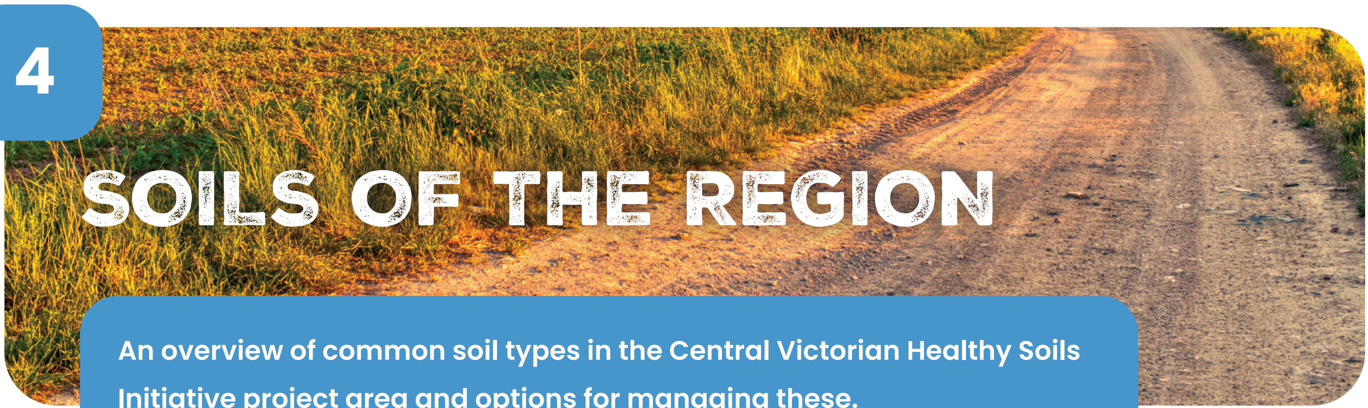


4

SOILS OF THE REGION

An overview of common soil types in the Central Victorian Healthy Soils Initiative project area and options for managing these.

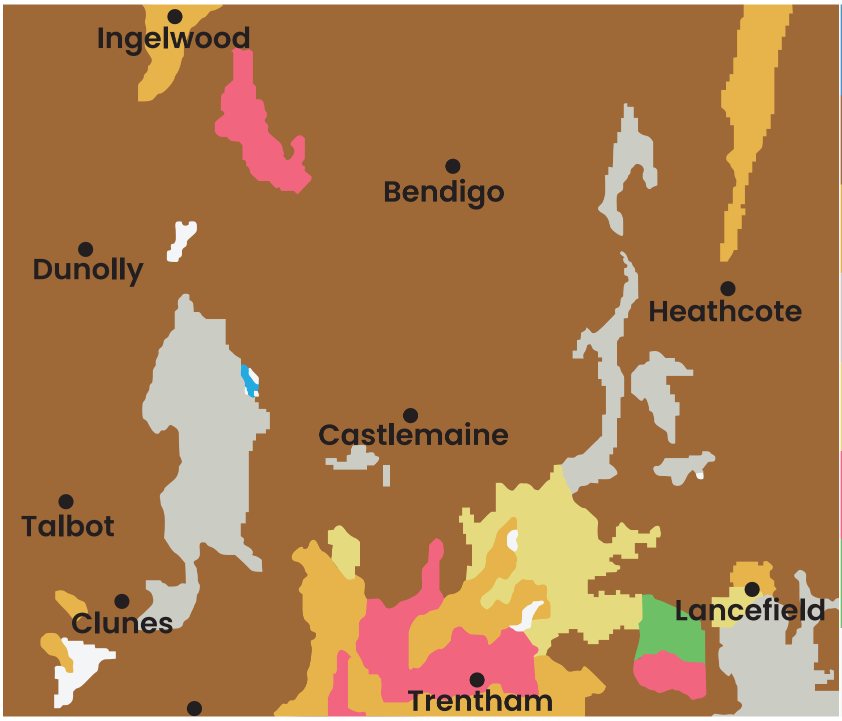
Figure 4.1 shows a generalised map of the common soil types in the Health Soils Initiative project area. This is indicative of broad categories of soil and provide a guide about the types of soil that may be present in a particular area. In reality, there can be considerable variability in soil characteristics and more specific soil types across a single paddock.

Table 4.1 describes the soil types and key management challenges and opportunities. Note this this map generalises soil types and does not show variability that occurs across terrain and even in individual paddocks. It is common for the depth of topsoils and even soil types to vary across individual farms.

The healthy Soils Initiative strongly promotes digging holes of at least 50-60cm on different parts of your farm to see how deep soils are and how soils vary across the farm. It is suggested that you focus on areas where plant growth is observed to be poor, but also dig some holes where plants are growing well to see what the differences are. The key indicators to look at is how deep plant roots are and how compacted surface and subsoils are. Factors to look for include:

- The depth, texture and colour of topsoil/upper soil (which is the layer of soil in which most roots grow and is usually, but not always, darker in colour, more friable and of lighter texture than clay subsoils. In some soils there is a very strong contrast in texture and/or colour of the upper and sub-soil, and some soils will have more than two distinct layers within the upper 60cm of soil. The upper layer of the topsoil under pasture and minimum tillage cropping land is typically darkest, indicating higher surface organic matter content.
- The texture and colour of the subsoil where root growth typically becomes weaker or close to non-existent. If this occurs less than 50cm from the surface, the soil has constraints. In many parts of the project area, subsoil constraints are experienced at between 20-40cm of depth and sometimes less. In most areas (but not all), this is due to the subsoil being a dense and compacted clay. The colour of the subsoil can indicate constraints. A pale grey or yellow clay subsoils often suggest poor nutrient availability, and blue-grey or red 'mottling' in heavy clays often indicates waterlogging and low oxygen conditions.
- pH testing using a field kit is also useful to assess whether excessive soil acidity (this is quite common in the project area), or alkalinity (less common) is a likely factor in shallow root growth.

Figure 1: Indicative soil map of the project area



Dominant soil types
Sodosols Also found: Chromosols
Chromosols Also found: Dermosols, Kurosols, Sodosols
Vertosols Also found: Chromosols, Sodosols
Kurosols Also found: Chromosols, Vertosols
Ferrosols Also found: Tenosols, Chromosols, Vertosols, Dermosols
Tenosols/ Chromosols Also found, Ferrosols, Sodosols
Dermosols Also found: Sodosols, Chromosols, Vertosols

Source: Adapted from https://portal.ansis.net/

Table 4.1

Soil type	Typical characteristics and issues in the project area district	Management options
Sodosols Also found: Chromosols	These soils are most common in the district. They have significant constraints, but with good management these soils can be productive. They tend to be shallow loams or clay loams overlying heavy, grey dispersive sodic (high sodium) clays. High sodium levels cause clays to 'disperse' and lack structure/porosity, restricting deeper root growth. These soils are typically susceptible to compaction and may have compaction layers from historic cropping practices. In many areas the upper clay-loam layer is a hard-setting clay. In granitic soils around Harcourt from Sutton Grange through to Lockwood, upper soils are often a shallow sandy-silt clay overlying a sodic clay. Where soils are strongly sodic, surface crusting can occur. In most areas, surface and subsoils tend to be acidic and prone to acidification. Clays and clay-loams have good water- and nutrient-holding potential and can typically maintain higher levels of longer-lasting organic carbon.	**Challenges:** • Shallow upper soil and root growth • Compaction • Poor water permeability • Mineral nutrient deficiencies Acidity/ acidification – with potential for nutrient deficiencies and aluminium toxicity. • Tunnel and surface soil erosion **Management options include:** • Reduce tillage and traffic to reduce compaction. • Use of sources of calcium such as gypsum and lime (on acidic soils) to reduce the effects of sodicity. • Increase organic matter down the soil profile to improve soil aggregate formation and porosity. • Manage soil fertility and pH constraints. • Strategic tillage with or without ameliorants such as gypsum or lime (if acidic) or compost.

Soil type	Typical characteristics and issues in the project area district	Management options
Vertosols Also found: Chromosols, Sodosols	With good management, Vertosols are typically naturally friable and good farming soils that are often used for cropping. They tend to be deeper brown or dark grey clay that is naturally friable and forms deep cracks when dry. Surface soils can be magnesic and even slightly sodic, so have potential for compaction. Some soils have calcareous and alkaline subsoils, but these are not common in the project area.	**Challenges:** • Has potential for surface compaction. **Management options include:** • Reduce tillage and traffic to reduce compaction. • Increase organic matter down the soil profile to improve soil aggregate formation and porosity. • Manage soil fertility and any pH constraints.
Kurosols Also found: Chromosols, Vertosols	These soils have strong texture contrasts between the upper soil (usually sandy or sandy loam) and sub-soil (usually a heavy and acidic clay, often with high sodium and/or magnesium relative to calcium).	**Challenges:** • These soils are often shallow, with the subsoil clay restricting deeper root growth. • Sandy upper soils with low organic matter content do not hold water or nutrients, so shallow rooted plants are prone to dry periods and nutrient deficiencies. • Acidic subsoils also restrict root growth. **Management options include:** • Build and maintain organic matter through increased retention of plant residues and management of livestock and wildlife grazing to maintain cover over dry and cold 'green drought conditions. • Consider growing 'green manure' or cover crops on soils with very low organic matter. • If financially viable, manage subsoil constraints by addition of lime with deeper ripping.
Dermosols Also found: Sodosols, Chromosols, Vertosols	Dermosols in Central Victoria are mostly clays and clay loams of volcanic origin occurring mainly in the southeast of the region. They can contain a lot of basalt rocks. They are generally well drained and friable when wet. They are often moderately deep soils, and don't have a distinct change in surface and subsoil down the profile. They can tend to become acidic.	**Challenges:** • Prone to compaction • Prone to acidification • Can have high rock content. **Management options include:** • Reduce tillage and traffic to reduce compaction. • Increase organic matter down the soil profile to improve soil aggregate formation and porosity. • Manage soil fertility and pH constraints

Soil type	Typical characteristics and issues in the project area district	Management options
Chromosols Also found: Dermosols, Kurosols, Sodosols	These soils have an abrupt colour and texture contrast between upper soil and subsoil. In the project area they tend to have a red-brown or yellow-brown topsoil. Subsoils tend to be heavy clays but are not strongly acidic like Kurosols (see below) nor sodic like Sodosols (above), and are often a bright or light yellow-orange colour. In the district these are often hard setting clays at the surface and are prone to compaction. These soils often have a high magnesium content relative to calcium, making them less permeable when wet.	**Challenges:** • Prone to compaction • Subsoils can be lower in nutrient and very compacted. **Management options include:** • Reduce tillage and traffic to reduce compaction. • Increase organic matter down the soil profile to improve soil aggregate formation and porosity. • Manage soil fertility and any pH constraints. • Deep ripping with or without ameliorants such as compost and gypsum (if magnesic) or lime (if acidic).
Ferrosols Also found: Chromosols, Vertosols, Dermosols	With good management, these are typically good farming soils and are often used for cropping, including potato and other vegetable growing. They are often deep friable clays with a high iron content, giving them a strong red colour. They are often relatively 'recent' geologically compared to many other soils in the area and are the result of surface volcanic activity and the weathering of basalt. As a result, they often have higher levels of available mineral nutrients, but can become acidic. They generally have excellent capacity to hold water, nutrient and carbon/organic matter. The high clay content can make the soil prone to compaction by livestock and vehicle traffic, when wet, but the natural friability of the soil makes compaction risk less of an issue than many other clay soils in the area.	**Challenges:** • Although these soils can be naturally friable due to swelling and contracting when wet and dry, these can be heavy clays and prone to compaction. • Soils can tend to acidity and have higher than desirable sodium, aluminium and iron content/ • High iron clays can reduce the availability of soil water to plants and, if soil become highly acidic, can create toxicity and nutrient availability problems for plants. • Management options include: • Manage tillage and vehicle and livestock traffic to avoid compaction. • Build and maintain soil organic matter – this will help with soil structure/ compaction and water availability. • Manage acidic pH if necessary.

Soil type	Typical characteristics and issues in the project area district	Management options
Tenosols Also found: Chromosols, Ferrosols, Sodosols	Tenosols in Central Victoria are generally shallow (<50cm) stoney loam or sandy soils overlying weathered mudstone, basalt or granite outcrops or gravel. They often occur on hillsides and rises in the south-eastern part of the region and on the 'granite country' running from Harcourt to Lockwood. Some more geologically recent volcanic areas have a mix of shallow tenosols and deeper chromosols, ferrosols and sodosols, and typically low-lying areas in the shaded areas are deeper soils.	**Challenges:** • The soils are inherently shallow and often on slopes. They reduce the potential for deeper root growth and can dry rapidly. It can be hard to maintain living or dormant plants during extended dry periods, leaving areas exposed to erosion. **Management options include:** • These areas are generally less productive, and consideration could be given to fencing areas to keep stock off them and revegetating with trees or shrubs. Perennial fodder plants shrubs such as lucerne and salt bush could be grown in fenced off areas, and lightly grazed during periods where there are 'feed gaps'.

Key messages

1. Many soils in central Victoria have significant constraints to deeper root growth and healthy plant growth. These constraints hold back the Healthy Plant ⇆ Healthy Soils cycle and limit further improvements in soil health.
2. Identifying and addressing soil constraints allows the Healthy Plant ⇆ Healthy Soils Cycle to improve and maintain soul health.
3. Common constraints include:
   a. Shallow topsoils overlying poorly structured and compacted clays. These impede deeper root growth and reduce water infiltration.
   b. Inherently low soil nutrient availability, and particularly phosphorous, as well as commonly sulphur, zinc, copper, molybdenum and boron, and sometimes calcium and potassium.
   c. Overly acidic soil pH which make essential nutrients less available to plants, and can result in levels of aluminium, manganese and iron that have toxic effect on root development and nutrient uptake.
   d. Heavy sodic and magnesic clays that contribute to poor soil structure and compaction.
   e. Clays with high iron levels that can make soil moisture less available to roots.
   f. Low levels of soil nitrogen because of constrains to healthy legume growth and nitrogen fixation.
   g. Low levels of soil organic matter and biological activity down the soil profile.

Key messages continued

4. These constraints can be managed through a range of strategies including:

    a. Application of sources of nutrition (fertilisers, manures, etc) and soil amendments such as gypsum, lime, compost.

    b. Infrequent strategic tillage to loosen compacted soil and integrate soil amendments.

    c. Sowing and promoting growth of plants with hardy 'clay breaking' and nitrogen fixing roots.

    d. Avoiding overgrazing by livestock and wildlife to maintain an average minimum pasture plant height of at least 5cm.

    e. When the seasonal conditions allow it, maintaining a cover of living or dormant plants and roots

    f. During dry periods, retaining crop and pasture residues to ensure the soil surface remains covered

    g. Increasing organic matter and beneficial soil biological activity (such as earthworms);

    h. Controlling vehicle and livestock traffic to reduce compaction

    i. Minimising the intensity of any tillage at sowing to reduce the depth and amount of soil disruption

    j. Maintaining soil surfaces so that there is more water infiltration and less run-off.

    k. Using good seasons to increase root depth and plant health and add more biomass to soil.

    l. Protecting soils during drought, and repairing them afterwards.

5. Although soil maps can provide an indication of your soil type, soil profiles typically differ across the landscape. Most farms a range of soils with differences in the depth of topsoils and the characteristics of subsoils. Most obviously these will involve texture and colour differences, but pH and nutrient levels can also vary. The only reliable way to assess your soil characteristics is to dig holes or take soil cores and assess changes down the profile.