Grey deep sandy duplex

These soils generally have neutral to mildly acid topsoils over poorly structured alkaline clays or clay loams, and are found intermixed with mallee shallow sandy duplex and duplex sandy gravel soils. Grey sandy duplex soils are most common, but yellow-brown duplex soils also occur, particularly to the north of the district.

They can be broadly divided into two types:

1. 30–80 cm sand over poorly structured clay, often with a bleached layer that may have a thin line of gravel between the sand and the clay. Remnant vegetation on these soils is dominated by mallees with mallee-melaleuca scrub on the shallower types, featuring blue mallee (*E. pleurocarpa*) and tea tree heath in the deep types. The soil surface tends to be loose but may be hard-setting on shallower variants.

2. 20–30 cm deep pale sand over sandy gravel over clay loam or clay. These soils are a deep sandy variant of duplex sandy gravels and are intermixed with them. Remnant vegetation is dominated by mallees with a mixed-species understorey that usually contains some *Proteaceae* (particularly hakeas) and scattered callitris pines. These soils often have a loose sandy surface and are more common on mid and upper slopes.

**Soil series:** Indinup (KA) series, Baanga (LG) series
<table>
<thead>
<tr>
<th><strong>Acidity</strong></th>
<th>High risk due to high acidification rate, acidic topsoil pH and low buffering capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Soil structure</strong></td>
<td>Firm to loose surface. Loamy sands may respond to deep ripping. Subsoils vary in root penetration properties, but tend to be more hostile than sand over gravel over clay</td>
</tr>
<tr>
<td><strong>Water repellence</strong></td>
<td>Very susceptible</td>
</tr>
<tr>
<td><strong>Waterlogging</strong></td>
<td>Moderate on shallower types</td>
</tr>
<tr>
<td><strong>Water erosion</strong></td>
<td>Low risk</td>
</tr>
<tr>
<td><strong>Wind erosion</strong></td>
<td>High risk</td>
</tr>
<tr>
<td><strong>Water availability</strong></td>
<td>Generally moderate but variable, depending on clay and gravel content, depth to clay, and ability of roots to penetrate subsoil. Water repellence early in growing season can also cause patchy water availability. Water perched above clay may be an advantage in some seasons</td>
</tr>
<tr>
<td><strong>Plant rooting depth</strong></td>
<td>Generally moderate, depending on depth of sandy layer and underlying soil structure</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td>Very susceptible to frost. Leaching may be a problem in wet years. Water repellence and rapid topsoil drying inhibits crop and pasture establishment in dry start to growing season. Sand over gravel over clay soils are productive over a range of seasons</td>
</tr>
<tr>
<td><strong>Cereals</strong></td>
<td>Moderate to good</td>
</tr>
<tr>
<td><strong>Canola</strong></td>
<td>Moderate to good</td>
</tr>
<tr>
<td><strong>Grain legumes</strong></td>
<td>Moderate narrow leaf lupin yield on deeper types</td>
</tr>
<tr>
<td><strong>Pastures</strong></td>
<td>See page 35</td>
</tr>
</tbody>
</table>
Landscapes and soils of the Lake Grace district

Shallow sandy duplex

WA soil groups: grey shallow sandy duplex; alkaline grey shallow sandy duplex

These soils can occur anywhere in the landscape but are most common in water gaining areas and below breakaways. They have about 10–30 cm grey to grey-brown, neutral to mildly alkaline topsoils over alkaline clays, and are found intermixed with deeper sandy duplex soils.

Subsoils are often sodic and poorly structured, or have a pale bleached band over a ‘seal’ that restricts water and root penetration over structured clays. The clays frequently have a domed structure with sand in cracks between domes that permit root growth.

Soils in the southern part of the district tend to have paler topsoils and poorer soil structure than those in the north.

Soil series: Pallarup series, Hurlstone sand (LG)

Vegetation: Mallee-melaleuca scrub. Water gaining areas tend to have more broombush-type melaleucas. Below breakaways, prickly melaleucas are more common. Inland wandoo may occur on breakaway soils near Hyden.

Acidity

Often alkaline subsoils, but sandy topsoil is acidic, with moderate to moderately high acidification rate. Breakaway soils may be acidic

Soil structure

May be susceptible to surface compaction. Subsoil clays vary in root penetration resistance that is reflected in crop yield potential

Water repellence

Moderate risk

Waterlogging

High risk in wet seasons in water gaining areas

Water erosion

Low risk

Wind erosion

Moderate to high risk

Water availability

Variable depending on clay content of topsoil and root penetration ability of subsoil, which can vary over short distances for no apparent reason. Water perched above the clay an advantage in some seasons in deeper variants

Plant rooting depth

Variable depending on clay content of topsoil and root penetration ability of subsoil

Other

Very susceptible to frost

Cereals

Moderate on average; yield can be restricted in both very dry and wet seasons

Canola

Variable

Grain legumes

Peas and vetches

Pastures

See page 35

The photographs on the next page depict shallow sandy duplex soils in the Lake Grace district.
April 2011

Shallow alkaline sandy duplex soils with differing depths of sand over a thin silica seal over domed clay.

Loamy sand

Mallee-melaleuca shallow sandy duplex

Hard-setting sandy duplex with prickly melaleuca understorey below a breakaway
Landscapes and soils of the Lake Grace district

**Morrel-blackbutt soil**  
WA soil group: Calcareous earth

These soils generally are powdery surfaced calcareous grey-brown loams with abundant free lime in the top metre. They tend to adjoin major valleys, usually on the south and east sides. They can be intermixed with aeolian sands, and grade into salmon gum calcareous duplex soils.

**Soil series:** Milarup series (LG)

**Vegetation:** Red Morrel, Kondinin blackbutt, and yorrell-type trees and mallees (*E. yilgarnensis, E. myriadena*) with saltbush and bluebush understorey

<table>
<thead>
<tr>
<th><strong>Acidity</strong></th>
<th>Alkaline</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Soil structure</strong></td>
<td>Well-structured subsoils, with a fluffy surface. The topsoil can form a crust, and seal if excessively cultivated or heavily grazed in early winter</td>
</tr>
<tr>
<td><strong>Water repellence</strong></td>
<td>Not a problem</td>
</tr>
<tr>
<td><strong>Waterlogging</strong></td>
<td>Well drained</td>
</tr>
<tr>
<td><strong>Water erosion</strong></td>
<td>Low risk but some intergrade loamy duplex soils, can have surface crusting soils that may seal with sudden heavy rain</td>
</tr>
<tr>
<td><strong>Wind erosion</strong></td>
<td>Very high risk</td>
</tr>
<tr>
<td><strong>Water availability</strong></td>
<td>Moderate to high plant-available water, but high natural soil salinity levels reduce the crop’s ability to extract water in dry seasons</td>
</tr>
<tr>
<td><strong>Plant rooting depth</strong></td>
<td>Moderate to deep but may be limited by salinity or boron toxicity</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td>Residues of sulfonylurea herbicides for prickly saltwort control preclude legume crops and pastures. In extended pasture leys, salt accumulation at surface can cause surface scalds</td>
</tr>
<tr>
<td><strong>Cereals</strong></td>
<td>Excellent in wet seasons, but high salt levels often restrict yields. Barley more tolerant than wheat</td>
</tr>
<tr>
<td><strong>Canola</strong></td>
<td>Low potential</td>
</tr>
<tr>
<td><strong>Grain legumes</strong></td>
<td>Suitable for pulses except narrow leaf lupins if sufficient soil moisture, but residual sulfonylurea herbicide could be limiting</td>
</tr>
<tr>
<td><strong>Pastures</strong></td>
<td>See page 35</td>
</tr>
</tbody>
</table>

Soil with abundant silica-lime nodules  
Soil with few nodules but abundant free lime
Red-brown heavy soils

WA soil group: self-mulching cracking clay; alkaline red loamy duplex; calcareous loamy earth, red shallow loam

These red to brown soils occur on uplands formed from dolerite or other mafic rocks, or in valleys in mafic areas.

Soils in this group include (most commonly) loamy duplexes, cracking and self-mulching clays and calcareous loamy earths. They are all red-brown with sandy loam to clay topsoils, and alkaline calcareous clay subsoils. Upland soils are most common in dissected landscapes, particularly in the Kulin to Hyden area. They are variable—reflecting differences in underlying geology and landscape formation processes—and are often intermingled with rock outcrops, and lateritic soils.

Soil series: Varley series, Barookee clay (LG)

Vegetation: York gum, salmon gum, gimlet, merrit, red morrel, mallees with melaleuca understorey

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acidity</td>
<td>Alkaline and calcareous subsoils</td>
</tr>
<tr>
<td>Soil structure</td>
<td>Firm to hard-setting with well-structured calcareous subsoils. Topsoil susceptible to compaction from cultivation and stock trampling when wet</td>
</tr>
<tr>
<td>Water repellence</td>
<td>No problem</td>
</tr>
<tr>
<td>Waterlogging</td>
<td>Low risk but boggy areas can occur in valleys, below rock outcrops or near bedrock highs</td>
</tr>
<tr>
<td>Water erosion</td>
<td>Moderate to high risk on uplands that tend to be dissected</td>
</tr>
<tr>
<td>Wind erosion</td>
<td>Low risk on loamy duplex soils, but self-mulching soils are susceptible</td>
</tr>
<tr>
<td>Water availability</td>
<td>Low to moderately high depending on soil depth. High clay soils retain more water in upper layers, increasing evaporation losses in dry seasons</td>
</tr>
<tr>
<td>Plant rooting depth</td>
<td>Moderate to shallow. Well-structured clays permit root penetration but boron toxicity and high natural salt content of some subsoils limit root growth</td>
</tr>
<tr>
<td>Other</td>
<td>Fertile soils with high yield potential when sufficient rainfall to fully wet the soil profile. Yields greatly reduced in very dry seasons. No-till seeding has greatly improved yields by reducing surface compaction, and loss of soil moisture. Groundwater salinity risk in valleys</td>
</tr>
<tr>
<td>Cereals</td>
<td>Generally excellent to good in average to wet seasons, depending on soil depth; poor in dry seasons</td>
</tr>
<tr>
<td>Canola</td>
<td>Good in average to wet seasons, depending on soil depth; poor in dry seasons</td>
</tr>
<tr>
<td>Grain legumes</td>
<td>Suitable for pulses, except for narrow leaf lupins</td>
</tr>
<tr>
<td>Pastures</td>
<td>See page 35</td>
</tr>
</tbody>
</table>

The photographs on the next page show red-brown heavy soils in the Lake Grace district.
**Winspear series:** Alkaline red shallow loamy duplex. This soil common on dolerite dykes

0–10 cm. Dark reddish-brown heavy clay loam, 15% medium ironstone gravel; pH 6.6

10–25 cm. Red moderately structured medium clay. Very calcareous; pH 8.1

> 25 cm. Red medium-heavy clay; highly calcareous with much soft lime; pH 8.5

**Filmer series:** Calcareous loamy earth

0–10 cm. Reddish-brown very highly calcareous heavy clay loam; pH 8.9

Below 10 cm. Yellowish-red to red medium heavy clay; strongly developed structure; very highly calcareous; pH 9.6

**Northam series:** red shallow loamy duplex to cracking clay

A. Reddish-brown sandy clay, loam to medium clay; often self-mulching with surface cracks pH 6.5

B. Reddish-brown medium clay, strongly structured; often contains dolerite rock; may contain lime at depth pH 6.5 to 8.5

C. Decomposing dolerite rock
Salmon gum grey heavy valley soils

These soils occur on the main valley floors, and are characterised by shallow hard-setting loamy sands or sandy loams, over structured grey to yellow orange mottled clay that usually have finely divided free lime at depth. They have more sodic soils than the red-brown salmon gum-gimlet valley soils in the north of the district, and there is a gradual trend to browner topsoils from south to north.

Soil series: Pallarup series (LG)

Vegetation: Salmon gum-gimlet-merrit forest

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Acidity</strong></td>
<td>Alkaline</td>
</tr>
<tr>
<td><strong>Soil structure</strong></td>
<td>Susceptible to surface compaction, particularly from heavy grazing early in growing season. Subsoil clays generally sodic, but enough structure to permit root penetration</td>
</tr>
<tr>
<td><strong>Water repellence</strong></td>
<td>Low risk</td>
</tr>
<tr>
<td><strong>Waterlogging</strong></td>
<td>Sandy duplex, high risk in wet years. Loamy duplex medium to high risk</td>
</tr>
<tr>
<td><strong>Water erosion</strong></td>
<td>Low risk</td>
</tr>
<tr>
<td><strong>Wind erosion</strong></td>
<td>Low (loamy surface) to moderate (sandy surface) risk</td>
</tr>
<tr>
<td><strong>Water availability</strong></td>
<td>Moderate to good. Receive run-off from summer rains and good water retention, but yield poorly in dry seasons</td>
</tr>
<tr>
<td><strong>Plant rooting depth</strong></td>
<td>Usually shallow to moderate, depending on subsoil structure</td>
</tr>
<tr>
<td><strong>Other</strong></td>
<td>High salinity risk, and more susceptible to frost than red-brown heavy soils</td>
</tr>
<tr>
<td><strong>Cereals</strong></td>
<td>Good yields in average seasons; poor in dry seasons and often in wet seasons</td>
</tr>
<tr>
<td><strong>Canola</strong></td>
<td>Reasonable yields in average seasons; poor in dry seasons and wet seasons</td>
</tr>
<tr>
<td><strong>Grain legumes</strong></td>
<td>Faba beans, peas and vetches</td>
</tr>
</tbody>
</table>

Pastures: See page 35

Left: Grey type more common in the south of the district.
Right: Grey-brown type that is more common in central and northern areas.
**Landscapes and soils of the Lake Grace district**

**Mallee shallow loamy duplex**

These soils generally have less than 20 cm of grey to grey-brown sandy loam to loam over yellow/grey/brown sodic clays. They often occur on lower slopes and valley floors, and grade into salmon gum grey heavy valley soils. These soils may have restricting layers between the loam and the clay. Others may have reasonably structured subsoils (sometimes with lime nodules), despite the clay being sodic due to moderately high salt levels in the soil that reduces clay dispersion.

**WA soil group: alkaline grey shallow loamy duplex**

**Soil series:** Camm series (LG)

**Vegetation:** Large mallees with a moderately high melaleuca understorey sometimes with the occasional merrit and salmon gum, and *E. tenera* mallet

**Acidity**

Alkaline

**Soil structure**

Susceptible to surface compaction, particularly from heavy grazing early in growing season. Restricting layers between loam and clay, and poorly structured clays, can restrict plant growth (although less common than sandy duplex)

**Water repellence**

Low risk

**Waterlogging**

Moderate to high risk in valleys in wet years

**Water erosion**

Low risk

**Wind erosion**

Low risk

**Water availability**

Moderate

**Plant rooting depth**

Usually shallow to moderate, depending on subsoil structure

**Other**

High salinity risk, and more susceptible to frost than red-brown heavy soils

**Cereals**

Moderate to good in an average season; poor in dry seasons and often poor in wet seasons

**Canola**

Reasonable yields in an average season; poor in dry seasons and wet seasons

**Grain legumes**

Faba beans, peas and vetches

**Pastures**

See page 35

Left: Massive soil south of the district

Soil profiles are often similar to grey salmon gum heavy soils. However, some differences are:

- subsoils generally have a more massive structure, particularly at low moisture contents
- soils may have lime nodules but rarely free lime
- a seal may be present at the top of the clay layer.
Moort-mallee clay

WA soil group: grey shallow sandy and loamy duplex

These soils mainly occur in the south of the district. They have very shallow crusting gritty loamy sands or sandy loams, or hard-setting loams and clay loams over massive poorly structured clays. Moort soils are often alkaline and on lower to mid slopes. Very acidic types also occur on uplands, particularly in a dissected laterite landscape where they are derived from exposed pallid zone, often merging into poorly structured shallow sandy and loamy duplexes.

Soil series: Bimburra (JE), Valona (JE)

Vegetation: Moort south of Lake Grace; inland wandoo and mallee wandoo near Hyden

<table>
<thead>
<tr>
<th>Acidity</th>
<th>Low risk on alkaline types, but acidic soil may need liming</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soil structure</td>
<td>Hard-setting poorly structured topsoil (susceptible to surface sealing) over dense clay that inhibits root penetration. Can be boggy. Test for gypsum response</td>
</tr>
<tr>
<td>Water repellence</td>
<td>Low risk</td>
</tr>
<tr>
<td>Waterlogging</td>
<td>Waterlogging problem on lower slopes and break of slope</td>
</tr>
<tr>
<td>Water erosion</td>
<td>Moderate to low risk, but can become very boggy and slippery</td>
</tr>
<tr>
<td>Wind erosion</td>
<td>Generally low risk</td>
</tr>
<tr>
<td>Water availability</td>
<td>Generally low (moderate in some soils with domed clays with sandy cracks or better structured clays)</td>
</tr>
<tr>
<td>Plant rooting depth</td>
<td>Shallow</td>
</tr>
<tr>
<td>Other</td>
<td>No-till seeding has greatly improved yield reliability by enabling earlier seeding, and improving topsoil structure. Lucerne can be grown on alkaline types</td>
</tr>
<tr>
<td>Cereals</td>
<td>Low (poor soil structure very wet or dry seasons) to moderate (improved structure) yield potential</td>
</tr>
<tr>
<td>Canola</td>
<td>Very variable</td>
</tr>
<tr>
<td>Grain legumes</td>
<td>Peas, vetches</td>
</tr>
<tr>
<td>Pastures</td>
<td>Often poor pasture establishment. See page 35</td>
</tr>
</tbody>
</table>

Left: Bimburra series (JE) alkaline grey clay
Right: Valona series (JE) acidic grey clay
Field trip

The main objectives of the field trip are:

- to give you practical experience in using the decision aids in your manual
- to give you practical experience with relevant landscapes and soils.

Materials required for this trip:

- Vehicle
- Spade or soil auger, water for soil texturing, and cloth to clean hands
- Insect repellent and protective clothing relevant to the season
- Blank copies of the site investigation sheet (photocopies of page 19)

The field tour traverses an area to the south-east of Lake Grace. Figure 20 shows a 3D aerial image of the route while Figure 21 shows a radiometrics image of most of the route.

Radiometric surveys use aerial or ground-based sensors that measure gamma ray emissions from thorium, uranium and potassium in the top 30 cm of the soil. These emissions when converted to colours and draped on digital terrain models can be used for mapping changes of soil type in the landscape.

In Figure 21, potassium is red, uranium is blue, and thorium is green. Maps display a range of colours and brightness according to the total amount and balance of these elements in different rocks and soils. Silica in the form of sand dilutes the radioelement concentrations and hence intensity of the colours. Silica sand topsoils also damp down gamma rays coming from lower layers.

Colours can also vary with different forms of data analysis. Granites and gneisses have relatively high amounts of potassium minerals such as feldspars, and uranium and thorium bearing minerals, and as such, outcrops have white or bright pink colours.

Mafic and ultramafic rocks have less total potassium and lower levels of uranium and thorium, and show up as shades of red.

Potassium is relatively high in ‘fresh’ granitic or mafic soils. Note that this is ‘total’ potassium that is concentrated in relatively erosion-resistant potassium feldspars, rather than the lesser available potassium for plants that is adsorbed on clays and organic matter. Uranium and thorium are concentrated in ferricretes and clays, but may have lower levels in very weathered clays such as pallid zone kaolinites. In Figure 21 the common shallow grey duplex soils are shown in blue, ranging to dark blue to black with increasing depth of sandy topsoil. Red-brown valley loams and clay tend to be brighter with yellow/greenish-brown mottles.

The radiometrics image in Figure 21 is quite coarse as it was flown at 400-m line spacing. It shows major areas but misses fine features at paddock scale.

In both maps, features such as ridges and valleys run in lines that are often at right angles to each other (north-west/south-east and east-north-east/ west-north-west or east-west) reflect underlying geological structures such as dykes and faults. Most ridges are underlain by intermediate to mafic gneisses and dolerite dykes. The underlying ridges are shown by areas of shallow iron-rich gravel (bright blue-green) and associated igneous rocky soil (red).
April 2011

Figure 20  Aerial photo relief map of the field trip route with stops shown in yellow

- Very dark blue: deep sandy duplex
- Bright green: shallow gravel
- Red: granite or shallow rocky soils
- Turquoise: often duplex gravels

Figure 21  Radiometrics map of the field trip route

- Light mottled blue: often red-brown loamy duplex or clay
- Bright blue: grey clay or shallow duplex soils
Tour notes

Odometer 0.0 km Depart from Lake Grace Department of Agriculture and Food and drive west on the main road.

1.6 km—Stop 1 GPS zone 50 641905/6330234. With the 110 km/h road sign on the right and the ‘Saltbush City’ sign on the left, turn around and park on the north side of the road.

![E. myriadena Lime nodules on the surface Soil profile revealed in railway cutting](image)

Figure 22  **Stop 1**

Table 2 is an example site investigation sheet that has been completed from information that is available at this stop.

<table>
<thead>
<tr>
<th>Indicator vegetation</th>
<th>Small <em>E. myriadena</em> trees with salt-tolerant saltbush and bluebush understorey</th>
</tr>
</thead>
<tbody>
<tr>
<td>Where are you in the landscape?</td>
<td>On the edge of a rise in a salt-lake valley chain</td>
</tr>
<tr>
<td>Surface clues</td>
<td>Lime nodules on the surface</td>
</tr>
<tr>
<td>Other clues</td>
<td>The railway cutting shows a uniform calcareous loam, with increasing lime nodules at depth. The soil surface is fairly loose and ‘fluffy’, which indicates high salt content</td>
</tr>
<tr>
<td>Your conclusion</td>
<td>Morrel-blackbut soil (page 49) on a dune in a salt lake chain</td>
</tr>
<tr>
<td>Landscape and soil(s)</td>
<td></td>
</tr>
</tbody>
</table>

Return to Lake Grace, turn right at the Shell service station and go down the road to Pingrup.

10.1 km—Stop 2 553382/6265190. Turn left into Willcocks Road and stop by the red morrel trees at the corner.

This stop shows a transition from a lateritic slope to the trunk valley. On the left (north) is the valley with aeolian calcareous grey loamy soils (morrel-blackbut soils, page 49) with red morrel trees at the roadside and salmon gums and mallees to the east where the soil changes to an alkaline sandy duplex (salmon gum grey heavy soil, page 52).
April 2011

Up the slope on the right (south), vegetation is mixed with grevilleas, sword sedge, roadside tea tree and tammas upslope that indicate a lateritic soil, and an abandoned gravel pit. This illustrates that lateritic sandplain may extend down a slope almost to the valley floor. It is likely that there is a seasonal perched fresh watertable where the sedges are thick near the change of soil type.

Continue along Willcocks Road.

At 10.7 km you will pass a gravel pit to your right on a low rise. Roadside tea tree, sword sedge and perennial grass in the road reserve indicate a change to lighter soil, but the vegetation quickly changes back with the mallee grey duplex soil on the other side of the road.

11.6 km—Stop 3 637155/6330290. Stop at the gate on the right. Investigate this stop using a site investigation sheet and compare your results with the completed sheet on page 68.

11.9 km—Stop 4 639073/6330276. Stop just past the dam to the right. This is the valley drainage line. Initially the stop appears to have the same soil type as Stop 3 but there are clues that indicate a difference.

Roadside vegetation species have changed. Overstorey species include salmon gum tree, merrit (*E. uma*) and gimlet (*E. salubris*) mallets (note the Y-shaped branching pattern), and *E. annulata* (greenish stems) mallee. Salmon gums grow on soils with calcareous subsoils. Merrit and gimlet are also found on these soils and on soils formed on weathering igneous (frequently mafic) loams and clays. *E. annulata* grows on these soils and also on shallow loamy duplexes.

Numerous lime nodules on the banks of the pale dam indicate calcareous subsoil.

A test hole confirms the soil to be a salmon gum grey heavy valley soil (see page 52). The soil profile is: 10 cm grey loam, pH 7.3 (CaCl₂) then a clear change to hard-setting sandy clay (pH 7.8.) that grades to a well-structured sandy clay with finely divided lime at 20 cm.

This soil has less resistance to crop root penetration than the mallee shallow loamy duplex at Stop 3.
Landscapes and soils of the Lake Grace district

Figure 24  Stop 4

14.6 km—Stop 5 Stop at the Cummings Road intersection. This stop contains three sites that provide a good illustration of an upland mosaic of soils that are a feature of this district.

Using the site investigation sheets, investigate the following areas and compare your results with completed sheets on pages 68 and 69.

14.5 km—5A 641715/6330241. Gateway on the western side the Cummings Road

14.7 km—5B 641900/6330240. Gravel pit

14.8 km—5C 641986/ 6330240. Right-hand side of Willcocks Road at the crest

Figure 25  Aerial photo showing stops 5A, 5B, and 5C

15.8 km—Stop 6 642269/6330252. Stop at the entrance to a track that leads up the hill to a gravel pit below a mafic ridge. The dense thicket on the lower slope contains red morrel trees (rough bark) mixed with *E. extensa* mallet and the equivalent *E. annulata* mallee (oily looking copper-green new bark overlain by almost black old bark) on loamy gravel to gravelly loamy duplex soil. *E. extensa* tends to occur as dense thickets near mafic breakaways.
Cereals on these soils tend to be manganese deficient. *E. annulata* is more common on loamy duplex soils.

On the opposite side of the road, the soil changes to a hard-setting red-brown loamy duplex (red-brown heavy soil, page 50). Note how the soil quickly changes again in the paddock to grey duplex soils that have formed from granitic rock.

![Image of plant species](image)

*E. extensa* mallet  *E. annulata* mallee  Red morrel (*E. longicornis*) tree

**Figure 26**  **Stop 6: *E. extensa* thicket upslope on gravelly loam (left); plant species on the other side of Willcocks Road (right)**

After Stop 6 the road traverses a large ridge that has a range of lateritic soils.

![Image of aerial photo](image)

**Figure 27**  **Aerial photo images of stops 7 to 12**

**17.4 km—Stop 7 644550/6330129.** This is pale deep colluvial sand on a lower slope (pale deep sand; page 41). Note the characteristic scrub with abundant banksias, other proteaceous plants and roadside tea tree. After this, note the change of vegetation to prickly proteaceous scrub on the shallow gravel ridge.
18.6 km—Stop 8 645769/6329726. Stop just past the old gravel pits on the ridge. The shallow gravel soil (page 37) and associated vegetation are common on uplands in the Lake Grace district.

18.8km—Stop 9 645769/6329669. Note how the vegetation shows changes from shallow gravel to soils with better plant-available water capacity. Native vegetation also changes from prickly scrub to tamma-proteaceae on the right side of the road (yellow sandy earth, page 42) then mallee-myrtaceae (not melaleucas though) and sedge vegetation at Stop 9. The soil here is deep duplex sandy gravel (60 cm pale yellow sand over gravel over clay, page 39). The mallee is ridge-fruited mallee (*E. incrassata*), a common sandplain mallee.

Figure 28 Prickly vegetation on shallow loamy sand gravel near Stop 8 (left); sandplain mallee low heath on duplex sandy gravel at Stop 9 (right).

Further down the road the there is a return to shallow gravel (note darker pattern in Figure 27) then yellow sand with taller heath associated with a low mafic laterite rise.

20.1 km—Stop 10 647281/6329559. 20.4 km—Stop 11 647505/6329555. These stops have yellow sandplain soils that are often associated with mafic laterites in the south and centre of the district. These are good agricultural soils. They are similar to the wodjil yellow sandplain of the north and eastern wheatbelt that begin north of Hyden.

Figure 29 Stop 10: Yellow gradational loamy sand (left); yellow loamy sand over gravel on an adjacent slight rise at Stop 11 (right). Both are classed as yellow sandy earth.
The key differences are that these soils are not highly acidic and have tamma, proteaceae, and native pine vegetation. Wodjil soils are more acidic, particularly at depth, with wodjil acacias generally present in the vegetation.

22.2 km—Stop 12 648432/6329542. This stop shows typical mallee-melaleuca heath on a yellow-brown shallow sandy duplex soil (shallow sandy duplex, page 47) in an upland valley. The subsoil appears to be clay but the soil profile is 20 cm fine loamy sand pH 5.4 over a hard silica-enriched orange-brown sandy loam 'seal' that could hinder agricultural plant root penetration. Melaleuca species are mainly small-leaved *M. eurystoma*, *M. pauperifiola* and *M. laterifolia* that are adapted to the winter-wet sandy duplex soil.

![Figure 30 Stop 12: Soil exposure shows dense subsoil (left); mallee-melaleuca scrub (right)](image)

Turn right on to Slarke Road. Note the sparse low heath after about 50 m with shallow sand over gravel soil on a relatively flat break of slope.

26 km Note the red-coloured dam on the hill to the right, excavated from red clay formed from mafic rock.

27.5 km—Stop 13 653060/6326394. Stop at the paddock entrance to the left on a slope just past the sign ‘Bulls Roar’. This is a typical dissected landscape, formed mainly on mafic rock. Note the red-brown loamy gravel, loam and clay soils, V-shaped waterways, dissected slopes, and salmon gum, mallee, merrit, and melaleuca vegetation.

![Figure 31 Stop 13](image)
As you leave this site note (1) how vegetation changes to black tamma on the dense mafic ironstone rises (2) gimlet-mallee-melaleuca thicket in the red-brown loamy duplex hollows (3) the change back to black tamma on the next rise and finally (4) the change to common tamma where there is deeper gravel over ironstone.

The soil then changes to light-coloured mallee-melaleuca duplex soils that were derived from granitic rocks. Note the changes in roadside vegetation and exposed soils on the road. These range from poorly structured duplex soils with very prickly melaleuca understorey to alkaline duplexes with taller melaleucas and abundant lime nodules.

At the intersection with Slarke Road, turn left on Mallee Hill Road (going east). Figure 32 shows a major north-west/south-east mafic dyke zone forming the ridge that crosses Mallee Hill Road. Rocks in the ridge are variable, with alternating areas of mafic and quartz-rich bands that are reflected in the soils and vegetation. The dyke and parallel salt lake show clearly in Figure 20.

![Aerial photo of stops 14 to 17](image)

**34.6 km— Stop 14** 653072/6320394. Stop at the ‘Arizona’ sign on the top of the ridge. The road cutting shows a mafic laterite profile, with iron-rich stony gravel overlying red clay.

![Stop 14](image)
Roadside vegetation is silver mallet (*E. argyphea*) with its mallee equivalent, white mallee (*E. falcata*). Silver mallet can easily be mistaken for merrit but it only occurs on laterite ridges, while merrit is found mainly on loam and loamy duplex soils. Further from the road is a pit with yellow sandy earth formed by erosion of the laterite ridge.

As you drive further east down the ridge, note the band of shallow soil with broombush (*Melaleuca uncinata* group) on the right that often indicates shallow igneous rock.

35.4 km—Stop 15 6548666/6320425. Stop at the entrance on the right and walk into the abandoned gravel pit. The soil and associated remnant vegetation here are typical of duplex gravels that are common in the Pingrup and Jerramungup areas.

Features of this site are:

- shallow (70 cm here but can be as shallow as 30 cm) sandy gravel over mottled clay
- mallee heath with a mixed shrub understorey that contains frequent melaleucas and few Proteaceae (mainly hakeas).

From Stop 15, the area becomes flatter, and you move from mafic dyke to grey deep sandy duplex soils. The mallee heath vegetation seems the same, although on close examination you'll find the understorey shrubs are nearly all melaleucas, and the soil surface is grey sand. You can also tell when you have come to the deep sandy duplex area by the distinctive pale ant mounds on the gravelly road verge, where ants have brought grey sand subsoil to the surface.

40 km—Stop 16 657152/6320767. See the paddock entrance on the right and possibly a white drum. This is a grey sandy duplex flat that surrounds the valley salt lake chain. This area is known locally as ‘frost alley’ as frosts are common on low-lying grey sandy surfaced soils.

This is a water gaining area that is susceptible to waterlogging in wet winters. Farmers delay crop seeding on these soils to avoid frost and to take advantage of the extended growing season that is made possible by the additional soil water. Soils are a mixture of deep sandy duplex and alkaline shallow sandy duplex.
From Stop 16 reverse direction and drive back up Mallee Hill Road. Continue past Slarke Road.

48.9 km—Stop 17 648356/6320444. Stop next to the breakaway on the right of the road. The breakaway is on a transition from mafic to higher quartz rock. A quartz-filled fault crosses the road.

Moort (*E. platypus*) is growing on the poorly structured grey clay exposed on the breakaway face. Moort-mallee clay (page 54) is common on dissected slopes near mafic dykes.

52.7 km—Stop 18 644473/6320518. This is an alkaline grey deep sandy duplex soil on a lower slope just past the Thornton Road turn-off. Figure 37 shows a roadside gully that revealed the soil profile following heavy rain. A dense sandy clay ‘seal’ is evident between the sand topsoil and well-structured calcareous clay subsoil with abundant lime nodules. This is a water gaining area that is susceptible to waterlogging and which grades to shallow alkaline sandy duplex at the waterway.
Mallee (E. tenera)-melaleuca vegetation. Blue mallee occurs in deeper sand areas.

Figure 37  Stop 18: Mallee heath and soil profile

Turn right at the Lake Grace–Pingrup Road. The salt lakes are the eastern edge of the salt lake chain that goes from Pingrup to Lake Grace, and eventually to the Avon River.

66.8 km—Stop 19 637062/6327252. See the sand pit on the left side of the road. Here aeolian sand from salt lakes has coated the landscape.

Direction of sand movement  Ridge  2 m contour lines  Swamp  Buried yellow sandy earth  Aeolian sand

At the sand pit a shallow overlay of aeolian yellow sand has coated a mafic lateritic yellow sandy earth ridge. North of the sand pit, pale sand has blown up and over a saddle in the landscape to coat the valley on the other side. Note the deep pale sand areas and the pine plantation. Sandy surfaced soils and associated seepages and swamps are visible in Figure 38. Green areas in the photograph have stayed green longer due to perched water in the sandy duplex soils.
The map with contour lines in Figure 38 has been downloaded from the NRM INFO website http://spatial.agric.wa.gov.au/slip/

Maps and other useful information are available at no cost.

Return to Lake Grace (80 km).
Appendix: Completed site investigation sheets

Stop 3

| Indicator vegetation | Mallee melaleuca woodland
Mallee species are square fruited mallee (E. calycogona), capped mallee (E. pileata) and redwood (E. neutral, which is the mallee form of E. transcontinentalis, a mallet). These species are common on hard-setting grey duplex soils.
The tall dense melaleucas with dark green foliage are a feature of these heavy alkaline soils. Common species are M. culcullata, M. eleuterostachya and M. pauperiflora |
| Where are you in the landscape? | Lower slope on the edge of a large valley |
| Surface clues | Lime nodules on the surface |
| Other clues | Pale clay dam with lime nodules |
| Your conclusion | Mallee shallow loamy duplex soil (page 53) |
| Landscape and soil(s) | Alkaline loamy duplex. Soil profile 0–10 cm sandy loam, pH (CaCl₂) 7.6 then a clear change to a hard-setting sandy clay pH 7.8. |

Stop 5

| 5A. Indicator vegetation | Close to the corner (5A.1) is gimlet with dense melaleuca understorey that grades to redwood mallee (E. neutral)-melaleuca scrub (5A.2) |
| Where are you in the landscape | A level rise at the end of a low ridge. On the western edge the soil grades to gravel |
| Surface clues | Lime nodules, scattered mafic gravel stones, hard brown surface |
| Soil profile near the gimlets is: a few centimetres of grey sand; 10 cm brown medium clay pH 8.4 then a gradual change to light cream-brown clay pH 8.4 with abundant fine lime. Soil near the redwood is similar but slightly less alkaline and paler with a denser subsoil. |
| Despite the grey veneer, this soil is a high clay variant of the red-brown heavy soil class (page 50). The soil would be very hard-setting and have very poor yields in dry seasons, but would yield well in wet seasons. |