



**Providing knowledge**  
St Peter's School/Lincoln University  
Demonstration Dairy Farm



ST PETER'S • CAMBRIDGE  
NEW ZEALAND



**Lincoln University**  
*Te Whare Wānaka o Aoraki*  
AOTEAROA • NEW ZEALAND

New Zealand's specialist land-based university

# Farm Focus Day

Wednesday, 8 March 2017

## St Peter's School / Owl Farm Hazard Notifications

Children are the responsibility of their parent or guardian

Normal hazards associated with a dairy farm

Other vehicle traffic on farm roads and races

Races may be slippery



# HAZARD SUMMARY

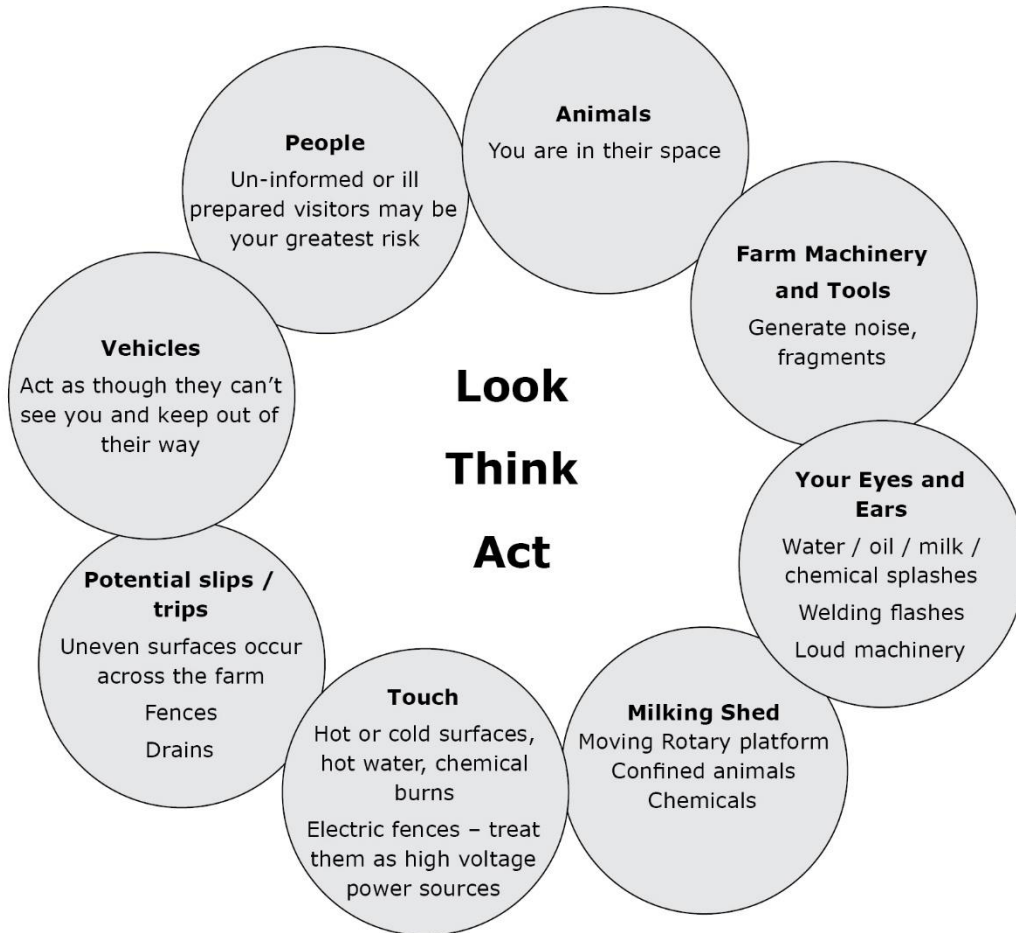
## Welcome to Owl Farm

Owl Farm is a fully operational commercial dairy farm with a number of potential hazards to both visitors and staff.

Many of these potential hazards cannot be eliminated while providing access to visitors therefore all staff and visitors MUST watch for potential hazards and act with caution.

## Hazard Summary

The following diagram provides a reminder of the types of hazards present.



**ARE YOU TRAINED FOR WHAT  
YOU ARE ABOUT TO DO?  
If not, STOP.**

**If you are uncertain how you should act or proceed stop and  
contact the farm manager, other farm staff or your host.**

In being on Owl Farm you are acknowledging your receipt of this hazard summary. By doing so you also agree to be personally responsible for monitoring any potential hazards and agree to act conscientiously to protect yourself and any others who are also on-farm.



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**Owl Farm**

St Peter's School Campus

**Legend**

- ☐ Paddock
- ☐ Farm and school extent
- ☐ Parcels (as at 02/04/2016)

Contains data sourced from Land Information New Zealand under CC-BY

0 100 200 m

1:2,500 @A0

Projection: NZGD 2000 New Zealand Transverse Mercator  
Project No: 3-38970.00  
Date: 28/04/2016  
Author: Renee Schicker@Opus.co.nz



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# OWL FARM - ST PETER'S SCHOOL / LINCOLN UNIVERSITY

## DAIRY FARM STRATEGY

### 1. Vision

#### a. Dairy Farm

- To apply proven research, utilising good on farm practice and scientific monitoring for the farm to become an exemplar in dairy production, financial, environmental and people performance, while maintaining the highest standards of health and safety.

#### b. Students

- To encourage more young people into the dairy industry.

### 2. Strategic Objectives

#### a. Dairy Farm

- Providing leadership to dairy farmers and the wider community by demonstrating progressive practices that can be achieved on farm.
- Optimise profit through identifying the appropriate dairy production system for Owl Farm.
- Achieving a farm sustainable environmental footprint based on industry good management practice.
- To attract, train and retain quality employees.

#### b. Students

- To provide educational opportunities and exposure to the dairy industry which demonstrates career opportunities to students.

### 3. Farm Development Stages

#### a. Stage 1 Objective (2015/16 – 2017/18)

Establish credibility by addressing current issues and performance, whilst setting up the farm for future development. During this stage, the farm will operate a pasture based system, with tactical supplementation strategies, based largely on existing infrastructure, to optimise profit while developing a resilient farm system.

#### b. Stage 2 Objective (2018/19 – onwards)

Testing and investigating in conjunction with partners, innovative strategies to lead sustainable profit. The farm system will be developed over years 1-3 and reflect demonstration requirements of industry that are relevant and appropriate at that time point.

### 4. Stage 1 Operational Objectives

#### a. Dairy Farm Performance

Owl Farms high level operational objectives relating to the farms performance throughout the duration of stage 1 (2015/16 – 2017/18) are outlined below. A full breakdown of specific key performance indicators within each of the following objectives can be found within the separate Stage 1 – Dairy Farm Performance Plan in which the farms annual performance can be measured and reviewed.

##### i. Planning, monitoring and reporting

- To ensure all farm management and commercial planning is supported by a sound business case, solid rationale and effective modelling
- Set appropriate goals that reflect the strategy, objectives and development plans for Owl Farm, with time bound action plans and key performance indicators.
- To ensure accurate and transparent reporting of success or failures of objectives is undertaken in line with agreed timeframes.
- To ensure performance is reviewed in line with objective timeframes set out within Stage 1 Plan.

##### ii. Financial

- To optimise profit returned through balanced financial management within the farms existing management system
- Invest appropriately in capital development to enable improved productivity.

##### iii. Environmental

- To implement sound science supported environmental management systems to achieve sustainable growth and profit while protecting the wider environment.

- To ensure compliance with all regulatory and industry requirements
- To engage with stakeholders to lead towards sustainable farming objectives while influencing future direction.
- To show leadership in establishment of biodiversity management practices relevant to the Waikato.

**iv. People**

- To implement best practice in people management.
- To develop and implement best practice effective health and safety systems and build a culture that ensures staff, contractors and any other visitors are protected as much as practicably possible while on farm.

**v. Herd Performance**

- To capitalise on genetic merit of herd with regard to per cow production
- To achieve or exceed industry targets for mating performance
- To meet or exceed all recognised industry standards regarding body weights and condition within a profitable system
- Use data to measure effectiveness of actions and make information readily available
- Effective health control is optimised through preventative treatments and any immediate health issues are treated as a priority
- To adopt practices in line with the animal welfare code

**vi. Soil**

- To have soil fertility levels (and fertiliser application) sufficiently high to optimise pasture and/or crop production
- To review and enhance Nutrient use efficiency over time
- To actively strive to avoid physical damage to the soil from pugging or mechanical means

**vii. Pasture, crops and feeds**

- To optimise pasture and crops grown and harvested so that cows consume as much metabolisable energy as practical from grazed pastures, home grown crops and supplements.
- To integrate strategic use of appropriate supplementary feed when there is a genuine feed deficit and where there's a clear financial return.

**viii. Community engagement**

- To establish Owl Farm so as to develop and demonstrate good practice in pasture based dairy farming systems and to transfer good practices to dairy farmers.
- To develop and implement a communications plan to engage the wider community around what we are doing and why.
- Contribute to building positive perceptions around dairying.

**b. Stage 1 – Students**

**i. Educational**

- Facilitate student farm visits to provide genuine exposure to farm and associated activities.
- Facilitate partner presentations within the educational curriculum.
- Provide data for student analysis that may benefit their area of school learning.
- Support the re-establishment of TeenAG programme within the school.

**ii. Career opportunities**

- Demonstrate career opportunities which exist within dairying and the primary industries through providing exposure with partners and associated companies businesses.

**iii. Community engagement**

- Provide farm as a resource to other school groups (primary/secondary) to support positive exposure to the dairy industry.
- Facilitate and complete a farm open day for all secondary schools.

**5. Stage 2 – Operational Targets**

**a. Dairy Farm Performance**

Stage two will continue to evolve over the space of the next 3-6 years.

## Owl farm SNAPSHOT

### Area

- Milking: 150 effective hectares
- Free hold land: 132 hectares
- Lease land: 18 hectares

### Stock

- 430 – 460 cows milked
- BW 110/43
- PW 133/50
- Ancestry 99%
- There is historically 6 weeks of AB followed by 4 weeks with bulls for a total mating period of 10 weeks.

### Soils

- The farm is long and narrow with 3.4km's boarding the Waikato River.

#### *Soil Type:*

Otorohanga deep clay

Pukehina deep sand

Kainui deep slit clay

Turangi deep sand

Rotokauri deep clay loam

Kaipaki deep peat

#### *Location:*

SH1, river and centre north

North of farm

Behind the Kahikatea Stand

Deer block

School grounds

Gully below the Avantidrome

### Topography

- Vary dramatically from heavy clays to light sands. The topography is flat contour over three terraces.

### Cowshed

- 36 bale rotary shed with cup removers, built in 1970 with an updated Waikato plant.
- Cows are run in two herds due to capacity of yard being only 400.

### Staff

- Farm Manager, Assistant Farm Manager and Dairy Assistant (3FTE).

### Effluent

- Direct application through sump and pump to travelling irrigator when conditions suit to 44ha.
- Effluent holding pond used when conditions don't suit application.

### Nitrogen

- 150kgN/ha is generally the maximum applied in any year
- Soil testing is undertaken in April annually to provide the fertiliser recommendations for coming season.

### Cropping / pasture

- 10% pasture renovation strategy achieved through summer cropping.
- Either turnips or chicory dependent on predicted summer conditions.
- Weekly pasture metering undertaken as well as annual pasture condition scoring, allows us to identify paddocks most in need of renovation.

### Supplement

- A mixture of grass silage, PKE and maize is used annually.



# OWL FARM SEASON TO DATE

NB: All information below can be found on our new and interactive website [www.owlfarm.nz](http://www.owlfarm.nz)

## General

- Past the half way point in the season and as expected we've experienced the usual ups and downs. Spring was obviously very challenging with the continuous rain impacting utilisation and production. The last 3 months have been better than expected with strong growth and good management improving the quality of feed. Production has been lifting steadily throughout this period. We are now facing dry conditions which is going to make fully feeding the herd difficult. Fortunately we have plenty of supplement on hand which will hopefully see us through the dry.
- The production overview below from Fonterra illustrates how we are tracking. Fortunately we have managed to capitalise on good conditions over the past few months to claw back lost production. This is a credit to Tom and team who have managed conditions very well.

Production	Quality	Protein & Fat	...more	<input type="checkbox"/> Show smoothed data ?			
Date	Litres	KgMS This Season		KgMS Last Season	Total KgMS	KgMS (%)	Avg. SCC
FebMTD	138,488	12,766.4	↑ 6.9%	11,942.5	144,928	9.60	116
January	222,115	20,696.9	↑ 7.8%	19,201.1	132,162	9.32	111
December	223,352	20,336.8	↓ 0.3%	20,396.8	111,465	9.11	100
November	229,509	20,430.8	↓ 7.7%	22,137.1	91,128	8.90	110
October	240,442	20,895.7	↓ 16.1%	24,899.3	70,697	8.69	97
September	263,880	23,266.5	↓ 0.7%	23,422.1	49,802	8.82	116
August	225,559	20,440.1	↑ 6%	19,276.5	26,535	9.06	147
July	62,475	6,095.2	↓ 9.8%	6,755.6	6,095	9.76	204
June	...	...	—	...	...	...	...
Total	1,605,820	144,928.3	↓ 2.1%	148,031.0	144,928	—	—

- Planning is well advanced for next season and beyond with regards to the modelling work that has been undertaken.
- The farm budget is in good shape after increases to the farm gate milk payout and tight management of expenses from Tom.
- Coming into the back end of the season there are a few things front of mind for us.
  - Firstly, it's important we continue to fully feed the cows as we start looking towards protecting next season's performance by targeting body condition gains. We are fortunate in that the cows are also milking exceptionally well at present and in setting up for next season, we are also chipping away at our season to date deficit.
  - We are also mindful of eczema and closely monitoring spore counts given the large scale impacts this had last season. The herd has received a zinc bolus. This is a significant cost but we weren't confident in relying on water treatment alone based what happened last season.
  - Majority of empties have been culled as we look to conserve as much feed as possible for those stock which form our productive herd next year.
  - We have undertaken our summer pasture condition scoring exercise which enables us to identify our worst paddocks to put through our pasture renovation policy which includes a rotation of both annual ryegrass and chicory. This information also helps to reviewing the success of recent pasture renovation.

## NOTES

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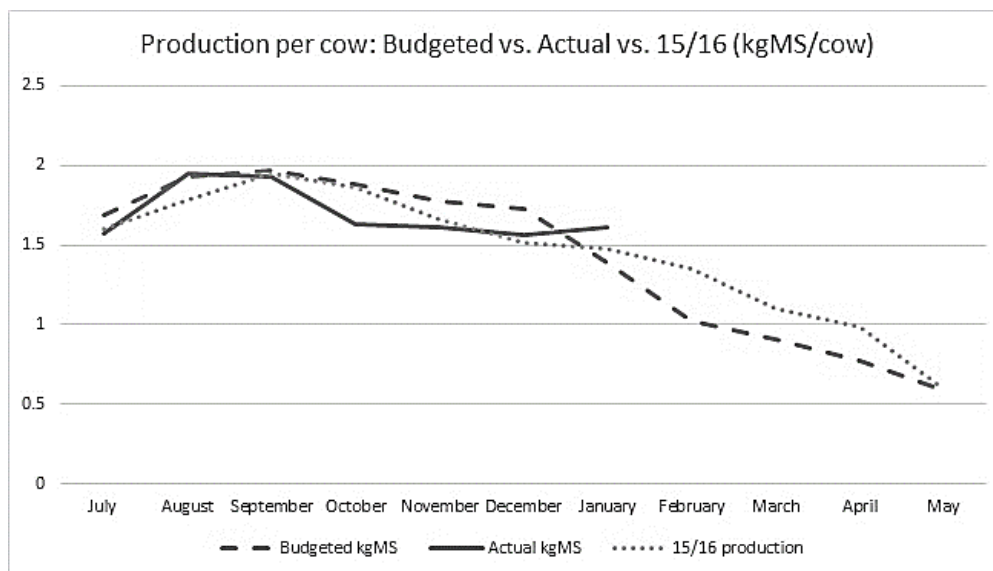
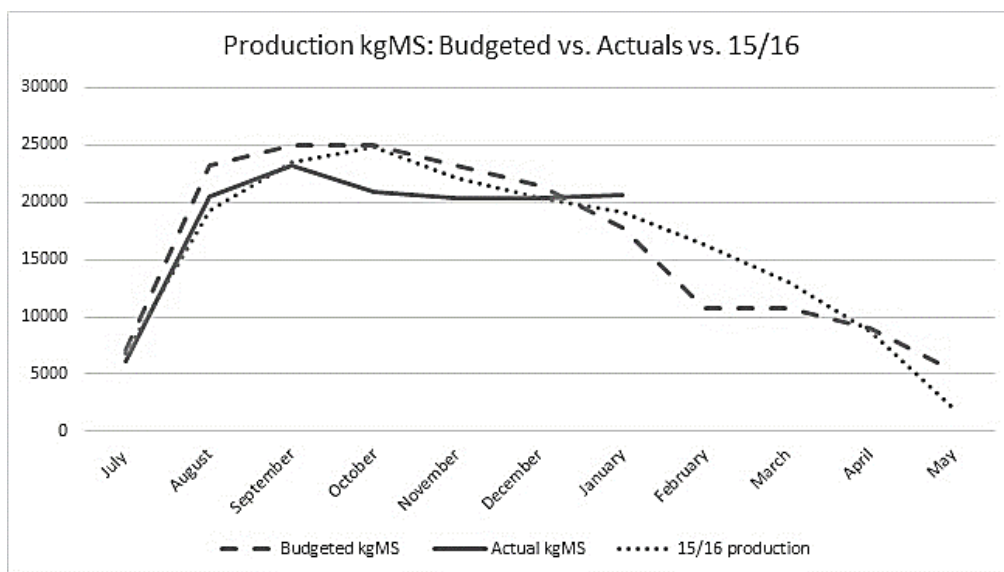


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## Milk Production

- We are currently recapturing lost ground with a 2.1% STD deficit from last season which is now getting smaller by the week. This deficit was as high as 5% behind earlier in the season.
- Although 2.1% behind STD we are also milking 4% less cows than last season which essentially puts us ahead on a per cow basis.
- The last two months have seen us significantly lift production on last season's January and February's production. This is largely down to better than anticipated growth rates and pasture quality allowing us to offer more pasture coupled with the introduction of summer chicory into the diet. It was quite remarkable to see the immediate lift in production when the cows first started grazing the chicory. They literally went up from 1.5kgMS to 1.7kgMS/cow overnight and managed to hold for the first half of January, this saw us finish almost 8% ahead for January.
- The following graphs illustrate the production challenges during spring but reflect a positive story for the past two months.



- Although capturing lost ground with the potential to finish at a similar position to last season, we are still likely to fall short off our budgeted season ending milk production. The following graph shows we are still 8% behind on budgeted production year to date. This trend seems to be fairly represented throughout the Waikato.

## NOTES

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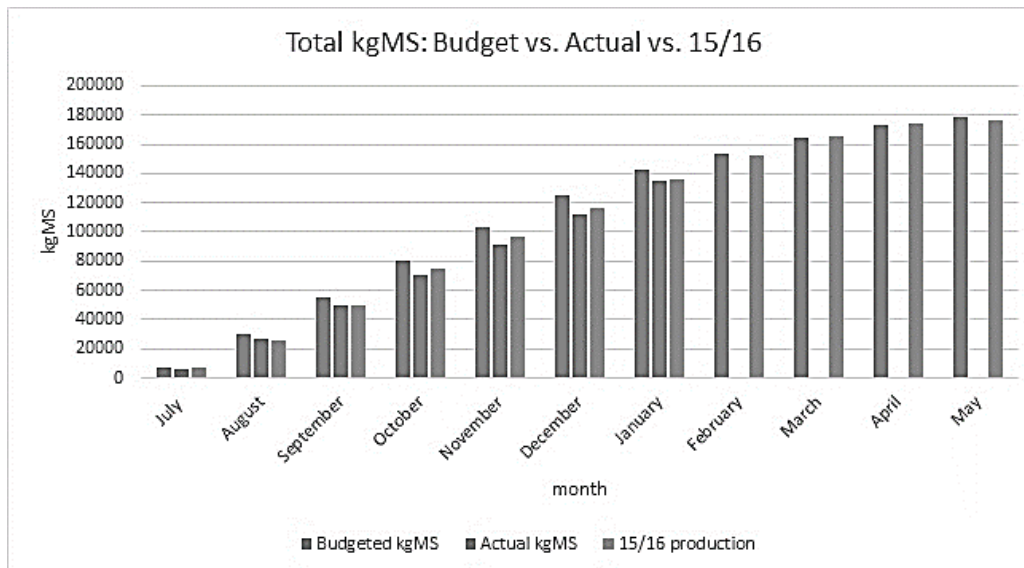


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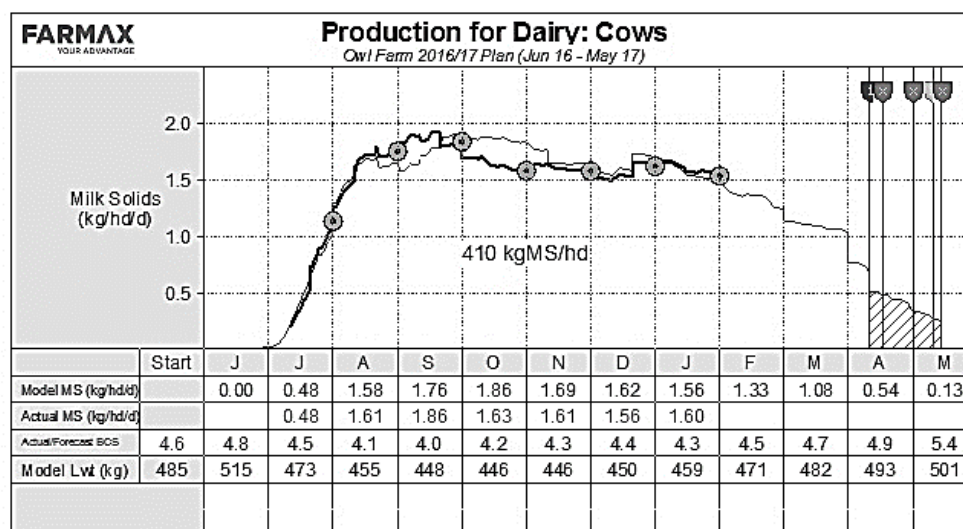


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- The below graph represents the Farmax production curve with the thin line showing modelled production based on feed offered, utilisation and energy while the thick line represents the actuals.



- The goal for the remainder of the season is to continue fully feeding the cows. Through this we are confident of not only improving body condition, but also capitalising on production.
- Given we hope to better mitigate the risk of eczema this season, it's possible we will finish on par or slightly ahead of last season. Although this would still be behind our budgeted production, it would be classified a win after the widespread challenging spring which was experienced.
- I wish to acknowledge Tom and team here for the hard work and commitment they have delivered in pulling production back over the past 3 months.

## Animal Health

- To follow is our fertility focus report which has been pulled from Minda. Although the results largely reflect the outcomes, there are a couple of aspects which have influenced the actual numbers to be slightly different from those here.

## NOTES

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- The number which the % are worked from is quite rightly 431 cows. We identified 11 cows which were going to be culls and therefore were considered for AI.
- Our initial pregnancy testing identified 313 cows in calf at 6 weeks.  $313/420 = 75\%$  - which is slightly higher than the 73% recorded.
- Our not in calf rate is also being calculated of the dominator of 431 cows. Off those 420 which we put, 41 have been recorded not in calf and have now largely been culled. With the additional 11 which were considered for mating, this would put the total at 52.  $52/431 = 12\%$  empty, if we worked off  $41/420$  (that we put up for mating), its closer to 10%. Both numbers are reasonably high but from what we have been hearing, empty rates on average have been double that of last season with the difficult conditions observed during mating.

## Fertility Focus 2016: Seasonal

**St Peters School Farm**  
**Doug Dibley**

Report date: 23/02/17

PTPT: HPTT

Herd Code: 2/1884

No of cows included: 431

These cows calved between: 21/05/16 and 26/11/16

Mating start & end date: 28/09/16 - 11/12/16  
(based on AI or pregnancy test data)

Next planned start of calving: 07/07/17

Duration of mating: 75 days

Duration of AB period: 45 days

### 1 Overall herd reproductive performance

**6-week in-calf rate**  
Percentage of cows pregnant in the first 6 weeks of mating

Your herd **73% (73-74%)** ☆☆☆☆☆

Aim above **78%**

**Not-in-calf rate**  
Percentage of cows not pregnant after 75 days of mating

Your herd **13% (11-13%)** ☆

Aim for **7%**

**% of herd in calf**  
Cumulative by week of mating

### 2 Drivers of the 6-week in-calf rate

**3-week submission rate**  
% of cows that were inseminated in the first 3 weeks of mating

Your herd **84%** ☆☆☆

Aim above **90%**

**Non-return rate**  
% of inseminations that were not followed by a return to heat

Your herd

Aim above

**Conception rate**  
% of inseminations that resulted in a confirmed pregnancy

Your herd **55%** ☆☆☆

Aim above **60%**

### 3 Key indicators to areas for improvement

**Calving pattern of first calvers**  
Well managed heifers get in calf quickly and calve early.

Calved by	Week 3	Week 6
Your herd	83%	93%
Aim above	75%	92%

**Calving pattern of whole herd**  
Did late calvers reduce in-calf rates?

Calved by	Week 3	Week 6	Week 9
Your herd	68%	86%	96%
Aim above	60%	87%	98%

**Pre-mating heats**  
A high % of well managed cows will cycle before the start of mating.

Your herd **0%** ☆

Aim above **85%**

**3-week submission rate of first calvers**  
Well managed heifers cycle early

Your herd **84%** ☆☆☆

Aim above **90%**

**Heat detection**  
A high % of early-calving mature cows should be inseminated in the first 3 weeks of mating.

Your herd **90%** ☆☆☆

Aim above **95%**

**Non-cycling cows**  
Treated non-cyclers get in calf earlier.

Treated	By MSD	Wks 1-3	Wks 4-6
Your herd	26%	0%	0%

Rating	What does it tell me?	What should I do?
☆☆☆☆	Top result	Ideal - keep up the good work!
☆☆☆	Above average	Getting there - focus on getting the details right.
☆☆	Below average	Plenty of room to improve - seek professional advice.
☆	No result	Not enough information provided - seek help with records.

**Performance after week 6**  
Expected not-in-calf rate helps assess management affecting performance after week 6 (including bull management and herd nutrition).

**Not-in-calf rate**

Your herd **13%** **Seek advice**

Expected **9%**

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## NOTES

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## Behind Your Detailed Fertility Focus Report

**Report period: Cows calved between 21/05/16 and 26/11/16.**  
This was the most recent period with sufficient herd records that enabled an analysis to be completed.

### Calving system: Seasonal

Your herd has been classified as seasonal calving because most calvings occurred in a single batch lasting less than 21 weeks.

### Level of analysis: Detailed.

Your good record keeping means a detailed analysis was possible for your herd.

Report date: 23/02/17

PTPT: HPTT

Herd Code: 2/1884

Calvings up to this date requested for analysis: 22/02/17

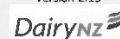
No of cows included: 431

These cows calved between: 21/05/16 and 26/11/16

Mating start & end date: 28/09/16 - 11/12/16  
(Based on AB or pregnancy test data)



Version 2.15



### Part A) Herd records cross check

Check that the herd records in the table are complete and correct.

2016/17	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	Total
No. of calvings		10	314	73	36								433
No. of AB matings					161	371	64						596
No. of preg tests								412		94			506
No. of non-aged/late aged positive preg tests										4			4
No. of cows culled or died	19	17	2		1	1	8			40			88

### Part B) Notes on the calculations

Use the following notes to see how your results were calculated.

#### 1 Overall herd reproductive performance

##### 6-week in-calf rate

Your report has been based on the mating and pregnancy test results you supplied. The ACTUAL 6 week in-calf rate is shown for your herd.

##### Records available for not-in-calf rate

Recorded pregnant	372
Recorded empty	39
Doubtful/recheck*	1
Culled without pregnancy test	9
No record of cull or pregnancy test	10
Cows analysed	431

\*Includes cows whose most recent empty diagnosis was less than 35 days after mating end date.

#### 2 Drivers of the 6-week in-calf rate

##### 3-week submission rate

431 cows had calving dates in the required range and were not culled before day 21 of mating and 84% of these were submitted during the first 21 days of mating.

##### Non-return rate

Non-return rate is not calculated when pregnancy test results provide an accurate estimate of conception rate.

##### Conception rate

The conception rate was calculated for 574 AB inseminations on and between 28.09.16 and 11.11.16.

#### 3 Key indicators to areas for improvement

##### Calving pattern of first calvers

98 cows with eligible calving dates were recorded as calving at less than 34 months of age. The calving pattern of first calvers was calculated from their records.

##### Calving pattern of whole herd

433 cows had calving dates that were eligible for this report.

##### 3-week submission rate of first calvers

97 first calvers had calving dates in the required range and were not culled before day 21 of mating and 84% of these were submitted during the first 21 days of mating.

##### Heat detection

182 cows at least 4 years old at calving had calved at least 8 weeks before mating start date and were not culled before day 21 of mating and 90% of these were submitted during the first 21 days of mating.

##### Pre-mating heats

431 cows had calving dates in the required range and were not culled before day 21 of mating and 0 of these had a pre-mating heat recorded.

##### Non-cycling cows

431 cows had calving dates in the required range and were not culled before day 21 of mating and 110 of these were identified as being treated for non-cycling.

##### Performance after week 6

Your herd's not-in-calf rate and 6-week in-calf rate were used to determine the success of your herd's mating program after the first six weeks. If bulls were used after week 6 of mating, this gives an assessment of how well they got cows in calf.

##### Induced cows

No cows were identified as having induced calvings. If cows were induced, ensure all inductions are recorded.

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Users should obtain professional advice for their specific circumstances.

- Pre-mating cycling still identified a large number of younger stock not cycling. Our use of CIDR's was once again high with 111 used.
- 6 weeks into mating and only 11 out of a possible 420 we wanted to put up had AI. This puts submission rates at 97%.
- Despite getting drier and feed becoming more limiting, the cows are largely holding condition.
- Body condition scoring is done monthly thanks to Wade (DairyNZ) and Tom. The following graph outlines actuals compared to targets. Some area for improvement during the start of next season.

#### NOTES

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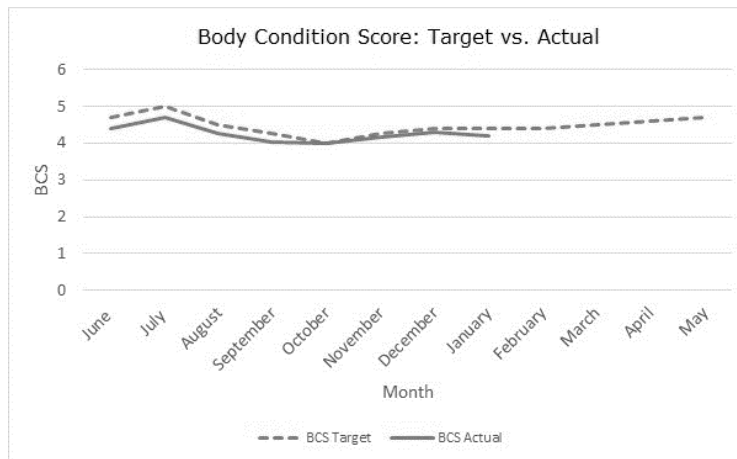


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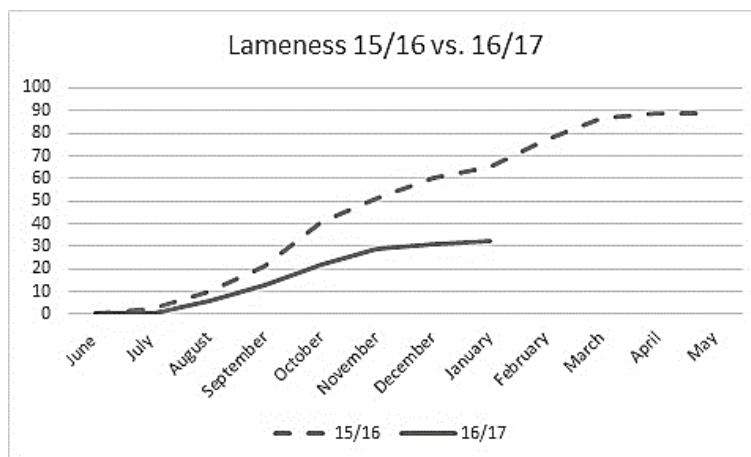


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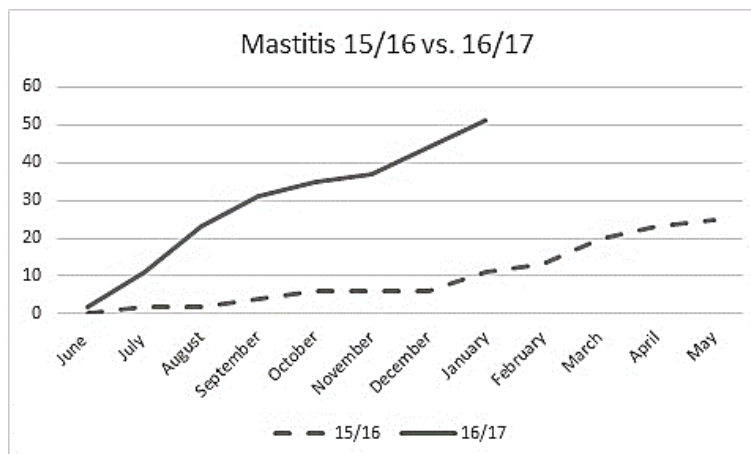




- Lameness continues to be a positive story with only 32 cows being identified season to date, compared to 65 at the same time last year. This is attributed to better races but more so to staff demeanour around stock.



- Mastitis on the other hand tells a different story. With wet weather and not having used dry cow therapy or teat seal on everything at the end of last season, this has had a significant impact.



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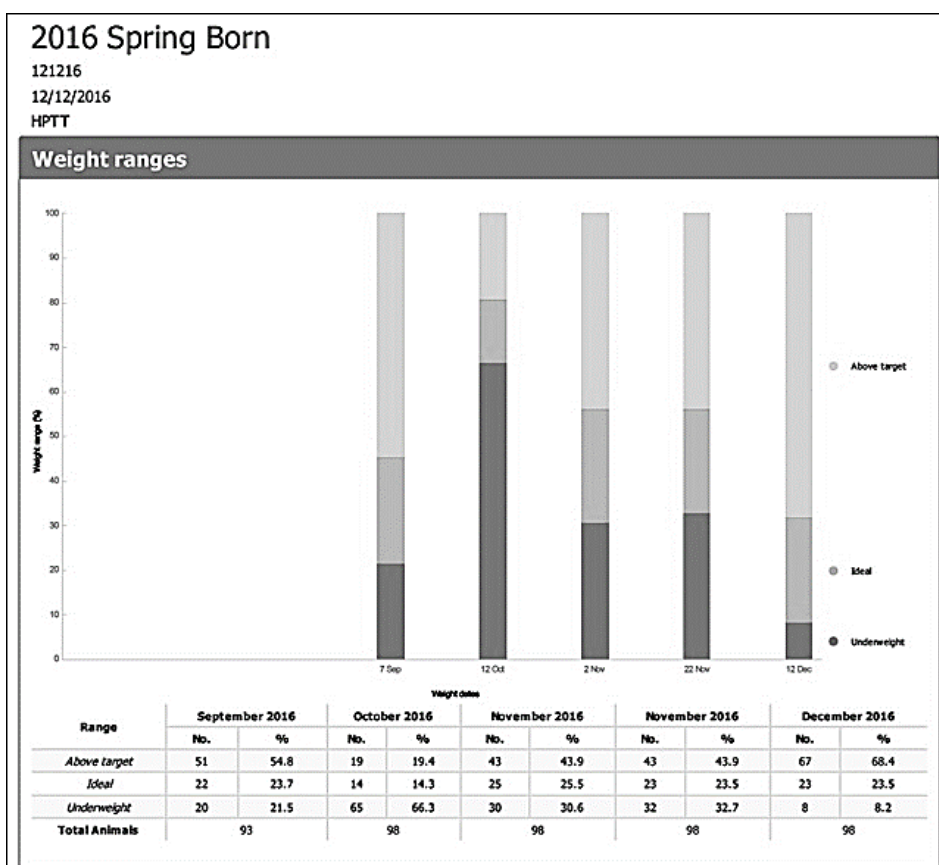
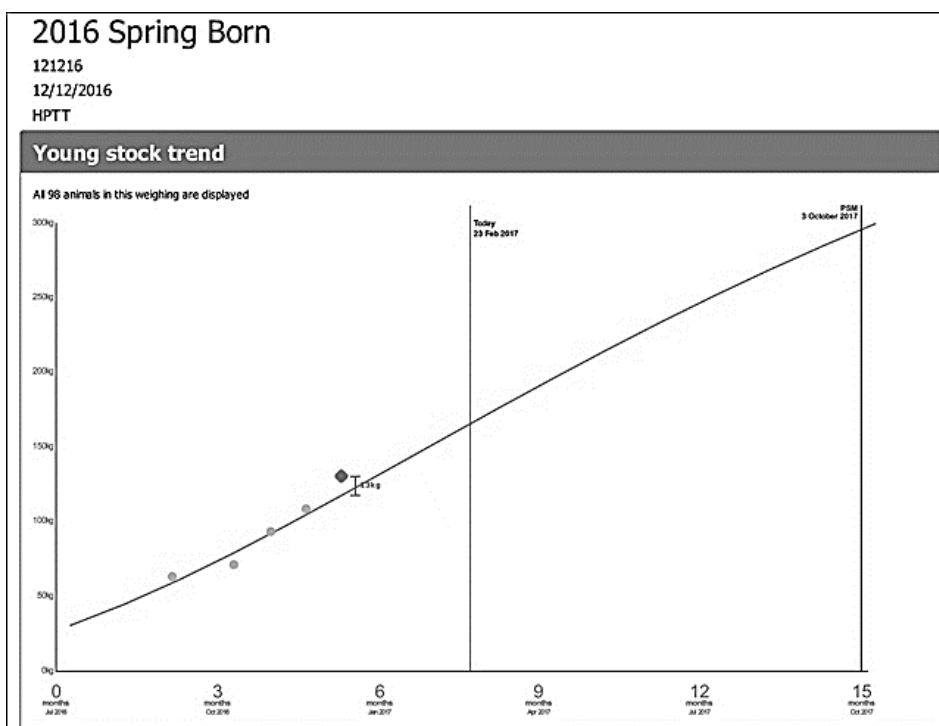
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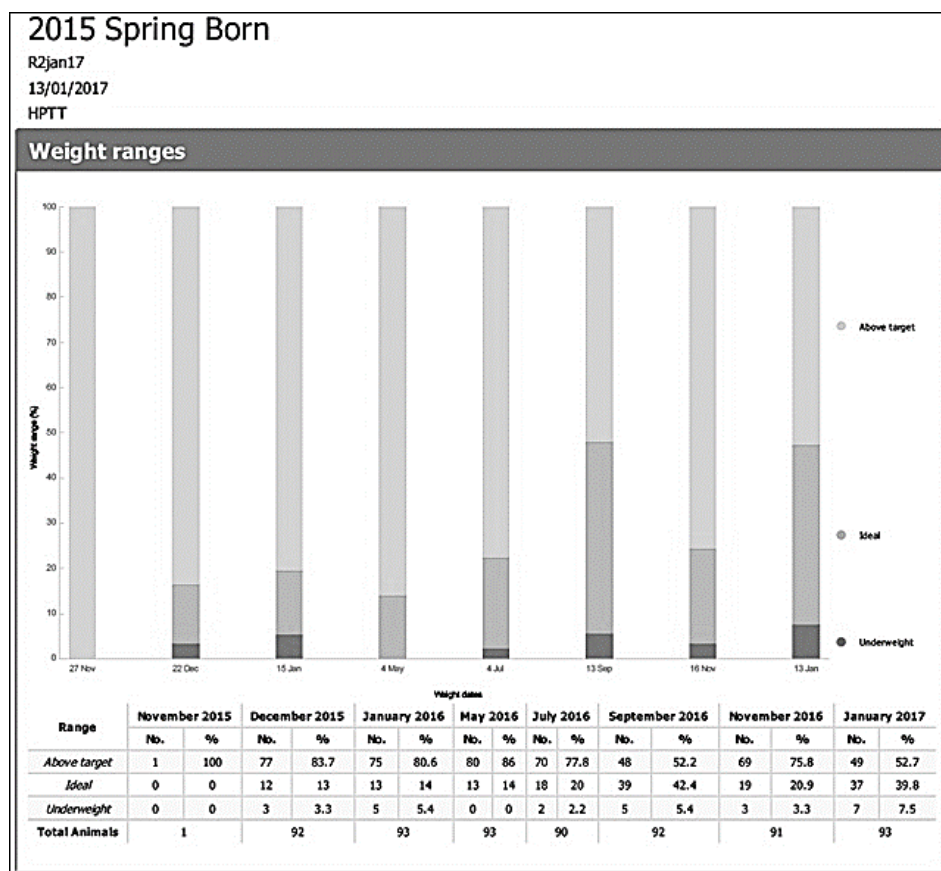
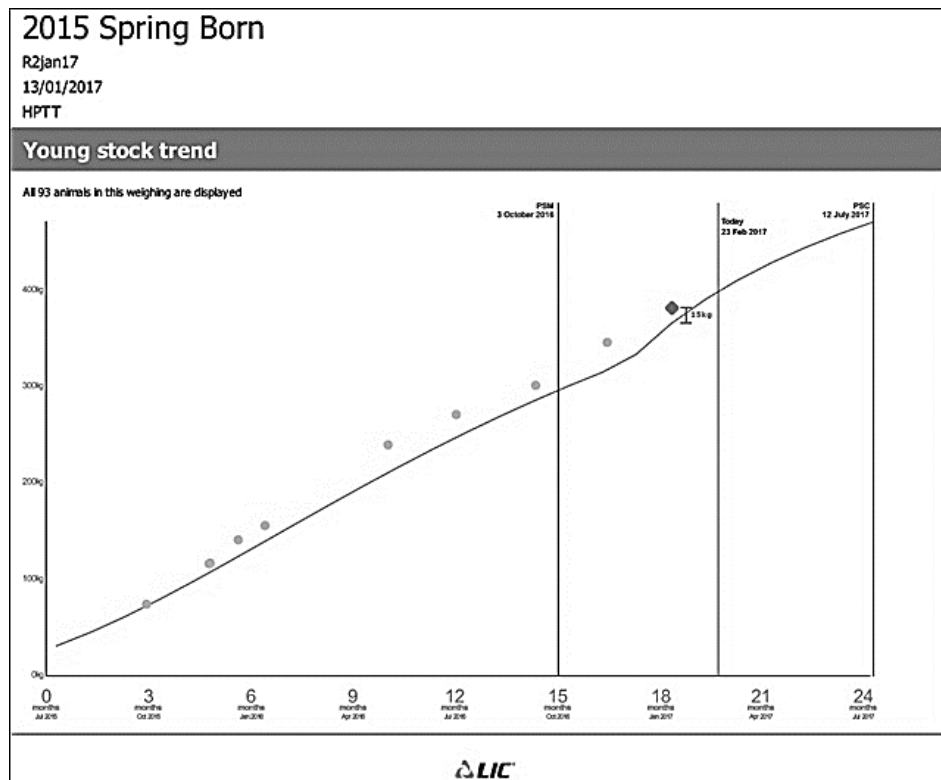
- Young stock are doing well at our graziers. Like all animals, they had a difficult spring but are bouncing back at present.
- Below are our R1's, which as you can see struggled early on but are recovering now.



NOTES



- Below are the R2's



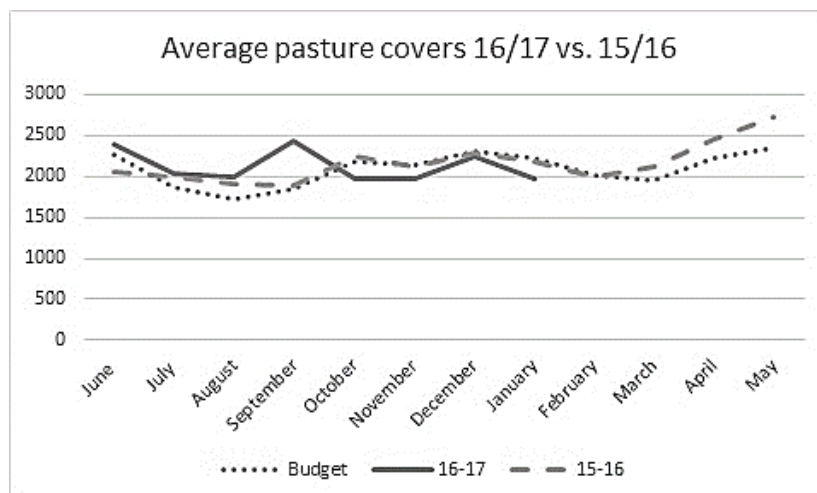
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## Pastures, Crops and Feed

- We are currently drying out with average pasture covers and growth rates dropping in recent weeks. The recent rain has certainly lifted growth however.
- We have seen better than expected growth coming through the summer and have managed to harvest much more surplus silage than we had anticipated – this has us well set for the remainder of this season as well as next.
- The following graph illustrates average pasture covers this year compared to last. This probably isn't a great comparison as heavy weed burden last season over estimated average covers during summer.



Average Pasture Covers modelled vs. actuals vs. 15/16 (kgDM/ha - Month beginning)			
Month	Budget	16-17	15-16
June	2266	2400	2052
July	1865	2045	1984
August	1716	1992	1902
September	1844	2440	1897
October	2192	1975	2244
November	2139	1964	2129
December	2316	2238	2296
January	2235	1982	2173
February	2016		1989
March	1944		2110
April	2228		2447
May	2346		2729
Average		2130	2162

- Growth rates on the other hand show a reasonably positive outcome with spring and summer pasture flushes coming through.

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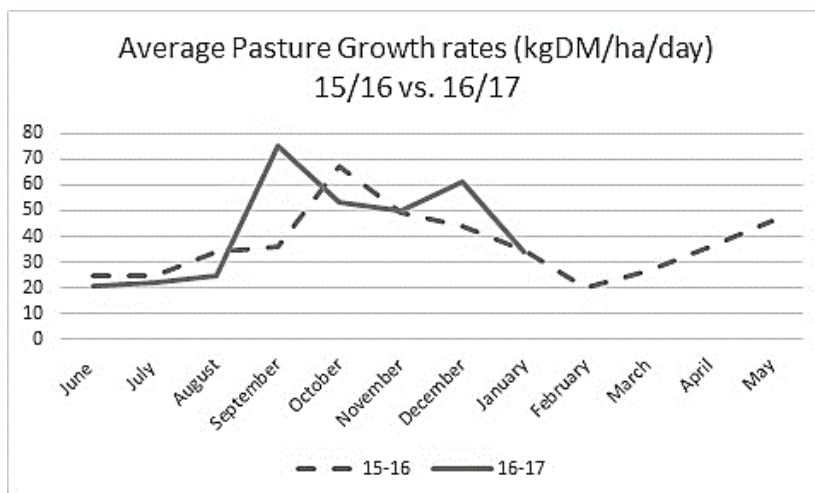


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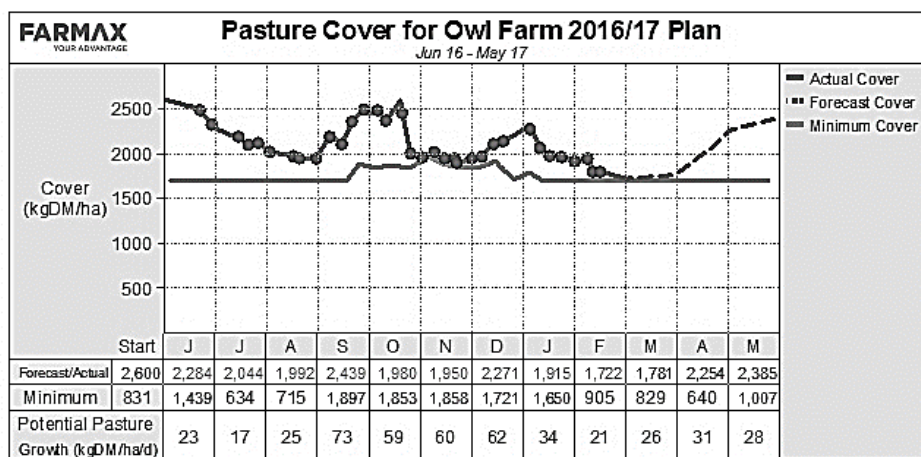
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Budgeted growth rates vs. actual			
Month	Budgeted	Actual	15/16
June	21	23	25
July	20	16	25
August	32	25	34
September	42	75	36
October	60	59	67
November	57	57	49
December	44	61	44
January	34	34	35
February	21		20
March	26		27
April	31		36
May	28		46
Average	38		37

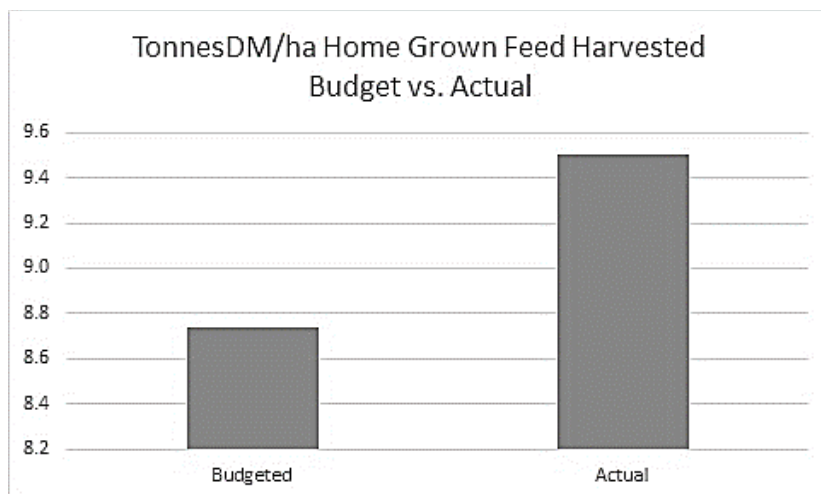
- Below is the pasture curve graph taken from our Farmax monitoring file. The dots represent pasture ride information which is uploaded weekly while the dashed green line is budgeted growth rates and covers for the remainder of the season. This has been a great tool in forward planning and monitoring covers/growth rates.



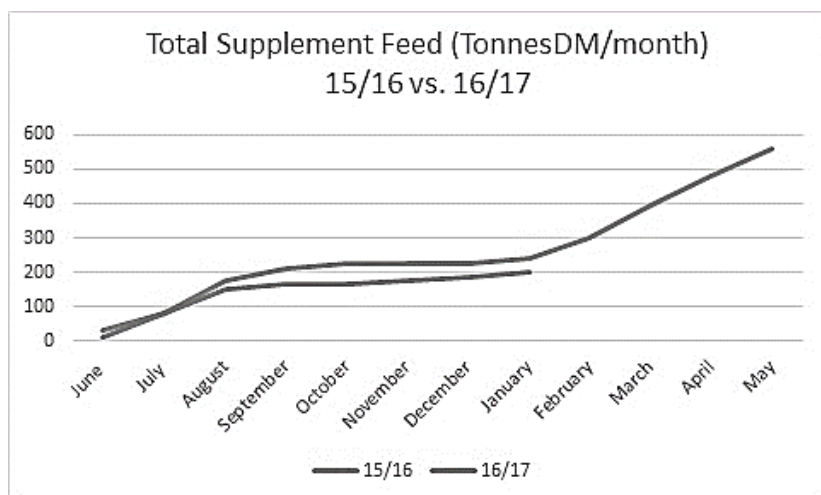
NOTES



- We are on track to exceed our budgeted home grown feed targets. Our budget for this season was 10% more than the poor 11.5tDM/ha harvested last season. Using Farmax we have been tracking actuals feed against budget and the results are pleasing. Not only are we harvesting more but we are using less supplements and maintaining a better per cow performance. The graph below shows actual home grown feed harvested against that budgeted, we are currently tracking 9.5% of target which as mentioned is ~10% more than last season.



- Chicory has been growing well, although dry weather is definitely slowing regrowth. From the three cut and dry samples we have taken we measured 4tDM/ha in the first cut, 2.5tDM/ha from the second cut and 1.75tDM/ha from the third cut. Regrowth after the last bit of rain is looking solid so hoping to finish with a last grazing over 2tDM/ha.
- Our target grown is 11.5tDM/ha with expected utilisation of 95%. We are likely to fall just short of this target. The biggest challenge was the timing for getting the crop drilled. Had we gotten it in the ground when planned yield would have been closer to target.
- The chicory has been a great resource in lifting production and providing the cows with high quality feed.
- Total supplementary feed STD is 15% lower than last year, closer to 10% on a per cow basis.



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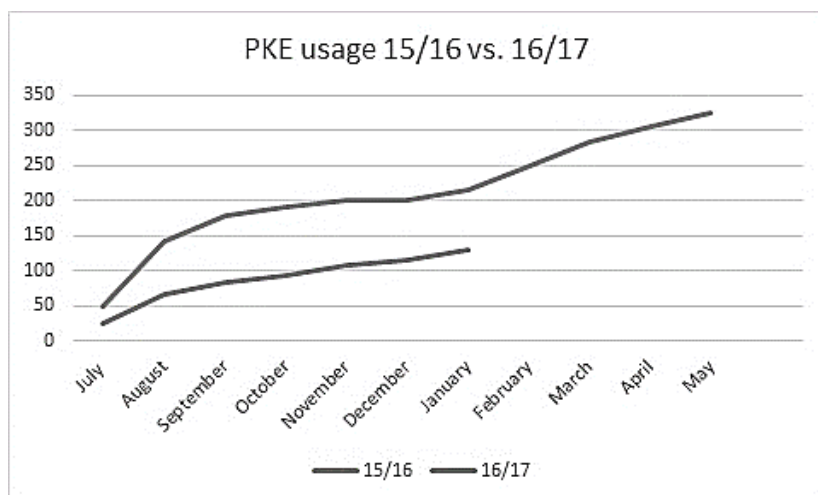
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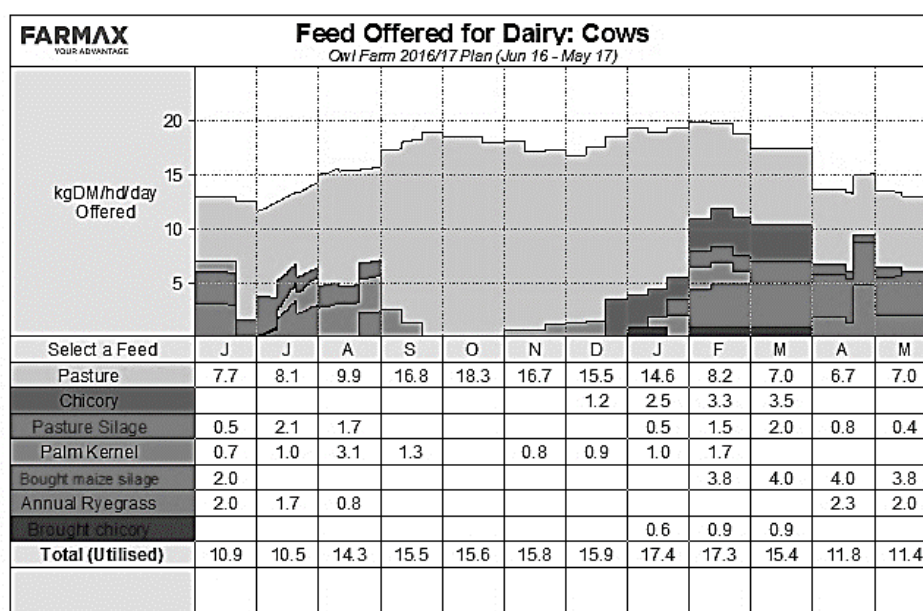
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- PKE usage remains 40% lower than last season.



- Below is the feed budget from Farmax, this represents STD actuals as well as the budgeted feed for months remaining. Farmax has proved an awesome tool in both monitoring, modelling and planning feed.



## Nitrogen

- We are 4 applications of our planned 5 applications of 30kgN/ha with one more round of Sustain planned for March/April to boost covers coming into winter. Although there have been opportunities to put on more and it would have no doubt buffered our pasture available, we have stuck strictly to our limits to ensure nitrogen leaching isn't increased.

## NOTES

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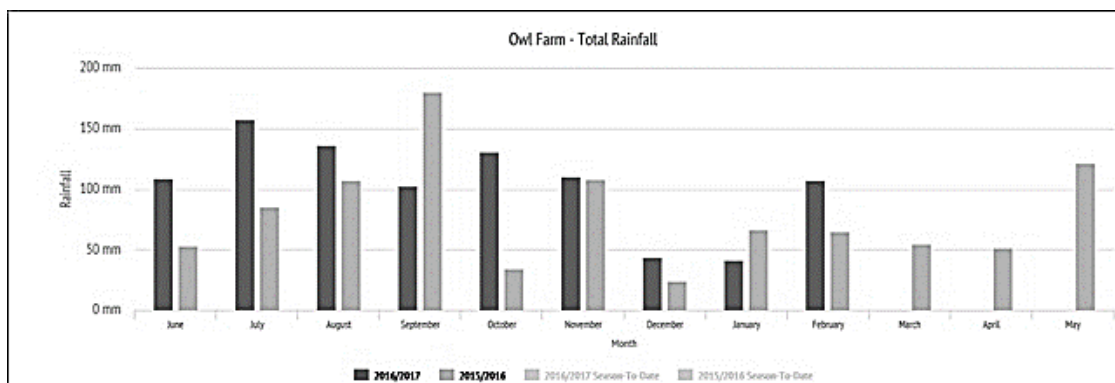


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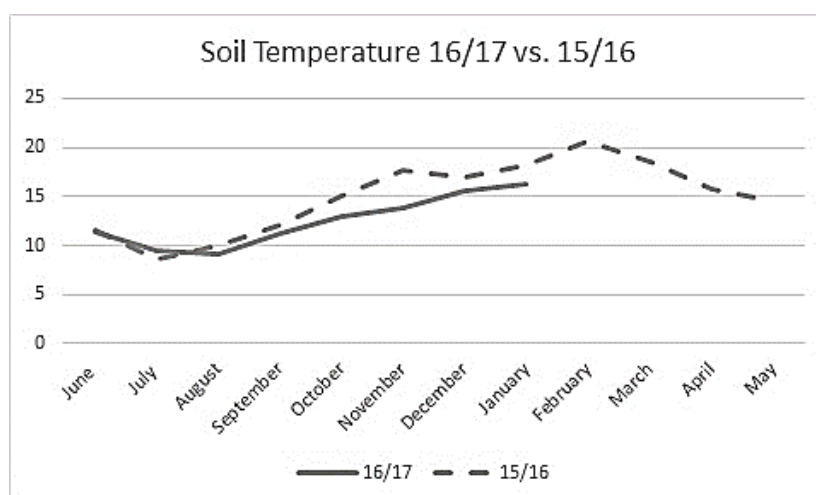
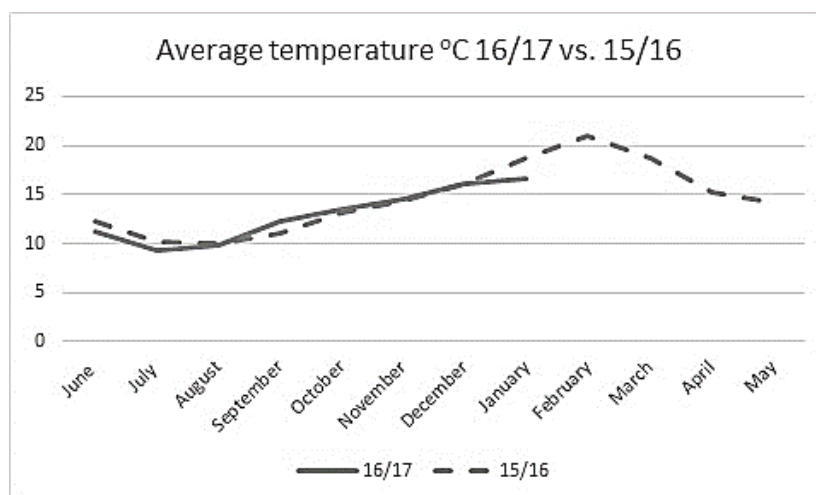


## Climate

- Rainfall has largely been the talking point so far this season, firstly with too much and then a lack of. The following shows how we are tracking this season compared to last.



- Season to date rainfall is currently sitting at 940mm compared to 726mm at the same time last year.
- Average temperature has been slightly less through both January and February compared to last season.



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# OWL FARM PASTURE CONDITION SCORE REPORT – FEBRUARY 2017

Prepared by Emma Bell and Kyle Gardyne, PGG Wrightson Seeds

## Pasture Condition Score Data

### CRITERIA

#### Pasture Condition Score (1-5)

Pasture Condition Scoring involves scoring individual paddocks using the PRCT criteria:

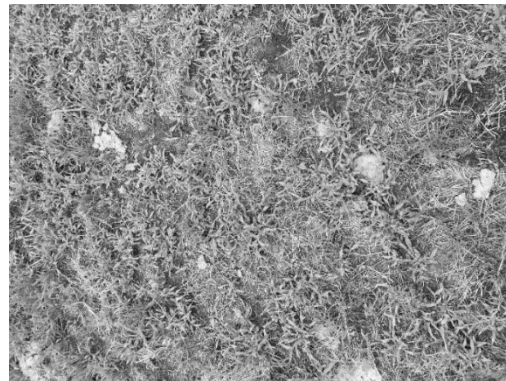
1. Entire Paddock is severely damaged.
2. Parts of the paddock have severe damage.
3. Majority of paddock has low level of damage, weeds, and less vigorous grasses.
4. Parts of the paddock show signs of low level damage, less vigorous grasses and some weeds.
5. Whole paddock has dense sward of desired grasses and clovers.

### RESULTS

The Pasture Condition Score data for Owl Farm now includes scores from August 2015, February 2016, August 2016 and February 2017. This enables us to look at year-on-year comparisons.

The below graph shows the year-on-year comparison for Pasture Condition Scores at Owl Farm, expressed as a percentage of paddocks on farm across the different scores (1-5).

The improvement in Pasture Condition is a direct reflection of the investment in pasture renovation during autumn 2016. There is still a significant proportion of paddocks in a condition score of **2** or less, however this is mainly attributed from the deer block where there are constraints in terms of pasture renewal options. With blocks 1 & 2 not receiving the same level of attention the black beetle population has multiplied and pasture pulling has increased, resulting in lower pasture condition scores as illustrated by the photos below.



LEFT: Black Beetle Larvae feeding, resulting in pasture pulling.

RIGHT: Paddock with a Pasture Condition Score of 1.

### SUMMARY

- **14%** of paddocks on farm are now a condition score of **5**, compared with only **3%** in February 2016.
- **34%** of the farm is now a condition score of **4** or more, compared with only **21%** last year.
- **80%** of all paddocks sown into new perennial pasture in autumn 2016 remain in a condition score of **4** or more.
- **Block 1 & 2 account for majority of the poorer performing paddocks on farm**
  - All paddocks that scored a **1** are from Blocks 1 & 2.
  - The average score from this block is **2.1**.
  - Nothing scored above a 3 on this block, with condition scores 3's mostly reflecting those paddocks that were undersown last autumn.

### NOTES

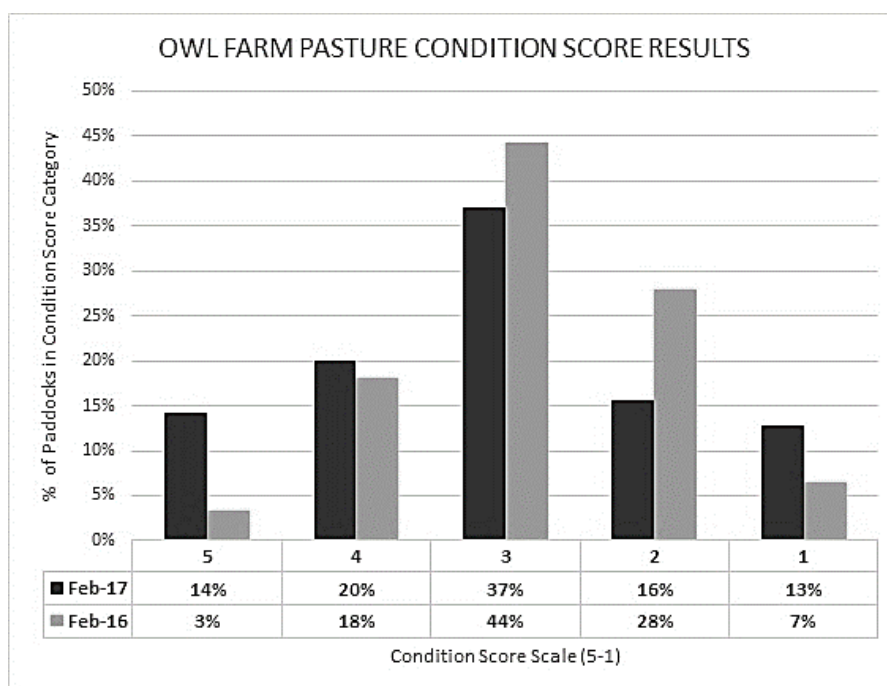
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### Reflection on Investment in Pastures

In autumn 2016, investment in pastures included:

- **12ha** new perennial ryegrass following chicory paddocks.
- **12ha** WinterStarII annual ryegrass.
- **12ha** under-sowing with Lush AR37 Italian ryegrass.
- **18ha** under-sowing with Prospect AR37 perennial ryegrass.
- **30ha** pasture weed spraying in all under-sown paddocks.

In terms of the influence of this investment on Pasture Condition Score, the results have been really positive. The following tables show the paddock history.

#### PROGRAMMED APPROACH

The struggles with poor pastures going into winter last year made us review the way we approach pasture renovation at Owl Farm. Instead of taking these poorer paddocks through the winter before cropping in spring, we used WinterStarII Annual ryegrass to help us achieve a few objectives:

- ✓ Increased dry matter production during winter and early spring (vs. status quo).
- ✓ Opportunity to break weed cycles by using an autumn glyphosate.
- ✓ Breaking pasture pest cycles, by using treated seed and then summer crop.
- ✓ Establishment of better summer crops, by correcting fertility 6-months prior, and breaking down perennial pasture thatch.

#### NOTES

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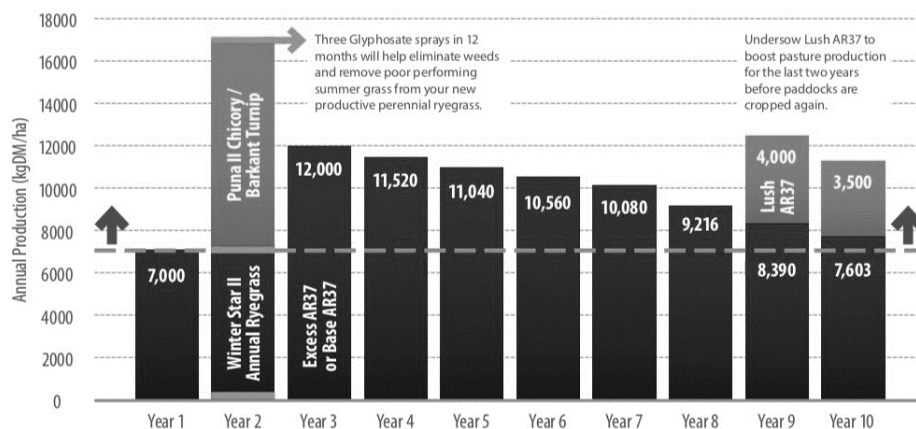


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## Programmed Approach™ Production (kgDM/ha) Benefits



ABOVE: Programmed Approach Diagram for Owl Farm – assuming the poorest paddock is producing 7,000kgDM/ha/yr. and new perennial pasture producing 12,000kgDM/ha/yr. The change in relative yield over time is according to the Pasture Renewal Charitable Trust Calculator assuming medium persistence. Assuming a 10% pasture renewal programme.

### 2016 SOWN PERENNIAL PASTURES

The Pasture Condition scoring of new pastures is a good “pulse check” to see how they are looking after almost 12 months. The table below shows very similar condition to August 2016 which is very pleasing to see, particularly when we consider where these paddocks have come from back in August 2015.

Treatment	Pdk	Feb-17	Aug-16	Feb-16	Aug-15
New Grass	5	5	5	Chicory	2
New Grass	15	4	5	Chicory	2
New Grass	55	5	5	Chicory	3
New Grass	56	5	5	Chicory	3
New Grass	6	5	5	Chicory	4
New Grass	R13	4	5	Maize	
New Grass	R12	5	5	Maize	
New Grass	11	4	4	Chicory	2
New Grass	30	3	4	2	3
New Grass	52	3	3	Chicory	2

### 2016 UNDERSOWN PASTURES

Under-sowing was an important part of the pasture renovation programme at Owl farm, with 30ha of Condition Score 3 and below paddocks undersown last autumn.

Of the total area, 12ha was undersown with a short term option (Lush AR37), into paddocks that are next on the priority list for renewal. A further 18ha with Prospect AR37 which was undersown into areas that are not likely to be renewed in the short term (i.e. difficult contour paddocks).

### NOTES

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Treatment	Pdk	Feb-17	Feb-16
Italian	2	4	3
Italian	58	2	Chicory
Italian	3	3	2
Italian	34	4	2
Italian	82	3	3
Italian	79	3	3
Italian	81	3	3
Italian	83	3	
Italian	33	3	2
Italian	36	4	2
Italian	44	5	3
Italian	35	4	2
Italian	47	5	3

Treatment	Pdk	Feb-17	Feb-16
Perennial	1	4	3
Perennial	42	4	Chicory
Perennial	25	3	1
Perennial	4	4	2
Perennial	27	2	3
Perennial	26	3	2
Perennial	24	3	2

### Autumn 2017 Pasture Renewal Recommendations

The Pasture Condition Score results will be overlaid with data from MINDA Land & Feed, and this will help us look at the selection of paddocks for pasture renewal for the coming season from an economic benefit point of view.

Until then, feedback from Tom, coupled with Pasture Condition Score data have been considered to come up with the following target areas:

#### PERENNIAL PASTURES (EX-CHICORY)

All Chicory paddocks (19ha) will be put back into perennial pasture.

Cultivar choice will be guided by the forage value index (see Appendix) and each individual paddocks situation e.g. soil type, fertility level, access to effluent etc.

**EFFLUENT BLOCK:** It is recommended that the paddocks in chicory on the Effluent Block are re-grassed with **Base AR37**. Base has a 5-star rating on the **Dairy NZ Forage Value Index (FVI)** for seasonal dry matter yield, and given this grass is a tetraploid, it is more palatable and thus has the potential to increase production through increased utilisation.

**NON-EFFLUENT AREAS:** The remaining chicory paddocks should be planted in **Excess AR37** which also has a 5-star rating on the **FVI**. Excess is a mid-heading ryegrass (+7 later than Nui) which offers us an opportunity to balance the heading date on farm and spread the loss of pasture quality which occurs in spring. Historically, late heading varieties have been used on this property, so Excess provides us an opportunity to buffer the range in heading dates on farm.

#### UNDER-SOWING RECOMMENDATION

Paddocks that have scored a 3 or less during the last pasture condition walk have been considered for under-sowing. **MINDA Land & Feed** information coupled with Pasture Condition Scores will enable us to select the most suitable paddocks for under sowing, which will mean those that pose the best potential economic benefit.

- **Lush AR37** is recommend for paddocks which will be cropped in spring 2018.
- **Rely AR37** & **Excess AR37** is recommended for paddocks which will not be cropped until 2019 or paddocks that will likely not be cropped at all due to the paddocks location.

#### NOTES

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Deer Block (1 & 2)

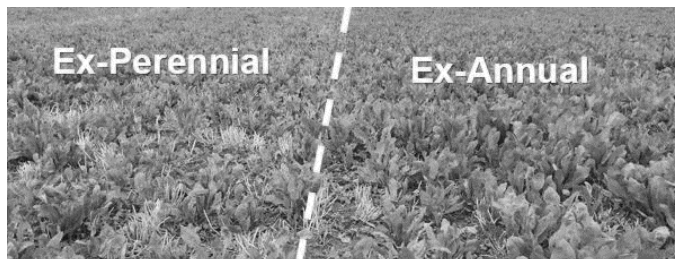
As already highlighted, the Pasture Condition Scores (PCS) from Blocks 1 & 2 have dramatically decreased compared with the same time last year. The average pasture condition score of 2.1, therefore urgent attention is required. These block are too far from the dairy shed to be considered for cropping.

As a result it is recommended that short-term options are considered:

- Paddocks that have scored a PCS of 1 should be sprayed out and re-grassed with **Lush AR37** or **Rely AR37** (Italian or perennial depending on longevity expectation).
- Paddocks scoring 2 should be undersown with **Lush AR37**.

ANNUAL RYEGRASS RECOMMENDATIONS

A total of 16ha has been identified as paddocks to be sown into Annual Ryegrass this autumn, followed by chicory in the spring.



ABOVE: Chicory established after old perennial pasture (left) and annual ryegrass (right)

  
**PGG Wrightson Seeds**

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# Perennial Ryegrass Forage Value List



Cultivars are sorted by star rating and then alphabetically. Note:

Perennial ryegrass FVI is currently a combination of seasonal dry matter performance values and economic values.

Metabolisable energy performance values are not yet included in the FVI calculation and are shown below as additional information until sufficient trial data becomes available.

Cultivars with SE are not recommended as they can cause ryegrass sluggers in summer and may reduce milk-solid production at this time.

Cultivars with AR1 endophyte are not recommended in the UNI as they provide limited protection against black beetle.



Evaluation date: 10/11/2016

FVI* (Star rating)	FVI Star Rating (\$/ha)	Cultivar	Performance Values <sup>2</sup> (1-5 rating)					Other cultivar information				
			Dry matter (DM)					Endo <sup>3</sup>	Ploidy <sup>4</sup>	HD <sup>5</sup>	Marketer	Conf <sup>6</sup>
			Winter	Early spring	Late spring	Summer	Autumn					
★★★★★	\$487 to \$521	Base AR37 Excess AR37 Oxide50 AR37 Prospect AR37 Trojan NEA2	4 5 5 5 5	4 4 3 4 5	4 4 3 4 5	5 5 5 4 5	5 5 5 4 4	AR37 AR37 AR37 AR37 NEA2	T D D D D	VL M L L L	PGG Whightson Seeds PGG Whightson Seeds Agrimom Agrimom Agrimom	7 3 10+ 10+ 10+
★★★★★	\$354 to \$487	Alto AR37 Ansa AR1 Arrow AR1 Matine SE Requies AR37 Ultra AR1	5 4 2 3 5 4	4 4 5 3 5 4	4 5 3 4 5 3	4 4 4 4 4 4	4 3 3 4 4 4	AR37 AR1 AR1 SE AR37 AR1	D D D D D D	L L M VL M L	Agrimom DLF Seeds Agrimom Agrimom Crepmark Crepmark	10+ 10+ 3 8 7 9 10+
★★★	\$220 to \$354	Alto AR1 Bealey NEA2 Excess AR1 Expo AR1 Expo AR37 Halo AR37 Oxide50 AR1 Rely AR37	3 4 2 3 5 4 3 3	3 3 4 4 3 3 3 3	3 2 3 3 3 1 2 4	4 4 4 3 3 4 4 2	3 4 2 3 3 4 4 5	AR1 NEA2 AR1 AR1 AR37 AR37 AR1 AR37	D T D D D T D D	L VL M L L VL L M	Agrimom Agrimom PGG Whightson Seeds PGG Whightson Seeds PGG Whightson Seeds Agrimom Agrimom PGG Whightson Seeds	10+ 10+ 2 7 4 10+ 10+ 3
★★	\$98 to \$220	AberMagic AR1 Base AR1 Chau AR37 Samson AR37 Samson SE	2 3 4 4 2	1 3 3 3 3	3 2 4 2 3	4 3 1 1 2	3 2 1 2 2	AR1 AR1 AR37 AR37 SE	D T T D D	L VL L M M	Genetic Technologies Ltd PGG Whightson Seeds Agrimom Agrimom Agrimom	4 2 4 5 10+
★	\$48 to \$98	Bionia AR1 Nui SE Pacific SE Robur NEA2 SF Stellar AR1	2 1 1 3 2	2 3 3 1 2	1 2 4 1 3	2 1 1 2 1	1 1 1 3 1	AR1 SE SE NEA2 AR1	D D D D D	L M M M M	DLF Seeds Common PGG Whightson Seeds Agrimom Seed Force	3 10+ 4 4 7
	\$583 to \$575	AberGreen WE AberMagic WE	1 1	1 1	1 1	1 1	1 1	WE WE	D D	L L	Genetic Technologies Ltd Genetic Technologies Ltd	2 4

\* 5 = top rank, 1 = bottom rank. <sup>1</sup> Winter = Winter dry matter production (May-June), Early Spring = Early spring dry matter production (July-Aug), Late Spring = Late spring dry matter production (Sept-Oct), Summer = Summer dry matter production (Nov-Jan), Autumn = Autumn dry matter production (Feb-Apr), <sup>2</sup> Endophyte: WE = without endophyte, <sup>3</sup> Ploidy: D= Diploid, T= Tetraploid, <sup>4</sup> Heading date (M=Mid, L=Late, VL=Very late), <sup>5</sup> Confidence (number of trials), <sup>6</sup> FVI ME concentration data based on 1 year of trial data from the Waikato. NT=No trial data available. For more information visit dairynz.co.nz/fvi

Cultivars included in the FVI lists without a star rating have enough trials to be eligible for the FVI, however they were excluded from the FVI Star Ratings due to poor performance in those trials.

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NOTES



# RECOMMENDATIONS REPORT: STAGE 2 FARM SYSTEM MODELLING

## 1. Introduction

Owl Farm has been developed in conjunction with our partners with the intention of demonstrating to farmers and rural professionals what a sustainable profitable farm for the Waikato and Bay of Plenty could look like going forward.

Within a rapidly changing environment we are experiencing significant change which is causing the farming community a level of uncertainty and anxiety. We are facing unprecedented global volatility impacting milk price, changing environmental regulations which are questioning status quo, more stringent health and safety legislations and more focus on people through attracting and retaining a quality workforce. These factors now need to be considered holistically when determining what a future proof sustainable farm system looks like.

Owl Farms development has been undertaken via a staged process. Stage 1 (1-3 years) has a primary focus on optimising our existing position within the present farm system utilising current infrastructure. Stage 2 (3-5 years) is about testing and investigating in conjunction with partners which farm systems are best suited to achieve long term sustainable profits.

The intention of this report is to provide a broad overview of a range of farm systems and to demonstrate how they measure up in relation to sustainable profits. Based on this information, recommendations will be developed as to the most appropriate future farm systems for further consideration. Ideally, it is anticipated that the Farm Governance Committee will agree on the direction of the future farm system which is most appropriate in achieving Owl Farm's objectives.

The Farm Management Committee identified the following range of farm systems. We believe these reflect the variety of options currently available from system 1 through system 5 and everywhere in between. These include:

1. Status Quo – Basefile
2. Status Quo – Wintering off 100 late calving cows
3. Status Quo – In-shed Feed system
4. Status Quo – In-shed feed system with wintering off 100 late calving cows
5. 2.7 cow/ha stocking rate – No imported feeds
6. 2.7 cows/ha stocking rate – Production optimised with PKE
7. Seasonal (spring calving) Feed Pad – Stocking rate of 3
8. Split calving (40% autumn/60% spring calving) Feed Pad – Stocking rate of 3
9. Winter milking Feed Pad (100% autumn calving) – Stocking rate of 3
10. Seasonal (spring calving) Herd Home – Stocking rate of 3
11. Seasonal (spring calving) Feed Pad – Stocking rate of 4

## 2. Methodology

For all intents and purposes this has been undertaken as a modelling exercise, with that it needs to be accepted that there will be a margin of error within the outputs. Regardless the numbers are deemed sufficient to warrant further robust discussion around the viability of farm system for Owl Farm.

As mentioned, sustainable profits have been identified as the key criteria in determining the most appropriate future farm system. The cash surplus of each modelled farm system along with the modelled nitrogen loss from overseer are therefore key metrics for comparison and overall evaluation. Cash surplus has been chosen as the measure of profitability above operating profit as the impact of any additional debt servicing must ultimately be considered in regards to take home income. Additionally, the return on assets has been calculated along with a sensitivity analysis for each scenario which will also be taken into consideration.

It is expected that criteria such as animal welfare, HR, health and safety, etc. are minimum practice within any implemented farm system and as such these aspects haven't been specifically considered within this report. In saying that, internal and external perception in some circumstances may be given consideration if it's believed pre-conceived ideas would be associated with particular models.

Above all else, Owl Farm must demonstrate leadership within the environmental space to ensure we operate within the regulations set out within the recently release Healthy Rivers: Plan for Change. As a minimum standard Owl Farm will be required to operate within a Nitrogen Reference Point which is likely to reflect the modelled nitrogen losses from either the 14/15 or 15/16 dairy seasons. Although not confirmed it is likely our nitrogen reference point will sit around 45kgN/ha. This is a crucial piece of information when considering which farm system is most appropriate for Owl Farm going forward.

### NOTES

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As a side note, the constructed treatment wetland and any potential associated benefits regarding nitrogen losses have not been considered for the purpose of this report.

The farm system scenarios outlined above have been modelled through several programmes to measure key metrics such as profitability, productivity, nitrogen loss, return on assets and sensitivity of changes in production or payout. By plotting these metrics against one another we wish to identify the sweet spot for what is deemed both an acceptable profit and sustainable outcome. It is expected that the direction of travel will not necessarily be the most profitable or the most sustainable option but one which has an acceptable level of both.

Farmax has been used as the primary Farm system modelling tool which includes feed, production and financial budgeting. Redsky is also likely to be used to review/ground truth the scenarios which hold the most appeal. Overseer has been used to complete the environmental modelling which demonstrates the likely nitrogen losses expected under each system. Finally, Westpac's budget structure has been used to provide a sensitivity analysis on both the milk price and production levels.

In regards to the return on assets, two calculations have been completed. The first is the return on any additional investment. This represents the additional operating profit above the baseline operating profit through any modelled scenario with a capital requirement. The additional operating profit is then divided by the value of the capital requirement. The second calculation is a straight return on asset for the entire business, this is the operating profit divided by the total asset base.

### 3. Assumptions Made

Given this is largely a modelling exercise there are a number of assumptions which have been used across all scenarios. This ensures consistency and allows accurate comparison between models. Assumptions include.

- Land: 154 hectares
- Capital:
  - Additional cows purchased @\$2000/cow
  - Additional shares purchased @\$6.00/kgMS
  - It has been assumed that a new effluent pond will be constructed irrespective of which farm system is selected however the feed pad scenarios have an additional cost relative to improvements in system and additional storage.
  - Depreciation: existing depreciation of infrastructure is consistent across all models at \$53,000.00. Additional depreciation has been added above this value when additional capital investment is required. Depreciation on additional capital has been based on the following assumptions:
    - Mixer wagon depreciated over 5 years
    - In-shed feed system depreciated over 10 years
    - Feed-pads, herd homes, feed bunkers and effluent systems depreciated over 25 years
- Financials: The following costs are consistent across all modelled scenarios, those which aren't covered below differ within each scenario.
  - Milk Price – \$5.50/kgMS plus 30c dividend
  - Wages
  - Animal Health - \$90/cow
  - Breeding - \$70/cow
  - Farm dairy \$10,000
  - Feed Price
    - Chicory - \$1000/ha
    - PKE - \$230/tonne
    - Brought Maize - \$300/tonne
    - Brought pasture silage - \$300/tonne
    - Calf feed - \$800/tonne
  - Grazing - \$7/wk. for heifer calves, \$9/wk. for rising 2 year olds, \$22/wk. for cows.
  - Fertiliser - \$65,000 (except for herd home scenario where additional effluent has reduced nitrogen requirement)
  - Regrassing - \$25,000
  - Repairs and Maintenance - \$25,000
  - Weed and pest
  - Admin, insurance, ACC and rates remain unchanged.
- Fertiliser: 150kgN/ha/yr. is consistent across each scenario applied via five dressings. The only scenario which differs is the herd home where additional effluent has meant several blocks have dropped an application.

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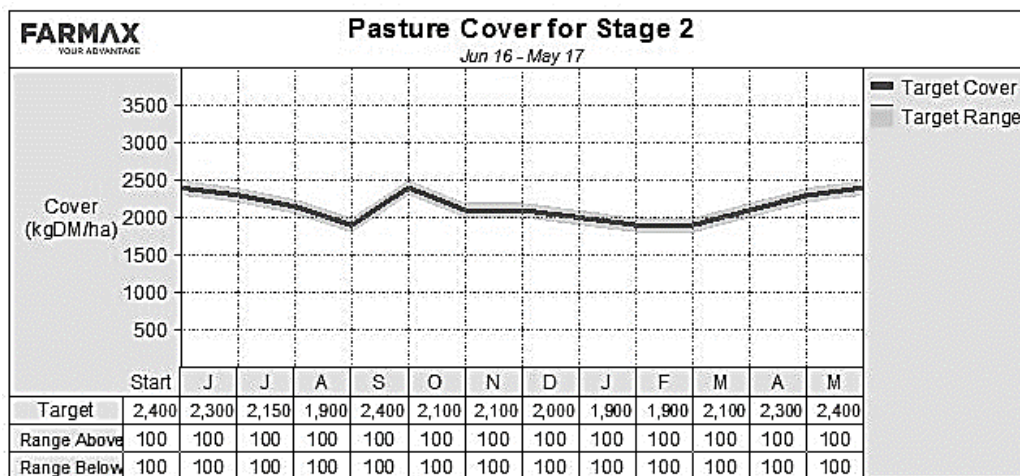
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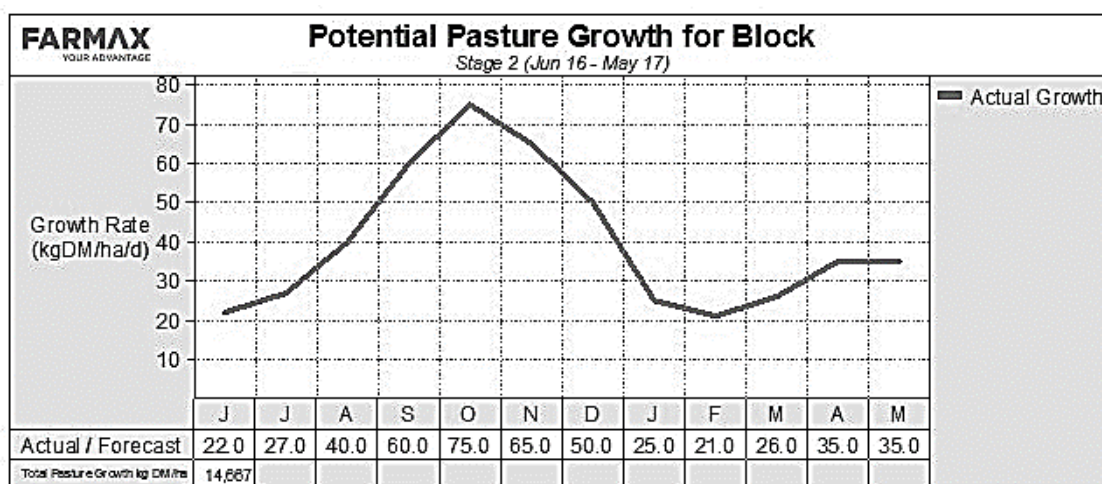


- Pasture

- Target pasture covers for each month have been entered into Farmax as seen below. The target covers are what they would be at the end of the month. The light green either side indicates an allowance for 100kgDM/ha either side of the target. This graph has been used as guide when building the feed budget in regards to how much pasture vs. supplement can be feed without compromising average pasture covers.



- Growth rates (kgDM/day). This illustrates a potential growth of 14,667kgDM/ha. It is likely growth rates would be higher within feed pad/herd home scenarios as grazing pressure is reduced, however no allowances have been made for this at this stage.



NOTES



- Pasture utilisation %.

<b>FARMAX</b> <small>YOUR ADVANTAGE</small>	
<b>Properties for Dairy Default</b> <i>Jun 16 - May 17</i>	
Month	Utilisation %
Jan	90
Feb	90
Mar	90
Apr	90
May	90
Jun	80
Jul	80
Aug	85
Sep	90
Oct	90
Nov	90
Dec	90
NB. Pasture utilisation only applies to adult stock.	

- Cow
  - Breed, BW/PW remain unchanged.
  - Liveweight has changed to 485kgLW based on weighing of a cross section which was undertaken in January.
- Feed
  - Feed will differ depending on scenario but characteristics of each feed (i.e. ME) remain unchanged. Utilisation of feed will differ depending on relevant infrastructure.
- Feeding levels
  - In all scenarios dry cows are offered 13-14kgDM to increase gut capacity and condition coming into calving. Once calved cows, feed offered is progressively increased to between 20-22kgDM (depending on model) during peak production months of September/October. This general philosophy has been followed in all models.

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#### 4. Farm System Modelling Overview

NB: Operating profit for the purpose of this includes depreciation and debt servicing to demonstrate the impact of any associated infrastructure.

Scenario	1	2	3	4	5	6	7	8	9	10	11
Total kgMS	184,410	187,634	199,364	195,575	171,002	184,536	211,171	203,151	205,000	211,171	259,467
Change in kgMS	-	+3,224	+14,954	+11,165	-13,408	+126	+26,761	+18,741	+20,590	+26,761	+75,057
kgMS/cow	419	426	452	444	420	453	479	453	455	479	462
Total Cows	450	450	450	450	416	416	470	470	470	470	620
Total Income	\$1,111,343	\$1,130,632	\$1,198,485	\$1,176,185	\$1,027,537	\$1,103,201	\$1,275,637	\$1,276,242	\$1,299,735	\$1,275,637	\$1,560,676
Change from basefile	-	+\$19,289	+87,142	+\$64,842	-\$83,806	-\$8,142	+\$164,294	+\$164,899	+\$188,392	+\$164,294	+\$449,333
Total Farm Expenses	\$767,091	\$764,129	\$799,178	\$789,190	\$690,126	\$718,091	\$851,376	\$869,461	\$880,849	\$900,176	\$1,119,532
Change from basefile	-	-\$2,962	+\$32,087	+\$22,099	-\$76,965	-\$49,000	+\$84,285	+\$102,370	+\$113,758	+\$133,085	+\$352,441
Operating Profit	\$344,252	\$366,233	\$399,307	\$386,995	\$337,411	\$385,111	\$424,260	\$406,781	\$418,886	\$374,460	\$441,144
Debt servicing and lease costs	\$225,750	\$226,290	\$232,500	\$231,420	\$225,750	\$225,750	\$245,550	\$244,200	\$244,200	\$273,643	\$280,380
Cash Surplus	\$118,502	\$139,943	\$166,807	\$155,575	\$111,661	\$159,361	\$178,710	\$162,581	\$174,686	\$100,817	\$160,764
Change from basefile	-	+\$21,441	+\$48,305	+\$37,073	-\$6,841	+\$40,859	+\$60,208	+\$44,079	+\$56,184	-\$17,685	\$42,262
Capital requirement	-	\$12,000	\$150,000	\$126,000	-	-	\$440,000	\$410,000	\$410,000	\$1,086,500	\$1,214,000
Return on additional investment	N/A	55%	37%	34%	N/A	N/A	18%	15%	18%	3%	8%
Return on asset	2.8%	3%	3.2%	3.1%	2.8%	3.1%	3.3%	3.2%	3.3%	2.8%	3.3%
Total imported supplement (tDM)	273	216	388	278	-	122	538	462	632	538	1206
kgN/ha leached	46	44	48	45	43	44	50	53	57	42	57
N conversion efficiency	33%	34%	33%	34%	34%	34%	35%	37%	33%	33%	33%

1 = Status Quo - basefile, 2 = Status Quo - wintering off 100 late calving cows, 3 = Status Quo - In-shed Feed system, 4 = Status Quo - In-shed feed system with wintering off 100 late calving cows, 5 = 2.7 cows/ha Stocking rate - No imported feeds, 6 = 2.7 cows/ha Stocking rate - Production optimised with PKE, 7 = Seasonal (spring calving) Feed Pad - Stocking rate of 3, 8 = Split calving (40% autumn/60% spring calving) Feed Pad - Stocking rate of 3, 9 = Winter milking Feed Pad (100% autumn calving) - Stocking rate of 3, 10 = Seasonal (spring calving) Herd Home - Stocking rate of 3, 11 = Seasonal (spring calving) Feed Pad - Stocking rate of 4 |

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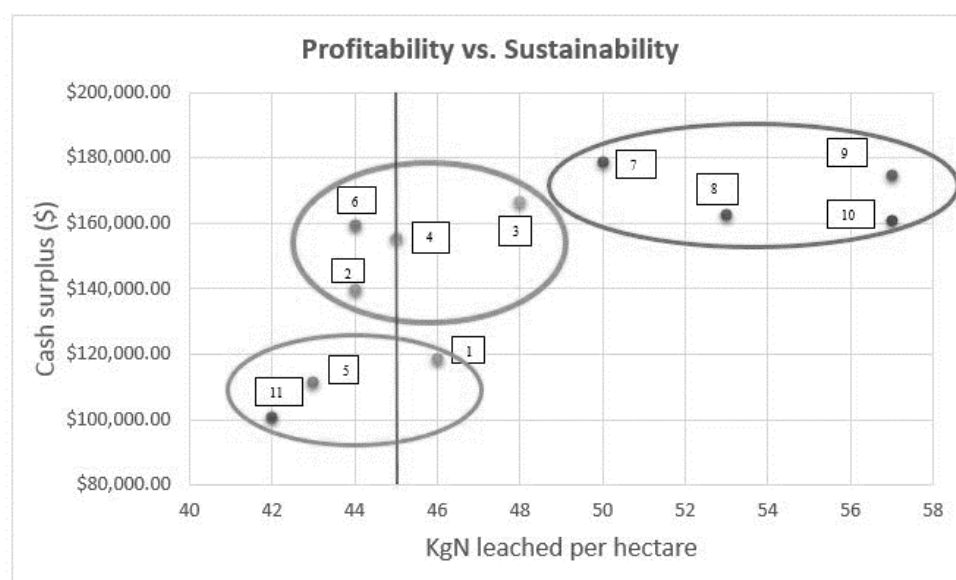


## 5. Farm System Modelling Summary

The table below summarises the key metrics which will largely influence the future direction of Owl Farm.

Farm System	Cash surplus	Return on Asset	Nitrogen loss
<b>1</b> = Status Quo – basefile	\$118,502.00	2.8%	46
<b>2</b> = Status Quo – wintering off 100 late calving cow	\$139,943.00	3%	44
<b>3</b> = Status Quo – In-shed Feed system	\$166,807.00	3.2%	48
<b>4</b> = Status Quo – In-shed feed system with wintering off 100 late calving cows	\$155,575.00	3.1%	45
<b>5</b> = 2.7 cows/ha Stocking rate – No imported feeds	\$111,661.00	2.8%	43
<b>6</b> = 2.7 cows/ha Stocking rate - Production optimised with PKE	\$159,361.00	3.1%	44
<b>7</b> = Seasonal (spring calving) Feed Pad – Stocking rate of 3	\$178,710.00	3.3%	50
<b>8</b> = Split calving (40% autumn/60% spring calving) Feed Pad – Stocking rate of 3	\$162,581.00	3.2%	53
<b>9</b> = Winter milking Feed Pad (100% autumn calving) – Stocking rate of 3	\$174,686.00	3.3%	57
<b>10</b> = Seasonal (spring calving) Feed Pad – Stocking rate of 4	\$160,764.00	3.3%	57
<b>11</b> = Seasonal (spring calving) Herd Home – Stocking rate of 3	\$100,817.00	2.8%	42

Modelled profitability (via the cash surplus figure) and nitrogen leaching have been plotted against one another in the graph below. This allows us to identify which scenarios achieve both an acceptable level of profit and nitrogen loss.



### 7, 8, 9 and 10 = high profit/low environmental – not recommended

The right circle illustrates the farms systems which would not likely be considered due to their associated environmental footprint. Although profitable, these have all been modelled with nitrogen losses in excess of 50kgN/ha which is likely to be in excess of our nitrogen reference point by 10% or more.

These four points reflect the feed pad scenarios at various stocking rates and calving alignments. 9 and 10 on the far side represent the complete winter milking scenario and feed pad with a stocking rate of 4 cows per hectare. At a modelled 57kgN loss per hectare it is suggested these options are eliminated from stage 2's thinking.

8 in the middle is the split calving scenario which is promising in terms of profit but also high in terms of modelled nitrogen loss. Alterations to this system such as stocking rate could reduce the modelled nitrogen loss but such changes would also impact profit for those reasons it is recommended that this option is not explored further.

7 in the top left of the circle represents the spring calving feed pad with a stocking rate of 3 cows per hectare. Of all the models this is the most profitable largely as a result of higher feed inputs and high utilisation leading to a more productive and ultimately more profitable outcome. Alterations could be made to the model to reduce nitrogen losses but to trim as much as 5kgN it would influence profitability.

#### NOTES

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### 1, 5 and 11 = high environmental/low profit – not recommended

The left circle represents those farm systems which have a low environmental footprint but also low profitability.

The worst of these is 11 which represents the herd home at a stocking rate of 3cows/ha. The low operating profit here is largely driven by the high debt servicing and depreciation costs while the imported feed bill is also very high. For this system to work we would need the ability to grow cheap feed either on or off farm.

The 2.7 cows/ha scenario 5, as expected the nitrogen footprint is low. This relates to the lower stocking rate and no purchased feed. This option is not recommended on the basis there are other options which for marginally higher nitrogen losses have a substantially higher cash surplus. The same can be said for the status quo – basefile which rounds out this circle.

### 2, 3, 4 and 6 = the “Sweet Spot” - Recommended

This circle houses the farm systems with the most potential to be considered as part of stage 2’s development.

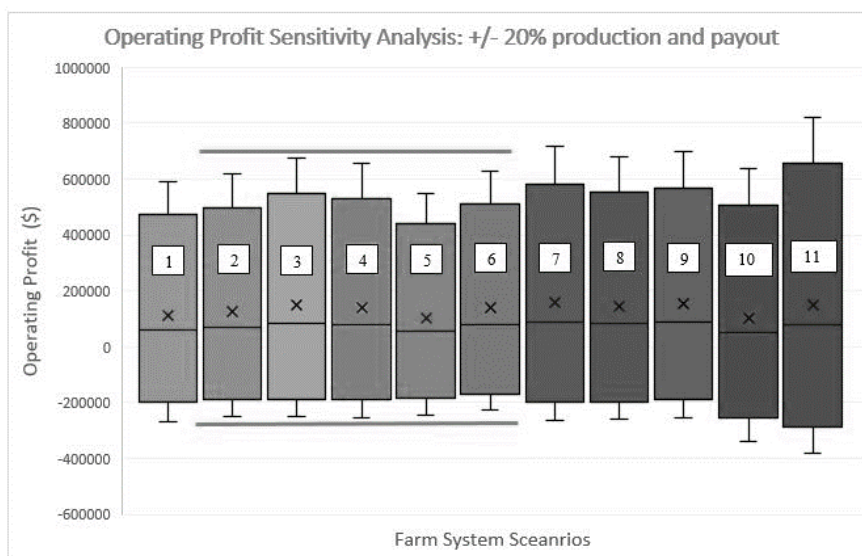
Of these the most profitable is 3 which represents in-shed feeding. Unfortunately, this is slightly higher in its modelled nitrogen loss. Slight alterations could however be made to reduce this back to within our nitrogen reference point. One of those options is the combination of wintering off late calving cows which is represented by 4. In reality, this option would be the most profitable for us as we already land available which we could use for wintering off late calving cows at a much lower cost than \$22/cow. There are also additional benefits with an in-shed feed system such as feed utilisation, mineral distribution and labour efficiency among others.

6 represents the scenario for 2.7 cows per hectare with purchased PKE to optimise production. At a modelled loss of 44kgN/ha and an operating profit which is almost \$160,000.00 this could be seen as one of the more favourable options. One of the limitations of this system remains the necessity to feed PKE in trailers in the paddock. During spring this season, our biggest challenge was undoubtedly being able to provide the cows with high quality feed when pasture utilisation was low. Given the saturation of the paddocks feeding PKE in the paddocks was not always an option meaning production went begging. In terms of developing a more resilient business we need to mitigate the risk of not being able to fully feed cows when conditions don’t suit. Outside of a feed pad an in-shed feed system remains our best option to achieve that.

2 represents status quo with wintering off 100 late calving cows. Although reasonably profitable in its own right profitability could be optimised with the additional investment of infrastructure such as an in shed feed system.

### Sensitivity analysis overview

The graph below represents the sensitivity analysis data which was calculated for each scenario within the report. The series in the legend reflect the farm system numbering structure outlined in the introduction. The X represents the current cash surplus whereas the highest and lowest points reflect what the cash surplus would be with both plus or minus 20% of production and payout i.e. the upper and lower extremes.



#### NOTES

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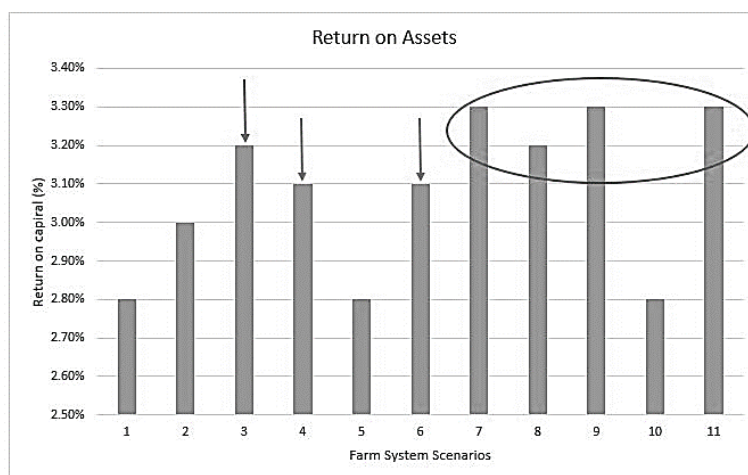
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This suggests that series 5 (2.7 cows/ha stocking rate – no imported feed) is the most resilient as the extremes are closest together, the cash surplus of this scenario however isn't favourable. At the other end of scale series 11 (feed pad with a stocking rate of 4) illustrates a significant range and therefore shows it is more sensitive to changes in production and payout.

Of the four recommended farm systems (series 2, 3, 4 and 6), all are nearly identical in regards to the bottom range for price and production sensitivity. As expected, both the in-shed feed systems (series 3 and 4) appear to be most profitable with increases to production and price.

## Return on Asset



The inclusion of feed pads have a slightly better return on asset as indicated in the circle above. However the associated environmental footprint likely rules these systems out for Owl Farm.

Of the recommended farm system models, the in-shed feed system alone (3) had the best return on asset at 3.2% per annum. Not far below at 3.1% was both the in-shed feed system with wintering 100 late calving cows off farm (4) and 2.7 cows per hectare with PKE (6).

## Summary

Although more profitable, the feed pad scenarios were unlikely to stack up environmentally. This was always going to be challenging given the farm system Owl Farm has historically operated. Although environmentally sound, the operating profit of a herd home given the significant capital investment also means this option for incorporating infrastructure isn't feasible. Similarly, the low input scenario of 2.7 cows per hectare scored well environmentally but lower productivity meant profitability is compromised.

This essentially leaves us with four options. Although wintering off 100 late calving cows scored well environmentally, there is still more that can be done to improve profitability without compromising environmental performance. Similarly, the in-shed system alone scored well profitability but with a higher environmental footprint. For that reason, wintering some late calving cows off with a combination of in-shed feeding to optimise productivity is a strong contender for stage 2. The other strong candidate is very similar to the existing farm system just with a slightly lower stocking rate of 2.7 cows/ha. Although certainly promising this farm system does still leave us vulnerable to extended periods on rainfall, with the potential impact on productivity likely to negatively influence profitability. In-shed feeding isn't without risk either. There is a risk that the cost of PKE increases or that feeding PKE becomes socially irresponsible in years to come. Although there are plenty of alternatives, the cost of feed would likely increase causing the operating profit and cash surplus to decrease. Feed utilisation during prolonged wet weather and cost of feed for in-shed feeding are expected to be strong discussion points at the Farm Governance Committee meeting.

## NOTES

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## 6. Specific Farm System Overview

### 6.1 Status Quo – Basefile

#### Farm System Overview – Key Figures

Total kgMS	184,410
KgMS per cow	419
Total cows	450
Total Income	\$1,111,343
Total farm expenses	\$767,091
Operating Profit	\$344,252
Debt servicing and lease costs	\$225,750
Cash Surplus	\$118,502
Capital requirement	-
Return on additional investment	N/A
Return on assets (%)	2.8%
Kg nitrogen leached per hectare	46
Nitrogen conversion efficiency	33%

This model essentially reflects our existing farm system with optimised production and profit based on ideal feed inputs, weather conditions and growth rates throughout the year. The existing farm system is essentially a system 3, with a stocking rate of 2.9cows/ha there is strategic use of PKE to reduce pressure on pasture and optimise production.

For the purpose of this report, all other modelled farm system scenarios will be compared against this as a basefile.

### 6.2 Status Quo – Wintering off 100 late calving cows

#### Farm System Overview – Key Figures

Total kgMS	187,634
KgMS per cow	426
Total cows	450
Total Income	\$1,130,632
Total farm expenses	\$764,129
Operating Profit	\$366,233
Debt servicing and lease costs	\$226,920
Cash Surplus	\$139,943
Capital requirement	\$12,000
Return on additional investment	55%
Return on assets (%)	3%
Kg nitrogen leached per hectare	44
Nitrogen conversion efficiency	34%

The same stocking rate and general feeding strategy has been employed here with a very similar overall production being achieved. This model differs in the wintering off 100 late calving cows of farm from the 1<sup>st</sup> of June until the 20<sup>th</sup> of July. The cash surplus is slightly higher as a result of slightly higher production and less demand on supplementary feed over winter given there is less feeding pressure. Although there are slightly higher grazing costs this still doesn't outweigh the cost of importing supplements to hit feeding targets.

There is a slight capital cost in the purchasing of 2000 additional Fonterra shares at \$6.00/kgMS.

As expected, this scenario has slightly dropped the nitrogen leaching from 46kgN/ha at the basefile to 44kgN/ha. This reflects taking stock off farm during winter as well as less imported supplements.

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### 6.3 Status Quo – In-shed Feed System

#### Farm Systems Overview – Key Figures

Total kgMS	199,364
KgMS per cow	452
Total cows	450
Total Income	\$1,198,485
Total farm expenses	\$799,178
Operating Profit	\$399,307
Debt servicing and lease costs	\$232,500
Cash Surplus	\$166,807
Capital requirement	\$150,000
Return on additional investment	37%
Return on assets (%)	3.2
Kg nitrogen leached per hectare	48
Nitrogen conversion efficiency	34%

This scenario sees the introduction of an in-shed feed system. PKE has been assumed as the feed source, different feeds at different prices would obviously impact the profitability. The rationale for this scenario is better feed utilisation, distribution of minerals and time efficiency.

Per cow production has increased significantly given PKE is feed in the shed throughout the season. This in turn has significantly increased the overall production and therefore total farm income which is \$87,142.00 more than the baseline at \$1,198,485.00. Expenses are higher given the increase in purchased supplement. The cash surplus is \$166,807.00 which is almost \$50,000.00 more than the basefile.

The \$150,000 capital requirement reflects the following:

- In-shed feed system @ \$60,000.00
- 15,000 additional Fonterra shares @ \$6.00kgMS

There has been a slight increase in modelled nitrogen leaching with an additional 2kgN/ha from the basefile. This reflects the additional supplement being brought in the farm gate.

### 6.4 Status Quo – In-shed feed system with wintering off 100 late calving cows

#### Feed System Overview – Key Figures

Total kgMS	195,575
KgMS per cow	444
Total cows	450
Total Income	\$1,176,185
Total farm expenses	\$789,190
Operating Profit	\$386,995
Debt servicing and lease costs	\$231,420
Cash Surplus	\$155,575
Capital requirement	\$126,000
Return on additional investment	34%
Return on assets (%)	3.1%
Kg nitrogen leached per hectare	45
Nitrogen conversion efficiency	34%

This scenario is similar to 6.3 above with the addition of wintering 100 late calving cows off farm from the 1<sup>st</sup> of June until the 20<sup>th</sup> of July. Throughout the milking season the feed budget looks very similar to the in-shed feed system scenario however the major difference comes through the reduction of imported supplements through the winter and reduced grazing pressure.

Once again per cow production has increased given PKE is feed in the shed throughout the season. This has increased the overall production and therefore total farm income which is \$64,842.00 more than the baseline at \$1,176,185.00. The cash surplus is 155,575.00 which is almost \$40,000.00 more than the basefile.

The \$126,000 capital requirement reflects the following:

- In-shed feed system @ \$60,000
- 11,000 additional Fonterra shares @ \$6.00kgMS

#### NOTES

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There has been a slight decrease of modelled nitrogen leaching of 1kgN/ha from the basefile which is the result of taking 100 late calving cows off farm for 50 days through winter. This is in line with what our Nitrogen Reference Point is likely to be.

## 6.5 2.7 cow/ha Stocking Rate – No imported feeds

### Farm Systems Overview – Key Figures

Total kgMS	171,002
KgMS per cow	420
Total cows	416
Total Income	\$1,027,537
Total farm expenses	\$690,126
Operating Profit	\$337,411
Debt servicing and lease costs	\$225,750
Cash Surplus	\$111,661
Capital requirement	-
Return on additional investment	N/A
Return on assets (%)	2.8%
Kg nitrogen leached per hectare	43
Nitrogen conversion efficiency	34%

This scenario is models on an all pasture system 1 farm milking 2.7 cows per hectare with no imported supplements. Production is significantly lower than the basefile due to lower stock numbers and not optimising production with purchased feed, this has led to a decrease of total income of \$81,010.00 from the basefile.

Understandably, of all the scenarios this is one of the most environmentally sustainable given the lower stocking rate and no purchased feed. This has a modelled reduction 3kgN/ha from the basefile.

## 6.6 2.7 cows/ha Stocking Rate – Production optimised with PKE

### Farm System Overview – Key Figures

Total kgMS	184,536
KgMS per cow	453
Total cows	416
Total Income	\$1,103,201
Total farm expenses	\$718,091
Operating Profit	\$385,111
Debt servicing and lease costs	\$225,750
Cash Surplus	\$159,361
Capital requirement	-
Return on additional investment	N/A
Return on assets (%)	3.1%
Kg nitrogen leached per hectare	44
Nitrogen conversion efficiency	34%

This farm system scenario is also based on a stocking rate of 2.7 cows per hectare with the strategic inclusion of PKE to optimise production. Within this model PKE is feed with troughs in the paddock. The additional PKE has lifted this modelled production almost 15,000kgMS over the previous model and essentially puts production on par with the base file.

The total income between this scenario and the basefile is very similar given the similar production totals. However given the expenses are less as a result of both per cow costs and lower imported PKE the cash surplus for this system is \$40,859.00 higher than the base file at \$159,361.00.

This is also favourable from an environmental perspective as the model demonstrates a 2kg decrease in nitrogen leaching from the basefile to 44kgN/ha. This is a result of the lower stocking rate throughout the season.

#### NOTES

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## 6.7 Seasonal (spring calving) Feed Pad – Stocking rate of 3

### Farm System Overview – Key Figures

Total kgMS	211,171
KgMS per cow	479
Total cows	470
Total Income	\$1,275,637
Total farm expenses	\$851,376
Operating Profit	\$424,260
Debt servicing and lease costs	\$245,550
Cash Surplus	\$178,710
Capital requirement	\$440,000
Return on additional investment	18%
Return on assets (%)	3.3%
Kg nitrogen leached per hectare	50
Nitrogen conversion efficiency	35%

This farm system scenario incorporates a feed pad to better utilise supplement. The stocking rate has also been slightly increased to 3 cows per hectare. Production has increased significantly as a result of high input system associated with the use of the feedpad.

As expected the increase in production has led to a significant increase in total income which is \$164,294.00 more than the basefile. Given the higher reliance on supplementary feeds the farm expenses have also increased by \$84,285.00 from the basefile. With a cash surplus of \$178,710.00 this option is \$60,208.00 more profitable than the basefile.

The \$440,000.00 capital requirement reflects the construction of the feedpad and additional effluent infrastructure along with the purchasing of additional Fonterra shares. The feed pad has only been sized for 300 cows given the farm currently operates a split herd, this will also save money on additional concrete. The feedpad has been designed with the most efficient concrete to feed face ratio. Pricing for all pads has also been provided through Archway, a company who specialises in agricultural concrete construction. The capital cost is outlined below.

- \$144,000.00 for feedpad incl. concrete, mesh steel, etc. nib walls and 130m of feed bins.
- \$16,000.00 for pipe work, gates and water troughs/system.
- \$100,000 for effluent system – scrapper, wedge with weeping wall, additional effluent storage, improvements to pump and pipes.
- 180,000.00 for additional Fonterra shares (30,000 @\$6.00kgMS)
- \$440,000.00

Although more profitable this farm system is not more sustainable, with 50% more imported supplement than the basefile as well 20 additional cows nitrogen leaching has increased by 4kgN/ha from the basefile to sit at a modelled 50kgN/ha.

## 6.8 Split Calving (40% autumn / 60% spring calving) Feed Pad – Stocking rate of 3

### Farm System Overview – Key Figures

Total kgMS	203,151
KgMS per cow	453
Total cows	470
Total Income	\$1,276,242
Total farm expenses	\$869,461
Operating Profit	\$406,781
Debt servicing and lease costs	\$244,200
Cash Surplus	\$162,581
Capital requirement	\$410,000
Return on additional investment	15%
Return on assets (%)	3.2
Kg nitrogen leached per hectare	53
Nitrogen conversion efficiency	37%

This farm system scenario also incorporates a feed pad to better utilise supplement. This models a split calving system whereby 40% of the herd calve in autumn and the remaining 60% calve in spring. The purpose of this model is to reflect the additional value derived from Fonterra's winter milk premium.

#### NOTES

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Farmax is a seasonal model. One limitation is therefore that it does not model winter milk particularly well in terms of the conversion of feed into milk. Actual milk production would likely be marginally higher than modelled during the winter months, though at a modelled 453kgMS/cow it is still quite high. Although not ideal, this model is more likely to be governed by nitrogen leaching than profitability. With a modelled nitrogen leaching of 53kgN/ha this model is unlikely to be seriously considered.

Regardless, this model does have a significantly higher total income than the basefile and a slightly higher total income than the seasonal feedpad from the previous model, this reflects the winter premium. Total farm expenses are higher than the previous model on the basis additional supplementary feed needs to be purchased to satisfy demand during winter. With a cash surplus of \$162,581.00 this scenario is \$44,079.00 more profitable than the base file.

In terms of capital investment the sizing and cost of feed pad is the same as the previous model. The \$30,000.00 difference reflects the lower production and therefore lower number of shares required.

## 6.9 Winter Milking Feed Pad (100% autumn calving) – stocking rate of 3

### Farm System Overview – Key Figures

Total kgMS	205,000
KgMS per cow	455
Total cows	470
Total Income	\$1,299,735
Total farm expenses	\$880,849
Operating Profit	\$418,886
Debt servicing and lease costs	\$244,200
Cash Surplus	\$174,686
Capital requirement	\$410,000
Return on additional investment	18%
Return on assets (%)	3.3%
Kg nitrogen leached per hectare	57
Nitrogen conversion efficiency	33%

A purely winter milking scenario has also been developed to demonstrate both the financial impact of the winter milk premium as well as the additional environmental challenges associated with transitioning to these systems.

At \$1,299,735.00, the total income is significantly higher (\$188,392.00) than the base file largely reflecting the higher per cow performance. The total income is also \$24,098.00 higher than the seasonal feed pad scenario put forward earlier which largely reflects the winter milk premium. Regardless of the higher total income the cash surplus for this model is slightly lower than the traditional feed pad scenario given the higher demand on purchased feed for the winter months.

The capital requirement for this scenario is the same as the previous split milking scenario.

At an cash surplus of \$174,686.00, this scenario is one of the most profitable farm systems, however with a modelled 57kg of nitrogen leaching per hectare this is also one of the most environmentally challenged scenarios. It is unlikely to be considered on those grounds alone.

## 6.10 Seasonal (Spring Calving) Herd Home – Stocking rate of 3

### Farm System Overview – Key Figures

Total kgMS	211,171
KgMS per cow	479
Total cows	470
Total Income	\$1,275,637
Total farm expenses	\$900,176
Operating Profit	\$374,460
Debt servicing and lease costs	\$273,643
Cash Surplus	\$100,817
Capital requirement	\$1,086,500
Return on additional investment	3%
Return on assets (%)	2.8%
Kg nitrogen leached per hectare	42
Nitrogen conversion efficiency	33%

This scenario has been modelled to essentially demonstrate the profitability of animal housing as well as illustrating the potential environmental benefits. Although it is acknowledged that herd homes are not necessarily classified as wintering barns, this still provides a high-level indication of where they would stack up on both scales.

#### NOTES

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The capital requirement is the biggest cost associated with this farm system with the cost of the herd home has been calculated at \$1875/cow. This is based on recommendations from a similar farm system we visited. At \$1875/cow the herd home alone would cost \$862,500.00, above this an additional \$50,000.00 feed bunker along with 29,000 Fonterra shares (\$174,000.00) means this system would require a \$1,086,000 capital injection.

In regards to total income, this system is no different from the feed pad scenario as the feed budget remains identical. It could be argued that cows produce more milk within these systems due to a reduction in heat stress. One such extrapolated assumption suggesting it could be within the vicinity of \$10,000/year. Heat stress cannot be modelled within Farmax and even with a potential \$10,000/year increase it would remain the least profitable.

There are less nitrogen costs given the redistribution of effluent from the bunkers but the cost of contractors to do this work has made it cost neutral. The high expenses driven by significant purchased feed and high depreciation has led to a low cash surplus of \$100,817.00 which is \$17,685.00 less than the basefile and \$77,893.00 less than the seasonal feed pad option.

Environmentally this system has been modelled with a nitrogen loss of 42kgN/ha. This is made possible through taking stock off pastures for 4-6 hours per day during the season, as well redistributing nutrients from effluent at a time and rate which soils can fully utilise.

Although these systems are clearly more sustainable their profitability remains questionable at a \$5.50kgMS payout, for that reason it is not a farm system that would likely be recommended.

## 6.11 Seasonal (Spring Calving) Feed Pad – Stocking rate of 4

### Farm System Overview – Key Figures

Total kgMS	259,467
KgMS per cow	462
Total cows	620
Total Income	\$1,560,676
Total farm expenses	\$1,119,532
Operating Profit	\$441,144
Debt servicing and lease costs	\$280,380
Cash Surplus	\$160,764
Capital requirement	\$1,214,000
Return on additional investment	8%
Return on assets (%)	3.3%
Kg nitrogen leached per hectare	57
Nitrogen conversion efficiency	33%

In reality this farm system has only been modelled to ensure a complete package of scenarios have been considered. Although not an option Owl Farm would likely consider, it is important to model by means of demonstrating the environmental impact for other farmers considering what impact different options may have on their businesses.

With a modelled stocking rate of 4 cows per hectare this scenario has 620 cows, 150 more than the stocking rate of 3 which has been used for many other scenarios. The higher stocking rate has meant a significant increase in purchased supplements with 933 tonnes DM more purchased than the basefile. Total income is significantly higher than the basefile (+\$449,333.00) resulting from the higher total milksolid production. However, with expenses also being \$352,411.00 more than the basefile the cash surplus is the lowest of all the feed pad scenarios at \$160,764.00.

Once again it has been assumed that a feedpad wouldn't be scoped to hold the entire herd given the split herd requirement, a 450 cow feedpad has therefore been priced. The capital requirement for this scenario is outlined below:

- \$180,000.00 for feedpad incl. concrete, mesh steel etc., nib walls and 240m of feed bins
- \$20,000.00 for pipe work, gates and water troughs/system
- \$100,000.00 effluent system – flood wash, wedge with weeping wall, additional storage
- \$50,000.00 for feed storage bins
- \$50,000.00 mixer wagon
- Additional stock 170 cows @\$2000 = \$340,000.00
- Additional Fonterra Shares required ~ 79,000 @\$6.00 = \$474,000.00

If this system was to be implemented, it's likely a bigger cowshed would need to be considered with the current only a 36 aside bale. For the purpose of this scenario, it has just been assumed that milking will be longer.

#### NOTES

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Environmentally, the additional cows and significant increase in purchased feed has illustrated the additional impact this system would put on water quality with nitrogen leaching increasing to 57kgN/ha/yr., for this reason alone it is likely this option would not be considered.

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# CONSTRUCTED WETLANDS AS A COST-EFFECTIVE NITROGEN MANAGEMENT TOOL ON FARMS

Prepared by Roger MacGibbon, Opus (027) 496-1365

## What can constructed wetlands do?

- Well-constructed wetlands can extract up to 70% of the nitrate contained in drainage water by converting it to atmospheric nitrogen ( $N_2$  gas) through a bacterial process called denitrification. For this reason wetlands have the potential to function as helpful tools for farmers to reduce the amount of nitrogen exported from the farm and entering surface water bodies and ground water.
- Wetlands can also serve to eliminate up to 90% of faecal micro-organisms (e.g. *E.coli*) by promoting mortality due to prolonged exposure to sunlight (UV).
- Wetlands are not particularly effective at removing phosphorus from drainage water and their nitrate removing capacity will be reduced if large amounts of sediment enter the wetland.

## Does the design and form of the wetland affect performance?

Yes! The shape, depth, size and substrate of a wetland and the nature of the vegetation growing in it will determine whether the wetland is fully effective in extracting nitrate or has no benefit at all.

While the science behind the design and functioning of wetlands as nutrient treatment devices is reasonably well known, there is no one design that will suit all farms. Every farm varies in terms of hydrology, topography, climate and nutrient loads; wetland design in terms of wetland location, size, configuration and plant species must accommodate each farm's unique conditions if good nutrient extraction performance is to be achieved.

## What is required to construct an effective nutrient treatment wetland?

- A relatively flat location where farm runoff and/or seepage water drains to, or a flat area alongside a stream or drain that water can be diverted to.
- Sufficient area to construct a wetland that is no less than 1% of the size of the catchment draining to it (the larger the wetland size compared to catchment size the more effective the nitrate extraction will be).
- The recommended length to width ratio should be between 3:1 and 10:1, and preferably between 3:1 and 5:1 for wetlands larger than 0.1ha.
- Lie on a gentle gradient and flat bottomed to encourage even water dispersal and maximum retention time. Water should remain resident in the wetland for at least 24 hours, preferably longer.
- Shallow – no deeper than 500mm at its deepest point and preferably between 200mm and 300mm. This is the depth that wetland reed, rush and sedge plants prefer and it also ensures maximum water – organic matter contact (the denitrifying bacteria reside on plant material and in decaying organic material).
- A full cover of wetland plant material. Open water areas are not effective at converting nitrate and can encourage ducks which can be counter-productive.
- A topsoil / organic layer on the bottom of the wetland suitable for plant growth.
- Selection of native wetland plant species that will tolerate the local conditions. Conditions that may influence survivability, and therefore species selection, are winter frosts, water depth, sediment and nutrient loads, and wetlands that dry up in summer.

## Construction and performance of the Owl Farm wetland.

- A 4 bay wetland has been built with a surface area of just under 0.4ha.
- The wetland receives drainage from approximately 33 ha (75% of the dairy platform above it). The wetland to catchment ratio is 1:1.2.
- The wetland receives a constant flow of seepage water between late April and late December from springs and tile drains along the terrace above the wetland. This water seems to be carrying moderate to very high nitrate concentrations (see table 1).

## Construction

- The design, construction and planting of the wetland cost \$64,200 plus GST. This includes the cost of fencing and some planting labour.
- The cost of earthworks (at \$25,000) was one third higher than normal because the valley was found to have been filled in at some time in the past. This material was unsuitable for a wetland base and had to be removed.

## NOTES

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- A very hard iron pan exists under this wetland which effectively provides a seal to water loss. Because of this water is held in the wetland all year round. Topsoil was re-applied to this pan and the plants planted into it.
- The bottom two narrow bays required no earthworks other than to build a weir half way down to retain water and slow down its passage.
- 6000 native sedges, reeds and rushes (7 species in total) were planted into the four wetland bays.
- Earthworks occurred in late March and April (before it got wet) and planting occurred in October and November.
- Plant survival and growth has been excellent although since Christmas moderate to large flocks of ducks that have been feeding on the farm chicory have been responsible for the mortality of patches of plants.
- Replacement planting will occur in April using leftover plants and by dividing the larger existing wetland plants.



### Performance

- One water sample at the outlet weir has been taken since construction (12 January). This shows **97% extraction** of nitrate from the seepage water entering the wetland. This result is an anomaly because no water was flowing out of the wetland at the time and so water residence time was much longer than normal, however, it illustrates what can be achieved if water can be retained for long periods. The denitrifying bacteria therefore had a prolonged period to remove the nitrate.
- When water begins to flow nitrate extraction is expected to be around 20% during the first year increasing to optimum levels (over 30%) by year 3 to 5.

**Table 1: Owl Farm Well, Drain and Outlet Water Quality Results**

Well site	Well depth (m)	Sample date	Nitrate (mg/L)	Total N (mg/L)	DRP (mg/L)	Total P (mg/L)
OFW1	3.55	12/01/2017	2.73	2.83	0.012	0.090
OFW1A	5.6	12/01/2017	4.77	4.83	0.004	0.055
OFW2	2.56	12/01/2017	11.40	11.60	0.002	0.020
OFW3	2.57	12/01/2017	7.61	10.40	0.001	0.058
Tile Drain		12/01/2017	10.00	11.50	0.001	0.556
Wetland Outlet		12/01/2017	0.19	1.20	0.002	0.056

### NOTES

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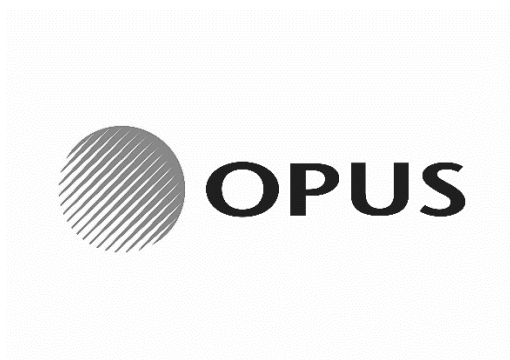
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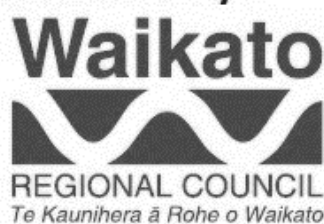


- When this wetland reaches a 30% nitrate extraction rate it will be removing around 450 kg of N per year. This equates to a 3 kg/ha reduction (from 45 to 42 kg/ha/yr.) in leaching losses when spread across the full 137 ha productive farm platform.
- Wetland generated N-loss reductions are NOT currently generated in OVERSEER®. The intention is to generate good data from this wetland and others to feed into OVERSEER so that eventually it does reflect the benefits of wetlands.



**Owl Farm wish to acknowledge and thank the following organisations for their generous support in the development of our Constructed Treatment Wetland.**

**Constructed Treatment Wetland funded by**



**Designed and project managed by**



**Water quality monitoring programme developed by**



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# Next Farm Focus Day

Wednesday, 17 May 2017



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