

## Definitions of the Soil Supergroups

Soil Supergroup	Definition
<b>Wet or waterlogged soils</b>	Soils seasonally wet within 80 cm of the surface for a major part of the year
<b>Rocky or stony soils</b>	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).
<b>Ironstone gravelly soils</b>	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.
<b>Sandy duplexes</b>	Soils with a sandy surface and a texture contrast or a permeability contrast (reticulite) at 3 to 80 cm.
<b>Sandy earths</b>	Soils with a sandy surface and grading to loam by 80 cm. May be clayey at depth.
<b>Shallow sands</b>	Sands ≤80 cm over rock, hardpan or other cemented layer.
<b>Deep sands</b>	Sands >80 cm deep.
<b>Loamy duplexes</b>	Soils with a loamy surface and a texture contrast at 3 to 80 cm.
<b>Loamy earths</b>	Soils with a loamy surface and either loamy throughout or grading to clay by 80 cm.
<b>Shallow loams</b>	Loams ≤80 cm over rock, hardpan or other cemented layer.
<b>Cracking clays</b>	Soils that have a clayey surface at least 30 cm thick and crack strongly when dry.
<b>Non-cracking clays</b>	Soils that have a clayey surface at least 30 cm thick and do not crack strongly when dry.
<b>Miscellaneous soils</b>	Other soils.

## Properties of the Soil Supergroups

### Soil attributes (dominant values)<sup>1</sup>

Soil Supergroup name	Water repellence	Soil structure decline	Subsurface acidification	Surface condition	Unrestricted rooting depth	Available water storage	Subsurface compaction	pH 0-10 cm	pH 50-80 cm	Soil permeability	Soil workability	Wind erodibility
<b>Wet or waterlogged soils</b>	L to M	L or na	L to H	va	XS to M	L to M	L or na	Ac to Ak	va	VS	va	L to M
<b>Rocky or stony soils</b>	L to na	L or na	L or na	va	VL to L	VL to L	L to M or na	N to Ak	va or na	va	VP to P	va
<b>Ironstone gravelly soils</b>	L to M	L	L to M	Lo to Fm	va	VL to M	L to M	N to Ac	N or na	M to MR	F to G	L to M
<b>Sandy duplexes</b>	L to H	L to M	L to M	va	Sh to M	L to M	L to M	N to Ac	va	S to M	F to G	M to H
<b>Sandy earths</b>	L to M	L	L to M	Lo to Fm	va	M	N to H	SA to N	va	M to MR	G	M to H
<b>Shallow sands</b>	L to H	L	L to M	So to Lo	Sh to M	VL to L	L to M	va	va	MR to VR	G	H
<b>Deep sands</b>	L to H	L	va	So to LO	D to VD	L to M	L to M	va	va	R to VR	G	H
<b>Loamy duplexes</b>	L to H	M to H	L to H	Fm to Ha	S to M	L to M	L to M	va	va	M to S	va	L
<b>Shallow loams</b>	L	L to M	L	va	M	L	M	va	va	M	F	L
<b>Loamy earths</b>	L to va	L to M	L to M	va	M to D	M to H	L to M	va	va	M	F to G	va
<b>Cracking clays</b>	L	va	L	Fm Ha Sm	M	M	L	N	N to Ak	M to S	va	L to M
<b>Non-cracking clays</b>	L	M to H	L	Fm to Ha	M	L to M	L	N	N to Ac	MS to S	F to P	L
<b>Miscellaneous soils</b>	va	va	va	va	va	va	va	va	va	va	va	va

#### Legend for soil attribute values

Ac	Acid	Ha	Hardsetting	P	Poor	va	Variable
Ak	Alkaline	L	Low	PA	Presently acid	VD	Very deep
C	Cracking	Lo	Loose	R	Rapid	VL	Very low
D	Deep	M	Moderate	S	Slow	VP	Very poor
F	Fair	MR	Moderately rapid	SA	Strongly acid	VR	Very rapid
Fm	Firm	MS	Moderately slow	Sh	Shallow	VS	Very slow
G	Good	N	Neutral	SM	Self-mulching	XS	Very shallow
H	High	na	Not applicable	So	Soft		

<sup>1</sup> See Appendix: *Soil attributes* for definitions of attributes and values

# Saline wet soil

## Soil Group 101

*Distribution map p. 99*

*Colour picture p. 116*

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, Saltland

### 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

### Soil attributes (dominant values)

Water repellence	Low
Soil structure decline	Low
Subsurface acidification	Low
Surface condition	Firm
Unrestricted rooting depth	Very shallow
Available water storage	Low

Subsurface compaction	Low
pH 0-10 cm	Neutral to acid
pH 50-80 cm	Neutral
Soil permeability	Very slow
Soil workability	Poor
Wind erodibility	Low to moderate

### 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

# Salt lake soil

## Soil Group 102

*Distribution map p. 99*

*Colour picture p. 116*

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 soil

### 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, and Lake McLeod north of Carnarvon

### Soil attributes (dominant values)

Water repellence	na
Soil structure decline	Low
Subsurface acidification	na
Surface condition	Variable
Unrestricted rooting depth	Very shallow
Available water storage	na

Subsurface compaction	na
pH 0-10 cm	Neutral to alkaline
pH 50-80 cm	Alkaline
Soil permeability	Very slow
Soil workability	Very poor
Wind erodibility	Low to moderate

### 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

Distribution map p. 99

Colour picture p. 116

Non-saline soils waterlogged to 30-80 cm for a major part of the year  
(Does not include soils that have a temporary perched watertable, e.g. wet surface or subsurface layer, such as an A<sub>2</sub>, over a dry clay).

### Characteristics

- Low er 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. A texture contrast horizon (often clay) may occur below 80 cm
- Common in plains with elevated fresh watertables

### 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

### Soil attributes (dominant values)

Water repellence	Low to moderate	Subsurface compaction	Low
Soil structure decline	Low	pH 0-10 cm	Neutral to acid
Subsurface acidification	Moderate to high	pH 50-80 cm	Neutral to acid
Surface condition	Loose to firm	Soil permeability	Very slow
Unrestricted rooting depth	Moderate	Soil workability	Good
Available water storage	Low to moderate	Wind erodibility	Low to moderate

### 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

# Tidal soil

## Soil Group 104

*Distribution map p. 99*

*Colour picture p. 116*

Soils subject to tidal inundation

### Characteristics

- Variable saline soils subject to tidal inundation

### Local names

Mangrove soil

### 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, especially parts of the Pilbara and Kimberley coastlines

### Soil attributes (dominant values)

Water repellence	Low
Soil structure decline	na
Subsurface acidification	na
Surface condition	na
Unrestricted rooting depth	Very shallow
Available water storage	na

Subsurface compaction	na
pH 0-10 cm	Alkaline
pH 50-80 cm	Alkaline
Soil permeability	Very slow
Soil workability	Very poor
Wind erodibility	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

*Distribution map p. 100*

*Colour picture p. 116*

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 watertables

### Local names

Swamp 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
- Scattered in other areas

### Soil attributes (dominant values)

Water repellence	Low to moderate	Subsurface compaction	Low
Soil structure decline	Low	pH 0-10 cm	Acid to strongly acid
Subsurface acidification	High	pH 50-80 cm	Acid to strongly acid
Surface condition	Loose to firm	Soil permeability	Very slow
Unrestricted rooting depth	Shallow to moderate	Soil workability	Poor
Available water storage	Low to moderate	Wind erodibility	Low to moderate

### Land use considerations

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

# Bare rock

## Soil Group 201

*Distribution map p. 100*

*Colour picture p. 116*

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

### Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

- *Not applicable*
- *Leptic Rudosol*

### Main occurrences in Western Australia

- Widespread, but rarely common.
- Most common in the Kimberley, Pilbara and parts of the South-west

### Soil attributes (dominant values)

Water repellence	na	Subsurface compaction	na
Soil structure decline	na	pH 0-10 cm	na
Subsurface acidification	na	pH 50-80 cm	na
Surface condition	na	Soil permeability	na
Unrestricted rooting depth	na	Soil workability	na
Available water storage	na	Wind erodibility	na

### 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

Distribution map p. 100

Colour picture p. 116

Soils which are stony or rocky and calcareous throughout

### Characteristics

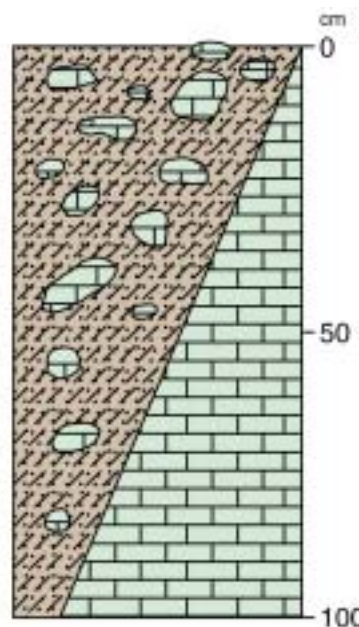
- Rocks and stones dominant throughout the profile
- Soil depth varies greatly over short distances
- Calcareous throughout
- Alkaline pH
- Usually very shallow, often over calcrete
- Sandy, loamy, clayey or gravelly soil matrix

### Local names

### 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

### Soil attributes (dominant values)

Water repellence	Low
Soil structure decline	Low
Subsurface acidification	Low
Surface condition	Firm
Unrestricted rooting depth	Shallow to moderate
Available water storage	Very low to moderate

Subsurface compaction	Low to moderate
pH 0-10 cm	Alkaline
pH 50-80 cm	Alkaline or na
Soil permeability	Variable
Soil workability	Poor
Wind erodibility	Variable

### 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

Distribution map p. 100

Colour picture p. 116

Soils which are coarse gravelly, stony or rocky throughout

### Characteristics

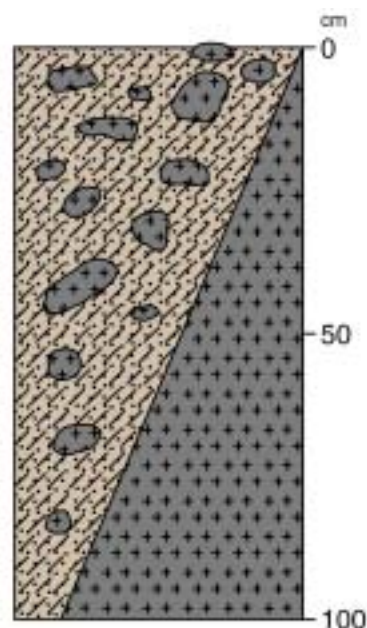
- Rocks and stones or coarse gravels dominant throughout the
- Usually very shallow
- Sandy, loamy, clayey or gravelly soil matrix
- Neutral to acid pH

### Local names

### Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

- *Lithosolic Clastic Rudosol*
- *Leptic Rudosol*
- Kandosol
- Dermosol



### Main occurrences in Western Australia

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

### Soil attributes (dominant values)

Water repellence	Low
Soil structure decline	Low
Subsurface acidification	Variable
Surface condition	Firm to hardsetting
Unrestricted rooting depth	Very shallow to moderate
Available water storage	Low

Subsurface compaction	Low
pH 0-10 cm	Neutral
pH 50-80 cm	na
Soil permeability	Variable
Soil workability	Very poor
Wind erodibility	Low

### 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

Distribution map p. 101

Colour picture p. 116

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%, but 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

### 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

### Soil attributes (dominant values)

Water repellence	Moderate
Soil structure decline	Low
Subsurface acidification	Low to moderate
Surface condition	Soft to loose
Unrestricted rooting depth	Deep
Available water storage	Low

Subsurface compaction	Low to moderate
pH 0-10 cm	Neutral to acid
pH 50-80 cm	Neutral
Soil permeability	Moderately rapid
Soil workability	Good
Wind erodibility	Low to moderate

### Land use considerations

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

# Duplex sandy gravel

## Soil Group 302

Distribution map p. 101

Colour picture p. 116

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

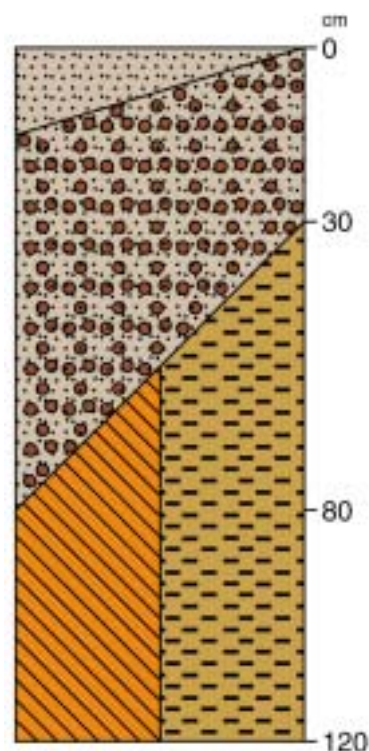
Buckshot gravel, Coarse gravel, Jarrah gravel, Sandy gravel, Gairdner gravelly duplex

### 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

### Soil attributes (dominant values)

Water repellence	Moderate
Soil structure decline	Low
Subsurface acidification	Low to moderate
Surface condition	Soft to loose
Unrestricted rooting depth	Moderate
Available water storage	Low to moderate

Subsurface compaction	Low to moderate
pH 0-10 cm	Neutral to acid
pH 50-80 cm	Neutral
Soil permeability	Moderately rapid
Soil workability	Fair to Good
Wind erodibility	Low to 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

Distribution map p. 101

Colour picture p. 117

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

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

### Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

- *Ferric Kandosol*
- Ferric Chromosol
- Ferric Dermosol

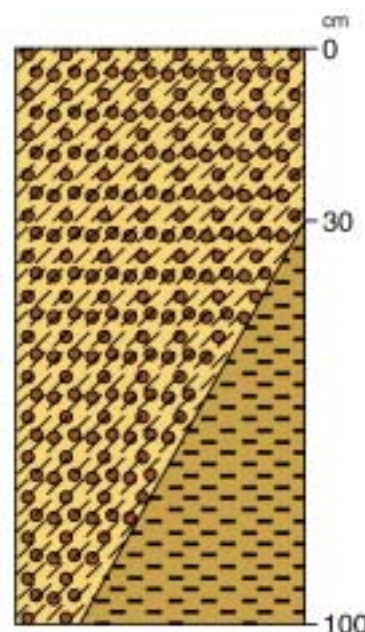
### Main occurrences in Western Australia

- 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

### Soil attributes (dominant values)

Water repellence	Low
Soil structure decline	Low
Subsurface acidification	Low to moderate
Surface condition	Loose to firm
Unrestricted rooting depth	Moderate to deep
Available water storage	Moderate

Subsurface compaction	Moderate
pH 0-10 cm	Neutral to acid
pH 50-80 cm	Neutral
Soil permeability	Moderate
Soil workability	Fair to good
Wind erodibility	Low



### Land use considerations

- High gravel content may limit water-holding capacity



# Shallow gravel

## Soil Group 304

Distribution map p. 101

Colour picture p. 117

Ironstone gravel soil over cemented gravels (ferricrete), rock or other hard or permanently cemented layers at  $\leq 80$  cm.

### Characteristics

- Yellow, brown, grey or sometimes red in top 30 cm
- Neutral to acid pH
- High gravel content (>20%, but 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

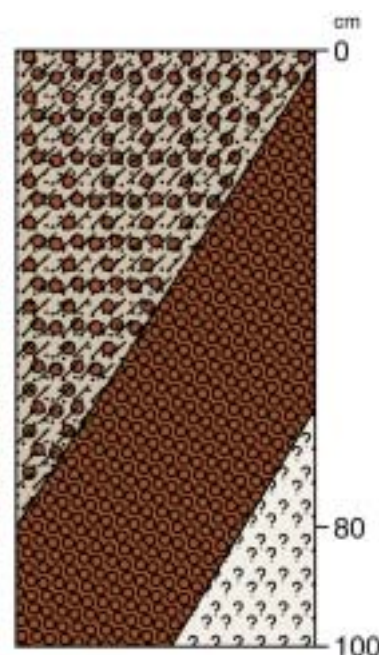
Buckshot gravel, Ironstone cap, Shallow gravel

### 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, southern rangelands and Kimberley
- Scattered throughout the arid interior

### Soil attributes (dominant values)

Water repellence	Low to Moderate
Soil structure decline	Low
Subsurface acidification	Low to moderate
Surface condition	Soft to firm
Unrestricted rooting depth	Shallow to Moderate
Available water storage	Very low

Subsurface compaction	Low
pH 0-10 cm	Neutral
pH 50-80 cm	Neutral or na
Soil permeability	Moderate
Soil workability	Fair
Wind erodibility	Low

### 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

Distribution map p. 102

Colour picture p. 117

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

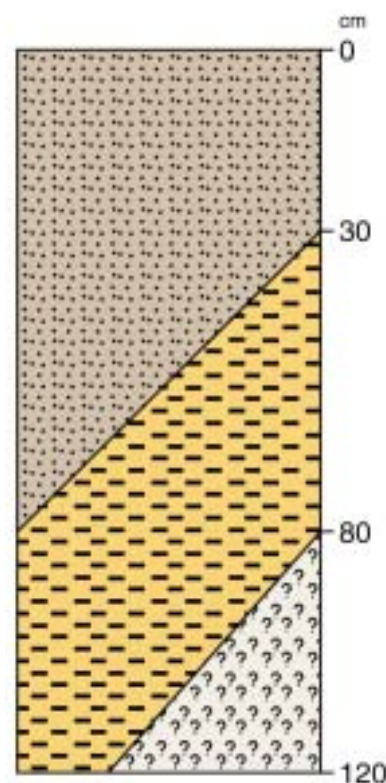
### Typical Australian Soil Classification (ASC)

(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



### Soil attributes (dominant values)

Water repellence	Moderate
Soil structure decline	Low
Subsurface acidification	Low
Surface condition	Loose
Unrestricted rooting depth	Moderate
Available water storage	Low

Subsurface compaction	Low to moderate
pH 0-10 cm	Neutral
pH 50-80 cm	Alkaline
Soil permeability	Moderately slow
Soil workability	Good
Wind erodibility	High

### Land use considerations

- Seasonal waterlogging over the clay may occur

# Alkaline grey shallow sandy duplex

## Soil Group 402

Distribution map p. 102

Colour picture p. 117

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 hardsetting

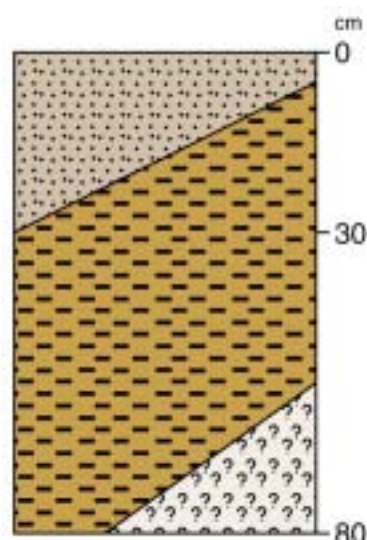
### Local names

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 Stirlings

### Soil attributes (dominant values)

Water repellence	Low to Moderate
Soil structure decline	Low to moderate
Subsurface acidification	Low
Surface condition	Loose to firm
Unrestricted rooting depth	Shallow
Available water storage	Low

Subsurface compaction	Low to moderate
pH 0-10 cm	Neutral
pH 50-80 cm	Alkaline
Soil permeability	Slow
Soil workability	Fair to good
Wind erodibility	Moderate

### Land use considerations

- Sandy topsoil may be seasonally waterlogged
- Subsoils are frequently dispersive



# Grey deep sandy duplex

## Soil Group 403

Distribution map p.102

Colour picture p.117

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

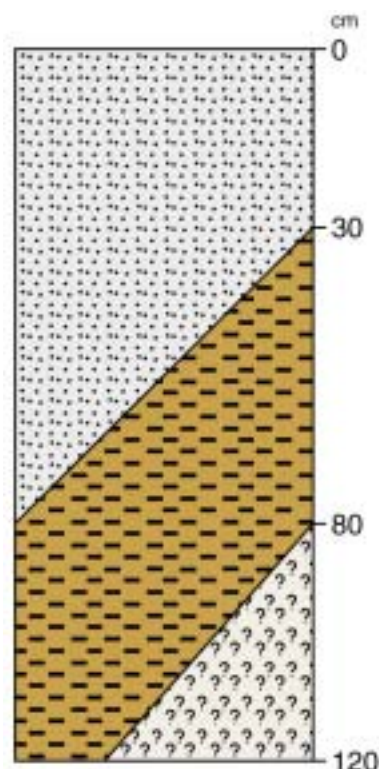
### Typical Australian Soil Classification (ASC)

(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



### Soil attributes (dominant values)

Water repellence	High
Soil structure decline	Low
Subsurface acidification	Moderate
Surface condition	Loose
Unrestricted rooting depth	Moderate
Available water storage	Low to moderate

Subsurface compaction	Low to moderate
pH 0-10 cm	Acid
pH 50-80 cm	Neutral to acid
Soil permeability	Moderately slow
Soil workability	Good
Wind erodibility	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

Distribution map p. 102

Colour picture p. 117

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

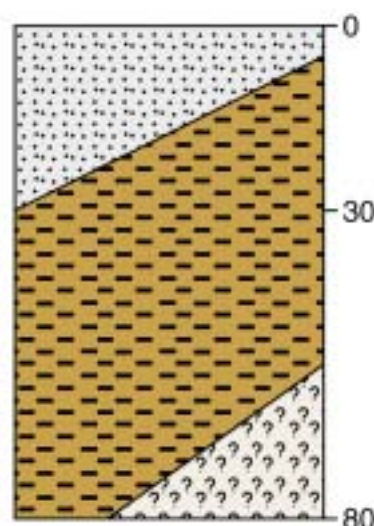
### Local names

Duplex soil, White gum soil, Spongeolite soil, Grey clay (where clay is near to surface)

### 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. Usually less common than Grey deep sandy duplex
- Scattered in other parts of the South-west

### Soil attributes (dominant values)

Water repellence	Moderate to high
Soil structure decline	Low
Subsurface acidification	Moderate
Surface condition	Loose
Unrestricted rooting depth	Shallow
Available water storage	Low

Subsurface compaction	Low to moderate
pH 0-10 cm	Acid
pH 50-80 cm	Neutral to acid
Soil permeability	Slow
Soil workability	Good
Wind erodibility	High

### Land use considerations

- Seasonal waterlogging may occur above the clay
- Wind erosion

# Red deep sandy duplex

## Soil Group 405

Distribution map p. 103

Colour picture p. 117

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

### Characteristics

- Red within top 30 cm
- Usually hardsetting 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*

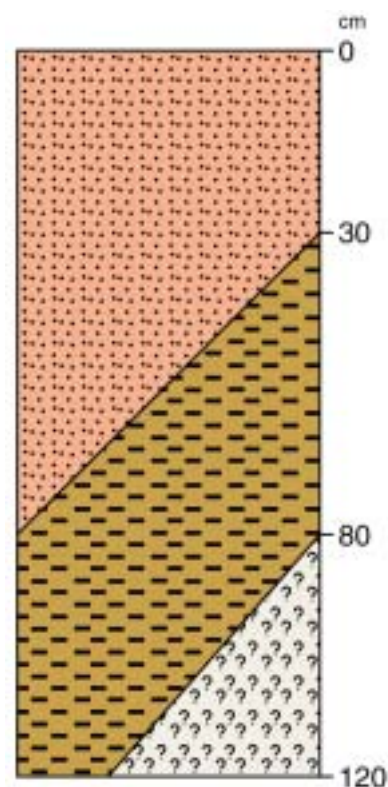
### Main occurrences in Western Australia

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

### Soil attributes (dominant values)

Water repellence	Low
Soil structure decline	Low to moderate
Subsurface acidification	Low
Surface condition	Hardsetting
Unrestricted rooting depth	Moderate
Available water storage	Low to moderate

Subsurface compaction	Moderate
pH 0-10 cm	Neutral to acid
pH 50-80 cm	Neutral to alkaline
Soil permeability	Moderate
Soil workability	Good
Wind erodibility	Moderate



### Land use considerations

- Productive soils
- Prone to surface compaction and crusting or hardsetting

# Red shallow sandy duplex

## Soil Group 406

Distribution map p. 103

Colour picture p. 117

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 hardsetting surface
- Clays may be underlain by rock or hardpan
- Stony or gravelly surface mantle common
- May be saline

### Local names

### Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

- *Red Chromosol*
- *Red Sodosol*

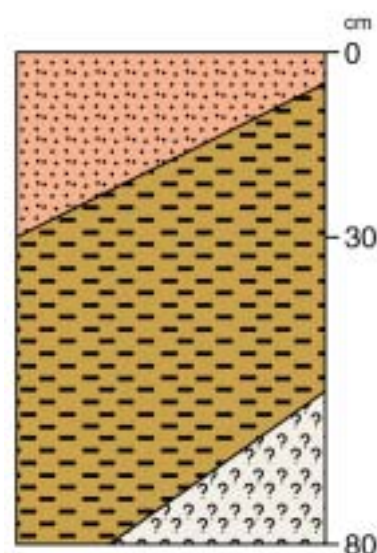
### Main occurrences in Western Australia

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

### Soil attributes (dominant values)

Water repellence	Low
Soil structure decline	Low
Subsurface acidification	Low
Surface condition	Hardsetting
Unrestricted rooting depth	Shallow
Available water storage	Low

Subsurface compaction	Low to moderate
pH 0-10 cm	Neutral to acid
pH 50-80 cm	Neutral to alkaline
Soil permeability	Moderately slow
Soil workability	Fair
Wind erodibility	Moderate



# Reticulite deep sandy duplex

## Soil Group 409

Distribution map p. 104

Colour picture p. 118

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

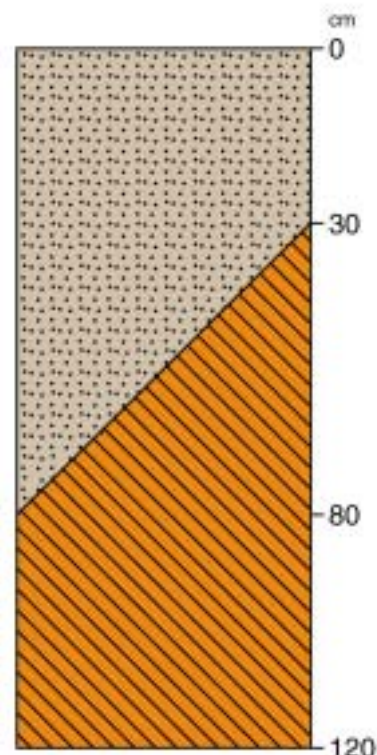
### Typical Australian Soil Classification (ASC)

(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



### Soil attributes (dominant values)

Water repellence	Moderate
Soil structure decline	Low
Subsurface acidification	Low to moderate
Surface condition	Soft to loose
Unrestricted rooting depth	Moderate
Available water storage	Low to moderate

Subsurface compaction	Moderate
pH 0-10 cm	Acid
pH 50-80 cm	Neutral to acid
Soil permeability	Moderately rapid
Soil workability	Fair to Good
Wind erodibility	Moderate



# Yellow/brown deep sandy duplex

## Soil Group 407

Distribution map p. 103

Colour picture p. 117

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

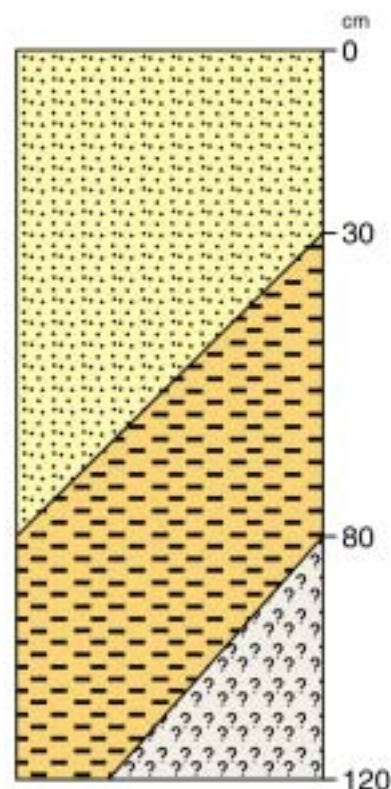
### Typical Australian Soil Classification (ASC)

(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



### Soil attributes (dominant values)

Water repellence	High
Soil structure decline	Low
Subsurface acidification	Moderate
Surface condition	Loose
Unrestricted rooting depth	Moderate
Available water storage	Low to moderate

Subsurface compaction	Low to moderate
pH 0-10 cm	Acid
pH 50-80 cm	Neutral to acid
Soil permeability	Moderately slow
Soil workability	Good
Wind erodibility	High

### Land use considerations

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

# Yellow/brown shallow sandy duplex

## Soil Group 408

*Distribution map p. 103*

*Colour picture p. 118*

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

### Characteristics

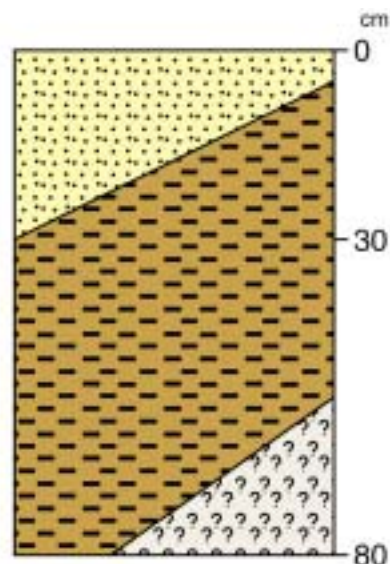
- Yellow or brown surface layers
- Various colours in subsoil, and mottling is common
- Neutral pH subsoil most common, but may be acidic to alkaline
- Ironstone gravel may occur, especially above clay

### Local names

### 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

### Soil attributes (dominant values)

Water repellence	Moderate to high
Soil structure decline	Low
Subsurface acidification	Moderate
Surface condition	Loose
Unrestricted rooting depth	Shallow
Available water storage	Low

Subsurface compaction	Low to moderate
pH 0-10 cm	Acid
pH 50-80 cm	Neutral to acid
Soil permeability	Slow
Soil workability	Good
Wind erodibility	High

### Land use considerations

- Seasonal waterlogging may occur above the clay

# Calcareous shallow sand

## Soil Group 421

Distribution map p. 104

Colour picture p. 118

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

### Characteristics

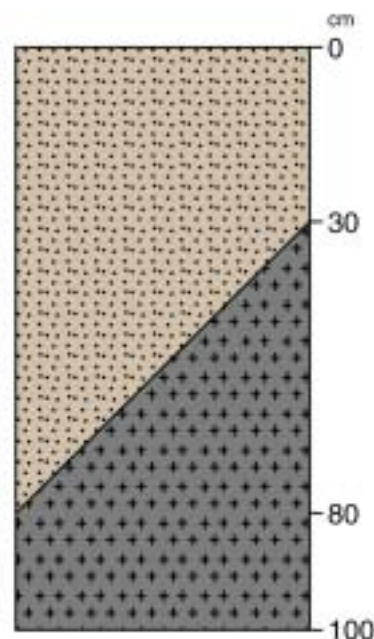
- Sandy throughout
- Grey or occasionally black topsoil
- Calcareous throughout
- Alkaline pH throughout
- Sometimes over limestone or calcrete

### Local names

### 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

### Soil attributes (dominant values)

Water repellence	Moderate to high
Soil structure decline	Low
Subsurface acidification	Low
Surface condition	Loose
Unrestricted rooting depth	Shallow to moderate
Available water storage	Very low

Subsurface compaction	Low
pH 0-10 cm	Alkaline
pH 50-80 cm	Alkaline or na
Soil permeability	Rapid to very rapid
Soil workability	Good
Wind erodibility	High

### 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

Distribution map p. 104

Colour picture p. 118

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

### Characteristics

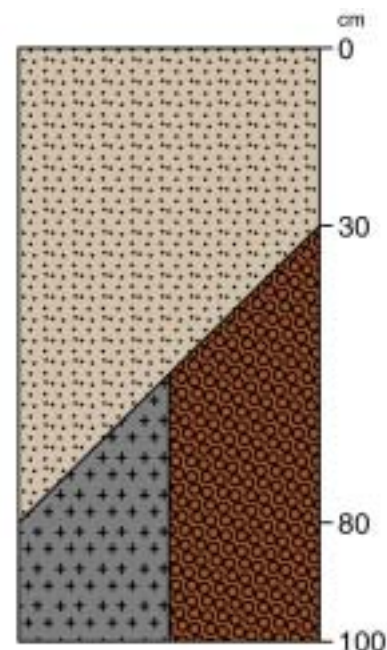
- White, grey or pale yellow within top 30 cm
- Neutral to acid pH
- Ironstone gravel may be present
- Often gritty sands over granite
- Often sand over cemented ironstone (ferricrete or bog iron) or other hardpan.

### Local names

### 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

### Soil attributes (dominant values)

Water repellence	Moderate to high
Soil structure decline	Low
Subsurface acidification	Low to moderate
Surface condition	Soft to loose
Unrestricted rooting depth	Shallow to moderate
Available water storage	Very low

Subsurface compaction	Low to moderate
pH 0-10 cm	Neutral to acid
pH 50-80 cm	Neutral or na
Soil permeability	Moderately rapid to very rapid
Soil workability	Good
Wind erodibility	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 water tables

# Red shallow sand

## Soil Group 423

Distribution map p. 104

Colour picture p. 118

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

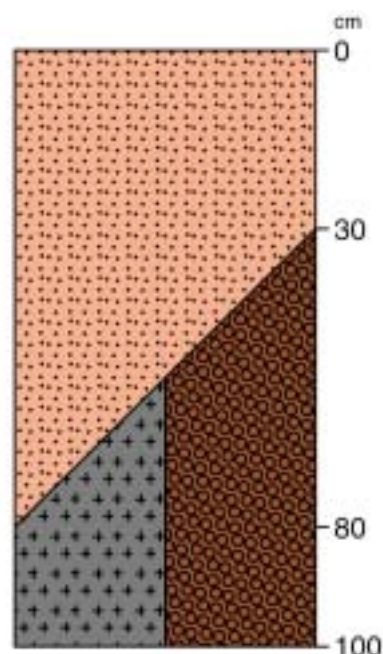
### Local names

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

### Soil attributes (dominant values)

Water repellence	Low to moderate
Soil structure decline	Low
Subsurface acidification	Low
Surface condition	Loose
Unrestricted rooting depth	Shallow to moderate
Available water storage	Very low to low

Subsurface compaction	Low to moderate
pH 0-10 cm	Neutral to acid
pH 50-80 cm	Neutral or na
Soil permeability	Moderately rapid to very rapid
Soil workability	Good
Wind erodibility	Moderate

### Land use considerations

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

# Yellow/brown shallow sand

## Soil Group 424

Distribution map p. 105

Colour picture p. 118

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

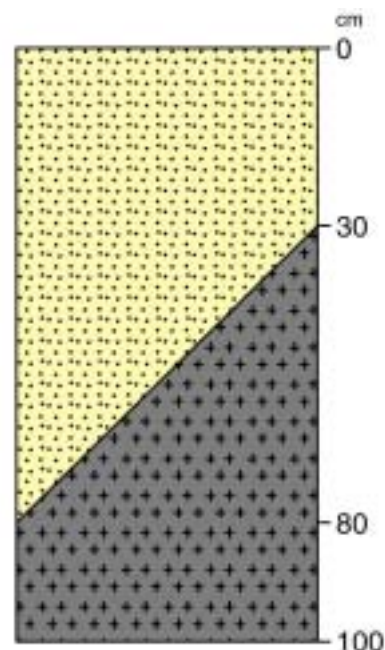
### Local names

Karrakatta sand (shallow phase), Spearwood sand (shallow phase)

### 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

### Soil attributes (dominant values)

Water repellence	Moderate to high	Subsurface compaction	Low to moderate
Soil structure decline	Low	pH 0-10 cm	Neutral to acid
Subsurface acidification	Low to moderate	pH 50-80 cm	Neutral or na
Surface condition	Loose	Soil permeability	Moderately rapid to very rapid
Unrestricted rooting depth	Moderate	Soil workability	Good
Available water storage	Very low	Wind erodibility	High

### Land use considerations

- Water-holding capacity is 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

Distribution map p. 105

Colour picture p. 118

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*
- Aeris Podosol

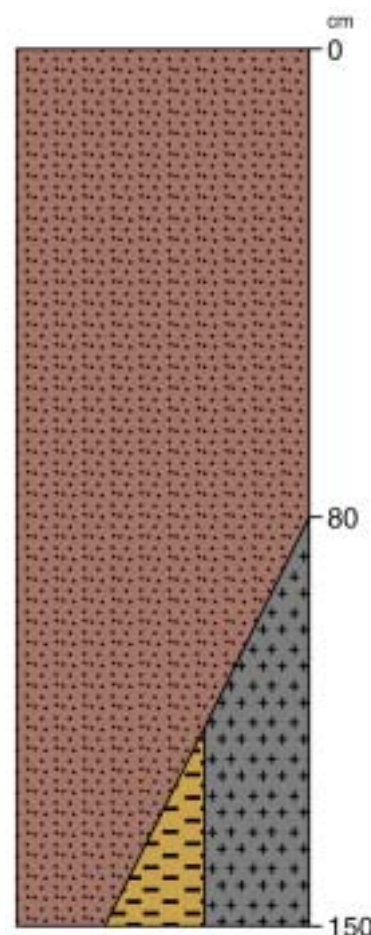
### Main occurrences in Western Australia

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

### Soil attributes (dominant values)

Water repellence	Low to moderate
Soil structure decline	Low
Subsurface acidification	Low to moderate or presently acid
Surface condition	Loose
Unrestricted rooting depth	Deep to very deep
Available water storage	Low to moderate

Subsurface compaction	Low to moderate
pH 0-10 cm	Neutral to acid
pH 50-80 cm	Neutral
Soil permeability	Moderately rapid
Soil workability	Good
Wind erodibility	High



### Land use considerations

- These soils usually have good physical properties and are suitable for a variety of agricultural land uses

# Calcareous deep sand

## Soil Group 442

Distribution map p. 105

Colour picture p. 118

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

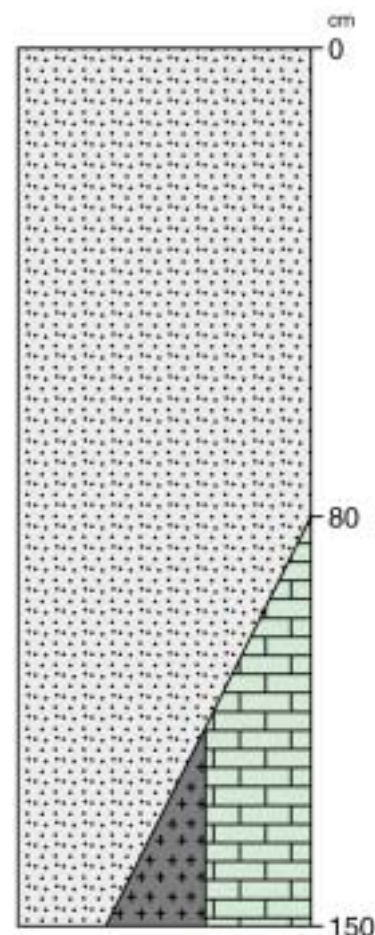
### Typical Australian Soil Classification (ASC)

(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



### Soil attributes (dominant values)

Water repellence	Moderate
Soil structure decline	Low
Subsurface acidification	Low
Surface condition	Loose
Unrestricted rooting depth	Deep to Very deep
Available water storage	Low

Subsurface compaction	Low
pH 0-10 cm	Alkaline
pH 50-80 cm	Alkaline
Soil permeability	Rapid to very rapid
Soil workability	Good
Wind erodibility	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

Distribution map p. 105

Colour picture p. 118

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, White sandy gravels

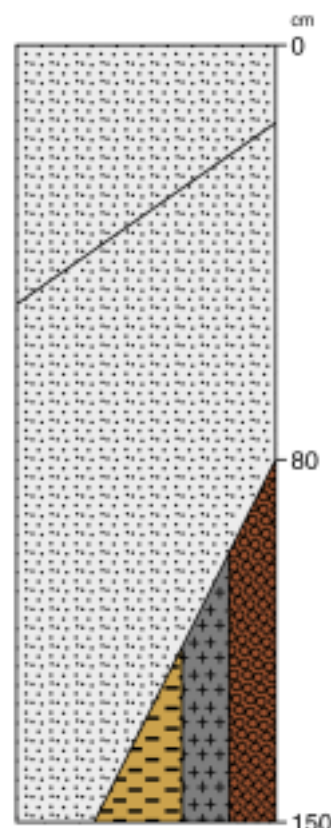
### Typical Australian Soil Classification (ASC)

(dominant ASC in *italics*)

- *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



### Soil attributes (dominant values)

Water repellence	High	Subsurface compaction	Low to moderate
Soil structure decline	Low	pH 0-10 cm	Neutral to acid
Subsurface acidification	Low to moderate	pH 50-80 cm	Neutral to acid
Surface condition	Soft to Loose	Soil permeability	Very rapid
Unrestricted rooting depth	Deep to very deep	Soil workability	Good
Available water storage	Low	Wind erodibility	High

### 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

Distribution map p. 106

Colour picture p. 119

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

### Characteristics

- White, grey or pale yellow (Munsell value 7 or higher) within top 30 cm
- Neutral to acid pH
- Ironstone gravel may be present, but not in large quantities
- 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

Spillway sand, Gutless sand, Silver loam, Tincurrin/Harrismith sand, Christmas tree and Banksia sand, Deep mallee sand, Mungie sand, Siliceous sand

### Typical Australian Soil Classification (ASC)

(dominant ASC in *italics*)

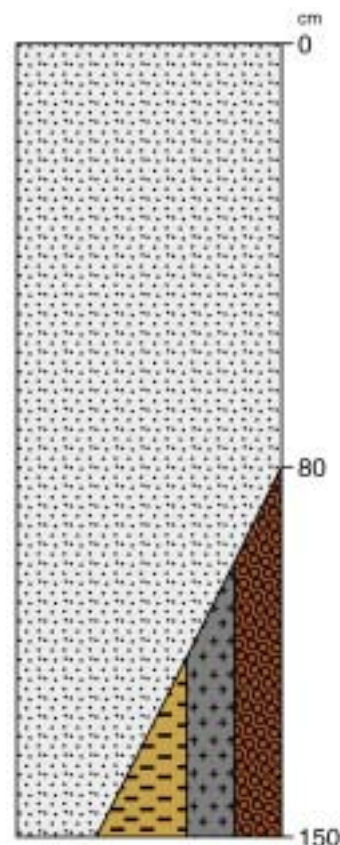
- *Bleached-Orthic Tenosol*
- *Aeric Podosol*

### 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

### Soil attributes (dominant values)

Water repellence	High	Subsurface compaction	Low to moderate
Soil structure decline	Low	pH 0-10 cm	Neutral to acid
Subsurface acidification	Low to moderate	pH 50-80 cm	Neutral to acid
Surface condition	Soft to Loose	Soil permeability	Very rapid
Unrestricted rooting depth	Deep to very deep	Soil workability	Good
Available water storage	Low	Wind erodibility	High



### 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

Distribution map p. 106

Colour picture p. 119

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, Siliceous sand

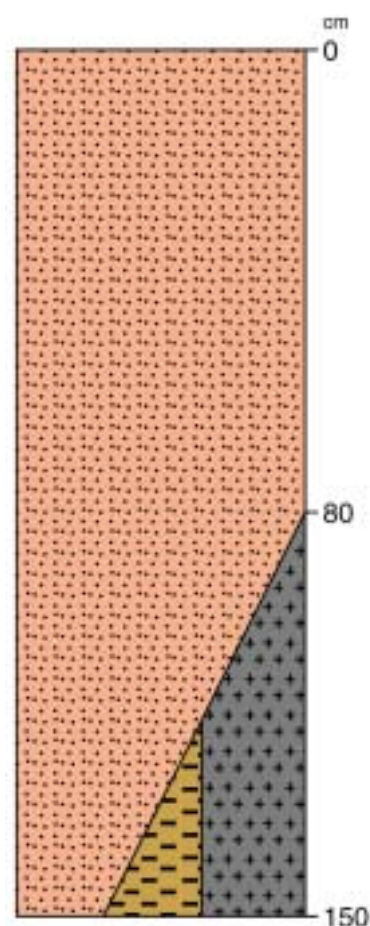
### Typical Australian Soil Classification (ASC)

(dominant ASC in *italics*)

- *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



### Soil attributes (dominant values)

Water repellence	Low to moderate
Soil structure decline	Low
Subsurface acidification	Low
Surface condition	Loose
Unrestricted rooting depth	Deep to very deep
Available water storage	Low to moderate

Subsurface compaction	Low to moderate
pH 0-10 cm	Neutral to acid
pH 50-80 cm	Neutral to acid
Soil permeability	Rapid
Soil workability	Good
Wind erodibility	Moderate to high

### Land use considerations

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



# Yellow deep sand

## Soil Group 446

Distribution map p. 106

Colour picture p. 119

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

Pear and pine sand, Sandplain, Spearwood sand, Eradu sandplain, Sands on limestone, Karakatta sand, Siliceous sand

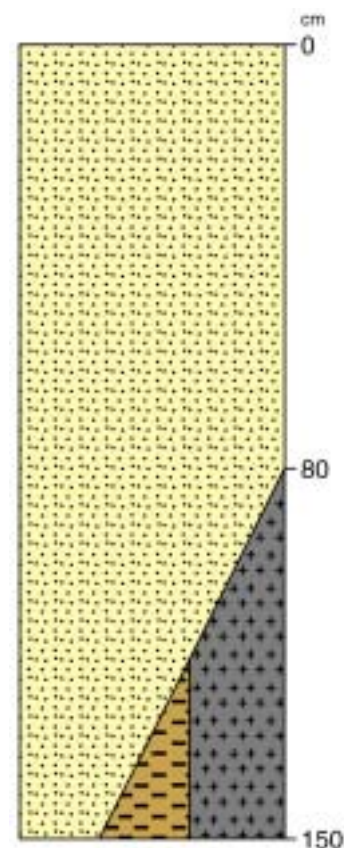
### Typical Australian Soil Classification (ASC)

(dominant ASC in *italics*)

- *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 of the South-west, extending north to Kalbarri and southern rangelands, although soils tend to be more loamy in inland areas (see sandy earths)
- Isolated occurrences throughout the remainder of South-west and widespread on sandstones in the Kimberley



### Soil attributes (dominant values)

Water repellence	Low to moderate
Soil structure decline	Low
Subsurface acidification	Variable
Surface condition	Soft to loose
Unrestricted rooting depth	Deep to very deep
Available water storage	Low to moderate

Subsurface compaction	Moderate to high
pH 0-10 cm	Neutral to acid
pH 50-80 cm	Neutral to acid
Soil permeability	Rapid to very rapid
Soil workability	Good
Wind erodibility	High

### 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

Distribution map p. 106

Colour picture p. 119

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

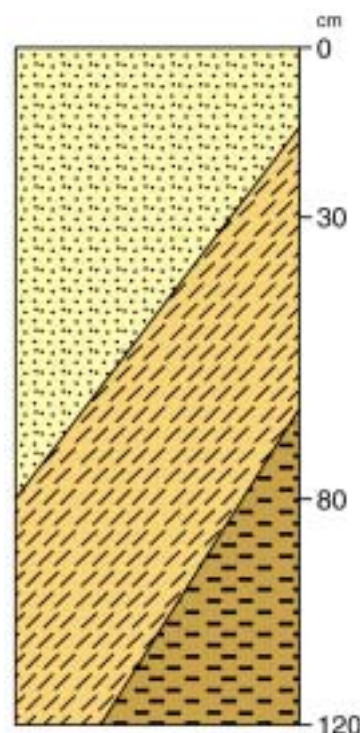
### Typical Australian Soil Classification (ASC)

(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, extending into the southern rangelands. Associated with Yellow sandy earths



### Soil attributes (dominant values)

Water repellence	Low
Soil structure decline	Low
Subsurface acidification	High to presently acid
Surface condition	Loose to firm
Unrestricted rooting depth	Shallow to moderate
Available water storage	Moderate

Subsurface compaction	Moderate
pH 0-10 cm	Acid to strongly acid
pH 50-80 cm	Strongly acid
Soil permeability	Moderate to moderately rapid
Soil workability	Good
Wind erodibility	Moderate to high

### Land use considerations

- Low subsoil pH and high concentrations of aluminum severely limit root growth into the subsoil and reduces yields of agricultural plants

# Brown sandy earth

## Soil Group 462

Distribution map p. 107

Colour picture p. 119

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

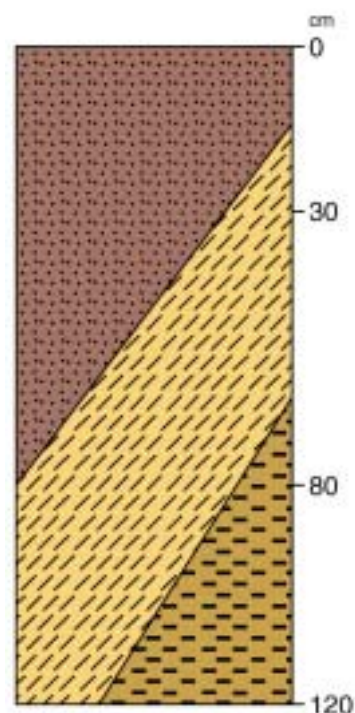
### Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

- *Brown Kandosol*
- Orthic Tenosol

### Main occurrences in Western Australia

- Minor alluvial soil in the South-west



### Soil attributes (dominant values)

Water repellence	Low to Moderate
Soil structure decline	Low
Subsurface acidification	Moderate
Surface condition	Firm
Unrestricted rooting depth	Deep
Available water storage	Moderate

Subsurface compaction	Moderate
pH 0-10 cm	Neutral to acid
pH 50-80 cm	Neutral to acid
Soil permeability	Moderate
Soil workability	Good
Wind erodibility	Moderate

### Land use considerations

- Good physical characteristics for plant growth (e.g. horticulture)

# Pale sandy earth

## Soil Group 465

Distribution map p. 107

Colour picture p. 119

Pale sand grading to loam by 80 cm

### Characteristics

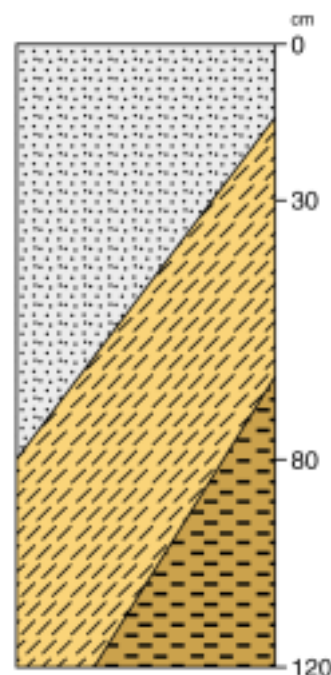
- White, grey or Munsell value of 7 or greater (pale yellow) within top 30 cm.
- Neutral to acid pH
- Gravels (mainly ironstone) may be present
- May be clayey at depth
- Usually massive or poorly structured
- Usually porous (sometimes called earthy fabric)

### Local names

### 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

### Soil attributes (dominant values)

Water repellence	Low to Moderate
Soil structure decline	Low
Subsurface acidification	Moderate to high or presently acid
Surface condition	Loose to firm
Unrestricted rooting depth	Deep to very deep
Available water storage	Moderate

Subsurface compaction	High
pH 0-10 cm	Neutral to acid
pH 50-80 cm	Neutral to acid
Soil permeability	Moderate to moderately rapid
Soil workability	Good
Wind erodibility	Moderate

### Land use considerations

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

# Red sandy earth

## Soil Group 463

Distribution map p. 107

Colour picture p. 119

Red sand grading to loam by 80 cm

### Characteristics

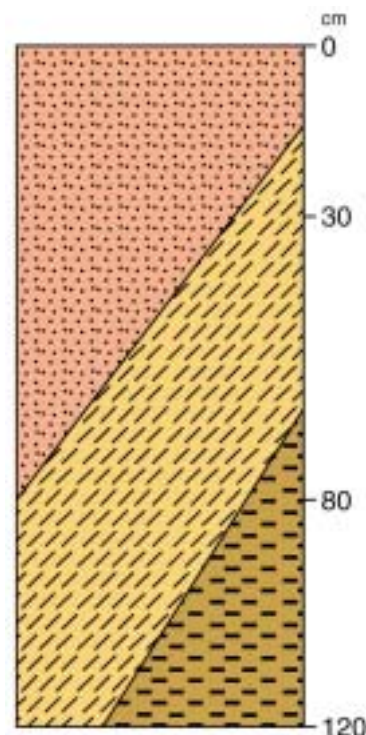
- Red throughout
- Usually massive or poorly structured
- Usually porous (sometimes called earthy fabric)
- Neutral to acid pH, but occasionally alkaline and calcareous at depth
- May have a red-brown hardpan at depth
- May be clayey at depth

### Local names

### 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) extending into the northern wheatbelt, often in association with red loamy earths

### Soil attributes (dominant values)

Water repellence	Low
Soil structure decline	Moderate
Subsurface acidification	Moderate to high
Surface condition	Firm
Unrestricted rooting depth	Deep
Available water storage	Moderate

Subsurface compaction	Moderate
pH 0-10 cm	Neutral to acid
pH 50-80 cm	Neutral to alkaline
Soil permeability	Moderate
Soil workability	Good
Wind erodibility	Moderate

### Land use considerations

- Good physical characteristics for plant growth (e.g. horticulture)



# Yellow sandy earth

## Soil Group 464

Distribution map p. 107

Colour picture p. 119

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

Tammar soil, Good sandplain soil

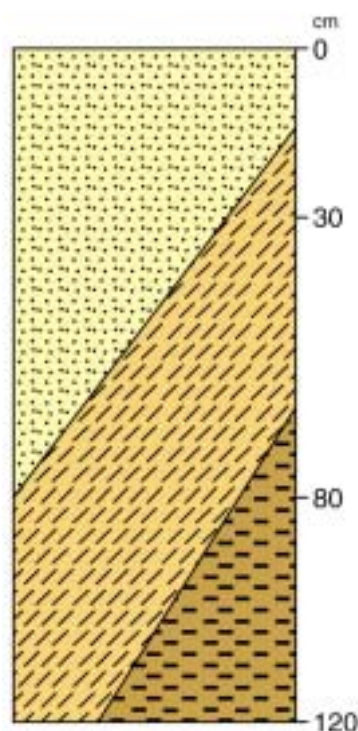
### Typical Australian Soil Classification (ASC)

(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), extending into the southern rangelands (Murchison and Goldfields)



### Soil attributes (dominant values)

Water repellence	Low to Moderate
Soil structure decline	Low
Subsurface acidification	Moderate to high or presently acid
Surface condition	Loose to firm
Unrestricted rooting depth	Deep to very deep
Available water storage	Moderate

Subsurface compaction	High
pH 0-10 cm	Neutral to acid
pH 50-80 cm	Neutral to acid
Soil permeability	Moderate to moderately rapid
Soil workability	Good
Wind erodibility	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

Distribution map p. 108

Colour picture p. 119

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

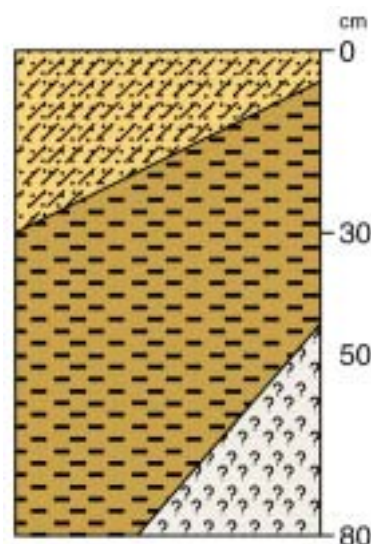
### Local names

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) and infrequent in the Goldfields

### Soil attributes (dominant values)

Water repellence	High
Soil structure decline	Moderate
Subsurface acidification	High
Surface condition	Firm
Unrestricted rooting depth	Shallow
Available water storage	Low

Subsurface compaction	Low to moderate
pH 0-10 cm	Acid to strongly acid
pH 50-80 cm	Acid to strongly acid
Soil permeability	Slow
Soil workability	Fair
Wind erodibility	Low

### 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

Distribution map p. 108

Colour picture p. 119

Grey loam over alkaline clay at <30 cm

### Characteristics

- Grey or brown topsoil
- Usually calcareous subsoil
- Alkaline pH subsoil
- Hardsetting surface

### Local names

Moort soil, Grey clay

### Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

- *Calcic Grey Sodosol*
- *Calcic Grey Chromosol*

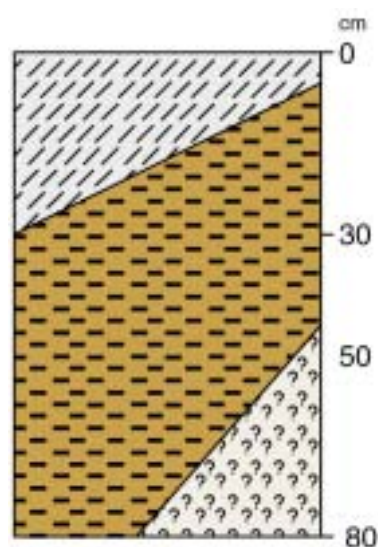
### Main occurrences in Western Australia

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

### Soil attributes (dominant values)

Water repellence	Low
Soil structure decline	High
Subsurface acidification	Low
Surface condition	Hardsetting
Unrestricted rooting depth	Shallow
Available water storage	Low

Subsurface compaction	Low to moderate
pH 0-10 cm	Neutral
pH 50-80 cm	Alkaline
Soil permeability	Slow
Soil workability	Fair
Wind erodibility	Low



### Land use considerations

- Undesirable to mix subsoil which is sodic and alkaline with topsoil when cultivating



# Alkaline red shallow loamy duplex

## Soil Group 503

Distribution map p. 108

Colour picture p. 120

Red loam over alkaline clay at <30 cm

### Characteristics

- Red topsoil
- Alkaline pH subsoil
- Usually calcareous subsoil
- Often hardsetting surface

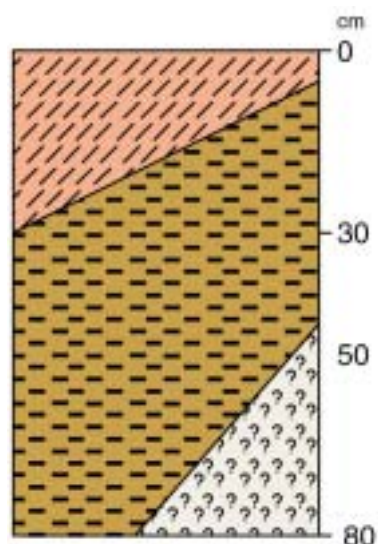
### Local names

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, and scattered in areas of rejuvenated drainage
- Minor in the Gnowangerup to Jerramungup areas

### Soil attributes (dominant values)

Water repellence	Low
Soil structure decline	Moderate
Subsurface acidification	Low
Surface condition	Hardsetting
Unrestricted rooting depth	Shallow
Available water storage	Low to moderate

Subsurface compaction	Low to moderate
pH 0-10 cm	Neutral
pH 50-80 cm	Alkaline
Soil permeability	Moderately slow
Soil workability	Fair
Wind erodibility	Low

### Land use considerations

- The surface is prone to hardsetting

# Brown deep loamy duplex

## Soil Group 505

Distribution map p. 109

Colour picture p. 120

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 hardsetting surface
- Non-alkaline clay subsoil
- Non-sodic subsoil more common than sodic

### Local names

Deep yate loam

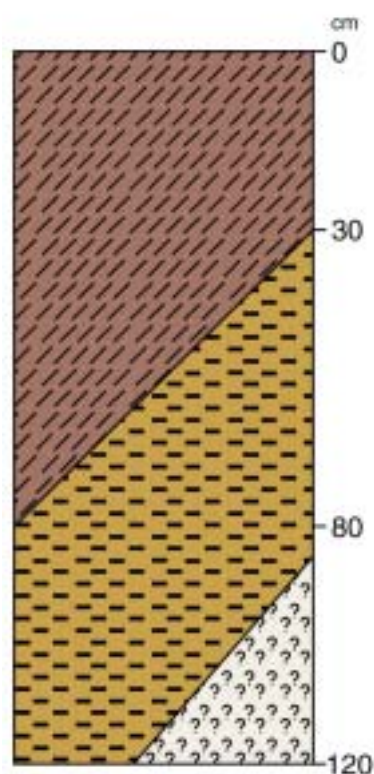
### Typical Australian Soil Classification (ASC)

(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



### Soil attributes (dominant values)

Water repellence	Low
Soil structure decline	Moderate
Subsurface acidification	Low
Surface condition	Firm to hardsetting
Unrestricted rooting depth	Moderate
Available water storage	Moderate

Subsurface compaction	Low to moderate
pH 0-10 cm	Neutral
pH 50-80 cm	Neutral
Soil permeability	Moderately slow
Soil workability	Good
Wind erodibility	Low

### Land use considerations

- A valuable soil for agricultural purposes

# Grey shallow loamy duplex

## Soil Group 504

*Distribution map p. 108*

*Colour picture p. 120*

Grey loam over non-alkaline clay at <30 cm

### Characteristics

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

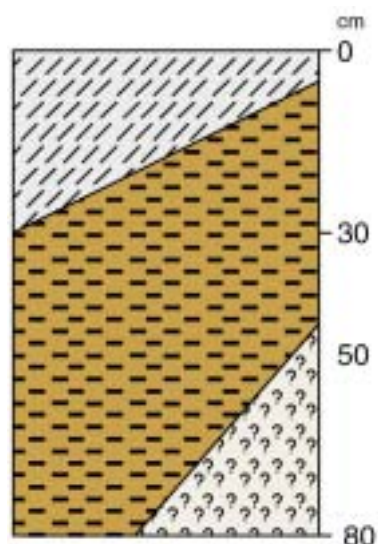
### Local names

Grey clay

### Typical Australian Soil Classification (ASC)

(dominant ASC in *italics*)

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



### Main occurrences in Western Australia

- Sw an Coastal Plain in the South-w est, and parts of the Kimberley

### Soil attributes (dominant values)

Water repellence	Low	Subsurface compaction	Low to moderate
Soil structure decline	Moderate	pH 0-10 cm	Neutral
Subsurface acidification	Moderate	pH 50-80 cm	Neutral
Surface condition	Hardsetting	Soil permeability	Moderately slow
Unrestricted rooting depth	Shallow	Soil workability	Fair to poor
Available water storage	Low	Wind erodibility	Low

### Land use considerations

- The hardsetting surface may respond to gypsum

# Red deep loamy duplex

## Soil Group 506

Distribution map p. 109

Colour picture p. 120

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 hardsetting surface

### Local names

Deep yate loam

### Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

- *Red Chromosol*
- Red Sodosol

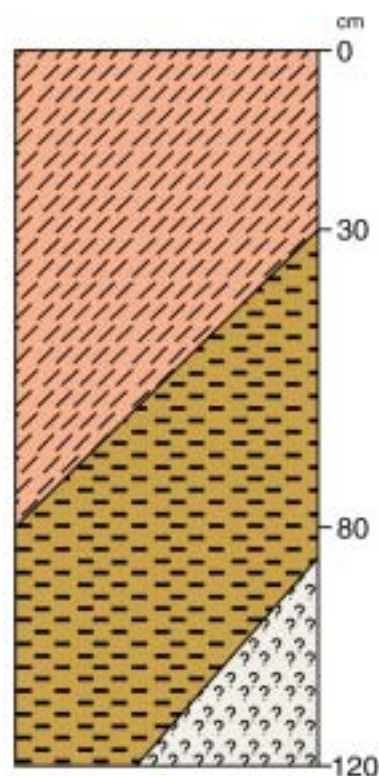
### Main occurrences in Western Australia

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

### Soil attributes (dominant values)

Water repellence	Low
Soil structure decline	Moderate
Subsurface acidification	Low
Surface condition	Firm to hard-setting
Unrestricted rooting depth	Moderate
Available water storage	Moderate

Subsurface compaction	Low to moderate
pH 0-10 cm	Neutral to acid
pH 50-80 cm	Neutral to alkaline
Soil permeability	Moderate
Soil workability	Good
Wind erodibility	Low



# Red shallow loamy duplex

## Soil Group 507

Distribution map p. 109

Colour picture p. 120

Red loam over non-calcareous clay at <30 cm

### Characteristics

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

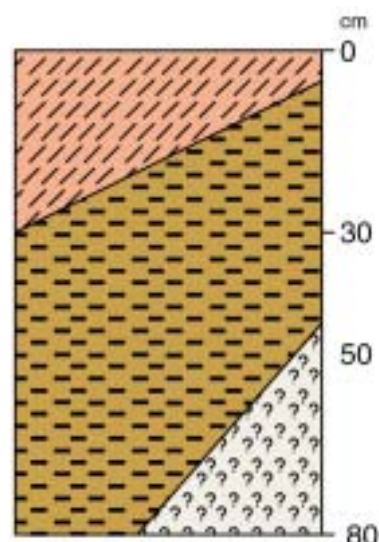
### Local names

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.

### Soil attributes (dominant values)

Water repellence	Low
Soil structure decline	Moderate
Subsurface acidification	Moderate
Surface condition	Firm to hardsetting
Unrestricted rooting depth	Shallow
Available water storage	Low

Subsurface compaction	Low to moderate
pH 0-10 cm	Neutral to acid
pH 50-80 cm	Neutral
Soil permeability	Moderate
Soil workability	Fair to poor
Wind erodibility	Low

### Land use considerations

- A generally fertile soil that needs to be managed carefully to prevent water erosion

# Yellow/brown shallow loamy duplex

## Soil Group 508

Distribution map p. 109

Colour picture p. 120

Yellow/brown loam over clay at <30 cm

### Characteristics

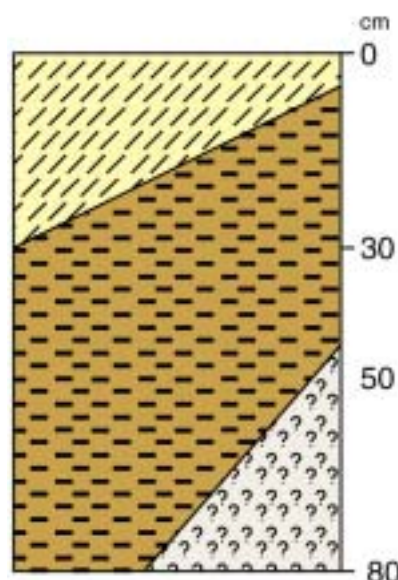
- Yellow or brown topsoil
- Neutral pH subsoil common, although rarely acid or alkaline
- Firm to hardsetting surface

### Local names

### Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

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



### Main occurrences in Western Australia

- Scattered in the South-west and parts of the Kimberley

### Soil attributes (dominant values)

Water repellence	Low
Soil structure decline	Moderate
Subsurface acidification	Moderate
Surface condition	Hardsetting
Unrestricted rooting depth	Shallow
Available water storage	Low

Subsurface compaction	Low to moderate
pH 0-10 cm	Neutral
pH 50-80 cm	Neutral
Soil permeability	Moderately slow
Soil workability	Fair to poor
Wind erodibility	Low



# Calcareous shallow loam

## Soil Group 521

Distribution map p. 110

Colour picture p. 120

Calcareous loam over rock or hardpan at <80 cm

### Characteristics

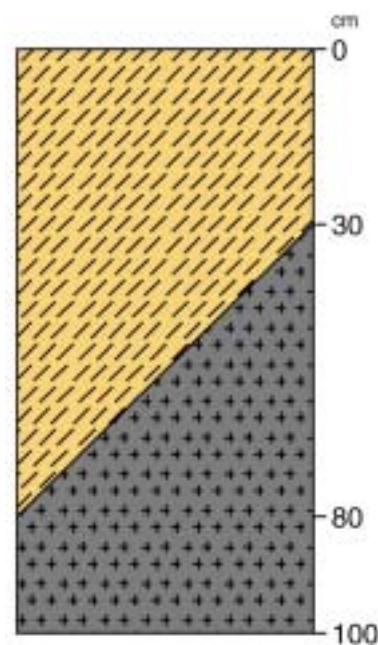
- Loamy throughout, although may grade to clay above the hard layer
- Brown, grey or red topsoil
- Calcareous throughout (or at least by 30 cm)
- Alkaline pH throughout
- Usually over limestone or calcrete

### Local names

### 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, and scattered throughout the Arid Interior and southern rangelands

### Soil attributes (dominant values)

Water repellence	Low
Soil structure decline	Low
Subsurface acidification	Low
Surface condition	Firm
Unrestricted rooting depth	Moderate
Available water storage	Low

Subsurface compaction	Moderate
pH 0-10 cm	Alkaline
pH 50-80 cm	Alkaline or na
Soil permeability	Moderate
Soil workability	Fair
Wind erodibility	Low

### 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

Distribution map p. 110

Colour picture p. 120

Red loam less than 80 cm deep over rock or hardpan

### 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

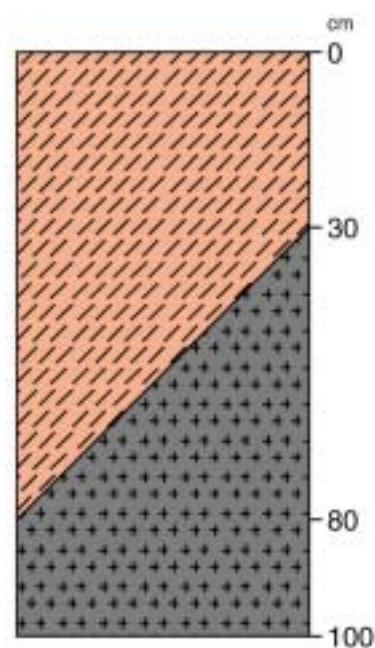
### Typical Australian Soil Classification (ASC)

(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



### Soil attributes (dominant values)

Water repellence	Low
Soil structure decline	Moderate
Subsurface acidification	Low
Surface condition	Hardsetting
Unrestricted rooting depth	Moderate
Available water storage	Low

Subsurface compaction	Moderate
pH 0-10 cm	Neutral to acid
pH 50-80 cm	Neutral to acid
Soil permeability	Moderate
Soil workability	Fair
Wind erodibility	Low

### Land use considerations

- Shallow soil depth limits rooting depth and water-holding capacity

# Red-brown hardpan shallow loam

## Soil Group 523

Distribution map p. 110

Colour picture p. 120

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

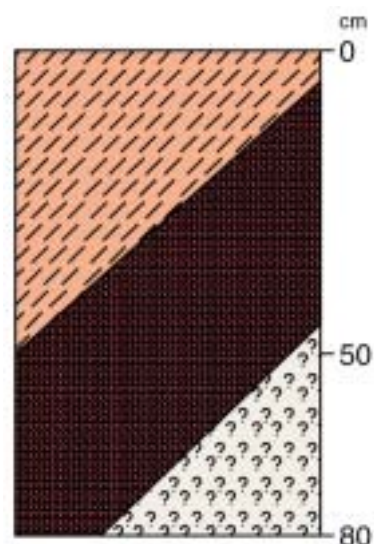
### Typical Australian Soil Classification (ASC)

(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



### Soil attributes (dominant values)

Water repellence	Low
Soil structure decline	Moderate
Subsurface acidification	Low
Surface condition	Hardsetting
Unrestricted rooting depth	Shallow to moderate
Available water storage	Low

Subsurface compaction	Moderate
pH 0-10 cm	Neutral to acid
pH 50-80 cm	Neutral
Soil permeability	Moderate
Soil workability	Fair
Wind erodibility	Low

### Land use considerations

- Shallow soil depth limits rooting depth and water-holding capacity

# Brown loamy earth

## Soil Group 541

Distribution map p. 110

Colour picture p. 121

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

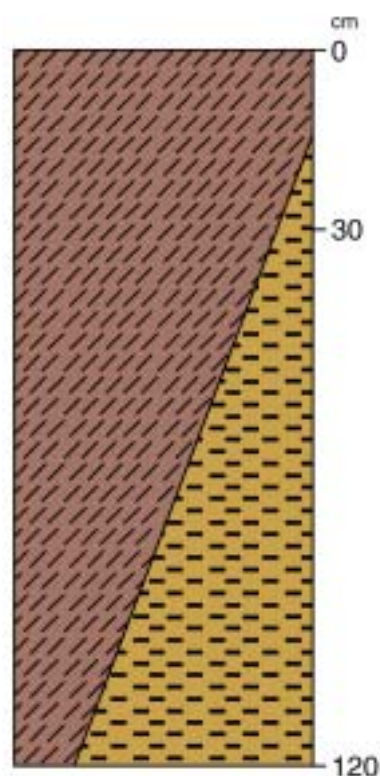
### Typical Australian Soil Classification (ASC)

(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



### Soil attributes (dominant values)

Water repellence	Low
Soil structure decline	Moderate
Subsurface acidification	Low
Surface condition	Firm
Unrestricted rooting depth	Deep
Available water storage	High

Subsurface compaction	Moderate
pH 0-10 cm	Neutral to acid
pH 50-80 cm	Neutral to acid
Soil permeability	Moderate
Soil workability	Good
Wind erodibility	Low

### Land use considerations

- Usually a good agricultural soil

# Calcareous loamy earth

## Soil Group 542

Distribution map p. 111

Colour picture p. 121

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
- Hardsetting or fluffy surface
- Sometimes saline
- Hard or soft carbonate segregations commonly occur in profile

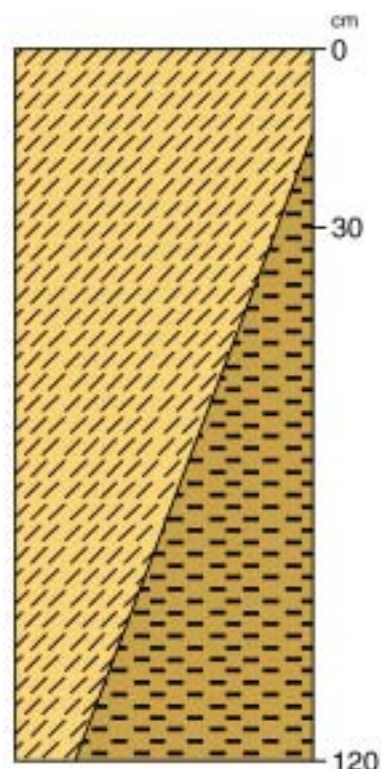
### Local names

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

### Typical Australian Soil Classification (ASC)

(dominant ASC in *italics*)

- *Calcic Calcarosol*
- Calcic Red Sodosol



### Main occurrences in Western Australia

- Western and northern Nullarbor
- Scattered in the South-west in the central and eastern wheatbelt, often near salt lakes, and the mallee north of Esperance
- In the Gascoyne at Cape Range near Exmouth

### Soil attributes (dominant values)

Water repellence	Variable
Soil structure decline	Low
Subsurface acidification	Low
Surface condition	Variable
Unrestricted rooting depth	Moderate
Available water storage	Moderate

Subsurface compaction	Low to moderate
pH 0-10 cm	Alkaline
pH 50-80 cm	Alkaline
Soil permeability	Moderately slow
Soil workability	Fair
Wind erodibility	Low to high

### Land use considerations

- High lime content may inhibit some agricultural crops
- May have high salt contents in subsoil



# Friable red/brown loamy earth

## Soil Group 543

Distribution map p. 111

Colour picture p. 121

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

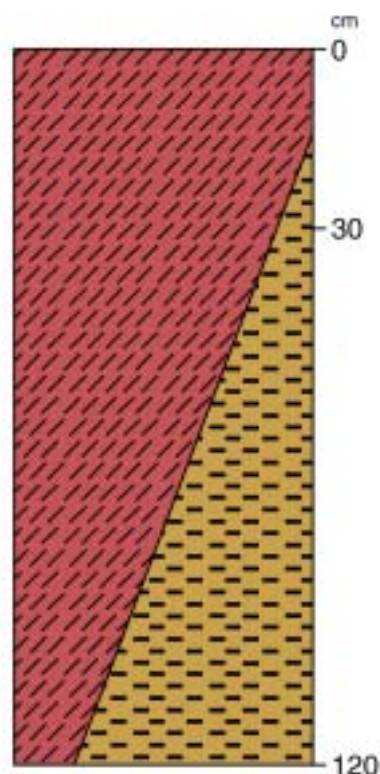
### Typical Australian Soil Classification (ASC)

(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. Commonly carried Karri forest
- Chittering area near Perth
- Minor in the Pilbara on basaltic parent materials



### Soil attributes (dominant values)

Water repellence	Low
Soil structure decline	Low
Subsurface acidification	Low
Surface condition	Soft to firm
Unrestricted rooting depth	Deep
Available water storage	High

Subsurface compaction	Low to moderate
pH 0-10 cm	Neutral to acid
pH 50-80 cm	Neutral to acid
Soil permeability	Moderate
Soil workability	Good
Wind erodibility	Low

### Land use considerations

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



# Red loamy earth

## Soil Group 544

Distribution map p. 111

Colour picture p. 121

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
- Hardsetting or crusting
- Sometimes with red-brown hardpan at >50 cm
- Gravels (usually non-ironstone) may be present

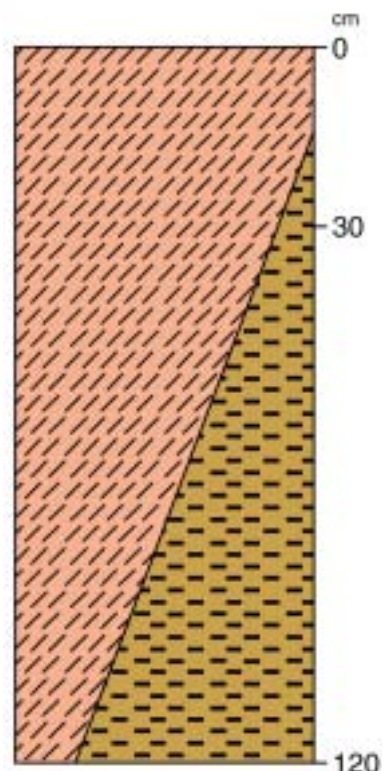
### Local names

Mulga loam, Yate 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

### Soil attributes (dominant values)

Water repellence	Low
Soil structure decline	Low to moderate
Subsurface acidification	Low
Surface condition	Hardsetting
Unrestricted rooting depth	Moderate
Available water storage	Moderate

Subsurface compaction	Moderate
pH 0-10 cm	Neutral to acid
pH 50-80 cm	Neutral to alkaline
Soil permeability	Moderate
Soil workability	Fair to good
Wind erodibility	Low

### Land use considerations

- Potentially highly productive soil with good physical properties

# Yellow loamy earth

## Soil Group 545

Distribution map p. 111

Colour picture p. 121

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

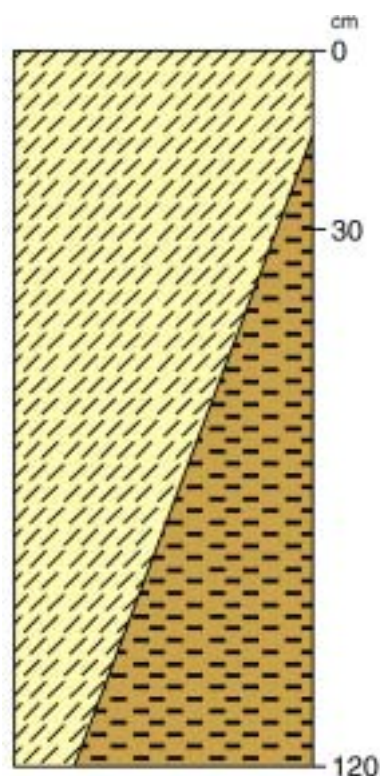
### Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

- *Yellow Kandosol*

### Main occurrences in Western Australia

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



### Soil attributes (dominant values)

Water repellence	Low
Soil structure decline	Low to moderate
Subsurface acidification	Low to moderate
Surface condition	Firm to hardsetting
Unrestricted rooting depth	deep
Available water storage	High

Subsurface compaction	Moderate
pH 0-10 cm	Neutral to acid
pH 50-80 cm	Neutral to acid
Soil permeability	Moderate
Soil workability	Good
Wind erodibility	Low

### Land use considerations

- Potentially highly productive soil with good physical properties

# Hard cracking clay

## Soil Group 601

Distribution map p. 112

Colour picture p. 121

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

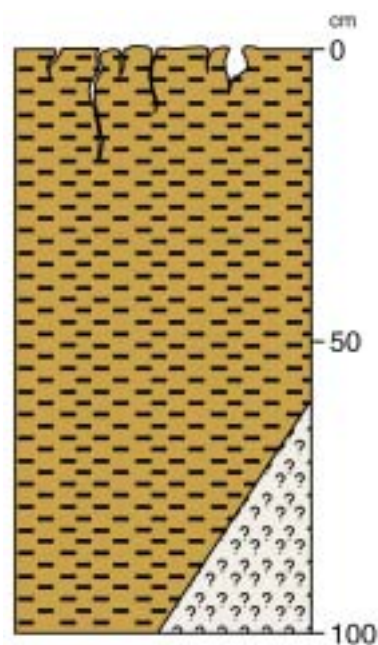
### Local names

Roebourne clay, Tablelands soil, Cracking clay, Crabhole depression soil

### Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

- *Epipedal, Crusty or Massive Vertosol*



### 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

### Soil attributes (dominant values)

Water repellence	Low
Soil structure decline	Moderate
Subsurface acidification	Low
Surface condition	Firm
Unrestricted rooting depth	Moderate
Available water storage	Moderate

Subsurface compaction	Low
pH 0-10 cm	Neutral
pH 50-80 cm	Neutral to alkaline
Soil permeability	Moderate
Soil workability	Fair
Wind erodibility	Low

### Land use considerations

- Low plant available water capacity in dry seasons limits yield potential

# Self-mulching cracking clay

## Soil Group 602

Distribution map p. 112

Colour picture p. 121

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 red variants in Pilbara

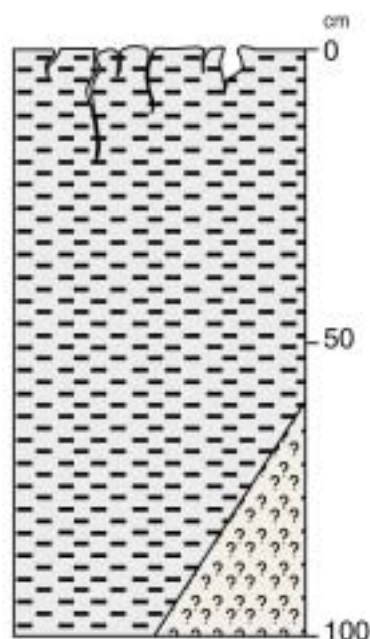
### Local names

Cununurra clay, Black soil, 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

### Soil attributes (dominant values)

Water repellence	Low
Soil structure decline	Low
Subsurface acidification	Low
Surface condition	Self-mulching
Unrestricted rooting depth	Moderate
Available water storage	Moderate to high

Subsurface compaction	Low
pH 0-10 cm	Neutral
pH 50-80 cm	Neutral to alkaline
Soil permeability	Variable
Soil workability	Good
Wind erodibility	Low to moderate

### Land use considerations

- Potentially suitable for irrigated agriculture

# Grey non-cracking clay

## Soil Group 621

Distribution map p. 112

Colour picture p. 121

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 hardsetting surface

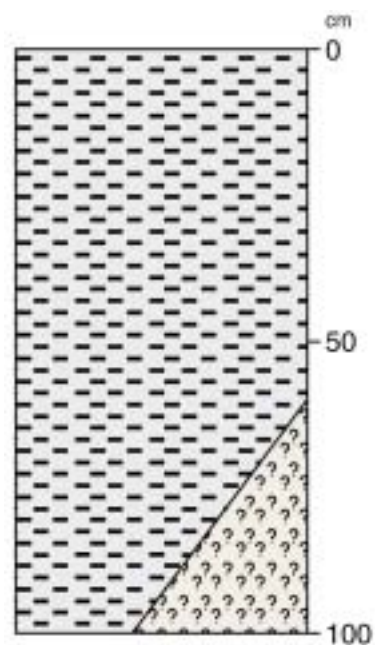
### Local names

Moort soil, Crabhole mound soil

### Typical Australian Soil Classification (ASC)

(dominant ASC in italics)

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



### Main occurrences in Western Australia

- Minor occurrences throughout the South-west

### Soil attributes (dominant values)

Water repellence	Low
Soil structure decline	Moderate to high
Subsurface acidification	Low
Surface condition	Hardsetting
Unrestricted rooting depth	Moderate
Available water storage	Low to moderate

Subsurface compaction	Low
pH 0-10 cm	Neutral
pH 50-80 cm	Neutral to alkaline
Soil permeability	Slow
Soil workability	Poor
Wind erodibility	Low

### Land use considerations

- Low plant available water capacity in dry seasons



# Red/brown non-cracking clay

## Soil Group 622

*Distribution map p. 112*

*Colour picture p. 121*

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 hardsetting
- Sometimes with a calcareous subsoil

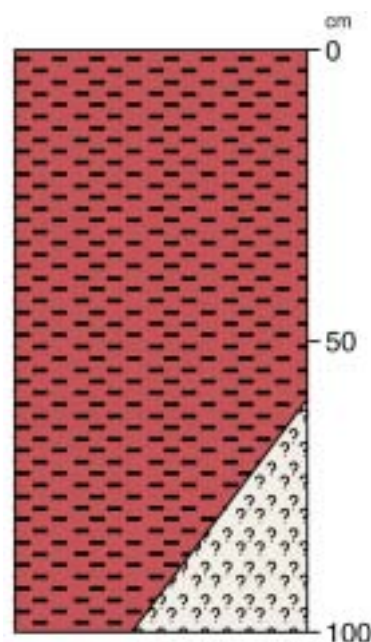
### Local names

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

### Soil attributes (dominant values)

Water repellence	Low
Soil structure decline	Moderate
Subsurface acidification	Low
Surface condition	Firm to hardsetting
Unrestricted rooting depth	Moderate
Available water storage	Moderate

Subsurface compaction	Low
pH 0-10 cm	Neutral
pH 50-80 cm	Neutral to alkaline
Soil permeability	Moderately slow
Soil workability	Fair
Wind erodibility	Low

### Land use considerations

- This soil is subject to structure decline



## Disturbed land

### Soil Group 701

*No distribution map or colour picture*

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

*No distribution map or colour picture*

Areas of permanent or semi-permanent water

## No suitable Group

### Soil Group 703

*No distribution map or colour picture*

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

*No distribution map or colour picture*

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 detail, and provision is required to communicate this fact.

## Soil attributes

For each of the soil attributes included in the descriptions of Soil Groups, the reference and range of values is provided below. Most are based on the land qualities as defined by van Gool and Moore (1999). A third edition of this publication by van Gool, Moore and Tille is in preparation (2002).

Surface condition is from the definitions of McDonald *et al.* (1990). The soil permeability is that of the surface layers based on the classes listed in Purdie (1993b). The pH attributes use the ranges in Purdie (1993a) that has fewer classes than those used in van Gool and Moore (1999).

Some of the land qualities of van Gool and Moore (1999) can be related directly to soil properties (e.g. Water repellence and Soil structure decline). However, some land qualities are influenced by the position in the landscape (e.g. Unrestricted rooting depth, Available 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 Wind erodibility is related to the land quality Wind erosion of van Gool and Moore. If the Soil Group is in a particularly exposed position, the risk of wind erosion will be higher than indicated. Likewise if it is in a sheltered area it will be lower.

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. available water storage for Bare rock), the value *not applicable* is used.

Attribute	Based on	Range of values
Water repellence	van Gool & Moore (1999)	Low, Moderate, High
Soil structure decline	van Gool & Moore (1999)	Low, Moderate, High
Subsurface acidification	van Gool & Moore (1999)	Low, Moderate, High, Presently Acid
Surface condition	McDonald <i>et al.</i> (1990, p142)	Cracking, Self-mulching, Loose, Soft, Firm, Hardsetting, (and others)
Unrestricted rooting depth	van Gool & Moore (1999)	Very shallow, Shallow, Moderate, Deep, Very deep
Available water storage	van Gool & Moore (1999)	Very low, Low, Moderate, High
Subsurface compaction	van Gool & Moore (1999)	Low, Moderate, High
pH 0-10 cm	Purdie (1993a)	Strongly acid, Acid, Neutral, Alkaline
pH 50-80 cm	Purdie (1993a)	Strongly acid, Acid, Neutral, Alkaline
Soil permeability	Purdie (1993b, p14)	Very slow, Slow, Moderately slow, Moderate, Moderately rapid, Rapid, Very rapid
Soil workability	van Gool & Moore (1999)	Good, Fair, Poor, Very poor
Wind erodibility	van Gool & Moore (1999)	Low, Moderate, High, Extreme

## 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, 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 89.

Table 1 describes in detail the standard set of Soil Group qualifiers used by the Department of Agriculture, and the Soil Groups to which they apply. Note that some appear similar but have different meanings and different Soil Group applicabilities.

Table 2 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 1 Standard list of Soil Group qualifiers for describing land units**  
(ordered by code)

Code	Qualifier name and summary description	Relevant soil groups
ACD	<b>Good acid subsoil:</b> clay loam to clay subsoil above 80 cm is acidic ( $\text{pH}_w < 6.0$ ) <b>and</b> non-sodic <b>and</b> well structured or permeable	404, 405, 407, 501, 505, 506, 508, 541, 543, 544, 545
ACD	<b>Good acid subsoil:</b> subsoil above 80 cm is acidic ( $\text{pH}_w < 6.0$ ) <b>and</b> non-sodic <b>and</b> well structured or permeable	461, 462, 463, 464, 465
ALK	<b>Good alkaline subsoil:</b> clay loam to clay subsoil above 80 cm is alkaline ( $\text{pH}_w > 8.0$ ) <b>and</b> non-sodic <b>and</b> well structured or permeable	402, 405, 406, 407, 408, 502, 503, 505, 506, 507, 508, 541, 542, 543, 544, 545
ALK	<b>Good alkaline subsoil:</b> subsoil above 80 cm is alkaline ( $\text{pH}_w > 8.0$ ) <b>and</b> non-sodic <b>and</b> well structured or permeable	462, 463, 464, 465
CAC	<b>Acid subsoil:</b> clay loam to clay subsoil above 80 cm is acidic ( $\text{pH}_w < 6.0$ )	302, 303, 601, 602, 621, 622
CLK	<b>Alkaline subsoil:</b> clay loam to clay subsoil above 80 cm is alkaline ( $\text{pH}_w > 8.0$ ) above 80 cm	601, 602, 621, 622
CLM	<b>Clayey matrix:</b> stones or gravel are surrounded by a predominantly clay loam to clay matrix	202, 203, 304
CLY	<b>Clay topsoil:</b> topsoil texture ranges from a clay loam to a clay	101, 103, 105
CNE	<b>Neutral subsoil:</b> 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	<b>Differentiation not required:</b> no further differentiation is required for this soil group	102, 104, 201, 701, 702, 703, 704
DSA	<b>Deep sand:</b> profile is non-alkaline <b>and</b> has sand to clayey sand texture to a depth of at least 80 cm	101, 103, 105
DSD	<b>Deep sandy duplex:</b> profile has a sandy topsoil <b>and</b> a texture contrast layer present at 30-80 cm	101, 103, 105
DSK	<b>Calcareous or alkaline sands:</b> profile is alkaline <b>and</b> has sand to clayey sand texture to a depth of at least 80 cm	101, 103, 105
EDX	<b>Effective duplex:</b> barrier to drainage (e.g. clay layer, solid rock or hardpan) is present at 80-150 cm	440
FSE	<b>Fair sand, effective duplex:</b> fine sand to 80 cm <b>or</b> sand increasing to clayey or loamy sand below 30 cm <b>and</b> a clay loam or clay layer (but no solid rock or hardpan) is present at 80-150 cm	441, 445, 446
FSR	<b>Fair sand, rock substrate:</b> fine sand to 80 cm <b>or</b> sand increasing to clayey or loamy sand below 30 cm <b>and</b> a hardpan or solid rock is present at 80-150 cm	441, 445, 446
FSV	<b>Fair sand, very deep:</b> fine sand throughout <b>or</b> sand increasing to clayey or loamy sand below 30 cm <b>and</b> no hardpan, solid rock or clay layer present within the top 150 cm	441, 445, 446
GRG	<b>Gravelly subsurface, good subsoil:</b> ironstone gravel (>20%) present below 15 cm <b>and</b> clay loam to clay subsoil above 80 cm is non-sodic <b>and</b> well structured or permeable	409
GRI	<b>Coarse gritty sand:</b> sand is coarse or gritty <b>and</b> solid rock is present at 30-80 cm	422
GRP	<b>Gravelly subsurface, poor subsoil:</b> ironstone gravel (>20%) present below 15 cm <b>and</b> clay loam to clay subsoil above 80 cm is poorly structured (typically sodic)	409
GRV	<b>Gravelly:</b> ironstone gravel (>20%) present in the top 15 cm	101, 103, 105
GSA	<b>Good sand topsoil, good acid subsoil:</b> topsoil is a clayey, loamy or fine sand <b>and</b> clay loam to clay subsoil above 80 cm is acidic ( $\text{pH}_w < 6.0$ ) <b>and</b> well structured or permeable	403

<b>GSE</b>	<b>Good sand, effective duplex:</b> clayey or loamy sand dominates the profile <b>and</b> occurs within the top 30 cm <b>and</b> a clay loam or clay layer (but no solid rock or hardpan) is present at 80-150 cm	301, 441, 445, 446
<b>GSE</b>	<b>Good sand, effective duplex:</b> clayey, loamy or fine sand dominates the profile below 30 cm <b>and</b> a clay loam to clay layer or soft coffee rock (but no solid rock or hardpan) is present at 80-150 cm	443, 444
<b>GSN</b>	<b>Good sand topsoil, good neutral subsoil:</b> topsoil is a clayey, loamy or fine sand <b>and</b> the clay loam to clay subsoil above 80 cm is neutral (pH <sub>w</sub> 6.0-8.0) <b>and</b> non-sodic <b>and</b> well structured or permeable	403
<b>GSP</b>	<b>Good sand topsoil, poor subsoil:</b> topsoil is predominantly a clayey, loamy or fine sand <b>and</b> clay loam to clay subsoil above 80 cm is poorly structured (typically sodic)	401, 403
<b>GSR</b>	<b>Good sand, deep rock substrate:</b> clayey or loamy sand ( <i>typically a dark colour in 442</i> ) dominates the profile <b>and</b> occurs within the top 30 cm <b>and</b> a hardpan, cemented layer or solid rock is present at 80-150 cm	301, 441, 442, 445, 446
<b>GSR</b>	<b>Good sand, deep rock substrate:</b> clayey, loamy or fine sand dominates the profile (below 30 cm) <b>and</b> a hardpan, cemented layer or solid rock is present at 80-150 cm	443, 444
<b>GSR</b>	<b>Good sand, rock substrate:</b> sand is predominantly fine grained, loamy or clayey ( <i>typically a dark colour for 421, may contain some gravels for 422-424</i> ) <b>and</b> a hardpan, cemented layer or solid rock is present at 30-80 cm	421, 422, 423, 424
<b>GSV</b>	<b>Good sand, very deep:</b> clayey or loamy sand dominates the profile (may grade into a clay below 80 cm) <b>and</b> no hardpan or solid rock is present within the top 150 cm	301
<b>GSV</b>	<b>Good sand, very deep:</b> clayey or loamy sand ( <i>typically a dark colour in 442</i> ) dominates the profile <b>and</b> occurs within the top 30 cm <b>and</b> no hardpan, clay layer or solid rock is present within the top 150 cm	441, 442, 445, 446
<b>GSV</b>	<b>Good sand, very deep:</b> clayey, loamy or fine sand dominates the profile below 30 cm <b>and</b> no hardpan, clay layer, reticulite or solid rock is present within the top 150 cm	443, 444
<b>GSX</b>	<b>Good sand, permeable substrate:</b> clayey or loamy sand dominates <b>and</b> a permeable layer of reticulite or clay is present at 80-150 cm	301
<b>GTR</b>	<b>Gritty sand, rock substrate:</b> gritty or coarse sand (typically bleached) <b>and</b> solid rock is present at 80-150 cm	443, 444
<b>GVR</b>	<b>Good sand, very shallow rock substrate:</b> dark loamy sand dominates the profile <b>and</b> solid rock or a cemented layer is present at <30 cm	421
<b>GWK</b>	<b>Good sand, good alkaline subsoil:</b> topsoil is a clayey, loamy or fine sand <b>and</b> clay loam to clay subsoil above 80 cm is alkaline (pH <sub>w</sub> >8.0) <b>and</b> non-sodic <b>and</b> well structured or permeable	401
<b>LCA</b>	<b>Loamy-calcareous:</b> soil is predominantly loamy <b>and</b> calcareous	101, 103, 105
<b>LDP</b>	<b>Loamy duplex:</b> profile has a loamy topsoil <b>and</b> a texture contrast layer present at 30-80 cm	101, 103, 105

## SOIL GROUP QUALIFIERS

## SOIL GROUPS OF WESTERN AUSTRALIA

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



<b>PWK</b>	<b>Poor sand, good alkaline subsoil:</b> sandy topsoil is coarse or medium grained <b>and</b> clay loam to clay subsoil above 80 cm is alkaline (pH <sub>w</sub> >8.0) <b>and</b> non-sodic <b>and</b> well structured or permeable	401
<b>PWN</b>	<b>Poor sand, good neutral subsoil:</b> sandy topsoil is coarse or medium grained <b>and</b> clay loam to clay subsoil above 80 cm is neutral (pH <sub>w</sub> 6.0-8.0) <b>and</b> non-sodic <b>and</b> well structured or permeable	403
<b>RET</b>	<b>Reticulite:</b> a reticulite layer is present at 30-80 cm	302, 303
<b>RKD</b>	<b>Deep rock substrate:</b> solid rock, hardpan or a cemented layer is present at 80-150 cm	301, 302
<b>RKM</b>	<b>Rock substrate:</b> 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
<b>RST</b>	<b>Rocky or stony:</b> soil has >20% rock or stones (>20 mm) throughout	101, 103, 105
<b>SAC</b>	<b>Acid sand:</b> sand is strongly acid (pH <sub>w</sub> <5.6) within the top 30 cm	422, 423, 424, 441, 443, 444, 445, 446
<b>SAL</b>	<b>Saline:</b> soil is saline (EC <sub>e</sub> >400 mS/m) within the top <30 cm	202, 304, 421, 422, 423, 424, 442, 520, 521, 522, 601, 602, 621, 622
<b>SAM</b>	<b>Sandy matrix:</b> stones or gravel are surrounded by a predominantly coarse to clayey sand sandy matrix	202, 203, 304
<b>DLM</b>	<b>Deep loam:</b> 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
<b>SEA</b>	<b>Sandy earth:</b> sandy topsoil grading to loam by 80 cm	101, 103, 105
<b>SHL</b>	<b>Shallow loam:</b> soil is a loam <b>or</b> a clay <b>and</b> solid rock, hardpan or a cemented layer is present at 30-80 cm	101, 103, 105
<b>SHS</b>	<b>Shallow sand:</b> soil is a sand <b>and</b> solid rock, hardpan or a cemented layer is present at 30-80 cm	101, 103, 105
<b>SSD</b>	<b>Shallow sandy duplex:</b> profile has a sandy topsoil <b>and</b> a texture contrast layer present at <30 cm	101, 103, 105
<b>SSS</b>	<b>Saline subsoil:</b> subsoil is saline (EC <sub>e</sub> >400 mS/m) <b>and</b> 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
<b>TYP</b>	<b>Typical:</b> typical qualifier for this soil group in this zone	All
<b>UDF</b>	<b>Undifferentiated:</b> soil has not yet been differentiated	All
<b>VDE</b>	<b>Very deep:</b> no solid rock, clay, hardpan or reticulite is present in the top 150 cm	440
<b>VGR</b>	<b>Very gravelly:</b> ironstone gravel content is predominantly >60% within the top 80 cm	301, 302, 303, 304
<b>VSH</b>	<b>Very shallow rock substrate:</b> solid rock, hardpan or a cemented layer is present at <30 cm	101, 103, 105, 202, 203, 304, 420, 422, 423, 424, 520, 522
<b>WSS</b>	<b>Good subsoil:</b> clay loam to clay subsoil above 80 cm is non-sodic <b>and</b> well structured or permeable	400, 409, 460, 500, 540

**Table 2 Order of applicable Soil Group qualifiers**

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

<b>101</b>	<b>Saline wet soil</b> 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		LMM: loamy matrix CLM: clayey matrix
<b>102</b>	<b>Salt lake soil</b> DNR: differentiation not required	<b>203</b>	<b>Stony soil</b> VSH: very shallow rock substrate SSS: saline subsoil SAM: sandy matrix LMM: loamy matrix CLM: clayey matrix
<b>103</b>	<b>Semi-wet soil</b> 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	<b>301</b>	<b>Deep sandy gravel</b> 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
<b>104</b>	<b>Tidal soil</b> DNR: differentiation not required	<b>302</b>	<b>Duplex sandy gravel</b> SSS: saline subsoil RKD: deep rock substrate VGR: very gravelly RET: reticulite PSS: poor subsoil CAC: acid subsoil CNE: neutral subsoil
<b>105</b>	<b>Wet soil</b> 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	<b>303</b>	<b>Loamy gravel</b> SSS: saline subsoil RET: reticulite VGR: very gravelly DLM: no clay loam in top 80cm PSS: poor subsoil CAC: acid subsoil CNE: neutral subsoil
<b>201</b>	<b>Bare rock</b> DNR: differentiation not required	<b>304</b>	<b>Shallow gravel</b> VSH: very shallow rock substrate SAL: saline VGR: very gravelly SAM: sandy matrix LMM: loamy matrix CLM: clayey matrix
<b>202</b>	<b>Calcareous stony soil</b> VSH: very shallow rock substrate SAL: saline SAM: sandy matrix	<b>400</b>	<b>SANDY DUPLEXES Supergroup</b> SSS: saline subsoil PSS: poor subsoil WSS: good subsoil
		<b>401</b>	<b>Alkaline grey deep sandy duplex</b> 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
<b>402</b>	<b>Alkaline grey shallow sandy duplex</b> SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil
<b>403</b>	<b>Grey deep sandy duplex</b> 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
<b>404</b>	<b>Grey shallow sandy duplex</b> SSS: saline subsoil RKM: rock substrate PSS: poor subsoil NEU: good neutral subsoil ACD: good acid subsoil
<b>405</b>	<b>Red deep sandy duplex</b> SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil ACD: good acid subsoil NEU: good neutral subsoil
<b>406</b>	<b>Red shallow sandy duplex</b> SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil NEU: good neutral subsoil
<b>407</b>	<b>Yellow/brown deep sandy duplex</b> SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil ACD: good acid subsoil NEU: good neutral subsoil
<b>408</b>	<b>Yellow/brown shallow sandy duplex</b> SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil NEU: good neutral subsoil
<b>409</b>	<b>Reticulite deep sandy duplex</b> SSS: saline subsoil RKM: rock substrate GRP: gravelly subsurface, poor

	subsoil PSS: poor subsoil GRG: gravelly subsurface, good subsoil WSS: good subsoil
<b>420</b>	<b>SHALLOW SANDS Supergroup</b> VSH: very shallow rock substrate
<b>421</b>	<b>Calcareous shallow sand</b> 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
<b>422</b>	<b>Pale shallow sand</b> 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
<b>423</b>	<b>Red shallow sand</b> SAL: saline VSH: very shallow rock substrate SAC: acid sand PSR: poor sand, deep rock substrate GSR: good sand, deep rock substrate
<b>424</b>	<b>Yellow/brown shallow sand</b> SAL: saline VSH: very shallow rock substrate SAC: acid sand PSR: poor sand, deep rock substrate GSR: good sand, deep rock substrate
<b>440</b>	<b>DEEP SANDS Supergroup</b> EDX: effective duplex VDE: very deep
<b>441</b>	<b>Brown deep sand</b> 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
<b>442</b>	<b>Calcareous deep sand</b> SAL: saline

## SOIL GROUP QUALIFIERS

## SOIL GROUPS OF WESTERN AUSTRALIA

	PSR: poor sand, deep rock substrate PSV: poor sand, very deep GSR: good sand, deep rock substrate
--	---

	WSS: good subsoil
<b>461</b>	<b>Acid yellow sandy earth</b> SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ACD: good acid subsoil

<b>443</b>	<b>Gravelly pale deep sand</b> 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
<b>444</b>	<b>Pale deep sand</b> 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
<b>445</b>	<b>Red deep sand</b> 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
<b>446</b>	<b>Yellow deep sand</b> 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
<b>460</b>	<b>SANDY EARTHS Supergroup</b> SSS: saline subsoil RKM: rock substrate PSS: poor subsoil

<b>462</b>	<b>Brown sandy earth</b> SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil ACD: good acid subsoil NEU: good neutral subsoil
<b>463</b>	<b>Red sandy earth</b> SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil ACD: good acid subsoil NEU: good neutral subsoil
<b>464</b>	<b>Yellow sandy earth</b> SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil ACD: good acid subsoil NEU: good neutral subsoil
<b>465</b>	<b>Pale sandy earth</b> SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil ACD: good acid subsoil NEU: good neutral subsoil
<b>500</b>	<b>LOAMY DUPLEXES Supergroup</b> SSS: saline subsoil PSS: poor subsoil WSS: good subsoil
<b>501</b>	<b>Acid shallow duplex</b> SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ACD: good acid subsoil
<b>502</b>	<b>Alkaline grey shallow loamy duplex</b> SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil
<b>503</b>	<b>Alkaline red shallow loamy duplex</b> SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil

## SOIL GROUP QUALIFIERS

## SOIL GROUPS OF WESTERN AUSTRALIA

<b>504</b>	<b>Grey shallow loamy duplex</b> SSS: saline subsoil RKM: rock substrate PSS: poor subsoil NEU: good neutral subsoil
<b>505</b>	<b>Brown deep loamy duplex</b> SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil ACD: good acid subsoil NEU: good neutral subsoil
<b>506</b>	<b>Red deep loamy duplex</b> SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil ACD: good acid subsoil NEU: good neutral subsoil
<b>507</b>	<b>Red shallow loamy duplex</b> SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil NEU: good neutral subsoil
<b>508</b>	<b>Yellow/brown shallow loamy duplex</b> SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ACD: good acid subsoil ALK: good alkaline subsoil NEU: good neutral subsoil
<b>520</b>	<b>SHALLOW LOAMS Supergroup</b> SAL: saline VSH: very shallow rock substrate LMR: loam, rock substrate
<b>521</b>	<b>Calcareous shallow loam</b> SAL: saline NSA: non-saline
<b>522</b>	<b>Red shallow loam</b> SAL: saline VSH: very shallow rock substrate LMR: loam, rock substrate
<b>523</b>	<b>Red-brown hardpan shallow loam</b> LVR: loam, very shallow rock substrate LMR: loam, rock substrate
<b>540</b>	<b>LOAMY EARTHES Supergroup</b> SSS: saline subsoil PSS: poor subsoil WSS: good subsoil
<b>541</b>	<b>Brown loamy earth</b> SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil ACD: good acid subsoil NEU: good neutral subsoil

<b>542</b>	<b>Calcareous loamy earth</b> SSS: saline subsoil PSS: poor subsoil ALK: good alkaline subsoil
<b>543</b>	<b>Friable red/brown loamy earth</b> SSS: saline subsoil PSS: poor subsoil ALK: good alkaline subsoil ACD: good acid subsoil NEU: good neutral subsoil
<b>544</b>	<b>Red loamy earth</b> SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil ACD: good acid subsoil NEU: good neutral subsoil
<b>545</b>	<b>Yellow loamy earth</b> SSS: saline subsoil RKM: rock substrate PSS: poor subsoil ALK: good alkaline subsoil ACD: good acid subsoil NEU: good neutral subsoil
<b>601</b>	<b>Hard cracking clay</b> SAL: saline CAC: acid subsoil CLK: alkaline subsoil CNE: neutral subsoil
<b>602</b>	<b>Self-mulching cracking clay</b> SAL: saline CAC: acid subsoil CLK: alkaline subsoil CNE: neutral subsoil
<b>621</b>	<b>Grey non-cracking clay</b> SAL: saline CAC: acid subsoil CLK: alkaline subsoil CNE: neutral subsoil
<b>622</b>	<b>Red/brown non-cracking clay</b> SAL: saline CAC: acid subsoil CLK: alkaline subsoil CNE: neutral subsoil
<b>701</b>	<b>Disturbed land</b> DNR: differentiation not required
<b>702</b>	<b>Water</b> DNR: differentiation not required
<b>703</b>	<b>No suitable group</b> DNR: differentiation not required
<b>704</b>	<b>Undifferentiated soils</b> DNR: differentiation not required

## 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<sub>w</sub> 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 program and land units can be obtained from Department of Agriculture, Western Australia's external website: [www.agric.wa.gov.au/progserv/natural/assess/Index.htm](http://www.agric.wa.gov.au/progserv/natural/assess/Index.htm), or for Department of Agriculture staff from the internal website: [agweb/progserv/natural/assess/Index.htm](http://agweb/progserv/natural/assess/Index.htm)

Enquiries about qualifiers, land units and other information held in the map unit database should be directed to Noel Schoknecht (contact details on page 4).