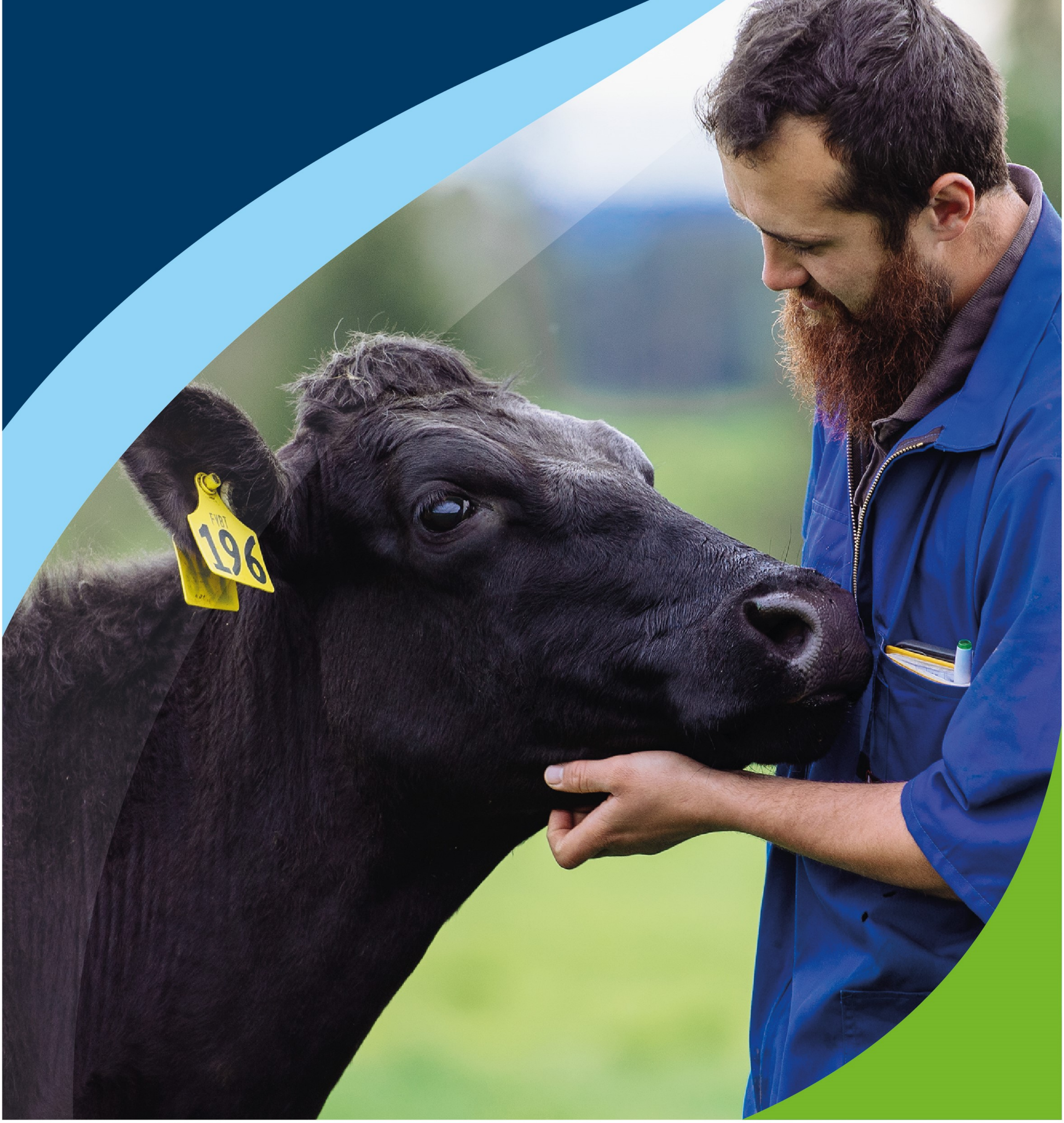
Fonterra

Dairy for life

Nitrogen Risk Scorecard - Manual



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1. Introduction

Fonterra has committed to ensuring every one of our farmers has a tailored Farm Environment Plan (FEP) by 2025. These FEPs will help farmers to efficiently address environmental risks through practical and clear actions set out in individual plans.

Fonterra has a team of 30 Sustainable Dairying Advisors (SDA) dedicated to supporting farmers through the delivery of FEPs. We believe that tailored FEPs are the best way to accelerate the adoption of good management practices and therefore decrease the water quality impacts of farming.

While the farm walk/visual assessment of critical source areas is well suited to putting in place actions to manage contaminants such as sediment, pathogens and phosphorus, assessing nitrogen loss risk (and putting actions in place to address the risk factors) requires a different approach. This is primarily because nitrogen loss risk is not generally associated with a visible source of a contaminant load that could be transported overland to waterways. Detailed information about the farming practices needs to be collected and assessed to provide an objective understanding of the level of nitrogen loss risk.

It is our view that the Nitrogen Risk Scorecard (or “Scorecard”) is a tool that can make the nitrogen risk assessment more objective, while remaining administratively efficient and presenting information back to farmers and farm plan advisors in a format that is intuitive and easily engaged with.

2. Background

Fonterra’s Nitrogen Management Programme has been running since the 2012/13 season. The programme formed part of Fonterra’s commitments under the Sustainable Dairying: Water Accord, collecting nutrient management data and modelling it in OVERSEER® using agreed industry protocols to report a nitrogen leaching to water and nitrogen use efficiency metric to all farmer suppliers.

The Nitrogen Programme has been successful in raising farmer awareness of the environmental risks around nitrogen, however, there are limitations to reporting whole farm level metrics when trying to focus farmer attention towards identifying and changing specific practices that are contributing to nitrogen loss risk.

As a result, Fonterra have developed an alternative approach to identifying environmental risks related to nitrogen loss, in a way that better fits with our strategic focus on achieving good farming practice outcomes through FEPs.

This led to the development of the Scorecard as a tool that provides a simplified objective assessment of the level of risk of nitrogen loss from a farm. The Scorecard uses annual farmer data relating to six key farm practices and applies a level of risk to each of those practices against a set of benchmark parameters. The Scorecard report also includes a calculated nitrogen surplus metric for the property.

With no manual data processing, the Scorecard is a practical cost-effective method of identifying high risk farms or inefficient management practices. Our SDAs can then focus their time on supporting farmers and utilising the Scorecard to help inform the type of actions appropriate to manage the risks through tailored FEP’s.

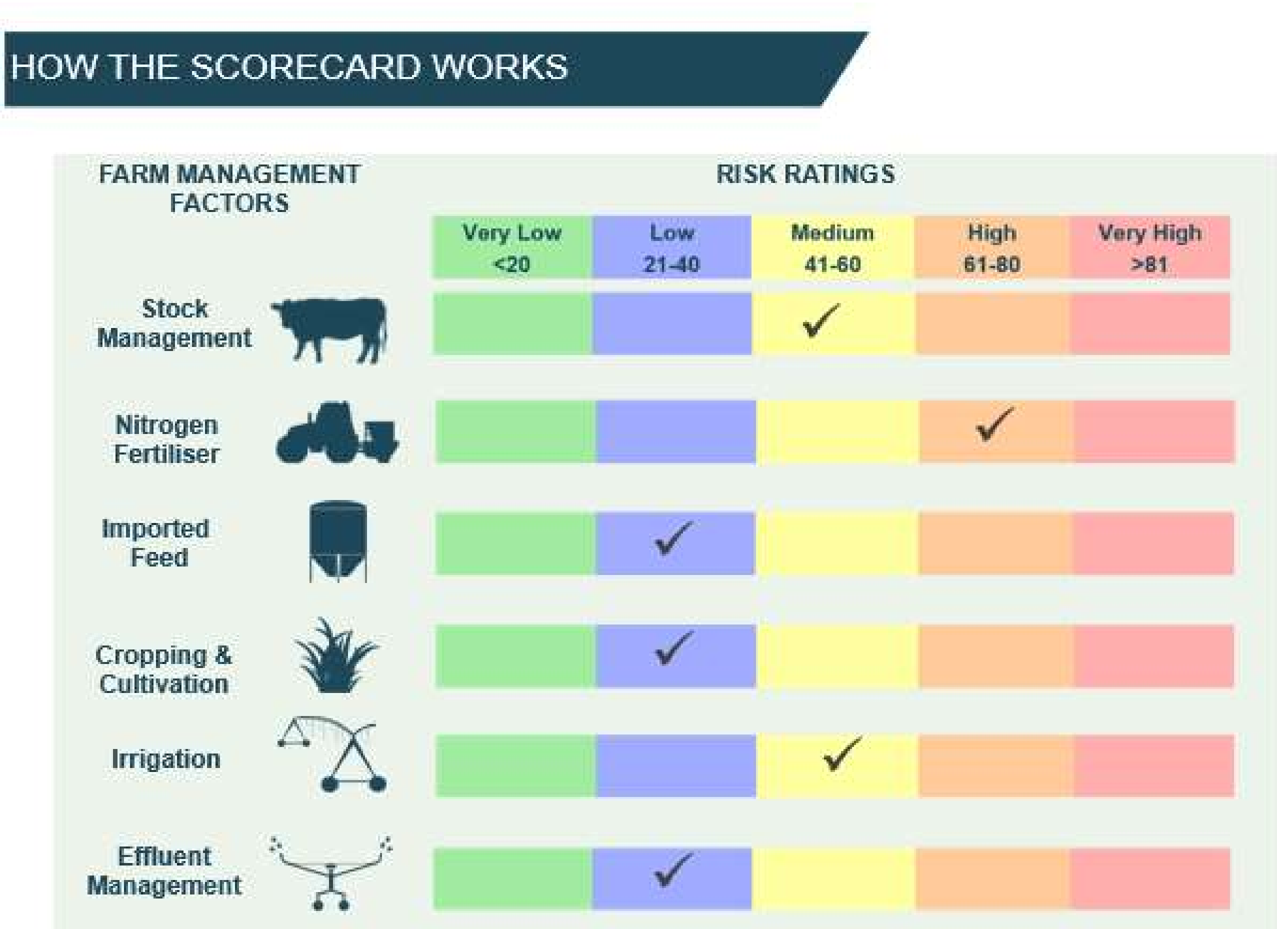
3. What is the Nitrogen Risk Scorecard?

The Nitrogen Risk Scorecard ("Scorecard") is an automated tool that provides for a simplified objective assessment of the level of risk of nitrogen loss from a farm.

The Scorecard engine (written in a SQL database) queries annual farmer data submitted electronically through the Farm Dairy Records (FDR). The FDR data relates to six key farm management practices (Stock Management, Nitrogen Fertiliser, Imported Feed, Cropping and Cultivation, Effluent Management and Irrigation). The Scorecard assesses and applies a level of risk to each of those practices, against a set of benchmark parameters.

The Scorecard does not model the whole farm effect of detailed scenarios, nor does it provide for a detailed nitrogen conversion efficiency metric that includes fixation and gaseous losses. Rather, it can be used to look individually at the practices within the farmer's control that might be expected to impact on the loss of nitrogen to the environment. The inclusion of a purchased nitrogen surplus (i.e. a whole farm system risk metric), allows the Scorecard to be used for benchmarking/referencing and then monitoring change in performance over time.

3.1 How does the Scorecard assess risk?



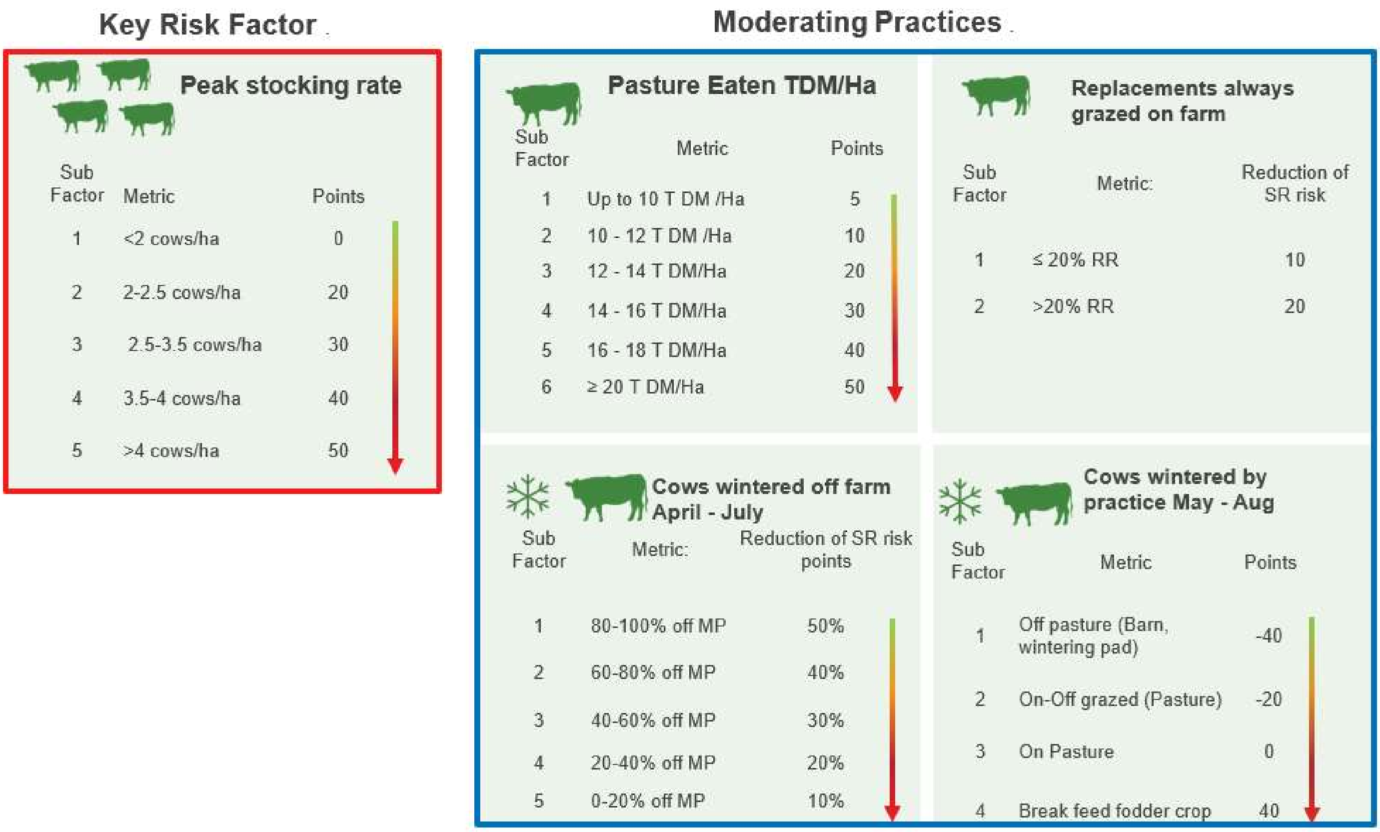
- Each management practice receives a risk rating
- The level of risk is determined by a score based on the farm data provided
- The risk score is calculated for each key farm practice. That score is then modified by consideration and scoring of 'sub factors' that might exacerbate or decrease the level of risk.

The level of risk for each of the 6 farm management practices is determined by calculating an overall score per management practice, with a score of less than 20 being very low risk ranging to a score greater than 80 being very high risk.

The score is determined by a points system for each of the farm management practices. Points are attributed to a key driver of risk for each management practice (e.g. stocking rate is the key driver for the Stock Management risk factor as is total tonnes of nitrogen applied per effective hectare for the Nitrogen Fertiliser risk factor). Other specific sub practices that will exacerbate or mitigate the risk are then used to moderate the score for the underlying management practice. Practices that would increase the risk of nitrogen loss attract additional points, while others that reduce nitrogen loss risk are assigned negative points.

The reported risk for each of the 6 farm management practices is determined by points assigned to the key driver of the particular risk area, modified by the consideration of sub practices (e.g. animals held on stand-off areas equates to a negative score as the stocking rate risk is reduced by the specific practice). Where data granularity allows, the sub practice points are applied proportionately (e.g. as the data shows a higher percentage of animal hours are spent on a structure where effluent is collected, the corresponding risk points are proportionally decreased). An example of this process is shown at Graphic 1.

Graphic 1. An example of the sub practices that moderate the overall primary risk practice



Each management practice starts from a position of '0' points or no risk, with points added or subtracted depending on the data relating to sub practices. Total scores for the overall management practice risk can range from a negative score to a score greater than 80. All scores <20 are considered very low risk, likewise all scores greater than 80 are considered very high risk.

Points are calculated on a pro rata/proportional basis where data granularity allows e.g. points for how animals are managed through winter are determined by calculating the percentage of animals being wintered in each location and multiplying the percentage to the points for each location.

The results of the assessment are produced into a Scorecard report and sent out to participating farmers annually. The report also includes the individual management practice risk ratings, purchased nitrogen surplus metric as described above and an environmental overlay that describes the inherent 'riskiness' of soils and climate

4. Data behind the Scorecard

Fonterra collects annual farmer data through our FDRs. These can be completed by farmers online (90% of farmers opting for this method) or via a paper booklet. The data collected is sufficiently detailed to ensure all key risks can be robustly assessed. While the Scorecard does not require the same level of granular block level data detail as an Overseer file, to robustly assess risk the Scorecard still requires a comprehensive suite of farm management information. While Fonterra uses our FDRs to collect the data required for the Scorecard, the data could be collected through any templated data collection approach that aligned with the Scorecard data fields.

For example, to assess the level of risk associated with the use of nitrogen fertiliser, data is required that describes: total amount of nitrogen fertiliser applied annually, application rates, timing of applications, the use of feed planning/budgeting, and production kgMS (for an efficiency calculation). See the graphic below for an example of the format Fonterra farmers submit this information in.

Graphic 2: Example of FDR format

NITROGEN FERTILISER INPUTS

	Fertiliser type/name	Amount applied (required)	Application rate (Optional)	Block(s) applied to	Month applied	Records for verification?
	Preferably the company and product name	Enter quantity in tonnes	What is the application rate?	Name the block or blocks (from the Dairy Farm Block table on page 2) that this fertiliser quantity was applied to	Month the product was applied?	Are records available to verify application and where are they kept?
e.g.	NZFert: Urea	1.5	60 kg/ha	Pasture Blocks 1 and 3	January	Yes, fertiliser records stored in office
1	Urea	2	50kg/ha	Flats	Dec	Yes
2	DAP	10	50kg/ha	Hills	Nov	Yes

4.1 Data quality

To ensure data is as robust as possible and fit for purpose, measures are in place to minimise data entry errors and/or inaccurate data entry. Some fields within the online FDRs are pre-populated with data that is typically constant in steady-state farm systems across multiple seasons e.g. such as farm area, requiring farmers to update or edit the data if it has changed between seasons. Other data entry fields have built in validation to ensure accuracy, e.g. ensuring that the total area entered in management blocks is equal to the total effective farm area. However, similarly to modelling farm systems in Overseer, data quality remains the responsibility of the farmer.

4.2 Processing of the data

The FDRs data used to inform the Scorecard is submitted in digital format directly into Fonterra's website or via the paper version of the farm dairy records which is subsequently transferred to digital format. Data is then stored in tables within our internal customer relationship management system The Scorecard engine queries the data held within the tables for each individual risk factor, attributing points to the individual risk factor based on pre-set benchmark parameters. This data is then used to populate the farmer facing reports.

5. The six underlying management practices considered within the Scorecard

This section outlines the 6 key management practices that will impact on nitrogen loss risk:

- Stock management
- Nitrogen fertilisers
- Effluent management
- Imported supplement
- Cropping & cultivation
- Irrigation management

These practices are the main contributing practices to a farm's nitrogen loss risk that are within the farmer's control to manage. It is acknowledged that rainfall and drainage play a significant role in nitrate leaching in pastoral farming, however the Scorecard's primary purpose is to inform farmers on the level of risk associated with their management practices. An environmental overlay section reporting rainfall and soil type, is included in addition to the six management risk practices to provide an understanding of how this risk may translate into environmental loss.

5.1 Stock management

Management practice overview

A high stocking rate is a key driver for increased nitrogen leaching on farm. Excess nitrogen ingested by animals (i.e. that fraction that is not converted in to milk or meat), increases the urinary nitrogen concentration which is deposited back to the soil via urine patches. The amount of nitrogen in a urine patch far exceeds plant requirements and the excess is therefore susceptible to leaching during winter months when soil drainage is highest. The higher the stocking rate the greater amount of nitrogen ingested, increasing the underlying nitrogen loss risk. In addition, the Scorecard further moderates the stocking rate risk by:

- total dry matter (DM) eaten (increasing risk as more DM is consumed)
- management over the winter months
- if animals are grazed off farm
- Calving date (i.e. do they winter milk).

To do this the Scorecard calculates the total number of hours over the winter months and how many of these hours the animals spend off pasture on some type of off-pasture facility where the effluent is captured. Points are assigned on a pro rata basis in situations where there is a split between different wintering options. Calving date also moderates the initial score as autumn calving will generally be associated with higher loss than spring calving. If it is a split calving herd it would land in the middle.

5.1.1 Stocking rate

The calculation for this factor is the number of animals divided by the effective farm area:

Stocking Rate	Points	Risk rating on report
<2 cows/ha	0	≤2.0 cows / ha
2-2.5 cows/ha	20	2.1-2.5 cows / ha
2.5-3.5 cows/ha	30	2.6-3.5 cows / ha
3.5-4 cows/ha	40	3.6-4 cows / ha
>4 cows/ha	50	>4 cows / ha

5.1.2 Pasture eaten (tonnes dry matter per hectare)

The Scorecard moderates the stocking rate risk by assessing the total amount of dry matter eaten. It is acknowledged that stocking rate alone as a method of assessing nitrogen loss risk does not account for the difference in breed and age of animals, both of which will contribute to differences in total dry matter eaten. The higher the amount of dry matter eaten the higher the mount of nitrogen ingested by the animal, with excess nitrogen in the diet being returned to pasture as urinary nitrogen and nitrogen in excreta.

T Dry Matter eaten	Points	Risk rating on report
Up to 10 T DM /Ha	5	Up to 10 T DM /Ha
10-12 T DM /Ha	10	10-12 T DM /Ha
12- 14 T DM/Ha	20	12- 14 T DM/Ha
14 - 16 T DM/Ha	40	14 - 16 T DM/Ha
16 - 18 T DM/Ha	60	16 - 18 T DM/Ha
≥ 18 T DM/Ha	80	≥ 18 T DM/Ha

5.1.3 Wintering off during May - August

Wintering animals off the farm reduces the number of animals depositing nitrogen back onto soil via excreta (mainly from urine patches), in turn reducing the overall nitrogen loss risk.

Sub practices - risk points calculation:
This section moderates the peak stocking rate risk by reducing the points attributed under the peak stocking section. This is calculated using the percentage of time animals spend off farm between the months of May – August. A maximum risk reduction of 50% is available and is attributed to a farm where 80% or more of the animals are wintered off through this period.

Wintering Off	Reduction of points	Risk rating on report
80-100% animals off farm	50%	80-100% animals off farm
60-80% animals off farm	40%	60-80% animals off farm
40-60% animals off farm	30%	40-60% animals off farm
20-40% animals off farm	20%	20-40% animals off farm
0-20% animals off farm	10%	0-20% animals off farm

5.1.4 Wintering practises

As described in the introduction to this section, the practice by which the animals are wintered has a major impact on the overall risk profile of the farming system. A farm system that practices 'on/off' grazing, therefore reducing the amount of time cows spend on pasture, will reduce the overall nitrogen loss risk for the farm. The winter months for the purposes of this calculation are May – August and have a total of 2,952 hours.

The Scorecard uses data from several different sections within the FDRs, such as cropping, winter standoff/housing, monthly animal numbers to calculate the total hours the animals spend in each of these activities over the winter.

Sub practices - risk points calculation:

The points scale for winter practices range from -40 to 40 at the highest risk end. The negative points range represents the mitigating factor of having animals off pasture or crops and on a surface with a contained effluent management system.

The overall risk is determined by allocating points on a pro rata basis from the percentage of the time (total hours) animals spent on either:

- Structures – wintering Pads/standoff Pad
- Grazing on crops
- Pasture (this is simply calculated as the time NOT spent on structures OR on crops)

Winter grazing practice	Points	Risk rating on report
Off pasture (barn, wintering pad)	-40	Off pasture (barn, wintering pad)
On pasture	0	On pasture
Break feed fodder crop	40	Break feed fodder crop

Working Example:

165 hours on structures (5.6% of total winter hours)	5.6%	x	-40	-2.24
1,484 hours on crops (50.3% of total winter hours)	50.3%	x	40	20.12
1,301 (remaining hours) hours where spent on Pasture	44.1%	x	0	0

Total Points	17.88

These points are then added to the score achieved by calculating the initial stocking rate risk.

5.1.5 Replacements grazed on-farm

Replacements grazed on farm can contribute to a lower nitrogen conversion efficiency as there will be a higher amount of feed that is being directed into non-milk producing animals. This can mean more fertiliser, or more brought on feed to support milk production, is required. Lowering the replacement rate and/or grazing replacements off-farm will therefore reduce the total number of animals returning urine to the soil.

Risk points calculation:

Points are attributed, based on a combination of the replacement rate and the extent to which animals are permanently grazed on farm.

Replacements grazed on-farm	Points	Risk rating on report
Replacement rate < 20% always on farm	10	Replacement rate < 20% always on farm
Replacement rate ≥ 20% always on farm	20	Replacement rate ≥ 20% always on farm

5.2 Nitrogen fertiliser

Management practice overview

The Scorecard assesses the level of risk associated with nitrogen fertiliser applications by evaluating the following:

- the total tonnes applied per hectare,
- the rate of individual applications,
- the timing of applications,
- the ratio of nitrogen fertiliser to milk solids production
- the use of feed budgeting to inform strategic use of nitrogen.

Nitrogen fertiliser is one of three ways that nitrogen is introduced to a farm system along with imported supplements and atmospheric fixation.

Nitrogen surplus is the measure of the amount of nitrogen brought into the farm system that does not leave the farm as product. The nitrogen surplus is therefore the amount of nitrogen that remains within the soil profile available to be leached.

The higher the nitrogen surplus the greater the potential for leaching. Increasing the efficiency with which imported nitrogen is converted to product, (exported supplements, milk & meat) will help reduce the surplus nitrogen that might be lost to the environment.

Typically, higher amounts of nitrogen fertilisers will increase the surplus. While fertilisers are not generally a large direct contributor of nitrogen loss (except at high application rates and when applied in high risk months), they do contribute indirectly by supporting a higher stocking rate.

5.2.1 Total nitrogen fertiliser applications

The total amount of nitrogen used per annum is the main driver for the nitrogen management risk factor, which is calculated by summing the total amount of nitrogen fertiliser applied annually kg per hectare across all blocks. The higher the amount of imported nitrogen the greater the number of points and nitrogen loss risk that will be attributed to the farm as displayed in the table below.

Risk points calculation:

The points scale for imported nitrogen ranges from 0 to 200 representing no risk at 0 through to very high above 80. This is the main driver and therefore the starting score for this management practice which will be moderated by the remaining sub risk practices.

Nitrogen fertiliser applications	Points	Risk rating on report
N Fert applied: ≤ 50 kg/ha	0	N Fert applied: ≤ 50 kg/ha
N Fert applied: 50-100 kg/ha	10	N Fert applied: 51-100 kg/ha
N Fert applied: 100-150 kg/ha	30	N Fert applied: 101-150 kg/ha
N Fert applied: 150-175 kg/ha	50	N Fert applied: 151-175 kg/ha
N Fert applied: 175-200 kg/ha	60	N Fert applied: 176-200 kg/ha
N Fert applied: 200-225 kg/ha	70	N Fert applied: >200 kg/ha
N Fert applied: 226-250 kg/ha	90	
N Fert applied: 251-300 kg/ha	150	
N Fert applied: > 300 kg/ha	200	

5.2.2 Conversion efficiency of nitrogen fertiliser to product

The conversion efficiency calculates how many kgMS are produced per kg of nitrogen applied. The more imported nitrogen that is converted to product the greater the conversion efficiency and the lower the nitrogen surplus will be, in turn reducing the overall nitrogen loss risk.

Sub practice - risk points calculation:

This sub factor is calculated by simply dividing the total amount of milk solids produced by the total kgs of nitrogen applied via fertiliser.

Conversion efficiency of nitrogen fertiliser to product.	Points	Risk rating on report
kgMS / kgN Fertiliser: >25	-40	kgMS / kgN Fertiliser: >25
kgMS / kgN Fertiliser: 13-25	-20	kgMS / kgN Fertiliser: 13-25
kgMS / kgN Fertiliser: 9-12	0	kgMS / kgN Fertiliser: 9-12
kgMS / kgN Fertiliser: 5-8	20	kgMS / kgN Fertiliser: 5-8
kgMS / kgN Fertiliser: 2-4	40	kgMS / kgN Fertiliser: 2-4
kgMS / kgN Fertiliser: ≤1		kgMS / kgN Fertiliser: ≤1

5.2.3 Timing of application

This sub practice assesses the timing of application of nitrogen fertilisers. Nitrogen fertiliser that is applied to cold wet soils in winter months when plants are not actively growing will have significantly more chance of leaching due to the higher rainfall and lower plant uptake.

The Scorecard looks at the timing of every nitrogen fertiliser application applied throughout the year and groups them into the parameters in the table below. September to April is the lowest risk window for application, when the soils are warmer, and the plants are actively growing. The highest risk period is considered between May – June with July – August considered medium risk.

Sub practice - risk points calculation:

The Scorecard works by grouping each of the farm's fertiliser applications into one of the 3 parameters and reporting the worst result i.e. if fertiliser is applied at a rate of 20 kg/ha or above in May-June then the result for this sub section will be "High Risk".

It is acknowledged with this approach there are situations where a farmer is applying 90% of their fertiliser in the spring/summer period, however they may also apply a small single application in a medium or high-risk period. To ensure that this single relatively small fertiliser application doesn't distort the overall risk a minimum application of 20kg/ha for any application outside of the lowest risk months has been set.

Timing of application	Points	Risk rating on report
N Fert Applied: Sept – Apr	-10	N Fert Applied: Sept – Apr
N Fert Applied ≥ 20kg/ha: Jul – Aug	20	N Fert Applied ≥ 20kg/ha: Jul – Aug
N Fert Applied ≥ 20kg/ha: May – Jun	40	N Fert Applied ≥ 20kg/ha: May – Jun

5.2.4 Feed budget

This section recognises the good farming practice of using a feed budget, or wedge, as a tool to help plan strategic fertiliser applications rather than using a routine or blanket nitrogen use strategy. Using a feed budget/wedge to identify any potential feed gaps provides the farmer with the opportunity to evaluate the best way to fill the deficit. Options could include the strategic use of low rates of nitrogen fertiliser or it could be to substitute nitrogen by importing a low protein feed such as maize silage.

Feed budget	Points	Risk rating on report
Feed budget used	-20	Feed budget used
No feed budget used	0	No feed budget used

5.2.5 Average monthly application rates

The application rate is an important consideration as research has shown there to be diminishing responses at high application rates. Smaller well-timed applications have the potential to grow more DM particularly when matched to good growing conditions as this will ensure the opportunity for loss to the atmosphere and water are reduced.

Sub practice - risk points calculation:

This sub practice calculates the average amount of nitrogen applied in any given month to a block by summing all monthly fertiliser applications. Total nitrogen applied is then divided across the block(s) it was applied to. For example, where a nitrogen fertiliser application is applied to multiple blocks in a month, we will pro rata the application across the blocks it was applied to. This is necessary because Product A (20% Nitrogen) could be applied every month across Block 1 and Block 2 BUT Product B (46% Nitrogen) was applied every month across Block 1 only.

If the average of all fertiliser applications across all months are ≤25kg/ha this would be considered to reduce the overall nitrogen fertiliser risk.

Average monthly application rate	Points	Risk rating on report
Highest N fert applied is Below 25 kg/ha	-20	Highest N fert applied is Below 25 kg/ha
Above 25 kg/ha	0	Above 25 kg/ha

5.3 Imported feed

Management practice overview

This section looks at the contribution importing supplementary feed into the farm system makes towards the farm purchased nitrogen surplus, through the addition of nitrogen contained within the feed. The greater the amount of imported feed the more nitrogen that enters the system. In addition to the total amount of imported supplements, the nitrogen content of the feed is important to understand. Feeding supplements with high protein content also increases the nitrogen concentration in animal's urine.

A high amount of nitrogen introduced into the farm system can increase the nitrogen surplus and therefore the nitrogen loss risk.

Risk points calculation:

In this section, the Scorecard calculates the total amount of imported nitrogen from supplements and assesses this against the parameters in the table below. The average percentage nitrogen content of all imported supplements is also assessed giving the farmer an indication as to the potential increased risk through increasing urinary nitrogen. These two parameters allow a farmer to understand how much nitrogen is entering their farm and where on the risk scale their chosen supplementary feed sits in terms of nitrogen content. This enables a farmer to investigate if there is an opportunity to utilise a lower nitrogen content feed.

Lastly the conversion efficiency of the nitrogen from supplements into products is considered also.

5.3.1 Total nitrogen per hectare from imported feed

This sub practice calculates the total amount of nitrogen introduced to the farm via all imported supplements. This is then displayed per hectare (dividing the total nitrogen by the total effective area of the farm) to allow the figures to be comparable between farms.

Total nitrogen from imported feed	Points	Risk rating on report
Total imported N from Feed ≤ 40 kg/ha	0	Total imported N from Feed ≤ 40 kg/ha
Total imported N from Feed 40-80 kg/ha	20	Total imported N from Feed 41-80 kg/ha
Total imported N from Feed 80-120 kg/ha	40	Total imported N from Feed 81-120 kg/ha
Total imported N from Feed 120-160 kg/ha	60	Total imported N from Feed 121-160 kg/ha
Total imported N from Feed > 160 kg/ha	80	Total imported N from Feed > 160 kg/ha

5.3.2 Average nitrogen content of imported supplements

In this sub practice, the Scorecard calculates the average nitrogen content of the imported supplements. The average % of nitrogen in the total amount of imported supplement is calculated on a pro rata basis.

Nitrogen content of imported supplements	Points	Risk rating on report
Imported Feed with average N % < 1	0	Imported Feed with average N % ≤ 1
Imported Feed with average N % < 1.5	3	Imported Feed with average N % ≤ 1.5
Imported Feed with average N % < 1.75	6	Imported Feed with average N % ≤ 1.75
Imported Feed with average N % < 2.0	9	Imported Feed with average N % ≤ 2.0
Imported Feed with average N % < 2.25	12	Imported Feed with average N % ≤ 2.25
Imported Feed with average N % < 2.5	15	Imported Feed with average N % ≤ 2.5
Imported Feed with average N % < 2.75	18	Imported Feed with average N % ≤ 3.0
Imported Feed with average N % > 3.0	20	Imported Feed with average N % > 3.0

5.3.3 Conversion efficiency of nitrogen from imported supplements to product

The Scorecard calculates the conversion efficiency of nitrogen introduced via supplements to productive outputs.

Conversion efficiency of N from imported supplements	Points	Risk rating on report
KgMS / Kg N from Supplements: >50	-40	KgMS / Kg N from Supplements: >50
KgMS / Kg N from Supplements: 31-50	-20	KgMS / Kg N from Supplements: 31-50
KgMS / Kg N from Supplements: 21-30	0	KgMS / Kg N from Supplements: 21-30
KgMS / Kg N from Supplements: 11-20	20	KgMS / Kg N from Supplements: 11-20
KgMS / Kg N from Supplements: 1-10	40	KgMS / Kg N from Supplements: 1-10
KgMS / Kg N from Supplements: <1		KgMS / Kg N from Supplements: ≤1

5.4 Irrigation

Management practice overview

Irrigation generally increases the nitrogen loss risk of a farm due to the potential for over irrigating to induce drainage events (and therefore nitrogen loss). This can happen due to not scheduling irrigation events based on environmental conditions (e.g. a calculated soil moisture deficit to trigger an event or a target deficit to determine the amount to apply) or, the system is not capable of varying application rates or return periods. Some systems are inherently riskier than others irrespective of management, such as border dyke irrigation.
This section assigns a level of risk to a farm's irrigation system infrastructure, and the management of that system e.g. their ability to monitor when to start and stop irrigating as well as to know how much water to apply at each event. The base risk is set by irrigation system type and is then moderated by the method of scheduling and management of applications. This section is designed so that only a pivot/linear system with soil moisture monitoring and variable rate irrigation (VRI) can achieve "very low risk". All other systems, dependant on the management will range from medium to high risk.

5.4.1 Irrigation method

Evaluates the farm's irrigation method, with the pivot/ linear system being the most efficient irrigation method in terms of water use and border dyke the least efficient.

Risk points calculation:

Points are allocated on a pro rata basis calculated by the percentage of each irrigation method in use on the farm.

Irrigation method	Points	Risk rating on report
Pivot or Linear	40	Pivot or Linear
Rotary Boom, Gun or K-line	60	Rotary Boom, Gun or K-line
Border dyke or wild flood	90	Border dyke or wild flood

5.4.2 Irrigation scheduling method

This section evaluates the farm's irrigation scheduling method. The options are grouped into two distinct approaches (i) where a farmer does some measurement/modelling (soil moisture tapes/probes/budget) to inform irrigation decisions, or (ii) irrigation occurs as a fixed routine or decisions are based on visual assessment only.

Risk points calculation:
If a farm has multiple irrigation scheduling methods, points are allocated on a pro rata basis across the methods.

Irrigation Scheduling Method	Points	Risk rating on report
Soil moisture tapes/budget	-15	Soil moisture tapes/budget
Visual assessment OR when water is available	30	Visual assessment OR when water is available

5.4.3 Irrigation application method

This section evaluates a farm's irrigation scheduling method categorised into three options: Fixed depth & return method that doesn't allow the farmer any flexibility to adjust for the soil's current moisture content, deficit irrigation method, where the irrigation system and management provide for an application depth sufficient to refill the soil to a target water content, and VRI system, typically a pivot that can deliver variable rates of water in a single pass of the irrigator based on programmed GIS GPS data such as underlying soil type, crop type and stage of growth, position in the grazing round, or pre-programmed high-risk areas.

Risk points calculation:
If a farm has multiple methods of irrigation, we allocate points on a pro rata approach

Irrigation Application Method	Points	Risk rating on report
VRI	-10	VRI
Deficit irrigation	0	Deficit irrigation
Fixed depth & return	30	Fixed depth & return

5.5 Effluent

Management practice overview
The way in which effluent is managed can have an impact on the farm's nitrogen loss risk through several pathways. Evaluating management practices such as the disposal method of effluent (spread to land or treated and discharged to water), storage volume, application rates and scheduling management decisions that govern its application. The Scorecard assesses and rates these sub-practices individually to derive the overall score for the effluent section.

Discharging to water carries the maximum very high-risk due to the fact these types of systems are often discharging high levels of nutrient directly to water. Often these are legacy systems that haven't undergone infrastructural upgrades as the farm has grown, they also discharge other contaminates such as E. coli. These systems are followed in risk by a mixed system (both discharge to land and water). Non-optimal discharge to land is where the system either doesn't have capacity to store effluent during periods where soil moisture levels are not appropriate for effluent to be discharged, or the farmer has described their decisions around when to irrigate as being based on factors other than soil moisture content. i.e. when the pond is full, or on a set schedule. This section also measures the risk of effluent application depth.

5.5.1 Discharge method

There are 3 potential options within this section. Discharging to land, discharge to water or a system that utilises both water and land discharges. Discharging treated effluent to land with sufficient storage to store effluent during wet conditions is lowest risk, through to discharge to water as the highest risk.

Risk points calculation:

Discharge Method	Points	Risk rating on report
Discharge to Land	0	Discharge to Land
Discharge to Land (non-optimal)	40	Discharge to Land (non-optimal)
Discharge to Land and Water	80	Discharge to Land and Water
Discharge to Water	100	Discharge to Water

5.5.2 Effluent discharge application depth

The Scorecard evaluates the effluent system's ability to apply effluent at low depths. Lower application depths will ensure greater flexibility with management, with more irrigation days available (where soil moisture deficit >application depth). Lower application depths ensure the plant has a greater chance of using the nutrient within the effluent rather than draining through the soil profile or running off to surface water.

Risk points calculation:

Farms will attract the points from the highest risk activity only.

Effluent application depth	Points	Risk rating on report
Application depth <12 mm	0	Application depth <12 mm
Application depth >12 mm	10	Application depth >12 mm

5.5.3 Disposal area

Ensuring the effluent disposal area is sufficiently sized for the farm system is important from both an environmental compliance and animal health perspective. An under sized effluent area can result in the average amount of nitrogen/hectare applied exceeding local rules and regulations, it can also create animal health issues during calving from excessive build-up of soil potassium levels.

The nitrogen content of effluent fluctuates depending on several factors such as diet, the time cows spend on the yard during milking, time spent on a feed pad/housing, the amount of time the effluent is stored in a pond, the pond characteristics (depth, surface area) and if the system has solids removal.

The Scorecard uses a pragmatic approach to assess the level of risk associated with the effluent disposal area, evaluating it based on the number of cows per hectare of disposal area. This approach removes the need to estimate the many variables in the nutrient loading of stored effluent that is applied to land. Simple effluent area thresholds are well suited for identifying those systems where the area is likely to be marginal, and further assessment may be required.

Risk points calculation:

For farms without a feed pad the disposal area should be greater than 4hectaresa/100 cows. The points are calculated on a pro rata basis.

See Appendix 1 for further calculations:

Without a feed pad:

Effluent disposal area	Points	Risk rating on report
Disposal area > 4 ha/100 cows (no feedpad)	0	Disposal area > 4.0 ha/100 cows
Disposal area 3-4 ha/100 cows	10	Disposal area 3.1-4.0 ha/100 cows
Disposal area 2-3 ha/100 cows	20	Disposal area 2.1-3.0 ha/100 cows
Disposal area 1-2 ha/100 cows	30	Disposal area 1.1-2.0 ha/100 cows
Disposal area 0 ha/100 cows (no feedpad)	40	Disposal area ≤1.0 ha/100 cows

With a feed pad:

Effluent disposal area	Points	Risk rating on report
Disposal area > 7 ha/100 cows (with feedpad)	0	Disposal area > 7.0 ha/100 cows
Disposal area 5-7 ha/100 cows	10	Disposal area 5.1-7.0 ha/100 cows
Disposal area 3-5 ha/100 cows	20	Disposal area 3.1-5.0 ha/100 cows
Disposal area 1-3 ha/100 cows	30	Disposal area 1.1-3.0 ha/100 cows
Disposal area 0 ha/100 cows (with feedpad)	40	Disposal area ≤1.0 ha/100 cows

5.6 Cropping and cultivation

Management practice overview

Cropping/cultivation can impact on nitrogen leaching due to the release of mineral nitrogen after cultivation. The release of mineral nitrogen when not up taken by a crop can lead to leaching. Full cultivation stimulates faster soil organic matter decomposition and mineral nitrogen release than minimum or no-tillage practices. Direct drilling is considered to have an insignificant impact on mineralisation and therefore was excluded from assessment as a cultivation risk within the Scorecard.

This section evaluates the risk posed by total area of a farm cultivated, in conjunction with the method/type of cultivation used. Farms with routine pasture renewal using minimum tillage techniques are considered as a low or very low risk, with larger areas, winter crops and use of conventional cultivation considered higher risk. A farm can have multiple areas cultivated by either of the two methods and therefore each section is assessed individually. For example, a farm cultivating 10% of the farm via minimum till and another 10% of the farm via conventional will attract a total of 70 points.

The harvest season also plays a significant role in nitrogen loss risk, crops harvested in winter pose a higher risk to leaching both due to how they are harvested, (e.g. grazed in situ) and if they are left fallow through the winter period with high rainfall. The method of harvest is not included as a risk factor for the Cropping and Cultivation section, rather it has been included in the Stock Management – Wintering Practices section.

5.6.1 Minimum tillage

This section is evaluating the risk of the total area cultivated under minimum tillage. This is a lower risk activity than conventional cultivation, however the risk increases with the total area cultivated.

Risk points calculation:

The total percentage of the farm cultivated under each method is calculated as the total cultivated area divided by the total effective area of the farm.

Minimum tillage	Points	Risk rating on report
2% or less of farm cultivated annually	0	2% or less of farm cultivated annually
2-4% of farm cultivated annually	5	3-4% of farm cultivated annually
4-6% of farm cultivated annually	10	5-6% of farm cultivated annually
6-8% of farm cultivated annually	15	7-8% of farm cultivated annually
8-10% of farm cultivated annually	20	9-10% of farm cultivated annually
10-15% of farm cultivated annually	30	11-15% of farm cultivated annually
15-20% of farm cultivated annually	40	16-20% of farm cultivated annually
>20% of farm cultivated annually	50	>20% of farm cultivated annually

5.6.2 Conventional cultivation

This section is evaluating the risk of the total area cultivated under conventional cultivation. This is a highest risk activity and the risk increases with the total area cultivated.

Risk points calculation:

Uses the same method as above for minimum tillage.

Conventional cultivation	Points	Risk rating on report
2% or less of farm cultivated annually	10	2% or less of farm cultivated annually
2-4% of farm cultivated annually	20	3-4% of farm cultivated annually
4-6% of farm cultivated annually	30	5-6% of farm cultivated annually
6-8% of farm cultivated annually	40	7-8% of farm cultivated annually
8-10% of farm cultivated annually	50	9-10% of farm cultivated annually
10-15% of farm cultivated annually	70	>10% of farm cultivated annually
16-20% of farm cultivated annually	90	
>20% of farm cultivated annually	120	

5.6.3 Season of harvest

Crops harvested in winter pose a higher risk of leaching due both to how they are harvested, (e.g. grazed in situ) and if they are left fallow through the winter period with high rainfall increasing the leaching risk. The season of harvest utilises which month the crop was harvested. The method of harvest and the risks associated with the different harvest options, are captured and assessed under the Winter Stock Management section.

Risk points calculation:

The season of harvest is taken directly from the harvest date recorded for each crop. If any crop's harvest date falls in April, May, June, July, August or September the farm will fall in the Winter Harvest category below.

Season of harvest	Points	Risk rating on report
October-March	-30	Summer Harvest
April-September	30	Winter Harvest

5.6.4 Fertiliser applied during high risk months

This sub practice considers whether nitrogen fertiliser was applied to crops during the high-risk months of May, June, July and August

Risk points calculation:

Month fertiliser applied	Points	Risk rating on report
September-April	0	No fertiliser applied during winter
May-August	30	Fertiliser applied during winter

6. Environmental overlay and benchmarking

As discussed in an earlier section of this document, the primary focus of the Scorecard is to assess the level of risk associated with each of the 6 key management practices and report these in a way that is easy to interact with. Focusing on the factors understood by, and within the control of farmers, is more likely to lead to enduring change than the current focus on a modelled whole farm leaching number.

Purchased surplus does not consider other inputs/outputs of nitrogen from the farm system such as nitrogen fixation by plants and gaseous nitrogen losses from the farm and therefore is a simple calculation based on farm data rather than a complex modelling exercise as per the Overseer ‘surplus’ output.

An efficiency metric – such as purchased surplus – can be used to inform a farmer / advisor conversation around imported resource cost and the profitability opportunities associated with increasing nitrogen conversion efficiency. It can also be used to reference and monitor change over time.

Environmental factors such as rainfall and soil type clearly play a significant role in determining how much of the surplus nitrogen within the farm system leaches below the root zone. Relevant information on these two factors are included in the final output report for each farm. Farms can be benchmarked against others with similar soil types and rainfall.

Appendix

8. Appendix

Example table to use in the calculations of the effluent area. Taken from then DNZ 'A guide to managing dairy farm effluent – Auckland'

Nutrients in the effluent from 100 cows under different scenarios

	Nutrient in effluent from 100 cows (kg/yr)			Effluent area needed to apply 150 kgN/ha	
No Feed Pad - Farm dairy effluent					
	N	**P**	**K**	**% of farm**	**ha/ 100 cows**
All grass system (milking 270 days, twice a day)	590	70	540	11	4
Feeding 2tDM/ha of maize silage in paddock	668	80	668	12	4.4
Using a feed pad - farm dairy effluent plus feed pad effluent (Feeding 2tDM/ha of maize silage)					
Time on the pad	**N**	**P**	**K**	**% of farm**	**ha/ 100 cows**
1/2 hour per day on the pad	838	100	868	14	5.6
1 hour per day on the pad	1008	120	1044	17	6.8
2 hours per day on the pad	1348	160	1396	22	8.8
Feed comparisons (2 hours/day on the pad)					
4tDM/ha/yr Maize silage	1360	164	1460	25	8.8
4tDM/ha/yr Grass silage	1588	184	1668	29	10.4

Taken from the DNZ 'A guide to managing dairy farm effluent – Auckland'