beef+lamb new zealand

Farm Plan Environment Module

Managing soil health

Chapter Overview

This chapter is broken down into 6 steps outlined below. Each step includes background information as well as a completed example of templates associated with that step. Blank templates are included with hard copies of the resource or can be downloaded from **beeflambnz.com/farmplan**

STEP 1 – Soil Goals

Identify any goals you have for managing soil health on your farm. These may link back to any goals identified in the Introduction chapter.

Template ST1 – Soil Goals

STEP 2 – Mapping soils

Map your soil types and appropriate soil properties.

STEP 3 - Assess your soils

Familiarise yourself with soil health, different soil attributes and the various assessment tools. Select the appropriate assessments to help you asses your soils and develop your understanding of soil health.

Template ST2 – Visual Soil Assessment Score Card – Soil Indicators

Template ST3 – Soil Assessment Summary

STEP 4 – Identify Risks, Opportunities and Management Actions

Identify possible risks and opportunities for your soil health and the factors contributing to the risk or enabling the opportunity. Assess the level of risk using the assessment matrix. Identify management actions that have been or could be taken. Table 1.1 provides guidance.

Template ST4 – Soil Risk Assessment and Management Actions

STEP 5 – Action Plan

Building on the management actions identified in step 4 Template ST5 record those that still need to be implemented.

Template ST5 – Soils Action Plan

STEP 6 – Monitoring and Review

Establish a programme for monitoring your soil health and at least annually review your soil management plan.

Template ST6 – Soil Monitoring Plan

Additional supporting resources are available at **beeflambnz.com/farmplan** and on the B+LNZ Knowledge Hub

Why is it important to look after the health of soils?

Soils are fundamental to a farming system. The soil resource will determine what the limitations and opportunities are for farm management and production. Soil health comprises physical structure, chemistry and biology. Looking after the health of the soils helps us to optimise production and ensures soils are not degraded or lost. Good soil health supports biodiversity, both within the soil itself and by sustaining whatever is growing on it. Soil formation is influenced by a range of factors interacting together – climate, parent material (rock type), topography, biological activity and time. Management influences soil health. Soils can take thousands of years to form and hence are not a renewable resource. Given this, it is important to look after them to optimise their use.

By completing this section, you should be able to:

- Understand the fundamental elements of soil health
- Be able to map some characteristics of your soils onto your farm map
- Identify risks and opportunities associated with your soils
- Link your soils to your Land Management Units to help inform your management of them
- Develop a plan to protect, enhance and monitor your soil health

STEP 1 – Soil Goals

Identify your goals for managing your soil resource

Soils are foundational to the productivity, profitability and sustainability of farms.

Refer to any overall farm vision, values and goals already completed in the Introduction chapter. You may also have community objectives that you want to include. These could be from your local Catchment Community Group or Regional Council.

Identify any specific goals for your farm in relation to managing your soil resource. Some examples include:

- To maintain or improve the physical and biological condition of soils in order to minimise the movement of sediment, phosphorus and other contaminants to waterways, and maximise the growing capacity of the soil resources.
- To manage and assess appropriate land use and grazing management for specific areas on farm in order to maintain and improve my soil health and minimise loss of contaminants.
- To manage my stock and cultivation activities to limit damage to the soil structure.

Record your soils goals in **Template ST1** in "Our Plan" an example is provided below.

Example ST1

Soil goals
To maintain or improve the physical and biological condition of soils in order to minimise the movement of sediment, phosphorus and other contaminants to waterways, and maximise the growing capacity of the soil resources.
To manage and assess appropriate land use and grazing management for specific areas on farm in order to maintain and improve my soil health and minimise loss of contaminants.
To manage my stock and cultivation activities to limit damage to the soil structure

Blank templates can be found in **Our Plan** section and at **beeflambnz.com/farmplan**

STEP 2 – Mapping soils

A farm-scale soil map can be a very useful resource for helping to manage your farming activities.

Knowing more about where different soil types are on your farm and how they respond to different management, uses or actions can help you manage your soil appropriately and improve your soil health and farm profitability.

Map all the relevant land and soil features that you have information about or can readily access. This may include:

- ☐ Soil type(s) or soil properties
- ☐ Land Management Units
- ☐ Slope, aspect and elevation
- ☐ Landforms (e.g. hills, flats)
- ☐ Erosion prone areas including active or potential slips
- ☐ Nutrient application areas or blocks
- ☐ Location of soil testing sites or transects
- ☐ Areas suitable for cropping
- ☐ Pasture renewal or regrassing programme blocks

You may have completed some mapping as part of Step 3: Farm Mapping in the Introduction chapter. If you have soil maps already this is a good time to collect your soil maps together and review the maps. You may also want to take the time to see if there are updated or more detailed maps available.

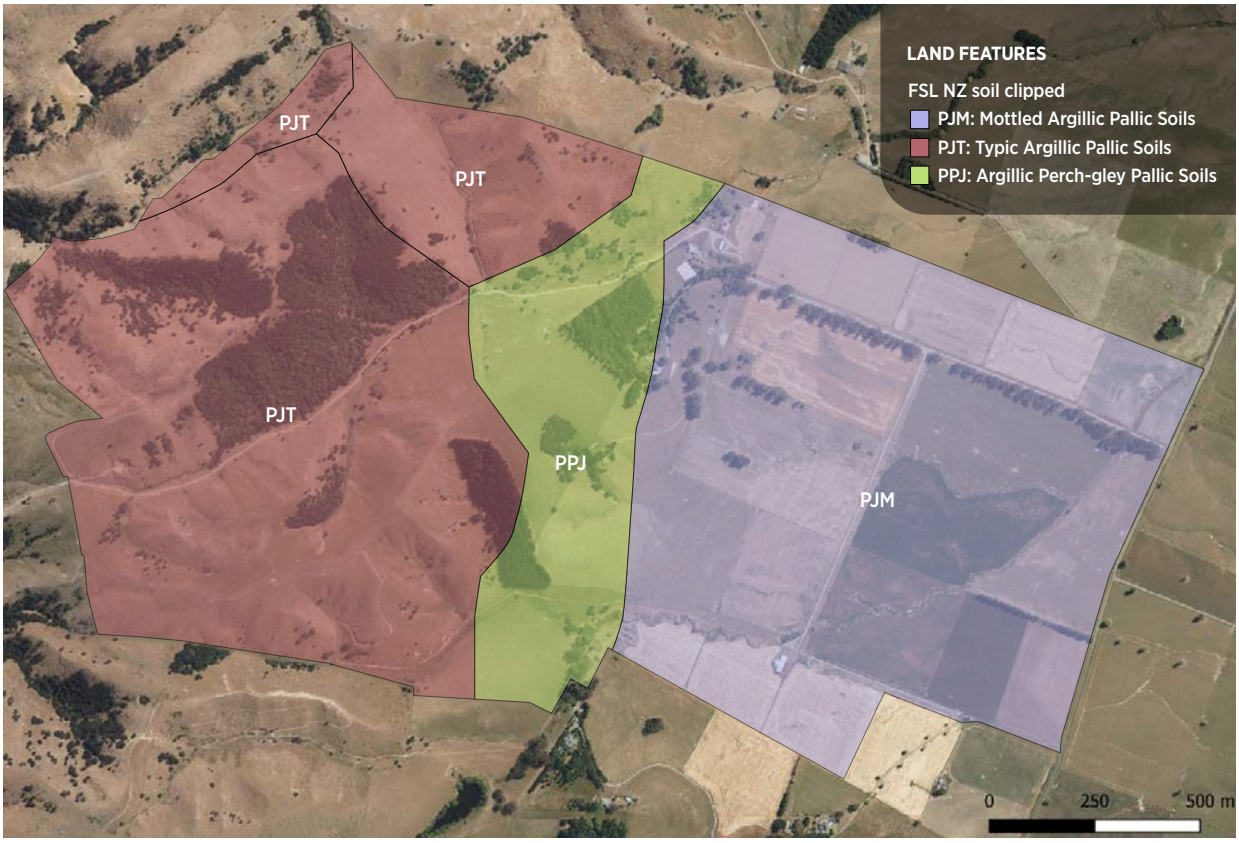
You can find freely available soil maps online, such as S-Map from Manaaki Whenua Landcare Research and some regional councils have soil maps available online. Land Use Capability (LUC) maps may indicate soil types and other useful information about soils such as slope and erosion potential. Go to **beeflambnz.com/farmplan** for links and more information.

Soil mapping consultants can produce maps of your farm soils. Some regional councils, fertiliser companies or other third parties may provide maps as part of their services or whole farm planning programmes.

Some of the available maps are at a scale which may not be detailed enough to represent what is actually present on your farm, so you may notice some discrepancies. You may want to consider mapping or making some notes from your own observations or knowledge about your soils, especially if you have noticed differences. You may already know how productive different areas are or if there are any areas that are prone to erosion, pugging or compaction. We will cover more about assessing soils in the next step.

In addition to soil type maps, you may have other soil related maps or information that you have collected yourself or have sourced externally such as parent rock type, soil texture, soil structure, soil depth, fertility or nutrient status, or soil drainage. These can help inform your farm decision making.

Example of a farm soil map



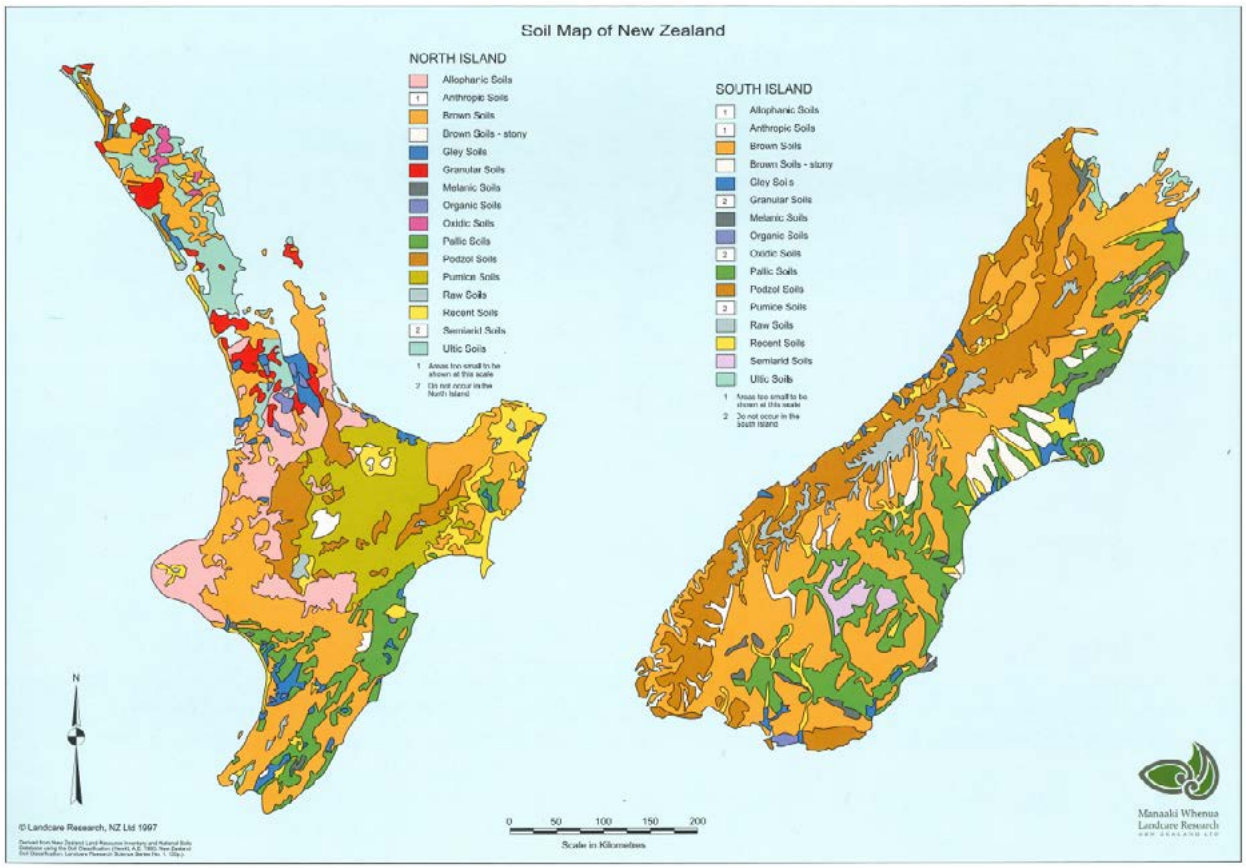
Soil types and classification

Soils are not all the same, there are many different types with a huge range in physical, chemical and biological properties. These properties such as fertility, drainage, depth, texture and structure, will influence what farming activities maybe suitable for a particular soil. Soil type is strongly influenced by the parent material (e.g. rock type or organic matter) and the climate in which the soil is formed (e.g. temperature and rainfall). Other factors include the topography, vegetation type and drainage characteristics that are present. Soils form very slowly over many years or even thousands of years.

Soils are described and identified by their physical, biological and chemical properties. Some soils have similar properties, appearance or formation and they can be grouped together, and classified to help us understand them and where they are located. In New Zealand the current system used to name and classify soil types is the New Zealand Soil Classification (NZSC). At its highest levels the NZSC has 15 groupings of soils called 'Soil Orders'. There are further classifications and each makes further refinements and can have useful information.

Information about different soil types can be found online from the Manaaki Whenua Landcare Research Soils Portal and some regional councils. They will often include information about key physical and chemical properties, such as soil structure and depth, texture, stone content and drainage. Go to **beeflambnz.com/farmplan** for links.

Soils Orders in New Zealand diagram (caution don't use this map to determine the soils on your farm as the scale is too coarse).

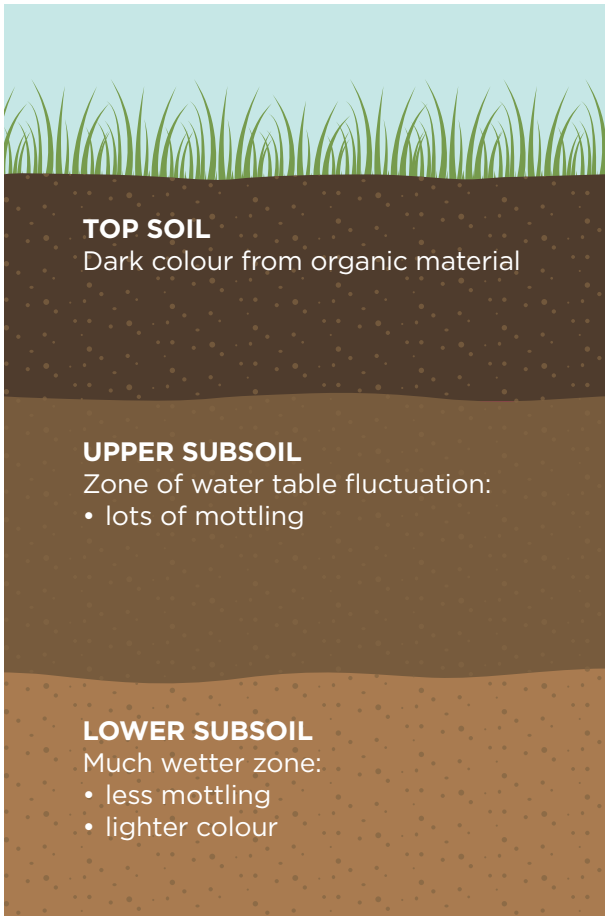


(Map credit: Manaaki Whenua Landcare Research)

Soil Horizons

In most soils there are different layers or horizons that can be observed when a hole is dug or the profile exposed such as along a track or cutting. These different horizons have different properties (see **Figure 1.1**). The whole profile is used when describing or classifying soils.

Figure 1.1 - Soil Horizons



STEP 3 – Assess your soils

Our soils are a precious and valuable resource. Keeping soils healthy and productive is important to your farming business. The better the information you have, the better the position you are in to manage your soils to ensure they are productive now and in the future.

Assessments are important to help you identify and understand the soils on your farm and any potential risks or opportunities associated with them. There are different ways to assess soils ranging from very simple observations you make yourself though to more complex ways such as a lab or consultant taking and analysing samples and sending you the results. Several assessments you can do yourself are referred to in this guide. They are:

- Visual Soil Assessment (VSA)
- Soil texture
- Soil structure
- Earthworm abundance surveys
- Cotton strip testing (for soil biological activity)

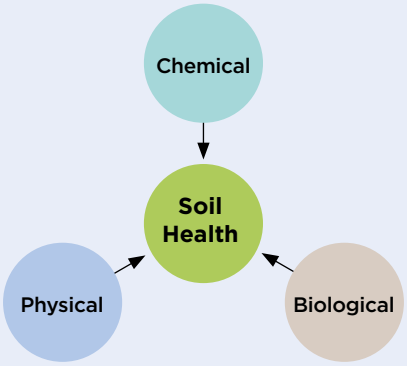
It is also important to record and understand results from other sources such as:

- Soil and fertility laboratory testing
- Nutrient budget (such as OverseerFM)

Soil assessments and testing can help you to understand the chemical, physical and biological attributes to ensure that the soils are within the agronomic optimum for plant and animal growth and health, while minimising your environmental losses.

Soil Health

Knowing more about your soils formation and origins (geology and parent material) and assessing the physical, biological and chemical properties can help describe, identify and understand your soils, as well as helping guide farm management decisions. B+LNZ has an online soil learning module to help you understand your soils. A link to the module can be found at **beeflambnz.com/farmplan.**



Soil health takes account of the condition of key chemical, physical and biological properties of a soil.

Soil physical properties – physical properties are used to describe how the soil looks and feels as well as characteristics that affect how water and air move and are stored in a soil. They also determine how easy it is to dig or work the soil, what drainage properties a soil may have and how resilient the soil is to compaction. The common physical properties of soil that are assessed are texture, structure, colour, porosity, bulk density, water-holding capacity and hydraulic conductivity.

Soil biology – describes the living component of soils including organisms such as bacteria, fungi, earthworms and other invertebrates, plant tissue and roots. The soil biology can help stabilise soil structure, facilitates and regulates the supply of plant nutrients and stores moisture. Soil biology assessments can include: earthworm counts, microbial biomass and community composition, and/or cotton strip testing which assesses the activity of soil microbiological life such as fungi and bacteria. Plants can also give an indication of what is happening in the soil, for example, poor growth may indicate limitations or poor soil health.

Soil chemistry – Soils have different chemical attributes which will influence or describe nutrient availability, fertility, what they can grow, and how they may interact with any fertilisers applied. The underlying geology, parent rock, weathering, and historic management can all have an influence. Chemical properties also include contaminants and toxic elements. A standard soil test can assess a range of attributes used to inform nutrient management decisions.

Soil Texture Assessments

Soil is made up of sand, silt and clay particles (**see Figure 1.2**). Soil texture refers to the proportion of these particles in a soil (**see Figure 1.3**) and influences soil characteristics such as structure, drainage, water holding, ease of cultivation and resilience to compaction. Sometimes soils are described as 'heavy', if they are dense and dominated by very small clay particles, or 'light' if they are lower density and have a larger proportion of sand relative to clay. If the proportions of sand, silt and clay particles are similar the soils are described as 'loamy'. Using the flow chart (**Figure 1.4**) you can identify your soil texture. Heavy soils tend to be more prone to pugging and compaction but hold water longer in a dry season, whereas lighter soils tend to dry out quicker, and can be at risk of nitrogen loss, but are less vulnerable in wet conditions. Loam soils have intermediate conditions and are often the most versatile. Understanding what your soil texture is for each part of your farm means you can make good decisions about what stock and forages/crops go where and the timing of grazing to optimise the production, and minimise environmental losses.

Figure 1.2 - Diagram of particle size
(Not to scale)

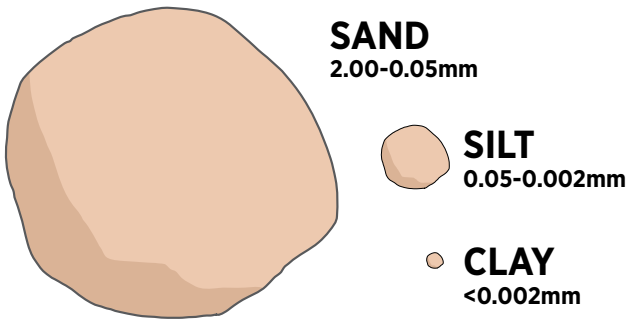
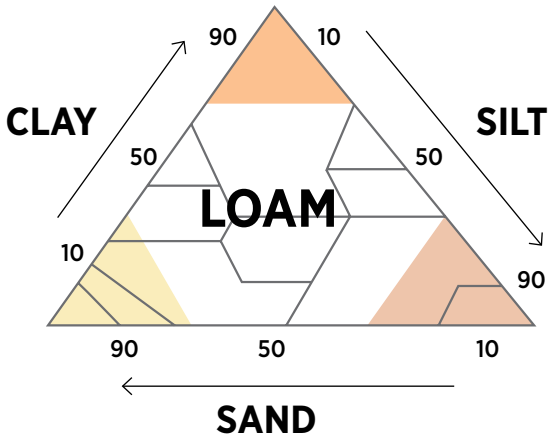
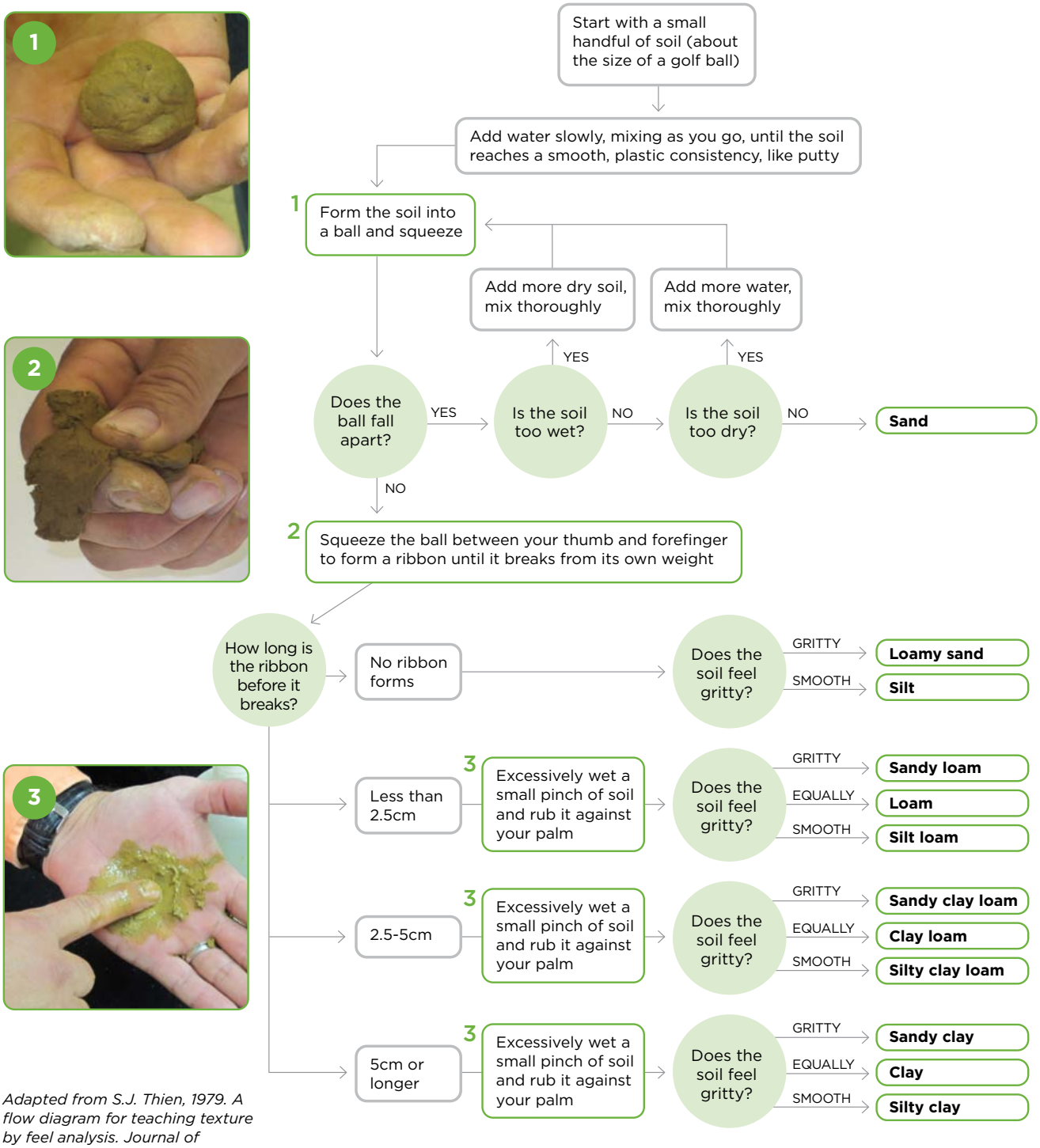


Figure 1.3 - Soil textural groups – A soil texture triangle is a tool used to classify soil textural class based on their proportions of sand, silt, and clay.



Use the flow chart (**Figure 1.4**) provided to help identify the dominant soil texture of each soil. Complete this exercise in each Land Management Unit (LMU), and where there may be a different landform within a LMU which could indicate a different soil. Record this as part of the description of the LMU in the resource chart (**Template OT3**) and add detail to any soil maps as appropriate.

Figure 1.4 Assessment of soil texture



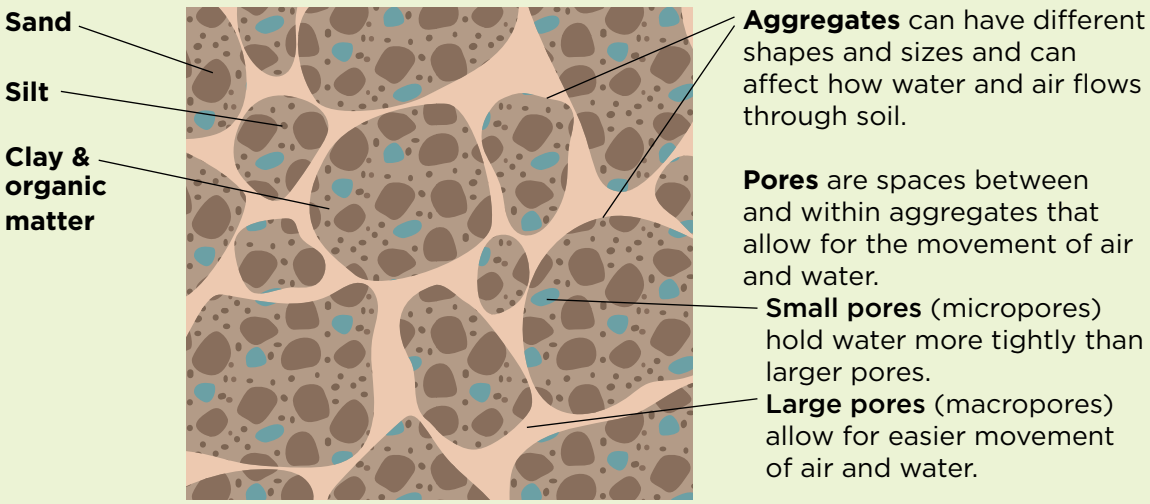
Adapted from S.J. Thien, 1979. A flow diagram for teaching texture by feel analysis. Journal of Agronomic Education 8:54-55.

Soil Structure Assessments

Soil structure refers to the size and shape of aggregates in the soil and the spaces or pores between them. Aggregates are made of up of sand, silt and clay that bind together with organic matter as a 'glue' to form soil particles. Pores are spaces between and within soil aggregates that allow for the movement of water and air. Small pores can hold water more tightly than larger pores, however larger pores allow for easier movement of water and air. See **Figure 1.5** below.

Some soils are naturally well structured and others less so. Soil structure usually improves with more organic matter, microbial activity and reduced soil disturbance. A well-structured soil will provide a favourable medium for root growth, and a good balance of air and moisture in the soil. It will also allow water to enter and move through the soil easily, thereby reducing run-off and erosion during heavy rain, while allowing adequate water for good plant growth. A poorly-structured soil will limit the movement of air and water through the soil and can restrict root and plant growth. Compaction, pugging and excessive mechanical cultivation are factors that can cause or contribute to poor soil structure and make soils more vulnerable to erosion by wind or water. Careful ripping or cultivation can be used to help improve structure of compacted or pugged soils, but care needs to be taken not to cause further damage.

Figure 1.5 – Soil aggregate diagram



Method to determine soil structure: Use the method described in the 'VSA assessment' section and compare your soil to the 'Soil Structure' photos to determine if you have good, moderate or poor soil structure.

You can also compare soil structure within a paddock to an area of undisturbed soil that has not been cultivated or impacted treading damage such as under a fenceline.


Soil with orange mottles

Mottling and gleying
Mottling appears as streaks or patches of yellow, orange, red, or grey that contrast with the surrounding soil. It is typically caused by intermittent waterlogging and more common in subsoil layers. Gleying refers to grey or blueish soil caused by prolonged periods of saturation and low oxygen levels. The presence of mottling or gleying can indicate a high water table, natural pan or poor drainage, all of which reduce soil aeration and affect soil health.

Visual Soil Assessments

A Visual Soil Assessment (VSA) is a useful, practical tool that can be used to get a quick understanding of the characteristics and health of the soil on your farm and if it may be limiting your pasture or crop productivity. There are several editions of field guides to Visual Soil Assessment for cropping, pastoral and hill country land uses available. Links to more information and field guides can be found at **beeflambnz.com/farmplan**.

There are a range of visual indicators used to determine the soil health. Some have a larger influence on soil health and plant growth than others. The indicators used for an abbreviated VSA are:

- Soil Structure
- Number and colour of mottles
- Soil colour
- Number of earthworms
- Soil smell
- Potential rooting depth
- Surface ponding

Plants can also be useful indicators of soil health and fertility. If you want to assess plant indicators for soil health more information and guides can be found at **beeflambnz.com/farmplan**.

Visual Soil Assessment location and timing

A VSA should be carried out in several representative locations within a Land Management Unit or paddock and away from areas that have be disturbed or altered significantly, such as near a track or gateway. If there are different landforms within a Land Management Unit, it is worth completing the assessment in each landform as there could be a different soil type.

The assessment should take place when it is not too wet or too dry, such as during late winter or early spring, but the appropriate time will depend on your region. The cultivate/graze test can be used to help determine appropriate soil moisture for this test (see **beeflambnz.com/farmplan**).

To help identify changes in your soils or overall trends in paddocks, Visual Soil Assessments can be carried out annually (as recommended by the VSA field guide). They may be done less frequently if there have been no major changes to your paddock management. However if you are making changes to grazing practices or land use (eg cropping) you should complete a VSA prior to the change and then as required to monitor and understand any impacts.

How to complete a Visual Soil Assessment (VSA)

1. **Dig** out a square of soil that is the width of your spade and approximately 200mm deep from soil that is not too wet or too dry.
2. **Break** the soil in half vertically (top to bottom) using your hands to prise it apart and gently loosen it to expose the soil structure and show the natural aggregates and clods. If it is not easily parted, use the required force.
3. **Score** your soil for each of the visual indicators (soil features) by **comparing** it to the photos and criteria in the VSA Scoring Guide. Give each indicator a visual score of 0 (poor), 1 (moderate) or 2 (good). You can use half marks if necessary. The photos are just a guide and your soils may look different to the ones shown.
4. **Calculate** results for each indicator to determine the soil quality index and record on the score card **Template ST2**.
5. **Record** the results for each soil assessment you do. Photos are helpful for comparison and future reference.
6. **Use** your results to inform risk assessments and identification of management actions. If any particular issues are identified, carry out further Visual Soil Assessments or seek out further advice from a soil specialist.

An example of a completed Visual Soil Assessment Score Card - Soil Indicators (**Template ST2**) follows the Visual Soil Assessment Scoring Guide.

Visual Soil Assessment Scoring Guide

Soil Structure

Good condition = 2
Soil dominated by friable, fine aggregates with no significant clodding. Aggregates are generally sub-rounded (nutty) and often quite porous

Moderate condition = 1
Soil contains significant proportions (50%) of both coarse clods and fine aggregates. The coarse clods are firm, sub-angular in shape and have few or no pores

Poor condition = 0
Soil dominated by very coarse to massive clods with very few fine aggregates. The clods are very firm, angular or sub-angular in shape and have very few of no pores

Soil mottles

Good condition = 2
Mottles generally absent

Moderate condition = 1
Soil has many (10-20%) fine and medium orange to grey mottles

Poor condition = 0
Soil has profuse (more than 50%) medium and coarse orange and particularly grey mottles

Earthworms

Earthworm numbers (per 20cm cube of soil)	**Score**
≥45 (with preferable 3 or more species)	**2.0** (Good)
35-44	**1.5** (Moderately good)
25-34 (with preferable 2 or more species)	**1** (Moderate)
15-24	**0.5** (Moderately poor)
<15 (with predominantly 1 species)	**0** (Poor)

Soil smell

Soil smell	**Score**
Soil has a distinct rich, earthy, sweet, wholesome or fresh smell	**2** (Good)
Soil has a slight earthy, sweet ordour or a “mineral” smell	**1** (Moderate)
Soil has a putrid, sour, chemical or unpleasant smell	**0** (Poor)

Soil Colour (relative to your own soils under your fence lines)

Good condition = 2
Dark coloured topsoil that is similar to, or darker than under the fence line

Moderate condition = 1
The colour of the top soil is somewhat paler than under the fence line, but not markedly so

Poor condition = 0
Soil colour has become significantly paler compared with under the fence line

Soil surface ponding

Good condition = 2
No ponding of water evident after 1 day following heavy rain on soils that were at or near saturation

Moderate condition = 1
Moderate surface ponding occurs for 3-5 days after heavy rain on soils that were at or near saturation

Poor condition = 0
Significant surface ponding occurs for longer than 7 days after heavy rain on soils that were at or near saturation

Potential rooting depth

Potential rooting depth (mm)	Score
>800	**2.0** (Good)
600-800	**1.5** (Moderately good)
400-600	**1** (Moderate)
200-400	**0.5** (Moderately poor)
<200	**0** (Poor)

The maximum depth roots are able to penetrate into the soil. To asses dig a deeper hole (if required). Use fine roots or root channels as a guide. Identify any layers or other barriers to root growth and measure to this point.

Use the Visual Soil Assessment Score Card – Soil Indicators (**Template ST2**) to record your visual scores and calculate the soil quality index.

B+LNZ would like to acknowledge Graham Shepherd for the contribution of images and material.

Visual Soil Assessment Score Card – Soil Indicators

Visual indicators for assessing soil quality under hill country land uses

Date: 1 February 2025 **Land use:** Grazing

Site location: North block **GPS reference:**

Landform: Mid slope

Aspect: NE **Slope angle:** 5°

Soil type: Loess **Topsoil depth:** 25cm

Textural group: ☐ Sandy ☑ Loamy ☐ Silty ☐ Clayey ☐ Peaty

Moisture condition: ☐ Dry ☑ Slightly moist ☐ Moist ☐ Wet

Seasonal weather conditions: ☐ Dry ☐ Wet ☐ Cold ☐ Warm ☑ Average

Visual Indicator of Soil Quality (see VSA scoring guide)	**Visual Score (VS)** 0 = Poor condition 1 = Moderate condition 2 = Good condition	**Weighting**	**Result of visual score (VS) x weighting**
Soil structure	2	x 3	6
Number & colour of mottles	1	x 2	2
Soil colour	2	x 2	4
Earthworms	2	x 3	6
Soil smell	2	x 2	4
Potential rooting depth	2	x 3	6
Surface ponding	1	x 3	3
SOIL QUALITY INDEX (Sum of result column)			31

Soil Quality Asssessment	**Soil Quality Index**
Poor	< 14
Moderate	14 – 25
Good	> 25

Example

ST2

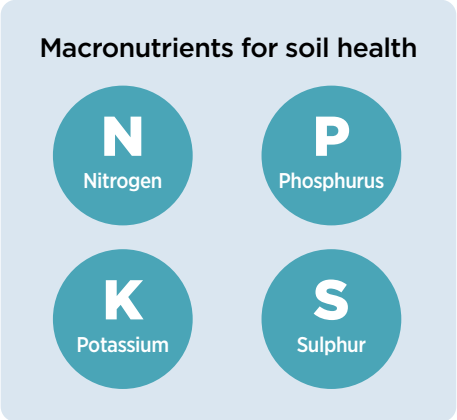
Blank templates can be found in **Our Plan** section and at **beeflambnz.com/farmplan**

Soil and fertility testing

Chemical analysis of soils and pasture helps to inform nutrient management decisions. Soil and pasture testing can provide an indication of whether soil nutrient levels are enough to sustain the level of plant growth required to achieve production goals and healthy pastures. It can give an indication of any deficiency, excess or imbalance of major nutrients. Soil tests are available from soil testing laboratories or from your fertiliser company to help determine what amounts of macronutrients (required in large quantities) and micronutrients (required in smaller quantities) your soil contain as well as physical and biological measurements.

Basic soil tests often include tests for:

- pH (alkalinity or acidity)
- Phosphours (Olsen-P)
- Calcuim (Ca)
- Magnesium (Mg)
- Potassium (K)
- Sulphur (S)
- Sodium (Na)
- Cation Exchange Capacity (CEC)
- Base Saturation
- Phosphorus (e.g. Olsen P)
- Nitrogen (Anaerobic Mineralisble Nitrogen)
- Organic matter



More tests are available to determine micronutrient levels. Your nutrient management advisor can help you determine what test might be best for your farm.

Well managed nutrient applications that keep results within target ranges helps to ensure the right amounts are available for healthy plant and animal growth while reducing risk of deficiencies, toxicity or environmental losses. Given the cost of purchasing and applying nutrients this assists both sustainable production and profitability.

To ensure you are optimising the benefit from any nutrient applications your nutrient management decisions should be based on:

- Proposed land use (pasture, crop or animal types)
- Soil test results
- Overall trends in nutrient levels
- Results of nutrient budget (if available)

Table 1.1 shows the target ranges for different soil classifications. **Table 1.2** shows the amount of nutrient required to raise the result by one unit. Ash and Pumice are volcanic in origin. Peat refers to organic soils and Sedimentary refers to most other soils especially those that are derived from sedimentary material (such as Brown or Pallic soils).

Table 1.1 Target soil test ranges

Soil test	Ash	Sedimentary	Pumice	Peat
Olsen P (mg/L)	20-30	20-30	35-45	35-45
Soil test K (Quick Test Units)	7-10	5-8	7-10	5-7
Sulphate-S (mg/kg)	10-12	10-12	10-12	10-12
Organic-S (mg/kg)	15-20	15-20	15-20	15-20
Soil test Mg (Quick Test Units)	pasture 8-10 animal 25-30	pasture 8-10 animal 25-30	pasture 8-10 animal 25-30	pasture 8-10 animal 25-30
pH	5.8-6.0	5.8-6.0	5.8-6.0	5.0-5.5 (0-75mm) 4.5-5.0 (75-150mm)

Table 1.2 Amounts of nutrients required to raise the soil test by 1 unit

Soils	Ash	Pumice	Sedimentary	Peat
Phosphate (P) (kg/ha)	11	7	5	6-9
Potassium (K) (kg/ha)	60	45	50**	30
Sulphur (S) (kg/ha)*	25	45	35	30
Magnesium (kg Mg/ha)	7	7	7	7
Lime (t/ha)	10	10	10	***

* To overcome deficiency **Brown soils ***Depends on depth

Tables from Fertiliser Association – Fertiliser use on New Zealand sheep and beef farms

If your soils are within the target ranges and nutrient applications are at maintenance rates monitoring your soil chemistry every two – three years may be sufficient. Annual testing is recommended if you are making capital applications to adjust nutrient levels or in cropping situations. If you are unsure or have specific requirements, get advice from a nutrient advisor. Ideally carry out soil testing at the same time of year along the same transect. Keep a record of your results.

Often your nutrient advisor or fertiliser representative will be able to take samples for you and arrange for them to be analysed. A brief guide follows if you want to do some of your own soil sampling.

How to collect soil samples

A soil sampling transect is a line that is followed across the soil surface along which samples are taken or observations are made at certain intervals.

1. Identify a representative, accessible site within each Land Management Unit.
   a. Transect should be long enough to represent the Land Management Unit
   b. Transect should not cross into different soil types as this can impact test results significantly.
2. Mark the start and end of the transect with a permanent identifier so that it can be found again each year. Ideally locate the transect with GPS coordinates.
3. Take a soil core sample to the appropriate depth (7.5cm for pasture, 15cm for crop) at approximately 10-20 points (or as advised), that are at spaced intervals along the length of the transect. Non-representative areas should not be sampled.
4. Usually the cores are all put in a bag together for each transect of soil type and sent off as a single sample, but the lab will be able to guide you on what to send.
5. Ensure samples are clearly and appropriately labelled to identify the transect and Land Management Unit or paddock and your contact details.
6. Send samples to the lab for analysis. There are many tests available, talk to the soil testing lab or your nutrient advisor to establish what to test is right for you as some tests can be expensive.
7. When you get the results back you can either interpret them yourself or get help from the lab, your nutrient advisor or fertiliser rep. They should be used to inform your fertiliser applications.
8. Keep a record of your soil test results.
9. Sample from the same transect each time and monitor trends over time.

For more information about soil sampling go to **beeflambnz.com/farmplan**.

Nutrient budget

Nutrient budget tools such as OverseerFM, are used on many farms throughout New Zealand. They show the flow of nutrients though your farm system and help you to minimise any nutrient losses from your farm.

While it is possible to complete a nutrient budget yourself, it is important to make sure information is inputted correctly so the results accurately represent your farm. Certified Nutrient Management Advisors, for example your local fertiliser representative, can also help. A template to help with data collection for OverseerFM can be found at **beeflambnz.com/farmplan**. Your nutrient budget should be updated at least once every three years or when a substantive farm system change is made or as required by regulatory or quality assurance bodies.

It is important to note that the nutrient budget information is only one part of soil management but will help you to understand your nutrient management risks and opportunities.

Consider your nutrient budget

1. Is your nutrient budget up to date? Do the blocks in your nutrient budget match your LMUs? If not, the next time you review your nutrient budget with your advisor, you might want to update it so that it reflects your LMUs better.
2. Looking at trends from previous years, is your soil fertility improving, being maintained or are there limitations or areas for improvement? (Note: Models like Overseer are a long-term model so updating some of the information annually and looking at trends provides an indication rather than an absolute result).
3. Is nutrient loss from specific LMUs a risk which is not currently well managed? It is important to recognise that even if farm average nutrient loss is low, there may be areas or blocks where it is high. These 'hotspots' are common and when managed to best practice risks can be minimised.
4. How does your nutrient budget relate to your goals in relation to soil fertility?
5. Are any actions required from your nutrient budget including any changes to your nutrient management?

Earthworm Abundance Survey

Refer to "The great kiwi earthworm survey" and "Identifying common pasture earthworms" resources to help you complete this assessment. You can record your earthworm counts as part of the VSA or in the Soil Assessment Summary (**Template ST3**).

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The Great Kiwi Earthworm Survey

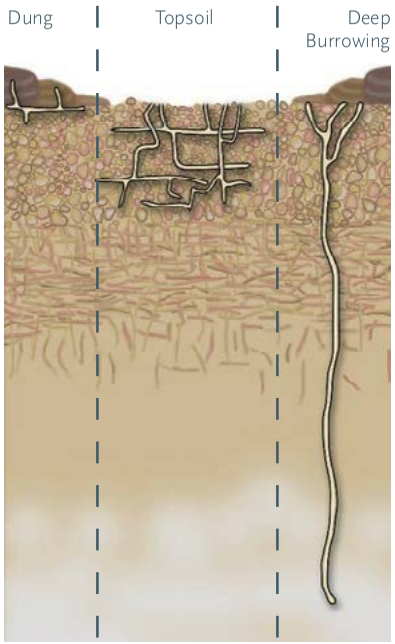
Earthworms are useful indicators of soil health

Earthworms feed on organic matter and move this into the soil, increasing soil fertility. At the same time earthworms assist the formation of soil structure, improving both the drainage and water holding capacity of soils.

Take part in the Great Kiwi Earthworm Survey and you can gain a better understanding of what is living underneath us and help improve our knowledge of how earthworm abundance and diversity changes across the New Zealand landscape.

Do you have healthy earthworm populations?

New Zealand's pasture earthworms arrived accidentally with the first european settlers, and because of this they can still have a patchy distribution. New Zealand also has a large number of interesting native earthworms but these are not common under pasture.



There are three types of earthworms with different roles in the soil that should be present in your soil.

Dung
earthworms feed on dung and do not form permanent burrows. Compost earthworms, such as the tiger worm, are also distinguished and are suited to areas with a high supply of fresh organic matter.

Topsoil
earthworms burrow through the topsoil, feeding on the organic matter here.

Deep-burrowing
earthworms feed on dung on the soil surface and take this into their deep burrows.

Ideally when assessing your soil, in a spade square you will have...

Earthworm Type	Number of worms
Dung	at least 1
Topsoil	at least 1
Deep Burrowing	at least 1
Total Earthworms	at least 16

This is equivalent to a total of 400 earthworms/m²....

- If a type of earthworm is absent it can be introduced
- Earthworm populations may be increased by avoiding pugging events and increasing available organic matter
- The optimum soil pH for earthworms is 6-7

Did you know that
the weight of earthworms in the soil is similar to the weight of stock above ground! No wonder they improve plant growth!

Assessing your earthworms

How to sample:

1. During June to September choose a paddock
2. Collect three spade spits (20x20cm, 20cm deep) per paddock
3. Hand-sort earthworms by crumbling the soil onto a sheet of plastic and looking through the roots. Put the earthworms in water.
4. Take the earthworms out of water and place onto a paper towel.
5. Look at the colour and size of the adult earthworms. Using the key can you see different types?
6. Place earthworms on white paper next to a ruler and take a close-up photo out of direct sunlight.
7. Record the average number of earthworms per spade square for each paddock and x25 to get number per square meter
8. Go to www.earthworms.nz and enter your observation.
9. Repeat in as many paddocks as you would like to get a representative sample over your farm

For more information about earthworms visit www.earthworms.nz or contact

Nicole Schon
nicole.schon@agresearch.co.nz

agresearch
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beef+lamb new zealand

Identifying common pasture earthworms

Y Do you have an adult earthworm?

Y Does your earthworm have a paler underside at the head end? N

Y Is the earthworm a red-brown colour with a purple sheen and iridescent in bright light? N

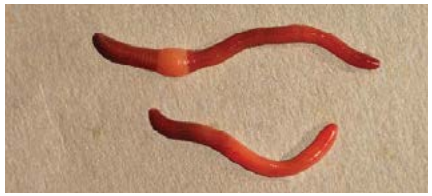
Is the earthworm very large, forming large casts?
Deep: *Lumbricus terrestris 'nightcrawler'* (90-300mm)

OR... is it smaller with a reddish saddle and very active when disturbed?
Dung: *Lumbricus rubellus 'dung worm'* (25-150mm)

Y Is the earthworm bright red with yellow? N

Is it found in a rich organic matter with yellow bands (when it stretches)?
Compost: *Eisenia fetida 'tiger worm'* (30-130mm)

OR... is it short with faint yellow colouring concentrated at the tail end?
Dung: *Dendrodrilus rubidus 'bark worm'* (20-100mm)



Y Is the earthworm a dark grey-brown colour? N

Is the earthworm large?
Deep: *Aporrectodea longa (blackhead worm'* (90-120mm)

OR... is it smaller, and darker along the length of its body?
Topsoil: *Aporrectodea trapezoides 'southern worm'* (40-90mm)

Y Is the earthworm a dark green-brown colour? N

Is it a long slender earthworm which writhes like a snake when disturbed?
Dung: *Amynthas corticis 'snake worm'* (70-180mm)

OR... is it greenish brown, coiling stiffly when disturbed?
Topsoil: *Allolobophora chlorotica 'green worm'* (40-70mm)

You have probably found a rare earthworm which is not in this key. Record it as unidentified.

Y Is the earthworm pale along its body with a small yellow tip at the tail? N

Topsoil: *Octolasion cyaneum 'yellow tail'* (65-180mm)

Y Is the earthworm pink or grey with a pink head? N

Is it very common in your sample, with a darker head?
Topsoil: *Aporrectodea caliginosa 'grey worm'* (40-100mm)

OR... Does it have a pale pink head and tail with a dark pink-orange saddle?
Topsoil: *Aporrectodea rosea 'pink worm'* (25-85mm)

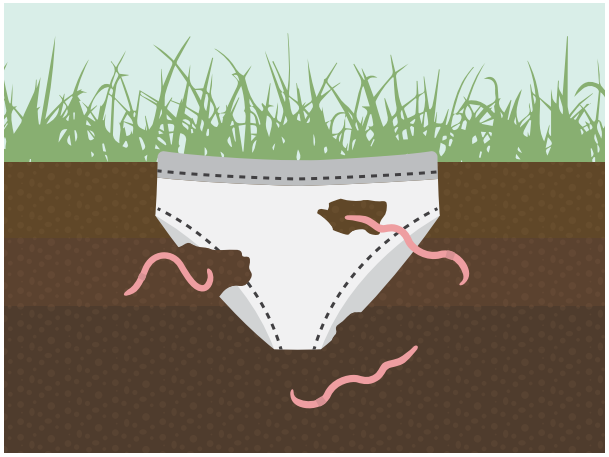
N Is the earthworm pink or grey with the saddle quite close to the head end? (Saddle starting before segment 22, compared with after segment 22 in many non-natives.) Y

There are about 200 native species (e.g. *Octochaetus multiporus*) which vary considerably in size and colour. They tend to be found in forests but some are found in low fertility hill country.

Earthworm key modified from J. Springett 1985. Photos by R. Gray.
Lengths given are for adult earthworms

Cotton Strip Test

As an optional extra, you might like to test soil biological activity by carrying out a 'Cotton Strip Test'. This can be a useful guide to the biological activity of things such as bacteria, worms, fungi, insects in your soil. The faster the cotton strips are broken down the more microbiological and soil animal activity there is. Faster breakdown indicates better soil health, fertility and soil moisture. A guide can be found on **beeflambnz.com/farmplan**.



Record Results

Record results from your soil assessments in a manner that suits your business. You can use **Template ST3** Soil Assessment Summary. An example is provided below.
There is no need to duplicate results, but you may want to make a note of where they are stored or include links or hard copies for ease of reference in the future.

Soil Assessment Summary

Sample Site/LMU	**Assessment Date**	**Assessment Type**	**Climatic Conditions** (if applicable)	**Results and Notes**
Cropping	*11 Sep 21*	*Visual Soil Assessment*	*Slightly moist soil Average seasonal conditions*	*Score = 34 Good*
Easy hills	*11 Sep 21*	*Visual Soil Assessment*	*Slightly moist soil Average seasonal conditions*	*Score = 30 Good*
Cropping	*11 Sep 21*	*Earth worm Count*		*11 worms – 5 dung, 4 topsoil, 2 deep burrowing Some spits had none*
Easy hills	*11 Sep 21*	*Earth worm Count*		*2 worms – 1 dung, 1 topsoil, 0 deep burrowing Turf mat evident*

Example ST3

Blank templates can be found in **Our Plan** section and at **beeflambnz.com/farmplan**

STEP 4 – Identify Risks, Opportunities and Management Actions

Risk and Opportunity Identification

There are a range of risks and opportunities created by how your soil resource is managed. The results of your assessments should help you to understand your soils and identify these. **Table 1.3** identifies some of the common risks, impacts and potential contributing factors, see which apply to your property.

Many of the physical, biological and chemical properties of soil can show as visual characteristics in soil or plants that are altered with changes in land management. The results of your Visual Soil Assessment will help you identify any potential issues.

The result of your soil texture assessments should be considered as different soil textures have different risks and benefits.

If you have the output from a nutrient budget this can help you identify and assess risks and opportunities in relation to nutrient management. These may be areas for development or potential for savings. It is important to recognise that even if farm average nutrient loss is low, there may be blocks where it is high. These 'hotspots' are common and can be managed appropriately to minimise risk.

When you are assessing the risks to soil health, you are likely to encounter some risks that impact on other aspects of your farm environment such as waterways. This is part of the integrated nature of your farm environment. Your farm plan can reflect that and help connect it together, record these in the manner that suits you best.

Complete **Template ST4** in "Our Plan" for your own farm business. An example is provided after **Table 1.3**. There is also space in the template to add other risks or opportunities that you identify.

Risk Assessment

For each factor contributing to risk identified, use the Risk Assessment Matrix to assess the likelihood and consequence and determine of the risk level is: high, medium or low. The risk level can then be recorded in **Template ST4** in "Our Plan".

Likelihood	Consequence		
	Slight	Serious	Major
Low	Low	Low	Medium
Medium	Low	Medium	High
High	Medium	High	High

Management Actions

The final column in **Table 1.3** provides examples of some possible management actions that could be taken to manage the various risks, or opportunities identified. Identify management actions that have or could be taken to manage soil health on your farm. Include any actions you identified as a result of carrying out the Visual Soil Assessment or nutrient budget. This will inform your action plan.

In addition to the examples provided in Table 1.3 some general considerations for managing soil health include:

- Animal management (e.g. avoiding wet soils with heavy stock)
- Appropriate land use and vegetation cover
- Manging erosion and soil loss as well as careful cultivation practices
- Improving soil structure and building organic matter
- Maintain optimal fertility and do not over fertilise

For each management action you have identified categorise it as: completed, ongoing or new.

- Completed actions require no ongoing implementation, you may like to note the location and date completed if applicable.
- Ongoing actions are actions you are currently doing or have done and need to continue doing into the future.
- New actions are those you plan to start.

Record your management actions and if they are completed, ongoing or new in **Template ST4** in "Our Plan". An example is provided after **Table 1.3**.

Managing your fertiliser application

Following the 4R approach can help you manage your fertiliser application. Discuss fertiliser application with your nutrient management advisor and fertiliser contractors, to determine what is right for your farm.

- Right product – matching fertiliser type to crop and pasture needs.
- Right rate – matching amount of fertiliser to crop and pasture needs.
- Right time – making nutrients available when crops and pasture can utilise them.
- Right place – keeping nutrients where crops and pasture can use them, away from waterways or other sensitive areas.

Erosion and soil loss

Erosion and soil loss is influenced by soil type, weather (including wind and rain), hydrology, topography, vegetation cover and how land is managed and used. While erosion is a natural process, removing vegetation and poor management practices can speed it up. Soil loss impacts on both short- and long-term production and profitability, can impact infrastructure such as roads, tracks and fences, and can have severe consequences for waterways, habitats and biodiversity.

To protect your productivity and support healthy ecosystems, it is important to understand erosion risk on your farm and to have a comprehensive long-term risk management plan. It is also important to monitor erosion and adapt management practices to prevent erosion when new risks emerge. For example, preventing a slip via poplar pole planting. Understanding what type of erosion is occurring will help identify the best approach to manage it. In some areas funding and advice may be available from Regional Councils.

Table 1.3 Risks and Management Options for Soil Health

Risk or opportunity	Impact	Some potential factors contributing to risk or enabling opportunity	Examples of possible management actions
Soil Structure	Damaged or poor soil structure (such as from pugging or compaction) may reduce water and air movement and root penetration. This can lead to reduced pasture growth rates, slower recovery, poorer water storage, lower fertility and can impact long term soil health. Soil structure can be improved over time with careful animal, vegetation and cultivation management.	**Inherent factors** • Soil type – heavy soils are more prone to compaction and pugging, while light or stony soils can be more resilient • Wet or waterlogged soil are more vulnerable to damage • Climate and rainfall • Vegetation cover and root structure **Management factors** • Incorrectly matching stock and crop types to the land capability • Stock type- Heavy or large stock classes on soil when it is wet can cause more damage • Tractor or heavy vehicle use when soils are vulnerable to damage • Over cultivation of weak, vulnerable, or wet soils	**Animal management** • Avoid or limit grazing of heavy stock on poorly drained or vulnerable soils when excessively wet (use the cultivate/graze test to check) • Avoid repeated overgrazing which can damage soil structure and cause shallow root systems **Vegetation management** • Consider drainage and/or planting trees on heavier soils to help dry them out • Retain high pasture residuals during wet periods • Use paddocks for grazing during wet periods that have good vegetation cover with more resilient soils • Encourage deep plant roots through good fertility and not overgrazing to help improve soil structure **Other** • Avoid or minimise the use of heavy machinery on wet soils, if can't be avoided restrict the area of use • Avoid cultivation or soil disturbance when soils are too wet (use the cultivate/graze test to check) • Minimum tillage and direct drilling can reduce soil structural damage • Repair damaged paddocks/areas where possible • Ripping may help break up compacted or pugged soils • Understand your soil structure and texture better by carrying our visual soil assessments in your paddocks and how different soils respond to your management practices • Excess stones in soils can be removed if practical in cropping situations
Soil loss and erosion	Loss of soil can lead to reduced pasture production, lower fertility and higher input nutrient costs. Soil loss can also cause sedimentation in waterways and impact freshwater ecosystems where it can disrupt aquatic life and habitats, increase flooding risk and carry nutrients leading to undesirable outcomes.	**Inherent factors** • Soil type and stability – some soil types are more prone to slips or erosion • Underlying geology can contribute to soil weakness and erosion • Climate – excessive wind and rain can cause soil loss • Steeper slopes can contribute to erosion and slips • High soil moisture may lead to greater risk of erosion or slips in steeper areas • Areas close to rivers and streams may be at risk to erosion during flooding • Soil can be lost from very dry, exposed soils soil due to wind erosion	**Animal management** • Exclude stock from waterways, gullies and critical source areas • Control pests that eat or damage vegetation in forested or riparian areas. • Keep stock off streambanks and away from steep hill country when it is wet • Consider retirement of land or land use change in erosion prone areas **Vegetation management** • Planting appropriate native or exotic trees on hill slopes and streambanks to meet your erosion control objectives. Different species have different erosion control properties or may be suited to different areas. Also consider any co benefits from timber production or shade and shelter • Stabilisation planting of riparian areas • Plant cover crops when land is left fallow to prevent the risk of bare soil being lost due to wind erosion of overland flow • Strategic planting of vegetation to help protect infrastructure such as track cuttings • Leave grassy filter/buffer strips around waterways to intercept sediment • Plant or oversow slips or unvegetated areas with grass, trees or an appropriate plant species

Table 1.3 Risks and Management Options for Soil Health
continued

Risk or opportunity	Impact	Some potential factors contributing to risk or enabling opportunity	Examples of possible management actions
Soil loss and erosion *continued*		**Management factors** • Land use can contribute to soil loss and erosion • More cultivation can increase soil loss • Heavy stock type and/or over grazing can lead to soil loss • Disturbance to the soil or land • Earthworks eg track maintenance • Bare soil or lack of groundcover increases erosion risk • Vegetation type and root depth	**Other** • Minimise the use of earthworks and work with the contour of the land • Repair wheel tracks with deep ripping prior to resowing • Use minimum till or direct drill wherever possible and don't cultivate land above 20° • Keep culverts and drains clear and direct water away from vulnerable slopes • Containment structures (e.g. debris dams) to prevent sediment reaching waterways • Matching land use to land class • Understand your soil types and their limitations and plan accordingly • Manage slips and gullies to minimise further erosion
Soil organic matter content and microbial activity	Soil organic matter helps to hold soil together, improve soil structure, provide and regulate nutrients for plant growth, help to retain plant available soil moisture, improve drainage and provide habitat for healthy soil biology. It contains a lot of carbon and can have biological materials that help to stabilise soil. Building the amount of soil organic matter over time can improve the above qualities and lead to more productive, healthy soils. Reducing organic matter of soils can lead to weaker soils, that are less fertile, less resilient to damage, hold less soil moisture and are less productive.	**Inherent factors** • During hot dry weather or droughts, organic matter may be lost • Soil moisture can affect soil organic matter **Management factors** • Vegetation type and amount will affect organic matter content of soil • Minimum tillage and direct drilling helps preserve organic matter content of soils • Over-cultivation can reduce organic matter content • Stock types and rates can affect organic matter though vegetation removal and dung deposition	**Animal management** • Use rotational grazing. Dung deposited from animals can increase organic matter content in soils • Prevent overgrazing which can reduce vegetation cover and lead to lower soil organic matter content • Worms, dung beetles and other invertebrates can help to process and incorporate organic matter into the soil. **Vegetation management** • Higher pasture cover and more leafy vegetation can lead to an increase soil organic matter content • Include multi year species such as pasture in a crop rotation • Drought tolerant species may help retain vegetation cover • Plant green mulch crops • Maintain soil fertility in target range **Other** • Use minimum tillage or direct drilling • Reincorporate crop residues and green manure crops

Table 1.3 Risks and Management Options for Soil Health
continued

Risk or opportunity	Impact	Some potential factors contributing to risk or enabling opportunity	Examples of possible management actions
Soil fertility and nutrients	The loss of excess nutrients comes at a cost to the production system and can have a significant impact on the health of waterways (see freshwater chapter for more information). Nutrient depletion will impact pasture and crop growth and therefore animal performance. An imbalance of nutrients can also lead to losses or restricted uptake by plants, so it is important to consider all nutrients required to meet plant and animal needs.	• Nutrient status of soil unknown, may result in over application, losses or compromised plant growth • Stock types and rates can affect nutrient levels and losses through deposition of urine and dung • Poor placement and timing of fertilisers application • Not knowing soil types or what they need to keep them healthy or how they respond to different management practices	**Animal management** • Note where stock camp areas are as they may need less fertiliser • Reticulated sources of stock water in each paddock can reduce animal transport of nutrients to waterways **Vegetation management** • Leave strategic vegetated-buffer areas where runoff converges, and around waterways • Crop rotation designed to utilise residual N in soil, e.g. cereals following fodder crops and cover crops following winter grazing **Nutrient testing and analysis** • Complete a nutrient budget such as OverseerFM for your farm to help identify nutrient flows, risk areas for losses and opportunities to improve nutrient status • Key sites for phosphorus and sediment losses identified • Olsen-P maintained at optimum levels • Nutrient applications informed by regular soil testing • Ensure other nutrients are non-limiting (maximise N-uptake opportunity) • Ensure pH is appropriate for soil type as this can impact the uptake of other nutrients • Deep soil N tests used as basis of N application to crops • Know your soil Anion Storage Capacity (ASC) – soils with high ASC require more P input to overcome deficiency than low ASC soils **Fertiliser application** • When applying fertiliser user the right product, the right rate, at the right timing and in the right place • Where conditions allow, use slow release P-fertiliser • No super-phosphate application when heavy rainfall is forecast • Calibration of equipment used for fertiliser application and/or precision application when appropriate • Avoid applications of N-fertiliser when plant growth is low • N application timing and rates set to match growth cycle of pasture or crop

Soil Risk Assessment and Management Actions

Risks and Opportunities	Factors contributing to risk or enabling opportunity	Risk level	Management Actions	Action completed, ongoing or new
Compaction and pugging of moist and wet soils	*Tractor use when soils vulnerable to damage*	*High*	· *Avoid the use of heavy machinery on wet soils and minimise area of use.* · *Will use the cultivate/graze test to check if soil moisture is ok to cultivate or graze.*	*New* *New*
Compaction and pugging of moist and wet soils	*Heavy or large stock classes on soil when it wet*	*High*	· *Limit heavy stock on poorly drained soils when saturated.* · *Will create a written winter grazing management plan and leave critical source areas unsown* · *Will use the cultivate/graze test to check if soil moisture is ok to cultivate or graze*	*New* *New* *New*
Soil loss due to erosion	*Soil type and stability– some soil types are more prone to slips or erosion especially on hill block*	*Medium*	· *Plant poplar poles on identified sites that are prone to erosion* · *Limit heavy stock on poorly drained soils when saturated (also used to help manage pugging)*	*New* *New*
Loss of soil organic matter and microbial activity	*Dry years or drought*	*Medium*	· *Change management to drought tolerant species*	*New*
Loss of soil organic matter and microbial activity	*Over-cultivation*	*High*	· *Mainly use direct drilling started in 2015*	*Ongoing*
Improve soil fertility	*Soil fertility and pasture production lower than optimum in some paddocks*	*Medium*	· *Will carry out visual soil assessments in several areas in paddocks and get nutrient testing done, apply recommended fertilisers at appropriate times to reduce environmental losses* · *Careful application of fertilisers using precision placement to avoid waterways*	*New* *Ongoing*

Example

ST 4

Blank templates can be found in **Our Plan** section and at **beeflambnz.com/farmplan**

STEP 5 – Soil Action Plan

Building on the management actions you have identified in step 4, **Template ST4** document a soils action plan. This should include details of those actions that still need to be implemented. Include the action to be taken, location, priority, assigning a timeframe and a person responsible and once completed note the date and any evidence of completion, such as photos. You can add to this Soil Action Plan at any time and it is good collect and record evidence of actions as you go.

Record your Soils Action Plan in **Template ST5** in "Our Plan". An example is provided over the page.

Soils Action Plan

Action	**Location** Land Management Unit or Paddock	**Priority**	**Planned Timeframe**	**Person responsible** and others involved	**Date completed and evidence of completion**
Avoid the use of heavy machinery on wet soils and minimise are of use. Put up poster in woolshed as reminder and make a note in farm diary.	*Hill and south facing hill block*	*High*	*Immediate start*	*Owner and staff*	
Limit heavy stock on poorly drained soils when saturated.	*Hill and south facing hill block*	*High*	*Next winter*	*Owner and staff*	
Will create a written winter grazing management plan and leave critical source areas unsown and take photos as evidence.	*Whole farm*	*High*	*Immediate start*	*Owner and staff*	
Will use the cultivate/graze test to check if soil moisture is ok to cultivate or graze and talk to cultivation contractors. Will print out a copy of the cultivation test and have available.	*Whole farm*	*Medium*	*Immediate start*	*Owner and contractors*	
Plant poplar poles on identified sites that are prone to erosion and take photos before and after.	*Hill block*	*Medium*	*Planting in 2023-2025*	*Owner and Farm Forestry Contracting Services*	
Changed management to drought tolerant species -started 2015 - ongoing. Make note in farm diary.	*Whole farm*	*Medium*	*Planting programme ongoing due to finish 2025*	*Owner and staff*	
Mainly use direct drilling and minimum tillage of cropped areas, Reduced use of full cultivation where possible. Make notes in farm diary when cultivating and save invoices from contractors.	*Flats - Cropping*	*Medium*	*Stared in 2015 - ongoing*	*Owner and contractors*	
Will carry out visual soil assessments (VSA) in several areas in paddocks and get nutrient testing done, apply recommended fertilisers at appropriate times to reduce environmental losses. Will save results on computer.	*Whole farm*	*Medium*	*Visual soil assessments and soil testing over the next 3 months. Fertiliser at correct rates and times next application*	*Owner and staff for VSA, fert rep for testing and recommendations on rates and time. Contractor for correct application*	
Careful application of fertilisers using precision placement to avoid waterways. Talk with fertiliser contractor before applying and also make sure they use GPS precision and proof of placement.	*Whole farm*	*High*	*Stared in 2015 – ongoing*	*Owner and contractors*	

Example

ST5

Blank templates can be found in **Our Plan** section and at **beeflambnz.com/farmplan**

STEP 6 – Monitoring and review

Monitoring your soils and reviewing your farm plan to make sure it is up-to-date are important parts of farm planning. This helps to make sure the information you have is current and an accurate reflection of the land use, management and actions happening on your farm. It is important to have flexibility to respond to changing conditions or circumstances on your farm and make appropriate decisions for the future.

Develop a regular soil monitoring programme

Develop a programme of regular monitoring for your soils. Consider which assessments are relevant and important for your farm and may including things from the following list:

- Soil structure
- Soil texture
- Visual Soil Assessment
- Soil testing
- Updates of nutrient budget
- Earthworm abundance and type survey
- Cotton strip test for soil biology

Record your Soil Monitoring Plan in **Template ST6** in "Our Plan". An example provided below.

Soil Monitoring Plan

Site name	Assessment Type	Person Responsible	Monitoring Frequency	Assessment Due Date			
Cropping (flats)	*Visual Soil Assessment*	*Manager*	*Every 3 years (spring or Autumn)*	*Sep 2021*	*April 2024*	*Sep 2027*	
Cropping (flats)	*Earth Worm Abundance Survey*	*Manager*	*Once every 2 years*	*April 2022*	*April 2024*	*April 2026*	
Easy Hills	*Visual Soil Assessment*	*Manager*	*Every 3 years (spring or Autumn)*	*Sep 2021*	*April 2024*	*Sep 2027*	
Easy Hills	*Earth Worm Abundance Survey*	*Manager*	*Once every 2 years*	*April 2022*	*April 2024*	*April 2026*	
Whole Farm	*Soil Testing*	*Manager*	*Prior to fertiliser applications*				
Whole Farm	*Nutrient Budget*	*Manager*	*Every 3 years*	*June 2021*	*June 2024*		

Blank templates can be found in **Our Plan** section and at **beeflambnz.com/farmplan**

Example

ST6

Review

Reviewing your plan should happen on a regular basis, perhaps annually or an appropriate interval that suits your farm business. It is also good to review your farm plan if you get new or updated information, or if you make changes to land use, your farm system or farm business.

Having more information about the soil types and characteristics on your farm will help you to make decisions about farm management and actions, such as fertiliser placement, land use or stock type. This can help you be more efficient, profitable and sustainable.

When reviewing you farm plan consider the relevant properties and characteristics of the soils on your farm and the things you have learnt from your maps and assessments such as:

- **Soil type** (from maps and factsheets)
- **Chemical properties** e.g. fertility, pH, organic matter content, nutrient status
- **Physical properties** e.g. texture, structure, colour, bulk density, porosity, water-holding capacity, hydraulic conductivity, potential for erosion, stoniness, compaction or pugging risk, topsoil depth, drainage
- **Biological properties** e.g. earthworm abundance, microbial biomass and community composition, activity of soil fungi and bacteria, humus type

Note any changes that you want to make and record any changes that you have already made since the last update or review in your farm plan.

Refine your Land Management Units

When you have completed some soil assessments across your farm and you have looked at your soil maps, you will have a better understanding of the soil types on your farm and within each Land Management Unit (LMU). This is a good opportunity to review or refine your LMUs. Consider the soil type, chemical, physical and biological properties of your soil. You can group together similar soil types or split areas up where appropriate, to identify a manageable number of land management units for your farm. You may also reconfirm the same LMU's you already have.

If you want to make any changes to your LMU's be sure to document this and update any LMU maps. Name and describe any new LMU's and note down strengths, weaknesses and any conditions of use in the resource chart **(Template OT3**).

The farm plan introduction chapter has more information about identifying LMUs and their strengths, weaknesses and conditions of use. Go to **beeflambnz.com/farmplan**

For further information please see:

beeflambnz.com/farmplan and the B+LNZ Knowledge Hub.

The other chapters in the B+LNZ Farm Plan: Environment Module are:

- Introduction
- Freshwater ecosystem health
- Integrating native biodiversity
- Responding to a changing climate
- Waste and chemical management
- Forage cropping management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