More photographs and descriptions that will help you to identify indicator vegetation follow.

**Brown mallet** (*E. astringens*) is common in the west of the district below breakaways on poorly structured mottled zone soils (‘mallet’ soils), and may occur on gravels with silver and blue mallets.

**Blue mallet** (*E. gardneri*) often occurs with silver mallet, mainly on mafic stony uplands. It has similar bark to brown mallet, but has distinctive dull blue-green leaves.

The Lake Grace district has three types of **wandoo**. All have dull leaves and smooth stems. Wandoo (*E. wandoo*) is a tree found on sandy duplex soils in the west of the district. Inland wandoo (*E. capillosa*) is found mainly in the north on gritty and sandy duplex pallid zone soils as a tree form (subsp. *capillosa*) or very shallow pallid zone soils as a mallee (subsp. *polyclada*).
Gimlet (*E. salubris*) is a mallet that occurs with salmon gums on valley clays, and with merrit on upland mafic rocky soils.

Moort (*E. platypus*) is a mallet that usually grows in single species clumps in the south. Moorts usually indicate poorly structured shallow duplexes, often formed from pallid zone. Acidic moort soils occur on dissected laterite uplands. Alkaline variants are more common on lower slopes and tributary valleys.

York gum (*E. loxophleba*) has three subspecies and an intergrade form in the Lake Grace district. They all have characteristic shiny green leaves but differ in their form and bark characteristics:

- **Ssp. loxophleba** (tree with rough bark) occurs on loamy soils formed from fresh rock, usually with jam (*Acacia acuminata*), and is the most common form in the western part of the district. Note that the rough bark changes to smooth further up the branches.

- **Ssp. lissophloia** is a smooth-barked mallee that occurs mainly at Kulin and further north in valleys generally on loams or loamy duplex soils and often with salmon gum and gimlet.

- **Ssp. gratiae** is similar to ssp. *lissophloia* but has larger buds and fruit and tends to be more common further south. Bark colour in both mallees ranges from pale pink to bronze/red.

- The tree/mallee intergrade form has a stocking bark and is common on loams and loamy duplex formed from mafic rock in the west of the district.
Several species of trees with a stocking of rough bark occur on alkaline valley soils and could be mistaken for York gum. Floral differences are shown on the next page.

**Red morrel** (*E. longicornis*) indicates calcareous loamy soils with abundant lime and other salts. It occurs on aeolian ‘fluffy’ loams near major valleys and mafic red-brown loams or loamy gravels.

**Kondinin blackbutt** (*E. kondininensis*) occurs on well-drained naturally saline aeolian soils. This is usually the main eucalypt that is closest to salt lakes.

**Snap and rattle** (*E. myriadena* syn Beard; *E. ovularis*) occurs on red-brown alkaline soils and is more common than York gum near salt lakes.

**Flat-topped yate** (*E. occidentalis*) occurs south of Pingrup on winter wet soils and waterways.
Guide to the most common rough-bark eucalypts

<table>
<thead>
<tr>
<th>Buds</th>
<th>Fruit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat-topped yate (mallet) <em>E. occidentalis</em></td>
<td>Mostly in fresh winter wet areas in the south of the district. Rough bark with ivory-coloured upper smooth bark branches.</td>
</tr>
<tr>
<td>Kondinin blackbutt (mallet) <em>E. kondininensis</em></td>
<td>Mostly near salt lakes. Rough 'stocking' bark. Copper-coloured upper smooth-bark branches</td>
</tr>
<tr>
<td>Red morrel (tree) <em>E. longicornis</em></td>
<td>Aeolian loams and mafic soils. Rough bark on whole trunk. Copper-coloured upper smooth-bark branches</td>
</tr>
<tr>
<td>York gum (tree form) <em>E. loxophleba</em></td>
<td>Rocky soils and loamy duplex valleys. It usually has branches lower on the trunk and coarser bark than red morrel. Greenish to copper smooth bark.</td>
</tr>
<tr>
<td>Snap and rattle (tree) <em>E. myriadena</em></td>
<td>Occurs on red-brown alkaline soils with York gum, and is more common near salt lakes. It looks similar to York gum, but has narrower leaves, more delicate buds and tightly held rough bark.</td>
</tr>
</tbody>
</table>

**Mallees** are the most common plant type in the district. There are dozens of species that are often intermixed. Apart from a few easily identifiable species such as blue mallee (*E. pleurocarpa*), they are difficult to identify without species identification keys.

Soils often occur in mosaics that merge into each other with several species of mallee on each soil type, although there is still a trend towards lateritic soils on rises and alkaline duplexes in valleys.

There is a good relationship between type (Proteaceous or myrtaceous), size and diversity of understorey plants below the mallees and soil properties, but species combinations vary.

**Broad guide to trends in eucalypt understorey with soil type**

- Mallees with sandplain understorey species such as banksias, chittick, roadside tea tree
  - Deep grey sand, gravelly sand over clay
- Mallee with proteaceous and tamma understorey
  - Sandy gravel, sand over gravel over clay, loamy gravels, shallow gravels
- Mallee understorey becomes more diverse as depth to clay increases and soils are better drained
- Eucalypts with a dense melaleuca understorey
  - Alkaline calcareous valley shallow duplex soils or alkaline mafic uplands
- Mallets or mallee with sparse, few species, melaleuca understorey
  - Poorly structured shallow duplex or clay soil
- Poorly structured shallow duplex or clay soil
Landslapes and soils of the Lake Grace district

Mallees with sparse or prickly understorey

Hard-setting loam on a quartz dyke

Low prickly melaleuca understorey on hard-setting shallow duplex near Hyden

Melaleuca coronicarpa is one of the prickly species found on poorly structured and shallow soils with moort thickets in the south of the district.

Eucalypts with tall melaleuca understorey

Eucalypts with tall melaleuca understorey types are found on mafic upland duplex and valley loamy duplex soils. Eucalypts include salmon gum, merrit, gimlet, E. extensa, and mallees (particularly E. annulata which is the mallee equivalent of the mallet (E. tenera), with dense melaleuca understorey.

E. extensa mallet on hard-setting brown loamy duplex. It may be mistaken for gimlet but has, different buds, darker bark and no stem twisting.

Two-tiered mallee melaleuca scrub on an alkaline shallow sandy duplex valley soil (E. annulata, E. calycogona, E. pileata)

Melaleuca eleuterostachya is a common species on these soils.
Mallees with melaleuca-dominant understorey on alkaline grey sandy duplex soils

30-cm grey sand over clay on lower slope 15-cm grey sand over clay on valley edge

Bluebush is a common volunteer species on alkaline shallow duplex, often found on soil road verges.

Mallee heath on shallow gravel over clay soils

Duplex gravel with clay within 30–40 cm are common in the south of the district. The shrub understorey has mixed species but only scattered proteaceae (usually hakeas).

Blue mallee (E. pleurocarpa) indicates better drained areas (often with 50+ cm to clay).

Sword sedge (Lepidoderma sp.) is common on sandy surfaced soils.
Mallee grey deep sandy duplex soils

Vegetation on these soils is mallee with a dense shrub understorey.

Well-drained soils often have a wide range of understorey species and forms. Proteaceae are a minor component except on gravelly variants. Often with 30–40 cm sand over clay, these soils are common on gentle slopes, and below rock outcrops.

Melaleucas are the dominant shrubs on valley/lower slope soils.

Deep sandy duplex flat south of Lake King. The white spots are mounds of sand brought up by ants.

Grey deep sandy duplex with mixed species understorey.

Melaleucas are widespread, but are dominant on wetlands and as understorey plants under eucalypts in clay, duplex, alkaline and poorly structured soils.

Booree *M. pauperiflora* (left) is common on heavy salt lake wetlands.

The broombush types of melaleucas (e.g. *M. acuminata*, *M. lateriflora*, and *M. uncinata* group) are common, particularly on igneous rock soils and sandy duplexes.

*M. uncinata* on shallow granitic soil with York gum mallee

Dense *M. lateriflora* heath on Lake Bryde floodplain.
Mallee grey deep loose sandy duplex soils

Such soils (> 50 cm sand) have sandplain mallees with grey sandplain understorey plants such as tea trees, banksias, chittick, and cabbage hakea.

Blue mallee with *Banksia media*–tea tree understorey south of Pingrup

*E. phaenophylla* mallee with cabbage hakea and roadside tea tree understorey at Tarin Rock

The plants below are common on grey sandy or gravelly sand soils. With the exception of roadside tea tree (*Myrtaceae*), they belong to the Proteaceae family.

Roadside tea tree (*Leptospermum erubescens*)

Chittick (*Lamberta inermis*)

Woolly bush (*Adenanthis sericea*)

Woolly banksia (*Banksia baueri*)

Fan-leaf hakea (*Hakea browneii*)

Cabbage hakea (*Hakea corymbosa*)
Proteaceous species are major components of lateritic and sandy heaths, and as understorey species are a good guide to distinguishing mallee duplex gravels from other duplexes.

**Banksias** are generally a good guide to sandy gravel and deep sandy soils.

**Grevilleas** are noticeable in lower rainfall sandplain heath, particularly yellow sand over gravel, but also occur on other well-drained upland soils.

**Hakeas** are widespread, but are very common on sandy gravel to shallow and loamy gravel soils with dryandras. They have similar flowers to grevilleas, but have a woody fruit.

**Dryandras** (now in the Banksia genus), with their prickly vegetation, are a noticeable feature of shallow gravel and sandy gravel soils.
**April 2011**

Tammas (mainly shrubs) and sheoaks (small trees) have needle-type foliage with separate male (pollen) and female (‘nut’) plants.

Black tamma (*Allocasuarina acutivalvis*) occurs mainly on mafic and yellow stony and shallow gravels.

The most common tamma (*Allocasuarina campestris*) occurs with black tamma, but tends to be more common in deeper or loamier gravels and yellow earths. It becomes very common in gravelly rises in yellow lateritic sandplain in the Hyden area.

*Allocasuarina corniculata* is a less common tamma that also occurs on gravelly soils.

Compass bush (*Allocasuarina pinaster*) occurs in grey and pale yellow sand over gravel banksia/tea tree heath.

Rock sheoak (not shown, *Allocasuarina huegeliana*) is widespread in the adjacent Narrogin and Katanning districts, but is limited to deep grey sandy surfaced soils or around granite outcrops in the west of the district.
Cypress pines (Callitris spp.) are scattered in well-drained soils of the district. Bright green Callitris preissii is common on yellow sandplain, but is also scattered through deep sandy duplex and other well-drained soils. Silver-grey Callitris canescens tends to be more common on shallower soils and is frequently found on breakaways.

Below are cypress pines and black tamma on a yellow loamy sand gravel/sandy earth slope at Karlgarin.

The next photographs show differing vegetation types on deep sandy areas.

- Cypress pine and sandplain heath
- Pale then yellow sand over gravel at Lake Grace
- Yellow sandplain south-east of Kulin
- Mainly acacias, hakeas, grevilleas
- Flame grevillea, tussock grass and sandplain heath
- Broombush, cypress pine and sword sedge
- Yellow sandy earth east of Hyden
- Yellow sand over ironstone at Holt Rock
Soil field texture guide

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

Step 1 Take an amount of soil that will sit comfortably in the palm of your hand from the layer of soil to be textured.

Step 2 Form a bolus (ball) of soil by moistening the sample with water and kneading it.

Step 3 Knead the soil for 1–2 minutes while adding more water or soil until it just fails to stick to the fingers. The soil is now ready for shearing (ribboning). Note how the bolus feels when kneading it.

Step 4 Press out the soil between the thumb and forefinger to form a ribbon. The ribbon should be only 2–3 mm thick.

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

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

Table 1 Soil texture groups
Common soils of the Lake Grace district

The following soil information sheets provide a guide to the major soils of this district, and contain brief soil capability and land use information. Each soil is identified by three characteristics: (1) common name (2) one or more Western Australian soil groups and (3) soil series. Coloured photographs of representative soil profiles are designed to aid identification.

The common name reflects natural soil units with broadly similar management characteristics.

Soil groups provide standard names for soils in Western Australia with emphasis on specific management characteristics that can vary rapidly across a field. They were developed to provide a simple way to recognise common soils across district boundaries (Schoknecht 2005).

Soil series in the district are limited to a survey of an area adjoining the main lake chain from Lake King to Hyden (Teakle et al. 1940). Soil series from adjoining districts have been used to describe soils that were not identified in this survey. These are identified by the following abbreviations: KA Katanning (Percy 2000), JE Jerramungup (Overheu 1995, 1996); MD Merredin (Bettaney and Hingston 1964); NO Northam (Lantzke and Fulton 1993).

Images of individual soils are point examples that are part of a continual change from one soil to another, although there is usually a pattern of soils that tend to appear together. For example:

- Well-drained upland soils formed on mafic rock are generally brown to red-brown with higher clay content. Soils vary from shallow to loamy gravels to loam, duplexes and clays that are usually alkaline and calcareous.

- Lateritic soils formed on granites/granitic gneisses in the north/north-east of the district resemble the eastern wheatbelt sandplain, with a general pattern of tamma yellowish shallow and duplex gravels on ridges above yellow deep loamy sands and sandy earths.

- Lateritic soils formed on granites/granitic gneisses in the west of the district are frequently yellow-orange to pale shallow gravels and deep sandy gravels with grey gravelly sand and deep sand in hollows.

- Lateritic soils on the subdued landscape south of Lake Grace are mostly duplex gravels that are very variable and are often intimately intermixed with sandy duplex and deep sand soils.
Gravelly and sandy surfaced, soils

> 20% gravel in top 30 cm soil?  

**YES**  

Loamy gravel page 36  

Shallow gravel page 37  

Grey yellow gravelly sand surface over sand/loamy sand gravel  

**Sandy gravel** page 38  

Shallow sandy gravel over mottled clay, or shallow gravelly sand over gravel over clay  

**Duplex sandy gravel** page 39

**NO**  

Deep sand, sand over gravel  

> 80 cm pale sand over gravel or clay  

**Deep pale sand** page 41  

Soils formed from granite outcrops  

Granitic sandy surfaced soils page 43  


downward

Sand over clay  

About 30–80 cm sand over clay or  

> 20 cm sand over sandy gravel over clay  

**Grey deep sandy duplex** page 45  


downward

Loam to clay soils

Grey-brown to red-brown ‘fluffy’ calcareous loams ‘lake bank country’  

**Morrel-blackbutt soils** page 49  

Red-brown loams and clays  

Red-brown soils with heavy alkaline and often calcareous subsoils  

**Red-brown heavy soils** page 50  

Loams and clays with light coloured subsoils  

Salmon gum alkaline calcareous valley loamy duplex  

Salmon gum grey valley soils page 52  

Mallee loamy duplex with sodic subsoils often with lime nodules. Can be well or poorly structured  

**Mallee shallow loamy duplex soils** page 53  

Mallee loamy duplex with sodic subsoils often with lime nodules. Can be well or poorly structured  

**Moort-mallee clay** page 54  

Alkaline shallow sandy duplexes in valleys and lower slopes, or upland shallow poorly structured sandy duplex (often breakaway) upper slope landscape  

**Shallow sandy duplex** page 47  

Hard-setting deep yellow loamy sand or loamy sand grading to a loam that may have gravel or reticulite  

**Yellow sandy earth** page 42

Deep sand, sand over gravel  

> 80 cm pale sand over gravel or clay  

**Deep pale sand** page 41  

Deep sand, sand over gravel  

> 80 cm pale sand over gravel or clay  

**Deep pale sand** page 41  

Deep sand, sand over gravel  

> 80 cm pale sand over gravel or clay  

**Deep pale sand** page 41
### Annual pasture legumes for common soils in the Lake Grace district

This table is a general guide only for soil type adaptation. Check species and varietal information. These can be found in *Pasture legumes for temperate farming systems: the ute guide*.

<table>
<thead>
<tr>
<th></th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unsuitable</td>
<td>Poorly suited</td>
<td>Suited to some situations or soils</td>
<td>Moderately suitable</td>
<td>Very suitable</td>
<td></td>
</tr>
<tr>
<td><strong>Subclover</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loamy gravel</td>
<td>4</td>
<td>2</td>
<td>3–4</td>
<td>3–4</td>
<td>4</td>
</tr>
<tr>
<td>Shallow gravel</td>
<td>2</td>
<td>0</td>
<td>2</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>Balansa clover</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sandy gravel</td>
<td>2–3</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td><strong>Bladder clover</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duplex sandy gravel</td>
<td>3–4</td>
<td>2</td>
<td>2</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td><strong>Eastern star clover</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pale deep sand</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td><strong>Biserrula</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yellow sandy earth</td>
<td>3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td><strong>Barrel medic</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Granitic sandy surfaced soils</td>
<td>3–4</td>
<td>2</td>
<td>2–3</td>
<td>2–3</td>
<td>3–4</td>
</tr>
<tr>
<td><strong>Sphe r medic</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grey deep sandy duplex</td>
<td>2–3</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Shallow sandy duplex</td>
<td>3</td>
<td>2</td>
<td>3–4</td>
<td>2–4</td>
<td>1</td>
</tr>
<tr>
<td><strong>Burr medic</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Morrel-blackbutt soils</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td><strong>French serradella</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Red-brown heavy soils</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td><strong>Yellow serradella</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Salmon gum grey valley soil</td>
<td>2</td>
<td>2</td>
<td>4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td><strong>Moort-mallee clay</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mallee shallow loamy duplex soil</td>
<td>2</td>
<td>2</td>
<td>3–4</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

1. Balansa clover is suited to winter wet areas.
2. Perennial pastures such as lucerne and saltbush are suited to some soils, but suitability is also determined by other factors such as position in the landscape. More information is available from the Evergreen Group: www.evergreen.asn.au
April 2011

Loamy gravel

WA soil group: loamy gravel

These are mafic gravels that often occur in relatively small areas in association with shallow ironstone and red-brown heavy soils. They are more common in the north and west of the district.

**Soil series:** Cumming series (KA)

**Vegetation:** Tamma scrub, mallee-tamma scrub, blue mallet

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Acidity</strong></td>
<td>Moderate risk. Mildly acidic but moderate buffering capacity</td>
</tr>
<tr>
<td><strong>Soil structure</strong></td>
<td>Deep firm to hard-setting loamy gravel topsoil with abundant gravel pebbles over reticulate ironstone or clay</td>
</tr>
<tr>
<td><strong>Water repellence</strong></td>
<td>Low to moderate risk</td>
</tr>
<tr>
<td><strong>Waterlogging</strong></td>
<td>Low risk</td>
</tr>
<tr>
<td><strong>Water erosion</strong></td>
<td>Moderate risk as they tend to occur on uplands and can initiate run-off and erosion downslope</td>
</tr>
<tr>
<td><strong>Wind erosion</strong></td>
<td>Low risk</td>
</tr>
<tr>
<td><strong>Water availability</strong></td>
<td>Moderately-low to moderate, depending on clay content and amount of gravel in profile</td>
</tr>
<tr>
<td><strong>Plant rooting depth</strong></td>
<td>Moderate but variable</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td>High phosphate retention index, and manganese deficiency in cereals may be a problem</td>
</tr>
<tr>
<td><strong>Cereals</strong></td>
<td>Moderate to moderately high yield potential</td>
</tr>
<tr>
<td><strong>Canola</strong></td>
<td>Moderate yield potential</td>
</tr>
<tr>
<td><strong>Grain legumes</strong></td>
<td>Field peas. Narrow leaf lupins are grown but yield is variable</td>
</tr>
<tr>
<td><strong>Pastures</strong></td>
<td>See page 35</td>
</tr>
</tbody>
</table>

Very gravelly soils with a mildly acidic sandy loam matrix that grades to a mildly acidic to neutral gravelly clay loam to clay. Alkaline clays may be present at depth.
**Shallow gravel**  
**WA soil group: shallow gravel**

This category covers a range of lateritic gravelly soils with less than 80 cm gravel or friable reticulite over dense ironstone. It is usually found on breakaways, crests, and ridges and upper slopes, and often grades into deeper lateritic sandy and gravelly soils. Yellow to brown sandy gravels are most common, but shallow loamy gravel, pale sandy gravel or sand over reticulite also occurs.

**Soil series:** Carmody series (LG)

**Native vegetation:** Tamma, mallet (particularly silver mallet) thicket, dense prickly heath

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Acidity</strong></td>
<td>Moderate risk</td>
</tr>
<tr>
<td><strong>Soil structure</strong></td>
<td>Generally loose or hard-setting sandy or loamy gravel over impermeable reticulite ironstone</td>
</tr>
<tr>
<td><strong>Water repellence</strong></td>
<td>Moderate to high risk</td>
</tr>
<tr>
<td><strong>Waterlogging</strong></td>
<td>Low risk</td>
</tr>
<tr>
<td><strong>Water erosion</strong></td>
<td>Moderate risk, but as they tend to occur on uplands they can initiate run-off and erosion downslope</td>
</tr>
<tr>
<td><strong>Wind erosion</strong></td>
<td>Low risk</td>
</tr>
<tr>
<td><strong>Water availability</strong></td>
<td>Generally low but variable due to variable topsoil texture, depth of gravel, and reticulite water-holding and root-penetration features</td>
</tr>
<tr>
<td><strong>Plant rooting depth</strong></td>
<td>Generally shallow but variable due to variable depth of gravel over reticulite; but some plant roots can travel down old root channels and cracks in reticulite</td>
</tr>
<tr>
<td><strong>Cereals</strong></td>
<td>Moderate to poor, depending on depth to ironstone and cracks in ironstone</td>
</tr>
<tr>
<td><strong>Canola</strong></td>
<td>Poor</td>
</tr>
<tr>
<td><strong>Grain legumes</strong></td>
<td>Not suitable for most; moderately low yield potential for narrow leaf lupins</td>
</tr>
<tr>
<td><strong>Pastures</strong></td>
<td>See page 35</td>
</tr>
</tbody>
</table>

Shallow gravel examples
Deep sandy gravel

WA soil group: shallow gravel

These are mainly yellow or brown sandy gravels on uplands in association with shallow gravels, generally north and east of Lake Grace. Grey sandy gravels are less common and tend to occur more south and west of Lake Grace.

Soil series: Carmody series (LG)

Vegetation: Proteaceae heath and tamma, often with scattered sandplain mallees

- **Acidity**: High. Originally mildly acidic, but have moderately high acidification rate due to high leaching sandy matrix soils
- **Soil structure**: Loose to firm topsoils with friable very gravelly subsoils
- **Water repellence**: Very susceptible
- **Waterlogging**: Not a problem
- **Water erosion**: Winter moderately low, summer moderate
- **Wind erosion**: Moderate to low
- **Water availability**: Moderately low
- **Plant rooting depth**: Deep
- **Cereals**: Moderately low to moderate, depending on soil texture
- **Canola**: Moderately low to moderate, depending on soil texture
- **Grain legumes**: Moderate narrow leaf lupin yield potential
- **Pastures**: See page 35

Sandy gravel mostly have increasing gravel and clay content at depth, usually overlying dense reticulate.

The soil on the left has more gravel and lower clay content than that on the far left.
Duplex sandy gravel  
WA soil group: duplex sandy gravel

These soils are characterised by 30–80 cm of (generally pale to yellowish brown) sandy gravel that changes abruptly to a mottled pale or yellowish clay loam or sandy clay that may be gravelly in the upper layer. The top 15 cm may be a sand or gravelly sand which can become deeper as they merge into sandy duplex (including sand over gravel over clay) soils.

These soils are the most common lateritic soils south and west of Lake Grace, particularly near Pingrup where they are intermixed with grey duplex soils.

In the north and east of the district, there is a trend into tamma yellow loamy sand duplex gravels intermixed with yellow shallow gravels, sandy gravels and sandy earths. These gravels are similar to the Merredin Ulva series, but tend to be less acidic.

Soil series: Wahkinup (KA), Ulva (MD), Koornong (Jerramungup) series

Vegetation: Dominant vegetation in south and central areas is mallee with a mixed-species shrub understorey. Shallow gravelly duplexes have a mainly melaleuca understorey. More Proteaceae occur as the clay becomes deeper and more permeable.

Yellow duplex gravels in the north/north-east frequently have tamma dominant vegetation, intermixed with sandplain mallees and other species.

Acidity  Moderate to high risk
Soil structure  Firm setting to loose surfaced soil. Moderately low risk of traffic pans
Water repellence  Susceptible to very susceptible
Waterlogging  Low to moderate on soils with shallow depth to clay layer and dense clay subsoil to south and west. Otherwise low
Water erosion  Moderate to low risk
Wind erosion  Moderately low risk
Water availability  Moderately low to moderate. Water repellence early in growing season can cause patchy water availability on low clay topsoils
Plant rooting depth  Moderate to low, depending on clay and gravel content, depth to clay, and ability of roots to penetrate subsoil. Soils with reticulite clay loam subsoils and those with deeper depth to the clay layer tend to allow deeper root growth and are less prone to waterlogging than those with shallow and dense sodic clays

Other  In the south of the district, these are some of the most consistently productive soils over a range of seasons
Cereals  Moderate to moderately high yield potential
Canola  Moderate yield potential
Grain legumes  Narrow leaf lupins
Pastures  See page 35

The photographs on the next page depict gravel profiles with characteristic vegetation.
Common duplex gravel profile. Note the characteristic mallee heath with melaleuca and scattered hakea understorey.
Pale deep sand

WA soil group: pale deep sand

These soils can be broadly divided into two types:

1. Deep often coarse sand often over gravel or reticulite or near granite outcrops that occur throughout the district, usually on slopes or hollows on uplands.

2. Deep sandy aeolian deposits beside salt lake chains, and in pockets with deep sandy duplex soils, mainly south of Lake Grace.

Soil series: Philips series (NO, white sand), Eaton series (NO, pale yellow sand)

Vegetation: Typically tall heath, sometimes with scattered sandplain mallees. Rock sheoak and Christmas tree can occur in areas

Acidity
High risk due to high acidification rate, low productivity, high leaching, very low buffering capacity, and acidic pH

Soil structure
Sandy and loose throughout profile

Water repellence
Extremely susceptible

Waterlogging
Not a problem

Water erosion
Low risk, run-off can occur from heavy rain on dry water-repellent soils

Wind erosion
Very high risk

Water availability
Low to very low

Plant rooting depth
Deep

Other
Nutrient leaching is a problem. Soaks may occur further downslope

Cereals
Very low potential

Canola
Very low potential

Grain legumes
Narrow leaf lupins: low to moderate yield potential if potassium is applied

Pastures
Serradellas: low to moderate yield potential if potassium is applied. Often planted to perennials such as tagasaste, perennial grasses and maritime pine


A1 Loose grey to light grey medium to coarse grained loose sand

A2 White to pale yellow medium to coarse grained sand

B White to pale yellow medium to coarse grained sand with large ironstone gravel

Note: this layer is not always present
Yellow sandy earth

These soils are good quality, yellow sandplain often with ironstone gravel at depth. They are most common in the north and east of the district and often occur with shallow and sandy gravels. Smaller areas occur in aeolian sandplain and colluvium below mafic gravels further west. These soils include deep loamy sands grading to sandy loam with depth (yellow and brown earths), and yellow loamy sand soils that have increasing clay content with depth, and a reticulite or gravelly layer deeper than 30 cm that can be dense or permeable. They do not include lower clay aeolian banksia deep yellow sands that adjoin major valleys more common to the west of the district.

Soil series: Wyola (NO), Ejanding (NO), Norpa (MD) series

Vegetation: Dense Proteaceae (particularly grevilleas and hakeas) and tamma heath that often contains callitris pines, sandplain mallees and acacias

Acidity
High risk due to high acidification rate and acidic pH

Soil structure
Firm setting surface. Very susceptible to traffic pan formation. Deep ripping gives a marked growth response in cereal crops and yield responses, except in dry years

Water repellence
Susceptible

Waterlogging
No problem

Water erosion
Moderate to low risk but hard-setting and can have run-off, particularly on tracks. Can be compacted into roaded catchments

Wind erosion
Moderate to high, depending on texture

Water availability
Generally medium

Plant rooting depth
Deep

Cereals
High. Reliable soils over a range of seasons

Canola
Moderate to high potential; soil acidity may reduce yields

Grain legumes
Narrow leaf lupins: high yield potential

Pastures
See page 35

Three variants of this soil type are shown below.
Granitic sandy surfaced soils  WA soil groups: grey deep and shallow sandy duplex; yellow-brown deep and shallow sandy duplex; shallow sand

These soils are most common in dissected landscapes, particularly in the Hyden area. They are very variable, reflecting differences in underlying geology and landscape formation processes, where they often are intermingled with rock outcrops and lateritic soils. Rocky red soils from mafic rocks are frequently intermixed with these soils. They generally have a sand or loamy sand surface with increasing clay or a duplex layer at varying depths (sometimes with a gravelly band) over decomposing granite or gneiss. These soils vary in pH, but generally have acidic topsoil over a mildly acidic to mildly alkaline subsoil.

Soil series: Maleballing (NO), Warup, Tarwonga (KA), Madden (LG) series

Vegetation: Tamma, broombush and York gum mallee frequently occur on shallow soils. Deeper soils have mixed vegetation that includes York gum and mallees, jam and a range of understorey shrubs.

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acidity</td>
<td>Generally mildly acidic to neutral. Moderate to high risk due to high acidification rate (high productivity, low buffering capacity)</td>
</tr>
<tr>
<td>Soil structure</td>
<td>Loose to firm-setting gritty soils generally with well-structured subsoils</td>
</tr>
<tr>
<td>Water repellence</td>
<td>Moderately to highly susceptible</td>
</tr>
<tr>
<td>Waterlogging</td>
<td>In patches below rock outcrops or near bedrock highs due to shallow rock</td>
</tr>
<tr>
<td>Water erosion</td>
<td>Moderate risk, particularly adjacent to rock outcrops</td>
</tr>
<tr>
<td>Wind erosion</td>
<td>Generally moderate risk</td>
</tr>
<tr>
<td>Water availability</td>
<td>Moderately low to moderately high, depending on depth to rock and soil texture</td>
</tr>
<tr>
<td>Plant rooting depth</td>
<td>Moderate to deep</td>
</tr>
<tr>
<td>Other</td>
<td>Quite productive soils except for very sandy and shallow soil over rock variants</td>
</tr>
<tr>
<td>Cereals</td>
<td>Generally moderate yields</td>
</tr>
<tr>
<td>Canola</td>
<td>Moderate yields</td>
</tr>
<tr>
<td>Grain legumes</td>
<td>Narrow leaf lupins yield well on deeper soils, although patches can be waterlogged in wet years. Peas also yield well but summer wind erosion risk is high</td>
</tr>
<tr>
<td>Pastures</td>
<td>See page 35</td>
</tr>
</tbody>
</table>

The photographs on the next page depict a range of granitic soils.
April 2011

Pale deep sand
50 cm coarse grey sand over clayey sand grading to sandy loam at 130 cm

Brown sandy earth
(Tarwonga series)
80 cm coarse sand, grading to sandy loam then sandy clay loam at 100 cm

Brown sandy earth
(Boyaminning series)
90 cm loamy sand over sandy loam

Yellow brown deep sandy duplex
(Maleballing 1 series)
20 cm brown loamy sand over yellow-brown coarse sand with yellow brown clay at 35 cm

Grey deep sandy duplex
(Warup series)
15 cm grey loamy coarse sand over light grey-brown clayey sand with yellow brown clay at 30 cm

Shallow sand
(Madden sand series)
Yellow-brown loamy sand over weathering gneiss