Erosion and Sediment Control Code of Practice

VERSION 2.0

JULY 2025

DRAFT FOR CONSULTATION

Codes of Practice form an integral part of the horticultural industry's system of continuous improvement – Joining the Dots.

AGRI LINK

Cover photo: Cross-contour oat strips in Pukekawa, Waikato. Used with permission from A.S. Wilcox & Sons.

This Code of Practice has been created to reduce the environmental impact of soil erosion and sediment entering waterways from horticultural production.

Soil is the most important resource to an outdoor grower. Soil loss through erosion not only deprives growers of this resource but it also does extensive damage to the environment. Damage to the environment from soil erosion chiefly comes from sediment entering waterways and damaging the freshwater ecosystem. Sediment contributes to increased water turbidity and often carries bound nutrients (predominantly nitrogen & phosphorus) leading to lower water quality.

Management practices to reduce the risk of erosion and soil loss focus on reducing the effect of erosive forces (water and wind) on the block, minimising the amount of erosion they cause and loss of sediment beyond the property boundaries.

This Code of Practice directs growers how to assess the risk of erosion and sediment loss, and identify appropriate practices to manage this risk.

Document control

Role	Name	Organisation	Date
Prepared by	Andrew Barber, Sarah Dobson and Henry Stenning	Agrilink New Zealand	April 2025
Reviewed by	Ailsa Robertson	Horticulture New Zealand	July 2025
Approved by	Michelle Sands	Horticulture New Zealand	July 2025

Summary of review changes since previous version (v1.1 – 2014)

Change	Reference
From Guideline to Code of Practice	Whole document
Addition of example Erosion and Sediment Control Plan	Appendix A

This code of practice will be reviewed, as necessary, by Horticulture New Zealand Limited. Suggestions for alterations, deletions or additions to this code of practice, should be sent, together with reasons for the change, any relevant data and contact details of the person making the suggestion to info@hortnz.co.nz.

Acknowledgements: This Code of Practice has been updated from the previous 2014 version, developed by Andrew Barber, Agrilink NZ. Funded through the Growing Change project by Horticulture New Zealand and Ministry for the Environment.

Vegetable RESEARCH+ INNOVATION

Contents

1 Code of Practice Overview

1.1 Introduction, purpose and scope

Protecting our soils

Soil is a critical resource for any commercial outdoor growing operation.While most practices in this code are relevant to cultivated growing systems, some are also relevant to permanent tree and vine cropping systems, depending on the level of erosion risk.

Natural soil characteristics such as water holding capacity, soil nutrients, soil structure and biological activity all contribute to the success of a growing operation. When soil moves within or off a block, there is a loss in productivity and profitability. In addition, soil moving off a grower's property creates sediment, which ends up on roads, in drains, streams, rivers and lakes, and the sea, generating significant negative impacts for the surrounding environment. These impacts and associated costs are borne by the whole community.

Therefore, retaining soil and its inherent characteristics through erosion and sediment control is important not only to the business of growing, but as part of our collective role in protecting our unique environment in Aotearoa. Maintaining soil health and retaining soil on farm is also critical to protecting the soil's life force (mauri) and conserving the soil's ability to produce food (mahinga kai) for future generations.

This Code of Practice

This Code of Practice has been built upon many years of grower and adviser experience, and industry research trials conducted during the Franklin Sustainability Project, as well as Holding it Together and Don't Muddy the Water projects. The Code of Practice also draws on Auckland Council's Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region (GD05), and its predecessor TP90, as well as TP223 Forestry Operations in the Auckland Region - A Guideline for Erosion & Sediment Control.

The recommended volumes and catchment areas for various sediment control devices differ from those in GD05[1], reflecting the difference in soil type and runoff factors from cultivated land, compared to earthwork sites. It was concluded, and accepted in submitted evidence to the Environment Court, that on cultivated land 0.5% storage is equivalent to or outperforms 2.0% storage on an earthworks site. The report *Justification of Silt Trap Capacity for Cultivated Land 0.5% vs. 2.0%* (Barber, 2012) describes this in more detail, along with the Don't Muddy the Water final project report. Copies are available from Horticulture New Zealand.

Table 1.1 outlines a range of control practices with estimated effectiveness and costs. The estimate of effectiveness was provided by John Dymond (Landcare Research). It assumes that the measures are used within their design limitations.

For example, a well-constructed vegetated buffer strip will have high effectiveness on low slope blocks, and a much lower effectiveness than shown in Table 1.1 on a steep block with channelised flow. There is no single silver bullet. Therefore, planning and implementation must include multiple complimentary control practices.

1 2023. Auckland Council. Erosion and sediment control guide for land disturbing activities in the Auckland region - Knowledge Auckland

Table 1.1 Cost and effectiveness of various management practices.

Pratices	Range in effectiveness (%)	Cost per hectare ($)*
Detailed erosion and sediment control plan	-	$200 - $250
Cover crop	90 - 99	$110
Uncultivated setback – 5 m		$90
Vegetated buffer strip – 5 m	50 - 80	$120 - $330
Stubble mulching	-	$100
Wheel track ripping or dyking	50 - 80	$50
Contour drains	30 - 70	$100
Benched headlands	50 - 80	$90
Super silt fence	80 - 95	$500
Decanting earth bund	80 - 95	$500 – 1,000
Silt trap	80 - 95	$1,000 - $1,500
Silt trap maintenance	-	$100/ha/year

* Estimated costs in 2025.

1.2 How to use this Code of Practice

This Code of Practice directs growers to undertake a block level risk assessment and provides information on a range of practices to support sustainable land management. The Code of Practice directs growers to more detailed information in FSP Doing it Right, and the most recently updated Auckland Council erosion control guide - GD05.

There are four key steps to assessing risk and managing erosion and sediment loss:

1. Know your block: Undertake a block assessment (Section 2)
2. Practices to stop or control water entering your block (Section 3.1)
3. Erosion control practices (Section 3.2)
4. Sediment control practices (Section 3.3)

Growers must complete block risk assessments for all their blocks and identify relevant erosion and sediment control measures appropriate to the block's level of erosion risk. Paddock risk assessments are to be completed within one year of your farm plan being created, and relevant erosion and sediment control measures must be in place within the following three years, or in time for your second audit. If your growing locations change, risk assessments must be completed on all new blocks within one year and can be done as part of your Erosion and Sediment Control Plan annual review.

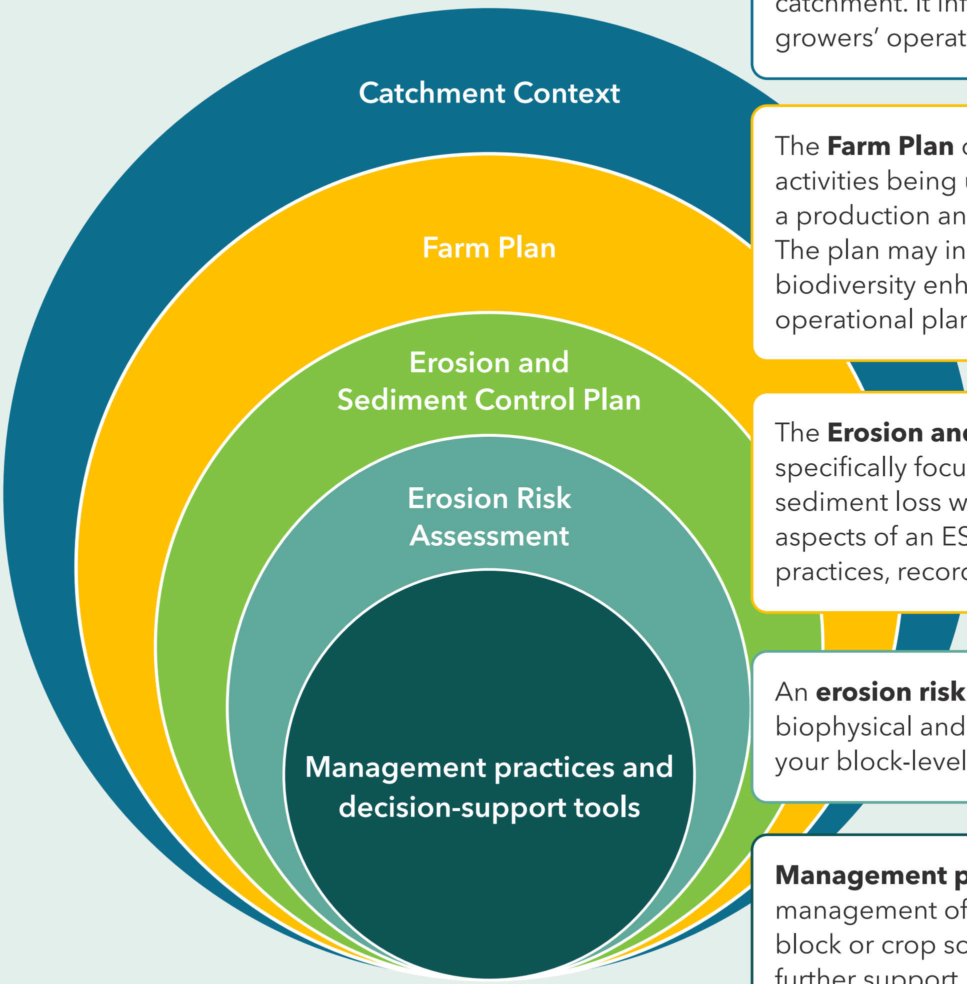
For leased and swapped land, which is typical in outdoor vegetable production rotation, implementing erosion and sediment control measures requires a conversation with the landowner. Because the installation of treatments and devices may involve physical works and changes to the land, it is ultimately at the landowner's discretion whether these measures are approved and maintained. As a lessee, you are responsible for assessing block risk and implementing practices to manage erosion during your cropping cycle (e.g., cover cropping, wheel track ripping, cross contour drains).

However, the proposal and implementation of management practices requiring physical works or changes to the land will require agreement from the landowner. It is recommended that you engage with the landowner early in the process to discuss the benefits and requirements of erosion and sediment control and to explore practical solutions that meet both parties' needs. In some cases, these expectations may also be formalised in lease agreements.

For growers undertaking any major orchard development or contouring (i.e., large-scale soil movement), please note these guidelines apply to 'business as usual'. In these other cases, growers should contact their local authority to understand what additional requirements they may need to meet. Nevertheless, the practices described in this guide will provide a very good practical starting point.

In this CoP most slopes are described in both degrees and percent. A 10-degree slope is equal to 17.6%, 45 degrees is equal to 100%. Degrees = tan-1 x (slope %) i.e., tan-1 x 0.176 = 10°.

Figure 1.1 sets out how farm planning, erosion risk assessment, and on-farm actions fit together.



The **catchment context** refers to the values and challenges for freshwater in the surrounding catchment. It influences whole farm planning and growers' operational activities and goal setting.

The **Farm Plan** considers the full range of activities being undertaken on the farm, from both a production and environmental perspective. The plan may include actions for freshwater, or biodiversity enhancement, as well as broader operational planning, like staff training.

The **Erosion and Sediment Control Plan** (ESCP) specifically focuses on minimising erosion and sediment loss within a growing operation. Key aspects of an ESCP include block risk assessments, practices, record keeping, and an action plan.

An **erosion risk assessment** includes both biophysical and management risks to understand your block-level erosion risk.

Management practices relate to the sustainable management of nutrients, whether at operation, block or crop scale. **Decision-support tools** further support practice implementation.

Figure 1.1. Erosion and sediment control planning within a wider farm/orchard context. Adapted from Edmeades et al. (2011)[2] and Foundation for Arable Research[3].

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[2] Edmeades, D. C., Robson, M., & Dewes, A. (2011). Setting the standard for nutrient management plans. https://flrc.massey.ac.nz/workshops/11/Manuscripts/Edmeades_2011.pdf

[3] https://www.far.org.nz/resources/far-focus-6-nutrient-management-plans.

1.3 Catchment context

Growers need to consider the catchment's context in their freshwater farm plan. Regional Councils are responsible for making catchment context information available.

The catchment context can impact on a grower's Erosion and Sediment Control Plan. Catchment context refers to information about what's important in your local freshwater area – like its natural features, how people use the water, and water quality challenges from activities like farming[4].

Catchments can be sensitive or vulnerable to degradation. Regional councils may require growers in these catchments to have specific or extra erosion management practices in their farm plan.

There is a need for Council driven catchment-scale solutions to manage water quality alongside farm-scale actions. In some catchments, for example, with significantly modified drainage and landforms, councils should be responsible for a catchment plan.

Requirements from councils for growers may include the following:

1. Awareness of catchment context, regulatory requirements and any non- regulatory catchment plans. Regional Councils are responsible for making this information available.
2. Setting of short, medium, and long-term objectives in their farm plan. Objectives related to environmental impact of the growing operation on surrounding waterbodies.
3. Progress towards practices, with timeframes set for actions to be undertaken.

Farm plans may also include non-regulatory, collective actions that contribute to improved water quality outcomes at a catchment scale.

While these actions may extend beyond the farm gate, they reflect a proactive and collaborative approach to freshwater management that complements individual on-farm practices.

Recognising and documenting such efforts in farm plans demonstrates a commitment to broader environmental outcomes and alignment with community-led freshwater improvement goals.

1.4 Farm Plan

A farm plan contains important information about your operation, and how you identify, assess, and manage risks. Most growers have integrated Good Agricultural Practice (GAP) farm plans. GAP farm plan standards integrate risk management across food safety, environment, and employment law.

Farm planning drives outcomes for both growing operations and the environment. The New Zealand Good Agricultural Practice (NZGAP) Environment Management System (EMS) add-on is designed as a farm planning pathway for growers to demonstrate environmental performance and meet regulatory requirements to manage impacts to freshwater. It covers property mapping, soil and nutrients, water, and biodiversity, and mahinga kai.

The Freshwater Farm Plan Regulations, under Part 9A of the Resource Management Act 1991, apply nationally and focus on addressing adverse effects from agriculture on freshwater. Freshwater farm plans contain farm maps, risk assessments, action planning, and records. Freshwater farm plans are one method that Councils can use to manage catchment water quality in regional plans.

This Code of Practice supports growers to develop an Erosion and Sediment Control Plan. Section 1.5 below introduces erosion and sediment control planning, and how this Code of Practice supports growers to build and maintain a plan for their operation, as part of their overall farm plan.

[4] https://www.horizons.govt.nz/managing-natural-resources/our-freshwater-future/freshwater-farm-plans/catchment-context,-challenges-and-values.

1.5 Erosion and Sediment Control Plan

An Erosion and Sediment Control Plan (ESCP) outlines how erosion and sediment loss is managed on a horticultural operation. It forms part of the overall farm/orchard plan and ties specific practices to an assessed level of risk. They are living documents that evolve with new knowledge, practices, tools, and regulatory requirements.

Once erosion risk levels are assessed, practices proportionate to the level of risk can be applied.

Each ESCP is tailored to the farm or orchard, and reviewed annually to reflect changing conditions, so that the plan stays relevant and practical. They include flexibility to manage uncertainty, such as extreme weather resulting in unexpected erosion and sediment loss. Using this approach, potential impacts can be minimised as much as practicable.

A well-communicated ESCP supports both performance and compliance. This Code of Practice helps growers develop a comprehensive ESCP that meet minimum expected industry practice and supports growers to address regulatory requirements. Knowing what rules apply to your farm or orchard helps build a plan that can both demonstrate compliance and become an asset to your business, to help achieve other goals, perhaps relating to finance, productivity, or soil health.

An example ESCP for a commercial vegetable operation is provided in Appendix A.

Criteria for a strong ESCP includes:

- **Clear goals and objectives**,
- **List of blocks** and crops of commercial horticultural production,
- **Erosion risk assessment** for each block (Section 2),
- **Practices to manage erosion and sediment losses** (Section 3),
- **Alignment with other management areas** in your wider farm plan, for example, irrigation management, and nutrient management,
- **Comprehensive records** of practices, for example, maps, block assessments, device design and implementation plans,
- **Action plan** of all actions, responsibilities and timeframes, and
- **Review process** to track and adapt over time.

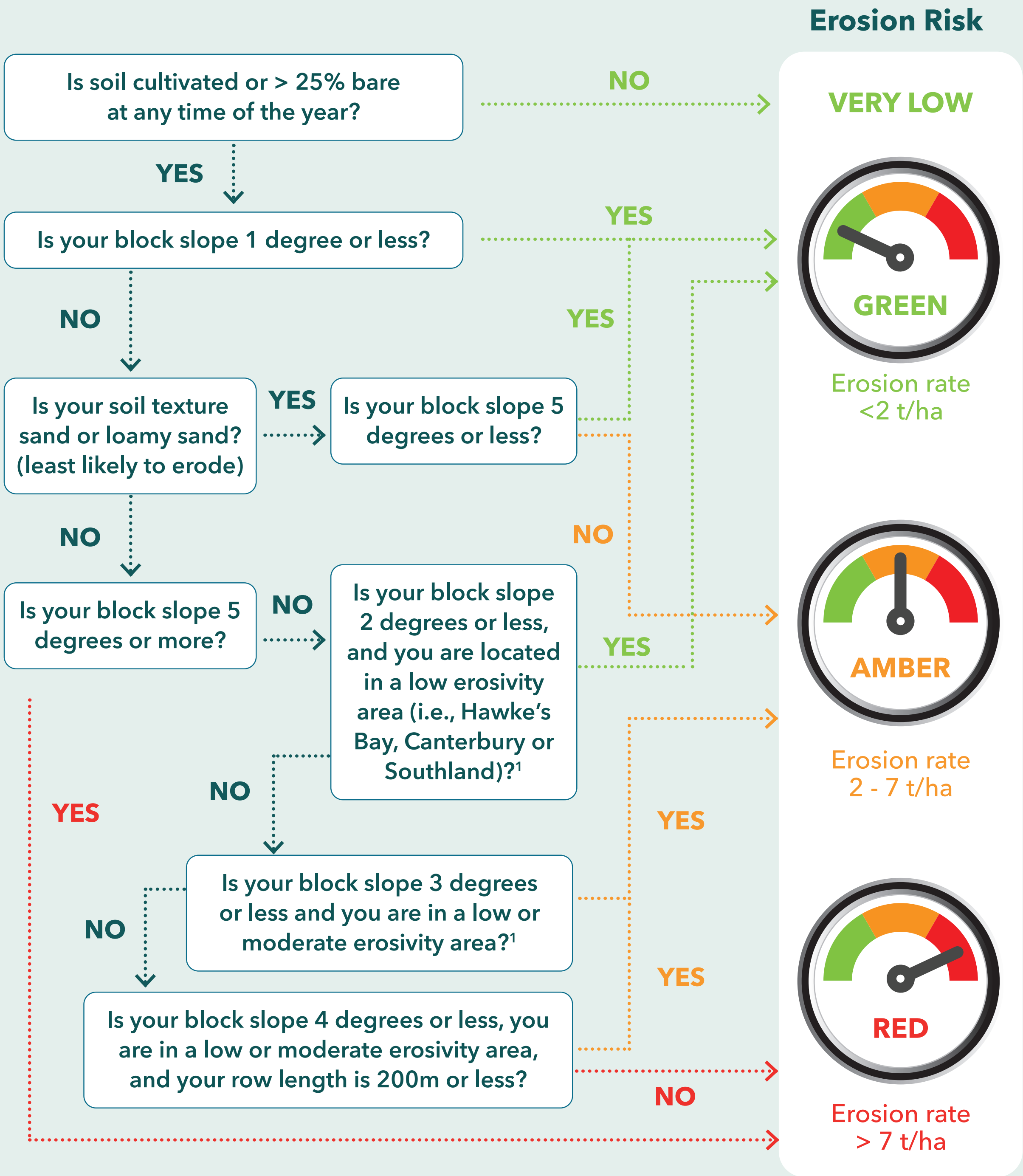
As part of the internal annual review of an ESCP , risk assessments may need to be updated to reflect any relevant changes, for example changes in location of your growing operation, or records of practices implemented.

2. Assessing Erosion Risk

2.1 Erosion Risk Assessment

This block risk assessment and following decision tree for practice implementation has been created for growers to easily identify the erosion risk of their block and associated management practices to implement as a result. The rates are based on cultivated land. Land that is predominantly in grass has significantly lower erosion rates and will generally be less than 2 t/ha (Very low or Green). Alternatively use the DMTW App to determine the best estimate of your erosion rate and appropriate practices.

As a reminder, when carrying out any assessments or practices, the health and safety of workers and the public must be an integral part of all activities, including the identification of hazards.



1. See the NZ erosivity map on page 66 (Klik et al., 2015). These regions generally have low rainfall erosivity. Use the DMTW App to determine the best estimate of your erosion rate. Low erosivity R factor is <1,000; moderate is 1,000 to 1,5000; high >1,500.

2.2 Erosion control decision tree

For implementing erosion and sediment control practices

Very Low	Minimise water entering the block: Intercept overland flow from catchments above with the use of **interception drains, diversion bunding, culverts**, and/or **benched headlands**. All **access ways should be raised**. Erosion control: Maintain **good ground cover** with long dense vegetation or coarse mulch. **Increase infiltration** through higher soil organic matter and mechanical aeration. **Level the ground** to reduce channelised flow.
	The above plus:
Green Erosion rate < 2 t/ha	Erosion control: Use **cover crops** where possible in your operation to avoid bare/fallow soil, especially during winter. **Grassed swales** are installed where appropriate. Follow COP described practices for **cultivation, harvest** and **postharvest paddock management**. Sediment control: Install and maintain **vegetated buffer strips** at the edges of your paddock or orchard to intercept runoff water. All **access ways should be raised.**
	The above plus:
Amber 2 – 7 t/ha	Erosion control: Where appropriate use **wheel track ripping** or **wheel track dyking** to increase infiltration on compacted wheel tracks (excluding spray tracks). Sediment control: Where appropriate install **vegetated buffer strips** – special attention needs to be paid to minimising channelised flow. Consider using **decanting earth bunds** or **sediment retention ponds** to prevent uncontrolled runoff water escaping the block.
	The above plus:
Red 7 t/ha	Erosion control: Consider **reducing row length** to < 200 m. Alternatively, install **contour drains**, or sow **in-row cross-contour vegetative strips**, to reduce the flow of water down the rows. Sediment control: Construct **decanting earth bunds** or **sediment retention ponds (SRPs)**. Where erosion rates are greater than 7 t/ha, vegetated buffer strips may become overwhelmed or have considerable channelised flow, making them ineffective.

2.3 Block Assessment

This is a critical step and must be undertaken for every block you grow on.

The assessment initially involves walking each block, mapping and identifying significant features (slope, drains, culverts, area, etc.). In particular, overland flow paths, where water is coming from and going to, and the location and type of existing management practices. Knowing the block history is invaluable. This first block assessment becomes the basis on which management practices are built, as well as future updates planned.

> "When we first go into a new block, planning the layout revolves around the lay of the land…where drains logically must go…look at entry and exit points…what is happening around the block...history...row direction etc." Kevin Balle – Balle Bros

1.1 Block Plan

Planning should be done on a block by block basis, building up to an Erosion and Sediment Control Plan, which sits within a wider farm plan. Erosion and sediment control practices will then be better integrated with your whole farm system to have maximum impact.

Start the planning process by walking around each block, particularly during or after heavy rain, and mark on a block map:

- Where water is coming from (e.g. roads, drains, buildings etc.)
- Where water is going or should go (e.g. any overland flow paths)
- Drains and bunds
- Any existing erosion or sediment control measures.

Also on the map:

- Note the block dimensions
- Mark the direction and steepness of the slope in different parts of the block
- Mark any streams and riparian strips.

Noting block slope is one of the most important parts of a block assessment. Slope has the single largest impact on erosion rates, with approximately 35 times the difference in unmanaged sediment loss on a 7 degree block, compared to a 1 degree block (see section on Vegetative Buffer Strips – Section 3.3.3).

A picture is worth a thousand words. It is a good idea to document your actions and keep a photographic record of where you started and what changes you have made. Furthermore, many of the erosion control measures you might implement, such as cover crops and wheel track ripping, may only be visible for a few months. Documenting your use of these erosion control measures is invaluable.

This map and information will be used to plan the most efficient and effective set of erosion and sediment control measures. Maps can be simple hand drawn diagrams or based on electronic aerial photographs. Electronic maps are readily available from Google MyMaps, Google Earth, or the Councils' GIS systems. The advantage of using the electronic mapping systems is that you can easily determine the catchment areas for your various sediment control options.

Figures 1.1 and 1.2 on the following page depict a hand drawn and a digital map of features noted in a block risk assessment.

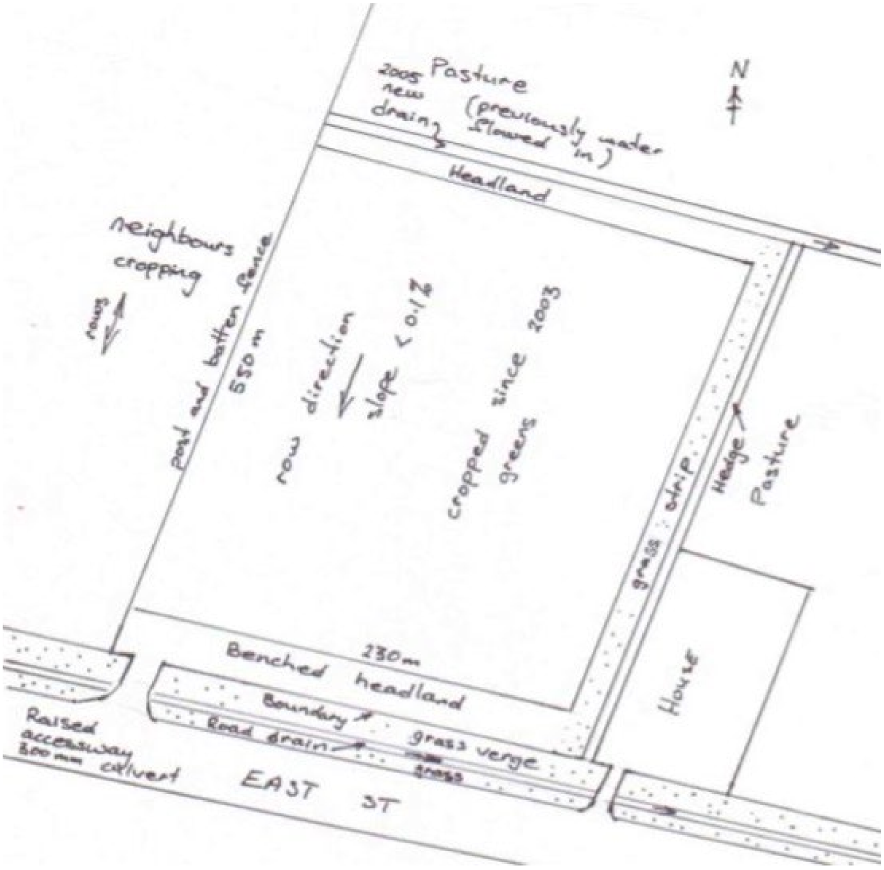


Figure 1.1 A simple hand drawn block map.

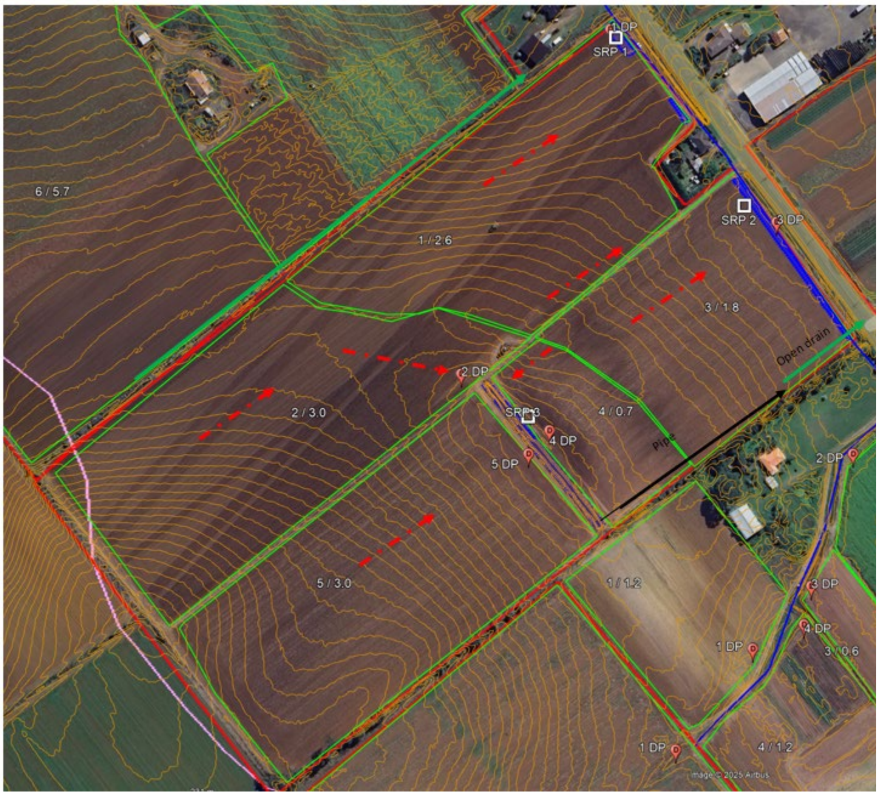


Figure 1.2 A digital block map showing contour lines (council provided) and location of sediment retention ponds (SRPs).

Photo credit: Woodhaven Gardens

3 Practices

In this section, management practices have been categorised by each of the steps to minimising erosion and sediment loss: controlling water entering blocks (Section 3.1); keep soil on the block (Section 3.2); and manage the water and suspended sediment moving off the block (Section 3.3).

Practices to

3.1 Control surface water entering blocks

3.1.1 Interception Drains

Practices for stopping or controlling water entering the block

Photo credit: Master & Sons

Identifying and then stopping or controlling water entering the block is crucial. Drains overtopping can be one of the biggest causes of erosion. In Pukekohe on the 21st January 1999, a short-duration high intensity storm struck. The most severe damage was caused where uncontrolled run-off entered blocks as a result of overflowing drains. In many places, inadequately sized culverts also caused drains to overflow. Keeping clean treated water off the block using interception drains wherever possible is crucial. Coordination of drains and erosion and sediment control practices between neighbours and council is essential to minimise soil loss. Meet on site with them to talk through and agree on what needs to be done.

Also:

- Ensure all drains are linked
- Check that drains and culverts are large enough to cope with the volume of water
- Carry out regular drain maintenance
- Discuss with your neighbours linking the drainage systems and know the catchment sizes above you.

Keeping water off the block using interception drains or bunds wherever possible is crucial. Where this is not possible due to the contour, grassed swales through the otherwise cultivated block should be considered.

Interception drains need to be built large enough to cope with the flow of water from the catchment above. Where the drain has a steep gradient, **check dams** (energy dissipaters) should be used to slow water flow and minimise drain scouring. Drains are most effective when both stabilised and vegetated to reduce the risk of scouring. Vegetated drains, compared to earth drains, more effectively filter out sediment (excepting extremely heavy rain events).

3.1.2 Culverts

Practices for stopping or controlling water entering the block

Culverts in drains are often undersized, which means they can easily become blocked with debris and rubbish, or simply cannot cope with large volumes, leading to overtopping. Like drains themselves, culverts need to be correctly sized and should have well-formed headwalls – in general, the bigger the better. The drain at the discharge end of the culvert should be protected with rock to prevent scouring. Table 3.1 gives an indication of the maximum catchment area for a range of culvert sizes for a 20% (1 in 5 year) and 5% (1 in 20 year) Annual Exceedance Probability (AEP) rainfall event.

The flow is based on having a 0.2m headwall above the top of the socket end culvert. The quantity of stormwater generated from a certain size catchment will vary depending on rainfall intensity, overland flow length, slope, and surface characteristics. The maximum catchment area given in Table 3.1 is a guide only and is based on a stormwater study conducted for the Bombay Hills. The area guide is likely to be conservative for most catchments as culverts in flatter catchments with less intense rainfall events could cope with larger catchment areas.

Table 3.1 Culvert size and associated flows and catchment area (ha).

Culvert size (mm)	Flow (L/sec)	Maximum catchment area (ha)	
		20% AEP	5% AEP
300	120	3.4	1.8
375	200	4.8	2.3
450	295	8.1	3.7
525	405	11.3	4.8
600	545	15.0	7.1
675	725	19.3	9.3
750	925	26.9	11.7
825	1100	35.9	14.8
900	1400	48.0	17.8
1050	2000	64.8	29.0
1200	2790	87.5	48.0
1350	3550	115.1	61.4

3.1.3 Benched Headlands

Practices for stopping or controlling water entering the block

Modifying headlands is a simple and effective way of controlling and managing soil and water runoff from block rows, particularly wheel tracks (a major source of sediment). Often called 'benched' or 'contoured' headlands, the entire headland area is designed to direct water to the side of the block or to a drain within the block.

The headland slopes away from the rows, sloping towards an earth bund. The headland is still used in the normal manner for access to planting, spraying and harvesting operations.

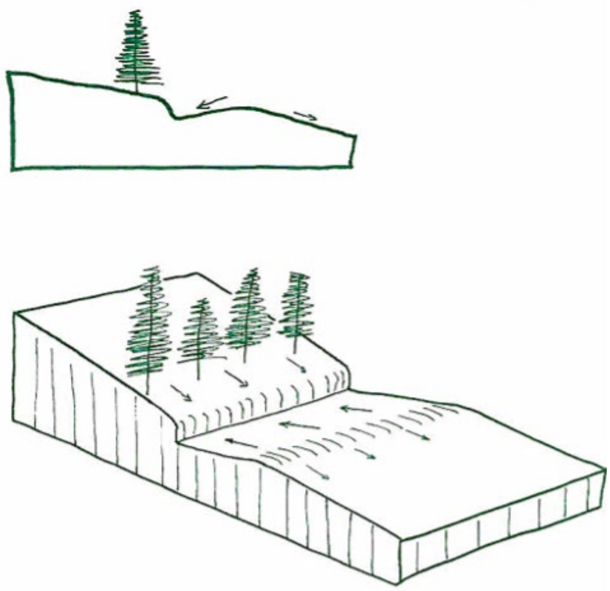
Grassing headlands will protect them from scouring and encourages silt to drop out before entering surface drains.

The easiest way to construct a benched headland is using a grader blade. Once in place, particularly if it is grassed, the only maintenance is to clear deposited soil and reshape in dry conditions or if major scouring occurs.

Benched headlands are used to good effect in breaking up the length of long block runs. If constructed to a broad shallow design, a tractor can be driven across the headland.

When constructing a benched headland attention needs to be paid to:

- Where water from the benched headland is being directed, for example, to a permanent drain which will carry it off-site in an effective manner
- Where silt will be deposited in the benched headland, and further down the drainage system.



Benched headland

Scouring of benched headlands can occur if:

- Excessive water volumes flow into a headland. Use contour drains across the field to reduce this
- Soil in the headland has not been compacted
- The slope of the headland is too steep, creating high water speeds during rainfall. Take measures to reduce volumes reaching the headlands by diverting water to drains or vegetate the headland to cope with the high water speed.

Check what happens when the water reaches the end of a headland, making sure the headland connects with a suitable sediment control measure or stabilised discharge point.

3.1.4 Diversion Bund

Practices for stopping or controlling water entering the block

Diversion (or earth) bunds are used to intercept water or run-off from another source, directing flow away from a potentially vulnerable block to a non-erodible outlet. Diversion bunding can be used as an alternative to interception drains. This practice both minimises the volume of water that can enter a block, thus reducing the risk of sediment loss, and reduces the need to potentially install a more significant sediment control practice at the bottom of the next block (as the bund reduces the catchment area).

Key considerations:

- If the water flow is clean (e.g., from a grassed block), the bund should divert the flow into a non-erodible clean drain or outlet
- If the water flow is dirty (e.g., run-off from another cultivated block), the bund should divert the flow into a treatment area (e.g., a decanting earth bund or sediment retention pond)
- The bund gradient should be uniform to avoid sediment dropping out early and building up along the bund
- The bund itself should be well-compacted and stabilised to reduce the risk of it breaching in high rainfall events
- Regular checks of the bunding are recommended, especially after heavy rain, to ensure no scouring or breaching has occurred.

Diversion bunding is also a recommended practice for managing sediment loss off a block. The same considerations apply but all water flow into the bund will be dirty.

3.1.5 Grassed Swale

Practices for stopping or controlling water entering the block

A swale is a surface drain that is often shaped into a shallow saucer. They are used to ensure water flowing along natural overland flow paths through cultivated areas do not cause significant erosion. Clean water can be directed along the swale, following its natural course, to a stabilised discharge point. Once formed the swale needs to be immediately stabilised with grass. The size is based on the catchment area above the block. As a minimum, the swale should be at least 3m wide. The swale should be shaped into a flat shallow saucer, about 0.3m deep, so it is easily driveable if it needs to intersect the cultivated rows.

A grassed swale may have prevented the damage shown in the photo (right). An interception drain or bund could not be used to cut this water off due to the contour. The water entering the block was clean so does not need any further treatment if it had passed over a grassed swale. Without the grassed swale, the volume required in the sediment control practices needs to account for the cultivated block as well as the catchment area above the block.


Photo credit: Provided by Bryan Hart from A.S. Wilcox & Sons

Erosion control practices to

3.2 Keep soil on the blocks

3.2.1 Cover Crops

Practices for keeping the soil on the block

Implementing in-block erosion control measures to minimise soil movement will retain and even improve soil structure. Although eroded soil caught in a sediment control device (e.g., earth bund or silt trap) can be redistributed back over the block, it is invariably in poor condition and no substitute for preventing soil from moving in the first place.

Green manure or cover crop describes any crop which is grown to be ploughed into the soil rather than harvested. This incorporation of a crop back into the soil is to improve soil quality and long-term production.

Benefits

The use of cover crops is beneficial in all long-term cropping situations for three main reasons:

1. To stabilise soil from erosion and improve water penetration and drainage
2. To produce dry matter, which improves organic matter and soil structure
3. To trap and cycle mobile nutrients from the previous crop.

Other benefits of using cover crops include:

- Smothering weeds (potentially reduce weed control costs)
- Improved soil fertility (improves productivity)
- Stimulating soil biological activity (e.g. earth worms) and assisting in breakdown of previous crop residues to reduce disease carry over and soil-borne diseases
- Providing a habitat for beneficial insects
- Fixation of nitrogen by some species.

3.2.2 Wheel Track Ripping

Practices for keeping the soil on the block


Credit: K Makan.

Wheel track ripping increases rainfall infiltration rates and significantly decreases soil movement. Ripped wheel tracks allow water to percolate into the soil rather than flow down the wheel tracks.

Compacted wheel tracks can act as drainage channels. Shallow ripping of wheel tracks, to just below the cultivation compaction zone, can reduce soil and crop loss.

Water flowing down the wheel tracks undermines the adjoining crop beds leading to extensive crop and soil loss. Where the wheel marks are ripped, water can infiltrate into the soil, reducing soil loss and preventing crop loss.

Wheel tracks in the rows used for spraying should not be ripped because the resultant loose track makes spraying difficult.

When any runoff reaches the bottom of the block, it needs to be dealt with by sediment control measures (e.g. decanting earth bunds or silt traps). The easiest and most effective way to deal with this problem is to minimise runoff in the first place. Ripped wheel tracks minimise runoff and reduces the pressure on any sediment control device.

Why rip wheel tracks?

Trials have found that wheel tracks are the key zones for initiation of surface runoff and erosion.

Reduction of water movement along wheel tracks is the key to reducing erosion rates. In a Franklin District trial, ripping wheel tracks increased the infiltration rate from 0.5 mm per hour to more than 60,000 mm per hour.

Table 3.2. Infiltration rate (mm/hour).

Treatment	June	October	January
Uncultivated wheel track	0.5	12.7	77.2
Cultivated wheel track	60,300	12,500	8,600
Onion beds	400	500	900

Table 3.3. Erosion rate (t/ha).

Treatment	Jun - Aug	Sept - Dec	TOTAL
Uncultivated wheel track	16.7	4.6	21.3
Cultivated wheel track	0.98	0.13	1.1

Because the infiltration rates are so high in both the ripped wheel tracks and onion beds, runoff would only be generated if the capacity for the soil to store water is exceeded.

As a word of caution, some growers attribute wheel track ripping to increased erosion. This underscores that no single measure will work for everyone in all situations. However, many growers and the research trials show that in most circumstances wheel track ripping will significantly reduce soil erosion.

How to rip wheel tracks?

Wheel tracking ripping in action (above).

Wheel track ripping is carried out as soon as possible after planting. A shallow tyned implement pulled behind a tractor is used for this purpose. It has double leg subsoiler shanks with small wing bases, mounted behind the wheels on a straight toolbar. Weights attached to the middle of the toolbar help with penetration of the implement.

3.2.3 Wheel Track Dyking

Practices for keeping the soil on the block

Dyking is a simple practice that creates a series of closely-spaced soil dams in wheel tracks (pictured below, right). These dams capture water in what amounts to small indentations. Water can then soak into the profile, minimising runoff and any associated movement of soil and nutrients. As with wheel track ripping, dyking offers a practical solution to reduce soil erosion before it becomes a bigger issue.

Small indentations along the wheel track can be seen filled with water (above).

These small dams slow the water down and settle the suspended sediment. Water also has a longer duration to infiltrate into the soil.

Why dyke wheel tracks?

Initial trials in the Horowhenua and Hawke's Bay have shown that dyking wheel tracks can be extremely effective in reducing runoff and soil and nutrient loss. In low and high rainfall events dyking eliminated runoff compared to undyked (standard) wheel tracks. This largely reflects the longer retention time water has behind soil dykes.

Dyked (left) vs undyked (right) wheel tracks.

Creating these small dams along the wheel tracks can have clear production benefits too, through the minimisation of ponding. Recent trials have shown just how costly this type of damage can be, with the potential for total crop loss in affected areas, even as a result of short-term ponding. Where crops survive the initial ponding events, crop performance is still often affected.

How to create wheel track dykes?

Soil dykes are created by a propeller-like instrument. A ripper shank works immediately in front of the propellers both to loosen the soil to create the small soil dams and to allow quick drainage (see the previous section). There are several different designs available, though most create soil dams about every 30 to 45 cm. The equipment itself is pulled behind a tractor and is mounted to a standard straight toolbar.

The best time to create the dams is when the soil has been recently worked. It is following this disturbance that soil is most at risk of moving. Soil dykes should be formed slightly below the top of the bed, so that if they overflow during extreme rainfall events the water will flow down the wheel track rather than across the bed. Don't work the wheel tracks if the soil is too wet – damage to soil structure is likely to outweigh any potential benefits.

In some situations there may be value in reforming dykes several times during the season, where in others once will suffice. Sowing oats at the same time the wheel tracks are dyked can increase the stability of the soil dams, but is not essential. Wheel tracks in the rows used for spraying should not be disturbed.

3.2.4 Contour Drains

Practices for keeping the soil on the block

Contour drains can be considered if the block is on a slope of 1°(1.7%) or more.

Contour drains are temporary drains used to collect runoff water. They effectively reduce the length of rows that runoff water can flow down by collecting water in shallow drains that run at a gentle gradient across the slope of the block. Water is then channelled into permanent drains or grassed alleyways. Contour drains also control the speed of runoff water when the correct gradient is used.

Contour drains MUST discharge into a permanent drain; otherwise the problem of erosion is simply shifted from within the block to the margins. The permanent drain must be capable of handling the volume of water discharged from the contour drains.

To work well, contour drains must be designed and constructed properly, taking the field's characteristics into account.

Contour drain spacing

The steeper the slope, the greater the number of contour drains needed. Table 3.4 provides appropriate drain spacing according to paddock slope.

Table 3.4 Contour drain spacing.

Paddock slope	Drain spacing
> 6° (10% i.e. 10m rise per 100m length)	20m
1.7° - 6° (3% - 10%)	30m
< 1.7° (3%)	50m

As a general rule, contour drains should never be more than 80m apart.

Getting the spacing of contour drains right is very important. Getting it wrong can actually create more problems than it solves. The golden rule is to avoid placing drains too far apart, as contour drains spaced too widely can overflow and CAUSE erosion.

Contour drain slope

It is important that contour drains are sloped correctly. If too flat they can silt-up or overflow, if too steep they become gouged-out. The best way to get the slope right is to survey the block to get the right fall in the contour drains.

Trials in the Franklin District have found a slope of 1.0° - 1.5°(1.7 - 2.6%) is appropriate for clay loam soil.

The most common fault seen with contour drains is that they are too steep and too far apart. To compensate for this, they are often deeper than necessary and therefore become a hindrance to sprayers and other field equipment.

Contour drain length

For contour drains, shorter is better. The longer the drain, the more likely it is to overflow. As a guide, the Kindred Landcare Group in Tasmania recommends that contour drains be no longer than 50m.

Contour drain construction

A clinometer, two equal length poles, an assistant and marker pegs should be used to mark out the placement of contour drains.

1. Stand at the top of the block halfway between the vertical drains on either side of the block or at the far side of the block if there is only one vertical drain.
2. Send your assistant to the edge of the block, their pole held upright.
3. Set the clinometer to the required angle. Rest it on your pole and look through it.
4. Ask your assistant to move down the block until the top of the poles line up with the hairline on your clinometer.
5. Peg both your and your assistant's position. This is the line for the contour drain.
6. Both move down the block 20 - 80m, depending on the block's characteristics, and repeat steps 3 and 4 and 5.

Once pegged out, drains can be constructed with a blade set on an angle. Soil should be pushed to the downhill side. Drains may need to be finished off by hand.

Contour drains should be put in immediately after sowing the crop - not the next week. It may be too late or may not get done at all.

3.2.5 Paddock Length

Practices for keeping the soil on the block

Row length is important if the block is on a slope of 2% (equivalent to about 1° degree) or more. In longer rows, erosion is often evident. This is because the cultivated rows act as channels, essentially a "race" for water and run- off. In blocks with both slope and a long run length, water has the opportunity to build up more volume and velocity. This significantly increases the risk of scouring, as well as sediment loss to the surrounding environment. Scoured and eroded rows significantly impact crop productivity and profitability.

Measures to manage block length risk

- If rows are oriented up and down the slope, restricting row lengths to 200 m or less is recommended.
- Contour drains can help to break this length up to reduce the overall row length. See page 23 for a guide on installing contour drains.
- Some growers around Pukekohe use cross-contour vegetative strips to reduce in-block erosion caused by long run lengths (see Figure 3). Sown across rows before sowing or planting of the main crop, the strips help drop out sediment at intervals down the block during the growing season. This reduces both scouring in the block and the quantity of sediment that needs to be dug out of a silt trap or SRP at the end of the season.
- Another method of reducing erosion in-row used by growers in Pukekohe has been to sow vegetative strips when wheel track ripping after planting (Figure 4).

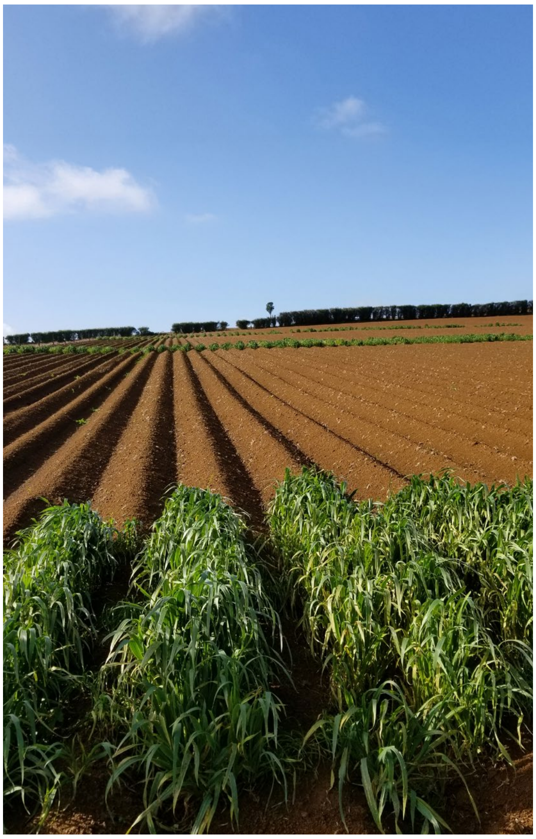


Figure 3. A grower's use of cross-contour oat strips on a steep block with a long run length. Used with permission.

Figure 4. A grower's use of in-furrow vegetative strips to reduce in-block erosion. Used with permission.

3.2.6 Cultivation Practices

Practices for keeping the soil on the block

Cultivation reduces the stability of most cropping soils over time. The how, when and where cultivation is done can have a big impact on the erosion potential of your soil. Good cultivation techniques can increase productivity and conserve soil, keeping it in good condition for the future.

Protecting the soil resource is very important as it can take many years to rebuild once it is lost through erosion. Consideration should also be given to retiring or resting blocks where the soil structure has been degraded by excessive or poorly timed cultivation. Continuing to crop blocks with degraded soil structure will only intensify soil loss and erosion, for example, with an increased number of passes required to prepare blocks for planting.

Cultivation practice to reduce block erosion:

- Adopting minimum tillage approaches or minimising the number of cultivation passes can be an effective means to reducing soil erosion.
- Maintaining good soil structure can reduce the costs of cultivation, for example, by reducing the number of passes needed to achieve the desired seed bed. Good soil structure also protects the health of the soil by allowing better aeration and drainage.
- Excessive cultivation with rotary hoes should be avoided. The exposure of less fertile subsoils can require higher inputs of fertiliser (added cost) to maintain crop productivity.
- Where possible, blocks should be cultivated in alternating directions in successive years to avoid moving whole fields downhill.

Uncultivated setback strips

- Leave a 5m setback between the cultivated area and all rivers as an interim measure. Over time, runoff into all rivers and drains needs to be controlled by an appropriate sediment treatment measure, determined through the block risk assessment process.
- A vegetated buffer strip or riparian margin is a means of managing soil that moves off a block and should be planned as part of the cultivation, so that an adequate area is left uncultivated. It forms a filter that can trap sediment in runoff and prevent it entering the waterway. Many Regional Plans require cultivation to have a setback distance from waterways. However, one of the problems is that cultivated blocks often form channelised flow paths, rather than sheet flow, which can cut through these vegetated margins no matter how wide they are.
- Refer to the section on Vegetated Buffers, Riparian Margins and Hedges later in this COP for details and examples of setback strips and riparian margins.

Some dos and don'ts for soil cultivation

1. **DO** minimise the number of passes over the block wherever possible.

   Every cultivation pass results in the loss of organic matter through decomposition and can have a detrimental effect on soil structure.

2. **DO** build the organic matter level of your soils.

   Cultivation reduces organic matter. Building organic matter can be done with the use of cover crops (see the Section Cover Crops) or compost. Organic matter is critical for maintaining the stability of soil aggregates and reducing nitrate leaching. It also allows for easier preparation of seedbeds. The organic matter additions must form part of your nutrient budget (See Nutrient Management COP).

3. **DON'T** cultivate right up to the sides of drains or streams.

   This will only speed up the loss of soil from blocks, block up streams and require more maintenance. **Do** leave a 1 m uncultivated setback.

4. **DON'T** cultivate when the soil is too wet.

   The best way of reducing compaction and the formation of pans is to avoid being on the land when it is too wet. Compaction slows the infiltration of water into the soil and increases the risk of soil erosion.

3.2.7 Soil compaction

Practices for keeping the soil on the block

Soil compaction significantly increases the risk of soil erosion. Compacted soils have reduced infiltration rates, leading to increased surface runoff and erosion, as water is unable to penetrate the soil and is instead carried away, taking soil particles with it. This also limits root growth and reduces plant cover, further exacerbating the problem.

Start by understanding the issue by measuring soil compaction using a penetrometer or simply digging a pit.

In cultivated horticulture compaction can be reduced with deep ripping. Wheel track ripping works by breaking up the compacted top layer in the wheel tracks and significantly increases infiltration rate.

In both permanent and cultivated horticulture management practices to reduce compaction includes:

1. Maintain and upgrade drainage systems.
2. Avoid traffic on wet soil.
3. Consider irrigation cycles and current soil conditions when scheduling machinery passes.
4. Avoid unnecessary machinery passes. Carefully consider the full cost-benefit of each machinery movement.
5. Reduce the weight of each pass, using tracked vehicles, extra or oversized tyres to spread the load and reduce downward pressure.
6. Create hard stands for loading and unloading operations, particularly around harvest activities.

In permanent horticulture other practices could include:

1. Maintain year-round vegetative ground cover (orchard sward).
2. Drive in alternate rows where possible and use the same wheel tracks and travel direction in each row to limit the areas that become compacted and needs remediation.

3.2.8 Harvest Management

Practices for keeping the soil on the block

At harvest, operations should be carried out in a manner that has least adverse effect on the soil and water resources.

Working blocks in wet conditions can lead to loss of soil structure, compaction, and increased sediment in the runoff. In addition, it can also increase wear and tear on plant and machinery, reduce labour efficiency, increase pressure on washing systems, and increase product reject levels. Additionally, mud left on the road can create a traffic hazard and result in public animosity toward land users.

However, timing of harvest operations can be dictated by the demands of markets or factory requirements (process vegetables). This makes it difficult for growers to always operate under good soil and climatic conditions.

All-weather facilities should be established for loading and marshalling areas to prevent severe compaction, breakdown of soil structure, or any limitation to access.

Where required, metal should be used in gateways and loading pads. Load out may occur in an adjacent block.

3.2.9 Post-harvest Management

Practices for keeping the soil on the block

Where a new crop is not going to be immediately sown following harvest, consideration needs to be given to block management to prevent soil erosion. Bare soil surfaces in blocks following harvest are vulnerable to erosion caused by wind and rainfall, with significant soil and sediment loss likely in heavy rainfall or storm events. Therefore, post-harvest block management should be planned before harvest to minimise this risk.

Establishing a cover crop soon after harvest can protect the soil and generate other advantages such as increased soil organic matter, preventing the breakdown of the soil structure, and providing a feed resource for grazing. With its fibrous root system, oats are an effective cover crop option. See Section Cover Crops for a detailed description on the use of cover crops.

Where a cover crop cannot be established following harvest, contour cultivation should be considered so that the soil surface is broken up and left in a condition that avoids erosion.

Contour cultivation (below) can provide a similar effect to contour drains. Because crop management no longer needs consideration, there should be greater choice on where such cultivation occurs and whether the whole area is given a breaking up pass or at regular intervals across the slope.

Returning blocks to pasture at regular intervals is an effective way of building up soil organic matter and avoids the build-up of pests, diseases, and weeds. When returning pasture blocks to cropping, take care not to undo all of the good work by over cultivating or working the ground in less than ideal conditions.

Rotation of crops is well recognised as a practice that replenishes different nutrients and organic matter, improves soil structure through varying root depths, and manages soil-borne disease pressures. The length of the rotation and cropping practices will influence the extent of soil damage that can result from repetitive cropping. Pasture can be an effective 'recuperation crop' in the rotation.

To gain the best recuperative effect from pasture in the crop rotation, the pasture needs to be carefully managed. Overgrazing, particularly at times when soil is vulnerable to pugging or drought, can negate many of the benefits that pasture can provide. Soils can erode or compact, which in turn can lead to increased levels of soil loss through sediment runoff.

Strip contour cultivation of a fallow block following harvest.

Practices to

3.3 Manage sediment and suspended sediment moving off the block

3.3.1 Raised Access Ways

Practices to Manage sediment and suspended sediment moving off the block

Raised access ways should form part of your co-ordinated sediment control practices. All runoff can then be managed and treated before leaving your property, stopping the loss of valuable soil from blocks onto roads and into waterways.

A raised access way (below) prevents water from flowing straight onto the road.

While access ways are sometimes most practically located at the lowest point of the block, unmanaged these become a discharge point for stormwater.

The following mitigations or practices, well planned and used together, will avoid or minimise soil losses from access ways:

1. **Position access ways away from lowest point**

   Never place access ways at the lowest point of the field where water is naturally diverted or concentrates. This may mean "off-setting" it from the bottom corner where a decanting earth bund is installed.

2. **Raise access ways**

   Raise the access way above the surrounding area to divert water into your sediment control system. This may be as simple as using a load of metal to form a hump over the access way (see photo below).

3. **Check point**

   Use the access way as a check point where you can spend a few minutes removing soil that has become stuck to the tractor. Soil is a valuable resource. Don't leave it on the road as you drive away. Keep it for your crops. For more information see the Farm Machinery Washdown Code of Practice.

Photo credit: Hira Bhana

3.3.2 Diversion Bund

Practices to Manage sediment and suspended sediment moving off the block

Diversion bunds are normally earth, or haybales if temporary, that prevent water discharging straight off the block. Like raised access ways, they divert water from a block into a sediment control device, like a decanting earth bund or sediment retention pond (SRP). Diversion bunds can also be used to re-direct water from flowing into a block – this is covered earlier in this COP.

Key considerations

- The bund will create channelised flow so water should be discharged into a treatment device (e.g., a decanting earth bund or sediment retention pond).
- The bund itself should be well-compacted and stabilised with vegetation.
- It needs to be high enough to reduce the risk of it breaching in high rainfall events.
- Regular checks of the bunding are recommended, especially after heavy rain, to ensure no scouring or breaching has occurred.

Vetiver grass

FSP trialled vetiver grass as a soil barrier. Planted at 20cm intervals it will form a dense hedge, approximately 1.5m tall of stiff erect stems in 3 years. Once established it can filter the water leaving sediment to settle in front. It suits temperate regions of New Zealand.

Photo credit: Master & Sons

3.3.3 Vegetated Buffer Strips

Practices to Manage sediment and suspended sediment moving off the block

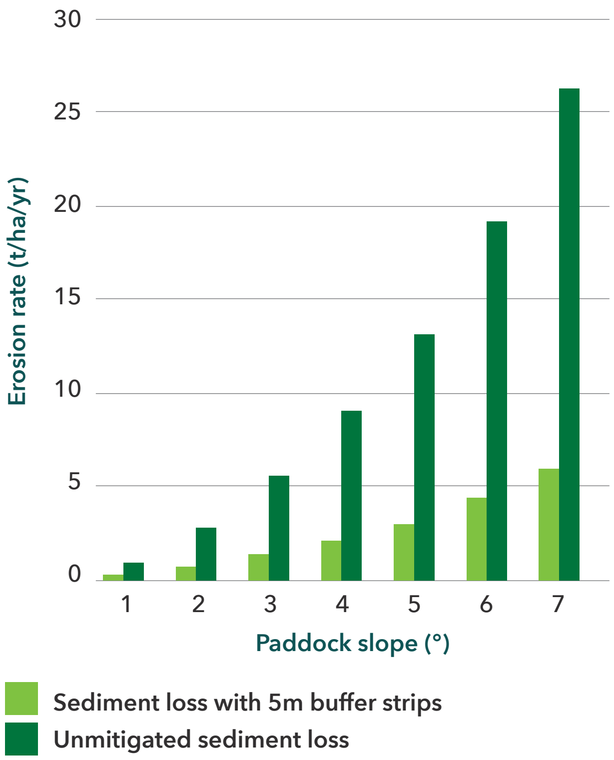
Vegetated buffer strips – also known as filter strips or riparian buffers - are a key management practice for sediment control.

With proper installation and maintenance, strips of vegetation – typically grass - can reduce the volume of soil moving off farm and into waterways. By increasing infiltration, reducing the velocity of runoff water, and filtration by plant material, buffer strips can reduce sediment loss. Co-benefits of buffer-strips also include a reduction in nutrient and pesticide contamination to the surrounding environment.

Vegetated buffer strips are one of two commonly used sediment control practices, the other being sediment retention ponds (SRP). While buffer strips are less technical to install than SRPs, when not installed or maintained correctly they can fail to effectively reduce soil loss from the farm. Preferential flow (channelisation) can bypass buffer strips entirely, resulting in a practice that looks visually effective but has little real effect on minimising sediment loss.

Figure 3.1 below shows graphs of modelled buffer strip efficiency and quantify the reduction in sediment loss based on buffer strip width and paddock slope. A 5m buffer strip (the optimal width based on modelling), when installed correctly, is a powerful tool to reduce sediment loss. To note, these graphs have been produced using modelled data from Barber & Stenning – actual erosion rates will vary.

Figure 3.1. Modelled buffer strip efficiency based on paddock slop and buffer width (Location - Levin).



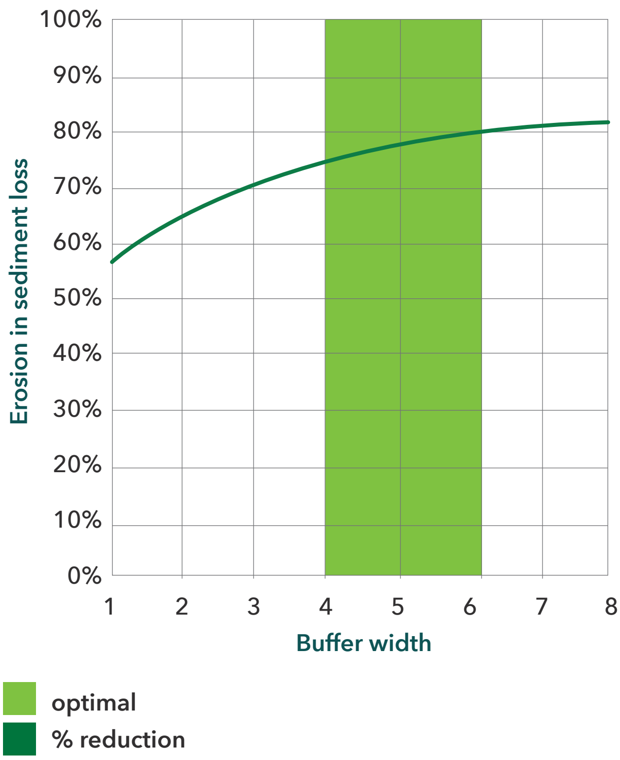


Photo credit: Woodhaven Gardens

Installing vegetated buffer strips

> "Unless [buffers] can be installed so that concentrated flow is minimised, it is unlikely that they will be very effective for agricultural nonpoint source pollution control" – Dillaha et al., 1989.

Level the ground to minimise channelised flow prior to sowing the buffer with grass. As can be seen in the photograph above, the headland has been moved further into the block to exclude traffic from the new buffer.

Vegetated buffer strip efficiency is contingent on runoff water entering as a continuous sheet, rather than at a singular point, as this leads to channelisation and bypassing of the vegetation.

To encourage sheet flow, the area where the future buffer strip will be placed has to be levelled. This can be accomplished using a power harrow with rollers, or a levelling bar. The image above shows the ideal ground preparation prior to seeding with grass or other vegetation.

The slope of the buffer strip should be between 2-6° (3-11%), sloping away from the block and headland to encourage runoff water movement across the buffer.

Orientation of vegetable rows to encourage sheet flow is important in preventing channelisation or other means of bypass.

The vegetated buffer should be 4 m to 6 m wide. It is recommended that an additional metre is added for contingency, as the edge of the buffer strip will inevitably become compromised over time by vehicle and machinery movement. It is especially important to ensure there is adequate headland space for vehicle movement in order to prevent vehicles tracking across the buffer strips and creating ruts and therefore channelised flow. A wide headland also enables runoff water to spread out and lose velocity as it exits the rows.

It is also wise to install a buffer strip a few metres wider than necessary to account for the inevitable encroachment over time caused by vehicle movements, soil build-up, and normal field operations.

The trafficked headland needs to be located between the cultivated block and the buffer strip. For many new buffer strip installations this will mean moving the headland into the block.

The choice of vegetation is also important. Most growers choose to use basic grass species, though oats, vetiver grass, and miscanthus are other species that can be used as an alternative. Generally, any plant species which has ground level vegetation and strong root systems will work to increase filtering and water infiltration. The vegetation must also evenly cover the entirety of the buffer strip to prevent preferential flow or routes of least resistance. Consideration must also be given to avoiding species that host crop and market access pests or may impact negatively on pollination.

3.3.4 Maintaining Vegetated Buffers

Photo credit: Woodhaven Gardens

> "Concentrated flow through riparian buffers [is] common and substantial" – Dosskey et al., 2002

Once established, buffer strips need to be maintained in order to keep them functioning effectively.

Buffer strips need regular inspection, particularly during winter. The first thing to keep an eye on is determining exactly where and how water is entering the buffer. It is not uncommon for small undistinctive topographical features to result in water bypassing the strip. This is often caused by soil buildup alongside the strip, which, whilst a good indication that the buffer strip is working, can often cause a bunding effect preventing water from entering the strip in a sheet flow. Therefore, it is important to watch runoff water during a rainfall event to ensure it is entering the strip without channelised flow, and to remove settled bedload from along the front edge of the buffer.

The second major issue to watch out for is channelisation within the vegetated buffer strip. This can be caused by vehicle wheel tracks or topographical variations causing channelised flow. It is important to fill in any channels, keeping a level vegetated surface to encourage sheet flow through the strip.

The last major area to be conscious of in your inspections should be the vegetation cover. Patches of no vegetation caused by errant herbicide use, channelisation or wheel tracks can further reduce the integrity of the buffer and encourage preferential flow. Re-seeding will occasionally be necessary to fill in patches in the vegetation.

The picture above shows a healthy, well maintained vegetated buffer strip with no signs of channelisation and consistent vegetation cover. The headland was recently levelled to encourage sheet flow into the buffer.

Further information on vegetated buffer strips can be found in Vegetated Buffer Strips - Background Material (Barber, Stenning, and Dobson, 2025), available from Horticulture New Zealand.

3.3.5 Silt Fences

Practices to Manage sediment and suspended sediment moving off the block

Silt Fences and Super Silt Fences are considered a temporary measure for trapping sediment- laden runoff from small catchments of usually less than 0.5 ha. When used on larger catchments careful consideration of the site characteristics is needed or other alternative management practices may be more appropriate. For gradients of less than 10% the slope length behind the Super Silt Fence is unlimited, however Silt Fences have a slope restriction of just 40m. FSP used them in trials as an effective means of demonstrating the quantity of soil that was being lost from a block. Inasmuch, they can serve as a means of justifying a more permanent, well-constructed silt trap.

In cultivated growing situations Super Silt Fences are the most appropriate. These use a geotextile fastened to a wire fence (e.g. chain link fence).

Regular wind or weed matting cloth is not suitable because these materials do not have good filtering characteristics or high flow rates The geotextile fabric must meet the following minimum requirements. Grab Tensile Strength: >440N, Tensile Modulus: 0.140 pa, Apparent Opening Size 0.1 – 0.5mm. Table 3.5 provides design criteria for super silt fences.

Detailed construction guidelines can be found on the Auckland Council website's technical publication Erosion and sediment control guide for land disturbing activities in the Auckland region GD05.

Table 3.5. Super Silt Fence Design Criteria

Slope Steepness in degrees (% in brackets)	Maximum Slope Length (m)	Spacing of Returns (m)
0 – 5.7° (0 – 10%)	unlimited	60
5.7° – 11.3° (10 – 20%)	60	50

3.3.6 Decanting Earth Bunds

Practices to Manage sediment and suspended sediment moving off the block

A Decanting Earth Bund is often constructed along the flat contour at the bottom of a block. By moving the headland itself several metres further up the block, the full width of the block can form a ponding area that will hold runoff long enough to allow sediment to drop out of suspension prior to discharge. This approach can avoid having to build deeper sediment retention ponds (SRP) in the corner of blocks in order to achieve the required volume.

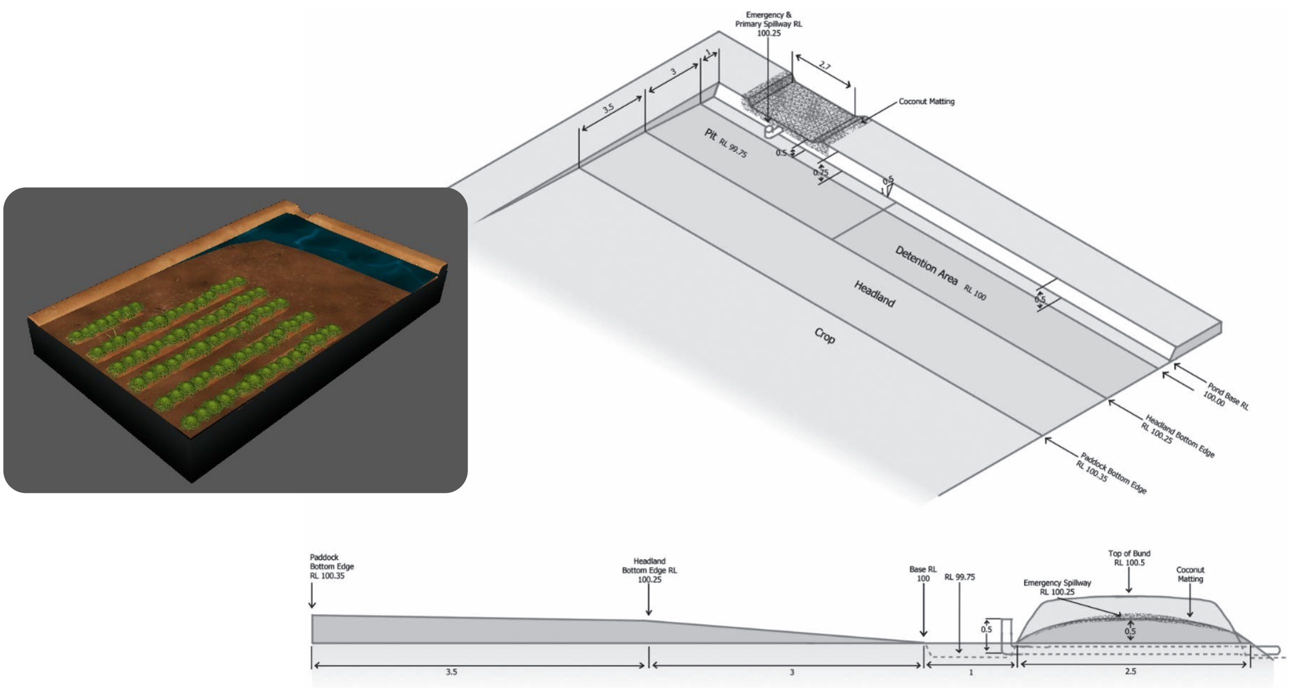
Creating sufficient capacity in Decanting Earth Bunds and Sediment Retention Ponds is essential for giving sediment sufficient time to settle. The recommended capacity is 0.5% (50 m3/ha) for catchments of less than 10 ha and 1% (100 m3/ha) for catchments over 10 ha. More details are provided in the next section on Sediment Retention Ponds.

Decanting rate

Decanting Earth Bunds and SRPs need to dewater so as to remove the relatively clean water without removing the settled sediment. The decanting rate is critical. Too fast and the sediment will not have time to settle. Too slow and the primary and emergency spillways will operate in even moderate sized rainfall events, which will also result in poor sediment capture efficiencies.

The recommended decant rate is 3 L/sec/ha. Table 3.6 shows the number of 12 mm holes required for various lengths of vertical snorkel in order to decant at a rate of 3 L/sec/ha. As the silt trap becomes deeper (longer snorkel) the average flow rate through each hole increases, hence less holes are needed. For example, if the Decanting Earth Bund has a 1-hectare catchment; on a 1m snorkel drill 60 12 mm diameter holes. This can be done in 6 vertical rows with 65 mm spaces from the top of the snorkel down to 0.3 m from the silt trap floor. A deeper trap with a 1.3m snorkel requires just 54 holes to achieve the same decanting rate of 3 L/sec/ha.

The number of holes will need adjusting based on the catchment area and the snorkel height. Larger catchments may require several vertical pipes.



A 0.5m high decanting earth bund that uses the width of the block as its detention area. The headland was moved 4m further into the block.

Table 3.6. Snorkel - Number of 12 mm holes to achieve a discharge rate of 3 L/sec/ha.

Snorkel length (m)	Hole length (from top) (m)[1]	Hole size (mm)	Total number of holes per snorkel	Number of hole lines per snorkel	Number of holes per line	Distance between holes (mm)	Number of snorkels
1.0 ha catchment							
1.5	1.05	12	12	4	3	263	1
1.0	0.7	12	15	3	5	140	1
0.5	0.4	12	24	6	4	80	1
5.0 ha catchment							
2.0	1.4	12	28	4	7	200	2
1.5	1.05	12	32	4	8	130	2
1.0	0.7	12	40	4	10	70	2

1. The bottom 30% of the snorkel does not have any perforations. This forms the dead storage. In decanting earth bunds the holes may go all the way to the bottom if the headland needs to be kept dry.

Photo credit: Master & Sons

It is recommended that the bottom 30% of the snorkel is not perforated. This will result in a permanent pool at the bottom of the silt trap, which helps sediment settle. 30% of the volume of the trap should be "dead storage" i.e. a pool of water and the other 70% is operating volume i.e. is the volume decanted off through the perforated upstand during and after rainfall events.

Key decanting snorkel requirements:

1. The open top of the snorkel acts as the primary spillway. There should be 300 mm gap between the top of the snorkel and the emergency spillway.
2. The decant rate should be 3 L/sec/ha. See Table 3.6.
3. The bottom 30% of the snorkel should not be perforated in order to leave dead storage
4. Snorkel should be securely fastened to a stake
5. The discharge point should be stabilised by discharging onto rocks or stabilised ground.

Emergency spillway

The emergency spillway discharges excess water in major storm events when the perforated snorkel and primary spillway are unable to cope. Position the spillway so that it is not inline with the entrance. The spillway needs to be stabilised with rock, geotextile or on firm vegetated undisturbed ground. The minimum width is 1.5m/ha of catchment. The spillway must be level and 300mm above the primary spillway. There should be 300mm between the top of the bund and the emergency spillway.

3.3.7 Sediment Retention Ponds

Practices to Manage sediment and suspended sediment moving off the block

Photo credit: Balle Bros

Sediment Retention Ponds SRPs, also known as silt traps, impound runoff water and ensure sufficient time for the suspended soil to settle. Volume is the key attribute.

Whenever possible:

1. Break the block into smaller catchments with their own treatment measures and sediment retention pond.
2. Treat runoff from a catchment only once and discharge it from the block into a stabilised drain.

Sediment Retention Ponds work best in combination with other practices that reduce the amount of soil reaching the ponds. SRPs alone are not the only means of controlling soil loss but are part of an overall system.

Details on constructing a SRP are provided below, built upon knowledge gained from the Franklin Sustainability Project and the more recent project Don't Muddy the Water.

Silt trap capacity: How big should it be?

SRP size depends on the several factors that influence potential soil movement. Factors include the size of the area draining into the SRP (catchment area), the slope and length of blocks in the catchment, the soil type, and severity of significant rainfall events.

Photo credit: Master & Sons

The SRP (pictured left) has water entering as far away from the outlet as possible. The emergency spillway is stabilised with geotextile cloth, level, and wide (1.5 m/ha of catchment). There are 2 snorkels with the required number of holes and the top is approximately 200 mm below the emergency spillway.

Table 3.7. is a general guide for SRP capacity. As discussed earlier, SRPs should be used with a combination of erosion practices to reduce the quantity of soil and sediment potentially moving off your blocks.

Table 3.7. Capacity criteria for sediment retention ponds.

Catchment area	Slope *	Capacity	Silt trap and bund capacity examples ^
< 5 ha	< 7° (12%)	50m³ / ha catchment	1 ha catchment = 50 m³. Trap dimensions = 11 m x 4 m x 1.5 m (batter 0.5 : 1)
5-10 ha	< 7° (12%)	75m³ / ha catchment	6 ha catchment = 450 m³. Trap dimensions = 35 m x 10 m x 1.5 m. (batter 0.5 : 1) Plus a forebay
> 10 ha	Or > 7° (12%)	> 100m³ / ha catchment	12 ha catchment, trap dimensions = 51 m x 11 m x 2.5 m = 1,200m³ (Batter 0.5 : 1)

* Average block slope

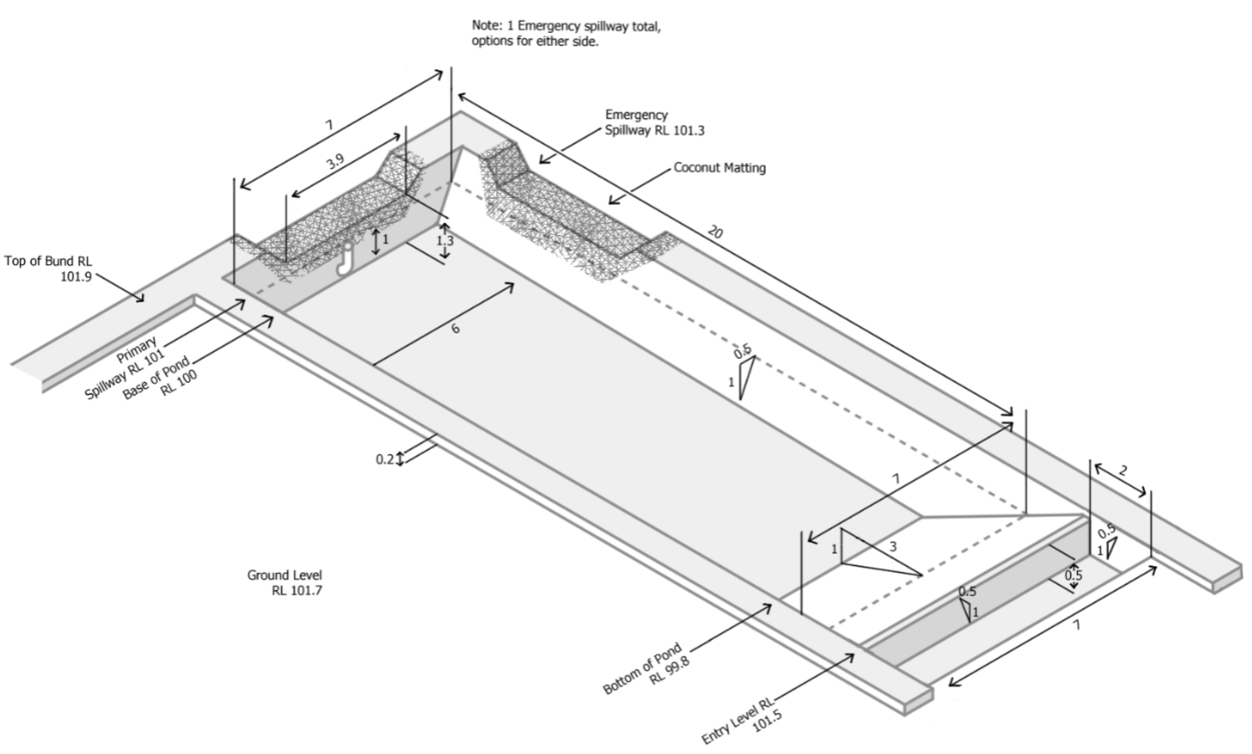
^ These silt trap dimensions are one example only of how to achieve the required trap capacity.

In general, aim to maintain at least 50 percent capacity for unexpected storm events. These measurements aim to detain the runoff long enough to allow for most sediment to drop out of suspension.

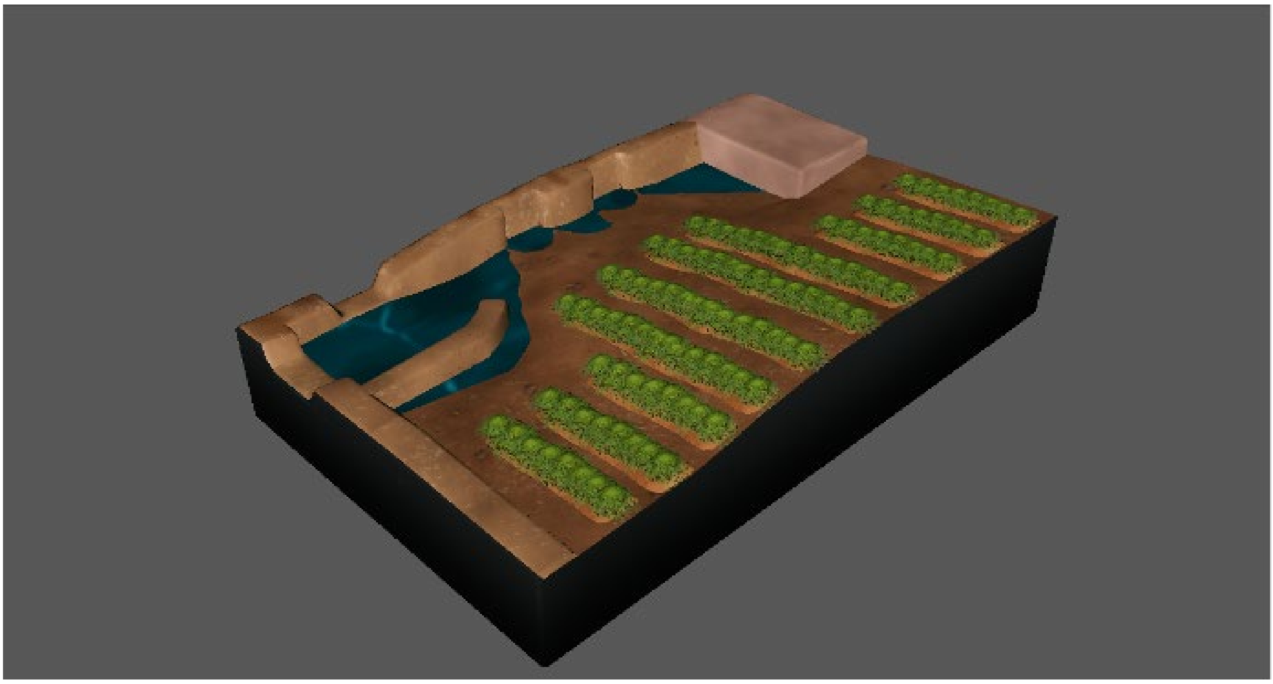
Constructing a silt trap

Before constructing a SRP, make sure the area you have selected is clear of cables/pipes etc. Strip any topsoil and vegetation from the area to create a firm foundation (if walls are being build up from this). Keep stock away from the site to avoid any pugging or damage.

The SRP should be between 3 to 5 times longer than it is wide with inflow entering at one end and the discharging through the outlet at the other.



An example of an SRP for a 2.5 ha catchment. This design included a forebay, designed to make maintenance easier.



The SRP filled to the height of the emergency spillway. Along the headland cutouts can be seen dug into the bank. These further help to reduce the quantity of sediment that reaches the SRP. Consequently, reducing the accumulation of sediment in the pond which compromises the available storage and detention time, particularly in winter when the SRP cannot be cleaned out.

Silt traps have four main components:

- Bund or walls
- Detention area
- Overflow or spillway
- Discharge mechanism (snorkel)

Bund or walls

1. They must be thoroughly compacted, otherwise they can blow out in storm events. Compact each 200mm of material added to the height of walls. Usually a minimum of three passes over the entire surface per layer is required.
2. Establish vegetation cover. It may be necessary to pin down coarse shade cloth to stabilise the slope face, and plant with grasses.
3. If clay has been used it will be necessary to add a layer of topsoil over the clay to establish grass. Grass seed and fertiliser should be applied.

Detention area

This is the area where runoff from the block will collect and settle for sufficient time to allow any sediment in suspension to drop out before the water drains away, through the snorkel or spillway. Benched headlands can direct water into the detention area.

Emergency spillway

An emergency spillway discharges the excess water runoff in major storm events and stops bunds breaking. Select the position carefully to minimise construction and later maintenance.

1. Ideally position the spillway so it is not in line with water entrance points.
2. If possible, situate the spillway on firm, undisturbed ground.
3. Ensure runoff discharges won't cause erosion.
4. Ensure that the minimum width is 1.5m/ha of catchment.
5. Ensure that the spillway is level across its width.
6. Make sure you protect the spillway sides against erosion, using either coarse shade cloth or coconut matting and sowing under the matting with grass. In some situations large rocks may be the best solution to stabilise the discharge point.

Discharge mechanism

The snorkel drains the silt trap between rainfall events. The target discharge rate is 3 L/s/ha.

Table 3.8.How large should the pipes be?

Pipe diameters	Catchment area
100 mm	< 1 ha
150 mm	1 – 2 ha
225 mm	> 2 ha

The number of holes in the snorkel is critical for controlling the rate of discharge. Too many holes and the detention time is shortened, and therefore the settling time for the suspended sediment is significantly compromised. Table 3.6 shows some typical examples for 1 ha and 5 ha catchments.

Installing the pipes:

1. The pipes are placed at the lowest point of the SRP and should discharge to an erosion-proof outfall. This may be the water table, a drain or stream.
2. Avoid crushing the pipe during installation. The soil should be thoroughly compacted around the pipe by hand.
3. Use non-perforated pipe through the bund wall, for example, solid PVC pipe.
4. For the upstand, use solid drainage pipe with six rows of 10 mm diameter holes, drilled at 50 mm spacings.
5. Use an 88° elbow to join the upstand and the pipe. It may be necessary to install a waratah into the ground next to the pipes for support.
6. The top of the snorkel should be 300mm below the emergency spillway.

More information on snorkels and decanting rates can be found in the previous section on Decanting Earth Bunds.

Don't forget trap maintenance

- Inspect traps regularly and after each storm
- Retain at least 50 percent storage capacity
- Check snorkels are not blocked, for example, with vegetation
- Fix any damage as soon as possible as the next storm event could be more severe and compromise the trap's ability to function effectively.

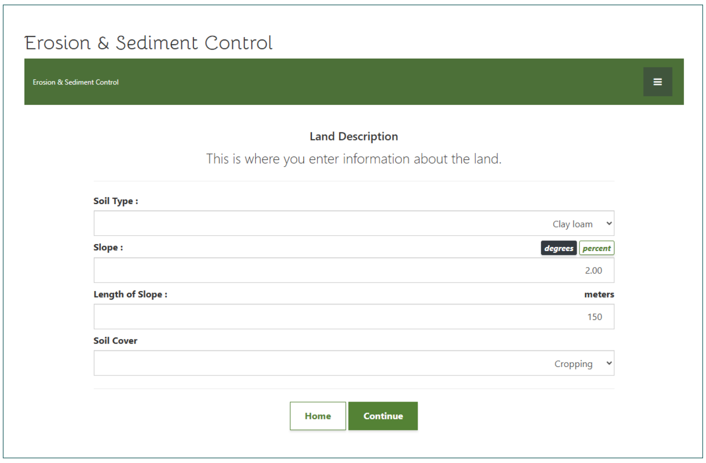
4 Decision Support Tools

4.1 DMTW App

Don't Muddy the Water E&S Control App

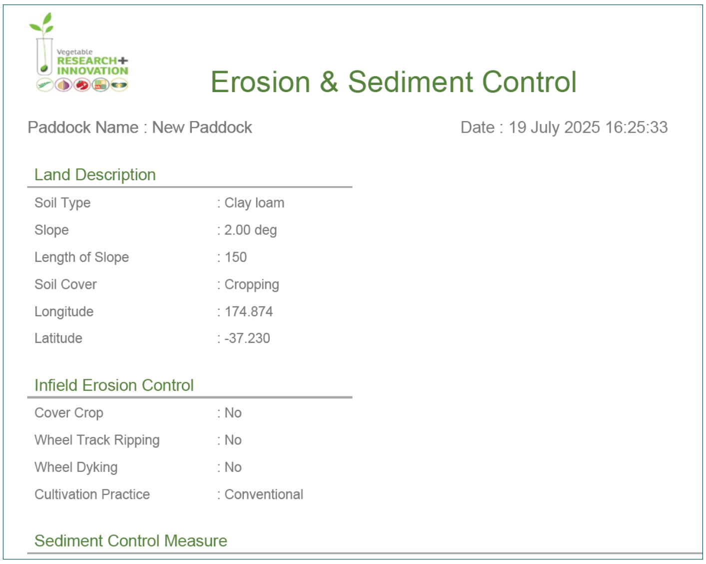
One of the most important outcomes from the Sustainable Farming Fund (SFF) project Don't Muddy the Water was the development of a mobile web-app to calculate erosion rates from vegetable cropping land, before and after management practices are applied.

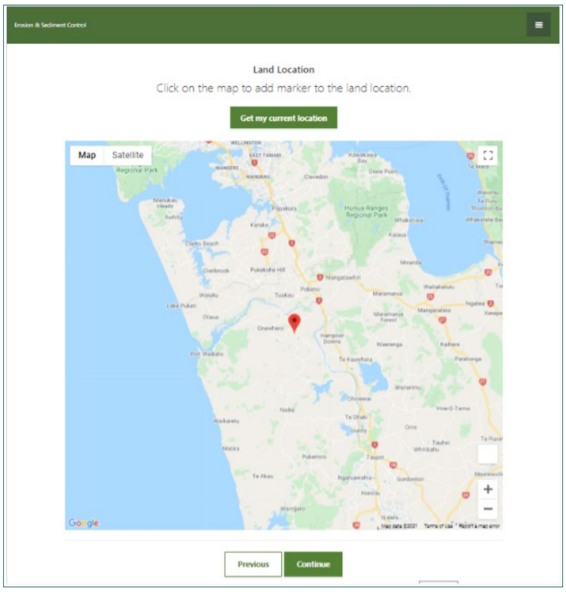
The application is available on the Vegetable Research & Innovation Board website.



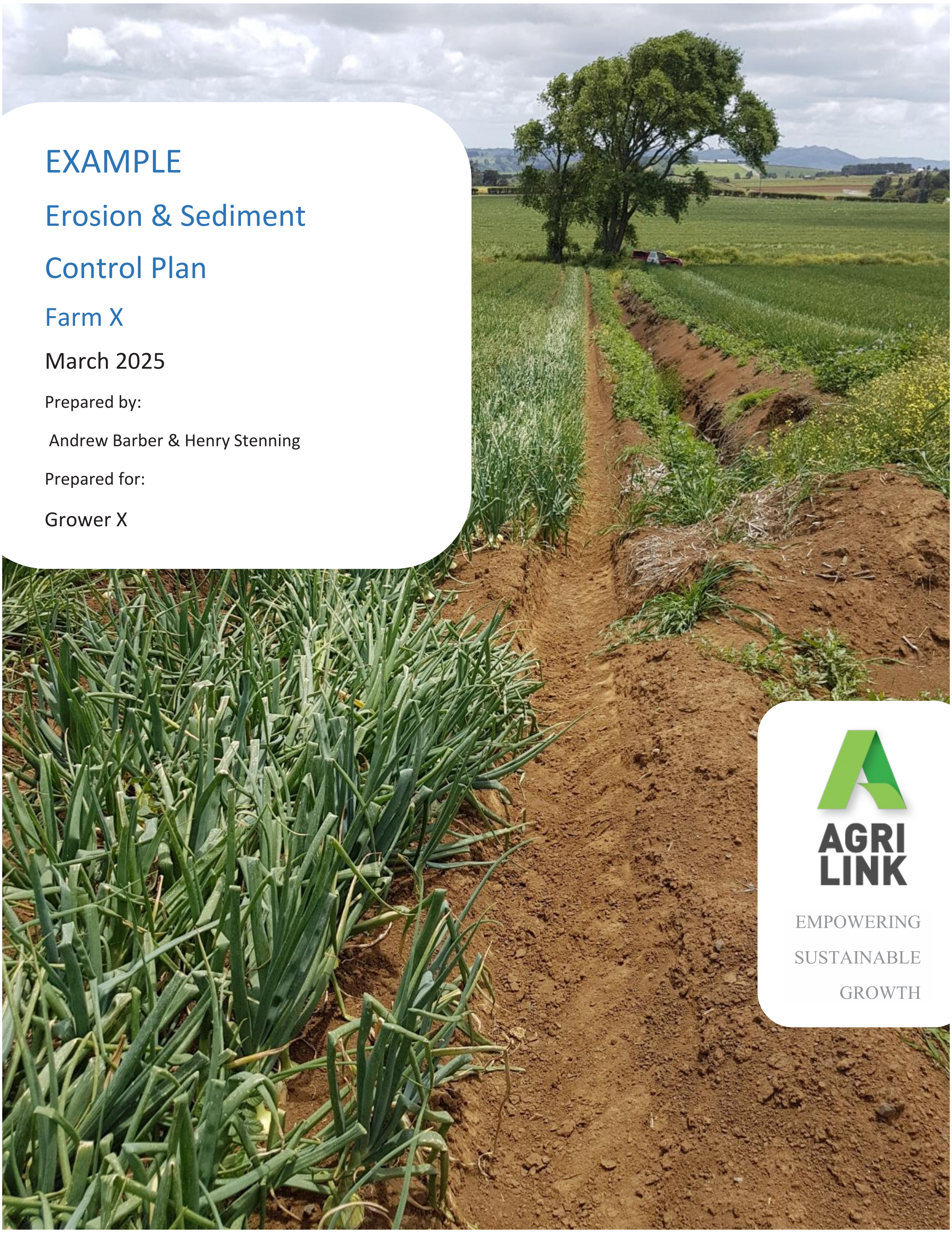
The app can be used to model block erosion rates and plan potential practices. Estimated erosion rates can be compared to form a risk assessment and prioritise erosion control strategies.

The ability to download and save modelled erosion rates also helps when preparing Farm Environment Plans (FEPs) and other evidence or planning documentation.





Appendix A: Example Erosion and Sediment Control Plan



EXAMPLE

Erosion & Sediment Control Plan

Farm X

March 2025

Prepared by Andrew Barber & Henry Stenning

Agrilink New Zealand

Prepared for Grower X and MPI SFF Project 407925

Contents

1 Business details

Business name: Grower X

NZGAP number: x

2 Property details

Location address: ---

Local authority name: Waikato District

Land area: 30 ha

Legal description: ---

Certificate of title: ---

3 Advisor details

Advising business: Agrilink NZ

Primary advisor name: Andrew Barber, BHort (tech) Hons

Secondary advisor name: Henry Stenning, BSc

Area of expertise: Erosion and sediment control

Phone: 027 498 3620

Email: andrew@agrilink.co.nz

4 Maps and property details

The property is located at _____________.

The total area of Farm X is 30 ha. It is divided into six paddocks, described in Table 1, with a total cropping area of 24 ha.

The soil type according to Landcare Research S-map reports is a clay, Onewhero*f,* a Typic Oxidic Brown Soil. Physical observation showed the soil to be very light and friable.

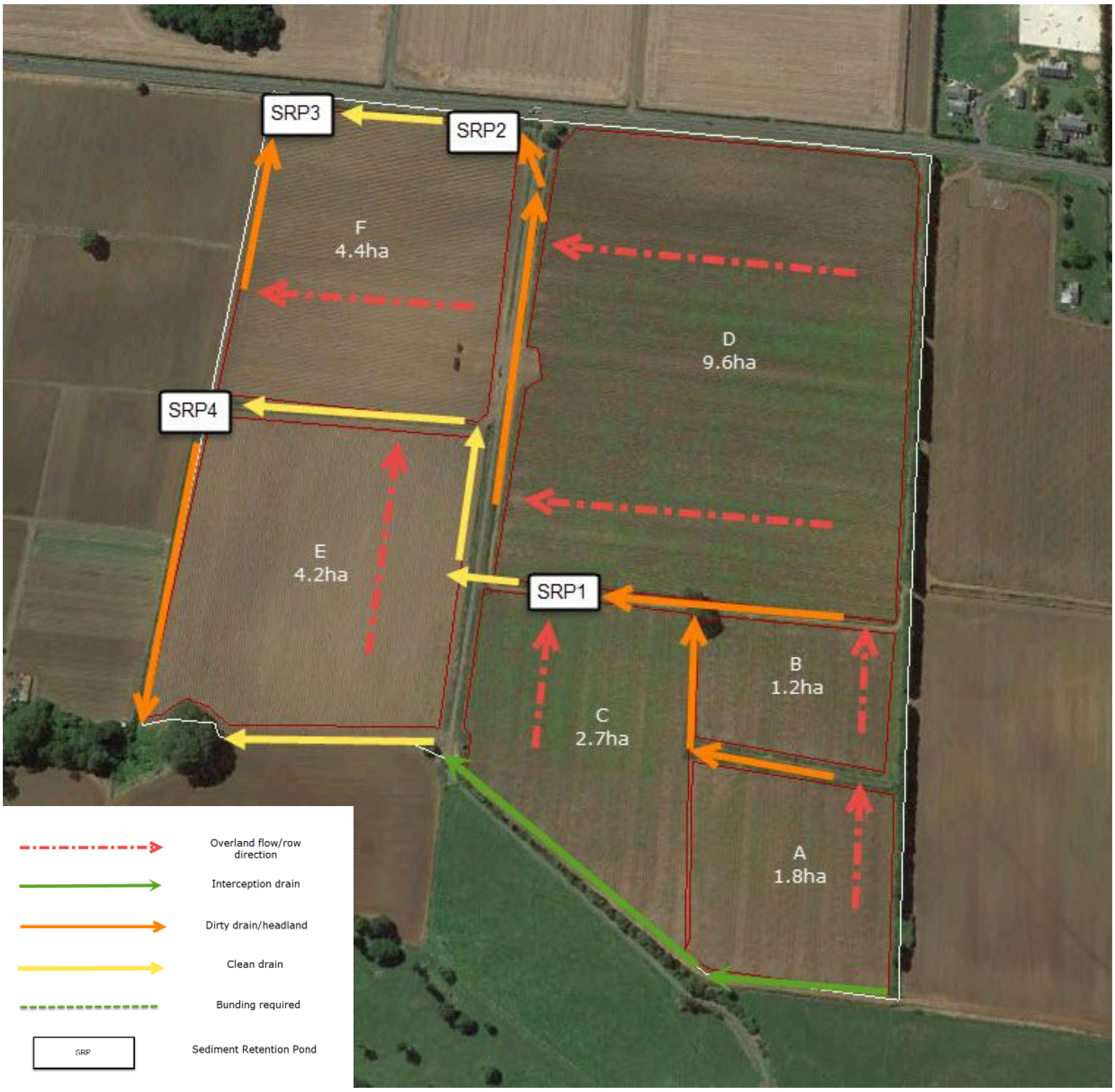


Figure 1. Current paddock map.

See the EMS for contour and other soil maps

Paddock Risk Assessment.

Based on the property being in a high erosivity area all paddocks have a **High** risk assessment.

The current overland flow direction and area of the paddocks, as well as SRP locations, are shown on the map (Fig.1), with the overland flow directions after action plan mitigation measures shown in Figure 2.

Table 1 describes the current overland flow situation. One of the identified issues is where SRP1 & 2 lead into drains which in turn leads to SRP3. Essentially clean water is discharging into dirty water and needs recleaning. This currently causes SRPs 3 to become overloaded, due to accepting overland flow from a much larger catchment area than they were designed for.

Appendix 2 contains the erosion rates and priority rankings for each paddock.

Together these form the Erosion Risk Assessment.

Table 1. Paddock descriptions and flow direction

Paddock name	Paddock area (ha)	Water origin	Water destination
A	1.8	Direct rainfall and from overland flow from the southern pasture – although an interception drain should divert most or all of this uphill water.	SRP1 then through drain and culvert under the drive/road, then along the drain alongside paddock E.
B	1.2	Direct rainfall and from paddock E – although the drain to the north should divert most or all of this uphill water.	SRP1 then through drain and culvert under the drive/road, then along the drain alongside paddock E.
C	2.7	Direct rainfall and from overland flow from the southern pasture – although an interception drain should divert most or all of this uphill water.	SRP1 then through drain and culvert under the drive/road, then along the drain alongside paddock E.
D	9.6	Direct rainfall and from paddock C.	Along the bunded and benched headland, then through culvert under the drive/road into SRP2, which discharges into a drain leading to SRP3.
E	4.2	Direct rainfall and from overland flow from the southern paddock – although an interception drain should divert most or all of this uphill water.	Headlands, through a 2m vegetated buffer, then into the drain alongside the paddock.
F	4.4	Direct rainfall only.	SRP3.

See Templates 6C to 6G in the EMS for paddock assessments.

5 Action Plan

Ref.	Management area and risk addressed (e.g. soil erosion)	Action to be completed	Location	Person responsible	Expected Date of Completion	Actual Date of Completion	Evidence to be Provided (e.g. records, photo)
6G. 7	Soil erosion	If a new SRP4 cannot be constructed until April 2026 then a silt fence should be installed in the existing SRP4 as a temporary measure.	Home Farm	XY	May 2025		Before and after photos
6E. 1	Soil erosion	The interception drain along the southern boundary needs re-digging. The culvert it leads to on the south-western edge of paddock C also needs digging out.	Home Farm	XY	April 2026		Before and after photos
6E. 4	Soil erosion	Bunds along the northern and western boundaries of paddock E should be installed so that overland flow from paddock E does not enter the clean drain.	Home Farm	XY	April 2026		Before and after photos
6G. 7	Soil erosion	A new SRP4 should be constructed in the north-western corner of paddock E, with the existing pseudo-SRP being re-structured as a clean drain accepting the flow from paddocks A and B. The spillways and snorkel from the new SRP should be directed into this drain.	Home Farm	XY	April 2026		Before and after photos

Ref.	Management area and risk addressed (e.g. soil erosion)	Action to be completed	Location	Person responsibl e	Expected Date of Completion	Actual Date of Completion	Evidence to be Provided (e.g. records, photo)
6G. 2	Soil erosion	Bunds along the northern edge of C should be installed above the clean drain originating from SRP1 so that overland flow is directed across the access way into SRP5.	Home Farm	XY	April 2026		Before and after photos
6G. 7	Soil erosion	A new SRP3 should be constructed to accept flow from paddock F, with the outflow entering the clean drain running along the northern boundary of paddock F.	Home Farm	XY	April 2026		Before and after photos
6G. 7	Soil erosion	The new SRP5 should be constructed by the culvert at the south-east boundary of paddock Db to accept flow from paddocks C and Da. The outflow from this SRP will then enter the existing culvert leading to the clean drain running along the eastern and northern boundaries of paddock E.	Home Farm	XY	April 2027		Before and after photos
6G. 7	Soil erosion	The clean drain leading from SRP2 should continue past paddock F and into the neighbouring leased site, where it will terminate at the north-western corner. The existing SRP3 will need to be reconfigured as a drain, with outlet pipes being removed.	Home Farm	XY	April 2027		Before and after photos

Ref.	Management area and risk addressed (e.g. soil erosion)	Action to be completed	Location	Person responsible	Expected Date of Completion	Actual Date of Completion	Evidence to be Provided (e.g. records, photo)
6G. 7	Soil erosion	A new SRP1 needs to be constructed at the north-western edge of paddock B. It should end just to the west of the culvert leading from the drain coming from paddock A. The emergency spillway and snorkel should be placed at the western end of the new SRP, so that the existing SRP1 acts as a drain.	Home Farm	XY	April 2028		Before and after photos
6G. 7	Soil erosion	The current SRP2 should be expanded to 0.75% in size, accepting overland flow from paddock Db via the existing culvert. Outflow from the snorkel will enter the clean drain along the northern boundary of paddock F. The emergency spillway (11m) to be constructed along the northern edge so as to discharge into the clean drain.	Home Farm	XY	April 2025		Before and after photos
Vegetated buffer strip <u>alternative</u> to expanded SRP2 (not shown on map):							
6G.7	Soil erosion	As SRP2 is 0.75% due to its catchment being >5ha, the existing 0.25% SRP could be left in place and a 5m vegetated buffer established alongside the bottom headland. Attention will need to be placed on minimizing channelised flow.	Home Farm	XY	April 2025		Before and after photos

EXAMPLE Erosion & Sediment Control Plan – Farm X March 2025 9 | P a g e

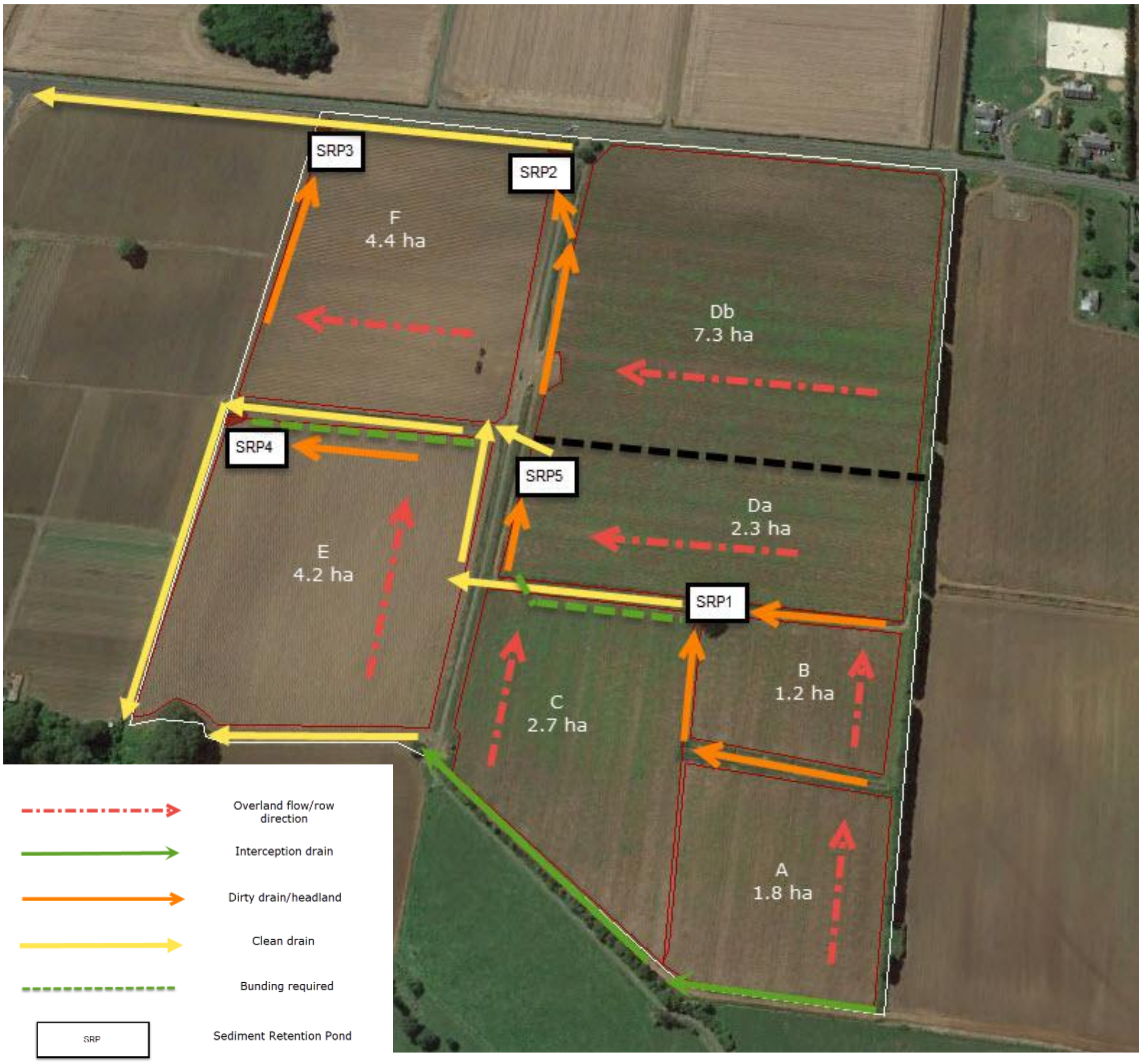


Figure 2. Paddock map of Farm X post action plan.

6 Sediment Retention Ponds (SRPs)

Table 5. Sediment Retention Pond catchments and sizes for Farm X

SRP Number	Current catchment area (ha)	Current catchment paddocks
1	5.7	A, B, C
2	9.6*	D
3	14.0	D, F
4	4.2*	E

*SRP2 and SRP4 are currently in line with the drains, with SRP2 outflow entering SRP3.

Table 6. Sediment Retention Pond catchments and sizes for Farm X following action plan

SRP Number	Catchment area post action plan (ha)	Catchment paddocks post action plan	Required volume (%)	Required volume (m^3)	Potential dimensions (m)*		Spillway width (m)
					3:1	5:1	
1	3.0	A, B	0.5%	150	20 x 6	26 x 5	4.5
2**	7.3	Db	0.75%	550	31 x 11	45 x 9	11.0
3	4.4	F	0.5%	220	22 x 8	30 x 6	6.6
4	4.2	E	0.5%	210	23 x 7	29 x 6	6.3
5	5.0	C, Da	0.5%	250	24 x 8	32 x 6	7.5

* Guideline only, actual dimensions will depend on site specifics. Assuming standard depth of 1.5 m and batter of 0.5 : 1.0.

** There is the option to install a 5m vegetated buffer instead of the SRP. See Section 7.0.

Table 7. Sediment Retention Pond Snorkel Sizes and Quantity for Farm X

SRP Number	Hole size (mm)	Total number of snorkels	Total number of holes per snorkel	Number of lines of holes per snorkel	Number of holes per line	Distance between holes (mm)
1	12	1	40	5	8	132
2	12	3	35	5	7	150
3	12	2	25	5	5	210
4	12	2	25	5	5	210
5	12	2	35	5	7	150

Note – the bottom 30% of the snorkel shouldn't have any perforations in order to create dead storage. Start drilling from the distance between holes from the top of the snorkel.

Our recommendations are based on the Erosion and Sediment Control Code of Practice. These recommend a minimum SRP size of 0.5%, or 50m^3/ha for catchments under 5 ha and 0.75% for catchments between 5 ha and 10 ha. These guidelines are supported by the industry and MPI SFF research project Don't Muddy The Water.

7 Vegetated buffer strip

SRP2 is required to be 0.75% as the catchment is greater than 5 ha and less than 10 ha.

An alternative is to establish a 5m vegetated buffer along the bottom of Paddock D. The cultivated paddock would be stepped further back up the paddock and headland moved to run between the new buffer and cultivated paddock. Paddock D is reasonably flat (1.5^o) so does suit buffers. Attention needs to be paid to minimising channelised flow.

This buffer will take pressure of the existing undersized SRP2, which could be retained to capture what isn't collected in the buffer.

8 Culverts

There are 8 identified culverts in Farm X. A culvert is judged to be large enough if it can handle overland flow from its receiving area in a 20% Annual Exceedance Probability (AEP) rainfall event.

- Culvert 1 is located at the end of the interception drain in the south-western corner of paddock C. This need digging out as it is currently buried by soil. The catchment area for the interception drain and therefore for the culvert is estimated at 16 ha. This means the current culvert is undersized and so needs to be monitored. If necessary, a larger culvert should be installed.
- Culvert 2 is large enough for its receiving area.
- Culvert 3 is large enough for its receiving area.
- Culvert 4 is large enough for its receiving area.
- Culvert 5 is large enough for its receiving area. However, it has no headwall height. Ideally it should be placed lower, or have soil placed on top of it to increase the headwall height.
- Culvert 6 is large enough for its receiving area. However, it has no headwall height. Ideally it should be placed lower, or have soil placed on top of it to increase the headwall height.
- Culvert 7 is large enough for its receiving area.
- Culvert 4 is large enough for its receiving area.

9 Maintenance schedule

- Ensure SRPs are dug out and maintained every 6 months – 1 year, or more frequently if sediment reduces the capacity by more than 20%.
- Ensure snorkel and spillways are working correctly with an inspection every 6 months or after every large rainfall event.
- Ensure that bunds have not been penetrated by water channels with an inspection every 6 months or after every large rainfall event.
- Ensure culverts remain unblocked with an inspection every 6 months or after every large rainfall event.
- Ensure all drains, including interception drains are clear, with an inspection every 3 months or after every large rainfall event.

10 Appendix

Appendix 1 – Site pictures

Figure 3. From top left clockwise: i) Overgrown and shallow interception drain along southern boundary. ii) Blocked culvert from southern boundary interception drain. iii) Culvert leading to SRP 2.

Figure 4. From top left clockwise: i) SRP 3. This SRP will need to be separated from SRP 2's outflow drain. ii) Vegetated buffer along the northern boundary of paddock E. iii) An example of cultivation too close to a drain. This will be stepped back by 1 m.

Appendix 2 – Risk Assessment and Erosion rates

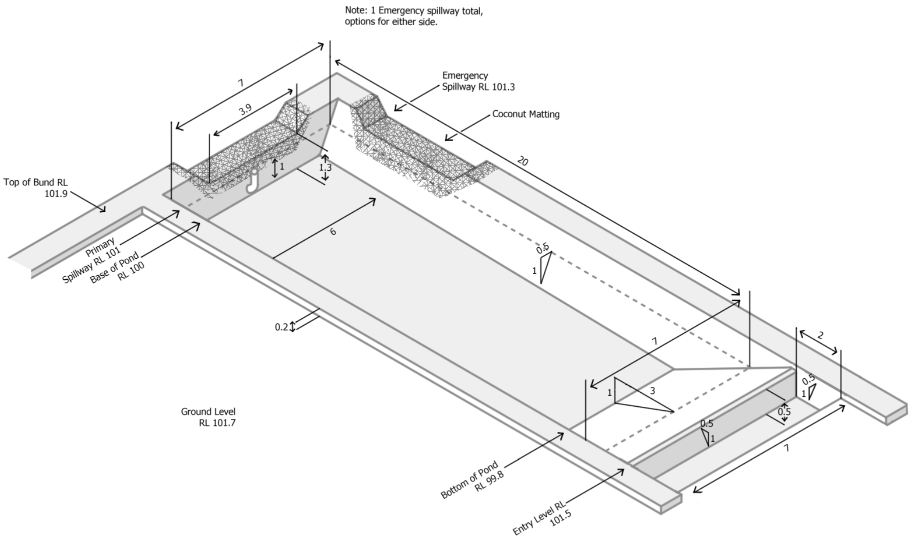
Based on the property being in a high erosivity area all paddocks have a **Red** risk assessment based on the Erosion Risk Assessment in the Erosion & Sediment Control Code of Practice. However, the more accurate assessment using the Don't Muddy the Water App, used to determine block erosion rates found blocks D and F were **Amber**.

Table A1. Erosion and sediment loss estimates for Farm X

Block name	Unmanaged sediment loss (t/ha/yr)	Level of sediment loss with current practice (t/ha/yr)				Level of sediment loss with enhanced practice (t/ha/yr)	
		Total sediment loss (t/ha/yr)	Suspended sediment reduction (%) *	Risk assessment	Priority ranking	Total sediment loss (t/ha/yr)	Suspended sediment reduction (%)
A	34	0.3	73%	Red	3	0.2	88%
B	29	0.2	73%	Red	4	0.2	88%
C	24	0.2	73%	Red	2	0.1	88%
D	3	0.0	<73%	Amber	5	0.0	93%
Alternative buffer strip in Paddock D +retain the existing small (< 0.25%) SRP2							
D						*0.0*	*73%*
E	12	9.7	0%	Red	1	0.1	88%
F	4	0.0	73%	Amber	6	0.0	88%
Total	**11**	**1.8**	**60%**	**Red**	**-**	**0.1**	**90%**

*Note- this is assuming that the current sediment traps are approximately 0.25%. Some are less than this, so the effectiveness of reducing suspended sediment may be lower than is shown, and they would need cleaning more regularly to maintain their capacity.

Appendix 3 – SRP construction details



SRP 1 Dimensions of 20 m x 6 m, plus an optional forebay

Key aspects to consider:

1. Volume is key for reducing suspended sediment.
2. A forebay is considerably easier to clean bedload soil from than the main SRP.
3. The decanting pipe should be raised above the bottom to create dead storage or start the holes at the 30% volume mark. For a 1,500mm deep pond start the holes at 450mm.
4. Follow the guide on decanting hole size and number. It is important to restrict the flow to approximately 3 L/s/ha. Too many holes and the detention time is reduced, which is the main mechanism to reduce suspended sediment.
5. The emergency spillway needs to be level and stabilised with a geotextile cloth.

Appendix B: Resources

HortNZ Codes of Practice

Other HortNZ Codes of Practice in this suite are listed below. These can be used by growers to build their overall farm plan.

Tool	Sector	Description
Nutrient Management Code of Practice 2025	All outdoor growing systems	Provides direction for horticultural growers to manage nutrient use responsibly while maintaining crop productivity. It explains how nutrients cycle through growing systems, how to assess block level nutrient loss risk, and apply appropriate practices to manage those risks. A Nutrient Management Plan workbook helps document current practices, assess risks, and plan nutrient use in a structured and practical way.
Nutrient Greenhouse Discharge Code of Practice 2025	Greenhouses	This Code outlines practices for managing nutrient-rich discharges from greenhouses. It includes guidance on treatment, reuse, and responsible discharge methods to protect soil and water resources. The Code helps greenhouse growers reduce nutrient losses and manage environmental compliance expectations.
Vegetable Washwater Code of Practice 2025	Outdoor vegetable production	This Code supports outdoor vegetable producers in managing washwater generated from washing vegetables during post-harvest processing. It provides recommendations for treatment, disposal, and reuse of washwater to minimise environmental impacts.
Farm Machinery Washdown Code of Practice 2025	All outdoor growing systems	Designed for use across all horticultural sectors, this Code sets out good practice for washing down farm machinery to prevent the spread of pests, diseases, and contaminants. It includes direction on siting washdown areas, managing washwater, and protecting soil and water from contamination.

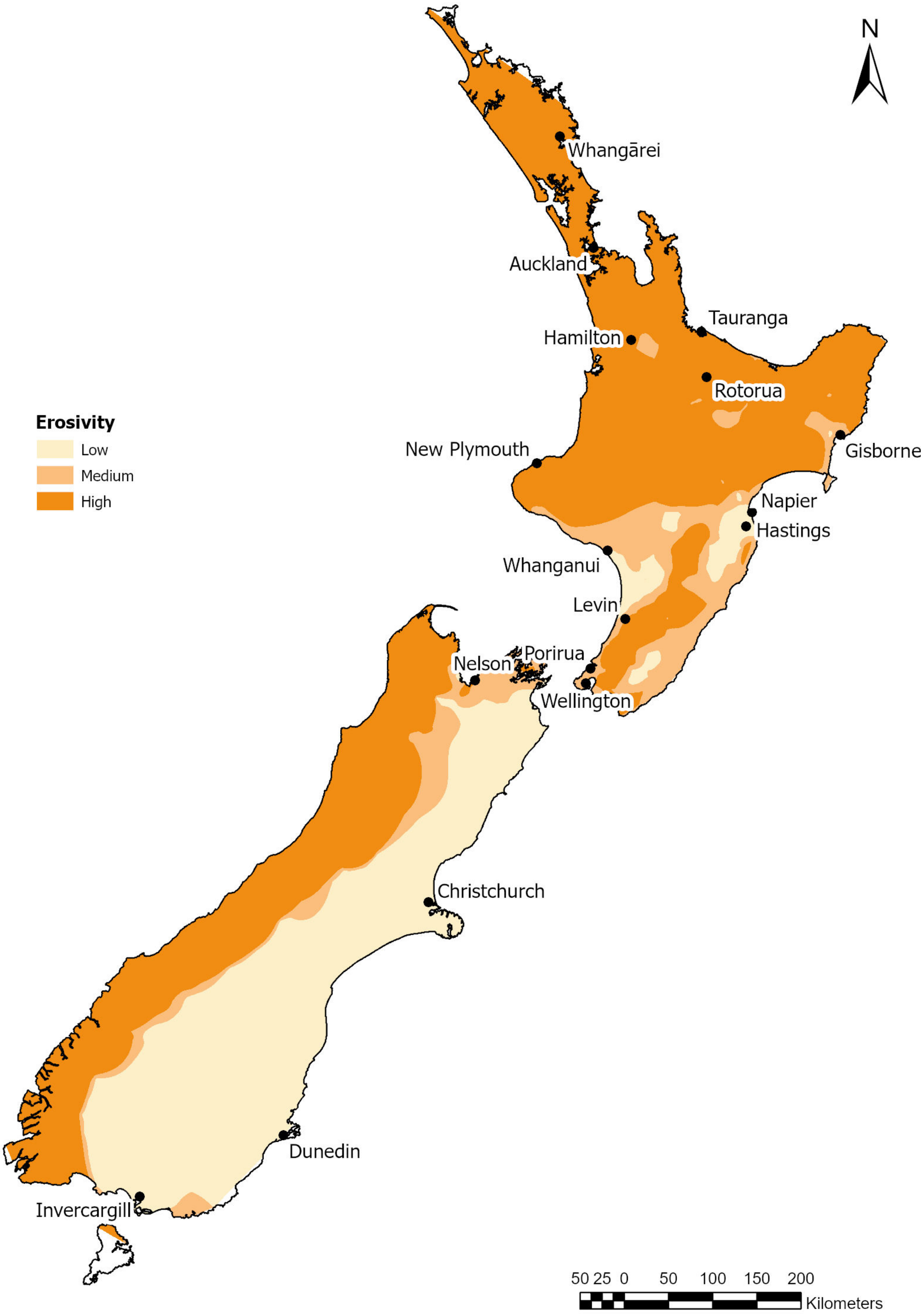
Other guides and resources

Other guides and resources, in addition to this Code of Practice, are available online for growers.

Name	Sector	Description
Buffer Strip Background Document	All outdoor growing systems	This background document supports the Erosion and Sediment Control Code of Practice. It covers the existing literature and grower experience on the implementation, maintenance, and effectiveness of vegetated buffer strips.
Fertiliser Association Code of Practice (2023)	All sectors	This Code of Practice for fertiliser nutrient management is intended to provide clear principle-based guidance on supplying the nutrients for growing healthy food, while at the same time avoiding or minimising the loss of those nutrients to the environment. Available here: https://www.fertiliser.org.nz/code-of-practice/.
Fertiliser Association Nutrient Management Planner	All sectors	The Fertiliser Association has an interactive pdf template, prepared by Fert Research, that could be used to prepare a nutrient management plan: https://www.fertiliser.org.nz/resources/nutrient-management-planner.
Nutrient Management for Vegetable Crops in New Zealand – JB Reid & JD Morton (2020)	Outdoor vegetable production	This guide was developed to provide guidance on nutrient applications for a range of outdoor vegetable crops: https://www.hortnz.co.nz/assets/Compliance/Nutrient-Management-for-Vegetable-Crops-in-NZ-Manual-Feb-2020.pdf.
Nutrient Management Adviser Certification Programme (NMCAP)	All sectors	The NMACP is an industry-wide certification programme targeted at those who provide nutrient management advice to New Zealand farmers: https://www.nmacertification.org.nz/site/nutrient_management/
Plant & Food Research – Guidelines for Soil Nitrogen Testing and Predicting Soil Nitrogen Supply (August 2022)	All sectors	Plant & Food Research NZ developed a factsheet on testing for soil nitrogen. Find the factsheet link on this page: https://www.plantandfood.com/en-nz/article/soil-nitrogen-testing-and-predicting-nitrogen-supply
LandWISE Fertiliser Equipment Performance Assessment – Online course	All operators spreading nutrients	An online course that describes fertiliser application equipment monitoring suitable for growers applying nutrients with their own equipment. The course covers broadcast and placement fertiliser spreading equipment: https://www.landwise.org.nz/courses/fertiliser-equipment-calibration/
A Lighter Touch	All sectors	How to interpret a soil test - Soil-testing-guide-v2.pdf
Fertmark	All users of fertiliser	Fertmark is quality assurance programme for fertiliser products that independently audits products to ensure what is on the label is in the bag: https://fertqual.co.nz/fertmark/
Spreadmark	Nutrient spreaders	Spreadmark is a nutrient spreading quality assurance and risk management programme. It certifies spreading equipment and audits the operators' assurance and compliance processes: https://fertqual.co.nz/spreadmark/

Soils		
Visual Soil Assessment (VSA) Field Guide – Graham Shepherd (2000)	All sectors	Released in 2000, the VSA guide was developed to help farmers understand soil quality, and how to manage their soils sustainably. This guide is targeted towards pastoral and cropping famers: https://www.landcareresearch.co.nz/assets/Publications/VSA-Field-Guide-/VSA_Volume1.pdf FAO (UN Food & Agriculture Organisation) has several VSA volumes published in one (also co-authored by Graham Shepherd), including a guide for orchards (find on page 92): https://www.fao.org/4/i0007e/i0007e00.pdf
Foundation for Arable Research	All sectors	Nitrate Quick Tool Guide describes how and when to take soil samples, and preparing the soil for testing. Quick-test-nitrate-guide.pdf
Fertiliser Association – Sampling pastoral, arable, and horticultural soils (2024)	All sectors	This booklet sets out to recommend soil sampling methods to ensure consistency in the approach. This consistency ensures valid comparison and interpretation of repeated sampling over time. Available on the Association's resources page or here: https://www.fertiliser.org.nz/files/site/Sampling-Pastoral-Arable-and-Horticultural-Soils-Final.pdf
Hill Labs – DIY Self-sampling Guide for soil and leaf.	All sectors	A guide produced by Hill Labs, one of the major testing labs in New Zealand, on best practice soil and leaf sampling, in addition to an overview of their tests and dispatch instructions. https://www.hill-labs.co.nz/media/msehbkce/hill-diy-test-8pp-web-1.pdf
Irrigation		
Irrigation New Zealand	All sectors	Codes of Practice covering, irrigation design, hydraulics and pumping, water measurement, fertigation, installation and performance assessment. Codes of Practice : IrrigationNZ
Other		
Constructed wetland practitioner guide – NIWA, DairyNZ (2022)	Written for pastoral but applicable to horticulture	This guide provides design and performance information to establish a surface-flow constructed wetland to reduce contaminant loss (nitrogen, phosphorus and sediment) from subsurface tile drains, shallow groundwater outflows from seeps and springs, and surface drains and small streams in pastoral farming landscapes. https://niwa.co.nz/sites/default/files/wetland%20practitioner%20Guide-web.pdf
Mitigating nutrient loss from pastoral and crop farms: A review of New Zealand literature. Horizons Regional Council.	All sectors	A compilation of mitigations that a pastoral and/or cropping farm operation could use to reduce its environmental impact. This document provides information on: • Wetlands (pages 1-5) • Riparian buffers (pages 6-8) https://www.horizons.govt.nz/HRC/media/Media/Consent/Mitigating-nutrient-loss.pdf

Erosivity Map



Low erosivity R factor is <1,000; moderate is 1,000 to 1,5000; high >1,500 MJ.mm.ha–1.h–1.

Appendix C: Glossary

Annual Exceedance Probability (AEP)
A statistical term defining the probability of an event occurring annually. Expressed as a percentage to define rainstorm intensity and frequency. For example, a 5% AEP event has a 5% chance of being exceeded in any one year. This has replaced the return period concept. A 5% AEP event expresses the 20 year return period in more probability terms.

Baffles
Semi-permeable or solid barriers placed in a sediment retention pond to deflect or regulate flow and effect a more uniform distribution of velocities, hence creating better settling conditions.

Batter
A constructed slope of uniform gradient.

Catchment
An area within which surface runoff flows to a common outlet or outlets.

Channel Stabilisation
Stabilisation of the channel profile by erosion control and/or velocity distribution through reshaping, the use of structural linings, rocks, vegetation and other measures.

Clean Water
Any water that has no visual signs of suspended sediment, e.g. overland flow (sheet or channelled) originating from stable well-vegetated or protected surfaces.

Contour
A line across a slope connecting points of the same elevation.

Contributing Drainage Area
All of that drainage area that contributes to the flow into a treatment device (e.g. earth bund). A contributing drainage area can include both clean and sediment-laden water flows. Commonly referred to as the catchment area.

Decant Rate
The rate at which water is decanted from a Decanting Earth Bund or Silt Trap. This should be 3 L/sec/ha.

Deposition
The accumulation of material that has settled because of reduced velocity of the transporting agent (water or wind).

Drain
Any artificial waterway designed, constructed, or used for the drainage of surface or subsurface water, but excludes artificial waterways used for the conveyance of water for electricity generation, irrigation, or water supply purposes.

Source: https://environment.govt.nz/acts-and-regulations/freshwater-implementation-guidance/clarification-of-the-essential-freshwater-programme-implementation-requirements/

Emergency Spillway
An Earth Bund, Silt Trap or Dam spillway designed and constructed to discharge flow in excess of the structure's primary spillway design discharge.

Energy Dissipater
A designed device such as an apron of rip-rap (rock) or concrete bags placed at the end of a water conduit such as a pipe, paved ditch or flume for the purpose of reducing the velocity and energy of the discharged water.

Ephemeral Waterway
A waterway that flows only part of the year; may include overland flow paths such as grassland swales and dry gullies which only flow during more intensive rainstorms.

Filter Strip
A long, narrow vegetative planting (e.g. vetiver grass) used to retard or collect sediment for the protection of adjacent properties or receiving environments.

Level Spreader
A device used to convert concentrated flow into sheet flow. Typically used at the entrance to SRPs.

Overland Flow Path
The route of concentrated flow.

Perennial Stream
A stream that maintains water in its channel throughout the year

Primary Spillway
The snorkel inlet within a Decanting Earth Bund or Silt Trap.

Riparian margin
An area adjacent to a waterway designated as a non-disturbance zone to provide a buffer between the waterway and cultivated block.

Rip-rap
Rock or other material used to armour channels, culvert abutments, and spillways against erosion.

River
A continually or intermittently flowing body of fresh water; and includes a stream and modified waterway; but does not include any artificial waterway (including an irrigation canal, water supply race, canal for the supply of water for electricity power generation, and farm drainage canal
Source: RMA 1991 (https://www.legislation.govt.nz/act/public/1991/0069/latest/DLM230272.html?search=sw_096be8ed81f72914_river_25_se&p=1&sr=1)

Sediment
Solid material, both mineral and organic, that is in suspension, is being transported, or has been moved from the original block by water or air and has come to rest.

Sediment Yield
The quantity of sediment discharged from a block in a given time, measured in dry weight or by volume. When erosion and sediment control measures are in place, sediment yield is the sediment discharged from the site after passing through those measures.

Settling
The downward movement of suspended sediment through the water column.

Snorkel
In a Decanting Earth Bund or Silt Trap, a vertically placed pipe which decants water and forms the inlet to the primary spillway.

Spreader (Hydraulics)
A device for distributing water uniformly in or from a channel.

Stabilisation
Providing adequate measures, vegetative and/or structural that will protect exposed soil to prevent erosion.

Surface Runoff
Rain that runs off rather than being infiltrated or retained by the surface on which it falls.

Suspended sediment
The fine soil particles that remain suspended in the water column rather than settling to the bottom.

Swale
A constructed depression or shallow channel across a block, that can be used to transport clean stormwater. It is usually heavily vegetated, and normally only flows during heavy storm events.

Waterway[5]
A waterway refers to all freshwater environments that have continually or intermittently flowing freshwater or surface water present. Waterways include natural, modified, and human-made or artificial waterways (also referred to as drains).

[5] https://environment.govt.nz/assets/publications/works-in-waterways-guideline.pdf#:~:text=For%20the%20purposes%20of%20this%20guideline%2C%20a%20waterway,or%20artificial%20waterways%20%28also%20referred%20to%20as%20drains%29.

Literature & further reading

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Zespri. Good practice guidance for kiwifruit growers is available from the Manage soil page of the Zespri Canopy website

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AGRILINK