



Drain Nutrient Solution Management Code of Practice

For covered cropping and hydroponic growers

Drain Nutrient Solution Management Code of Practice

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Document control

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Summary of changes since previous version (2020, version 1.2)

Change	Reference
Content merge, revision, and full content update, based on the 2007 and 2020 versions of this Code	Whole document
Development of an Excel workbook to develop a Drain Solution Management Plan	Appendix A
Design update	Whole document
Name and terminology change to Drain Nutrient Solution Management	Title

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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1 Code of Practice overview

This Code of Practice is for growers with hydroponic or covered cropping systems. It provides a structured, risk-based approach to applying drain nutrient solution to land. Applying this valuable resource to land can support the ongoing production of outdoor crops and plants.

1.1 Introduction

Hydroponics or covered cropping systems above ground in soilless media usually generate drain nutrient solution. This is referred to as a run-to-waste system. As systems run, salts and other compounds build up, and the nutrient mix needs refreshing. Some modern operations are moving towards zero waste or closed reticulated systems. However, many soilless growing setups still produce some form of drain nutrient solution. While this solution may not be suitable to reuse within the same growing system, it can often be re-purposed. An example of this is using drain solution as a liquid fertiliser to grow other outdoor commercial crops.

It is important to manage drain solution application to land to minimise the risk of nutrient losses through leaching or overland flows. Loss of excess nutrients into waterbodies can impact water quality and freshwater ecosystems. Industry standards (this Code of Practice) provide a

structured process for operations to manage these risks. This approach supports the long-term sustainability of covered cropping and hydroponic growing systems.

This Code of Practice provides practical steps for storing and applying drain nutrient solution to land. Growers develop a Drain Solution Management Plan to cover requirements and considerations for storage and applications to land. The Code also assists growers to meet applicable council requirements. An Excel-based Drain Solution Management Plan workbook accompanies this Code of Practice.

This update builds on content from earlier versions, which include the original 2007 version, *A Code of Practice for the Management of Greenhouse Nutrient Discharges*, and the 2020 version, *Greenhouse Nutrient Solution Discharge: The requirements for achieving Good Practice*.

1.2 Scope and terminology

This Code of Practice applies to all hydroponic, covered, or indoor growing systems that grow crops above ground, and generate drain nutrient solution that will be applied to land. This includes vertical farms, tunnel houses, and greenhouse systems. The Code is intended to be flexible and suitable for operations of different sizes and levels of technology.

In this Code, the term *soilless growing system* will be used to refer to covered, indoor or hydroponic growing systems to which this Code applies. *Nutrient solution* refers to the solution used to grow the covered or hydroponic crop. *Fertigation* refers to the system used to deliver the solution

to the plant. *Drain nutrient solution* or *drain solution* refer to the run-off solution collected from the *soilless growing system* that requires further management. Any reference to *land application* or *irrigation* in this Code of Practice specifically relates to the application of drain solution to land.

The Code of Practice focuses on the application of drain nutrient solution to land. It does not cover direct discharges to water. These are typically more tightly regulated under regional plans and resource consent may be required. Consult your council if you are unsure which rules apply to your situation.

1.3 How to use this Code of Practice

The Code of Practice directs growers to develop a Drain Solution Management Plan (DSMP) to manage risks to water from the application of drain nutrient solution to land.

Managing applications of drain nutrient solution to land follows the same principles as applying fertiliser to crops - the 4 Rs, which include Right product, Right rate, Right time and Right place. Planning applications to land is primarily about managing the timing and rate of drain solution applications. Timing and rate are largely dependent on how saturated the soil is, and the nutrient load of the solution applied. A DSMP helps growers demonstrate, with sufficient evidence, how applications to land are carried out in accordance with this Code of Practice.

This Code contains 8 sections to support growers to develop a Drain Solution Management Plan:

- Section 1 introduces the Code and includes a drain solution management hierarchy in Section 1.5 and alternatives to land application in Section 1.6.
- Section 2 describes nutrient loss risk factors to consider when setting up a DSMP.
- Section 3 includes criteria and considerations when selecting an application site.
- Section 4 contains a set of calculations to help growers determine their nutrient load and estimate storage requirements for winter, when soils are often too saturated to irrigate.
- Section 5 includes key steps to follow when applying to land.
- Section 6 provides growers with a set of management practices they can implement to reduce nutrient loss risk.
- Section 7 contains a checklist for growers to use, to capture key guidance included in this Code.

This Code is supported by several appendices:

- [Appendix A](#) contains the Drain Solution Management Plan (DSMP) workbook, which is a structured and practical tool growers can use to implement this Code.
- [Appendix B](#) contains further information and resources.
- [Appendix C](#) contains a lookup table, which supports growers when working through Section 4.

In addition to following industry guidance (this Code), growers applying drain nutrient solution to land need to ensure they are compliant with all applicable regulatory requirements. A supporting document, *Regional Council Rules Guidance for Drain Nutrient Solution Management*, was developed to help growers understand what rules may apply to their operation. Find this document on the HortNZ Codes of Practice [webpage](#).

This Code of Practice can be used as evidence to demonstrate compliance with applicable requirements. Most horticulture growers in New Zealand are certified under a Good Agricultural Practice (GAP) programme, either NZGAP or GLOBALG.A.P. to meet market and regulatory requirements. A DSMP will form part of a hydroponic or covered cropping operation's overall GAP farm plan.

NZGAP's Environment Management System (EMS) is designed to respond to New Zealand's national and regional environmental regulation, including farm environment plans and freshwater farm plans. The EMS is underpinned by this and other industry environmental codes of practice. Hydroponic and covered cropping growers using the EMS will develop a DSMP as part of their evidence to meet applicable requirements through GAP.

1.4 Drain Solution Management Plan

This Code of Practice directs growers to develop a DSMP to meet applicable regulatory requirements. Criteria for a DSMP includes:

- **Overview of growing operation**, including business environmental goals and objectives
- **Production site description**, including system diagrams and details on drain solution storage
- **Drain solution application site description**, including total area (hectares), site maps (soils layers/data), land-use, and application or irrigation system
- **Identified nutrient loss risk factors** for the application site(s)
- **Description of management practices** used to minimise the risk of nutrient loss to freshwater from applying drain solution to land
- **Application record**, including volumes applied and nutrient loadings (kg N/ha, kg P/ha)
- **Maintenance schedule and records** for typical maintenance areas, including tanks, pump stations, pipe work and fittings, and irrigator sprinklers/nozzles

- **Other records and supporting documentation**, including consent details (if applicable), calculations for storage requirements including emergency storage, solution and soil test results, and nutrient budgets (for the application site).

An Excel-based DSMP workbook has been developed to support growers to implement this Code of Practice. The workbook contains fillable tabs for the information above. The workbook is not exhaustive, and growers need to be mindful that additional regulatory requirements may apply to their operation. The workbook is available on [HortNZ's website](#) and in [Appendix A](#).

To note, while the DSMP workbook has fillable tabs to record the above criteria, if information is already recorded in another document (e.g. a freshwater farm plan), there is no need to duplicate this information. Provide links or a reference to note where the information is stored.

1.5 Drain solution management hierarchy

When considering the overall management of drain nutrient solution in soilless growing systems, work through the hierarchy in Figure 1.1 on the next page, as follows:

1. **Eliminate** the production of drain nutrient solution
2. **Minimise** the volume of drain nutrient solution produced
3. **Manage** drain solution application to land with a Drain Solution Management Plan

Eliminating the production of drain nutrient solution has significant benefits to the environment. In systems with no drain solution or very minimal drain solution, solution is recirculated back into the soilless growing system. In zero liquid discharge systems, any drain solution remaining is evaporated. However, fully closed reticulated systems can be complex, costly, and potentially very energy intensive. Minimising drain solution where possible is often more practical for growers with existing operations.

Minimising the quantity of drain nutrient solution generated from a soilless growing system, where practicable, has several advantages. It can reduce environmental impact by decreasing the volume applied to land. This can offer significant cost savings. Savings can include reduced fertigation and pump costs, smaller storage requirements, and less land required for application.

This Code focuses on the **Manage** step. By developing a DSMP, growers can effectively manage land applications to minimise risks to freshwater. Drain nutrient solution can be a valuable resource when applied to support the production of outdoor crops. The solution often contains essential macro- and micro- nutrients for plant growth. Part of effective management is finding ways to use drain solution to support the growth of another crop, for example, pasture, cut and carry silage, catch crops, or annual crops. However, not all growers will have a suitable quantity of land available to apply some or all their growing operation's drain nutrient solution to land. Alternative options for drain solution management are covered in Section 1.6.

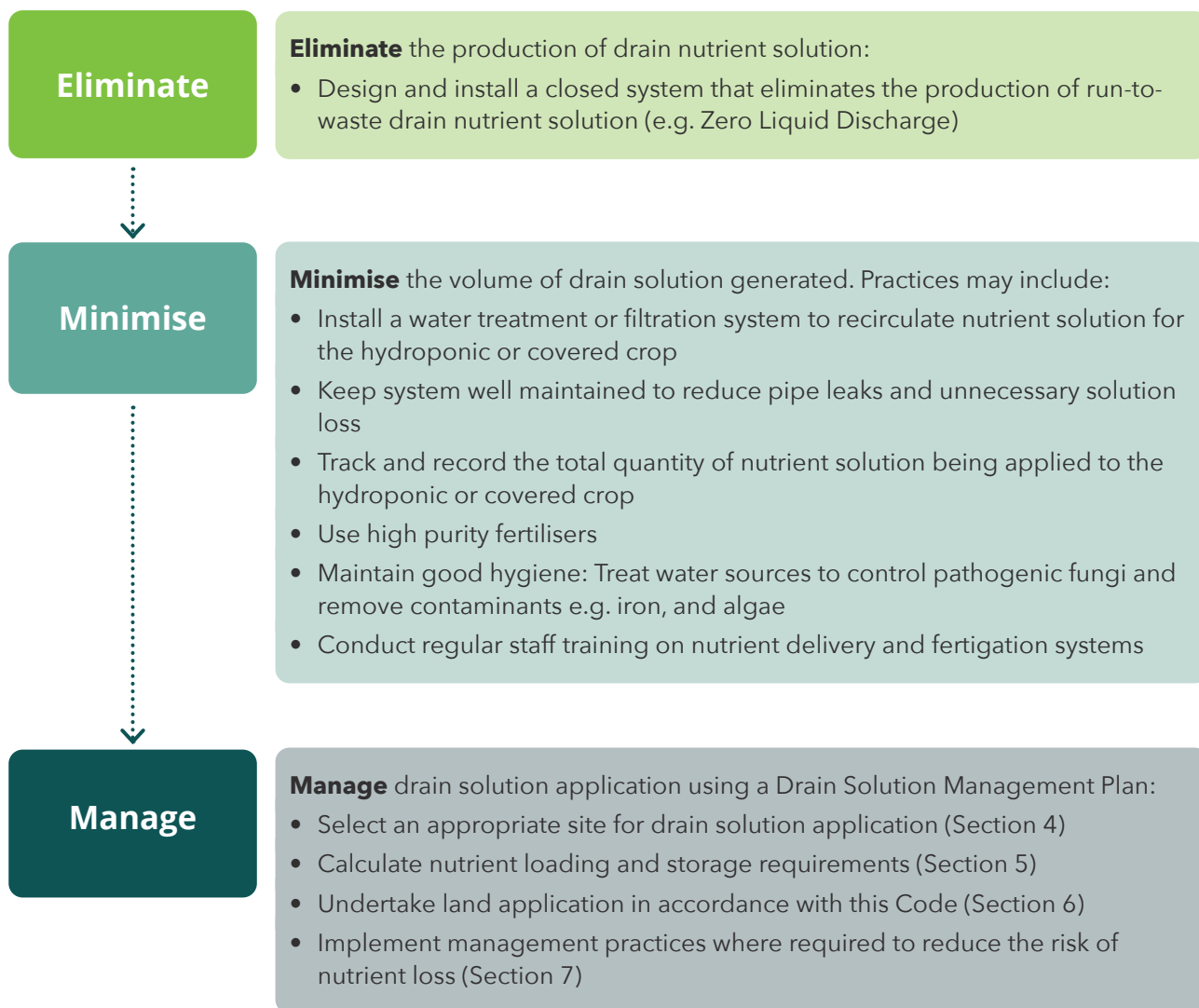


Figure 1.1. Hierarchy of management approaches for drain nutrient solution from soilless growing systems.



1.6 Potential alternatives to land application

It is not always feasible or appropriate for all operations to apply drain nutrient solution to land. For example, there may be limited land available for application, or circumstances where a full or partial refresh of nutrient solution is required (such as in response to a significant disease event) or insufficient storage to temporarily hold the volume of solution generated.

In these situations, growers may want to consider alternative approaches, accounting for site constraints, operational practicality, and relevant regulatory requirements. It is recognised that not all growers will be able to implement the same response. Approaches must be technically and economically viable for the operation concerned. Factors such as site constraints, crop type, seasonal conditions, infrastructure, and cost can all influence what is achievable for individual operations.

Alternative drain solution management options growers may want to consider include:

Collection and haulage

- Arranging for drain solution to be transported to land that is suitable for application, for example, to a neighbouring property. Regional council requirements for off-site application need to be considered.
- Transporting drain solution to an off-site treatment or disposal facility using a liquid waste management service.

Connection to a council wastewater system

- In some locations, connection to a council wastewater system may be an option.
- This approach is likely to involve significant cost, particularly if dealing with large volumes of drain nutrient solution. Ensure specialised advice is sought.

Managed draw down at the end of a crop

- Where appropriate, drain solution may be reduced gradually through crop transpiration toward the end of a production cycle.
- This approach may be more applicable for operations that do not crop over winter, and where system and crop conditions allow.

Thermal evaporation

- Thermal evaporation is used in some Zero Liquid Discharge systems (i.e. closed reticulated systems). This involves using heat to evaporate water into a vapour, leaving behind solid waste (e.g. concentrated salts) and no liquid drain solution.
- While thermal evaporation substantially reduces liquid volumes, it typically requires a high energy input and careful consideration of cost and feasibility. Ensure specialised advice is sought.

2 Nutrient loss risk factors

When applying drain nutrient solution to land, there is a risk that excess nutrients (e.g. nitrogen and phosphorus) can be lost through leaching or runoff and not taken up by plants. Loss of excess nutrients into nearby waterbodies can impact water quality and freshwater ecosystems. Losses can occur via leaching through the soil profile, or overland runoff during a rainfall or irrigation event. Nutrient losses also mean that additional nutrients, and therefore additional cost, may be needed to finish growing the crop growing on the application site.

This section provides descriptions of the relevant biophysical and management risk factors that can contribute to nutrient losses associated with applying drain nutrient solution to land. The sections following this build on this information and describe how these risks can be managed.

2.1 Biophysical risk factors

Biophysical risks relate to the application site's natural environment. Examples of biophysical risks are topography, rainfall, and soil texture. Table 2.1 describes each risk factor and how it relates to nutrient losses.

Table 2.1: Biophysical risk factors and their influence on potential nutrient loss to the environment. N and P refer to nitrogen and phosphorus, respectively.

Risk factor	Description
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 increase the risk of dissolved N & P entering waterbodies ¹ . This risk increases during or after rainfall. Steeply sloped ground can increase loss of N & P via surface runoff or overland flow.
Rainfall	High annual rainfall, or significant rainfall events, increase drainage and the risk of nitrate leaching out of the soil profile. This risk increases on light soils or 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.
Soil type	Soils with a lighter or coarse texture like sand have a lower water holding capacity and can be excessively free draining. These soils are more likely to leach nitrogen. Soils with poor drainage also 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 increase the risk of surface runoff and bypass flow, respectively.
Proximity to waterbodies	Application sites close to waterbodies (e.g. drains, streams, rivers, coastal waterbodies) have an increased risk of nutrient loss to freshwater. This could occur if the delivery or irrigation system is incorrectly set up, resulting in application over drains or waterbodies, or if too much drain solution is applied, resulting in runoff directly into waterbodies.

¹ [Critical source areas: Guidance for intensive winter grazing \(Ministry for the Environment 2023\)](#)

2.2 Management risk factors

Management risk factors relate to what crop or cultivar is grown on the application site, and other factors like the rate and timing of applications. Table 2.2 describes each risk factor and how it relates to nutrient loss.

Table 2.2: Management risk factors and their influence on potential nutrient loss to the environment. N and P refer to nitrogen and phosphorus, respectively.

Risk factor	Description
Crop rooting depth	Shallow-rooted crops primarily take up nutrients from the topsoil. As a result, leftover nutrients, particularly nitrate deeper down the soil profile, can leach after rainfall. In contrast, deeper rooted crops access nutrients from deeper soil layers, reducing the build-up of unused nutrients lower in the soil profile.
Seasonality and crop growth rates	Seasonality and temperature influence ground cover or crop growth on the application site. During winter, or in periods of slow growth, the crop will uptake N and P at a slower rate compared to other times of the year. This can increase the risk of nutrient loss, particularly as periods of slow growth often coincide with wetter weather.
Application rate and timing	The rate and timing of drain solution application influence the potential for nutrient losses to the environment. Applying drain solution at rates that exceed the soil's capacity to absorb and retain water and nutrients can increase the risk of ponding, runoff, and nitrogen leaching. This risk is higher when soils are already wet or when rainfall occurs soon after application.
Irrigation management	The design, operation, and maintenance of irrigation or other delivery systems also influence nutrient loss risk. Uneven application of drain solution can result in over-application in some areas, increasing the risk of ponding, surface runoff, and nutrient loss to waterbodies. Equipment that is poorly maintained, incorrectly calibrated, or inaccurately positioned may reduce application accuracy and increase the likelihood of discharge occurring near sensitive areas such as drains, rivers, and other waterbodies.
Stock nutrient inputs and outputs	Animals grazing on the application site, particularly cattle, contribute additional nutrients to the system. If these nutrient inputs are not accounted for when planning drain nutrient solution applications, excess nutrients may accumulate in the soil and increase the risk of nutrient losses to freshwater.

3 Selecting an application site

When selecting a site to apply drain nutrient solution, there are several factors to consider. Examples include the ground cover or crop, delivery, application or irrigation system, nutrient loss risk factors (described in the previous section), setbacks from waterbodies, and considerations if applying to another landowner's

property. Any risk factors identified should be supported with relevant management practices. This information forms the foundation of your Drain Solution Management Plan (DSMP). In addition, the application site's annual rainfall and soil profile available water (PAW) will influence the storage calculations in [Section 4.3](#).

3.1 Site information

Use the DSMP workbook (Appendix A) to capture application site information in tab 3. *Application site*. Information includes:

- **Site 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) (see Figure 3.1) - these features can be mapped.
- **Environment and freshwater:** Identification of closest waterbodies to the site

- **Risk factors:** Biophysical and management risk factors relating to the site. See [Section 2: Nutrient loss risk factors](#)
- **Risk management:** Management practices in place (Section 3.2 and Section 6)

Depending on land availability near your growing operation, you may look to pipe or transport drain solution to an adjacent or nearby landowner for use in their operation (e.g. for pasture growth on a dairy farm). In these situations, work closely with the landowner to ensure compliance with any resource consent or other council requirements that may apply.



Figure 3.1: Example Smap screenshots, showing soil profile available water (PAW), and soil drainage characteristics. Smap is a free online mapping software, provided by Manaaki Whenua Landcare Research.

3.1.1 Ground cover

Look for a nearby site with existing ground cover. Alternatively, find a site where a crop is intended to be grown, requiring the water and nutrients supplied by the drain solution. As the nutrient concentrations in the drain solution can be high, ideally the application site has a healthy, well-managed crop or ground cover, to reduce the risk of nutrient loss.

Good winter growth is also important, as slow growth over winter is a high-risk period for nutrient loss. The ground should never be fallow (i.e. without a growing crop) when applying drain solution.

Ground cover crops may include:

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

Look to sow or plant species that can use excess nitrogen in the soil. Catch crops are especially beneficial for this purpose. Good options for catch crops include cereals, such as oats and triticale². More information on ground cover species to reduce nutrient loss is provided in [Section 6: Management practices](#).

3.1.2 Delivery system

A delivery system needs to be set up to apply the drain nutrient solution. Drain solution is normally applied to land via an irrigation system. Several options may be available, depending on existing infrastructure³. Examples of systems include:

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

Many irrigation resources are available online – providing detailed information on different types of irrigation systems is outside the scope of this Code of Practice. For more information and links to further resources, refer to Appendix B, which includes the IrrigationNZ Codes of Practice for the design and installation of irrigation systems.

Site proximity to the main growing operation should also be considered, to avoid extensive piping or haulage.

3.1.3 Setbacks from waterbodies

Councils may require setback distances between the application site and certain features like surface waterbodies or drinking water bores. Refer to the supporting document, *Regional Council Rules Guidance for Drain Nutrient Solution Management*.

In the absence of council requirements, a minimum five-metre setback from all rivers should be used as an interim measure. This may be reduced where an effective buffer (e.g. riparian strip) is in place to protect waterbodies. Where regulatory requirements specify a larger setback, those requirements take precedence. Over time, any runoff into rivers or drains needs to be controlled by contouring to intercept overland flow or using an appropriate treatment (e.g. vegetated buffer strip). See [Section 6: Management practices](#), for more information.

² [DairyNZ - Catch crops](#)

³ [Overseer - Application system types](#)

3.2 Managing nutrient loss risk factors

The previous [Section 2: Nutrient loss risk factors](#) outlined the dominant biophysical and management risk factors related to applying drain nutrient solution to land. Table 3.1 provides management practices to address the risks identified.

Table 3.1: Biophysical (light green) and management risk factors (white) with supporting practices to manage the risk of nutrient loss on your application site.

Risk factor	Management practices
Topography	<ul style="list-style-type: none"> • Fill-in, or avoid applying on depressions where ponding is often observed. • Select a site that is flat or gently sloped to minimise run-off risk. • Contour the site to direct any flow paths to a border control (see Section 6 for more information on this). • Decrease the application rate to reduce the risk of ponding and allow the drain solution to infiltrate soil.
Rainfall	<ul style="list-style-type: none"> • Ensure drain solution is only applied when there is a soil moisture deficit. Do not apply when soils are saturated. • Avoid applying drain solution when rain is forecast. • Have sufficient storage to hold drain solution when the soil is saturated (Section 4.3).
Soil type	<ul style="list-style-type: none"> • Consider smaller, more frequent applications on more free draining soils. • Take care to ensure the site has sufficient soil moisture deficit before applying drain solution on poorly drained soils. • Have sufficient storage to hold drain solution when the soil is saturated (Section 4.3).
Proximity to waterbodies	<ul style="list-style-type: none"> • Use border controls around waterbodies to avoid drain solution directly entering nearby waterbodies. See Section 6 for more information. • Contour the site to prevent flow paths that form in heavy rain, flowing across the site directly into waterbodies.
Crop rooting depth	<ul style="list-style-type: none"> • Consider planting deep-rooted crops. Options are provided in Section 6. • Consider smaller applications on shallow-rooted crops to increase nutrient use efficiency.
Seasonality and crop growth rates	<ul style="list-style-type: none"> • Use a nutrient budget to inform the crop's nutrient growth requirement and apply drain solution in line with budget. Obtain a fertiliser recommendation as needed. • Consider pausing or reducing land applications in periods of slow growth, as nutrient uptake will be slower and the risk of nutrient loss higher. Store drain solution until the crop is growing more actively. • Investigate winter-active crop options. See Section 6 for more information.
Application rate and timing	<ul style="list-style-type: none"> • Monitor soil moisture or keep a soil moisture budget to determine when there is sufficient soil moisture deficit to apply. Find soil moisture budget information in Appendix B.
Irrigation management	<ul style="list-style-type: none"> • Monitor the application site when irrigating to observe any ponding or uneven applications, making adjustments if and when required to avoid this for future applications. • Regularly maintain and calibrate equipment to ensure the system is working as anticipated. Follow all IrrigationNZ Codes, linked in Appendix B.
Stock nutrient inputs and outputs	<ul style="list-style-type: none"> • Prepare a nutrient budget to capture animal inputs into the system, alongside drain solution applications, to guide decision making on when the crop has capacity to uptake the additional nutrients (i.e. the drain solution) applied. If applying to a neighbour's property, have relevant information like volumes and nutrient loads available upon request.

4 Calculating your requirements

Once a suitable application site is identified, the next step is to determine your system requirements. This helps to ensure drain nutrient solution can be applied at the right rate and timing to manage the risk of nutrient loss. These calculations will support you to maximise the nutrient use efficiency of your drain solution, for the crop or ground cover receiving the solution, whilst managing the risk of nutrient loss.

The calculations in this section include:

1. Calculating the volume of drain solution generated
2. Calculating the potential nutrient load on the application site (e.g. kg N/ha, kg P/ha)
3. Estimating storage capacity requirements to hold drain solution, based on annual rainfall and soil profile available water (PAW)

All calculations in this section are built into the Drain Solution Management Plan Excel workbook ([Appendix A](#)), under the Calculator tab. Read through this section first to understand what's behind the calculations, then refer to the workbook and input your own values.

4.1 Calculating the volume of drain solution generated

The volume of drain solution produced influences both the nutrient load and potential size of the application site, as well as the estimated volume of storage. This section supports you to calculate the daily drain solution volume from your production site, which can be multiplied out to a monthly or annual basis.

The volume figures include:

- Summer* daily drain solution rate (m³/ha/day or m³/day for the production site)
- Winter* daily drain solution rate (m³/ha/day or m³/day for the production site)
- Average* daily drain solution rate (m³/ha/day or m³/day for the production site)

*Summer runs from 1 Oct to 30 April (212 days) and winter runs from 1 May to 30 Sept (153 days). From these figures, a weighted average drain solution rate is provided in the workbook calculator.

Seasonal daily drain solution rates are calculated because the quantity of drain solution varies over the production year. The winter daily drain solution rate is used to determine storage requirements in Section 4.3, as the ground is often too saturated to apply drain solution in winter and shoulder seasons (1 May to 30 Sept) for many regions.

The summer and winter drain solution rates are averaged to calculate an average drain solution rate for the production system, which is used to determine nutrient load in the next section.

To note, make sure the drain rates calculated are based on drain solution going into storage for further management (i.e. application to land). Exclude solution recirculated back into the system.

To calculate the daily drain solution rate from your production site, several methods can be used, depending on your system and setup:

1. Using flow meter data at the point of drain solution, if available. This is the most accurate form of measurement. Note down seasonal figures and calculate a yearly average.
2. Using the total volume of solution generated over a certain period, divide this by the number of days in that period. This could be done by monitoring changes in levels of storage tank over a given period, calculating the difference in volume, and dividing by the number of days.

3. Estimating drain solution rates using volumes supplied to plants and the percentage runoff (i.e. drain) of the system. These calculations are built into the Calculator tab in the Excel workbook, under 'Drain solution rate calculator'. The calculations can be viewed when in the Excel tab.

Whatever method and assumptions are used, continue to adopt these over time for consistency. If using flow meter data or other measured volumes, ensure these are representative, and not under or over representing standard drain solution or runoff rates for your growing operation.

4.2 Calculating the application site nutrient load

Nutrient load is the quantity of nutrients in your drain solution that will be applied onto the application site. Understanding nutrient load is important because it helps determine whether the quantity of nutrients being applied to the crop or ground cover match the crop's growth demand at that time.

Several councils have rules that specify a maximum quantity of nitrogen or phosphorus that can be applied to land. Therefore, this calculation is important if needing to comply with council rules (see *Regional Council Rules Guidance for Drain Nutrient Solution Management*).

4.2.1 Collect a sample for lab analysis

The first step to calculating your nutrient load is to collect a sample of drain solution and send it off for lab testing. If you have runoff test results already, use these results.

To collect a sample for lab analysis:

1. Contact your preferred laboratory to request a chain of custody and collection container for a water sample to be tested for total nitrogen and total phosphorus.
2. Before collecting the sample, read all laboratory instructions on collection, handling and transport of water samples.
3. Collect a sample of the drain solution in the bottle.
4. Send the sample to the laboratory as soon as possible after collection, with the chain of custody.

Lab analyses of drain solution should be collected at least once a season, when the crop changes, or when the concentration of nutrients significantly changes. If the drain solution test results and nutrient loadings will inform a nutrient budget, also test for mineral nitrogen concentrations (nitrate N and ammonium N).

4.2.2 Nutrient load calculation

Use the calculation below to work out the loads of nitrogen (kg N/ha/year) and phosphorus (kg P/ha/year) applied to the application site. The following values can be input into the *Calculator* tab in the Excel workbook, or using the equation on the next page. Use a lab test result with values for total N and total P that are typical for your operation. If nutrient concentrations vary considerably, calculate an average total N and total P, based on several sets of results from the growing season.

Values needed include:

- Total N in drain solution (ppm, mg/L, or g/m³)
- Total P in drain solution (ppm, mg/L, or g/m³)
- Application site area (ha)
- Average daily drain solution rate (m³/ha/day or m³/day for the production site)
- Hydroponic or covered cropping production area (ha) - needed if the drain solution rate units are m³/ha/day

For unit conversions, 1 ppm is equivalent to 1 mg/L or 1 g/m³. If application site area is unknown (for example, if undertaking a desktop exercise), then test a range of different areas in the calculator to understand how area affects the nutrient load.

If drain rate is supplied in m³/ha/day;

- Multiply the average drain solution rate (m³/ha/day) by the total production area (ha) and 365 (days in one year) to calculate the annual drain solution volume in m³.

If drain rate is supplied in m³/day;

- Multiply the average drain solution rate (m³/day) by 365 (days in one year) to calculate the annual drain solution volume in m³.

Then, enter the values into the equation below:

$$\text{Nitrogen load on drain solution application site (kg N/ha/year)} = \frac{\text{Annual volume of drain solution (m}^3\text{)} \times \text{total N in drain solution (ppm)}}{\text{Application site area (ha)} \times 1000}$$

The same equation can be used to work out phosphorus loadings in kg P/ha/year. Simply replace the total N concentration in ppm with total P in ppm.

Worked example

A capsicum grower in Northland has a 0.5-hectare greenhouse. The annual drain solution volume is 292 m³, based on an average daily drain solution rate of 1.6 m³/ha/day. Their drain solution typically contains around 400 ppm total N, based on water testing. The grower uses an adjacent paddock for their drain solution to land applications - that paddock is 1.5 ha.

$$\text{Estimated nitrogen load on drain solution site (kg N/ha/year)} = \frac{(292 \text{ m}^3 \times 400 \text{ ppm})}{(1.5 \text{ ha} \times 1000)}$$

Based on the grower's figures, they will be applying 78 kg N/ha/year to their application site. The grower will check with their council for any rules that may apply and create a nutrient budget to track solution applications, as well as other inputs to the site.

4.2.3 Interpreting your results

Your nutrient load results indicate the quantity of nutrients you have available to apply to the application site. Once calculated, you should:

Check the council rules

Check what council rules may apply in the supporting document, *Regional Council Rules Guidance for Drain Nutrient Solution Management*. Some rules may have conditions or limits on the volumes of drain solution that can be applied to land, and over what period the limit applies.

Match nutrient load to crop uptake using decision support tools

Drain nutrient solution is a useful resource to support pasture and/or crop growth on the application site. To maximise nutrient use

efficiency and limit potential nutrient loss, use a nutrient budget or similar decision support tool to match the nutrient load applied with pasture or crop uptake. [Refer to Section 6: Management practices](#) for information on nutrient budgeting tools.

If your nutrient load might exceed relevant council requirements or significantly exceeds the nutrient requirements for the crop growing on the application site, refer to [Section 6](#) for management practices to address this, or [Section 1.6](#) for alternative management options to manage your drain solution.

4.3 Estimating storage volume

All soilless growing systems that produce drain solution in winter and over the shoulder seasons require storage before application to land. There must be enough storage to hold drain solution when soil conditions at the application site are unsuitable, for example, when the soil is saturated and/or crop growth is slow. This will mostly occur over the winter months, when rainfall is high and evapotranspiration is low.

Even systems with minimal to no drain solution need to have emergency storage available, or a plan in place to manage solution, if a full system solution changeover is required. Section 1.6 provides some alternative management options.

4.3.1 Storage calculator

The Drain Solution Management Plan (DSMP) Excel workbook contains a storage calculator in the *Calculator* tab to help you estimate how much storage volume you may need to hold your drain solution over winter. The calculations are written out below, with supporting reference material provided in Appendix C.

Have the following information on hand for the calculations:

- Annual rainfall (mm) for the application site
- Soil profile available water (mm) for the application site
- Closest weather station (see Appendix C)
- Hydroponic or covered cropping production area (ha)
- Winter drain solution rate ($\text{m}^3/\text{ha}/\text{day}$ or m^3/day)*
- Percentage of covered (e.g. tanks) vs. uncovered (e.g. lined outdoor ponds) storage volume

*If your winter drain rate is in $\text{m}^3/\text{ha}/\text{day}$, multiply the average drain solution rate ($\text{m}^3/\text{ha}/\text{day}$) by the total production area (ha) to convert units to m^3/day i.e. solution generated for the whole site.

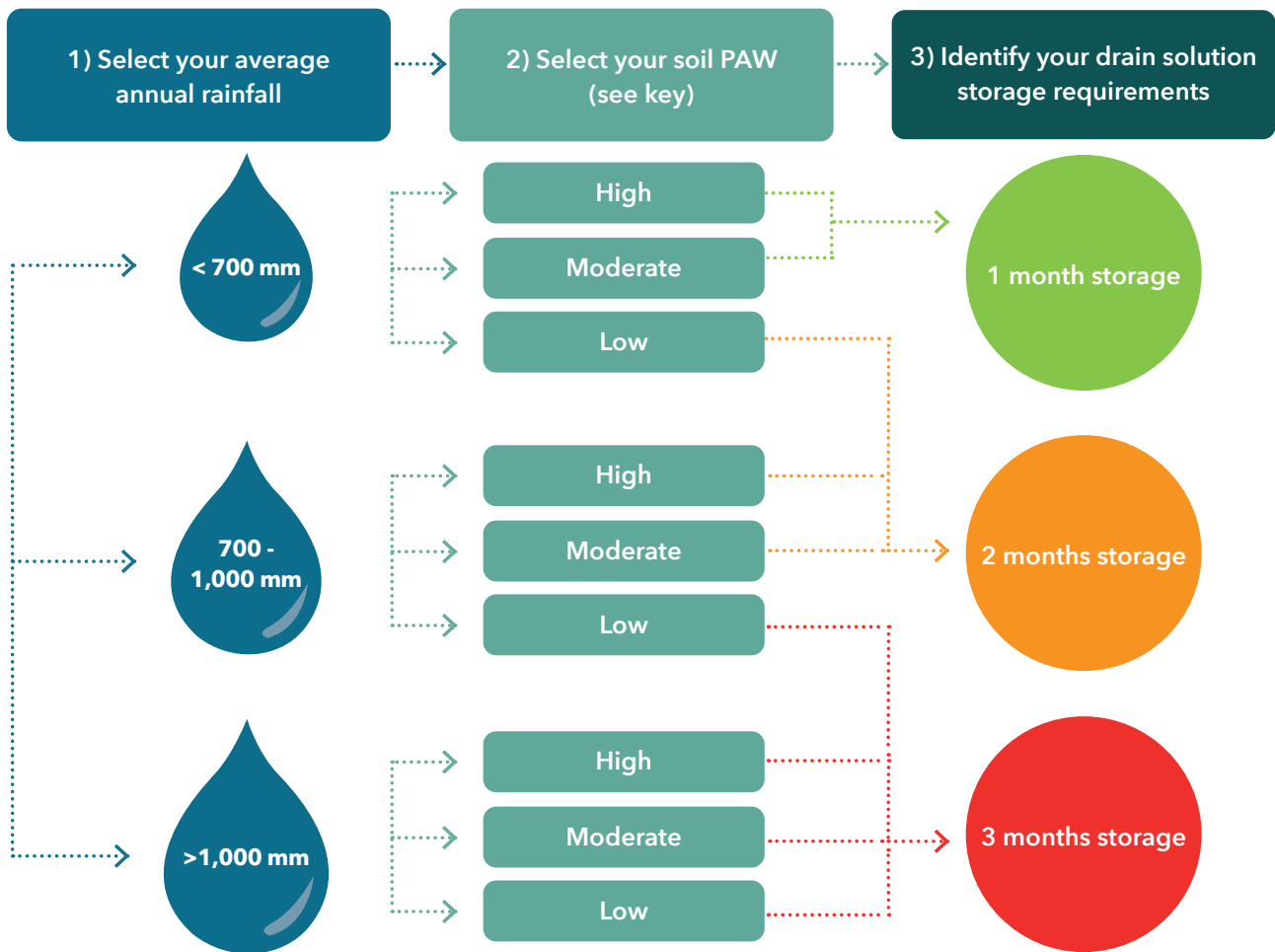
This calculator is intended to be a guide only. If you currently have no storage, then work towards increasing storage up to the estimated volume, to see what volume works best for your specific operation and environment. This will ensure storage requirements are based on the climate and soil conditions of your application site.

4.3.2 Biophysical risk assessment

The purpose of this risk assessment is to determine the volume of winter storage needed for an operation. When soils are saturated, the risk of nutrient loss, particularly nitrogen, increases. This is because the dominant leaching pathway for nitrogen is through the soil, below the plant's active root zone. Having sufficient storage capacity over winter is an important aspect of your DSMP because drain solution's nutrient composition may increase the risk of nutrient loss in times of slower plant growth.

Key drivers of nitrogen leaching risk are rainfall and soil profile available water (PAW). More information on PAW is provided on the next page. Rainfall and soil PAW form the basis of the biophysical risk assessment in Figure 4.1, which uses these parameters to estimate how many months of drain solution storage you should look to have available over winter.

This risk assessment is automatically calculated for you in the DSMP Excel workbook. If you don't know your annual rainfall or soil PAW, the calculator will use average values from the nearest weather station to your drain solution application site. The weather station lookup table that sits behind the workbook calculator is available in Appendix C.



KEY:

Profile available water (PAW) in top 1m of soil

High PAW (> 150 mm)

Moderate PAW (61-150 mm)

Low PAW (< 60 mm)

Figure 4.1: Biophysical risk assessment to estimate winter storage volume for drain solution. See the following section for a description of profile available water.

Soil profile available water

Soil profile available water (PAW) is the total amount of water that soil can hold and supply to plants within their root zone. PAW is a soil property influenced by soil texture, as texture affects the soil's ability to retain and release water to plants. Medium textured soils like loams generally hold more plant available water than sandy or heavy clay soils.

Figure 4.2 shows PAW mapped for New Zealand soils. PAW data has been sourced from the Fundamental Soil Layer⁴ managed by

Bioeconomy Science Institute - Manaaki Whenua Landcare Research (BSI-MWLR). This is a publicly available mapping tool that provides a range of information on soil properties across New Zealand. MWLR also manages the online soil information resource, S-map. S-map contains PAW estimates in the top 1m of soil. BSI-MWLR are actively updating S-map. PAW by rooting depth is available for some but not all of New Zealand soils, at the time of publication of this Code of Practice.

⁴ <https://soils.landcareresearch.co.nz/tools/fsl>

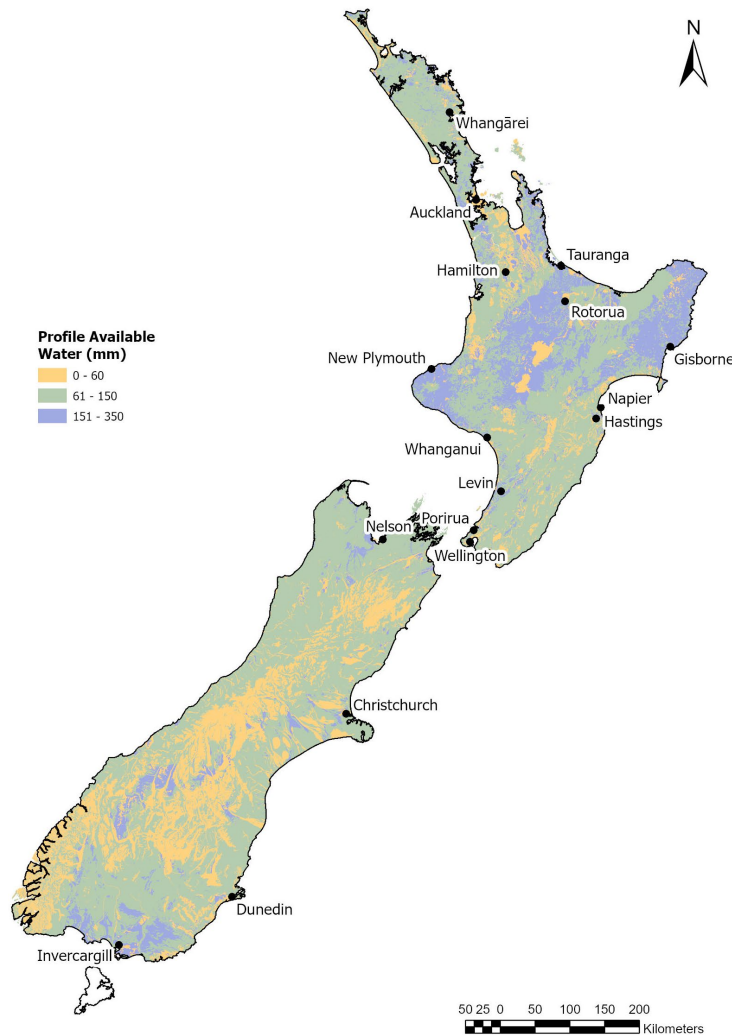


Figure 4.2: A map of PAW classes in the biophysical risk assessment to a depth of 0.9 m .

4.3.3 Storage volume calculation

To estimate storage volume, multiply the average daily winter drain solution generated from the production area (m³/day) by the months of storage* as calculated in the biophysical risk assessment, with an additional multiplier to account for rainfall on uncovered storage (see next section).

*1 month = 30 days of storage; 2 months = 60 days of storage; and 3 months = 90 days of storage.

$$\text{Storage volume (m}^3\text{)} = \left(\begin{array}{l} \text{Daily winter drain solution rate (m}^3\text{/day)} \\ \times \text{ required days of storage} \\ \times \text{ percentage of covered storage} \\ \text{volume (\%)} \end{array} \right) + \left(\begin{array}{l} \text{Daily winter drain solution rate (m}^3\text{/day)} \\ \times \text{ required days of storage} \\ \times \text{ percentage of uncovered storage} \\ \text{volume (\%)} \times \text{uncovered multiplier} \end{array} \right)$$

To convert storage volume in m³ to litres, multiply by 1,000:

- For example, 500 m³ of storage is equivalent to 500,000 litres (l) of storage.

Uncovered storage multiplication factor

A multiplier is applied to storage if it is uncovered because additional capacity for rainfall is needed. This is why the percentage of covered storage volume and uncovered storage volume is included in the above calculation. 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 profile and is linked to weather station data built into the Calculator tab in the Excel workbook. If the weather station cell in the Calculator is left blank, the default uncovered multiplier is 1.8. Find the lookup table for the uncovered multipliers in [Appendix C](#).

Worked example

A grower operating a 2-hectare tomato glasshouse in Tuakau is looking to work out the estimated volume of winter storage for their drain solution. They have an average daily winter drain solution rate of 0.5 m³/ha/day. Their annual rainfall is 1250 mm and the application site's soil profile available water is moderate (90 to 110 mm on Smap). They are looking at a 70% uncovered / 30% covered split of storage, based on their existing infrastructure.

- Their total site drain solution rate is 1.0 m³/day (2 ha × 0.5 m³/ha/day).
- Based on the site's biophysical features, they will need to have 3 months, or 90 days of storage available.
- As they are in Tuakau, their closest weather station, using the look-up table in [Appendix C](#), is Auckland - Pukekohe. This means their uncovered multiplier is 1.84.

To calculate their estimated storage volume:

$$\text{Storage volume (m}^3\text{)} = (1.0 \text{ m}^3/\text{day} \times 90 \text{ days} \times 30\%) + (1.0 \text{ m}^3/\text{day} \times 90 \text{ days} \times 70\% \times 1.84)$$

The grower requires a total volume of 143 m³ or 142,900 L to ensure there is sufficient capacity to store drain solution over winter, when soil conditions are saturated.

4.3.4 Other storage considerations

- Have sufficient storage to hold all solution from the production system, should a full solution changeover be required i.e. emergency storage. If you do not have sufficient storage, you need to have a clear plan for how you will manage your drain solution during wet periods or in emergency situations. Section 1.6 provides alternative management options.
- The storage system, including all tanks and ponds, should be maintained in a watertight condition to avoid leakages. This includes all pipes and holding tanks that drain solution flows through, before application to land.
- 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.

5 Land application

This section covers a pre-application check and how to responsibly apply drain nutrient solution to land. Both are key aspects of your Drain Solution Management Plan (DSMP). Use the DSMP Excel workbook in Appendix A to capture all information required in this section. Keep detailed records as evidence you are following industry standards and responsibly applying drain solution to land.

5.1 Pre-application check

The application site needs to be assessed before land application. This can be done either the day before, or the morning of your planned application. Assessing the site is especially important in winter and over the shoulder seasons (May to September), when the ground is often saturated and crop growth is slow. These conditions increase the risk of nutrient loss to waterbodies. Checking the conditions before each application helps to manage this risk.

A set of pre-application questions are provided in Table 5.1, with supporting information for each question supplied after the table. Use these

questions as a decision framework to determine when conditions are appropriate to apply to land i.e. irrigate. There is a column in the DSMP Excel workbook, under the *Application Record* tab, to indicate you checked the conditions before applying to land. The questions in Table 5.1 are also included in a quick-reference checklist in [Section 7](#).

If the answer to all questions is 'Yes', proceed with the land application following the criteria in Section 5.2. If 'No' is answered for any questions, pause and re-evaluate until all conditions can be met.

Table 5.1: Pre-application check questions.

	GO	NO-GO
Are weather conditions suitable for land application today and later this week?	Yes	No
Do soil moisture levels indicate irrigation demand?	Yes	No
Does my crop growth indicate a demand for nutrients?	Yes	No
Will this land application comply with consent conditions or permitted activity rules that apply to my operation?	Yes	No
Is the delivery or irrigation system set up to apply the volume of drain solution planned to the application site?	Yes	No

Are weather conditions suitable for land application today and later this week?

Applying drain solution when weather conditions are wet, or rain is forecast, increases the risk of soils becoming saturated, and nutrients leaching below the active root zone. It should not be raining, and no rain should be forecast for the following few days, when deciding to apply.

Do soil moisture levels indicate irrigation demand?

Assessing conditions to apply drain solution requires growers to have a method of calculating or monitoring soil moisture, to evaluate the soil moisture deficit. This might include using a quick draw tensiometer (Figure 5.1, left), or hand-held time domain reflectometer (Figure 5.1, right). Soil moisture budgets can also be used. A deficit of > 5 mm is recommended in summer, and > 10 mm in winter.

Further information, including links to soil water budgets, is provided in Appendix B. For growers that don't have a soil moisture monitoring system in place, wait 7 days since the last rainfall event before applying to land, especially over the winter months (May to September). Some regional councils may have modelled soil moisture monitoring maps available, to help determine soil moisture.

Figure 5.1: Examples of soil moisture probes. Left - Quick draw tensiometer. Right - Hand-held time-domain reflectometer.



Does my crop growth indicate a demand for nutrients?

Look for signs the crop or ground cover is actively growing before applying drain solution, because this means the crop will be able to uptake the nutrients applied. A nutrient budgeting tool (see [Section 6.1](#)) will help with scheduling when to apply what quantity of nutrients, to match supply with demand.

Will this land application comply with consent conditions or permitted activity rules that apply to my operation?

Different regions have different rules that apply to drain solution management. See *Regional Council Rules Guidance for Drain Nutrient Solution Management* for more information. Maintain awareness of the rules that apply in your region, to your operation, and track nutrient loading on your application site. The Excel workbook contains a reporting dashboard to help you do this.

Is the delivery or irrigation system set up to apply the volume of drain solution planned to the application site?

Ensure the application system is ready to deliver the drain solution to where you plan on irrigating. Check it is maintained and operating correctly before proceeding.

5.2 Applying drain nutrient solution to land

Follow the criteria below when applying drain nutrient solution to land. These criteria are aimed at maximising nutrient use efficiency, minimising nutrient loss to the environment, and supporting compliance with council rules. These criteria are also included in a quick reference checklist in [Section 7](#).

- Undertake all land applications in accordance with any permitted activity standards or consent conditions.
- Avoid exceeding the soil's water holding capacity when irrigating drain solution. Avoid applying to land if the soil is saturated.
- Ensure there is ground cover or a crop actively growing on the application site.
- Avoid applying drain solution onto water or any other environmentally sensitive areas.
- Ensure there is no runoff or ponding from the site.
- If soil is too dry and in a hydrophobic state, minimise runoff by encouraging infiltration through altering the rate and timing of the drain solution.
- If stock are present on the site, have a nutrient budget to monitor additional nutrient inputs and test soil to monitor potassium levels (see [Section 6.2](#)).
- Keep the application system well-maintained to ensure drain solution is evenly applied over the site.
- Keep records of all drain solution applications (see next section).
- Ensure all employees carrying out drain solution applications are trained and competent to do so.

5.3 Record keeping

5.3.1 Drain solution applications

Comprehensive records of all drain solution land applications need to be available, such as those recorded in your DSMP Workbook. Records should contain:

- Application date
- Location of application site
- Soil moisture level before application, if using a soil moisture probe or a soil water budget (optional)
- Total volume of drain solution applied
- Nitrogen applied in kg N/ha
- Phosphorus applied in kg P/ha (optional)
- Drain solution test results (total N and total P)
- Monthly and annual nitrogen applied in kg N/ha, from drain solution

The DSMP Workbook contains space to record this information. The *Reporting dashboard* tab allows you to calculate monthly and annual nutrient loadings.

Total nitrogen applied should match crop or plant uptake on the applicate site, to manage the risk of nutrient loss. Therefore, records of other sources of N applied to the site (e.g. fertiliser, animal inputs) should also be available, as part of a nutrient budget (see [Section 6.1](#)).

5.3.2 Drain solution testing

Drain solution tests should be carried out at least once a season or for every significant production change in the soilless growing system. More information on solution testing is available in [Section 4.2](#).

5.3.3 Soil testing

Collect an annual soil test for the site, or request it from the landowner, to understand trends in soil nutrient status including imbalances or build up. This is particularly important if using the site to graze stock. If imbalances start to occur, apply drain solution over a larger area, or find a new, suitable site. [Section 6.2](#) under Management Practices provides more information on this.

5.3.4 Other supporting information

Have other supporting information on hand. This may include:

- Rainfall or weather data specific to your site (e.g. collected from an operation weather station)
- Irrigation system maintenance plans and records. A maintenance record tab is available in the Excel workbook to track any maintenance activities. See [Appendix B](#) for IrrigationNZ resources.
- Training records: As all staff operating the irrigation or delivery system need to have suitable training, records of this training should be available.
- Maps of application site and relevant features (e.g. topography, soil, freshwater bodies, catchment, any significant areas)

6 Management practices

This section contains a set of practices to manage the risk of nutrient loss when applying drain solution to land. These practices are referred to throughout this Code, to support you to address nutrient loss risk factors when identified. If implementing any of these management practices to support your Drain Solution Management Plan, capture these in the tab, 3. *Application site*, where space is provided to detail how identified risk factors are being managed. Have supporting information on hand as evidence.

6.1 Prepare a nutrient budget

Nutrient budgeting is a useful management practice to support your Drain Solution Management Plan. A nutrient budget is an estimate of the nutrients entering, leaving, and remaining within a growing system over a set period. A basic nutrient budget quantifies the nutrients applied through fertiliser (inputs) and what is removed in the harvested crop (outputs).

For drain solution application to land, a nutrient budget can match the nutrient requirements of the crop growing on the application site with the nutrients supplied in the drain nutrient solution.

Matching inputs (supply) with outputs (demand) helps to manage nutrient loss risk. Nutrient budgeting is particularly important if the site is grazed, because stock will input additional nitrogen and phosphorus that needs to be accounted for. Table 6.1 contains two nutrient budgeting tool options to consider, depending on the land use of the application site.

If supplying drain solution to a neighbouring property for land application within their system, ensure the landowner has all required information to capture the drain solution as a nutrient input.

Table 6.1: Decision support tools to match nutrient supply with crop uptake on the application site.

Tool	Description	Crops	Cost*
SVS Tool	A nitrogen balance and decision-support tool designed specifically for vegetable production systems. It uses crop, soil, and weather data to help growers optimise nitrogen fertiliser applications in real time, improving efficiency while reducing environmental losses and supporting compliance.	Developed for vegetable crops. Wide range of vegetable crops, arable, and green manures. This tool is appropriate if applying drain nutrient solution to a commercial vegetable crop.	Free
OverseerFM	A farm nutrient budgeting and environmental management tool used to estimate nutrient flows (such as nitrogen and phosphorus) within pastoral and arable farming systems. It helps farmers and advisors make informed decisions to optimise productivity while meeting environmental and regulatory requirements.	Developed for pastoral systems (dairy, beef, pig), arable, seed, green manures, forage. This tool is appropriate if applying drain nutrient solution to a pastoral crop.	\$750/year + GST

*Last updated in 2026.

6.2 Soil testing for stock health

High potassium levels in pasture can lead to mineral imbalances between cations and have serious animal health implications if high levels of potassium-rich nutrients are being applied to the soil. Therefore, if stock are present on the application site, regularly test soil to monitor potassium levels. Ideally keep soil Quick Test K

levels between 7 to 10 to ensure optimum plant health without causing animal health concerns. The potassium content of the drain solution may determine the minimum application area, rather than nitrogen content if the site is being grazed, because of the risk to stock health when potassium levels are high.

6.3 Adjust system parameters to reduce nutrient load

The size of the application site, volume of drain solution applied, and drain solution nutrient concentration determine the quantity of nutrients applied (i.e. the nutrient load). In some cases, nutrient load will exceed the ground cover or crop's requirements, which can be tracked using a nutrient budget. Exceeding a crop's requirement or demand for nutrients significantly increases the risk of nutrient loss.

Altering the application site size or volume of drain solution applied can reduce nutrient loadings:

- A larger application site means drain solution is applied over a larger area. This spreads out the nutrients applied, therefore reducing kg N/ha or kg P/ha applied.
- Reducing the volume of drain solution applied reduces the quantity of nutrients delivered in the drain solution, therefore also reducing nutrient loadings.

Use the *Calculator* tab in the Excel workbook to understand how these parameters impact your overall nutrient load, and how much additional land, or reduction in drain solution volume, might be needed, to better match nutrient supply with crop demand.

Practical options to adjust system parameters to reduce nutrient load include:

- Find a neighbouring property to apply drain solution on, if you have no further land near your production site available to increase your application area. Consider any requirements that may apply when irrigating drain solution on sites owned by someone else.
- Look to minimise the volume of drain solution produced. The drain solution management hierarchy in Section 1.5 contains a list of ways to minimise drain solution volume.

To reduce the concentration of nutrients in the drain solution before application, which will also help to reduce nutrient load on the application site, see [Section 6.5](#) about woodchip bioreactors.

6.4 Select a deep-rooted, winter-active ground cover or crop

The choice of ground cover or crop on the application site will significantly affect the quantity of nutrients taken up and utilised. As the risk of nutrient loss is highest in winter, planting a deep-rooted, winter-active crop, will help to manage this risk. If you can control what ground cover or crop is sown on your application site, then consider the options in Table 6.2. If using a neighbouring property or crop, look for sites with crops that have high nitrogen requirements. Always ensure you are aware of any regulatory requirements that may apply when using someone else's land to apply or irrigate drain solution.

Depending on the availability of equipment (e.g. tractors, seed drills), catch crops can be a good choice for ground vegetation. Catch crops are grown to use excess nitrogen and other nutrients in the soil. They generally have deep root systems, establish quickly, and tolerate cooler, winter conditions⁵. If you choose to sow different catch crops across your application site, make sure at least one block or part of the site has an actively growing crop at any time. Do not apply drain solution on bare or fallow ground. Aim to sow any crops in autumn (i.e. before winter) to improve nutrient uptake, nutrient use efficiency, and reduce the risk of nitrogen leaching⁶. Refer to the Catch Crops for Reduce Nitrate Leaching – Guidelines (October 2024) for more information – a link is provided in [Appendix B](#).

Table 6.2: Catch crop options for improved nitrogen use efficiency on your application site.

Species	Considerations
Oats	Fast-growing and winter active. Use for silage or winter green feed, if the application site is stocked. High nitrogen uptake levels and good yield.
Triticale	Cereal catch crop, which is a cross between wheat and ryecorn. Good winter activity – similar to oats. Oats normally outperform triticale in terms of nitrogen uptake, except in cooler climates like Southland.
Italian ryegrass	Improved performance in cooler conditions compared to perennial ryegrass. Use with other cereals (e.g. oats) for silage, which can be harvested multiple times. Lower nitrogen uptake rates and overall yield compared to oats and triticale.

6.5 Woodchip bioreactor to pre-treat drain solution

Woodchip bioreactors, also known as denitrification beds, are a tool that can be used to reduce the concentration of nitrogen in your drain nutrient solution before it is applied over your site (Figure 6.1). Bioreactors work by using bacteria, present on the woodchips, to break down nitrate present in the solution⁷ and convert it to nitrogen gas. The solution flows through

the bioreactor and is collected at the other end after treatment, ready for land application. Once installed, woodchip bioreactors last 10-15 years, before needing replacement. Resources on installing a woodchip bioreactor are provided in [Appendix B](#). If using a treatment device like a bioreactor, then drain solution needs to be tested again after treatment, to calculate the new nutrient load on the application site.

⁵ [DairyNZ - Catch crops](#)

⁶ [Catch crops for reduced nitrate leaching \(October 2024\)](#).

⁷ [CAREX Toolbox Handout 4 - Nutrients \(nitrate\)](#)



Figure 6.1: The Waituna woodchip bioreactor, from the 2015 ‘The Nitrate Catcher’ report⁸. Photo used with permission and taken by Evan Baddock, Earth Sciences New Zealand.

6.6 Use border controls near waterbodies

Border controls act as physical or vegetative barriers between the drain solution application site and waterbodies. They aim to minimise the risk of drain solution directly entering waterbodies when applying to land. Border controls, alongside careful application management, are the final barrier to protecting water quality.

In practice, a border control could be a riparian or vegetative strip along drains, or waterbodies next to the drain solution application site (Figure 6.2). When looking into border control options, consider the site’s topography and runoff risk, and focus on parts of the site where a border control could intercept runoff, if it occurs. As an interim measure before border controls are in place, look to use a 5 m setback rule from all waterbodies. Some plans may require a greater setback.



Figure 6.2: Example of a waterbody riparian planting. Used with permission from DairyNZ.

⁸ [The ‘Nitrate Catcher’ report - McKergow et al., 2015.](#)

7 Checklists

These two checklists support growers to check off all key considerations when developing a comprehensive Drain Solution Management Plan, in accordance with this Code of Practice. Feel free to print these two pages as quick reference sheets.

Planning and management	Yes	No
A Drain Solution Management Plan (DSMP) is prepared and documented using the Excel workbook (Appendix A) or an alternative format.		
Goals or objectives are set for the long-term management of drain nutrient solution.		
Any regulations or requirements around the management and application of drain nutrient solution are understood and complied with, including regional plans.		
Any industry or customer (stakeholder) requirements relating to the management of drain nutrient solution are implemented.		
Property maps are available for the production site and drain solution application site.		
Eliminate and minimise		
Actions have been undertaken to eliminate and/or minimise the volume of drain nutrient solution produced (Section 1.5).		
Drain solution application site		
The application site has been assessed for suitability to apply drain nutrient solution, with supporting property details, biophysical features recorded, and a description of nearby freshwater waterbodies and freshwater ecosystems nearby (Section 3.1).		
Key biophysical and management factors contributing to the risk of nutrient loss and freshwater systems are described, with management practices in place (Section 3.2 and Section 6).		
The application site meets all setback (buffer) distances required (Section 3.1.3).		
Storage		
Sufficient storage is available to hold drain nutrient solution until conditions are suitable for application to land, or for emergency storage (Section 4.3).		
The storage system is regularly maintained to ensure no leakage of nutrient solution.		

Drain solution land applications

Pre-application check (Section 5.1)	Yes	No
Are weather conditions suitable for land application today and later this week?		
Do soil moisture levels indicate irrigation demand?		
Does my crop growth indicate a demand for nutrients?		
Will this land application comply with consent conditions or permitted activity rules that apply to my operation?		
Is the delivery or irrigation system set up to apply the volume of drain solution planned to the application site?		
Key requirements when applying drain nutrient solution to land (Section 5.2 and 5.3)		
All applications are undertaken in accordance with permitted activity standards or consent conditions.		
Drain nutrient solution is not applied to saturated soils.		
There is an actively growing crop or ground cover on the application site.		
Drain nutrient solution is not applied to water or other environmentally sensitive areas.		
There is no runoff or ponding from the site.		
The application system (e.g. irrigation system) is well-maintained to ensure drain solution is applied evenly over the site.		
Nutrients supplied via drain solution, along with other nutrient sources (e.g. stock), match nutrient demand on the application site (Section 6.1).		
If stock are present on the site: <ul style="list-style-type: none"> • There is a nutrient budget to account for additional nutrients into the system. • Soil tests are available to monitor potassium levels for stock health. 		
All employees carrying out drain solution applications are trained and competent to do so.		
There are application records, including volume applied and nitrogen loadings.		
Drain solution is sampled and sent off for lab testing at least once a season, or with every major crop change.		

8 Bibliography

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Appendix B: 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

A range of resources are provided below. Depending on your operation size and level of technology, some resources may be more or less useful.

Name	Sector	Description
NZPPI Sustainable Water Management Code of Practice (2024)	NZ nursery production	Industry Code of Practice to promote sustainable water use, initiated by New Zealand Plant Producers Incorporated. https://nzppi.co.nz/WATER-CONSERVATION/29606/
Nursery Industry Water Management Best Practice Guidelines (2010)	Australia nursery industry	Industry Best Practice Guidelines for Australian nursery growers. https://nurseryproductionfms.com.au/wp-content/uploads/download-manager-files/Water-Management-Best-Practice-Guidelines.pdf
RII Best Practices Guide for Water Circularity (2023)	USA controlled environment agriculture operations	North American research body resource by the Resource Innovation Institute to support understanding of water conservation principles, technology available, maximising energy-efficiency, and protection of water resources. https://resourceinnovation.org/wp-content/uploads/2023/06/RII-Water-BPG-2023.pdf
Best Practice Guidelines for Greenhouse Water Management (2016)	European greenhouse growers	Overview of current best practice for the application and recycling of water and nutrients in greenhouses. Written for a European audience. https://hortamericas.com/wp-content/uploads/2018/09/grodan_best-practice-water-management.pdf
Water conservation for growers - Sustainabloom (2025)	USA floriculture industry, but applicable to covered cropping	Concise high-level resource for water management in floriculture production (but applicable principles). https://e1.nmcdn.io/assets/sustainabloom/wp-content/uploads/2025/11/21.ConsumerGuide_Water-Conservation-Growers.pdf

Management practices

Name	Sector	Description
Catch Crops for Reduce Nitrate Leaching - Guidelines (2024)	Agriculture, but applicable to all sectors	Guidance on the use of catch crops after forage crop grazing to take up nitrogen (N) during the coolest months of the year. It aims to explain the whys and hows to help manage your expectations and decision making. https://assets.far.org.nz/CB0-3368_BrendonMalcolm_Catch-Crop-Guidelines_UPDATE-Oct-2024.pdf
Carex handout: Edge-of-field nitrate reduction with woodchip bioreactors (2018)	All sectors	Guidance on building a bioreactor (denitrification bed) using wood-chip. Useful for reducing nitrogen levels in drain solution. Download from: https://figshare.com/articles/journal_contribution/CAREX_Toolbox_Handout_4_-_Nutrients_nitrate_/6848537

NIWA - Riparian Buffer Design Guide (2022)	Pastoral-farming focused but applicable to all sectors with land & nearby waterbodies	This guide discusses design principles, and provides high-level information about the likely performance of riparian buffers. https://niwa.co.nz/sites/default/files/Riparian%20Guidelines%20WEB_0.pdf
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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 drain solution application to land. 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 drain solution application to land. 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 C: Storage lookup table

This table sits behind the Calculator tab of the Drain Solution Management Plan workbook. Use this to estimate storage volume in Section 4.3, or to understand more about how the calculations in the workbook function. When no climate, rainfall, or soil data is entered into the Calculator, the default values will be used. Climate data was originally sourced from CliFlo, the NIWA's original National Climate Database.

Storage			
Weather station	Annual rainfall (mm)	Soil PAW (mm)	Uncovered multiplier
Northland (Whangarei)	1,339	100	1.33
Auckland - Kumeu	1,217	100	1.51
Auckland - Pukekohe	1,324	100	1.84
Hamilton	1,139	100	1.43
Palmerston North	970	100	1.40
Levin	1,163	100	1.51
Gisborne	1,000	200	1.31
Hastings (Bridge Pa)	731	100	1.09
Nelson (Brightwater)	1,086	100	1.58
Christchurch (Lincoln)	611	100	1.15
Dunedin (Airport)	663	100	1.16
Default	1,339	50	1.8



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