Horticulture New Zealand
Ahumāra Kai Aotearoa

Vegetable Washwater Management

Code of Practice

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Version 2.0 | June 2026

Document control

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Summary of changes since previous version (2017, version 1.2)

Change	Reference
Name change from Vegetable Washwater Discharge to Vegetable Washwater Management	Title
Addition of a washwater management hierarchy Addition of new flow chart to select treatments	Section 1.4 Section 3
Change to focus on individual practices and removal of Good Practice tables. Guidance on application to land moved to a standalone section.	Section 4 Section 4.3
Design update	Whole document

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

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Contents

1 Code of Practice overview

This Code of Practice supports growers to manage discharges generated from washing fresh vegetables. It provides a practical approach to characterising washwater, calculating storage, and applying land-based treatment options.

1.1 Introduction

Following harvest, growers may wash fresh vegetables to remove soil and other residues. Washing fresh vegetables, such as leafy greens and brassicas, is a food safety requirement, as some fresh produce can be eaten without cooking or processing. Growers must meet food safety requirements to sell their produce to supermarkets.

After its use in the postharvest facility, washwater must be managed to minimise risks of losses including sediment and nutrients to freshwater, when applied to land. Vegetable washwater can contain dissolved nutrients, sediment, organic matter, and chemical residues. There are several land-based treatment options available for vegetable washwater, but most typically it involves applying to land via an irrigation system.

This Code of Practice supports growers to meet applicable regulatory requirements for the application of washwater to land. Managing potential risks to freshwater requires an understanding of what's in your washwater and selecting an appropriate treatment method. It may be necessary to temporarily store washwater onsite until it can be treated via land application. Storage is typically for 2 to 4 weeks, in order to avoid application to land when conditions would otherwise cause ponding or overland flow. All storage must be fully contained (lined or sealed with no outfall or spillway).

As industry knowledge and research evolve, this Code will be reviewed and updated to remain practical and fit-for-purpose.

1.2 Scope

This Code of Practice is aimed at growers who wash fresh vegetables onsite in a postharvest facility, alongside their commercial vegetable growing operation. Vegetable washing can encompass washing, transportation, or cooling in a postharvest facility.

As vegetable washwater is considered a discharge under the Resource Management Act (RMA), it may require a resource consent or must comply with the conditions of a permitted activity rule. The supporting document, *Regional Council Rules Guidance for Vegetable Washwater Management*, was developed to guide growers on what rules may apply to their operations, depending on the region. You should check your regional council's specific requirements or seek advice from a suitably qualified planner. The washwater generated from processing vegetables, such as peeling or juicing, is outside the scope of this Code of Practice. These activities can affect the composition of washwater in other ways that may require alternative treatment, depending on the extent of processing. Operations undertaking these activities should seek specialist advice to meet regulatory requirements.

1.3 How to use this Code of Practice

This Code of Practice begins with a washwater management hierarchy to identify areas where water use can be minimised to reduce the quantity of washwater generated (Section 1.4).

Section 2 steps through how to characterise washwater composition, measure flow and volumes, and laboratory analysis. This information supports growers to complete the 'Steps to developing a washwater treatment system' based on the decision tree in Figure 3.1 (Section 3.2). This decision tree guides growers through a flow chart of treatment options for their operation.

Section 4 includes details of pre-treatment, storage, and land-based treatment. For growers looking for more detailed information, each option has links to further information. Section 5 covers maintenance and monitoring.

The Code is supported by three appendices: Appendix A, which contains links to further resources, Appendix B, a glossary, and Appendix C, which contains a storage lookup table supporting calculations in Section 4.4.

Refer to the supporting document, *Regional Council Rules Guidance for Vegetable Washwater Management*, to understand the regulatory requirements that may apply when discharging vegetable washwater to land.

1.4 Washwater management hierarchy

Alongside assessing treatment options in this Code of Practice, growers should first look to avoid, reduce, or reuse water where possible. Reducing the amount of washwater generated has a range of benefits. It reduces the volume of storage that may be required, which is linked to financial and land utilisation benefits. Reduced discharge volumes reduce the potential risks to freshwater from applying washwater to land. It can potentially improve alignment with any market or customer requirements, where applicable.

The hierarchy in Figure 1.1 steps through the options - avoid, reduce, reuse, treat, and discharge washwater.

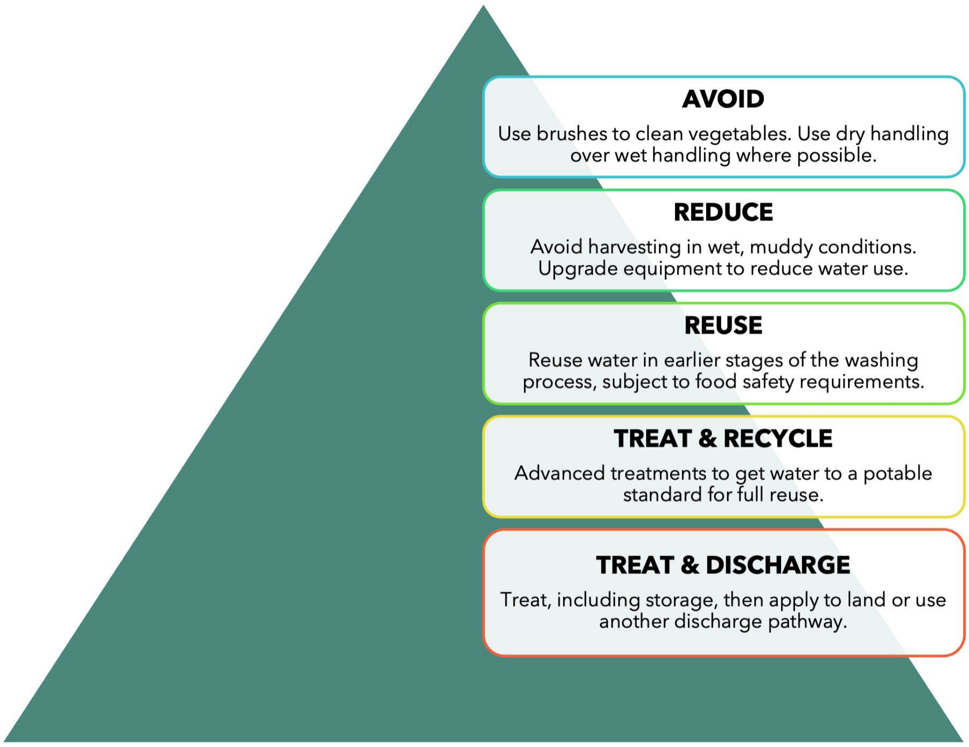

Figure 1.1. Washwater management hierarchy to guide grower decision making.

Ways to reduce the volume of washwater generated and treatment required

Several methods to reduce water use are provided below.

- Harvest: Where possible, minimise soil on the harvested produce (i.e. avoid harvesting in wet, muddy conditions).
- Use other methods to remove soil and debris like brush lines or compressed air. This may not be appropriate for all crops.
- System design and hardware: Upgrade to more efficient and lower water use systems and hardware (e.g. nozzles), where practicable.
- Input water: Use high quality water with low levels of dissolved nutrients (e.g. nitrogen, phosphorus), where possible.
- Maintenance: Keep the wash system well maintained to reduce pipe leaks and unnecessary water loss.
- Training: All staff that operate equipment receive training to optimise water use efficiency.
- Monitoring: Identify areas of washing activities where water savings can occur.

2 Characterise your washwater

Understanding both the volume and composition of vegetable washwater generated will help guide growers when evaluating management options. Because washwater volumes can vary throughout the year, tracking flow rates and volumes can help identify potential pinch points. For example, this is important when storing washwater for later application to land, or when treatment systems have maximum daily hydraulic loads[1]. Having this information on hand will help guide decision-making.

2.1 Volume and flow monitoring

Monitoring washwater volumes and flow rates is a useful activity to undertake within postharvest facilities. It will help determine the amount of washwater requiring treatment and identify opportunities to improve water efficiency and reduce operating costs.

Measuring volume means calculating the total volume of water (e.g. litres or m^3) used within a set period (e.g. 8-hour day). Volume data informs the quantity of washwater requiring treatment. The flow rate is how fast the water is moving through the system or leaving the facility to be treated. Flow rate can be expressed as L/min or L/sec. Knowing the flow rate is important for understanding the quantity of water entering a treatment system, as treatments will vary in effectiveness if the flow rate is too high or low.

Flow rate and volume are linked, so can be calculated, if time is known. Switch between time (sec., min., hours) or volume units (L, m^3) to best suit your operation.

Total volume (l) = Flow rate (l/min) × time (min)

Collect data on volume and flow several times over a season, or on a representative day. It is also useful to collect data on peak days or peak weeks, as this will inform the maximum system capacity (i.e. hydraulic load) and flow requirements.

Several options are available to calculate water volumes and flow rates. Multiply the data collected out across the week or month to understand how much washwater the system is generating.

1. **Using water meter readings:** Record water meter readings at the start and end of a day, to know how much water has been used to wash your vegetables. Divide by the total running time to calculate an average flow rate.
2. **Use flow meter readings:** Track flow rates using flow meters installed on the equipment, or on the water pipe leaving the facility. Flow meters can provide more insight into variation over the day, especially if data is logged automatically.
3. **Track storage tank levels:** Measure the washwater level in storage at the beginning of the day and at the end of the day and subtract the difference to calculate the volume generated.
4. **Estimate using pump or equipment specifications:** Check the pump specifications or rating written on the pump used for the washline. If the pump uses 500 L/hr for example, then multiply this by the time the pump is switched on over a workday, to estimate water used. Exclude time that equipment is switched off for breaks over the day.
5. **Do a bucket test:** Calculate the time it takes to fill a container (e.g. 100 L) with water leaving the facility. Divide volume by time to fill, to calculate the flow rate.

[1] See Appendix B: Glossary.

2.2 Water sampling and laboratory analysis

Laboratory analysis of washwater is an important part of vegetable washwater management. Depending on the treatment system or management pathway used, testing can help growers monitor treatment performance and maintain records where required for permitted activity rules or resource consent conditions. For example, where settling ponds are used to remove sediment, testing the washwater before and after settling or storage can help demonstrate how effectively the pond reduces suspended solids.

While application to land is the recommended treatment pathway in this Code, soakage pits can be an effective option in some situations. Seek further advice from the council or a specialist, if looking to investigate soakage pits, as losses of nitrogen and phosphorus to ground and surface water need to be considered.

When undertaking washwater sampling, it is important to collect samples that are representative of typical operating conditions. Sampling should reflect an average day of production and the usual crop types processed at the facility. Seasonal variation should also be considered as winter root crops generally generate higher sediment and contaminant loads than summer salad crops.

Take samples of the incoming water supply, the untreated washwater leaving the postharvest facility, and stored washwater prior to land application.

If a treatment system is already in place, sample before and after treatment to assess the system's effectiveness. Where washwater is reused within the facility (e.g. in soak tanks or for preliminary washing), this water should also be tested, particularly for food safety purposes.

2.2.1 Water testing parameters

Many different water quality parameters can be analysed, depending on the intended use and associated risks. Where washwater is intended for land application, measure the following parameters from samples taken prior to land application. Contact your preferred provider for water testing to understand what tests they have available.

- TSS - Total Suspended Solids
- Total nitrogen and total phosphorus
- Major cations: sodium, calcium, magnesium, and potassium (relevant for soil fertility)
- pH

If irrigating treated washwater over crops for human consumption, follow all food safety guidelines, which will likely including additional testing for microorganisms (i.e. *E. coli*). A grower factsheet on managing water use and food safety is provided in Appendix A. Also make sure to check for any council permitted activity or consent conditions, where applicable, that may stipulate certain water testing parameters.

2.3 The composition of vegetable washwater

Vegetable washwater typically contains a mixture of sediment, organic matter, nutrients (e.g. nitrogen and phosphorus) and trace chemical residues (e.g. agrichemical residues) from the production or post-harvest cleaning process. Washing activities can also influence other properties of the washwater, including temperature, pH, and biological oxygen demand of the water.

This section provides reference information on the typical composition of washwater, based on an analysis of grab samples collected from commercial operations.

Table 2.1 summarises average concentrations across grab samples collected from three root vegetable washing operations, two leafy green washing operations, and two sediment traps (representing cultivated land runoff).

Samples were taken from postharvest washwater (the exit point from the postharvest facility) for both root vegetable and leafy green operations. Additional samples were taken at the point of exit from outdoor storage ponds holding excess washwater before application to land (exit storage pond) – 'point source' discharges.

Samples were also taken from the outflow of sediment retention ponds associated with outdoor vegetable production (sediment pond – entry and exit points) - these samples provide a useful comparison with background 'non-point source' runoff from cultivated land.

All samples were analysed by Hill Laboratories for suspended solids, total nitrogen, and total phosphorus. While the dataset is limited, it provides an indication of the relative concentrations of these elements in washwater compared to typical overland flow.

Table 2.1: Washwater discharge characteristics, compared to background rates from cultivated land (entry into a sediment trap). All units are in g/m³. Data averaged from a sample of New Zealand vegetable grower postharvest facilities and sediment traps. This data is supplied by the authors, Agrilink NZ.

	Suspended solids		Phosphorus		Nitrogen	
	Exit postharvest facility	Exit storage pond	Exit postharvest facility	Exit storage pond	Exit postharvest facility	Exit storage pond
Washing: Root veg	2,130	70	3.6	0.6	28	6
Washing: Leafy green	80	-	0.6	-	12	-
	Entry	Exit	Entry	Exit	Entry	Exit
Sediment pond	210	100	1.1	0.8	4	6

As shown in Table 2.1, suspended solids, phosphorus, and nitrogen from washing operations, following pond storage, are less than the background overland discharge rates from cultivated land (measured at the entry point into a sediment trap).

To better understand what these concentrations mean in practice, Table 2.2 converts the data into application rates (kg/ha/month) assuming a discharge rate of 20 m³/day, a 30-day period, and application over a two-hectare land area. If applied over a larger area, the nutrient and sediment loading per hectare would decrease further.

Table 2.2: Washwater discharge characteristics, compared to background rates from cultivated land (entry into a sediment trap and winter soil mineralisation rates). All units are in kg/ha/month, washwater is based on a discharge rate of 20 m³/day, over a 30-day period, applied over a 2 ha washwater application site. This data is supplied by the authors, Agrilink NZ.

	Suspended sediment		Phosphorus		Nitrogen	
	Exit postharvest facility	Exit storage pond	Exit postharvest facility	Exit storage pond	Exit postharvest facility	Exit storage pond
Washing: Root vegetables	640	20	< 1	< 1	8	2
Washing: Leafy green	25	-	< 1	-	4	-
	Entry	Exit	Entry	Exit	Entry	Exit
Sediment trap*	60	30	< 1	< 1	1	2
Soil N mineralisation (winter)	-	-	-	-	15 (55 mg/kg)	

* Sediment trap entry and exit quantities based on peak measured flow rate of 300 m³/ha – Don't Muddy the Water – Final Report (Barber, et al., 2019.). Per hectare discharge, not applied to land.

Table 2.2 shows that, after pond storage, the sediment and nutrient loads associated with washwater application are broadly comparable to those occurring from natural runoff from cultivated paddocks (represented by sediment trap inflows). Notably, nitrogen applied via washwater (e.g. ~2 kg/ha/month after pond storage for root vegetables) is significantly lower than natural soil nitrogen mineralisation in winter (approximately 15 kg/ha/month). Furthermore, both nitrogen and phosphorus loads from washwater are also substantially lower than typical fertiliser application rates used in outdoor vegetable production.

At the assumed discharge rate in Table 2.2, a total of 600 m³ of washwater is generated per month. When stored in open ponds, rainfall can contribute an additional 60–500 m³ depending on local climate conditions. When applied to land over a 2 ha area, this equates to an average application depth of approximately 1 mm/day. In winter, this is generally comparable to, or slightly below, crop evapotranspiration rates. This indicates that, with appropriate design and sufficient land area, washwater application can align with plant water use and avoid excess drainage.

Overall, vegetable washwater is primarily composed of sediment and nutrients that are already present in agricultural soils and runoff. Applying washwater to land is considered an effective treatment method (see Section 3).

3 Washwater treatment selection

3.1 Factors influencing treatment selection

Options for vegetable washwater treatment depend on a range of factors. These factors will heavily influence the choice of treatment. Factors include:

- **Washwater volume:** Cost and treatment options vary, depending on the volume of washwater
- **Crop type:** Root vegetables vs. other crops grown in, or near soil
- **Seasonality:** Summer washing only, or all year round
- **Land availability:** To apply vegetable washwater to land
- **Storage capacity:** To hold washwater when crop water demand is low (i.e. winter) and to prevent ponding and overland flow as result of application to land
- **Postharvest activities:** Washing/transportation/cooling only, or additional processing activities
- **Operational or financial constraints:** How much capital is available for investment
- **Sustainability goals:** Targets to reduce water use or fully recirculate

Considering these factors, this Code of Practice provides guidance on four treatment pathways for vegetable washwater. These include:

1. Application to land
2. Soakage pit
3. Off-site management
4. Advanced treatment, including full recirculation (closed system).

3.2 Steps to developing a washwater treatment system

To guide growers on what washwater treatments would work best for their system, a step-by-step process is provided below. This process uses the decision tree (Figure 3.1) on the following page. This decision tree guides growers to select one of the four treatment options above. Use the step-by-step process in combination with the decision tree to navigate through the Code of Practice, referring to relevant sections as needed.

Check the requirements
Check what regulatory requirements may apply to your operation – refer to the supporting document, *Council Rules Guidance for Vegetable Washwater Management.*

Characterise your washwater
Collect data on volumes, flow rates and laboratory analysis over the season (Section 2).

Assess and select a treatment pathway
Use the water management decision tree (Figure 3.1) to assess and select the best treatment pathway.

Develop and implement a washwater management plan
Based on your washwater test results, council requirements, and treatment pathway, develop and implement a washwater management plan, using guidance on different treatments (Section 4).

Maintain and monitor
Keep the system maintained and monitor for ongoing effectiveness (Section 5).

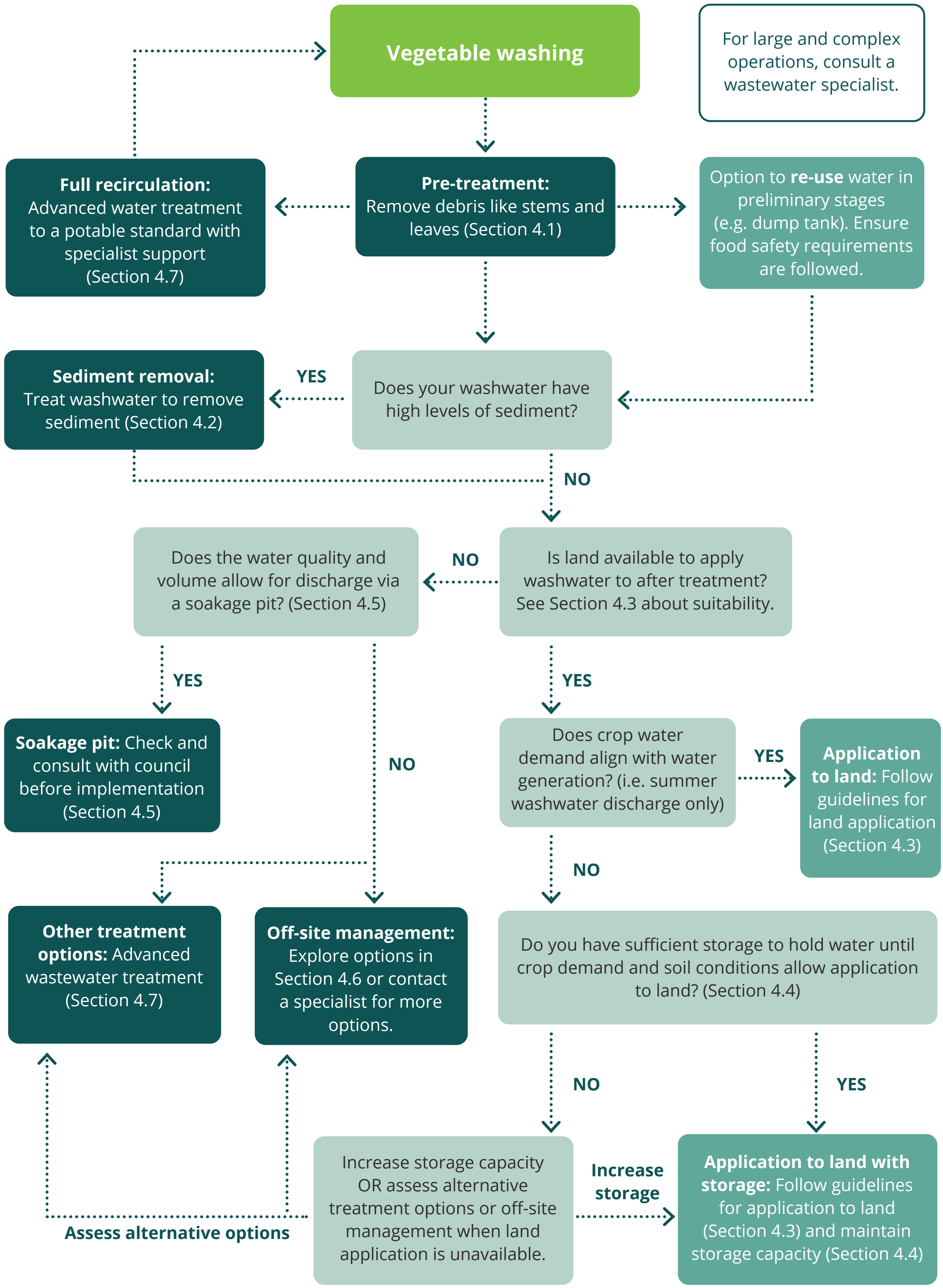

Figure 3.1: Washwater management decision tree.

4 Treatments

This section provides an overview of the treatment options presented in the washwater management decision tree (Figure 3.1 in Section 3). Each treatment option includes a purpose, brief description, key considerations, and links to further information where available.

Sections 4.3 (Application to Land) and 4.4 (Storage) are presented in a different format, as they include more detailed supporting information. This reflects their practical importance as application to land is likely to be the most accessible treatment option for many growers. In suitable situations, this treatment may be implemented without specialist advice.

The treatment options described in this section are not exhaustive. Additional or more advanced treatment systems may be required in some circumstances, particularly where full water recirculation is intended (see Section 4.7), or where the condition of the surrounding biophysical environment may call for additional treatment prior to land-based application. In these cases, engaging a wastewater specialist or consultant is strongly recommended.

For growers seeking more detailed information, the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) published a comprehensive manual on fruit and vegetable washwater treatment in 2017. This manual is a useful reference for treatment options included in this Code of Practice, as well as additional methods beyond its scope. A link is provided in Appendix A, and the manual is referenced throughout this section where relevant.

Treatments contained in this section include:

4.1 Pre-treatment to remove debris and coarse solids

Pre-treatment technologies help to remove debris and coarse solids from vegetable washwater. Examples can include stones, soil clods, stems, leaves, and broken or damaged vegetables. Removing debris is important to reduce biochemical oxygen demand (BOD) and to avoid clogging up the treatment system.

Treatments to remove debris and coarse solids may include:

- Sieving or screens (for all crops)
- Silt traps (primarily for root crops)

4.1.1 Screening/sieving

Treatment aim	Remove debris and coarse solids (e.g. stems, leaves, stones, soil clods) from washwater.
Description	Use of a screen, sieve, or mesh to trap debris in line with the recirculation system or once water leaves the processing line. Several screens can be used in a series to progressively remove smaller and smaller solids. There are a range of screening technologies available.
Considerations	• Screens and sieves need to be regularly cleaned and maintained so water flow is not restricted. The solids collected from the screens need to be managed appropriately (e.g. composted, if mostly plant material).
Links to further information	Ontario Vegetable and Fruit Washwater Treatment Manual – 8.4 Debris removal (page 54)

4.1.2 Silt trap

Treatment aim	Remove soil bedload from washwater.
Description	A silt trap can simply be a holding tank or dropout pit where washwater is held for a short time to allow the soil washed off vegetables to sink to the bottom of the trap. This helps to reduce the quantity of soil and solids flowing through pipes to the next treatment stage.
Considerations	• Silt traps are a cost-effective pre-treatment to remove soil bedload from washwater. • Regular cleaning is required to ensure the tank retains capacity to capture soil. This method will not remove fine sediment as it is only meant to be held for a short time. • Larger settling ponds will help to remove suspended sediment (see Section 4.2).
Links to further information	

Figure 4.1: Settling pond.

4.2 Sediment removal

Vegetable washwater, especially from root vegetable washing, can have high levels of sediment. Sediment levels in washwater will increase in winter, as conditions are often muddy and wet, so soil is more likely to stick to produce. From an irrigation system management perspective, suspended sediment in washwater should be reduced before final treatment (e.g. application to land), as sediment can block pipes and nozzles.

Treatments to remove sediment can include:
- Settlings ponds or tanks
- Coagulation and flocculation
- Weeping wall

4.2.1 Settling ponds or tanks

Treatment aim	Reduce suspended sediment to avoid blocking up irrigation or other application to land systems.
Description	Settling ponds or tanks hold washwater, allowing gravity to help suspended sediment particles settle at the bottom of the pond or tank. Tanks or ponds can be standalone, or part of a series (Figure 4.1). Settling ponds can also help to remove dissolved phosphorus from washwater, if held for long enough. Ponds can be covered or open.
Considerations	• Tanks or ponds can be a cost-effective treatment to remove suspended sediment. They can also double as storage to hold washwater, before application to land. See Sections 4.3 and 4.4 for more information about application to land and storage capacity. • The quantity of washwater is an important factor when designing and installing settling ponds. It is recommended to consult a specialist for this. • Ponds should be cleaned out before the volume of accumulated sediment reaches 20% of the total pond design volume. • A pond should have a minimum of 300 mm freeboard, and there must be no spillway. Therefore, contingency measures are required if the storage nears capacity. • Covered ponds offer several benefits over uncovered ponds, which require additional capacity for rainfall, and are at risk of faecal contamination by ducks or other birds. • Aids such as coagulants and flocculants can be added (see below) to speed up settling time and effectiveness, particularly for clay particles, which can take several weeks to settle. Ensure any aids used are approved for use in settling ponds or tanks.
Links to further information	Ontario Vegetable and Fruit Washwater Treatment Manual – 8.5.4 Settling tanks (page 67)

4.2.2 Coagulation and flocculation (C&F)

Treatment aim	Improve the efficacy of settling tanks or ponds to remove sediment and other particulate matter from washwater.
Description	C&F is used in combination with settling ponds or tanks to improve the efficiency of particulate and dissolved matter removal. Coagulants and flocculants are chemicals that are added to washwater to help particles bind and drop out of the washwater. Systems can be a simple dosing C&F at a set rate, or complex, where dosing is adjusted based on the washwater flow and quality.
Considerations	• C&F is most effective on washwater with fine suspended sediment (i.e. clay-based soils). These soils normally take a long time to settle without treatment. • The use of professionals to set up this treatment is recommended, to ensure treatment still enables later application to land. • Any C&F aids used must be approved for use in settling ponds or tanks, considering any ecotoxicity risks.
Links to further information	Ontario Vegetable and Fruit Washwater Treatment Manual – 8.5.5 Coagulation and Flocculation (page 71) Use of coagulants and flocculants for sediment control – Environment Canterbury Sustainable Sanitation & Water Management Toolbox – Factsheet on Coagulation and Flocculation, by F. Mazille and D. Spuhler. Wastewater treatment focus.

4.2.3 Weeping wall

Treatment aim	Remove solids and other particulate matter from vegetable washwater with high levels of soil and sediment.
Description	A weeping wall is a solids removal treatment, currently used for farm dairy effluent, but with applicable principles to removing sediment from vegetable washwater. A sludge bed is built behind the weeping wall, which can consist of timber or metal slats. The washwater seeps through the wall, leaving behind solids, which build up in the sludge bed. Often two sludge beds and walls are constructed, to allow one to dry for solids removal, while the other is used for treatment.
Considerations	• Weeping walls can be a useful treatment to combine with outdoor storage ponds, land allowing, as the wall collects soil and sediment, reducing the need to pump and empty what the first settling pond would collect. This reduces pumping costs and improves ease of management. • Contact an engineering specialist if considering installing a weeping wall.
Links to further information	Northland Regional Council – Weeping wall leaflet for farm dairy effluent

Figure 4.2: Weeping wall for dairy farm effluent, showing the wall, and sludge collected. Liquid seeps through the wall, to then be held ready for land application. Used with permission from Northland Regional Council.

4.3 Application to land

After pre-treatment in a storage pond (if sediment levels are high), vegetable washwater can be irrigated to land. When carried out in accordance with this Code, land application is an effective treatment to manage sediment and nutrients that might be present in the washwater. Reusing washwater as irrigation water can support the growth of pasture or forage crops, or potentially another vegetable crop (with consideration to food safety requirements).

This section contains detailed guidance on irrigating to land. Sub-sections include:

- Site suitability and environmental risk factors
- Delivery system
- Ground cover
- Pre-application check
- Key requirements when applying water to land
- Considerations if using neighbouring land
- Council requirements

4.3.1 Site suitability and environmental risk factors

When selecting a site for washwater disposal through application to land, growers should consider the site's biophysical features and surrounding environment. Features such as topography and soil type can increase the risk of washwater running into waterways. As washwater may contain dissolved nutrients or sediment, it is important that this risk is minimised by first selecting a suitable site.

Site information
Collect and keep records of the below features of the application site. Note down the source of any externally sourced records (e.g. climate databases), in case proof is ever required.

- **Property details:** Address, area in hectares, physical description including land use and ground cover, and delivery or irrigation system.
- **Biophysical features:** Annual rainfall (mm), description of topography, slope, soil type and profile, and soil profile available water (PAW)
- **Environment and freshwater:** Identify nearby fresh waterbodies e.g. rivers and streams.
- **Risk management:** If risk factors are present (see next section), there is a plan or description of how risks are mitigated.

Environmental risk factors
Table 4.1 describes several biophysical risk factors that growers need to consider if applying washwater to land. Biophysical risk factors relate to the natural characteristics of the environment within and around an operation, such as soil type, rainfall, and land slope. The following sections describe these risk factors in terms of how they may contribute to, or exacerbate, potential risks to freshwater arising from the land-based treatment of vegetable washwater.

Table 4.1: Environmental risk factors to consider when applying to land, alongside mitigations to manage the risk.

Risk factor	Description	Management practices
Topography	Depressions or low-lying areas on an application site have an increased risk of extended ponding. For sites near surface water, these depressions may connect to temporary flow paths across the site, which increases the risk of washwater entering waterways[2]. Steeply sloped ground can also increase the risk of surface runoff or overland flow.	Fill-in, or avoid applying on depressions where ponding is observed. Decrease the application rate to reduce the risk of ponding and allow the water to infiltrate the soil. Select a site that is flat or gently sloped to reduce run-off risk. Contour the site to direct any flow paths to a treatment device e.g. constructed wetland, riparian vegetative strip.
Rainfall	High annual rainfall, significant or winter rainfall events, increase drainage and the risk of nitrogen leaching out of the soil profile. This risk increases on light soils, and fallow ground. Heavy rainfall can also increase the risk of overland flow paths and surface runoff of N & P, especially for sites with depressions and ponding (see above), or steeply sloped sites, during heavy or intense rainfall events.	Ideally irrigate when there is a soil moisture deficit. Avoid irrigating when rain is forecast. If the soil is saturated, apply at a very low rate (i.e. 5 mm). Have 2 to 4 weeks storage to hold water when conditions are too wet (Section 4.4).
Soil type	Light soils with lower water holding capacity and very free-draining will have less residence time for treatment. Soils with poor drainage increase the risk of nutrient loss because the risk of ponding and surface runoff increases. Caution should also be exercised if soils have a surface cap, or deep cracks, which further increase the risk of surface runoff and bypass flow, respectively.	Apply smaller (5 mm) and more frequent applications to lighter soils. Avoid poorly drained soils, and those with surface capping or deep cracks. Have sufficient storage to hold the washwater water when the soil is at risk of ponding or have overland flow (Section 4.4).
Proximity to waterbodies	Application sites close to waterbodies (e.g. drains, streams, rivers, coastal waterbodies) have an increased risk of contaminant loss to freshwater. This could occur if the application or irrigation system is incorrectly set up, resulting in application over drains or waterbodies, or if too much water is applied, resulting in runoff directly into waterbodies.	Map out a buffer zone near waterbodies to ensure no risk of washwater being applied to these waterbodies. Have a minimum setback distance of 5 m. For steeper-sloped application sites, a larger setback distance may be required, as the risk of run-off into waterbodies may increase. Use border controls around waterbodies (e.g. vegetative buffer strip, riparian margin). Contour land to prevent flow paths that form in heavy rain, flowing across the site directly into waterbodies.

[2] Critical source areas: Guidance for intensive winter grazing (Ministry for the Environment 2023)

4.3.2 Ground cover

Look for a nearby site with existing ground cover. Alternatively, find a site where a crop is intended to be grown, where the crop can take up water and any nutrients potentially supplied within the washwater. Ideally, the application site has a healthy, well-managed crop or ground cover when applying to land. Good winter growth is also important, as slow growth over winter is a high-risk period for run-off and leaching. The ground should never be fallow (i.e. without a growing crop) when applying vegetable washwater.

Ground cover crops may include:

- Pasture harvesting e.g. silage and hay
- Pasture grazed by animals
- Crops – annual and permanent
- Catch crops

4.3.3 Delivery system

A delivery system needs to be set up to apply the vegetable washwater to land. Washwater can easily be applied to land via an irrigation system. Several options may be suitable, depending on existing infrastructure . Examples of systems that could be used include:

- Solid set sprinkler systems
- Moveable sprinklers (e.g. travelling irrigators, K-lines)
- Micro-irrigation: Drip and sprinklers

Many irrigation resources are available online with detailed information on types of irrigation systems. For more information and links to further resources, refer to Appendix A. This includes links to the IrrigationNZ codes of practice for the design and installation of irrigation systems.

4.3.4 Pre-application check

Assess the site before application. This can be done either the day before, or the morning of a planned application. Assessing the site is especially important in winter, when the ground is often wet and crop growth is slow. These conditions increase the risk of water ponding or running off the application site. Checking the conditions before each application event helps to manage this risk.

A set of pre-application questions are provided in Table 4.2. Use these questions as a decision framework to determine when conditions are appropriate to apply to land. If 'Yes' is answered for all questions, carry out the application according to the requirements in the following section. If 'No' is answered for any questions, pause and re-evaluate until all conditions can be met.

Table 4.2: Pre-application questions.

	GO	NO-GO
Are weather conditions suitable for application today and later this week?	Yes	No
Is the application light enough to prevent ponding or overland flow?	Yes	No
Are appropriate buffer distances in place to ensure there is no risk of application to waterbodies?	Yes	No
Will this application comply with consent conditions or permitted activity rules that apply?	Yes	No

4.3.5 Key requirements when applying washwater

Once the pre-application check is complete, proceed with application to land. Growers should look to ensure they meet the following requirements when applying to land. These requirements reduce the risk of water ponding or running off the site and into surface waterbodies.

- Soil conditions will not cause ponding or surface run-off.
- Application rates are low to prevent ponding or surface run-off.
- All council and consent conditions are followed (e.g. buffer distances, volume limits)
- All food safety requirements are complied with if irrigating a crop for human consumption. The use of sanitisers may affect discharge rules. Seek further advice if sanitisers are used.
- There is sufficient storage for when conditions are unsuitable to irrigate (see Section 4.4).
- Records of all applications are kept, including date, volume and location.
- Representative water tests are collected on the washwater that is being irrigated (Section 2.3).

4.3.6 Considerations if applying washwater on neighbouring land

Depending on the land available adjacent to your postharvest facility, it may be more convenient to pipe or haul washwater to a neighbouring property for land application, for example, to support pasture growth. As the discharge is leaving the property, it will require a resource consent. In these situations, work closely with the regional council and the landowner receiving your washwater to meet compliance with a resource consent or other council requirements. As well as any council requirements, follow industry standards i.e. this Code of Practice, or NZGAP EMS Add-on if applicable. If the council rules are not clear, speak to your local council or seek specialist planning advice.

4.3.7 Council requirements

Requirements for land-based treatments of vegetable washwater can vary from council to council. This can include rules around avoiding ponding and run-off, and buffer distances are typically required between the application site and certain features like surface waterbodies and bores. Refer to the supporting document, *Regional Council Rules Guidance for Vegetable Washwater Management*, for rules specific to each council that apply to your operation. This Code of Practice will support growers to undertake the best practicable option for their operation.

In the absence of council requirements around buffer distances from waterways, use a five-metre setback from all rivers as an interim measure. For steeper-sloped application sites, a larger setback distance may be required, as the risk of run-off into waterbodies may increase.

4.4 Storage capacity for application to land

Where vegetable washwater is applied to land during winter, sufficient storage capacity must be available to ensure washwater can be held until soil conditions are suitable, and application rates can be managed to avoid ponding or overland flow.

Storage also functions as a treatment method to reduce sediment, nutrients, and other chemical residues in washwater. The storage must ensure there is no discharge to water by having a tank or lined/sealed pond. A pond should have a minimum of 300 mm freeboard, and there must be no spillway. Therefore, contingency measures are required if the storage nears capacity.

4.4.1 Storage required

In most cases, storage capacity should be sufficient to hold between 2 and 4 weeks of washwater. This allows application rates and timing to be managed so that water can be applied gradually, reducing the risk of ponding and overland flow. It also provides detention time, enabling suspended sediment, nutrients, and other contaminants to settle or reduce prior to application.

Where land application is used, it is important that the storage system does not leak. Leaking ponds essentially bypass the treatment function of land application. Any pond will either need to be lined or well-sealed.

This storage requirement is intended to be a guide only. For sites with no existing storage, a staged approach can help determine what may work best for specific operation and site conditions i.e. gradually increasing storage capacity. For larger or more complex systems, look to use a specialist consultant to calculate storage volume requirements. This will ensure storage requirements are appropriately sized based on local climate, soil conditions and operational factors.

4.4.2 Storage volume calculation

Calculate average daily winter washwater discharge by working out the average washwater discharge rate (m^3/day) between 1 May to 30 September, which is when soils are often saturated and storage is required. To estimate storage volume, multiply the average daily winter discharge (m^3/day) by the days of storage needed, with an additional multiplier to account for rainfall on uncovered storage (see next section).

Storage volume (m^3)

=

Daily winter discharge rate (m^3/day) × number of days storage x percentage of covered storage volume (%)

+

Daily winter discharge rate (m^3/day) × number of days storage x percentage of uncovered storage volume (%) × uncovered multiplier (see below)

To convert storage volume in m^3 to litres, multiply by 1,000.

- For example, 500 m^3 of storage is equal to 500,000 litres (l) of storage.

Uncovered storage multiplication factor

If storage is uncovered, a multiplication factor is applied to storage volumes to allow extra space for rainfall (after accounting for evaporation). For this reason, the calculation distinguishes between covered and uncovered storage volumes.

For the calculation, either input percentages based on your existing storage, or the proportion you plan to have, if installing more storage. The multiplier varies based on the site's winter rainfall. Use the values provided in Appendix C.

Worked example

A grower washing lettuce in Auckland is expanding their washing facilities. The grower has selected land application as their treatment pathway, given sufficient land is available.

The operation has an average winter discharge of 50 m^3/day. The grower plans to provide 30 days of storage to ensure washwater can be held during periods when land application would risk ponding or overland flow, and to allow for time for settling. This results in a total winter storage volume of 1,500 m^3 (50 m^3/day × 30 days).

A resource consent was obtained to apply washwater to a neighbour's 5 ha pasture block. The grower decided to use a sealed, uncovered pond for storage, as covered storage options (e.g. tanks or bladders) were outside of this grower's budget. To account for net rainfall (rainfall less evaporation) a multiplication factor of 1.84 (from Appendix C) is applied. This increases the total storage requirement to approximately 2,750 m^3.

A single 2 m deep pond would need to measure approximately 50 m x 29 m to provide this volume. However, due to site constraints, the grower will construct a series of three ponds, each 2 m deep:

- Pond 1: 30 m x 6 m, designed to capture heavier sediments
- Pond 2: 45 m x 15 m
- Pond 3: 45 m x 15 m

Together, these ponds provide a total storage volume of approximately 2,750 m^3.

Washwater will be applied across the 5 ha area at an average rate of 1 mm/day. A low-rate irrigation system is used, applying 5 mm per event, which requires around six irrigation passes per month.

Based on water test results (10 mg/L of N, and 1 mg/L of P) the grower estimates that the washwater will contain:

- 15 kg N per month (3 kg N/ha/month)
- 1.5 kg P per month (0.3 kg P/ha/month)

These nutrient loads are low compared to typical fertiliser application rates, and can be factored into the overall nutrient management of the crop or pasture.

4.4.3 Other storage considerations

- The storage system, including all tanks and ponds, should be maintained in a watertight condition to avoid leakages.
- Constructing or installing storage may require a building consent, or the need to meet a set of requirements. Contact your relevant council, which may include a district council, to seek further advice.

4.5 Treatment and discharge to water: Soakage pit

If land is unavailable to treat vegetable washwater via land application, soakage pits are an alternative option. Soakage pits are commonly used for stormwater management. However, as washwater will flow through to groundwater using this method, the water quality of the washwater going into the pit will determine whether this treatment is a viable alternative, as well as the biophysical features (e.g. soil type, topography) of the proposed site. Before considering a soakage pit, seek advice on whether washwater parameters and the surrounding environment are suitable to consider this as a treatment option.

Treatment aim	To dispose of washwater through slow filtration back into the ground water.
Description	Soakage pits are a method of treating washwater via disposal and infiltration through the ground. Soakage pits are commonly used for stormwater management.
Considerations	• Soakage pits can be a good on-site treatment option when limited land is available for land application. They take up a small amount of space and have low capital and operational costs. Hydraulic loading needs to be considered, based on the volume and flow rates calculated in Section 2.1. • Consent may be required when constructing a soakage pit, and council rules may apply, as the washwater flows through the soil into ground water. • Before considering a soakage pit, seek advice on whether washwater parameters and the surrounding biophysical environment are suitable to consider this as a treatment option. Other considerations include location – it must be located away from drinking water bores. • Washwater must be pretreated to remove solids such as sediment, before discharge into a soakage pit, to avoid the system clogging.
Links to further information	BRANZ - https://www.branz.co.nz/design-build/articles/soak-pits EngineeringNZ – Soakage pit draft guidelines April 2026

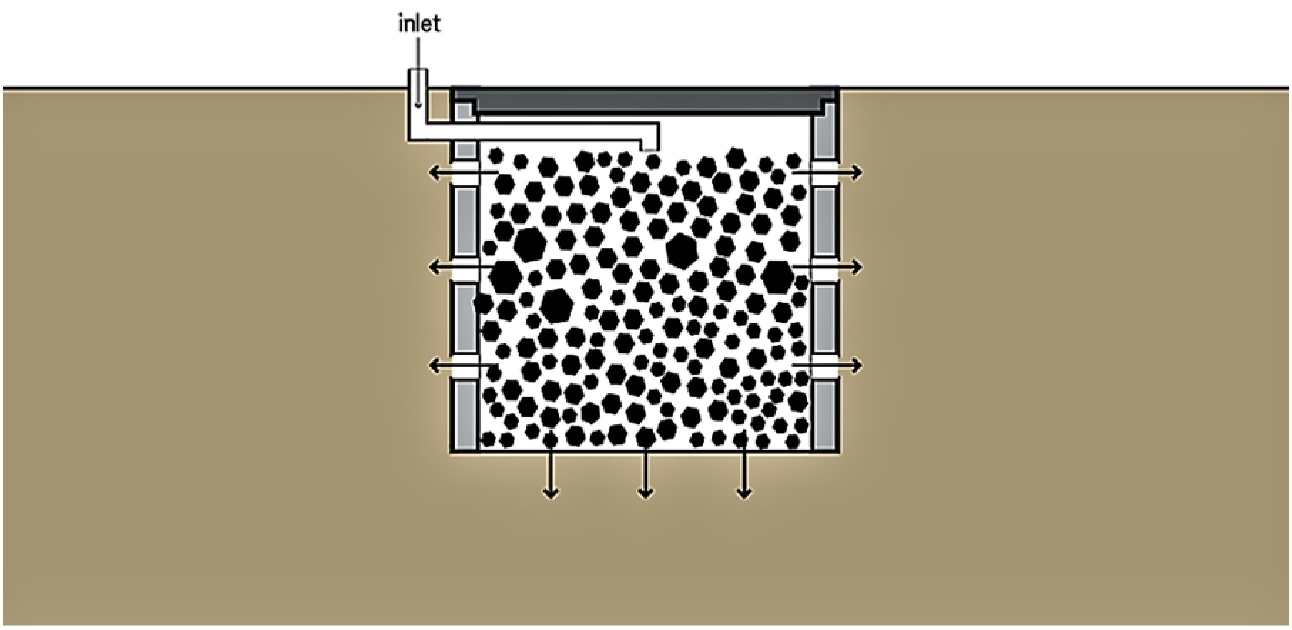

Figure 4.3: Schematic of a soak pit. Sourced from Tilley et al. (2014), on www.sswm.info.

4.6 Off-site management

Off-site washwater management means washwater is transported and treated elsewhere. This may require a resource consent. This is a viable option if, for example, there is insufficient land and no on-site treatment option available. However, off-site management will be costly, especially for the large volumes of water used in vegetable washing. Look to implement other treatment options before exploring off-site management, unless an alternative, cost-effective solution is available.

Off-site management options may include:

- Connection to council wastewater system for treatment – trade waste bylaws apply
- Removal by liquid waste service – trade waste bylaws apply

4.6.1 Connection to council wastewater system for treatment

Treatment aim	Utilise existing council wastewater treatment network and system to manage washwater.
Description	For growing operations located within connection of council services, washwater could be connected into the wastewater network and treated by the council wastewater system. This will be controlled by council trade waste bylaws.
Considerations	• The cost of the service will likely be linked to the volume and quality of water requiring treatment. Therefore, for operations discharging large volumes of water, this might not be a cost-effective option. • Some storage may be required when the council is working on the system (e.g. scheduled maintenance).
Links to further information	Refer to your local or regional council for more information on volume limits, discharge standards, costs, and bylaw requirements.

4.6.2 Removal by liquid waste service

Treatment aim	Use of a professional liquid waste service to manage water, where no other treatments are practical or available.
Description	A professional liquid wastewater service is used to truck away water for treatment. Although vegetable washwater carries a significantly lower human health or environmental risk profile compared to other liquid wastes (e.g. effluent, grease traps, septic tanks), it cannot be discharged into a drain (i.e. discharge to surface water) without consent. Therefore, waste services should be utilised while an alternative treatment pathway is developed, or consents are obtained.
Considerations	• This treatment should be considered as a back-up option, where no other treatment option is available, because the cost will be considerable. • Use council-approved liquid waste services. More information will be available on council websites.
Links to further information	Refer to your local or regional council for information on liquid waste services.

4.7 Advanced washwater treatments

In some situations, more advanced treatment systems may be required to achieve higher levels of contaminant removal, improve water quality for reuse, or reduce discharge volumes. An advanced washwater treatment system is required for closed systems i.e. full recirculation of water, or if seeking a consent to discharge to water. These systems are generally more complex and may involve higher capital and operational costs compared to land-based approaches.

Examples of advanced produce washwater treatment technologies include:

- Membrane filtration systems, such as ultrafiltration or reverse osmosis
- Dissolved air flotation (DAF) systems for removing suspended solids and organic matter
- Advanced oxidation processes, including ozone or ultraviolet (UV) treatment

The suitability of advanced treatment systems will depend on factors such as washwater quality, system scale, operational requirements, and intended end use or management pathway. The Ontario Ministry of Agriculture, Food and Rural Affairs fruit and vegetable washwater treatment manual contains guidance on a number of these treatments (Appendix A).

If looking to explore and implement an advanced washwater treatment system, contact a water treatment specialist.

5 Maintain and monitor

Once the washwater treatment system is in place, it needs to be regularly maintained and monitored for effectiveness.

Maintenance
Maintenance activities might include:

- Maintaining and calibrating irrigators, if irrigating to land
- Checking all water delivery systems for leaks or blockages
- Removing sediment from traps to maintain capacity in traps and ponds
- Cleaning filters and screens to maintain filtering effectiveness
- Undertaking all scheduled maintenance on treatment technology

Have a maintenance plan or log in place, so evidence is available if requested, and treatment systems are maintained when required. This ensures systems can operate effectively.

Monitoring
Continue monitoring washwater test results, including the washwater leaving the postharvest facility, as well as treated washwater ready for application to land. This is important to detect system changes, ensure the system is working as designed, and monitor the system's effectiveness. Laboratory test results of what is being irrigated to land, or re-used in the postharvest facility, may also be important for meeting permitted activity standards, if applicable, or food safety standards.

If required, submit monitoring records to council, or have records ready if requested.

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Appendix A: Resources

HortNZ Codes of Practice

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

Tool	Sector	Description
Nutrient Management Code of Practice 2026	All outdoor growing systems	This Code provides direction for outdoor fruit and vegetable 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 & Erosion Management Excel workbook supports growers to develop a Nutrient Management Plan by documenting current practices, assessing risks, and planning nutrient use in a structured and practical way.
Erosion and Sediment Control Code of Practice 2026	All outdoor growing systems	This Code provides practical direction on managing erosion and sediment loss from outdoor horticultural production activities. It includes a block erosion risk assessment process, and range of risk-based practices to minimise erosion and soil loss, maintain soil health, and protect waterways. A Nutrient & Erosion Management Excel workbook supports growers to develop an Erosion and Sediment Control Plan by documenting current practices, assessing risks, and implementing erosion and sediment control measures in a structured and practical way.
Vehicle and Machinery Washdown Code of Practice 2026	All outdoor growing systems	This Code provides direction on practices to implement to reduce the movement of soil offsite, which also prevents the spread of pests, diseases, and contaminants. It includes direction on siting washdown areas, managing washwater, and protecting soil and water from contamination.
Drain Nutrient Solution Management Code of Practice 2026	Soilless growing systems that generate drain solution requiring management	This Code outlines practices to manage drain nutrient solution from soilless growing systems. It focuses on responsible drain solution land application to protect soil and water resources and optimise resource use. The Code helps growers reduce nutrient losses and manage environmental compliance expectations by developing a Drain Solution Management Plan, which is supported by a Drain Solution Management Plan Excel workbook.
Vegetable Washwater Management Code of Practice 2026	Vegetable growing operations that generate washwater from vegetable washing	This Code provides guidance for vegetable growers, who use water for washing, to sustainably manage the resulting washwater produced. Guidance focuses on selecting the most appropriate treatment option for each grower's operation, providing high level information on a range of treatment options, with links to further resources where required.

Other resources

General

Name	Sector	Description
Vegetable and Fruit Washwater Treatment Manual – Ontario Ministry of Agriculture, Food and Rural Affairs (2017)	Canadian fruit and vegetable washing facilities	Comprehensive manual on technologies used to treat washwater from fruit and vegetable washing activities. Useful document to understand technologies potentially available: https://files.ontario.ca/omafra-vegetable-fruit-washwater-treatment-manual-pub-852-en-2023-04-05.pdf
Erosion and Sediment Control Guide for Land Disturbing Activities in the Auckland Region – Auckland Council (2016) [GD05]	Construction	The erosion and sediment control guideline for the construction industry. Contains information on coagulation and flocculation (page 133): https://www.aucklanddesignmanual.co.nz/content/dam/adm/adm-website/developing-infrastructure/infrastructure-technical-guides/gd05-erosion-and-sediment-control/GD05.pdf
Constructed Wetland Practitioner Guide – NIWA and DairyNZ (2022)	Pastoral farming, but can be used in horticulture	Guidance on establishing a surface-flow constructed wetland to reduce contaminant loss in pastoral farming landscapes: https://www.dairynz.co.nz/media/eu0pdsuh/wetland-practitioner-guide-web-aug-2022.pdf

Food safety and water use

Name	Sector	Description
Fresh Produce Safety Centre: Managing water (2025)	Growers who use water	Grower factsheet published by the Fresh Produce Safety Centre Australia and NZ on managing water: https://fpsc-anz.com/wp-content/uploads/2025/11/Quick-Guide-C07-Managing-Water.pdf

Irrigation and soil moisture monitoring

Name	Sector	Description
The New Zealand Piped Application Systems Design Code of Practice	Anyone who irrigates	IrrigationNZ Code of Practice for the design of piped application systems. Design and install in accordance to this Code if installing a piped system for washwater land application. https://www.irrigationnz.co.nz/Attachment?Action=Download&Attachment_id=48
The New Zealand Piped Application Systems Design Standards	Anyone who irrigates	IrrigationNZ Design Standards if installing a piped system for washwater land application. https://www.irrigationnz.co.nz/Folder?Action=View%20File&Folder_id=107&File=2013-INZ-Design-Standard.pdf
IrrigationNZ – Scheduling, including a soil water budget spreadsheet	Anyone who irrigates	IrrigationNZ guidance on soil moisture monitoring, including a soil water budget spreadsheet. https://www.irrigationnz.co.nz/PracticalResources/GMP/Scheduling
FAR – Soil water budget tool & user guide	Arable-based	FAR soil water budget tool, which includes user guidance on how to use the workbook. https://www.far.org.nz/resources/soil-water-budget-tool-user-guide

Appendix B: Glossary

Best Practicable Option (BPO)

Under section 2 of the Resource Management Act (RMA), BPO is defined as:

"The best method for preventing or minimising the adverse effects on the environment" having regard to:

(a) the nature of the discharge or emission and the sensitivity of the receiving environment to adverse effects; and

(b) the financial implications, and the effects on the environment, of that option when compared with other options; and

(c) the current state of technical knowledge and the likelihood that the option can be successfully applied.

Biochemical oxygen demand (BOD)

The amount of dissolved oxygen consumed by aerobic microorganisms in a body of water to break down organic material present in a given water sample at certain temperature over a specific time period.

Chemical oxygen demand (COD)

The amount of dissolved oxygen in a body of water required to break down the organic material via chemical oxidation.

Coagulation

A chemical treatment process used to neutralise charges and form a gelatinous mass to trap (or bridge) particles. The aim of coagulation is to form a mass large enough to settle or trapped in a filter. Coagulants are chemicals used to cause coagulation.

Flocculation

The action of polymers (in flocculant) to form bridges between flocs in wastewater, to bind and bridge particles into large clumps.

Freeboard

Is the vertical distance between the maximum designed water level and the top (crest) of the surrounding embankment or pond wall. It acts as a crucial safety margin to prevent the pond from overflowing, overtopping, or breaching.

Hydraulic load

The volume of wastewater applied to or flowing through a treatment system over a specified period of time, typically expressed as a flow rate or as volume per unit treatment area (e.g. L/day). Hydraulic load influences the treatment performance of wastewater systems.

Potable water

Water that is safe and suitable for human consumption in accordance with drinking water standards.

Total Dissolved Solids (TDS)

The portion of solids that will travel through a filter.

Total solids

A measure of the solid material in a sample.

Total Suspended Solids (TSS)

The portion of total solids which can be caught by a filter.

Turbidity

A measure of the degree to which suspended particles in a liquid scatter and absorb light, altering water clarity. Turbidity is commonly measured in Nephelometric Turbidity Units (NTU) using a nephelometer.

Appendix C: Storage lookup table

Use this to estimate storage volume in Section 4.4. The uncovered multiplier accounts for rainfall and evapotranspiration for each locality.

Storage	
Weather station	**Uncovered multiplier**
Northland (Whangarei)	1.33
Auckland - Kumeu	1.51
Auckland - Pukekohe	1.84
Hamilton	1.43
Palmerston North	1.40
Levin	1.51
Gisborne	1.31
Hastings (Bridge Pa)	1.09
Nelson (Brightwater)	1.58
Christchurch (Lincoln)	1.15
Dunedin (Airport)	1.16
Default	1.8

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