

By Farmers. For Farmers™

FARM PLAN

ENVIRONMENT MODULE



Introduction and overview

The Farm Plan - Environment Module will guide you through developing and further enhancing your understanding of your farm's natural resources and how your farming system interacts with them. Specifically, the plan covers understanding your land resource, managing soil health, protecting and enhancing native biodiversity, understanding freshwater health and what drives it and responding to climate change. It also covers a range of farm management practices that can impact natural resources if not well-managed. These subject areas do not sit in isolation of each other, or of your farming system. They are interlinked and often impacted in different ways, positively and negatively, by the practices we undertake. For this reason, assessments and actions are recorded together at the end of this document so that you can consider all of the actions, how they relate to each other and how you can optimise the outcomes for your natural resources, your business and your community.



Using this resource

This resource has been created to guide you through a process to increase your understanding of farm resources, make a plan to achieve goals, manage risks, and monitor your progress over-time. The ringbinder makes it easy to work on sections and pull out different bits you will need as you work through the plan development. This also means you can add your own resources, and as more information is available, B+LNZ will send it to you to update your plans. Sections that are not relevant to your farm system can also be removed.

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The resource includes some 'in the field' tools which are laminated so that you can utilise them on-farm. These are in the folder pocket.



Throughout this resource there are examples of the Templates to fill in to create your Farm Plan – Environment Module. You will find the blank versions to fill in for your farm in the "Our Plan" section at the back of the folder, and this is the place to keep your active plans. If you need more copies, you will find the files at beeflambnz.com/farmplan



Developed with support from the Red Meat Profit Partnership (RMPP), a joint Primary Growth Partnership initiative between the New Zealand red meat sector and the New Zealand Ministry for Primary Industries By working through this document, you will gain further understanding of your natural resources in the context of your farming system, and local catchment. The diagram below provides an overview of this framework.

The process includes:

- identifying natural resources along with infrastructure and other key elements on a map,
- identifying land management units (LMUs),
- understanding LMU strengths, weaknesses and opportunities, and risks and
- ensuring farming policies are well suited to them.

For each of the key sections, information is provided to help describe and understand these resources and their risks; learn some practical ways of assessing, monitoring and managing them; and identify actions to protect and enhance where needed.



The plan is designed to be a long-term document and is a process rather than an output. Working through this document will enable you to develop an action plan, but it will never be 'complete' as constant revision results in the farm system continually developing and evolving.

Many of the actions you identify and document are ongoing, and are, or will, become embedded as part of your day-to-day management. Other actions will be related to more targeted projects to be completed over a period of time. It is important to capture all of these.

Creating and documenting your Farm Plan - Environment Module

We have broken it down into a **series of steps** to help you work through the process to create and document your plan and keep it active on a day to day basis. You can **tick off these steps as you go**, to get an idea of progress; you don't have to do them all at once; you don't even have to do them in the same order as we suggest. And some steps may not apply.

STEP 1

OVERVIEW

Outline your Vision, Values and Goals

Write down your Vision, Values and Goals, for your farm business. You can record these in **Template OT1** in the "Our Plan" section, or in an existing business plan. An example is on the next page. Alternatively, the Red Meat Profit Partnership developed 'BizPlan', an online tool to create your Business Plan, and you'll find a link to it at **beeflambnz.com/farmplan**

By identifying your vision, values and goals, you can ensure that your farm plan supports you in achieving your vision while being true to your values.

This section should include a brief statement on the intent of your plan (why you are writing it), the philosophy that underlies your farm management (e.g. high performance/low-impact, low input, etc), and the general location and history of your property. The introduction should include some general comments on your management approach and/or some of the key assumptions that underlie the management of your property.

The vision statement can outline how the farm's environment might be at some point in the future (perhaps in 50 years' time). It is a general statement about how the environment will look at this time. A good way to think about this, is 'What do I want the person farming this land in say 50-years' time to say about me?' Your values are your beliefs. Your vision and values will be personal to your farming business.

The online module on Business Planning outlines more about setting your vision and values. Go to **beeflambnz.com/farmplan** to find the link.

As you work through the plan, you will develop more specific goals and objectives that link back to your overall vision.



Vision, Values and Goals

Date compiled: 1 March 2020



VISION: The overarching aspirations for the farm business. I.e. the big picture of where you want to be

· Profitable environmentally friendly business that produces top quality meat for our community

VALUES: Standards or Principles that are important to the farm business and its owners. Such as family ownership/involvement and being environmentally sustainable

- · Family ownership
- · Environmentally sustainable
- · Profitable
- · Embrace new ideas and technology
- · Share best practice ideas with the community

OVERALL GOALS: The long-term (1 year, 2 year, 5 year and more) aims that you want to achieve. Should include business and personal goals.

- · Develop and implement succession plan to ensure ongoing family involvement and ownership by 2021
- · Increase scanning by 25% within 3 years

1. SOILS 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 the appropriate land use and grazing management for specific areas on farm in order to maintain and improve the physical and biological condition of soils and minimise the diffuse discharges of contaminants.

2. FRESHWATER GOALS

- · Secure safe drinking water for house and animals
- · Safe swimming in the river
- · Sustainable habitat for native fish and insects
- · A peaceful place to relax and enjoy my farm environment

3. BIODIVERSITY GOALS

- · To protect and enhance biodiversity assets on farm and within our community.
- · To develop an effective pest and weed management strategy

4. RESPONDING TO CLIMATE CHANGE GOALS

- · Understanding our emissions number and profile
- · Be prepared for an adverse events flood and snow.
- · By 2025, have a plan to measure and manage emissions and be ready to participate in a pricing mechanism as part of the industry commitment.

5. WASTE AND CHEMICAL MANAGEMENT GOALS

- · Offal pits, silage and effluent, runoff from stock yards, tracks, races and rubbish dumps: To manage the number and location of these sources to minimise risk to health and water quality.
- · Containment sources: to manage other containment sources e.g. fuel supplies, chemical mixing areas, fertiliser loading areas.

6. FORAGE CROPPING GOALS

- · Keep stock out of waterways with appropriate buffer areas
- · Create a winter grazing plan each year
- · Use strategic grazing techniques for wintering to minimise sediment loss
- · Replant winter paddocks as soon as practical after winter to reduce nutrient and sediment losses
- · Keep animals well-fed and in good condition



STEP 2 OVERVIEW

Outline the objectives for your catchment

Becoming part of a farmer-led Catchment Community Group is one of the most powerful actions farmers can take to positively influence the environment. Each group identifies with a geographical area usually based around a river or lake catchment and the individuals act together towards a common vision. The most effective catchment groups take a good amount of time at the outset to agree on what exactly has brought them together. If you are part of a group, include your existing catchment management plan or the key information from it.

If you are not in a catchment group, B+LNZ encourages you to join one, or even create one. You can find information about catchment groups and getting involved by following the link on **beeflambnz.com/farmplan**. B+LNZ have developed a series of workshops to help your group identify your vision and start forming a plan to realise that vision. You can insert this information into your Farm Plan as it is important for your plan to sit with in the context of its catchment or landscape.

Table 0.1 below contains suggestions for creating a catchment community plan **Table 0.2** (overleaf) identifies a range of uses and values identified by catchment groups and the issues that affect those uses and values. It also includes relevant highlevel objectives and management variables (attributes) to enable specific objectives to address those issues. This provides the link between what is valued, what impacts those values, what the catchment group wants to achieve and what needs to be managed to address the impacts.

Table 0.1 Catchment Community Plan Example

Use the template guide below to help complete your plan or add your existing Catchment Community Plan.

Catchment Plan Section	Information you could include
Title page	 Catchment name Plan name Date Photo of catchment group/iconic image from catchment etc
1. Purpose of this plan: Why are we coming together?	 What the plan is for? Who is the plan for? Why do you need it? Reoccurring themes behind group formation, include: Creating and owning your own future. Working together to achieve better outcomes, rather than working alone. Establishing a communication pathway with decision makers to help shape the rules and influence regional plans. Engaging with your wider community. Creating a catchment story that highlights the great progress farmers are making to improve the environment and potentially enhances future profitability (through environmental compliance). Taiao - connection we have to the environment - earth, sky, air, water and all of life it supports and the interconnected relationship of it.

Catchment Plan Section	Information you could include
2. Current state: What great stuff is already happening?	
	 Insert a map of the catchment, describe where the catchment is etc Describe the catchment group – when formed, how, why etc
	 Outline all the great work that is already happening Outline existing values for the catchment, such as: Values described in regional plans Values described in farm plans Describe the current environmental state of your catchment. Consider including information like: Freshwater ecosystem health - you may be able access information from regional council or consider getting a professional in to help you assess this. Have a look at the fact sheet on freshwater health to get you started (beeflambnz.com/farmplan) Is there native bush occurring across the catchment? Where? Consider using maps to show information spatially. You may be able to combine farm plan information into a catchment scale map.
3. Future state: What's our vision for the future? What are our objectives? (Table O.2)	 What is your vision for the future? Try to keep this short and to the point (no more than a paragraph). Consider the objectives below for a wide range of examples. Some examples from other catchment groups include: Water - healthy waterways, swimmable, fishable Biodiversity - native corridors, appropriate planting in the right place, return of native species Soils - healthy productive soils over generations Climate - adaptable, resilient farm systems Other - our work is recognised by the community; we are recognised as smart farmers/good stewards of the land; have autonomy to farm/make land management decisions; working together as a community etc; recreational activities.
4. Action Plan: What actions are we going to take?	 Think about and list what actions will help the group move towards its vision for the catchment? Indicate which actions are the highest priority Include information like who/what/when/costs etc. Are there any funding opportunities, such as regional council/government funds that the group could apply for? Are there opportunities to link with the wider community, such as a community planting day or connecting with the local school? Can actions be achieved through farm plans? Linking farm plans to a catchment plan can achieve better outcomes, rather than working alone (1+1=3).
5. Communications Plan: How will we tell our story?	 Outline who your audience is? Local community - Rural/urban/schools District/ regional council/central government Consumers What are the key messages you want to share with your audience? Note key messages may vary with audience you are presenting to. How will you get your key messages across? Consider: Website Social media channels Email Kids/school Iwi Events such as field days/conferences etc Google Earth Drone footage

Table 0.2 Example Catchment Objectives

attribute Specific objectives	 and water streams, rivers, lakes and wetlands. streams, rivers, lakes and wetlands. Identify practices in the catchment that may reduce ecosystem health and work to improve these. Improve riparian habitat and native plantings. 	 Maintain current water quality for recreational use. Maintain current level of public access to lakes and their margins. Ensure recreational use does not impact on sensitive wetlands and lakes.
Management variable/attribute	 Water levels in lakes and water extraction Riparian cover Nutrient inputs (nitrogen and phosphorous) Pest species (distribution/populations) 	 E. coli concentrations Cyanobacteria Extent/type of public access
High level objectives	Protect the ecological values of all outstanding lakes.	Maintain water quality for recreational activity Maintain current levels of public access. (Measure: cyanobacteria; reports of illness)
Issues that impact use and values	 Livestock access to lakes Nutrient enrichment from land use/discharges to land Exotic and pest species Lack of riparian vegetation 	 Livestock access to lakes (E. coli) Water clarity as a result of nutrients/ sediment Wildfowl
Use and values	Ecosystem health Native fish Rare plants Wetland habitats Native birdlife	Recreation Camping Jet boating/skiing Fishing Swimming Education Bird watching Waka ama Canoeing Duck shooting

Use and values	Issues that impact use and values	High level objectives	Management variable/attribute	Specific objectives
 Cultural values Cultural rituals (for example, christening) Waahi tapū. Sites of significance (for example, taonga/waka) Mahinga kai 	 Livestock access to lakes (E. coli) Exotic species (for example, pest fish and aquatic plants) Lack of awareness/damage to sites of significance 	Improve cultural 'health' and awareness. Measure: incidents of damage/disturbance of cultural sites. Eel (tuna) populations/catch records.	 Lake levels E. coli Algae blooms and water clarity Riparian cover Native aquatic species 	 Improve public awareness and understanding of cultural values at sites of significance to tangata whenua within the catchment. Enhance the sustainability of important māhinga kai species and their habitats. Identify and protect sites of significance to Māori.
Socio-economic Firefighting Primary industry (irrigation, stock drinking, dairy shed) Domestic supply Commercial fisheries Forestry	Access to freshwater (for primary industry and domestic use) Loss of nutrients from land Reliability of water supplies	Enhance the productive capacity of land in the Poutō lakes catchment. Measure: uptake of water quality improvement plans and good practice.	 Access to water and reliability of supply Nutrient/sediment loss 	 Ensure limits on water extraction from lakes provide capacity for economic growth and reasonable access to and reliability of supply of water. Minimise the loss of nutrients through leaching/run-off from primary production.
Natural character Aquatic habitat Natural ecosystem processes Low levels of modification by structures, noise and light Visual aesthetics Low pest plant and animal numbers	 Nutrient enrichment (trophic state) Modification by structures, lake bed disturbance, noise and light Stock access to lakes Presence of pest species in lakes (fish and plant) 	Improve the natural character of high and outstanding value lakes. Measure: trophic state; Trophic Level Index; change/increase in pests.	Riparian cover Nutrients (nitrogen and phosphorous) Pest species (distribution) New structures/bed disturbance Water extraction/lake levels	 Restrict the spread and minimise the impact of pest species on aquatic habitats in high and outstanding value lakes. Enhance riparian vegetation.

STEP 3 **OVERVIEW**

Describe your farm system

Outlining your farm system means that everyone using the plan will understand the context you are farming in. It also provides detail to be able to complete the risk assessments.

In the "Our Plan" section describe your farm system as it is using Template OT2 (an example is given below), recognising overtime you may make changes. Typically these may take time to implement.

Describe your farm system

OT2

Example



Farm Location (Region; District; Nearest Town)	123 Anywhere Road, Everytown 9873	
Total Farm Area	395ha	
Describe farm stocking policy	Breeding ewes, sell lambs store, bull finishing	
Stock numbers	1850 MA ewes, 450 ewe hoggets, 100 R2 bulls	
Lambing/calving dates	Lambs: 20 August	



STEP 4 OVERVIEW

Identify your farm features on a map

Some farms will have maps with many resources already identified. Ensure that these maps contain all of the resources listed below. There are several features to identify so have enough copies of your map so that they are not too cluttered. You can create different digital layers if you are doing this electronically. On your maps identify the following features:

1) Farm infrastructure

Property boundaries, fencing, races/lanes and tracks, riparian vegetation and fencing, water takes and irrigation zones, houses, septic tanks, yards/animal holding areas/shearing sheds, implement sheds and other buildings, stock crossings, bridges, culverts, bores, feed pads, feed lots, offal pit/dead stock disposal, rubbish dump, silage pits, feed storage, effluent storage and application (where applicable), cultivation set-backs, contaminated sites, chemical storage, fertiliser storage, fuel storage, sediment traps/bunds and other soil conservation structures.

2) Biophysical

- **Waterbodies** wetlands, lakes, dams, springs, drains, rivers, streams, creeks, intermittent, ephemeral, ground water/aquifers (more information about identifying different waterbodies is provided in the Freshwater section).
- **Terrestrial vegetation** native forest, shrubland, grassland, exotic forestry plantation, woodlots, shelterbelts, soil conservation plantings (see Biodiversity section for descriptions).
- **Significant Natural Areas (SNA)** these are identified in district plans (further detail will be provided with the National Policy Statement for Indigenous Biodiversity).

3) Identify Critical Source Areas (CSA) and overland flow pathways

Critical source areas are areas in a paddock or on a farm that can contribute to relatively large amounts of nutrient and sediment losses to waterways. They are often wet areas such as gullies and swales, where overland runoff can transport sediment and nutrients. They may be wet or flow all the time or only occasionally during and after larger rainfall events or wet periods. Overland flow is the movement of water over the land, downslope toward a water body which can also carry contaminants to waterways such as sediment or faecal matter.





4) Identify areas under irrigation (if any)

Identify the areas which are irrigated and by which irrigation type.

5) Identify areas serviced by subsoil drainage (if any)

Identify the areas which have artificial subsoil drainage. Include:

- Mole and tile
- Nova flow

Identify any management of the outflow on your map.

6) Identify areas that could be used for forage cropping (if undertaken)

Annual forage cropping areas need to be identified for each year on a map. Work through the forage cropping section or complete the B+LNZ Winter and Forage Cropping Workshop to record these details.

7) Significant sites

Identify any other areas that are of significance to you including cultural, recreational (such as hunting, fishing, swimming or kayaking) and heritage, or that a district plan might identify as significant (such as pa sites, heritage trees, geological preservation sites, landscape zones). Some of these sites may be specified within local plans. It can also be valuable to speak to Mana Whenua who can help identify location, type and state of cultural sites.



Farm Team

Outline your farm team, including those involved with implementing the farm plan (who may be external), in Template OT3.

Team member	Role	Role in implementing farm plan
Jane	Manager	Explaining the plan to staff, making sure the work is completed on time and to required standard
John	Farm worker	Making sure resources and stock are managed according to plan
AgCulitvate	Contractor	Making sure the right areas are cultivated at the right time to avoid soil and nutrient loss

Understanding and mapping your Land Resource

Why is it important to understand and map the land resource?

The land resource is the foundation of New Zealand's pastoral farming system. By developing a detailed and documented understanding of land resources and mapping these, stock policies and land management uses can be appropriately matched to optimise performance while minimising impact's on natural resources. It also provides a foundation to assess future land use opportunities by helping understand the potential as well as the limitations of each area of the farm (or Land Management Unit).

STEP 6 **OVERVIEW**

Map the Land Resource

Some farms already have detailed land resource maps which include Land Resource Inventory and Soil and Land Use Capability (LUC). If you already have these maps, review them and include them in your farm plan.

A note about scale and professional resource mapping

All of New Zealand has been surveyed at the regional scale (1:50,000 and 1:63,360). While the level of detail in these maps is too coarse for farm management purposes, maps at this scale can be useful starting points for further investigation. Soil maps are available for most areas also at this scale. Land Resource Inventory Worksheets and the NZ LRI database are available for all of New Zealand. Copies or extracts may be obtainable from local libraries, on-line through Crown Research Institutes such as Manaaki Whenua - Landcare Research, farm mapping companies, fertiliser companies, and regional councils.

When using these at a farm level it is critical to validate them and refine the detail so they better reflect differences within the farm. To demonstrate the difference in scale, 1:10,000 is one observation per hectare, whereas at 1:50,000 this is one to 25ha. A lot can change in 25ha!

B+LNZ strongly supports farmers getting their farms mapped at farm scale (generally less than 1:10,000, but some farms are large enough to support a slightly lesser resolution (e.g. 1:20,000). This can be done by a soil conservation specialist and there are a number around New Zealand who do this. While there is a cost involved with this, it only needs to be done once, and provides an objective, enduring assessment and stocktake of your resource-base to ensure you are looking after resources and optimising land use within your farm business objectives.



On a Farm Map:

- Primary landforms are easy-to-recognise differences in the landscape associated with changes in geology, morphology (shape and form), slope, and other physical factors such as location of waterways or changes in soil type.
- Map out primary landforms on a separate aerial photocopy or layer (if using electronic mapping). Start with the obvious, such as separating flat land from hilly areas. Then focus on each primary landform and break it down further.
 For example, it may be possible to break hilly areas into gorges, valley floors, steepland, rolling hills, etc.
- If only one landform is evident (e.g. a completely flat farm) move onto the next step (you may refine further there).

Landform examples

- Mountain land
- Hill country
- Alluvial/River flats
- Alluvial fans
- Terraces
- Gorges
- Steepland
- Rolling hills
- Spurs

- · Valley floors
- · Scarp slopes
- Ridge tops
- Swamps
- Basins
- · Glacial moraine
- Dunes
- Flood plains



- Focus on a single landform. Are there areas within the landform that have other physical differences? Consider:
 - Differences in slope can you get a tractor over it? (Flat to rolling country) Or just a quad bike? (rolling country, easy hill, hill) Sheep tracks start to show at about 25° (steep hill country). Above 35° is steepland. You can use the inclinometer on a smart phone to help measure slope.
 - soil types have you noticed a different soil structure, texture, colour or drainage characteristics?
 - pasture production do you notice differences in pasture production within landforms?
 - Other physical characteristics and qualities examples are given below.
- Repeat the same exercise for each landform, mapping each major difference as a new land type.
- · Create a legend with names that describe each land type.

Land characteristics and qualities to consider

- Vegetation cover
- Wetness
- Iron or clay pans
- Changes in geology
- P retention status
- Soil depth
- Erosion —existing and at-risk areas
- Aspect
- Stoniness
- Flooding frequency
- Elevation
- Contour and slope
- Workability (ability to carry out tillage without causing structural damage)





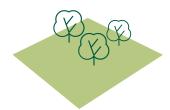
How well matched is the current system?

Can land management be changed to better the land resource?

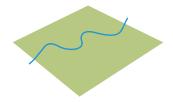
Can the land resource be developed to improve land use? What are the opportunities? What are the limitations?



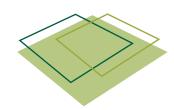
Aim to combine the many different land types into a more manageable set of LMUs.



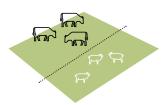
Firstly, name all areas of woody vegetation (e.g. forestry, bush) as their own LMUs (production forestry should be a separate block from bush). These areas require different management by default. Many areas of the same type can be grouped as one LMU (e.g. patches of bush or farm woodlots). For the native vegetation, this will be refined later.



Secondly, identify the wetlands and waterbodies. Consider how these are managed (e.g. weed and pest control, planting regime, fenced or unfenced, etc) and if there are differences, then identify them as separate LMUs.



For the remainder, consider each land type individually. What makes it different? Does it have favourable qualities? Unfavourable qualities? Can it be grouped with other similar land types?



You may already have different management blocks. There may be a lambing block, beef unit block, cropping block, back country block, and so on. Map these existing management blocks against your Land Resource Map. Based on the resources, strengths and weaknesses identified, are there any opportunities or constraints in the current management blocks that could be changed to better use your land?

Once you have worked through the soil management section, you will identify the strengths, weaknesses, and conditions of use of each of your Land Management Units.

STEP 7 OVERVIEW

Complete a Resource Chart for your LMUs

Using Template OT4 in "Our Plan" outline strengths, weaknesses, uses and management for each Land Management Unit. See the example below.

Resource Chart

Example OT4

LMU	DESCRIPTION	STRENGTHS	WEAKNESSES	USES AND MANAGEMENT
1. Bush Blocks	Scattered bush fragments unfenced	Shade and shelter Aesthetics	Possum refuge Trees are not pasture	 Fence off and protect Possum control
2. River flats	Flat sandy soils, stones in patches	 Cultivatable Sheltered High K reserves Well drained and resilient to pugging 	 Dry Patchy production Minor flood risk Small area away from main access 	IrrigationDeerLamb finishingIntensive beef
3. Gorge block	Steep sided gorge with sandstone bluffs and scrub	Sheltered and dry Accessible	 Steepness Possums Difficult to muster Erosion prone Flash floods in creek 	Emergency feed Retire Emergency protection for ewes after shearing
4. Stoney hills	Rolling hills with well developed but dry soils on gravels	 Well drained Resilient to pugging Easy contour 	 Tunnel gullying Dry Poor pasture species Gorse Exposed 	 Grapes Cattle wintering Requires shelter belts K line irrigation
S. Wet hill country	Developed mudstone hill country	 Large area Holds on through summer High natural fertility 	 Rushes Earthflow erosion in spots Pugs up in winter 	No cattle in winter Add space planted trees

Glossary

Alluvial fans: A triangle-shaped deposit of gravel, sand, and even smaller pieces of sediment, such as silt.

Alluvial/River flats: An alluvial plain is a largely flat landform created by the deposition of sediment over a long period of time by one or more rivers coming from highland regions, from which alluvial soil forms.

Basins: A geolocial depressin in the surrounding area.

Biodiversity: Native (indigenous) biodiversity. Including the plants, animals, insects and fungi that occur naturally in New Zealand.

Carbon Sink: Natural reservoirs that absorb and store more carbon than they release.

Creek: A creek is a stream that is usually smaller than a river.

Critical Source Area (CSA): Critical source areas are areas in a paddock or on a farm that can contribute to relatively large amounts of nutrient and sediment losses to waterways.

Critical Source Area management: To identify and manage the critical source areas from which N, P, sediment and pathogens are lost to waterways.

Dam: A dam is a barrier that stops or restricts the flow of water or underground streams.

Drain: The natural or artificial removal of a surface's water and sub-surface water from an area with excess of water.

Dunes: A large mass of wind-blown sand.

Ecosystem health: Ecosystem health describes the physical, chemical and biological components of an ecosytem.

Ecosystem services: Ecosystem services are the many and varied benefits to humans gifted by the natural environment and from healthy ecosystems.

Ephemeral waterway: An overland waterway that flows intermittently.

Floodplains: A floodplain or flood plain or flood-plain is an area of land adjacent to a stream or river which stretches from the banks of its channel to the base of the enclosing valley walls, and which experiences flooding during periods of high discharge.

Forage crops: Annual or biennial crops, which are grown specifically to be grazed by livestock or conserved as hay or silage.

Glacial moraine: A glacially formed accumulation of unconsolidated glacial debris that occurs in both currently and formerly glaciated regions.

Global Warming Potential (GWP): This allows the various GHGs to be compared to each other as different gases differ in their ability to absorb energy (radiative forcing) and how long they stay in the atmosphere (lifetime).

Gorges: A deep cleft between escarpments or cliffs resulting from weathering and the erosive activity of a river over geologic time scales.

Greenhouse gases (GHG): A number of the gases in the atmosphere (such as carbon dioxide, methane and nitrous oxide) act like a blanket around the earth, trapping warmth from the sun. For this reason, we call them greenhouse gases. Greenhouse gases exist naturally in low concentrations and maintain the earth's average temperature at around 15°C. Without them, too much heat would escape, and the temperature at the surface of the planet would be -18°C. But human activities are rapidly increasing the amount of these gases in the atmosphere, which is causing the temperature to increase and the climate to change.

Hill country: Land with slopes above 15° and located below an altitude of 1000m.

Lake: A body of fresh water which is entirely or nearly surrounded by land. (source: RMA)

Land use and grazing management: To manage and assess the appropriate land use and grazing management for specific areas on farm in order to maintain and improve the physical and biological condition of soils and minimise the diffuse discharges of contaminants.

Land Management Unit (LMU): Areas of land that can be farmed or managed in a similar way because of underlying physical similarities. They can represent a static snapshot of how land is currently used, or an insight into how land could be used if all physical opportunities were realised.

Land resource inventory (LRI): Inventory of five physical factors (rock, soil, slope, erosion type & severity, and vegetation) which is the basis of assessing land resources.

Land Use Capability map (LUC): Maps created to represent the potential uses of a "unit" of land.

Māhinga kai (food gathering): Species, natural habitats, materials and practices used for harvesting food, and places where food or resources are, or were, gathered. It refers to multiple species and inter-relationships rather than something specific. These areas were significant to Māori and were often given names to identify who were the whānau or hapū kaitiaki (guardians). They could be shared with others but would normally involve reciprocal arrangements.

Mountain land: A large landform that rises above the surrounding land in a limited area, usually in the form of a peak.

Natural Capital: The world's stock of natural resources, which includes geology, soils, air, water and all living organisms. Some natural capital assets provide people with free goods and services, often called ecosystem services.

Natural Resource: Materials and components (something that can be used) that can be found within the environment.

Overland Flow: Where water is more likely to flow over the soil rather than into it, due to saturation of the soil or a physical barrier that restricts water penetration such as a compacted soil surface.

Pest and weed management: To develop an effective pest and weed management strategy.

Pond: A pond is an area filled with fresh water, either natural or artificial, that is smaller than a lake.

Ridge tops: A geographical feature consisting of a chain of mountains or hills that form a continuous elevated crest for some distance.

Riparian management: To manage waterway margins to avoid damage to the bed and margins of a water body, avoid direct input of nutrients, and to maximise riparian margin nutrient filtering.

River: A continually or intermittently flowing body of fresh water; and includes a stream and modified watercourse; but does not include any artificial watercourse (including an irrigation canal, water supply race, canal for the supply of water for electricity power generation or farm drainage canal). (source: RMA)

Rolling hills: Rolling hills are a series of low hills; rolling refers to the up-and-down motion of riding over them.

Scarp slopes: A steep slope or long cliff that forms as a result of faulting or erosion and separates two relatively level areas having different elevations.

Significant Natural Area (SNA): Natural areas that provide habitats for native plant and animal species, and provide ecosystem services to the region.

Soil management: 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.

Spring: A point at which water flows from an aquifer to the Earth's surface.

Spurs: A lateral ridge or tongue of land descending from a hill, mountain or main crest of a ridge.

Steep land: Hill and mountain land greater than 20 degrees in slope.

Stream: A body of water with surface water flowing within the bed and banks of a channel.

Swale: A shady spot, or a sunken or marshy place.

Swamps: A forested wetland.

Terraces: A natural, flat surface that borders and lies above the floodplain of a stream or river.

Thriving Biodiversity and Healthy Ecosystems: Waterways support region appropriate diversity of flora and fauna, nutrient concentrations and habitat and life supporting qualities.

Valley floors: A low area between hills or mountains typically with a river running through it.

Visual Soil Assessment: A tool designed to assess soil quality easily, quickly, reliably and cheaply on a paddock scale.

Water Bodies: Water bodies are not just what we see on the surface, but also what is underground, groundwater refer to the Freshwater Ecosystem Health section for a guide on water bodies.

Waterway: Waterways are not just what we see on the surface, but also what is underground, groundwater refer to the Freshwater Ecosystem Health section for a guide on waterways.

Wetland management: To manage wetlands to avoid damage to the margins, maximise filtering and flood control and support a healthy wetland or catchment ecosystem.

Wetland: Permanently or intermittently wet areas, shallow water, and land water margins that support a natural ecosystem of plants and animals that are adapted to wet conditions. (source: RMA)

01 Managing soil health

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 of 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. Soils 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 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.





risks associated with your soils, link your soils to your Land Management Units to help inform your management of them and

develop a plan to protect, enhance and monitor your soil health.

What information do you need?

- Farm-scale map of your soils
- Overseer Nutrient Analysis
- Soil test results

Describe the different soils on your farm

Our soils are a precious and valuable resource. The more information you have, the better position you are in to manage your soils to ensure they are productive now and in the future. "Soil Management" (later in this section) provides more detail about describing your soils. Completing a Visual Soil Assessment will help you understand more about the overall health of your soil. The Worm Abundance Survey, Cotton Strip Test and your regular soil testing will further inform your assessment of soil health. If you do not have a farm-scale soil map, this can be a very valuable resource and B+LNZ strongly recommends you obtain one. There are soil mapping experts available and some Regional Councils provide this as part of their whole farm planning programmes.

STEP 1

MANAGING SOIL HEALTH

Identify your goals for managing your soil resource

In relation to your long-term vision and goals identified at the start, in **Template OT1** in "Our Plan" identify specific goals for managing your soil resource in relation to the soils you have and the risks associated with those soils. This can also help you identify opportunities to improve soil health and therefore productivity on-farm. In developing your Land Management Units, you may have some ideas already.

Below are some example goals that might help. You may also have objectives from your Regional Council which you need to address in your Farm Plan.

- **Soil management:** 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.
- Land use and grazing management: To manage and assess the appropriate land use and grazing management for specific areas on farm in order to maintain and improve the physical and biological condition of soils and minimise the diffuse discharges of contaminants.

STEP 2

MANAGING SOIL HEALTH

Visual Soil Assessment

Visual soil assessments are a tool that can be used to get a quick understanding of the characteristics and health of your soil. Undertake a Visual Soil Assessment at a representative site in each Land Management Unit (LMU). If there are different landforms within a Land Management Unit, it is worth completing the assessment in each landform as this is likely to be a different soil type. Examples of Visual Soil Assessments are included here, blank templates are available in "Our Plan" (Templates ST1 and ST2). The form can be downloaded from beeflambnz.com/farmplan

The assessment should take

The assessment should take place in late winter or early spring. Use the cultivate/graze test (this guide is in the front pocket of the folder) to check that the soil is not too wet or too dry to do the assessment. Note the conditions leading up to the assessment (e.g. very wet winter).

The link to the Visual Soil Assessment Resource book can be found on beeflambnz.com/farmplan

If you are not able to complete a Visual Soil Assessment, at least identify the soil texture **(Table 1.2)** in "Soil Management" (later in this section) and consider this in relation to how those soils are managed at different times of the year. See also B+LNZ's fact sheet on soil texture.

C

Visual Soil Assessment Score Card - Soil Indicators

ST1 Example

Visual indicators for assessing soil quality under hill country land uses

Date: 1 February 2021	La	nd use:Gr	azing	
Site location: North block				
Law disaway	Shoulder [Track Upper s Other		Back slope Mid slope
Soil type: Loess		Aspect: <i>NE</i>	S	Slope angle: 5^o
Textural qualifier: Sandy	Loamy	amy Clayey		
Moisture condition: Dry	Slightly moist	Moist	Wet	
Seasonal weather conditions:	Wet [Cold	Warr	m Average
Visual Indicator of Soil Quality (see soil resources on www.beeflambnz.com for details)	Visual Score 0 = Poor con 1 = Moderate 2 = Good cor	dition condition	Weighting	VS Ranking
Degree of soil erosion	1		x 3	3
Surface relief	2		x 1	2
Topsoil depth	2		x 2	4
Organic Matter (Humus)	1		x 2	2
Soil structure and consistence	2	2		6
Soil porosity	1		x 3	3
Soil colour	2		x 2	4
Number and colour of mottles	1		x 2	2
Earthworm counts	2		x 2	4
RANKING SCORE (Sum of VS rankings	5)			30
Soil Quality Asssessment		Ranking S	core	
Poor		< 10		
Moderate		10 - 25		
Good		> 25		

Visual indicators for assessing soil quality under hill country land uses

Visual Indicator of Soil Quality	Visual Score (VS) 0 = Poor condition 1 = Moderate condition 2 = Good condition	Weighting	VS Ranking
Pasture composistion	0	x 3	0
Pasture growth and regrowth	1	x 3	3
Pasture utilisation*	1	x 1	1
Area of bare ground	1	x 3	3
Drought stress	0	x 2	0
Stock carrying capacity and fertiliser use*	1	x 2	2
RANKING SCORE (Sum of VS rankings)	9		

^{*}Perceived

Plant Quality Asssessment	Ranking Score
Poor	< 10
Moderate	10 - 25
Good	> 25

Overall Quality Asssessment		Do the soil and plant indicators give a different soil quality assessment? If so, why?	
Soil indicators	Plant indicators	Yes, Overdue renewal?	
30	9	Soil fertility/PH?	

Notes:

- Not renewed in memoryWeed and annual grasses dominate
- · Need soil tests

Identifying potential issues and causes

The Visual Soil Assessment will help you identify potential issues with the soil. It is useful to identify these as soon as possible so that you can mitigate them where possible, noting improving soil normally takes time. Outlined below are some of the common issues you may observe. See the 'Soil Management' section for more detail.

- Soil loss/Erosion Erosion is the greatest environmental risk on most hill country properties and is also a threat to production. Active erosion can be observed and understanding what type of erosion is occurring will help identify the best approach to manage it. Note, active erosion doesn't always mean large slips. There may also be evidence of previous erosion events. Most regional councils have staff who can provide advice and support in relation to managing erosion.
- **Stoniness** If there are stones in your soil, estimate the percent-stoniness. Identify limitations in use associated with stony areas and/or actions to manage (e.g. rock picking).
- Compaction and pugging You can identify compaction or pugging when you dig a spade spit; soil will layer in horizontal lines. The more obvious the lines the more damage that has occurred. Identify potential causes of this, and a plan to improve structure (e.g. ripping, changing stock class when soils wet, etc).
- Treading Treading can be identified as divots in the surface of the soil caused by hooves.
- Over-cultivation Soils that have been over-cultivated can be very loose and not clump together in well formed aggregates. This is often seen when cultivating and the cultivated soil is very fine and at risk of wind-blow (contributes also to erosion risks). Reducing cultivation practices and using minimum tillage or direct drilling can help.
- Mottling and gleying Mottling is the appearance of blotches or streaks which are distinctive from the main soil colour and can be, yellow, orange or reddish and are influenced by a seasonal water table. Gleying is where the soil is a grey from prolonged anaerobic conditions (lack of oxygen). The presence of mottling and/ or gleying can indicate a natural pan, or high water table, or an issue with artificial drainage being blocked. Soil health is impacted by this through reduced oxygen in the soil pores. Consider how the soil is managed during wet periods to minimise the issues with this. If you are investing in artificial drainage, ensure you manage the outflow to avoid issues for freshwater.

Note any actions in your Action Plan (Template IT1) you have identified as a result of carrying out the Visual Soil Assessment.

STEP 3 MANAGING SOIL HEALTH

Earthworm Abundance Survey Optional

Refer to "The great kiwi earthworm survey" and "Identifying common pasture earthworms" resources to help you complete Template ST3. An example is shown below.

Earthworm Abundance Survey table

ST3

Example

LMU	Number of dung worms	Number of topsoil worms	Number of deep burrowing worms	Notes
Back 3	5	4	2	Some spits had none
Irrigation flats	5	8	2	
Hill - dry	1	1	0	Turf mat evident





Earthworm Survey **The Great Kiwi**

indicators of soil health Earthworms are useful

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

Earthworm Survey and you can nelp improve our knowledge of gain a better understanding of Take part in the Great Kiwi

diversity changes across the New what is living underneath us and how earthworm abundance and Zealand landscape.

earthworms burrow through

the topsoil, feeding on the

organic matter here.

high supply of fresh organic

matter

are also distinguished and

such as the tiger worm,

Compost earthworms,

dung and do not form

earthworms feed on

permanent burrows.

are suited to areas with a

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

this into their deep burrows.

on the soil surface and take

earthworms feed on dung

Deep-burrowing

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

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



New Zealand's pasture earthworms arrived accidentally with the first

earthworm populations? Do you have healthy

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.

Did you know that

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

Assessing your earthworms

roles in the soil that should

be present in your soil.

earthworms with different

There are three types of

Deep Burrowing

Topsoil

Dung

How to sample:

- During June to September choose a paddock
- Collect three spade spits (20x20cm, 20cm deep) per paddock
- sheet of plastic and looking through the roots. Put the Hand-sort earthworms by crumbling the soil onto a earthworms in water.
- Take the earthworms out of water and place onto a paper
- Look at the colour and size of the adult earthworms. Using the key can you see different types?
- Place earthworms on white paper next to a ruler and take a close-up photo out of direct sunlight. 9
- square for each paddock and x25 to get number per square Record the average number of earthworms per spade
- Go to www.earthworms.nz and enter your observation ∞.
- 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@agresearch.co.nz Nicole Schon





5

Identifying common pasture earthworms





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





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

Deep: Aporrectodea

large?

Is the earthworm

worm' (90-120mm)

longa (blackhead







OR... is it smaller, and darker along the

Topsoil: Aporrectodea

length of its body?

trapezoides 'southern

worm' (40-90mm)



Z Is the earthworm bright red with yellow?

Is the earthworm a dark green-brown colour?



writhes like a snake

when disturbed?

earthworm which

Is it a long slender

corticis 'snake worm'

Dung: Amynthas (70-180mm)



fetida 'tiger worm' (30-Compost: Eisenia 130mm)

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



yellow bands (when it organic matter with Is it found in a rich

chlorotica 'green worm

40-70mm)

Topsoil: Allolobophora

brown, coiling stiffly when disturbed?

OR... is it greenish

200 native species

but some are found in and colour. They tend considerably in size



Do you have an adult earthworm?



Z

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

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

Is the earthworm a dark grey-brown colour?









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





low fertillity hill country

You have probably found a rare earthworm which is not in

this key. Record it as unidentified.

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



STEP 4 MANAGING SOIL HEALTH

Record Soil Test Results

Ensure you are monitoring your soil chemistry by soil testing every one to two years and keep a record of these results. It is important to record trends and make nutrient management decisions based on the proposed land use, soil test results and the trends to ensure you are maximising the benefit from any nutrient application.

STEP 5 MANAGING SOIL HEALTH

Cotton Strip Test (the 'Soil Your Undies' test) Optional

As an optional extra, you might like to test soil biological activity by carrying out a 'Cotton Strip Test' Details as outlined in the guide below.

HOW HEALTHY IS YOUR SOIL?

Biological indicators of soil health and the role of earthworms and dung bettles as ecosystem engineers





Soils provide the ecosystem services and the basis of biodiversity, food production and carbon storage which our economy, culture and communities rely on.



Dung beetles are ecosystem engineers.



The cotton strip (undies) test and earthworm counts are biological indicators of the health of soil.



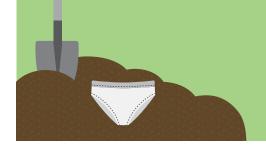
DAY 1



DAY 30

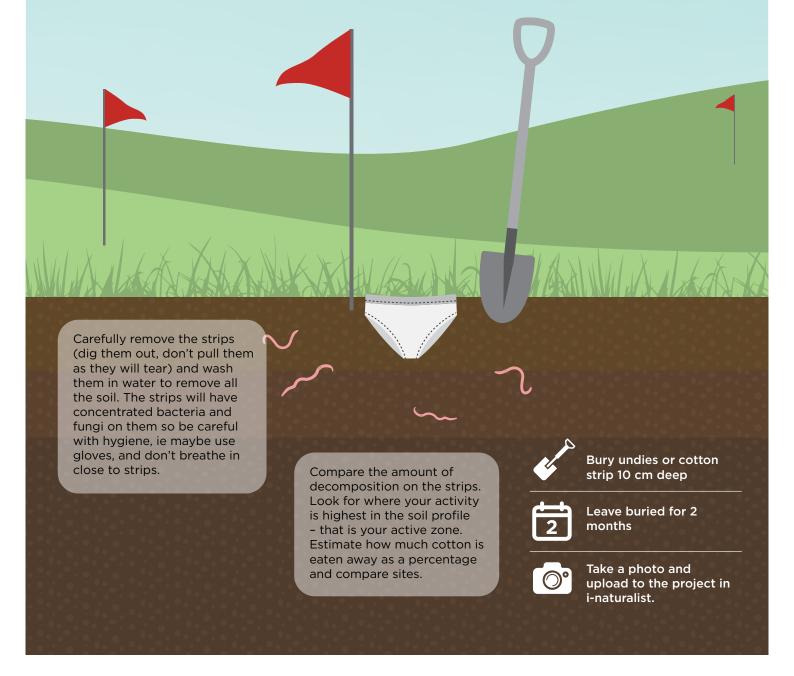


DAY 60



Choose several sites for comparison (eg. best / worst soils). At each strip site, create a vertical slit in the soil with a flat spade. Then place the cotton strip (or undies) on the spade with the waistband closest to the handle, and the other end at the bottom of the spade. Insert this into the soil so that the waistband is flush with the soil surface. Push back the soil to have good contact with both sides of the cotton. Mark each site with the flag – you will need to find them later!

The time required to see decomposition depends on your location, season, moisture and soil type. Generally 2 months is a good guide and starting point. Warm and wet weather will help decompose the cotton faster, and cold and dry will be slower.



STEP 6 MANAGING SOIL HEALTH

Mapping soils

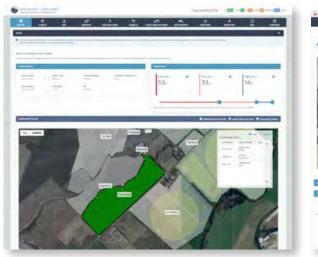
In developing your Land Management Units (LMU) you considered the different landforms present on your farm. Different landforms have a strong relationship with different soil types, which will in turn influence the way they behave under certain types of management and environmental conditions. This will also influence the risk of sediment loss and erosion.

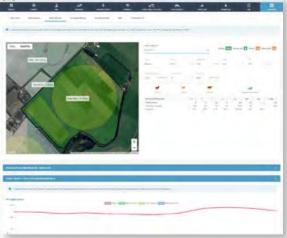
Consider the factors you have identified in your Visual Soil Assessment and locate on the map of soils within your Land Management Units the following:

- highly productive areas (good fertility, deep topsoil, friable and well-developed)
- erosion prone areas
- pugging or compaction risk areas (heavy soils)
- fragile soils (light soils, shallow topsoil)
- active erosion
- stony/free-draining areas

See the soils fact sheets or seek additional guidance to further define these aspects.







STEP 7

MANAGING SOIL HEALTH

Complete an OverseerFM Nutrient Analysis

OverseerFM nutrient budgets are a standard component of good management practice in modern farming, ensuring continuous improvement through efficient fertiliser use and helping minimise nutrient losses from the farm. Certified Nutrient Management Advisors can create nutrient budgets with OverseerFM.

While it is possible to complete the OverseerFM budget yourself, it is important to have someone who is trained in operating OverseerFM to ensure the results are valuable and as representative as possible. This is especially so when considering different scenarios or using the information for compliance purposes. Your nutrient budget should be updated annually.

The outputs in a nutrient budget will help you target areas for development and nutrient savings on your farm. The information it provides is key to understanding your nutrient management risks and opportunities.

It is important to note that OverseerFM will only provide information in relation to nutrient management on farm, which is only one part of waterway management.

A template to help with data collection for OverseerFM can be found at **beeflambnz.com/farmplan**

Review the nutrient budget

- 1. Is your nutrient budget up to date? Do the blocks in OverseerFM match your LMUs? If not, the next time you review your OverseerFM 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 management improving or are there areas for improvement? (Note: Overseer is 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 blocks where it is high. These 'hotspots' are common and when managed to best practice risks can be minimised.
- 4. Are nutrients within LMUs balanced? Are limitations from certain nutrients impacting plant uptake of other nutrients? Is soil fertility declining, improving or being maintained? How does this relate to your goals in relation to soil fertility?
- 5. If actions are required, include these in your Soils Action Plan (Template IT1) in "Our Plan".

Risk Assessment

There are a range of risks created by how we choose to manage our soils. Understanding our soils enables us to identify these risks and the opportunities to develop the long term value of our soils, production system and environment.

Table 1.1 provides a detailed table highlighting risks to soil health as well as how these risks could be mitigated.

Complete the Risk Assessment Template ST4 in "Our Plan" (example below) for your own farming system. This will inform your action plan. Use the Risk Assessment Matrix chart to identify the overall risk by assessing the likelihood and impact to your farm business and the environment.

Risk Assessment Matrix

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

Risk Assessment - Soil Health

ST4 **Example**

Risk to soil health	Risks on your farm	Overall risk
Compaction and pugging of moist and wet soils from treading or heavy machinery use. Heavy soils are more prone	 Reduced production from damaged soils Tractor use in spring 	Medium Medium
Soil loss to erosion – wind, slip, slump, earthflow, gully, tunnel gully and stream bank. Silt deposition associated with flooding	Slips in gullies in hill country during heavy rain Flooding on flats	Low Medium
Loss of soil organic matter and microbial activity	Dry years or drought Over-cultivation	Medium Low
Nutrients below optimum or declining or nutrients in excess	Delay to getting fertiliser on at the right time Not getting soil fertility tests done	Low Medium

Identify actions

In the Soils Action Plan Template IT1 (example page 16), identify actions to help you achieve your goals, address any issues you have identified through your assessments, and any opportunities you have identified. Table 1.1 overleaf provides a range of actions to mitigate risks which may help your thinking.

Some items to include in your action plan are:

- Erosion Management
- Managing run-off from paddocks, tracks, yards and Critical Source Areas
- Maintaining the appropriate type and quantity of vegetative cover
- Protecting soil structure
- · Building soil structure
- Improving organic matter and soil biology
- Animal management (e.g. avoiding wet soils with cattle)



Table 1.1 Risks to soil health and options to mitigate

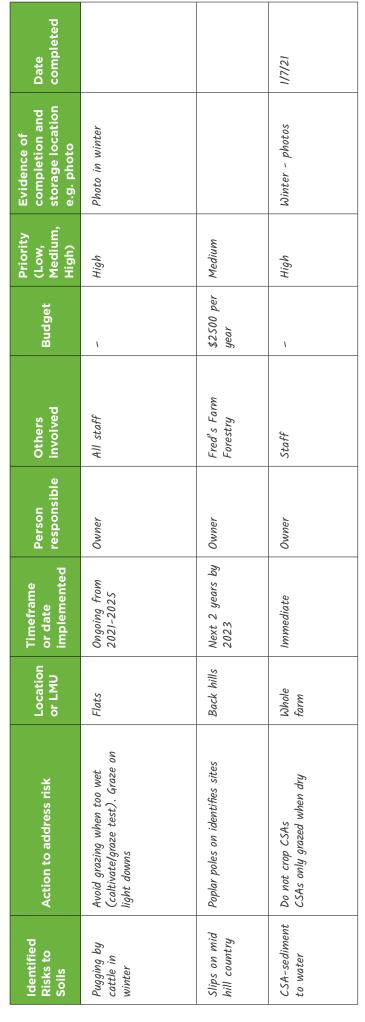
Risks to soil health	Impact	Management options
Compaction and pugging of moist and wet soils from treading or heavy machinery use. Heavy soils are more prone.	Reduces porosity of soil which reduces water and air movement and root penetration. This leads to reduced pasture growth rates (by about 50% from heavy treading), slower recovery, increased weeds and can impact long term soil health.	 Limit heavy stock on poorly drained soils when saturated. Avoid grazing or cultivation when soils are too wet (use the cultivate/graze test to check) Consider drainage and/or planting trees on heavier soils to help dry them out (remember to think about drainage and ensure it is not going into a Critical Source Area) Retain high pasture residuals during wet periods. Use paddocks for grazing during wet periods that have a well-developed turf mat. Limit grazing time during wet periods using stand-off areas. Consider the use of off-farm grazing. Repair damaged paddocks/areas where possible. Avoid overgrazing to prevent shallow root systems. Avoid the use of heavy machinery on wet soils or minimise area of use. Use minimum tillage or direct drill
Soil loss to erosion. Leading cause is bare soil or lack of appropriate vegetative cover on erosion-prone soils.	Loss of soil to the receiving environment where it can disrupt ecosystems in waterways and significantly impact on freshwater life. Also reduces pasture production where soil losses have occurred.	 Planting appropriate trees on hill slopes and streambanks. These can be native or exotic. It is important to get the right species depending on your objectives as not all trees have the same erosion control benefits. You also may have other objectives alongside erosion control planting. It is important to have a management plan for the trees; don't just plant them and walk away. They require the same care and attention as your stock. Fence gullies and waterways to prevent stock access Stabilisation planting of riparian areas Control pests that eat vegetation reducing vegetative cover in forested areas, riparian areas or on pastures and crops. Plant cover crops when land is left fallow to prevent the risk of bare soil being lost Keep stock off streambanks and away from steep hill country when its wet Minimise the use of earthworks and work with the contour of the land Rip wheel tracks in cultivated land where runoff and erosion on the tracks is an issue Use minimum till or direct drill wherever possible and don't cultivate land above 20° Maintain vegetative cover of pastures and crops with deep roots Retiring areas from grazing Afforestation for timber Containment structures (e.g. debris dams) Strategic planting to protect infrastructure Matching land use to land class Grassy filter/buffer strips Over-sow and topdress slips

Risks to soil health	Impact	Management options
Loss of soil organic matter and microbial activity	Reduces presence of adhesive materials to stabilise soil aggregates. Increases risk and extent of breakage of aggregates when soils are wet. Reduces nutrient regulation of soil.	 Minimum till or direct drilling Include pasture in a period of crop rotation Plough in crop residues and green manure crops Add farm dairy effluent (avoiding excessive rates) Rotational grazing
Nutrients below optimum or declining or nutrients in excess assessed through soil tests	Excess of nutrients can result in losses from the production system (which is a cost) and this can have a significant impact on the health of waterways (see freshwater section). 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.	 Complete an OverseerFM nutrient budget 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 Alternative sources of stock water in each paddock Strategic vegetated-buffer areas where runoff converges, and around waterways in intensely farmed areas. Where conditions allow, use slow release P-fertiliser No super-phosphate application when heavy rainfall is forecast Olsen-P maintained at optimum levels Regular soil tests and nutrient applications are carried out on the basis of the results, particularly trends. Calibration of equipment used for fertiliser application and/or precision application where possible from external providers Avoid winter applications of N-fertiliser 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 N application rates set to match growth cycle of pasture or crop Cultivation practices and timing adjusted to minimise N losses Crop rotation designed to utilise residual N in soil, e.g. cereals following fodder crops. Erosion is managed/minimised Direct drilling or minimum tillage used Know your soil Anion Storage Capacity (ASC) - soils with high ASC require more P input to overcome deficiency than low ASC soils.

Soils Action Plan

Blank templates can be found in **Our Plan** section

Example



STEP 10 MANAGING SOIL HEALTH

Develop a regular soil monitoring programme

Develop a programme of regular monitoring for your soils including the following:

- Visual Soil Assessment
- Earthworm abundance and type survey optional
- Cotton strip test for soil biology optional
- Soil testing
- Ongoing updates of OverseerFM nutrient assessment

Record this in the Monitoring Plan (Template IT3).



STEP 11 MANAGING SOIL HEALTH

Refine Land Management Units

Now that you have a better understanding of the soil types within each Land Management Unit, you may decide to add Land Management Units, or refine existing ones. Consider whether there may be value in moving fence lines or putting new fence lines in to help achieve this practically. If this is the case, document this as an action in the plan.

You should now be able to further document the strengths, weaknesses and conditions of use of each Land Management Unit (Template OT4).

- A strength is a favourable land quality, while a weakness is a not-so-favourable quality.
 A condition of use is a restriction you have on an area from a management perspective (e.g. not grazed by cattle in winter, no stock access, no multiple-bearing ewes to lamb here, crops rotate through this LMU, no limitations, etc).
- What is defined as a strength or a weakness depends on the management purpose being considered. For example, stoniness may be a weakness for cropping, but it may represent a strength for winter grazing of cattle (to avoid pugging). It is OK for these to be in both columns.
- A condition of use is a restriction you place on that piece of land due to its limitations (e.g. no cattle in winter, single-lambing only, no stock access in riparian areas, use for emergency shelter after shearing only, direct drill only, etc)

Examples of possible strengths:

- Free draining
- Deep topsoil
- Good soil moisture- holding ability
- High natural fertility
- · Good soil structure
- Balanced soil texture (e.g. loam)
- · Resistant to pugging
- Well aerated
- · Optimum P, K, S levels
- Optimum pH
- · Flat land
- · Naturally sheltered
- Warm aspect
- Stable (no erosion)
- New pasture
- Good pasture quality
- Well sheltered by trees
- · Artificially drained
- · Low insect risk
- · Low in weeds
- Good stock access to water
- Good machinery access

Examples of possible weaknesses:

- Poorly drained
- Shallow topsoil
- Poor soil moisture-holding ability
- Low natural fertility
- · Poor soil structure
- Too much clay or sandy
- Susceptible to pugging or compaction
- High water table
- High nutrient leaching
- High runoff risk
- · Excessive stoniness
- Hot dry aspect
- Wet cold aspect
- Drought prone
- Erosion prone
- Flooding riskLow quality pasture
- Excessively steep
- Exposed
- · Weeds or pests are a problem
- Poor stock access to water
- · Small or fragmented
- Poor machinery access

Soil Management

a) Description of your soils

There are a range of characteristics used to describe and identify soils. Experts spend a long-time understanding soils to be able to characterise them. For you to understand more about your soils, having an understanding of the geology and parent material of your soils, the texture, an assessment of biological activity, and soil chemistry is a good place to start. There is a lot more detailed information available to get to know your soils better. B+LNZ recommend the Visual Soil Assessment as a great way to help you see what is happening to your farm's 'engine under the ground'.

Soils are described by their physical, biological and chemical properties.

Physical properties – physical properties are used to describe how water and air move and are stored in a soil. They also indicate how easy it is to dig or work the soil. The common physical properties of soil that are assessed are texture, structure, colour, bulk density, water-holding capacity and hydraulic conductivity.

Soil biology - is a key characteristic which stabilises soil structure, facilitates and regulates the supply of plant nutrients and stores moisture. This can be assessed though earthworm counts or cotton strip testing which assess the activity of soil microbiological life such as fungi and bacteria.

Soil Chemistry - Soils have different chemical attributes which will influence what they can grow, and how they interact with nutrients applied. The underlying geology, parent rock, weathering, and historic management can all have an influence. Chemical properties also include contaminants and toxic elements. A range of attributes are assessed (such as phosphate, potassium, calcium, magnesium, sulphur, pH, cation exchange capacity, organic matter etc) in a standard soil test which should be used to inform nutrient management decisions.



b) Soil Loss

Soil loss occurs when soil and rock is stripped away from landforms. It is commonly referred to as erosion. Often people link erosion with hill country slips, slumps and earthflows, but it can also include wind, gully, tunnel gully, stream bank, silt deposition associated with flooding, surface runoff, etc. Different types of erosion have different landscape indicators, which doesn't necessarily include visible bare soil. The process of erosion creates sediment which is then transported by water or wind across or down the landscape.

Erosion is influenced by soil type, climate (including wind), 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 pole planting can be one of the best actions to take. It can take more than 70 years to build the soil back up to where it was before a slip occurred.

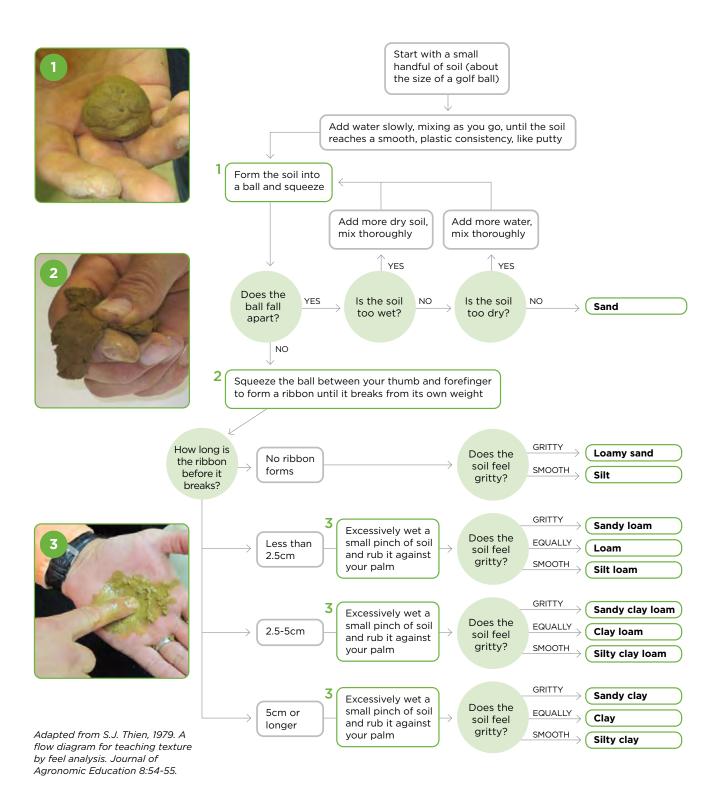
In most regions where hill country erosion is a dominant feature of the landscape, there is fully-or well-funded support from Regional Councils to address erosion. They generally use the Land Resource Inventory and identify farm-scale soil and Land Use Capability maps as discussed in the previous section. If the Regional Council can't offer funding, they usually have experts within their teams who can provide advice and can also recommend other specialists. Councils may also provide funding support to carry-out works associated with these plans (e.g. discounted poplar and willow poles). If you are in an area where this is not provided, it is recommended you access expert advice to ensure your erosion management plan is suitable for your landscape and farm system.

c) Understand Soil Texture

Soil texture is the proportion of sand, silt and clay particles which influences how the soil feels. You may describe soils as 'light' or 'heavy'. This usually refers to the clay proportion (heavy soils are predominantly clay, while light soils are high in sand relative to clay). Using the flow chart you can identify your soil texture. This is a useful soil property to understand as it is heavily impacted by management. Heavy soils tend to be more prone to pugging and compaction but hold on 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. Understanding what your soil texture is for each part of your farm means you can make good decisions about what stock go where and when to maximise the production, and minimise environmental losses.

Use the flow chart **(Table 1.2)** provided to help identify the dominant soil texture of each soil. Complete this exercise in each Land Management Unit, and where there may be a different landform within a Land Management Unit which could indicate a different soil. Identify this on your Land Management Unit map.

Table 1.2 Flow chart to determine soil texture by feel



The greater the clay content of soil the 'heavier' it is, and the greater the sand content of soil, the 'lighter' it is. Pumice soil is also considered 'light'. Consider the risks and benefits associated with your different soil textures in the risk assessment.

d) Soil testing

Chemical analysis of soils helps to inform nutrient management decisions. Soil 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 it can give an indication of deficiency, excess or imbalance of major nutrients.

Regular soil tests should be carried out annually or every two years on the same transect to be able to make meaningful comparisons between years. Management decisions should be made based on the trends rather than a single result.

Setting up a transect and sampling

- 1. Identify a representative, accessible site within each Land Management Unit.
 - · Transect should be long enough to represent the Land Management Unit
 - 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. Sample across the transect taking 5-10 cores at the appropriate depth (7.5cm for pasture and 15cm for crop).
- 4. Ensure samples are appropriately labelled to the transect and Land Management Unit.
- 5. Send samples to the lab for analysis.
- 6. Sample from the same transect each time and record trends.

Soil test results can also be used to inform your Overseer nutrient budget and ensure this is as accurate as possible.

02 Freshwater ecosystem health

Why do we need to manage freshwater?

Life does not exist without water. Farming relies on water for stock and human health and to grow pastures and forages. In turn, farm management influences waterway ecosystems. For that reason, it is important the farming system supports healthy waterways and that we have a reliable supply of water to meet the farm system needs, ecological needs and community objectives of waterways.



Objective of this section

By completing this section, you should be able to understand freshwater ecosystem health in the context of your farm and catchment. You will be able to identify the water resources on your property, and in your catchment, identify and assess risks to freshwater health and specify actions to mitigate those risks. You may set goals and outcomes for yourself and that meet your catchment needs, and identify actions to achieve these, as well as the monitoring required to assess freshwater health.

What information do you need?

- Farm map with your waterways identified.
- Existing waterbody ecological health assessments (such as the Waterway Self-Assessment).
- Identification of Critical Source Areas and overland flow pathways
- OverseerFM nutrient analysis (indicative of nutrient loss below the root zone).
- Include any information you can access regarding your catchment including an inventory and commentary on the condition of the health of waterways in the catchment. A map of the catchment or catchments you farm in is also valuable.
- If you are not working in a catchment group, your Regional Council should be able to provide information to help you understand more about your catchment, the state it is in and if there have been any community processes to identify values that you are not aware of. This can guide your actions (e.g. managing sediment loss in hill country to protect your soils, and flood plains downstream, or ensuring run-off from yards and tracks is managed to protect swimming holes from microbial contamination).

Freshwater Values and Goals

Why is freshwater important on your farm?

Setting your freshwater values and goals or things you want to achieve helps with better management of freshwater resources on your farm. Understanding what you and your community value in freshwater is an important step to making decisions that achieve good farming and environmental outcomes. Freshwater values and goals often fit into some broad categories including economic, social, cultural, recreational, natural character, ecosystem health, and human health and wellbeing. You may also want to consider adding in the values of your local catchment group.

Examples of freshwater values and goals

- Clean water: surface and groundwater supplies are safe to use for all users
- Thriving freshwater biodiversity and healthy ecosystems: supports healthy ecosystems in all waterways, including native biota
- Cultural: sites of significance, Māhinga kai (food gathering) such as eel, koura, trout
- **Recreation:** water resources can be used for recreation such as swimming, kayaking and hunting
- **Natural character:** visual aesthetics, natural ecosystem processes, low pest numbers, low levels of modification
- Socio-economic: firefighting, irrigation, tourism

Record your freshwater values and goals in **Template OT1** in "Our Plan". Examples are below.

Freshwater Values and Goals

OT1

Example

My freshwater values and goals
Secure safe drinking water for house and animals
Safe swimming in the river
Sustainable habitat for native fish and insects
A peaceful place to relax and enjoy my farm environment



 ■ Blank templates can be found in Our Plan section



Assess your waterways

In this section you will map your freshwater resources and get to know how healthy your waterways and freshwater bodies are.

Make sure that you have mapped your waterways and other water features onto your farm maps. This should include features such as streams, rivers, drains, wetlands, swamps, ponds, lakes, critical source areas, areas prone to flooding and any other significant freshwater features on your farm.

A great way to assess the waterway health for yourself is to carry out a **Stream Health Check** or similar on-farm assessment. More information on assessments can be found later in this section, and you may already have some information on this, such as water quality testing results or waterway health testing done on your property or with your catchment group.

A summary of your assessments can be recorded in **Template FW1** in "Our Plan". See an example table below to help better understand the waterways on your farm and for future reference. Be sure to write in any notes such as the score of any assessments made, and what the score means, such as good health, intermediate health or lower health that might need attention. You should also note in any factors that may be contributing to reduced freshwater ecosystem health.

Freshwater Assessment Summary

FW1

Example

Waterway	Date	Flow conditions	Assessment type	Notes (such as assessment score, overall health (e.g. good, intermediate, low), factors to consider)
Upper flats	11 Feb 2021	Fine, sunny no rain for 2 weeks	Steam health check	Score =234 Intermediate health- stock access to waterways needs to be reduced
Gorge	11 Feb 2021	Fine, sunny no rain for 2 weeks	Steam health check	Score =260 Good health
Lower flats	12 Feb 2021	Overcast, no rain for previous 2 weeks	Steam health check	Score=134 Intermediate - need to reduce stock access and sediment loss from riverbanks

Blank templates can be found in **Our Plan** section

Identifying the water resources on-farm

Below is a guide to help you recognise different types of waterways on your property. A good way to think about it is that regardless of size, or type, an area that holds water is a potential ecosystem to be looked after. Waterways are not just what we see on the surface, but also what is underground. It is just as important to look after groundwater.

Once you understand more clearly what the different verities of waterways are, you may like to be more specific about the different types or identify additional waterways on your map. This can also help you understand what your obligations are to keep stock out of certain waterways. Make sure you check with your regional council about what you need to do to keep stock out of waterways and by when. For more information about stock exclusion and waterways visit **beeflambnz.com/farmplan**.

There may be areas on your farm that only channel overland flow at certain times of year where water is more likely to flow over the soil, rather than into it, during rain events. When these events happen, the areas can contribute relatively large amounts of contaminants to waterways in the short time they are flowing. These are known as 'Critical Source Areas' (CSAs).

Guide to different types of waterways

Broad definitions of the different types of waterways you may come across are outlined below. Different types of waterways have different indicators of ecosystem health. It is useful to understand the different types of waterways you have on your property so that you can ensure you are managing them effectively.



Rivers streams, burns and creeks - continually or intermittently flowing bodies of freshwater.



Lakes, tarns, ponds and dams - body of freshwater entirely or nearly surrounded by land; ponds and dams are usually man-made.



Artificial watercourse (e.g. ditches, drains, water race) – human-made or modified waterway with continually or intermittently flowing water.



Wetlands, swales and swamps - wet areas that support plants and animals that are adapted to wet conditions.

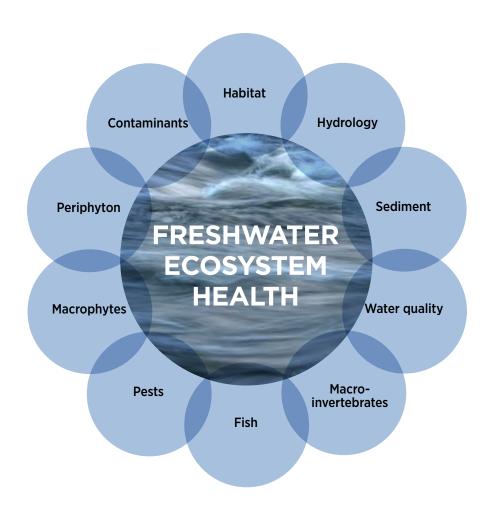
Groundwater/Aquifers – water that has travelled through the soil, or from river and lake beds, into underground rock formations containing significant amounts of water.

What is freshwater ecosystem health?

Freshwater ecosystem health includes a waterway's aquatic life, physical habitat, water quality and water flow patterns. This helps determine the overall state of the freshwater system.

Water quality often focuses on a number of parameters such as water clarity, the nutrients nitrogen (N) and phosphorus (P) and the faecal indicator, *E. coli.* However, these things on their own don't tell us about how healthy the freshwater ecosystem is and can vary widely in a short space of time.

A number of factors are considered when assessing freshwater ecosystem health. Water quality is one aspect but should be considered in association with shape of waterway, water quantity, flow patterns, habitat quality, fish, macroinvertebrates (e.g. insects, snails and worms), plant life (macrophytes, periphyton), pest species, sediment, clarity, water chemistry, temperature, dissolved oxygen and nutrient content.



Waterways can be good indicators for broader environmental conditions or land uses in the catchment that the stream or river drains from. Depending on the land, how it is used, as well as the characteristics of the waterways, there could be different areas of concern. For example, hill country streams typically have lower levels of nutrients like nitrogen and phosphorus than lowland streams in more intensive farming systems. However, sediment lost to waterways can be an issue for hill country properties due to the type of soil, rock, and slope.

A waterway's health and quality (e.g. sediments and dissolved nutrients) will often show the effects of farm management. Certain activities on-farm can have a significant impact on waterways but there are many ways to reduce this impact. However, it is important to know what the issue in the waterway is first before changes are made on-farm to address these.

Your local Regional Council will undertake monitoring at specific sites within different catchments. The data will often be collected regularly and may be a good source of information on the state of the waterways in your area. Water quantity and quality are already monitored on some sheep and beef farms as part of consent requirements for irrigation and other farm management practices. Talk to your local Regional Council or visit their website if you want to know about sites close to your property. The Land and Water Aotearoa site is also a good source of information - the link can be found in **beeflambnz.com/farmplan**.

Freshwater indicators and measurements

There are a range of indicators of ecosystem health in a waterway which are covered by the on-farm tools to a greater or lesser extent. These are outlined below adapted and summarised from NIWA.

Stream life

Fish and macroinvertebrates are good indicators of the health of the habitat and to a greater or lesser extent, water quality.

Benthic Macroinvertebrates: Small aquatic animals and insects that live at the bottom of streams and lakes, including the immature stages of insects such as flies, mayflies, caddisflies, stoneflies, beetles and damselflies. There are also worms, snails, leeches and crustaceans such as kōura and shrimps. Macroinvertebrates provide a good long-term (weeks to years) indicator of stressors because different types have different levels of tolerance to water quality and live for a number of years. Just like the quality of your stock reflects their management and health over the last month to years, so too does the presence of different aquatic animals reflect their living conditions in a waterway overtime. This is assessed by sampling the stream and looking at presence of species in relation to their tolerance score. Professionals use the Macroinvertebrate Community Index (MCI).





Fish: There are around 50 species of native freshwater fish in New Zealand, most of which are in decline. They have an important role as top predators in healthy ecosystems and can indicate the abundance of different stream bugs and some ecosystem processes. They are good for assessing biodiversity but links with external stressors are not so clear cut. Many are highly mobile and affected by factors outside the influence of one farm. Fish will sometimes be spotted when assessing streams, it is also possible to spotlight for fish at night (most species are nocturnal). With specialist equipment and training, trapping and electrofishing can be used to assess fish types and numbers.

Water quality

Water quality is measured in a lab from water samples taken on-site. Note: A single test result does not give a true representation of water quality. A number of measurements captured over time are required to better represent water quality. A water sample will be assessed for the following components:

Nutrients: Phosphorus (P) and nitrogen (N) are two nutrients found in waterways, however too much can be problematic. If there is too much, unwanted algal growth can occur resulting in reduced dissolved oxygen levels and subsequent fish deaths. Different types of nitrogen (nitrate and ammonium) and phosphorus (phosphate) impact waterways in different ways so it can be beneficial to understand which types are present to understand the risk. Both nitrogen and phosphorous are measured as mg/L.

Sediment: Sediment assessment and turbidity are measures of how much fine particulate material is in the water. Too much sediment can reduce habitat for aquatic plants and animals and block out light.

Conductivity: This indicator measures how well water conducts an electrical current and provides a quick indication of salt content. A change in conductivity might indicate a source of pollution as it is generally stable. Needs to be considered in context of other factors such as light, temperature, flow, geology etc.

pH: Measures how acidic or alkaline the water is. Often this will be neutral but can change from a variety of natural or human induced reasons. The pH can be affected by water chemistry and what types of animals live there.

Dissolved oxygen: A variety of measures are used to determine oxygen content and consumption rates. Oxygen is important for plant and animal life to thrive, if the levels drop, ecosystem health can be reduced by making it hard for certain types of aquatic life to survive.

Escherichia coli (E. coli): Are bacterial indicators of faecal pollution and other pathogenic organisms that may pose harm to humans and/or animals. *E. coli* numbers can be reported as either 'Colony Forming Units per mL' (CFU/mL) or 'Most Probable Number' (MPN per 100 mL). A water sample needs to be analysed within 24 hours of collection.

Habitat

Habitat is usually assessed visually and there are a range of components which are assessed to understand the health of the habitat in waterways.

Physical habitat: Habitat provides a place to live, shelter from high flows, protection from predators and a place to lay eggs. It is defined as the whole stream environment including stream bed, banks and land use in the riparian zone and is influenced by geology, climate, land-use and topography. It is assessed visually.

Composition: The type and size of particles that make up the stream bed. Predominantly boulders and cobbles provide a range of hard surfaces for macroinvertebrates and spaces for fish to shelter, feed and nest. Fine sediment can smother these spaces and clog fish gills. It is assessed visually, or by measuring the different sizes of particles randomly selected. It is reported as percentage coverage by different categories and sizes of particles.

Periphyton: Periphyton is the algae and cyanobacteria attached to sediments or plants and can vary from green to brown and slippery films to long filaments or thick mats. Presence indicates high nutrient levels, excess light and high temperatures. Generally associated with stony bottomed waterways, periphyton needs to be assessed in summer at low flow. It is assessed visually and reported as a percentage coverage of the stream bed.

Macrophytes: Large aquatic plants usually with leaves and roots found in muddy or sandy-bottomed streams. At low levels, they provide habitat, oxygen and assist with nutrient cycling, but too much can deplete oxygen levels, and cause sediment build-up on the stream bed. Assessed visually as a percentage based on cover of surface or volume of water they occupy.



A check-up of your waterways

There are a range of methods for assessing ecosystem health and quality of waterways. Regional councils are required to conduct water quality monitoring in catchments as part of their reporting requirements. However, these don't always give a detailed assessment of the waterway's health, especially at a farm-scale. It can be valuable to do some checking yourself as well as engage a specialist to help with these assessments. They can also help ensure you are applying the on-farm tools appropriately.

Below are some ways that you could use to help assess the waterways on your property.

Stream Health Check

The Stream Health Check involves a visual assessment of the stream and its immediate surroundings. Targeted questions are used to determine a score that tells you how healthy, or unhealthy, a waterway is. It is designed to provide an initial feel for the condition of the stream. The value of the Stream Health check is that it is something a farmer can do themselves because it doesn't require expert stream ecosystem knowledge. There is not a significant amount of time involved in collecting the information and expensive scientific equipment or tests aren't required either. It gives a good indication of overall stream health and can also be used to indicate long-term trends.

Template FW2 Stream Health Check is included in the "Our Plan" section. You can also find a link in **beeflambnz.com/farmplan**. The assessment focuses on four groups of factors that are indicative of stream health including:

- 1 Stream surroundings (e.g. shading, bank condition)
- 2 Activities affecting the stream (e.g. stock, fertiliser)
- 3 Factors in the stream (e.g. clarity, sediment)
- 4 Stream life (e.g. animals, algae, plants)

As part of your Stream Health Check you will have identified areas to help improve your scores and where risks may be greater. The final column in the Stream Health Check links to **Table 2.1** Risk factors and drivers for freshwater ecosystem health in freshwater risks section. By considering together the results from your assessment, identifying specific risk areas, and working through the risk matrix you will complete your freshwater action plan. It will help you address the areas of greatest risk first and identify appropriate actions to enhance freshwater ecosystem health on your farm.

Stream Health Check

Developed by Dr. Russell Death, Massey University

FW2 Example

Stream banks					
What type of vegetation is along the banks and sides of the stream?	Trees with dense groundcover e.g. tussock, toetoe, ferns, flax, rushes.	Tall grasses with patchy trees and groundcover.	Patchy trees, groundcover grazed or absent.	Grazed pasture grasses to stream edge.	Α,
	16	8	4	2	D,
How continuous is the vegetation (other than pasture) along the stream banks?	Tall vegetation (over 3m)/trees continuous, or a few small gaps.	Tall vegetation (over 3m)/trees a few large gaps or several small gaps.	Breaks in tall vegetation (over 3m)/trees frequent and very patchy.	Many large gaps in tall vegetation (over 3m)/ trees or no tall vegetation at all.	E, F
	16	8	4	2	

Blank templates can be found in **Our Plan** section

Related waterway health risk (see Table 2.1 Risk factors and drivers)



Stream Health Monitoring Assessment Kit (SHMAK):

NIWA's Stream Health Monitoring Assessment Kit (SHMAK) gives landowners, iwi, school and community groups simple, scientifically-sound tools and resources to monitor the ecological health of New Zealand's streams. There are a range of kits available for purchase from NIWA. More information and an order form can be found by following the link beeflambnz.com/farmplan.

Rapid Habitat Assessment:

This assessment was developed by the Cawthron Institute and is used by some of the regional councils, landowners and citizen scientists to help give a quick indication of stream health. You can find a link to their webpage on **beeflambnz.com/farmplan**.

Water quality testing:

Provides a snapshot in time of conditions in the catchment upstream of the sampling site. A sample can be taken by farmers and sent to a lab for testing and analysis. It is important to identify what should be tested, know how to interpret the results and act accordingly when results indicate issues. Unless done very regularly, and accurately, this does not provide a good indication of overall ecosystem health.

Wetland assessment:

The New Zealand Landcare Trust have developed a practical tool to assess wetlands which may be useful if you have wetlands on your farm. You can find a link to their webpage on **beeflambnz.com/farmplan**. Note that your Regional Council may also have an estimate of wetlands on your property as well. This is really important when considering any stock exclusion obligations you may have.

You may be water testing and/or assessing freshwater ecosystem health on your farm or within your catchment community. These results can also be included in your Farm Plan where appropriate. Consider the conditions prior to and during testing as these conditions will have an influence on the variables measured. For example *E. coli* and sediment measurements can spike after rainfall events.

Interpreting results

Once you have some results from the assessment it is important to use these to make management decisions accordingly. You may want to work with an expert, such as a freshwater ecologist to help interpret your results or answer any questions that have arisen. While monitoring should be done regularly and trends are important to understand, it is also important to act quickly if monitoring indicates an issue. This will help prevent further decline or other issues evolving as many factors are inter-linked in waterway ecosystems. Because waterway outcomes are determined by all users in a catchment, poor results often will require a community effort. This is another reason catchment groups are valuable. Talk to your neighbours and Regional Council staff about results and collective efforts that can be made to achieve the desired outcomes.

Identify risks for freshwater ecosystem health

Ecosystem health of waterways is impacted by a range of factors, most of which are influenced by how land is used and therefore is something farmers can actively manage. Different farms will influence waterways in different ways depending on a range of factors including geology, topography, soil type, climate, and farm system. This is one of the reasons why matching your farm system to the natural resource base is so important and why you went through this process earlier. Once you've completed all of the sections, you will check that your stocking policies are well matched to your natural resources.

Forage cropping, particularly in winter can be a significant risk to ecosystem health of waterways. If you are using forage cropping in your farm system, ensure you complete the section of this plan on forage cropping management and/or attend a B+LNZ Workshop on Forage Cropping and Winter Grazing. More information on winter grazing can be found at **beeflambnz.com/farmplan**.



Table 2.1 Risk factors and drivers for freshwater ecosystem health

Outlined below are a range of risk factors to ecosystem health, impacts and drivers which can impact ecosystem health of freshwater environments.

Risk to ecosystem health	Impact to ecosystem health	Driver	On-farm risks	
A. Deposited fine sediment	Sediment accumulates in waterway margins and beds smothering habitat for freshwater fish and invertebrates.	Sediment loss from overland flow due to erosion, or runoff from tracks and yards. It is often impossible to see sediment flows except in high rainfall events. But sediment flow can occur even with very small rainfall events. It is the very fine particles (clay) which have the greatest impact.	 Slope Rainfall Erosion-prone soils Low vegetation cover Poorly located and/or maintained tracks and yards Bare soil Stream bank erosion High proportion of heavier stock on erosion-prone soils Riparian margin width too narrow for adjacent activities Riparian margin vegetation inadequate Location of stored feed such as baleage, silage pits etc close to waterways resulting in heavy machinery use nearby Cropping on a slope, particularly when strip-grazed on heavy soils 	Good substrate Too much fine sediment
B. Excessive algae / periphyton / slime	Increased plant / slime biomass on stream substrate provides low quality food for stream life. As it decomposes it removes oxygen and alters the water chemistry. It destroys habitat for fish and macroinvertebrates.	High nutrient levels in combination with light from canopy removal. Also, removal of flushing/flood events due to drought, water abstraction or summer low flows. High flows will wash the periphyton off the stones and rocks.	Risk factors as above, and: Olsen P levels greater than agronomic optimum. Soil and rock type with low P retention. Lack of vegetative buffers Soil type (free-draining soils are greater risk for nitrogen loss) Stocking rate Type of livestock (Sheep, Cattle or Deer) Older vs younger livestock Over-application of irrigation increases nitrogen risk Excessive nitrogen fertiliser application Artificial drainage Critical Source Areas not well managed High concentration of nitrogen in diet Compacted or saturated soil	Good amount slime Too much slime

Table 2.1 Risk factors and drivers for freshwater ecosystem health continued

Risk to ecosystem health	Impact to ecosystem health	Driver	On-farm risks
C. Nitrogen concentrations	Increased nitrogen concentrations in waterways can lead to excessive slime and algal growth (periphyton). High concentrations of nitrogen in drinking water has been linked to an increased risk of certain illnesses in may have an impact on human health.	Nitrogen is a much more mobile chemical than phosphorus and moves easily through the soil. Nitrogen is dissolved in water and is primarily lost through the soil profile when water in the soil profile moves below the rootzone, entering aquifers or lateral systems connected to waterways. It can also be lost in surface runoff in certain conditions.	 Rainfall Bare soil Soil type (free-draining soils are greater risk) Stocking rate Type of livestock (Sheep, Cattle or Deer) Older vs younger livestock Over-application of irrigation Excessive nitrogen fertiliser application Bare soil during rainfall events (e.g. break-feeding crop) Artificial drainage Critical Source Areas not well managed High concentration of nitrogen in diet Compacted or saturated soil
D. Phosphorus concentrations	Increased nutrient concentrations in waterways can lead to, excessive slime and algal growth (periphyton).	Phosphorus is bound to soil particles (sediment), so enters waterways primarily through overland flow of sediment. Direct deposition of phosphorus fertiliser to waterways is another source. Can lead to issues when phosphorus is limiting in a waterway.	 Rainfall Slope Olsen P levels greater than agronomic optimum. Soil and rock type with low phosphorus retention. Lack of vegetative buffers Bare soil Compacted soil Bare soil during rainfall events (e.g. break-feeding crop) Critical Source Areas not well managed Compacted or saturated soil
E. Faecal bacteria, viruses and protozoa.	Elevated levels of faecal bacteria viruses and protozoa in fresh water are a public health hazard and can impact human and animal health. They include Cryptosporidium, Giardia, Salmonella, Campylobacter, Leptospirosis and <i>E. coli</i> .	Direct deposition of faecal material from stock accessing waterways, and run-off from tracks and yards as well as pasture and crops. Protozoan oocytes are very easily transported across land to waterways.	 Rainfall Soil type Stock type Stocking rates Compacted soil Poorly located and/or maintained tracks and yards leading to run-off. Bare soil Critical Source Areas not well managed Lack of vegetative buffers/riparian margins Stock access to waterways (particularly cattle, pigs and deer) Septic tanks poorly maintained

Risk to ecosystem health	Impact to ecosystem health	Driver	On-farm risks
F. High temperature	Many of New Zealand's native fish and invertebrates require cool water temperatures (below 20°C) to survive. Warmer temperatures reduce the oxygen concentrations in waterways and can increase the rate of photosynthesis of weed and algae species.	Lack of shade and reduced water flow.	 Riparian margins without enough woody vegetation (riparian planting) Modification of waterways Reduced waterway flow though water removal
G. Harmful chemicals	Chemicals entering waterways can be toxic to native fish and invertebrates as well as animals and people. Some of the natural chemicals in waterways can increase as oxygen levels go down reaching potentially lethal levels (e.g. arsenic).	Poor practice around use of chemicals and disposal of containers, run-off from infrastructure poorly managed, waste disposal poorly managed.	 Waste disposal sites connected to waterways (e.g. high water-table, close to waterway) Free draining soils or artificial drainage where chemicals are used. Run-off from silage pits or other areas such as yards, stand-off pads reaching waterways. Old dip sites
H. Altered river channel form and margins	New Zealand's native fish and invertebrates utilise diverse habitat in waterways and the margins including rapids and riffles, pools, runs, backwaters, in-stream cover such as overhanging vegetation, a range of substrate in river bed (gravels, stones and boulders), freshwater plants, debris, undercut banks and riparian vegetation (used for shade, shelter and spawning for some species).	Reduced water flow, sediment deposition (see above), lack of riparian vegetation, straightened or narrowed waterways, river widening, river earthworks.	 Modification of waterways (e.g. crossings, straightening, cleaning drains) Lack of diversity in riparian habitat (grasses, shrubs, trees) Sediment run-off from erosion Stock access to waterways and riparian areas
I. Toxic algae	Cyanobacteria is a type of slime that can grow in streams and can produce toxins that are lethal to stock, dogs and humans. The toxin can be present even when the algae is dry on the river banks.	The exact causes of toxic algal presence are still unclear. But they are often abundant during summer low flows or in streams with lots of deposited fine sediment.	 Erosion-prone soils Low vegetation cover Poorly located and/or maintained tracks and yards Bare soil Stream bank erosion Cropping on a slope, particularly when strip-grazed on heavy soils

Identify the risk factors and complete the risk assessment for your farm

Table 2.1 Risk factors and drivers above can help you learn about risk factors and drivers and understand the factors contributing to risk. Consider which of these factors contribute to risk on your property. Risks in relation to nutrients can be assessed by looking at the output from an OverseerFM nutrient budget and can help to build your risk assessment. 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.

There are a range of risks to freshwater ecosystem health created by the management of our farm system and that of other land users in our catchments.

Consider these risks and complete the Risk Assessment (Template FW3) in "Our Plan" for your own farm and in the context of your catchment management plan (where applicable). This will inform your action plan. For each risk factor you identify on your farm use the following Risk Assessment Matrix to assess the likelihood and consequence to your freshwater resources or your farm business to determine the overall risk for each factor. An example is shown below.

Risk Assessment Matrix

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

Record your risks to freshwater ecosystem health and the risk factors on your farm in the Template FW3 in the "Our Plan" section of this manual with the overall risk rating for each factor.

Freshwater Risk Template

FW3 Example

Risk to ecosystem health	Risks on your farm	Overall risk
Deposited fine sediment	 Erosion-prone soils in upper gullies Stream bank erosion	Medium Medium
Phosphorus	 Olsen P test high in paddocks near stream Critical Source Areas 	Low Medium
Nitrogen	· Free draining soils on flats	High
Faecal bacteria	Overland flow from irrigationSeptic tank runoff from house	Medium Low
High temperature	· Lack of trees or vegetation in upper part of stream	Medium
Degraded physical form of waterway and margins	· Drains need cleaning	Medium
Harmful chemicals	Old dip site runoffSeptic tank from house	Low
Toxic algae	· Toxic algae in stream	Low

Blank templates can be found in **Our Plan** section

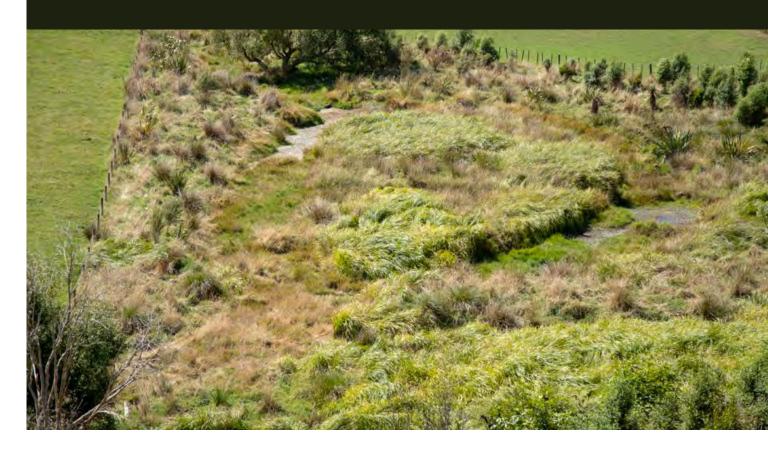
Managing risk

Understanding the risks on your farm will help you to identify how they can be managed. The key management practices to consider are:

- Managing the riparian margin to ensure it supports the adjacent waterway and is not damaged by stock or vehicles. B+LNZ recommends margins are at least 3m wide (or 5m for forage crop grazing) and increase in width as the slope of the paddock increases. Also, check with the local regulations and rules about riparian management and stock exclusion.
- Invest in stock water reticulation to help attract animals away from waterways. Visit
 the B+LNZ Knowledge Hub Module on stock water management and MPI's stock water
 management page via the shortcut on beeflambnz.com/farmplan.
- **Planting** appropriate plants or retaining grass to help stabilise soil and stop nutrient runoff flowing directly into water.
- Maintain water levels to help promote healthy ecosystems.
- Consider wet areas on your farm; they may be classified as a wetland and need protecting or they may lend themselves to being turned into a wetland.
- **Good practice nutrient management** will ensure nutrients are used efficiently and effectively to minimise losses.
- Prevent sediment run-off by protecting soils and maintaining infrastructure
- **Prevent contamination** from faecal bacteria and chemicals by excluding stock from waterways and managing chemical disposal effectively.
- Ensure infrastructure is well maintained to help reduce the risk of slips and flood damage.

A note on wetlands

Wetlands are a special resource. They act like the kidneys of the earth, cleaning the water that flows into them. They can trap sediment and soils, filter out nutrients and remove contaminants, can reduce flooding and protect coastal land from storm surge, are important for maintaining water tables and they also return nitrogen to the atmosphere. They are an outstanding natural filtering system. Over 90% of New Zealand's wetlands have been drained or filled so it is vitally important to protect the ones remaining and reinstate old wetland areas where possible. Looking after wetlands can be complex and you can usually get some good advice from your regional authority via online resources or specialist staff.



STEP 4 FRESHWATER ECOSYSTEM HEALTH

Identify actions

Consider the risks you have identified, what you have observed in your waterways and your understanding of the health of your freshwater ecosystems from your assessment. Identify the practices and actions that you are undertaking to protect ecosystem health, and any new practices and projects which can further protect or enhance these areas.

Past Actions that have helped improve Freshwater health

You may have already completed some actions in the past that are already contributing to improving freshwater health. It is a good idea to write down these actions so that you have a record of them. These may be things such as:

- · Fencing off waterways
- Joining your local catchment group
- Using nutrient budgeting tool such as Overseer
- Grazing your stock in a different way to reduce impact on waterways
- Putting in native planting along waterways
- · Restoring waterways natural flow
- · Removing willows or weeds
- Installing bridges or crossing for stock
- · Changing your fertiliser application regime
- · Removing heavy stock from steep, erosion prone areas
- · Creating wetland areas or sediment traps

Record these actions in Template FW4 in "Our Plan". An example is shown below.

Freshwater Actions completed to date

FW4 Example

Action	Location	Date or year
Fenced off and planted lower waterway in the flats block	Flats block	2004
Used precision fertiliser spreading to stop fertiliser going into my waterways	Whole farm	2008
Put in a wetland area approx. 0.5 hectare	Near middle creek	2012
Put in culverts at main crossings	Whole farm	2012-2014
Keep large buffers around winter grazing paddocks	Winter grazing paddocks	2014

Blank templates can be found in **Our Plan** section

Freshwater Action Plan

In this section you will consider your freshwater values and goals, your assessment of the freshwater resources on your farm and how healthy it is, and the risks on your farm that may impact on freshwater. Actions are the things you will do or change on your farm such as changing on-going management or putting in place infrastructure or resources that will help to reduce farming impacts on freshwater.

Consider actions to improve freshwater health and manage the following:

- Sediment loss
- **Nutrient loss**
- Contamination from faecal bacteria
- Physical form of waterway and riparian margin
- Habitat (water temperature, feed source, riparian margins)

Some examples are included overleaf to help you fill out Template IT1 for Freshwater in "Our Plan".

If you have specific projects to address, use Action Plan - Specific Projects (Template IT2) in "Our Plan" to add additional detail for each project. In the project plan identify the actions you can undertake to meet your objectives for freshwater, address any issues identified through your waterway self-assessment, manage risks you have identified and realise any opportunities. Some of the actions may have already been identified in the soils section.

Examples of freshwater project actions:

- Fencing off waterways
- Planting riparian areas
- Planting to reduce sediment loss to waterways
- Creation of sediment traps (the maintenance of these then becomes a management action)
- Installing crossing or culverts
- Restoring or creating wetlands
- Learn how to collect appropriate samples for testing



Blank templates can be found in **Our Plan** section

Date completed		Ongoing			
Evidence of completion and storage location e.g. photo	Photos after planting stored in 'Environment' folder on desktop	Written in farm diary	Photo of grass buffer area stored in 'Environment' folder on desktop	Pre and post photos and consent approval stored under "Flynn folder' in Environment folder on desktop	Invoice, receipts, and pre- and post photos stored under "Flynn folder' in Environment folder on desktop
Priority (Low, Medium, High)	Medium	нідһ	Medium	Нідһ	гом
Budget	\$2600/yr	\$2000 upfront and \$300 ongoing	\$500	\$7000	\$10,000
Others involved	Land Management Advisor	Fertiliser Rep		Consents advisor, Manager, Digger guy	Land management advisor, Manager, Fencing contractor
Person responsible	Manager	Manager	Manager	Owner	Owner
Timeframe or date implemented	Ongoing from 2021-2025	Ongoing starting in 2021	April 2021	November 2022	February 2023
Location, Land Management Unit or paddock	Тор Ыоск	Whole farm	Lower flats	Flynn Paddock	Flynn Paddock
Action to address risk	Plant 100 poplar poles in erodible gullies each year at 14m spacing. Cattle to be excluded via hotwire from area for at least a year. Replacements established two years after initial planting as needed.	Adjust stock location in winter months as needed based on nutrient modelling estimates of highest risk paddocks	Reduce risk of overland flow by establishing grass buffer strip along edges of winter grazing paddocks. Cattle are excluded with a I wire electric fence. Sheep have access to manage pests and weeds.	Culvert erected at stream crossing. Resource consent application likely required.	Establish suitable native plants at 2m spacing and erect fence at 3m distance from edge of Flynn Creek. Pre-spraying and release spraying of planting required.
Identified Risks to Freshwater Health	Sediment	Nutrient leaching	Phosphorus	Stock access to waterway	Shading of streams

Develop a regular monitoring programme for freshwater ecosystems

Long-term monitoring of your waterways will help you to keep track of any changes in freshwater on your farm. By carrying out your own checks it will help keep you informed about their current state, which you can use to help guide your farm management decisions. Use the Stream Health Check or similar assessment on a regular basis (each year or as required) at fixed representative locations in your waterways. At a larger scale you may want to talk with others in your catchment about what results they got on their properties. You may be able to gather some valuable data that will help with catchment planning.

Establish a programme for regular monitoring of your waterways to assess stream health using the Stream Health Check (or alternative assessment) along with taking photos at fixed points can help keep track of any changes in waterways and areas around them.

If you have wetlands, you can use the Landcare Trust Wetland Assessment (find the link at **beeflambnz.com/farmplan**).

Set out your Freshwater Monitoring Plan in Template FW5 in "Our Plan". An example is set out below.

Freshwater Monitoring Plan

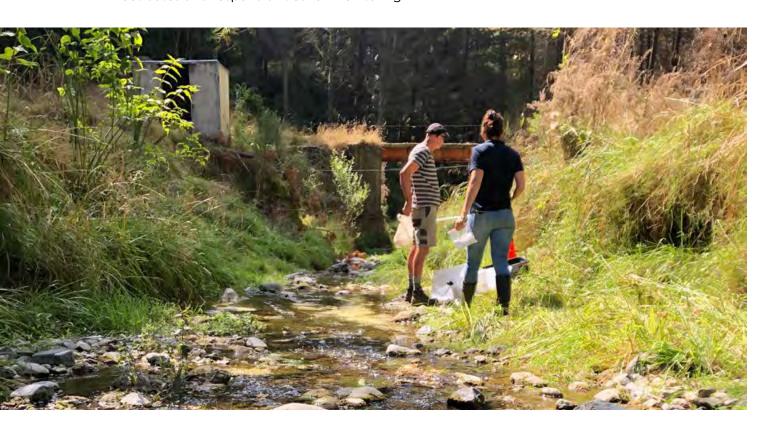
Example

Waterway Site Name	Monitoring Frequency	Date due to monitor	Assessment type	Person Responsible	Notes and scores	Date completed
Upper flats	Once per year	February	Stream Heath Check	Manager	Score=168 Needs improving, look at sediment management	February
Gorge	Once per year	February	Stream Heath Check	Manager	Score=280 Good water health	February
Lower flats	Once per year	February	Stream Heath Check	Manager	Score= 154 Ok but could be better for habitat	February
Wetland	Once per year	March	Landcare wetland assessment- Wetmak- photo points	Manager		

■ Blank templates can be found in **Our Plan** section

Some things you may want to consider when establishing a monitoring programme on you farm are:

- Choosing a site to assess your waterways that is representative or typical of the rest of the waterway. If you have long stretches of waterways on your property you may choose to break this into smaller sections and assess them separately.
- Using the same location each time you make an assessment. This can be marked with a metal standard in a place that won't get lost during floods
- Take photographs up and down the stream (this will be included in your photopoint monitoring for biodiversity).
- Repeat the stream Health Check (or alternative assessment) at least annually or as required. A freshwater ecologist will be able to offer advice on this.
- Carry out the assessments at the same time of the year and under similar stream water flow conditions (ideally low flow).
- Low flow conditions in summer when there has not been any recent rain is usually the best time to carry out the stream health check
- Ideally monitoring is conducted on all waterways on the property, or alternatively a
 representative sample. Depending on the situation, it might be beneficial to sample
 a stream where it enters the farm and again where it leaves the farm and to include
 additional sampling sites along the main stem of a waterway.
- Streams for sampling need to be wadable under normal flows (so excluding large braided rivers) and should be representative of those present on the property.
- Keep a written record of the results it will help to ensure you meet your freshwater goals.
- A place to store your data and information so that it can be referred to in the future the farm planning folder is a good place for this
- Put your approximate assessment dates in your calendar or diary so you know when it is due.
- Set dates and responsibilities for monitoring.



03 Integrating native biodiversity

Why is native biodiversity on your farm important?

There are many reasons why integrating native biodiversity into your farm system is important, both for your farm and more widely.

At a fundamental level, we can only support New Zealand's native biodiversity in New Zealand. It occurs nowhere else, and the biodiversity on your farm is different to that on other farms – each farmer is custodian to a unique complement of New Zealand's native biodiversity. Furthermore, sheep and beef farms are particularly important because they are often located in areas where there is little public conservation land such as reserves and most of the remaining native biodiversity in rural New Zealand occurs on farms.





Understanding your native biodiversity resource

Biodiversity is the variety of all living things and ecosystems. It includes plants, animals, fungi and micro-organisms as well as the ecosystems (on land or in water) where they live. Native biodiversity in Aotearoa is rich and unique. Many of our plants, birds, bats, insects, fungi, reptiles and fish aren't found anywhere else in the world.

Changes in the use of our lands and sea, invasive species, pollution, harvesting/extraction and the rapidly increasing threat from climate change are all current threats to native biodiversity.

Biodiversity resources or assets can be identified on your farm at different scales, including larger areas of habitat (such as native bush block or wetlands) to individual species that are present on your farm. You may have species present that are regarded as rare, special or iconic species that require specific management or protection.

This section will help you describe the terrestrial biodiversity habitat assets (such as forest and shrubland remnants, wetlands, scattered native trees, matagouri scrub and tussock grassland) and the native species that occur on your farm, assess their condition and consider what native biodiversity occurs in areas adjacent to your farm.

STEP 1

INTEGRATING NATIVE BIODIVERSITY

Identify your goals for integrating native biodiversity into your farming system

In relation to your long-term vision and goals identified at the start, in **Template OT1** in "Our Plan", identify specific goals for native biodiversity on your farm. It is important to consider how biodiversity and native habitats can be protected and improved on your farm. There are a range of experts available locally to help you understand what biodiversity is special to your area. Many you can access for free including your local Department of Conservation office or Regional Authority. There are also professional ecologists who can help.

Below are some objectives in relation to this that might help. You may also have objectives that your Regional Council have outlined which you need to address in your Farm Plan.

- **Biodiversity:** To protect and enhance biodiversity assets on farm and within my community
- **Pest and weed management:** To develop an effective pest and weed management strategy



STEP 2

INTEGRATING NATIVE BIODIVERSITY

Update and review farm map

Review your **farm map** and ensure that you have identified the major areas of native vegetation. It is also helpful to map the areas of adjacent biodiversity (on neighbouring properties) on the map of your farm. These areas can be important for the biodiversity on your farm, for example as seed sources for your farm, because the birds that occur on your farm are also dependent on these areas, or because the biodiversity on your farm helps support adjacent areas (e.g. through an interconnected wetland).

STEP 3

INTEGRATING NATIVE BIODIVERSITY

Map Significant Natural Areas

Almost all district and regional councils include criteria for assessing ecological significance in their plans. Councils typically include rules around what farm management can be done in areas that meet these criteria (e.g. restricting vegetation clearance). It is important that you as a farmer are aware of any areas on your farm that have already been identified as significant or could potentially be considered as significant.

On your **farm map** you should include any areas on your farm that have been identified as significant by a district or regional council. In undertaking your own assessment of the biodiversity assets on your farm, you (or the ecologist helping you) should also be considering if any of these areas might be considered significant in terms of the criteria outlined in **'Integrating native biodiversity - Further Reading'** later in this section.



STEP 4

INTEGRATING NATIVE BIODIVERSITY

Once you've marked areas of native vegetation on your farm map, complete **Template BT1** in the "Our Plan" section (example below). This is a simple 'stocktake' of your Farm's native biodiversity assets (and those in your wider neighbourhood).

Farm Biodiversity Assessment - Whole Farm

BT1

Adjacent areas of native vegetation:

Neighbours on western boundary and other neighbour on southern boundary share native forest area that continues from our place. The total area of the native block is approximately 130ha over the 3 properties.

There is a Department of Conservation reserve that is 2km from our property boundary and has native bush.

Neighbours 3km further down the road have a large native bush block

Rivers going though several properties have riparian areas that are being planted in natives as part of catchment group project

Note if any areas of native vegetation adjoin the property or are located in close proximity including both public conservation land areas on other farms. Where possible include these on the farm map (below).

General trends in native birds:

Bellbirds, fantail, kereru all seen regularly numbers seem stable

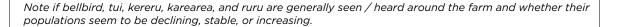
Tuis used to come to the kowhai trees, none seen for last 2 years

Kereru seen over summer in flocks of 10-20, I think the flocks used to be bigger when I was younger. Seem to come back regularly. I-2 birds seen regularly around the house block most of the year

No falcon seen- several Harrier Hawk though

Occasional Ruru (Morepork) heard at night

Other smaller birds present in bush in good numbers



General trends and animal pests and weeds:

Possum numbers high until recently when possum control work was carried out by contractors

Stoats -see them around occasionally. Have been trapping for them around the house block. Catchment group project to do some stoat trapping on the properties in the area

Spraying near top bush block has reduced gorse. Will keep spray programme going next year.

Spotlighting for rabbits and hares, still in reasonable numbers.

Pigs and goats on decline, not as many as previous years, controlling though shooting.

Note any particular animal pests or weeds that affect the farm or may potentially affect the farm in the near future and whether they are in decline, stable, or increasing.

Farm Native Biodiversity Assessment - Individual Sites

Assess each of the areas of native biodiversity identified on your Farm Map with the Farm Biodiversity Assessment - Individual Sites (**Template BT2** available in 'Our Plan').

A framework has been developed that allows you to classify the native vegetation present even if you do not know the species present. The classification is based on the growth form of the dominant plants (forest, shrubland, grassland, wetland), their origin (remnant of the original pre-human vegetation, regenerating after past farming or planted) and the amount of canopy cover (continuous or diffuse). The framework and examples of its application are included later in this section, in 'Integrating native biodiversity - Further Reading'.

Describe and Assess Condition

The detail provided here in **Template BT2** will depend on the ecological information available, but the following issues should, where possible, be addressed:

- Area (ha)
- Physiography (type of country- e.g. gully, slopes, aspects, altitude etc)
- Vegetation type (forest, shrubland, wetland, remnant, regenerating, continuous canopy, diffuse canopy etc)
- Dominant plants by layers (canopy, understorey, ground)
- Rare plant species if known
- Native birds, reptiles (lizards and geckos), fish (eels, whitebait, bullies etc), invertebrates (butterflies, snails, weta etc) and other fauna (e.g. bats)
- Canopy conditions e.g. any evidence of dieback
- Understorey condition e.g. has it been browsed out
- · Soil disturbance e.g. by pigs
- · Evidence of timber harvesting past or recent
- Fire impacts
- · Hydrological changes e.g. straightening up of streams, damming etc
- Presence and condition of fencing
- Predators presence and sign e.g. stoats, cats, rats
- · Herbivores and omnivores presence and sign e.g. deer, possums, pigs
- Wasps
- Weeds woody, vines, herbaceous
- Human influence conservation management, rubbish etc
- Distance to other native areas- important for seed source and allowing animals to move in or out
- Any formal protection (e.g. QEII covenants)

Identifying individual species on-farm - Native Birds; Native Invertebrates, lizards and bats Optional

More detailed information on biodiversity can be collected by identifying particular animals and invertebrates on your property. Some species may be iconic such as the kiwi or native falcon/karearea, or distinctive of your region (for example kauri and pōhutukawa in the northern North Island, and tree daisies in Otago). Others may hold cultural significance or be important indicator species. Often whether these species are present or not, and their abundance can give an indication of overall ecosystem health or biodiversity. Knowing what is present can also help you prioritise your actions to protect their habitat or control for specific pests and weeds.

In the templates provided for Identifying Individual Species (BT3 Recording Sheet for Birds and BT4 Recording Sheet for Native Invertebrates, Lizards and Bats, found in "Our Plan"), start creating a list of the species you have or see on your farm. More information and additional resources are provided later in this section (see 'Integrating native biodiversity – Further Reading'). You may also want to use the inaturalist app to help identify species.

Depending on your skill level you may be able to identify several species and start to build that list over time. Resources to help with identification may be available from local libraries, schools, QEII National Trust, Department of Conservation, or local and regional councils. Alternatively, you may want to get specialist help from an ecologist or someone with skills in animal or plant identification. They can be very useful to help build picture of your current biodiversity and make suggestions to help you protect and enhance biodiversity on your farm. The cost of this person could be shared with a catchment group or neighbouring properties.





STEP 7

INTEGRATING NATIVE BIODIVERSITY

Identify risks to biodiversity on your farm

Key risks to native biodiversity

A range of factors threaten native biodiversity on farms and the focus of this part of the Plan is being aware of what risks might be affecting your biodiversity and implementing management practices to address these risks. Some of the factors that represent risks to native biodiversity include:

- Loss of remnant areas ongoing loss of areas of native vegetation due to grazing or clearing reduces the amount of habitat available.
- **Isolation of remnant areas** because of habitat loss, remnants are isolated which can be a major barrier for native species to move between remnants or recolonise if they go locally extinct.
- External effects impacts of activities in areas adjacent to remnants (e.g. land-use, herbicide, fire) can adversely impact remnants.
- **Introduced herbivores** (deer, goats, pigs, possums, hares, rabbits) damage the understorey and grasslands and prevent regeneration.
- **Introduced predators** (stoats, cats, rodents, possums etc) kill native animals especially birds and reptiles.
- **Weeds** (wilding conifers, willow, hawthorn, old man's beard, blackberry etc) smother native vegetation and prevent native plants from regenerating.
- **Benign neglect** a lack of management or a lack of awareness of what native biodiversity is present can result in ongoing biodiversity decline (e.g. through cattle grazing under bush remnants).
- **Climate change** as conditions become more extreme (droughts, flash floods etc) native plants and animals are impacted through habitat loss and impact on food supply.

Risk Assessment

Consider these risks and complete the Biodiversity Risk Assessment Template BT5 in "Our Plan" (example below) for your own farming system. This will inform your action plan. Use the Risk Assessment Matrix chart to identify the overall risk by assessing the likelihood and impact to your farm business and the environment.

Risk Assessment Matrix

l ikaliha ad		Consequence	
Likelihood	Slight	Serious	Major
Low	Low	Low	Medium
Medium	Low	Medium	High
High	Medium	High	High

Risk Assessment - Biodiversity

Example BT5

Risk to biodiversity	Risks on your farm	Overall risk
Loss and isolation of remnant area	Top Bush block not fenced Scrub clearing on neighbouring areas	Medium Low
Introduced plant and animal species	· Pigs and possums	Medium
Benign neglect	· Top bush block not fenced	Medium
Climate Change (considered also in Climate Change section)	· Change in climate leading to more pests and diseases	Medium

Blank templates can be found in **Our Plan** section

Identify actions to protect and enhance biodiversity assets

Now that you have an understanding of what biodiversity assets you have on your property, what condition they are in and what risks you may have to them you can identify actions and management strategies in **Template IT1** "Our Plan" to protect and enhance biodiversity assets (example below). You may also identify new areas to develop such as wetlands or new shelterbelts.

The plan should also consider biodiversity assets in areas adjacent to your farm (e.g. remnants on an adjacent property or public conservation land such as a scenic reserve). These areas can be important as seed sources for your farm or because the birds that occur on your farm are also dependent on these areas, or because the biodiversity on your farm helps support adjacent areas (e.g. as part of an interconnected wetland system).

Some examples of management actions are provided in **Table 3.1**. This also discusses the role of exotics which you may like to consider in your responses.

Native Biodiversity Action Plan

IT1 Example

Identified Risk to Native Biodiversity	Actions to address risk	Location and/or LMU	Timeframe or Date Implemented	Person responsible/ Others involved	Priority (Low, Med, high)	Date completed
Loss of remnant area	Will fence top block to stop access from cattle to the native bush area. Some scrub areas to be left and not cleared	Top block	Will start fencing November 2021	Manager	High	
Introduced plant and animal species	Start shooting more pigs and allow some pig hunters access.	Whole farm	May 2021	Manager and hunters	Medium	
	Control of possums by pest contractors	Whole farm	June 2021			
Benign neglect	Active control of pigs and possums and other pests and fencing native bush area to stop cattle access	Top block	May 2021	Manager	Medium	
Climate Change	Create a plan pest and diseases management	Whole farm	October 2021	Manager	Medium	
	Attend workshop on climate change impacts and resilience in rural communities		August 2021			

Blank templates can be found in **Our Plan** section

Table 3.1 Management options to enhance native biodiversity

Management practice	Explanation
Fencing (livestock and/or rabbits and/or feral animals such as deer & goats)	Allows native vegetation to regenerate, restoration plantings to grow, and stops degradation of wetlands and riverbanks.
Feral animal control (shooting and/or traps)	Reduces pressure on palatable native plants allowing them to grow, especially restoration plantings and forest understorey species.
Possum control (traps and/or baits)	Reduces damage to vegetation and allows palatable species to regenerate.
Predator control (traps and/or baits)	Reduces pressure on native animals (birds, lizards, insects etc) and allows them to increase in abundance.
Weed control (manual, spray, biological	Reduces the abundance of weeds allowing native vegetation to develop towards a more mature condition.
Wasp control (poison)	Reduces food competition with and predation of native animals and makes bush areas friendlier for people.
Planting (including enrichment planting)	Increases area of native habitat and can bring back locally absent species such as tōtara and beech.
Providing key food resources for birds (can use exotic plantings)	Helps sustain native birds like bellbird/korimako and kereru/wood pigeon within the area.
Enhancing nesting opportunities (nest boxes)	Allows some native birds to be able to nest free of predation pressure (e.g. ruru/morepork).
Managing diffuse trees or shrubs across paddocks for shade and shelter (tōtara, kanuka, matagouri, tussocks etc.)	Retaining these species can be good for providing shelter and shade for livestock (e.g. for lambing or calving) while also enhancing native habitat across the farm
Sustainable timber production (beech or tōtara)	Native species can be managed for sustainable timber production under an MPI sustainable management plan or permit
Mānuka honey	A long-term nursery crop for native forest regeneration and can provide an economic return for many years.
Grazing and pasture management for sustaining short tussock grasslands	Grazing can be a 'two-edged sword' in short tussock grasslands with too-much or too-little grazing leading to loss of the tussock cover, but when done at the right level can result in good pasture and shelter for livestock while retaining tussock cover (photo-monitoring is a good tool for tracking tussock cover).
Erosion plantings (ngaio, tōtara, cabbage tree/ ti kōuka, flax/harakeke)	While poplars or willows are most often used, native species can also be used to increase biodiversity so long as they are protected from livestock
Wetland planting (flax/harakeke, pūrei, anuka)	Can act as a sediment trap and enhance water quality
Using native plants in shelter belts	Consider using native species as part of new shelterbelts or in enhancing existing shelter belts - habitat for native species and aesthetic values (e.g. kowhai and harakeke).



Develop a regular monitoring programme for your biodiversity assets

Key principles that underpin biodiversity monitoring include:

- Remember that biodiversity changes can take a long time to be visible, you may not see changes in your monitoring for some time. Photo-points are a useful tool to observe small changes.
- Having clear objectives being clear about the questions that monitoring is addressing is essential in order to develop appropriate methods.
- Only monitor when necessary monitoring can be time and resource expensive and needs to focus on the key issue(s) of interest.
- Use repeatable and simple (but appropriate) methods simple methods are usually easier to repeat than complex methods and are likely to be less sensitive to equipment changes than complex methods.
- Keep the time of year monitoring is undertaken the same this is important to avoid seasonal variations.
- Choosing appropriate variables to monitor the indicator chosen needs to be appropriate
 for answering the question being asked and should focus on biodiversity outcomes (e.g.
 canopy cover) rather than pressures on biodiversity (e.g. deer or possum numbers).
- Choosing the right scale to monitor monitoring needs to be undertaken at a scale that is appropriate to the question. For example, one-off stream chemistry measurements will not provide an assessment of overall stream and catchment health.
- Having a robust monitoring system -clearly and accurately document all that you do including how the information collected is stored.

The recommended ongoing monitoring approaches for the biodiversity section of the Farm Plan are:

- Photo-point monitoring. See **Template BT6** in "Our Plan".
- Individual monitoring of native animals including birds (annually and throughout the
 year), fish, macroinvertebrates, lizards, and bats throughout the year as they are sited.

The detail on these monitoring approaches can be found in 'Further Reading' in this section

Integrating native biodiversity - Further Reading

Identifying the biodiversity resources on your farm

There are a range of publicly available information sources that could hold information on biodiversity on your farm or in the wider area that you might want to consult (or ask an ecologist to check for you). These include reports prepared through the Protected Natural Areas Programme (your local council should have copies of these), a range of scientific publications (e.g. natural history reports, scientific journals like New Zealand Journal of Botany, Notornis and New Zealand Journal of Ecology), publicly available databases like the National Vegetation Survey (NVS) database and citizen science databases such as iNaturalist (see below). In addition, regional and district councils may have also done surveys and hold information on your property either as reports or as map layers in their GIS systems.

Vegetation assessment framework and examples

The native biodiversity on your farm comprises the different native vegetation types and the native plants and animals that occur in them. This guidance will help you name or classify what the native vegetation is on your farm.

It is important to have some knowledge of the different vegetation types present on your farm to guide management in and around this. An ecologist would establish plots in native vegetation patches, recording information on the different species present and their abundance, as a basis for describing vegetation. As this is not always possible for an individual farmer the following framework has been designed as a simple tool to help you describe and map native vegetation types present on your farm without needing to know all of the species present, although knowing dominant plants can add value to your descriptions.

The framework is based on a three-level classification reflecting the **type of vegetation** (growth form) present, its origin and if its cover is continuous or not.

The type of native vegetation present:

- Forest (beech, tōtara, kahikatea, mixed podocarp-broadleaved, kauri, etc)
- Wetland (flax, raupo, sedges, saltmarsh etc)
- Shrubland (kānuka, mānuka, matagouri, tauhinu etc)
- Grassland (snow tussocks, short tussocks)
- Other (rock bluff, scree slope etc)

The pre-human vegetation that occurred in those parts of New Zealand that are used for pastoral farming today was predominantly forest or wetland. Natural shrublands would have been of limited extent (exposed coastal sites, recent river floodplains etc) while natural grasslands were largely restricted to above the alpine tree line. With human deforestation, grasslands expanded in the South Island and throughout New Zealand, shrubland has also expanded into areas that were previously forested.

Overlap between vegetation types does of course occur, especially between shrubland and forest, where some shrubland communities (e.g. kānuka and mānuka) can be transitional to forest. In some situations, mixed communities can also be common (e.g. forest/shrubland or grassland/shrubland mixtures). In these cases, you can either refer to the predominant vegetation type or note that it is mixed.

The origin of the vegetation:

- Original (remnant of the original or pre-human vegetation, no matter how modified)
- Regenerating (vegetation that has regenerated on previously farmed paddocks such as kānuka shrubland or young tōtara and kahikatea forest)
- Deliberately planted (e.g. riparian plantings)

The origin of the current vegetation is important as remnants of the original native forest and wetland, no matter how modified (e.g. through past logging or grazing), are significant as they represent what used to be present across your farm. As well as being of immense value in themselves, such remnants and their soils contain propagules (seeds, or spores) of plants and animals that can disperse out and recolonise regenerating and planted sites (seeds, fungi, insects etc).

New Zealand farms also have large areas of regenerating native vegetation, mainly shrubland and forest, which has established on sites that were previously grazed. This vegetation is also important because if managed properly, it will develop into mature forest similar to what would have been there in the past. Regenerating vegetation is critical for enhancing connectivity across the landscape for mobile species like birds as well as increasing the total area of native habitat present.

Canopy condition:

- Continuous (>70% canopy cover largely intact native vegetation)
- Scattered (15-70% canopy cover native vegetation is scattered through pasture)

In many situations, native vegetation is not continuous and occurs scattered through the pasture matrix (e.g. tōtara trees scattered across farmland or short tussocks scattered through pasture). Scattered or diffuse native vegetation still has important biodiversity values (e.g. birds using paddock tōtara or kahikatea) and can also be really important for farming (as shade and shelter). Mapping scattered native vegetation is important for planning farm management.

There will be instances where exotic species occur in mixtures with natives (e.g. gorse shrubland with mahoe or five-finger regeneration coming up through it) and these can also be mapped using the system described here. It is also possible to map exotic woody vegetation like forest and shrubland where planted and regenerating examples can be readily distinguished (e.g. farm woodlot or gorse and broom shrubland).

When you come to map the different patches of native vegetation on your farm, you can supplement the descriptions derived from the framework outlined here with the names of dominant species that you know. This provides further information on what you have. Examples might be a continuous tawa-rimu original forest, scattered regenerating tōtara forest, continuous regenerating kānuka shrubland, or scattered regenerating short tussock grassland.

Examples of how classification works

The following examples illustrate how the classification can be applied. The primary focus here is on forest and wetland as this would have been the predominant native vegetation across pastoral farms before human clearance. Furthermore, active management of regenerating native vegetation like kānuka and mānuka and restoration plantings also usually aim to restore forest and wetland.

Original Regenerating Planted

Usually a younger stage of a planted restoration site (before canopy closure)

Figure 3.1 Forest vegetation

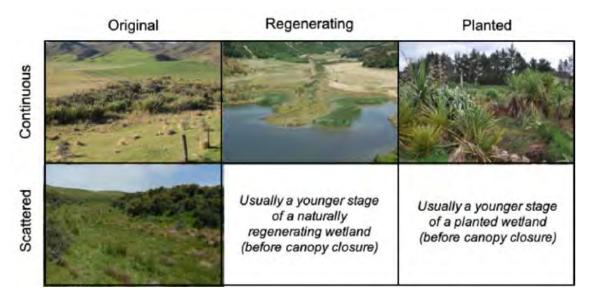
The examples in the above photos are described as:

- Original continuous a cutover stand of podocarp-broadleaved forest that would have been dominated by rimu, tōtara, kaihikatea etc over a canopy of broadleaved trees, but after historic logging is now dominated by tawa, rewarewa, hinau etc and is typical of much North Island remnant forest (King Country).
- Original scattered black beech forest that has been partially cleared but still retains standing mature beech trees (Canterbury).
- Regenerating continuous a mixed stand of kānuka and tōtara on a site that was previously pasture (Northland).
- Regenerating scattered scattered tōtara through paddocks (King Country).
- Planted continuous mixed-species forest restoration planting (Canterbury).

Original forest is critically important because the forest and its soil has always been present at the site, even though it might have been logged or grazed in the past. Such forest remnants and remnants of the original wetlands are the most important areas of native vegetation across pastoral farmland. However, the distinction between shrubland and forest is often a fuzzy one as young regenerating shrubland (e.g. comprising native species like kānuka, karamu, kōhūhū, five-finger, broadleaf, mahoe etc or even exotic species like gorse) will eventually develop into forest. It is therefore best to classify regenerating shrubland as regenerating forest.



Figure 3.2 Wetland vegetation



The examples in the above photos are described as::

- Original continuous flax/harakeke wetland with a minor shrubland component (Canterbury).
- Original scattered scattered plants of purei (Carex secta) in a narrow wetland now largely invaded by exotic grasses and sedges (Canterbury).
- Regenerating continuous raupo establishing around the edge of an artificial pond (Canterbury).
- Planted continuous wetland restoration with ti kouka, harakeke and purei (Northland).

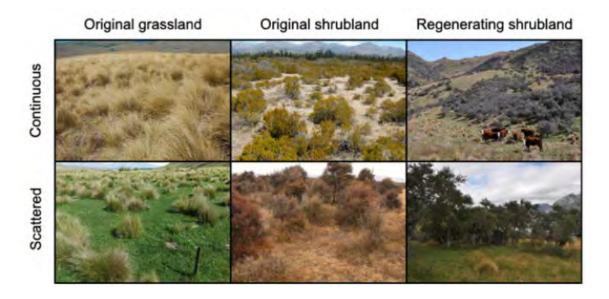
Wetlands although of minor extent in the modern landscape are really critical for both their native biodiversity and as filters for runoff from paddocks. Most wetlands occur in sites that would have always supported wetlands. Remnants of original wetlands are still widespread but can be isolated and usually lack their original marginal woody vegetation. However, many wetlands have been invaded by exotic grasses, sedges and rushes, often because of drainage, and only scattered native wetland plants remain. In some cases, native wetland plants are regenerating in sites where they previously didn't occur such as damp paddocks or artificial ponds.

Figure 3.3 Other Vegetation Types

For other vegetation types (grassland, shrubland, rock bluffs etc) the framework discussed here doesn't work as well as only a subset of the different combinations occur.

Native grassland on pastoral farms is largely restricted to the South Island and is mainly dominated by either snow tussocks (including red tussock) or short tussocks (hard tussock and silver tussock). Although many of these grasslands have been induced by early Māori burning, they are best regarded as original in terms of the framework discussed here.

In some parts of New Zealand there are original shrublands on farms, examples include shrublands on recent alluvial surfaces, in frost flats or on sand dunes and exposed coastal cliffs. However, most shrublands are either regenerating back to forest (as discussed above) or because of lack of seed sources and management history (especially oversowing and top-dressing) are less likely to revert to forest – examples include matagouri and tauhinu shrubland and can be mapped as shrubland.



The examples in the above photos are described as::

- Original continuous grassland snow tussock grassland (Canterbury).
- Original scattered grassland silver tussocks in a pasture matrix (Canterbury).
- Original continuous shrubland bog pine shrubland with native woolly moss (Southland).
- Original scattered shrubland dryland kānuka shrubland partially invaded by exotic grasses (Canterbury).
- Regenerating continuous shrubland continuous matagouri shrubland (Canterbury).
- Regenerating scattered shrubland matagouri shrubland with pasture grasses (Otago).

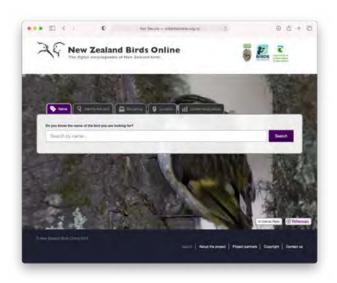
Adding in information on individual species

For plants, you will know some of them already (e.g. common trees like beech or tōtara and distinctive plants like harakeke/flax and ti kouka/cabbage trees) but many others may not be familiar to you. There are some resources available to help you, especially through the NZ Plant Conservation Network (www.nzpcn.org.nz/flora/plant-identification).

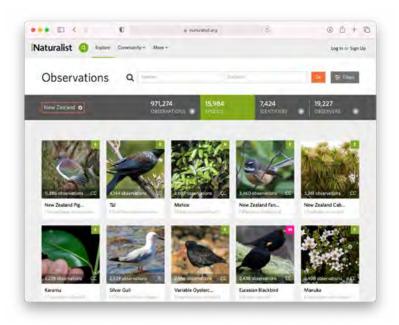
You may have identified a range of invertebrate species that are present in waterways on your farm when doing your Waterway Self Assessment in the Freshwater section. Most freshwater fish in New Zealand are nocturnal, so red-light spotlighting at night is a great way to see what you might have. Further information on the assessment of aquatic biodiversity is included in the Freshwater section as this relates to the assessment of the ecosystem health of aquatic habitat. For help identifying freshwater fish visit NIWA page on identifying fish species. You can find a link to the exact page on **beeflambnz.com/farmplan**

You may already have an idea of what birdlife there is on your farm. Start building a list of species that are present. Birds are very mobile and may be present occasionally or seasonally in particular areas throughout the year. If you are unsure of species, try to take a picture if possible but this is often challenging with birds. There are a range of good resources to help, for example the NZ Birds Online resource is a great starting point (www.nzbirdsonline.org.nz).

There may also be other animals present like lizards, bats and of course terrestrial invertebrates (weta, beetles, snails etc). Lizards, snails and other terrestrial invertebrates don't move as far as birds,



however they can be easier to see at various times of the year, often during warmer months. Information on identifying native animals can be found on the DOC website. You can find a direct link on **beeflambnz.com/farmplan**



Another great tool is iNaturalist: www.inaturalist.nz. It is a community-based tool (web or app) which allows you to share what you see, set-up citizen science and community-based monitoring projects, meet other nature watchers and learn about what you are seeing. You can load a picture of plants or animals that you see and the community will help identify them (if you don't know already).



Significance assessment

The attributes that are used to assess if a site is significant vary slightly around New Zealand and the proposed National Policy Statement (NPS) on Indigenous Biodiversity (2019) includes a set of common criteria for assessing significance that, should the NPS be enacted, then all councils will be required to use. These include how representative the site is of broader ecological patterns, the diversity within the site, the presence of rare and distinctive species, and the ecological context of the site.

Significance assessment requires a good ecological knowledge of both what native biodiversity is on your farm (as discussed above) and what is present in the wider area (e.g. is a particular native plant on your farm rare or common in the wider area). It is very much in your interest to know not only what native biodiversity is present, but if any of this is considered significant. Having this knowledge puts you in a much stronger position when it comes to discussions with Councils and others on how you can farm your land. Significance can be assessed at both the scale of individual biodiversity assets (e.g. a bush or wetland remnant) or at the scale of the whole farm. The correct approach will depend on your situation and may be something that an ecologist can provide advice on.

Role of exotics

Exotic or introduced species are often not included in native biodiversity assessments. However, there are times when you may want to include these species. For example, occasionally areas of gorse may provide important habitat and protection from predators for rare or threatened native animals, such as lizards or insects. The gorse keeps predators away and provides protection to the native species. If contained, it can also provide an excellent nursery crop for the regeneration of native vegetation. In waterways you may want to note down if there are introduced fish such as trout present as they can be important indicators of healthy, clean waterways, although trout are also predators of native fish. Exotic woody vegetation (woodlots and homestead garden) can also be important as habitat and especially food for native birds like tui and kereru. In considering biodiversity on your farm, be prepared to think laterally and recognise that in some situations exotic vegetation can play positive roles.

Identifying and recording individual native birds

Native birds are a distinctive feature of most sheep and beef farms with a wide range of birds present across a diversity of habitats including grassland, riverbeds, wetlands, shrubland and forest (Table 3.2). Many are iconic species and part of what makes New Zealand distinctive and their conservation is seen as a priority. In addition, there are also a range of introduced bird species that are common across rural landscapes.

Table 3.2 Common native birds found on sheep and beef farms

Habitat	Common native birds
Riverbeds, lakes, ponds & wetlands	Paradise shelducks, scaup, pukeko, grebe
Forest and shrubland	korimako/bellbird, tui, kereru, piwakawaka/fantail, riroriro/greywarbler, ruru/morepork
Grassland	Pipit, banded dotterel
Widespread species	karearea/falcon and kahu/harrier

The presence and abundance of native birds can be useful indicators of environmental condition and the effects of farm management. However, it is important to recognise that the abundance of native birds is driven by a range of factors including predation pressure (mustelids, cats, possums etc), competition (with exotic birds), resource availability (e.g. food and nesting sites) and habitat connectivity. Not all of these can be influenced by farm management and for more mobile species like kereru or tui, factors beyond the farm can be as important for determining on-farm bird presence and abundance. Notwithstanding this, indices of native bird presence and abundance can be an important part of on-farm biodiversity monitoring and these notes provide guidance on how you can do this on your farm.

The most common approach to monitoring native birds in New Zealand involves either five-minute bird counts at a stationary point or walked transects of defined length or time, with the number of birds seen or heard, and their distance from the observer recorded. These observations are then used to develop indexes of bird conspicuousness that can be compared through time to assess trends in bird abundance. These methods require good bird identification skills, including identifying birds by their calls. They are not recommended for on-farm monitoring. However, if you are confident with your identification skills, you may like to do this.

See the Cacophony Project (**www.cacophony.org.nz**) if you are interested in identifying bird calls and using information technology to help protect our native birdlife.



The method for on-farm bird monitoring that is recommended here is to develop a simple index for one or a few distinctive birds that can be used to track changing bird activity across your farm. As is the case with all monitoring, there are a few simple rules that will make the results of your bird monitoring useful:

- Undertake bird monitoring at the same place each time you do it. Ideally these sites should be clearly marked on the ground (e.g. with a tag in a tree) and recorded on the farm plan.
- Record birds for the same length of time at each monitoring period (e.g. 5-10 mins).
- Undertake your monitoring at the same time of day, at the same time of year and under similar weather conditions (best done in fine weather in spring/early summer and within 1-2 hours of first light).

A range of birds can be assessed (Table 3.3) but if you have bush remnants it is suggested you use simple bellbird/tui activity counts as an index of bird activity (unless you are really good at bird calls, don't try and separate bellbirds and tui based on calls). Have 2-4 sites around your farm in or adjacent to areas of bush or other woody vegetation (could even be your homestead garden), and spend 5-10 minutes listening and recording all birds heard or seen (best done in late spring/early summer). Try and be objective and count the actual number of birds if at all possible. If you have a acoustic recorder, make a recording at the same time as this can be analysed in the future. It is recommended that you repeat this bird monitoring on at least three consecutive mornings under similar weather conditions so you build up a picture of overall bird activity.

You could do similar monitoring for your wetlands (e.g. ponds) recording the species and number of birds seen at the same time of day for three days. For rare birds like kea, grebe or falcon/karearea, you could simply record them whenever you see a bird, noting where it was on the farm and the time and date using **Template BT3** in "Our Plan".

Table 3.3 Examples of birds that could be monitored on sheep and beef farms

Bird	Methods
Bellbirds and/or tui	Record number of individual birds seen and heard in forest remnants, or even around the homestead, at least once each year, making sure that the month and time of day, and weather conditions, are broadly similar, and that records are made from the same place each time (probably best done for 5-10 minutes, three or four times during one week).
Water birds	Same as above but counting number of individuals of each species present on a waterbody (e.g. scaup and pukeko) at a set time.
Karearea/falcon	Note all sightings including date and location on the property for this iconic bird.
Rare birds	Note all sightings including date and location on the property for rare birds like kea and grebe.



On most sheep and beef farms the best approach is likely to be a mix of formal counts (e.g. bellbird/tui and/or water birds) supplemented by incidental observation of rare or unusual species. There is also merit if you drive or walk a standard route regularly or at the same time of year (e.g. mustering), to keep a count of particular species along that route. A really good resource to help support you with identifying birds is the New Zealand birds online web site (www.nzbirdsonline.org.nz) which covers native and exotic birds with excellent photos and audio recordings of their calls, and a tool to help you identify birds.

It is important that you as the land manager have "ownership" of your biodiversity and the way your management interacts with it, and monitoring is an ideal way for doing this. The bird monitoring system proposed here has been designed so that you can be actively involved in establishing, repeating and interpreting the monitoring. However, in interpreting the results of any monitoring, including bird monitoring, it is important to recognise that farm management is not the only factor that influences native biodiversity, and the abundance of birds can be affected by factors beyond your control such as pest species and availability of habitat on adjacent properties. The greatest value of any monitoring comes from long-term sequences of observations, so make it a priority to keep up with the monitoring.



Identifying and recording individual native invertebrates, lizards, and bats.

There may also be other animals present like lizards, bats and of course terrestrial invertebrates (weta, beetles, snails etc). Lizards, snails and other terrestrial invertebrates don't move as far as birds, however they can be easier to see at various times of the year, often during warmer months. Keep an eye out for anything that catches your eye or looks unusual. Many of New Zealand's native animals are nocturnal, so having an explore of the farm (safely) after dark might be a good way to see what you have. Keep a list of these animals and take a picture of them if possible. Note down the location and date (**Template BT4**) in "Our Plan".

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Photo-point monitoring

Photo-points provide a relatively simple and objective tool for tracking change in native vegetation on a farm through time. In essence, photo-point monitoring involves taking repeat photos of the same scene from the same place for several years. Although photo-points can't provide detailed information on all the plant species present, photo-points are ideal for assessing the broad effects of your management (e.g. stocking pattern or fencing) on native vegetation cover and hence on native biodiversity. As such, they are very useful for helping you review your biodiversity management and for showing others the changes that have resulted from your management. One of the key reasons for undertaking photo-monitoring is that it provides a simple but objective way of recording change. No matter how good we think we are at observing change, our own assessments are influenced by our perceptions of what we think should be happening, an inability to fully recall what conditions were like in the past, and a failure to compare exactly the same place or in the same season.

Photo-points can be used to follow changes in both overall vegetation cover (landscape photo-points; Figure 3.4) and vegetation composition (close-up photo-points; Figure). The latter can be used to track changes in shrub or tussock density, or forest understorey condition. The strength of photo-points is that they are cheap and easy to do, and can be established and managed. Depending on how they are set up and repeated, it is also possible to extract some quantitative information from them, at least for dominant species (e.g. by counting the number of tussocks or shrubs present).

There are some simple steps to obtaining a successful sequence of photos that can allow interpretation of vegetation cover through time (Table 3.4).

Table 3.4 Key steps for photo-monitoring

Key steps	Explanation
Permanently mark photo- points	This ensures photos are always taken from the same place - best done using a metal standard driven into the ground as fences, buildings and trees can be moved.
Take copies of previous photos when repeating photos	Essential to ensure that the same view is photographed each time (e.g. angle, inclusion of key features etc) Having a camera with the ability to zoom is helpful to make sure that the area captured in the image is the same each year.
Take photos at the same time of year	Photos are best taken in early summer (November-December) after the spring growth flush but before vegetation starts to brownoff through the heat and dry of summer. This reduces seasonality differences.
Develop a series of photos over several years	A single unusual season can result in misleading results so building up a sequence of images over several years avoids this.

The approach to taking landscape and close-up photo-points are slightly different. Landscape photo-points are best for illustrating changes in major landcover types like shrubland or forest and should include whole hillsides or similar large areas in the image. Accurate repeat photos and subsequent comparisons are best done when the image includes some distinctive features like ridges or rock bluffs. It is also important to ensure that the view being photographed will not be blocked out by changes in the foreground in the foreseeable future (e.g. tree growth or new buildings).

Close-up photo-points provide more detailed information on dominant species and their cover abundance at a particular site. For these, permanent reference points such as metal standards allow precise locations for accurate comparisons between years. Close-up photo-points are best located within areas of vegetation that are typical of the more general conditions in the paddock or block of interest, and should be relatively uniform with respect to vegetation, landform and management regime, and preferably on the mid-slope. They should also be at least 20 m away from structures (fences, water troughs, shelterbelts, tracks, buildings etc) as these can modify grazing animal behaviour and hence vegetation. Finally, the site should one that won't be disturbed in the foreseeable future (e.g. through cultivation).

Drones also provide an excellent way to obtain aerial images of remnants and other biodiversity areas that are hard to photograph from the ground (Figure 3.6). With modern drones it is possible to program them so they take a photo from the same place and in the same direction each time, which greatly increases their value.

The number of photo-points established will vary depending on the size of the property and the amount of native biodiversity present. Too-few photopoints will not provide sufficient information on overall property condition while too-many will most likely result in their never being properly analysed. For landscape photo-points, several photos can be taken from the same place (a panorama – Figure 3.7). Depending on the size and nature of a property, the number of landscape photo-points is likely to range from 5–20 per property. The number of close-up photo-points will depend on the vegetation present and management issues that might apply on the farm. If the farm has some tussock grassland, then close-up photo-points are very good for tracking changes in tussock density. Close-up photo-points are also great in bush remnants or regenerating forest such as kānuka to track change in their understorey vegetation through time (Figure 3.8).

Once established, photo-points should initially be re-photographed annually for four or five years to establish a good baseline, and then at least every other year to develop a long-term sequence. Where possible, photo-points should be established close to access routes (e.g. farm tracks) as this will substantially reduce the amount of time required to photograph them. The position of photo-points should be marked on your farm map, ideally having been recorded using a GPS, as well as marking them on the ground. Photos need to be properly annotated and stored once they have been taken.

It is important that you as the land manager have "ownership" of your biodiversity and the way your management interacts with it, and photo-monitoring is an ideal way for doing this. You should be actively involved in establishing, repeating and interpreting photo-point monitoring. However, in interpreting the results of any monitoring, including photo-points, it is important to recognise that farm management is not the only factor that influences native biodiversity, and the results of monitoring need to consider other potential influences (e.g. factors beyond your control such as pest species and drought). The greatest value of photo monitoring comes from long-term sequences of photos, so make it a priority to keep up with the monitoring.

Figure 3.4 Landscape photo-point showing change in vegetation cover on a retired sheep and beef farm over 13-years (2005 left, 2018 right). Note the increase in shrub cover on the hill side in the top right and restoration plantings below this, and the changes to the two ponds and especially expansion of raupo on the left-hand pond. Mahoe is also now dominant in the vegetation on the spur in the foreground where it was less important in 2005. The flats in the middle distance were cut for bailage not long before the 2018 photo was taken.



Figure 3.5 Close-up photo-point sequence showing little change in fescue tussock grassland over 13 years. Note tape lines (estimated in 2018) for reference.



Figure 3.6 Drone image of Hawkes Bay forest remnant (Adam Forbes photo).



Figure 3.7 Panorama of three images of high country farmland taken from the same spot (Otago).



Figure 3.8 Close-up photo-point showing rapid re-growth of mahoe under a kānuka canopy over three years with grazing animal retirement. Note background trees for reference.



04 Responding to a changing climate

Why do we need to respond to climate change?

A changing climate affects everyone; it is a global challenge. Farmers are especially affected due to farming systems being dependent on the climate and weather. Everybody has their part to play in reducing emissions and adapting to a changing climate.

There are two aspects to a response; managing greenhouse gas emissions and removals to limit the warming of our world, and building resilience to the impacts of changing climatic conditions.





Goals or values for responding to climate change

In relation to your long-term vision and goals identified at the start, identify specific goals for climate change on your farm, and note these in Template CC1 in "Our Plan". It may be about understanding your emissions, it may be about managing or mitigating your emissions, it may be about being prepared for an adverse event or changing climatic conditions. By 2025, all farmers need to have a plan to measure and manage emissions and be ready to participate in a pricing mechanism as part of the industry commitment to He Waka Eke Noa - The Primary Sector Climate Action Partnership.

Greenhouse gas and climate change values and goals

CC1

Example

Responding to Climate Change Goals

To gain market recognition for products with low emissions

To produce low emission and eco-efficient product valued by consumer

Know my greenhouse gas emissions numbers and have a plan to manage them

Be able to adapt and change to a range of changing climate scenarios

Blank templates can be found in **Our Plan** section





further background information

STEP 2

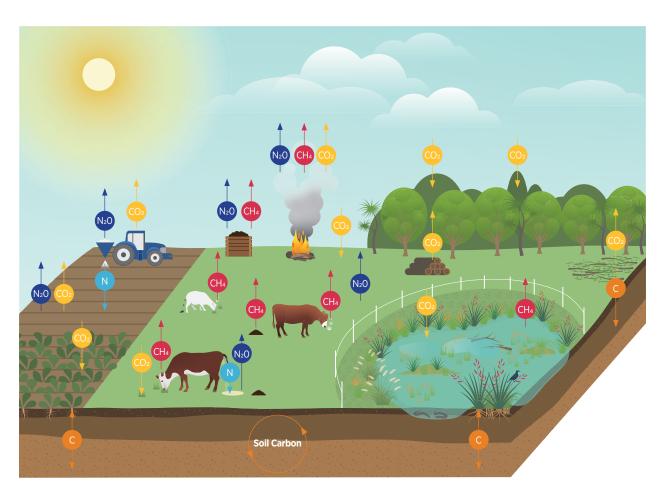
RESPONDING TO A CHANGING CLIMATE

What are sources and sinks of greenhouse gas emissions on farm?

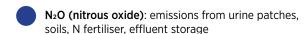
Sources of emissions from your farm system may include: Methane from ruminants (e.g. sheep, cattle, deer), effluent storage and wetlands.

Nitrous oxide from urine patches, soils, nitrogen fertilisers and effluent storage.

Carbon dioxide emissions from the decomposition of biomass, burning of fires, soil respiration, burning of fossil fuels and deforestation. Sinks of carbon dioxide, in the form of carbon, are trees, plants, pasture, soils, wetlands and in animals products (meat, milk, fibre).



Farming emissions and sinks come from a variety of sources



CO₂ (carbon dioxide): emissions from petrol and diesel use, deforestation, soil respiration, burning wood, plant decomposition; taken up by trees, plants, pasture, wetlands

C (carbon): stored in soils, plants and animal products (meat, milk, fibre)

CH4 (methane): emissions from animal burps, wetlands, dung and effluent storage

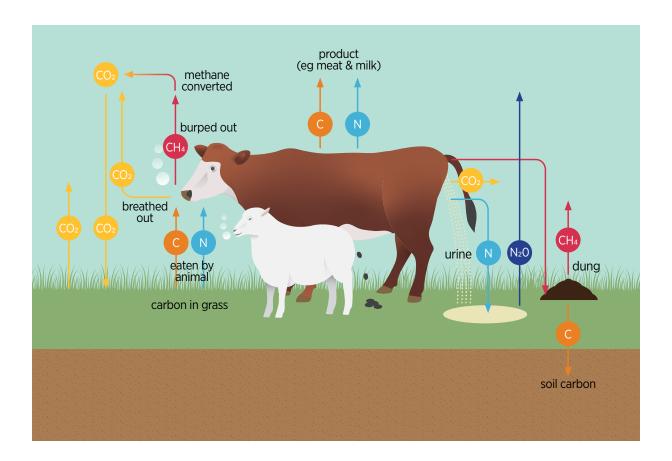
N (nitrogen): added as fertiliser, urine, dung and effluent

Methane and nitrous oxide from livestock

Methane is produced by ruminant animals and is released into the atmosphere as burps. It is produced via a complex process that occurs when ruminants eat plant material which is eventually transformed into methane by methanogens in the gut.

With a traditional pasture-based diet there is a direct relationship between the amount of dry matter eaten and the amount of methane produced. Approximately 21-22 grams of methane is produced per kilogram of dry matter intake (DMI).

Nitrous oxide is produced when soil microbes interact with nitrogen (N) in the soil and release N₂O. The more N in the soil the more microbial activity and thus the more N₂O produced. Common sources of N on farm are urine patches and N fertiliser.



What is a sink?

Carbon sinks are natural reservoirs that absorb carbon dioxide and store more carbon than they release. On farm, the main sources of carbon sinks are actively growing trees. Soils also act as sinks, however, this is not well understood in New Zealand at the moment and they are not recognised at present. Therefore, carbon sinks focus on woody vegetation (trees). A forest acts as a sink as long as the sequestration (carbon storage) is greater than the carbon release of dead and decaying matter. Often, once a forest reaches maturity the system is in balance and is no longer a sink, if the forest is harvested it then becomes a source of carbon dioxide emissions.

Sequestration: Recording current areas of woody vegetation

Under current policy settings, land that was not in forest on 31 December 1989 (known as post-1989 land) and has been planted or is regenerating is eligible for earning credits under the New Zealand Emissions Trading Scheme (ETS); if it is greater than a hectare, average width of 30m, will reach at least 5m at maturity, and will have at least 30% canopy cover at maturity.

Land that was forested on 31 December 1989 (known as pre-1990 land) is not eligible for credits in the New Zealand Emissions Trading Scheme (although has liabilities if harvested and not replanted). However, this area may still provide carbon sequestration.

In Template CC2 in "Our Plan", identify your current area of woody vegetation by type (regardless of whether you are registered for the New Zealand Emissions Trading Scheme). It is recommended to include all areas of woody vegetation, including those areas which may not be eligible for the Emissions Trading Scheme- such as small areas under 1ha, waterway plantings, scrub and shrubland areas. All these areas may still be sequestering carbon so it is important to account for and map these areas too. An example is given below.

Identify the following:

- Age of forest (approximate if you are unsure)
- State consider if it is declining, static or improving. You may have identified this in the biodiversity section for native vegetation. Forest that is declining may have understory that is being impacted by stock access, pests or weeds, whereas you may be undertaking pest and weed control and have excluded stock leading to improved understory health. Plantation forests are more likely to be static, although some may have regenerating vegetation in the understory also.
- You can get a rough idea of carbon sequestration for post-1989 forest land by using the Ministry for Primary Industries (MPI) look-up tables: You can find the link to the tables on beeflambnz.com/farmplan.
- In your Action Plan (Template CC6) identify any areas suitable for new/additional planting of natives, exotics or new areas of regenerating native (including shrublands), that could meet the definitions for generating carbon credits (currently, land that was not forested on 31 December 1989, where canopy cover at maturity is 30%, is at least 1ha, trees will grow to a height of at least 5m at maturity, and the stand is at least an average of 30m wide).

Current Areas of Woody Vegetation

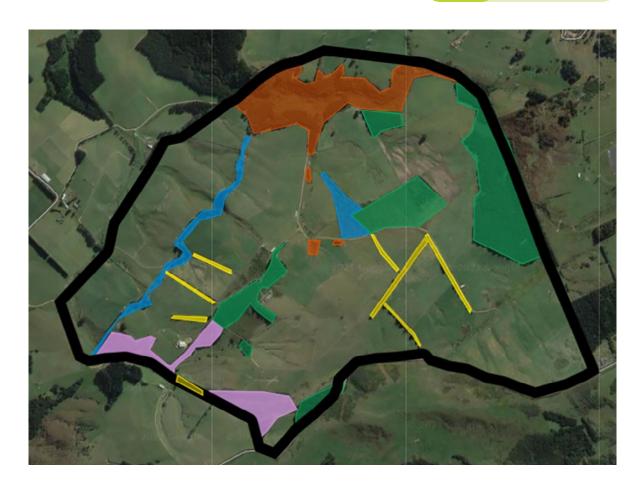
Example

Vegetated area type and description (native, exotic, shrubland)	Approx age or year of planting	Area (ha) Pre- 1990	Area (ha) Post- 1989	Approx canopy cover (%)	Annual sequestration if known (kg CO ₂ provided from some calculators)	ETS eligible? Y/N	State (declining, static, improving)
Planted pine plantation- exotic	19 years (planted 2002)		18	100%		У	Improving
Regenerating manuka in step south facing middle country- native	25		20	70%	114		Improving
Old growth Kahikatea- native	100+	35				N	Static
Shelter belts	15 years		3.4	80%		N	Improving
TOTAL		35	41.4		114		

In this section (Template CC3) please include a map of your farm to identify areas of sequestration. These may include planted forest blocks, native bush and scrub blocks and also other areas of woody vegetation such as waterway plantings and shelterbelts. A useful way to do this is on a copy of your farm map or using an aerial photograph. Mapping can also be done online using various free tools and then printed out. These tools can also help to calculate the size of different areas.

Areas of sequestration map

Example



Key

- Shelterbelts = 3.3ha
- Waterway and wetland plantings = 5.3ha
- Planted pine blocks = 27.5ha
- Native Forest = 16.9ha
- Scrub = 7.9ha

Total farm area = 263ha

Assessment of greenhouse gas emissions and sinks on farm

Know your number

There are a range of free tools available to calculate your emissions and sinks and most align their approach to the National Greenhouse Gas Inventory (the National Standard). If you are using OverseerFM for nutrient budgeting, it will have also calculated your emissions and sinks.

Note: greenhouse gas emissions are not actually measured at farm scale, as the technologies to do this do not exist. Instead, measurements are carried out under experimental conditions and the resulting data are used as proxies to estimate emissions on farm.

Some of the tools include:

- B+LNZ GHG calculator: provides a free, farmer facing tool to report the on-farm sequestration and emissions of the business, and reflects the individual farm's livestock and production system. The tool is designed to help the red meat sector's reporting requirements to satisfy He Waka Eke Noa regulations.
- OverseerFM: more complex calculator that estimates on-farm emissions and their sources. It can be used to test the impact of farm management changes on emissions (and nutrient flows) before those changes are made. It also accounts for sequestration by trees.
- Farmax 8: provides an estimate of on-farm emissions. It can be used to test the impact of farm management changes on emissions as well as animal production and profitability. It also accounts for sequestration.

Follow the link on **beeflambnz.com/farmplan** to find links to access the tools.

Benchmarks will shortly be available from the B+LNZ Economic Service Survey Farm Data.

In Template CC4 in "Our Plan", identify your emissions and sinks. An example is given below.

For the table below fill out the numbers that are provided from your greenhouse gas calculator. If your tool does not provide emission numbers for methane and nitrous oxide on a per hectare basis, you can convert them by dividing by your total farm area (not effective area).

Our Farm's Emissions and Sinks

CC4 Example

Production/ Financial Year and Date Calculated	Emission Methane		Emission Nitrous		Carbon	Defor- estation	Gross emissions	Seques- tration or sinks	Net	Tool used for calculations
	kgCH4/ ha/year	kgCO2e/ ha/year	kgN20/ ha/year			kgCO₂e/ ha/year	kgCO₂e/ ha/year	kgCO₂e/ ha/year	kgCO₂e/ ha/year	
2019/2020 season Nov 2020	78.6 kg	1965 kg	2.06 kg	615 kg	36 kg		2615 kg	691 kg	1924 kg	B+LNZ GHG Calculator

Note - some tools only provide values for methane and nitrous oxide in CO_2e . Fill in what you can, CO_2e gives enough information to complete the calculations of gross and net emissions.

Blank templates can be found in **Our Plan** section

STEP 3

Risks of greenhouse gas emissions and impacts of a changing climate

More information is available in a set of GHG Factsheets which can be found on the B+LNZ website. Visit beeflambnz.com/farmplan.

Farmers are adapting to different climatic conditions and weather patterns all the time; it is the nature of farming. The future impacts of climate change are based on modelled predictions and extensive knowledge and understanding of the impact of climate and temperature on weather patterns. This modelling suggests more frequent and more prolonged adverse events such as drought, floods, and snowstorms.

While we cannot predict when these events will occur, we can develop plans to manage them when they do. Having a plan in place can make dealing with an adverse event a little bit easier, and provides a starting point to respond.



Consideration of risks for climate change and greenhouse gas emissions

Identifying the risks of climate change and greenhouse gas emissions on farm and to the environment can help to prioritise actions or identify opportunities that will reduce the risk. This can help create a more resilient and sustainable business.

Below are some of the potential risks that you may want to consider, but there may be others that you identify for your farm system. There are additional risk areas listed in tables 4.1-4.5 that you may want to consider.

Potential risks from climate change impacts may include:

- · Not being resilient or adaptable to climate change, including being ready for the opportunities it may create
- More frequent extreme events such as flooding or droughts or storms
- Coastal areas susceptible to inundation, erosion or flooding
- Changes in growing seasons or areas suitable for particular crops or species
- Changes in distribution and prevalence of pests, weeds and diseases
- Changes in water supply availability and increased need for irrigation
- Human and animal health impacts
- · Increased risks of fires
- Changes in potential production

There are also risks factors that are related to greenhouse gas emissions from your farm. These can be direct risks to your business or risks to the environment.

Potential greenhouse gas emissions risks may include:

Risks to business - for example:

- Not knowing or measuring greenhouse gas emissions sources and sinks on farm
- Not having a plan to manage on farm emissions or adapt to a changing climate
- · Lack of eco-efficiencies in the farming system- such as genetics, animal health and productivity
- Lack of access to domestic and international markets due to market requirements and consumer expectations
- Changes in legislative and financial obligations for greenhouse gas emissions

Methane emission risks - for example:

- Lack of eco-efficiencies (production system not optimised)
- Poor genetics of stock
- High proportion of capital stock
- Poor animal health
- Feed type and wastage

Nitrous oxide emissions risks - for example:

- Fertiliser type and rate used
- Urinary nitrogen from stock
- Emissions from soils
- Feed type

Carbon dioxide emissions risks - for example:

- Fertiliser and lime use
- Fuel and electricity use
- Excessive agrichemical use

Carbon sequestration risks - for example:

- Deforestation or woody vegetation removal
- Lack of sequestration opportunities on farm
- Woody vegetation areas not mapped or quantified

Identify the risk factors and complete the risk assessment for your farm

Consider the risks of greenhouse gas emissions and impacts of climate change on your farm and complete the Risk Assessment (Template CC5) in "Our Plan". This will inform your action plan. For each risk factor you identify on your farm use the following Risk Assessment Matrix to assess the likelihood and consequence of greenhouse gas emissions or impacts of climate change on your farm business and/or environmental risk to determine the overall risk for each factor. An example is shown below.

Risk Assessment Matrix

l ilealile e e el		Consequence	
Likelihood	Slight	Serious	Major
Low	Low	Low	Medium
Medium	Low	Medium	High
High	Medium	High	High

Climate change and Greenhouse gas emissions risk template

CC5 Example

Climate change and GHG emissions risks	Potential risks on farm	Overall risk rating
Climate change impacts	 Pests more prolific New diseases in stock and pasture Weeds More frequent extreme climatic events Changes to weather patterns Different growing seasons 	Low Medium Medium High Medium Low
Risk to business	· Market access	Medium
Methane	Poor genetics Inefficiency in system	Medium High
Nitrous Oxide	 Urine patch emissions Nitrogen fertiliser emissions Soil emissions	Medium Low Low
Carbon dioxide	Use of fossil fuels Lime use Electricity use	Low Medium Low
Carbon sequestration	 Woody vegetation not mapped Riparian laneways not mapped 	High High

Blank templates can be found in **Our Plan** section

Develop an action plan to manage emissions and respond to climate change impacts

Managing greenhouse gas emissions on-farm

Every kg of Dry Matter Intake (DMI), consumed by a ruminant animal, results in the production of methane (and indirectly the production of nitrous oxide). Therefore, it is important to maximise the amount of product per unit of feed eaten.

A continued focus on capturing efficiencies in the farm system ensures feed eaten is used as efficiently as possible to contribute to the production of meat and wool on farm. The following areas (see **Table 4.1**) can impact productivity and therefore may offer scope for increased on-farm efficiency – enabling more production from the current feed supply, or maintaining production from a smaller feed supply (in either case reducing the amount of methane produced per kilogram of product). This idea of "achieving more with less" is often termed '**eco-efficiency**'. More, or the same, agricultural product with less input of land, water, nutrient and less GHG emissions with less impact on water quality, soil health and biodiversity, and with improvements in animal wellbeing.

At present there are limited options available to reduce emissions in more extensive grass based farming systems. Some of the options are presented in **Tables 4.2, 4.3 and 4.4**. In some instances, these can be implemented while maintaining or even increasing profitability (as shown by modelling work). It is important to assess options in relation to your overall business goals and other goals within your farm plan as some may lead to increased impacts elsewhere.

These potential mitigation and management options need to be carefully considered within the context of the whole farm system. While some strategies may reduce emissions in one area of the farm system, they have the potential to increase emissions overall depending on the farm management response. The impacts of changes to farm management practices must also be considered in the context of impacts on nutrient losses to water, soil health and biodiversity. Testing scenarios in Overseer or within farm system modelling software such as Farmax is beneficial to understand the potential outcomes across the farm business.

Consider the following mitigation practices and develop plans to measure and manage (over time) the on-farm greenhouse gas emissions from your farm system. Additional guidance is also available on the He Waka Eke Noa website, and an example follows this table. Record this into **Template CC6** in "Our Plan".

Mitigation strategies and practices are outlined on **www.agmatters.nz** and will be updated as the science advances and more activities are included in the national Greenhouse Gas Inventory. The site also includes case studies and videos of farmers.

More information is available in a set of GHG Factsheets which can be found on the B+LNZ website. Visit **beeflambnz.com/farmplan**.

Table 4.1 Options for eco-efficiency benefits

Areas for consideration	Some suggested actions on-farm to achieve the list on the left. These are not exhaustive and are for guidance only
Genetics	Selection for low methane sheep (and in the future cattle and potentially deer)
	Genetic improvement of stock for lamb/calf survival and maternal ability
	Improved pastures – careful selection of pasture mixes for pasture renewal (select those appropriate for the region taking in to account future changes in climate)
	Terminal sires to increase young stock growth rates (effectively allow more production per unit of feed)
Animal health	Prepare and follow a comprehensive animal health plan in consultation with a vet or other expert
	Reduction of drench resistance/failure
	Adequate shelter and shade to reduce animal stress in winter and peak summer (region dependent)
	Identification and treatment of subclinical disease
Improved lambing, calving and fawning percentages	 Ensure animals are at optimal mating weight/condition score Adequate and appropriate shelter on lambing, calving and
	fawning paddocks
	Checking rams/stags/bulls for reproductive fitness (improved pregnancy rates)
	Flushing ewes
Improved growth rates and	Pregnancy scanning and preferential treatment of multiples
reduced time to slaughter	Adequate and appropriate shelter on lambing paddocks
	Routine lambing beats to increase lamb survival
Pasture and soil management	In conjunction with agrichemical and seed suppliers create a pasture renewal programme
	Liaise with a qualified fertiliser specialist to prepare a fertiliser plan in combination with a soil nutrient budget
	Pasture and soil management to optimise utilisation
	Reticulated water and improved subdivision (smaller paddocks) to improve pasture efficiency and stock management
	Early identification and management of soil, pasture and crop pests
	Utilise tools and expertise to create a feed budget, with regular reviews and refinements

Table 4.2 Options to manage methane production

Areas for consideration	Some suggested actions on-farm to achieve the list on the left. These are not exhaustive and are for guidance only
Genetics	Select rams for low methane production
Low emission feeds	 Forage rape (30% less methane per kg DMI when fed as a sole feed). Fodder beet (needs to be more than approx. 75% of the diet which may cause animal health concerns)
Options for high input systems	 Better manage nitrogen fertiliser Reduce bought in supplementary feed and/or analyse efficiency of alternative supplementary feeds Improved effluent storage management Farm to the grass curve/grazed forage supply and optimise feed efficiency
Changes to the stock ratio	 Optimise stock policy to pasture growth curve Improve productivity of beef cattle
Future options	 Vaccine Bolus Drench Feed additives (compounds that reduce methane production in the rumen) Genetic selection for low methane emitting animals of other livestock species

Table 4.3 Options to manage nitrous oxide emissions

Areas for consideration	Some suggested actions on-farm to achieve the list on the left. These are not exhaustive and are for guidance only
Low emission feeds	 Plantain (research continuing but indications are it requires at least 30% of the pasture to be plantain to be effective) Fodder beet has a lower N content resulting in lower urinary N and thus lower N₂O (although in wet conditions nitrous oxide can increase)
Reduce urinary N lossess - either per animal or in the whole system	 Change to low N feeds to reduce urinary N Reduce stocking rate to reduce total urine Use nitrification inhibiters (if/where available)
Fertiliser	 Liaise with a qualified fertiliser specialist to prepare a fertiliser plan in combination with a soil nutrient budget. Appropriate timing and rate of application Optimise total N fertiliser inputs Use of urease inhibitors
Future options	Widespread use of nitrification inhibitors

Table 4.4 Options to manage carbon dioxide emissions

Areas for consideration	Some suggested actions on-farm to achieve the list on the left. These are not exhaustive and are for guidance only
Electricity use	'Green' electricity sources (e.g. solar panels)
Reduce fuel use	 Electric vehicles Drones Ensure full truckloads carting produce / livestock Reduced transportation of animals, feed, fertiliser
Optimise fertiliser use	 Liaise with a qualified fertiliser specialist to prepare a fertiliser plan in combination with a soil nutrient budget. Appropriate timing of applications Optimise total N fertiliser inputs Use of urease inhibitors
Targeted lime use	• Soil test and target lime applications to maximise effectiveness. Excess/ineffective liming adds CO ₂ emissions from manufacturing.
Reduce chemical use	• This reduces CO ₂ produced in manufacturing, transport and application.
Future options	Electric tractors, utes, farm bikes and other vehicles.

Identify sequestration opportunities

While you may be able to achieve small emission reductions through some of the changes above, you may also have opportunities to sequester carbon through woody vegetation - exotics or natives, permanent forest or plantation forestry. See Table 4.5 for examples. This can also enhance biodiversity outcomes for your farm and depending on the location, can also support healthy freshwater outcomes by reducing erosion risk or providing riparian habitat.

Table 4.5 Options for increased sequestration

Areas for consideration	Some suggested actions on-farm to achieve the list on the left. These are not exhaustive and are for guidance only
Increased sequestration	Retiring less productive areas (where applicable) and planting in natives or exotic forestry
	Planting shelter belts for improved animal production and sequestration
	Collaborate with neighbours and council to form catchment groups for a cohesive catchment approach to planning riparian plantings or other areas such as eco-corridors
	Planting of riparian areas and retiring critical source areas for dual sequestration and water quality outcomes
	Control pests, diseases, and weeds in planted areas to maximise survival and sequestration of planted areas

Climate resilience and adaptation

Outlined below are some things to consider in building a resilient and adaptable farm system.

- · Know the signs of stress and have some strategies to manage stress for you and
- Secure water supply and water reticulation for stock (year-round)
- Ensure adequate shade and shelter for stock
- Have a proactive animal health plan
- · Maintain healthy, well-fed stock year round
- Budget for adverse events even budgeting a small amount each year can take a bit of pressure off when an adverse event hits
- Source access to a generator or back-up option for extended power loss
- Back-up for communication (e.g. old-style phone)
- Maintain regular feed budgeting
- Retain a buffer of supplementary feed on-hand
- Consider the use of summer crops, cereal crops, specialist dryland species such as lucerne, strategic use of winter crops can add resilience
- Review alternative/more flexible farming systems with diverse production types, including aspects such as timing and how this may impact your stock classes
- Consider irrigation and water storage options
- Be proactive with erosion management to limit the damage and soil loss from storms.

Action plan to manage emissions and respond to climate change impacts

900

Example

	Areas to consider	Action to address risk	Location, Land Management Unit or paddock	Timeframe or date implemented	Person responsible/ Others involved	Budget	Priority (Low, Medium, High)	Evidence of completion and storage location e.g. photo	Date completed
Eco-efficiency	Eco-efficiency gains Pasture and soil management	Prepare an animal health plan Early identification of soil and pasture pests Create a feed budget and review regularly.	Whole farm	Nov 2021	Manager and Vet Manager and agronomist Manager		Medium		
Methane	Low emission feeds	Investigate winter crops that have lower emisssions		Before sowing next spring	Manager and farm advisor		Medium	Emails with Fert rep	
Nitrous Oxide	Fertiliser use	Talk with fert rep or specialist and come up with plan reduce N fert or use urease inhibitators		September 2022	Manager and fert rep	To be determined after consultation	High		
Carbon dioxide	Reduce fuel use	Over time replace older vehicles with more fuel efficient vehicles		Next S years	Manger	Build costs into long term budget	Low		
Carbon sequestration	Identify areas of woody vegetation on farm and retire Iess productive areas on farm	Carry out mapping of shelter belts and other woody vegetation Look at retiring part of top block	Whole farm Top Block	September 2022 Next 3 years	Manager Manager and ecologist	\$500	Medium		
Climate change impacts	Erosion management Backup Generator	Erosion management with plantings Buy backup generator incase of power	Top Block	Next 3 years December		\$3000	Medium Low		
Other									

You may already have made changes to your farm system or are carrying out actions that are already helping to manage your greenhouse gas emissions and/or are making your farm more resilient to climate change impacts. Use tables 4.1-4.5 to help you identify these actions and write them into Template CC7 (Example below). This will help create a recored of climate change and emissions management actions to date.

Actions to date: Climate Change and **Greenhouse Gas emissions management**

Example

	Areas considered	Action	Location or Land management unit (if applicable)	Date or year
Eco-efficiency		New ram selection criteria (including n-prove) for improved genetics and breeding	Whole farm	2020
Methane	Eco-efficiency gains	Increased lambing percentage to be more efficient with feed Sheep to cattle ratio changed		2002
Nitrous oxide	Fertiliser	Targeted fertiliser use and started using urease	Lower flats	2010
Carbon dioxide	Fuel and electricity use	More fuel efficient vehicles Solar-powered fencing		2019 2020
Carbon sequestration	Increase sequestration	More shelterbelts planted Riparian areas fenced and planted Some of marginal land on top block retired	Lower flats Top Block	Started in 2002
Climate change impacts	Resilience and adaptaion	Erosion prone land planted with open tree plantings to stabilise land incase of heavy rain events	Top Block	2010





Develop a regular monitoring programme for your climate change response

In the **monitoring plan (Template CC8)**, outline your monitoring programme for your climate change response. Your ongoing monitoring should include include:

- calculating and documenting your agricultural greenhouse gas emissions and sinks annually
- review and revise plans to measure and manage GHG emissions
- updating on any regulatory requirements associated with this.

Additionally, following an adverse event, it is useful to update your adaptation plans to incorporate anything you have learned from your response. It is also beneficial to periodically review your adaptation plan to ensure it is still fit for purpose in relation to your farm system and environmental conditions.

Set out your monitoring plan in **Template CC8** in "Our Plan". An example is below.

Monitoring Plan - to manage emissions and respond to climate change impacts

CC8 Example

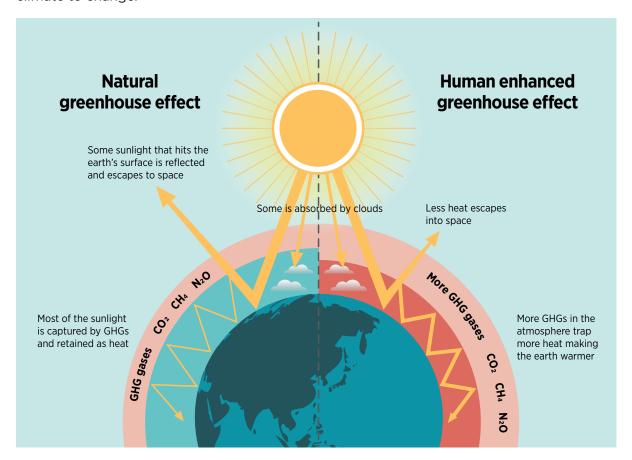
Monitoring or review action	Evidence	Monitoring frequency	Due Date to monitor	Assessment	Person respon- sible	Notes	Date completed
Complete GHG calc	Diary GHG calculator Stock numbers Weaning weights Fert use Deforestation	Annual	June each year	B+LNZ GHG Calculator	Manager		
Review areas of woody vegetation	Aerial farm map in Climate change chapter of farm plan	Annual	June each year	Aerial map	Manager	Use updated aerial map or map	

Background information

More information is available in a set of GHG Factsheets which can be found on the B+LNZ website. Visit beeflambnz.com/farmplan.

Greenhouse gases

A number of the gases in the atmosphere act like a blanket around the earth, trapping warmth from the sun. For this reason, we call them greenhouse gases. Greenhouse gases exist naturally in low concentrations and maintain the earth's average temperature at around 15°C. Without them, too much heat would escape, and the temperature at the surface of the planet would be -18°C. Human activities are rapidly increasing the amount of these gases in the atmosphere, which is causing the temperature to increase and the climate to change.



Many gases created by human activities act as greenhouse gases, but the three most important from a New Zealand perspective are:

- Carbon dioxide (CO₂): Carbon dioxide enters the atmosphere when fossil fuels (oil, natural gas and coal), solid waste, trees and wood products burn, and during other chemical reactions such as manufacturing cement. Carbon dioxide is removed from the atmosphere by growing plants, which absorb and store it in their tissue. It gets released again when plants decay as part of the biological carbon cycle. Carbon dioxide from fossil fuels makes up 44% of New Zealand's gross annual greenhouse gas emissions. This is **new** carbon dioxide that **adds** to the total amount of carbon dioxide in the atmosphere.
- Methane (CH₄): Methane is emitted during the extraction and transportation of coal, natural gas and oil. Methane emissions also come from ruminant livestock and agricultural practices such as growing rice, and by the decay of organic waste in landfills. It makes up 43% of New Zealand's gross emissions, mainly from cattle and sheep.
- Nitrous oxide (N₂O): Nitrous oxide is emitted during agricultural and industrial activities, and when fossil fuels and solid waste burn. It makes up 12% of New Zealand's gross emissions and is emitted from urine patches as well as fertiliser.

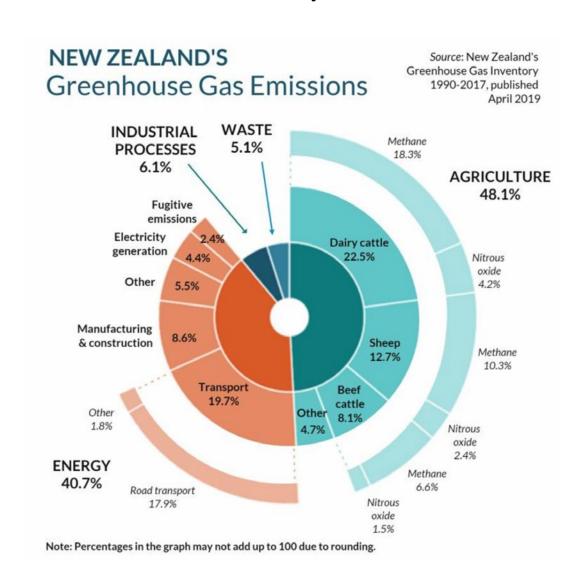
Short-lived verses long-lived gases

Methane is a **short-lived gas** and degrades in the atmosphere in decades. **Biogenic methane** from animals is formed when animals eat plants that have taken up carbon dioxide already in the atmosphere. The gut microbes in the ruminant animal convert excess carbon to methane which is more potent than CO₂ BUT over a relatively short time it decays back to CO₂ without adding to the atmospheric concentration of CO₂. This is a cycling of existing CO₂ that is producing a valuable commodity product and supporting our economy at the same time. Because methane is a short-lived gas, if animal numbers remain relatively stable, then so does the concentration of methane in the atmosphere. This is because as methane declines it is replaced by the newly emitted methane from animals, but the process is in a steady state.

Carbon dioxide, on the other hand is a **long-lived gas** and it stays in the atmosphere for hundreds to thousands of years. This means that continuing to burn fossil fuels and continuing to increase fuel consumption will continue to increase the concentration of CO_2 in the atmosphere.

More information is available in a set of GHG Factsheets which can be found on the B+LNZ website. Visit **beeflambnz.com/farmplan**.

New Zealand's Greenhouse Gas Emissions by sector



New Zealand's greenhouse gas emissions

Not all emissions are created equal. The emissions from the agricultural sector are made up of predominantly methane and nitrous oxide. Emissions from the energy sector by comparison are primarily carbon dioxide from the burning of fossil fuels. There is an important differentiation between biological greenhouse gases from animals (biogenic methane and nitrous oxide) and carbon dioxide from the burning of fossil fuels.

Often gases are referred to by their Global Warming Potential (GWP) as this allows the different gases to be compared to each other as these gases differ in their ability to absorb energy (radiative forcing) and how long they stay in the atmosphere (lifetime). GWP is a measure of how much energy the emissions of 1 tonne of a gas will absorb over a given timeframe compared to 1 tonne of carbon dioxide. The GWP that is most often used in New Zealand (including in the reports we publish internationally) is GWP100, which is a measure of how much energy 1 tonne of gas will absorb over 100 years.

Thus, gases can be reported in carbon dioxide equivalents by converting the amount of the gas to the equivalent amount of carbon dioxide with the same global warming potential. This is often written as CO₂e, for example a farm may have an emissions profile of 3000 kg CO₂e/ha/yr made up of methane (2300 kg CO₂e/ha/yr), nitrous oxide (610 kg CO₂e/ha/yr), and carbon dioxide (90 kg CO₂e/ha/yr).

Using GWP100, New Zealand's gross emissions in 2018 consisted of:

- 44% from carbon dioxide
- 43% from methane
- 12% from nitrous oxide

The balance (about 1% of total emissions) was from less common gases such as hydrofluorocarbons.

Using GWP100, New Zealand's greenhouse gas emissions profile for 2018 was dominated by emissions from the Agriculture (48%) and Energy (41%) sectors. This is different to the greenhouse gas profile for most other developed countries where 80% of the emissions come from the energy and transport sectors and only 11% from agriculture.

It is important to note that the science around gases is rapidly evolving and there is growing recognition that GWP100 is not the best way to represent the warming impact of different gases. Other metrics may be more suitable to use, however for now GWP100 is the metric New Zealand is committed to using.

Source: https://www.otago.ac.nz/oerc/symposia/archives/otago735003.pdf

Changing climate and conditions

Source: www.agmatters.nz

Here in New Zealand, temperatures are about 1°C hotter than they were a century ago, with three of the hottest years on record occurring since 2014. Effects are already being felt in land, freshwater and marine environments:

- Sea levels have risen 14-22cm since the early 1900s.
- Our glaciers have lost 25% of their ice in the past 40 years.
- The country is experiencing fewer frost days and more warm days. Some locations are also experiencing drier soils and altered precipitation patterns.
- More intense weather events (droughts and storms) have occurred in many parts of the country in the last few years, and at unexpected times of the year. Some recent events were more intense because of the warmer climate.

These conditions and trends are set to continue.

As our climate changes, it might not be possible to farm in the same way or the same places as we can now. A couple of degrees of warming might not seem much, but it can have a big effect on crop and pasture growth, and on pests and diseases. Here are some predictions:

- Many places will see more than 80 days per year above 25°C by 2100, which will have a significant impact on ryegrass growth (which prefers temperatures in the range of 5-18°C), animal performance and staff welfare/working conditions.
- Annual average rainfall is expected to decrease in the north-eastern South Island and northern and eastern North Island and increase in other parts of New Zealand.
- Farmers in dry areas can expect up to 10% more drought days by 2040.

The Ministry for the Environment (MfE) have a resource available that outlines likely future changes to the climate of each region and what that means for each region. Follow the link on **beeflambnz.com/farmplan** to find the MfE resource.



Responding to adverse events

Drought

Droughts are very challenging to deal with as they can have long-term impacts and there is no predictable 'end-point'. Even when it rains it can take several months or more to recover. The key to drought management is looking after yourself, your family and team and making decisions to protect your capital breeding stock.

There is a saying to keep in-mind when managing a drought: 'it's better to make the wrong decision too early, than the right decision too late'.

For more information on drought management follow the link on **beeflambnz.com/ farmplan** and check out Beef + Lamb New Zealand's Extreme Dry Management Toolkit.

Flood

There is usually some warning or indication of a flood. There will always be unknown factors to deal with but having a checklist that you can work through when a flood is likely and then in response can help. For more information on flood management follow the link on **beeflambnz.com/farmplan** to read more, including a checklist for preparataion for and management of floods.

Snowstorm

Snowstorms are generally forecast although not always. Farmers in parts of the country where snowstorms are common are usually experienced in managing them. It may be beneficial to get some advice from other farmers. For more information on snowstorm management follow the link on **beeflambnz.com/farmplan** to read more.





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What has New Zealand committed to do to respond to climate change?

The Paris Agreement on climate change

New Zealand signed the Paris Agreement on climate change in 2016. It is an international agreement that aims to hold the global average temperature increase to well below 2°C above pre-industrial levels, pursuing efforts to limit the increase to 1.5°C above pre-industrial levels. Under the Paris Agreement countries also agreed to increase their ability to adapt to the adverse impacts of climate change and respond to climate change in a manner that does not threaten food production.

New Zealand has a role to play to contribute to the global effort to achieve these goals. To do this, New Zealand has set a target under the Paris Agreement to reduce our greenhouse gas emissions, as a country, to 30% below 2005 levels by 2030.

The Zero Carbon Act

In order to achieve its commitments under the Paris Agreement, the Government passed the Zero Carbon Act in 2019. The Government set three domestic greenhouse gas emissions reduction targets in the Zero Carbon Act:

- 1. Reduce emissions of long-lived gases (mainly carbon dioxide and nitrous oxide) to net zero by 2050
- 2. Reduce emissions of biogenic methane to 10% below 2017 levels by 2030
- 3. Reduce emissions of biogenic methane to 24 47% below 2017 levels by 2050.

Targets 2 and 3 that focus on biogenic methane (which comes mainly from the belching of ruminant animals) are likely to be the ones that have the most impact on sheep and beef farmers.

He Waka Eke Noa - the Primary Sector Climate Action Partnership

The agriculture sector, like all other parts of the economy, has a role to play to contribute to meeting these international and domestic targets. To do this, primary sector leaders have come together to make an unprecedented commitment from across the pastoral, horticultural and arable sectors to achieving enduring progress towards the goals of managing agricultural emissions and building resilience of our primary sectors.

This includes a commitment to mitigating (reducing) the primary sector's contribution to climate change through actions that manage, reduce or offset emissions, in support of the Paris Agreement and Zero Carbon Act goals. Through He Waka Eke Noa - the Primary Sector Climate Action partnership, the sector will respond to the threats of climate change in a way that is environmentally, socially, culturally and economically sustainable.

The following milestones for He Waka Eke Noa are legislated through the Climate Change Response (Emissions Trading Reform) Amendment Act:

- By 31 December 2021, 25% of farms in New Zealand hold a documented annual total of on-farm greenhouse gas emissions and have a written plan in place to measure and manage these emissions.
- By 31 December 2022, all farms in New Zealand hold a documented annual total of on-farm greenhouse gas emissions and
- By 1 January 2025, all farms have a written plan in place to measure and manage these emissions.

Further details are available at hewakaekenoa.nz

Waste is a typical outcome of most activities, and chemical use occurs in most processes (whether using natural or synthetic chemicals). It is important to understand the risks associated with waste products, and chemical use (including fuel and fertiliser). If not managed properly there is a risk to human and animal health as well as risk of contamination in waterways (as covered in the freshwater section). It is therefore useful to have a plan to manage risks and to identify ways to reduce, reuse and recycle.

Most Regional Authorities and District Councils have rules around waste management such as proximity to waterways and groundwater, odour management, boundaries, dwellings, fencing and covering. Ensure you are aware of the rules in your area.

Table 5.1 outlines key risks and management practices that can be used to manage waste and chemicals.



Waste is a typical outcome of most activities, and chemical use occurs in most processes (whether using natural or synthetic chemicals). It is important to understand the risks associated with waste products, and chemical use (including fuel and fertiliser). If not managed properly there is a risk to human and animal health as well as risk of contamination in waterways (as covered in the freshwater section). It is therefore useful to have a plan to manage risks and to identify ways to reduce, reuse and recycle.

STEP 1

WASTE AND CHEMICAL MANAGEMENT

Goals for Waste and Chemical Management

In **Template OT1** (in the "Our Plan" section), identify your specific goals for waste and chemical management.

Below are some examples that might help. You may also have objectives from your Regional Council to include in your Farm Plan.

- Offal pits, silage and effluent, runoff from stock yards, tracks, races and rubbish dumps: To manage the number and location of these sources to minimise risk to human and animal health, and freshwater ecosystem health.
- **Containment sources:** to manage risks from other containment sources e.g. fuel supplies, chemical mixing areas, fertiliser loading areas.

STEP 2

WASTE AND CHEMICAL MANAGEMENT

Ensuring you meet local compliance requirements

Your local Regional and District Council may have specific rules relating to waste and chemical management that you should be familiar with and comply with. These may include storage and disposable of potential contaminants, for example, from offal pits or stored silage.

Some councils for example require resource consents for silage pits or offal pits if they cannot meet the nominated conditions such as the number and size of offal pits or the location of silage pits in relation to water bodies.

List resource consents and other relevant compliance documents in **Template WC1** in "Our Plan". Some examples are listed here.

WC1 Example

Compliance document	Requirements	Notes
Council Resource consent No xxx	Silage pit in back block	Consent expires June 2030

Review Risk Areas and Management Practices

The table below outlines key areas that you should consider regarding how waste and chemicals are managed.

Table 5.1 Risks and management practices to mitigate

Risks	Management practices
Offal pits/holes • Risk of losses from leaching to groundwater, or run-off to surface water • Risk of soil contamination • Risks to humans and animals	 Offal pits/holes located at least 30m away from waterways (there may be a legal distance requirement) Offal pits/holes not at risk of a rising water table - bottom of offal pit should be at least 1m above the seasonally highest water table level (there may be a legal depth requirement) Offal pits/holes covered and fenced off Cook offal for dogs Dead animals buried (away from waterways and not posing a risk to groundwater)
 On-farm rubbish Risk of losses from leaching to groundwater, or run-off to surface water Risk of soil contamination Risk of unsustainable land use from non-biodegradable waste build-up 	 Reduce, reuse, recycle wherever possible Recycle chemical containers Recycle silage and baleage wrap and net Rubbish disposed of in offal pit/hole following practices above Household waste recycled Household scraps fed to pigs, worms or composted
Silage pits • Risk of losses from leaching to groundwater, or run-off to surface water • Risk of soil contamination	 Located at least 30m away from waterways (there may be a legal distance requirement) Silage pit sealed Run-off from silage pit contained (e.g. sump) or diverted to a paddock with appropriate soils rather than a waterway
Risk of run-off of faecal matter to waterways from yards, tracks or other areas where stock are concentrated for a period of time	Run-off contained (e.g. sump) or diverted to a paddock
Chemical storage Risk to humans or animals from chemical spills or chemical residue if inappropriately stored Risk of waterway and soil contamination	 Farm staff handling chemicals have the appropriate training and certification Chemicals are stored safely in a secure location Fertiliser bins are located away from waterways and are not at risk of leaching if they get wet Fuel is stored safely and secured with a drip tray to prevent soil contamination
Chemical management Risk to humans or animals from chemical spills or chemical residue if inappropriately used Risk of waterway and soil contamination	 Spray plan in place Farm staff handling chemicals have the appropriate training and certification Appropriate PPE is worn when handling chemicals Chemical mixing area is well-ventilated with a good water source and located well away from surface water Unwanted chemicals disposed of appropriately (your Regional Council can advise on this) Unwanted containers disposed of appropriately (e.g. AgRecovery) Old dip sites or chemical disposal sites on-farm are sealed

Waste and chemical risks and management practices to minimise risks

In **Template IT1**, identify risk for each management area and how these risks will be managed on-farm. Some examples are presented here.

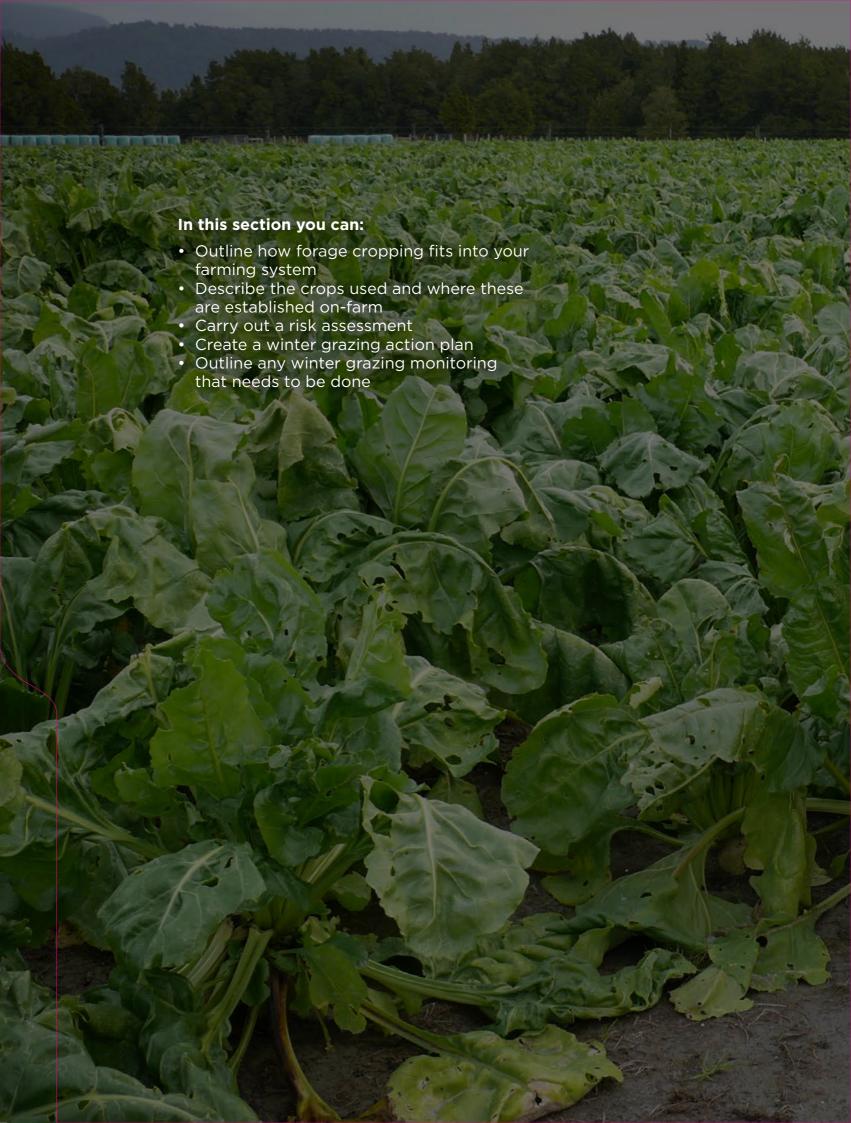
IT1 Example

Identified Risks	Action to address risk	Location or LMU	Timeframe or date implemented	Person responsible/ Others involved	Budget	Priority (Low, Medium, High)
Offal pits/holes Losses from leaching to groundwater, or run- off to surface water Soil contamination	Offal pit away from waterway Offal pit fenced and covered	Flats	Ongoing	Owner	N/A	Low
On-farm rubbish: Silage wrap; Chemical containers; Household rubbish	Recycle chemical containers Store baleage wrap for recycling Household rubbish recycled or disposed of	Yard block	Immediate	All staff	\$1000 per annum for disposal	Medium
Effluent from woolshed and runoff from yards: • Run-off of faecal matter to waterways from yards, tracks or other areas where stock are concentrated for a period of time	 Woolshed cleaned out and manure sold for school fundraiser Cattle and sheep yards have runoff onto paddock 	Yard block	By January next year	All Staff Bob's Bobcats	\$1000	Low
Silage pits: Losses from leaching to groundwater, or runoff to surface water Soil contamination	Silage pit has a bund and sump which is diverted into trees away from the stream	Trees Block	By start of summer, before silage made.	John C.	\$1200	Medium

O6 Forage cropping management

Forage cropping is an integral part of the farming system on many properties. It is a way to ensure a supply of good quality feed for maintenance of animal condition and when grazing pasture may not be possible or insufficient to meet animal requirements. Forage cropping has risks of nutrient and sediment loss to waterways as well as faecal contamination if good practices are not implemented or cropping occurs in high-risk locations. Long term soil damage and loss of subsequent pasture production can also result. When good management practices are implemented, including careful management before, during and after grazing, research shows that the risks can be significantly lowered.

Winter forage crop grazing is a specific type of forage cropping and often has a higher risk of negative impacts to the environment. It happens at a time of year when conditions are more likely to contribute to contaminant loss if the appropriate care is not taken. This section has strong links to the soil and freshwater sections in the farm plan. It may be useful to refer to these sections where necessary. Making sure that animals are cared for and fed appropriately is important for keeping stock healthy and in good condition. There are also a number of factsheets, resources and further information that can be found at beeflambnz.com/wintergrazing



Why am I forage cropping?

Forage crops grown on-farm for supplementary feed are an important part of farm systems. They are often utilised as part of a resilient farm system to ensure adequate feed for stock when grass growth has slowed and there are potential feed gaps, such as during the winter or in summer-dry areas. They are also used if a high-quality feed is needed finish stock or increase production.

A forage crop is an area of crop that is grown to feed stock, usually directly from where the crop is grown (in situ). Forage crops include cereals (such as sorghum, barley, oats, ryecorn and triticale), brassicas (such as kale, turnips and swedes), fodder beet and maize and can include annual ryegrass.

Forage crops can also be used as part of the pasture renewal programme. Often as pastures age, the species composition changes and over a period of years, less palatable and less nutritious species can dominate a pasture. Weeds, pests and diseases can also become a problem. Pastures are often resown on a rotation of a period of 10 years or more, but this will be dependent on the farm system, soil type, pasture species and farm management objectives.

Intensive winter grazing is a common part of forage cropping and happens at a time of year when soils may be more vulnerable to damage. The higher stocking intensity of animals also adds to the risk of sediment and nutrient loss and damage to soils. Animal health also needs to be managed carefully due to the prevailing climatic and soil conditions and can be influenced by the crop type and amount/type of supplement also fed. If you are grazing a winter forage crop during the winter months you must undertake it in accordance with relevant regulations.



In **Template FC1** in "Our Plan" (example below) outline the main reasons for forage cropping. These might be things such as:

- · Pasture renewal
- · Providing additional feed to fill summer or winter feed gaps
- · Limiting the impact stock may have on pastures

If forage cropping is used for winter grazing, also outline outline how winter grazing currently fits, or will fit into your farming system.

Why am I forage cropping?

FC1

Example

V

Pasture renewal

/

Providing additional feed to fill summer or winter feed gaps

V

Limiting the impact stock may have on pastures



Other: (please describe below)

To replace ryegrass endophyte with one better for animal welfare and production Weed control for establishment of lucerne stands



Blank templates can be found in **Our Plan** section

STEP 2

FORAGE CROPPING MANAGEMENT

Forage Crop Goals

It is a good idea to record the high-level objectives of your forage cropping. Some examples are:

- Keep animals healthy, with adequate feed and with appropriate shelter
- · Minimise the risk of sediment, nutrient and faecal losses to waterways
- Keep stock out of waterways
- Have a written (winter) grazing plan
- Have a plan for adverse weather events to reduce risk to stock and the environment
- Minimise soil and pugging damage
- Undertake forage cropping in accordance with relevant regional rules and regulations

In "Our Plan" fill out **Template OT1** with your forage cropping goals. An example is shown below.

OT1 Example

Our forage crop grazing goals

Date:

1 February 2021

Keep stock out of waterways with appropriate buffer areas

Create a winter grazing plan each year

Use strategic grazing techniques for wintering to minimise sediment loss

Replant winter paddocks as soon as practical after winter to reduce nutrient and sediment losses

Keep animals well-fed and in good condition

Description of forage cropping

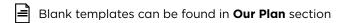
It is good to have a written record of your current forage cropping programme. Fill out **Template FC2** Forage Crop Programme in "Our Plan". An example is filled in below.

To help with this, map out the areas (paddocks or land management units) you intend to graze next season. You may have already done this in previous sections, but if you haven't, create a map of your forage cropping paddocks.

Forage Crop Programme

FC2 Example

Year:	2021-22		
Crop type sown	Kale	Summer turnips	Swedes
Season or month the forage crop fed	Winter	Summer	Winter
What month do you usually sow?	October	September	November
Cultivation and sowing method	Spray and drill	Spray and drill	Ridged
Location/Land management units used	Lower flats	Easy rolling block	Lower flats
Identification of any unfenced waterways in winter crop paddocks	No- always fenced off	No- always fenced off	None in swede paddocks
Area sown in crop (ha)	14ha	10ha	4ha
Typical yield (t DM/ha)	14	11.5	18t
Fertiliser used	DAP 200kg/ha	150kg/ha DAP	DAP 350kg/ha sown 55kg/ha urea
What class(es) of stock graze this crop?	RI and R2 Beef cattle	Mixed age ewes/ cattle as needed	MA ewes





Intensive winter forage cropping

You need to be aware of the national and regional rules and graze in accordance with the regulations for your region. Information on rules, including requirements for record keeping, and regulations can be found in the National Environment Standards for Freshwater (2020) subpart 3 Intensive Winter Grazing (a link and more information can be found at **beeflambnz.com/wintergrazing**) or from your local regional council.

In some cases you may need to apply for a resource consent to winter graze on crops.

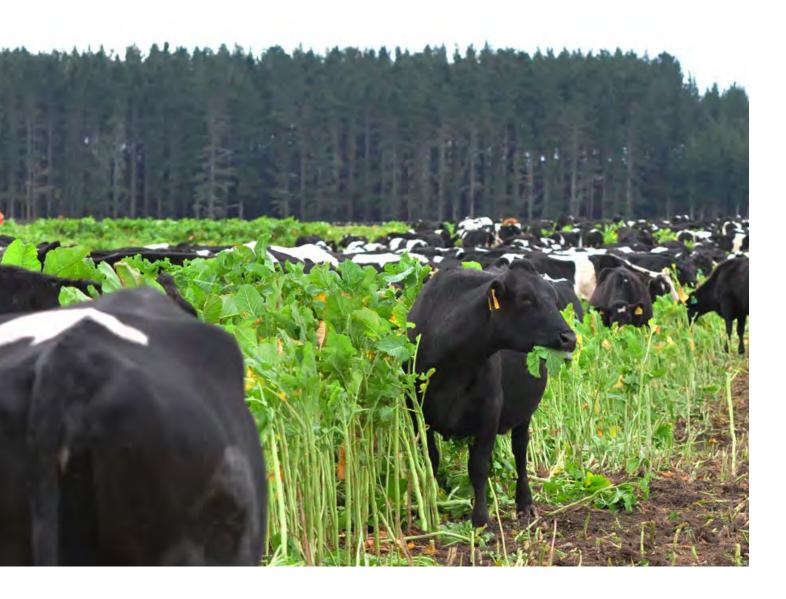
The definition of 'intensive winter grazing' under the National Environmental Standards for Freshwater (2020) is:

• grazing livestock on an annual forage crop at any time in the period that begins on 1 May and ends with the close of 30 September of the same year

An 'annual forage crop' is:

• a crop, other than pasture, that is grazed in the place where it is grown

The definition of 'intensive winter grazing' does not include stock which are only grazed on pasture during winter months or forage crops fed outside the winter period (1 May-30 September).



Farm mapping and winter forage cropping details

If your forage cropping system meets the definitions of an intensively winter grazed forage crop then you will have to make sure that you record (and keep updated) some extra information. Some of the information you need to collect and have recorded is suggested below in templates FC3 and FC4. If you are unsure of the rules and requirements for winter grazing, talk to your local regional council. Further information can also be found at **beeflambnz.com/wintergrazing**

All areas proposed to be winter cropped and grazed on the farm need to be identified on a map. Use this section to include a farm map showing paddocks to be used for wintering. Please include key paddock features such as:

- · Paddock boundaries
- Waterways
- Wetlands
- Drains
- · Critical source areas
- Slope
- Areas prone to erosion

You will also need to relate this section to your soil and freshwater sections. Having the land management units mapped will also help to determine if you are winter forage grazing in the most appropriate areas on your farm to reduce environmental losses and avoid damage to your soils.

If required, complete **Templates FC3** and **FC4** in "Our Plan", each year you intensively winter graze. Examples are below.

Winter forage crop grazing - Farm details

FC3 Example

Farm details	Farm Name	Top Station Farm
	Farm Address	195 Station Road, RD2 Otago
	Total farm area (ha)	640 ha
Farm owner details	Name	Jane Farmer
	Phone number	021 123 456
	Email address	Stationfarm@mail.nz
	Mailing address	As above
Manager details	Name	As above
(if applicable)	Phone number	
	Email address	
	Mailing address	
Stock owner details	Name	
(if applicable)	Phone number	
	Email address	
	Mailing address	
Staff details	Name	Jimmy Moover
	Phone number	021 123 567
Other	Spray Contractor	Spray Easy - 027 234 567

Blank templates can be found in **Our Plan** section

5

Fill out **Template FC4** in "Our Plan" with the numbers of stock in different stock classes that will be wintering on crop, the type of crop and the size of the area that will be grazed, and type and quantity of supplements you will use. You can with fill this in over your whole farm or where appropriate give more detail for each land management unit (or paddock)

Winter forage crop grazing - Animal details

Example
FC4

				Numk	Number of stock, area or supplement	upplement	
	Stock type	Stock type and class or	Total	Location (on-farm	Location (on-farm), Land Management Unit (LMU) or paddock (if applicable)	Unit (LMU) or pado	dock (if applicable)
	crok	crop type	Across	Name Top block	Name Lower flats	Name	Name
Stock numbers wintered on forage crop	Beef Cattle	RI/R2			08		
(break up by age or class as required, e.g.,		Breeding cows			011		
ewes, lambs, hoggets, weaners, stags,							
hinds)	Dairy Cattle	Dairy cows			06		
	Sheep	Hoggets		800			
	Deer	Weaners			100		
		Hinds			140		
Area of Winter forage crop to be grazed over coming winter (ha)	Bulb brassica (swede/turnip) (ha)	a ip) (ha)		15			
	Kale (ha)				20		
	Fodder beet (ha)	t (ha)					
	Other (please specify) (ha)	se specify)					
Other supplements to be fed to winter grazed stock (e.g. silage, baleage, hay, straw)				40 Round bales baleage Round bales baleage	60 Round bales baleage		
Other							

Blank templates can be found in **Our Plan** section

STEP 5 FORAGE CROPPING MANAGEMENT

Risk Assessment

Forage cropping, particularly in winter can pose a significant risk to freshwater ecosystem health. Waterways can be at risk though sediment, nutrient and faecal/microbial contamination. Soils are also at risk of short and long-term damage, through compaction, pugging, loss of soil structure and reduced infiltration potential.

There are national and regional regulations that need to be adhered to if you are winter forage crop grazing. These relate to both environmental management and animal welfare.

This risk assessment section will help you to identify potential risks on your farm and with your farming system.

What is a critical source area?

Critical source areas are areas in a paddock or on a farm that can contribute to relatively large amounts of nutrient and sediment losses to waterways. They are often wet areas such as gullies and swales, where overland surface runoff converges and can transport sediment and nutrients. The surface flow in critical source areas usually occurs during or after rainfall event of sufficient size and intensity to move water over the surface of the soil rather than draining through it.



Table 6.1 shows common risks, impacts and risk factors associated with intensive winter forage crop grazing. You can use this as a guide when filling out the risk assessment in "Our Plan". There is also space in our plan to add other risks that you identify with your wintering areas.

Use the Risk Matrix Chart to assess risk factors that you have in and around your winter grazing areas. You can also attend the B+LNZ workshops on forage cropping and winter grazing. There are also great resources and factsheets about forage cropping and winter grazing risks and risk management that can be found on the link **beeflambnz.com/wintergrazing**

For each risk factor you have identified, asses the likelihood and consequence and determine the risk rating, high, medium or low. This can then be recorded in **Template FC5** in "Our Plan". An example is given after Table 6.1.

Risk Assessment Matrix

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

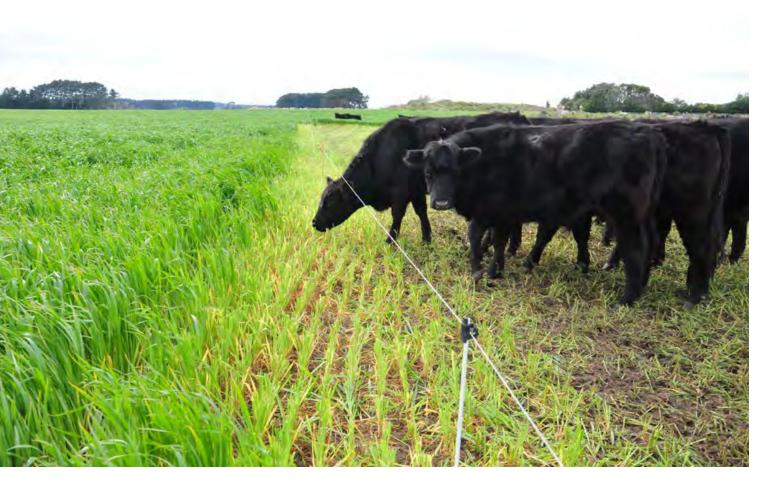


Table 6.1 Risk factors to consider for your farm forage crop grazing

Risks of winter forage crop grazing	Impact	Risk Factors	On-farm considerations that are higher risk
Sediment and	Phosphorous and sediment	Slope Risk	• Steeper slopes have greater risk
	flow. Phosphorous entering waterways may cause excess algae growth in water bodies.	Erosion risk	 If erosion is visible or likely within the area to be cropped it will be a higher risk Stock type (deer and large cattle are more likely to cause erosion)
	Sediment can reduce or change habitat by smothering and clogging spaces in the stream bed making it less suitable for a wide diversity of stream life.	Overland transport of sediment and nutrients	 Paddock is prone to flooding Presence of a Critical Source Area within the paddock Waterway is within or close to the paddock being winter grazed Surface flow within paddock to be winter grazed will flow directly into nearby waterway Soils are heavy or poorly drained Soil surface is pugged or damaged reducing water infiltration Cultivation is done via a method where soil is exposed (i.e. not direct drill) Cultivation is done down the slope rather than across it High soil Olsen P levels
Faecal microbial loss	Pathogens or microbes such as <i>E. Coli</i> may potentially have an impact on human or animal health if they are able to enter into waterways.	Contamination of freshwater	 Water can directly flow overland from the paddock being winter grazed into a waterway Stock have unrestricted access to waterways Drinking water bore or takes are close to paddocks or downstream of winter grazed area Winter Grazing is occurring on stony soils close to a drinking water bore
Nitrogen loss	Nitrogen can potentially enter waterways and cause excess algae growth. Nitrogen usually	Nitrogen Leaching	 Winter grazing is occurring on free-draining/stony soils Sub-surface drains are present within paddock Soils are left bare for more than 2 weeks post-grazing
	moves though the soil profile with water. High nitrogen leaching can also impact nitrate levels in drinking water impacting human health.	Nitrogen sources	 Higher density stocking will mean more animals in a given area, leading to higher deposition of N Critical Source Areas will be cultivated or grazed Crops have differing concentrations of N and may alter the amount of N excreted by animals Urinary concentration of N is often higher in mature cattle compared to sheep deer or younger cattle

Risks of winter forage crop grazing	Impact	Risk Factors	On-farm considerations that are higher risk
Soil damage	Soil health and structure is damaged impacting on nutrient and sediment flow pathways as	Stock class type	 Heavier stock classes increase the risk of damage Supplementary feeding areas and water troughs are not located in drier parts of the paddock
	well as productive capacity of	Soil Type	• Soils that are not free draining are more at risk to damage and pugging and compaction
		Crop type	 Crops with higher yields may mean animals are concentrated on a smaller area of crop which will increase risk Crops are not established using minimum tillage or direct drilling to minimise soil structural damage
Cultural and Social	Your values or catchment values	Social	Proximity to sites or areas that may be impacted by winter grazing or effects
values	could be at risk from winter grazing activities.	Cultural	• Winter grazing in close proximity to sites or areas of cultural significance such as areas used for māhinga kai (traditional food gathering)
Animal Welfare	Animal health and wellbeing is compromised and limits the production of high value products.	Climate and shelter	 Limited provision of adequate shelter and a dry resting place (areas retained in grass, stand-off area, or an alternative paddock to move stock to when conditions are wet) Temperature conditions are cold for significant lengths of time Animals birthing in a winter crop paddock without stand-off area
		Feed and water	 Limited supply of good quality feed and non-convenient access to clean water No use of Feed budgeting to ensure animals nutritional needs are being met
		Soil surface	• Limited soil surfaces that animals can comfortably lie down on and not excessively wet or muddy will reduce animal health risk
		Transition to crop	• Transition time on and off a forage crop is curtailed
Human factors	People are a key part of the winter grazing system as they are required to make decisions and carry out tasks.	People	 No plan or lack of planning Lack understanding or training for staff Poor decision making

Risk Assessment for forage cropping

Land Management Unit (LMU) or paddock (if applicable) Name Name Risk rating (High, Medium, Low) Name Lower flats Blank templates can be found in **Our Plan** section Medium Medium Medium Medium Medium Medium High row LOW row LOW LOW LOW LOW LOW Name Top block Medium Medium Medium Medium Medium Medium High High High row row LOW LOW LOW LOW Whole farm Risk factors on your farm Contamination of freshwater risk Overland transport of sediment Temperature and shelter risk Nitrogen leaching risk Training and skills risk **Erosion potential risk** Nitrogen sources risk Stock class type risk Feed and water risk **Ground surface risk** and nutrients risk Crop type risk Soil Type risk **Cultural risk** Social risk Other risk Other risk Other risk Other risk Slope risk Other risk Other risk nutrient and sediment flow pathways as well as productive Sediment or phosphorus potentially entering waterways Contaminants, like pathogens such as E. Coli, potentially may cause excess algae growth, habitat loss other harm Your values or catchment values at risk from your winter Risks created or increased by people (rather than risks to people) that may impact on winter forage cropping Nitrogen potentially entering waterways impacting Soil health and structure is damaged impacting on **Animal Welfare risks** Animal health and wellbeing considerations freshwater health or drinking water quality Sediment and Phosphorus loss risks Risk Social or cultural values at risk impacting on human health Faecal microbe loss risks to freshwater health. Nitrogen loss risks Soils damage risks grazing activities. Human risks capabilities. Other risks activities

STEP 6 FORAGE CROPPING MANAGEMENT

Identify actions and mapping

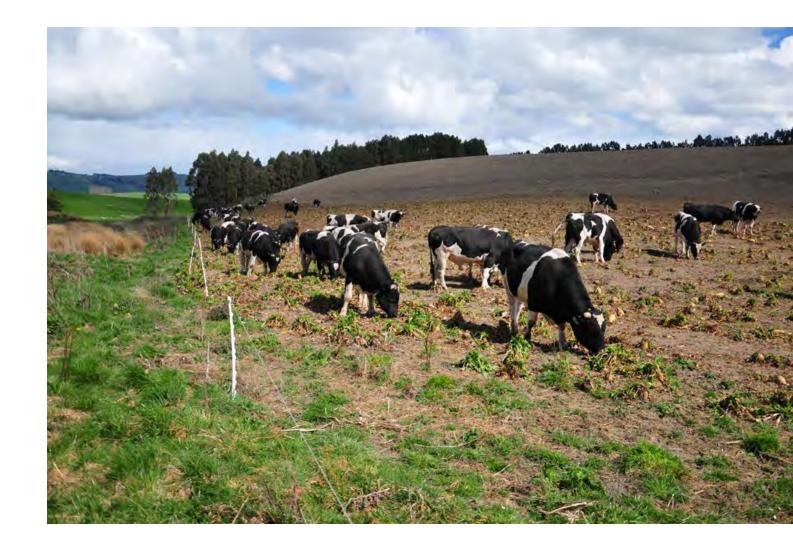
Although grazing animals on a forage crop may create risks to animal welfare and the environment, the risk can be reduced by careful management. Follow the link on **beeflambnz.com/wintergrazing** for more information and resources on management of (winter) forage cropping systems to reduce the risks.

Strategic winter grazing uses a range of techniques to minimise sediment and nutrient loss. Research has shown that when used in combination, the techniques can reduce sediment loss by up to 80% when compared to more traditional winter grazing methods. Soil loss and structural damage can be reduced and will help keep valuable topsoil on your paddock. Strategic grazing usually involves grazing down the slope, (usually fences run across the slope starting with breaks at the top and then moving towards the bottom), regular back fencing and no grazing in critical source areas.

On your winter grazing maps it can be useful to draw arrows on the paddocks to indicate the way you will move the feed breakfences. Make sure you consider the slope and proximity to waterways and critical source areas.

Considerations for forage cropping, particularly in winter

- Plan early for stock class, animal welfare, access, biosecurity, and the use of catch crops use a feed budget to work out appropriate crop type and area of crop.
- Record what you are doing and where. Make sure you share it with staff, contractors and anyone involved in winter grazing. This may be required as part of your compliance obligations with the Regional Council.
- Look after your stock provide adequate feed, shelter, fresh clean water, and dry areas for suitable for resting and loafing
- Have a plan for adverse weather events such as a safe area to move stock to if heavy rain or snow is forecast
- Minimise excessive disturbance of wet soil by animals and machinery
- Steeper paddocks come with greater risks; do you really need to crop certain paddocks or the entire paddock?
- Consider proximity to waterways and gullies, as well as flood risks
- Soil type can determine the suitability of a paddock as well as impact productivity, nutrient loss and animal welfare
- The greater the risk of soil, phosphorus, or nitrogen loss, the smaller the animal you should be grazing on the paddock or the lower the stocking rate for heavier animals
- Keep stock out of waterways and Critical Source Areas
- Leave ungrazed buffer zones around Critical Source Areas
- Graze from the top down in sloping paddocks, and from the opposite end of a paddock to a waterway if present
- Use long and narrow breaks, particularly with cattle
- Back-fence to protect soils while allowing animals access to shelter in adverse weather events
- · Allow soils time to dry sufficiently before cultivating
- Use a catch-crop where possible and practical, to reduce nutrient loss, minimise bare soil and increase feed production.



Action Plan for an Intensively Grazed Winter Forage Crops

Some paddocks and land areas will pose higher risks than others based on the characteristics of the topography, soil, and site. These are things that can't always be controlled but they can be managed so that the risks to freshwater, soil, human and animal health is lowered. It is usually best to address the higher risk factors first.

Table 6.2 has a range of risk factors, and actions that can be considered to reduce the risk rating. Use this table to help you fill out **Template IT1** in "Our Plan". (An example is filled out overleaf). Some of the common risk areas are in the table, where relevant you can use these to help address the risks on your farm. Add in the actions you identify to help address these risks and also any other risks and actions you identify. Fill in the other parts of the table such as location and time frame. The location can be all, or part of your farm, such as a paddock or land management unit. This will depend on the scale of your winter forage cropping and the detail you require.

You can find more information about management options for winter grazing at **beeflambnz.com/farmplan**

Table 6.2 Management options for winter grazed forage cropped areas

Risk area	Management goal	Actions or management options to consider
Sediment or phosphorus entering waterways	Slow the flow of water over the surface of exposed soils	 Maintain as much vegetation down slope as possible. This could include the use of strategic directional grazing moving breaks from top of paddock down the slope with long-narrow feed breaks Cropping on less steep areas - , if it is too steep for a tractor, then it is too steep for stock on a winter crop
	Reduce the likelihood of contaminants entering waterways	 Buffer strips established within paddock to slow the flow of water and trap sediment and nutrients Riparian buffer strips or ungrazed areas established around Critical Source Areas and waterways (note this must be 5m width for waterways) Sowing of crops along, rather than up and down, the slope of the paddock where safe to do so Sediment is prevented from entering larger waterbody via sediment trap/dam Start grazing at in areas of a paddock that are the least risk to waterways (often this will mean starting grazing in areas furthest from waterways)
	Reduce the time and extent of bare soil exposed to stock and the elements	 Regularly back-fence to reduce the stock impact on bare soil Use of direct drilling or minimum till cultivation Re-sow the paddock as soon as is it practical to do so (based on weather and soil moisture levels). Leave Critical Source Areas uncropped and ungrazed wherever possible Leave some residual crop after grazing where practical
Faecal microbes contaminating waterways and impacting on human and animal health	Stock have limited or no access to waterways or contaminant transport pathways	 Stock are excluded from waterways by a 5m vegetated buffer. Stock water reticulation system operating effectively and efficiently Bailage/feed sites where stock tend to congregate are away from waterways and critical source areas
Nitrogen entering waterways (either directly or indirectly via	Record and estimate/calculate the inputs, utilisation, and losses of nutrients from the farming system	 Use of nutrient modelling tool to understand and manage nitrogen losses occurring on-farm Soil nutrient status is used to guide post- grazing plant nutrient requirements and fertiliser application.
groundwater)	Low Nitrogen Feeds	 Use of a low-N feed such as a fodder beet crop (note that the management benefit can be lost if high yields are used to increase stock density) Use of supplementary feeds with low Nitrogen (like Grass Silage) to reduce the overall content of Nitrogen in the diet, and thus urine
	Utilise excess nutrients	 Establishment of a 'catch crop' to soak up excess nutrients remaining in soil For heavier soils, fallow periods are kept to a minimum
	Limit risk of nutrient concentration transport via above or below ground drainage	 Exclude stock from drains Avoid grazing cattle in paddocks with tile or mole drains and if this is done, limit grazing to lower stock classes and total stocking units
	Avoid high risk areas or soil types	• Avoid grazing cattle on stony soils or limit grazing to lower stock classes and total stocking units

Risk area	Management goal	Actions or management options to consider
Soil health and structure	Limit stock movements and concentration	 Portable troughs and reticulated water system for clean stock drinking water Back-fencing behind sheep and cattle, especially cattle Paddock has multiple entry/exit points to prevent stock congregation around one gateway
	Limit heavy machinery use on fragile soils	• Place baleage/additional feed in paddock before it is too wet to access
	Reduce structural damage risk to soils	 Stock can be moved to an alternative area, such as a run-off block or laneway, to prevent damage to soil or animal health during storm events Rotate paddocks that are being winter grazed so that the same area is not pugged year after year Exclude stock from steep or erosion prone parts of a paddock, as stock presence is likely to cause extensive soil damage and more erosion. This is especially the case for deer.
	Minimise fence pacing and wallowing by deer	 Provide a 'safe' wallow that is not connected to a waterway Have weaner deer in a paddock out of line-of sight of hinds to reduce fence pacing Provide shelter to reduce fence pacing
Cultural and social values	Social	• Awareness of locations that are socially important in the community that are in close proximity to winter forage crop activities
	Cultural	• Be aware of sites or locations of cultural significance that may be affected by winter grazing activities and manage potential impacts
Animal Welfare	Animals are transitioned onto crops well and have appropriate feed and shelter	 Stock are given required time and space to safely adjust their diet to the crop Stock have sufficient feed allocation though good feed budgeting. Animals have protection from adverse weather (like storms) Stock are able to lie down and rest comfortably for sufficient periods to meet their behavioural needs. Stock have access to sufficient supply of clean drinking water
Human factors	Appropriate training, knowledge and equipment	 Give appropriate training to staff Have effective communication with all people involved with winter grazing Make sure you stay updated with current regulatory requirements and latest information Keep equipment well serviced

Action Plan for Intensively Grazed Winter Forage Crops

Identified Risks from winter grazing	Action to address risk	Location, Land Management Unit or paddock	Timeframe or date implemented	Person responsible	Others involved	Budget	Priority (Low, Medium, High)	Evidence of completion and storage location e.g. photo	Date completed
Sediment and Phosphorus loss	Moving breaks from top of paddock down the slope with long-narrow feed breaks	Top Block	June 2021 - ongoing	Manager	Staff		High	Photo stored in 'winter grazing' in Environment folder on desktop	
Faecal microbe loss	Not cropping the CSA at the bottom of the hill and leaving a Sm buffer strip	Whole farm	June 2021 -ongoing	Manager	Staff		Нідһ	Photo stored in 'winter grazing' in Environment folder on desktop	
Nitrogen loss	Use of nutrient modelling tool to understand and manage nitrogen losses occurring on-farm	Lower flats	Jan 2021	Manager	Fertiliser Rep	\$800	Нідһ	OVERSEER nutrient file link and summary stored in 'winter grazing' in Environment folder on	Feb 2021
	Sowing a catch crop to soak up excess nutrients remaining in soil	Lower flats	Sept 2021		Contractor		Medium	desktop	December 2021
Loss of soil structure and soil health	Back-fencing regularly behind sheep and cattle	Whole farm	August 2021	Staff	Staff		Medium	Notes in diary	
Cultural and social risks	Check with catchment group for sensitive sites close by	Whole farm	March 2021	Manager	Staff		Medium	Email to catchment group	June 2021
Animal welfare risks	Stock are transitioned properly Animals have protection from adverse weather events Stock are able to lie down and rest comfortably Feed requirements are calculated with a feed budget	Whole farm	September 2020	Manager	All staff		Нідһ	Notes in diary	October 2021
Human risks	All staff to attend B+LNZ wintering workshop and weekly farm meetings to discuss winter grazing progress and issues	Whole farm	June 2021 - ongoing	All staff	All staff		Medium	Notes in diary	
Other		High	Feb 2021 – ongoing weekly						

Paddock winter forage cropping plan

Include a representative paddock scale map that will show how you intend to graze your paddocks. Choose a paddock that is representative of the characteristics and risks you will have in your winter grazing paddocks and fill out **Template FC6** in "Our Plan". An example is given below. Depending on the extent of your winter cropping activities you may need to show more than one paddock plan.

Winter grazing paddock plan template

On your paddock map draw on or indicate:

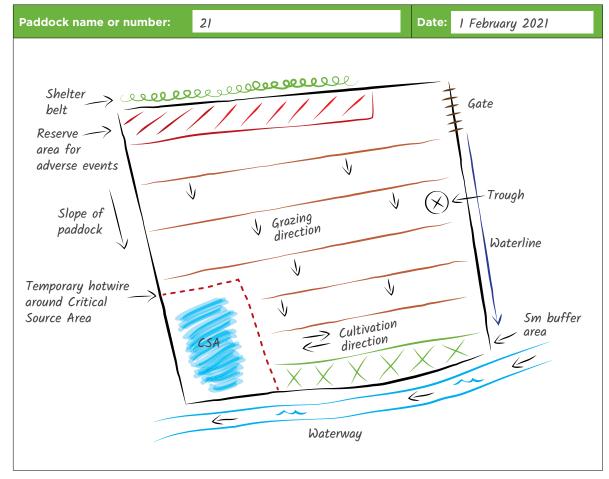
FC6	Example

Physical features of this paddoc	k
Feature	Key (symbol)
Fences and gates	-+++-
Slope direction	\mathcal{U}
Waterways and drains	
Critical source areas	
Waterlines and troughs	\otimes
Shelter	مع

Action plan for this paddock	
Feature	Key (symbol)
Cultivation direction	\Rightarrow
Grazing direction (which way the breaks will move)	\
Areas not grazed	
Buffer areas around waterways and critical source areas	XXX
Other (such as backfences or reserve areas)	////
Other	

Notes

- · Cultivate across slope
- · 3 days feed in reserve area
- · No grazing or cultivation in CSA
- · Direct drilled crop
- · Start grazing at top of slope and move to bottom
- · Will use portable trough and regular back fencing





Adverse weather plan

We can't predict the future, but we can plan for it. During winter there are usually some particularly bad weather events, either storms, cold weather and snow or high rainfall events. There is a need to have a contingency plan for cold weather and storm events as these may have a large impact on the environment and animals. Typically this includes planning to allow more feed and shelter for stock, and where possible options to keep stock further away from waterways or wet areas and put them in areas less prone to mud.

Some actions you may consider using during adverse events are:

- Feed an area of crop saved in a drier, lower risk part of the paddock, or a different paddock further away from waterways, preferably with some shelter such as a shelter belt. This will help keep water ways and critical source areas protected.
- Use races/laneways, yards, rough grass areas away from waterways as stand-off areas for animals.
- Utilise tree blocks that have a lower risk of environmental losses and provide shelter.
- Budget more feed as stock will require more feed to stay warm. Allow for an extra 10% above usual winter intake during cold and wet conditions.
- Consider offering larger breaks with several days allowance at once.
- Grass support block paddocks can be used when the weather is poor, and there are options to utilise feed supplements while on these areas.
- Get livestock to sheltered areas with reticulated drinking water available whenever possible.

In **Template FC7** in "Our Plan" (example below) note down what plans you have in place to identify when stock should be moved to an alternative location, what and where this area is, and any other actions you may take to reduce the risk to soil or animal health if there is a serious storm or adverse weather event.

Adverse weather event planning

FC7

Example

	Location or area that stock will go to	Feed type and allocation	Number of days of feed budgeted for adverse events	Preparation before winter	Conditions when stock will return to regular winter grazing
If there is an adverse (large) rainfall event	Will move animals to grass area next to yards	Baleage put next to yards Have enough for ad lib feeding.	14 days	Place bales next to yards	When rain stops and waterways have lowered levels, paddock has no surface water
If there is an adverse (very cold) storm event	As above but if a large snow event also have tree block available to put stock in.	As above. Also have bales in reserve if have to feed in tree block	As above	As above	When storm is over and paddock is not too wet and waterways levels dropped/snow cleared.

Monitoring and review

Throughout the season it is important to monitor your forage cropping, particularly over the grazing period. This will be important for all types of forage cropping systems. If you monitor during the season you can make adjustments where necessary to reduce the risks. You can use this information to refine your forage cropping system in future seasons. If you are winter forage crop grazing make sure you are familiar with your local regional council requirements as in some situations you may need to let them know of any issues or changes to your plan.

At the end of the season or cropping period it is important to reflect and review on:

- 1) What worked well
- 2) Areas that need improvement
- 3) Things that you leaned over the cropping period or action that you will implement next season.

Taking photos can be a useful way to record observations in the field. If possible take some representative photos with the location recorded (geolocated- using the GPS in your mobile phone, or location noted in a diary). This will help show the good management actions that you are using to reduce the risk of contaminant losses. Photos can also serve as a reminder of things that need to be improved.

Taking some photos before the forage crop is grazed, some during and some after grazing will help keep a record of the winter forage crop grazing.

Fill out **Template FC8** in "Our Plan" or use the questions to help record your observations from over the forage cropping season. Use this information in future years to help refine your grazing management and forage crop grazing plan. An example of FC8 is given below.



	Yes/ No	Notes
Was the paddock sown to plan?	Yes	Left Critical Source Areas uncultivated
Was the paddock grazed to plan?	Yes	Grazed, top to bottom and away from Critical Source Areas
Were you able to avoid significant pugging in the paddock(s)?	Yes	Paddock 15 got too wet. Moved animals into next paddock which was drier underfoot, put animals back into 15 when it dried out
Do you have some photos of the forage cropping paddocks before, during and after grazing?	Yes	A before, during and after picture for each paddock saved on computer in "Winter photos" folder
Do you have locations recorded for each photo e.g. geolocated with GPS on mobile phone camera?	Yes	Locations of photos taken in mobile phone with GPS enabled. Also noted in farm diary where each photo taken
Have you saved photos in a place you can easily access?	Yes	Saved on computer in "Winter photos" folder
Have you taken some notes over the forage cropping season?	Yes	Noted comments in farm diary and asked staff to report back too.
Did you need to action your adverse weather event plan for extreme weather?	Yes	Large snow event, actioned adverse weather plan when I heard the forecast. Moved stock to near yards, where there was long grass area and baleage
Did you have sufficient feed and area allocated for your adverse weather plan?	Yes	Allowed for more feed during the cold
Did you sow any catch crops?	Yes	Put in on stony lower flats paddocks that were dry enough to sow catch crop with direct drilling. Too wet on other paddocks in top block

Based on your check, at the end of the season or cropping period it's important to reflect and review on: 1) What worked well

- · Adverse event area worked well, kept stock happy and warm in the snowstorm. It also reduced the pugging.
- · Non cultivation of critical source areas worked well, just need to work with contractor to make sure right areas left unsprayed and uncultivated.
- · Top to bottom grazing- worked well and looked like less pugging at end of winter, just need to make sure that had portable troughs for water

2) Areas that need improvement

- · Back fencing more regularly- need to talk with staff
- · Getting the baleage and supplements in the right place before winter
- · Have more portable troughs for water so will make it easier to backfence
- · Planning earlier

3) Things that you learnt over the cropping period or action that you will implement next season?

- · Planning winter grazing earlier next season
- · Adverse event planning made it easier as I had the feed and areas ready-to-go
- · Will reserve some crop in dry parts of wintering paddocks and use if very wet and then save area next to yards if more shelter needed for animals

07 Irrigation

Many farmers using irrigation will be doing so with a Resource Consent or as part of a collective scheme. If not, please refer to the resources available from IrrigationNZ. The majority of the management and actions should have been considered within the relevant sections of soil health and freshwater. Details of irrigation management, risks, and actions can be inserted here if appropriate.





Irrigation Farm Environment Plan

(courtesy of Irrigation New Zealand)

Irrigation Farm Environment Plans, in combination with Audited Self-Management, have become the preferred mechanism for rural land users to satisfy current and future water quantity and quality regulatory requirements.

IrrigationNZ with funding from the Ministry for Primary Industries has engaged with a number of primary sectors, irrigation schemes and Regional Councils to produce -

A Farm Environment Plan Template. Note: As this template becomes more widely used it will be updated to reflect the issues encountered and better ways to address them.

A 'How to' Guide to assist irrigation schemes or collectives in Irrigation Audited Self Management. This document includes, protocols, procedures and templates for its successful implementation. Note: it is also possible for other rural land users not linked to irrigation to use this approach.

A Background Report that provides details of why Irrigation Audited Self Management has been developed and how it addresses regulatory requirements.

An **Audited Self Management** workshop was held in 2011. The report Building knowledge and understanding of Audited Self Management summarises the outcomes from this.

A link to the Irrigation New Zealand webpage with these templates can be found at **beeflambnz.com/farmplan**

