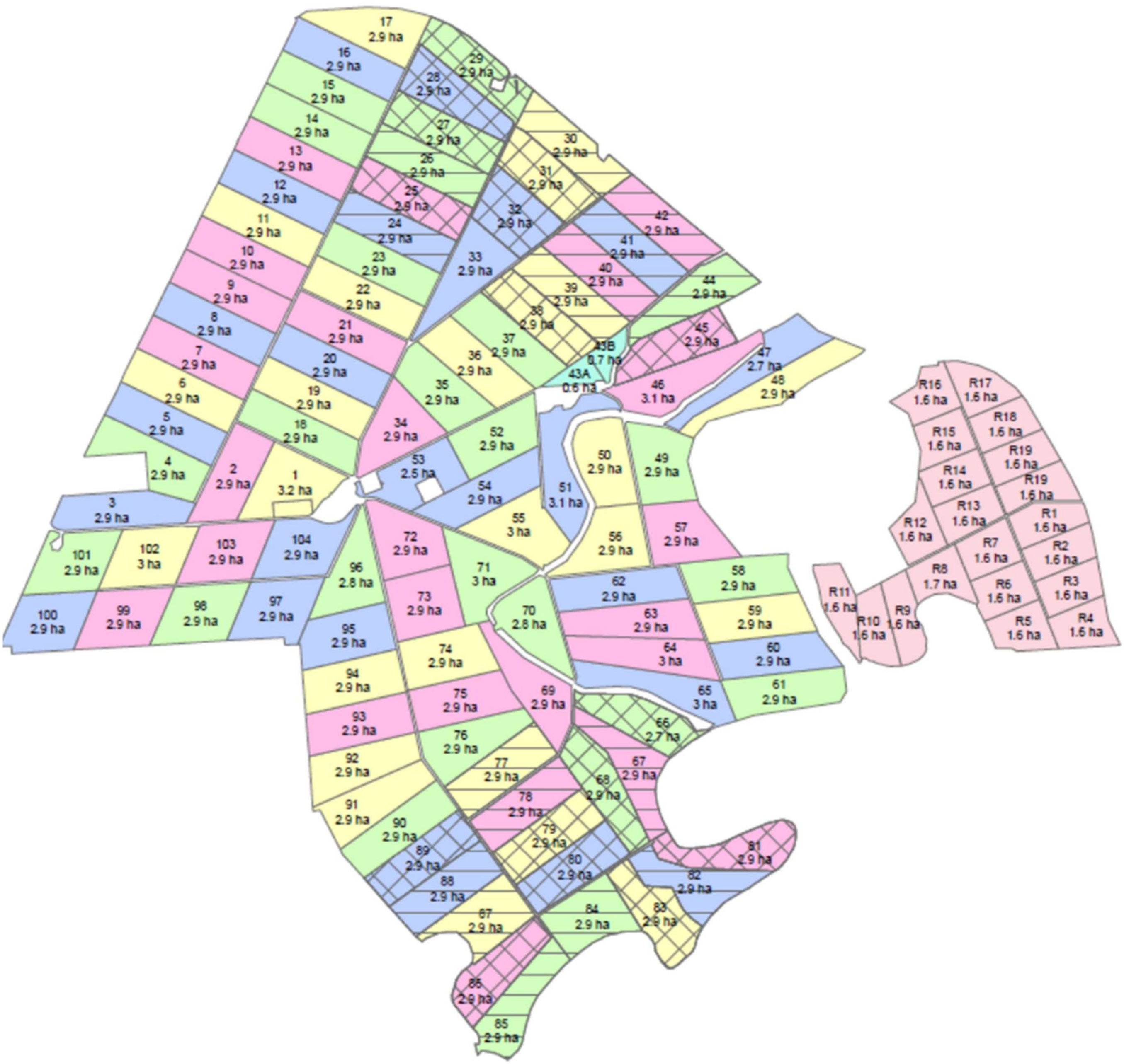
Leading Innovation for
Southern farmers' propserity

SOUTHERN DAIRY HUB

July Field Day 2022

Contents

Farm Map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Covid-19 Information:

- All attendees must maintain 1 metre physical distancing at all times
- Good health and hygiene standards must be maintained throughout the event and use of a face mask is compulsory for all attendees
- Attendees must record their attendance to enable contact tracing and scan the COVID QR code upon arrival
- Please do not attend this event if you are unwell or suspect you may have been exposed to COVID-19

<u>Please note: The above requirements may be subject to change in accordance with COVID alert levels and Government requirements at the time of the event</u>.

Visitor Health and Safety Requirements

Entry onto property by permission and appointment only.

Contact either:

General Manager <u>Louise Cook 027 564 5595</u> or

Ops Manager <u>Charlie McGregor 027 207 6012</u>

All visitors required to sign in and out accepting farm rules

A farm map will be provided showing any general hazards on the farm; the manager will instruct you of any new hazards

General Rules

- Communication – sign in and out
- Children on farm – must be under constant adult supervision and only with express permission of manager
- Reporting – Please notify manager immediately any accidents or near miss events/hazards
- Drive to the conditions – Max speed of 30km/hr

- Farm bikes – trained operators only, helmet with strap done up at all times, never operate if under 16 years old
- Vehicles – no one to operate farm vehicles without manager's permission
- Water ponds/troughs – Keep a close eye on children around water sources – do not drink from farm taps, troughs, water ways

- In emergency – Please report back to farm manager at Assembly point in front of cowshed
- Fire extinguishers – found in farm houses, dairy shed, vehicles, and woolshed
- No smoking in cowshed, buildings, or vehicles
- Firearms – only with approval of farm manager, must hold current licence

Biosecurity Requirements for Southern Dairy Hub (SDH)

<u>All visitors must comply with the Biosecurity Requirements when visiting the SDH</u>

- Visitors must comply with MOH guidelines regarding COVID-19, including wearing of masks indoors and presenting a valid vaccine passport.
- All footwear must be disinfected with materials supplied, upon arrival at and departure from the SDH farm site.
- Protective footwear may be borrowed from the SDH upon request, and must be cleaned thoroughly before its return. People wearing inappropriate (or no) footwear will not be allowed onto the SDH premises.
- All visitors are expected to wear clean protective clothing, including wet weather gear if necessary when on the farm(s).
- No farm visits will be allowed, under any circumstances, from anyone within five days of their arrival in New Zealand from Central or South America, any part of Asia or any part of Africa. Further restrictions may be applied at any time, dependent upon international disease status.
- On farm, visiting vehicles must be parked in designated visitor parking areas. Approved vehicles may only access the farm after washing the undercarriage. This may be repeated prior to departure but this is up to the operator concerned.
- SDH retains the right at any time to refuse access to any person or persons deemed not to be complying with these requirements.

SDH Winter 2022 – contingency planning and implementation triggers

Stand-off Area Decision Rules

Make on a paddock-by-paddock basis

Gumboot score 1			No water pooling Soil firm Cows can lie down
Gumboot score 2			No water pooling Soil sticky Cows may lie down
Gumboot score 3			Water pooling Soil liquified Cows will not lie down

Time at a gumboot score of	2	3
0-24 hours	Monitor conditions/weather Can feed extra baleage Can spread straw	Monitor conditions/weather Can feed extra baleage Can spread straw
24-48 hours	**Crop paddocks:** Consider removing back fence Can feed extra baleage Can spread straw **Grass paddocks:** Can remove back fence or double break area Can feed extra baleage Can spread straw	**Crop paddocks:** Remove back fence Feed extra baleage Spread straw **Grass paddocks:** Remove back fence or double break area (need to shift bales) Feed extra baleage Can spread straw
48-72 hours	**Crop paddocks:** Can open access to break-out area and/or spread straw Feed extra baleage **Grass paddocks:** Can shift cows to a drier area and/or spread straw Feed extra baleage	**Crop paddocks:** Open access to break-out area Can spread straw Feed extra baleage **Grass paddocks:** Shift cows to a drier area Feed extra baleage

Feed type	Pros	Cons	Cost/ha inc cost of baleage	Cost/ Farmlet	Wet Weather Strategy
Brassicas Swede Clean Crop 15TDM/ha	• Low risk feed for animal health Steady yield • Low weed pressure in crop • Good energy for weight gain • Variable bale quality has low impact • Goes well with minimum tillage	• Crop must be finished by early August or seeds • Potential for issues with Rot/crop quality • One year crop cycle only - more area needed • Wet weather strategy needed	$3,991 Ex Springer Incl: Seed, Fert, Spray, cult/drill, Baleage x23 bales/ha	$15,964	Used: Remove back Fence – Day 2 Full cultivation – straw Day 2 Breakout to Italians – Day 3
Fodder Beet Jamon 20-25t/ha	• Great weight gain • High yield means less area needed • Can crop 2 years running • Fewer crop diseases affect quality • Variable bale quality has low impact	• Weed Management Variable • Reduced yield for minimum tillage • Wet weather strategy needed, and actioned earlier than brassicas • Significant health risk for stock. • Requires extra fencing and extra supplement - labour intensive feeding	$5,899 Ex Springer Incl: Seed, Fert, Spray, cult/drill, Phos minerals, Baleage x 46 Bales/ha	$17,697	Used: Remove back Fence – Day 2 Full cultivation – straw Day 2 Breakout to Italians – Day 3
Baleage Italian pasture In pdk Baled and Bought in 100 bales/ha 22Ton "crop	• Low risk feed for animal health • Flexi-yield, we choose the bales/ha • Can winter same area 2 years running • Wet weather management was easy, needing least intervention and have the most options in paddock to address	• Variable bale quality can impact weight gain A lot more bale wrap to dispose of! Paddocks require regrassing after winter	$7,829 Ex Springer Incl: Italian Seed, Fert, Spray, cult/drill, Baleage x 100 bales/ha	$23,487	Used: Remove back Fence – Day 3

Crops sown with areas left in grass for cows to use as "break-out" areas within the paddock, used as "fresh" area for resting in poor weather

To cultivate or not? – Hedgehope-Makarewa Catchment Group Winter 2021 crop establishment pilot study summary

Key learnings

Farmers need to carefully assess their own situation, adjust what they do as conditions change during winter, and have systems in place to support the changes.

Good management of crops and stock were the main factors that impacted soil conditions and mud creation during winter grazing across a range of soil types, winter crops and stock classes.

At SDH:

1. Minimum till establishment of fodder beet resulted in slightly better soil structure (from visual soil assessments) post grazing compared with conventional cultivation and establishment.
2. Water infiltration was better pre-grazing in the conventionally established treatments, and resulted in less water pooling but deeper pugging during grazing, compared to the direct drilled crop establishment.
3. Minimum till fodder beet crops had lower yields and were weedier with more yield variation across the paddock

The study found that the following steps will make the biggest improvement to wintering outcomes:

1. Good paddock selection, preparation, and agronomy practices to achieve optimum crop yields.
    a. Short cuts with paddock preparation will impact germination and subsequent yield
    b. Weed and pest control is paramount with minimum till establishment
2. Utilising portable troughs and back fencing.
3. Implementing Good Management Practices to maximise the time animals spend in better conditions
4. Having a Plan B and those on the ground knowing when to implement it.

Minimum till crop establishment methods are not a silver bullet solution to poor crop planning and grazing management implementation during winter

SDH

Key Project Objective

To test whether utilising strip tillage or direct drilling to establish fodder beet crops and direct drill to establish kale crops maintains soil structure and strength, thereby reducing the occurrence of pugging and improving animal welfare during winter grazing, compared to crop establishment using conventional cultivation.

Short description

At the Southern Dairy Hub, in spring 2020 two pasture paddocks were selected, one was sown into fodder beet, the other into kale.

The fodder beet paddock was split in half and then one third of each half of the paddock was established using strip tillage, direct drilling or conventional cultivation as per the best practice for each establishment method.

For the kale paddock, half the paddock was established using direct drilling, and the other half using conventional cultivation as per best practice for each establishment method.

Methods

Crop yields from each treatment area were undertaken monthly from mid-March until the end of the grazing period for each treatment. For fodder beet this involved sampling each replicate area and sampling the leaf and bulb separately. Assessments for kale were taken in each treatment area.

Visual soil assessments were undertaken in each treatment area before and after grazing. An attempt was made at measuring the infiltration before and after grazing using infiltration rings and water, however this method was only moderately successful. A penetrometer was used to assess how compacted each area was prior to grazing. In both paddocks penetrometer readings were taken within or between the rows pre grazing and in a similar area of the paddock post grazing.

Soil moisture was determined from 10 soil cores from each treatment area and the soil profile was assessed by digging a 'trench' approximately 30 cm wide, spade depth and across 2 rows or fodder beet keeping one edge as straight as possible.

During grazing measurements of pugging depth (using a 30 cm ruler), water pooling (within the immediate area of the measurement site) and gumboot scores (1 = dry, 2 = wet and 3 = sodden) were assessed from 25 sites in each treatment area daily.

Results

There were a few timing issues with establishment, weed and pest control that impacted on the results of this pilot at SDH. We didn't always get everything right but learnt a lot about the preparation of the paddocks and timing of establishment of our strip till and direct drill fodder beet crops due to the issues we encountered. The issues primarily related to the complexity of the paddock layout, soil conditions and timing.

- Direct drill
    - soil conditions were not ideal at the time of planting – too wet,
    - too much dead trash remaining after spraying which provided a haven for insects,
    - poor plant survival due to insect damage,
    - pasture and weed competition following redrilling.

- Strip till
    - soil conditions not ideal at the time of planting – too wet,
    - too much dead trash remaining after spraying which provided a haven for insects,
    - poor germination due to uneven seed depth
    - poor plant survival due to insect damage,
    - significant competition from grass due to poor spray out and mistimed follow up sprays

Crop yield

A significant contributor to the differences in crop yields between the treatments was the number of seeds that germinated and survived. In both the minimum till establishment treatments insect damage at the time of germination resulted in poor plant populations.

At grazing the conventional fodder beet averaged 22.3 t DM/ha (range 21-25 t DM/ha) with 24% leaf. This compares with 10.8 (8-15) t DM/ha with 33% leaf and 14.8 (13-17) t DM/ha with 28% leaf for direct drilled and strip till areas respectively. The higher leaf yield for the direct drill may have resulted from the later sown plants in the crop.

Average kale yield at grazing was 10.2 t DM/ha for both treatments.

Crop utilisation

There were no differences in crop utilisation between the establishment methods for either fodder beet (94-99% utilisation) or kale (82-84% utilisation).

Soil structural measurements

There were no differences measured between the establishment treatments in visual soil assessment prior to winter grazing in either the fodder beet or kale paddocks. In both paddocks the VSA's within the paddock were considerably lower than those from samples collected under the fenceline (Table 1).

In the fodder beet paddock the post grazing VSA's for the conventionally established areas were lower (indicating poorer soil structure) than those in the DD and ST areas but all results were much lower than the pre-grazing measurements (Table 1). The trends were less clear in the kale paddock where lower VSA's were recorded pre and post grazing in the conventionally established area (Table 1).

The rate of water infiltration was faster for the conventionally cultivated areas of the paddock pre-grazing in the fodder beet and kale paddocks (Table 1).

Table 1: Average visual soil assessment, penotrometer reading (compaction) and infiltration rate (seconds) pre and post grazing for paddocks established in fodder beet and kale using a range of conventional and minimum till establishment methods.

	Visual Soil assessment		Penotrometer reading		Infiltration
	Pre-graze	Post-graze	Pre-graze	Post-graze	Pre-graze
Fodder beet					
Fenceline	30.5				
Conventional	26.0	15.1	358	382	125
Direct Drill	25.8	17.9	431	395	187
Strip Till	26.0	17.5	438	412	151
Kale					
Fenceline	29.3				
Conventional	27.5	15.5	326	343	79
Direct Drill	24.5	16.5	383	409	199

Soil conditions during grazing

In the fodder beet paddock pugging depth was deepest for the conventionally cultivated treatment, followed by strip till and direct drilled (Table 2). A smaller proportion of the conventionally cultivated measurements were scored as wet and there tended to be less surface pooling with this treatment. The direct drilled area had a higher proportion of sites with surface pooling but the lowest pugging depth.

Differences between treatments were smaller in the kale paddock with no clear trends evident (Table 2).

Table 2: Average pugging depth, gumboot score, soil wetness and pooling for paddocks established in fodder beet and kale using a range of conventional and minimum till establishment methods

Fodder beet	Pugging depth (cm)	Gumboot score (0-2)	Dry (%)	Wet (%)	Sodden (%)	Pooling (%)
Conventional	5.6	0.57	57	29	14	32
Direct Drill	2.6	0.60	52	36	12	38
Strip till	4.2	0.58	55	32	13	34
Kale						
Conventional	3.5	0.56	58	27	14	42
Direct Drill	3.7	0.57	57	29	14	38

Pugging depth (Figure 1), gumboot scores and surface pooling all responded positively to rainfall. Within one day of a significant rainfall event or consecutive days of smaller rainfall events increases in gumboot scores, pugging depth and surface pooling were observed. For all these metrics values dropped within a couple of days of the event. In the fodder beet paddock pugging depth was consistently higher for the conventionally established treatment and lowest for the direct drilled.

Fodder beet treatments tended to have higher surface pooling for longer after rainfall events than the kale treatments. In general, the average pugging depth in the kale paddock was less than that measured in the fodder beet.

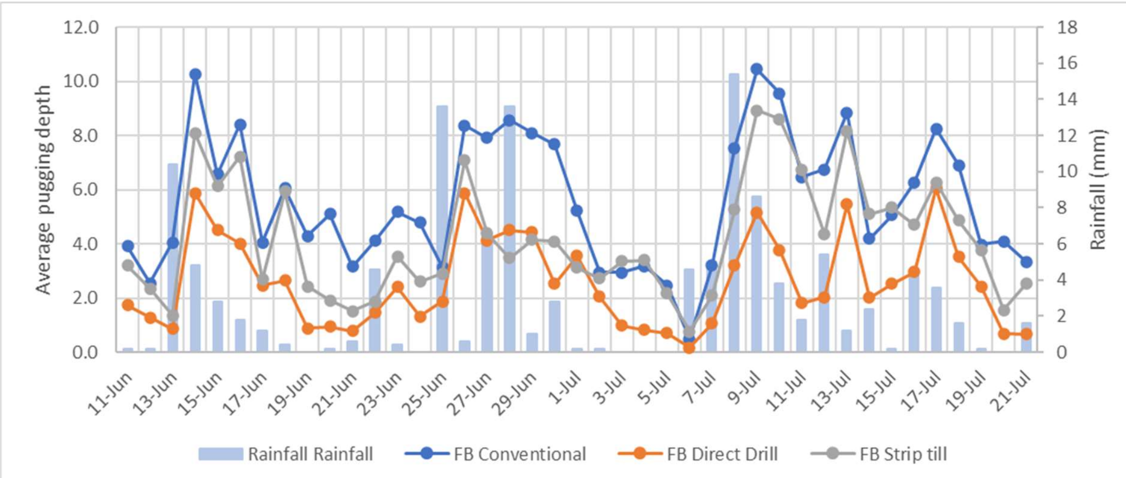


Figure 1: Relationship between average daily pugging depth and rainfall for the fodder beet treatments during the grazing period.

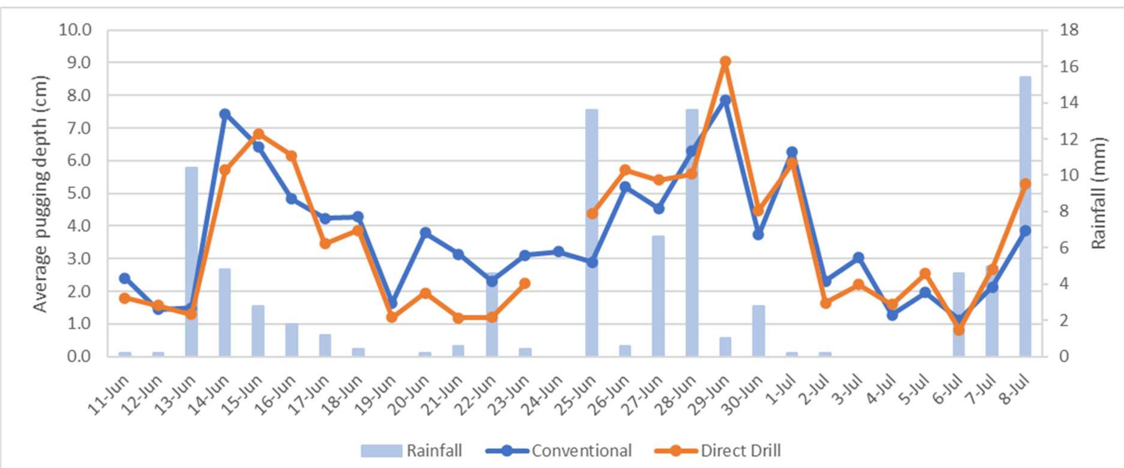


Figure 2: Relationship between average daily pugging depth and rainfall for the kale treatments during the grazing period.

There were several rainfall events during the winter period that resulted in 100% of the measurement sites being assessed with water pooling (Figures 3 & 4) and a higher percentage pooling was recorded for longer after the events in the direct drilled fodder beet area.

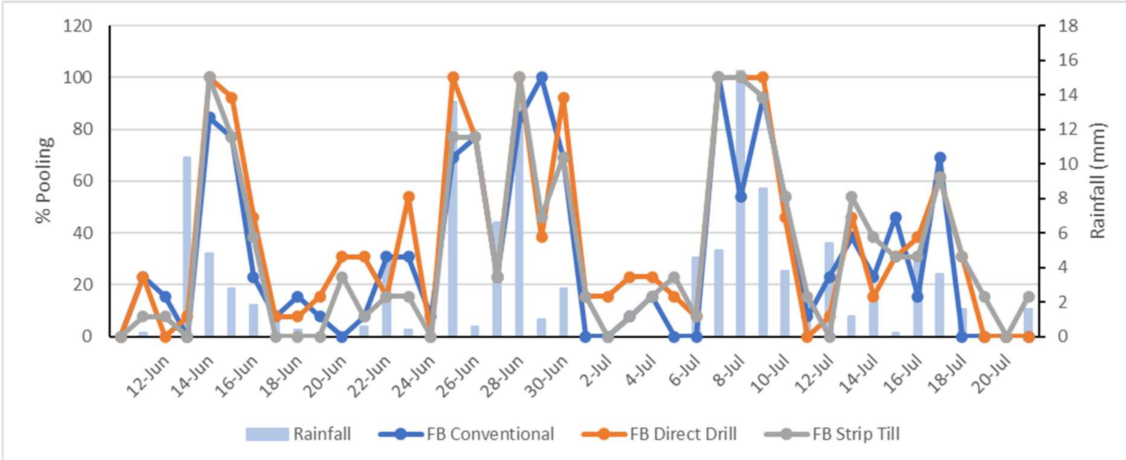


Figure 3: Relationship between the proportion of the grazing break with surface pooling and rainfall for the fodder beet treatments during the grazing period.

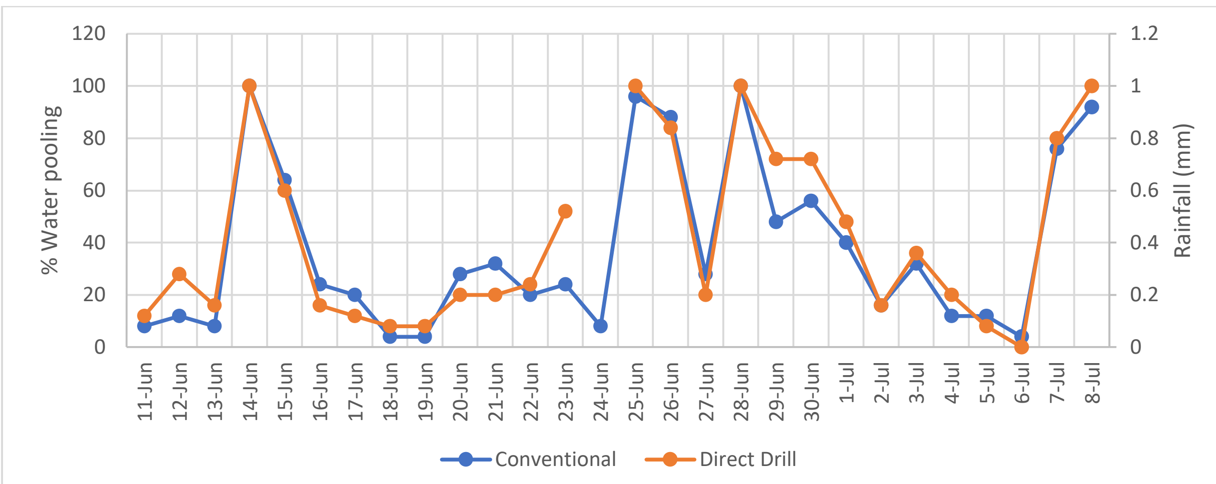


Figure 4: Relationship between average proportion of the paddock with surface pooling and rainfall for the kale treatments during the grazing period.

Commercial Farms

Background

A pilot study funded by Thriving Southland was undertaken across 10 commercial Southland farms and the Southern Dairy Hub (SDH) to investigate the impact of alternative crop establishment methods on both soil and crop characteristics, as well as animal welfare.

The study aimed to understand whether low or no tillage options (low/no soil disturbance) at crop establishment provide better soil conditions, and to gain practical on-farm information about different aspects of winter grazing (e.g. cultivation, crop, soil condition and animal welfare) to support farmers in Southland and across New Zealand meet the upcoming Essential Freshwater Regulations.

About the study

In their efforts to establish crops with better outcomes for various stock classes and to identify ways to reduce mud and support better environmental and animal welfare outcomes, members of the Hedgehope Makarewa Catchment Group volunteered to be part of a trial investigating cattle and sheep grazing behaviour and soil surface conditions.

The study looked at paddock conditions, the ability for livestock to lie down, and their behaviour/comfort, in the hopes of finding out when paddock conditions start to affect animal behaviour. This in turn reduces the impact on the environment and improves animal welfare. Measurements/observations similar to those made at SDH were made from late May to early August 2021. The measurements of the crops were staggered between sites to fit in with the farmer's plans to graze each winter crop paddock in line with their usual winter grazing practice. It also provided easier measurement collection as each site required significant work with large distances between sites across the Southland region.

The findings suggested that the crop establishment method may not be as important as crop husbandry and stock management over the winter grazing period in determining the best outcomes for livestock.

The project highlighted the diversity of practices on farms across the region and demonstrated that there are many factors that affect winter grazing outcomes.

An army of volunteers supported the data collection and became passionate advocates for rallying the farming community to talk about practices and good management.

The most significant learning was that the daily management of grazing stock had the greatest impact on soil damage, rather than soil type and crop establishment methods. Although soil type did appear to influence the occurrence of surface water pooling, pugging and compaction risk.
It highlighted that having a winter grazing plan, with planned crop husbandry and stock management, supported the best wintering successes. Farmers who carefully assessed their own situation, adapted what they did as conditions changed, and had good systems in place, had the best outcomes.

However, the study also found that there was no silver bullet, and there was no clear 'best alternative' to conventional cultivation. It found that although lower yields reduced the stocking density in a given area, regulatory limitations on the proportion of the farm that can be used for winter grazing actually favours intensification. This puts pressure on farmers as they try and support sustainable agriculture, striving for high crop yields and simultaneously protecting soils.

<u>Different crop establishment methods</u>

The study found that you get out what you put in. Yields were relative to the amount of time, effort and expenditure spent on crop establishment. It found that with careful thought and preparation, many outcomes, including feed security and animal welfare, improved.

Although low or no till options may appear to be more environmentally sustainable (from a carbon and soil structure perspective), observations from this study were of lower yields, greater weed burdens, and increased pest pressure. An unintended consequence of minimal/low till establishment was the increased need for chemical weed and pest control to help achieve a more sustainable yield in both the main crop and when returning to permanent pasture.

The data collected on the commercial farms was variable, and the thousands of photos and observations collected gave a unique picture of day-to-day conditions across a range of soil types, crops, stock classes and management.

Opportunities of grass-based wintering – Participatory Research Project Scenario modelling results

We know there is no 'one size fits all' approach when it comes to achieving improved environmental outcomes, so in our *Participatory Research* project we partnered with four farms across the Otago and Southland regions to better understand their environmental and financial performance and identify management options to improve performance. Two of the four farms chose to investigate baleage wintering as a scenario to model for their farm using OVERSEER and FARMAX.

Modelling showed both scenarios increased purchased nitrogen surplus due to the extra baleage that was purchased, but this increased by differing amounts (24% Dingle and 5% McLeod). Methane emissions were increased (1-2%) due to pasture baleage having a lower feed quality than the crops grown in the Base system. Operating profit was reduced in both scenarios (Table 3).

The two scenarios differed in their effect on nitrogen leaching loss and long-lived gases (N_2O and CO_2). These were increased in the Dingle scenario likely due to a small increase in N fertiliser use, whereas for the McLeod scenario these were reduced some of which was due to the stand-off pad also including in the modelling (Table 3). Environmental responses to wintering system change will also depend on soil type and rainfall differences between farms and regions.

Before making the decision to switch to grass-based wintering, we recommend doing some farm systems modelling to estimate the impact the change may have on your farm system, particularly nitrogen surplus and greenhouse gas emissions.

Table 3: Percentage changes in environmental and profit indicators for scenarios modelled, compared to the Base (2019-20) farm system, a negative value indicates a reduction.

	Rob and Rachael Dingle: Baleage wintering Remove fodder beet from milking platform and support block and winter cows on baleage (13 kg DM/cow/day plus 1 kg DM/cow/day pasture), additional baleage purchased for this. Note: 193 cows still wintered on kale at grazier and the youngstock grazed off at a grazier until 1 year old.	**Doug and Emma McLeod:** Baleage wintering, no kale Half the herd wintered on milking platform on baleage (11 kg DM/cow/day plus 1 kg DM/cow/day pasture), stand-off structure for 240 cows to stand off for 12 hours/day during winter and for adverse weather conditions during autumn. Remaining cows wintered off-farm on kale, remove 2.7 ha kale on platform from the system.
Purchased N-surplus	24%	5%
N loss	2%	-7%
P loss	3%	-3%
Methane	2%	1%
N_2O	3%	-4%
CO_2 from urea fertiliser	3%	-1%
He Waka Eke Noa GHG	2%	0%
Operating profit	-8%	-15%

What do cows prefer to lie on when taken off paddock?

Background

With increased interest in off paddock facilities and alternative loafing surface options, performance criteria were required to determine the suitability of new and emerging options suitable for use in dairy systems. The ‘knee drop’ test previously used to test the comfort of loafing surfaces is very subjective and not repeatable.

The project set out to identify mechanical tests for key performance criteria that could be used to screen surface materials for suitability. The output of the tests needed to be well aligned/correlated with animal behaviour indicators of suitable loafing surfaces.

Wintering Surface Options

The surface options generally fit into 3 broad categories:

Rubber matting

- Interlocking or rolls of rubber matting as currently used in dairy yards and feed pads
- Laid over a low-cost base e.g., laid on heavily compacted aggregate rather than concrete

Pour-in-place surfaces

- Typically used for playgrounds or as sports turf underlay
- Examples include recycled rubber or rubber/plastic chip materials bonded with resin
- These materials will likely require a durable top surface for use with animals

Loose fill bedding

- Wood chips, post peelings, sawdust etc
- Sand
- Recycled rubber chip as used in horse arenas
- Synthetic mulch as used for horse racetracks
- Reclaimed natural fibre materials e.g., wool

Surface performance Criteria

Performance criteria	Surface requirements
Comfort	Enables natural resting behaviour & reduces fatigue when standing Causes minimal abrasions Has suitable thermal properties & low moisture retention properties
Traction	Enables natural gait in all conditions with minimal slippage Supports safe sitting/standing transition Enables grooming and social interaction
Durability	Suitable for animal and vehicle loads Maintains structural properties over its life cycle Replacement & maintenance intervals are practical
Cleanliness/hygiene	Enables adequate animal cleanliness Practical method of cleaning
Environmental	Supports reduced GHG emissions Enables effluent management where leachate can be contained Preference for separating solids & liquids Low impact on air quality
Sustainability	Low impact on the environment and people’s health Preference for renewable/waste & low energy materials Acceptable plan for surface disposal
Cost	Life cycle cost is affordable

Animal Behaviour Trial

Four surfaces of $56m^2$ areas were established, two on each side of the Calan gate barn, with ad lib access to silage feed and water. The surfaces were selected to give a wide range in firmness.

The four surfaces in the study were:

1. 300mm deep post peelings (reference surface)
2. 23mm interlocking rubber matting (NUMAT Double Stud)
3. 25mm rubber/plastic chip pour-in-place surface (Tiger Turf Ecocept) with a geotextile (NUMAT Cow Carpet) glued on top for durability
4. 50mm shredded rubber pour-in-place surface (NUMAT SustainPor) with NUMAT Cow Carpet glued on top

Ecocept

SustainPor

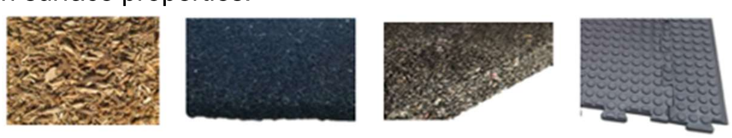
Ecocept is a mix of recycled rubber and plastic chip bonded with a resin and is used under synthetic sports turf such as football and hockey fields.

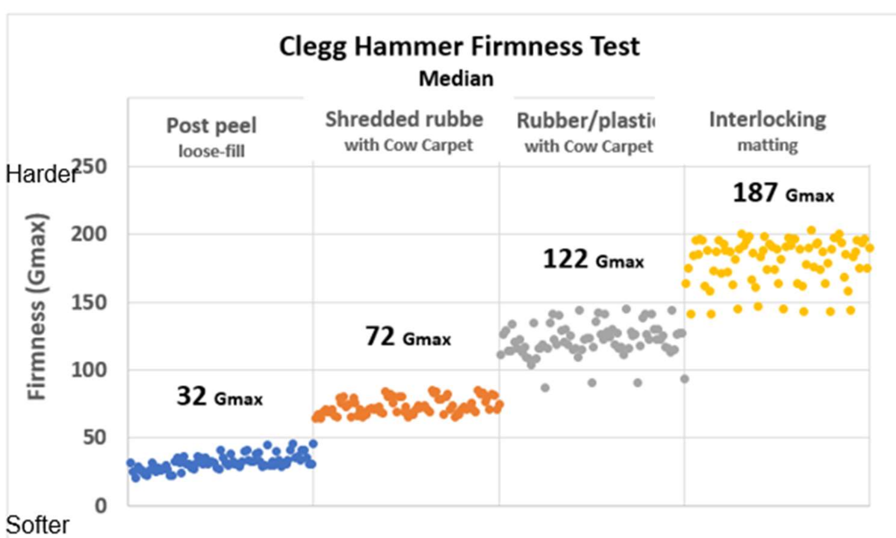
SustainPor is made from shredded recycled rubber bonded with a resin and is used on playgrounds. Both products have cushioning properties to reduce injury risk.

Cow Carpet is a geotextile selected as the top layer due to successful use of a very similar product in a previous study.

Surface testing – firmness

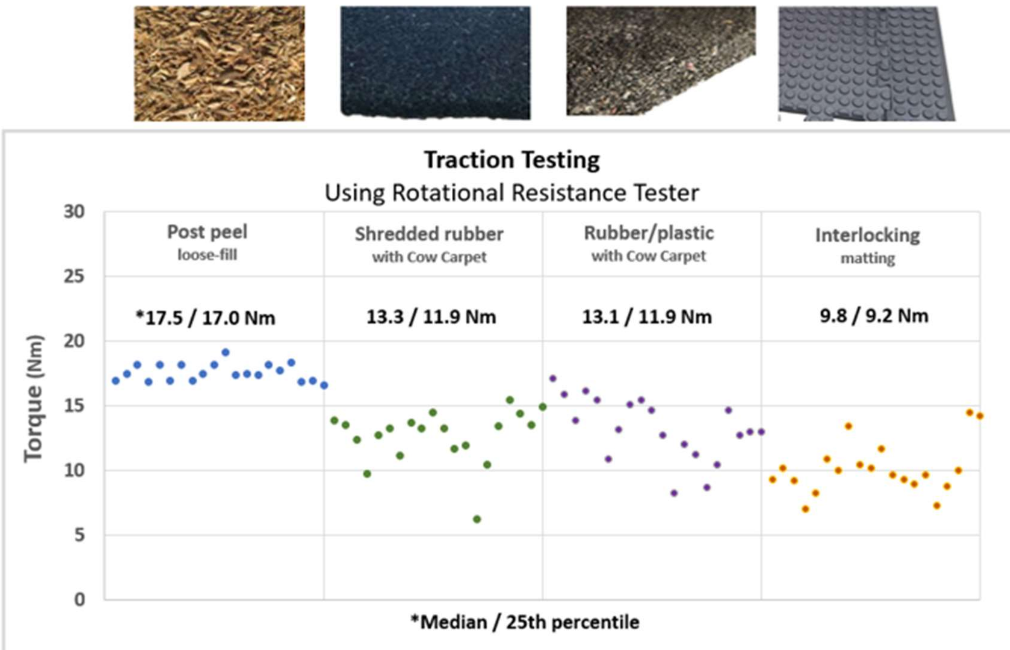
The surfaces were firmness-tested using a 2.25kg Turf Clegg Hammer. The Clegg hammer uses an accelerometer to measure the peak force (Gmax) when the instrument strikes the surface. Four consecutive impacts were recorded at each of 20 sites in a double V pattern across the surface to account for variability in surface properties.



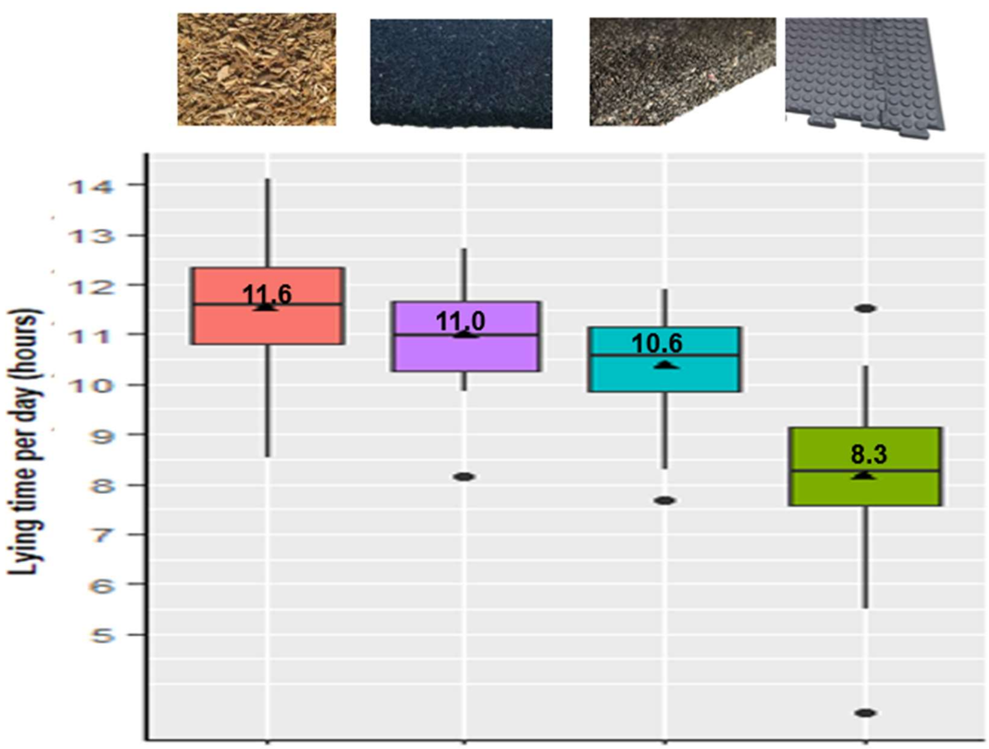


Surface testing – traction

The surfaces were tested using a Rotation Resistance tester fitted with lameness pads on the base plate. Torque measurements were recorded at 20 sites in a double V pattern across each surface. The testing was conducted after cows had been on the surfaces for 24h and was in soiled condition.



Cow lying behaviour



Cow behaviour – Lying bouts

The number of lying bouts per day were substantially lower on the rubber matting (around 7) compared to the two pour-in-place surfaces (around 12), with post peel intermediate at around 9 bouts per day.

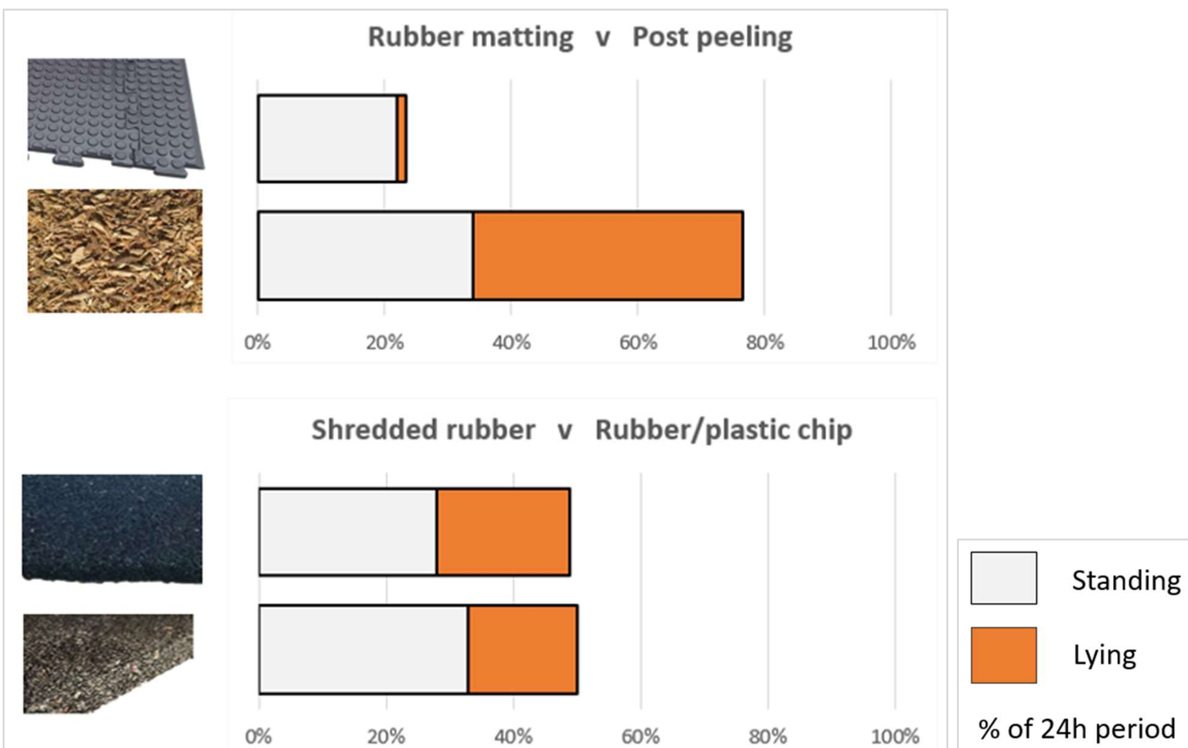
Lying hours and number of bouts were used to calculate average bout length. Post peel and rubber matting had 1.2 to 1.4 hours/bout and the two pour-in-place surfaces around 0.8 to 1 hour per bout.

Interlocking rubber matting had both a low total lying time per day and number of bouts. This indicates that the surface has compromised the resting behavior of the cows on that surface.

Surface Preference

There was a strong preference for lying on the softer post peelings rather than the rubber matting (top graph). The cows spent 96% of their collective lying time on the post peeling.

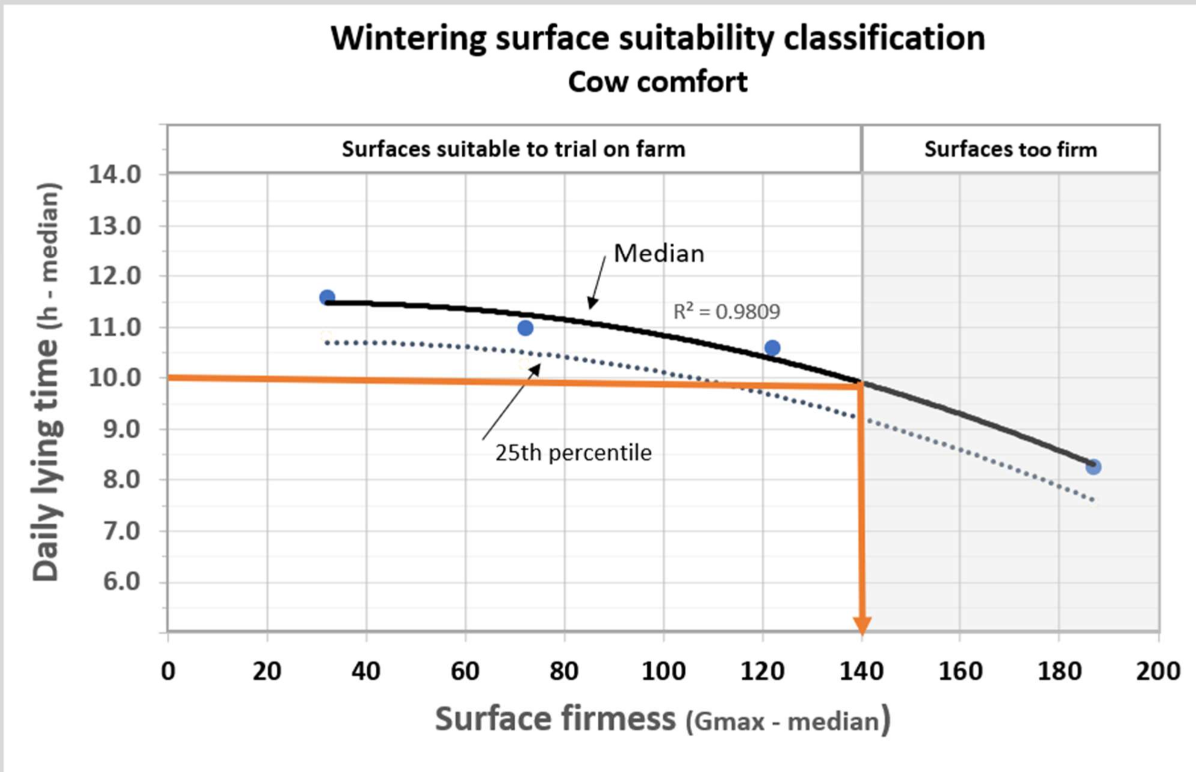
There was a slight preference for lying on the softer shredded rubber (bottom graph). The cows spent 55% of their estimated 9.2h/d of total mean lying time on this surface.



Guidelines – Surface firmness

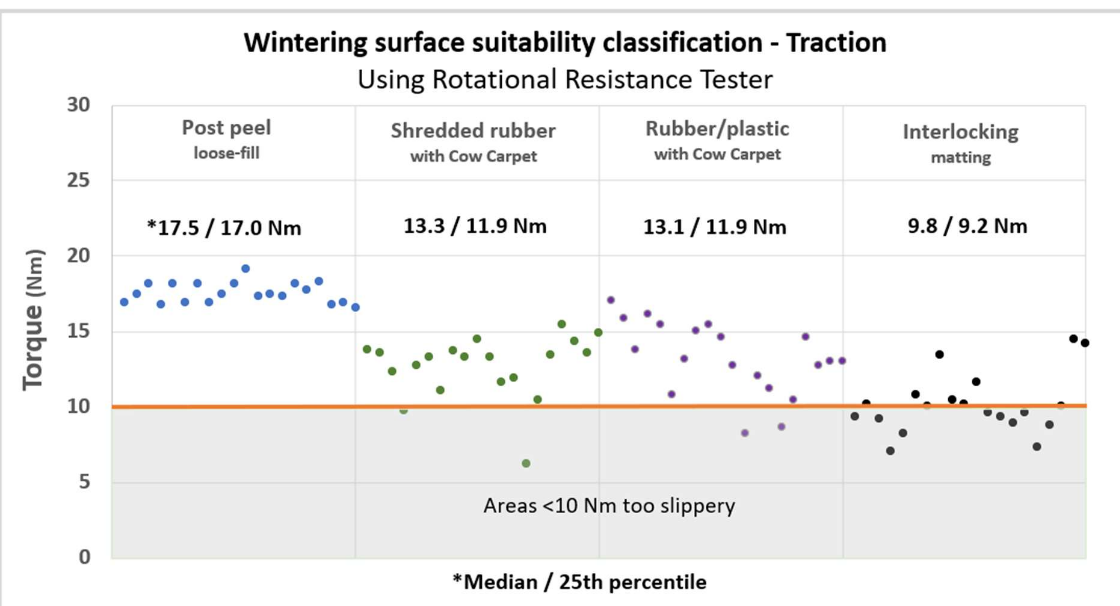
A median daily cow lying time of 10h/d corresponds to a surface firmness measurement of 140 Gmax (median) on our graph.

Post peeling (point 1) and two pour-in-place surfaces would be suitable loafing surfaces to trial on farms. Surfaces firmer than 140 Gmax would still be suitable for feeding areas within wintering system designs, when used with an appropriate loafing surface.



Guidelines – Surface traction

As a guide to suitability, we consider surfaces to be too slippery when the 25th percentile torque value using the rotational resistance tester is less than 10 Nm. This is based on visual observations and anecdotal reports during our study and not a detailed examination of cow movements on the surfaces.Further testing of surfaces in a farm environment where slipping is observed would be useful to reinforce our findings. The optimal traction threshold may be higher than the 10 Nm proposed from the current study.



Infrastructure Development

Concepts

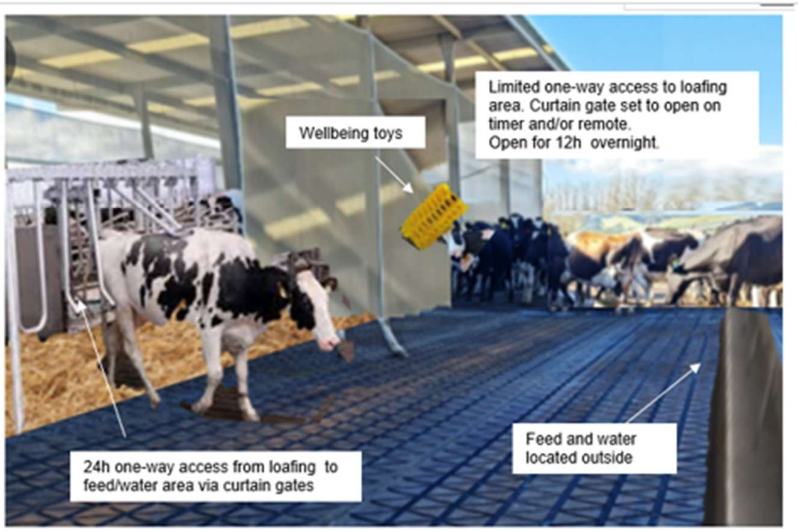
Design 1: Roofed woodchip system with managed cow flow

Design objectives:

- High quality and economic loafing surface
  - Improved bedding performance of wood chip
  - "50%" increase in wood chip lifecycle through reduced effluent loading
- Multi-purpose facility
  - All-year feed pad and covered loafing pad
  - Calving pad

Key features:

- Separate loafing and feeding areas
- Lightweight roof over wood chip loafing area and part of feed pad
- Durable rubber matting over compacted aggregate base on feeding area (Gmax <140)
- Use of smart gate technology to manage cow flow and reduce access to and therefore effluent onto the loafing area.



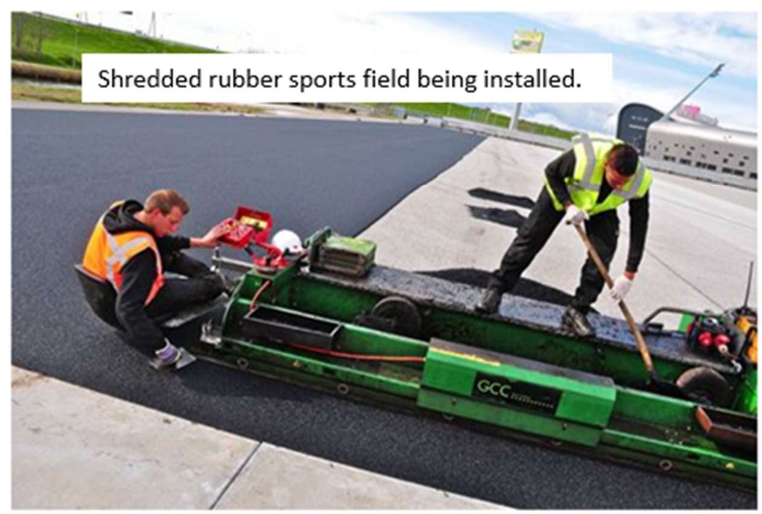
Design 2: Unroofed artificial surface system

Design objectives:

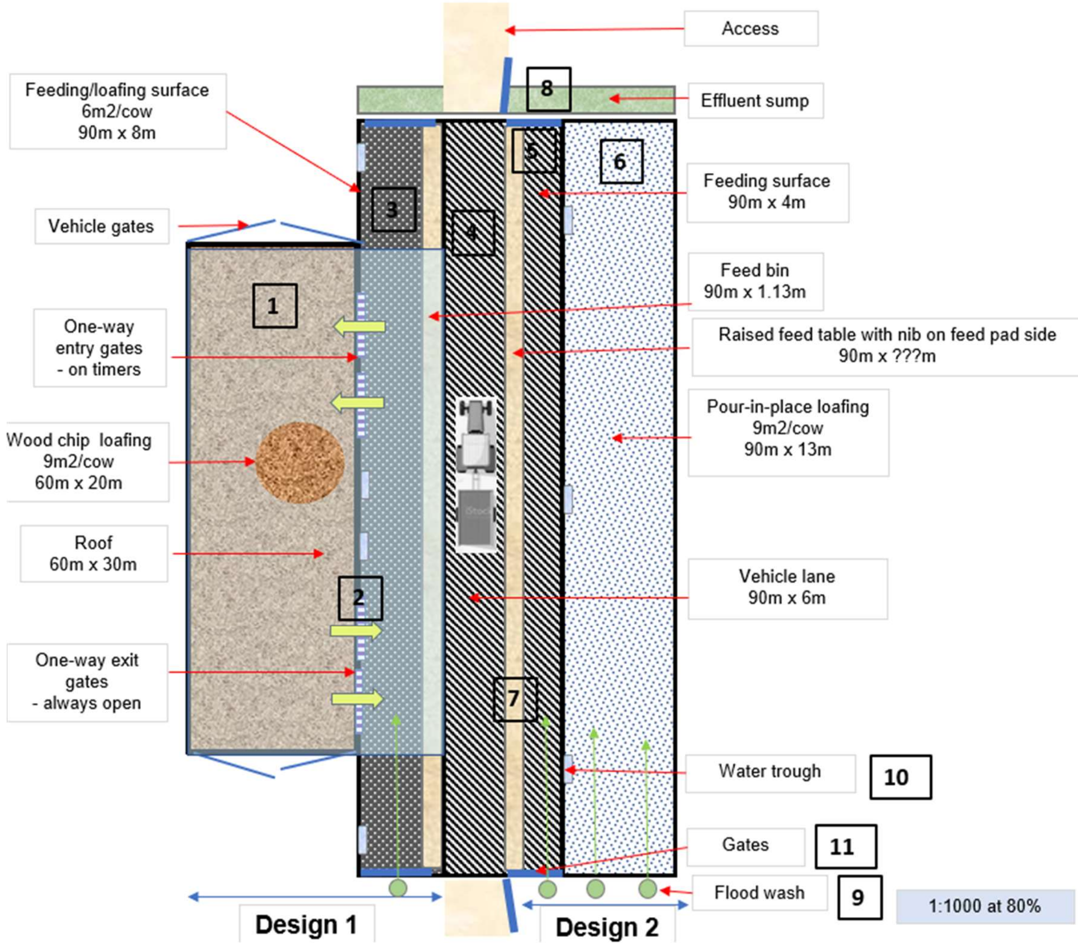
- Surface performs well without a roof
- Surface provides suitable comfort level for loafing over extended durations
- Low-cost construction with surface laid over heavily compacted aggregate base
- Can serve as feed pad for lactating cows

Key features:

- Combined loafing and feeding area using pour-in-place surface underlay with durable geotextile surface or suitable rubber interlocking matting
- High level of cow comfort (e.g. Gmax around 100)
- Firmer surface (concrete or rubber matting) can be used as a skirt in front of feed bins to discourage cows from sitting there.
- Standard feed pad layout with greater area for long term occupancy
- Low labour automated green wash or dung buster gate cleaning system



Design



Proposed siting at SDH

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The Farm

Farm Area

Milking platform: 299 ha
Support Block: 39 ha
Unproductive land: 2 ha

Milking infrastructure

60 bale rotary dairy with DeLaval plant and Delpro Herd Management software
Automatic cup removers and on-platform teat spray, Automatic drafting and weighing
Greenwash on the backing gate

Climate

Mean Annual Maximum Temperature - 17.7 °C
Mean Annual Minimum Temperature - 5.4 °C
Average Annual Soil Temperature – 11.0 °C
Average Annual Rainfall – 785.4 mm

Soil Types

Table 4: Soil types, locations and characteristics on farm

Soil type	Location	Characteristics
Edendale	Top terrace	Well drained, high WHC, seldom dries out
Pukemutu	Through centre of farm	Poorly drained due to sub surface pan between 600 and 900 mm deep. Vulnerable to waterlogging.
Makarewa	Bottom terrace	Poor aeration during wet periods due to poor sub surface drainage and slow permeability. Severely vulnerable to waterlogging in wet periods.

Staffing and management

Roster System – Year-round 8 on 2 off, 8 on 3 off
Milking Times – cups on at 5 am / 2.30 pm

Effluent System

Two receiving ponds with weeping walls, leading into a storage pond. Effluent applied by travelling irrigator. Solids cleared out November 2018. Some effluent applied by umbilical system in March 2019. Greenwash on the backing gate

Herd Details

Table 5: BW and PW as of 28 March 2022

		BW	PW
Pink – Std Kale	**Cows (195)**	150	208
Blue – LI Kale	**Cows (156)**	158	212
Green - Std FB	**Cows (193)**	151	195
Yellow – LI Kale	**Cows (156)**	164	221
Grouped	**Youngstock**	244	270

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We would also like to recognise and thank the businesses who continue to support us, specifically:

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