Nutrient Management Plans

• What is a nutrient management plan?
• Resources
• Nutrient management checklist
Introduction

“Each unit of land should be farmed within its limits; achieving sustainability does not need to come at the cost of production or profit”

A nutrient management plan is your plan for optimising the use of nutrients on your farm.
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1. Background

- Nutrient management plans
- Nutrient planning linkages
This FAR Focus is designed to provide you with information about nutrient management planning for your arable farm

A nutrient management plan is a personalised business document for your farm. It is unique to your farm as every farm is different and every farmer has different business objectives. It is your plan and it needs to be developed and implemented to work for you.

Your nutrient management plan will highlight practices which can be implemented to optimise the use of nutrients. Losses from leaching and run-off will be reduced to give you better cost efficiencies and better environmental outcomes.

To be an effective farm management tool, your nutrient management plan requires your input. It needs to be revisited and updated annually to deliver benefits to your business. It requires you to identify what can realistically be done on your farm with the available resources, and to develop a plan to implement change. It is likely that all regulatory authorities will require farmers to have a nutrient management plan in the future. This is already in place in some regions.

A number of people can help you develop a nutrient management plan. These include farm employees, farm consultants and fertiliser company consultants.

In summary:
Your nutrient management plan is:
• is a personalised business document for your farm;
• is developed with your input;
• and implemented by you;
• an action plan to optimises the use of nutrients on your farm for better productivity and environmental benefits.

Farming practices have impacts on water, soils and greenhouse gas emissions. Farmers all around the world are under increasing pressure to reduce their environmental footprint by minimising nutrient losses and emissions from their land. Lost nutrients are a cost to both the farm business and the environment.

All New Zealanders have a common interest in ensuring our freshwater lakes, rivers, aquifers and wetlands are managed wisely. They are part of our natural heritage, contributing to our well-being and must be preserved for future generations. By world standards New Zealand’s water quality is high, but nutrient loss from our farms is having a significant impact. Nitrogen and phosphorus drive farm productivity but when they leach or wash into fresh water they become environmental pollutants, reducing the quality of the water in our lakes and rivers and harming fresh water eco-systems.

Farmers are under pressure from regional councils, industry and environmental groups, and the public to minimise nutrient losses. A number of national objectives through the National Policy Statement for Fresh Water and the Land and Water Forum are in place that will impact on farmers. These include the setting of nutrient load limits for catchments by regional councils and their requirements for farmers to have nutrient management plans. Industry partnerships, such as the Dairying and Clean Streams Accord, are focusing on reducing the impacts of dairying on fresh water quality.

It is essential that farmers understand the potential effect of their management practices on water resources, and that they use a range of practices to minimise nutrient losses to the environment.

Nutrient management planning is a process that farmers can use to assess the effectiveness of their nutrient management practices and the risk of environmental damage from nutrient losses from their land.

This nutrient management plan checklist and template has been developed throughout 2011 and 2012 by New Zealand cropping farmers for New Zealand cropping farms. The active components of the plan can be downloaded from the FAR website www.far.org.nz.

In the future, we expect the nutrient management plan for cropping farmers will be available through some dedicated software.

Nutrient management plans

There are two ways that environmental performance can be improved.

Input controls
Where farm inputs are capped and controlled by regulatory bodies, or by the better option;

Output reporting
Where farmers control their inputs through management practices and they report on the nutrient outputs from their farming systems.

The nutrient management plan is the tool for this purpose.
The catchment plan sets the objectives for the catchment. It usually focuses on water quality, but might include other environmental and economic objectives. All the land within the catchment is considered.

The whole farm plan considers the full range of activities being undertaken on the farm, often from an environmental perspective. They may include action plans for soil erosion, biodiversity enhancement, animal welfare and wetland and riparian management.

A nutrient management plan considers the whole farm. It involves;
• Setting business objectives – economic, environmental and social.
• Performing a risk assessment for the sustainable management of nutrients.
• Deciding on a plan of action – including time frames and costs.
• Keeping records that are auditable by an independent third party.

The nutrient budget compares crop inputs with crop outputs, partitioning the nutrients between the crop and the environment. Nutrient budgets are completed for land management units at the end of the season. OVERSEER® is one nutrient budgeting tool that has been developed for NZ farms.

Soil tests and soil quality measurements provide the basis for risk assessment for managing nutrients and maintaining the soil productivity. They provide evidence that the NMP is delivering on its objectives.
2. Introduction

- Why do I need a nutrient management plan?
- What is a nutrient management plan?
- What should my nutrient management plan include?
- The most important part - making it happen!
Why do I need a nutrient management plan?

They can save you money
A nutrient management plan (NMP) is custom-made for your farm. It will help you utilise nutrients more efficiently, but there is more to efficient nutrient management than just getting the fertiliser inputs right.

Although fertiliser is a key source for the nutrients utilised by your crop, there are other nutrient sources and management factors involved. Consideration must also be given to soil and stock management, irrigation and the use of winter crops. Fertiliser response will be better managed if all these factors are taken into consideration, and improved efficiencies will provide real savings.

A well thought out NMP makes good business sense.

Market assurance
An accredited and approved nutrient management plan demonstrates that you are capably addressing the potential environmental impacts of your business. This is an increasingly important consideration in terms of market quality assurance programs and government regulation.

Nutrient management plans will meet regional council rules
Regional councils are charged with monitoring and protecting our natural resources including the quality of water ways. Scientific monitoring has shown a decline of water quality in lowland rivers, lakes and groundwater systems, and regional councils are taking steps to halt the decline. For example, Environment Waikato and Horizons Regional Council now require anyone using more than 60 kg N/ha/year to have a NMP. Other regional councils are likely to implement similar rules, so let’s stay ahead of the game.

What is a nutrient management plan?
A nutrient management plan is a written document which describes how major nutrients (N, P, K, S, and others of importance to specialist crops) will be managed annually. It is implemented to optimise productivity, reduce nutrient losses and address any potential adverse effects on the environment.

We need to remember that our nutrient practices must be managed all year round for crops, stock grazing and land that is being fallowed.

What should my nutrient management plan include?
A nutrient management plan must identify your farm goals and objectives, the farm resources and the significance of any risk areas. It should identify the actions to be taken and records to be kept.
A farm map is a useful starting point for a nutrient management plan. If you do not already have a farm map, we recommend you develop one. It doesn’t have to be a large task and there are guidelines in the technical notes on what should be included. Farm mapping services are widely available (see Resources).

Good record management is a key part of nutrient management. Your NMP should have copies of, or reference to the location of, the following documents:

- Nutrient management checklist (see next)
- Soil sampling protocols
- Soil test results
- Fertiliser recommendations
- Fertiliser inputs
- Nutrient budgets
- Soil moisture monitoring and irrigation inputs
- Actions required
- Identified areas of responsibility
- Records of monitoring of outcomes

Keep this information in a safe location. You may wish to keep this information together in a specific nutrient management folder, alongside supporting information.

Farm management software is widely available.

The nutrient management checklist

The checklist will take you through the issues that as an arable farmer you need to consider.

The checklist is a series of questions relating to different topics, each with a YES/NO answer. Not all topics may be relevant to you. There are technical notes for each question with more details explaining why it is important to get it right.

The red boxes on the checklist alert you to where action may be required but you need to come up with the best solution for your farm.

The most important part - making it happen!

A nutrient management plan is not just about collecting bits of paper. It involves action on those issues identified in the checklist.

- Set time frames to implement solutions for issues identified in the checklist and follow it through.
- Communicate the actions to your staff and contractors.
- Revise your plan annually to monitor progress and identify any new issues that need addressing.
3. Resources

This section provides information on resources. While every effort has been made to ensure the information is as complete as possible, it may not include all suppliers of resources and the contact details may change from the date of publishing.
Nutrient management tools
www.fertresearch.co.nz
Fertmark is an independently assessed fertiliser quality assurance programme.
www.fertqual.co.nz
Spreadmark certified operators.
www.fertqual.co.nz
www.defra.gov.uk/rb209
AmaizeN
Forecasting software for yield and N fertiliser of maize silage and grain crops.
www.far.org.nz

Wheat Calculator
Forecasting software for yield, N fertiliser and irrigation of wheat crops.
www.far.org.nz

Irrigation management tools
Aquaflex™ irrigation calculator.

Farm mapping
Frontier mapping www.frontiermapping.co.nz
WMC farm mapping www.farmmap.co.nz
CRS farm mapping www.crsoftware.co.nz
Farmworks www.farmworkspfs.co.nz
Farm mapping NZ www.farmmapping.co.nz
RM Tech www.rmtech.co.nz
Mosaic mapping www.mosaicmap.co.nz
Rural mapping www.ruralmapping.co.nz
Land Vision www.landvision.co.nz
NZ Centre for Precision Agriculture www.nzcpa.co.nz

Soil mapping
Land Vision www.landvision.co.nz
NZ Centre for Precision Agriculture www.nzcpa.co.nz
Agri Optics www.agrioptics.co.nz
Wheresmycows www.wheresmycows.com

Published soil maps
LandCare Research www.mwp.co.nz
S-map Online www.smap.landcareresearch.co.nz
Regional Councils

Soil testing services
Analytical Research Laboratories www.ravensdown.co.nz
Hill Laboratories, Hamilton www.hill-labs.co.nz
NZ Labs, Hamilton www.nzlabs.co.nz

Soil moisture monitoring services and equipment
Hydro-Services www.hydroservices.co.nz
AgFirst www.agfirst.co.nz
Fruitition www.fruitrition.net.nz
Water Force www.waterforce.co.nz
Water Dynamics www.waterdynamics.co.nz
Aquaflex www.streatsahead.com
FruitFed Supplies www.fruitfed.co.nz

Regional and district councils
Your local regional or district council is a valuable source of information. Check their websites for specific information about their environmental rules for your region. They also provide information about the services that are available in your region.

North Island
Northland Regional Council www.nrc.govt.nz
Auckland Council www.aucklandcouncil.govt.nz
Waikato Regional Council (Environment Waikato) www.ew.govt.nz
Bay of Plenty Regional Council www.envbop.govt.nz
Gisborne District Council www.gdc.govt.nz
Hawke’s Bay Regional Council www.hbrc.govt.nz
Manawatu-Wanganui Regional Council (Horizons) www.horizons.govt.nz
Taranaki Regional Council www.trc.govt.nz
Greater Wellington Regional Council www.gw.govt.nz

South Island
Canterbury Regional Council (Environment Canterbury) www.ecan.govt.nz
Otago Regional Council www.ozc.govt.nz
Southland Regional Council (Environment Southland) www.es.govt.nz
West Coast Regional Council www.wcrc.govt.nz
Marlborough District Council www.marlborough.govt.nz
Tasman District Council www.tasman.govt.nz
Selwyn District Council www.selwyn.govt.nz

Dairying and Clean Streams Accord
www.mfe.govt.nz/issues/land/rural/dairying-accord
DairyNZ www.dairynz.co.nz
Beef & Lamb www.beeflambnz.com
HortNZ www.hort.nz.co
NZ GAP www.newzealandgap.co.nz

New Zealand Water Environment Research
Foundation Sustainable Drainage Management
4. **The nutrient management checklist**

- Property management
- Fertiliser management
- Soil management
- Water management
The nutrient management checklist

This check-list does not comprise a full farm nutrient management plan.

If you are starting out, use the checklist to work through all the components of your farm system that will be included in a full nutrient management plan. Take time to consider your answers and refer to the technical notes for more information. The checklist will enable you to quickly pin-point areas or management practices on your farm that could be improved. Use it as a building block to lead you to improved sustainability. Technical notes relating to each question are provided after the tables.

If you are employing someone else to develop a nutrient management plan, use this checklist for guidance when considering the plan they are developing.

The building blocks for a whole-farm nutrient management plan

Use the information in the completed checklist to identify areas that need attention on your farm.

Develop a full nutrient management plan for your farm by following these steps.

---

**Step 1** Work through the checklist by yourself or with your consultant or advisor. Refer to the resource page for tools to use or people who can provide advice. Many of these are free. Use the checklist to prioritise areas of work. The checklist might indicate several areas that need attention, consider the size of the job and your resources.

**Step 2** Consider your remedial actions:

- Determine the activities that will be involved, the time frame for completing the job and the cost of doing so.
- Develop a detailed plan for the work.
- Document the annual activities and the costs.

**Step 3** Whole-farm nutrient management plan developed and in action.

- Staff and contractors on board.
- Record-keeping system maintained.
- Progress reviewed annually.
The checklist

Your personal and business goals determine how you manage the farm.

### PROPERTY MANAGEMENT

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<tr>
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<tbody>
<tr>
<td>1</td>
<td>Have you considered and set production objectives for your farm?</td>
<td>YES</td>
</tr>
<tr>
<td>2</td>
<td>Have you considered and set environmental objectives for your farm?</td>
<td>YES</td>
</tr>
<tr>
<td>3</td>
<td>Have you considered and set social objectives for your business?</td>
<td>YES</td>
</tr>
<tr>
<td>4</td>
<td>Are you aware of your regional council’s current nutrient management requirements?</td>
<td>YES</td>
</tr>
<tr>
<td>5</td>
<td>Are you aware of your industry or customers’ current nutrient management requirements?</td>
<td>YES</td>
</tr>
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### FARM RESOURCES

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<tbody>
<tr>
<td>6</td>
<td>Do you have a farm map with details of land management units, soil types and significant environmental areas?</td>
<td>YES</td>
</tr>
<tr>
<td>7</td>
<td>Does your map show where the nutrient hot-spots are? These include; silage pits, offal pits, farm dumps, feed pads, fertiliser stores, effluent ponds, stock yards, stock camps, stock wintering areas, flat areas at the bottom of a catchment and wash down areas.</td>
<td>YES</td>
</tr>
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### Fertiliser management

Manage your fertiliser inputs to achieve your yield objectives and minimise losses to the environment.

### FERTILISER MANAGEMENT

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<tbody>
<tr>
<td>8</td>
<td>Do you follow the best management practices for transporting, storing, applying and disposing of fertilisers as recommended in Fertresearch's <strong>Code of practice for nutrient management</strong> <a href="http://www.fertresearch.org.nz">www.fertresearch.org.nz</a>?</td>
<td>YES</td>
</tr>
<tr>
<td>9</td>
<td>Do you use a qualified person who uses an appropriate nutrient management tool to prepare your fertiliser recommendations?</td>
<td>YES</td>
</tr>
<tr>
<td>10</td>
<td>Do you use a crop calculator or previous research data to determine fertiliser application rates and dates?</td>
<td>YES</td>
</tr>
<tr>
<td>11</td>
<td>Do you follow the fertiliser recommendations with respect to rate and timing?</td>
<td>YES</td>
</tr>
<tr>
<td>12</td>
<td>Do you record your fertiliser inputs, including the rate and product used and the application date?</td>
<td>YES</td>
</tr>
<tr>
<td>13</td>
<td>Do you use a nutrient budget to assess cumulative nutrient effects on your farm?</td>
<td>YES</td>
</tr>
<tr>
<td>14</td>
<td>Do you calibrate your fertiliser application equipment or use a <strong>FertMark</strong> certified operator?</td>
<td>YES</td>
</tr>
<tr>
<td>15</td>
<td>Do you match your nitrogen applications to times of rapid plant growth?</td>
<td>YES</td>
</tr>
<tr>
<td>16</td>
<td>If you are in a high rainfall area, do you split your N fertiliser applications to reduce leaching?</td>
<td>YES</td>
</tr>
<tr>
<td>17</td>
<td>Do you apply less than 30 kg N/ha during winter (May to July)?</td>
<td>YES</td>
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### FERTILISER MANAGEMENT - Organic sources composts/manures/effluents

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<tr>
<td>18</td>
<td>Do you test and record the nutrient content of any organic fertilisers before application?</td>
<td>YES</td>
</tr>
<tr>
<td>19</td>
<td>Do you test and record the nutrient content of effluent before application?</td>
<td>YES</td>
</tr>
<tr>
<td>20</td>
<td>If you apply effluent, is it at a rate that meets your local regional council requirements for nutrient concentrations?</td>
<td>YES</td>
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# Soil management

A strategy to improve or at least maintain your soil quality will improve your profitability.

## SOIL TESTING

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<tbody>
<tr>
<td>21</td>
<td>Do you collect soil tests from each of your land management units every 1-3 years?</td>
<td>YES</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>22</td>
<td>Do you have documented soil sampling protocols (sampling patterns)?</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>23</td>
<td>Do you keep copies of all your soil tests?</td>
<td></td>
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<tr>
<td>24</td>
<td>Do you use soil mineral N tests to determine fertiliser N inputs?</td>
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<td></td>
<td></td>
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<tr>
<td>25</td>
<td>Is your soil Olsen P (0-15 cm) less than 40 µg/ml?</td>
<td>YES</td>
<td>NO</td>
<td></td>
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<tr>
<td>26</td>
<td>Do you regularly monitor and record changes in your soil structure by using a soil assessment tool such as VSA?</td>
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## SOIL MANAGEMENT

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<tbody>
<tr>
<td>27</td>
<td>Do minimise run-off and erosion by matching your cultivations to the soil type and land contour?</td>
<td>YES</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>28</td>
<td>Do you cultivate and plant across the contour of sloping ground rather than up and down it?</td>
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<tr>
<td>29</td>
<td>Do you have drainage systems for your heavy-medium soils?</td>
<td></td>
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<tr>
<td>30</td>
<td>Do your soil and irrigation management systems prevent ponding during rain and irrigation?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>31</td>
<td>Do you use reduced tillage techniques whenever possible?</td>
<td>YES</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>32</td>
<td>Do you manage grazing stock to prevent pugging and compaction?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>33</td>
<td>Do you remove compacted or pugged areas before establishing the next crop?</td>
<td>YES</td>
<td>NO</td>
<td></td>
</tr>
<tr>
<td>34</td>
<td>Do you use cover crops, when resting paddocks in your crop rotations?</td>
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</table>
Water management

Preventing nutrients and sediments getting into water.

**IRRIGATION**

<table>
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<tr>
<th></th>
<th></th>
<th>YES</th>
<th>NO</th>
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<tbody>
<tr>
<td>35</td>
<td>Do you irrigate? (If the answer is no, proceed to question 41)</td>
<td></td>
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<tr>
<td>36</td>
<td>Do you have resource consent to irrigate and if so, do you meet the requirements of this consent?</td>
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<tr>
<td>37</td>
<td>Have you installed water meters?</td>
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<tr>
<td>38</td>
<td>Is your irrigation managed to improve efficiency and reduce run-off?</td>
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<tr>
<td>39</td>
<td>Do you use tools such as soil moisture monitoring or soil water budgets to schedule irrigation?</td>
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<tr>
<td>40</td>
<td>Does the water infiltrate your soils without any surface ponding?</td>
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<tr>
<td>41</td>
<td>Do you apply less than 50 mm of irrigation in any one application?</td>
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<tr>
<td>42</td>
<td>Do you regularly check for and repair leaks and worn components in your system?</td>
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**WATER WAYS**

<table>
<thead>
<tr>
<th></th>
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<th>YES</th>
<th>NO</th>
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<tbody>
<tr>
<td>43</td>
<td>Do you leave a 2 m margin between your cultivation and any water way (excludes ephemeral streams)?</td>
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<tr>
<td>44</td>
<td>Do you have riparian plantings on waterway boundaries?</td>
<td></td>
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<tr>
<td>45</td>
<td>Do you have drains and/or use contouring to eliminate the movement of water across your paddocks during heavy rain?</td>
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<tr>
<td>46</td>
<td>Do you have grass filtration strips around the paddock boundaries and at water-way edges to catch sediments?</td>
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<tr>
<td>47</td>
<td>Do you prevent fertiliser entering water ways during spreading?</td>
<td></td>
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<tr>
<td>48</td>
<td>Are your stream and drain banks free from erosion?</td>
<td></td>
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<tr>
<td>49</td>
<td>Is the water from sub-surface drains prevented from flowing directly into a water ways?</td>
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<tr>
<td>50</td>
<td>Are stock excluded from water ways?</td>
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**Definition**

A water-way is commonly defined as being “wider than a stride, and deeper than a red band gumboot.”

Ephemeral streams (intermittent water ways which may only be present in winter) are excluded. Note: Some regional councils have specific ‘legal’ definitions which apply to their regulations. Always check the requirements of your regional council.

**Once the checklist has been completed:**

Check out the number of questions that you have answered “no” to. These will be the areas that need remedial action on your farm.

Effective remedial action needs to include:

- Details of what needs to be changed
- An action plan detailing what is going to be done, with the costs and time-frame considered.
5. Technical notes to accompany your checklist

- Property management objectives
- Farm resources
- Fertiliser management
- Soil management
- Preventing nutrients and sediments from getting into water
- Waterways
Property management objectives

1. Have you considered and set production objectives for your farm?
The production objectives set by you for your crops in kg DM/ha or T/ha determine the level of inputs, both nutrient and water, that will be required to meet the yield demand. These may also be referred to as productivity targets.

2. Have you considered and set environmental objectives for your farm?
The environmental objectives for the farm provide a framework for the environmental planning for your farm. This might include development, conservation or remediation of environmental areas on your farm. Examples of environmental areas are areas of native bush and wetlands. Beef & Lamb Land and Environment Planning are an example of environmental planning. (www.beeflambnz.com/farm/tools-resources/land-and-environment-planning-toolkit).

3. Have you considered and set social objectives for your business?
Social objectives determine the level of well-being of yourself, your family and your staff. These may include such things as:
- Exposure to risk
- Education
- Retirement and succession planning
- Staff training and education
- Time-out from the business

4. Are you aware of your regional council’s current nutrient management requirements?
Current information about your responsibilities as a land manager is available from your local district or regional council. It is important that you know the details of your regional plan that specifically relate to your business.

For example, if you are farming in the Waikato and are applying more than 60 kg N/ha/year, you must have a nutrient management plan. Horizons Regional Council requires farmers to prepare nutrient budgets. Other regional councils are reviewing their nutrient management requirements, it is important to keep up to date with your council’s regional requirements.

5. Are you aware of your industry or customers’ current nutrient management requirements?
Some of your customers might have specific requirements around nutrient management. If their requirements aren’t met, you may find that they will not accept your product. Industry examples of these include NZ GAP, the Silver Fern Farms farm assurance programmes and the Dairying and Clean Streams Accord.

Farm resources

6. Do you have a farm map with details of land management units, soil types and significant environmental areas?

7. Does your map show where nutrient hot-spots are?
These include; silage pits, offal pits, farm dumps, feed pads, fertiliser stores, effluent ponds, stock yards, stock camps, stock wintering areas, flat areas at the bottom of a catchment and wash down areas.

The farm map should include land management units, soil types, paddock boundaries, farm tracks, buildings, sensitive areas and nutrient hot spots.

- Land management units are parcels of the farm that are similar in soil type, contour, management etc. Management units may be individual paddocks or groups of paddocks.
- Soils - The soil name is less important than the properties of the soil, such as its texture (sand, silt, clay, peat), drainage characteristics (poorly drained, free draining), and the potential rooting depth (depth to stones, water table, iron pan etc). Your regional council should have copies of soil maps for your region. You can get a good idea of the differences in soil type on your farm by digging a series of soil pits, to at least the depth of the rooting zone. Tactile examination of the soils will determine if they are sands, silts or clays. Problems with drainage may be seen as blue-grey bands in the profile. Regular, recorded visual soil assessments (VSA) provide valuable data about changes in your soil’s quality. Electro-magnetic (EM) surveys can tell you about paddock scale variation in soil properties; this is a starting point for variable management for nutrients and irrigation. EM mapping is a process that maps the relative conductivity of the soils in your paddock. Soil properties that influence conductivity include; soil texture, soil moisture, cation exchange capacity, bulk density and salinity. There is a link between the soil’s conductivity and its water holding capacity.
- Environmentally sensitive areas including retired areas, steep slopes, wet lands, native bush, and water ways (streams, drains, ponds, lakes),
- Nutrient hot spots include offal pits, farm dumps, effluent ponds (current and historic), silage stacks, fire sites, wash-down areas and areas where water ponds.
- Areas where farm effluents are regularly applied.

Rubbish and offal holes are a source of nutrients, bacteria and other contaminants which can leach into waterways and ground water. Appropriate placement and depth of farm dumps and offal pits is important to minimise nutrients getting into water bodies. It’s probably not practical to move existing dumps or offal holes, but you should carefully consider potential environmental effects when installing new ones. Check your regional council regulations and requirements.
Fertiliser management

8. Do you follow the best management practices for transporting, storing and disposing of fertilisers as recommended in Fertresearch’s Code of practice for nutrient management (www.fertresearch.org.nz)

Fertiliser should be stored out of the weather, preferably on a pallet and on a concrete floor to maintain its quality and to prevent nutrient losses. Do not store fertilisers and fuel together - they can be a volatile mix!

The ‘Code of Practice for Nutrient Management’ has more information on fertiliser storage, use and application.

9. Do you use a qualified person who uses an appropriate nutrient management tool to prepare your fertiliser recommendations?

10. Do you use a crop calculator or previous research data to determine fertiliser application rates and dates?

The interpretation of soil test results in relation to crop demand must consider factors such as; location, soil type, sowing time, crop species and cultivar, and plant population. Environmental effects must be considered alongside the crop response.

There are many consultants who can prepare fertiliser recommendations for you. It is recommended that you choose accredited advisors who have completed the Intermediate and Advanced short courses on “Sustainable Nutrient Management in New Zealand Agriculture”, which focus on nutrient management for the best economic and environmental outcomes.

Computer based decision support tools such as the Wheat Calculator and AmaizeN have been designed specifically for wheat and maize. They use soil, weather and soil test information to predict the N fertiliser requirements for the crop, and predict yield and harvest date.

Regardless of who prepares your fertiliser recommendation and nutrient management plan, make sure you keep a copy of it.

11. Do you follow the fertiliser recommendations with respect to rate and timing?

There may be very good reasons to deviate from your fertiliser recommendations. Seasonal conditions or fertiliser prices might cause you to reconsider your requirements. Whatever the reason for the change, make sure you record it and what your actual applications were.

12. Do you record your fertiliser inputs, including the rate and product used and the application date?

Keeping this information will help you interpret changes in soil nutrient status and compile nutrient budgets. For all fertiliser applications ensure that you record:

- The calibration details of your application equipment.
- If using a contractor, who, and if they are FertMark certified.
- The type of fertiliser and the rate applied.
- Percentage of nitrogen, phosphorus, potassium and other nutrients in the fertiliser (fertiliser names and formulations can change).
- Where, when and how it was applied. If the spreader can provide an application map, keep it as record. Your contractor can supply you with application maps.
13. Do you have a nutrient budget to assess cumulative nutrient effects on your farm?
A nutrient budget describes and quantifies all the nutrient inputs (e.g. fertilisers) and outputs (e.g. crop removal and N leaching). Nutrient budgets are often best prepared using computer based tools such as the Wheat Calculator, AmaizeN and OVERSEER® nutrient budgets. OVERSEER® has modules for pastoral farms, fruit crops and arable and vegetable crops. It works retrospectively, i.e. the nutrient budget refers to the crop that has been recently harvested.

You can develop your own simple nutrient budget for some crops by working out the quantity of nutrients that will be removed as grain, seed or forage and the quantity of nutrients needed to match this removal and any normal losses or inefficiencies of the cropping system.

Print out the Nutrient Budget report for inclusion in your nutrient management plan.

14. Do you calibrate your fertiliser application equipment or use a Spreadmark certified operator?
If you are doing your own fertiliser application, calibrate your spreader, drill and/or side-dresser regularly to ensure the application rate is correct. Check that your application pattern is even. Calibration involves checking that the spreader is delivering the right weight or volume of fertiliser to a known area.

If using a contractor, check that they are Spreadmark certified. Spreadmark accredited operators have independently tested machinery, audited procedures and trained drivers. Spreadmark is a scheme run by the New Zealand Fertiliser Quality Council.

Precision spreading, using GPS and GIS systems, has enabled commercial fertiliser spreaders (ground and aerial) to achieve a high degree of fertiliser spreading accuracy. This technology enables spreaders to cover precise areas with minimal overlap or gaps between spreading runs and to achieve accurate buffers between target and non-target areas. Many spreaders have headland control to ensure even spreading across the whole paddock.

15. Do you match your nitrogen applications to times of rapid plant growth?
If nitrogen inputs exceed the uptake by the crop, there is a risk that there will be losses, either through leaching after rain or by volatilisation. To avoid this, match the applications to the periods of most rapid growth in the crop and avoid times when the soils are cold and wet or very dry.

In crops such as wheat, maize, ryegrass and oil seed rape, there is very good scientific data on how nitrogen is utilised to maximise yield, relative to the growth stages of the plant. This information is built into the Wheat Calculator and AmaizeN, or is available in FAR’s cropping strategy documents and Arable Updates; www.far.org.nz.

16. If you are in a high rainfall area, do you split N fertiliser applications?
Leaching is driven by drainage from high rainfall events or irrigation. Check weather forecasts and avoid application if heavy rain seems likely. Light soil types such as sands and silts, or shallow soils over stones are prone to rapid drainage and nitrogen losses through leaching. Split applications to match crop demand may be an effective nutrient management strategy on these soils.

17. Do you apply less than 30 kg N/ha during winter (May to July)?
Winter is often when drainage and leaching risk is greatest; there is more rain, less evaporation and
reduced crop uptake. Soil temperatures may also be
too cool for any plant uptake. Don’t apply fertilisers
when the soil temperature is less than 4°C. Take care
with residual nitrogen and nitrogen applications over
this period. Late autumn applications that match plant
uptake are more effective than winter applications.

18. Do you test and record the nutrient content
of any organic fertilisers before application?

19. Do you test and record the nutrient content
of effluent before application?
Just like mineral fertilisers, materials such as chicken
manure, dairy effluent or compost will contain
nutrients. If asked, suppliers should provide a copy of
the nutrient content. If they can’t supply this, collect a
sample yourself for analysis.

To get a representative sample for testing, take 10-
12 samples from the heap or pond and mix them
together. Take a sub-sample from the mixture for
testing. If sampling from the effluent pond, agitate the
effluent before sampling. This will produce a slurry
with a more representative sample of the effluent
nutrients. If sampling from a feed pad storage facility
where the yard is scraped, it may be more appropriate
to provide a composite sample taken over an
extended period of time to give average values.

Calculate an appropriate application rate. Be aware
that the nutrient levels in effluent are very variable, so
the test results are only a rough estimate.

Most soil testing labs will be able to test your
organic fertilisers and many have custom kits for
effluent sampling.

20. Does your effluent application rate meet
your local regional council requirements?
Check with your local council to find out what the
local rules for effluent applications are. Measure the
application rate by putting out containers during the
application and measuring the depth. Multiply the
volume applied by the nutrient content of the effluent
to determine the total nutrient application.

The easiest way to do this is put at least five clean
ice-cream containers in the field to collect product
during application. This will provide you with a
representative sample as well as give an indication
of the application rate.

Soil management

21. Do you collect soil tests from each of your
land management units every 1-3 years?
It is important to measure the nutrient levels in your
soils through soil testing on a regular basis. Your soil
test results provide actual measurement of nutrient
levels in your soils; these, with your crop yields,
provide you with evidence about how well your
nutrient management plan is working.

Nutrient prediction and budgeting tools use the
nutrient levels in your soils, to work out how much
fertiliser is needed to reach the production targets for
your crops with minimal losses. Take soil tests before
you plant for nutrient analysis. FAR funded research
has shown that the most cost effective approach is
to sample each of your land management units on an
annual basis.

22. Do you have documented soil sampling
protocols (sampling patterns)?
Soil can be quite variable, even over a short distance.
The way the soil samples are collected is important
as it has an impact on the test results. To minimise
variability in soil tests, collect the soil samples at the
same depth, using the same sampling pattern, at the
same time each year.

The standard soil sampling pattern is extremely
important. You can use GPS to map your sampling
pattern, but diagonal transects between marked fence
posts can be just as effective. When establishing your
sampling pattern, avoid gate ways, hot spots and other
abnormal areas in the paddock. These should be
marked on your farm map!

The equipment required is: a 15 cm corer for basic
soil tests and/or an auger for deep mineral N tests
(60 cm depth) plus a bucket for mixing the samples
for a composite sub-sample, sample bags that seal,
and labels - use a water-resistant pen for labelling.
Samples should be stored in a chilly bin with ice to
keep them cool. If you are unable to transport them
to the lab on the same day, store them in the freezer.

There may be a high turnover of fertiliser company
reps, who commonly undertake soil samples on
behalf of growers, so you should keep a copy of the
sampling protocol and make sure everyone uses it.
You can also use the same sampling pattern to collect
herbage samples.

23. Do you keep copies of all your soil tests?
Regular soil tests are valuable for tracking long
term changes in soil fertility thereby allowing you to
make good decisions around capital dressings of
lime, phosphorus and potassium etc. Most fertiliser
companies will keep copies of the results for you, but
it’s a good idea to keep your own as a back-up.

Part of an effective farm management plan includes
a record keeping system. This must be easy for all
staff to access and use and has a provision for
summary reporting.

24. Do you use soil mineral N tests to determine
fertiliser N inputs?
Nitrogen is the nutrient most likely to limit crop yields,
and the nutrient most commonly applied as fertiliser.
Nitrogen also has the greatest environmental risk,
so care must be taken to use the right amount. The
Wheat Calculator and AmaizeN both use soil mineral
N results to determine fertiliser N inputs. This is also
called the Deep N test.

Because maize and cereals are deep rooting, the
deeper we can collect the soil samples, the more
accurate our fertiliser recommendation will be. Currently the recommendation is to test for soil mineral N to 60 cm, except in dry regions or shallow soils, where shallower samples are acceptable.

After collection, the samples should be chilled immediately and submitted to the soil lab as soon as possible. For autumn sown wheat, we recommend the samples are collected in late winter/early spring after the winter rains, and for maize, sample three to four weeks after sowing (collect from the mid row to avoid the fertiliser applied at planting). Further guidelines for Deep N testing are provided with the Wheat Calculator and AmaizeN, both of which are available from FAR.

25. Is your soil Olsen P (0-15 cm) less than 40 µg/ml?
The Olsen P test estimates the level of plant available inorganic P in the soil. It can give variable results depending on soil characteristics such as pH and levels of soil organic matter. It does not assess the organic component of P in the soil.

Cereals and maize do not require large amounts of phosphorus. For example, maize plants contain less than 0.2% phosphorus. Exceeding the optimum soil fertility range does not make economic sense. Most phosphorus contamination of fresh water comes from soil sediments in run off. The high levels of phosphorus stimulate plant growth in the water and may lead to toxic algae blooms. High soil Olsen P levels make no sense economically or environmentally.

26. Do you regularly monitor and record changes in your soil structure by using a soil assessment tool such as VSA?
Environmental and economic sustainability of cropping and pastoral farms can be greatly influenced by soil quality. The visual soil assessment method (VSA) provides land managers with a simple tool to assess and monitor soil quality.

VSA is based on the visual, qualitative scoring of key bio-physical indicators of soil quality, and incorporated on an easy to use scorecard. The soil indicators include an assessment of texture, porosity, colour and the presence of soil mottles. The soil indicators are supported by plant performance indicators that link soil condition to crop production. The indicators are underpinned by extensive research and are linked to economic performance.

The value of VSA comes from repeat assessments over time, as changes to soils can be slow. Keep a record of your assessment for reference. These records are valuable for monitoring improvements to soils brought about by a change in the farm management systems, or capital investment e.g. reducing tillage and drainage.

VSA provides an effective and immediate way to assess soil quality quickly and cheaply in the field.

Information about VSA can be accessed at: www.landcareresearch.co.nz/research/soil/vsa and your local regional council.

27. Do you minimise run-off and erosion by matching your cultivations to the soil type and land contour?
Soil can either be lost gradually through wind and water erosion or rapidly during major storm events. Cultivation practices such as strip and no tillage preserve the soil structure and reduce the likelihood of erosion. Match your cultivation to the soil type; for example, if you farm on light, wind-erodible soils, reduce your cultivation intensity to prevent top soil being lost by wind and water action.

28. Do you cultivate and plant across the contour of sloping ground rather than up and down it?
Cultivate and plant along the contour or at a slightly angle to it rather than directly down the slope. Leave grass filter strips across steep slopes to slow water
flow and help deposit sediments before they get into waterways. Contour cultivation provides benefits in low rainfall areas by slowing run-off and increasing absorption into the soil.

Sediment traps at the base of slopes can be used to contain run-off and prevent off-site impacts. However they require regular maintenance and eroded soil must be removed and spread back onto the land.

29. Do you have drainage systems for your heavy-medium soils?
Ineffective drainage in heavy soils can cause water-logging and loss of soil structure. Anaerobic conditions also exacerbate nitrous oxide emissions.

Signs of ineffective drainage include:
- Ponding.
- Slow drying with soil mottling orange/grey colours.
- Quick return to a water logged state.
- Patches of poor crop growth – plants may have yellow leaves, indicating nitrogen deficiency.
- Restricted rooting.
- Increased pest and disease damage.

Poorly drained, waterlogged soils are more likely to become compacted. The best remediation is through drainage and secondary treatments such as sub-soiling. Sub-soilers shatter and crack compact layers improving drainage. The most effective time to do this is when the soil is drying.

30. Do your soil management systems maintain the soil structure to prevent ponding during rain and irrigation?
Ponding occurs when excess water flows to low lying, poor draining parts of the paddock. It is an indication that the rain or water application rate from the irrigator, in mm/hr, is greater than the ability of the soil to absorb it (infiltration rate). Ponding has a detrimental effect on crop, the soil becomes anaerobic and roots die. Run-off from ponded areas carries soil sediments and nutrients into water ways, with negative impacts for water quality.

31. Do you use reduced tillage techniques whenever possible?
Reduced tillage has a number of economic and environmental benefits. The benefits to the soil include less compaction, better traffic ability and improved resilience to extreme weather impacts, such as drought and heavy rain events. Less time on the tractor for cultivation equates to economic gains through improved machinery and labour utilisation and direct savings from reduced diesel usage.

Other benefits to the farm system are reduced fallow times and the utilisation of crop residues for weed management. Farmers also need to be aware of potential negatives, such as increased pressure from establishment pests and the build-up of grass weeds over time. Refer to FAR Focus - Non Inversion Agronomy; Guidelines for successful reduced tillage and FAR Focus 5 - Grass to Crop.

32. Do you manage any grazing stock to prevent pugging and compaction?
Keep stock off wet soils wherever possible. Intensive grazing can cause pugging, compaction and loss of soil quality. This will affect drainage and increase run-off losses. The soil will need more work to get a good seed bed for your next crop. Over time excessive cultivation reduces soil structure and soil organic matter.

Damage can be minimised by considering when the livestock will be on the land. Graze wetter paddocks in the drier part of the season or use lighter stock on wet paddocks. Maintain good pasture cover and move stock before they strip it down to the roots. Remove heavy stock to a feed pad for part of the day. Refer to DairyNZ’s fact sheet for more information: www.dairynz.co.nz/file/fileid/37481.

33. Do you remove compacted or pugged areas before establishing the next crop?
Pugged soils have:
- Poor drainage.
- Poor plant growth.
- Higher fertiliser requirements.
- More topsoil and contaminant run-off to waterways.

Before beginning any remediation, dig a series of holes down to 0.5 m, to look for surface crusting and compacted layers through the profile. Choose the correct remediation option based on the level of damage to your soil. Cultivation and aeration operations aerate the soil to a depth of 150-200 mm. Sub-soiling shatters deeper subsoil layers to depths of 200-350 mm enabling deeper root growth.

34. Do you use cover crops when resting paddocks in your crop rotations?
Winter grass or cover crops have many advantages. They can provide a source of winter feed for stock. They reduce soil erosion and mop up any excess nutrients thereby reducing leaching losses to the environment. Deep rooting cover crops like brassicas can improve compaction damage and increase the soil’s permeability. Legumes fix atmospheric nitrogen which becomes available once the cover crop is worked in.
Preventing nutrients and sediments from getting into water

36. Do you have a resource-consent to irrigate and if so, do you meet the requirements of this consent?

Check with your local council to find out what their irrigation consent rules are.

The consent requirements will differ between regional councils, and possibly between catchments within a region. It is your responsibility to be familiar with the rules for your region.

Councils need to know when and how much water is being used to be able to manage the resource in a fair and efficient way. They closely monitor surface and ground water quantities and will penalise any breaches of the consent conditions.

37. Have you installed water meters?

The Government has made water metering mandatory for all water users extracting over 5 l/s.

The deadline for compliance depends on your allowed rate of take:
- 20 litres per second or more: no later than 10 November 2012.
- 10 litres per second up to 20 litres per second: no later than 10 November 2014.
- 5 litres per second up to 10 litres per second: no later than 10 November 2016.

38. Is your irrigation managed to optimise efficiency and reduce run-off?

Irrigation needs to be efficient and effective otherwise the costs to farm business and the environment are high. Under-watering causes reduced crop yields and over-watering is a waste of water and may cause nutrients to be lost through leaching and run off. This requires good system design, installation, operation and maintenance.

Good irrigation practices ensure there is little chance of drainage and the plant growth is optimised. Optimising plant growth optimises nutrient uptake and the risk of nutrient leaching is reduced.

When buying a new irrigator, ensure that the commissioning of the system includes an irrigation audit to ensure the prescribed standards are being met.

An irrigation audit identifies how efficiently an irrigation system is working by checking how well the system is performing and how well it is being managed. Performance checks cover the uniformity of the water distribution and will consider filtration and pump efficiency. Management checks cover the application volumes and timing and may include verifying that the regulatory requirements are being met.

39. Do you use tools such as soil moisture monitoring, or soil water budgets to schedule irrigation?

Determining when and how much irrigation to apply is important for a number of reasons.
- Drought stress costs yield: Yield and money is saved when irrigation is scheduled before the crop is in critical moisture deficit.
- Irrigation is costly: Irrigating before it is necessary, or applying too much water, or water in the wrong place, is a waste of money.
- Irrigation may cause leaching: Nitrogen and other water soluble nutrients may be leached out of the root zone if too much water is applied. Deep rooting cereals and maize have a better opportunity to use nutrients from depth than shallow rooted crops, such as pasture and clover.

Given the investment in irrigation and the potential costs of getting it wrong, it is worth investing in tools for scheduling irrigation. There are many options, including soil moisture budgets, soil moisture monitoring tools, software such as the Wheat Calculator and AquaTRAC, or a comprehensive professional soil moisture monitoring and scheduling service (see resources).

40. Does the water infiltrate your soils, without leaving any surface ponding?

Compacted and poorly drained soils have a reduced ability to soak up water. If irrigated water is applied too quickly for absorption, it will run-off and collect in the low points of the paddock, causing ponding. Heavy rain behaves in the same way. Ponding is an indicator of drainage problems which may be due to compaction or changes in the soil type within the paddock. Ponding may occur some distance from the problem. Identify and remediate the problem or match the water application rate to the areas with the slowest infiltration.

41. Do you apply less than 50 mm of irrigation in any one application?

The soil’s capacity to store water is affected by its porosity, texture and structure. Stony and sandy soils and those with low organic matter have poor water storage. Once the soil reaches field capacity, it can hold no more and drainage occurs. Understanding the water-holding capacity of your soils is important for managing irrigation.
Irrigation volume should be targeted to supply water only to the root zone, with no drainage below it. The amount of soil water available to plants is governed by the depth of soil that the roots can explore and the nature of the soil material. Over-irrigating with large volumes of water, so there is drainage below the root zone, is a waste of water and money.

Deep soil moisture monitoring (e.g. by neutron probe) will show you how far the irrigation water is moving in the soil profile and the depth it is being taken up from.

42. Do you regularly check for, and repair leaks and worn components in your system?
Leaks can come from split pipes or poor connections. Water leaking from the system is a cost and may cause ponding, erosion, run off and leaching.

Worn nozzles are like leaky pipes; they decrease the system’s efficiency and increase the energy demands.

An irrigation audit will check for these problems.

A minor improvement in irrigation efficiency can result in major increases in available water and the cost benefit of irrigation.

**Waterways**

43. Do you leave a 2 m margin between your cultivation and any water way (excludes ephemeral streams)?
Water ways are sensitive to nutrient contamination from surface run-off. A two metre buffer zone, preferably grassed, reduces the risk of sediments entering water ways. Steeper slopes with faster run-off will need wider buffer zones. Many regional plans stipulate the requirement for buffer zones for sediment control.

44. Do you have riparian plantings on waterway boundaries?
Riparian buffer zones are vegetated areas along the edges of water bodies. They act as buffers to protect surface waters from contamination from run-off and protect the stream banks from erosion. Riparian plants provide habitats for a variety of birds and insects. Care must be taken in selecting species for planting to ensure they will not increase the risk of flooding or be hosts for pests and diseases of your crops.

Your regional council has information about riparian management.

45. Do you have drains and/or use contouring to eliminate the movement of water across your paddocks during heavy rain?

46. Do you have grass filtration strips around the paddock boundaries and at water way edges to catch sediments?
Surface run-off from your paddocks indicates that the rain fall or irrigation rate is faster than the absorption rate of the soil. When this happens the water ponds on the soil surface and gravity determines where it ends up. Surface water flowing to water-ways carries sediment and nutrients with it. Top soil erosion is a high cost to productivity and sediments are harmful to fresh water ecosystems.

Identify where surface run off is likely to occur and take steps to minimise it by leaving grass buffers around the water-ways to slow surface water movement and trap sediments.

Contour drains run across slopes to break run-off flow down the slope.

The Franklin Sustainability Project – soil and drainage management guide has good information about minimising sediment losses.


47. Is fertiliser prevented from entering water during spreading?
Fertiliser must not be applied directly into to waterways under any circumstances. A clear buffer zone is required between the application zone and the water.

It is high risk to apply fertiliser within buffer zones. Surface run-off from paddocks can flow into water-ways causing water quality issues. Use headland management systems on your fertiliser spreader when spreading near waterways.

48. Are your stream and drain banks free from erosion?
The adverse effects of erosion to water ways can be minimised by stabilising stream banks. Soil lost from eroding banks increases the sediment load of the water making it murky. Nutrients such as phosphorus and nitrogen stimulate algal growth and may be toxic to fish and humans. Unstable water way edges can be protected by planting riparian strips with suitable vegetation and/or fencing to exclude stock.

49. Is the water from sub-surface drains prevented from flowing directly into a water ways?
Sub-surface drains reduce run-off and soil pugging but can transport nutrients and micro-organisms directly into waterways. Where possible design your sub-surface drains to discharge into wetlands or filter strips, not directly into open water-ways.

50. Are stock excluded from water ways?
If stock have access to stream and drain banks they will cause damage and erosion. If they have access to the water they will add large amounts of faecal pollution. Fenced water ways prevent stock access and reduce stock losses.
6. Appendices
Fact sheets

- Drainage
- Soil Water
- Irrigation Audits
Drainage

Good drainage systems quickly remove excess surface and sub-surface water from the paddock. An effective drainage system will remove excess soil water within 24 hours of the rainfall event. A good time to assess the needs on your farm is after a heavy rain event when problems with ponding and run-off are easy to see.

There are a number of options available to improve drainage, including:
- Re-shaping the layout or contour of the paddock.
- Improving surface drainage to remove surface water quickly from cropped areas.
- Installing subsurface drainage to remove water from saturated soils by downward flow.

Planning

A farm drainage system requires careful planning to optimise the capital expenditure. A successful scheme will consider these factors:
1. What is causing the water-logging problem? Is it from surface or subsurface water or both? Where is the water coming from?
2. What is the frequency and duration of water logging and how big is the affected area? Is remediation a priority for on-going profitability?
3. Is there sufficient outfall available? Water needs to be drained away to somewhere else, preferably by gravitational flow, otherwise it becomes a costly exercise involving pumps. Are the outfall drains well maintained and deep enough to remove water quickly?
4. What are the likely benefits? Will the cost of the drainage scheme be returned through increased productivity and how long will it take?
5. Which areas should be drained first? Efficiency and cost savings can be gained by considering the drainage plan for the whole farm and working out which part should be tackled first.
6. What type of drainage system is required?
7. Do I need assistance to develop a plan?

Reshaping

Precision levelling using high accuracy GPS.

Other options include ensuring surface contour allows effective water movement. Precision land levelling is useful in removing depressions in paddocks where ponding is a problem. Bunded headlands can prevent water flowing into the crop and cultivation methods such as furrow diking reduce run-off by slowing the water movement along wheel tracks.

Surface drains

Surface drains are useful for intercepting run-off from neighbouring higher areas and draining surface water off the land quickly. They also collect water from sub-surface drains. Surface drains include ditches, drains and grassed waterways. They must be regularly maintained to keep them flowing and may be a hazard for machinery and animals. Care must be taken to prevent bank erosion and damage from stock access.

Subsurface drains

Installing sub-surface drainage with gravel envelope.

Subsurface drains remove excess water from the soil profile via networks of perforated plastic tubes, (tile-drains) or unlined channels (mole-drains), installed below the soil surface. Water drains into the tubes or channels and flows away to a surface drain.

Mole drains can only be made in heavy soils with a clay sub-soil. Long lasting channels need a clay content of 30-35%. They are made by pulling a ripper blade or mole plough through the subsoil and rely on the soil structure to support and keep the channel open. Ideally the soil should be free of stones at the mole drain depth.

Use an experienced drainage contractor to assist with the development of your drainage plan.

Environmental concerns

Drainage has both positive and negative effects on water quality. In general, land with good sub-surface drainage has less surface run-off, erosion, and phosphorus loss, than land that has no drainage improvements or only surface drainage. However subsurface drainage is a significant route for water soluble nutrients like nitrates to reach fresh water.

Wetlands are an important part of a drainage system. They have a role in regulating water flow and maintaining water quality, as well as providing habitat for water-based wildlife.

Constructed wetlands are a simple, practical tool farmers can use to intercept tile drainage water to reduce nutrient losses.

NIWA’s publication; New Zealand Guidelines for Constructed Wetland Treatment of Tile Drainage, guides farmers on how to develop an effective wetland on their farm and provides guidance on wetland planting, weed control and maintenance.
Soil water

Soil holds water like a sponge. It soaks it up until it can hold no more, then it drains. The amount that can be held is the water-holding capacity of that soil and is related to soil texture and structure. Coarse textured soils have low water storage and fast drainage. Silts and clays retain more water and drain more slowly.

Well-structured soils have networks of inter-connecting pores which enable water to infiltrate and drain easily. Compacted soils have fewer spaces for the water and the flow rate through it is slower. These soils tend to pond when it rains because their infiltration is poor. A soil’s infiltration rate is the rate at which it is able to absorb rainfall or irrigation.

The soil’s water holding capacity

Water is held in the soil in the macro and micro pores between the soil particles. When all the pores are full the soil is saturated. If more water is added it drains out under the force of gravity. This is drainage.

After a day or two, the macro pores empty. Micro pores are able to hold water against gravity so are still full. At this stage the soil is said to be at Field Capacity.

Water is held in the pores by capillary action, the smaller the pore, the more tightly it is held.

Water availability for the crop

Plants access easy-to-get water first, but as the soil dries, capillary forces become too strong for the plant. This is termed Stress Point, beyond which growth is slowed and yield is lost. Plants will survive but become increasingly stressed.

At a certain level, plants can get no more water and become permanently wilted. This is the Permanent Wilting Point.

The amount of water in a soil that supports maximum plant growth is known as Readily Available Water. It is the difference between Field Capacity and the Stress Point.

Efficient irrigation scheduling balances the crop demand for water with the soil supply. The crop gets enough water to reach its yield potential and there is no waste.

Efficient and effective irrigation keeps water in the root zone between Field Capacity and Stress Point. Plant growth is maximised and the risk of run-off and leaching are reduced.

Apply the water at the right rate and in the right place. Application rate should not exceed the infiltration rate of the slowest soils in the paddock. If it does, run-off and ponding will occur. Timing of irrigation is also important. Soil moisture monitoring keeps track of the available water and the water should be applied before the crop’s stress point is reached.
Irrigation audits

An irrigation auditor assesses and reports on the performance of the system.

Two main aspects of efficiency are considered:
1. The performance of the system, including an assessment of the distribution uniformity of the water and checks on pump and filtration performance.
2. The management of the system, focussing on the timing and depth of irrigations and the system’s maintenance.

The audit report provides recommendations for improvements to the efficiency of the system based on the audit findings. New systems should be audited before commissioning to check that the contract specifications have been met.

Distribution uniformity (DU) calculates how evenly water is applied to the paddock during an irrigation event. It is expressed as a %, where the higher the value, the more even the distribution. A high DU depends firstly on the system design and installation. Badly designed systems do a poor job at each run and cost irrigators money. The second consideration is how well the system performs. The DU will decrease if there blockages and leaks, and if application rates exceed the soil’s ability to absorb the water.

The audit measures for DU calculation are:
• Pressure checks, across the system.
• Water delivery across the system, via catch cans, for flow rate and/or spray patterns.
• Nozzle and emitter performance.
• Visual observation of leaks, runoff, soil type, and other system specific problems.

Energy efficiency

Energy Efficiency is important because of the direct cost of energy losses. The auditor will check pumps, motors, pressure regulators and filters. It is important that pumps and motors are the right size for the system. If they are too big they will operate outside their efficiency range and power is wasted. If both are inefficient the effect is multiplied and the losses can be large. Many systems have too many pressure regulators. Dirty and blocked filters and nozzles reduce efficiency and cost money.

Irrigation scheduling

Irrigation scheduling is an important aspect of irrigation management, applying enough water when it’s needed ensures good crop yields and reduces waste. The auditor will check how the irrigations are being scheduled. Scheduling depends on knowing:
• The soil’s available moisture status.
• How fast the available water is being used, through crop uptake and by evapotranspiration.
• How much water is being effectively applied.

Water use efficiency

Water Use Efficiency or application efficiency (AE) is the ratio between the amount of irrigation water effectively used by the crop and the amount that was applied (less the change in soil moisture storage). It is affected by both the distribution uniformity and irrigation scheduling.

Over-watering is the most likely cause of water loss in any irrigation system, so scheduling is important for high efficiencies.

The irrigation audit can assess a one-off application for efficiency, but tracking efficiency over the season requires good record-keeping. Critical information includes irrigation event dates, durations, water volume applied, and rainfall figures.
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