# Vegetated Buffer Strips
## Code of Practice

**GUIDANCE FOR ACHIEVING GOOD PRACTICE**

VERSION 1.0 | APRIL 2021

Vegetable RESEARCH + INNOVATION

PREPARED BY AGRILINK NZ FOR VEGETABLE RESEARCH & INNOVATION BOARD


Guides form an integral part of the horticultural industries framework of continual improvement, referred to as Joining the Dots

This guide on vegetated buffer strips has been commissioned by the Vegetable Research & Innovation Board and developed by Agrilink NZ. Agrilink NZ and the VR&I Board would like to acknowledge the valuable contribution made by Woodhaven Gardens.

# Contents



## This guide is designed to assist you in making decisions related to installing and maintaining vegetated buffer strips.

Vegetated buffer strips – also known as filter strips and riparian buffers - are a key mitigation strategy for sediment control on cultivated operations. With proper implementation 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. Buffer strips also can **reduce nutrient and pesticide contamination** in the receiving environment.

Vegetated buffer strips are one of two commonly used sediment control mitigations, the other being sediment retention ponds (SRP). While buffer strips are less technical to install than SRP's, 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 mitigation measure that looks visually effective but in reality, has little real effect on minimising sediment loss. This guide contains information on optimising the installation and use of buffer strips.

The following decision trees (pages 4 & 5) can be used by growers to take a risk assessment based approach to guide their decisions on sediment control.

The first step is a soil risk assessment. This includes considering factors such as topography, row length, region (rainfall intensity), and soil type.

Always aim for Good or Best Practice rather than just achieving council compliance.

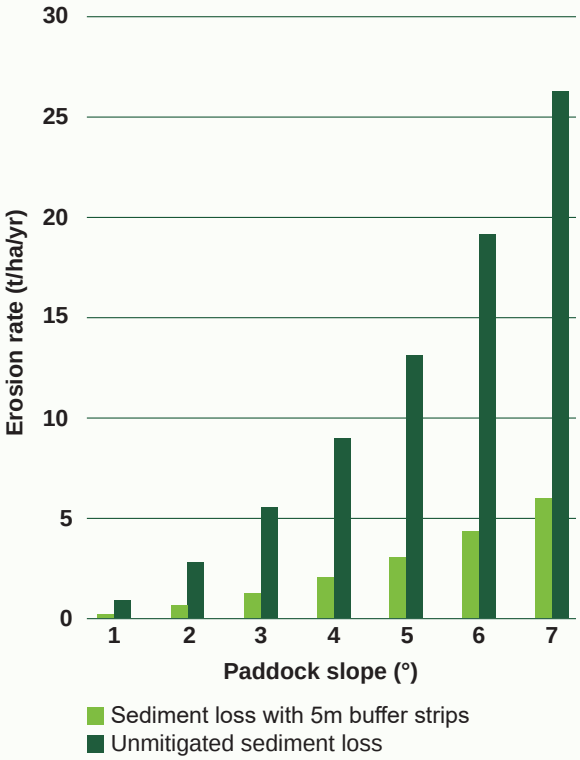
**Further information** on vegetated buffer strips can be found in Vegetated Buffer Strips - Background Material (Barber and Stenning, 2020), available from HortNZ. Neither Horticulture NZ, the VR&I Board and Agrilink make any warranty about the recommendations contained within. Use of this information is strictly at your own risk.

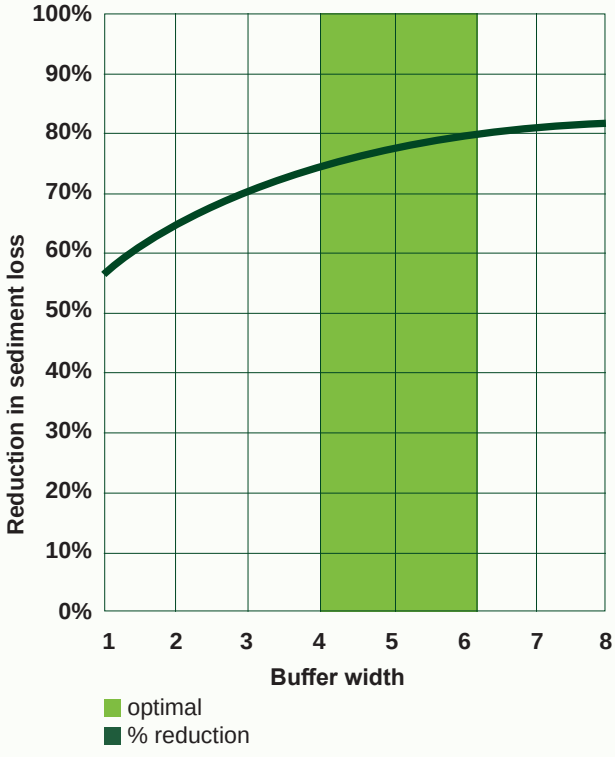
## Buffer Strip **Efficiency**

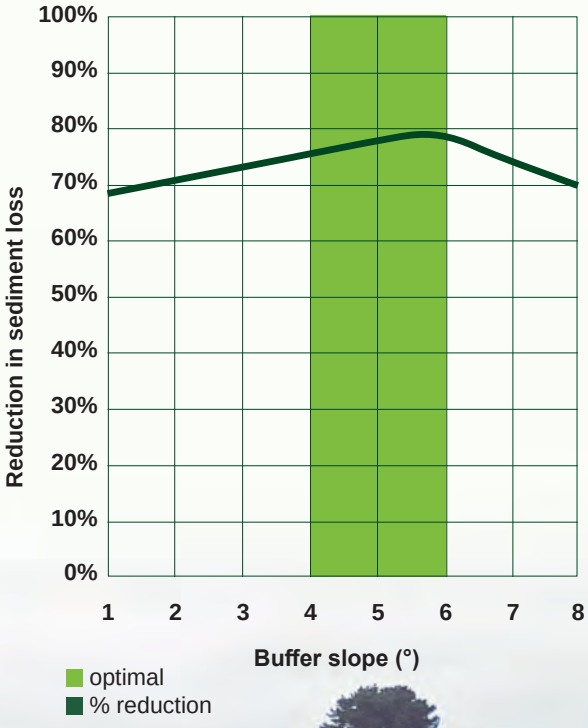
Buffer strip efficiency has been modelled by numerous researchers. The **Don't Muddy the Water Erosion and Sediment Control App** (see page 9 of this guide) quantifies the reduction in sediment loss based on a range of buffer widths and paddock factors.

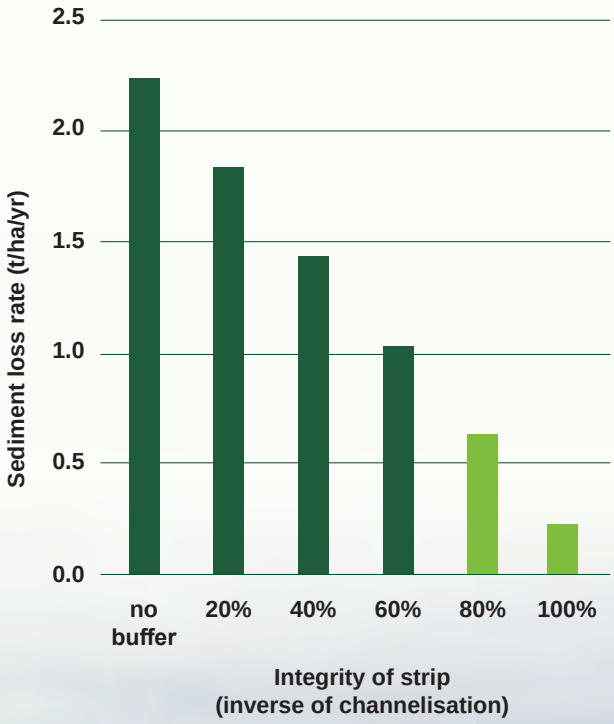
The graphs below demonstrates the key factors affecting buffer strip efficiency – paddock slope, buffer slope, buffer width, and strip integrity. This should provide a guide as to the optimum dimensions, but it is important to note that each site will have unique factors impacting the implementation of buffer strips and any planned buffer should be established according to those conditions.

NOTE
The erosion rates shown in the graphs below were generated using a range of variables (e.g. soil type and location), therefore the numbers should be considered for demonstration purposes only.


30
25
20
15
10
5
0
Erosion rate (t/ha/yr)
1
2
3
4
5
6
7
Paddock slope (°)
Sediment loss with 5m buffer strips
Unmitigated sediment loss


100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Reduction in sediment loss
1
2
3
4
5
6
7
8
Buffer width
optimal
% reduction

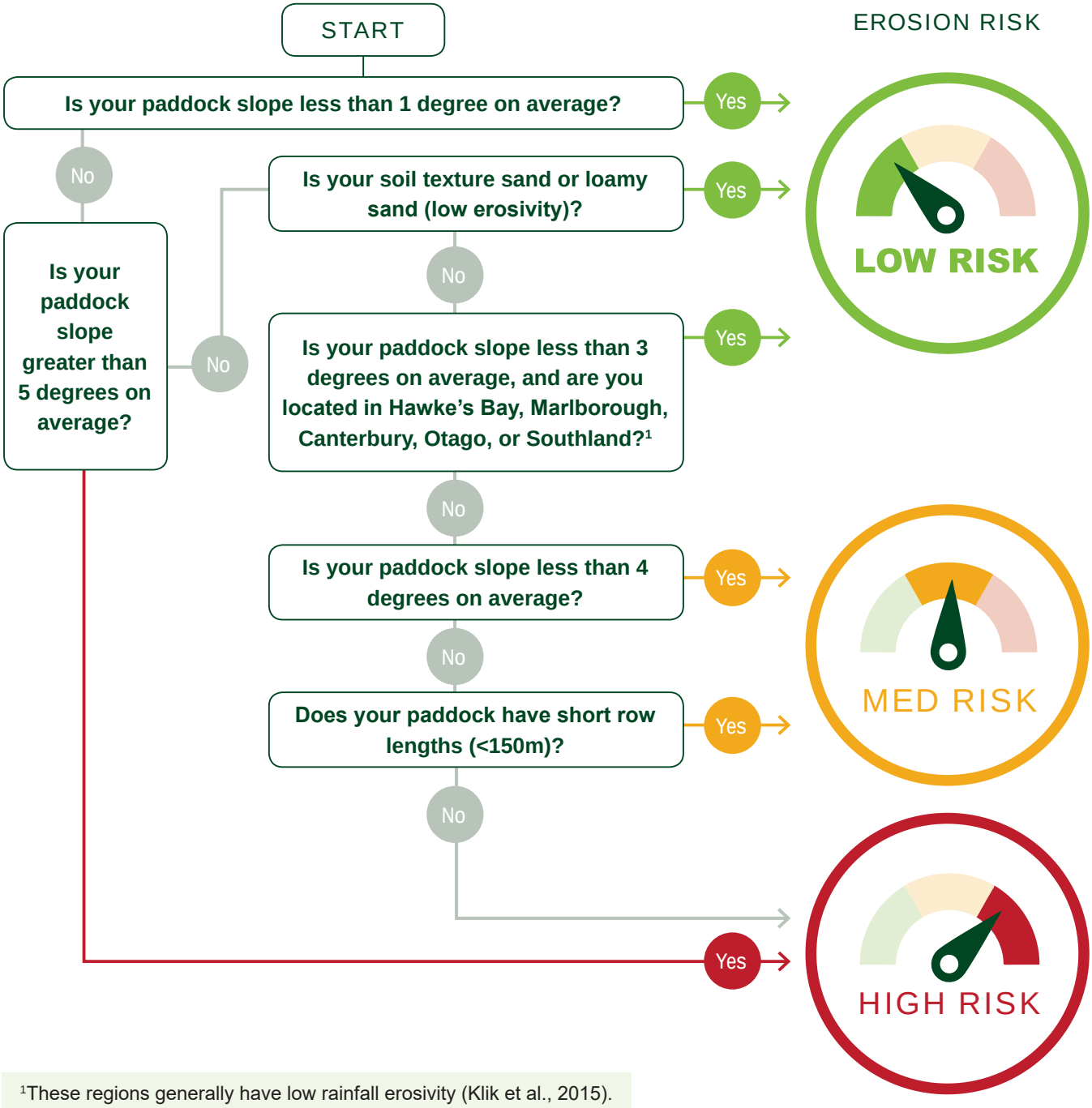

100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Reduction in sediment loss
1
2
3
4
5
6
7
8
Buffer slope (°)
optimal
% reduction


2.5
2.0
1.5
1.0
0.5
0.0
Sediment loss rate (t/ha/yr)
no buffer
20%
40%
60%
80%
100%
Integrity of strip
(inverse of channelisation)

# Decision Tree

## PADDOCK RISK ASSESSMENT DIAGRAM

**Health and safety of workers and the public must be an integral part of all activities, including the identification of hazards.**




[1]These regions generally have low rainfall erosivity (Klik et al., 2015).

# Decision Tree

## FOR IMPLEMENTING EROSION AND SEDIMENT CONTROL MEASURES

**Low Risk**

Erosion control: Intercept overland flow from catchments above with the use of **interception drains** or bunds.

Erosion control: Use **cover crops** where possible in your crop rotation, especially during winter.

Sediment control: Install and maintain **vegetated buffer strips** at the edges of your paddock to intercept runoff water.

**Medium Risk**

The above plus:

Erosion control: Where appropriate use **wheel track ripping** or **wheel track dyking** to increase infiltration on compacted wheel tracks (excluding spray tracks).

Sediment control: Consider using **decanting earth bunds** to prevent runoff water from escaping the paddock uncontrolled. Use instead of vegetated buffer strips, especially where channelising becomes a problem.

**High Risk**

The above erosion control measures plus:

Sediment control: Construct 0.5% (50m$^3$/ha) **Sediment Retention Ponds (SRPs).** Use instead of vegetated buffer strips or decanting earth bunds.

Information on the different types of mitigation measures can be found in the Erosion & Sediment Control Guidelines for Vegetable Production
**http://archive.hortnz.co.nz/assets/Natural-Resources-Documents/ES-Control-Guidelines-1-1.pdf**

# Summary

## Establishment

- Minimising channelling is the most crucial aspect of vegetated buffer strip installation.
- If water flows off a paddock and discharges in a concentrated flow, then vegetated buffers will not work. Either the ground needs to be recontoured to create sheet flow across a buffer, or an alternative sediment control measure is needed.
- Bunding in front of the buffer needs to be minimised, as this leads to channelling and flooding on a flat paddock.
- Ensure ground has a consistent gradient directed away from the paddock. This gradient should be enough to direct runoff across the strip but not enough to dramatically increase runoff velocity (i.e., 2 - 6°).
- Ensure the buffer strip is perpendicular to the rows so it will intercept runoff.
- Push the headland back into the paddock to ensure that there is enough room for vehicles to turn without encroaching on the buffer. Consider constructing a greater than 5m wide buffer to account for inevitable shrinkage over time.
- Choose appropriate vegetation for the buffer. Generally, grass will work fine, but consider adding other low-level vegetation with strong root systems to increase biodiversity. If in a riparian zone, consider planting with taller riparian vegetation to provide shading (lowers water temperature) and a habitat for greater biodiversity.
- Vegetated strips can also be used to protect drains that may run parallel to the row direction. As overland flow is unlikely to pass across them, so that they therefore do not need to be wide enough to reduce sediment loss from overland flow, they do function to keep cultivation and vehicles back from the drain. Therefore, these vegetated strips help to protect the integrity of the drain. The drains themselves should also be stabilised with either vegetation, rock riprap, geotextile, and or baffles.
- Depending upon the paddock configuration, buffer strips can typically occupy 2% to 5% of the paddock area.
- Installation costs, including ground preparation and sowing, are approximately $120 to $180 per hectare of productive land.

## Maintenance

- Regularly inspect the buffer strips, especially during and after rainfall events, to watch for channelisation or other bypassing of the buffer.
- If necessary, fill in any channelisation pathways and re-seed with vegetation.
- Level the headland in front of the vegetated buffer. Remove any soil build up or wheel rutting along the full length of the buffer entrance. Bunding causes the water to build up, potentially flooding the paddock, and eventually breaking through the bund in a concentrated channelised flow.
- Annual costs include the value of the land occupied by the buffers at $50 to $130 per hectare of productive land, plus maintenance of $10 to $40 per productive hectare.
- First year costs, installation and land, range between $175 to $310 per productive hectare. Year 2 onwards, maintenance and lease costs, ranges between $70 to $160 per productive hectare.

Practice:

# Installing Vegetated Buffers

*"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.*

## Purpose and specifications

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 of runoff water, 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 paddock 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. Rows perpendicular to the field margin are superior to parallel rows for encouraging sheet flow.

It is especially important to ensure there is adequate headland space for vehicle movements to prevent vehicles tracking across the buffer strips and creating channels. A wide headland also enables runoff water to spread out and lose velocity as it exits the rows. It is generally also wise to install a buffer strip a few meters wider than necessary to account for the inevitable encroachment over time caused by vehicle movements and normal field operations.

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

The choice of vegetation is also important. Most growers choose to use basic grass species, though oats, vetiver grass, and miscanthus are amongst the 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.

Practice:

# Maintaining Vegetated Buffers

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

## Purpose and specifications

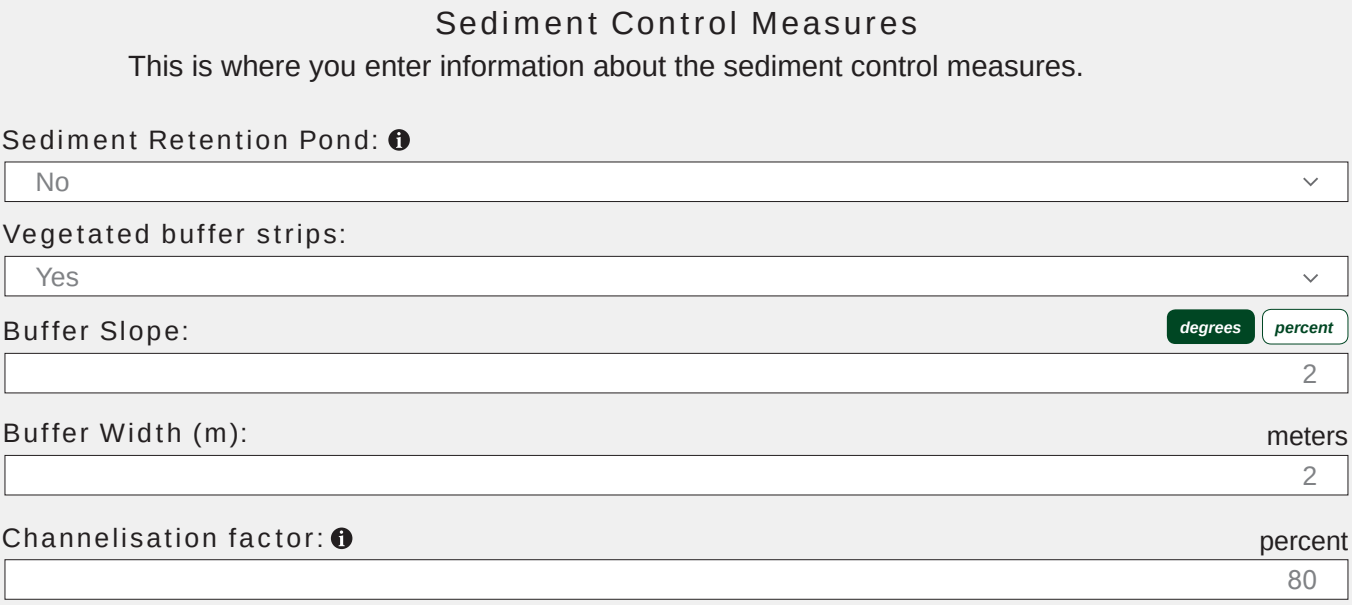
Once established buffer strips need to be maintained in order to keep them functioning effectively.

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 strip. It is not uncommon for small undistinctive topographical features to result in water bypassing the strip. This is often caused by soil build up 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 preferential flow, and to remove settled bedload from around the strip.

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 preferential flow. It is important to fill in any channels to keep 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 strip 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.




Practice:

# Using the DMTW Erosion & Sediment Control App to Inform Management Decisions

## Purpose and specifications

The Don't Muddy The Water (DMTW) erosion and sediment rate calculator is a web-app developed to aid growers in prioritising appropriate mitigation measures for their property based on modelled erosion and sediment loss rates.

By inputting paddock dimensions, soil type, and location, a grower can model their baseline erosion rates with no mitigations present. The grower can then select a variety of erosion mitigations like cover crops and wheel track ripping in order to demonstrate their effectiveness. Likewise, sediment control measures such as vegetated buffer strips and sediment retention ponds (SRPs) can be selected to model the effect these measures would have on sediment loss rates. This decision support tool can then aid growers in justifying management decisions on what mitigation measures should be implemented and how they should be prioritised.

Vegetated buffer strips are present as a sediment management practice in the web-app. The user needs to input the slope of the buffer strip (in degrees or percent) as well as its width. A channelisation factor is then selected by the user. This is essentially the percentage of the strip that is uncompromised by channelisation – enabling growers to model existing buffer strips based on their actual physical condition.

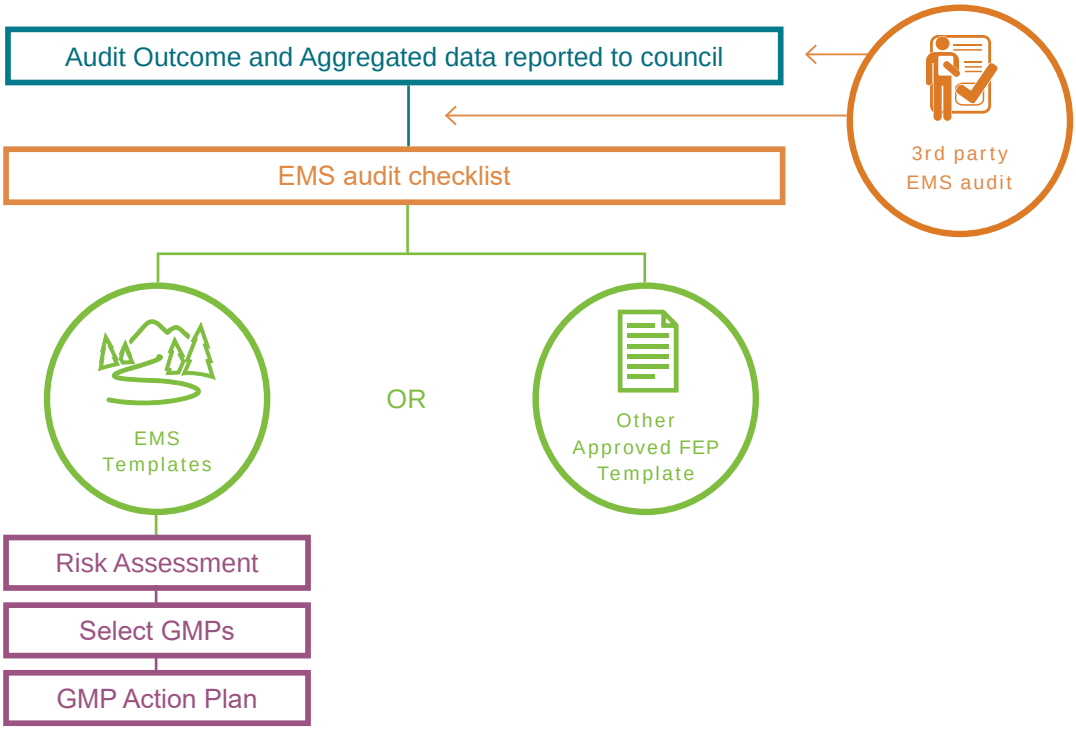
The results from the calculator can be downloaded as a single page PDF report and used as evidence for management decisions in Farm Environment Plans (FEPs).

The app is located on the Vegetable Research and Innovation website **here.**

# Action Plan

As part of your NZGAP Environmental Management System (EMS) any identified changes should be added to your Farm Environment Plan (FEP) Action Plan.

## EMS Assurance Framework




| 10A Environmental 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.3 | Soil - Erosion control | Install a new buffer strip at the southern boundary of Paddock 1 | Paddock 1 | XY | April 2021 | | Before and after photos |
| 6G.3 | Soil - Erosion control | Re-shape existing buffer at eastern edge of Paddock 2 to prevent channelisation | Paddock 2 | XY | April 2021 | | Before and after photos |

# Further Information:


**Vegetated Buffer Strips: Background Material and Literature Review (Barber and Stenning, 2020). Available from Hort NZ.**

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Basher, L., Peterson, P. 2018. Don't Muddy the Water: Erosion measurements at Levin, Pukekohe, and Gisborne Final Report. Landcare Research. Prepared for Horticulture New Zealand.

Dillaha, T. Reneau, R., Mostaghimi, S., Lee, D. 1989. Vegetative Filter Strips for Agricultural Nonpoint Source Pollution Control. American Society of Agricultural Engineers. Vol 32(2).

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Gharabaghi, B., Rudra, R., Whiteley, HR., Dickinson, WT. 2000. Sediment removal efficiency of vegetative filter strips. Annual Research Report of Guelph Turfgrass Institute

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Stehle, S., Dabrowski, J., Bangert, U., Shulz, R. 2015. Erosion rills offset the efficacy of vegetated buffer strips to mitigate pesticide exposure in surface waters. Science of the Total Environment. 545-546 (2016) 171-183.

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Yuan, Y., Bingner, R., Locke, M. 2009. A Review of effectiveness of vegetative buffers on sediment trapping in agricultural areas. Ecohydrology. 2, 321-336 (2009). DOI: 10.1002/eco.82.

Zhang, X., Liu, X., Zhang, M., Dahlgren, R. 2010. A Review of Vegetated Buffers and a Meta-analysis of Their Mitigation Efficacy in Reducing Nonpoint Source Pollution. J. Environ. Qual. 39:76-84 (2010) DOI:10.2134/jeq2008.0496

# Notes

AGRI LINK

Vegetable RESEARCH+ INNOVATION