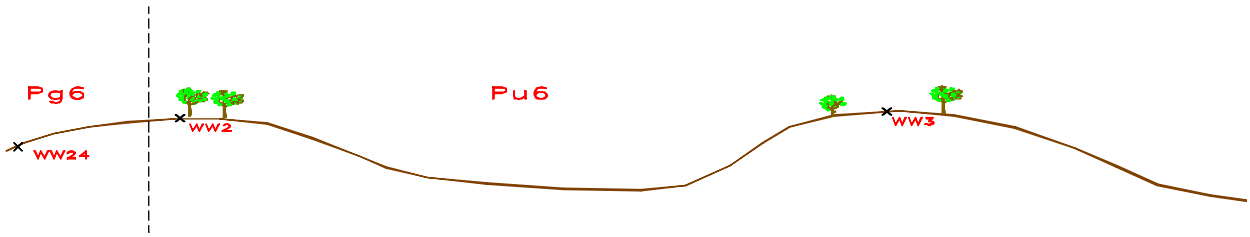
6.2.6 LIMESTONE RISES - 6 LAND SYSTEM
Map units Pg6, Pu6



Landscape

This land system occupies a small, dissected area of the shire. The landscape of this land system is variable. There is a small area, north of Serviceton, of undulating plains with gently sloping low rises, dissected by clay plains. North of Goroke, an example of terra rossa soils occurs on the edge of an elevated plain. There are very small occurrences in the south of the shire, around Harrow and Dergholm, where the limestone outcrops between the other geologies. This latter occurrence of terra rossa soils is not mapped as it was not sighted during the survey; the occurrence is noted as a result of local knowledge.

Plate 13 A small area of terra rossa soils with vertosols on both sides

Soil types

This land system describes the occurrences of terra rossa and similar soils in the shire, but because there only are very small patches of terra rossa soils, mapping is broad to cover all similar associated soils.

Sites WW3 and WW24 have characteristics of terra rossa soils, although they occur in very small patches. They have shallow clayey soil over limestone or calcium carbonate, and the clay is non-dispersive.

WW2 is located close to WW3 and is used to illustrate the soil differences in this land system. WW2 is distinct, compared to that of WW3 and WW24, because of its impeded internal drainage.

WW24 is located on the lower slopes off an elevated plain and occurs in conjunction with cracking grey clay. The occurrences of these three sites is an indication of how small and patchy the existence of terra rossa soils is in the shire.

Representative soil type of land units

Since the occurrence of terra rossa soils is quite small and scattered, it is difficult to establish the common soil type. For the purpose of this study, WW3 has been used to represent this land system as it is the largest mappable area.

REPRESENTATIVE SOIL TYPE FOR LIMESTONE RISES - 6 - Pu6 LAND UNITS

MAP UNIT: Pu6 **Site No.:** WW3

Position in Landscape: Crest **Grid Ref:** 499 954 E, 5977 399 N
Aust. Soil Class.: Haplic, Hypercalcic, Red CHROMOSOL
Northcote Factual Key: Dy2.13 ***Great Soil Group:*** Terra rossa

General Landscape Description:

This soil type occurs on gently undulating to undulating plains. The soils of this land system are variable compared with that of WW2, which is distinctly different because of its impeded internal drainage. The soil at WW3 is a terra rossa soil, although its occurrence is very scattered. This soil type is regarded as the most appropriate to represent the Limestone Rises-6 gently undulating to undulating plains land units.

Soil Profile Morphology:

Topsoil
A1 0-10 cm Very dark greyish brown (10YR3/2) *fine sandy clay loam*, structureless (massive), very firm consistence when dry. pH 7.9. Clear transition to:

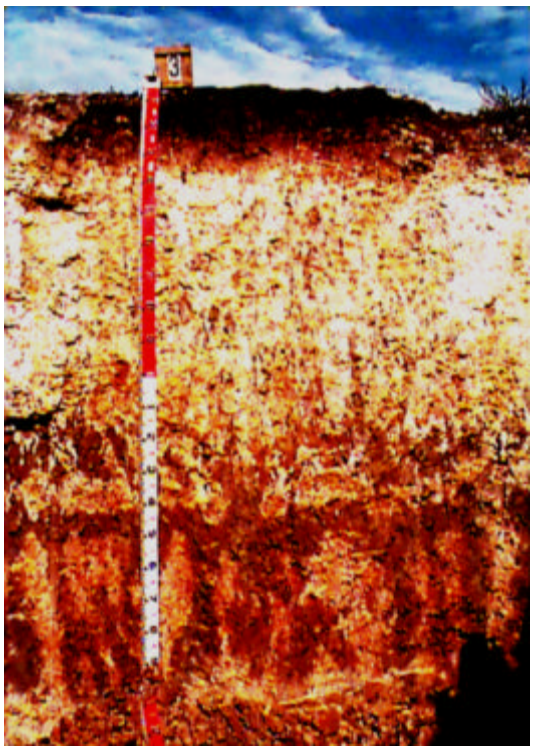
Subsoil
B21 10-25 cm Dark red (2.5YR4/8), *medium clay*, moderate to strong blocky structure, (peds 20-50 mm), smooth faced peds, strong consistence when dry. pH 8.3 Clear transition to:

B22 25-35 cm Brown (7.5YR5/4) *light medium clay*, moderate polyhedral structure, (peds 10-20 mm breaking to 5-10 mm), a few hard calcium carbonate nodules and many (30%) soft calcium carbonate segregations. pH 8.6. Clear transition to:

B23k 35-110 cm Abundant (>50%) soft to semi hard calcium carbonate segregations, with a small percentage of hard calcium carbonate/silica nodules. *Light clay* texture. pH 9.1. Clear but irregular transition to:

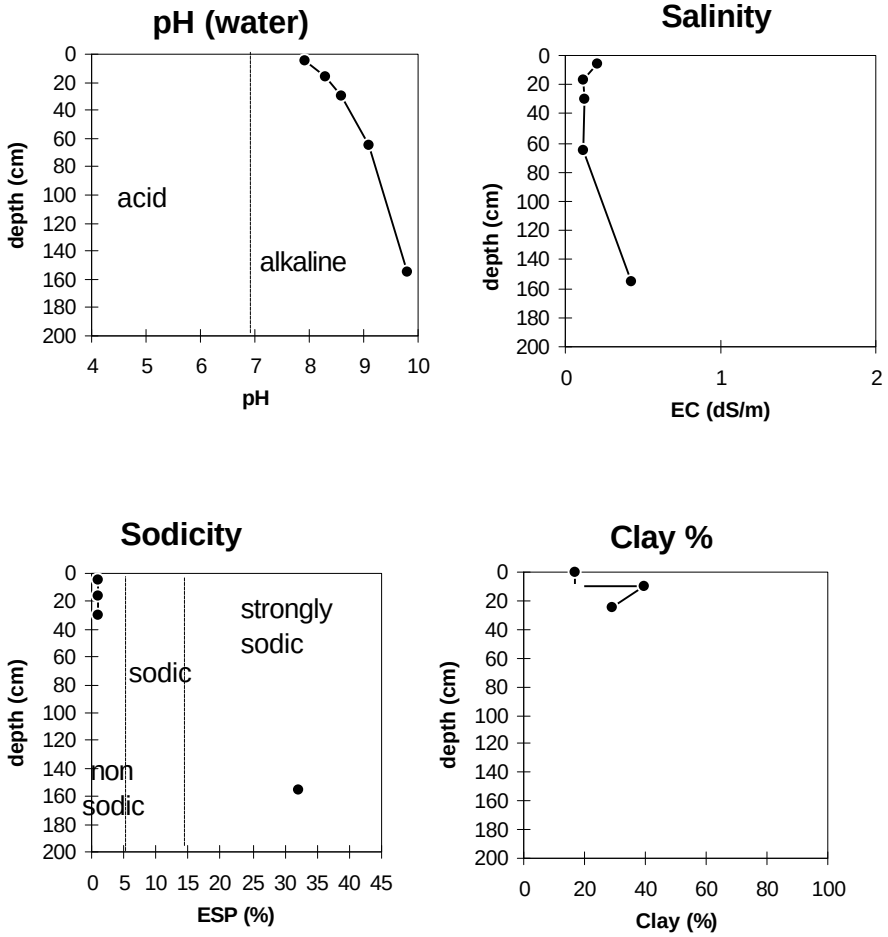
B24 110-200 cm+ Very pale brown (10YR7/3) *medium clay*, many coarse to very coarse distinct reddish yellow mottles, strong polyhedral structure, (peds 20-30 mm breaking to 10-20 mm), smooth fabric. pH 9.8. Flecks of manganese on faces and down cracks.

Within this horizon there are tongues of soft carbonate with hard silica and calcium carbonate nodules with a coarse sandy clay texture. pH 9.9.



Soil Profile Characteristics:

Horizon	pH	Salinity	Sodicity	Dispersion	Internal Drainage	Hydro-phobicity
Surface (A1 horizon)	Slightly alkaline	low	non-sodic	nil	moderately well drained	nil
Subsoil (B21 horizon)	moderately alkaline	very low	non-sodic	nil		
Deeper subsoil (at 1 metre)	very strongly alkaline	low-medium	non-sodic	nil		



Key Profile Features:

- Carbonate horizon
- Plant Available Water Capacity (PAWC) is considered to be low (estimated at 91 mm) for this site profile based on an Effective Rooting Depth (ERD) of 35 cm. Rooting depth will be restricted by subsoil conditions, very high carbonate (lime) content (not applicable to all plant species) or hard rock.
- Good structure (B21)
- Soil is non-dispersive throughout, therefore the profile is reasonably well drained, although there is evidence (manganese flecks) of impeded drainage or perched watertable at depth

Soil Restrictions and Management Prescriptions

Feature	Result	Management Prescription
Carbonate layer (lime)	Highly alkaline layer. Can restrict root growth of sensitive plant species. Potential for nutrient imbalance. May restrict water movement if layer is hard rock.	Grow alkaline tolerant species. Supply trace elements ie zinc. Considered sub-surface drainage (if appropriate).
Very low and low Plant Available Water Holding Capacity (PAWC)	Poor plant available water holding capacity. Indication of light soil texture or shallow effective plant rooting depth (ie presence of restrictive layers, salinity, pH or structure).	Improve organic matter through maintenance of vegetative cover and growing green manure crops. Increase effective rooting depth by reducing the effect of the restrictive layer.

Land Suitability Rating Table

LAND USE	SUITABILITY CLASS	MAJOR LIMITING COMPONENT
Wheat	2	Soil
Canola	2	Soil
Chickpeas	2	Soil
Lentils	2	Soil
White clover seed	2	Soil
Lucerne for seed production	2	Soil
Viticulture	2	Soil
Apples	3	Soil
Potatoes	3	Soil
Carrots	3	Soil
Onions	3	Soil
Sweet corn	3	Soil
Radiata Pine	3	Climate, soil
Blue Gum	3	Climate, soil

Land Suitability Assessment and Primary Limitations

Wheat	*Climate*	1	No major limitation
	Landscape	1	No major limitation
	Soil	2	Depth of topsoil, slightly alkaline subsoil pH
Canola	*Climate*	1	No major limitation
	Landscape	1	No major limitation
	Soil	2	Depth of topsoil, slightly alkaline subsoil pH
Chickpeas	*Climate*	1	No major limitation
	Landscape	1	No major limitation
	Soil	2	Depth of topsoil, slightly alkaline subsoil pH, soil salinity, slightly impeded internal drainage
Lentils	*Climate*	1	No major limitation
	Landscape	1	No major limitation
	Soil	2	Depth of topsoil, slightly alkaline subsoil pH, soil salinity, slightly impeded internal drainage
White clover seed	*Climate*	1	No major limitation
	Landscape	1	No major limitation
	Soil	2	Depth of topsoil, slightly alkaline pH, soil salinity
Lucerne for seed production	*Climate*	1	No major limitation
	Landscape	1	No major limitation
	Soil	2	Slightly alkaline subsoil pH, slightly impeded internal drainage
Viticulture	*Climate*	1	No major limitation
	Landscape	1	No major limitation
	Soil	2	Slightly alkaline subsoil pH, soil salinity, slightly impeded internal drainage
Apples	*Climate*	2	Slightly high mean maximum January temperatures
	Landscape	1	No major limitation
	Soil	3	Alkaline subsoil pH
Potatoes	*Climate*	2	Slightly high mean maximum January temperatures
	Landscape	1	No major limitation
	Soil	3	Shallow depth of topsoil, alkaline topsoil pH

Carrots	*Climate*	1	No major limitation
	Landscape	1	No major limitation
	Soil	3	Shallow depth of subsoil, alkaline subsoil pH
Onions	*Climate*	1	No major limitation
	Landscape	1	No major limitation
	Soil	3	Shallow depth of topsoil, alkaline subsoil pH
Sweet corn	*Climate*	1	No major limitation
	Landscape	1	No major limitation
	Soil	3	Shallow depth of topsoil
Radiata Pine	*Climate*	3	Low rainfall
	Landscape	1	No major limitation
	Soil	3	Alkaline subsoil pH
Blue Gum	*Climate*	3	Low rainfall
	Landscape	1	No major limitation
	Soil	3	Alkaline subsoil pH

ASSOCIATED SOIL TYPE FOR THE LIMESTONE RISE - 6 - Pu6 LAND UNITS

MAP UNIT: Pu6 **Site No.:** WW2

Position in Landscape: Crest **Grid Ref:** 498 922 E, 5977 485 N
Aust. Soil Class.: Hypercalcic, Subnatric, Red Sodosol
Northcote Factual Key: Dy2.13 ***Great Soil Group:*** Transitional terra rossa

General Landscape Description:

This site occurs just north of Serviceton on an undulating plain. Variable soil types occur in this landscape. This site is on the crest of a low rise. WW3 is located on the next rise to give an indication of the variable nature of the soils on these rises. WW3, although an associated soil type, has been used to represent the Limestone Rises-6 gently undulating and undulating plains land unit.

Soil Profile Morphology:

Topsoil
A1 0-5 cm *Fine sandy clay loam*, weak blocky structure, (peds 5-10 mm). pH 6.4 Clear transition to:

Subsoil
B21 5-25 cm Yellowish red (5YR5/6) *medium clay*, weak to moderate prismatic structure, (peds 20-50 mm), breaking to weak subangular blocky structure, (peds 5-10 mm), rough fabric, rigid structure when dry. pH 7.8. Completely disperses when dry. Patches of dark greyish brown (10YR4/2) with stronger structure. Gradual and wavy boundary to:

B22k 25-45 cm Yellowish red (5YR5/6)

medium clay (sandy), weak to moderate blocky structure, (peds 20-50 mm), breaking to moderate subangular blocky structure, (peds 2-5 mm), rough fabric, rigid consistence when dry, many (20-50%) soft carbonate segregations. pH 8.8. Abrupt transition to:

B23k 45-80 cm Very pale brown (10YR7/3) *light medium clay*, many coarse faint reddish yellow mottles, moderate blocky structure, (peds 20-50 mm), breaking to moderate polyhedral structure (peds 10-20 mm) (strong structure when less $CaCO_3$), smooth fabric, strong consistence when slightly moist. Many (50%) soft calcium carbonate segregations although percentage is variable with some thick patches occurring. pH 9.8. Diffuse transition to:

B24 80-110 cm Very pale brown (10YR7/3) *light medium clay (sandy)*, coarse, distinct light brown mottles are common, moderate blocky to polyhedral structure, (peds 20-50 mm), smooth fabric, very firm consistence when slightly moist, soft calcium carbonate segregations are abundant. pH 9.8. Gradual to diffuse transition to:

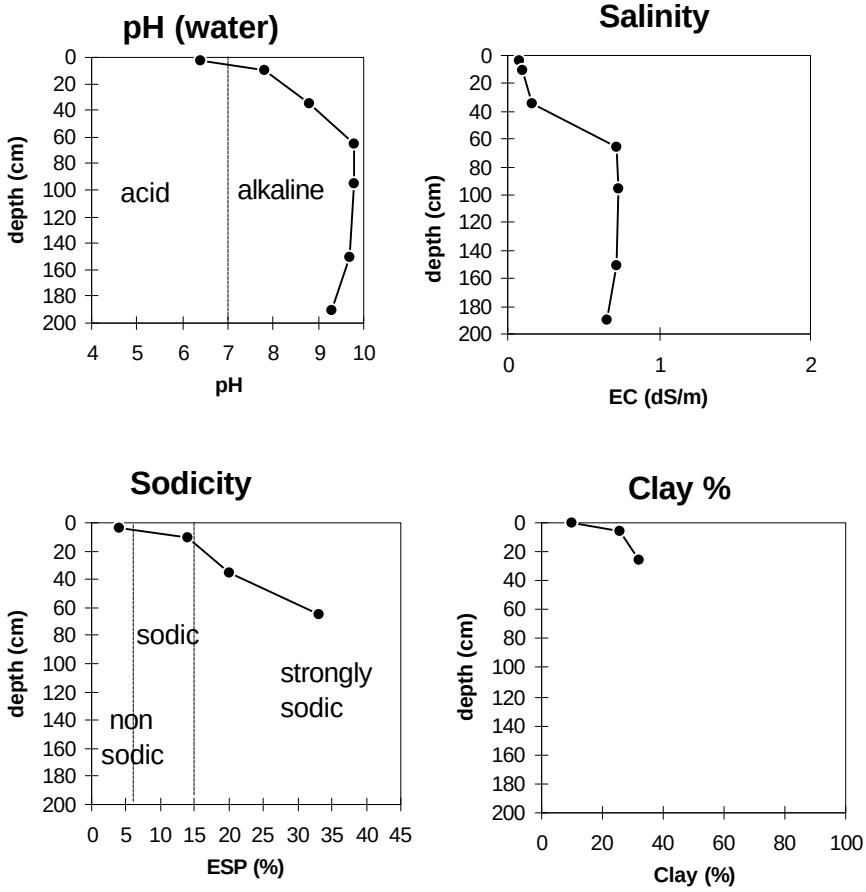
B25 110-190 cm Very pale brown (10YR7/4) *light medium clay (sandy)*, coarse distinct yellowish red mottles are common, moderate blocky to polyhedral structure, smooth fabric, firm consistence when moderately moist. pH 9.7.

B26 190-200 cm+ Very pale brown (10YR7/3) *medium clay*, coarse distinct yellow and red mottles are common, moderate polyhedral structure, (peds 20-50 mm), smooth structure, firm consistence when moderately moist, manganese is evident. pH 9.3.

Soil Profile Characteristics:

Horizon	pH	Salinity	Sodicity	Dispersion	Internal Drainage	Hydro-phobicity
Surface (A1 horizon)	slightly acid	very low	non-sodic	-		nil
Subsoil (B21 horizon)	slightly alkaline	very low	sodic	complete	imperfectly drained#	
Deeper subsoil (at 1 metre)	extremely alkaline	medium-high	strongly sodic	complete		

most impeding horizon of the profile that will affect plant growth



Key Profile Features:

- Shallow depth of topsoil
- Sodic subsoil
- Dispersive subsoil
- Increasing alkalinity down profile
- Calcium carbonate horizons beneath the clay
- Mottling in subsoil
- Soil salinity increases at depth
- Plant Available Water Capacity (PAWC) is considered to be medium (estimated at 100 mm) for this site profile based on an Effective Rooting Depth (ERD) of 45 cm. Rooting depth will be restricted by subsoil conditions, such as strongly sodic (Exchangeable Sodium Percentage >20%), high soluble salt levels (Chloride >0.1%), poor structure (e.g. massive or very coarse, columnar or prismatic), very high carbonate (lime) content (not applicable to all plant species) or hard rock.

Soil Restrictions and Management Prescriptions

Feature	Result	Management Prescription
Shallow topsoil depth	Reduced water and nutrient holding capacity. Reduced root growth. Potential for waterlogging.	Improve organic matter through maintenance of vegetative cover and growing green manure crops. Reduce tillage to protect against water and wind erosion. Optimise plant growth through a regular and balanced fertiliser programme. Consider sub-surface drainage (if appropriate).
Sodic clay subsoil	Poor water and air movement into the subsoil resulting in waterlogging (impeded internal drainage). Poor root growth into the subsoil reducing the volume of the soil able to be exploited.	Gypsum applications if the subsoil is close to the surface and topsoil textures are light. *Dryland cropping* - include deep rooted crops in the rotation, minimum tillage and stubble retention.
Dispersion (dry soil)	Indication of soil sodicity. Soil structure collapses following wetting resulting in poor soil structure that reduces water movement and plant root growth (see sodic subsoil). Increases water erosion hazard.	*Dryland cropping* - apply gypsum, include deep rooted crops in the rotation, minimum tillage and stubble retention.
Alkaline subsoil	Potential nutrient imbalance. Unsuitable for alkaline intolerant plants. May indicate subsoil sodicity.	Grow shallow rooted species. Grow alkaline tolerant plants.
Carbonate layer (lime)	Highly alkaline layer. Can restrict root growth of sensitive plant species. Potential for nutrient imbalance. May restrict water	Grow alkaline tolerant species. Supply trace elements ie zinc. Considered sub-surface drainage (if appropriate).

	movement if layer is hard rock.	
Mottled subsoil	Indication of periodic waterlogging, particularly if grey and yellow mottles predominate.	Consider sub-surface drainage (if appropriate). Apply gypsum if subsoil is sodic and close to the surface.
Soil salinity at depth	Poor or no plant growth for deeper rooted species. Indication of waterlogging (impeded internal drainage) or high water table.	Grow shallow rooted species. Increase plant water use throughout the catchment. Install subsoil drainage (if appropriate). Minimise irrigation water loss below the root zone (improve irrigation efficiency).

Land Suitability Rating Table

LAND USE	SUITABILITY CLASS	MAJOR LIMITING COMPONENT
Wheat	2	Soil
Canola	3	Soil
Chickpeas	3	Soil
Lentils	3	Soil
White clover seed	2	Soil
Lucerne for seed production	3	Soil
Viticulture	3	Soil
Apples	3	Soil
Potatoes	3	Soil
Carrots	3	Soil
Onions	3	Soil
Sweet corn	3	Soil
Radiata Pine	3	Climate, soil
Blue Gum	3	Climate, soil

Land Suitability Assessment and Primary Limitations

Wheat	*Climate*	1	No major limitation
	Landform	1	No major limitation
	Soil	2	Depth of topsoil, slightly impeded internal drainage, slightly alkaline subsoil pH
Canola	*Climate*	1	No major limitation
	Landform	1	No major limitation

	Soil	3	Salinity (5.76 ECe (dS/m) at 45 cm+)
Chickpeas	*Climate*	1	No major limitation
	Landform	1	No major limitation
	Soil	3	Impeded internal drainage
Lentils	*Climate*	1	No major limitation
	Landform	1	No major limitation
	Soil	3	Impeded internal drainage
White clover seed	*Climate*	1	No major limitation
	Landform	1	No major limitation
	Soil	2	Shallow topsoil, slightly alkaline subsoil pH, soil salinity, slightly impeded internal drainage
Lucerne for seed production	*Climate*	1	No major limitation
	Landform	1	No major limitation
	Soil	3	Impeded internal drainage, soil salinity
Viticulture	*Climate*	1	No major limitation
	Landform	1	No major limitation
	Soil	3	Soil salinity, impeded internal drainage
Apples	*Climate*	2	Slightly high mean maximum January temperature
	Landform	1	No major limitation
	Soil	3	Alkaline subsoil pH, soil salinity
Potatoes	*Climate*	2	Slightly high mean maximum January temperature
	Landform	1	No major limitation
	Soil	3	Depth of topsoil, impeded internal drainage
Carrots	*Climate*	1	No major limitation
	Landform	1	No major limitation
	Soil	3	Depth of topsoil, impeded internal drainage
Onions	*Climate*	1	No major limitation
	Landform	1	No major limitation
	Soil	3	Depth of topsoil, impeded internal drainage
Sweet corn	*Climate*	1	No major limitation
	Landform	1	No major limitation
	Soil	3	Depth of topsoil, impeded internal drainage

Radiata Pine	*Climate*	3	Low rainfall
	Landform	1	No major limitation
	Soil	3	Alkaline subsoil pH
Blue Gum	*Climate*	3	Low rainfall
	Landform	1	No major limitation
	Soil	3	Alkaline subsoil pH

REPRESENTATIVE SOIL TYPE FOR THE LIMESTONE RISES - 6 -Pg6

MAP UNIT: Pg6 **Site No.:** WW24

Position in Landscape: Edge of elevated plain **Grid Ref:** 54 3600 E, 5918 900 N
Aust. Soil Class.: ? Petrocalcic, Calcic CALCAROSOL (Confidence level 4),
Great Soil Group: terra rossa

General Landscape Description:

This site occurs on the edge of an elevated plain. This is a Miocene limestone outcrop or carbonate associated with Pliocene deposits or with surrounding material. The extent of this soil in the area is very patchy as the surrounding areas tend to be grey or brown cracking clays. Terra rossa soils are scarce and scattered throughout the shire. This soil is an example of a terra rossa soil.

Soil Profile Morphology:

Topsoil
A1 0-10 cm Dark brown (7.5YR3/3) *light clay*, a few faint red mottles, strong subangular and polyhedral structure, (peds 10-20 mm breaking to 5-10 mm and to 2-5 mm), weak consistence when dry. pH 8.5.

Subsoil
B2 10-40 cm Brown (7.5YR4/3) *medium heavy clay*, faint red mottles are common, strong polyhedral structure, (peds 2-5 mm), firm consistence, a few soft and hard calcium carbonate nodules. pH 8.5.

C 40+ cm *Limestone*

Soil Profile Characteristics:

Horizon	pH	Salinity	Sodicity	Dispersion	Internal Drainage	Hydro-phobicity
Surface (A1 horizon)	moderately alkaline	very low	non-sodic	nil[1]	moderately well drained	nil
Subsoil (B21 horizon)	moderately alkaline	very low	non-sodic	nil[1]		

1 slight dispersion after remoulding

Key Profile Features:

- Shallow topsoil
- Limestone (Carbonate)
- Clayey profile
- Shallow soil

Soil Restrictions and Management Prescriptions

Feature	Result	Management Prescription
Carbonate layer (lime)	Highly alkaline layer. Can restrict root growth of sensitive plant species. Potential for nutrient imbalance. May restrict water movement if layer is hard rock.	Grow alkaline tolerant species. Supply trace elements ie zinc. Considered sub-surface drainage (if appropriate).
Shallow topsoil depth	Reduced water and nutrient holding capacity. Reduced root growth. Potential for waterlogging.	Improve organic matter through maintenance of vegetative cover and growing green manure crops. Reduce tillage to protect against water and wind erosion. Mounding for orchards and vineyards. Form beds for vegetables. Optimise plant growth through a regular and balanced fertiliser programme. Consider sub-surface drainage (if appropriate).

Land Suitability Rating Table

LAND USE	SUITABILITY CLASS	MAJOR LIMITING COMPONENT
Wheat	2	Climate
Canola	2	Climate, soil
Chickpeas	2	Climate, soil
Lentils	2	Climate, soil
White clover seed	2	Soil
Lucerne for seed production	2	Soil
Viticulture	2	Climate, soil
Apples	3	Soil
Potatoes	3	Soil
Carrots	3	Soil
Onions	3	Soil
Sweet corn	2	Soil
Radiata Pine	3	Climate, soil
Blue Gum	3	Climate, soil

Land Suitability Assessment and Primary Limitations

Wheat	*Climate*	2	Moderate frost risk
	Landscape	1	No major limitation
	Soil	1	No major limitation
Canola	*Climate*	2	Moderate frost risk
	Landscape	1	No major limitation
	Soil	2	Slightly alkaline pH
Chickpeas	*Climate*	2	Moderate frost risk
	Landscape	1	No major limitation
	Soil	2	Slightly impeded internal drainage, subsoil texture
Lentils	*Climate*	2	Moderate frost risk
	Landscape	1	No major limitation
	Soil	2	Slightly impeded internal drainage, subsoil texture
White clover seed	*Climate*	1	No major limitation
	Landscape	1	No major limitation
	Soil	2	Slightly alkaline pH

Lucerne for seed production	*Climate*	1	No major limitation
	Landscape	1	No major limitation
	Soil	2	Slightly impeded internal drainage
Viticulture	*Climate*	2	Moderate frost risk
	Landscape	1	No major limitation
	Soil	2	Slightly alkaline pH, slightly impeded internal drainage
Apples	*Climate*	2	Slightly high mean maximum January temperature, moderate frost risk
	Landscape	1	No major limitation
	Soil	3	Alkaline pH, depth to limestone
Potatoes	*Climate*	2	Slightly high mean maximum January temperature
	Landscape	1	No major limitation
	Soil	3	Alkaline pH
Carrots	*Climate*	1	No major limitation
	Landscape	1	No major limitation
	Soil	3	Alkaline topsoil pH
Onions	*Climate*	2	Moderate frost risk
	Landscape	1	No major limitation
	Soil	3	Alkaline topsoil pH, topsoil texture
Sweet corn	*Climate*	1	No major limitation
	Landscape	1	No major limitation
	Soil	2	Slightly alkaline pH, slightly impeded internal drainage
Radiata Pine	*Climate*	3	Low rainfall
	Landscape	1	No major limitation
	Soil	3	Depth to limestone
Blue Gum	*Climate*	3	Low rainfall
	Landscape	1	No major limitation
	Soil	3	Depth to limestone