

# Five Steps to Healthy Soils

on grazing properties

## Introduction

Soil is the foundation of all ecosystems and plays a fundamental role in growing the food we eat, providing homes for plants, animals, and microorganisms, and even helping to regulate our climate.

In short, soil is a mixture of minerals, dead and living organisms (organic materials), air, and water. These four ingredients interact with one another in amazing ways, making soil one of our planet's most dynamic ecosystems and important natural resources. Soils play a critical role in feeding plants and creating structure for essential fungal and bacterial relationships to help plants grow.

The purpose of Five Steps to Healthy Soils on grazing properties is to help you better understand soils on your land, to identify soil constraints and select the most appropriate management actions to support healthy pastures.

As a landholder you are responsible for protecting soils to prevent degradation and erosion. Most simply, this involves maintaining sufficient ground cover to protect soil and not allowing overgrazing to occur.

## About this Guide

This guide is part of a series designed to support smart, well-timed land management actions for key areas on your property:

- **Emissions**
- **Native vegetation**
- **Watercourses**
- **Weed control**
- **Revegetation**
- **Dam enhancement**

Using one or more of these guides will help you make informed decisions, care for natural resources and boost your efficiency as a land manager. Choose the guides that suit your needs – or use them all to create a complete stewardship plan for your property.

The content draws on the knowledge and experience of our stewardship and agriculture teams, local landholders, and partners working across the Hills and Fleurieu region.

We wish you every success.



## Acknowledgement of Country

The Hills and Fleurieu Landscape Board acknowledges First Nations as the first people of the lands and waters where we live and work. We respect the Peramangk, Kaurna, and Ngarrindjeri peoples, past and present, who have cared for Yerta/Ruwe for generations, nurturing its life, stories, and landscapes. We recognise their deep knowledge, spiritual belonging, and enduring connection to Country.

We are committed to walking alongside First Nations, listening, learning, and working together to protect and restore these lands and waters.

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# STEP 1

## Start a plan and map soil types

The first step in achieving healthy soils is to make a plan. You can download the Healthy Soils Action Plan template from our website. Creating a plan will provide guidance and ensures your efforts are strategic, well-timed and meaningful. A plan can help you stay in control and set you up for manageable actions.

The first step in the plan is the map soil types.

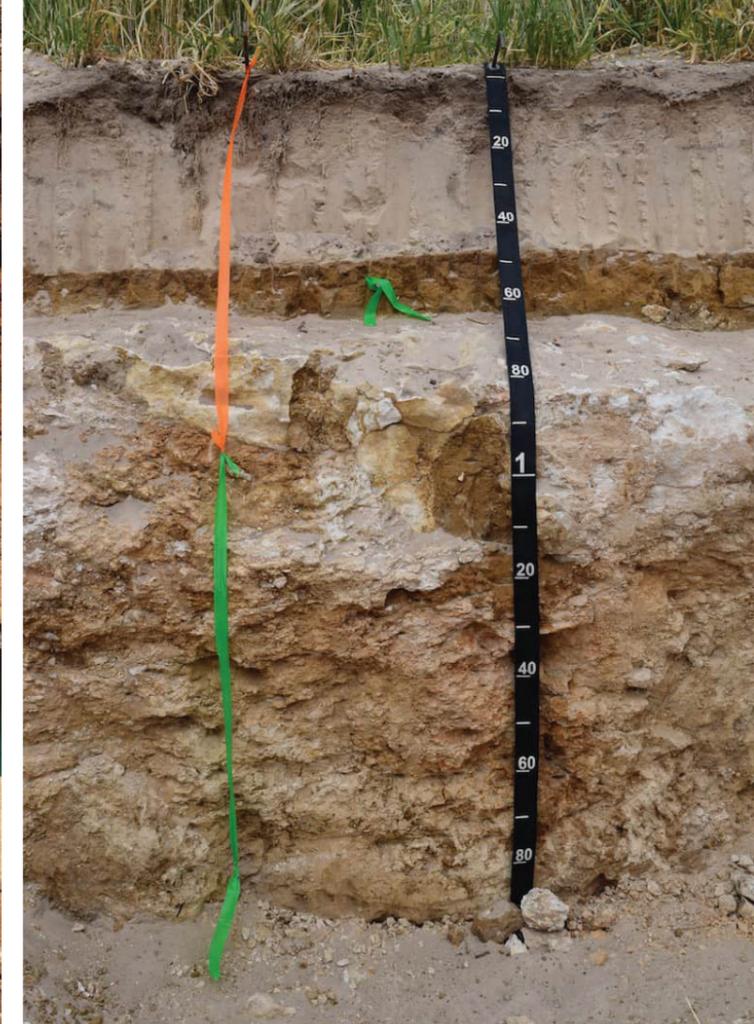
There are around 48 different soil types mapped across the Hills and Fleurieu region. Soil types can vary across any one property. It is important to know what soils you have before making decisions on how to manage them. For example, you could have a loamy clay over light sandy clay and a sand over clay in the same paddock.

### Common soil textures include:

- Sand
- Sandy Loam
- Loam or Sandy Loam
- Clay
- Sandy Clay Loam
- Clay Loam
- Silty Clay Loam

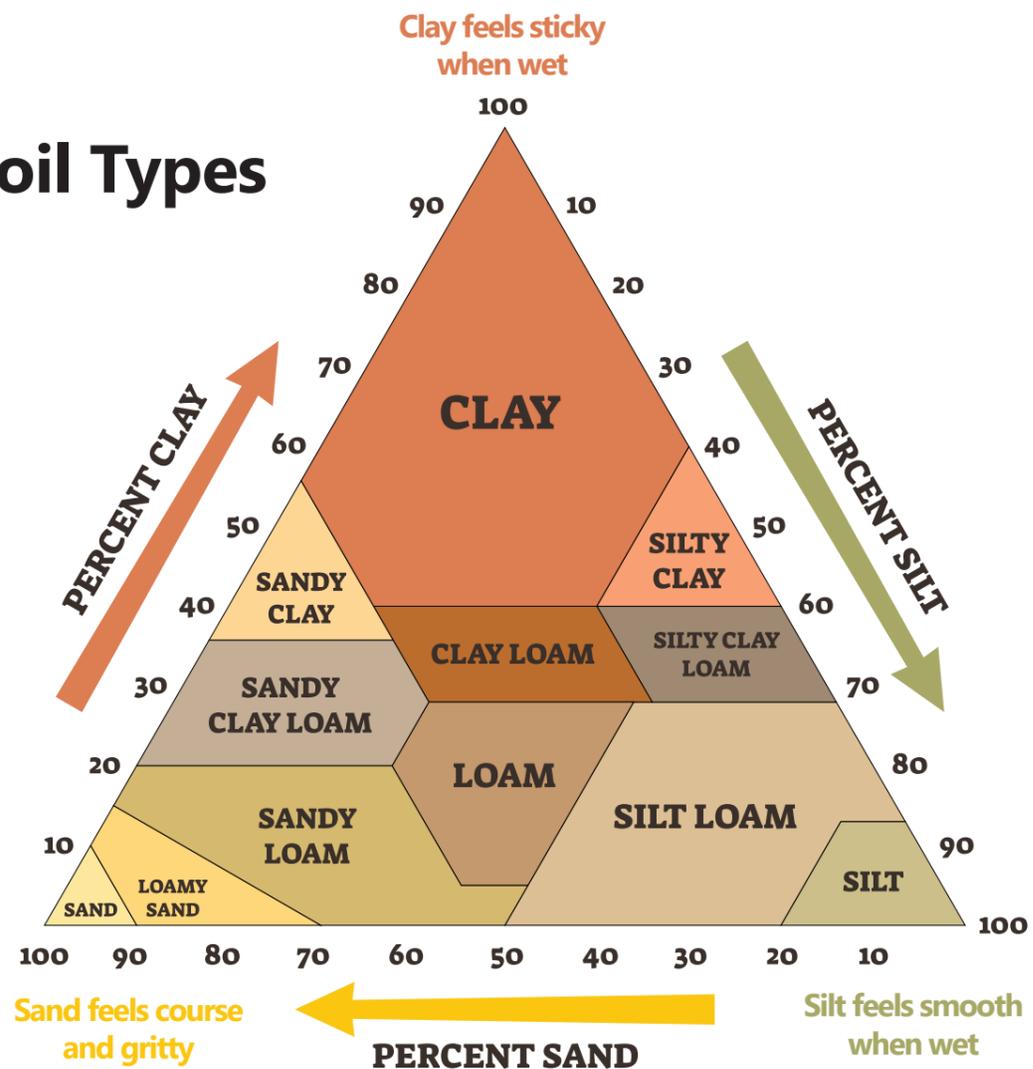


Loamy clay over light sandy clay



Sand over medium clay with a hardpan

## Soil Types



## Reading the landscape - recognise landforms and land capability

Walking your property, together with aerial images with contour overlays can assist in reading the landscape. Aerial images and data layers including land system and soil type maps are available for free online using NatureMaps.

Recognise landforms like hills, slopes, ridges, valleys, and plains. Understand how natural processes have shaped the land. For example, the movement and flow of water through the landscape and natural drainage lines. These landscape features can help to identify soil types across your property. For example, it is likely that deeper, more fertile soils will be located at the base of slopes and valleys, with shallower, stonier and less fertile soils on the hill tops.

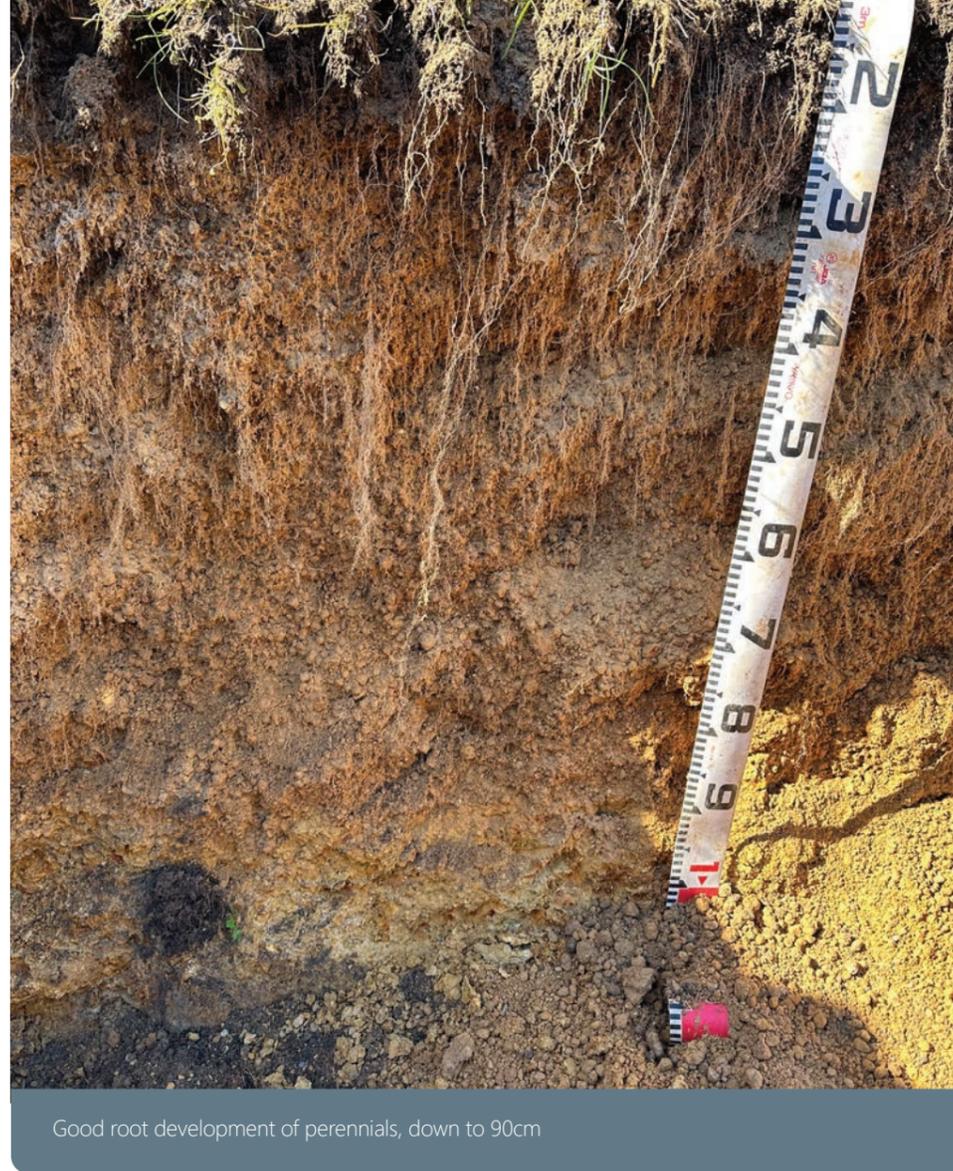
When evaluating land capability and suitability for agriculture, conservation or development, consider factors like soil type, slope, drainage, and potential for erosion.

**NatureMaps** is a free online interactive mapping tool provided by the Department for Environment and Water in South Australia. It serves as a centralised access point for a variety of maps and geographic information about the state's natural resources. This includes data on flora and fauna, vegetation, soil, protected areas, landscapes, heritage sites, fire records, and more. Access the tool at [naturemaps.sa.gov.au](http://naturemaps.sa.gov.au)

## Soil profiles on your property

Beneath the surface, soils consist of layers or horizons, collectively forming a soil profile. These layers reflect the soil's age, parent material, climate, and other factors. Some profiles feature shallow soils over parent rock, while others are deep sands with minimal differentiation.

Understanding soil profiles is essential to effective management, as any agricultural enterprise relies on them. Most annual pastures have a root depth of about 10–15 cm deep, whereas perennial plants (i.e., lucerne, tall fescue and phalaris) can reach depths of one metre or more. Digging a soil pit reveals the soil profile and can identify growth limitations like waterlogging, salinity, or physical barriers hindering root development.

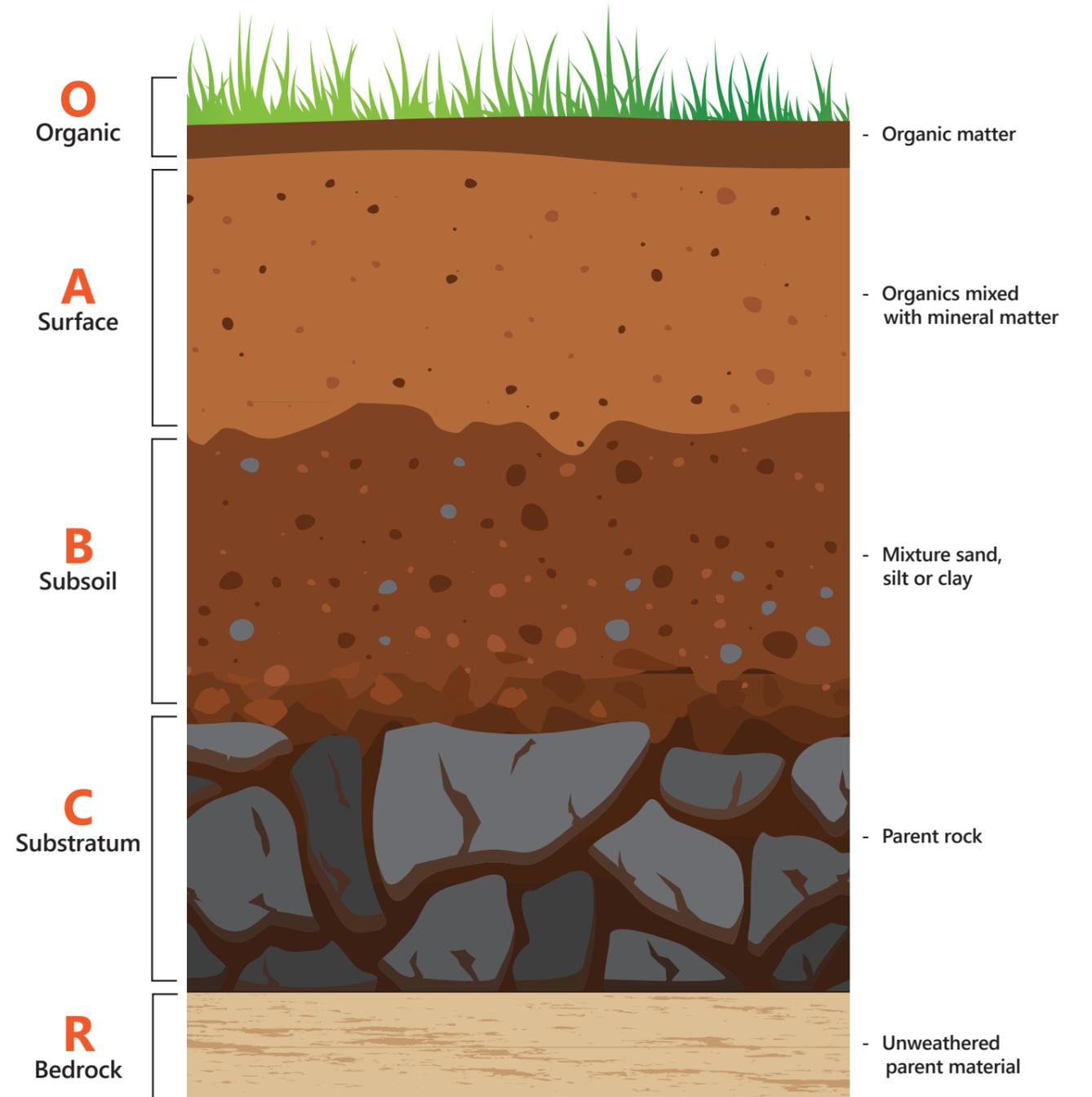
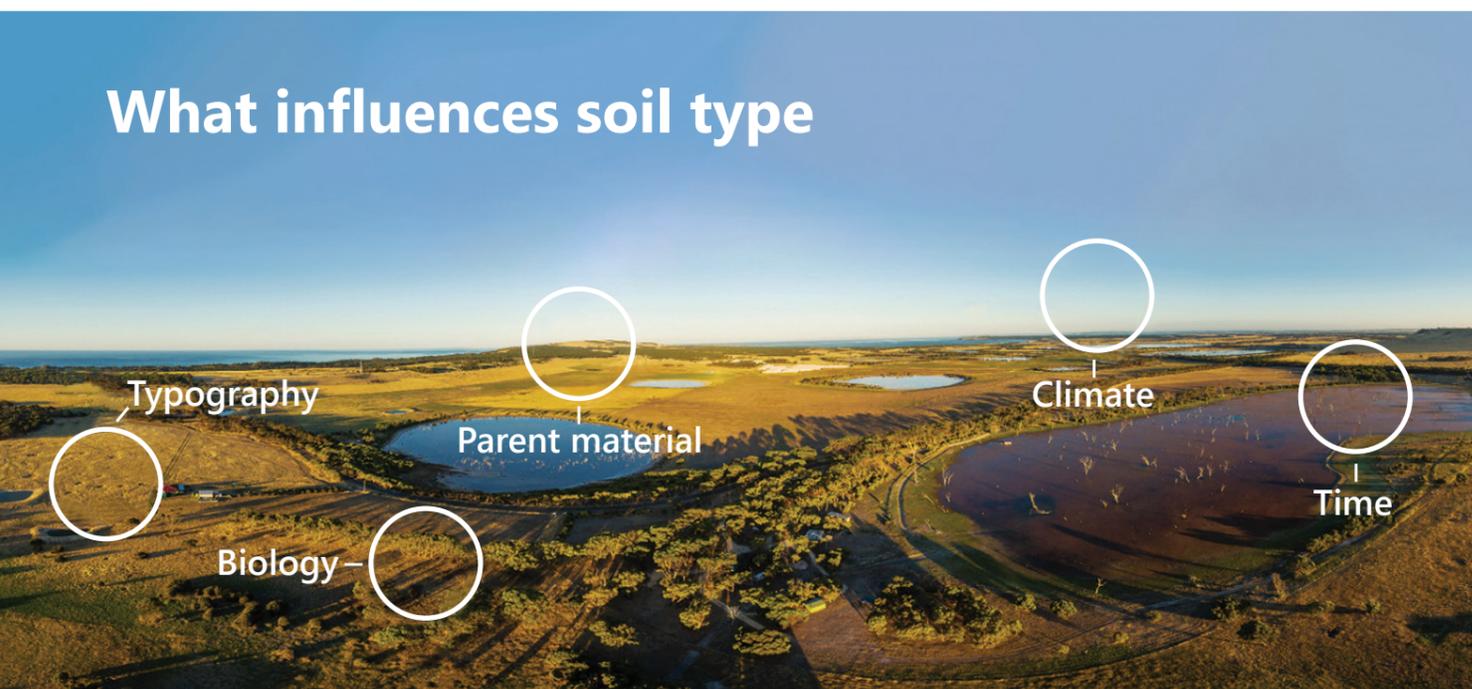


## Landscape benefits of caring for soil

A healthy soil is a productive soil with obvious farm benefits; however, a healthy soil is also important at the landscape scale. A healthy soil:

- Protects water quality, with reduced runoff and nutrient leaching
- Increases resilience to climate variability and climate change
- Helps mitigate climate change and supports soil carbon storage
- Protects from wind erosion by supporting groundcover
- Increases local food security with higher productivity
- Provides ecosystem services and supports natural predators/pathogens for integrated pest and disease management
- Reduces reliance on synthetic inputs (fertilisers, pesticides, fungicides).

## What influences soil type



# STEP 2

## Understand your soil

### Soil testing

The best way to assess soil health is to venture into the paddock, dig a hole and take a deeper look. There are a number of soil tests you can do to further characterise your soil and determine its current suitability for supporting pasture and grazing.

The 'Knowing Your Soils - Ute Guide' [landscape.sa.gov.au/hf/soiltesting](https://sa.gov.au/hf/soiltesting) provides step by step instructions for simple soil assessments that you can complete yourself with basic tools. These tests include:



Water infiltration test



Testing soil pH



Soil microbial test, Soil your undies



Texturing soil, ribbon test



Organic matter build up in topsoil

Soil Assessment	Purpose	Ute Guide Page	
<b>Physical</b>	Soil texture ribbon test	Soil texture refers to the ratio of sand, silt, and clay in the mineral portion of soil. This composition affects water retention, drainage, nutrient supply, root growth, and erosion resistance.	23
	Ground cover and weed cover percentage	Maintaining groundcover year-round is important to care for soil health. Aim for greater than 70% groundcover on flats and 90% groundcover on slopes year round. Measuring and monitoring groundcover is a key step in soil management.	15
	Leaf colour	Leaf colour can provide an indication of nutrient limitations, soil compaction or waterlogging. Yellowing pasture leaves can be result of nutrient deficiencies like potassium and nitrogen.	16
	Root development	Healthy root development indicates good soil structure and minimal soil constraints.	19
	Water repellence and non-wetting soils	Assess the severity of water repellence to assist management.	20
	Topsoil colour	Soil colour is a key indicator of soil type and formation. Two primary factors affect soil colour: 1. The type of mineral matter – reflects the parent rock’s hue. 2. The amount of organic matter.  Climate also plays a role, with warmer, moist conditions enhancing weathering and resulting in more vividly coloured soils.  Assessment of soil characteristics based on colour: <ul style="list-style-type: none"> <li>Dark colours = near soil surface indicates high levels of organic matter and high soil fertility</li> <li>Reds and oranges = iron oxides in aerobic conditions in subsoils, indicates good drainage</li> <li>Dull colours and mottles = waterlogging</li> <li>Pale colours and whites = low organic matter and leaching</li> </ul>	21
	Soil compaction	A dense section or layer of soil within the soil profile can impact plant growth, water infiltration and biological activity.	22
	Soil slaking (topsoil) and dispersion (topsoil and subsoil)	A test for soil structure stability. Soil structure refers to how soil particles - sand, silt, and clay - clump into aggregates. A well-structured soil has stable aggregates that allow water and air to penetrate, thanks to the binding effect of organic matter. In contrast, poorly structured soil forms large, dense clods that block root growth and hinder water movement. Surface structure is of special importance as it effects water infiltration into the soil.  Soil slaking is the breakdown of soil aggregates (clumps) into smaller pieces when they are rapidly wetted.  Soil dispersion is where soil aggregates collapse and break down into individual clay particles when wet with fresh water. The soil will appear "milky cloudy".	27
	Water infiltration	Measures how fast water soaks into the soil. A higher infiltration rate generally corresponds to better soil structure and less runoff. A very high infiltration rate in sandy soils can lead to nutrient leaching.	29
	<b>Chemical</b>	Soil pH – topsoil and subsoil	Soil pH measures the soil acidity or alkalinity.
<b>Biological</b>	Soil microbial test (Soil Your Undies)	A creative way to visualise the presence of soil microorganisms in organic matter breakdown and nutrient cycling. Buried 100% cotton undies will be broken down if there is microbial activity.	14
	Soil organism type and earthworm count	A healthy soil biota is a sign of healthy soil.	17



Laboratory analysis of soil samples will provide a comprehensive nutrient analysis of your soils. Testing soil when it's dry provides the most reliable results, particularly for nutrient level tests. It may also be beneficial to seek plant leaf/tissue analysis to assist diagnosis and help identify solutions to address nutrient deficiencies.

Testing is recommended before changing management or adding inputs. It's best to sample different soil types separately, avoiding areas like stock camps or tracks.

While standard soil tests indicate readily available nutrients, they may not capture the full picture. Many minerals, accessible through soil microbes, won't show up on typical tests. By nurturing these microbes, we can enhance the availability of essential minerals and trace elements that fertilisers might not provide.



Dig a hole with a shovel to assess soil health

Inspecting for red legged earthmites

# STEP 3

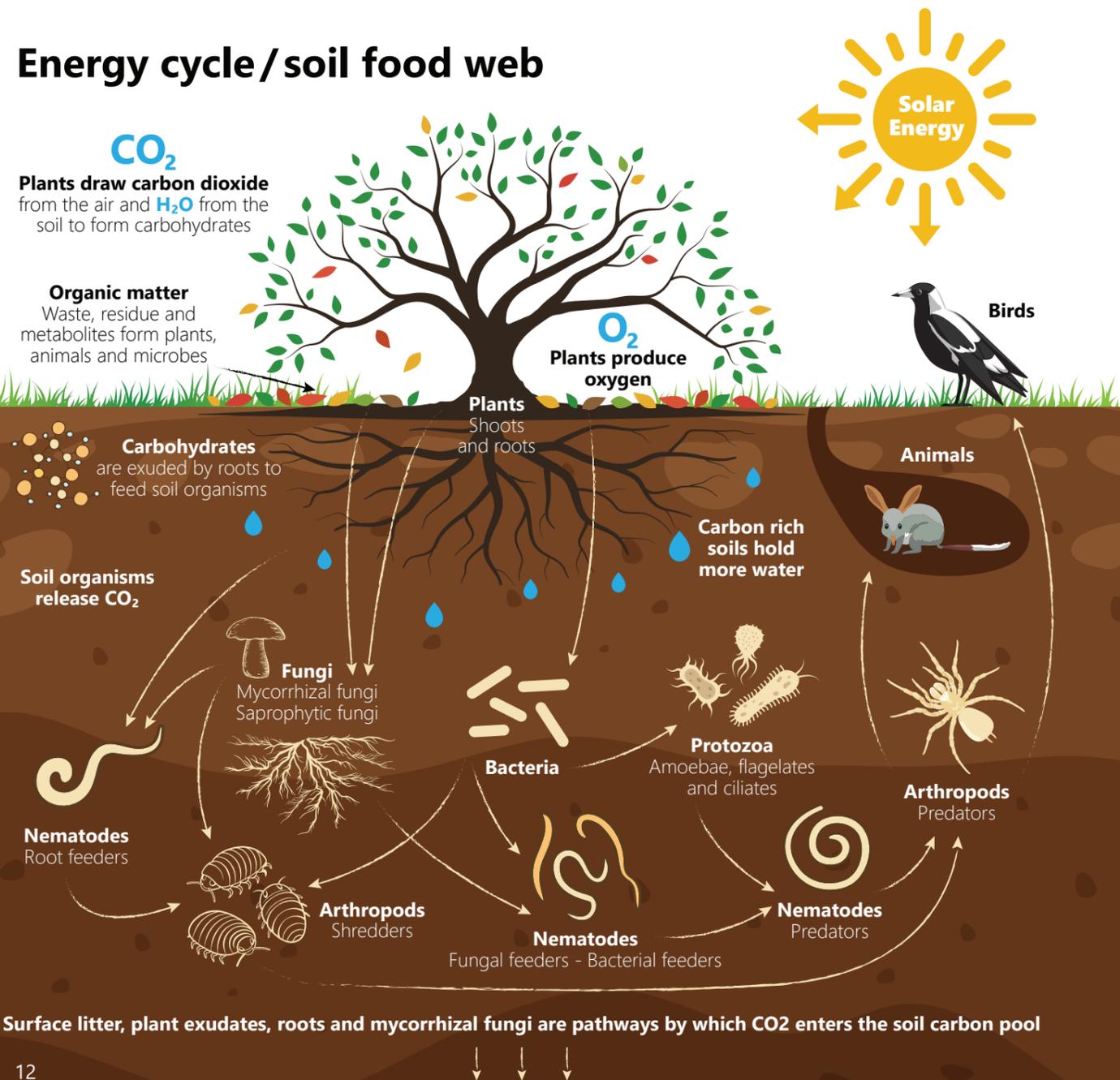
## Know your soil management needs

Australia's soils are among the oldest on Earth, shaped by millions of years of weathering and leaching. This history often results in lower nutrient and organic matter levels. Soil characteristics like colour, layers, texture, and structure depend on the parent rock and environmental influences.

Soil health is assessed through its physical, chemical and biological properties.

Healthy soils allow water and air to circulate freely, facilitating root penetration and nutrient uptake. Understanding plant-soil interactions is crucial for managing soil health and maintaining adequate nutrient and water levels.

## Energy cycle/soil food web

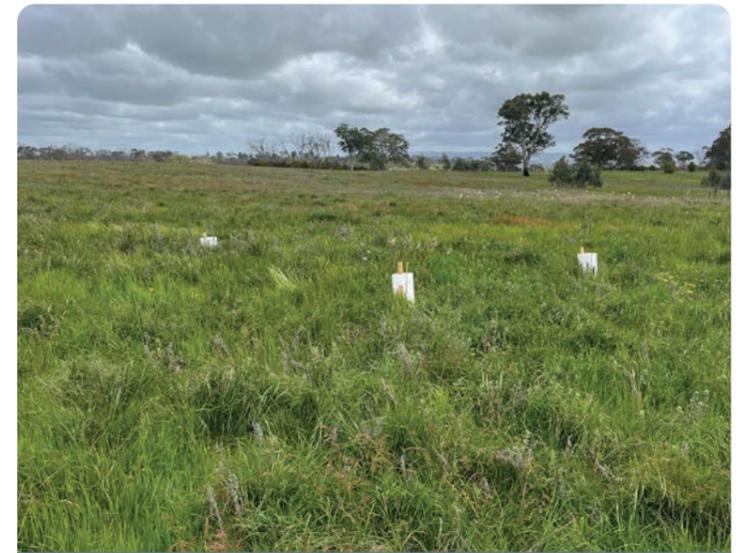


## Strategies to care for soil health

When caring for soils it is important to holistically consider the physical, chemical and biological properties. Each soil characteristic influences the other and achieving the right balance will result in a healthy and productive soil. The best management strategies that enhance soil health include:

1. Maintain soil groundcover year round
2. Minimise soil disturbance
3. Maximise plant and living roots diversity

Here is a summary of soil properties and best practice management considerations:



Good groundcover and diversity in plant species

Soil properties	Soil attributes	A healthy soil has:	Best management practices
<b>Physical</b>	<ul style="list-style-type: none"> <li>• Texture</li> <li>• Structure</li> <li>• Porosity</li> <li>• Bulk density</li> <li>• Consistency</li> <li>• Temperature</li> <li>• Colour</li> <li>• Infiltration / Permeability</li> <li>• Water holding capacity</li> <li>• Aggregate stability</li> <li>• Air</li> <li>• Organic matter</li> </ul>	Good physical structure with pore spaces for water drainage, air circulation and unrestricted root growth. It is also more resistant to degradation and less susceptible to wind and water erosion and compaction.	<ul style="list-style-type: none"> <li>• Rotational grazing</li> <li>• Organic inputs</li> <li>• Cover cropping</li> <li>• Mulching</li> <li>• Crop rotation</li> <li>• Intercropping</li> <li>• Stubble retention</li> <li>• Prevent soil compaction by controlling traffic when soil is moist</li> </ul>
<b>Chemical</b>	<ul style="list-style-type: none"> <li>• Macronutrients</li> <li>• Secondary nutrients</li> <li>• Micronutrients</li> <li>• pH</li> <li>• Cation Exchange Capacity (CEC)</li> <li>• Salinity</li> <li>• Organic matter</li> </ul> <p><i>*See 'Essential nutrients for soil health' table over page</i></p>	High soil organic carbon content is free from harmful chemicals or toxins and has optimal soil nutrient and pH. There is minimal loss of nutrients from leaching and minimal fertiliser application is required.	<ul style="list-style-type: none"> <li>• Enhance soil organic matter – e.g. organic inputs</li> <li>• Appropriately manage nutrient applications; reduce/remove inorganic inputs (fertilisers)</li> <li>• Manage soil pH by applying lime</li> </ul>
<b>Biological</b>	<ul style="list-style-type: none"> <li>• Soil megafauna</li> <li>• Soil macrofauna</li> <li>• Soil mesofauna</li> <li>• Soil microfauna</li> <li>• Microflora/Microorganism</li> </ul> <p><i>*see 'Soil organisms' table over page</i></p>	Dense and diverse plant cover and a large and diverse population of beneficial organisms to assist with nutrient cycling, decomposition of organic matter, and maintenance of soil structure.	<ul style="list-style-type: none"> <li>• Rotational grazing</li> <li>• Organic inputs</li> <li>• Reduce/remove chemical inputs (herbicides, pesticides and fungicides)</li> <li>• Cover cropping</li> <li>• Mulching</li> <li>• Stubble retention</li> <li>• Increasing diversity of pasture species with diverse root structures</li> </ul>

Essential nutrients are crucial for soil health by promoting a balanced nutrient cycle, supporting good soil structure, enhancing plant growth, and providing essential functions like water regulation, pollutant filtering, and soil biodiversity. Adequate nutrient levels support diverse soil organisms and ensure the soil can effectively perform these vital roles.



Nutrient	Role
<b>Nitrogen (N)</b>	Nitrogen is critical for plant protein synthesis and leaf growth. In South Australia, nitrogen deficiency is common due to leaching. Plants with yellowing older leaves may be lacking nitrogen. Overusing synthetic nitrogen can harm soil health. Legumes like lucerne and clover naturally enrich the soil with nitrogen, adding around 225 kg/ha and 100 kg/ha annually, respectively.
<b>Phosphorus (P)</b>	Most Australian soils are naturally phosphorus deficient, which is a vital element for strong root development. Stunted plant growth can indicate a lack of phosphorus. However, added phosphorus can be tied up by clay particles and organic matter, limiting availability. In alkaline soils or those high in iron, calcium, or aluminium, phosphorus becomes less soluble. Sandy soils in high-rainfall areas are also prone to leaching.
<b>Potassium (K)</b>	Potassium deficiencies are rare but can arise from practices like continuous hay cutting. This nutrient is essential for flowering and seed production.
<b>Sulphur (S)</b>	Sulphur is critical for plant growth and chlorophyll production. It is found in organic matter and requires soil microorganisms to mineralise sulphur to sulphate to be readily available to plants.
<b>Calcium (Ca)</b>	Most Australian soils contain sufficient calcium, mainly from limestone and calcrete. However, acidic soils may be low in calcium, leading to plant disorders.
<b>Magnesium (Mg)</b>	In sandy soils of high-rainfall areas, magnesium can be leached away, sometimes requiring dolomite lime to correct acidity and restore magnesium levels.
<b>Trace Elements</b>	Though needed in small amounts, trace elements are vital for plant health and can significantly impact animal production. <b>Deficiencies are most likely in:</b> <ul style="list-style-type: none"> <li>Copper (Cu) in acid and calcareous sands</li> <li>Manganese (Mn) in highly calcareous soils</li> <li>Zinc (Zn) in sandy and calcareous soils</li> <li>Molybdenum (Mo) in sandy, acidic soils</li> <li>Iron (Fe) in calcareous soils</li> <li>Boron (B) in leached sandy soils (toxic in some clays if over 15 ppm)</li> </ul>

Soil organisms are vital for soil health as they recycle nutrients, decompose organic matter, improve soil structure, suppress plant diseases, and facilitate symbiotic relationships with plants. These functions provide plants with essential nutrients, create better soil for root growth, protect against illness, and boost overall soil fertility and ecosystem balance.



Soil organism	Size	Example	Role
<b>Microflora / Microorganisms</b>	<5 µm	Bacteria, fungi, archaea, algae, viruses	Nutrient cycling, organic matter decomposition, plant growth promotion, soil structure, disease suppression, carbon sequestration, nitrogen fixation, phosphorous solubilization, regulate soil pH, water retention, biocrust formation
<b>Microfauna</b>	0.1mm – 0.2mm	Protozoa, nematodes	Feed on bacteria and fungi, regulate microbial populations and contribute to nutrient cycling
<b>Mesofauna</b>	0.1mm – 2mm	Mites, springtails, nematodes, rotifers, tardigrades	Feed on litter, fragment organic matter, prey on microfauna and fungi, influence nutrient cycling and decomposition
<b>Macrofauna</b>	2mm – 20mm	Earthworms, beetles, ants, termites, isopods, millipedes	Modify soil structure, break down organic matter and influence nutrient availability
<b>Megafauna</b>	Small animals	Mammals (echidna), reptiles (snakes), amphibians (burrowing frogs)	Modify soil structure, transport organic matter, soil aeration, water infiltration and drainage/nutrient cycling and aid in soil aeration



# Understand soil constraints

Our soils come with physical, chemical and/or biological constraints, inherited from how they were formed, from past land management, or from what we expect of them. It is not always a matter of changing a soil but rather understanding its natural properties and working with the soils as best we can, within their limitations.

Soil constraint	Description	Assessment method/s
<b>Soil compaction</b>	A compacted soil is denser in either a layer or section of the soil profile. The soil particles are packed close together resulting in reduced pore spaces between them. This results in reduced air and water for roots and soil biology to grow and prosper. Compacted layers can be formed by natural processes or by human activity. Some dry, light textured soils may be naturally compact.	Visual assessment in 30cm deep sampling hole. Ute Guide page 22
<b>Soil structural stability</b>	Sodic soils contain excessive sodium, affecting clay particles and leading to poor soil structure, which in turn hampers water and air penetration. This can result in water pooling on the surface.	Soil slaking test (topsoil) Soil dispersion test (topsoil and subsoil) Ute Guide page 27
<b>Salinity</b>	Saline soils are those with levels of soluble salts high enough to impede the healthy growth of plants. Different species will have varying tolerances to salt, but where concentrations are high, plants may not grow at all.  Salts can consist of the cations of sodium, potassium, calcium and magnesium and ions of chloride, sulphate, carbonate and bicarbonate. However, in South Australia most of the salts are sodium chloride. Measuring soil salinity is based upon a process of electrical conductivity. The higher the salt concentration, the easier an electric current will pass through the solution.  Dryland salinity occurs when rising water tables bring salts to the surface, negatively impacting plant health. The clearing of trees and deep-rooted perennials has significantly contributed to this issue.	Prepare a soil solution and use an electrical conductivity (EC) probe.  Knowing Your Soils page 73.
<b>Soil erosion</b>	Erosion from wind and water can severely degrade land, with even a millimetre of topsoil loss translating to significant nutrient depletion - 10 kg/ha of nitrogen and 2 kg/ha of phosphorus. Light, sandy soils are particularly vulnerable to wind erosion, especially when disturbed by cultivation or grazing.  Water erosion is influenced by soil texture, slope surface disturbances, and rainfall intensity. Cultivated land with slopes of 4% to 12% face a medium to high erosion risk, particularly in high rainfall areas.	Measure and monitor groundcover regularly.  Knowing Your Soils page 54-55.
<b>Soil acidity</b>	Soils can be classified as acidic or alkaline based on their pH, which is a logarithmic scale ranging from 0.0 to 14.0, with 7.0 being neutral. This means a pH of 5.0 is ten times more acidic than 6.0, and 100 times more acidic than 7.0.  Soils with a pH below 7.0 are considered acidic, and those below 5.0 are strongly acidic. This ideal pH range for soil productivity in our region is 5.5-7.  At home pH test kits will measure pH (water). Most labs measure pH using two methods: pH (water) and pH (CaCl <sub>2</sub> ), with the latter typically being more accurate and about 0.8 units lower.	Soil pH test (topsoil and subsoil) Ute Guide page 25  <b>Did you know pH stands for potential of Hydrogen? pH is a measure of the concentration of Hydrogen ions.</b>
<b>Non-wetting soils</b>	Some sandy soils are known as "non-wetting," where water beads on the surface and penetrates slowly, leading to uneven wetting and patchy crop establishment. This issue may arise from organic matter that forms a waxy film over sand particles, creating a barrier to water absorption.	Water repellence test Ute Guide page 20
<b>Waterlogging</b>	Waterlogging is a natural process, whereby water enters the soil faster than it can leave, leading to oxygen depletion in the root zone. This condition can stunt plant growth and cause nitrogen loss, along with potential toxin production. Waterlogging is common above low-permeability clay layers and in low-lying areas when water slows or pools.	Visual assessment Knowing Your Soils page 27



Compaction under tyre tracks



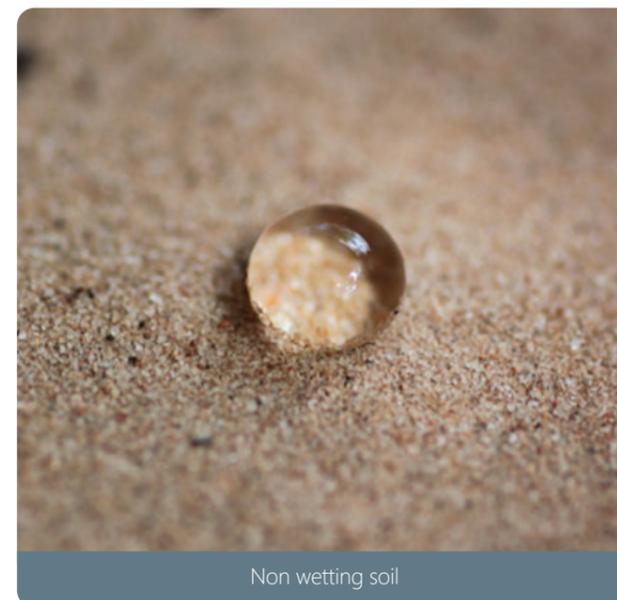
Wind erosion



Water erosion



Cropping paddock with acidity (bare patches)



Non wetting soil



Waterlogging

# Understand the influence of management practices

Management of the land can impact soil health. There's growing interest in regenerative agriculture, which emphasises holistic management to increase species diversity and build soil biology. Using organic fertiliser inputs rather than synthetic options can also enhance long-term soil health.



Management practices	Risk	Opportunity
<b>Grazing management</b>	Overgrazing in the Hills and Fleurieu region is the most common and widespread threat to the health of soil. Overgrazing occurs by running more livestock than the carrying capacity of the land, leading to loss of groundcover and topsoil loss through erosion. Livestock carrying capacity is greatly reduced in summer and autumn, even more so in drier years. Overgrazing can result in increased risks of soil erosion, loss of soil fertility, increased water runoff and water quality issues and impact carbon in soils.	Livestock carrying capacity requires a well-planned grazing program with flexibility in grazing management to allow for seasonal de-stocking and/or containment feeding.  Rotational grazing and well-designed containment feeding areas for drier times are important to support soil health.
<b>Tillage</b>	Soil disturbance and tillage may boost soil nutrient cycling in the short term but will degrade overall soil health in the long-term. In turn this impacts soil biological processes that cycle nutrients to plants. With the soil surface exposed there is also increased risks of erosion and loss of topsoil. Over time this can lead to a decline in soil fertility and productivity.	Consider options that minimise soil disturbance such as no-till farming practices, cover cropping, and/or mulching.
<b>Precision agriculture</b>	In some circumstances, not using precision agriculture techniques may expose farmers to various risks such as economic losses due to inefficient fertiliser usage, and increased environmental impact (i.e., run-off from over-application of fertiliser and soil degradation from unnecessary inputs).	Precision agriculture tailors management practices to specific areas and optimises resource use.
<b>Livestock and machinery movements</b>	Livestock and machinery movements can compact soils. Compacted soils have less pore spaces for the movement of air and water to support plant growth and soil biology.	By controlling livestock and machinery movements, areas affected by compaction can be reduced. This also may include the use of precision agriculture (e.g. using drones to monitor water troughs to minimise machinery movement).
<b>Fertiliser application/s</b>	The use of inorganic or synthetic fertilisers can negatively impact soil biology, creating boom bust cycles, and thus impact natural nutrient cycling in soils.	Organic inputs can enhance soil biological activity and further promote natural nutrient cycling.
<b>Pesticide, insecticide and fungicide application/s</b>	The use of chemical inputs can negatively impact soil biology and thus impact natural nutrient cycling in soils.	Integrated Pest Management (IPM) minimises chemical inputs whilst maximising pest control. Plant diversity can enhance beneficial insects for natural predation.
<b>Herbicide application/s</b>	The use of chemical inputs can negatively impact soil biology and thus impact natural nutrient cycling in soils.	Where the use of herbicides is necessary, plan timely application and use appropriate equipment and techniques for most efficient effect.



Land degradation, overgrazing and lack of ground cover



Drone technology is one form of ag tech that can help map soil pH across a paddock. This information then enables precision management.

# STEP 4

## Take action to care for your soil

### The main strategies to care for soil are:

1. Maintain soil groundcover year-round
2. Minimise soil disturbance
3. Maximise plant and living root diversity

The following actions support these strategies.



Soil biology is a good indicator for soil health.

## Actions to care for soil health

Possible Action	Action description	Benefits
<b>Rotational grazing</b>	Livestock management where animals are moved regularly between different paddocks to allow for rest and recovery between grazing periods, promoting healthy plant growth and more even distribution of grazing pasture. Improves pasture productivity and persistence.	<ul style="list-style-type: none"> <li>• Soil structure</li> <li>• Water infiltration</li> <li>• Nutrient cycling and distribution</li> <li>• Organic matter</li> <li>• Reduce risk of soil erosion</li> <li>• Groundcover</li> <li>• Plant diversity</li> </ul>
<b>Control traffic/livestock when soil is moist</b>	Prevent soil compaction by controlling access of livestock and machinery to moist or waterlogged soils.	<ul style="list-style-type: none"> <li>• Soil structure</li> <li>• Soil biology</li> <li>• Water holding capacity</li> <li>• Nutrient cycling</li> <li>• Groundcover</li> </ul>
<b>Organic inputs</b>	Inputs sourced from natural origin, including plant, animal, microbial or mineral sources.	<ul style="list-style-type: none"> <li>• Soil biology</li> <li>• Nutrient cycling</li> </ul>
<b>Appropriately manage nutrient applications; reduce/remove inorganic inputs (fertilisers)</b>	<p>Matching nutrient application to crop needs, considering all nutrient sources, and implementing practices to improve nutrient use efficiency.</p> <p>Adopting best management practices – right source, right rate, right time, right place.</p>	<ul style="list-style-type: none"> <li>• Prevents leaching</li> <li>• Soil biology</li> <li>• Nutrient cycling</li> </ul>
<b>Reduce/remove chemical inputs</b>	Consider integrated pest management and precision farming techniques to reduce or remove chemical (herbicides, pesticides and fungicides) inputs.	<ul style="list-style-type: none"> <li>• Soil biology</li> <li>• Nutrient cycling</li> <li>• Resilience to pests and diseases</li> </ul>
<b>Mulching</b>	A layer of organic material placed on the soil surface.	<ul style="list-style-type: none"> <li>• Protects soil surface</li> <li>• Organic matter</li> <li>• Soil biology</li> </ul>
<b>Cover cropping</b>	Growing a non-cash crop to cover and help protect the soil.	<ul style="list-style-type: none"> <li>• Reduces risk of erosion</li> <li>• Water infiltration</li> <li>• Nutrient cycling</li> <li>• Groundcover</li> <li>• Plant diversity</li> </ul>
<b>Intercropping</b>	Growing two or more different crops simultaneously on the same piece of land.	<ul style="list-style-type: none"> <li>• Nutrient cycling</li> <li>• Groundcover</li> <li>• Plant diversity</li> </ul>
<b>Increase plant diversity</b>	Introducing a variety of plant species into the pasture system, i.e. broadleaves, grasses, natives, perennial and annuals	<ul style="list-style-type: none"> <li>• Soil biology</li> <li>• Organic matter</li> <li>• Ground cover</li> <li>• Soil structure</li> </ul>

# Actions to manage soil constraints

Some soil constraints have simple solutions while others may require a long-term management strategy.

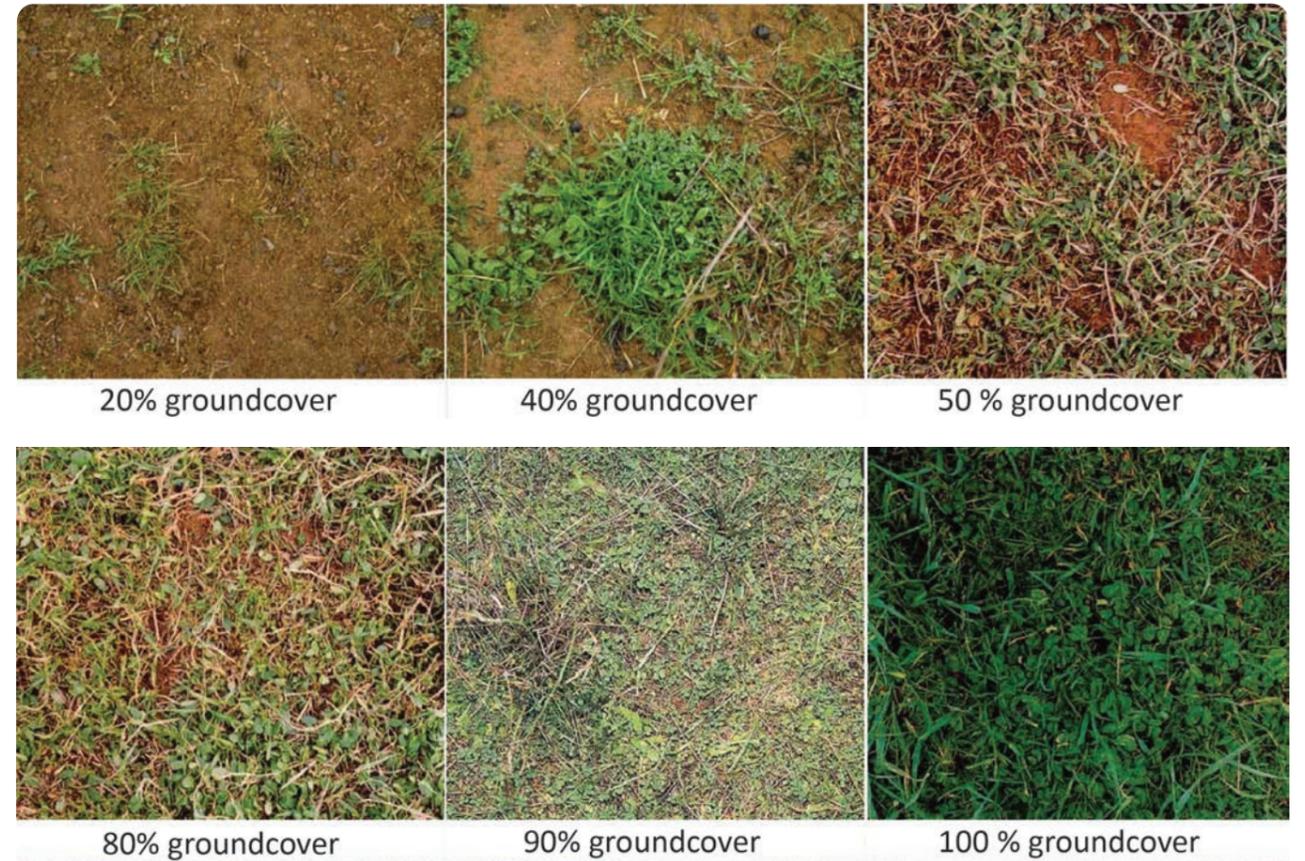
Soil constraint	Management options
<b>Soil compaction</b>	Manage the movement of machinery and livestock particularly when soils are moist to avoid soil compaction.
<b>Soil structural stability</b>	<p>Adding organic matter promotes aggregation and releases nutrients for plant growth.</p> <p>Gypsum (calcium sulphate) is often used to reclaim these soils by replacing sodium with calcium, improving aggregation and structure. For acidic sodic soils, a combination of lime and gypsum may be necessary. Careful management is essential to prevent water erosion in these soils.</p> <p>Gypsum can also improve heavy clay soils by displacing sodium with calcium, improving better soil structure and water penetration. It's important to note that gypsum is used for sodic soils, while lime addresses acidic soils.</p>
<b>Salinity</b>	<p>Mildly saline-affected grazing areas can be managed by sowing tolerant pasture species, fencing areas to enable targeted management, and planting deep rooted vegetation. If areas are strongly saline, fencing to exclude stock and revegetation with native salt tolerant trees and shrubs should be considered to protect the soil surface from erosion.</p> <p>Monitor groundwater levels to better understand salinity.</p>
<b>Soil erosion</b>	<p>In the Hills and Fleurieu, water erosion is more prevalent than wind erosion. Maintaining good surface cover throughout the year is the key to reducing the risk of soil erosion. Generally, landholders should always maintain a minimum of 70% groundcover on flats and 90% on slopes. Groundcover should be at least 3cm high with living roots.</p> <p>Implement rotational grazing practices to maintain annual and perennial pastures, including confinement feeding when needed in dry times.</p> <p>Limit tillage - Direct drilling into soil is recommended to reduce erosion risk.</p>
<b>Soil acidity</b>	To remedy acid soils, lime (calcium carbonate) can be applied, which neutralises acidity and raises pH. Enhancing soil biology can also assist pH. Managing pH requires a planned long-term management strategy.
<b>Non-wetting soils</b>	Management techniques, such as furrow sowing or clay spreading, can help manage water repellence and improve water infiltration.
<b>Waterlogging</b>	Not grazing waterlogged areas during winter can help prevent soil compaction, allowing for better recovery when the soil dries out in spring. Drainage can also be improved depending on the area.



Sodicity (Left) and gypsum (Right)



Lime applied to a trial site to address acidity



20% groundcover

40% groundcover

50% groundcover

80% groundcover

90% groundcover

100% groundcover

Good ground cover measurement; aim for at least 70% cover on flats and 90% cover on slopes.

# STEP 5

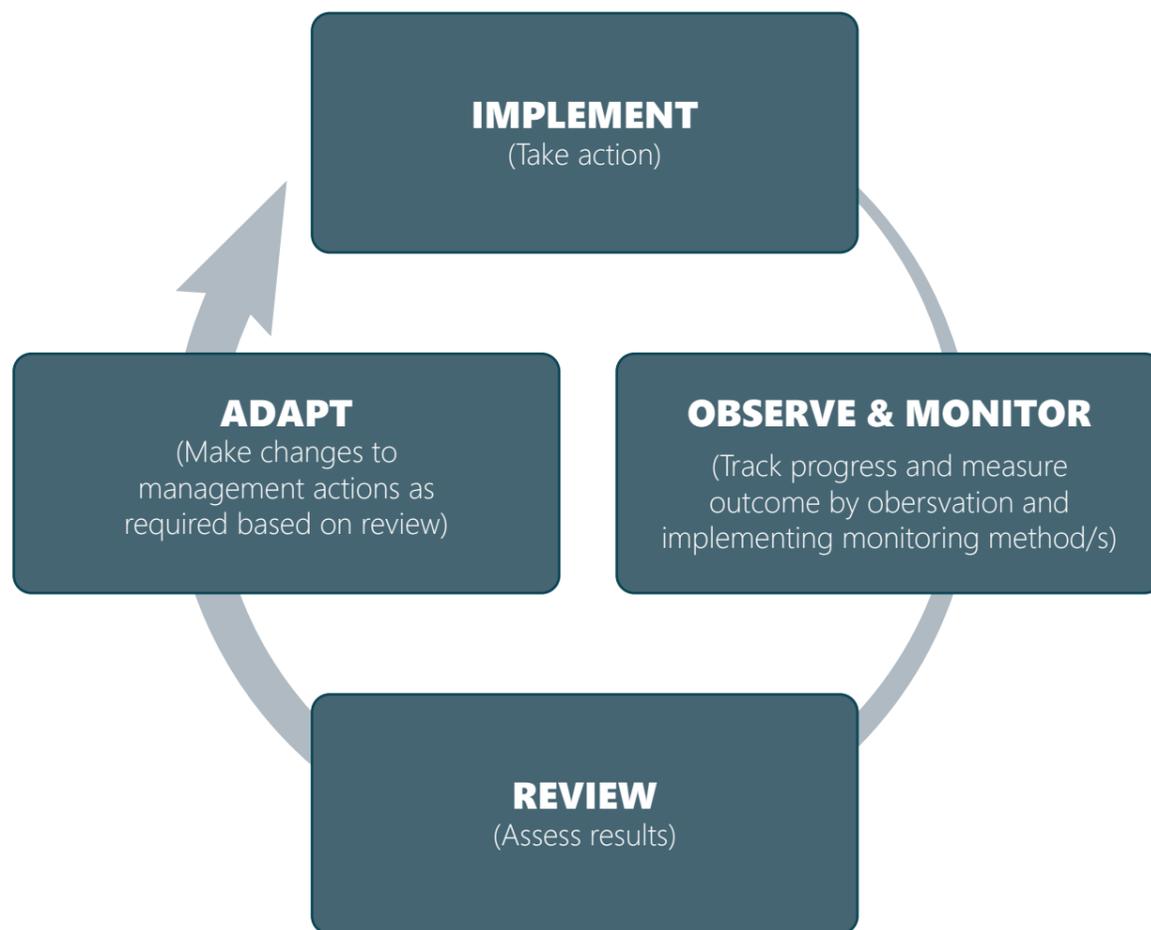
## Monitor your results

### Setting a baseline

Before implementing any management actions, it's beneficial to collect baseline data to understand the status and condition of the soils on your farm. Regular monitoring identify whether your actions are succeeding. What success means will depend on your farm goals.

### Monitoring on your farm

Monitoring will help you respond to emerging issues and identify successes and whether actions need to be adapted or changed; it is an ongoing process of learning and improvement. If the monitoring data indicates that the management actions are not achieving the desired outcomes, adjust the management actions accordingly.



## What to monitor

There are many things that can be monitored and measured. However, it is important that what you measure provides answers to the original desired outcome. Refer to your goal in caring for soil on your farm.

Implementing the tests in the 'Knowing Your Soils - Ute Guide' is a great start to monitoring your soils. There are several other monitoring methods and tools available, here are a few ideas:

What to assess	Method	Tools / Resources	*Recommended timing			
			Sum	Aut	Win	Spr
<b>Soil health and soil constraints</b>	Soil in field tests	Knowing Your Soils SA Ute Guide. Available from our website.		*		*
<b>Soil constraints</b>	Pasture species as indicator species	Using pasture weeds to read the landscape. Available from our website.				*
<b>Groundcover</b>	Assess and calculate	MLA Pasture Paramedic	*	*	*	*
<b>Soil chemistry</b>	Soil lab test	Fact Sheet – Soil sampling for lab testing. Available from our website.		*		*
<b>Nutrient deficiencies / overload</b>	Plant leaf/ tissue analysis	Time of sampling will be species dependent.	*	*	*	*
<b>Available pasture</b>	Measure and calculate	MLA Pasture Ruler	*	*	*	*

\*Go to [landscape.sa.gov.au/hf/soiltesting](http://landscape.sa.gov.au/hf/soiltesting) to access the resources mentioned above.



Monitor pH with a kit available from most hardware stores



## Conclusion

Soil is one of our most valuable natural resources, playing a vital role in supporting ecosystems, agriculture, and climate regulation. Understanding and caring for soil is essential for sustainable land management, especially in the Adelaide Hills and Fleurieu Peninsula, where soil health directly affects productivity and environmental stability.

By maintaining groundcover year-round, minimising soil disturbance, and maximising plant and living root diversity, landholders can improve overall soil health. Sustainable practices, including regenerative agriculture and appropriate fertiliser use, help to preserve soil fertility and ensure long-term productivity.

Protecting our soils is a shared responsibility. With careful management and ongoing education, we can safeguard this essential resource for future generations. Healthy soils mean healthier landscapes, more resilient farming systems, and a stronger, more resilient environment for all.



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