($\text{pH}_w > 8.0$) and non-sodic and well structured or permeable	462, 463, 464, 465
CAC	Acid subsoil: clay loam to clay subsoil above 80 cm is acidic ($\text{pH}_w < 6.0$)	302, 303, 601, 602, 621, 622
CLK	Alkaline subsoil: clay loam to clay subsoil above 80 cm is alkaline ($\text{pH}_w > 8.0$) above 80 cm	601, 602, 621, 622
CLM	Clayey matrix: stones or gravel are surrounded by a predominantly clay loam to clay matrix	202, 203, 304
CLY	Clay topsoil: topsoil texture ranges from a clay loam to a clay	101, 103, 105
CNE	Neutral subsoil: clay loam to clay subsoil above 80 cm is neutral ($\text{pH}_w 6.0-8.0$) (<i>may be alkaline in 303</i>)	302, 303, 601, 602, 621, 622
DNR	Differentiation not required: no further differentiation is required for this soil group	102, 104, 201, 701, 702, 703, 704
DSA	Deep sand: profile is non-alkaline and has sand to clayey sand texture to a depth of at least 80 cm	101, 103, 105
DSD	Deep sandy duplex: profile has a sandy topsoil and a texture contrast layer present at 30-80 cm	101, 103, 105
DSK	Calcareous or alkaline sands: profile is alkaline and has sand to clayey sand texture to a depth of at least 80 cm	101, 103, 105
EDX	Effective duplex: barrier to drainage (e.g. clay layer, solid rock or hardpan) is present at 80-150 cm	440
FSE	Fair sand, effective duplex: fine sand to 80 cm or sand increasing to clayey or loamy sand below 30 cm and a clay loam or clay layer (but no solid rock or hardpan) is present at 80-150 cm	441, 445, 446
FSR	Fair sand, rock substrate: fine sand to 80 cm or sand increasing to clayey or loamy sand below 30 cm and a hardpan or solid rock is present at 80-150 cm	441, 445, 446
FSV	Fair sand, very deep: fine sand throughout or sand increasing to clayey or loamy sand below 30 cm and no hardpan, solid rock or clay layer present within the top 150 cm	441, 445, 446
GRG	Gravelly subsurface, good subsoil: ironstone gravel (>20%) present below 15 cm and clay loam to clay subsoil above 80 cm is non-sodic and well structured or permeable	409
GRI	Coarse gritty sand: sand is coarse or gritty and solid rock is present at 30-80 cm	422

Code	Qualifier name and summary description	Relevant soil groups
GRP	Gravelly subsurface, poor subsoil: ironstone gravel (>20%) present below 15 cm and clay loam to clay subsoil above 80 cm is poorly structured (typically sodic)	409
GRV	Gravelly: ironstone gravel (>20%) present in the top 15 cm	101, 103, 105
GSA	Good sand topsoil, good acid subsoil: topsoil is a clayey, loamy or fine sand and clay loam to clay subsoil above 80 cm is acidic (pH _w <6.0) and well structured or permeable	403
GSE	Good sand, effective duplex: clayey or loamy sand dominates the profile and occurs within the top 30 cm and a clay loam or clay layer (but no solid rock or hardpan) is present at 80-150 cm	301, 441, 445, 446
GSE	Good sand, effective duplex: clayey, loamy or fine sand dominates the profile below 30 cm and a clay loam to clay layer or soft coffee rock (but no solid rock or hardpan) is present at 80-150 cm	443, 444
GSN	Good sand topsoil, good neutral subsoil: topsoil is a clayey, loamy or fine sand and the clay loam to clay subsoil above 80 cm is neutral (pH _w 6.0-8.0) and non-sodic and well structured or permeable	403
GSP	Good sand topsoil, poor subsoil: topsoil is predominantly a clayey, loamy or fine sand and clay loam to clay subsoil above 80 cm is poorly structured (typically sodic)	401, 403
GSR	Good sand, deep rock substrate: clayey or loamy sand (<i>typically a dark colour in 442</i>) dominates the profile and occurs within the top 30 cm and a hardpan, cemented layer or solid rock is present at 80-150 cm	301, 441, 442, 445, 446
GSR	Good sand, deep rock substrate: clayey, loamy or fine sand dominates the profile (below 30 cm) and a hardpan, cemented layer or solid rock is present at 80-150 cm	443, 444
GSR	Good sand, rock substrate: sand is predominantly fine grained, loamy or clayey (<i>typically a dark colour for 421, may contain some gravels for 422-424</i>) and a hardpan, cemented layer or solid rock is present at 30-80 cm	421, 422, 423, 424
GSV	Good sand, very deep: clayey or loamy sand dominates the profile (may grade into a clay below 80 cm) and no hardpan or solid rock is present within the top 150 cm	301
GSV	Good sand, very deep: clayey or loamy sand (<i>typically a dark colour in 442</i>) dominates the profile and occurs within the top 30 cm and no hardpan, clay layer or solid rock is present within the top 150 cm	441, 442, 445, 446
GSV	Good sand, very deep: clayey, loamy or fine sand dominates the profile below 30 cm and no hardpan, clay layer, reticulite or solid rock is present within the top 150 cm	443, 444
GSX	Good sand, permeable substrate: clayey or loamy sand dominates and a permeable layer of reticulite or clay is present at 80-150 cm	301
GTR	Gritty sand, rock substrate: gritty or coarse sand (typically bleached) and solid rock is present at 80-150 cm	443, 444

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Code	Qualifier name and summary description	Relevant soil groups
GVR	Good sand, very shallow rock substrate: dark loamy sand dominates the profile and solid rock or a cemented layer is present at <30 cm	421
GWK	Good sand, good alkaline subsoil: topsoil is a clayey, loamy or fine sand and clay loam to clay subsoil above 80 cm is alkaline (pH _w >8.0) and non-sodic and well structured or permeable	401
LCA	Loamy-calcareous: soil is predominantly loamy and calcareous	101, 103, 105
LDP	Loamy duplex: profile has a loamy topsoil and a texture contrast layer present at 30-80 cm	101, 103, 105
LMM	Loamy matrix: stones or gravel are surrounded by a predominantly sandy loam, loam, silty loam or sandy clay loam matrix	202, 203, 304
LMR	Loam, rock substrate: solid rock or hardpan is present at 30-80 cm	520, 522, 523
LMY	Loam topsoil: soil is a deep loam or a loam grading into a clay (i.e. a loamy earth)	101, 103, 105
LVR	Loam, very shallow rock substrate: solid rock, a cemented layer or hardpan is present at <30 cm	523
NEU	Good neutral subsoil: clayey subsoil above 80 cm is neutral (pH _w 6.0-8.0) and non-sodic and well structured or permeable	404, 405, 406, 407, 408, 504, 505, 506, 507, 508, 541, 543, 544, 545
NEU	Good neutral subsoil: subsoil above 80 cm is neutral (pH _w 6.0-8.0) and non-sodic and well structured or permeable	462, 463, 464, 465
NSA	Non-saline: non-saline (EC _e is <400 mS/m) above 80 cm	521
PEA	Peaty: soil (which is typically sandy) is dominated by organic matter	105
POE	Poor sand, effective duplex: gravel is surrounded by a predominantly a sand or loamy sand matrix in the top 80 cm and a clay loam to clay layer which provides an impediment to water movement is present at 80-150 cm	301
PPS	Poor sand, poor subsoil: topsoil is predominantly a coarse or medium grained sand and the clay subsoil is poorly structured (typically sodic)	401, 403
PSE	Poor sand, effective duplex: coarse or medium sand is dominant and a clay loam to clay layer or soft coffee rock (but no solid rock or hardpan) is present at 80-150 cm	441, 443, 444, 445, 446
PSR	Poor sand, deep rock substrate: sand is predominantly coarse or medium grained (and pale coloured for 442, can also be a loamy sand for 301) and a hardpan, cemented layer or solid rock is present at 80-150 cm	301, 441, 442, 443, 444, 445, 446
PSR	Poor sand, rock substrate: sand is predominantly coarse or medium grained (and pale for 421) and a hardpan, cemented layer or solid rock present at 30-80 cm	421, 422, 423, 424

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Code	Qualifier name and summary description	Relevant soil groups
PSS	Poor subsoil: poorly structured (typically sodic) clay or clay loam subsoil above 80 cm which provides an impediment to water movement and root growth	302, 303, 400, 402, 404, 405, 406, 407, 408, 409, 460, 461, 462, 463, 464, 465, 500, 501, 502, 503, 504, 505, 506, 507, 508, 540, 541, 542, 543, 544, 545
PSV	Poor sand, very deep: sand is predominantly coarse or medium grained (<i>and pale coloured for 442, can also be a loamy sand for 301</i>) and no hardpan, solid rock or clay layer is present within the top 150 cm	301, 441, 442, 443, 444, 445, 446
PSX	Poor sand, permeable substrate: gravel is surrounded by a predominantly sand or loamy sand matrix in the top 80 cm and a reticulite or permeable clay layer is present at 80-150 cm	301
PVR	Poor sand, very shallow rock substrate: sand is coarse to fine grained with low organic matter content (i.e. pale coloured) and a solid rock or cemented layer is present at <30 cm	421
PWA	Poor sand, good acid subsoil: sandy topsoil is coarse or medium grained and clay loam to clay subsoil above 80 cm is acid ($\text{pH}_w < 6.0$) and non-sodic and well structured	403
PWK	Poor sand, good alkaline subsoil: sandy topsoil is coarse or medium grained and clay loam to clay subsoil above 80 cm is alkaline ($\text{pH}_w > 8.0$) and non-sodic and well structured or permeable	401
PWN	Poor sand, good neutral subsoil: sandy topsoil is coarse or medium grained and clay loam to clay subsoil above 80 cm is neutral ($\text{pH}_w 6.0-8.0$) and non-sodic and well structured or permeable	403
RET	Reticulite: a reticulite layer is present at 30-80 cm	302, 303
RKD	Deep rock substrate: solid rock, hardpan or a cemented layer is present at 80-150 cm	301, 302
RKM	Rock substrate: solid rock, hardpan or a cemented layer is present at 30-80 cm	401, 402, 403, 404, 405, 406, 407, 408, 409, 460, 461, 462, 463, 464, 465, 501, 502, 503, 504, 505, 506, 507, 508, 541, 544, 545
RST	Rocky or stony: soil has >20% rock or stones (>20 mm) throughout	101, 103, 105
SAC	Acid sand: sand is strongly acid ($\text{pH}_w < 5.6$) within the top 30 cm	422, 423, 424, 441, 443, 444, 445, 446
SAL	Saline: soil is saline ($\text{ECe} > 400$ mS/m) within the top <30 cm	202, 304, 421, 422, 423, 424, 442, 520, 521, 522, 601, 602, 621, 622
SAM	Sandy matrix: stones or gravel are surrounded by a	202, 203, 304

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Code	Qualifier name and summary description	Relevant soil groups
	predominantly coarse to clayey sand sandy matrix	
DLM	Deep loam: the texture of the matrix surrounding the gravel ranges from a sandy loam to sandy clay loam in the top 80 cm (i.e. no clay loam or clay layer)	303
SEA	Sandy earth: sandy topsoil grading to loam by 80 cm	101, 103, 105
SHL	Shallow loam: soil is a loam or a clay and solid rock, hardpan or a cemented layer is present at 30-80 cm	101, 103, 105
SHS	Shallow sand: soil is a sand and solid rock, hardpan or a cemented layer is present at 30-80 cm	101, 103, 105
SSD	Shallow sandy duplex: profile has a sandy topsoil and a texture contrast layer present at <30 cm	101, 103, 105
SSS	Saline subsoil: subsoil is saline (EC _e >400 mS/m) and occurs above 80 cm	203, 301, 302, 303, 400, 401, 402, 403, 404, 405, 406, 407, 408, 409, 460, 461, 462, 463, 464, 465, 500, 501, 502, 503, 504, 505, 506, 507, 508, 540, 541, 542, 543, 544, 545
TYP	Typical: typical qualifier for this soil group in this zone	All
UDF	Undifferentiated: soil has not yet been differentiated	All
VDE	Very deep: no solid rock, clay, hardpan or reticulite is present in the top 150 cm	440
VGR	Very gravelly: ironstone gravel content is predominantly >60% within the top 80 cm	301, 302, 303, 304
VSH	Very shallow rock substrate: solid rock, hardpan or a cemented layer is present at <30 cm	101, 103, 105, 202, 203, 304, 420, 422, 423, 424, 520, 522
WSS	Good subsoil: clay loam to clay subsoil above 80 cm is non-sodic and well structured or permeable	400, 409, 460, 500, 540

Table 4: Order of applicable Soil Group qualifiers

For a given Soil Group (listed by code order) start at the top of the list of qualifiers, and working down the list select the *first* applicable qualifier.

101	Saline wet soil VSH: very shallow rock substrate RST: rocky or stony CLY: clay topsoil LCA: loamy-calcareous SHL: shallow loam LDP: loamy duplex LMY: loam topsoil GRV: gravelly SHS: shallow sand SSD: shallow sandy duplex DSD: deep sandy duplex SEA: sandy earth DSK: calcareous or alkaline sands DSA: deep sand	203	Stony soil VSH: very shallow rock substrate SSS: saline subsoil SAM: sandy matrix LMM: loamy matrix CLM: clayey matrix
102	Salt lake soil DNR: differentiation not required	301	Deep sandy gravel SSS: saline subsoil VGR: very gravelly POE: poor sand, effective duplex GSE: good sand, effective duplex PSX: poor sand, permeable substrate GSX: good sand, permeable substrate PSR: poor sand, deep rock substrate GSR: good sand, deep rock substrate PSV: poor sand, very deep GSV: good sand, very deep
103	Semi-wet soil VSH: very shallow rock substrate RST: rocky or stony CLY: clay topsoil LCA: loamy-calcareous SHL: shallow loam LDP: loamy duplex LMY: loam topsoil GRV: gravelly SHS: shallow sand SSD: shallow sandy duplex DSD: deep sandy duplex SEA: sandy earth DSK: calcareous or alkaline sands DSA: deep sand	302	Duplex sandy gravel SSS: saline subsoil RKD: deep rock substrate VGR: very gravelly RET: reticulite PSS: poor subsoil CAC: acid subsoil CNE: neutral subsoil
104	Tidal soil DNR: differentiation not required	303	Loamy gravel SSS: saline subsoil RET: reticulite VGR: very gravelly DLM: no clay loam in top 80cm PSS: poor subsoil CAC: acid subsoil CNE: neutral subsoil
105	Wet soil VSH: very shallow rock substrate RST: rocky or stony CLY: clay topsoil PEA: peaty LCA: loamy-calcareous SHL: shallow loam LDP: loamy duplex GRV: gravelly SHS: shallow sand SSD: shallow sandy duplex DSD: deep sandy duplex SEA: sandy earth DSK: calcareous or alkaline sands DSA: deep sand	304	Shallow gravel VSH: very shallow rock substrate SAL: saline VGR: very gravelly SAM: sandy matrix LMM: loamy matrix CLM: clayey matrix
201	Bare rock DNR: differentiation not required	401	Alkaline grey deep sandy duplex SSS: saline subsoil RKM: rock substrate PPS: poor sand, poor subsoil GSP: good sand topsoil, poor subsoil PWK: poor sand, good alkaline subsoil GWK: good sand, good alkaline subsoil
202	Calcareous stony soil VSH: very shallow rock substrate SAM: sandy matrix LMM: loamy matrix	402	Alkaline grey shallow sandy duplex SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil

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403	<p>Grey deep sandy duplex SSS: saline subsoil RKM: rock substrate PPS: poor sand, poor subsoil GSP: good sand topsoil, poor subsoil GSN: good sand topsoil, good neutral subsoil GSA: good sand topsoil, good acid subsoil PWN: poor sand, good neutral subsoil PWA: poor sand, good acid subsoil</p>		
404	<p>Grey shallow sandy duplex SSS: saline subsoil RKM: rock substrate PSS: poor subsoil NEU: good neutral subsoil ACD: good acid subsoil</p>	422	<p>Pale shallow sand SAL: saline VSH: very shallow rock substrate SAC: acid sand GRI: coarse gritty sand PSR: poor sand, deep rock substrate GSR: good sand, deep rock substrate</p>
405	<p>Red deep sandy duplex SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil ACD: good acid subsoil NEU: good neutral subsoil</p>	423	<p>Red shallow sand SAL: saline VSH: very shallow rock substrate SAC: acid sand PSR: poor sand, deep rock substrate GSR: good sand, deep rock substrate</p>
406	<p>Red shallow sandy duplex SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil NEU: good neutral subsoil</p>	424	<p>Yellow/brown shallow sand SAL: saline VSH: very shallow rock substrate SAC: acid sand PSR: poor sand, deep rock substrate GSR: good sand, deep rock substrate</p>
407	<p>Yellow/brown deep sandy duplex SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil ACD: good acid subsoil NEU: good neutral subsoil</p>	441	<p>Brown deep sand SAC: acid sand PSR: poor sand, deep rock substrate PSV: poor sand, very deep PSE: poor sand, effective duplex FSR: fair sand, rock substrate FSE: fair sand, effective duplex FSV: fair sand, very deep GSR: good sand, deep rock substrate GSE: good sand, effective duplex GSV: good sand, very deep</p>
408	<p>Yellow/brown shallow sandy duplex SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil NEU: good neutral subsoil</p>	442	<p>Calcareous deep sand SAL: saline PSR: poor sand, deep rock substrate PSV: poor sand, very deep GSR: good sand, deep rock substrate GSV: good sand, very deep</p>
409	<p>Reticulite deep sandy duplex SSS: saline subsoil RKM: rock substrate GRP: gravelly subsurface, poor subsoil PSS: poor subsoil GRG: gravelly subsurface, good subsoil WSS: good subsoil</p>	443	<p>Gravelly pale deep sand SAC: acid sand GTR: gritty sand, rock substrate PSR: poor sand, deep rock substrate PSE: poor sand, effective duplex PSV: poor sand, very deep GSR: good sand, deep rock substrate GSE: good sand, effective duplex GSV: good sand, very deep</p>
421	<p>Calcareous shallow sand SAL: saline PVR: poor sand, very shallow rock substrate GVR: good sand, very shallow rock substrate PSR: poor sand, deep rock substrate GSR: good sand, deep rock substrate</p>	444	<p>Pale deep sand SAC: acid sand GTR: gritty sand, rock substrate</p>

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	PSR: poor sand, deep rock substrate PSE: poor sand, effective duplex PSV: poor sand, very deep GSR: good sand, deep rock substrate GSE: good sand, effective duplex GSV: good sand, very deep		ALK: good alkaline subsoil ACD: good acid subsoil NEU: good neutral subsoil
445	Red deep sand SAC: acid sand PSR: poor sand, deep rock substrate PSV: poor sand, very deep PSE: poor sand, effective duplex FSR: fair sand, rock substrate FSE: fair sand, effective duplex FSV: fair sand, very deep GSR: good sand, deep rock substrate GSE: good sand, effective duplex GSV: good sand, very deep	501	Acid shallow duplex SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ACD: good acid subsoil
446	Yellow deep sand SAC: acid sand PSR: poor sand, deep rock substrate PSE: poor sand, effective duplex PSV: poor sand, very deep FSR: fair sand, rock substrate FSE: fair sand, effective duplex FSV: fair sand, very deep GSR: good sand, deep rock substrate GSE: good sand, effective duplex GSV: good sand, very deep	502	Alkaline grey shallow loamy duplex SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil
461	Acid yellow sandy earth SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ACD: good acid subsoil	503	Alkaline red shallow loamy duplex SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil
462	Brown sandy earth SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil ACD: good acid subsoil NEU: good neutral subsoil	504	Grey shallow loamy duplex SSS: saline subsoil RKM: rock substrate PSS: poor subsoil NEU: good neutral subsoil
463	Red sandy earth SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil ACD: good acid subsoil NEU: good neutral subsoil	505	Brown deep loamy duplex SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil ACD: good acid subsoil NEU: good neutral subsoil
464	Yellow sandy earth SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil ACD: good acid subsoil NEU: good neutral subsoil	506	Red deep loamy duplex SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil ACD: good acid subsoil NEU: good neutral subsoil
465	Pale sandy earth SSS: saline subsoil RKM: rock substrate PSS: poor subsoil	507	Red shallow loamy duplex SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil NEU: good neutral subsoil
		508	Yellow/brown shallow loamy duplex SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ACD: good acid subsoil ALK: good alkaline subsoil NEU: good neutral subsoil
		521	Calcareous shallow loam SAL: saline NSA: non-saline
		522	Red shallow loam SAL: saline VSH: very shallow rock substrate LMR: loam, rock substrate

SOIL GROUPS OF WESTERN AUSTRALIA

523	Red-brown hardpan shallow loam SSS: saline subsoil LVR: loam, very shallow rock substrate LMR: loam, rock substrate
541	Brown loamy earth SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil ACD: good acid subsoil NEU: good neutral subsoil
542	Calcareous loamy earth SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil
543	Friable red/brown loamy earth SSS: saline subsoil PSS: poor subsoil ALK: good alkaline subsoil ACD: good acid subsoil NEU: good neutral subsoil
544	Red loamy earth SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil ACD: good acid subsoil NEU: good neutral subsoil
545	Yellow loamy earth SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil ACD: good acid subsoil NEU: good neutral subsoil
601	Hard cracking clay SAL: saline CAC: acid subsoil CLK: alkaline subsoil CNE: neutral subsoil
602	Self-mulching cracking clay SAL: saline CAC: acid subsoil CLK: alkaline subsoil CNE: neutral subsoil
621	Grey non-cracking clay SAL: saline CAC: acid subsoil CLK: alkaline subsoil CNE: neutral subsoil

622	Red/brown non-cracking clay SAL: saline CAC: acid subsoil CLK: alkaline subsoil CNE: neutral subsoil
701	Disturbed land DNR: differentiation not required
702	Water DNR: differentiation not required
703	No suitable group DNR: differentiation not required
704	Undifferentiated soils DNR: differentiation not required

4.4 Land units

Land units are combinations of soil and landform that repeatedly occur at similar points in the landscape (van Gool and Moore 1999). They have a defined set of properties relevant to land management. They are similar in concept to the **land management units (LMUs)** that are often used in catchment or farm planning. The key difference is that land units are more tightly defined than land management units, and often provide more information or detail than is required to partition the landscape for management purposes. Land management units are groups of land units that perform similarly under a specified land use.

In the soil-landscape mapping available for south-western Australia, the land units are typically made up of three components:

1. *Soil Group*
2. *Soil Group qualifier* (additional information about soil group relevant to land management)
3. *Landform*

An example of a land unit from the Busselton-Margaret River area is:

Soil Group: **Brown loamy earth** (code: 541)

Soil Group qualifier: **Good neutral subsoil:** clayey subsoil above 80 cm is neutral (pH_w 6.0-8.0) and non-sodic and well structured or permeable neutral pH and well structured or permeable non-sodic subsoil (code NEU)

Landform: **well drained flat** (code FWD)

Each land unit is then given values for a range of land qualities based on soil, landform and soil-landform characteristics.

In the soil-landscape mapping for south-western Australia conducted by the Department of Agriculture there are at present about 9,000 land units. These can be grouped into about 100 main land management units for the agricultural area. Within any regional area it is possible to aggregate these to about 20 or 30 land management units which are relevant to land management.

More information on the soil-landscape mapping methodology and map units can be obtained from Resource Management Technical Report 280 (Schoknecht *et al.* 2004).

Saline wet soil

Soil Group 101

Seasonally waterlogged soils subject to secondary salinity

Characteristics

- Seasonally wet to within 80 cm for a major part of the year
- Sands, loams and clays
- Affected by moderate to extreme secondary salinity
- Commonly over clay or pan

Local names

- Salt
- Salt land

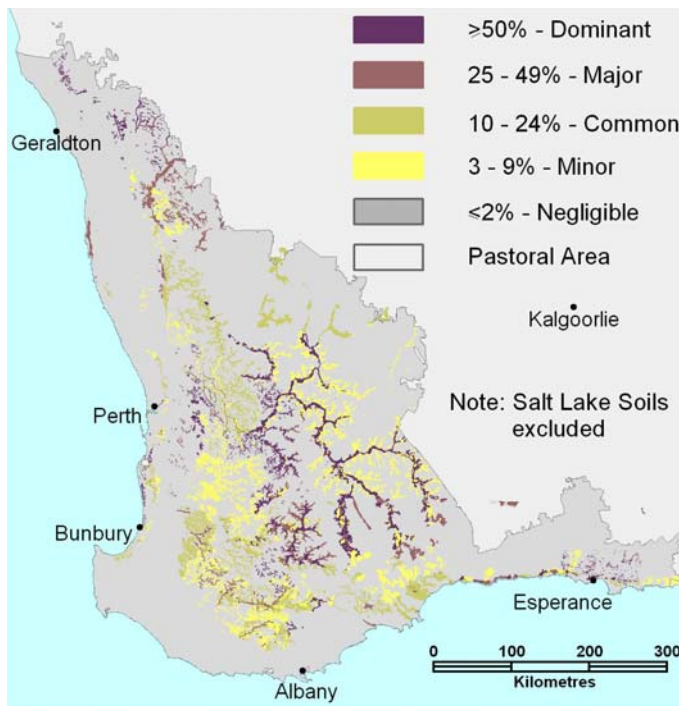
Typical Australian Soil Classification (ASC)

(dominant ASC in *italics*)

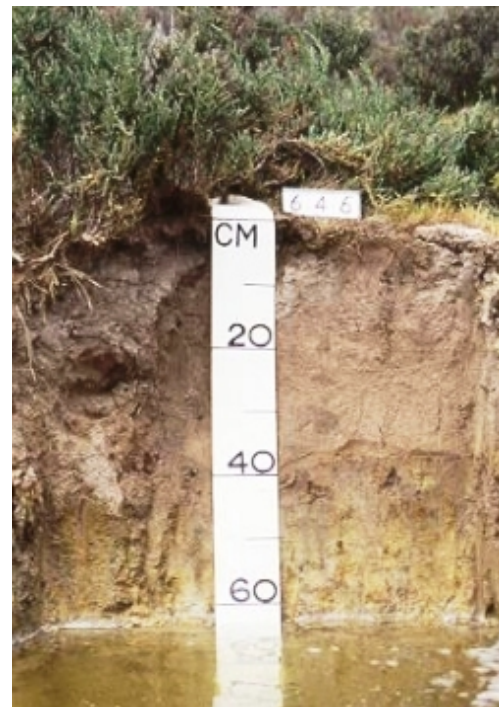
- *Salic Hydrosol*

Main occurrences in Western Australia

- Areas of secondary salinity in the wheatbelt of the South-west



Distribution map of Saline wet soil
in the South-west of WA



Saline wet soil
(Pingrup)

Land use considerations

- Waterlogging and high salinity severely limits growth of most plants, except halophytes
- These soils are frequently degraded by sheet, rill and wind erosion and may be devoid of vegetation

Available qualifiers of Saline wet soil (in order from most to least restrictive)

- VSH very shallow rock substrate
- RST rocky or stony
- CLY clay topsoil
- LCA loamy-calcareous
- SHL shallow loam
- LDP loamy duplex
- LMY loam topsoil
- GRV gravelly
- SHS shallow sand
- SSD shallow sandy duplex
- DSD deep sandy duplex
- SEA sandy earth
- DSK calcareous or alkaline sands
- DSA deep sand

Soil attributes of Saline wet soil (dominant values)

ATTRIBUTE	QUALIFIER						
	VSH	RST	CLY	LCA	SHL	LDP	LMY
Inherent fertility	Moderate	Moderate	High	Moderate	High	Moderate	Moderate
Permeability 0-50 cm	Moderately slow	Moderate	Very slow	Moderate	Moderately rapid	Moderately rapid	Moderate
pH at 0-10 cm	Slightly acid	Slightly acid	Slightly acid	Moderately alkaline	Slightly acid	Slightly acid	Slightly acid
pH at 50-80 cm	Slightly acid	Neutral	Slightly acid	Moderately alkaline	Neutral	Neutral	Neutral
Profile stones and gravels	Not applicable	Abundant	Very few	Few	Abundant	Few	Nil
Rooting depth	Shallow	Moderately shallow	Shallow	Moderately shallow	Moderate	Moderate	Moderately shallow
Soil water storage	Very low	High	Very low	Very low	High	High	High
Subsurface acidification	Moderate	Low	Low	Low	Moderate	Low	Low
Subsurface compaction	Moderate	High	Low	Moderate	Moderate	High	High
Surface organic carbon	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Surface soil structure decline	Low	Low	Moderate	Moderate	Moderate	Moderate	Low
Water repellence	Nil	Nil	Nil	Nil	Nil	Nil	Nil

ATTRIBUTE	QUALIFIER						
	GRV	SHS	SSD	DSD	SEA	DSK	DSA
Inherent fertility	Moderate	Low	Moderate	Moderate	Moderate	Moderate	Low
Permeability 0-50 cm	Rapid	Rapid	Slow	Rapid	Moderately rapid	Rapid	Rapid
pH at 0-10 cm	Slightly acid	Slightly acid	Slightly acid	Slightly acid	Slightly acid	Moderately alkaline	Slightly acid
pH at 50-80 cm	Neutral	Neutral	Neutral	Neutral	Neutral	Moderately alkaline	Neutral
Profile stones and gravels	Many	Abundant	Few	Few	Very few	Nil	Very few
Rooting depth	Moderate	Moderate	Moderate	Moderate	Deep	Moderate	Moderate
Soil water storage	High	High	High	High	High	High	High
Subsurface acidification	Low	Low	Moderate	Low	Low	Low	Moderate
Subsurface compaction	High	High	High	Moderate	High	Moderate	Moderate
Surface organic carbon	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Surface soil structure decline	Moderate	Moderate	Moderate	Low	Moderate	Low	Low
Water repellence	Nil	Nil	Nil	Nil	Nil	Nil	Nil

Salt lake soil

Soil Group 102

Variable, seasonally waterlogged, salt lake soils

Characteristics

- Seasonally wet to within 80 cm for a major part of the year
- Variable textures
- Highly saline
- Often gypseous
- Often calcareous
- Primary salinity areas of salt lake beds and adjacent flat saline areas with salt-tolerant vegetation (halophytes)

Local names

- Salt lake

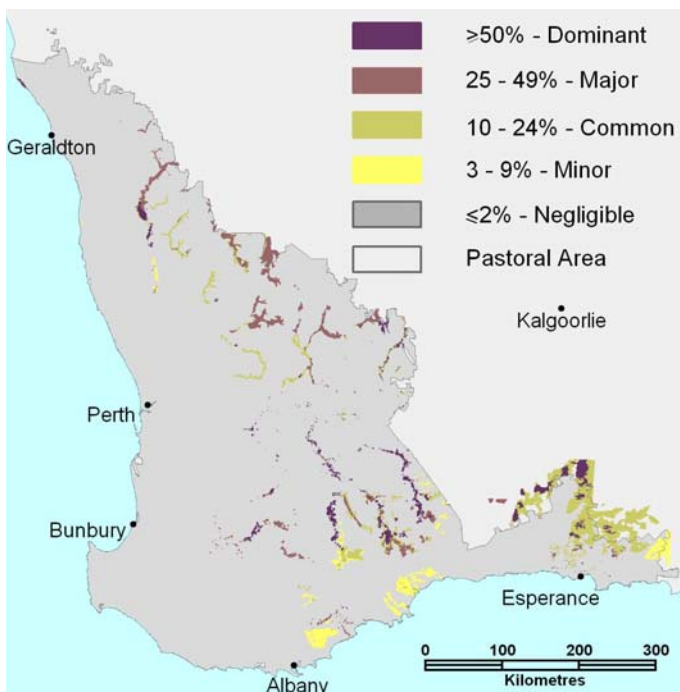
Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

- *Hypersalic Hydrosol*

Main occurrences in Western Australia

- Common in seasonally wet salt lakes in the South-west (central to eastern wheatbelt), Murchison, Goldfields and Arid Interior
- Also on the coastal plain north of Jurien
- Lake McLeod north of Carnarvon



Distribution map of Salt lake soil
in the South-west of WA



Salt lake soil
(Wheatbelt)

Available qualifiers of Salt lake soil

- DNR Differentiation not required

Soil attributes of Salt lake soil (dominant values)

	QUALIFIER	
	DNR	
ATTRIBUTE	Inherent fertility	Low
	Permeability 0-50 cm	Very slow
	pH at 0-10 cm	Neutral to alkaline
	pH at 50-80 cm	Alkaline
	Profile stones and gravels	Not applicable
	Rooting depth	Very shallow
	Soil water storage	Not applicable
	Subsurface acidification	Not applicable
	Subsurface compaction	Not applicable
	Surface organic carbon	Variable
	Surface soil structure decline	Low
	Water repellence	Not applicable

Land use considerations

- High salinity and seasonal waterlogging render this soil unsuitable for the growth of most plants, except halophytes (e.g. saltbush) in fringing areas

Semi-wet soil

Soil Group 103

Non-saline soils waterlogged to 30-80 cm for a major part of the year

Characteristics

- Lower part of profile (30-80 cm) saturated for the major part of the year
- Often with dark grey, brown or black topsoil
- Sands, loams and clays
- Acid to neutral pH
- Variable subsoil, may contain bog iron
- Common in plains with elevated fresh water tables

Local names

- Mungite soil
- Coolup sand
- Boyanup loam

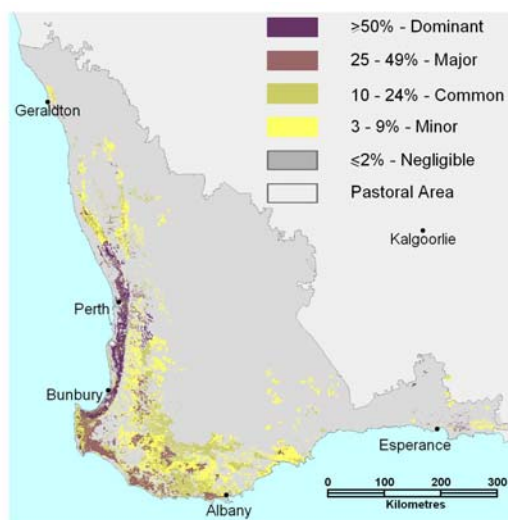
Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

- *Redoxic or Oxyaquic Hydrosol*
- *Aquic or Semiaquic Podosol*
- Kandosol
- Rudosol
- Sodosol
- Tenosol

Main occurrences in Western Australia

- Seasonally wet areas in the South-west, including extensive areas of seasonally wet duplex soils on the coastal areas of the South-west of WA
- Especially the Swan Coastal Plain, North Coastal Plain and Scott River Plain on the south coast, Margaret River Plateau, southern Darling Plateau
- Scattered in other areas in depressions and valley floors



Distribution map of Semi-wet soil
in the South-west of WA



Semi-wet soil
(South coast)

Land use considerations

- Waterlogging and seasonal inundation moderately limit land use options
- Artificial drainage may sometimes be an option
- Often have good summer moisture for perennial pastures, summer cropping

Available qualifiers of Semi-wet soil (in order from most to least restrictive)

- VSH very shallow rock substrate
- RST rocky or stony
- CLY clay topsoil
- LCA loamy-calcareous
- SHL shallow loam
- LDP loamy duplex
- LMY loam topsoil
- GRV gravelly
- SHS shallow sand
- SSD shallow sandy duplex
- DSD deep sandy duplex
- SEA sandy earth
- DSK calcareous or alkaline sands
- DSA deep sand

Soil attributes of Semi-wet soil (dominant values)

ATTRIBUTE	QUALIFIER						
	VSH	RST	CLY	LCA	SHL	LDP	LMY
Inherent fertility	Moderate	Moderate High		High	High Moderate		Moderate
Permeability 0-50 cm	Moderately slow	Moderate	Very slow	Moderate	Moderately rapid	Moderately rapid	Moderate
pH at 0-10 cm	Slightly acid	Slightly acid	Slightly acid	Moderately alkaline	Slightly acid	Slightly acid	Moderately acid
pH at 50-80 cm	Slightly acid	Neutral	Slightly acid	Moderately alkaline	Slightly acid	Slightly acid	Slightly acid
Profile stones and gravels	Not applicable	Abundant	Very few	Few	Abundant	Few	Nil
Rooting depth	Shallow	Deep	Moderately shallow	Moderately shallow	Moderate	Deep	Deep
Soil water storage	Very low	High	Very low	Low	High	High	High
Subsurface acidification	Moderate	Low	Low	Low	Moderate	Moderate	Low
Subsurface compaction	Moderate	Moderate	Low		Moderate	Moderate	High
Surface organic carbon	High	High	High	High	High	High	High
Surface soil structure decline	Low	Low	High	High	High	Moderate	
Water repellence	Nil	Nil	Nil	Nil	Nil	Nil	Nil

ATTRIBUTE	QUALIFIER						
	GRV	SHS	SSD	DSD	SEA	DSK	DSA
Inherent fertility	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Permeability 0-50 cm	Rapid	Rapid	Slow	Rapid	Moderately rapid	Rapid	Rapid
pH at 0-10 cm	Slightly acid	Neutral	Moderately acid	Moderately acid	Moderately acid	Neutral	Moderately acid
pH at 50-80 cm	Slightly acid	Neutral	Slightly acid	Slightly acid	Slightly acid	Moderately alkaline	Slightly acid
Profile stones and gravels	Many	Abundant	Few	Few	Very few	Nil	Very few
Rooting depth	Deep	Moderate	Moderate	Deep	Deep	Deep	Deep
Soil water storage	High	High	High	High	High		
Subsurface acidification	Low	Low	Moderate	Moderate	Moderate	Low	Presently acid
Subsurface compaction	High	High	High	Moderate		High	Moderate
Surface organic carbon	High	High	High	High	High	High	High
Surface soil structure decline	Moderate	Moderate	Moderate	Moderate	Low	Moderate	Low
Water repellence	Nil	Nil	Nil	Nil	Nil	Nil	Nil

Tidal soil

Soil Group 104

Soils subject to tidal inundation

Characteristics

- Variable saline soils subject to tidal inundation

Local names

- Mangrove soil
- Saline mud

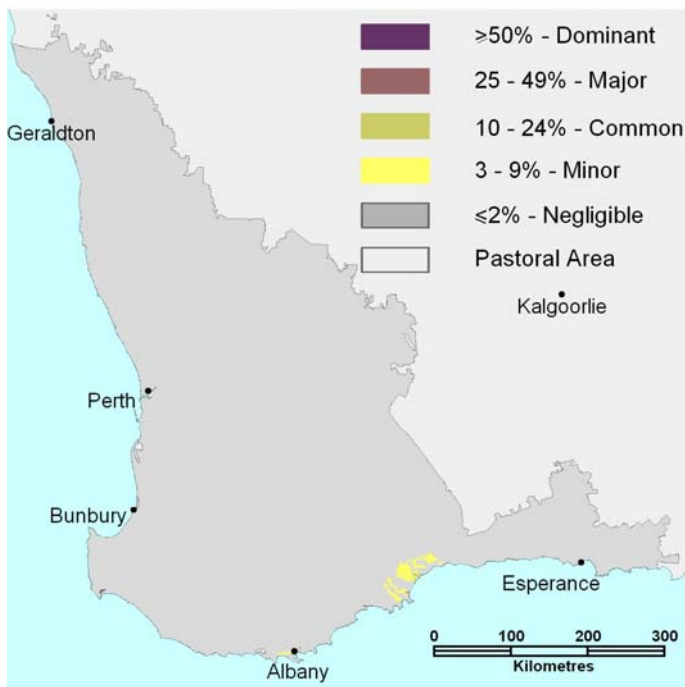
Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

- *Intertidal, Supratidal or Extratidal Hydrosol*

Main occurrences in Western Australia

- Coastal areas subject to tidal inundation
- Common in the North-west coast, especially parts of the Pilbara and Kimberley coastlines



Distribution map of Tidal soil
in the South-west of WA



Tidal soil
(Roebourne)

Available qualifier of Tidal soil

- DNR Differentiation not required

Soil attributes of Tidal soil (dominant values)

ATTRIBUTE		QUALIFIER
		DNR
	Inherent fertility	Low
	Permeability 0-50 cm	Very slow
	pH at 0-10 cm	Alkaline
	pH at 50-80 cm	Alkaline
	Profile stones and gravels	Not applicable
	Rooting depth	Very shallow
	Soil water storage	Not applicable
	Subsurface acidification	Not applicable
	Subsurface compaction	Not applicable
	Surface organic carbon	Variable
	Surface soil structure decline	Not applicable
	Water repellence	Low

Land use considerations

- High salinity and regular inundation by sea water severely limit plant growth to a few specialist species, e.g. mangroves and halophytes in fringing areas

Wet soil

Soil Group 105

Non-saline soils waterlogged to <30 cm for a major part of the year

Characteristics

- Most of the profile (to less than 30 cm) saturated for the major part of the year
- Dark grey, brown or black topsoil
- Sands, loams and clays
- Acid pH
- May be organic in swamps
- Variable subsoil, may contain bog iron or clay
- Commonly in swamps but also areas with elevated fresh watertable

Local names

- Swamp soil
- Peaty soil

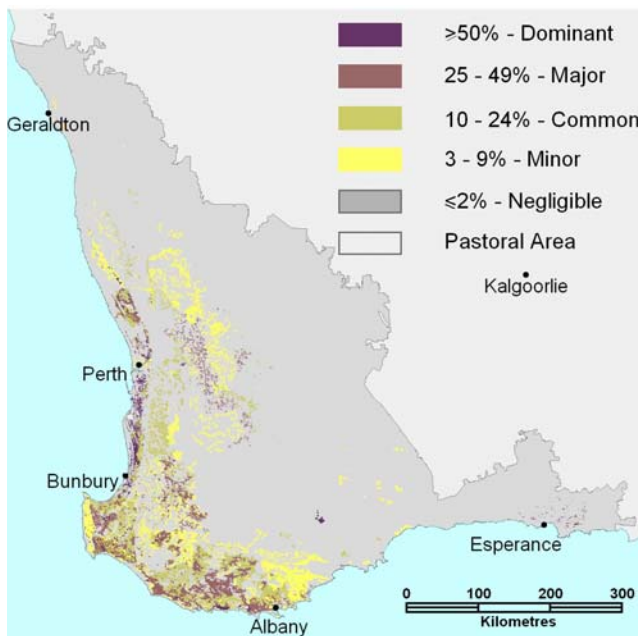
Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

- *Redoxic or Oxyaquic Hydrosol*
- Organosol

Main occurrences in Western Australia

- Swampy areas in the South-west, including some areas of seasonally wet duplex soils on the coast
- Most common, but never widespread, on the Swan Coastal Plain, North Coastal Plain and Scott River Plain on the south coast



Distribution map of Wet soil
in the South-west of WA



Wet soil
(Swan Coastal Plain)

Land use considerations

- Waterlogging and seasonal inundation severely limit land use options
- Artificial drainage may sometimes be an option

Available qualifiers of Wet soil (in order from most to least restrictive)

- VSH very shallow rock substrate
- RST rocky or stony
- CLY clay topsoil
- PEA peaty
- LCA loamy-calcareous
- SHL shallow loam
- LDP loamy duplex
- GRV gravelly
- SHS shallow sand
- SSD shallow sandy duplex
- DSD deep sandy duplex
- SEA sandy earth
- DSK calcareous or alkaline sands
- DSA deep sand

Soil attributes of Wet soil (dominant values)

ATTRIBUTE	QUALIFIER						
	VSH	RST	CLY	PEA	LCA	SHL	LDP
Inherent fertility	Moderate	Moderate High		Moderate	High High	Moderate	
Permeability 0-50 cm	Moderately slow	Moderate	Very slow	Moderately rapid	Moderate	Moderately rapid	Moderately rapid
pH at 0-10 cm	Slightly acid	Moderately acid	Slightly acid	Moderately acid	Neutral	Moderately acid	Slightly acid
pH at 50-80 cm	Neutral	Moderately acid	Slightly acid	Moderately acid	Moderately alkaline	Moderately acid	Neutral
Profile stones and gravels	Not applicable	Abundant	Very few	Nil	Few	Abundant	Few
Rooting depth	Shallow	Moderate	Moderately shallow	Moderate	Moderately shallow	Moderate	Moderate
Soil water storage	Very low	High	Very low	High	Low	High	High
Subsurface acidification	Moderate	Low	Moderate	Presently acid	Low	High	Moderate
Subsurface compaction	Moderate	Moderate Low		Moderate	Moderate	Moderate High	
Surface organic carbon	High	High	High	High	High	High	High
Surface soil structure decline	Low Low	High		Low High		High	High
Water repellence	Nil	Nil	Nil	Nil	Nil	Nil	Nil

ATTRIBUTE	QUALIFIER						
	GRV	SHS	SSD	DSD	SEA	DSK	DSA
Inherent fertility	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
Permeability 0-50 cm	Rapid	Rapid	Slow	Rapid	Moderately rapid	Rapid	Rapid
pH at 0-10 cm	Moderately acid	Moderately acid	Slightly acid	Strongly acid	Strongly acid	Neutral	Moderately acid
pH at 50-80 cm	Neutral	Moderately acid	Neutral	Moderately acid	Slightly acid	Moderately alkaline	Slightly acid
Profile stones and gravels	Many	Abundant	Few Few	Very	few	Nil	Very few
Rooting depth	Moderate	Moderate	Shallow	Moderate	Moderately shallow	Moderate	Moderate
Soil water storage	High	High	Very low	High	Very low	High	High
Subsurface acidification	Low	Presently acid	Moderate	Presently acid	Presently acid	Low	Presently acid
Subsurface compaction	Moderate	High High	Moderate		High	Moderate	Moderate
Surface organic carbon	High	High	High	High	High	High	High
Surface soil structure decline	Low Moderate		Moderate	Low Moderate		Low Low	
Water repellence	Nil	Nil	Nil	Nil	Nil	Nil	Nil

Bare rock

Soil Group 201

Rock outcrop

Characteristics

- Areas generally bare of soil on outcropping rock strata or bare rock surfaces
- Includes some areas with minimal soil development
- Excludes ferricrete/duricrust outcrop

Local names

- Granite outcrop
- Outcrop

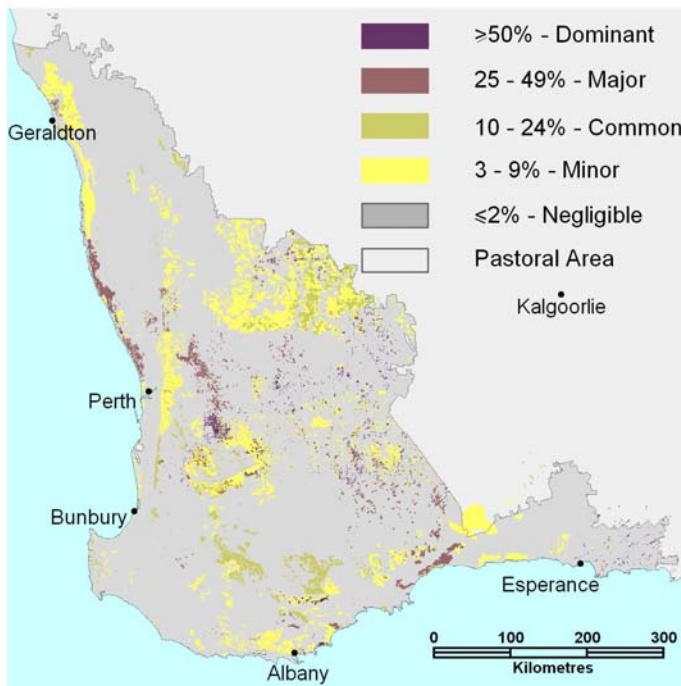
Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

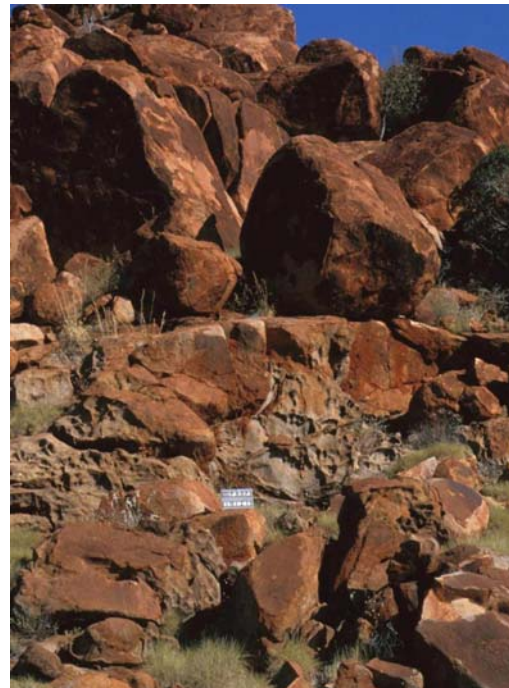
- *Leptic Rudosol*
- Not applicable

Main occurrences in Western Australia

- Widespread, but rarely common
- Most common in the Kimberley and Pilbara
- Scattered in the South-west



Distribution map of Bare rock
in the South-west of WA



Bare rock
(Pilbara)

Available qualifier of Bare rock

- DNR Differentiation not required

Soil attributes of Bare rock (dominant values)

	QUALIFIER	
	DNR	
ATTRIBUTE	Inherent fertility	Not applicable
	Permeability 0-50 cm	Not applicable
	pH at 0-10 cm	Not applicable
	pH at 50-80 cm	Not applicable
	Profile stones and gravels	Not applicable
	Rooting depth	Not applicable
	Soil water storage	Not applicable
	Subsurface acidification	Not applicable
	Subsurface compaction	Not applicable
	Surface organic carbon	Not applicable
	Surface soil structure decline	Not applicable
	Water repellence	Not applicable

Land use considerations

- Soil development minimal in cracks/fractures in rock rendering it unsuitable for the growth of most plants
- Shedding of water may contribute to water erosion of adjacent areas or provide water supplies

Calcareous stony soil

Soil Group 202

Soils which are stony or rocky and calcareous throughout

Characteristics

- Rocks and stones dominant throughout the profile
- Soil depth varies greatly over short distances
- Calcareous throughout
- Alkaline pH
- Usually very shallow, often over calcrete
- Sandy, loamy, clayey or gravelly soil matrix

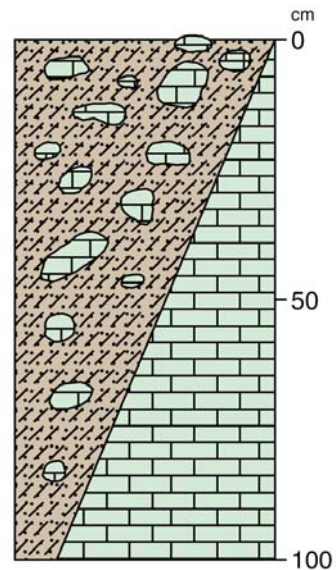
Local names

- Rocky lime soil
- Rocky kopi

Typical Australian Soil Classification (ASC)

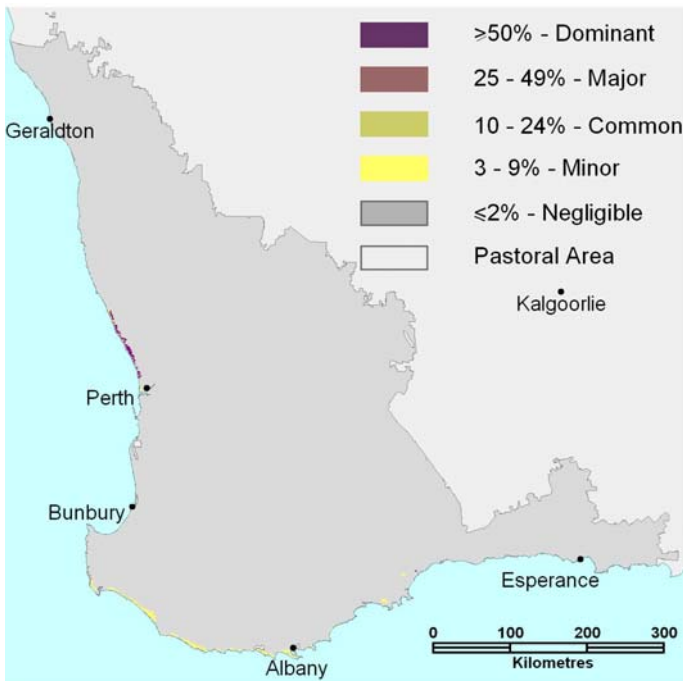
(dominant ASC in italics)

- *Calcic or Lithocalcic Calcarosol*
- *Lithosolic Clastic Rudosol*



Main occurrences in Western Australia

- Rocky limestone areas in the Kimberley, Gascoyne (Cape Range north of Exmouth), Murchison, Goldfields and Nullarbor
- Rare on coastal limestone in the South-west



Distribution map of Calcareous stony soil in the South-west of WA



Calcareous stony soil (Carnarvon)

Available qualifiers of Calcareous stony soil (in order from most to least restrictive)

- VSH very shallow rock substrate
- SAM sandy matrix
- LMM loamy matrix

Soil attributes of Calcareous stony soil (dominant values)

		QUALIFIER		
		VSH	SAM	LMM
ATTRIBUTE	Inherent fertility	Low Moderate		Moderate
	Permeability 0-50 cm	Moderately slow	Rapid	Moderate
	pH at 0-10 cm	Moderately alkaline	Moderately alkaline	Moderately alkaline
	pH at 50-80 cm	Moderately alkaline	Moderately alkaline	Moderately alkaline
	Profile stones and gravels	Not applicable	Abundant	Abundant
	Rooting depth	Shallow	Moderate	Deep
	Soil water storage	Very low	Very low	Moderately low
	Subsurface acidification	Low	Low	Low
	Subsurface compaction	Moderate Moderate		Low
	Surface organic carbon	High	High	High
	Surface soil structure decline	Low	Low	High
	Water repellence	Nil	High	Nil

Land use considerations

- Water-holding capacity is low due to the shallow depth of the profile and the amount of stone or rock
- The stoniness or rockiness severely limits most land uses

Stony soil

Soil Group 203

Soils which are coarse gravelly, stony or rocky throughout

Characteristics

- Rocks and stones or coarse gravels dominant throughout the profile
- Usually very shallow
- Sandy, loamy, clayey or gravelly soil matrix
- Neutral to acid pH

Local names

- Rocky/rubble soil

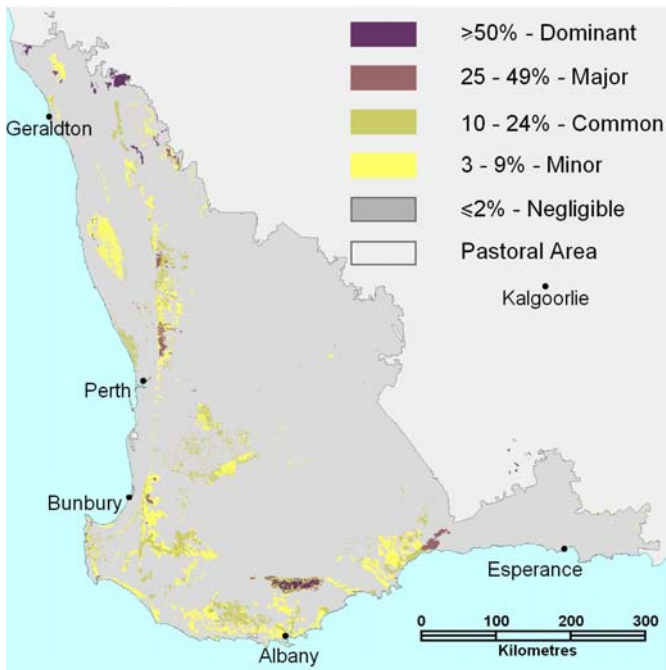
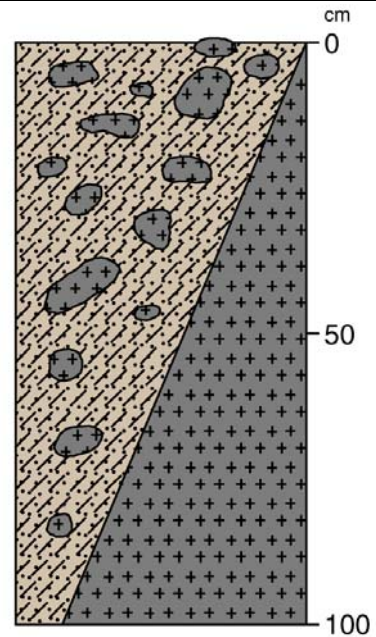
Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

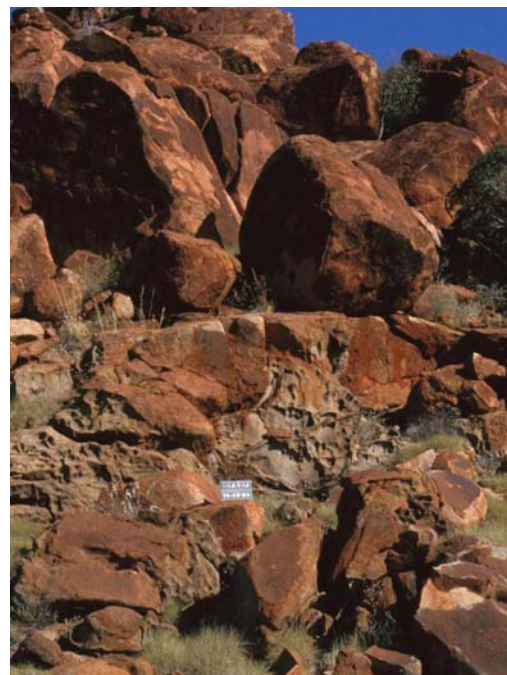
- *Lithosolic Clastic Rudosol*
- *Leptic Rudosol*

Main occurrences in Western Australia

- Widespread throughout, but rarely common
- Most common in the Kimberley and parts of the Pilbara



Distribution map of Stony soil in the South-west of WA



Stony soil (Pilbara)

Available qualifiers of Stony soil (in order from most to least restrictive)

- VSH very shallow rock substrate
- SSS saline subsoil
- SAM sandy matrix
- LMM loamy matrix
- CLM clayey matrix

Soil attributes of Stony soil (dominant values)

	QUALIFIER				
	VSH	SSS	SAM	LMM	CLM
Inherent fertility	Moderate	Moderate Low		Moderate Moderate	
Permeability 0-50 cm	Moderately slow	Moderate	Rapid	Moderate	Moderately slow
pH at 0-10 cm	Neutral	Moderately acid	Slightly acid	Slightly acid	Neutral
pH at 50-80 cm	Neutral	Neutral	Slightly acid	Slightly acid	Neutral
Profile stones and gravels	Not applicable	Abundant Abundant	Abundant	Abundant Abundant	Abundant
Rooting depth	Shallow	Deep	Deep	Deep	Deep
Soil water storage	Very low	Low	Low	Moderate	Moderately low
Subsurface acidification	Moderate	Moderate	Low	Low	Low
Subsurface compaction	Low	High High Low			Low
Surface organic carbon	High	High	High	High	High
Surface soil structure decline	Low	Moderate Moderate High			High
Water repellence	Nil	Moderate	Moderate	Nil	Nil

Land use considerations

- Water-holding capacity is low due to the shallow depth of profile and amount of stone and rock
- The stoniness or rockiness severely limits most land uses

Deep sandy gravel

Soil Group 301

Ironstone gravel soil, with a predominantly sandy matrix, usually over clay, cemented gravels (ferricrete) or reticulite at >80 cm

Characteristics

- Yellow, brown and grey colours common
- Neutral to acid pH
- High gravel content (>20%, often much higher) throughout
- Usually over sandy loam to sandy clay loam (reticulite), sandy clay loam to clay, or cemented gravels (ferricrete) at >80 cm
- Native vegetation, especially proteaceous species, appears to have a role in the formation of these soils

Local names

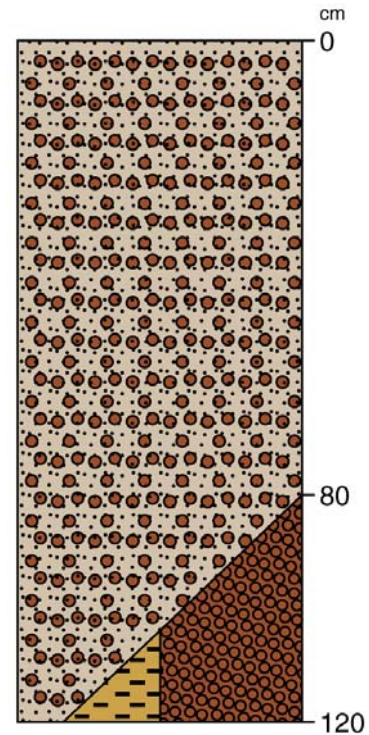
- Buckshot gravel
- Forest gravel
- Pea gravel

Typical Australian Soil Classification (ASC)

(dominant ASC in *italics*)

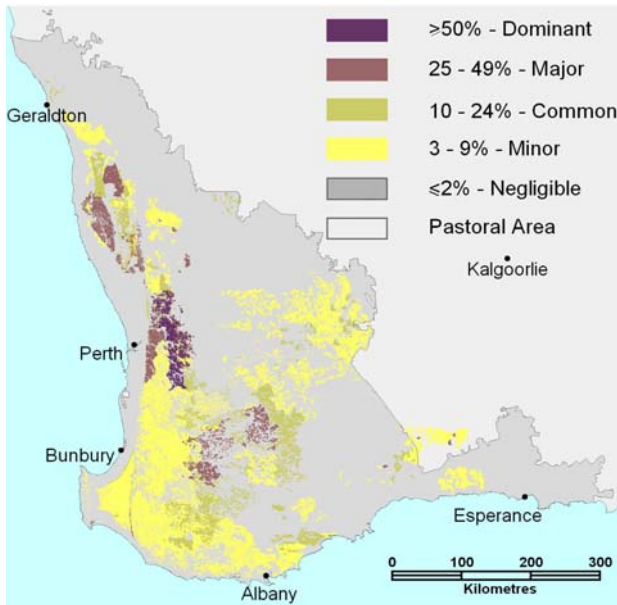
- *Ferric or Ferric-Petroferric Tenosol*
- Ferric Kandosol
- Ferric Chromosol

Note: these soils may be genetically linked to Podosols



Main occurrences in Western Australia

- Common in the South-west between Busselton and Augusta
- Jarrah forests of the Darling Plateau
- Scattered in other parts of South-west



Distribution map of Deep sandy gravel in the South-west of WA



Deep sandy gravel (Boyup Brook)

Available qualifiers of Deep sandy gravel (in order from most to least restrictive)

- SSS saline subsoil
- VGR very gravelly
- POE poor sand, effective duplex
- GSE good sand, effective duplex
- PSX poor sand, permeable substrate
- GSX good sand, permeable substrate
- PSR poor sand, deep rock substrate
- GSR good sand, deep rock substrate
- PSV poor sand, very deep
- GSV good sand, very deep

Soil attributes of Deep sandy gravel (dominant values)

ATTRIBUTE		QUALIFIER				
		SSS	VGR	POE	GSE	PSX
	Inherent fertility	Low	Low	Low Moderate		Very low
	Permeability 0-50 cm	Rapid	Rapid	Rapid	Rapid	Rapid
	pH at 0-10 cm	Moderately acid	Moderately acid	Moderately acid	Moderately acid	Slightly acid
	pH at 50-80 cm	Slightly acid	Moderately acid	Slightly acid	Neutral	Neutral
	Profile stones and gravels	Many Abundant		Many Many		Many
	Rooting depth	Deep	Very deep	Deep	Deep	Very deep
	Soil water storage	Very low	Very low	Very low	Very low	Very low
	Subsurface acidification	Moderate	High	High	Low	Moderate
	Subsurface compaction	Moderate Low		Moderate High		Moderate
	Surface organic carbon	High	High	Moderate	High	Moderate
	Surface soil structure decline	Low Moderate		Low Moderate		Low
	Water repellence	High	High	High	Moderate	High

ATTRIBUTE		QUALIFIER				
		GSX	PSR	GSR	PSV	GSV
	Inherent fertility	Moderate	Very low	Moderate	Low	Moderate
	Permeability 0-50 cm	Rapid	Rapid	Rapid	Rapid	Rapid
	pH at 0-10 cm	Moderately acid	Slightly acid	Slightly acid	Moderately acid	Moderately acid
	pH at 50-80 cm	Slightly acid	Neutral	Neutral	Neutral	Slightly acid
	Profile stones and gravels	Abundant	Many Many	Many		Many
	Rooting depth	Very deep	Deep	Deep	Very deep	Very deep
	Soil water storage	Very low	Very low	Low	Very low	Low
	Subsurface acidification	Low	Moderate	Low	Moderate	Low
	Subsurface compaction	High	Moderate High		Moderate	High
	Surface organic carbon	High	Moderate	High	Moderate	High
	Surface soil structure decline	Moderate Low		Moderate Low		Moderate
	Water repellence	Moderate	High	Moderate	High	Moderate

Land use considerations

- High gravel content limits water-holding capacity of the soil

Duplex sandy gravel

Soil Group 302

Ironstone gravel soil, with a predominantly sandy matrix, over a permeability contrast layer at 30-80 cm. The permeability contrast layer may be either a texture contrast or reticulite (mottled sandy loam to sandy clay loam)

Characteristics

- Yellow, brown or grey in top 30 cm
- Neutral to acid pH
- Over clay loam to clay or reticulite (mottled sandy loam to sandy clay loam) at 30-80 cm
- High gravel content (>20%, but often much higher) above the texture or contrast layer
- Native vegetation, especially proteaceous species, appears to have a role in the formation of these soils

Local names

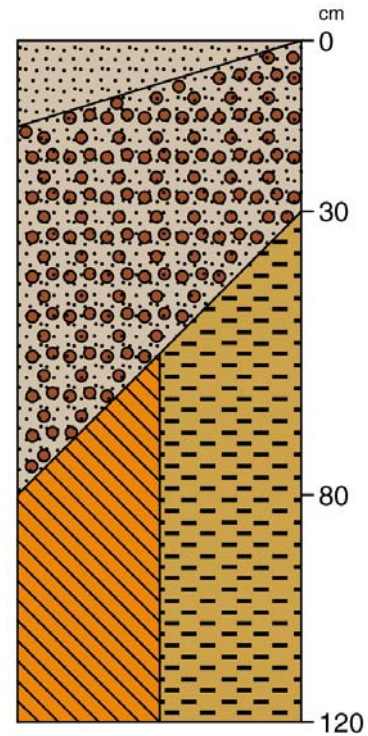
- Buckshot gravel
- Coarse gravel
- Jarrah gravel
- Sandy gravel
- Gairdner gravelly duplex

Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

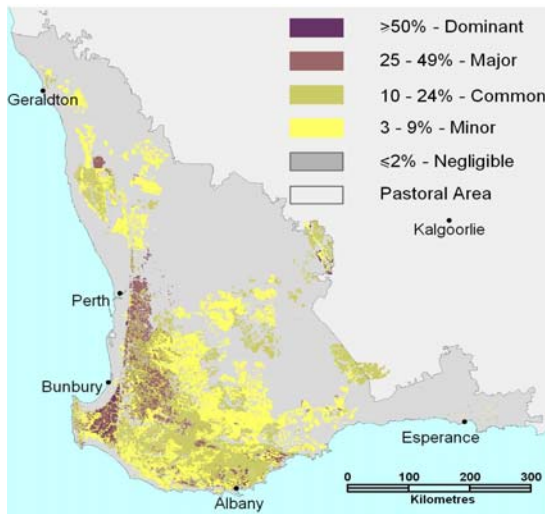
- *Ferric Chromosol*
- Ferric Sodosol
- Ferric Kandosol

Note: these soils may be genetically linked to Podosols



Main occurrences in Western Australia

- Clayey subsoils are common in the South-west in Jarrah forests east of the Darling Scarp and West Midlands, and minor north-west of Esperance
- Reticulite subsoils are common throughout the southern part of the central wheatbelt and the Great Southern



Distribution map of Duplex sandy gravel in the South-west of WA



Duplex sandy gravel (West Midlands)

Available qualifiers of Duplex sandy gravel (in order from most to least restrictive)

- SSS saline subsoil
- VGR very gravelly
- RET reticulite
- PSS poor subsoil
- RKD deep rock substrate
- CAC acid subsoil
- CNE neutral subsoil

Soil attributes of Duplex sandy gravel (dominant values)

ATTRIBUTE	QUALIFIER			
	SSS	VGR	RET	PSS
Inherent fertility	Moderate	Moderate Low		Low
Permeability 0-50 cm	Slow	Rapid	Rapid	Slow
pH at 0-10 cm	Moderately acid	Moderately acid	Moderately acid	Slightly acid
pH at 50-80 cm	Slightly acid	Slightly acid	Slightly acid	Moderately acid
Profile stones and gravels	Many	Many	Many	
Rooting depth	Moderate	Very deep	Very deep	Moderate
Soil water storage	Very low	Low	Low	Very low
Subsurface acidification	High	High	Moderate	High
Subsurface compaction	Moderate Low		Moderate	Moderate
Surface organic carbon	High	High	High	High
Surface soil structure decline	Low Moderate		Low Low	
Water repellence	High	Moderate	Moderate	High

ATTRIBUTE	QUALIFIER		
	RKD	CAC	CNE
Inherent fertility	Moderate Low		Moderate
Permeability 0-50 cm	Moderate	Rapid	Rapid
pH at 0-10 cm	Slightly acid	Very strongly acid	Moderately acid
pH at 50-80 cm	Slightly acid	Very strongly acid	Slightly acid
Profile stones and gravels	Many	Many	Many
Rooting depth	Deep	Very deep	Very deep
Soil water storage	Moderately low	Low	Moderately low
Subsurface acidification	Moderate	Presently acid	Moderate
Subsurface compaction	High	Moderate	High
Surface organic carbon	High	High	High
Surface soil structure decline	Low	Low	Low
Water repellence	Moderate	High	Moderate

Land use considerations

- A seasonal perched watertable may overlie the texture or permeability contrast layer
- High gravel contents may limit water-holding capacity of the soil

Loamy gravel

Soil Group 303

Ironstone gravel soil, with a predominantly loamy matrix, often grading to clay at >30 cm

Characteristics

- Yellow, red or brown in top 30 cm
- Neutral to acid pH
- High gravel content (>20%, but often much higher) throughout
- Usually grading to clay by 30-80 cm but occasionally deeper

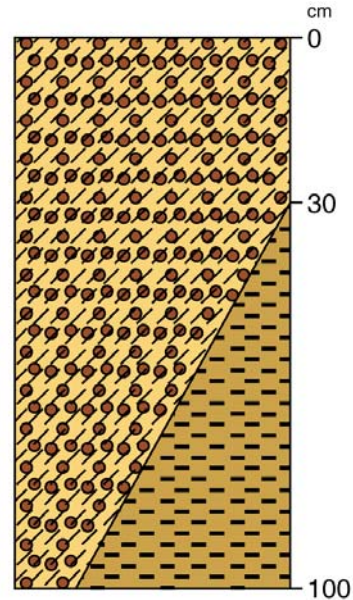
Local names

- Fine loamy type gravel
- Loamy gravel
- Forest grove gravel
- Forest hill gravel
- Pea gravel
- Jarrah gravel

Typical Australian Soil Classification (ASC)

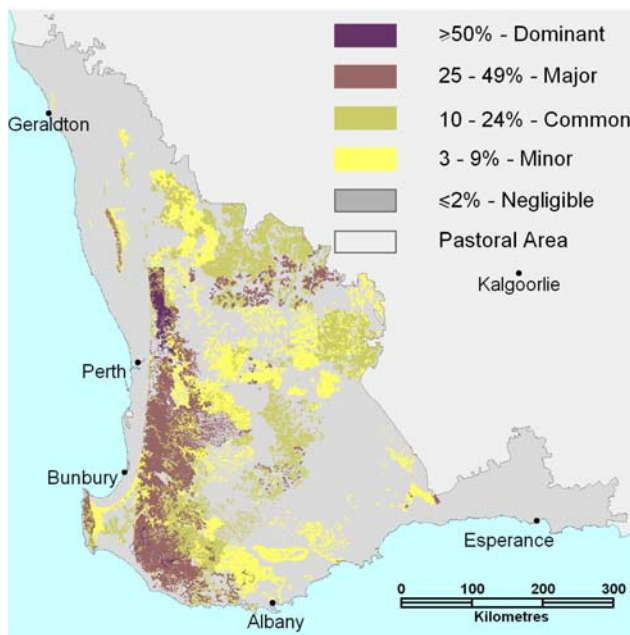
(dominant ASC in italics)

- *Ferric Kandosol*
- Ferric Chromosol
- Ferric Dermosol



Main occurrences in Western Australia

- Mostly in the South-west agricultural area where they are common east of the Darling Scarp from Gingin to Bridgetown
- Also on the Donnybrook Sunklands and low hilly areas west of Denmark



Distribution map of Loamy gravel in the South-west of WA



Loamy gravel (Bridgetown)

Available qualifiers of Loamy gravel (in order from most to least restrictive)

- SSS saline subsoil
- RET reticulite
- VGR very gravelly
- DLM no clay loam in top 80cm
- PSS poor subsoil
- CAC acid subsoil
- CNE neutral subsoil

Soil attributes of Loamy gravel (dominant values)

ATTRIBUTE	QUALIFIER			
	SSS	RET	VGR	DLM
Inherent fertility	Moderate	Moderate Moderate	ate Moderate	
Permeability 0-50 cm	Slow	Moderately rapid	Moderately rapid	Moderately rapid
pH at 0-10 cm	Moderately acid	Moderately acid	Slightly acid	Slightly acid
pH at 50-80 cm	Slightly acid	Slightly acid	Slightly acid	Neutral
Profile stones and gravels	Many Many	Abundant		Many
Rooting depth	Moderate	Very deep	Very deep	Very deep
Soil water storage	Very low	Moderately low	Very low	Moderately low
Subsurface acidification	Moderate	Moderate	Moderate	Low
Subsurface compaction	High High Low			High
Surface organic carbon	High	High	High	High
Surface soil structure decline	Low Moderate		Moderate Moderate	
Water repellence	Moderate	Nil	Nil	Nil

ATTRIBUTE	QUALIFIER		
	PSS	CAC	CNE
Inherent fertility	Moderate Moderate	Moderate	
Permeability 0-50 cm	Slow	Moderately rapid	Moderately rapid
pH at 0-10 cm	Moderately acid	Strongly acid	Moderately acid
pH at 50-80 cm	Slightly acid	Strongly acid	Slightly acid
Profile stones and gravels	Many	Many	Many
Rooting depth	Moderate	Very deep	Very deep
Soil water storage	Very low	Moderately low	Moderately low
Subsurface acidification	Moderate	Presently acid	Low
Subsurface compaction	High High High		
Surface organic carbon	High	High	High
Surface soil structure decline	High	Moderate	Moderate
Water repellence	Moderate	Moderate	Nil

Land use considerations

- High gravel content may limit water-holding capacity

Shallow gravel

Soil Group 304

Ironstone gravel soil over cemented gravels (ferricrete), rock or other hard or permanently cemented layers at ≤ 80 cm

Characteristics

- Yellow, brown, grey or sometimes red in top 30 cm
- Neutral to acid pH
- High gravel content (>20%, often much higher) throughout
- Sandy, or less commonly loamy, matrix
- Overlies cemented gravels (ferricrete), rock or other hard or permanently cemented layers at <80 cm
- Native vegetation, especially proteaceous species, appears to have a role in the formation of these soils

Local names

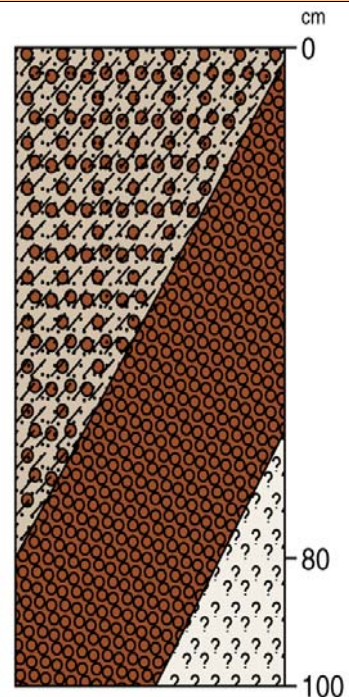
- Buckshot gravel
- Ironstone cap
- Gravelly sand on laterite

Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

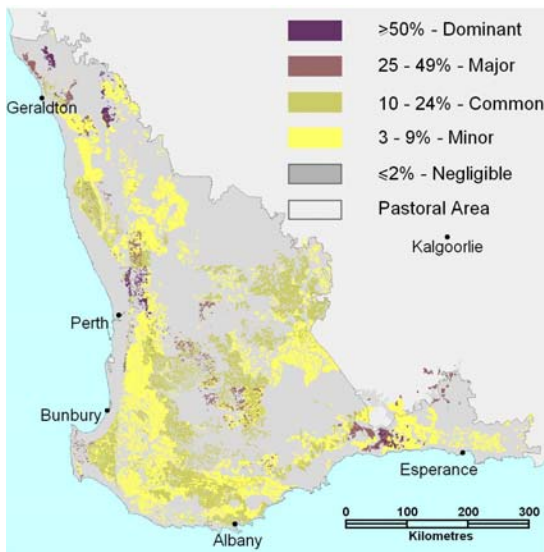
- *Ferric-Petroferric Tenosol*
- Ferric Petroferric Kandosol
- Ferric Petroferric Chromosol

Note: these soils may be genetically linked to Podosols

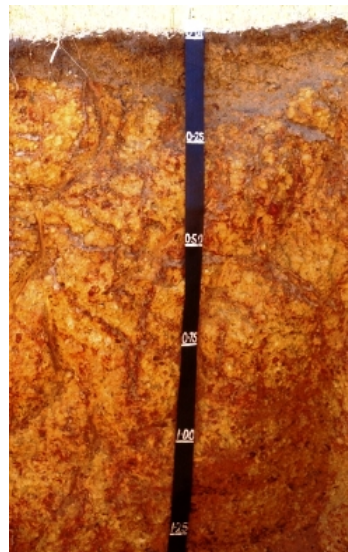


Main occurrences in Western Australia

- South-west inland from the Darling Scarp
- Isolated lateritic remnants throughout the South-west and Kimberley
- Scattered throughout the arid interior



Distribution map of Shallow gravel in the South-west of WA



Shallow gravel (Narrogin)

Available qualifiers of Shallow gravel (in order from most to least restrictive)

- VSH very shallow rock substrate
- SAL saline
- VGR very gravelly
- SAM sandy matrix
- LMM loamy matrix
- CLM clayey matrix

Soil attributes of Shallow gravel (dominant values)

		QUALIFIER					
		VSH	SAL	VGR	SAM	LMM	CLM
ATTRIBUTE	Inherent fertility	Very low	Moderate	Low Low	M	oderate	Moderate
	Permeability 0-50 cm	Moderately slow	Moderate	Moderately slow	Rapid	Moderate	Moderately slow
	pH at 0-10 cm	Moderately acid	Moderately acid	Moderately acid	Moderately acid	Slightly acid	Moderately acid
	pH at 50-80 cm	Slightly acid	Slightly acid	Neutral	Slightly acid	Moderately acid	Slightly acid
	Profile stones and gravels	Not applicable	Common	Not applicable	Abundant	Abundant	Abundant
	Rooting depth	Shallow	Moderate	Moderately shallow	Moderate	Moderate	Moderate
	Soil water storage	Very low	Very low	Very low	Very low	Very low	Very low
	Subsurface acidification	High	High	Moderate	High	High	Moderate
	Subsurface compaction	Low High		Low Moderate		High	Low
	Surface organic carbon	High	High	High	High	High	High
	Surface soil structure decline	Low Moderate		Low Low	High		High
	Water repellence	Moderate	Moderate	Moderate	Moderate	Moderate	Nil

Land use considerations

- Water-holding capacity is generally low due to the shallow depth of the profile and high gravel content
- Gravel limits workability
- Deeper variants are suitable cropping soils in areas with higher rainfall
- High recharge hazard

Alkaline grey deep sandy duplex

Soil Group 401

Grey sand over alkaline sandy clay loam to clay at 30-80 cm

Characteristics

- Grey to brown surface, bleached grey subsurface, various colours in subsoil (mottling common)
- Often calcareous subsoil
- Alkaline pH subsoil
- Subsoil often sodic

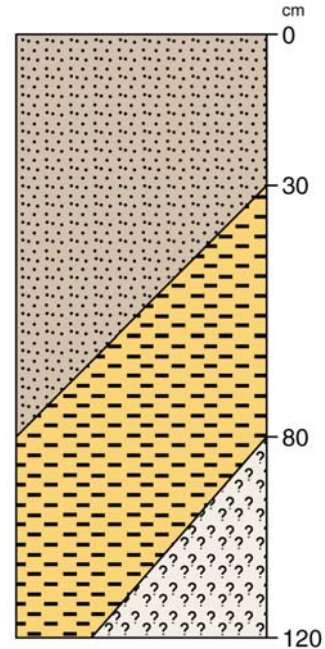
Local names

- Mallee soil
- Scaddan sand

Typical Australian Soil Classification (ASC)

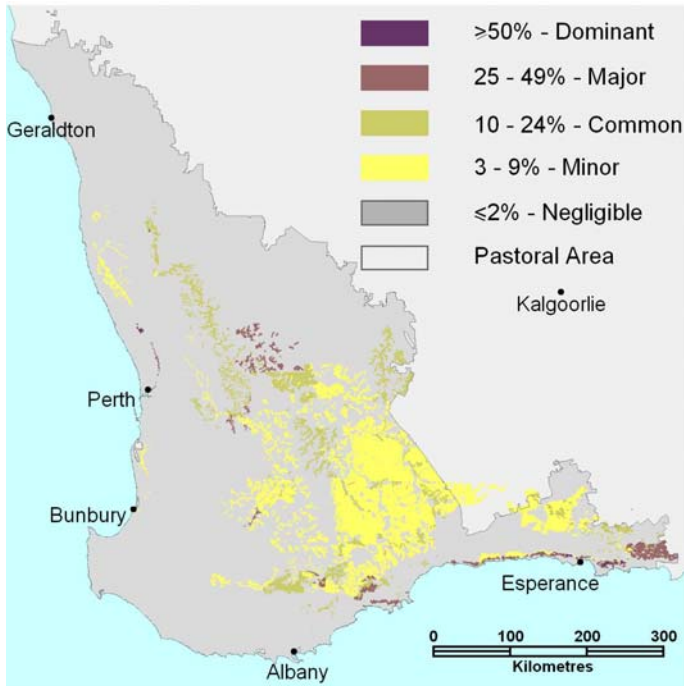
(dominant ASC in *italics*)

- *Calcic Grey, Yellow or Brown Sodosol*
- Calcic Grey, Yellow or Brown Chromosol



Main occurrences in Western Australia

- Associated with, but usually much less common, than Alkaline grey shallow sandy duplex
- Widespread throughout the wheatbelt and mallee country north of Esperance
- Minor in other parts of the South-west, for example the North Stirlings



Distribution map of Alkaline grey deep sandy duplex in the South-west of WA



Alkaline grey deep sandy duplex (Wheatbelt)

Available qualifiers of Alkaline grey deep sandy duplex (in order from most to least restrictive)

- SSS saline subsoil
- RKM rock substrate
- PPS poor sand, poor subsoil
- GSP good sand topsoil, poor subsoil
- PWK poor sand, good alkaline subsoil
- GWK good sand, good alkaline subsoil

Soil attributes of Alkaline grey deep sandy duplex (dominant values)

ATTRIBUTE	QUALIFIER					
	SSS	RKM	PPS	GSP	PWK	GWK
Inherent fertility	Moderate Low		Moderate M	oderate Low		Moderate
Permeability 0-50 cm	Moderately slow	Moderately slow	Slow	Slow	Moderately slow	Moderately slow
pH at 0-10 cm	Slightly acid	Slightly acid	Moderately acid	Slightly acid	Slightly acid	Moderately acid
pH at 50-80 cm	Neutral	Neutral	Neutral	Neutral	Neutral	Neutral
Profile stones and gravels	Few	Common	Very few	Very few	Very few	Few
Rooting depth	Very deep	Moderate	Moderate	Moderate	Very deep	Very deep
Soil water storage	Moderately low	Very low	Very low	Very low	Moderately low	Moderately low
Subsurface acidification	High	High	High	High	High	Moderate
Subsurface compaction	Moderate Moderate		Moderate Moderate		Moderate Moderate	
Surface organic carbon	Moderate	Moderate	Moderate	High	Moderate	High
Surface soil structure decline	Low Low		Low Low	Low	Low	
Water repellence	Moderate	Moderate	High	Moderate	High	Moderate

Land use considerations

- Seasonal waterlogging over the clay may occur
- Sandy surfaces are highly prone to wind erosion on exposed flats and rises

Alkaline grey shallow sandy duplex

Soil Group 402

Grey sand over alkaline sandy clay loam to clay at <30 cm

Characteristics

- Grey surface layers, various colours in subsoil
- Often calcareous subsoil
- Alkaline pH subsoil
- Usually sodic subsoil
- May include sandy loams in the lower topsoil
- Usually not hard setting

Local names

- Mallee soil
- Scaddan sand
- Moort soil

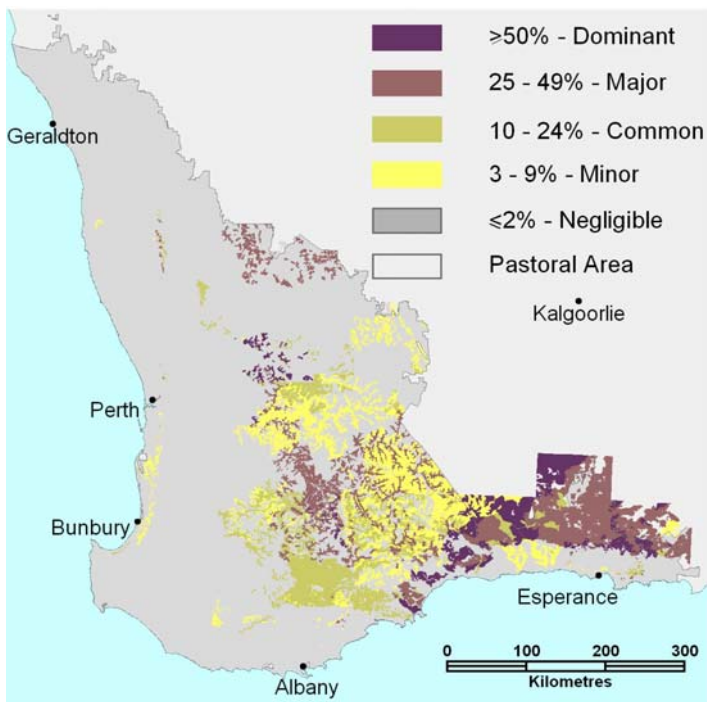
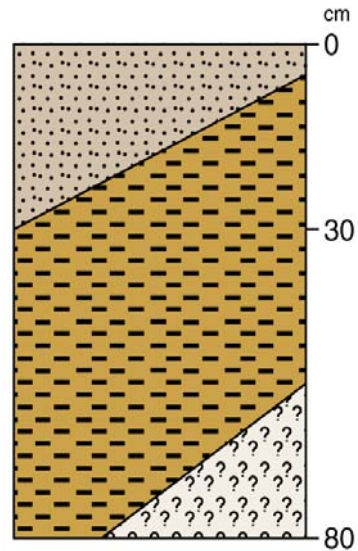
Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

- *Calcic Grey Yellow or Brown Sodosol*
- Calcic Grey, Yellow or Brown Chromosol

Main occurrences in Western Australia

- Widespread in the South-west throughout the wheatbelt and mallee country north of Esperance
- Minor occurrences in other parts of the South-west, for example the North Stirling



Distribution map of Alkaline grey shallow sandy duplex in the South-west of WA



Alkaline grey shallow sandy duplex (Midlands)

Available qualifiers of Alkaline grey shallow sandy duplex (in order from most to least restrictive)

- SSS saline subsoil
- RKM rock substrate
- PSS poor subsoil
- ALK good alkaline subsoil

Soil attributes of Alkaline grey shallow sandy duplex (dominant values)

		QUALIFIER			
		SSS	RKM	PSS	ALK
ATTRIBUTE	Inherent fertility	Moderate	Moderate Moder	ate Moderate	
	Permeability 0-50 cm	Slow	Moderately slow	Slow	Moderately slow
	pH at 0-10 cm	Slightly acid	Moderately acid	Moderately acid	Slightly acid
	pH at 50-80 cm	Moderately alkaline	Moderately alkaline	Moderately alkaline	Strongly alkaline
	Profile stones and gravels	Few	Many	Few	Few
	Rooting depth	Moderately shallow	Moderate	Moderately shallow	Very deep
	Soil water storage	Very low	Low	Very low	Moderate
	Subsurface acidification	Low	Moderate	Moderate	Low
	Subsurface compaction	Low Low		Low Low	
	Surface organic carbon	Moderate	Moderate	Moderate	Moderate
	Surface soil structure decline	High High		Low	High
	Water repellence	Moderate	Moderate	High	Moderate

Land use considerations

- Sandy topsoil may be seasonally waterlogged
- Sandy surfaces are highly prone to wind erosion on exposed flats
- Subsoil's are frequently dispersive and may lead to water erosion on long slopes

Grey deep sandy duplex

Soil Group 403

Grey sand over non-alkaline sandy clay loam to clay at 30-80 cm

Characteristics

- Grey topsoil colour common
- Often with bleached grey subsurface and various colours in subsoil (mottling common)
- Neutral to acid pH subsoil
- Ironstone gravel often present, especially on top of clay

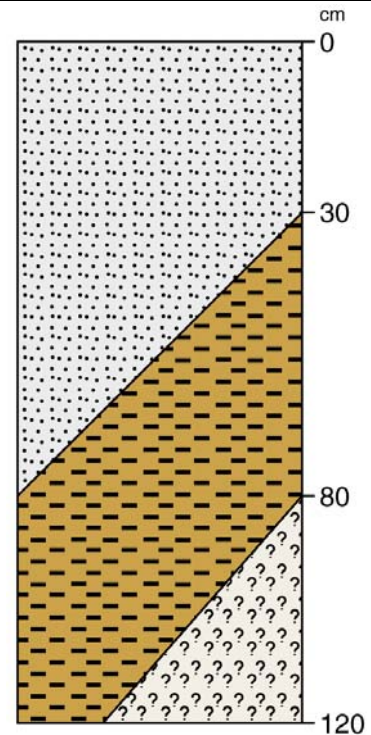
Local names

- Esperance sandplain
- Swamp road gravel
- Fleming sand
- Fleming gravelly sand
- Sheoak soil
- Sand over clay
- Sandy duplex

Typical Australian Soil Classification (ASC)

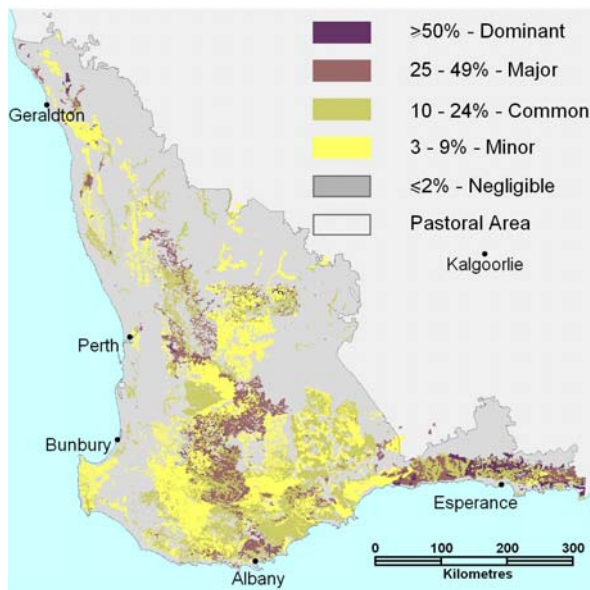
(dominant ASC in italics)

- *Grey, Yellow or Brown Sodosol*
- *Grey, Yellow or Brown Chromosol*

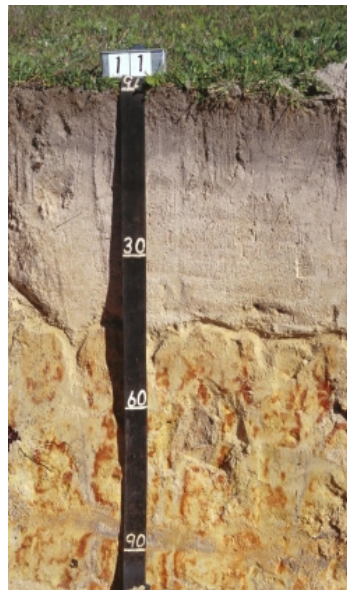


Main occurrences in Western Australia

- Common in the South-west, especially in the Esperance sandplain and west to the Fitzgerald and Great Southern areas
- Widespread and scattered in other areas such as the Swan Coastal Plain and the West Midlands



Distribution map of Grey deep sandy duplex in the South-west of WA



Grey deep sandy duplex (Geraldton)

Available qualifiers of Grey deep sandy duplex (in order from most to least restrictive)

- SSS saline subsoil
- RKM rock substrate
- PPS poor sand, poor subsoil
- GSP poor sand, poor subsoil
- GSN good sand topsoil, good neutral subsoil
- GSA good sand topsoil, good acid subsoil
- PWN poor sand, good neutral subsoil
- PWA poor sand, good acid subsoil

Soil attributes of Grey deep sandy duplex (dominant values)

ATTRIBUTE	QUALIFIER			
	SSS	RKM	PPS	GSP
Inherent fertility	Moderate Low		Low	Moderate
Permeability 0-50cm	Rapid	Very rapid	Rapid	Rapid
pH at 0-10 cm	Moderately acid	Moderately acid	Strongly acid	Moderately acid
pH at 50-80 cm	Slightly acid	Slightly acid	Moderately acid	Slightly acid
Profile stones and gravels	Few	Common	Few	Few
Rooting depth	Deep	Moderate	Deep	Deep
Soil water storage	Very low	Very low	Very low	Low
Subsurface acidification	High	High	Presently acid	High
Subsurface compaction	Moderate	Moderate	Moderate	Moderate
Surface organic carbon	High	High	Moderate	High
Surface soil structure decline	Low	Low	Low	Low
Water repellence	High	High	High	Moderate

ATTRIBUTE	QUALIFIER			
	GSN	GSA	PWN	PWA
Inherent fertility	Moderate	Moderate	Low	Low
Permeability 0-50 cm	Rapid	Rapid	Rapid	Rapid
pH at 0-10 cm	Moderately acid	Moderately acid	Moderately acid	Very strongly acid
pH at 50-80 cm	Slightly acid	Moderately acid	Slightly acid	Strongly acid
Profile stones and gravels	Few	Few	Few	Few
Rooting depth	Very deep	Very deep	Very deep	Very deep
Soil water storage	Moderately low	Moderately low	Moderately low	Low
Subsurface acidification	High	High	High	Presently acid
Subsurface compaction	Moderate	Moderate	Moderate	Moderate
Surface organic carbon	High	High	Moderate	Moderate
Surface soil structure decline	Low	Low	Low	Low
Water repellence	Moderate	Moderate	High	High

Land use considerations

- Seasonal waterlogging over the clay may occur

- Prone to wind erosion in exposed situations if left bare of surface cover

Grey shallow sandy duplex Soil Group 404

Grey sand over non-alkaline sandy clay loam to clay at <30 cm

Characteristics

- Grey surface layers
- Various colours in subsoil, and mottling is common
- Neutral to acid pH subsoil
- Ironstone gravel common, especially above clay
- Often in old drainage lines

Local names

- Duplex soil
- White gum soil
- Spongeolite soil
- Grey clay

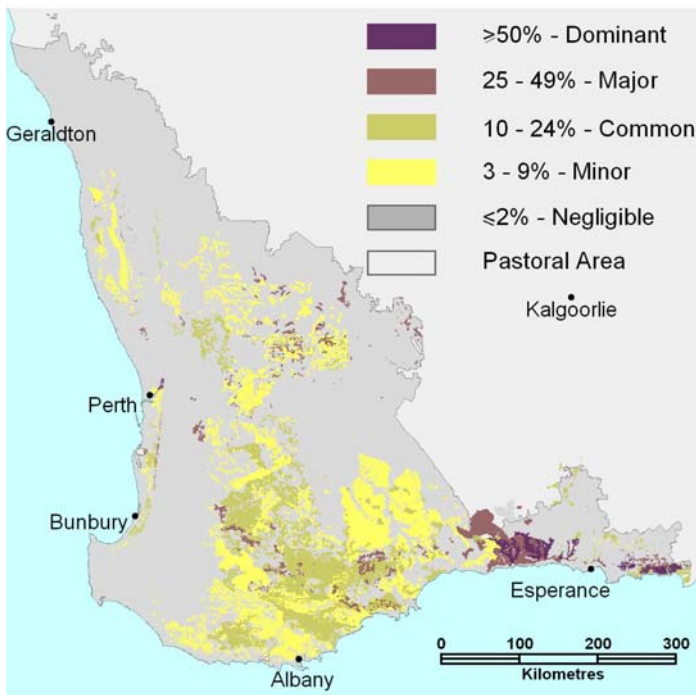
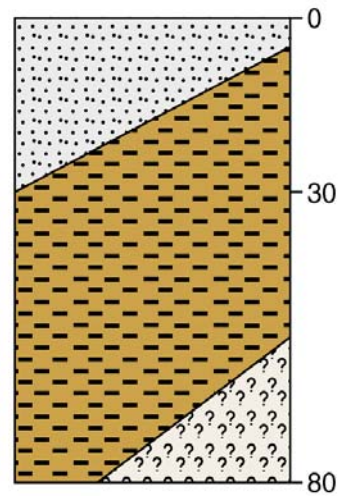
Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

- *Grey, Yellow or Brown Sodosol*
- *Grey, Yellow or Brown Chromosol*

Main occurrences in Western Australia

- Widespread in the South-west throughout the Zone of Rejuvenated Drainage from Moora south to Katanning and east to Jerramungup and Esperance
- Scattered in other parts of the South-west



Distribution map of Grey shallow sandy duplex in the South-west of WA



Grey shallow sandy duplex (Swan Coastal Plain)

Available qualifiers of Grey shallow sandy duplex (in order from most to least restrictive)

- SSS saline subsoil
- RKM rock substrate
- PSS poor subsoil
- NEU good neutral subsoil
- ACD good acid subsoil

Soil attributes of Grey deep sandy duplex (dominant values)

		QUALIFIER				
		SSS	RKM	PSS	NEU	ACD
ATTRIBUTE	Inherent fertility	Moderate	Moderate	Moderate	Moderate	Moderate
	Permeability 0-50 cm	Slow	Moderately slow	Slow	Moderately slow	Moderately slow
	pH at 0-10 cm	Moderately acid	Slightly acid	Moderately acid	Moderately acid	Moderately acid
	pH at 50-80 cm	Neutral	Neutral	Neutral	Neutral	Moderately acid
	Profile stones and gravels	Few	Many	Few	Few	Very few
	Rooting depth	Moderately shallow	Moderate	Moderately shallow	Very deep	Very deep
	Soil water storage	Very low	Low	Very low	Moderate	Moderate
	Subsurface acidification	High	Moderate	Moderate	High	Presently acid
	Subsurface compaction	Moderate	Moderate	Moderate	Moderate	High
	Surface organic carbon	High	High	High	High	High
	Surface soil structure decline	Low	Low	Low		Low
	Water repellence	Moderate	Moderate	Moderate	Moderate	Moderate

Land use considerations

- Seasonal waterlogging may occur above the clay
- Wind erosion may occur on exposed flats

Red deep sandy duplex

Soil Group 405

Red sand over sandy clay loam to clay at 30-80 cm

Characteristics

- Red within top 30 cm
- Usually hard setting surface
- Neutral pH subsoil, may be calcareous in Goldfields
- Sometimes with a saline subsoil
- Occasionally with a stony surface mantle

Local names

- Red soil

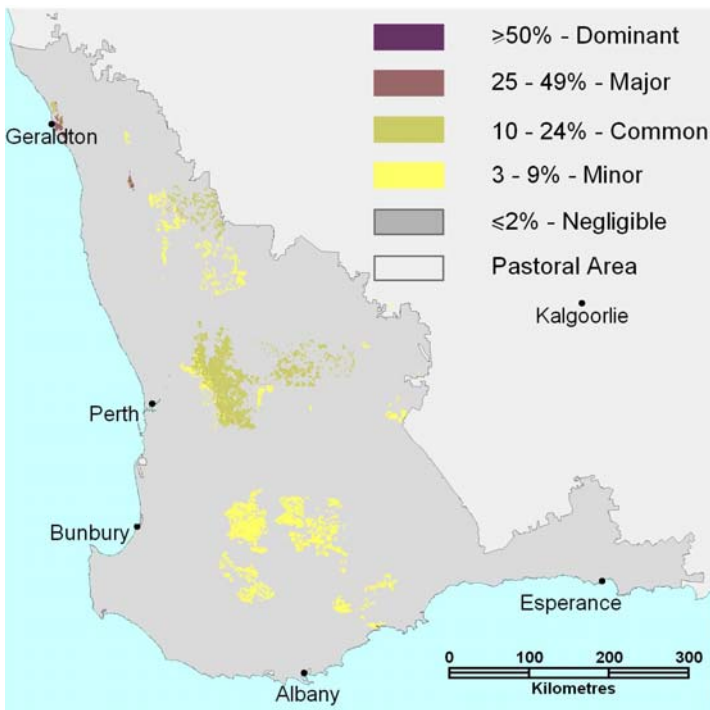
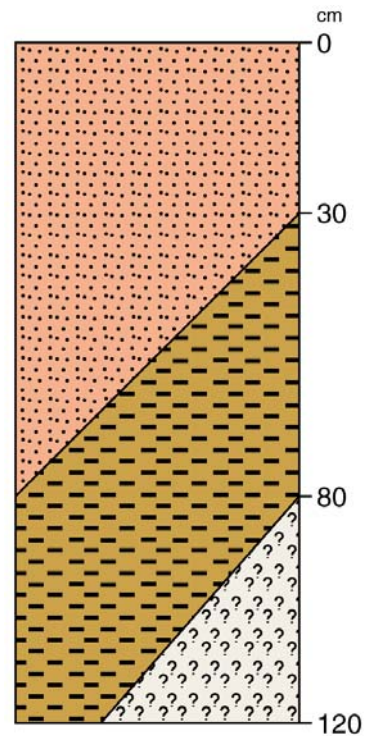
Typical Australian Soil Classification (ASC)

(dominant ASC in *italics*)

- *Red Chromosol*
- *Red Sodosol*

Main occurrences in Western Australia

- Infrequent but widespread throughout the southern rangelands and Pilbara
- Scattered elsewhere in South-west



Distribution map of Red deep sandy duplex in the South-west of WA



Red deep sandy duplex (Greenough)

Available qualifiers of Red deep sandy duplex (in order from most to least restrictive)

- SSS saline subsoil
- RKM rock substrate
- PSS poor subsoil
- ALK good alkaline subsoil
- ACD Good acid subsoil
- NEU good neutral subsoil

Soil attributes of Red deep sandy duplex (dominant values)

ATTRIBUTE	QUALIFIER						
	SSS	RKM	PSS	ALK	ACD	NEU	
Inherent fertility	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	
Permeability 0-50 cm	Slow	Moderately slow	Slow	Moderately slow	Moderately slow	Moderately slow	
pH at 0-10 cm	Slightly acid	Slightly acid	Slightly acid	Slightly acid	Slightly acid	Slightly acid	
pH at 50-80 cm	Moderately acid	Slightly acid	Moderately acid	Neutral	Moderately acid	Moderately acid	
Profile stones and gravels	Very few	Common	Very few	Few	Very few	Few	
Rooting depth	Moderate	Moderate	Moderate	Very deep	Very deep	Very deep	
Soil water storage	Low	Low	Low	Moderate	Moderate	Moderate	
Subsurface acidification	High	High	High	Moderate	Presently acid	High	
Subsurface compaction	High	High	High	High	High	High	
Surface organic carbon	High	High	High	High	High	High	
Surface soil structure decline	Low	Low	Low	Low	Low	Low	
Water repellence	Nil	Nil	Nil	Nil	Nil	Nil	

Land use considerations

- Productive soils for agricultural purposes
- Prone to surface compaction and crusting or hard setting

Red shallow sandy duplex

Soil Group 406

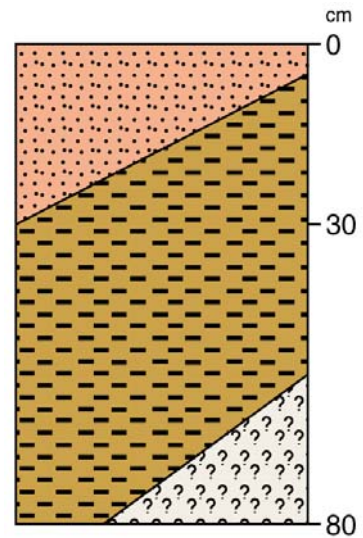
Red sand over sandy clay loam to clay at <30 cm

Characteristics

- Red within top 30 cm
- Neutral to alkaline pH subsoil
- Subsoil may be calcareous (e.g. in Goldfields)
- Usually hard setting surface
- Clays may be underlain by rock or hardpan
- Stony or gravelly surface mantle common
- May be saline

Local names

- Mallet soil
- York gum soil
- Red loam
- Rocky outcrop country



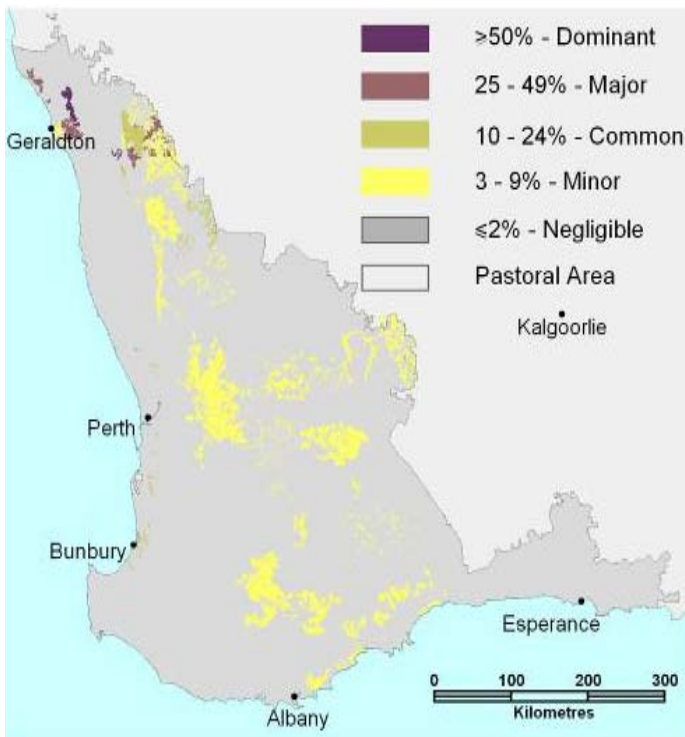
Typical Australian Soil Classification (ASC)

(dominant ASC in *italics*)

- *Red Chromosol*
- *Red Sodosol*

Main occurrences in Wes Australia

- Common, but rarely dominant, throughout the rangelands, especially the southern Kimberley, Gascoyne and Murchison



Distribution map of Red shallow sandy duplex in the South-west of WA



Red shallow sandy duplex (Mullewa)

Available qualifiers of Red shallow sandy duplex (in order from most to least restrictive)

- SSS saline subsoil
- RKM rock substrate
- PSS poor subsoil
- ALK good alkaline subsoil
- NEU good neutral subsoil

Soil attributes of Red shallow sandy duplex (dominant values)

	QUALIFIER				
	SSS	RKM	PSS	ALK	NEU
Inherent fertility	Moderate	Moderate	Moderate	Moderate	Moderate
Permeability 0-50 cm	Slow	Very slow	Slow	Moderately slow	Moderately slow
pH at 0-10 cm	Slightly acid	Slightly acid	Slightly acid	Slightly acid	Slightly acid
pH at 50-80 cm	Neutral	Neutral	Neutral	Moderately alkaline	Neutral
Profile stones and gravels	Very few	Many	Very few	Very few	Few
Rooting depth	Moderately shallow	Moderate	Moderately shallow	Very deep	Very deep
Soil water storage	Very low	Low	Very low	Moderate	Moderate
Subsurface acidification	Moderate	Moderate	Moderate	Moderate	Moderate
Subsurface compaction	High	High	High	High	High
Surface organic carbon	Low	Low	Low	Low	Low
Surface soil structure decline	Moderate	Low	Moderate	Low	Low
Water repellence	Nil	Nil	Nil	Nil	Nil

Land use considerations

- Prone to surface compaction and crusting or hard setting
- May occur wind erosion on exposed flats and rises

Yellow/brown deep sandy duplex

Soil Group 407

Yellow/brown sand over sandy clay loam to clay at 30-80 cm

Characteristics

- Surface layers mainly yellow or brown
- May have a paler subsurface and various colours in subsoil
- Neutral subsoil pH common, but may be acid to alkaline
- Ironstone gravel sometimes present, especially on top of clay

Local names

- Mallee broombush soil
- Blue mallee soil

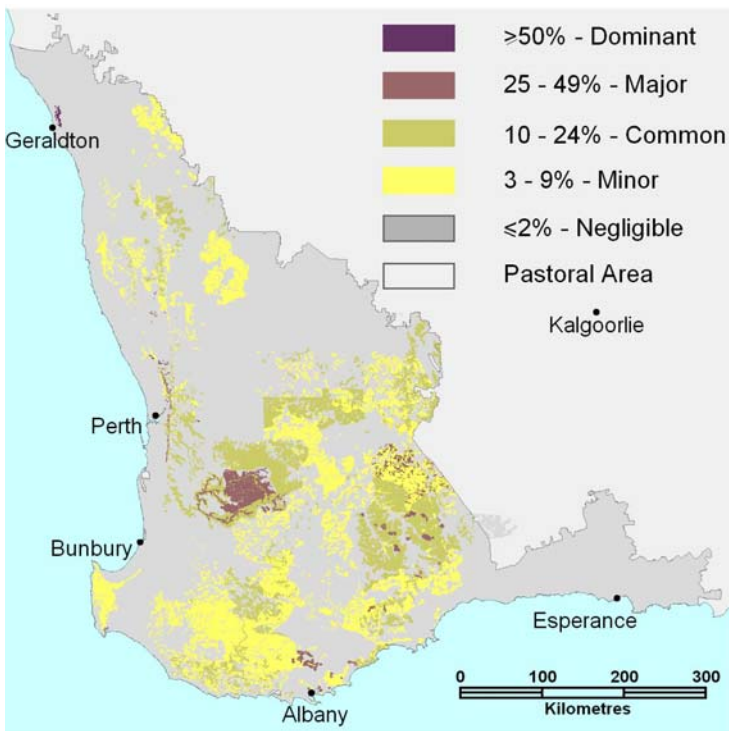
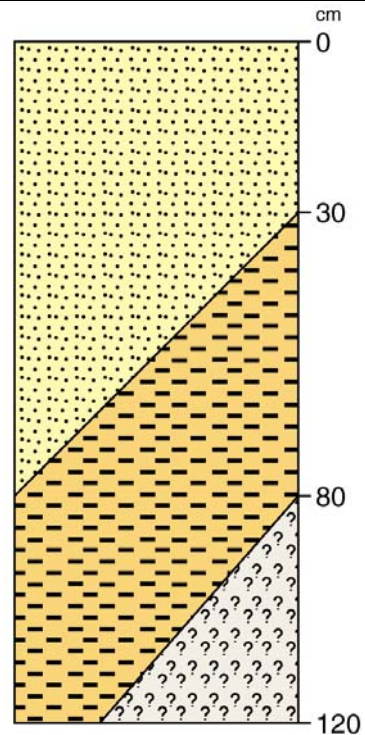
Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

- *Yellow or Brown Chromosol*
- Yellow or Brown Sodosol

Main occurrences in Western Australia

- Occurs throughout the South-west, but rarely common



Distribution map of Yellow/brown deep sandy duplex in the South-west of WA



Yellow/brown deep sandy duplex (Donnybrook)

Available qualifiers of Yellow/brown deep sandy duplex (in order from most to least restrictive)

- SSS saline subsoil
- RKM rock substrate
- PSS poor subsoil
- ALK good alkaline subsoil
- ACD good acid subsoil
- NEU good neutral subsoil

Soil attributes of Yellow/brown deep sandy duplex (dominant values)

		QUALIFIER					
		SSS	RKM	PSS	ALK	ACD	NEU
ATTRIBUTE	Inherent fertility	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
	Permeability 0-50 cm	Rapid	Rapid	Rapid	Rapid	Rapid	Rapid
	pH at 0-10 cm	Slightly acid	Moderately acid	Moderately acid	Slightly acid	Strongly acid	Slightly acid
	pH at 50-80 cm	Slightly acid	Moderately acid	Moderately acid	Slightly acid	Strongly acid	Slightly acid
	Profile stones and gravels	Few	Few	Few	Few	Few	Few
	Rooting depth	Deep	Moderate	Deep	Very deep	Very deep	Very deep
	Soil water storage	Moderately low	Low	Moderately low	Moderately low	Moderately low	Moderately low
	Subsurface acidification	Moderate	High	High	High	Presently acid	High
	Subsurface compaction	High	High	High	High	High	High
	Surface organic carbon	High	High	High	High	High	High
	Surface soil structure decline	Low	Low	Moderate	Low	Low	Low
	Water repellence	Nil	Nil	Nil	Nil	Nil	Nil

Land use considerations

- Prone to wind erosion in exposed situations if left bare of surface cover
- Plant available water capacity are low to moderately low

Yellow/brown shallow sandy duplex

Soil Group 408

Yellow/brown sand over sandy clay loam to clay at <30 cm

Characteristics

- Yellow or brown surface layers
- Various colours in subsoil, and mottling is common
- Neutral pH subsoil most common, but may be acidic to alkaline
- Ironstone gravel may occur, especially above clay

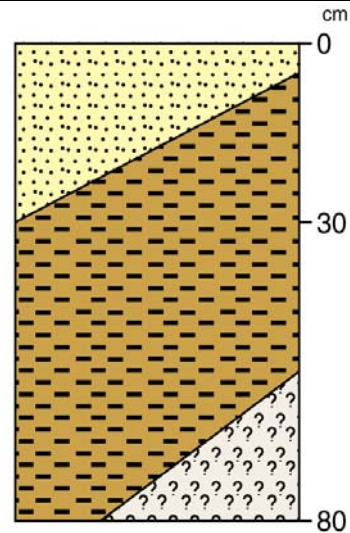
Local names

- Mallee duplex
- Moort soil

Typical Australian Soil Classification (ASC)

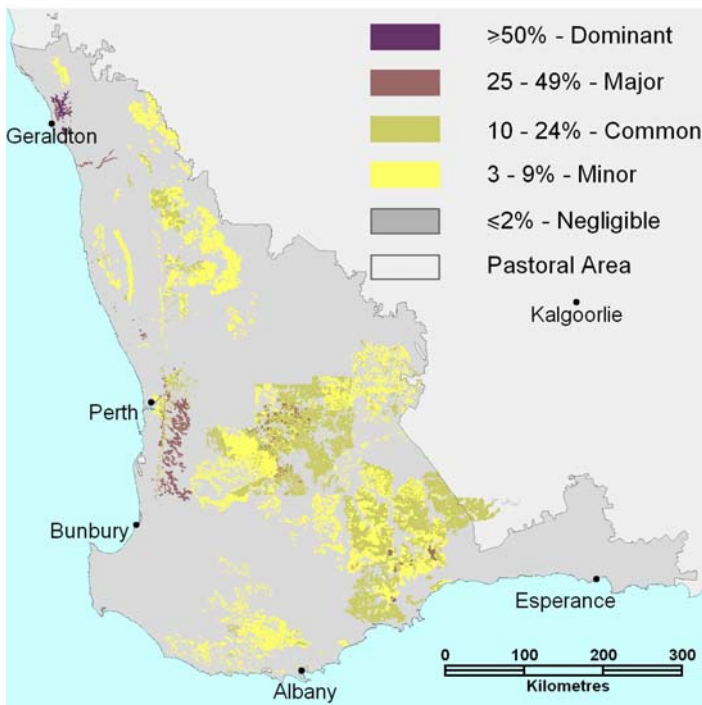
(dominant ASC in italics)

- *Yellow or Brown Chromosol*
- *Yellow or Brown Sodosol*



Main occurrences in Western Australia

- Occurs throughout the South-west, but rarely common
- Scattered in other parts, especially the Kimberley



Distribution map of Yellow/brown shallow sandy duplex in the South-west of WA



Yellow/brown shallow sandy duplex (South Coast)

Available qualifiers of Yellow/brown shallow sandy duplex (in order from most to least restrictive)

- SSS saline subsoil
- RKM rock substrate
- PSS poor subsoil
- ALK good alkaline subsoil
- NEU good neutral subsoil

Soil attributes of Yellow/brown shallow sandy duplex (dominant values)

ATTRIBUTE	QUALIFIER				
	SSS	RKM	PSS	ALK	NEU
Inherent fertility	Moderate	Moderate	Moderate	Moderate	Moderate
Permeability 0-50 cm	Slow	Moderately slow	Slow	Moderately slow	Moderately slow
pH at 0-10 cm	Moderately acid	Slightly acid	Moderately acid	Neutral	Moderately acid
pH at 50-80 cm	Neutral	Neutral	Neutral	Moderately alkaline	Neutral
Profile stones and gravels	Few	Many	Few	Many	Many
Rooting depth	Moderately shallow	Moderate	Moderately shallow	Very deep	Very deep
Soil water storage	Very low	Low	Very low	Moderate	Moderate
Subsurface acidification	Moderate	High	Moderate	Moderate	High
Subsurface compaction	High	High	High		
Surface organic carbon	High	High	High	High	High
Surface soil structure decline	Moderate	Low	Moderate	Moderate	Low
Water repellence	Nil	Nil	Nil	Nil	Nil

Land use considerations

- Seasonal waterlogging may occur above the clay
- Prone to wind erosion on exposed surfaces

Reticulite deep sandy duplex

Soil Group 409

Grey to yellow or brown sandy surface layer over reticulite (mottled loamy sand to sandy clay loam) subsoil at 30-80 cm

Characteristics

- Grey to yellow or brown in top 30 cm
- Neutral to acid pH
- Reticulite at 30-80 cm
- Usually gravelly above the reticulite layer

Local names

- Sandy gravel

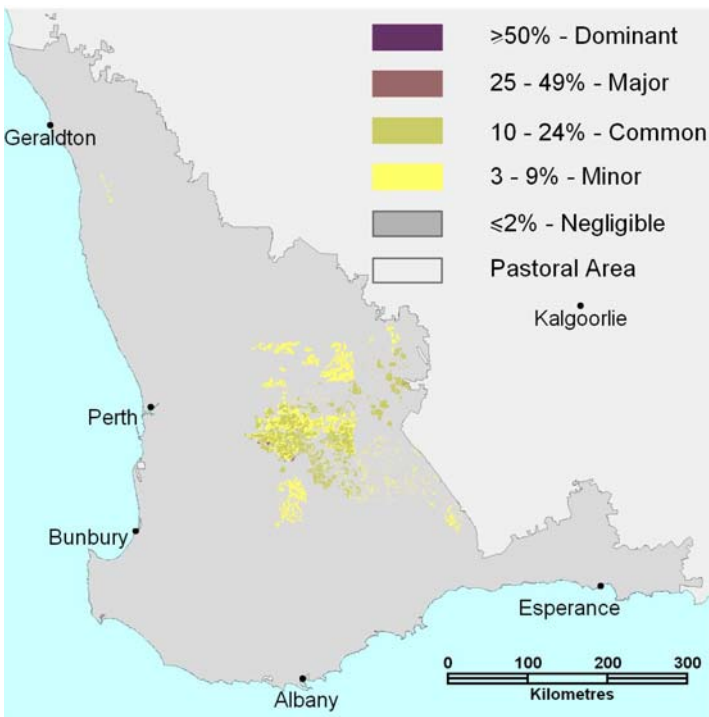
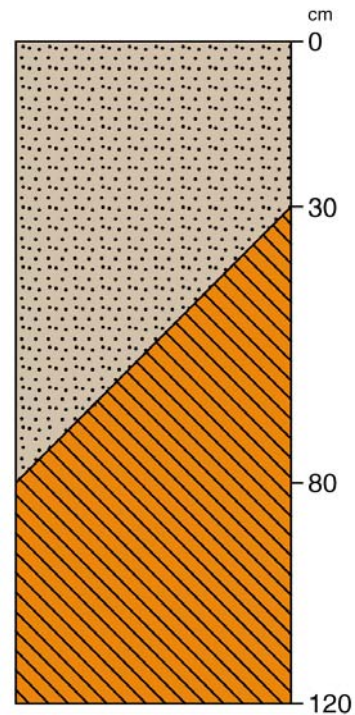
Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

- *Reticulate Kandosol*
- Reticulate Chromosol
- Tenosol

Main occurrences in Western Australia

- Common in the southern part of the central wheatbelt and the Great Southern, east of Narrogin



Distribution map of Reticulite deep sandy duplex in the South-west of WA



Reticulite deep sandy duplex (Corrigin)

Available qualifiers of Reticulite deep sandy duplex (in order from most to least restrictive)

- SSS saline subsoil
- RKM rock substrate
- GRP gravelly subsurface, poor subsoil
- PSS poor subsoil
- GRG gravelly subsurface, good subsoil
- WSS good subsoil

Soil attributes of Reticulite deep sandy duplex (dominant values)

		QUALIFIER					
		SSS	RKM	GRP	PSS	GRG	WSS
ATTRIBUTE	Inherent fertility	Low Very	low	Low Low	Low	Low	
	Permeability 0-50 cm	Rapid	Very rapid	Rapid	Rapid	Rapid	Rapid
	pH at 0-10 cm	Moderately acid	Moderately acid	Moderately acid	Moderately acid	Moderately acid	Moderately acid
	pH at 50-80 cm	Slightly acid	Slightly acid	Neutral	Slightly acid	Slightly acid	Moderately acid
	Profile stones and gravels	Common	Common	Common	Common	Common	
	Rooting depth	Very deep	Moderate	Very deep	Very deep	Very deep	Very deep
	Soil water storage	Low Very	low	Low Low	Low	Low	
	Subsurface acidification	Moderate	Moderate	Low	Moderate	High	High
	Subsurface compaction	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
	Surface organic carbon	Low	Low	Low	Low	Low	Low
	Surface soil structure decline	Low Low	Low	Low	Low	Low	
	Water repellence	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate

Land use considerations

- High gravel content may limit water-holding capacity of the soil
- Prone to wind erosion on exposed flats and rises

Calcareous shallow sand

Soil Group 421

Calcareous sand over rock, hardpan or other cemented layer at <80 cm

Characteristics

- Sandy throughout
- Grey or occasionally black topsoil
- Calcareous throughout
- Alkaline pH throughout
- Sometimes over limestone or calcrete

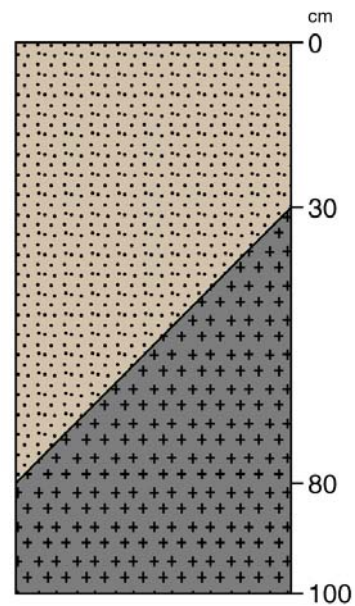
Local names

- Coastal sand
- Black wattle sand

Typical Australian Soil Classification (ASC)

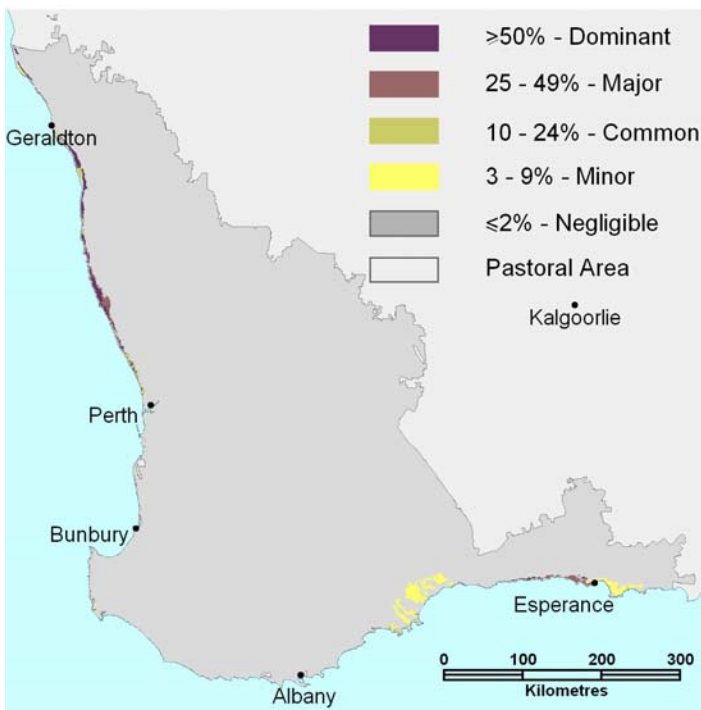
(dominant ASC in italics)

- *Shelly Rudosol*
- *Leptic Rudosol*
- *Calcareous Paralithic or Lithic Tenosol*
- Shelly Calcarosol



Main occurrences in Western Australia

- Calcareous shallow sands are widespread on coastal limestone, especially in the South-west, but are never common



Distribution map of Calcareous shallow sand in the South-west of WA



Calcareous shallow sand (Margaret River)

Available qualifiers of Calcareous shallow sand (in order from most to least restrictive)

- SAL saline
- PVR poor sand, very shallow rock substrate
- GVR good sand, very shallow rock substrate
- PSR poor sand, deep rock substrate
- GSR good sand, deep rock substrate

Soil attributes of Calcareous shallow sand (dominant values)

		QUALIFIER				
		SAL	PVR	GVR	PSR	GSR
ATTRIBUTE	Inherent fertility	Moderate	Low Moderate		Low Moderate	
	Permeability 0-50 cm	Rapid	Moderately slow	Moderately slow	Very rapid	Rapid
	pH at 0-10 cm	Moderately alkaline	Moderately alkaline	Moderately alkaline	Moderately alkaline	Moderately alkaline
	pH at 50-80 cm	Moderately alkaline	Strongly alkaline	Moderately alkaline	Moderately alkaline	Moderately alkaline
	Profile stones and gravels	Abundant	Not applicable	Not applicable	Abundant	Abundant
	Rooting depth	Moderate	Shallow	Shallow	Moderate	Moderate
	Soil water storage	High	Very low	Very low	Very low	Very low
	Subsurface acidification	Low	Low	Low	Low	Low
	Subsurface compaction	Low	Moderate Low		Moderate Low	
	Surface organic carbon	High	High	High	High	High
	Surface soil structure decline	Low Low	Low	Low	Low	
	Water repellence	Moderate	Moderate	Moderate	Moderate	Moderate

Land use considerations

- High pH may limit growth of some agricultural species
- Shallow soil depth limits rooting depth and water-holding capacity

Pale shallow sand

Soil Group 422

White, grey or pale yellow sand over rock, hardpan or other cemented layer at <80 cm

Characteristics

- White, grey or pale yellow within top 30 cm
- Neutral to acid pH
- Ironstone gravel may be present
- Often gritty sands over granite
- Often sand over cemented ironstone (ferricrete or bog iron) or other hardpan

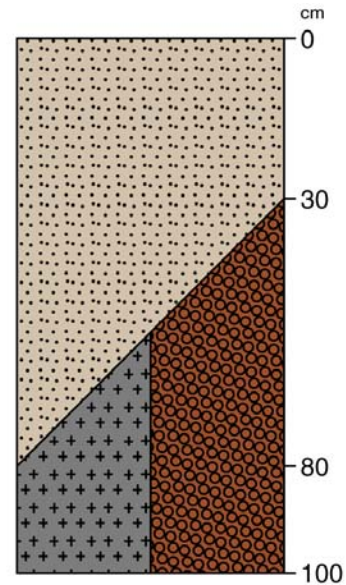
Local names

- Gutless/Gritty sand
- Gritty sheoak sand

Typical Australian Soil Classification (ASC)

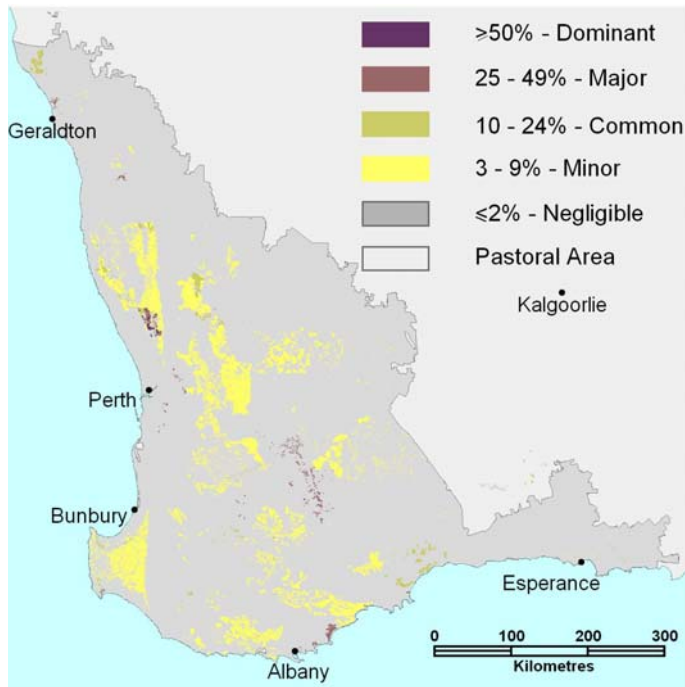
(dominant ASC in *italics*)

- *Leptic Tenosol*
- *Paralithic or Lithic Bleached-Orthic Tenosol*
- Leptic Rudosol



Main occurrences in Western Australia

- Gritty forms are common on areas fringing granite outcrop, most common in the Yilgarn Craton of the South-west
- Overlaying coarse-textured rocks such as sandstone in the Kimberley or scattered in other areas



Distribution map of Pale shallow sand in the South-west of WA



Pale shallow sand (Wongan Hills)

Available qualifiers of Pale shallow sand (in order from most to least restrictive)

- SAL saline
- VSH very shallow rock substrate
- SAC acid sand
- GRI coarse gritty sand
- PSR poor sand, deep rock substrate
- GSR good sand, deep rock substrate

Soil attributes of Pale shallow sand (dominant values)

	QUALIFIER						
	SAL	VSH	SAC	GRI	PSR	GSR	
Inherent fertility	Very low	Very low	Very low	Very low	Very low	Low	
Permeability 0-50 cm	Rapid	Moderately slow	Rapid	Very rapid	Rapid	Rapid	
pH at 0-10 cm	Slightly acid	Moderately acid	Strongly acid	Slightly acid	Moderately acid	Moderately acid	
pH at 50-80 cm	Slightly acid	Slightly acid	Very strongly acid	Moderately acid	Slightly acid	Slightly acid	
Profile stones and gravels	Abundant	Not applicable	Abundant	Abundant	Abundant	Abundant	
Rooting depth	Moderate	Shallow	Moderate	Moderate	Moderate	Moderate	
Soil water storage	Very low	Very low	Very low	Very low	Very low	Very low	
Subsurface acidification	High	High	Presently acid	High	High	High	
Subsurface compaction	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	
Surface organic carbon	Moderate	Moderate	Moderate	Low	Low	High	
Surface soil structure decline	Low	Low	Low	Low	Low		
Water repellence	High	High	High	High	High	High	

Land use considerations

- Water-holding capacity is low due to the shallow depth of the profile and coarse textures
- The soils are usually well drained, although the hard underlying layer may cause seasonally perched watertable

Red shallow sand

Soil Group 423

Red sand over rock, hardpan or other cemented layer at <80 cm

Characteristics

- Red sand over rock, hardpan or other cemented layer by 80 cm, and often <30 cm
- Surface mantle of stones is common
- Gravel (ironstone and non-ironstone) may be present
- Neutral to acid pH

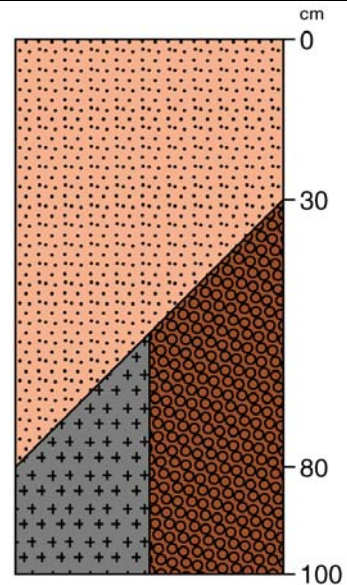
Local names

- Wyarri sand

Typical Australian Soil Classification (ASC)

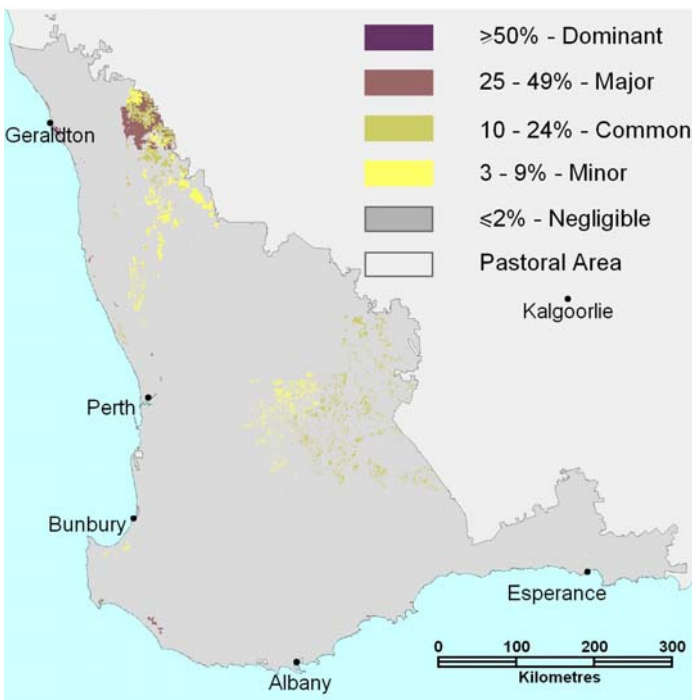
(dominant ASC in italics)

- *Leptic Tenosol*
- *Paralithic or Lithic Orthic Tenosol*
- Leptic Rudosol



Main occurrences in Western Australia

- Southern rangelands (Murchison, Gascoyne, Goldfields) but rarely dominant
- Minor occurrences on limestone in the South-west, Pilbara and Arid Interior



Distribution map of Red shallow sand in the South-west of WA



Red shallow sand (Merredin)

Available qualifiers of Red shallow sand (in order from most to least restrictive)

- SAL saline
- VSH very shallow rock substrate
- SAC acid sand
- PSR poor sand, deep rock substrate
- GSR good sand, deep rock substrate

Soil attributes of Red shallow sand (dominant values)

		QUALIFIER				
		SAL	VSH	SAC	PSR	GSR
ATTRIBUTE	Inherent fertility	Low	Very low	Low	Very low	Low
	Permeability 0-50 cm	Rapid	Moderately slow	Rapid	Rapid	Rapid
	pH at 0-10 cm	Slightly acid	Slightly acid	Moderately acid	Slightly acid	Slightly acid
	pH at 50-80 cm	Slightly acid	Slightly acid	Very strongly acid	Slightly acid	Slightly acid
	Profile stones and gravels	Abundant	Not applicable	Abundant	Abundant	Abundant
	Rooting depth	Moderate	Shallow	Moderate	Moderate	Moderate
	Soil water storage	Very low	Very low	Very low	Very low	Very low
	Subsurface acidification	High	High	Presently acid	High	Moderate
	Subsurface compaction	Moderate	Moderate	Moderate	Moderate	Moderate
	Surface organic carbon	Low	Low	Low	Low	Moderate
	Surface soil structure decline	Low	Low	Low	Low	
	Water repellence	Moderate	Moderate	Moderate	Moderate	Moderate

Land use considerations

- Water-holding capacity is very low due to the shallow depth of the profile and coarse textures
- Usually rapidly drained

Yellow/brown shallow sand

Soil Group 424

Yellow or brown sand over rock, hardpan or other cemented layer at <80 cm

Characteristics

- Yellow or brown within top 30 cm
- Neutral to acid pH
- Commonly over limestone in coastal areas
- May occur over bog iron on the coastal plains

Local names

- Karrakatta sand
- Spearwood sand

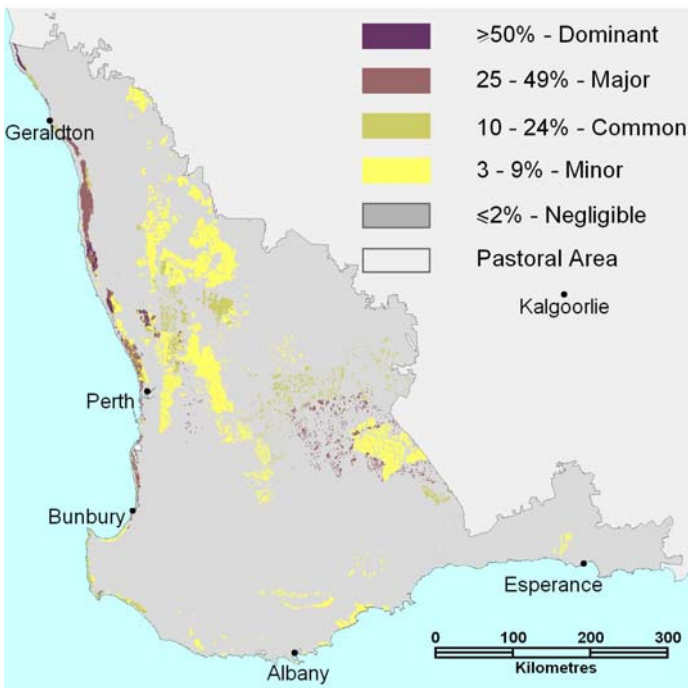
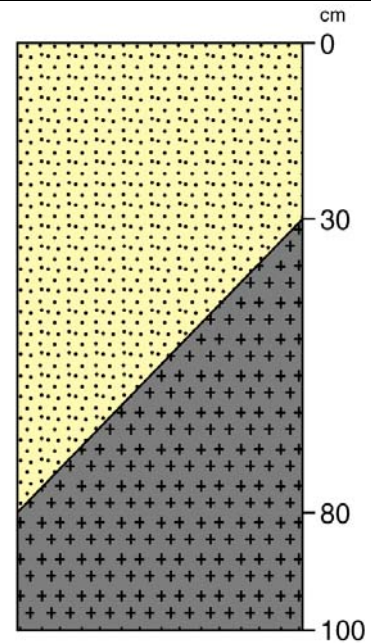
Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

- *Leptic Tenosol*
- *Paralithic or Lithic Orthic Tenosol*
- Leptic Rudosol

Main occurrences in Western Australia

- Occasionally on limestone near the coast in the South-west
- Scattered elsewhere on a variety of materials



Distribution map of Yellow/brown shallow sand in the South-west of WA



Yellow/brown shallow sand (West Gingin)

Available qualifiers of Yellow/brown shallow sand (in order from most to least restrictive)

- SAL saline
- VSH very shallow rock substrate
- SAC acid sand
- PSR poor sand, deep rock substrate
- GSR good sand, deep rock substrate

Soil attributes of Yellow/brown shallow sand (dominant values)

		QUALIFIER				
		SAL	VSH	SAC	PSR	GSR
ATTRIBUTE	Inherent fertility	Low Low	Low	Low	Low	
	Permeability 0-50 cm	Rapid	Moderately slow	Rapid	Rapid	Rapid
	pH at 0-10 cm	Slightly acid	Slightly acid	Moderately acid	Slightly acid	Slightly acid
	pH at 50-80 cm	Slightly acid	Slightly acid	Very strongly acid	Slightly acid	Neutral
	Profile stones and gravels	Abundant	Not applicable	Abundant	Abundant	Abundant
	Rooting depth	Moderate	Shallow	Moderate	Moderate	Moderate
	Soil water storage	Very low	Very low Very	low Very	low Very	low
	Subsurface acidification	Moderate	Moderate	Presently acid	Moderate	Low
	Subsurface compaction	Moderate	Moderate	Moderate M	oderate	Moderate
	Surface organic carbon	High	High	High	Moderate	High
	Surface soil structure decline	Low Low	Low	Low	Low	
Water repellence	Moderate	Moderate	Moderate	Moderate	Moderate	

Land use considerations

- Water-holding capacity is very low due to the shallow depth of the profile and coarse textures
- Usually rapidly drained
- Soil depth may vary greatly over short distances

Brown deep sand

Soil Group 441

Brown sand >80 cm deep

Characteristics

- Brown or rarely black topsoil
- Brown within top 30 cm
- Sandy throughout
- May be humic
- Neutral to acid pH
- Usually of alluvial or lacustrine origin
- May be over rock, clay or other unconsolidated materials

Local names

- Alluvial sand
- Alluvial brown sand

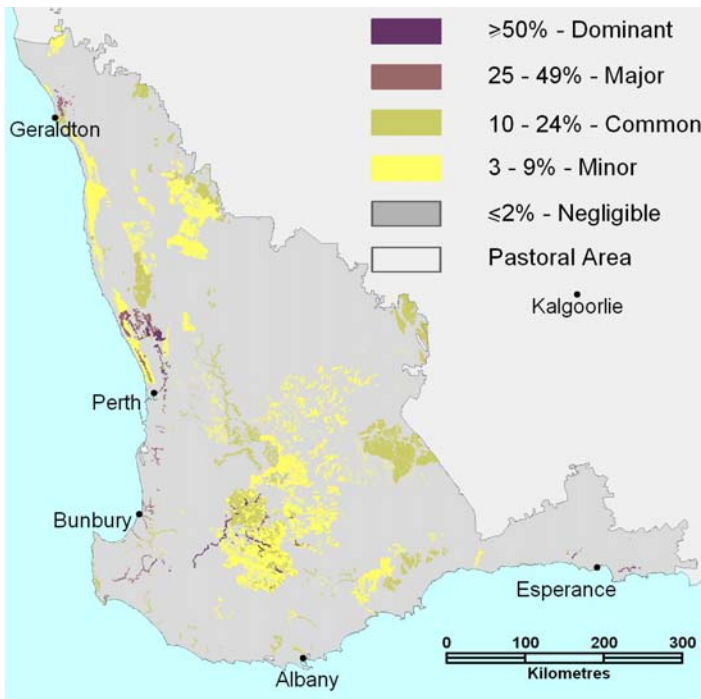
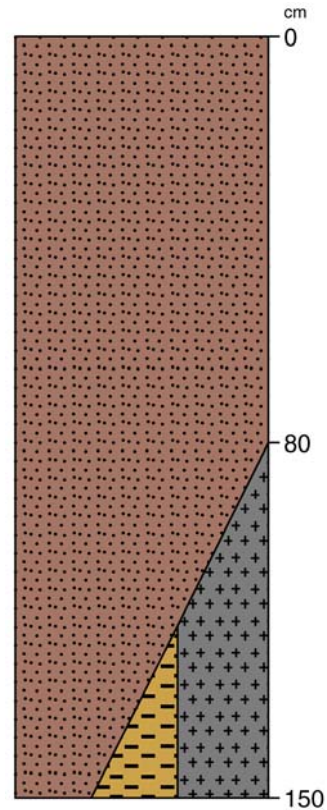
Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

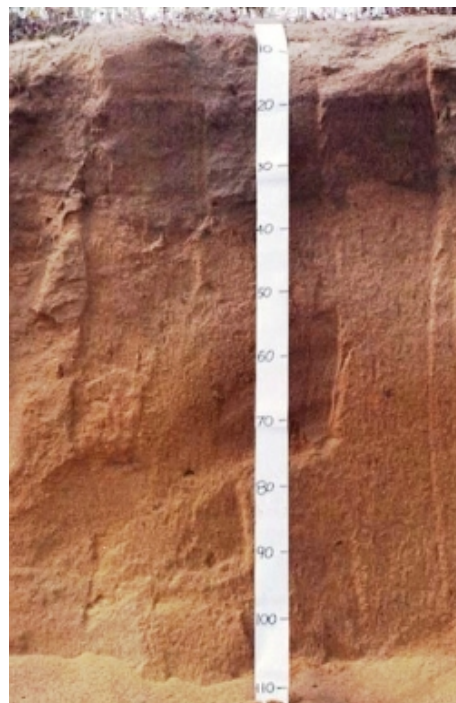
- *Orthic Tenosol*
- Aeric Podosol

Main occurrences in Western Australia

- Minor alluvial soils in the South-west
- Coastal plains in South-west



Distribution map of Brown deep sand in the South-west of WA



Brown deep sand (Kukerin)

Available qualifiers of Brown deep sand (in order from most to least restrictive)

- SAC acid sand
- PSR poor sand, deep rock substrate
- PSV poor sand, effective duplex
- PSE poor sand, very deep
- FSR fair sand, rock substrate
- FSE fair sand, effective duplex
- FSV fair sand, very deep
- GSR good sand, deep rock substrate
- GSE good sand, effective duplex
- GSV good sand, very deep

Soil attributes of Brown deep sand (dominant values)

ATTRIBUTE	QUALIFIER					
	SAC	PSR	PSV	PSE	FSR	
Inherent fertility	Low	Low	Low	Low	Low	
Permeability 0-50 cm	Rapid	Rapid	Rapid	Rapid	Rapid	
pH at 0-10 cm	Moderately acid	Slightly acid	Slightly acid	Slightly acid	Moderately acid	
pH at 50-80 cm	Strongly acid	Neutral	Slightly acid	Neutral	Neutral	
Profile stones and gravels	Few	Few	Few	Few	Few	
Rooting depth	Very deep	Deep	Very deep	Deep	Deep	
Soil water storage	Low	Very low	Very low	Very low	Very low	
Subsurface acidification	Presently acid	High	High	High	High	
Subsurface compaction	Moderate	Moderate	Moderate	Moderate	Moderate	
Surface organic carbon	High	Moderate	Moderate	Moderate	High	
Surface soil structure decline	Low	Low	Low	Low	Low	
Water repellence	Moderate	Moderate	Moderate	Moderate	Moderate	

ATTRIBUTE	QUALIFIER					
	FSE	FSV	GSR	GSE	GSV	
Inherent fertility	Low	Low	Moderate	Moderate	Moderate	
Permeability 0-50 cm	Rapid	Rapid	Rapid	Rapid	Rapid	
pH at 0-10 cm	Slightly acid	Slightly acid	Moderately acid	Strongly acid	Slightly acid	
pH at 50-80 cm	Neutral	Slightly acid	Slightly acid	Moderately acid	Slightly acid	
Profile stones and gravels	Few	Few	Few	Few	Few	
Rooting depth	Deep	Very deep	Deep	Deep	Very deep	
Soil water storage	Very low	Very low	Low	Low	Low	
Subsurface acidification	High	High	High	High	High	
Subsurface compaction	Moderate	Moderate	Moderate	Moderate	High	
Surface organic carbon	High	High	High	High	High	
Surface soil structure decline	Low	Low	Low	Low	Low	
Water repellence	Moderate	Moderate	Moderate	Moderate	Moderate	

Land use considerations

- These soils are suitable for a variety of agricultural land uses
- Prone to wind erosion in exposed positions

Calcareous deep sand

Soil Group 442

Calcareous sand >80 cm deep

Characteristics

- Sandy throughout
- White, grey, yellow or occasionally black
- Calcareous throughout, although occasionally non-calcareous in top 30 cm in older dunes
- Alkaline pH throughout
- Often very deep in dune deposits, or occasionally over limestone or calcareous hardpan

Local names

- Beach dune sand
- Calcareous sand

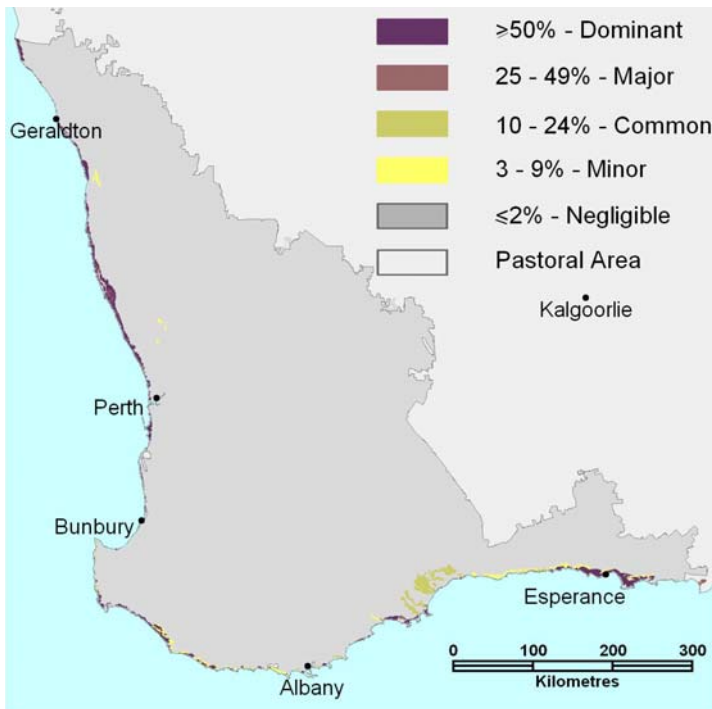
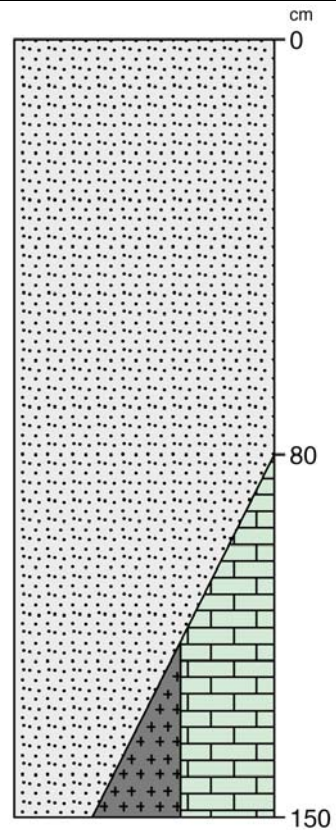
Typical Australian Soil Classification (ASC)

(dominant ASC in *italics*)

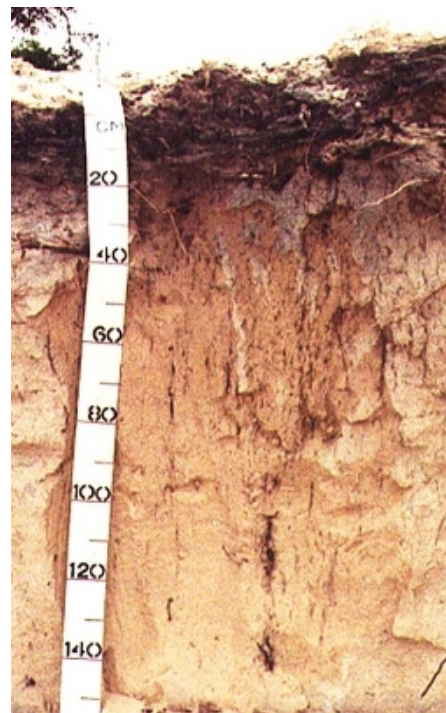
- *Shelly Rudosol*
- Shelly Calcarosol

Main occurrences in Western Australia

- Commonly on coastal dunes from Exmouth to the South Australian border
- Rare on the Pilbara and Kimberley coasts



Distribution map of Calcareous deep sand in the South-west of WA



Calcareous deep sand (West Coast)

Available qualifiers of Calcareous deep sand (in order from most to least restrictive)

- SAL saline
- PSR poor sand, deep rock substrate
- PSV poor sand, very deep
- GSR good sand, deep rock substrate
- GSV good sand, very deep

Soil attributes of Calcareous deep sand (dominant values)

		QUALIFIER				
		SAL	PSR	PSV	GSR	GSV
ATTRIBUTE	Inherent fertility	Low	Very low	Very low	Moderate	Moderate
	Permeability 0-50 cm	Rapid	Very rapid	Very rapid	Rapid	Rapid
	pH at 0-10 cm	Moderately alkaline	Moderately alkaline	Moderately alkaline	Moderately alkaline	Moderately alkaline
	pH at 50-80 cm	Moderately alkaline	Moderately alkaline	Moderately alkaline	Moderately alkaline	Moderately alkaline
	Profile stones and gravels	Very few	Very few	Very few	Very few	Very few
	Rooting depth	Very deep	Deep	Very deep	Deep	Very deep
	Soil water storage	Very low	Very low	Very low	Very low	Very low
	Subsurface acidification	Low	Moderate	Low	Low	Low
	Subsurface compaction	Moderate	Moderate	Moderate	Moderate	Moderate
	Surface organic carbon	Moderate	Low	Low	High	High
	Surface soil structure decline	Low	Low	Low	Low	Low
	Water repellence	Moderate	High	High	High	High

Land use considerations

- These soils frequently occur in exposed positions along the coast and are prone to wind erosion and high airborne salt loads
- High pH and low water-holding capacity may limit plant growth

Gravelly pale deep sand

Soil Group 443

Sand >15 cm (and pale to at least 30 cm) over gravelly sand >80 cm deep. Gravels are a dominant feature of the profile

Characteristics

- Ironstone gravel is present and common (>20% and at least 20 cm thick) below 15 cm
- Usually white, grey or pale yellow
- Neutral to acid pH
- Coffee rock, clay or ferricrete may be present at >80 cm
- The subsoil matrix of a coloured sand may be present at 30-80 cm

Local names

- Gravelly sand
- Sand over gravel
- White sandy gravels

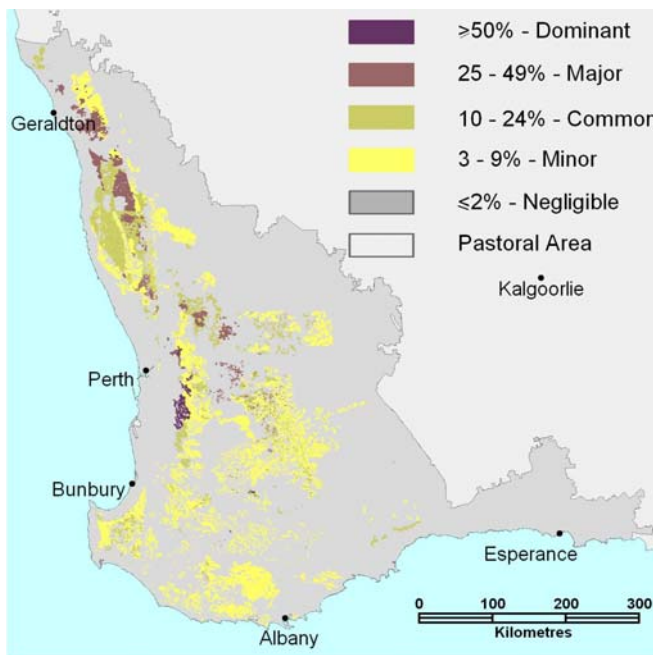
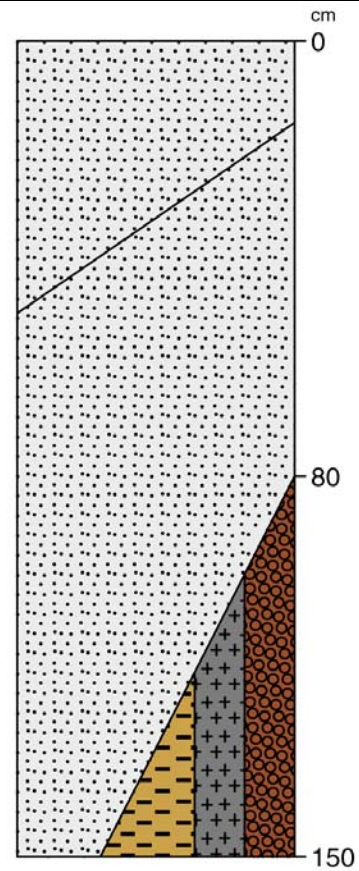
Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

- *Sesqui-Nodular Tenosol*
- Ferric Bleached-Orthic Tenosol

Main occurrences in Western Australia

- Common in the South-west agricultural area on the Coastal Plain north and south of Perth
- Also in broad valleys in lateritic terrain throughout the South-west, notably in the West Midlands north of Perth
- Scattered in other South-west areas



Distribution map of Gravelly pale deep sand in the South-west of WA



Gravelly pale deep sand (Geraldton)

Available qualifiers of Gravelly pale deep sand (in order from most to least restrictive)

- SAC Acid sand
- GTR gritty sand, rock substrate
- PSR poor sand, deep rock substrate
- PSE poor sand, effective duplex
- PSV poor sand, very deep
- GSR good sand, deep rock substrate
- GSE good sand, effective duplex
- GSV good sand, very deep

Soil attributes of Gravelly pale deep sand (dominant values)

ATTRIBUTE	QUALIFIER			
	SAC	GTR	PSR	PSE
Inherent fertility	Low	Very low	Very low	Very low
Permeability 0-50 cm	Rapid	Very rapid	Rapid	Rapid
pH at 0-10 cm	Strongly acid	Slightly acid	Moderately acid	Slightly acid
pH at 50-80 cm	Very strongly acid	Neutral	Moderately acid	Slightly acid
Profile stones and gravels	Many	Many	Many	Many
Rooting depth	Very deep	Deep	Deep	Deep
Soil water storage	Very low	Very low	Very low	Very low
Subsurface acidification	Presently acid	High	Presently acid	High
Subsurface compaction	Moderate	Moderate	Moderate	Moderate
Surface organic carbon	Moderate	Low	Low	Low
Surface soil structure decline	Low	Low	Low	Low
Water repellence	High	Moderate	High	High

ATTRIBUTE	QUALIFIER			
	PSV	GSR	GSE	GSV
Inherent fertility	Very low	Low	Low	Low
Permeability 0-50 cm	Rapid	Rapid	Rapid	Rapid
pH at 0-10 cm	Slightly acid	Moderately acid	Slightly acid	Strongly acid
pH at 50-80 cm	Slightly acid	Moderately acid	Slightly acid	Slightly acid
Profile stones and gravels	Many	Many	Many	Many
Rooting depth	Very deep	Deep	Deep	Very deep
Soil water storage	Very low	Low	Low	Low
Subsurface acidification	High	High	High	High
Subsurface compaction	Moderate	High	High	High
Surface organic carbon	Low	Moderate	Moderate	Moderate
Surface soil structure decline	Low	Low	Low	Low
Water repellence	High	Moderate	Moderate	Moderate

Land use considerations

- Poor fertility and water-holding characteristics
- Nutrient leaching and groundwater recharge are significant issues
- Prone to wind erosion in exposed positions
- Prone to water repellence, especially after legume cropping

Pale deep sand

Soil Group 444

Sand >80 cm deep with white, grey or pale yellow topsoil

Characteristics

- White, grey or pale yellow within top 30 cm
- Neutral to acid pH
- Ironstone gravel may be present
- Coffee rock, clay or ferricrete may occur at >80 cm
- A weak coffee rock layer may occur within 80 cm
- A coloured sand may be present at 30-80 cm

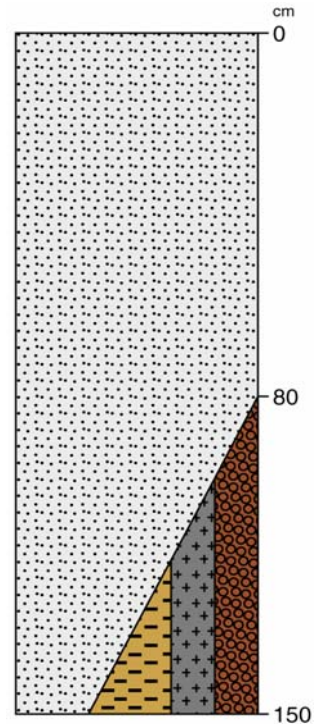
Local names

- Gutless/Gritty sand
- Grey sandplain
- Harrismith sand
- Christmas tree/Banksia sand
- Deep mallee sand
- Spillway/Siliceous sand
- Silver loam

Typical Australian Soil Classification (ASC)

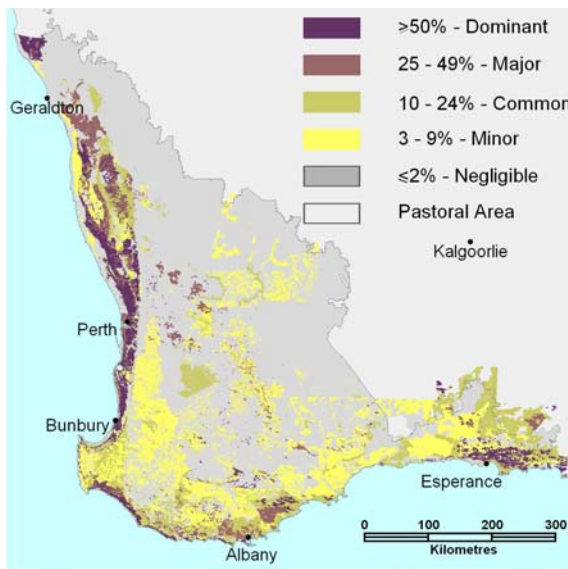
(dominant ASC in italics)

- *Bleached-Orthic Tenosol*
- Aeric Podosol



Main occurrences in Western Australia

- Common in the South-west agricultural area on the Swan Coastal Plain, the Scott River Plain and Cape Arid east of Esperance
- Also in broad valleys in lateritic terrain throughout the South-west, notably in the West Midlands north of Perth
- Scattered in other South-west areas



Distribution map of Pale deep sand in the South-west of WA



Pale deep sand (Jerramungup)

Available qualifiers of Pale deep sand (in order from most to least restrictive)

- SAC acid sand
- GTR gritty sand, rock substrate
- PSR poor sand, deep rock substrate
- PSE poor sand, effective duplex
- PSV poor sand, very deep
- GSR good sand, deep rock substrate
- GSE good sand, effective duplex
- GSV good sand, very deep

Soil attributes of Pale deep sand (dominant values)

ATTRIBUTE	QUALIFIER			
	SAC	GTR	PSR	PSE
Inherent fertility	Low	Very low	Very low	Very low
Permeability 0-50 cm	Rapid	Very rapid	Rapid	Rapid
pH at 0-10 cm	Strongly acid	Neutral	Slightly acid	Moderately acid
pH at 50-80 cm	Moderately acid	Slightly acid	Slightly acid	Slightly acid
Profile stones and gravels	Very few	Few	Few	Very few
Rooting depth	Very deep	Deep	Deep	Deep
Soil water storage	Low	Very low	Low	Very low
Subsurface acidification	Presently acid	High	High	High
Subsurface compaction	Moderate	Moderate	Moderate	Moderate
Surface organic carbon	Low	Low	Low	Low
Surface soil structure decline	Low	Low	Low	Low
Water repellence	High	Moderate	High	High

ATTRIBUTE	QUALIFIER			
	PSV	GSR	GSE	GSV
Inherent fertility	Very low	Low	Low	Low
Permeability 0-50 cm	Rapid	Rapid	Rapid	Rapid
pH at 0-10 cm	Slightly acid	Moderately acid	Slightly acid	Slightly acid
pH at 50-80 cm	Slightly acid	Neutral	Slightly acid	Neutral
Profile stones and gravels	Very few	Very few	Very few	Very few
Rooting depth	Very deep	Deep	Deep	Very deep
Soil water storage	Very low	Low	Low	Low
Subsurface acidification	High	High	High	Moderate
Subsurface compaction	Moderate	Moderate	Moderate	Moderate
Surface organic carbon	Low	Moderate	Moderate	Moderate
Surface soil structure decline	Low	Low	Low	Low
Water repellence	High	Moderate	Moderate	Moderate

Land use considerations

- Poor fertility and water-holding characteristics
- Nutrient leaching and groundwater recharge are significant issues
- Prone to wind erosion in exposed positions
- Prone to water repellence, especially after legume cropping

Red deep sand

Soil Group 445

Red sands greater than 80 cm deep

Characteristics

- Red in top 30 cm
- Neutral to acid pH
- Gravel (including ironstone) may be present in subsoil

Local names

- Wandarrie sand
- Cockatoo sand
- Red sand

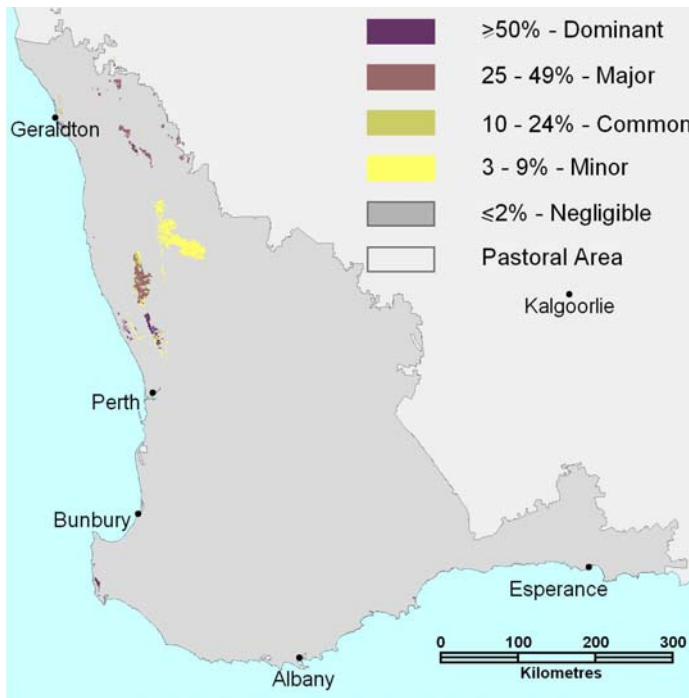
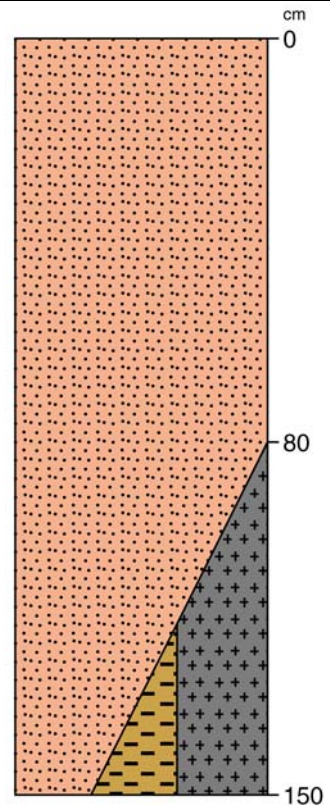
Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

- *Red-Orthic Tenosol*

Main occurrences in Western Australia

- The dominant soil of the Arid Interior, extending from north of the Nullarbor Plain to the Kimberley
- Common near the coast from Kalbarri to Exmouth
- Isolated in the South-west, especially in the Geraldton and Dandaragan area
- Minor in the East Kimberley



Distribution map of Red deep sand in the South-west of WA



Red deep sand (Murchison)

Available qualifiers of Red deep sand (in order from most to least restrictive)

- SAC acid sand
- PSR poor sand, deep rock substrate
- PSV poor sand, effective duplex
- PSE poor sand, very deep
- FSR fair sand, rock substrate
- FSE fair sand, effective duplex
- FSV fair sand, very deep
- GSR good sand, deep rock substrate
- GSE good sand, effective duplex
- GSV good sand, very deep

Soil attributes of Red deep sand (dominant values)

ATTRIBUTE	QUALIFIER				
	SAC	PSR	PSV	PSE	FSR
Inherent fertility	Low	Low	Low	Low	Low
Permeability 0-50 cm	Rapid	Rapid	Rapid	Rapid	Rapid
pH at 0-10 cm	Strongly acid	Moderately acid	Slightly acid	Moderately acid	Slightly acid
pH at 50-80 cm	Very strongly acid	Neutral	Neutral	Slightly acid	Neutral
Profile stones and gravels	Few	Few	Very few	Few	Few
Rooting depth	Very deep	Deep	Very deep	Deep	Deep
Soil water storage	Low	Very low	Very low	Very low	Low
Subsurface acidification	Presently acid	Moderate	High	High	Moderate
Subsurface compaction	Moderate	Moderate	Moderate	Moderate	Moderate
Surface organic carbon	High	Moderate	Moderate	Moderate	High
Surface soil structure decline	Low	Low	Low	Low	Low
Water repellence	Moderate	Moderate	Moderate	Moderate	Moderate

ATTRIBUTE	QUALIFIER				
	FSE	FSV	GSR	GSE	GSV
Inherent fertility	Low	Low	Moderate	Moderate	Moderate
Permeability 0-50 cm	Rapid	Rapid	Rapid	Rapid	Rapid
pH at 0-10 cm	Slightly acid	Slightly acid	Moderately acid	Moderately acid	Slightly acid
pH at 50-80 cm	Neutral	Slightly acid	Neutral	Slightly acid	Neutral
Profile stones and gravels	Very few	Few	Few	Very few	Few
Rooting depth	Deep	Very deep	Deep	Deep	Very deep
Soil water storage	Low	Low	Low	Moderately low	Moderately low
Subsurface acidification	Moderate	High	Low	Moderate	Low
Subsurface compaction	Moderate	Moderate	High	High	High
Surface organic carbon	High	High	High	High	High
Surface soil structure decline	Low	Low	Low	Low	Low
Water repellence	Moderate	Moderate	Nil	Nil	Nil

Land use considerations

- Moderate low fertility and water-holding characteristics
- Prone to wind erosion in exposed positions

Yellow deep sand

Soil Group 446

Yellow sands greater than 80 cm deep

Characteristics

- Yellow within top 30 cm
- Neutral to acid pH
- Ironstone gravel may be present throughout, sometimes common (>20%) below 15 cm
- Limestone or ferricrete may be present at >80 cm

Local names

- Yellow sandplain
- Pear and pine sand
- Spearwood/Karrakatta sand
- Eradu sandplain
- Sands on limestone
- Siliceous sand

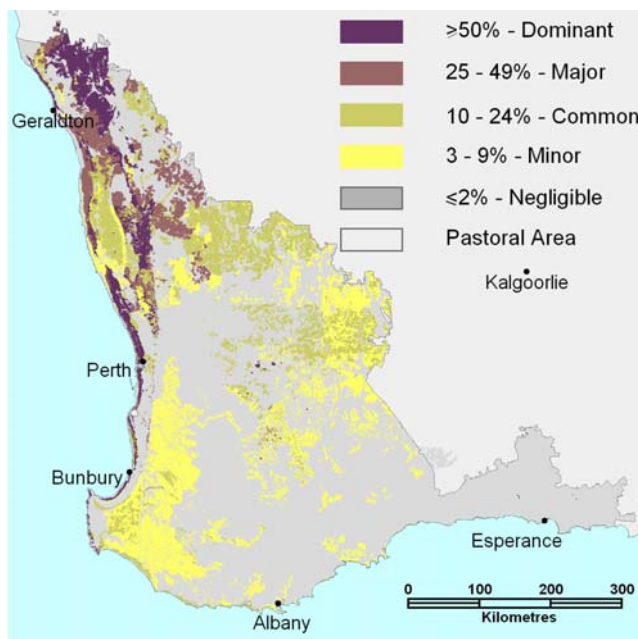
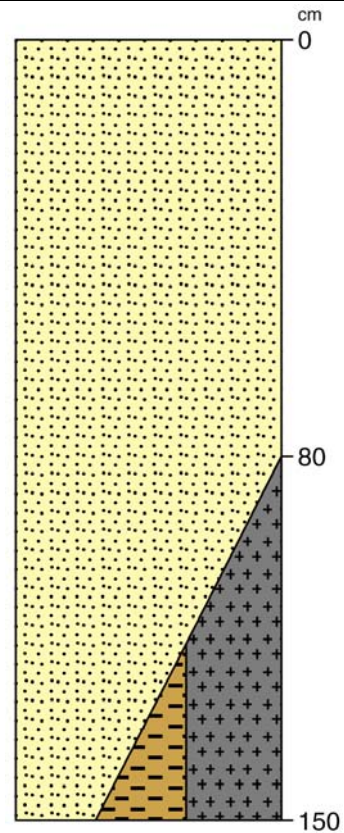
Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

- *Yellow-Orthic Tenosol*

Main occurrences in Western Australia

- Common on coastal limestone on the coastal plain from Augusta to Geraldton in the South-west
- Sandplain remnants in the northern and eastern wheatbelt, extending north to Kalbarri and southern rangelands
- Isolated occurrences throughout the remainder of South-west and widespread on sandstones in the Kimberley



Distribution map of Yellow deep sand in the South-west of WA



Yellow deep sand (Geraldton)

Available qualifiers of Yellow deep sand (in order from most to least restrictive)

- SAC acid sand
- PSR poor sand, deep rock substrate
- PSV poor sand, effective duplex
- PSE poor sand, very deep
- FSR fair sand, rock substrate
- FSE fair sand, effective duplex
- FSV fair sand, very deep
- GSR good sand, deep rock substrate
- GSE good sand, effective duplex
- GSV good sand, very deep

Soil attributes of Yellow deep sand (dominant values)

ATTRIBUTE	QUALIFIER				
	SAC	PSR	PSE	PSV	FSR
Inherent fertility	Low	Very low	Very low	Low	Low
Permeability 0-50 cm	Rapid	Rapid	Rapid	Rapid	Rapid
pH at 0-10 cm	Strongly acid	Moderately acid	Slightly acid	Slightly acid	Slightly acid
pH at 50-80 cm	Very strongly acid	Neutral	Neutral	Neutral	Slightly acid
Profile stones and gravels	Few	Few	Few	Few	Few
Rooting depth	Very deep	Deep	Deep	Very deep	Deep
Soil water storage	Low	Very low	Very low	Low	Low
Subsurface acidification	Presently acid	High	High	High	High
Subsurface compaction	Moderate	Moderate	Moderate	Moderate	Moderate
Surface organic carbon	Moderate	Low	Low	Low	Moderate
Surface soil structure decline	Low	Low	Low	Low	Low
Water repellence	Moderate	Moderate	Moderate	Moderate	Moderate

ATTRIBUTE	QUALIFIER				
	FSE	FSV	GSR	GSE	GSV
Inherent fertility	Low	Low	Moderate	Moderate	Moderate
Permeability 0-50 cm	Rapid	Rapid	Rapid	Rapid	Rapid
pH at 0-10 cm	Slightly acid	Slightly acid	Moderately acid	Slightly acid	Slightly acid
pH at 50-80 cm	Neutral	Slightly acid	Neutral	Slightly acid	Neutral
Profile stones and gravels	Few	Few	Few	Few	Few
Rooting depth	Deep	Very deep	Deep	Deep	Very deep
Soil water storage	Low	Low	Low	Low	Moderately low
Subsurface acidification	High	High	High	High	High
Subsurface compaction	Moderate	Moderate	High	High	High
Surface organic carbon	Moderate	Moderate	Moderate	Moderate	Moderate
Surface soil structure decline	Low	Low	Low	Low	Low
Water repellence	Moderate	Moderate	Nil	Nil	Nil

Land use considerations

- Prone to wind erosion in exposed positions
- Some have poor fertility and water-holding characteristics
- Moderate recharge hazard under annual agriculture

Acid yellow sandy earth

Soil Group 461

Strongly acid yellow sand grading to loam by 80 cm

Characteristics

- Yellow throughout, may be grey at the surface
- Strongly acid pH, especially in subsurface and subsoil
- Ironstone gravel may be present
- May be clayey at depth

Local names

- Wodjil sand/soil

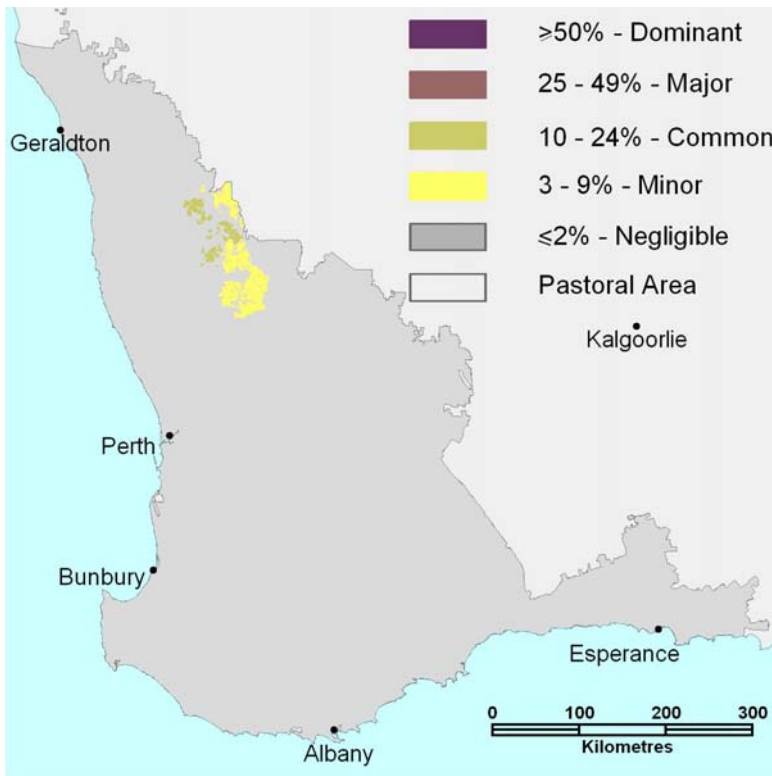
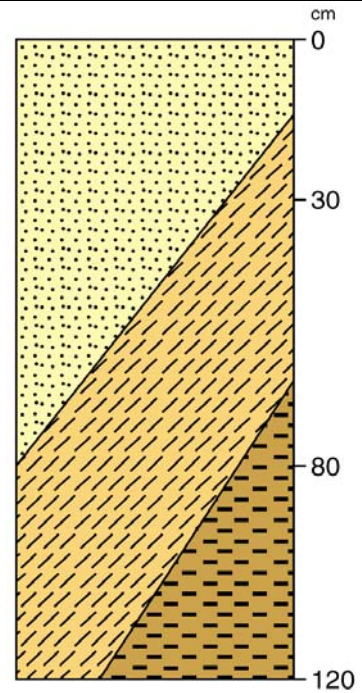
Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

- *Acidic Yellow Kandosol*
- Acidic Orthic Tenosol

Main occurrences in Western Australia

- Occasionally on sandy uplands in the central, eastern and northern wheatbelt areas of the South-west
- Scattered in the southern rangelands, associated with Yellow sandy earths



Distribution map of Acid yellow sandy earth in the South-west of WA



Acid yellow sandy earth (Bencubbin)

Available qualifiers of Acid yellow sandy earth (in order from most to least restrictive)

- SSS saline sub soil
- RKM rock substrate
- PSS poor subsoil
- ACD good acid subsoil

Soil attributes of Acid yellow sandy earth (dominant values)

		QUALIFIER			
		SSS	RKM	PSS	ACD
ATTRIBUTE	Inherent fertility	Moderate	Moderate	Moderate	Moderate
	Permeability 0-50 cm	Moderately rapid	Moderately rapid	Moderately rapid	Moderately rapid
	pH at 0-10 cm	Moderately acid	Moderately acid	Moderately acid	Moderately acid
	pH at 50-80 cm	Very strongly acid	Strongly acid	Very strongly acid	Very strongly acid
	Profile stones and gravels	Few	Many	Few	Few
	Rooting depth	Very deep	Moderate	Deep	Very deep
	Soil water storage	Moderately low	Low	Moderately low	Moderately low
	Subsurface acidification	Presently acid	Presently acid	Presently acid	Presently acid
	Subsurface compaction	High	High	High	High
	Surface organic carbon	High	High	High	High
	Surface soil structure decline	Low	Low	Moderate	Low
	Water repellence	Moderate	Moderate	Moderate	Moderate

Land use considerations

- Low subsoil pH and high concentrations of aluminium severely limit root growth into the subsoil and reduces yields of agricultural plants
- Plant available water capacity are low to moderately low

Brown sandy earth

Soil Group 462

Brown sand grading to loam by 80 cm

Characteristics

- Brown topsoil
- Sands grading to loams by 80 cm
- Neutral to acid pH
- Usually alluvial
- May be clayey at depth

Local names

- Alluvial brown sand/soil

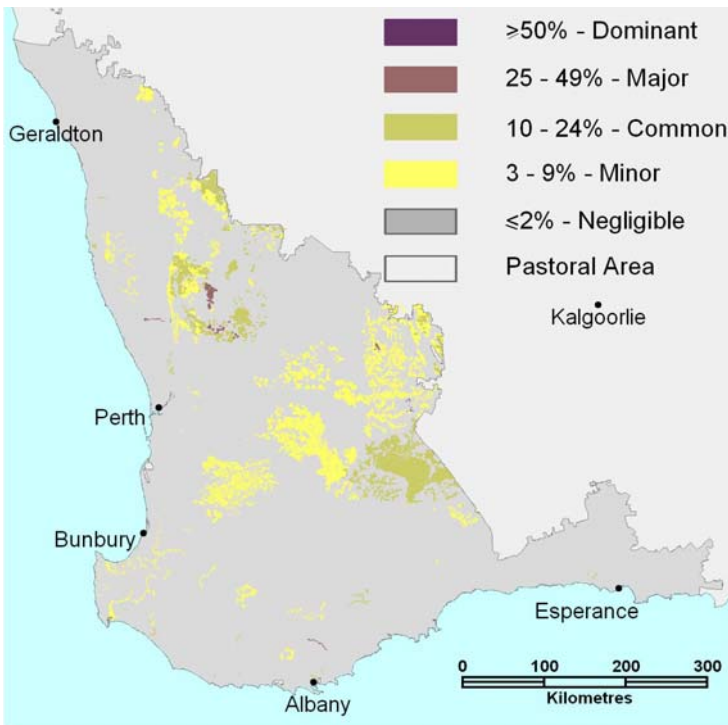
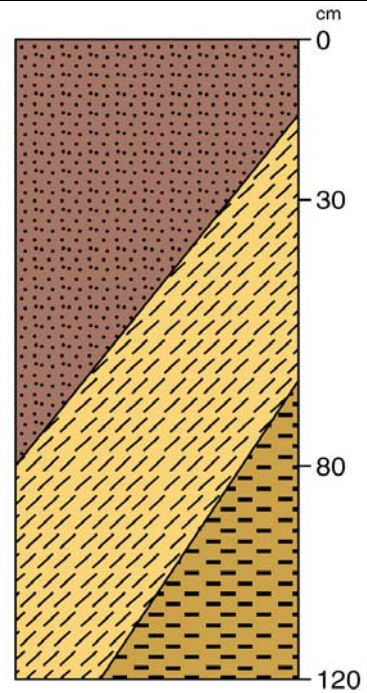
Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

- *Brown Kandosol*
- Orthic Tenosol

Main occurrences in Western Australia

- Minor alluvial soil in the South-west
- Scattered in the wheatbelt areas



Distribution map of Brown sandy earth in the South-west of WA



Brown sandy earth (Jerramungup)

Available qualifiers of Brown sandy earth (in order from most to least restrictive)

- SSS saline subsoil
- RKM rock substrate
- PSS poor subsoil
- ALK good alkaline subsoil
- ACD good acid subsoil
- NEU good neutral subsoil

Soil attributes of Brown sandy earth (dominant values)

	QUALIFIER						
	SSS	RKM	PSS	ALK	ACD	NEU	
Inherent fertility	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	
Permeability 0-50 cm	Moderately rapid	Moderately rapid	Moderately rapid	Moderately rapid	Moderately rapid	Moderately rapid	
pH at 0-10 cm	Slightly acid	Moderately acid	Slightly acid	Slightly acid	Moderately acid	Moderately acid	
pH at 50-80 cm	Slightly acid	Neutral	Neutral	Neutral	Strongly acid	Slightly acid	
Profile stones and gravels	Very few	Many	Few	Very few	Few	Few	
Rooting depth	Very deep	Moderate	Deep	Very deep	Very deep	Very deep	
Soil water storage	Moderate	Low	Moderately low	Moderately low	Low	Moderate	
Subsurface acidification	Moderate	Low	Low	Low	Presently acid	Moderate	
Subsurface compaction	High	High	High	High	High	High	
Surface organic carbon	High	High	High	High	High	High	
Surface soil structure decline	Moderate	High	High	Low	Low	Low	
Water repellence	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	

Land use considerations

- Good physical characteristics for plant growth (e.g. horticulture)
- The sandy topsoils can be susceptible to wind erosion, especially in exposed windy positions

Red sandy earth

Soil Group 463

Red sand grading to loam by 80 cm

Characteristics

- Red throughout
- Usually massive or poorly structured
- Usually porous (sometimes called earthy fabric)
- Neutral to acid pH, but occasionally alkaline and calcareous at depth
- May have a red-brown hardpan at depth
- May be clayey at depth

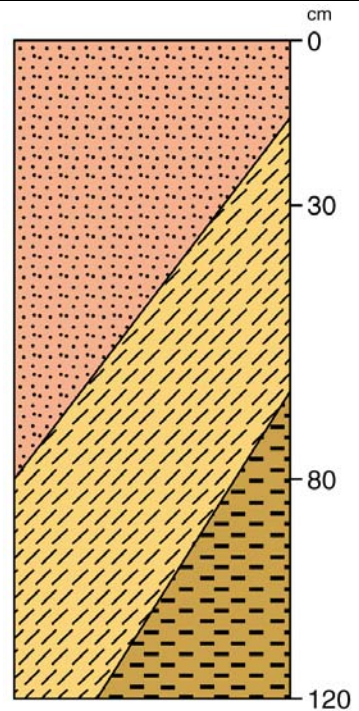
Local names

- Marybrook soil
- Pindan sand
- Cockatoo sand
- Red sandy loam

Typical Australian Soil Classification (ASC)

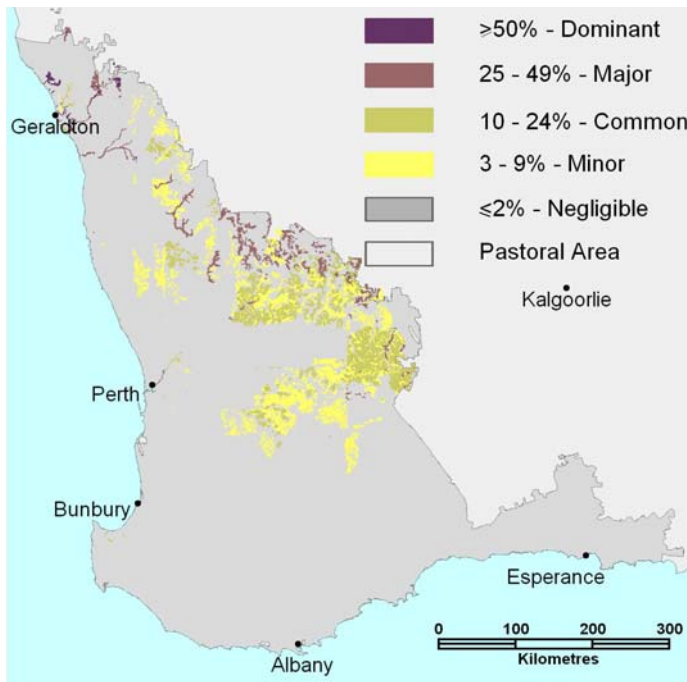
(dominant ASC in *italics*)

- *Red Kandosol*
- Orthic Tenosol



Main occurrences in Western Australia

- Widespread in the southern rangelands (Murchison, Goldfields and Gascoyne)
- Scattered in the northern wheatbelt, often in association with red loamy earths



Distribution map of Red sandy earth in the South-west of WA



Red sandy earth (Greenough River)

Available qualifiers of Red sandy earth (in order from most to least restrictive)

- SSS saline subsoil
- RKM rock substrate
- PSS poor subsoil
- ALK good alkaline subsoil
- ACD good acid subsoil
- NEU good neutral subsoil

Soil attributes of Red sandy earth (dominant values)

	QUALIFIER						
	SSS	RKM	PSS	ALK	ACD	NEU	
Inherent fertility	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	
Permeability 0-50 cm	Moderate	Moderately rapid	Moderately rapid	Moderate	Moderate	Moderate	
pH at 0-10 cm	Neutral	Slightly acid	Neutral	Neutral	Moderately acid	Moderately acid	
pH at 50-80 cm	Neutral	Moderately acid	Neutral	Neutral	Strongly acid	Slightly acid	
Profile stones and gravels	Few	Many	Very few	Few	Few	Very few	
Rooting depth	Moderate	Moderate	Deep	Very deep	Very deep	Very deep	
Soil water storage	Low	Low	Moderately low	Moderately low	Moderately low	Moderately low	
Subsurface acidification	Moderate	High	Moderate	Moderate	Presently acid	High	
Subsurface compaction	High	High	High	High	High	High	
Surface organic carbon	Low	Low	Low	Low	Low	Low	
Surface soil structure decline	Low	Moderate	High	Low	Low	Low	
Water repellence	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	

Land use considerations

- Good physical characteristics for plant growth (e.g. horticulture)
- The sandy topsoils can be susceptible to wind erosion

Yellow sandy earth

Soil Group 464

Yellow sand grading to loam by 80 cm

Characteristics

- Yellow to within 30 cm
- Neutral to acid pH
- Gravels (mainly ironstone) may be present
- May be clayey at depth
- Usually massive or poorly structured
- Usually porous (sometimes called earthy fabric)

Local names

- Tamar soil
- Good sandplain soil

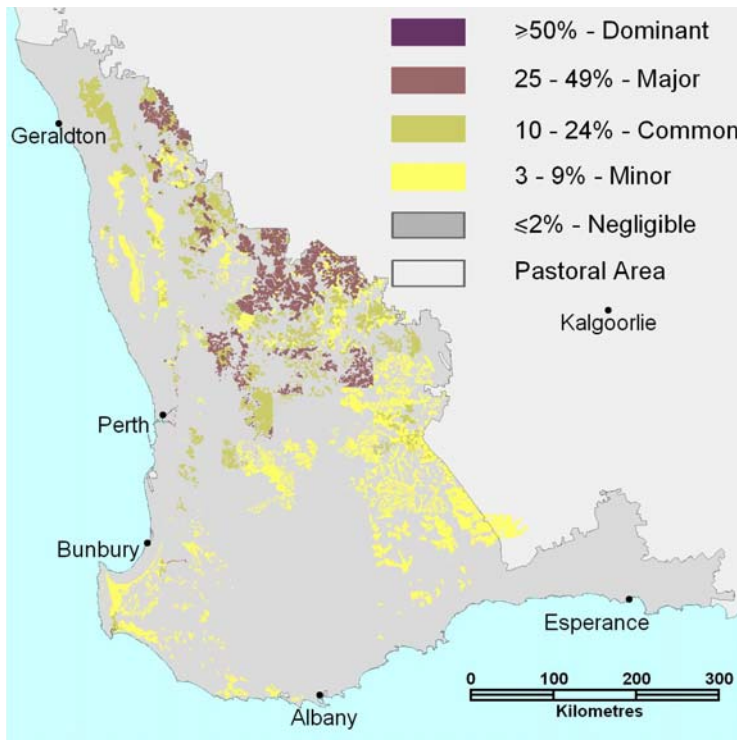
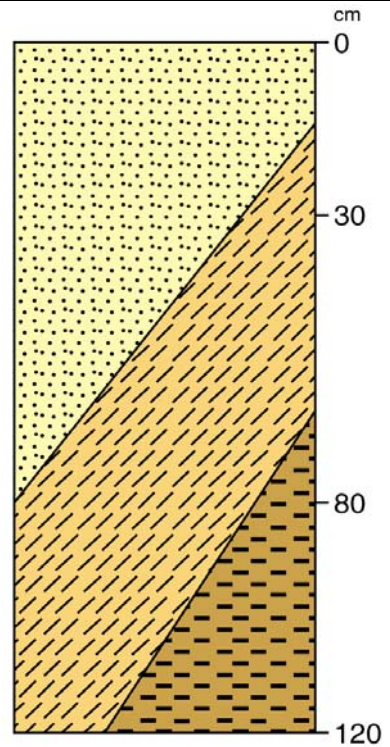
Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

- *Yellow Kandosol*
- Orthic Tenosol

Main occurrences in Western Australia

- Widespread on sandy uplands in the South-west (central, eastern and northern wheatbelt)
- Scattered throughout the southern rangelands (Murchison and Goldfields)



Distribution map of Yellow sandy earth in the South-west of WA



Yellow sandy earth (Bencubbin)

Available qualifiers of Yellow sandy earth (in order from most to least restrictive)

- SSS saline subsoil
- RKM rock substrate
- PSS poor subsoil
- ALK good alkaline subsoil
- ACD good acid subsoil
- NEU good neutral subsoil

Soil attributes of Yellow sandy earth (dominant values)

		QUALIFIER					
		SSS	RKM	PSS	ALK	ACD	NEU
ATTRIBUTE	Inherent fertility	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
	Permeability 0-50 cm	Moderately rapid	Moderately rapid	Moderately rapid	Moderately rapid	Moderately rapid	Moderately rapid
	pH at 0-10 cm	Moderately acid	Moderately acid	Moderately acid	Neutral	Strongly acid	Moderately acid
	pH at 50-80 cm	Slightly acid	Slightly acid	Slightly acid	Neutral	Very strongly acid	Slightly acid
	Profile stones and gravels	Few	Many	Few	Few	Few	Few
	Rooting depth	Very deep	Moderate	Deep	Very deep	Very deep	Very deep
	Soil water storage	Moderately low	Low	Moderately low	Moderately low	Moderately low	Moderately low
	Subsurface acidification	Moderate	Moderate	Moderate	Low	Presently acid	Moderate
	Subsurface compaction	High	High	High	High	High	High
	Surface organic carbon	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
	Surface soil structure decline	Low	Moderate	High	Low	Low	Low
	Water repellence	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate

Land use considerations

- Good physical characteristics for plant growth (e.g. horticulture)
- May be prone to subsurface acidification

Pale sandy earth

Soil Group 465

Pale sand grading to loam by 80 cm

Characteristics

- White, grey or Munsell value of 7 or greater (pale yellow) within top 30 cm
- Neutral to acid pH
- Gravels (mainly ironstone) may be present
- May be clayey at depth
- Usually massive or poorly structured
- Usually porous (sometimes called earthy fabric)

Local names

- Busselton sand

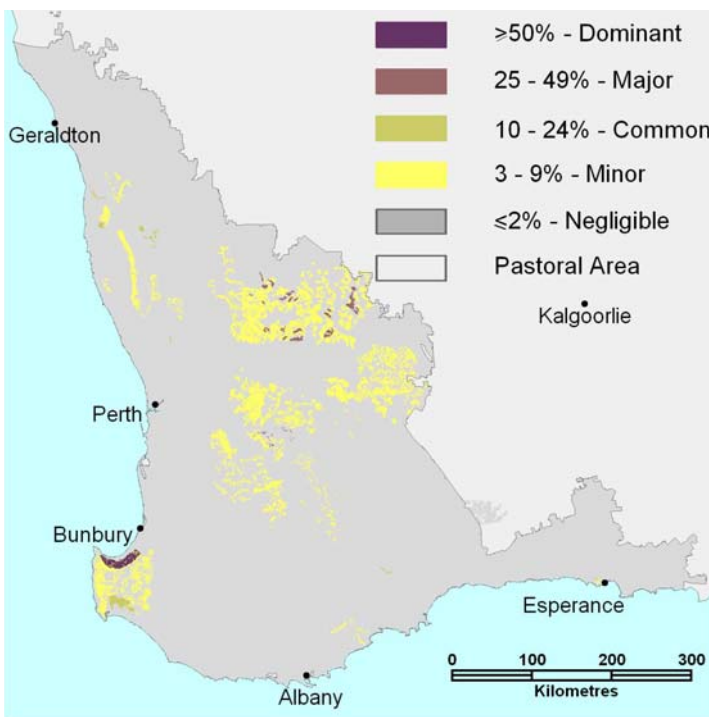
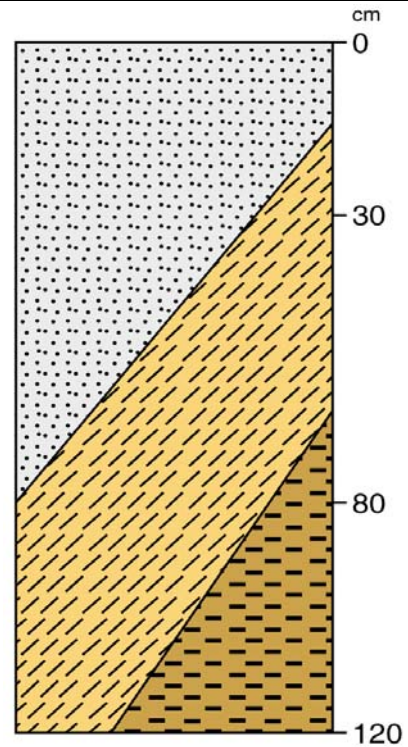
Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

- *Grey Kandosol*
- Bleached-Orthic Tenosol

Main occurrences in Western Australia

- Scattered through the South-west and the Kimberley



Distribution map of Pale sandy earth in the South-west of WA



Pale sandy earth (Busselton)

Available qualifiers of Pale sandy earth (in order from most to least restrictive)

- SSS saline subsoil
- RKM rock substrate
- PSS poor subsoil
- ALK good alkaline subsoil
- ACD good acid subsoil
- NEU good neutral subsoil

Soil attributes of Pale sandy earth (dominant values)

	QUALIFIER						
	SSS	RKM	PSS	ALK	ACD	NEU	
Inherent fertility	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	
Permeability 0-50 cm	Moderately rapid	Moderately rapid	Moderately rapid	Moderately rapid	Moderately rapid	Moderately rapid	
pH at 0-10 cm	Slightly acid	Moderately acid	Moderately acid	Neutral	Strongly acid	Moderately acid	
pH at 50-80 cm	Neutral	Neutral	Neutral	Neutral	Strongly acid	Moderately acid	
Profile stones and gravels	Few	Many	Few	Few	Few	Few	
Rooting depth	Very deep	Moderate	Deep	Very deep	Very deep	Very deep	
Soil water storage	Moderately low	Low	Moderately low	Moderately low	Moderately low	Moderately low	
Subsurface acidification	Low	Low	Low	Low	Presently acid	Presently acid	
Subsurface compaction	High	High	High	High	High	High	
Surface organic carbon	High	High	High	High	High	High	
Surface soil structure decline	Low	Moderate	Moderate	Low	Low	Low	
Water repellence	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	

Land use considerations

- Good physical characteristics for plant growth (e.g. horticulture)
- May be prone to subsurface acidification

Acid shallow duplex

Soil Group 501

Loam or sand over strongly acid clay at <30 cm

Characteristics

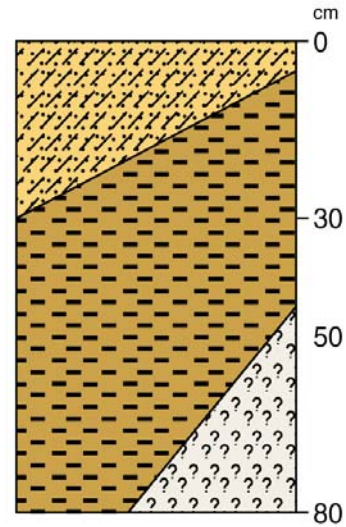
- Thin loam or occasionally loamy sand over pink, grey or brown clay
- Strongly acid pH in subsoil
- Often sodic
- Commonly below breakaways

Local names

- Pink clay
- Mallet soil
- Grey mallee clay

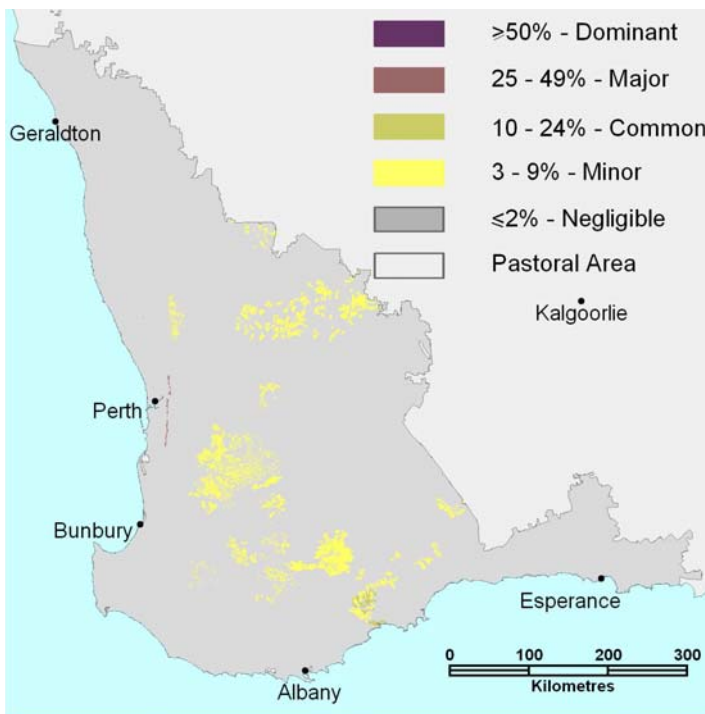
Typical Australian Soil Classification (ASC)
(dominant ASC in italics)

- *Red, Yellow, Grey, or Brown Kurosol*



Main occurrences in Western Australia

- Minor areas below breakaways in the South-west (mainly the wheatbelt)
- Scattered in the Goldfields



Distribution map of Acid shallow duplex in the South-west of WA



Acid shallow duplex (Kojonup)

Available qualifiers of Acid shallow duplex (in order from most to least restrictive)

- SSS saline subsoil
- RKM rock substrate
- PSS poor subsoil
- ACD good acid subsoil

Soil attributes of Acid shallow duplex (dominant values)

		QUALIFIER			
		SSS	RKM	PSS	ACD
ATTRIBUTE	Inherent fertility	Moderate	Moderate	Moderate	Moderate
	Permeability 0-50 cm	Slow	Slow	Slow	Moderately slow
	pH at 0-10 cm	Slightly acid	Strongly acid	Strongly acid	Strongly acid
	pH at 50-80 cm	Very strongly acid	Very strongly acid	Strongly acid	Moderately acid
	Profile stones and gravels	Few	Few	Few	Few
	Rooting depth	Moderately shallow	Moderately shallow	Moderately shallow	Very deep
	Soil water storage	Very low	Very low	Very low	Moderate
	Subsurface acidification	Presently acid	Presently acid	Presently acid	Presently acid
	Subsurface compaction	Low	Low	Low	High
	Surface organic carbon	High	High	High	High
	Surface soil structure decline	High	High	High	Moderate
	Water repellence	High	Moderate	High	Moderate

Land use considerations

- Very poor soils for agricultural purposes
- Surface has a tendency to set hard and can also be water repellent
- Root growth is restricted in the subsurface and subsoil by salinity, sodicity and acidity

Alkaline grey shallow loamy duplex

Soil Group 502

Grey loam over alkaline clay at <30 cm

Characteristics

- Grey or brown topsoil
- Usually calcareous subsoil
- Alkaline pH subsoil
- Hard setting surface

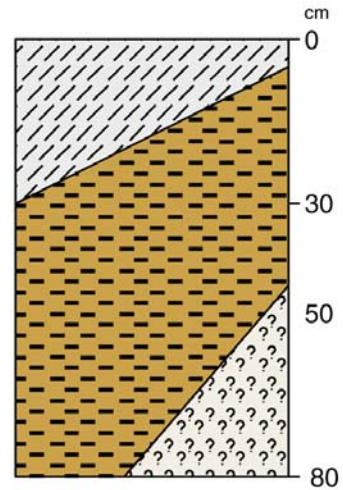
Local names

- Moort soil
- Grey clay

Typical Australian Soil Classification (ASC)

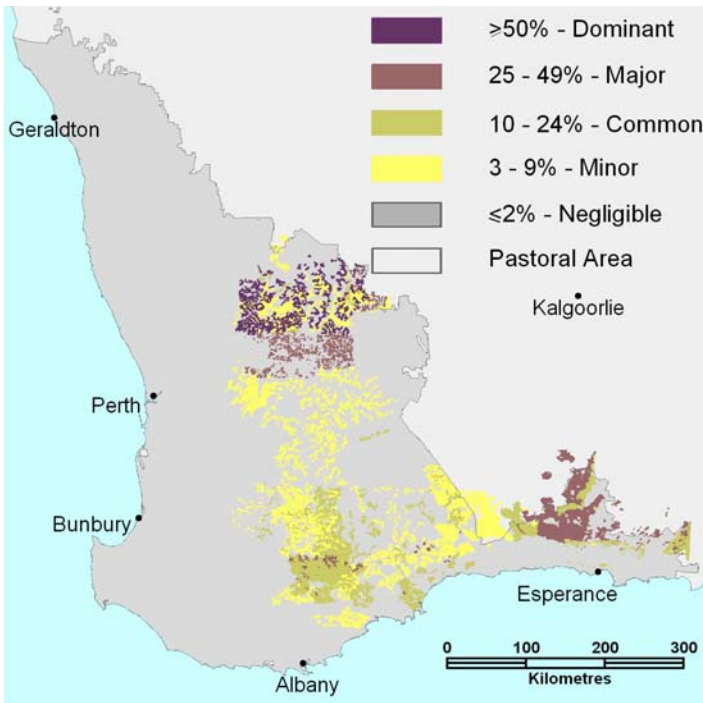
(dominant ASC in italics)

- *Calcic Grey Sodosol*
- Calcic Grey Chromosol

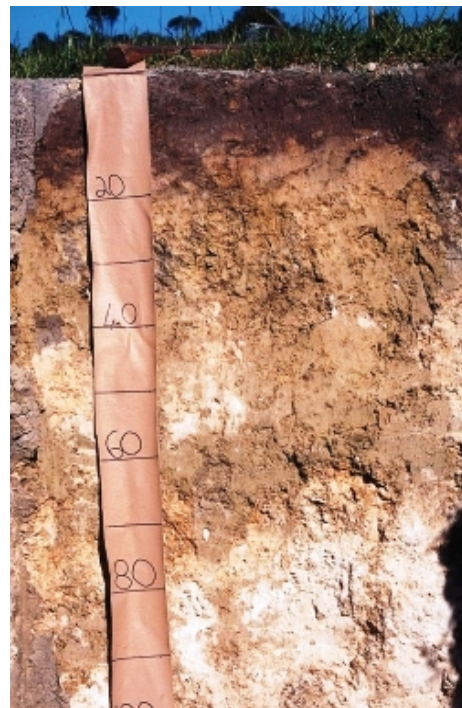


Main occurrences in Western Australia

- Great southern region
- Eastern wheatbelt and mallee country
- North-west of Esperance/Ravensthorpe



Distribution map of Alkaline grey shallow loamy duplex in the South-west of WA



Alkaline grey shallow loamy duplex (Salmon Gums)

Available qualifiers of Alkaline grey shallow loamy duplex (in order from most to least restrictive)

- SSS saline subsoil
- RKM rock substrate
- PSS poor subsoil
- ALK good alkaline subsoil

Soil attributes of Alkaline grey shallow loamy duplex (dominant values)

		QUALIFIER			
		SSS	RKM	PSS	ALK
ATTRIBUTE	Inherent fertility	Moderate	Moderate	Moderate	Moderate
	Permeability 0-50 cm	Slow	Moderately slow	Slow	Moderately slow
	pH at 0-10 cm	Neutral	Neutral	Slightly acid	Neutral
	pH at 50-80 cm	Moderately alkaline	Moderately alkaline	Moderately alkaline	Moderately alkaline
	Profile stones and gravels	Few	Few	Few	Few
	Rooting depth	Moderately shallow	Moderate	Moderately shallow	Very deep
	Soil water storage	Very low	Moderately low	Very low	Moderate
	Subsurface acidification	Low	Low	Low	Low
	Subsurface compaction	Low	Low	Low	Low
	Surface organic carbon	High	High	High	High
	Surface soil structure decline	Moderate	High	High	High
	Water repellence	Nil	Nil	Nil	Nil

Land use considerations

- Undesirable to mix subsoil which is sodic and alkaline with topsoil when cultivating
- Hard setting surfaces are common
- Plant available water capacity are very low to moderately low

Alkaline red shallow loamy duplex

Soil Group 503

Red loam over alkaline clay at <30 cm

Characteristics

- Red topsoil
- Alkaline pH subsoil
- Usually calcareous subsoil
- Often hard setting surface

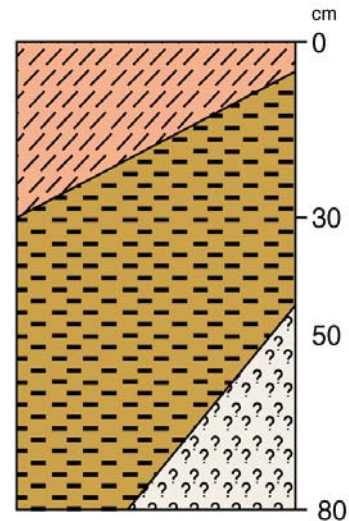
Local names

- Salmon gum soil
- York gum soil
- Red brown earth

Typical Australian Soil Classification (ASC)

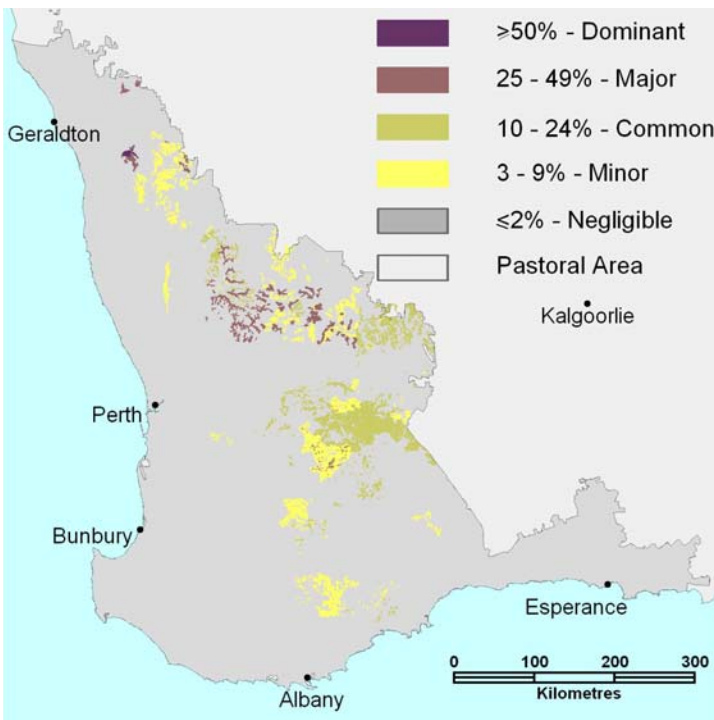
(dominant ASC in italics)

- *Calcic Red Sodosol*
- Calcic Red Chromosol

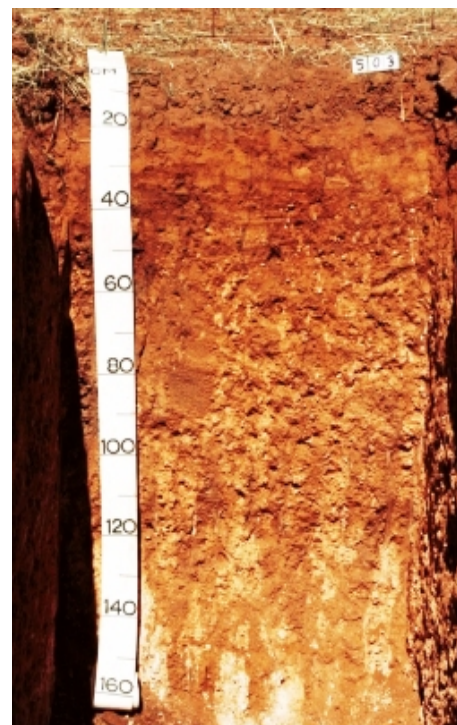


Main occurrences in Western Australia

- Common in the South-west in the eastern and northern wheatbelt
- Scattered in areas of rejuvenated drainage
- Minor in the Gnowangerup to Jerramungup areas



Distribution map of Alkaline red shallow loamy duplex in the South-west of WA



Alkaline red shallow loamy duplex (Dalwallinu)

Available qualifiers of Alkaline red shallow loamy duplex (in order from most to least restrictive)

- SSS saline subsoil
- RKM rock substrate
- PSS poor subsoil
- ALK good alkaline subsoil

Soil attributes of Alkaline red shallow loamy duplex (dominant values)

		QUALIFIER			
		SSS	RKM	PSS	ALK
ATTRIBUTE	Inherent fertility	High	High	High	High
	Permeability 0-50 cm	Very slow	Slow	Very slow	Slow
	pH at 0-10 cm	Neutral	Neutral	Neutral	Neutral
	pH at 50-80 cm	Moderately alkaline	Moderately alkaline	Moderately alkaline	Moderately alkaline
	Profile stones and gravels	Few	Few	Few	Few
	Rooting depth	Moderately shallow	Moderate	Moderately shallow	Very deep
	Soil water storage	Very low	Low	Very low	Moderate
	Subsurface acidification	Low	Low	Low	Low
	Subsurface compaction	Low	Low	Low	Low
	Surface organic carbon	High	High	High	High
	Surface soil structure decline	Moderate	High	High	High
Water repellence	Nil	Nil	Nil	Nil	

Land use considerations

- The surface is prone to hard setting and may very hard when dry
- Plant available water capacity are very low to moderate

Grey shallow loamy duplex

Soil Group 504

Grey loam over non-alkaline clay at <30 cm

Characteristics

- Grey topsoil
- Neutral pH
- Firm to hard setting surface
- Non-alkaline clay subsoil

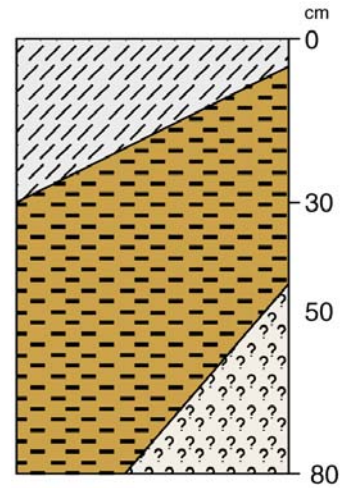
Local names

- Grey clay
- Moort loam/clay

Typical Australian Soil Classification (ASC)

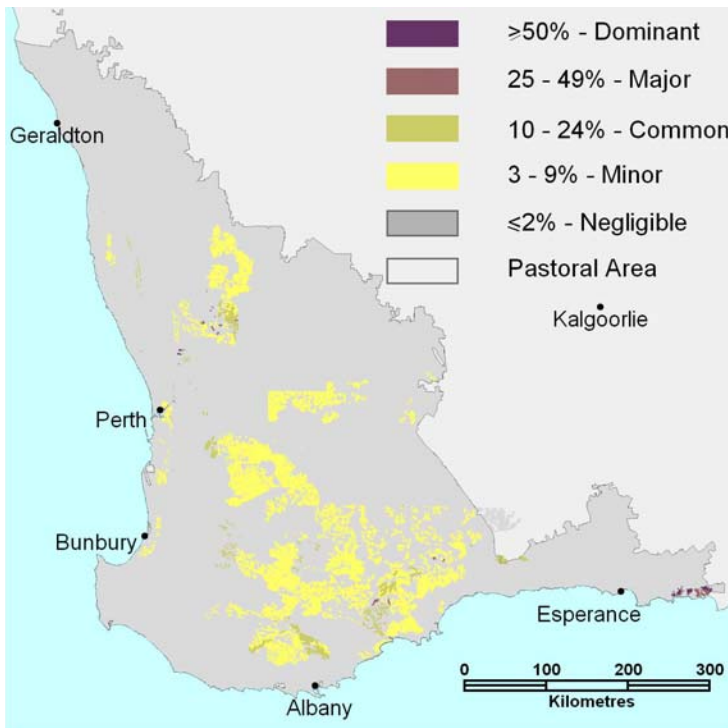
(dominant ASC in italics)

- *Grey or Yellow Chromosol*
- *Grey or Yellow Sodosol*

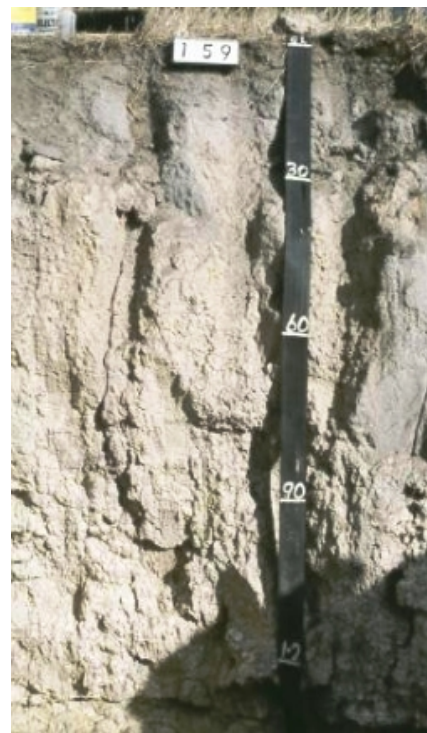


Main occurrences in Western Australia

- Widespread throughout the South-west, and parts of the Kimberley
- Scattered in the Swan Coastal Plain



Distribution map of Grey shallow loamy duplex in the South-west of WA



Grey shallow loamy duplex (Katanning)

Available qualifiers of Grey shallow loamy duplex (in order from most to least restrictive)

- SSS saline subsoil
- RKM rock substrate
- PSS poor subsoil
- NEU good neutral subsoil

Soil attributes of Grey shallow loamy duplex (dominant values)

		QUALIFIER			
		SSS	RKM	PSS	NEU
ATTRIBUTE	Inherent fertility	High	High	Very high	Very high
	Permeability 0-50 cm	Slow	Moderately slow	Slow	Moderately slow
	pH at 0-10 cm	Slightly acid	Slightly acid	Slightly acid	Slightly acid
	pH at 50-80 cm	Neutral	Neutral	Neutral	Neutral
	Profile stones and gravels	Few	Very few	Few	Few
	Rooting depth	Moderately shallow	Moderate	Moderately shallow	Very deep
	Soil water storage	Very low	Moderately low	Very low	Moderate
	Subsurface acidification	Low	Moderate	Low	Moderate
	Subsurface compaction	Low	Low	Low	Low
	Surface organic carbon	High	High	High	High
	Surface soil structure decline	Moderate	High	High	High
	Water repellence	Nil	Nil	Nil	Nil

Land use considerations

- The hard setting surface are common and may respond to gypsum
- Plant available water capacity are very low to moderate

Brown deep loamy duplex

Soil Group 505

Brown loam over clay at 30-80 cm

Characteristics

- Brown the dominant colour of the surface layer/s
- Surface may be grey or black
- Neutral pH
- Firm to hard setting surface
- Non-alkaline clay subsoil
- Non-sodic subsoil more common than sodic

Local names

- Deep yate loam

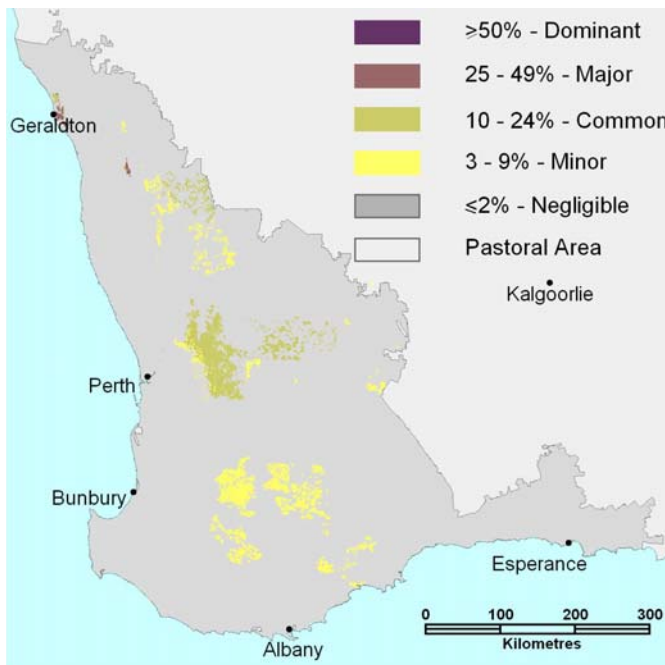
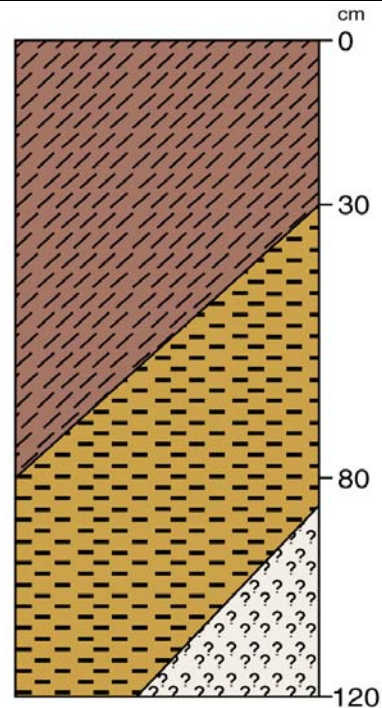
Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

- *Yellow or Brown Chromosol*
- Yellow or Brown Sodosol

Main occurrences in Western Australia

- Scattered throughout the state, especially in alluvial situations in the South-west



Distribution map of Brown deep loamy duplex in the South-west of WA



Brown deep loamy duplex (Dalwallinu)

Available qualifiers of Brown deep loamy duplex (in order from most to least restrictive)

- SSS saline subsoil
- RKM rock substrate
- PSS poor subsoil
- ALK good alkaline subsoil
- ACD good acid subsoil
- NEU good neutral subsoil

Soil attributes of Brown deep loamy duplex (dominant values)

		QUALIFIER					
		SSS	RKM	PSS	ALK	ACD	NEU
ATTRIBUTE	Inherent fertility	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
	Permeability 0-50 cm	Moderately rapid	Moderately rapid	Moderately rapid	Moderately rapid	Moderately rapid	Moderately rapid
	pH at 0-10 cm	Moderately acid	Slightly acid	Moderately acid	Slightly acid	Slightly acid	Slightly acid
	pH at 50-80 cm	Slightly acid	Slightly acid	Slightly acid	Neutral	Moderately acid	Slightly acid
	Profile stones and gravels	Few	Few	Few	Few	Few	Common
	Rooting depth	Deep	Moderate	Deep	Very deep	Very deep	Very deep
	Soil water storage	Moderate	Moderately low	Moderately low	High	High	High
	Subsurface acidification	Low	Low	Low	Low	High	Low
	Subsurface compaction	High	High	High	High	High	High
	Surface organic carbon	High	High	High	High	High	High
	Surface soil structure decline	Moderate	Moderate	High	Moderate	Moderate	Moderate
	Water repellence	Nil	Nil	Nil	Nil	Nil	Nil

Land use considerations

- A valuable soil for agricultural purposes
- Plant available water capacity are high to moderately low

Red deep loamy duplex

Soil Group 506

Red loam over clay at 30-80 cm

Characteristics

- Red or brown topsoil, red within 30 cm
- Neutral to alkaline pH subsoil
- Subsoil may be calcareous
- Firm to hard setting surface

Local names

- Deep yate loam
- York gum soil

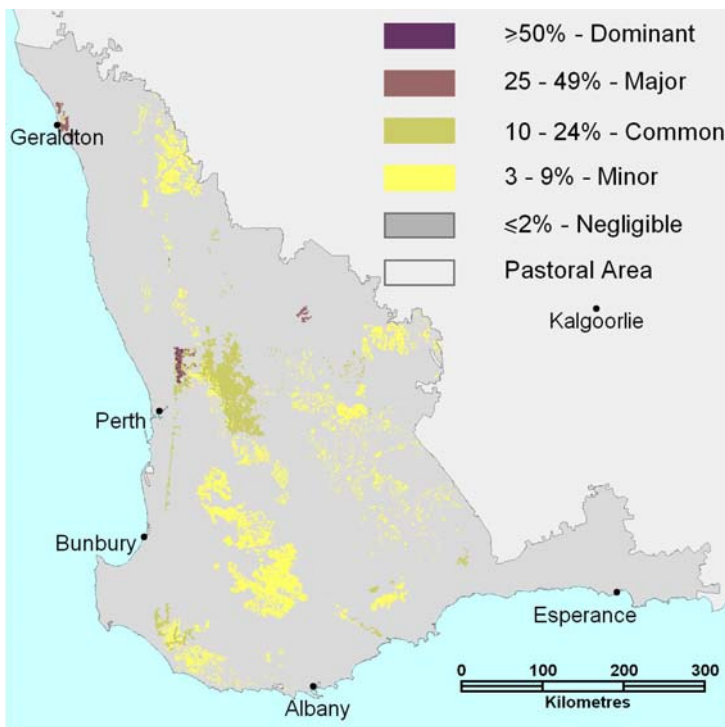
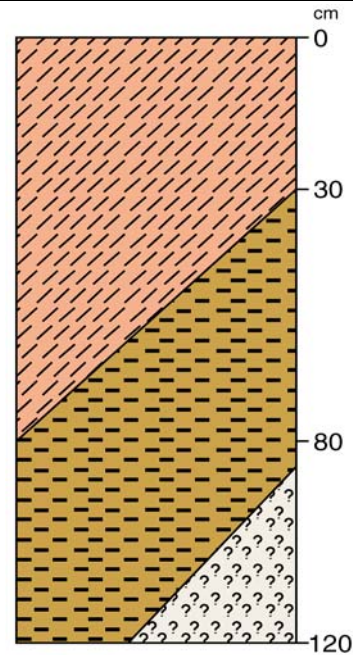
Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

- *Red Chromosol*
- Red Sodosol

Main occurrences in Western Australia

- Scattered throughout the southern rangelands
- Common in the Pilbara and Goldfields but rarely dominant
- Minor in South-west



Distribution map of Red deep loamy duplex in the South-west of WA



Red deep loamy duplex (Narrogin)

Available qualifiers of Red deep loamy duplex (in order from most to least restrictive)

- SSS saline subsoil
- RKM rock substrate
- PSS poor subsoil
- ALK good alkaline subsoil
- ACD good acid subsoil
- NEU good neutral subsoil

Soil attributes of Red deep loamy duplex (dominant values)

	QUALIFIER						
	SSS	RKM	PSS	ALK	ACD	NEU	
Inherent fertility	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	
Permeability 0-50 cm	Moderate	Moderate	Moderately rapid	Moderate	Moderate	Moderately rapid	
pH at 0-10 cm	Slightly acid	Slightly acid	Moderately acid	Slightly acid	Slightly acid	Slightly acid	
pH at 50-80 cm	Slightly acid	Slightly acid	Slightly acid	Neutral	Moderately acid	Slightly acid	
Profile stones and gravels	Few	Few	Few	Few	Common	Common	
Rooting depth	Deep	Moderate	Deep	Very deep	Very deep	Very deep	
Soil water storage	Moderate	Moderately low	Moderately low	High	High	Moderate	
Subsurface acidification	Low	Low	Low	Low	High	Low	
Subsurface compaction	Moderate	Moderate	High	Moderate	Moderate	High	
Surface organic carbon	High	High	High	High	High	High	
Surface soil structure decline	Moderate	Moderate	High	Moderate	Moderate	Moderate	
Water repellence	Nil	Nil	Nil	Nil	Nil	Nil	

Land use considerations

- A generally fertile soil for agricultural purposes
- Plant available water capacity are high to moderately low

Red shallow loamy duplex

Soil Group 507

Red loam over non-calcareous clay at <30 cm

Characteristics

- Red within top 30 cm
- Neutral pH subsoil
- Firm to hard setting surface

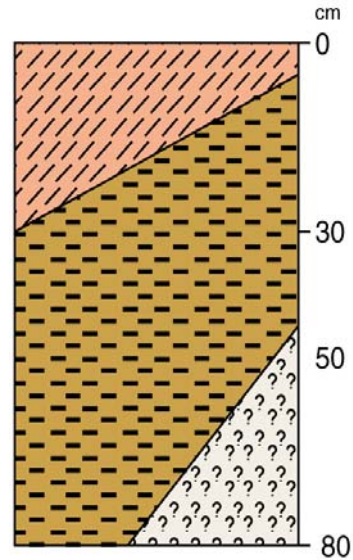
Local names

- Jam soil
- York gum soil
- Chapman valley loam
- Avon valley loam
- Red soil

Typical Australian Soil Classification (ASC)

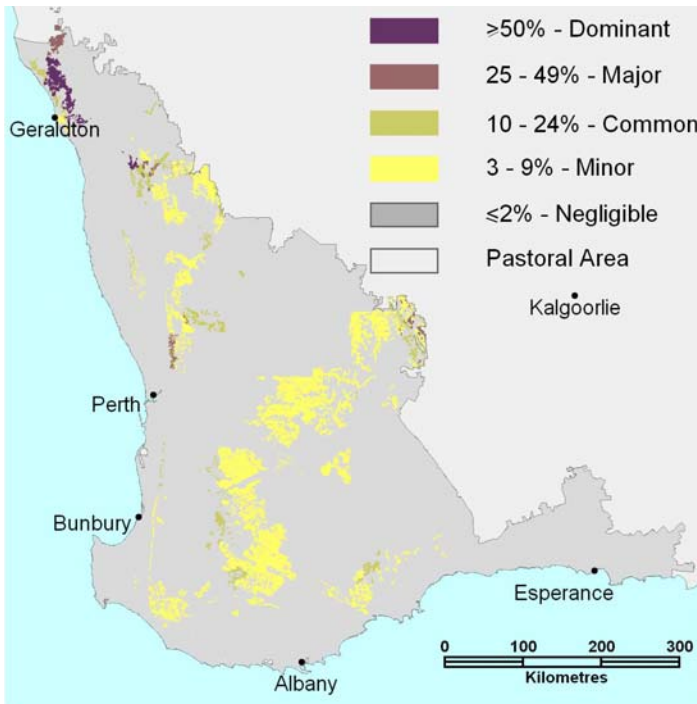
(dominant ASC in italics)

- *Red Chromosol*
- Red Sodosol
- Red Dermosol

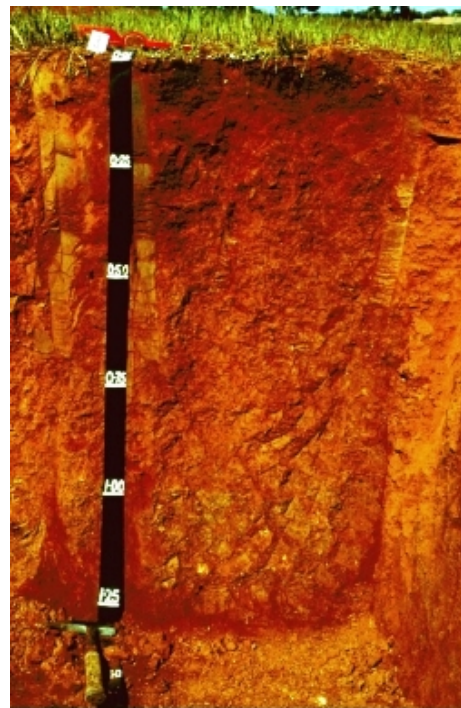


Main occurrences in Western Australia

- Widespread, but rarely common, in areas of rejuvenated drainage on granite, between Moora and Bridgetown
- Scattered throughout the wheatbelt



Distribution map of Red shallow loamy duplex in the South-west of WA



Red shallow loamy duplex (Three Springs)

Available qualifiers of Red shallow loamy duplex (in order from most to least restrictive)

- SSS saline subsoil
- RKM rock substrate
- PSS poor subsoil
- ALK good alkaline subsoil
- NEU good neutral subsoil

Soil attributes of Red shallow loamy duplex (dominant values)

		QUALIFIER				
		SSS	RKM	PSS	ALK	NEU
ATTRIBUTE	Inherent fertility	Moderate	Moderate	Moderate	Moderate	Moderate
	Permeability 0-50 cm	Slow	Moderately slow	Slow	Moderately slow	Moderately slow
	pH at 0-10 cm	Slightly acid	Slightly acid	Slightly acid	Neutral	Moderately acid
	pH at 50-80 cm	Neutral	Neutral	Neutral	Moderately alkaline	Neutral
	Profile stones and gravels	Common	Few	Common	Common	Common
	Rooting depth	Moderately shallow	Moderate	Moderately shallow	Very deep	Very deep
	Soil water storage	Very low	Low	Very low	Moderate	Moderate
	Subsurface acidification	Low	Moderate	Low	Low	Moderate
	Subsurface compaction	Low	Low	Low	Low	Low
	Surface organic carbon	High	High	High	High	High
	Surface soil structure decline	High	High	High	High	Moderate
	Water repellence	Nil	Nil	Nil	Nil	Nil

Land use considerations

- A generally fertile soil that needs to be managed carefully to prevent water erosion
- Plant available water capacity are moderate to very low

Yellow/brown shallow loamy duplex

Soil Group 508

Yellow/brown loam over clay at <30 cm

Characteristics

- Yellow or brown topsoil
- Neutral pH subsoil common, although rarely acid or alkaline
- Firm to hard setting surface

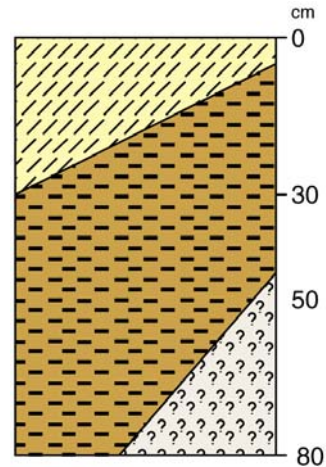
Local names

- Mallee duplex

Typical Australian Soil Classification (ASC)

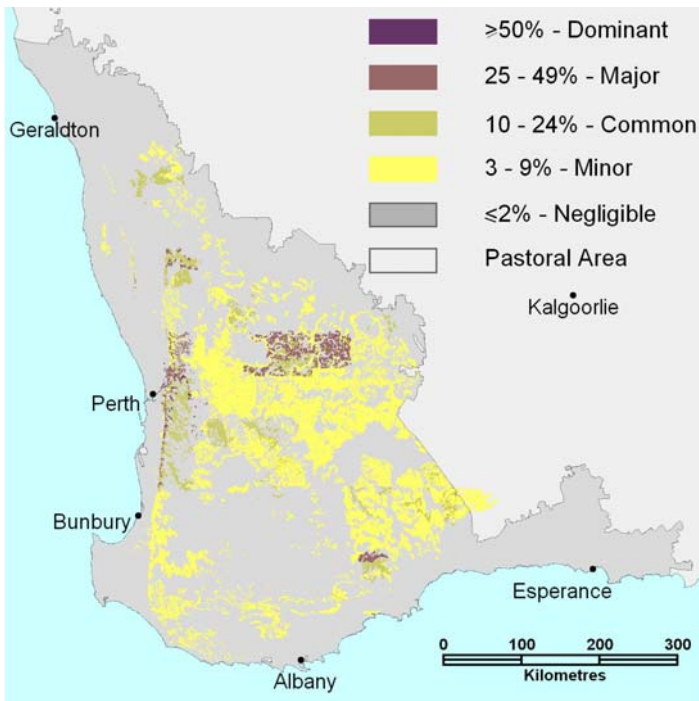
(dominant ASC in italics)

- *Yellow or Brown Chromosol*
- Yellow or Brown Sodosol



Main occurrences in Western Australia

- Widespread throughout the South-west and parts of the Kimberley
- Scattered in the wheatbelt



Distribution map of Yellow/brown shallow loamy duplex in the South-west of WA



Yellow/brown shallow loamy duplex (Donnybrook)

Available qualifiers of Yellow/brown shallow loamy duplex (in order from most to least restrictive)

- SSS saline subsoil
- RKM rock substrate
- PSS poor subsoil
- ACD good acid subsoil
- ALK good alkaline subsoil
- NEU good neutral subsoil

Soil attributes of Yellow/brown shallow loamy duplex (dominant values)

	QUALIFIER					
	SSS	RKM	PSS	ACD	ALK	NEU
Inherent fertility	High	Moderate	Moderate	High	High	High
Permeability 0-50 cm	Slow	Moderately slow	Slow	Moderately slow	Moderately slow	Moderately slow
pH at 0-10 cm	Slightly acid	Slightly acid	Slightly acid	Strongly acid	Slightly acid	Slightly acid
pH at 50-80 cm	Neutral	Neutral	Neutral	Moderately acid	Moderately alkaline	Neutral
Profile stones and gravels	Common	Few	Common	Common	Common	Common
Rooting depth	Moderately shallow	Moderate	Moderately shallow	Very deep	Very deep	Very deep
Soil water storage	Very low	Low	Very low	Moderate	Moderate	Moderate
Subsurface acidification	Low	Low	Low	High	Low	Moderate
Subsurface compaction	Low	Low	Low	Low	Low	Low
Surface organic carbon	High	High	High	High	High	High
Surface soil structure decline	Moderate	Moderate	High	Moderate	High	Moderate
Water repellence	Nil	Nil	Nil	Nil	Nil	Nil

Land use considerations

- A generally fertile soil for agricultural purpose
- Wind erosion may occur and needs to be managed carefully to prevent erosion

Calcareous shallow loam

Soil Group 521

Calcareous loam over rock or hardpan at <80 cm

Characteristics

- Loamy throughout, although may grade to clay above the hard layer
- Brown, grey or red topsoil
- Calcareous throughout (or at least by 30 cm)
- Alkaline pH throughout
- Usually over limestone or calcrete

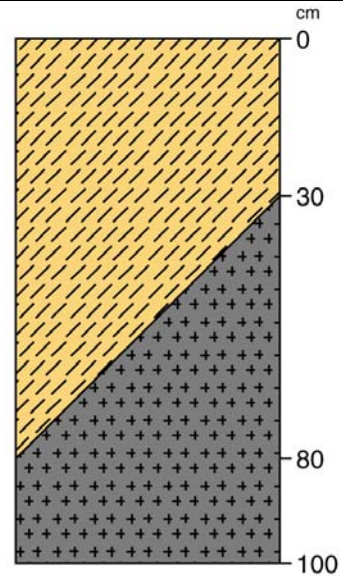
Local names

- Salmon gum-gimlet soil
- Fluffy gimlet soil
- Crabhole soil
- Beete loam
- Kopi-fluff

Typical Australian Soil Classification (ASC)

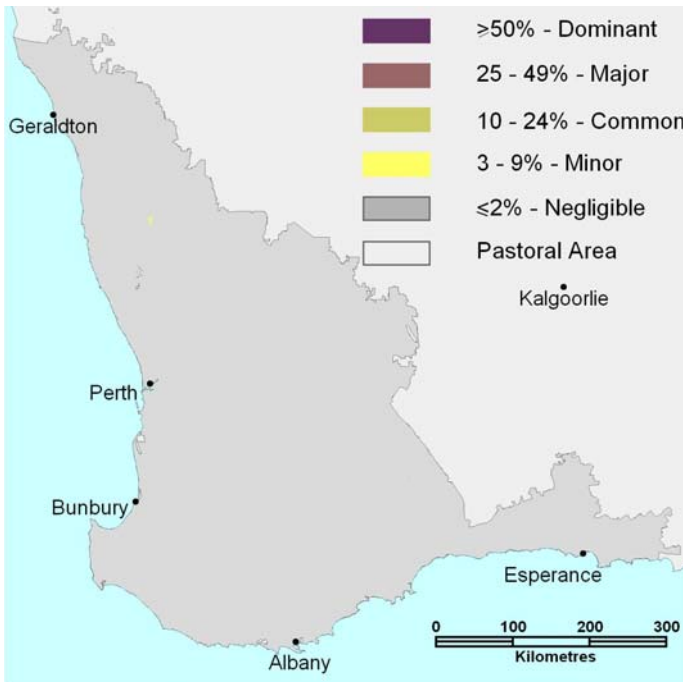
(dominant ASC in italics)

- *Paralithic or Lithic Calcic Calcarosol*



Main occurrences in Western Australia

- The dominant soil of the Nullarbor Plain
- Also in the Gascoyne at Cape Range near Exmouth
- Scattered throughout the Arid Interior and southern rangelands



Distribution map of Calcareous shallow loam in the South-west of WA



Calcareous shallow loam (Kambalda)

Available qualifiers of Calcareous shallow loam (in order from most to least restrictive)

- SAL saline
- NSA non-saline

Soil attributes of Calcareous shallow loam (dominant values)

		QUALIFIER	
		SAL	NSA
ATTRIBUTE	Inherent fertility	High	High
	Permeability 0-50 cm	Moderate	Moderate
	pH at 0-10 cm	Neutral	Neutral
	pH at 50-80 cm	Strongly alkaline	Strongly alkaline
	Profile stones and gravels	Few	Few
	Rooting depth	Moderate	Moderate
	Soil water storage	Moderately low	Moderately low
	Subsurface acidification	Low	Low
	Subsurface compaction	Moderate	Moderate
	Surface organic carbon	High	High
	Surface soil structure decline	Moderate	High
	Water repellence	Nil	Nil

Land use considerations

- High pH may limit the growth of some agricultural species
- Shallow soil depth limits rooting depth and water-holding capacity

Red shallow loam

Soil Group 522

Red loam less than 80 cm deep over rock or hardpan (not red-brown)

Characteristics

- Red loam over rock, hardpan or other cemented layer by 80 cm, and often <30 cm
- A surface mantle of stones may be common
- Gravel may be present
- Usually neutral to acid pH

Local names

- Jam soil
- York gum soil

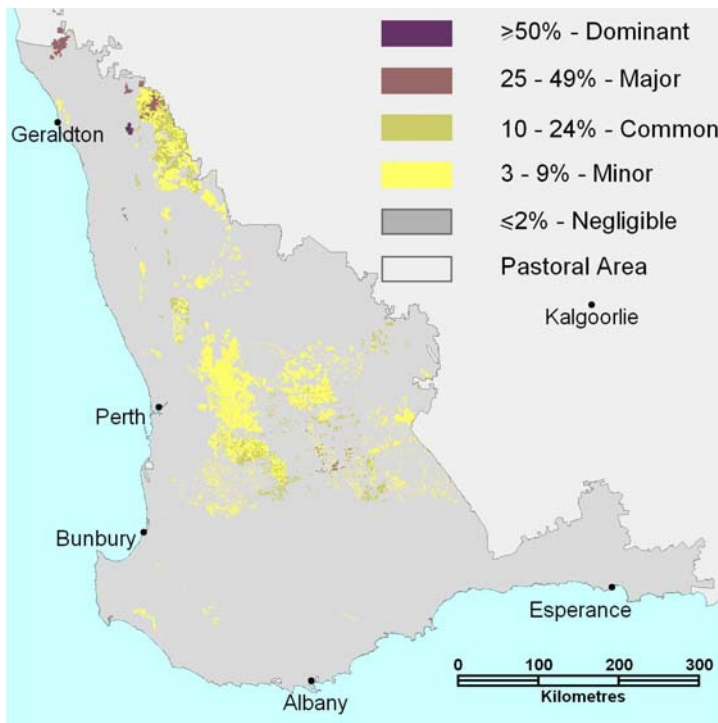
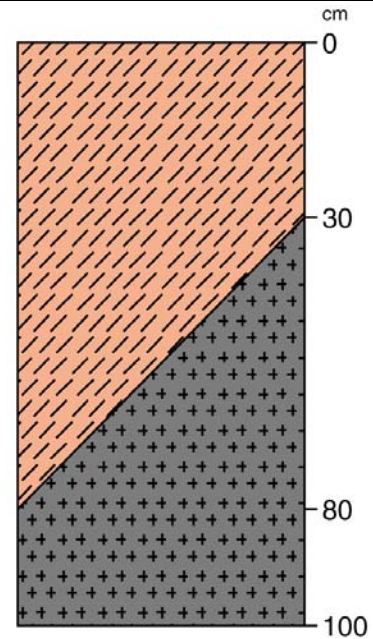
Typical Australian Soil Classification (ASC)

(dominant ASC in *italics*)

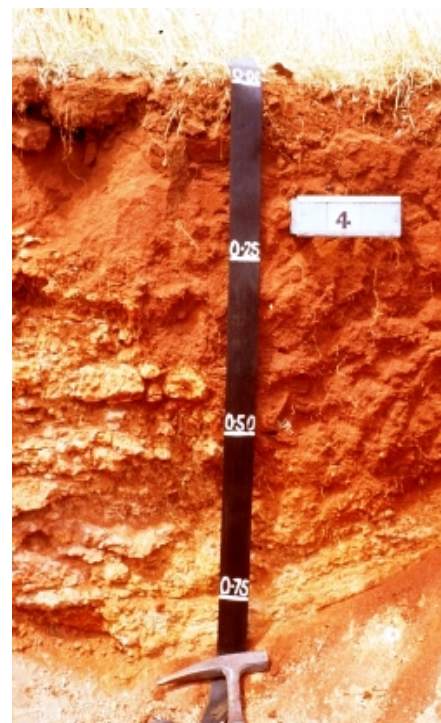
- *Red Kandosol*

Main occurrences in Western Australia

- Widespread in southern Kimberley
- Scattered throughout the Pilbara, Gascoyne, Murchison, Goldfields and South-west



Distribution map of Red shallow loam in the South-west of WA



Red shallow loam (Mullewa)

Available qualifiers of Red shallow loam (in order from most to least restrictive)

- SAL saline
- VSH very shallow rock substrate
- LMR loam, rock substrate

Soil attributes of Red shallow loam (dominant values)

		QUALIFIER		
		SAL	VSH	LMR
ATTRIBUTE	Inherent fertility	Moderate	Moderate	Moderate
	Permeability 0-50 cm	Moderate	Moderate	Moderate
	pH at 0-10 cm	Slightly acid	Slightly acid	Slightly acid
	pH at 50-80 cm	Neutral	Neutral	Neutral
	Profile stones and gravels	Few	Many	Few
	Rooting depth	Moderate	Moderate	Moderate
	Soil water storage	Moderately low	Low	Moderately low
	Subsurface acidification	Moderate	Moderate	High
	Subsurface compaction	Moderate	Moderate	Moderate
	Surface organic carbon	Low	Low	Low
	Surface soil structure decline	Moderate	Low	Moderate
	Water repellence	Nil	Nil	Nil

Land use considerations

- Shallow soil depth limits rooting depth and water-holding capacity
- Water erosion can be problem on sloping land or drainage lines

Red-brown hardpan shallow loam

Soil Group 523

Red loam over red-brown hardpan at <50 cm

Characteristics

- Red within top 30 cm
- Red-brown hardpan by 50 cm
- Often with stony surface mantle

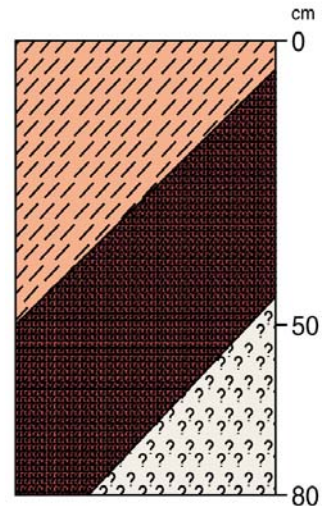
Local names

- Murchison cement loam
- Red-brown hardpan soil
- Mulga loam

Typical Australian Soil Classification (ASC)

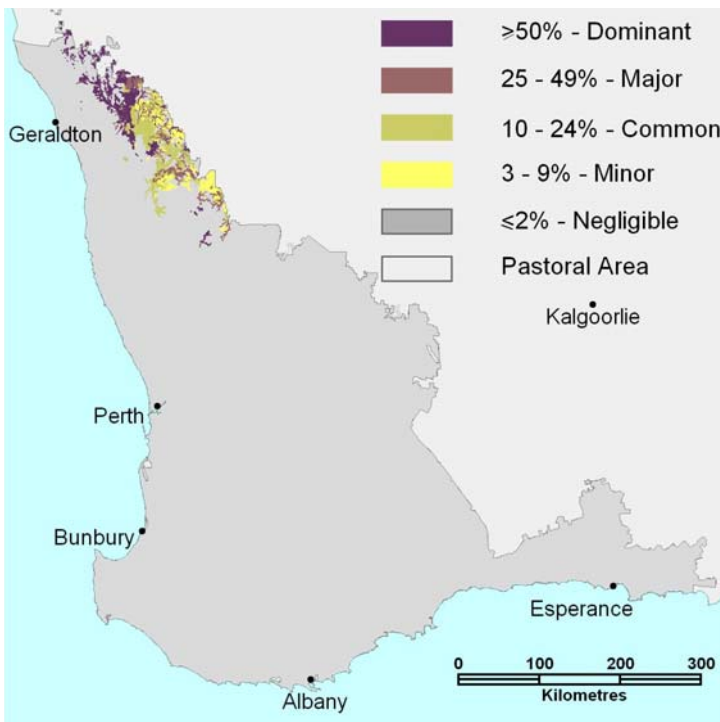
(dominant ASC in italics)

- *Duric Red Kandosol*



Main occurrences in Western Australia

- Very common in the southern rangelands (Murchison, Gascoyne and Goldfields) and northern areas of the South-west
- Stretching from Mullewa to the Pilbara and eastwards to the northern Goldfields and the edge of the Arid Interior



Distribution map of Red-brown hardpan shallow loam in the South-west of WA



Red-brown hardpan shallow loam (Murchison)

Available qualifiers of Red-brown hardpan shallow loam (in order from most to least restrictive)

- SSS saline subsoil
- LVR loam, very shallow rock substrate
- LMR loam, rock substrate

Soil attributes of Red-brown hardpan shallow loam (dominant values)

		QUALIFIER		
		SSS	LVR	LMR
ATTRIBUTE	Inherent fertility	Moderate	Moderate	Moderate
	Permeability 0-50 cm	Very slow	Moderate	Very slow
	pH at 0-10 cm	Slightly acid	Neutral	Slightly acid
	pH at 50-80 cm	Neutral	Neutral	Neutral
	Profile stones and gravels	Few	Many	Few
	Rooting depth	Moderately shallow	Moderate	Moderately shallow
	Soil water storage	Low	Low	Low
	Subsurface acidification	Moderate	Low	Moderate
	Subsurface compaction	Moderate	Moderate	Moderate
	Surface organic carbon	Low	Low	Low
	Surface soil structure decline	High	High	High
	Water repellence	Nil	Nil	Nil

Land use considerations

- Shallow soil depth limits rooting depth and water-holding capacity
- Water erosion can be a problem on sloping land and drainage lines

Brown loamy earth

Soil Group 541

Brown loam (may be clayey at depth)

Characteristics

- Brown or grey topsoil
- Loam throughout, or grading to clay with depth
- Neutral to acid pH, may be calcareous at depth
- Gravels may be present in subsoil
- Phases with a grey topsoil are often mottled
- Often formed in recent alluvium

Local names

- Alluvial brown loam
- Yate loam

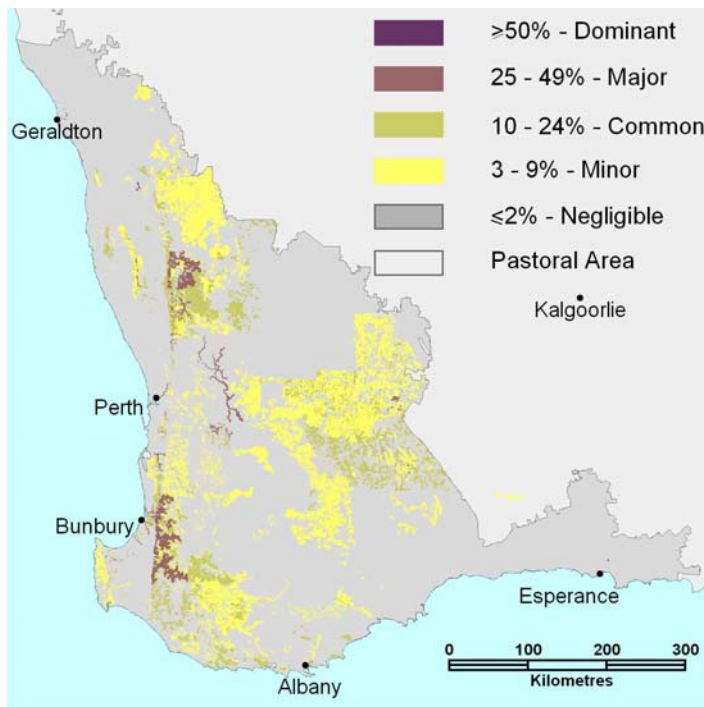
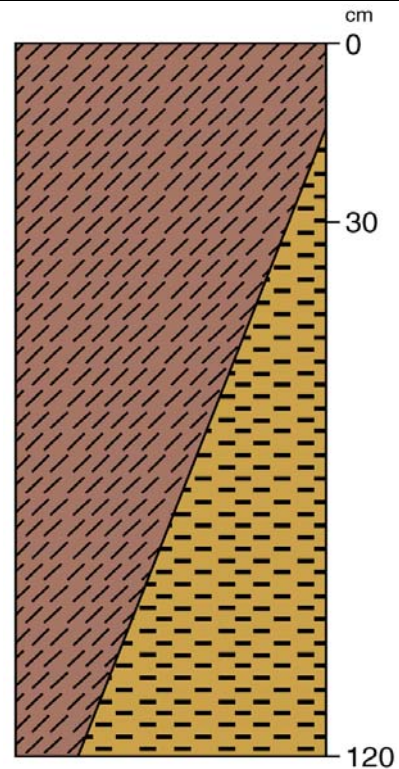
Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

- *Brown Kandosol*
- *Brown Dermosol*

Main occurrences in Western Australia

- Common on alluvial flats between Perth and Dunsborough in the South-west
- Scattered elsewhere in South-west, usually in valley floors/lower positions in landscape
- Gravelly variants may occur in the wheatbelt



Distribution map of Brown loamy earth in the South-west of WA



Brown loamy earth (Narrogin)

Available qualifiers of Brown loamy earth (in order from most to least restrictive)

- SSS saline subsoil
- RKM rock substrate
- PSS poor subsoil
- ALK good alkaline subsoil
- ACD good acid subsoil
- NEU good neutral subsoil

Soil attributes of Brown loamy earth (dominant values)

		QUALIFIER					
		SSS	RKM	PSS	ALK	ACD	NEU
ATTRIBUTE	Inherent fertility	High	Moderate	High	High	Moderate	High
	Permeability 0-50 cm	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
	pH at 0-10 cm	Moderately acid	Moderately acid	Slightly acid	Neutral	Moderately acid	Moderately acid
	pH at 50-80 cm	Neutral	Slightly acid	Slightly acid	Neutral	Moderately acid	Slightly acid
	Profile stones and gravels	Few	Abundant	Few	Few	Few	Few
	Rooting depth	Moderate	Moderate	Moderate	Very deep	Very deep	Very deep
	Soil water storage	Moderately low	Moderately low	Moderately low	Moderate	Moderate	Moderate
	Subsurface acidification	Low	Moderate	High	Low	High	High
	Subsurface compaction	High	Low	High	Moderate	Moderate	High
	Surface organic carbon	High	High	High	High	High	High
	Surface soil structure decline	Moderate	High	High	High	High	Moderate
	Water repellence	Nil	Nil	Nil	Nil	Nil	Nil

Land use considerations

- Usually a good agricultural soil and not a significant problem
- The loamy textures result in mostly moderate soil water storage

Calcareous loamy earth

Soil Group 542

Calcareous loam, may grade to calcareous clay

Characteristics

- Loam throughout, or may grade to clay
- Calcareous throughout, although may be non-calcareous in top 30 cm
- Usually red or brown topsoil but may be grey
- May have limestone or calcrete at depth
- Calcareous gravel often present in profile
- Hard setting or fluffy surface
- Sometimes saline
- Hard or soft carbonate segregations commonly occur in profile

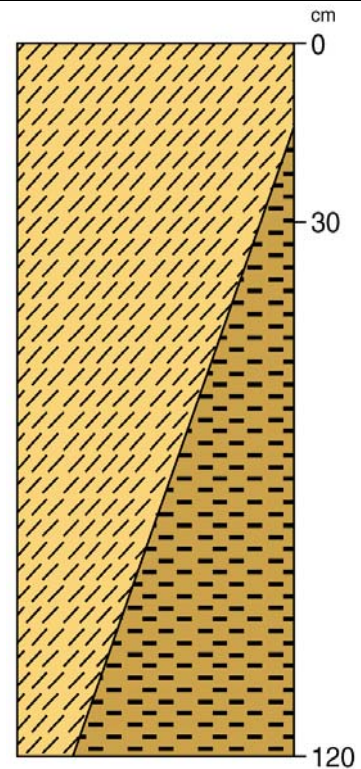
Local names

- Morrel soil
- Salmon gum-gimlet soil
- Lake bank soil
- Merredin sandy loam
- Kopi soil

Typical Australian Soil Classification (ASC)

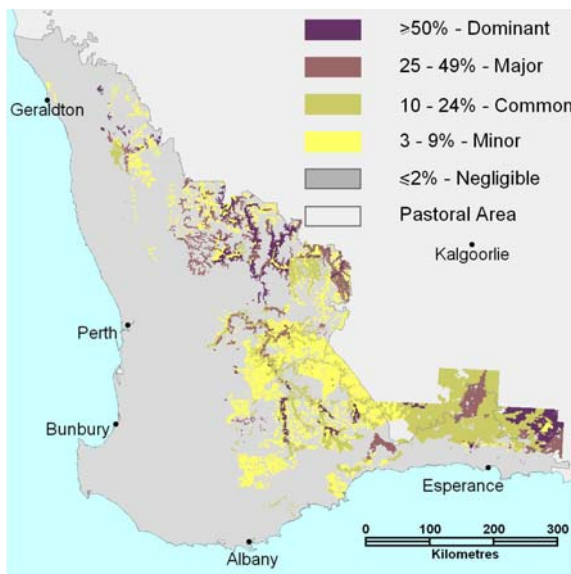
(dominant ASC in italics)

- *Calcic Calcarosol*
- Calcic Red Sodosol



Main occurrences in Western Australia

- Widespread in the western and northern Nullarbor
- Scattered in the South-west wheatbelt and the mallee country (north of Esperance)
- Minor in the Gascoyne at Cape Range near Exmouth



Distribution map of Calcareous loamy earth in the South-west of WA



Calcareous loamy earth (Mount Beaumont)

Available qualifiers of Calcareous loamy earth (in order from most to least restrictive)

- SSS saline subsoil
- RKM rock substrate
- PSS poor subsoil
- ALK good alkaline subsoil

Soil attributes of Calcareous loamy earth (dominant values)

		QUALIFIER			
		SSS	RKM	PSS	ALK
ATTRIBUTE	Inherent fertility	High	High	High	High
	Permeability 0-50 cm	Slow	Slow	Slow	Moderately slow
	pH at 0-10 cm	Moderately alkaline	Moderately alkaline	Moderately alkaline	Moderately alkaline
	pH at 50-80 cm	Moderately alkaline	Moderately alkaline	Moderately alkaline	Strongly alkaline
	Profile stones and gravels	Few	Few	Few	Few
	Rooting depth	Moderate	Moderate	Moderate	Very deep
	Soil water storage	Low	Low	Low	Moderate
	Subsurface acidification	Low	Low	Low	Low
	Subsurface compaction	Moderate	Moderate	Moderate	Moderate
	Surface organic carbon	Moderate	Moderate	Moderate	Moderate
	Surface soil structure decline	Moderate	Moderate	Moderate	Moderate
	Water repellence	Nil	Nil	Nil	Nil

Land use considerations

- High lime content may inhibit some agricultural crops
- High salinity level may be present in the subsoil

Friable red/brown loamy earth

Soil Group 543

Red/brown loam, may grade to clay, very friable and porous

Characteristics

- Red or brown within top 30 cm
- Neutral to acid pH
- Friable topsoil
- Porous throughout
- Gravel (ironstone and non-ironstone) may be present

Local names

- Karri loam
- Marybrook soil

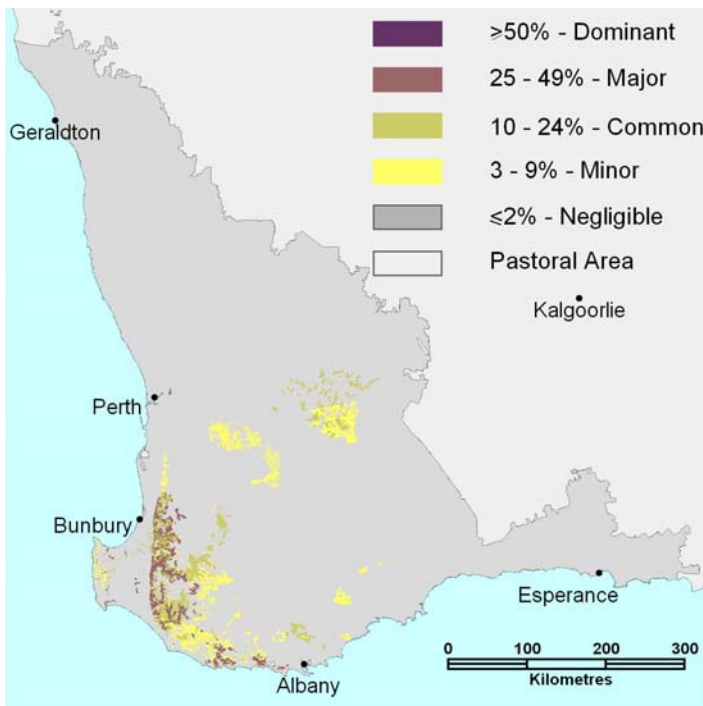
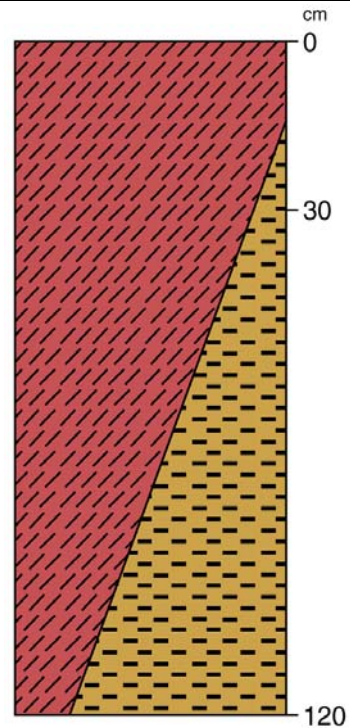
Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

- *Red or Brown Dermosol*
- *Red or Brown Kandosol*
- Red or Brown Ferrosol

Main occurrences in Western Australia

- Common in higher rainfall areas in the South-west e.g. Pemberton Karri forest
- Chittering area near Perth
- Minor in the Pilbara on basaltic parent materials



Distribution map of Friable red/brown loamy earth in the South-west of WA



Friable red/brown loamy earth (Denmark)

Available qualifiers of Friable red/brown loamy earth (in order from most to least restrictive)

- SSS Saline subsoil
- PSS poor subsoil
- ALK good alkaline subsoil
- ACD Good acid subsoil
- NEU good neutral subsoil

Soil attributes of Friable red/brown loamy earth (dominant values)

		QUALIFIER				
		SSS	PSS	ALK	ACD	NEU
ATTRIBUTE	Inherent fertility	Moderate	Moderate	Very high	Very high	Very high
	Permeability 0-50 cm	Moderate	Moderate	Moderate	Moderate	Moderate
	pH at 0-10 cm	Moderately acid	Moderately acid	Slightly acid	Moderately acid	Moderately acid
	pH at 50-80 cm	Slightly acid	Slightly acid	Neutral	Moderately acid	Slightly acid
	Profile stones and gravels	Few	Few	Few	Common	Few
	Rooting depth	Moderate	Moderate	Very deep	Very deep	Very deep
	Soil water storage	Moderate	Moderately low	Moderate	High	Moderate
	Subsurface acidification	Moderate	Moderate	Low	High	Moderate
	Subsurface compaction	Low	Moderate	Moderate	Low	Moderate
	Surface organic carbon	High	High	High	High	High
	Surface soil structure decline	Moderate	High	Moderate	Moderate	Moderate
	Water repellence	Nil	Nil	Nil	Nil	Nil

Land use considerations

- Water erosion a risk on steeper slopes
- Highly productive soil with good physical properties
- If cropped can develop a hard setting surface

Red loamy earth

Soil Group 544

Red loam, may grade to clay, may have a red-brown hardpan below 50 cm

Characteristics

- Red top 30 cm
- Usually massive or poorly structured
- Usually porous (sometimes called earthy fabric)
- Neutral to acid pH, or sometimes calcareous at depth
- Hard setting or crusting
- Sometimes with red-brown hardpan at >50 cm
- Gravels (usually non-ironstone) may be present

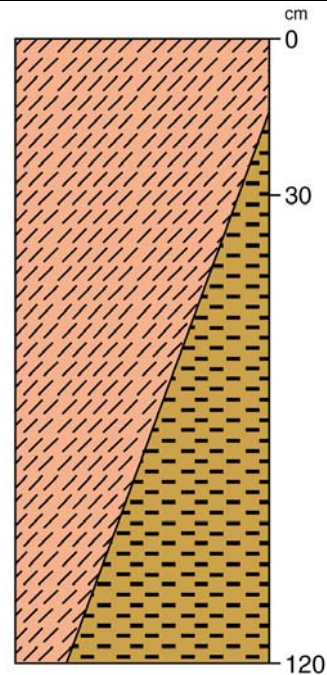
Local names

- Mulga loam
- Yate loam
- Red loam

Typical Australian Soil Classification (ASC)

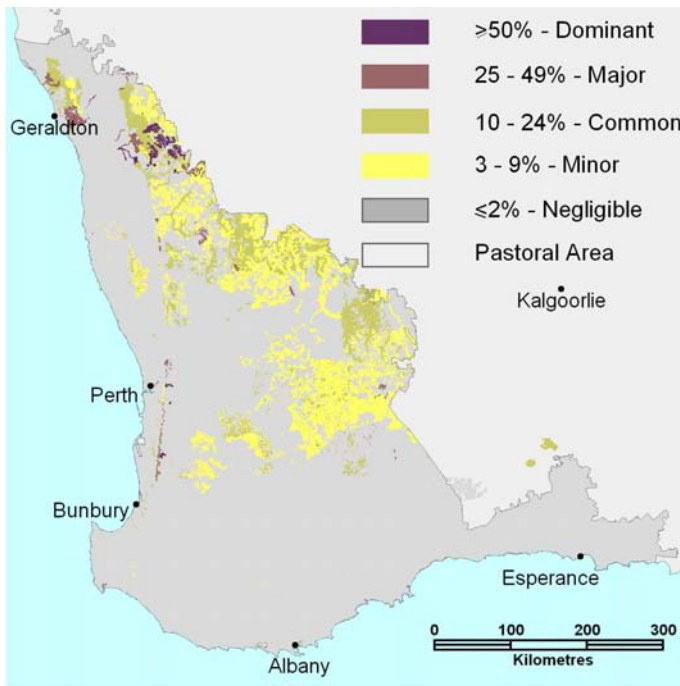
(dominant ASC in italics)

- *Red Kandosol*
- Red Dermosol



Main occurrences in Western Australia

- Widespread and common throughout the rangelands, except the Nullarbor where calcareous soils dominate and the Great Sandy Desert where red sands are dominant
- Also scattered throughout the central and north-eastern wheatbelt



Distribution map of Red loamy earth in the South-west of WA



Red loamy earth (Greenough River)

Available qualifiers of Red loamy earth (in order from most to least restrictive)

- SSS saline subsoil
- RKM rock substrate
- PSS poor subsoil
- ALK good alkaline subsoil
- ACD good acid subsoil
- NEU good neutral subsoil

Soil attributes of Red loamy earth (dominant values)

	QUALIFIER						
	SSS	RKM	PSS	ALK	ACD	NEU	
Inherent fertility	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	
Permeability 0-50 cm	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	
pH at 0-10 cm	Slightly acid	Slightly acid	Slightly acid	Neutral	Strongly acid	Slightly acid	
pH at 50-80 cm	Slightly acid	Neutral	Slightly acid	Neutral	Moderately acid	Slightly acid	
Profile stones and gravels	Few	Abundant	Few	Few	Few	Few	
Rooting depth	Moderate	Moderate	Moderate	Very deep	Very deep	Very deep	
Soil water storage	Moderate	Moderately low	Moderate	Moderate	Moderate	Moderate	
Subsurface acidification	Moderate	Moderate	Moderate	Low	Presently acid	Moderate	
Subsurface compaction	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	
Surface organic carbon	High	High	High	High	High	High	
Surface soil structure decline	High	Moderate	High	Moderate	Moderate	Moderate	
Water repellence	Nil	Nil	Nil	Nil	Nil	Nil	

Land use considerations

- Potentially highly productive soil with good physical properties
- Water erosion may occur on steeper slopes

Yellow loamy earth

Soil Group 545

Yellow loam, may grade to clay

Characteristics

- Yellow within top 30 cm
- Neutral to acid pH
- Gravels may be present in subsoil
- Usually porous with an earthy fabric
- Usually massive or weakly structured

Local names

- Yellow earth

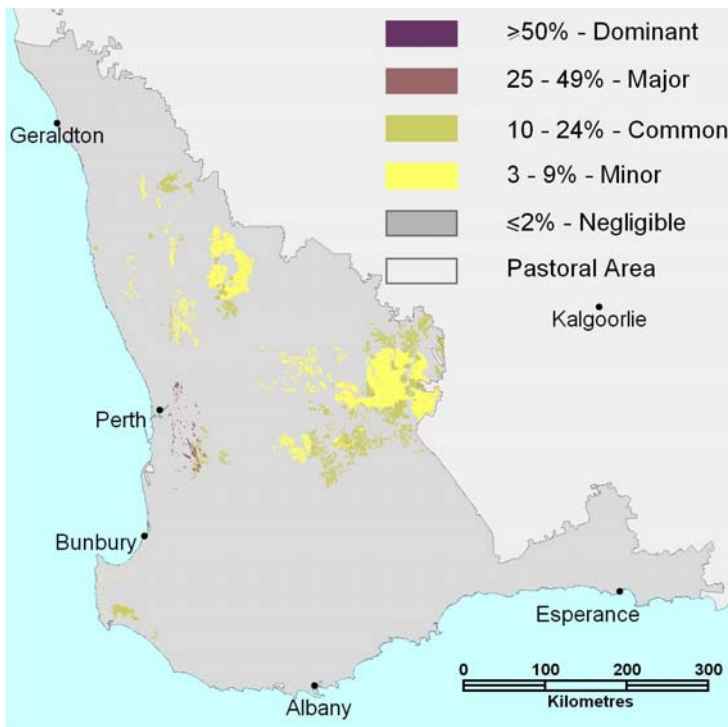
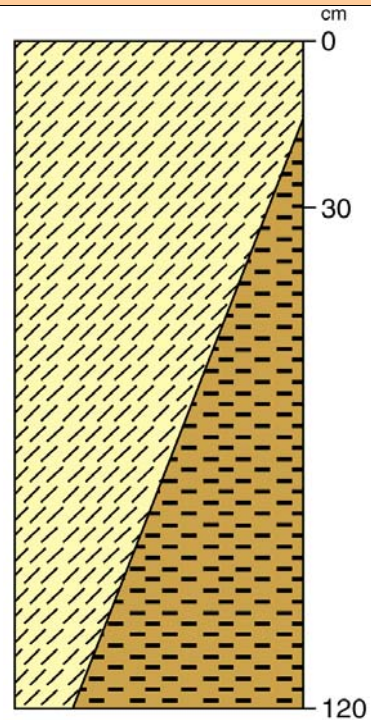
Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

- *Yellow Kandosol*

Main occurrences in Western Australia

- Widespread in the Kimberley
- Also occurs in the central and north-eastern wheatbelt extending into the southern rangelands (Murchison and Goldfields)



Distribution map of Yellow loamy earth in the South-west of WA



Yellow loamy earth (Northern wheatbelt)

Available qualifiers of Yellow loamy earth (in order from most to least restrictive)

- SSS saline subsoil
- RKM rock substrate
- PSS poor subsoil
- ALK good alkaline subsoil
- ACD good acid subsoil
- NEU good neutral subsoil

Soil attributes of Yellow loamy earth (dominant values)

		QUALIFIER					
		SSS	RKM	PSS	ALK	ACD	NEU
ATTRIBUTE	Inherent fertility	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
	Permeability 0-50 cm	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
	pH at 0-10 cm	Moderately acid	Moderately acid	Moderately acid	Slightly acid	Moderately acid	Moderately acid
	pH at 50-80 cm	Slightly acid	Slightly acid	Slightly acid	Neutral	Very strongly acid	Slightly acid
	Profile stones and gravels	Common	Abundant	Few	Few	Few	Few
	Rooting depth	Moderate	Moderate	Moderate	Very deep	Very deep	Very deep
	Soil water storage	Moderately low	Moderately low	Moderately low	Moderate	Moderate	Moderate
	Subsurface acidification	High	Moderate	High	Moderate	Presently acid	High
	Subsurface compaction	High	Low	High	High	High	High
	Surface organic carbon	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate
	Surface soil structure decline	Moderate	Moderate	High	Moderate	Moderate	Moderate
Water repellence	Nil	Nil	Nil	Nil	Nil	Nil	

Land use considerations

- Potentially highly productive soil with good physical properties
- Usually not a significant problem

Hard cracking clay

Soil Group 601

Cracking clay without a self-mulching surface

Characteristics

- Red, brown, yellow or grey within top 30 cm
- Deep cracks when dry
- Clay textures throughout profile
- Surface not self-mulching
- Variable pH
- Massive or pedal
- May have a crusting surface

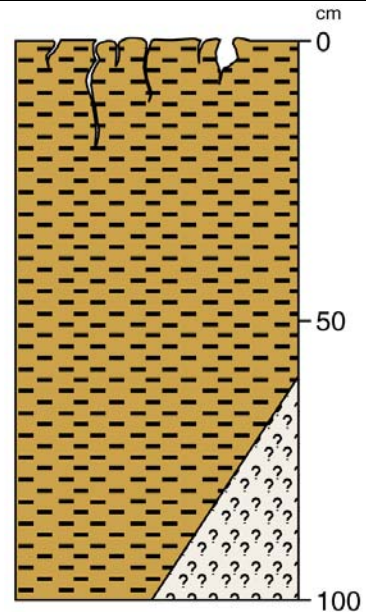
Local names

- Roebourne clay
- Tablelands soil
- Cracking clay
- Crabhole depression soil
- Dowak clay loam

Typical Australian Soil Classification (ASC)

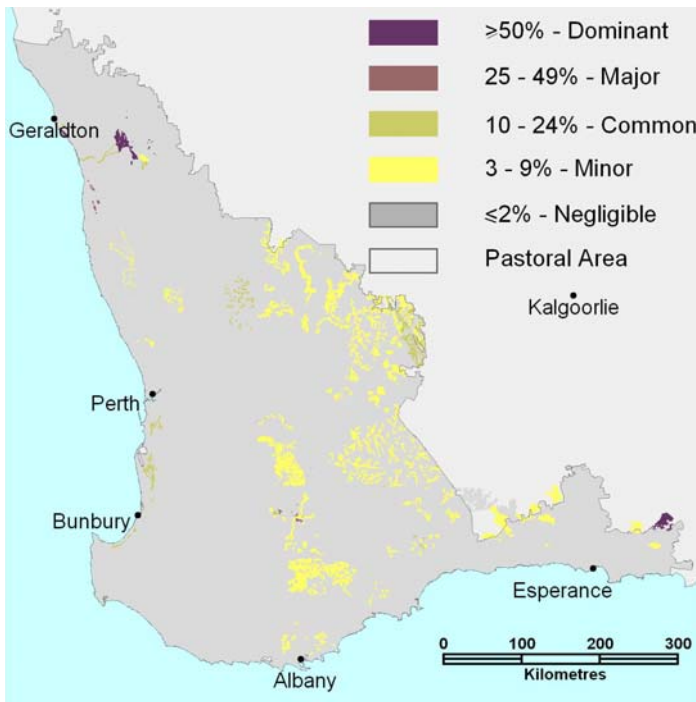
(dominant ASC in italics)

- *Epipedal, Crusty or Massive Vertisol*

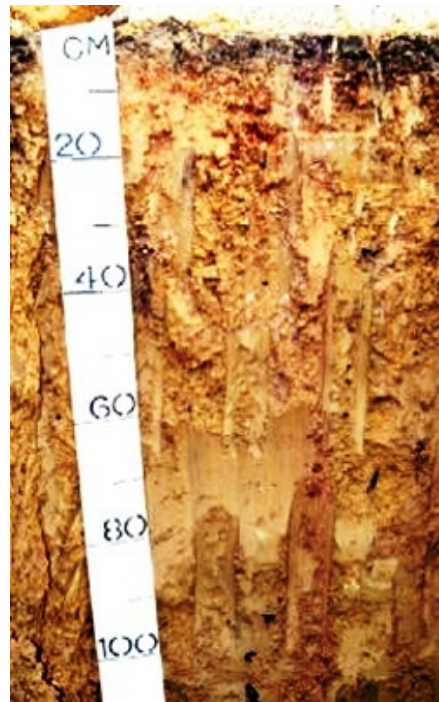


Main occurrences in Western Australia

- Kimberley and Pilbara on basaltic parent materials
- Common on the Roebourne Plain
- Isolated in the South-west, especially on doleritic dykes



Distribution map of Hard cracking clay in the South-west of WA



Hard cracking clay (Jerramungup)

Available qualifiers of Hard cracking clay (in order from most to least restrictive)

- SAL saline
- CAC acid subsoil
- CLK alkaline subsoil
- CNE neutral subsoil

Soil attributes of Hard cracking clay (dominant values)

	QUALIFIER			
	SAL	CAC	CLK	CNE
Inherent fertility	Moderate	Moderate	High	High
Permeability 0-50 cm	Slow	Slow	Slow	Slow
pH at 0-10 cm	Moderately alkaline	Moderately acid	Moderately alkaline	Neutral
pH at 50-80 cm	Moderately alkaline	Moderately acid	Moderately alkaline	Neutral
Profile stones and gravels	Few	Few	Few	Few
Rooting depth	Shallow	Moderate	Moderate	Moderate
Soil water storage	Very low	Moderately low	Moderately low	Moderately low
Subsurface acidification	Low	High	Low	Low
Subsurface compaction	Low	Low	Low	Low
Surface organic carbon	Low	Low	Low	Low
Surface soil structure decline	Moderate	Moderate	Moderate	Moderate
Water repellence	Nil	Nil	Nil	Nil

Land use considerations

- Low plant available water capacity in dry seasons limits yield potential
- Hard setting surface are common

Self-mulching cracking clay

Soil Group 602

Cracking clay with a self-mulching surface

Characteristics

- Often grey, but also yellow, brown and red within top 30 cm
- Deep cracks when dry
- Clay textures throughout profile
- Self-mulching surface
- May have a stony surface mantle, especially in Pilbara

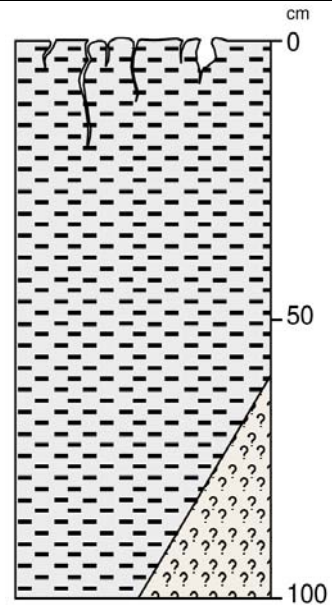
Local names

- Black soil
- Cununurra clay
- Crabhole mound soil
- Tablelands soil
- Dolerite dyke soil
- Cracking clay

Typical Australian Soil Classification (ASC)

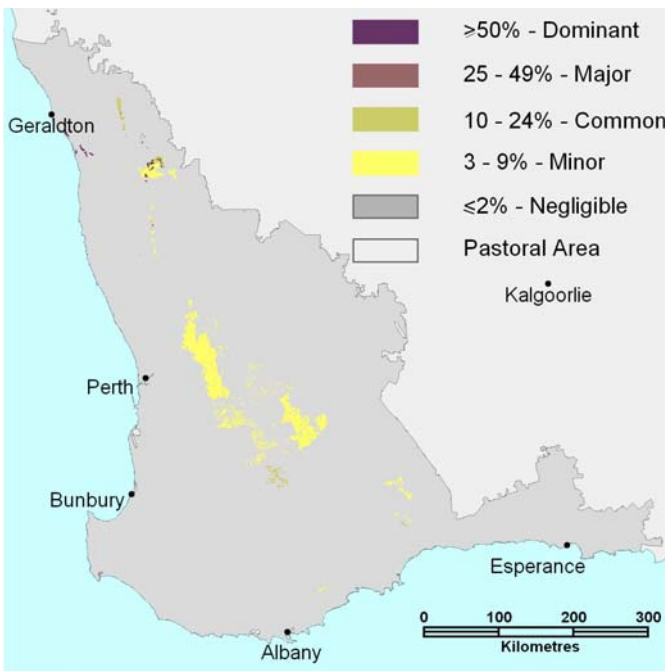
(dominant ASC in italics)

- *Self-mulching Vertosol*



Main occurrences in Western Australia

- Grey/brown/black variants common in the Kimberley on the floodplains of major rivers e.g. Ord and Fitzroy
- Isolated in the South-west (e.g. Ravensthorpe) and on dolerite dykes
- Red/brown variants occur on basalts in the Pilbara



Distribution map of Self-mulching cracking clay in the South-west of WA



Self-mulching cracking clay (surface) (East Kimberley)

Available qualifiers of Self-mulching cracking clay (in order from most to least restrictive)

- SAL saline
- CAC acid subsoil
- CLK alkaline subsoil
- CNE neutral subsoil

Soil attributes of Self-mulching cracking clay (dominant values)

		QUALIFIER			
		SAL	CAC	CLK	CNE
ATTRIBUTE	Inherent fertility	Moderate	Moderate	High	High
	Permeability 0-50 cm	Slow	Slow	Slow	Slow
	pH at 0-10 cm	Moderately alkaline	Moderately acid	Moderately alkaline	Slightly acid
	pH at 50-80 cm	Moderately alkaline	Moderately acid	Moderately alkaline	Neutral
	Profile stones and gravels	Few	Few	Few	Few
	Rooting depth	Moderate	Moderate	Moderate	Moderate
	Soil water storage	Moderate	Moderate	Moderate	Moderate
	Subsurface acidification	Low	High	Low	Moderate
	Subsurface compaction	Low	Low	Low	Low
	Surface organic carbon	High	High	High	High
	Surface soil structure decline	Moderate	Moderate	Moderate	Moderate
	Water repellence	Nil	Nil	Nil	Nil

Land use considerations

- Potentially suitable for irrigated agriculture
- Plant available water capacity are high to moderate

Grey non-cracking clay

Soil Group 621

Grey non-cracking clay

Characteristics

- Often grey, sometimes yellow or brown or rarely black within top 30 cm
- Often calcareous in subsoil
- Often alkaline pH in subsoil
- Clay textures throughout profile
- Does not seasonally crack
- Often with a hard setting surface

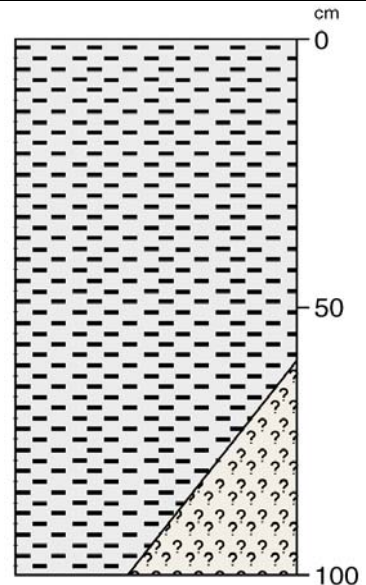
Local names

- Moort soil
- Crabhole mound soil
- Grey clay

Typical Australian Soil Classification (ASC)

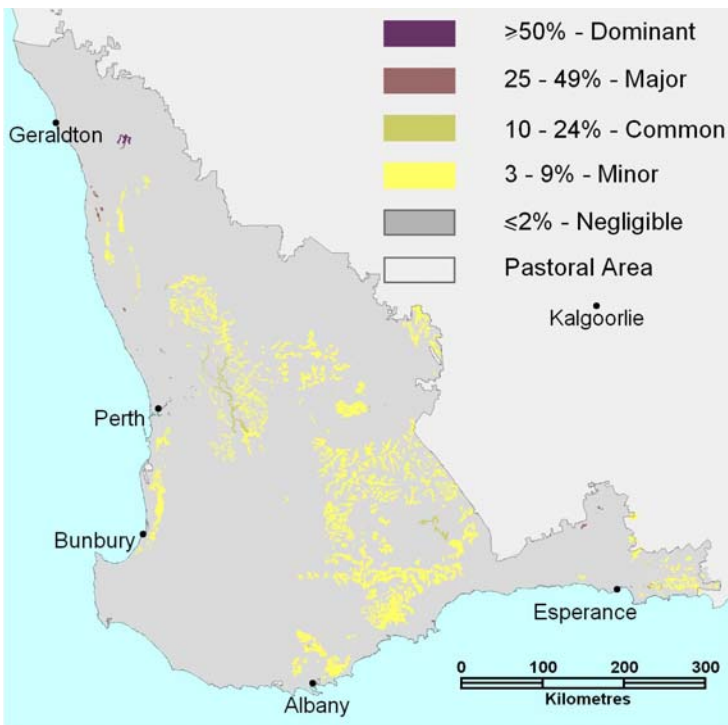
(dominant ASC in italics)

- *Grey or Yellow Dermosol*
- Grey or Yellow Kandosol



Main occurrences in Western Australia

- Scattered throughout the South-west agricultural regions
- Minor occurrences in the South-west coastal areas



Distribution map of Grey non-cracking clay in the South-west of WA



Grey non-cracking clay (Nyabing)

Available qualifiers of Grey non-cracking clay (in order from most to least restrictive)

- SAL saline
- CAC acid subsoil
- CLK alkaline subsoil
- CNE neutral subsoil

Soil attributes of Grey non-cracking clay (dominant values)

	QUALIFIER			
	SAL	CAC	CLK	CNE
Inherent fertility	Moderate	Moderate	High	High
Permeability 0-50 cm	Slow	Slow	Slow	Slow
pH at 0-10 cm	Neutral	Slightly acid	Neutral	Slightly acid
pH at 50-80 cm	Neutral	Moderately acid	Neutral	Slightly acid
Profile stones and gravels	Very few	Very few	Very few	Very few
Rooting depth	Shallow	Moderate	Moderate	Moderate
Soil water storage	Very low	Low	Low	Low
Subsurface acidification	Low	High	Low	Low
Subsurface compaction	Low	Low	Low	Low
Surface organic carbon	Moderate	Moderate	Moderate	Moderate
Surface soil structure decline	Moderate	High	High	High
Water repellence	Nil	Nil	Nil	Nil

Land use considerations

- Low plant available water capacity in dry seasons may limit yield potential
- Could be hard when too dry

Red/brown non-cracking clay

Soil Group 622

Red or brown non-cracking clay, usually with a moderately to strongly developed structure

Characteristics

- Red or brown within top 30 cm
- Usually structured and friable
- Clay textures throughout profile
- Often hard setting
- Sometimes with a calcareous subsoil

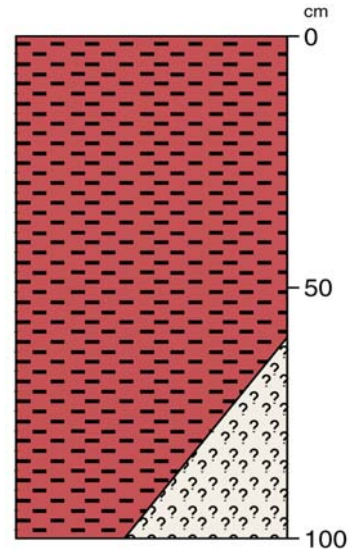
Local names

- Dolerite dyke soil
- York gum/Jam country

Typical Australian Soil Classification (ASC)

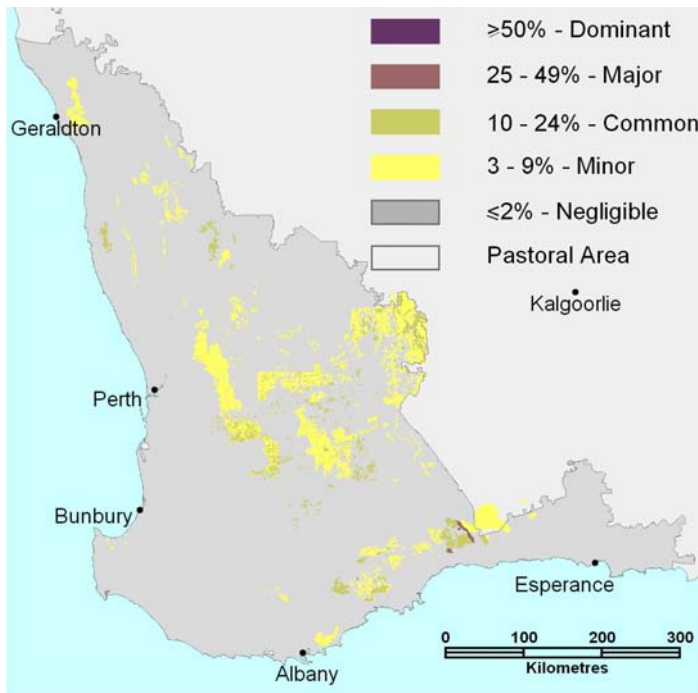
(dominant ASC in italics)

- *Red or Brown Dermosol*
- Red or Brown Kandosol



Main occurrences in Western Australia

- Widespread, but rarely common, throughout most areas of the State
- Most common in the Pilbara, and on greenstone ranges stretching from Ravensthorpe in the South-west to the Goldfields
- Frequent in isolated areas on dolerite dykes in the South-west



Distribution map of Red/brown non-cracking clay in the South-west of WA



Red/brown non-cracking clay (Jurien East)

Available qualifiers of Red/brown non-cracking clay (in order from most to least restrictive)

- SAL saline
- CAC acid subsoil
- CLK alkaline subsoil
- CNE neutral subsoil

Soil attributes of Red/brown non-cracking clay (dominant values)

		QUALIFIER			
		SAL	CAC	CLK	CNE
ATTRIBUTE	Inherent fertility	Moderate	Moderate	High	High
	Permeability 0-50 cm	Slow	Slow	Slow	Slow
	pH at 0-10 cm	Slightly acid	Slightly acid	Neutral	Slightly acid
	pH at 50-80 cm	Slightly acid	Moderately acid	Moderately alkaline	Neutral
	Profile stones and gravels	Few	Few	Few	Few
	Rooting depth	Shallow	Moderate	Moderate	Moderate
	Soil water storage	Very low	Moderately low	Moderately low	Moderately low
	Subsurface acidification	Moderate	High	Low	Low
	Subsurface compaction	Low	Low	Low	Low
	Surface organic carbon	High	High	High	High
	Surface soil structure decline	Moderate	High	High	High
	Water repellence	Nil	Nil	Nil	Nil

Land use considerations

- This soil is subject to structure decline
- Low plant available water capacity in dry seasons may limit yield potential

Disturbed land

Soil Group 701

Areas which are highly disturbed, e.g. mine sites

Areas of land which are highly disturbed by human activities. This could include mine sites, quarries etc. where major soil upheaval, mixing or removal has occurred.

Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

- *Anthroposol*

Water

Soil group 702

Areas of permanent or semi-permanent water

Areas of land which are permanently or semi-permanently under water.

Note: *Water, although not a soil, is described as a Soil Group to enable 100% area attribution for all map units in DAFWA's Map Unit Database.*

No suitable Group

Soil group 703

Other minor soils not described within the main Soil Groups or Supergroups

This Group covers soils of limited extent which do not easily fit within the main Soil Groups. Examples of soils which have been encountered in Western Australia that fit within this Group include:

Soil

Shelly sands
Dry river beds (sands, gravels etc.)
Layered alluvial soils
(this list is not exhaustive)

Location

Isolated in coastal areas
Scattered throughout State
Anywhere in alluvial positions

Undifferentiated soils

Soil group 704

Other soils which are not differentiated to the level of Soil Group

This category covers situations where the soils are, for whatever reason, not divided to the level of Soil Groups.

An example could be in areas of rocky terrain where the mapping may not examine all soils in details, and provision is required to communicate this fact.

5. REFERENCES

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- Pathan, S. and Schoknecht, N. (2012). An Interactive Pathway Key to Identify Western Australian Soils. Department of Agriculture and Food, Western Australia. Available on the web at www.agric.wa.gov.au/
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- Purdie, B.R. (1993). Data set and Code Definitions for Soil Profile Description (DAFWA regional mapping program). Resource Management Technical Report 140, Department of Agriculture and Food, Western Australia.
- Schoknecht, N., Tille, P. and Purdie, B.R. (2004). Soil-landscape Mapping in South-Western Australia – Over View of Methodology and Outputs. Resource Management Technical Report 280, Department of Agriculture and Food, Western Australia.
- van Gool, D., Tille, P. and Moore, G.A. (2005). Land Evaluation Standards for Land Resource Mapping. Resource Management Technical Report 298, Department of Agriculture and Food, Western Australia.

Appendix A. Characteristic soils map of Western Australia

The soil map provides an overview of the distribution of soils in South-west of Western Australia (i.e. Agricultural Region; see page 150) and rest of Western Australia (i.e. Rangelands; see page 151). The soil map of Agricultural Region shows 21 groups of soils that characterise the South-west of Western Australian soil-landscapes (Version 5; June 2012). These are broadly grouped into the following 8 categories:

1. Soils with shallow watertables	Soils which are wet in some part of the profile for a major part of the year
2. Gravelly soils	Soils dominated by ironstone gravels
3. Deep sandy soils	Soils which are sandy to at least 80 cm
4. Deep sandy and sandy earth soils	Soils which are sandy at the surface, and sandy to loamy at depth
5. Loamy earth soils	Soils which are loamy at the surface, and loamy to clayey at depth
6. Texture contrast soils (duplexes)	Soils with a texture contrast within the top 80 cm (e.g. sand over clay, loam over clay)
7. Clayey soils	Soils which are clayey throughout
8. Rocky or stony soils	Soils dominated by stone or rock

The map is based on *systems* level information from the soil-landscape mapping conducted by the former Land Resources Assessment and Monitoring (LRAM) group. More information on the soil-landscape mapping program can be obtained from the Department of Agriculture and Food, Western Australia. The soil-landscape *systems* for Western Australia form part of a mapping hierarchy, where detailed mapping is used to build map units which can be used at a broader scale. The soil-landscape *systems* information is the fourth level in the six level mapping hierarchy, and is useful for regional level assessments of soil resources.

How to interpret the map

At the *systems* level the map units are impure, with many soils potentially occurring within any given system. The map therefore presents individual soils or groups of soils that are *characteristic* for each system, although an individual soil may not dominate each system.

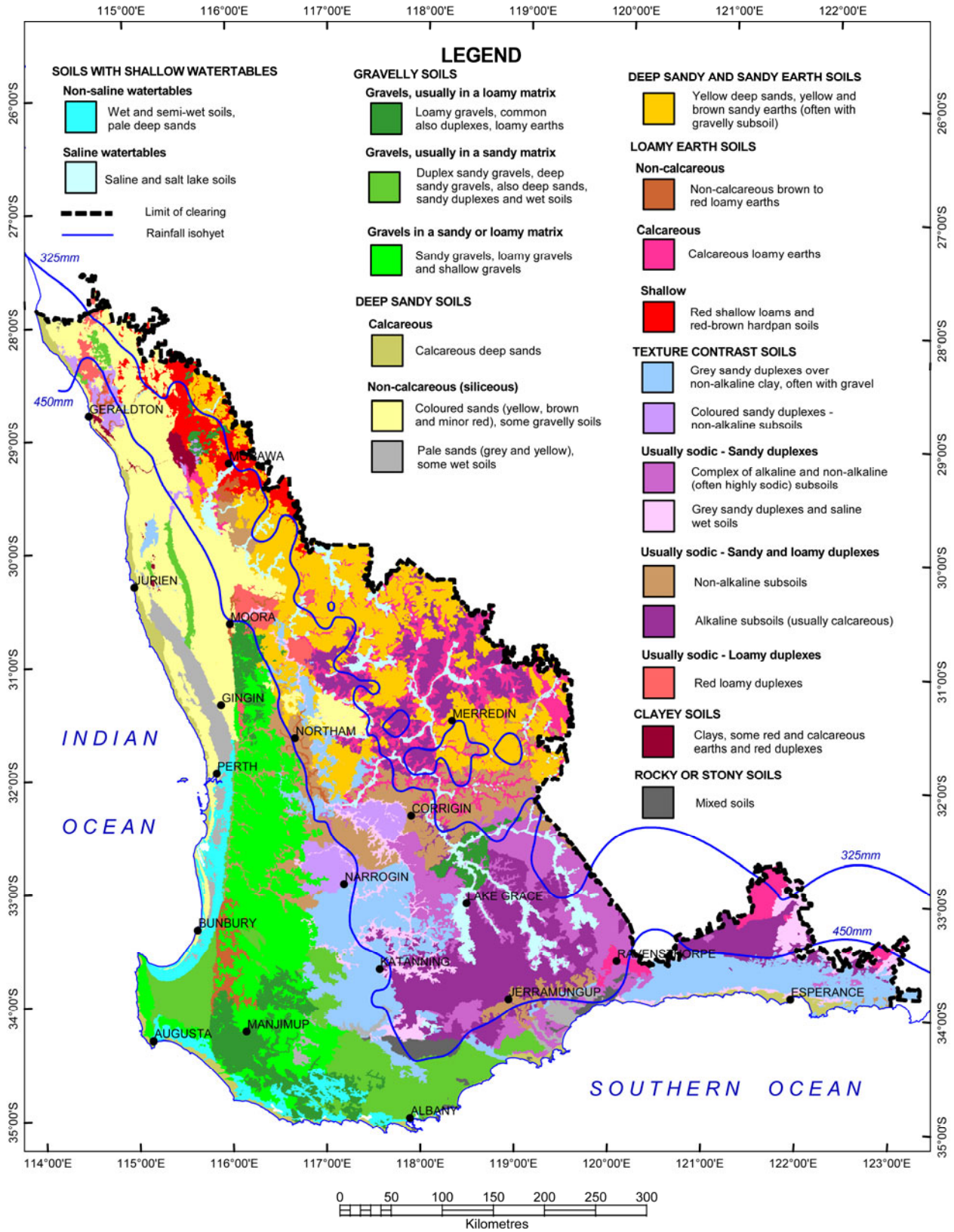
Uses of the map

The map provides a useful overview of the regional soil resources of the State relevant to:

- education
- regional agricultural industry planning
- farming systems
- plant breeding
- land use planning
- agricultural extension
- soil-related hazards.

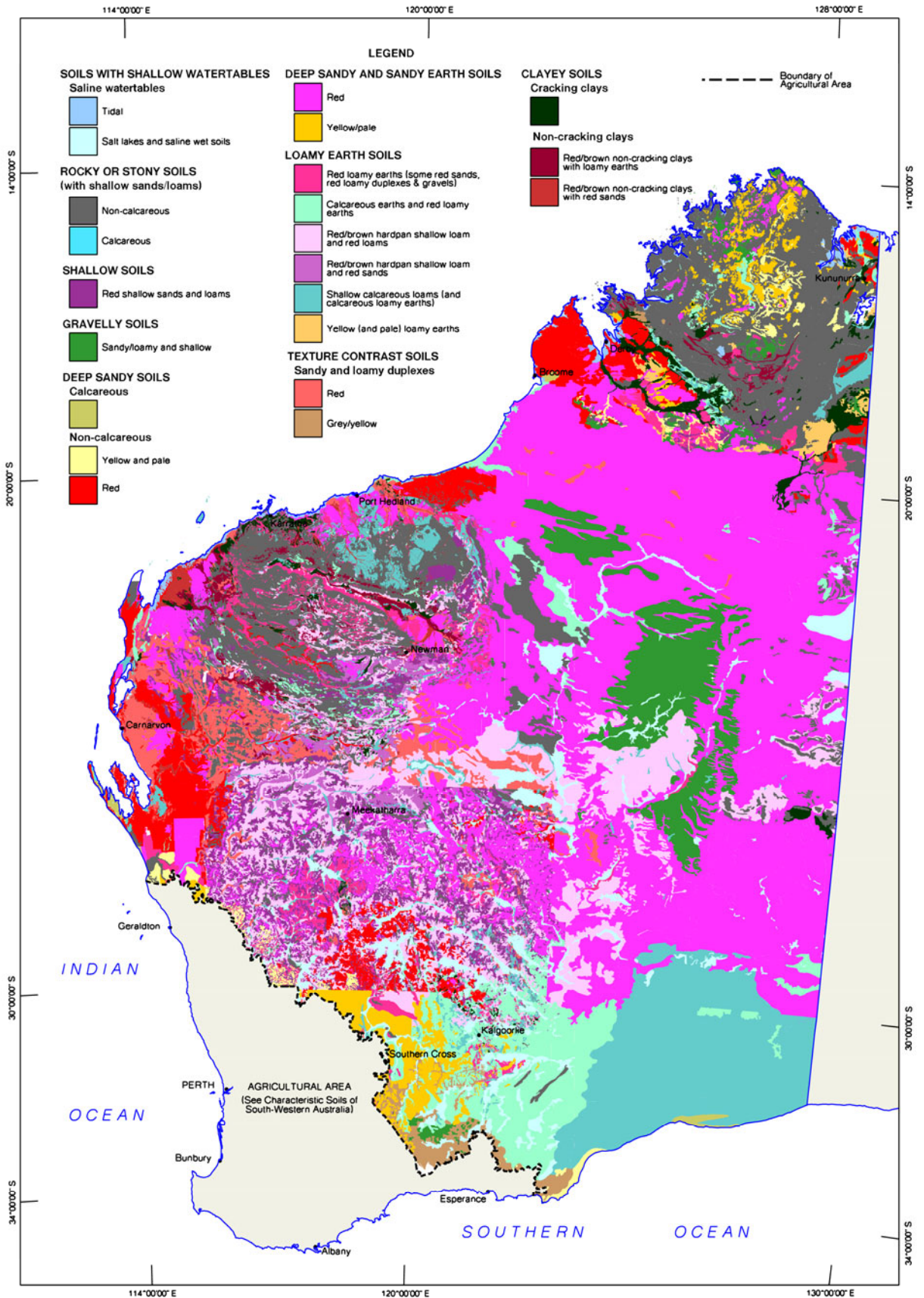
Characteristic Soils of South-Western Australia

(Based on proportional allocation of soil groups to soil-landscape systems, June 2012)



REFERENCE
 Projection: Transverse Mercator
 Datum: Geocentric Datum of Australia 1994
 Grid: Map Grid of Australia 1994, zone 50
 Source data: DAFWA Soil-landscape systems Version 5
 Job No: 2012254
 Date: June 2012

Characteristic Soils of the Rangelands of Western Australia
 (Based on proportional allocation of soil groups to mapping units, November 2002)

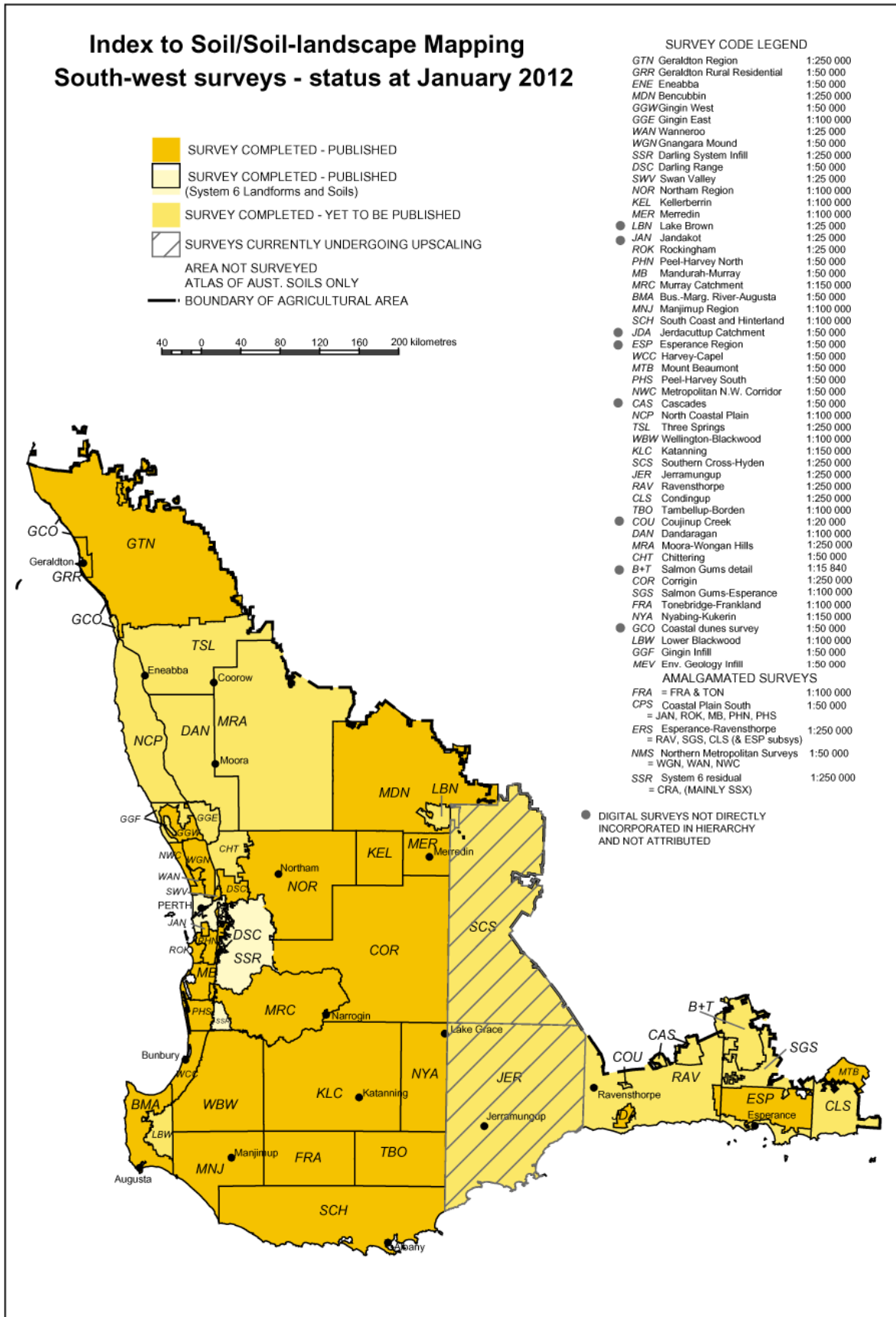


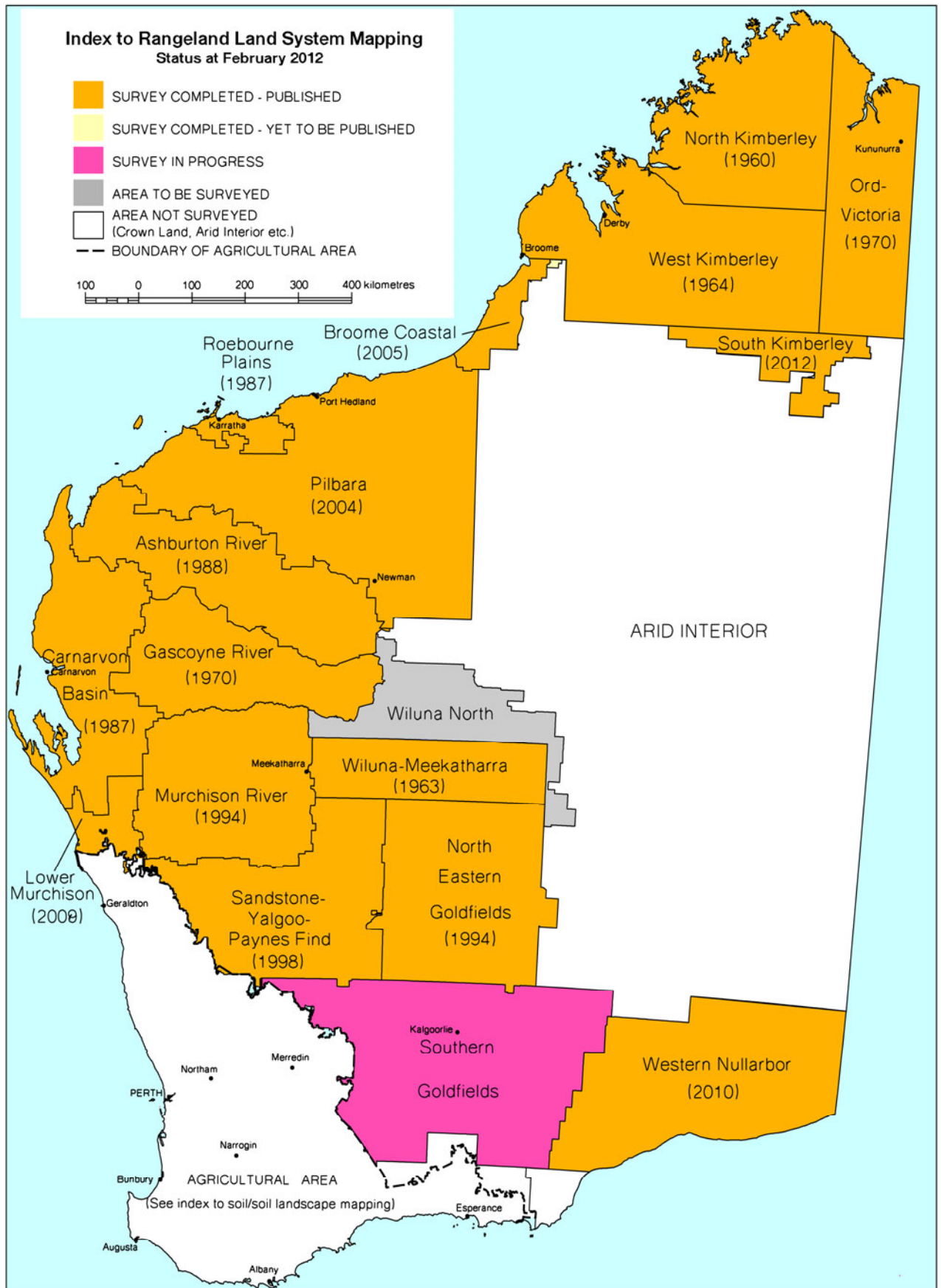
Reference
 Projection: Universal Transverse Mercator Zone 50
 Grid: Geocentric Datum of Australia 1994
 Source data: Land system mapping (rangelands), Atlas of Australian Soils
 Date: November 2002

0 100 200 300 400 500 kilometres

Natural Resources Assessment Group

Appendix B. Soil and soil-landscape mapping indexes of Western Australia





Appendix C. Soil Supergroups and Soil Group names and database codes

	Database code	Page no.
WET OR WATERLOGGED SOILS	100	14
Saline wet soil	101	34
Salt lake soil	102	36
Semi-wet soil	103	38
Tidal soil	104	40
Wet soil	105	42
ROCKY OR STONY SOILS	200	14
Bare rock	201	44
Calcareous stony soil	202	46
Stony soil	203	48
IRONSTONE GRAVELLY SOILS	300	15
Deep sandy gravel	301	50
Duplex sandy gravel	302	52
Loamy gravel	303	54
Shallow gravel	304	56
SANDY DUPLEXES	400	16
Alkaline grey deep sandy duplex	401	58
Alkaline grey shallow sandy duplex	402	60
Grey deep sandy duplex	403	62
Grey shallow sandy duplex	404	64
Red deep sandy duplex	405	66
Red shallow sandy duplex	406	68
Yellow/brown deep sandy duplex	407	70
Yellow/brown shallow sandy duplex	408	72
Reticulite deep sandy duplex	409	74
SHALLOW SANDS	420	17
Calcareous shallow sand	421	76
Pale shallow sand	422	78
Red shallow sand	423	80
Yellow/brown shallow sand	424	82
DEEP SANDS	440	17
Brown deep sand	441	84
Calcareous deep sand	442	86
Gravelly pale deep sand	443	88
Pale deep sand	444	90
Red deep sand	445	92
Yellow deep sand	446	94
SANDY EARTHS	460	18
Acid yellow sandy earth	461	96
Brown sandy earth	462	98
Red sandy earth	463	100
Yellow sandy earth	464	102
Pale sandy earth	465	104

	Database code	Page no.
LOAMY DUPLEXES	500	18
Acid shallow duplex	501	106
Alkaline grey shallow loamy duplex	502	108
Alkaline red shallow loamy duplex	503	110
Grey shallow loamy duplex	504	112
Brown deep loamy duplex	505	114
Red deep loamy duplex	506	116
Red shallow loamy duplex	507	118
Yellow/brown shallow loamy duplex	508	120
 SHALLOW LOAMS	 520	 19
Calcareous shallow loam	521	122
Red shallow loam	522	124
Red-brown hardpan shallow loam	523	126
 LOAMY EARTHS	 540	 19
Brown loamy earth	541	128
Calcareous loamy earth	542	130
Friable red/brown loamy earth	543	132
Red loamy earth	544	134
Yellow loamy earth	545	136
 CRACKING CLAYS	 600	 20
Hard cracking clay	601	138
Self-mulching cracking clay	602	140
 NON-CRACKING CLAYS	 620	 20
Grey non-cracking clay	621	142
Red/brown non-cracking clay	622	144
 MISCELLANEOUS SOILS	 700	 20
Disturbed land	701	146
Water	702	146
No suitable Group	703	146
Undifferentiated soils	704	146

Appendix D. Index to local soil names of Western Australia

Local name	page no.	Local name	page no.
Alluvial brown sand/soil	98	Sandy gravel	52, 74
Alluvial brown sand	84, 128	Ironstone cap	56
Alluvial sand	84	Jam soil	118, 124
Avon valley loam	118	Jam country	144
Banksia sand	90	Jarraah gravel	52, 54
Beach dune sand	86	Karrakatta sand	82, 94
Beete loam	122	Karri loam	132
Black soil	140	Kopi soil	130
Black wattle sand	76	Kopi-fluff	122
Blue mallee soil	70	Lake bank soil	130
Boyanup loam	38	Loamy gravel	54
Buckshot gravel	50, 52, 54	Mallee soil	58, 60
Busselton sand	104	Mallee duplex	72, 120
Calcareous sand	86	Mallee broombush soil	70
Chapman valley loam	118	Mallet soil	68, 106
Christmas tree sand	90	Mangrove soil	40
Coarse gravel	52	Marybrook soil	100, 132
Coastal sand	76	Merredin sandy loam	130
Cockatoo sand	90, 100	Moort soil	60, 72, 108, 142
Coolup sand	38	Moort loam/clay	112
Crabhole soil	122	Morrel soil	130
Crabhole depression soil	138	Mulga loam	126, 134
Crabhole mound soil	140, 142	Mungite soil	38
Cracking clay	138, 140	Murchison cement loam	126
Cununurra clay	140	Outcrop	44
Deep mallee sand	90	Pea gravel	50, 54
Deep yate loam	114, 116	Pear and pine sand	94
Dolerite dyke soil	140, 144	Peaty soil	42
Dowak clay loam	138	Pindan sand	100
Duplex soil	64	Pink clay	106
Eradu sandplain	94	Red brown earth	110
Esperance sandplain	62	Red-brown hardpan soil	126
Fine loamy type gravel	54	Red soil	66, 118
Fleming gravelly sand	62	Red sand	92
Fleming sand	62	Red loam	68, 134
Fluffy gimlet soil	122	Roebourne clay	138
Forest gravel	50	Rocky lime soil	46
Forest grove gravel	54	Rocky kopi	46
Forest hill gravel	54	Rocky outcrop country	68
Gairdner gravelly duplex	52	Rocky/rubble soil	48
Good sandplain soil	102	Salmon gum soil	110
Gravelly sand	88	Salmon gum-gimlet soil	122, 130
Gravelly sand on laterite	56	Salt	34
Granite outcrop	44	Salt land	34
Grey clay	64, 108, 112, 142	Salt lake	36
Grey sandplain	90	Saline mud	40
Grey mallee clay	106	Sand over gravel	88
Gritty sheoak sand	78	Sand over clay	62
Gutless/Gritty sand	78, 90	Sands on limestone	94

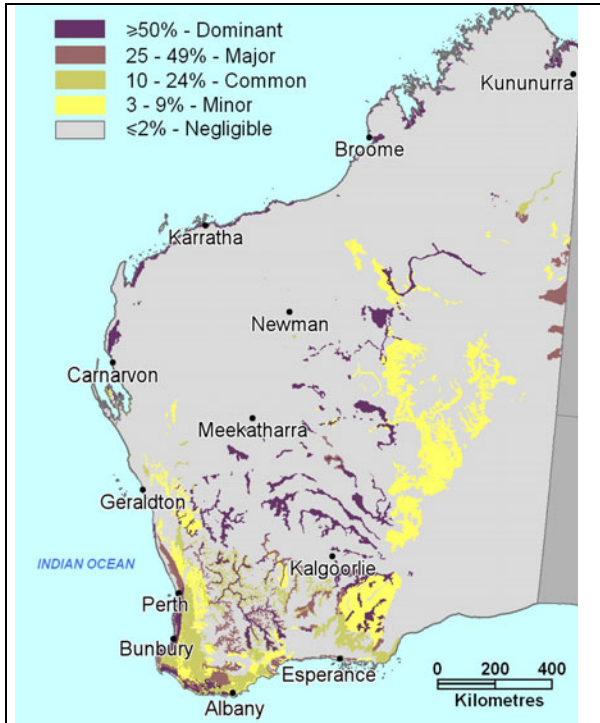
Local name	page no.	Local name	page no.
Sandy duplex	62	Tammar soil	102
Scaddan sand	58, 60	Harrismith sand	90
Sheoak soil	62	Wandarrie sand	92
Siliceous sand	90, 94	Wandoo soil	78
Silver loam	90	White gum soil	64
Spearwood sand	82, 94	White sandy gravels	88
Spillway sand	90	Wodjil sand/soil	96
Spongeolite soil	64	Wyarri sand	80
Swamp road gravel	62	Yate loam	128, 134
Swamp soil	42	Yellow earth	136
Tablelands soil	138, 140	York gum soil	68, 110, 116, 118, 124

Appendix E. Index to Soil Groups of Western Australia

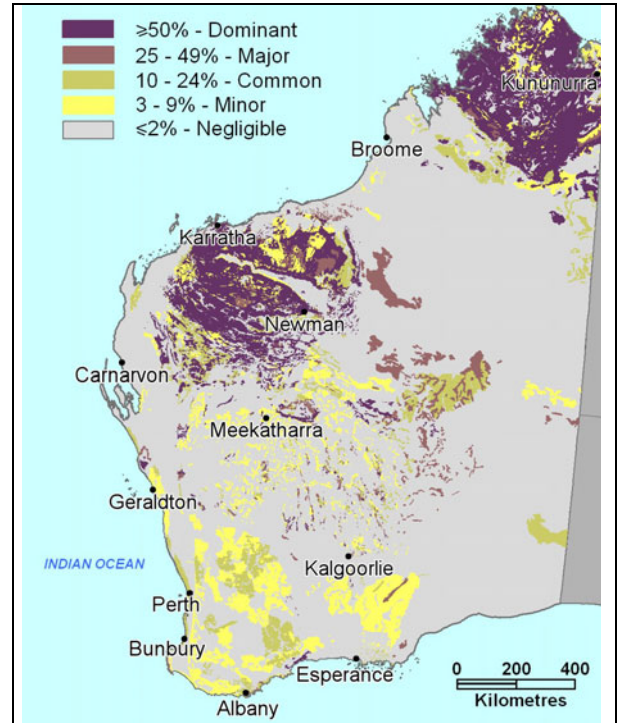
Name	page no.	Name	page no.
Acid shallow duplex	106	Pale shallow sand	78
Acid yellow sandy earth	96	Red deep sand	92
Alkaline grey deep sandy duplex	58	Red deep loamy duplex	116
Alkaline grey shallow loamy duplex	108	Red loamy earth	134
Alkaline grey shallow sandy duplex	60	Red deep sandy duplex	66
Alkaline red shallow loamy duplex	110	Red sandy earth	100
Bare rock	44	Red shallow loam	124
Brown deep loamy duplex	114	Red shallow sand	80
Brown deep sand	84	Red shallow loamy duplex	118
Brown loamy earth	128	Red shallow sandy duplex	68
Brown sandy earth	98	Red/brown non-cracking clay	144
Calcareous deep sand	86	Red-brown hardpan shallow loam	126
Calcareous loamy earth	130	Reticulite deep sandy duplex	74
Calcareous shallow loam	122	Saline wet soil	34
Calcareous shallow sand	76	Salt lake soil	36
Calcareous stony soil	46	Self-mulching cracking clay	140
Deep sandy gravel	50	Semi-wet soil	38
Disturbed land	146	Shallow gravel	56
Duplex sandy gravel	52	Stony soil	48
Friable red/brown loamy earth	132	Tidal soil	40
Gravelly pale deep sand	88	Undifferentiated soils	146
Grey deep sandy duplex	62	Water	146
Grey non-cracking clay	142	Wet soil	42
Grey shallow loamy duplex	112	Yellow deep sand	94
Grey shallow sandy duplex	64	Yellow loamy earth	136
Hard cracking clay	138	Yellow sandy earth	102
Loamy gravel	54	Yellow/brown deep sandy duplex	70
No suitable Group	146	Yellow/brown shallow sand	82
Pale deep sand	90	Yellow/brown shallow loamy duplex	120
Pale sandy earth	104	Yellow/brown shallow sandy duplex	72

A. Distribution maps of Soil Supergroups in Western Australia

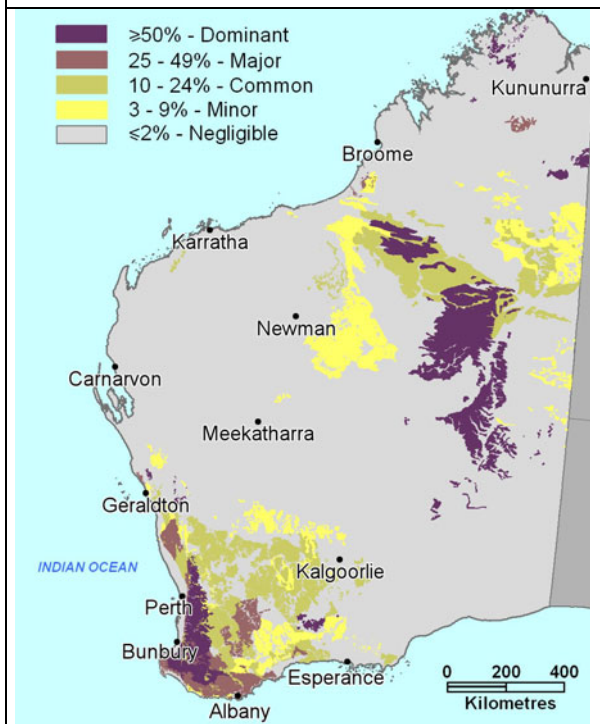
Distributions of Soil Groups and Soil Supergroups based on allocations to the soil-landscape sub-systems map of Western Australia (Version 4; November 2002).



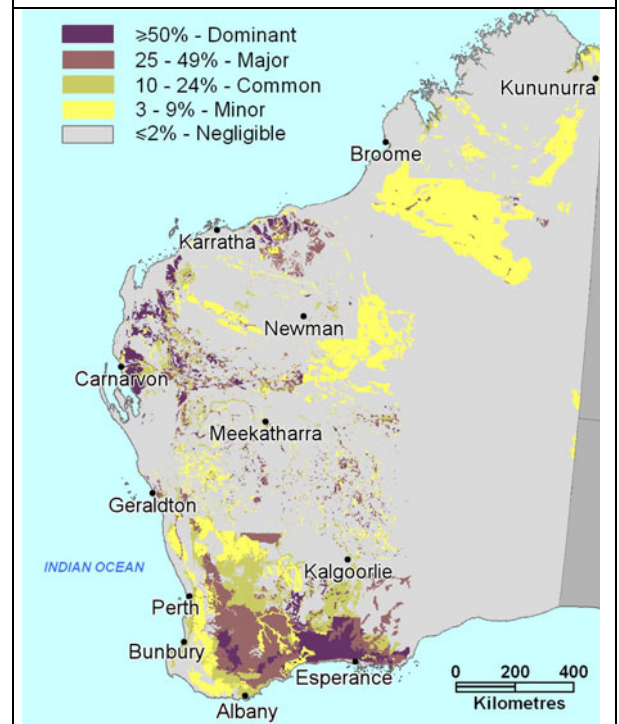
100 WET OR WATERLOGGED SOILS
Supergroup
 p 14



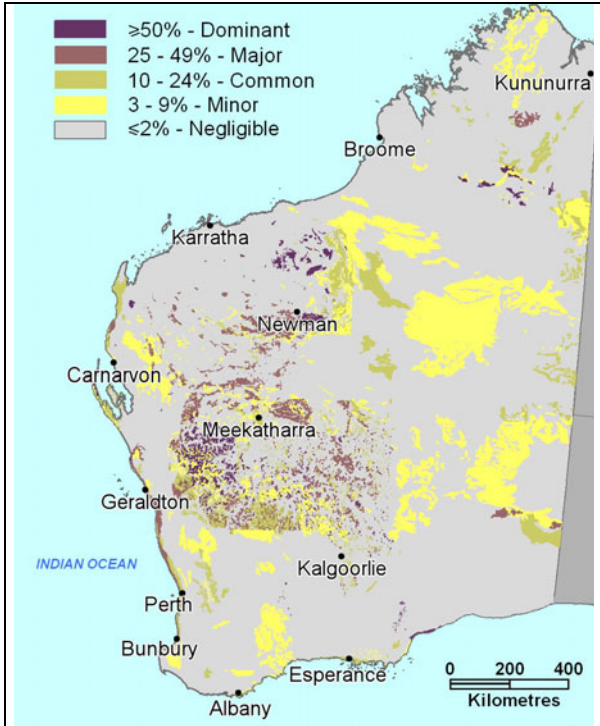
200 ROCKY OR STONY SOILS
Supergroup
 p 14



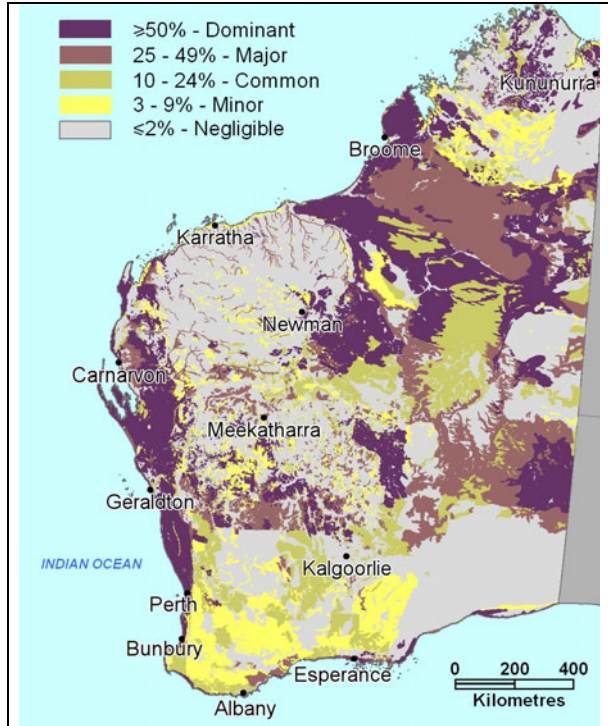
300 IRONSTONE GRAVELLY SOILS
Supergroup p 15



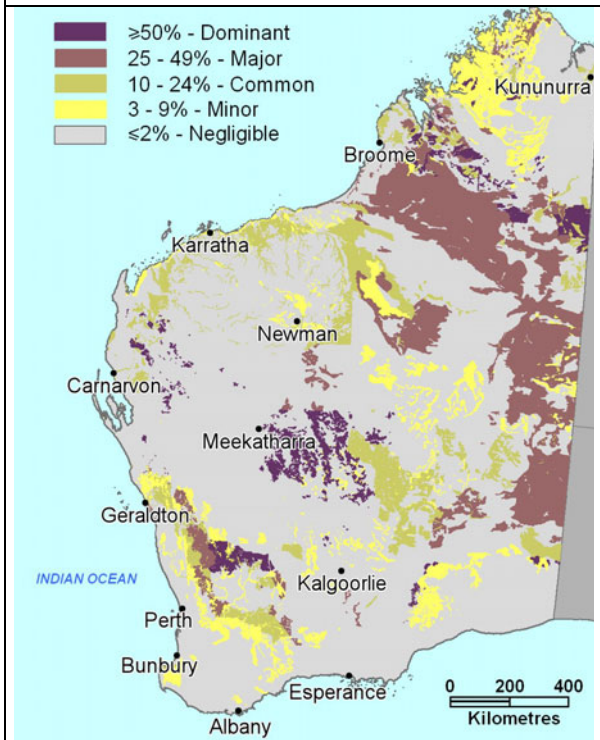
400 SANDY DUPLEXES Supergroup
 p 16



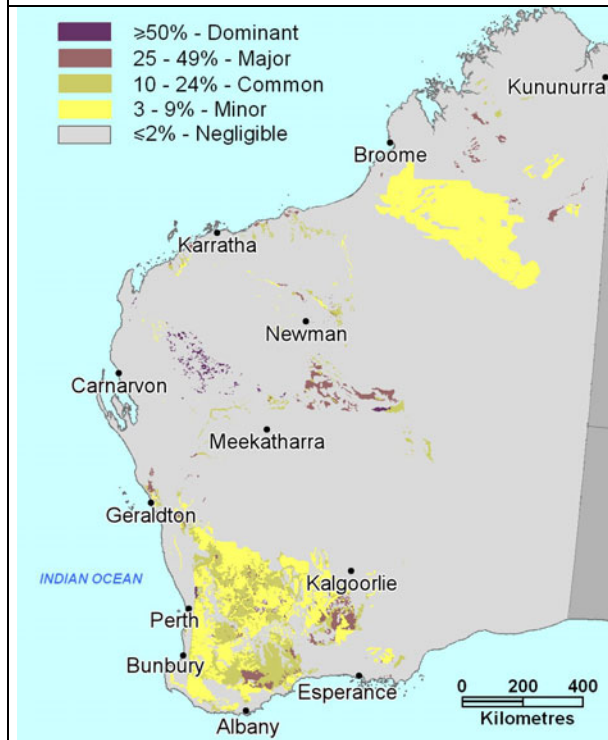
420 SHALLOW SANDS Supergroup
p 17



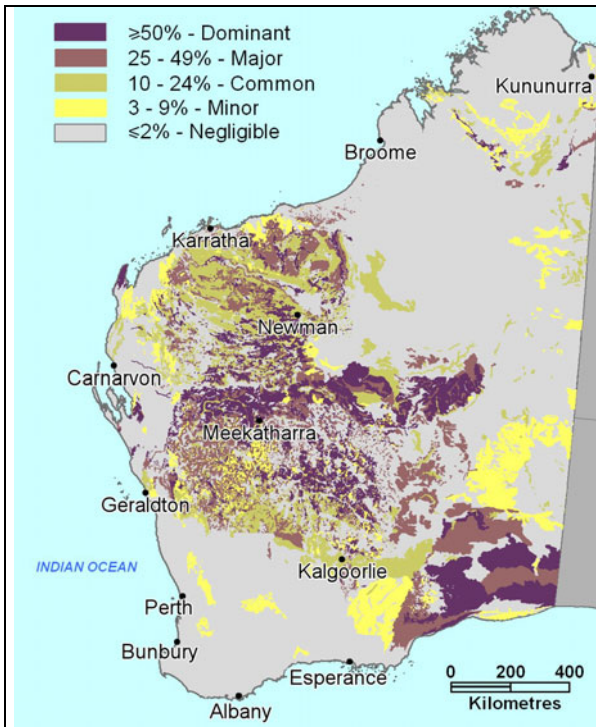
440 DEEP SANDS Supergroup
p 17



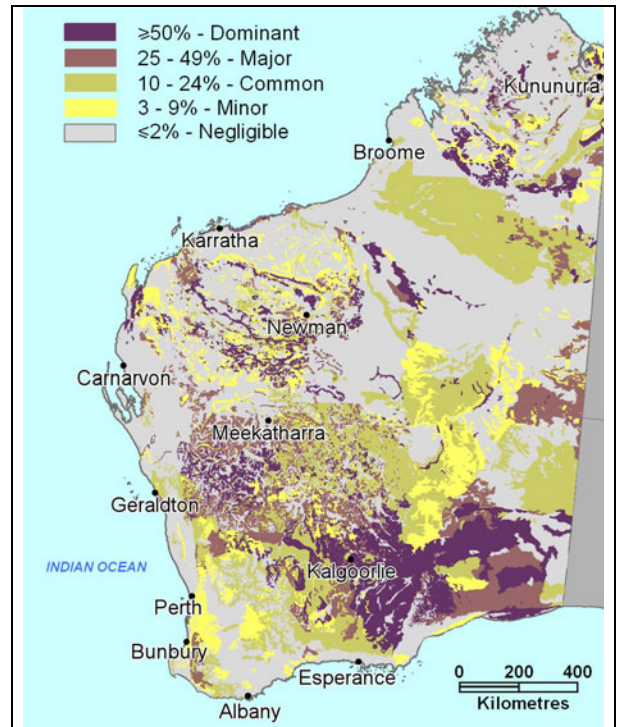
460 SANDY EARTHS Supergroup
p 18



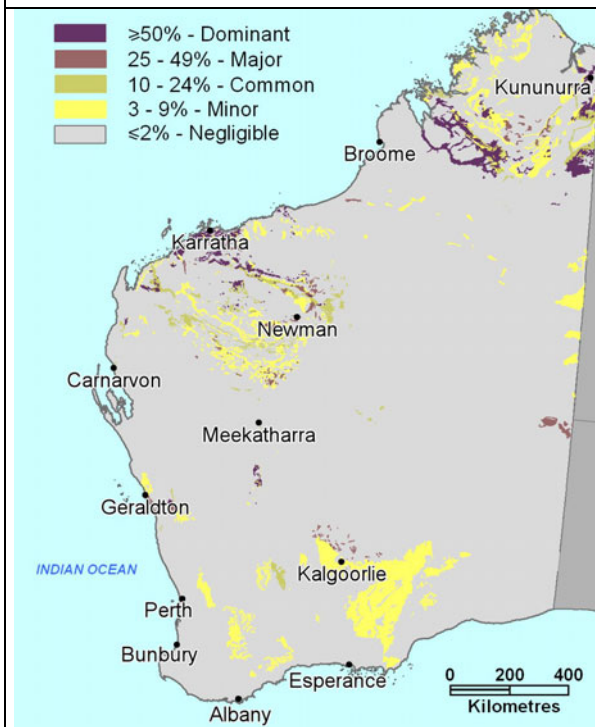
500 LOAMY DUPLEXES Supergroup
p 18



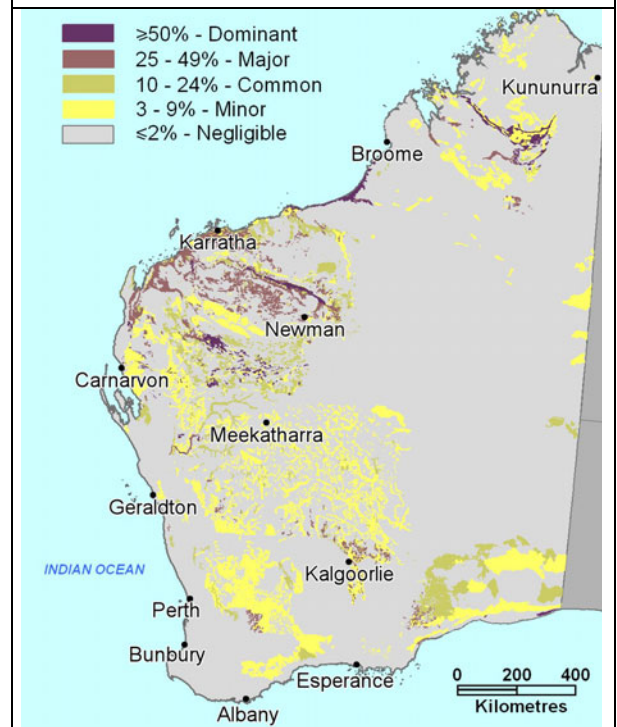
520 SHALLOW LOAMS Supergroup
p 19



540 LOAMY EARTHS Supergroup
p 19

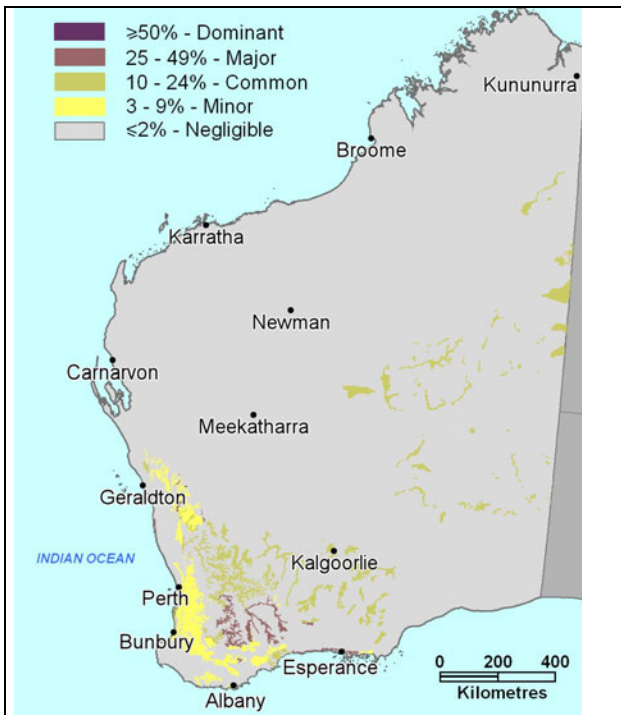


600 CRACKING CLAYS Supergroup
p 20

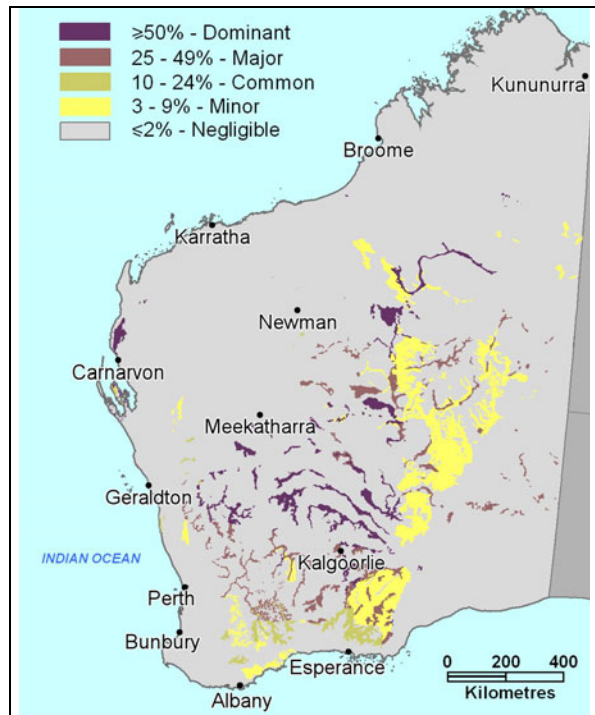


620 NON-CRACKING CLAYS Supergroup
p 20

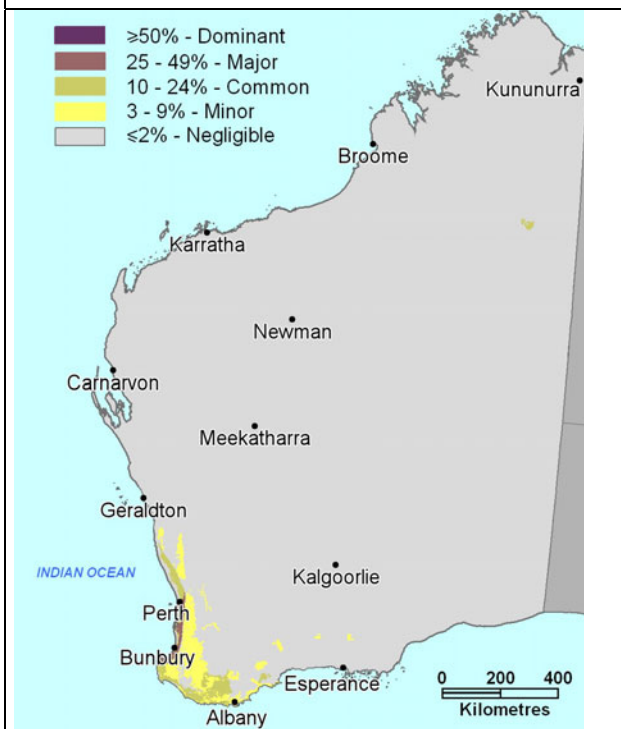
B. Distribution maps of Soil Groups in Western Australia



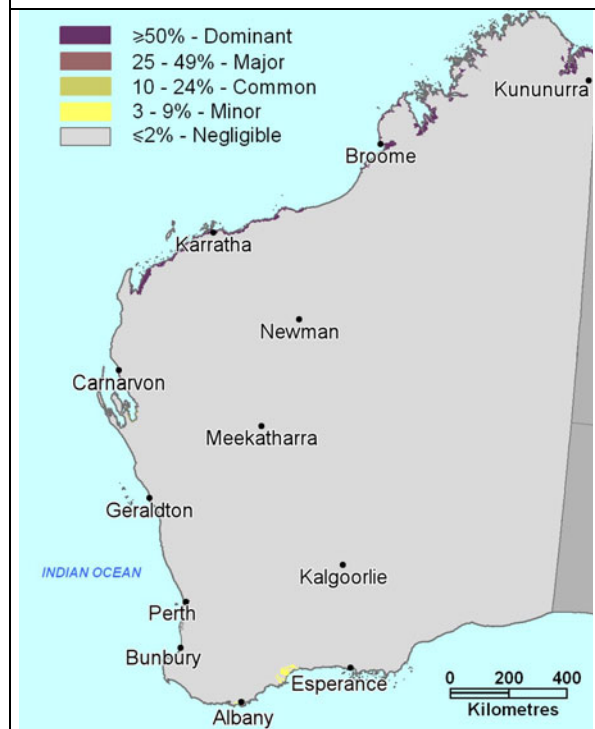
101 Saline wet soil
p 34



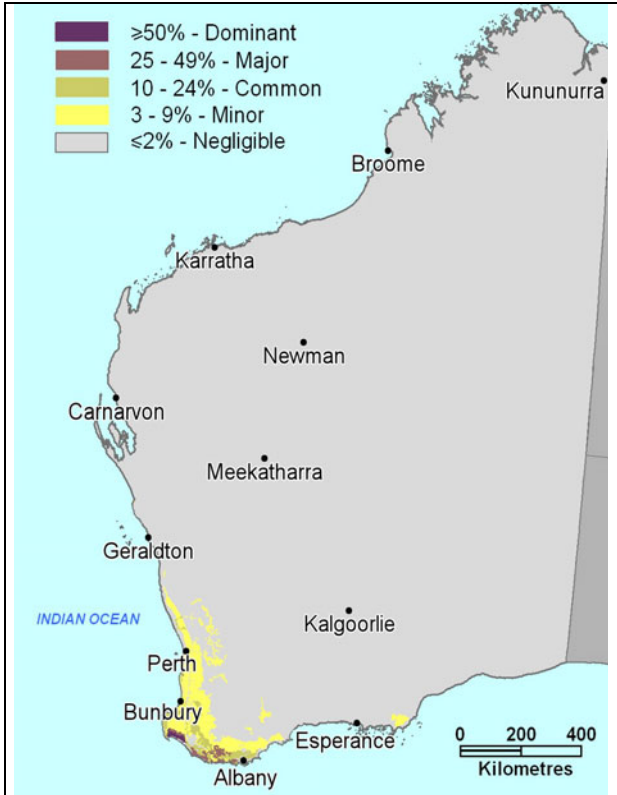
102 Salt lake soil
p 36



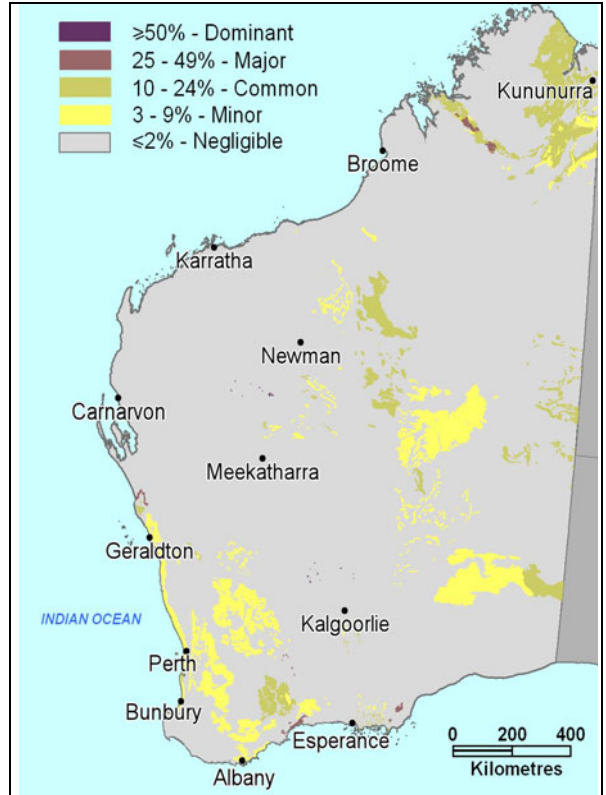
103 Semi-wet soil
p 38



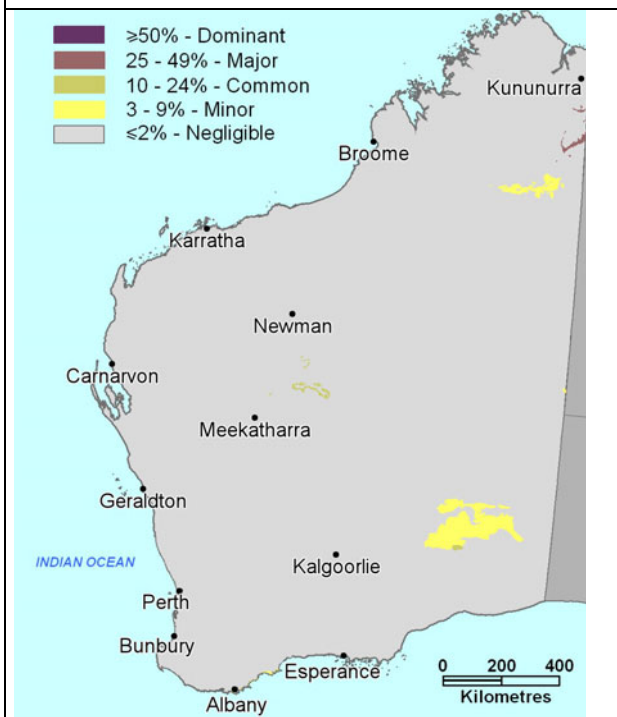
104 Tidal soil
p 40



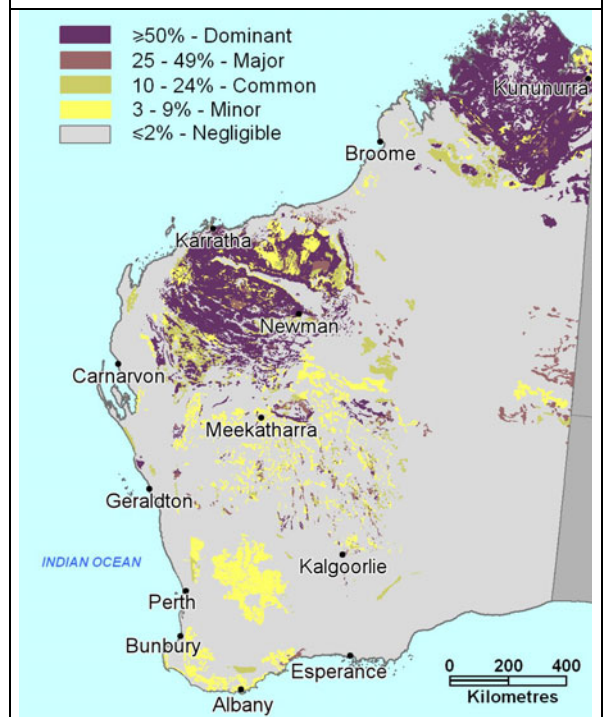
105 Wet soil
p 42



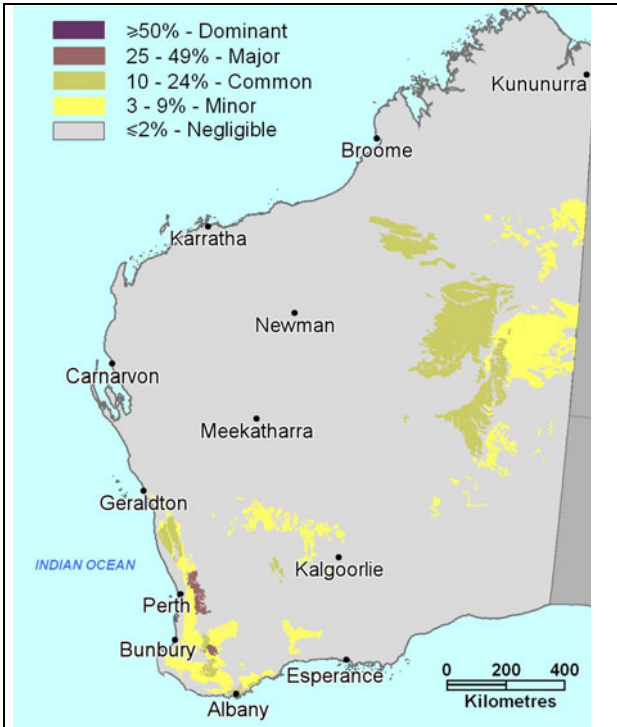
201 Bare rock
p 44



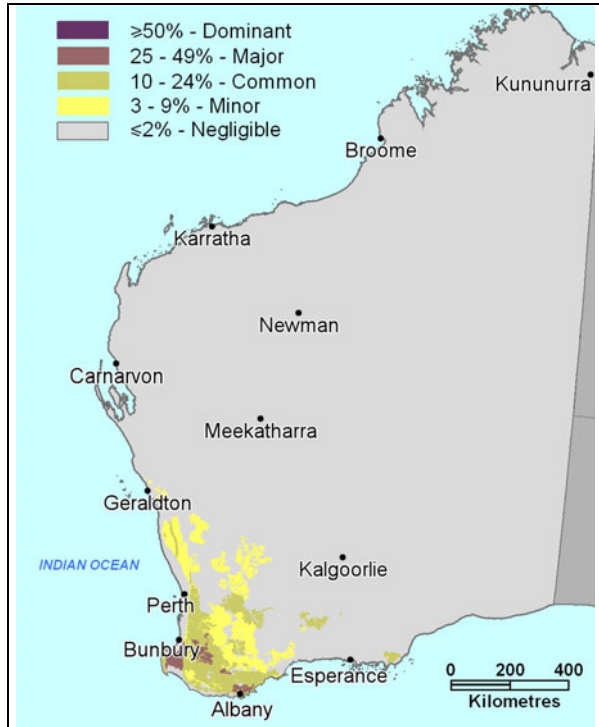
202 Calcareous stony soil
p 46



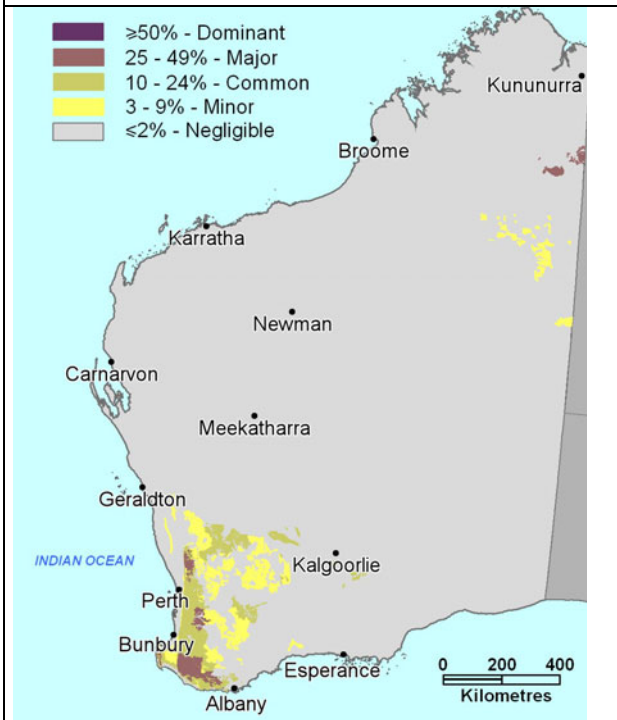
203 Stony soil
p 48



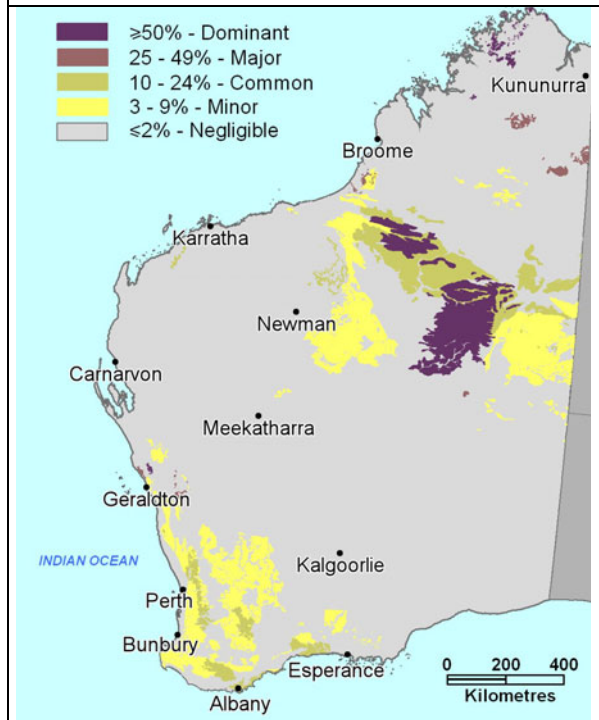
301 Deep sandy gravel
p 50



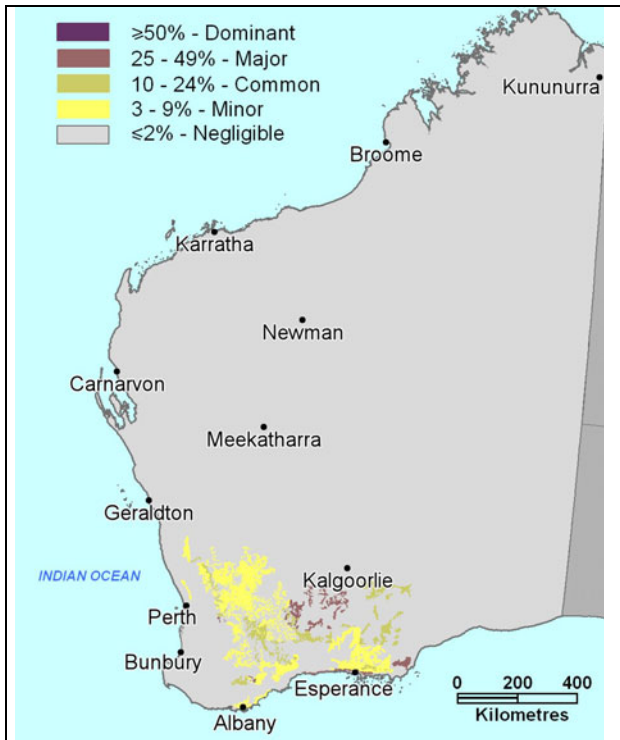
302 Duplex sandy gravel
p 52



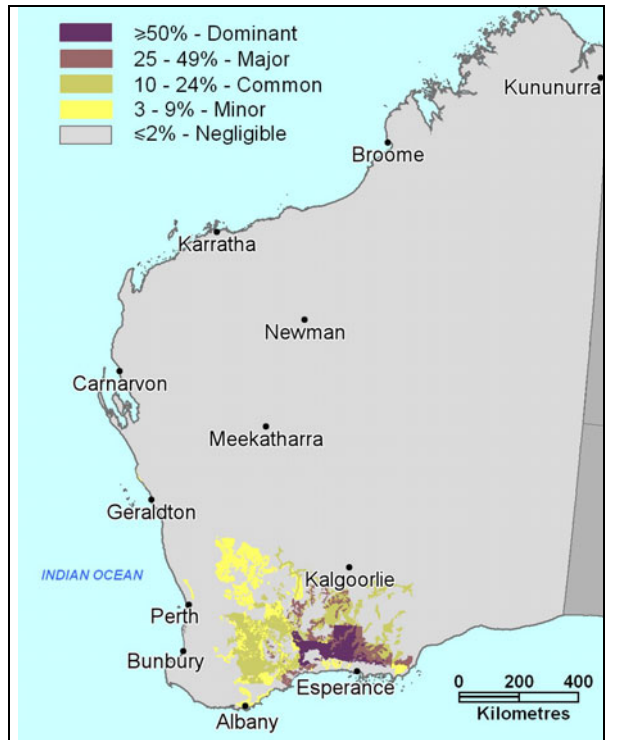
303 Loamy gravel
p 54



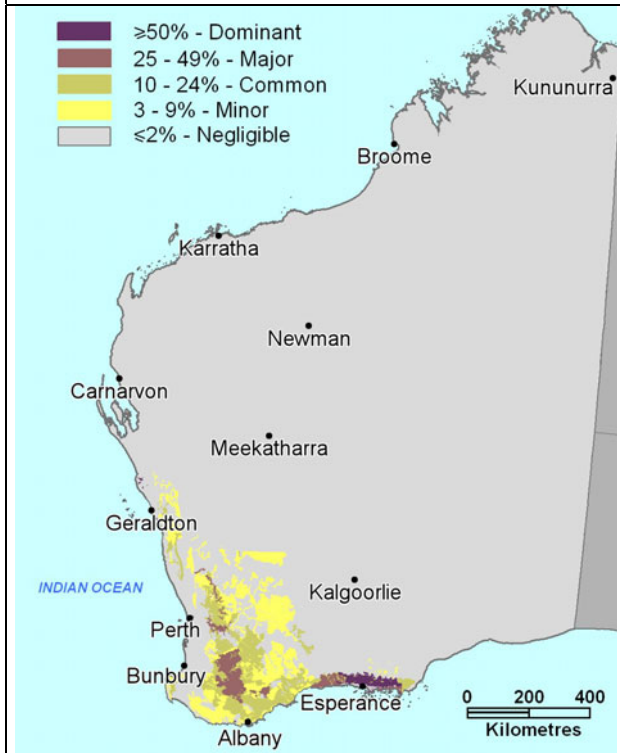
304 Shallow gravel
p 56



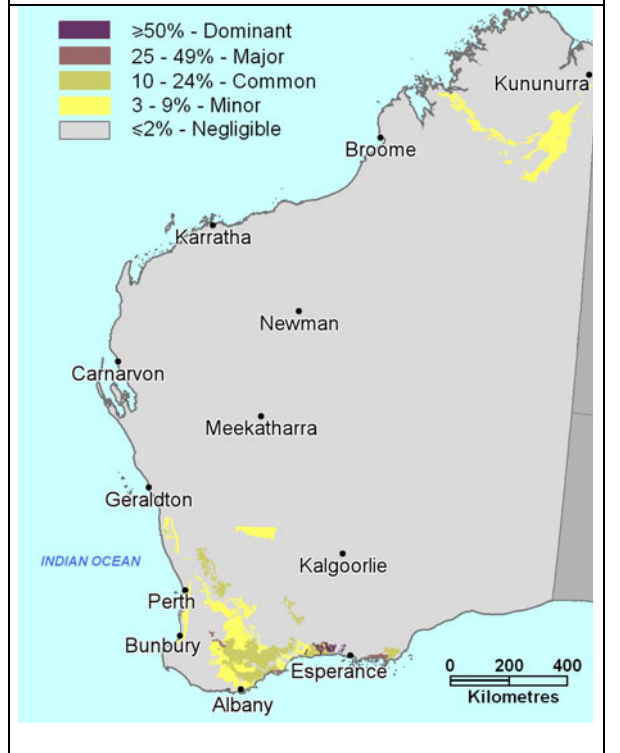
401 Alkaline grey deep sandy duplex
p 58



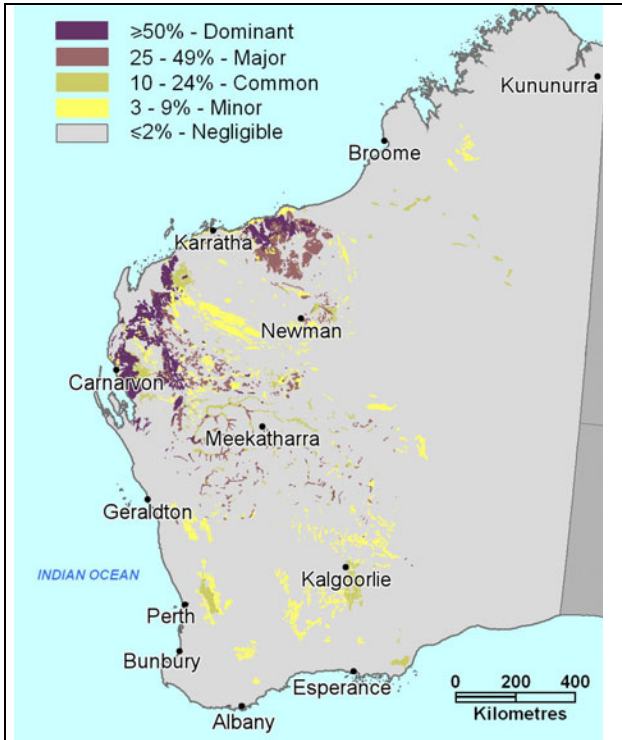
402 Alkaline grey shallow sandy duplex
p 60



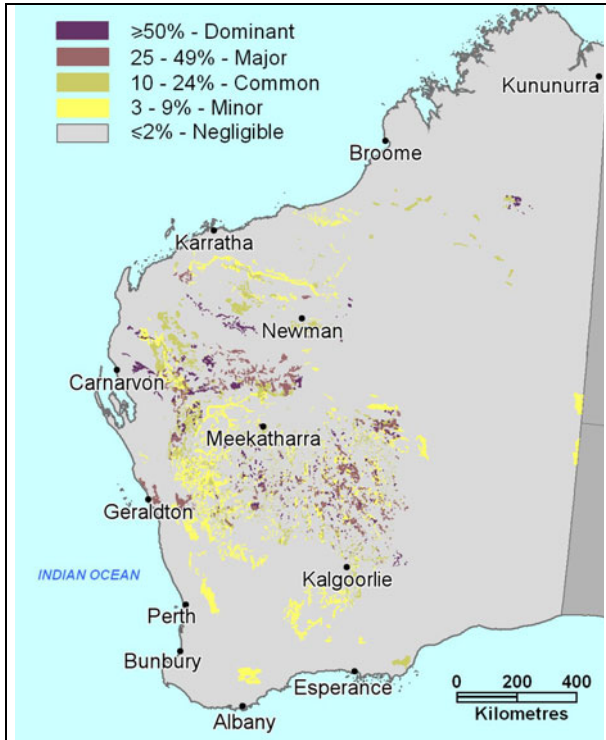
403 Grey deep sandy duplex
p 62



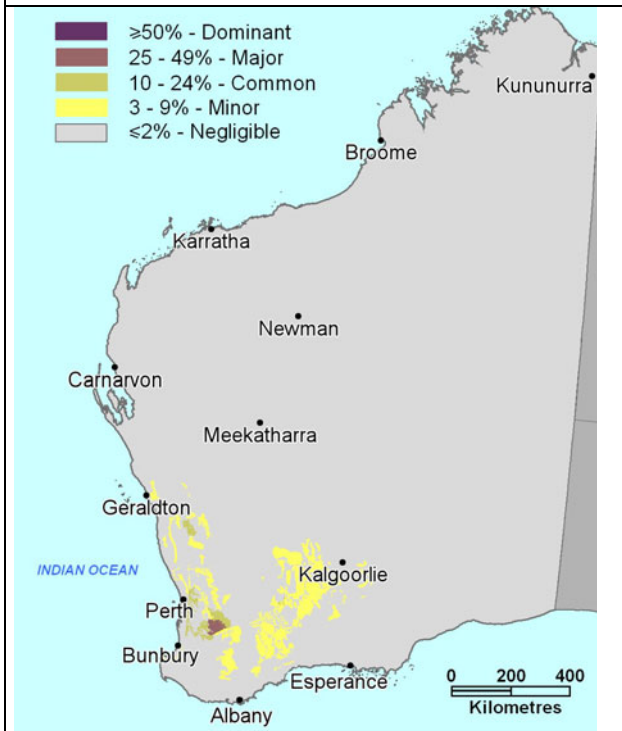
404 Grey shallow sandy duplex
p 64



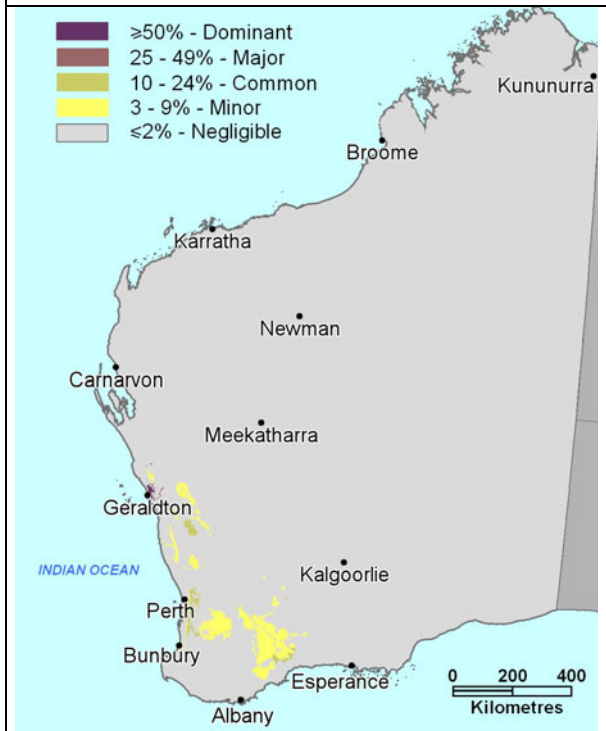
405 Red deep sandy duplex
p 66



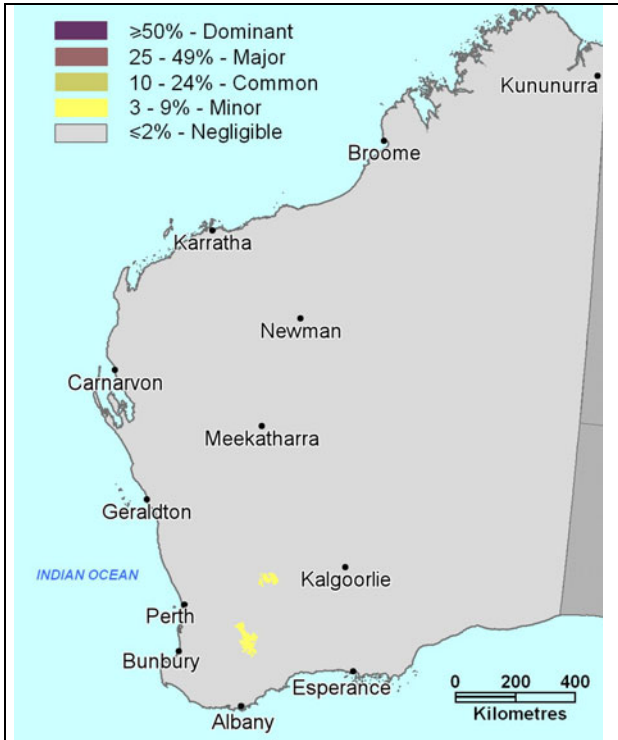
406 Red shallow sandy duplex
p 68



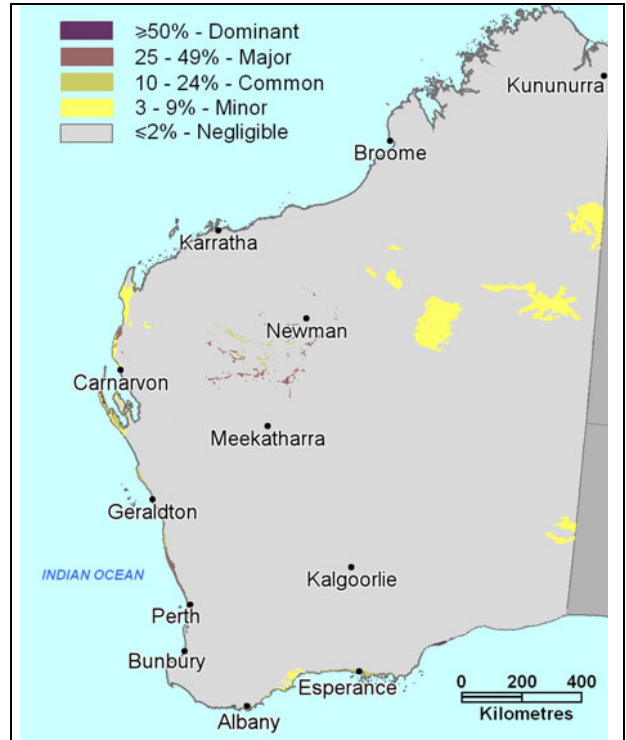
407 Yellow/brown deep sandy duplex
p 70



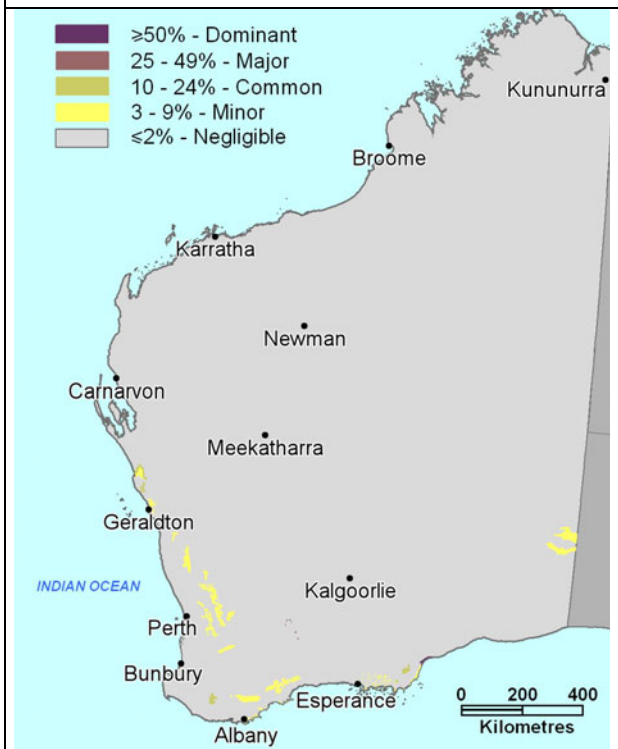
408 Yellow/brown shallow sandy duplex
p 72



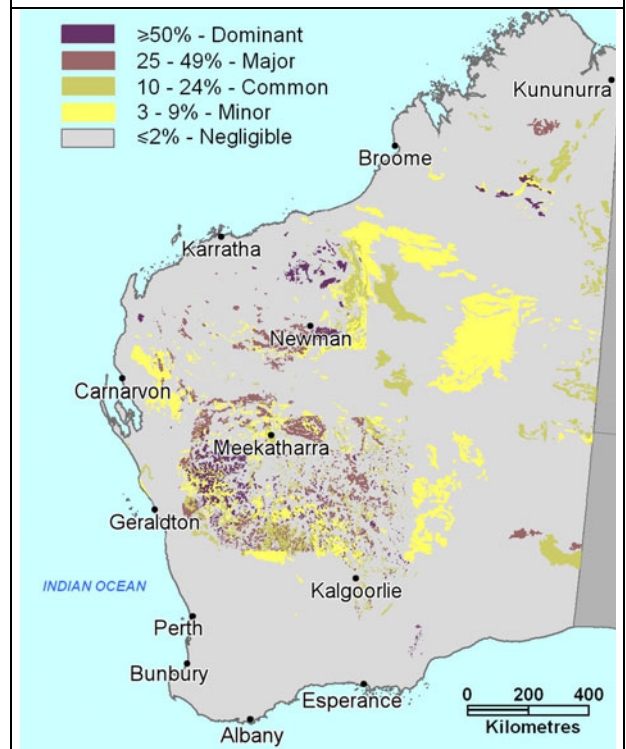
409 Reticulite deep sandy duplex
p 74



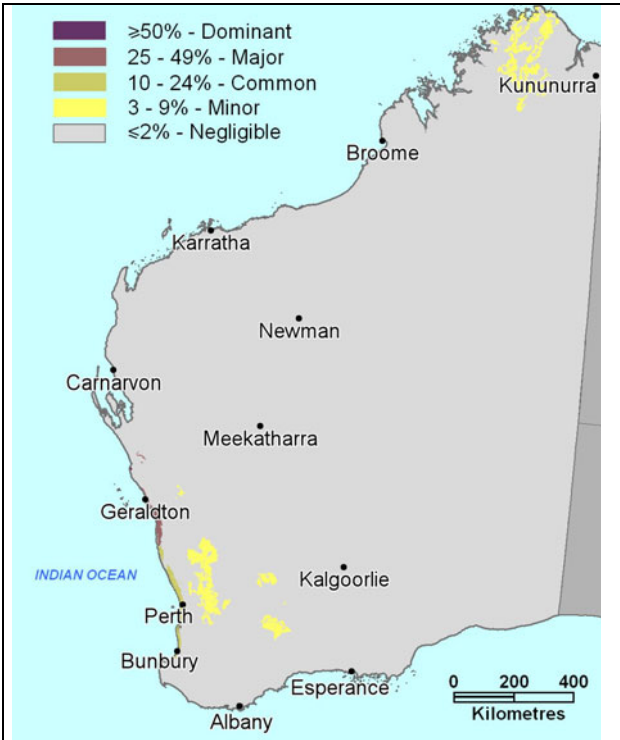
421 Calcareous shallow sand
p 76



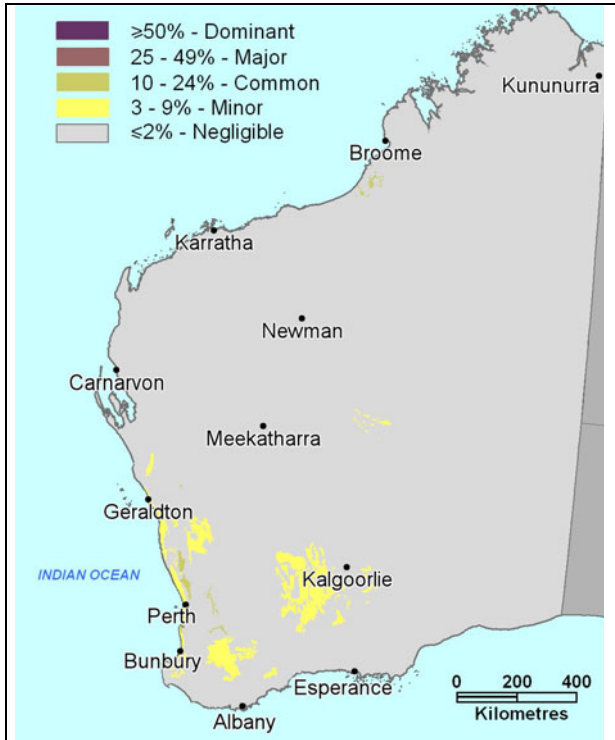
422 Pale shallow sand
p 78



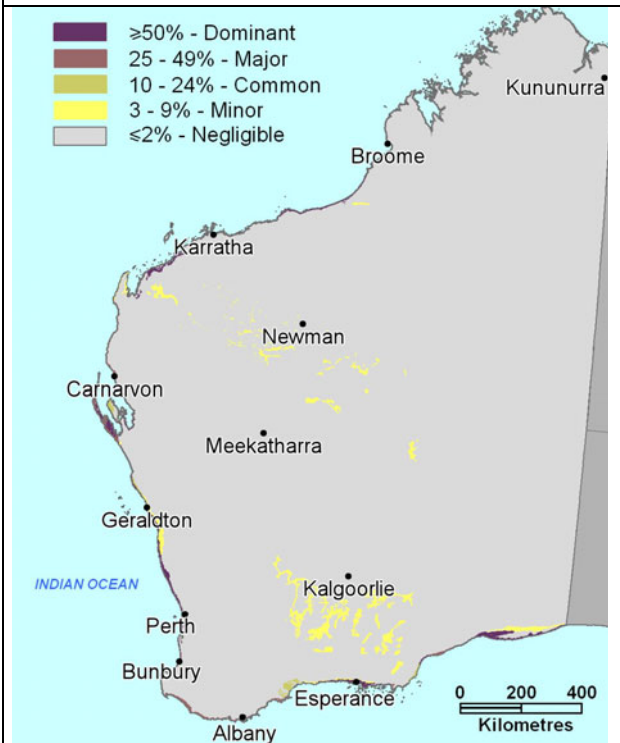
423 Red shallow sand
p 80



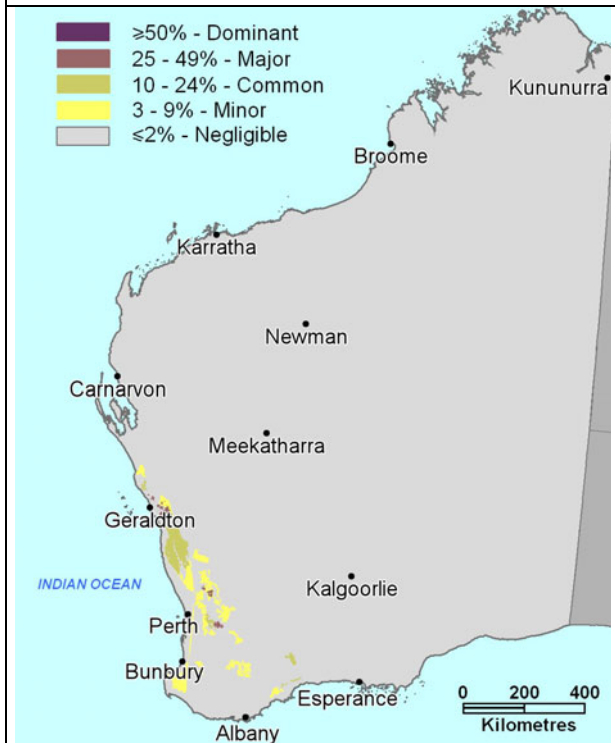
424 Yellow/brown shallow sand
p 82



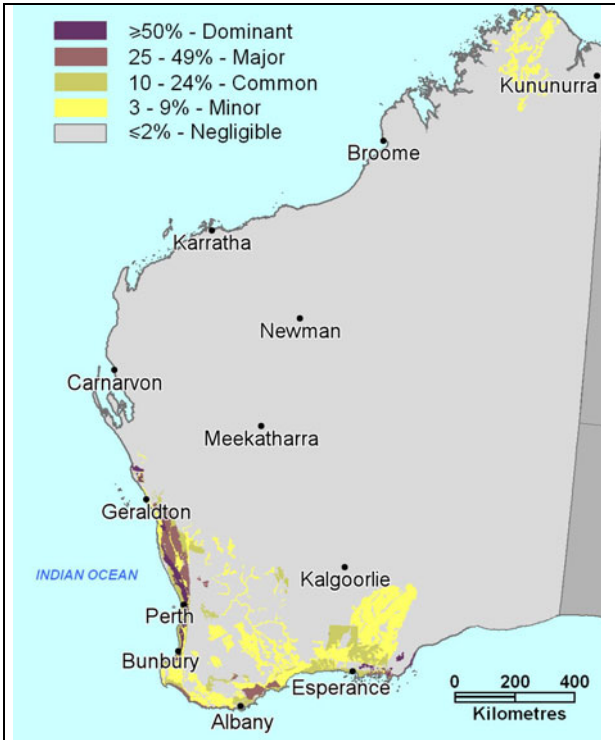
441 Brown deep sand
p 84



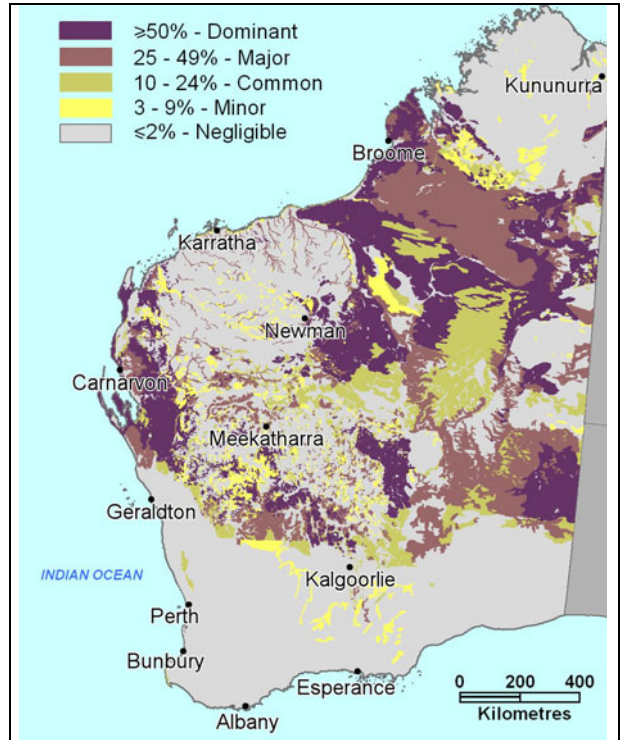
442 Calcareous deep sand
p 86



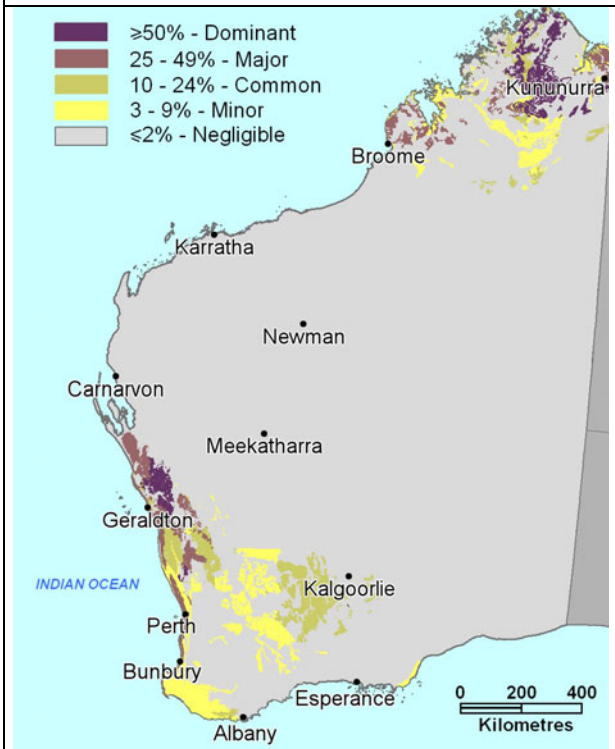
443 Gravelly pale deep sand
p 88



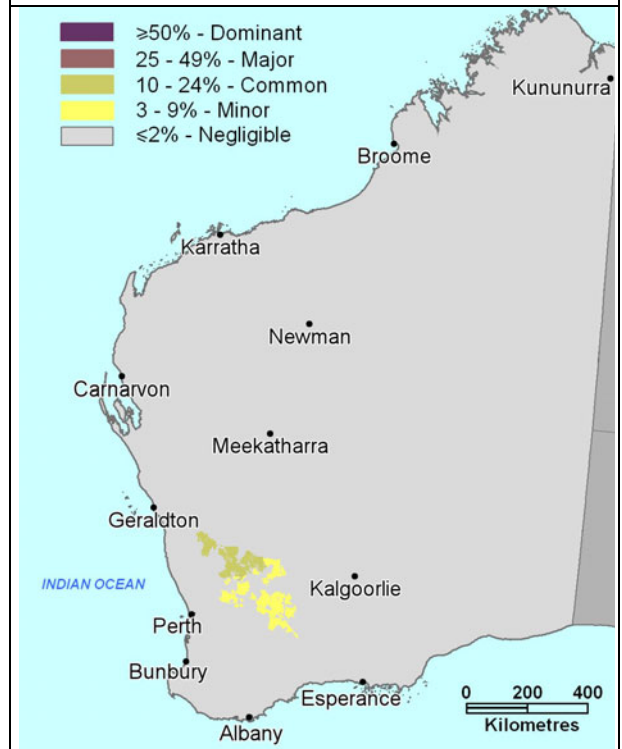
444 Pale deep sand
p 90



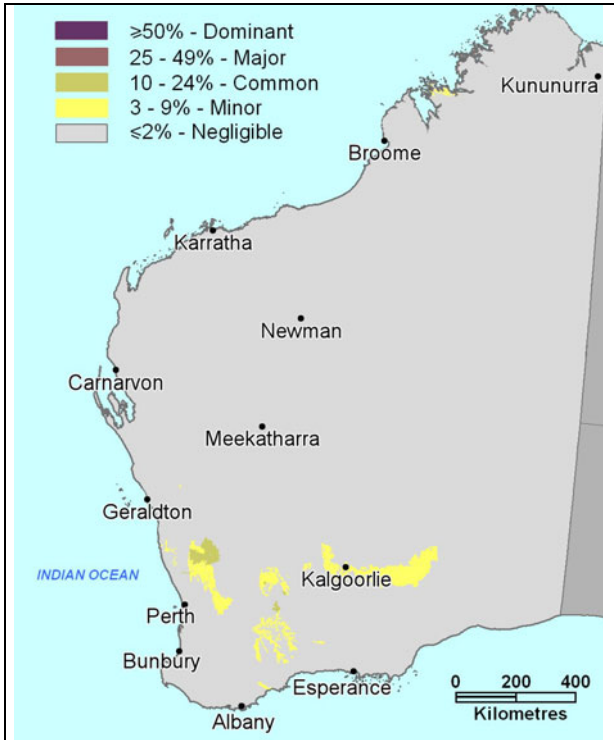
445 Red deep sand
p 92



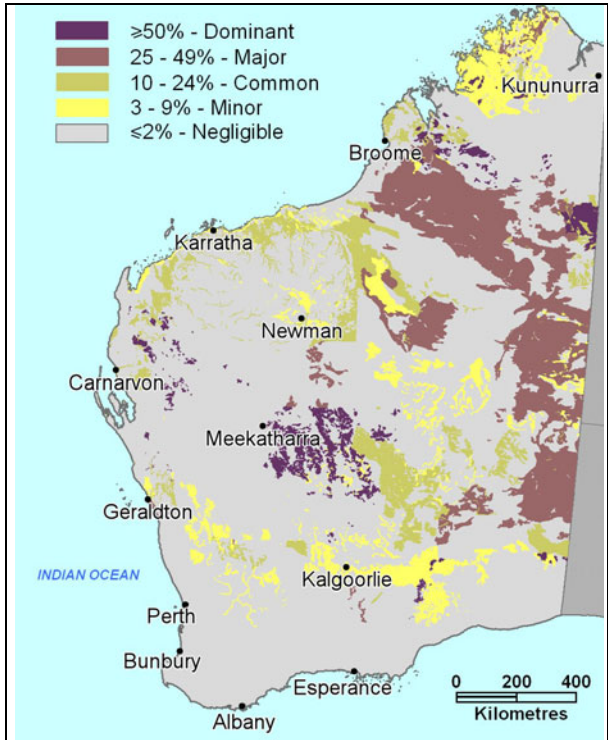
446 Yellow deep sand
p 94



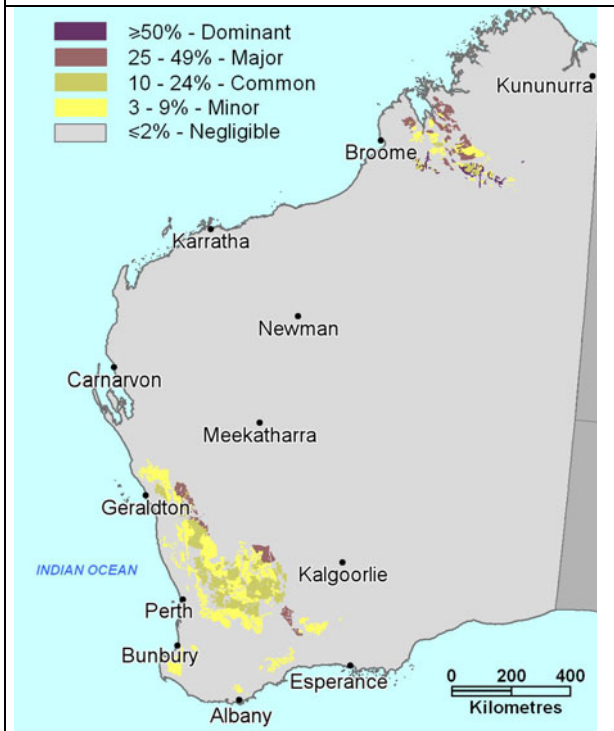
461 Acid yellow sandy earth
p 96



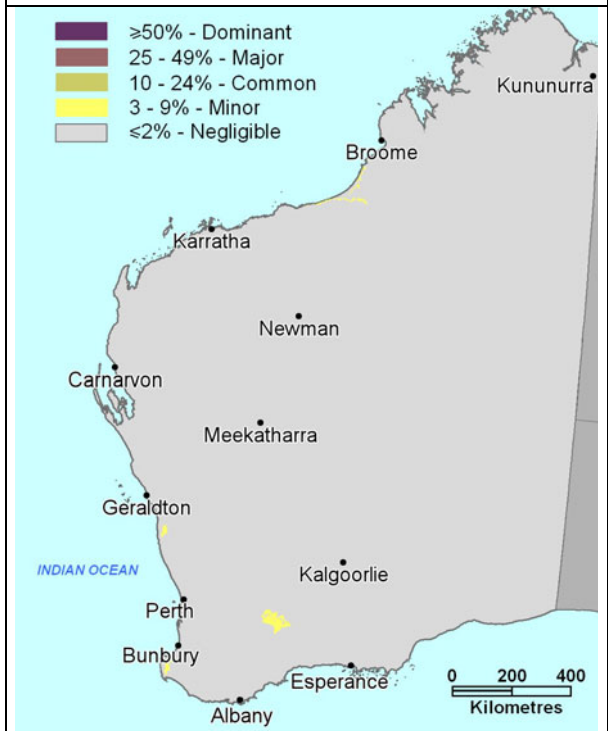
462 Brown sandy earth
p 98



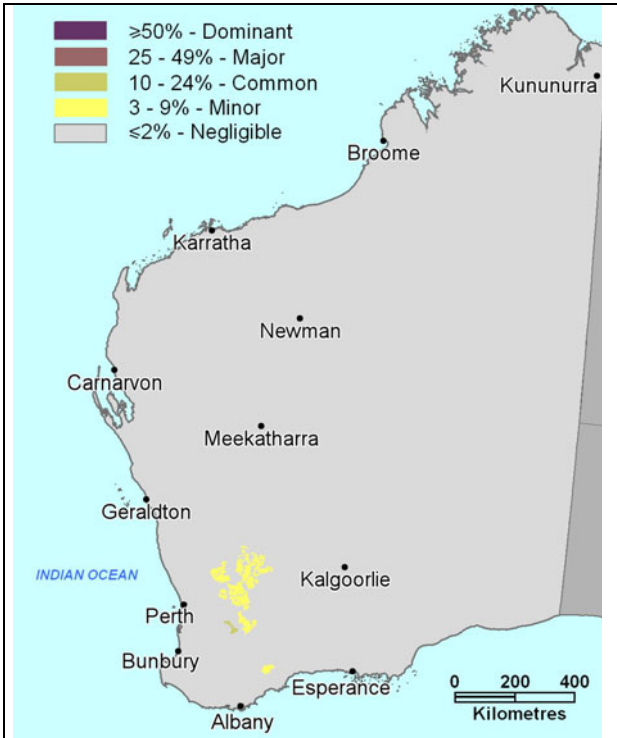
463 Red sandy earth
p 100



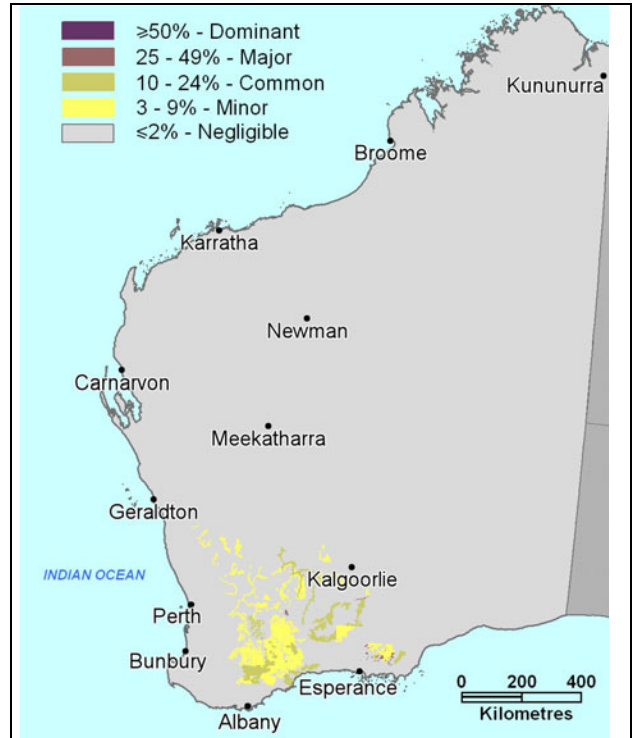
464 Yellow sandy earth
p 102



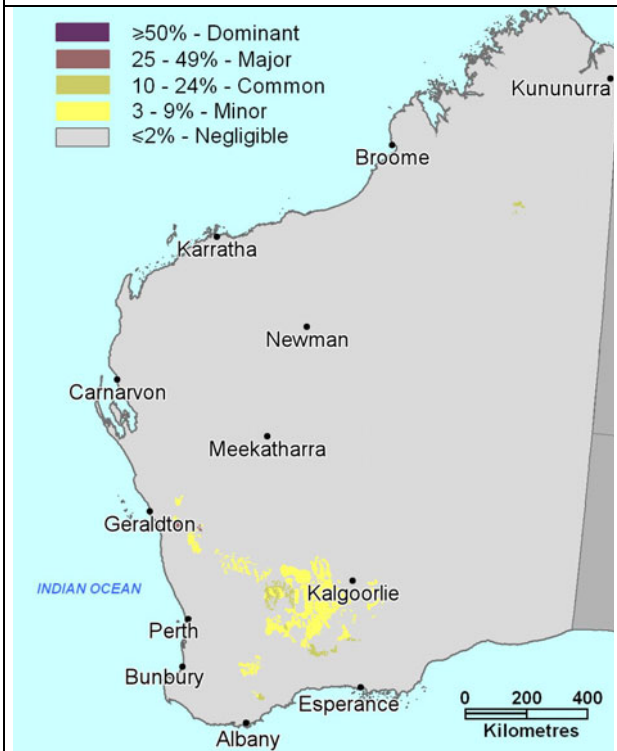
465 Pale sandy earth
p 104



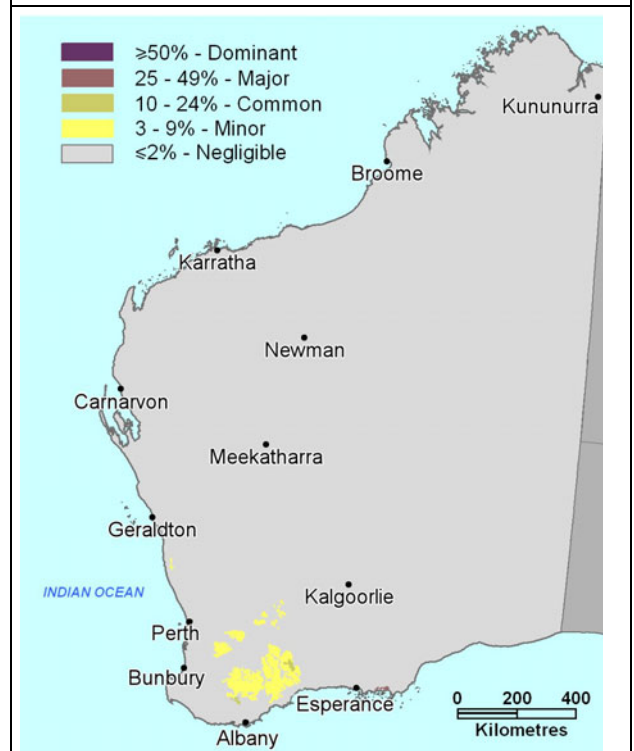
501 Acid shallow duplex
p 106



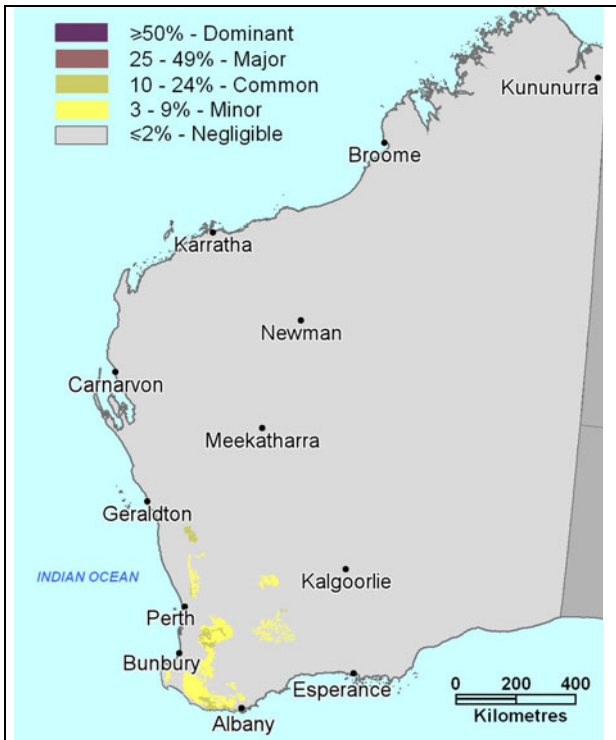
502 Alkaline grey shallow loamy duplex
p 108



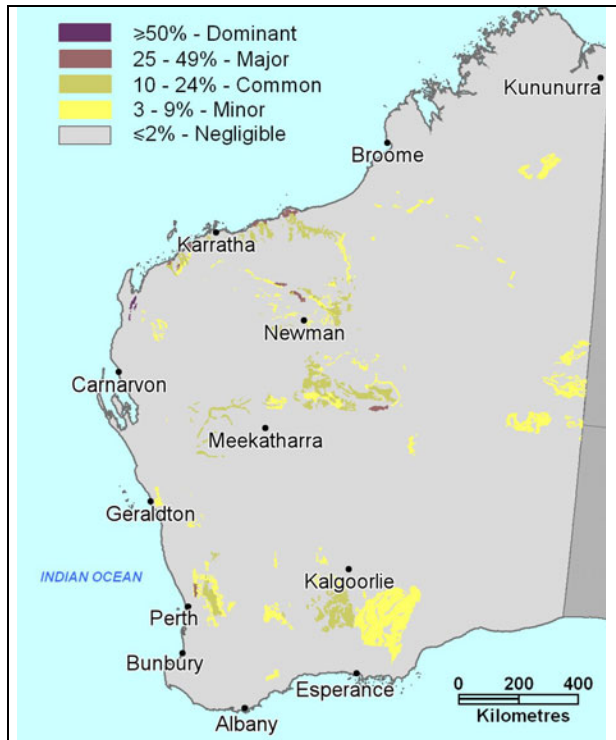
503 Alkaline red shallow loamy duplex
p 110



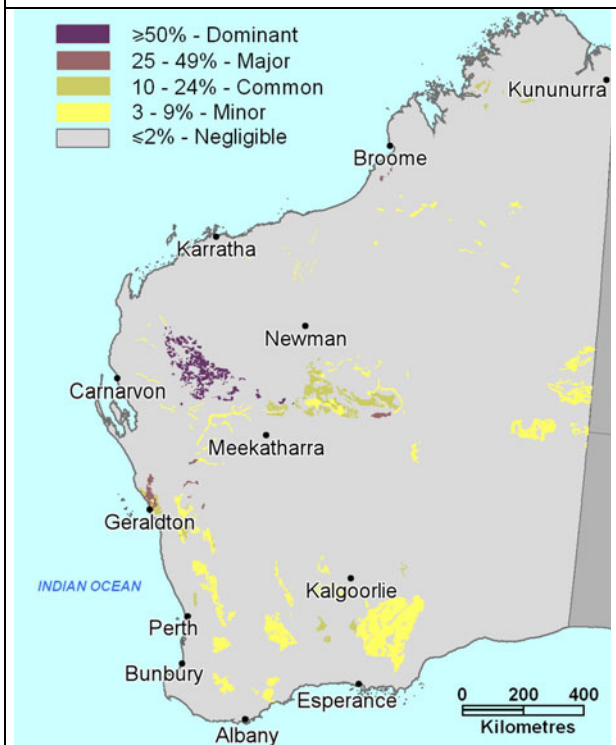
504 Grey shallow loamy duplex
p 112



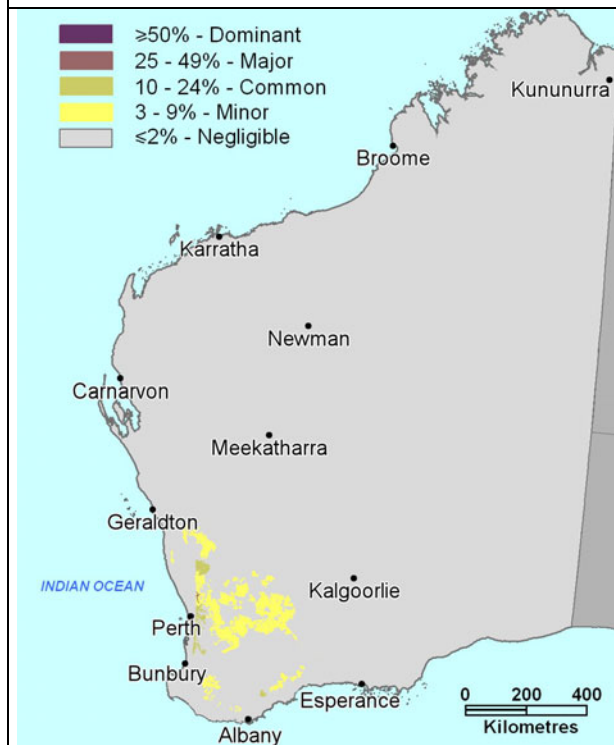
505 Brown deep loamy duplex
p 114



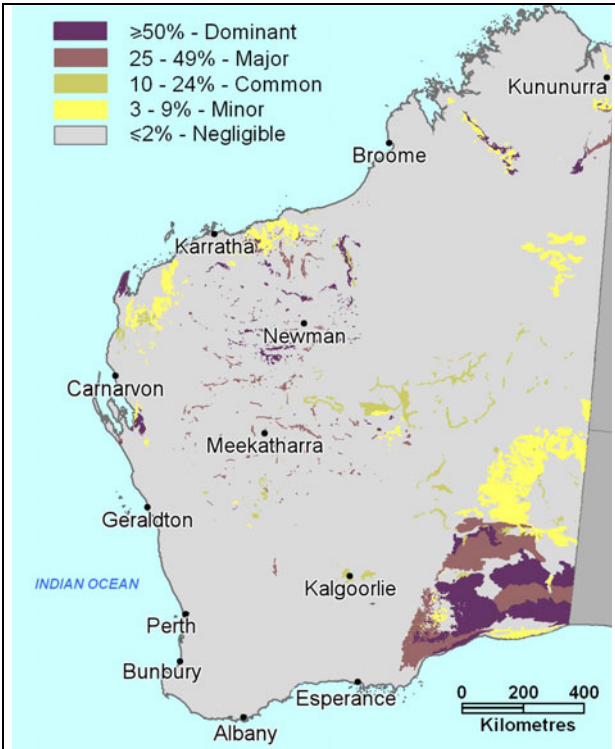
506 Red deep loamy duplex
p 116



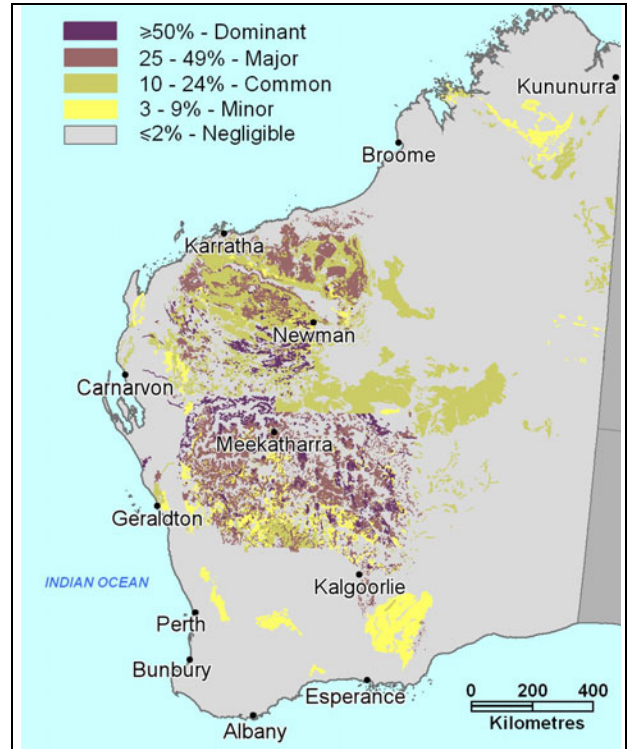
507 Red shallow loamy duplex
p 118



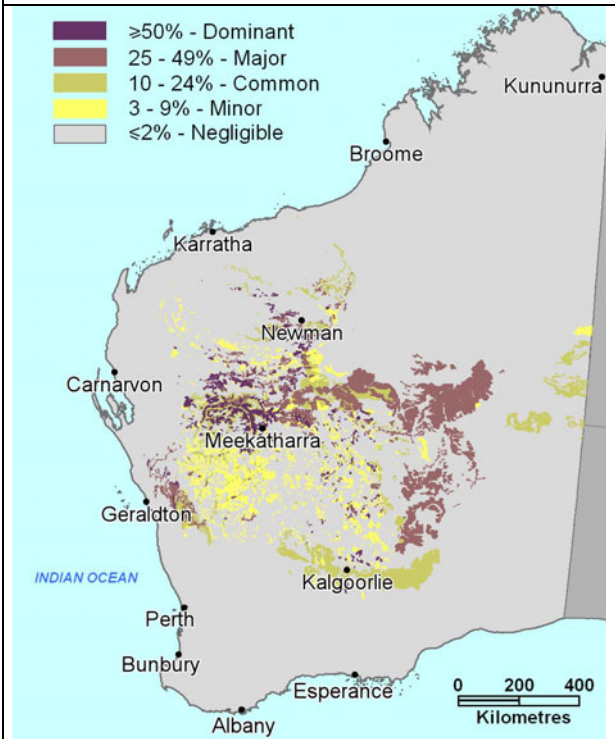
508 Yellow/brown shallow loamy duplex
p 120



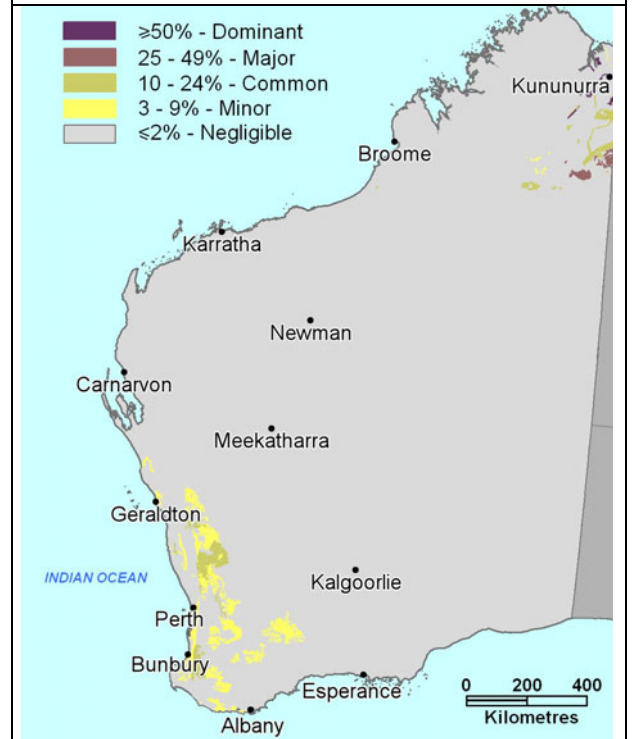
521 Calcareous shallow loam
p 122



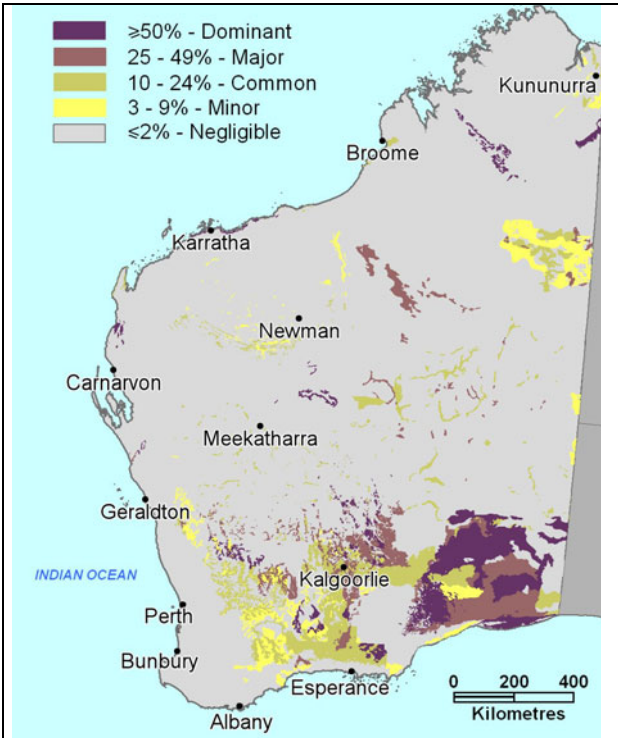
522 Red shallow loam
p 124



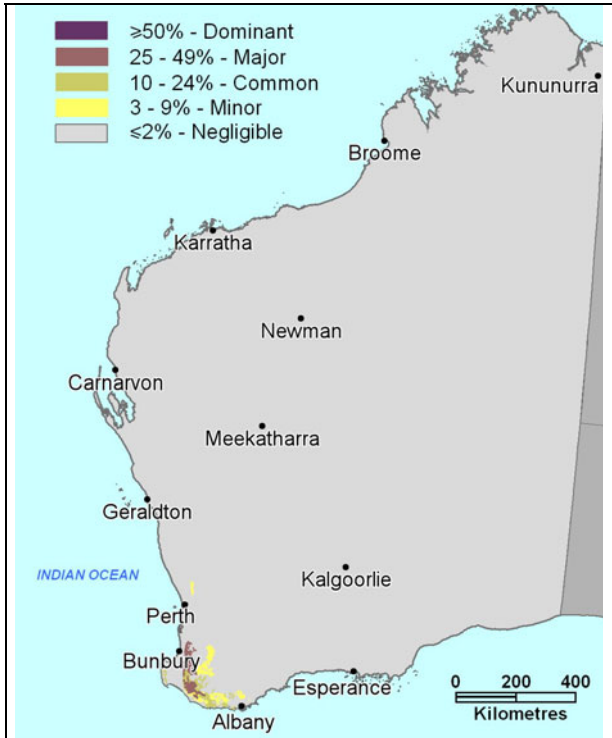
523 Red-brown hardpan shallow loam
p 126



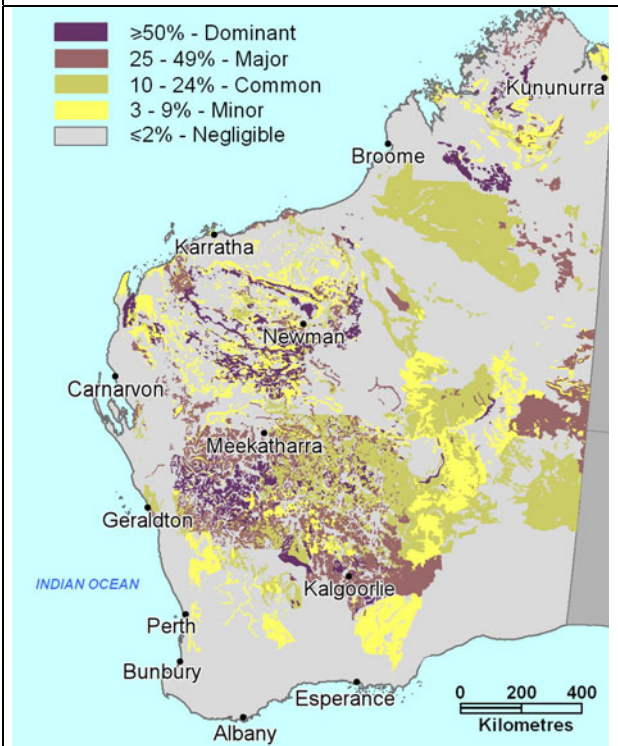
541 Brown loamy earth
p 128



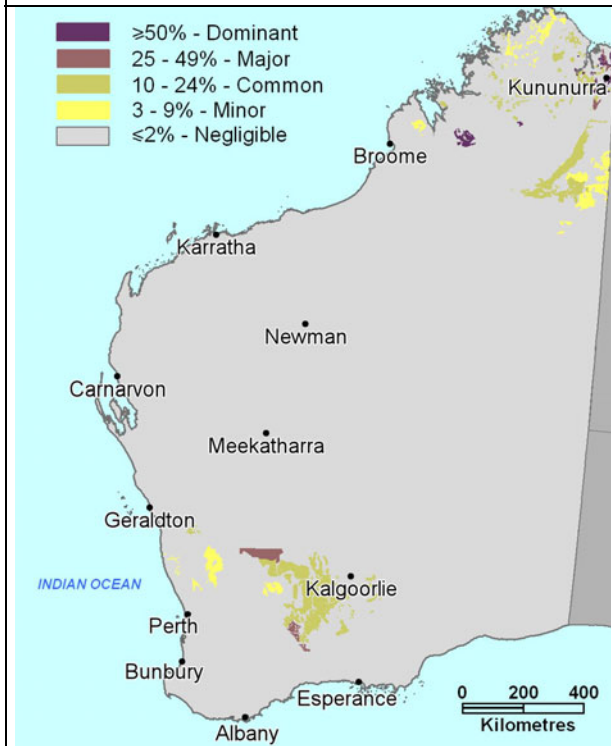
542 Calcareous loamy earth
p 130



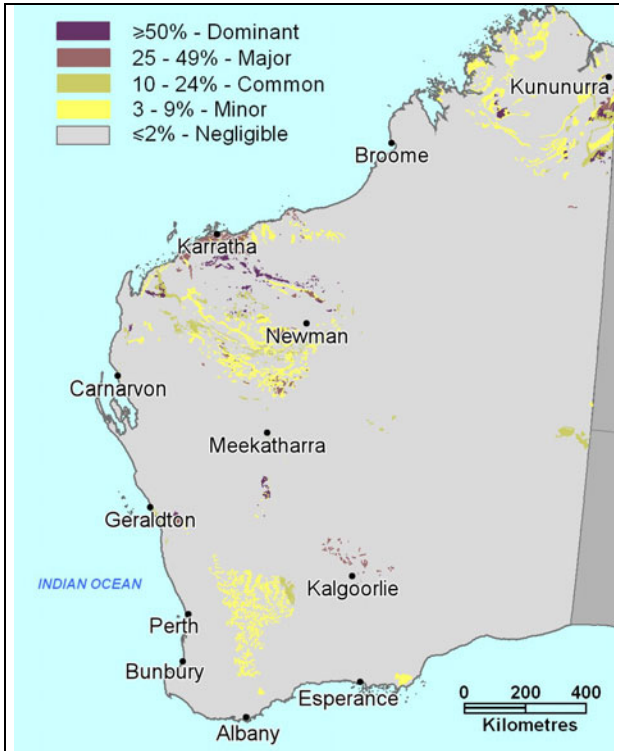
543 Friable red/brown loamy earth
p 132



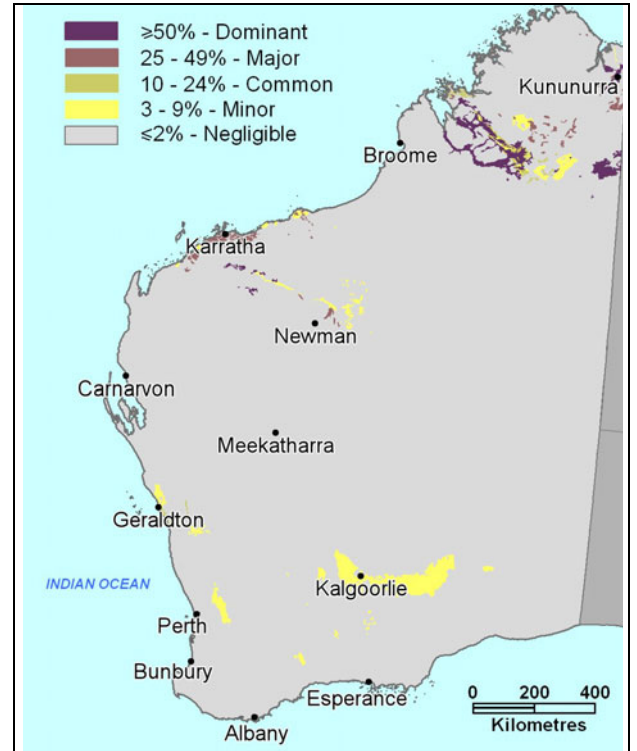
544 Red loamy earth
p 134



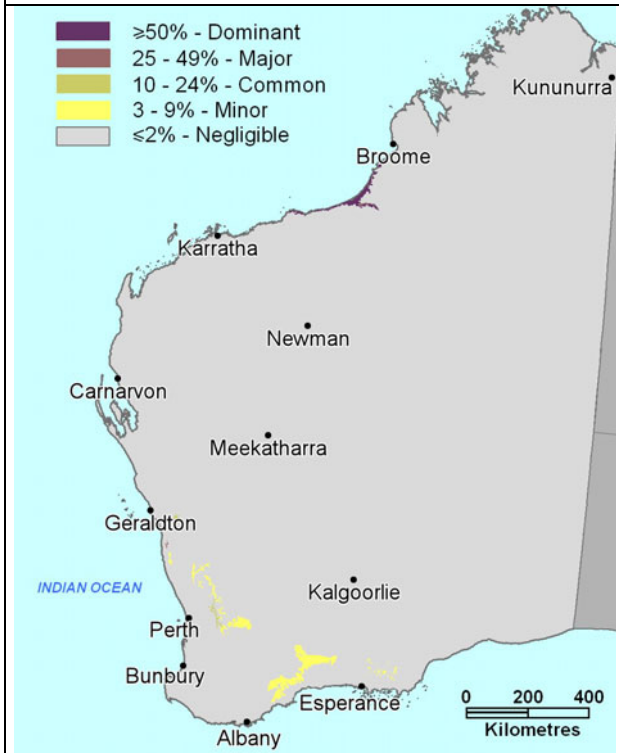
545 Yellow loamy earth
p 136



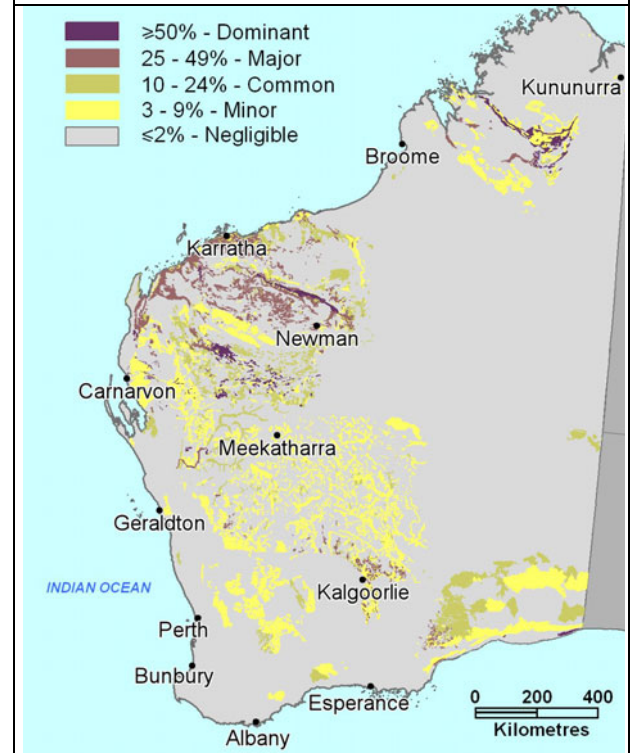
601 Hard cracking clay
p 138



602 Self-mulching cracking clay
p 140



621 Grey non-cracking clay
p 142



622 Red/brown non-cracking clay
p 144