Appendix 1 to Evidence of Richard Allen for Fonterra Co-operative Group Ltd

Nitrogen Risk Scorecard

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FARM SOURCE SUSTAINABLE DAIRYING

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 the Plan.

The Tiaki Sustainable Dairying Programme has a team of 30 Sustainable Dairying Advisors across the country dedicated to supporting farmers through the delivery of Farm Environment Plans. 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 very well suited to putting in place actions to manage contaminants such as sediment, microbes 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. To understand the nitrogen loss risk, detailed information about the farming practices needs to be collected and assessed to provide an 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 N risk assessment more objective, while remaining administratively efficient and presenting information back to farmers and farm plan advisors 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 figure to all farmers.

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 action on specific practices that are contributing to the nitrogen loss risk.

As a result, Fonterra have been developing an alternative approach to delivering our Nitrogen Programme, in a way that better fits with our strategic focus on achieving good farming practice outcomes through Farm Environment Plans.

This led to the development of a Nitrogen Risk Scorecard ('Scorecard'), a tool that provides for 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 weighted aggregated risk score 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 Sustainable Dairy Advisors 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 Farm Environment Plans.

Fonterra believes there is also an opportunity for the Scorecard to be used within a regulatory framework. The Scorecard concept was introduced through the submissions process to the Healthy Rivers Wai Ora Plan Change 1 in the Waikato. If adopted in to the plan the Scorecard has the potential to simplify implementation and decrease the costs of managing nitrogen under the Proposed Plan Change 1.

It is our view that the Scorecard may have a place in other regulated catchments due to its ability to simplify the implementation process, improve farmer engagement and decrease the costs and complexity of managing nitrogen. A method that reports on practices 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.

3. What is the Nitrogen Risk Scorecard?

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

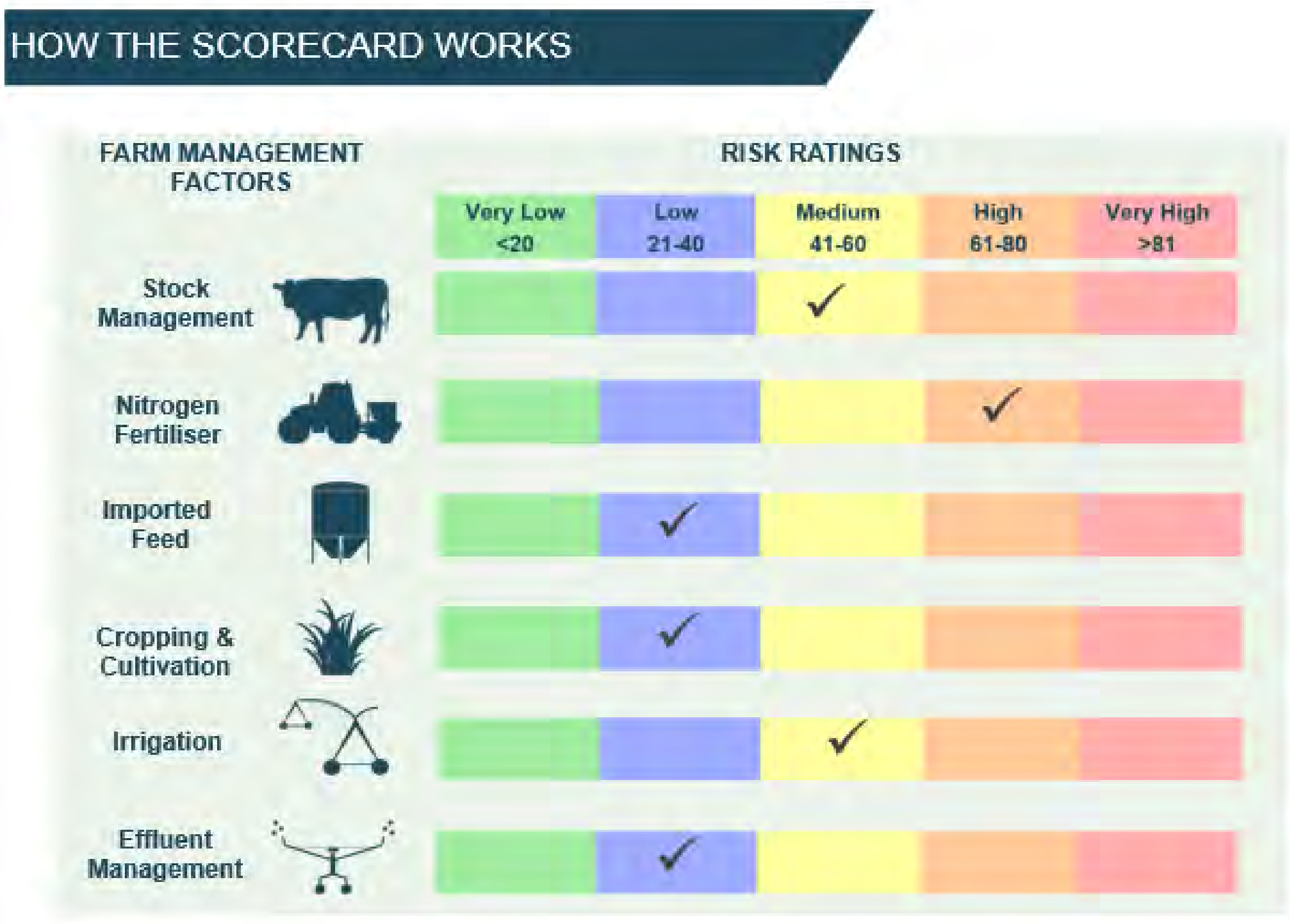
The Scorecard engine (written in a SQL database) queries annual farmer data submitted electronically through the Farm Dairy Records. The FDR data relates to six key farm management practices which the Scorecard assesses and applies a level of risk to each of those practices, against a set of benchmark parameters. The data collected via the FDR's is stored against each individual supply number by section making processing the data into the final output report of the Scorecard a repeatable and robust process uninfluenced by a processors interpretation of the data.

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 farmers control that might be expected to impact on the loss of nitrogen to the environment. The inclusion of a weighted aggregated risk score (i.e. a whole farm system risk metric), allows the Scorecard to be used for benchmarking / referencing and then monitoring change in whole farm risk over time.

3.1 How does the Scorecard assess risk?

The key output from the Scorecard is an assessment of risk across 6 key farm practices that are recognised as the primary drivers of farm nitrogen loss risk. These key farm practices are: stocking rate, imported N in fertiliser, imported N in feed, irrigation, cropping and effluent management. There are 5 simple risk ratings that can be applied to each factor; Very low, Low, Medium, High and Very High.

Diagram showing the 6 underlying farm management practices and risk ratings



- 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.
- High risk practices receive higher points then lower risk practices and mitigating practices carry negative points

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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 N 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 N loss risk carry negative points.

The reported risk for each of the 6 farm management practices is therefore based on a final score determined by points assigned to the key driver of the particular risk area, modified by the consideration of, and points applied to, a number 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 on a variable scale (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 the sub practices that moderate the overall primary risk practice

Stocking rate

Category	Metric	Points
S 1.1	SR <2 cows/ha	0
S 1.2	SR 2-2.5 cows/ha	20
S1.3	SR 2.5-3.5 cows/ha	40
S 1.4	SR 3.5-4 cows/ha	80
S 1.5	SR >4 cows/ha	100

How much time animals spend on each of these locations during April, May, June, July, August & September

Category	Metric	Points
S 2.1	Winter - Off pasture (Barn, wintering pad)	-40
S 2.2	Winter - On-Off grazed (Pasture)	-20
S 2.3	Winter - Pasture	0
S 2.4	Winter - Break feed fodder crop	40

Winter Milkers (Collections >15 days during June and July)

Category	Metric	Points
S 3.1	Calving - Spring	20
S 3.2	Calving - Autumn	20

As 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 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.

While the risk rating doesn't increase for a score above 80, the total points contribute to a weighted aggregated score for the property. The aggregated risk score allows for farm performance to be benchmarked and relative risk considered on a year by year basis. The aggregated score can also be used to consider underlying N loss risk against any selected peer grouping. (by soils, climate, farm system, catchment etc).

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, the aggregated score as described above and an environmental overlay that describes the inherent 'riskiness' of soils, climate and where possible, the sensitivity of the receiving environmental.

4. Data behind the Scorecard

Fonterra collects annual farmer data through our Farm Dairy Records. The Farm Dairy Records (FDR's) 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 data detail as an Overseer file, to robustly assess risk the Scorecard still requires a fairly comprehensive set of farm management information. (Note that 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 N fertiliser applied annually, application rates, timing of applications, the use of feed planning/budgeting, and production kg MS/ (for an efficiency calculation). See the table below for an example of the format Fonterra farmers submit this information in.

NITROGEN FERTILISER INPUTS

This section records the use of commercial nitrogen fertiliser.

NITROGEN FERTILISER INPUTS

FERTILISER TYPE/NAME	*Example: Ballance-Urea*				**BLOCK(S) APPLIED TO**				*Pasture Blocks 1 and 3*			
Month applied (required)	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
Enter quantity (tonnes)			*1.5*	*2*	*1.5*							
FERTILISER TYPE/NAME	Ballance - Urea				**BLOCK(S) APPLIED TO**				Milking Platform			
Month applied (required)	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
Enter quantity (tonnes)			2	6	8	8	8	6	8	6	4	
FERTILISER TYPE/NAME	Ballance -Urea				**BLOCK(S) APPLIED TO**				Runoff			
Month applied (required)	JUN	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY
Enter quantity (tonnes)							2	1	8	1		

4.2 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 FDR's are pre-populated with data such as farm area, where we already hold the data about a farm, allowing farmers to simply 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, ultimately data quality remains the responsibility of the farmer.

4.3 Processing of the data

The FDR data used to inform the scorecard is submitted in digital format directly into our website or via the paper version the farm dairy records which is subsequently transferred to digital format. Data is then stored in tables with our internal CRM system 'Farmer Central'. 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:

1. Stock management
2. Nitrogen Fertilisers
3. Effluent management
4. Imported Supplement
5. Cropping & Cultivation
6. Irrigation Management

These practices are the main contributing practices to a farms nitrogen loss risk that are within the farmers 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.

5.1 Stock Management

Management practice overview

A high stocking rate is a key N loss 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 N concentration which is deposited back to the soil via urine patches. The amount of N in a urine patch far exceeds the plants requirements and the excess is therefore susceptible to leaching during winter months when drainage is high. This section therefore evaluates the farm's stocking rate. The higher the stocking rate the greater the underlying nitrogen loss risk. In addition, the Scorecard further moderates this risk by how the herd is managed over the winter months and if they calve in autumn (Winter Milk).

To do this the Scorecard calculates the totals number of hours over the Winter months and how many of these hours the animals spend on off-pasture facilities where the effluent is captured. Points are applied pro-rata 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. If it is a split calving herd it would land in the middle.

5.1.1 Stocking Rate

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

Answer	Points	Risk
SR <2 cows/ha	0	
SR 2-2.5 cows/ha	20	
SR 2.5-3.5 cows/ha	40	
SR 3.5-4 cows/ha	80	
SR >4 cows/ha	100	

5.1.2 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 risk loss for the farm. The winter months are April – September and have a total of 4,392 hours.

The Scorecard uses data from several different sections within the FDR’s, 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. It is possible for a farms points to fall anywhere along this continuum. The negative points range represents the mitigating factor of having animals off pasture or crops on a structure with a contained effluent 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:

- structures – Wintering Pads / Standoff Pad
- Grazing on Crops
- Pasture (This is calculated as the time NOT spent on structures OR on crops)

Answer	Points	Risk
Off pasture (Barn, wintering pad)	-40	
On-Off grazed (Pasture)	-20	
On Pasture	0	
Extensive fodder crop	20	
Break feed fodder crop	40	

EG. Farm 12345's herd spent:

245 hours on structures (5.6% of total winter hours)	5.6%	x	-40	-2.24
2,208 hours on crops (50.3% of total winter hours)	50.3%	x	40	20.12
1,939 (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.

5.1.3 Winter Milking (Autumn Calving)

This section calving date also moderates to overall score as autumn calving will generally be associated with higher loss than spring. Farms are considered to have 'winter milked' if they have supplied greater than 15 days during June and July.

Risk points calculation:

Points are attributed to the highest risk activity only.

Answer	Points	Risk
Calving - Spring	-20	
Calving - Autumn	20	

5.2 Nitrogen Fertiliser

Management practice overview

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

1. the total tonnes applied per hectare,
2. the rate of individual applications,
3. the timing of applications,
4. the ratio of nitrogen fertiliser to milk solids production
5. 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 conversion efficiency at which imported nitrogen is converted to product (exported supplements, milk & meat) will help reduce the surplus available for loss.

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 / ha) 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.

Answer	Points	Risk
N Fert applied: 0-50 kg/ha	0	
N Fert applied: 50-100 kg/ha	10	
N Fert applied: 100-150 kg/ha	30	
N Fert applied: 150-175 kg/ha	50	
N Fert applied: 175-200 kg/ha	60	
N Fert applied: 200-225 kg/ha	70	
N Fert applied: 225-250 kg/ha	90	
N Fert applied: 250-300 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 KG's MS are produced per KG of N 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.

Answer	Points
N Fert/Kg MS: 0-0.05	-40
N Fert/Kg MS: 0.05-0.1	-20
N Fert/Kg MS: 0.1-0.15	0
N Fert/Kg MS: 0.15-0.2	20
N Fert/Kg MS: >.2	40

5.2.3 Timing of Application

This sub practice assesses the timing of application of nitrogen fertilisers. Fertiliser that is applied to cold wet soils in Winter months when plants are not actively growing will have significantly more chance of being leached due to the higher rainfall in winter.

The scorecard looks at the timing of every fertiliser application 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 warm and the plant 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 farms fertiliser applications into one of the 3 parameters and reporting the worst result i.e. if a single fertiliser application above 20 kg/ha is made 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 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 rate of 20kg /ha for any single application outside of the lowest risk months has been set.

Answer	Points	Risk
N Fert Applied > 20kg/ha: Sept – Apr	-10	
N Fert Applied > 20kg/ha: Jul – Aug	20	
N Fert Applied > 20kg/ha: May – Jun	40	

5.2.4 Feed Budget

This section recognises the good farming practice of using a feed budget or wedge to help plan strategic fertiliser applications rather than routine or blanket N use. The benefit of 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 N fertiliser or it could be to substitute N by importing a low protein feed such as maize silage.

Answer	Points
Feed Budget Used	-20

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 N applied in any given month to a block by summing all monthly fertiliser applications entered the FDR's. A look-up table is used to determine the N content of each fertiliser product applied. Total N is then divided across the block(s) it was applied to. For e.g. where an N Fert 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 N fertiliser risk.

Answer	Points
Highest N Fert Applied < 25kg/ha	-20

5.3 Imported Feed

Management practice overview

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

A high amount of N introduced into the farm system will increase the N surplus and therefore the N loss risk. It is therefore important to understand how much N is being introduced from supplements to ensure it is efficiently converted to product.

Risk points calculation:

In this section, the Scorecard calculates the total amount of imported N from supplements and assesses this against the parameters in the table below. The average percentage N content of all imported supplements is also assessed giving the farmer an indication as to the potential increased risk through increasing urinary N.

These two parameters allow a farmer to understand how much N is entering their farm and where on the risk scale their supplements sit in terms on N content. This would provide information such that the farmer could investigate if there is an opportunity to utilise a lower N content feed.

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

5.3.1 Total imported N ha from imported feed

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

Answer	Points	Risk
Total imported N from Feed < 40 kg/ha	0	
Total imported N from Feed 40-80 kg/ha	20	
Total imported N from Feed 80-120 kg/ha	40	
Total imported N from Feed 120-160 kg/ha	60	
Total imported N from Feed > 160 kg/ha	80	

5.3.2 Average Nitrogen content of imported supplements

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

Answer	Points	Risk
Imported Feed with average N % < 1	0	
Imported Feed with average N % < 1.5	5	
Imported Feed with average N % < 1.75	10	
Imported Feed with average N % < 2.0	15	
Imported Feed with average N % < 2.25	20	
Imported Feed with average N % < 2.5	25	
Imported Feed with average N % < 2.75	30	
Imported Feed with average N % > 3.0	40	

5.3.3 Conversion efficiency of Nitrogen from imported supplements to product

The Scorecard calculates the conversion efficiency of N introduced via supplements to product. Measures the efficiency of Nitrogen from supplements converted into kg MS

Answer	Points	Risk
N Supplements /Kg MS: 0-0.05	-40	
N Supplements /Kg MS: 0.05-0.1	-20	
N Supplements /Kg MS: 0.1-0.15	0	
N Supplements /Kg MS: 0.15-0.2	20	
N Supplements /Kg MS: >.2	40	

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.

This section assigns a level of risk to a farms irrigation system, the and the management of the 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 irrigator 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 VRI can achieve very low risk. All systems dependant of the management will range from medium to high risk.

5.4.1 Irrigation Method

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

Risk points calculation:

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

Answer	Points	Risk
Pivot or Linear	40	
Rotary Boom, Gun or K-line	60	
Border dyke or wild flood	90	

5.4.2 Irrigation Scheduling Method

This section evaluates farm's irrigation scheduling method. The farmer's ability to decide when to start and when to stop irrigating. 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 decision are based on visual assessment only.

Risk points calculation:

If a farm has multiple irrigation scheduling methods, we allocate points on a pro rata basis across the methods.

Answer	Points	Risk
Soil moisture tapes/probes/budget	-15	
Fixed routine or visual assessment	30	

5.4.3 Irrigation Application Method

This section evaluates a farm's irrigation scheduling method breaking them down into three options. A Fixed depth & return method being the highest risk as this doesn't allow the farmer any flexibility to adjust for the soils current moisture content. A deficit irrigation method where the irrigation system and management provides for an application rate sufficient to refill the soil to a target water content.

Lastly variable rate irrigation (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

Answer	**Points**	**Risk**
VRI	-10	
Deficit irrigation	0	
Fixed depth & return	30	

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 treat and discharge to water), storage volume, application rates and what the management decisions are 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 is 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 under gone infrastructural upgrades as the farm has grown, they also discharge other contaminates such as E. coli. These systems are closely 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 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.

5.4.4 Effluent 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. Discharging treated effluent to land with the sufficient storage to store effluent during wet conditions is lowest risk through to discharge to water at the highest risk.

Risk points calculation:

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

Answer	Points	Risk
Discharge to Land	0	
Discharge to Land (non-optimal)	40	
Discharge to Land and Water	80	
Discharge to Water	100	

5.4.5 Effluent Discharge Application Depth

The Scorecard is simply evaluating the effluent systems ability to spray effluent at low rates. Low rates will ensure greater flexibility with management with more irrigation days available, it will 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.

Answer	Points	Risk
Application depth <12 mm	0	
Application depth >12 mm	20	

5.4.6 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/ha applied exceeding local rules and regulations, it can also promote animal health issue 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.

Due to this 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 Ha of disposal area. While this is an older more rule of thumb approach it serves to identify those systems where the size is at the marginal level and further assessment may be required.

Risk points calculation:

For farms without a feed pad the disposal area should be greater than or equal to 4ha/100 cows.

See Appendix for further calculations:

Without a feed pad:

Answer	Points	Risk
Disposal area > 4 ha/100 cows	0	
Disposal area < 4 ha/100 cows	20	

With a feed pad:

Answer	Points
Disposal area < 6ha/100 cows ½ hour spent on the pad	20
Disposal area < 7 ha/100 cows 1 hour spent on the pad	
Disposal area < 9 ha/100 cows 2 hours spent on the feed pad	

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. The cultivation method is significant in the impact of releasing mineral nitrogen with conventional cultivation creating a greater risk as it breaks up organic compounds containing mineral nitrogen.

Therefore, the total area cultivated each year is one of the determining factors in the amount of N that becomes mineralised. Through the peer review process direct drilling was 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 should come out as a low or very low risk, but bigger areas, winter crops, conventional cultivation will end up higher risk.

The harvest season also plays a significant role, 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 to the Cropping and Cultivation section rather it has been included in the Stock Management - wintering practices section.

5.5.1 Minimum Till

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 by, the total area reported via the FDR's divided by the total effective area of the farm. 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.

Answer	Points	Risk
2% or less of farm cultivated annually	0	
2-4% of farm cultivated annually	5	
4-6% of farm cultivated annually	10	
6-8% of farm cultivated annually	15	
8-10% of farm cultivated annually	20	
10-15% of farm cultivated annually	30	
15-20% of farm cultivated annually	40	
>20% of farm cultivated annually	50	

5.5.2 Conventional

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.

Answer	Points	Risk
2% or less of farm cultivated annually	10	
2-4% of farm cultivated annually	20	
4-6% of farm cultivated annually	30	
6-8% of farm cultivated annually	40	
8-10% of farm cultivated annually	50	
10-15% of farm cultivated annually	70	
15-20% of farm cultivated annually	90	
>20% of farm cultivated annually	120	

5.5.3 Season of Harvest

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 increasing the leaching risk. The season of harvest simply determines which month the crop was harvested, the method 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 taken from the farm dairy

Answer	Points	Risk
Summer Harvest	-30	
Winter Harvest	30	

5.5.4 Fert Applied in May, June, July August

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

Risk points calculation:

If fertiliser is applied during high risk months attribute 30 points

Answer	Points
N Fert applied MJJA	30

6. Aggregated Score

The Aggregated Score gives farms an overall Nitrogen Risk Score, which can be used for benchmarking and potentially for regulation. The score is an aggregation of the risk ratings from the six practices:

- Nitrogen
- Imported Feed
- Stock Management
- Irrigation
- Effluent
- Cropping and Cultivation

Each of the practices contribute varying amounts of risk to each farm's whole farm nitrogen loss risk, therefore they are weighted to appropriately represent the risk. Scores for each individual risk factor will be calculated. The aggregated score will be derived from multiplying each risk factor by a weighted co-efficient held in a reference table.

The aggregated score doesn't account for variables. If data is not submitted for a practice, it is assumed the farm does not undertake that practice e.g. if a farm doesn't use irrigation, they have no risk from irrigation.

7. 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.

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 will be included in the final output report for each farm. This additional information will provide a farmer with further context as to how their overall reported risk from management practices may be exacerbated due to a soils water holding capacity and the annual rainfall.

Note: The current singular focus on high leaching loss farms, in our view means the opportunity to address significant nitrogen use inefficiencies, that might occur on any farm is being missed. Identifying and addressing inefficient resource use, regardless of the climate and soils factors that might create a higher or lower leaching risk, is an opportunity to decrease total nitrogen losses and therefore loads to water. The Scorecard can directly support robust efficiency actions in Farm Environment Plans – even where modelled leaching numbers are low.

Farms will be benchmarked against others with similar soil types and rainfall. In addition, the Scorecard calculates and reports the farms nitrogen 'simple surplus'. Simple surplus for the purposes of the Scorecard being: nitrogen imported through fertiliser and feed minus nitrogen leaving the property in productive outputs, reported as Kg N/ha. This is metric that has been widely used in other countries to understand the efficiency of resource conversion in to productive outputs.

Simple 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 simple surplus – can be used to inform a farmer / advisor conversation around imported resource cost and the profitability opportunities associated with increasing nitrogen conversion efficiency. Like aggregated score it can also be used to reference and monitor change over time.

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 - famr 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 then DNZ 'A guide to managing dairy farm effluent – Auckland'