National Animal Welfare Advisory Committee

Code of Welfare Evaluation Report

Dairy Cattle

[Document Date]

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1 Purpose

The purpose of this report is to describe the evaluation process that the National Animal Welfare Advisory Committee (NAWAC) has completed in reviewing and updating the 2019 version of the Code of Welfare for Dairy Cattle (the Code). NAWAC is proposing changes to the code to ensure that minimum standards are in place to protect the welfare of dairy cattle according to requirements of the Animal Welfare Act 1999 (the Act). In considering these matters, NAWAC have evaluated good practice, available technology and scientific knowledge to inform the proposed changes to the code.

2 Background

2.1 Strengthening Codes Programme

In June 2018, the Associate Minister of Agriculture convened an animal advocacy hui; this forum provided an opportunity for people to come together and have a constructive dialogue about the animal welfare issues that mattered to them. Four focus areas were identified and incorporated into the Framework for action on animal welfare in New Zealand and one of these was to strengthen the codes of welfare.

Following the hui, the livestock sector met in August 2018 to identify gaps and opportunities to improve the animal welfare system in New Zealand. The Farm to Processor Animal Welfare Forum identified three key areas of work, which included a review of the pastoral species codes of welfare.

In February 2020, NAWAC provided a prioritised list with indicative timeframes for reviewing codes of welfare. It also recommended that during this review process several topics should be given greater prominence in every code, namely animal sentience and positive welfare, contingency planning for animals, selective breeding and quality assurance. NAWAC confirmed the need to review the Code of Welfare for Dairy Cattle as a priority due to the industry's prominence in the country's economy, the need for strong legislated welfare codes to manage reputational risk, and a range of public concerns for the welfare of animals in New Zealand's commercial dairying systems.

2.2 Code of Welfare: Dairy Cattle Review

The Code was last amended in 2019. More recently, the Animal Welfare (Care and Procedures) Regulations 2018 were developed and incorporated into the code. Moving forward, the Code requires amendments to incorporate advances in animal welfare science, updates to dairy cattle farming systems and management practices as well as to reflect changing views and expectations by the New Zealand public.

In line with the directives of the Act, NAWAC has reviewed the Code with specific focus on the following topics. These include:

- good practice, available technology and current scientific knowledge.
- the need for any regulations including section 183A(2) transitions or exemptions.
- positive welfare and sentience.
- assurance programmes.
- on-farm killing.
- emergency management and preparation.
- selective breeding.

The Code was initially reviewed by a working group comprised of representatives from DairyNZ, Dairy Industry Technical Advisory Group (dairy companies), Federated Farmers, New Zealand Veterinary Association (NZVA) Dairy Cattle Veterinarians, Beef & Lamb, NAWAC and MPI (including Animal Welfare Compliance, Verification Services, Animal Welfare Science, Animal Welfare Sector Liaison and Animal Welfare Policy). The working group was tasked to bring a reviewed document to NAWAC. During a series of videoconference workshops, they discussed and proposed changes to update the standards in the Code. This approach allowed a comprehensive package of amendments to the standards for dairy cattle welfare for public consultation.

NAWAC also extended an invitation to the New Zealand Animal Law Association (NZALA), SAFE, World Animal Protection (WAP), Guardianz Animal Law and the New Zealand Society for the Prevention of Cruelty to Animals (SPCA NZ) to provide feedback on the 2019 Code. Written feedback was received from the SPCA NZ, WAP and NZALA. The NAWAC Dairy Code liaison members, NAWAC's chair and NAWAC secretariat met via Teams with representatives of Guardianz Animal Law and the SPCA NZ upon their request.

The NAWAC Dairy Code Review Subcommittee further engaged with the members of the working group as well as representatives from the Meat Industry Association, ANZCO, Road Transport Forum NZ Inc – Ia Ara Aotearoa Transporting NZ, livestock agents, Fonterra, NZVA and the Deer Industry NZ to discuss recommendations for regulations. NAWAC acknowledge the efforts of the working group in assisting with the Code review.

NAWAC considered the draft from the working group, alongside feedback from industry and animal welfare organisations, and has proposed additional changes and clarifications in the final draft that has been released for public consultation.

This evaluation report outlines the background for the changes to the 2019 Code that NAWAC is recommending to the Minister as a draft for public consultation. The draft code and code review evaluation report outline NAWAC's general direction of thinking, but do not represent a final view. They are intended to promote further discussion and submissions. Once NAWAC have received and considered these, a final version of the Code will be recommended to the Minister for gazetting for issue under the Act.

3 Key Documents

In developing its opinion, NAWAC has had cognisance of a range of key documents. These include national strategies to protect animal welfare and guiding principles for the development of the livestock farming sector in New Zealand, recent research and enquiries into aspects of shelter provision with particular reference to management systems and practices for wintering livestock, Regulations Review Committee directives for codes of welfare, and a range of other key NAWAC documents as described below.

3.1 Strategies

3.1.1 New Zealand Animal Welfare Strategy – Animal welfare matters[1]

Key points:

- It matters how animals are treated – it matters to the animals and it matters to us. We have responsibilities toward animals in our care and animals affected by our activities. Using animals is acceptable as long as it is humane.
- Better planning to prevent animal welfare problems by identifying risks and plan to prevent animal welfare issues before they arise.
- Animal husbandry is important aspect and knowledge, skills and behaviour of stock people are integral to the standard of welfare.
- Some practices and technologies in use may be outdated and there are opportunities to adopt less harmful practices and technologies and to invest in research and development to support improvements (e.g., environmental enrichment).
- Science is a critical part of New Zealand's animal welfare infrastructure and provides a secure foundation for animal welfare policy and developing animal welfare standards.

[1] Ministry for Primary Industries (2013). *Animal Welfare Matters: New Zealand Animal Welfare Strategy.* https://www.mpi.govt.nz/dmsdocument/3963-Animal-Welfare-Matters-New-Zealand-Animal-Welfare-Strategy

- Clear expectations and sanctions with help for people to comply.
- Everyone to understand and provide for the needs of animals in their care and to improve practices and adopt better technology if necessary and address welfare issues before they occur.

3.1.2 Primary Sector Roadmap – Fit for a better world: Accelerating our economic potential[2]

The vision of the Primary Sector Council and MPI for the future of New Zealand's primary industries. Key points:

- New Zealand has a unique story to tell the world about its safe, high-quality food and fibre products. Our reputation for integrity underpins it all.
- Our primary sectors have the opportunity to extract greater value across the value chain, by being responsive to evolving consumer wants and needs, and by being smarter and more innovative than our global competitors.
- Achieving our sustainability goals requires a focus on the health of our soil, plants, animals and people.
- We will support businesses to manage future disruptions without compromising animal welfare or environmental standards. We will encourage the sector to prepare for future challenges, including climate change adaptation, managing disruptions to supply chains, and responding to changing consumer preferences.

3.2 Shelter Research

3.2.1 Expectations of Pastoral Animal Shelter among Farmers, Stakeholders and the General Public[3]

A technical paper prepared by MPI in July 2019 outlines a survey undertaken to help MPI work to align expectations and recommendations for the provision of shelter and highlight the main barriers to the greater adoption of standards.

Results of the survey showed that farmers and stakeholders linked animal welfare with productivity and profit, shelter was seen as a fundamental component of living in a natural environment. It was noted, however that provision of shelter on farms was not purely to improve animal welfare but for other reasons e.g., erosion control. Farmers' views were also that whilst it is 'optimal' to provide shelter to animals all of the time, when this wasn't feasible other factors could be managed in adverse weather, such increased feeding and rotation of paddocks. Adequate shelter options were seen as anything that allows the animal to escape adverse weather - e.g., flaxes, hedgerows, trees and gullies amongst other natural provisions.

Shelter described as inadequate was flat bare land that deprived animals completely of shelter and shade. The overarching opinion was that the more extreme the weather, the more crucial shelter provision was.

Finally, it was highlighted that shelter provision could potentially impact other factors such as reduced grass production, increased mud and greater risk of water contamination due to effluent. Furthermore, it was stated that many systems would need to intensify to make shelter provisions financially viable. The main barriers to providing additional shelter apart from natural options were resource-based relating to financial and time constraints.

[2] Ministry for Primary Industries (2020). *Fit for a better world – accelerating our economic potential.* https://www.mpi.govt.nz/about-mpi/our-work/fit-for-a-better-world-accelerating-our-economic-potential/

[3] Ministry for Primary Industries (2019). *Expectations of pastoral animal shelter among farmers, stakeholders & the general public.* https://www.mpi.govt.nz/dmsdocument/37658-Expectations-of-Pastoral-Animal-Shelter-among-farmers-Stakeholders-the-general-public

3.3 Winter Grazing

3.3.1 Winter Grazing Taskforce – Final report and recommendations[4]

"Improving Animal Welfare on Winter Grazing Systems" was compiled by a pan-sector action group upon the request of Minister O'Connor.

The Taskforce was established following environmental, political and welfare concerns regarding intensive winter crop feeding systems, mainly used in the South Island but also becoming more popular in certain regions of the North Island. The idea behind this feeding method is to preserve soil structure and pasture during its most vulnerable time of year.

The Taskforce determined that certain things should never happen namely:

- Animals giving birth in mud.
- Avoidable deaths in adverse weather events.
- Mass mortality events on winter grazing systems.

Equally, it was determined that certain things should always happen, namely:

- Provision for animals to lie comfortably (on a compressible dry substrate for as long as they want to).
- Ability to readily move animals to shelter/dry land in adverse weather before harm occurs.
- Continuous and convenient access to fresh water.
- Access to an adequately balanced diet, including appropriate supplementary feeding for animals on fodder beet and other crops, that keeps animals warm and doesn't cause acute or chronic malnutrition and metabolic problems.

3.3.2 Winter Grazing Action Group – Short-term expected outcomes for animal welfare[5]

The Winter Grazing Action Group was established in early 2020 to implement the recommendations of the Winter Grazing Taskforce to improve animal welfare in winter grazing systems.

The group has put together guidance for farmers -"Short-term expected outcomes for animal welfare"- to help farmers understand what they are doing well, where improvements can be made, offers advice around planning and has highlighted some important winter grazing management practices.

3.4 Regulations Review Committee

3.4.1 Recommendations for Codes of Welfare[6]

In 2016, the Regulations Review Committee considered a complaint regarding the Code of Welfare for Layer Hens. Its investigations raised some concerns and recommendations for NAWAC relevant for all codes.

It recommended that terminology used in code reports must be consistent with the Animal Welfare Act 1999 and must not use concepts that are not based on those in the Act. For example, the terms "essential" and "non-essential" behaviour does not exist in the Act. The Act requires that animals be provided with the "opportunity to display normal pattern of behaviour", which the Committee suggested to mean that animals must be able to display a reasonable range of behaviours that are beneficial to the animal.

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[4] https://www.mpi.govt.nz/dmsdocument/38210-Winter-Grazing-Taskforce-Final-report-with-appendices-included.pdf

[5] Ministry for Primary Industries (2020). *Winter Grazing Action Group Short-erm expected outcomes for animal welfare*. https://www.mpi.govt.nz/dmsdocument/41683-Short-term-expected-outcomes-for-animal-welfare

[6] Complaint about Animal Welfare (Layer Hens) Code of Welfare 2012 (14 October 2016). https://www.parliament.nz/en/pb/sc/reports/document/51DBSCH_SCR71235_1/complaint-about-animal-welfare-layer-hens-code-of-welfare

Main points:

- Terminology consistent with Animal Welfare Act.
- Minimum Standards are not to be achieved by 'trading-off' some needs against others.
- Proposed Minimum Standards must be the minimum necessary to ensure that the purposes of the Act will be met and recommended best practices are appropriate.
- If practicality and economic impact are taken into account, how are these factors considered relevant?

3.5 Operational Research

3.5.1 Welfare indicators for pastoral species

An unpublished report commissioned by MPI in 2014 provides animal-based indicators that can be applied to the minimum standards for all pastoral species, including dairy cattle. Example indicators that sit alongside the minimum standards had not been included in the current Code, except for the 2019 amendments. Example indicators provide guidance on ways the minimum standard can be met or to assess whether a minimum standard is being met (see below section on NAWAC's deliberations for more information).

The 2014 report was used to provide relevant example indicators for the minimum standards in the draft Code where not already present.

3.6 NAWAC & MPI Documents

3.6.1 Codes review timeline[7]

In the timeline for reviewing codes of welfare, NAWAC noted that all codes when reviewed, will need the following aspects to be considered:

- Assurance programmes.
- Killing / emergency killing.
- Positive welfare and sentience.
- Emergency management and preparation.
- Selective breeding (where relevant).

3.6.2 NAWAC opinion on animal welfare issues associated with selective breeding[8]

NAWAC considers it unethical to knowingly use animal breeding programmes that produce animals whose physical, health and behavioural needs are compromised by their genetic status.

The 2019 Code does not contain any information on selective breeding. NAWAC has agreed to add a selection and breeding section to codes where there is none.

3.6.3 NAWAC's animal sentience statement[9]

Animal sentience was explicitly recognised in the Animal Welfare Act 1999 in 2015. NAWAC understands animal sentience to mean that animals have emotions, feelings, perceptions, and experiences that matter to them. These can be negative (such as pain or boredom) as well as positive (such as pleasure or comfort).

[7] https://www.mpi.govt.nz/dmsdocument/39998-Timeline-for-reviewing-codes-of-welfare

[8] NAWAC Opinion on animal welfare issues associated with selective breeding (2017) https://www.mpi.govt.nz/dmsdocument/17053-NAWAC-Opinion-on-animal-welfare-issues-associated-with-selective-breeding

[9] https://www.nawac.org.nz/animal-sentience/

NAWAC has agreed to review the codes of welfare with animal sentience in mind, adding information and best practices that promote positive welfare. NAWAC has therefore included reference to sentience, and what it considers sentience to mean, within the Part 2: Stockpersonship and Animal Handling. Positive experiences, including interactions, are considered in Parts 2, 4, 5, and 6.

3.6.4 Statements in the Painful Husbandry Procedures Code of Welfare

NAWAC stated in the Code of Welfare: Painful Husbandry Procedures that:

- Painful husbandry procedures should be looked upon as transitional management practices. While such procedures may be seen as necessary at present, operators and farm industries are encouraged to further develop management systems and breeding programmes which do not require them to be performed routinely.
- It is therefore important to only undertake procedures likely to cause pain and distress when they are necessary. Greater justification is required for more invasive procedures, which are more likely to cause pain and distress.
- Aligned with a justification for the procedure, the operator must consider farming methods and systems which would reduce the need to routinely perform painful procedures (i.e. deal with the factors underlying the problem). In addition, techniques for minimising the discomfort, pain or distress caused to the animals, and whether it is necessary to always treat all animals in that way, have to be considered.

3.6.5 2018 regulations – items not progressed[10]

Some of the proposed regulations that were consulted on in 2018 were not progressed. One was relevant to dairy cattle and the issue will be considered as part of the code review process:

- All animals - Twisting an animal's tail

4 NAWAC's Deliberations and Scientific Literature

NAWAC's deliberations and reasoning, alongside relevant science supporting the proposals for changes to current standards and recommendations for regulations, are outlined in the sections below (see Appendix 1 for references).

This review does not attempt to provide an exhaustive summary to every section of the Code. The aim is to provide an evidence base for the topics and questions most discussed by the Code working group, raised by welfare groups and those discussed by the NAWAC Dairy Code Review Subcommittee.

When making recommendation for regulations NAWAC had to consider that regulations must be specific, observable, enforceable, clear, effective and equitable. While NAWAC may take into consideration economic impact when making recommendations, MPI must take this into account when developing regulations.

4.1 Example Indicators

As part of the review process a number of example indicators have been added to minimum standards in the Code where not already present (i.e., the behaviour and off-paddock facilities sections had example indicators added as part of the 2019 amendment).

The Guidelines for Writing Codes of Welfare[11] provide the following information on example indicators:

[10] 18989-Animal-Welfare-Appendix-Three-Proposals-that-will-not-progress-at-this-time (mpi.govt.nz)

[11] https://www.mpi.govt.nz/dmsdocument/1478-Guidelines-for-Writing-Codes-of-Welfare

While the minimum standards carry a legal obligation to comply, there is no legal obligation to use indicators. However, they may be used to demonstrate in a factual way whether or not the minimum standard has been complied with. It may not be necessary to meet all of the indicators in order to meet the minimum standard but the fewer indicators of a minimum standard that are met the more likely it is that the standard has not been achieved.

As far as possible, minimum standards should avoid being prescriptive. Data such as target body weights, feed inputs, pen sizes, stocking rates should not be included in minimum standards unless they are essential for describing a necessary input. Such data may, however, be provided in indicators or as guidance in the general information subsection or in appendices to the code. Alternatively, references to other source documents may be provided.

Where a minimum standard prescribes a necessary facility, input or arbitrary limit, the introductory section to that minimum standard should make it clear what outcome the minimum standard is intended to achieve.

4.2 Sentience and Positive Welfare

NAWAC has highlighted that giving dairy cattle the opportunity to engage in behaviours they find rewarding promotes positive experiences and improves their quality of life.

NAWAC strongly encourages stockpersons to go above and beyond meeting the minimum requirements for animal welfare by following recommended best practices and by promoting positive experiences. It has therefore included various relevant recommended best practices throughout the Code. Examples include:

- Dairy cattle should be allowed to forage and select feed according to individual requirements and preferences and be offered a variety of feed with different tastes and textures providing there is no negative impact on their health and welfare.
- Dairy cattle should be given opportunities to engage in rewarding behaviours to promote positive experiences.
- Walking distances and milking routines should provide dairy cattle with sufficient time to eat, lie down and socialise appropriately each day.
- Dairy cattle should be given the opportunity to graze daily.
- All dairy cattle should have the opportunity to freely access effective shade with sufficient air flow at all times (minimum of $6m^2$ per cow).
- Dairy cattle should have the choice to access places to separate for calving, such as appropriate hides in intensive pasture settings or separate calving pens in off-paddock situations.
- Where outdoor management systems do not provide natural materials for enrichment (e.g., opportunities for grooming/scratching) appropriate enrichment should be provided (e.g., mechanical brushes in paddocks or at the milking parlour).
- Providing that weather and ground conditions are suitable, mature dairy cattle held in off-paddock facilities should be given the choice to access pasture on a daily basis.
- Calves should be provided with meaningful enrichment to engage in play and exploration, for example treat food, balls, hay bales or a length of rope attached to the pen wall.

4.3 Key Points for Debate

4.3.1 Water

NAWAC proposes an update to the minimum standard for drinking water to require all dairy cattle, including calves from birth, to have easy access to palatable and high-quality drinking water sufficient for their needs and that is not harmful to their health.

Drinking water is critical for maintaining health and animal welfare (Jensen and Vestergaard, 2021). The main sources of water are drinking water and water contained in the feed. Free water intake is impacted by water quality factors including the temperature, taste and odour of the water, its salinity and the presence of heavy metals, microbes and minerals (El Mahdy *et al*., 2016; Schütz *et al*., 2019a; Jensen and Vestergaard, 2021), but also animal factors, such as age, milk yield, feed composition and milk allowance (calves). In addition, season and weather conditions will influence water requirements (e.g., both cows and calves increase water intake in warm weather).

As discussed in the previous code report (Code of Welfare for Dairy Cattle 2010)[12], the minimum water requirements are not based on scientific recommendations. There is no allowance for different requirements for different individuals. For instance, the water requirements for cows producing 2 kg milk solids per day are quite different than for cows producing 0.6 per day. NAWAC believes that setting the minimum standard as a requirement for sufficient therefore requires that the stockperson considers the needs of the individual animal. Water requirements for dairy stock vary widely depending on factors including weather conditions and the nature of the feed e.g., proportion of pasture.

Dairy cattle prefer to drink clean water. For example, they have been shown to reduce water intake even when contaminated with small amounts of manure (Schütz *et al.,* 2019a). Schütz *et al.* (2019a) studied the impact of manure contamination on water consumption by offering animals either tap water without manure contamination (clean water), tap water with 0.05mg/g water manure contamination (low contamination) or tap water with 1.0mg/g water manure contamination (high contamination). Cows reduced their water intake by 10% and 28% for the low and high contamination treatments, respectively, compared to the clean water treatment. Cows in the high contamination treatment also consumed less water when compared to the low treatment. When cows had a choice, they showed a preference for clean water. When cows had a choice between clean water and low or high contaminated water, they preferred clean water; 75% and 99% of water intake was from the clean water when the other option was the low and high contaminated water, respectively. Cows presented with a choice between the low and high contamination treatments preferred to drink water with less contamination.

NAWAC has added example indicators that drinking water does not contain any contaminants at a level that is harmful to the health of dairy cattle or that inhibit animals from drinking and that troughs are cleaned and maintained regularly.

Visual water contamination can be assessed quickly by using a water clarity card. This is a simple test, devised by PAACO Dairy Welfare Audits http://www.paacodairywelfareauditortraining.com, whereby the ability to read the card while submerged at 15-25cm below the water surface is assessed. However, regular (at least yearly) water quality tests for every source of water on farm should be undertaken to determine levels of any contaminants as per the newly added recommended best practice.

As already mentioned, water requirements change with physiological status of the animal (e.g., sickness, lactation), feed type (dry matter content) and in response to environmental conditions. Cows can easily drink more than 100L/day in warm weather conditions (Roche *et al*., 2017; Schütz *et al.,* 2021), replenishing water lost by evaporation from lungs and through sweating. Having sufficient water available during warm conditions is therefore an important heat mitigation strategy for cows, especially when they are lactating.

Water intake and feed intake are closely linked. An increase in dry matter intake increases water intake requirements (Stockdale and King, 1983). This highlights the need for an adequate supply of water not only for warm, but also for cold conditions. Water availability is important to ensure feed intake is maintained, which in turn is an important cold mitigation strategy.

Water delivery systems therefore must be reliable and maintained to meet demand in all seasons.

Water for Calves

The minimum standard for water provisions also applies to calves of all ages. Water intakes depend on the volume and source of milk (whole milk or milk replacer), the amount of liquid contained in milk replacer and the

[12] https://www.mpi.govt.nz/dmsdocument/46087-Dairy-Cattle-Animal-Welfare-Code-of-Welfare-Review-of-Submissions-and-Update

amount and quality of solid feed consumed by the calf (Broucek, 2019; Jensen and Vestergaard, 2021), as well as the age and health status of the calves and ambient and water temperature. Even calves fed milk *ad libitum* require access to drinking water, as milk does not meet the animals' need for water (Jensen and Vestergaard, 2021). While calves may initially only consume small amounts of water while milk feeding, free water seems to play a role in calf growth (Wickramasinghe *et al.,* 2019) as well as rumen development (Govil *et al.,* 2017).

In a review article by Jensen and Vestergaard (2021) summarising water intake of unweaned calves, it was reported that during the first 28 days of age, calves consumed on average between 1 and 2.5 L/d of water when offered milk allowances ranging from 4 to 6 L/d, whereas the water intake ranged from 1.2 to 4.7 L/d when this was measured during the first 56 days among calves on a similar milk allowance. Wickramasinghe *et al.* (2019) assessed water intake in calves up to 17 days of age showing that calves consumed on average 0.75kg of water per day during the first 2 weeks after birth. In addition, calves that had free access to drinking water from birth drank about 300g more milk and tended to achieve a greater body weight pre-weaning and had greater apparent total-tract digestibility for fibre and feed efficiency post-weaning.

Water in the rumen comes mostly from free water intake, as milk is diverted directly to the abomasum via the oesophageal groove when sucking from a teat (i.e. oesophageal groove reflex upon milk ingestion) thus bypassing the reticulorumen (Govil *et al.,* 2017; Wickramasinghe *et al.,* 2020). The voluntary free water intake of pre-weaned calves thus appears to partially represent the water requirement of the developing rumen. Depriving calves fed milk at 10% of birth body weight from drinking water during their first month of life reduced solid feed intake and growth. For instance, it caused a 38% reduction in growth rate and a 31% lower concentrate intake compared with calves with free access to water during this time (Kertz *et al.,* 1984), illustrating the importance of water intake for solid feed intake, rumen development, and growth.

Bacteria in the rumen also require water. Wickramasinghe *et al. (*2020) studied the impact of early water intake on the species richness and abundance of bacterial communities in dairy calves' faecal matter with results suggesting that offering drinking water from birth could potentially affect gut microbiota composition and thereby have a favourable effect in growth and feed conversion efficiency during early stages of development.

Water intake is directly related to feed intake meaning that the more solid feed a calf consumes the higher its water intake (Kertz *et al.,* 1984; Broucek, 2019).

In warm weather, calf water requirements increase due to loss of water through evaporation (Jensen and Vestergaard 2021). Also, diarrhoea in calves causes loss of body water and increased free water intake in unweaned 2- to 21-d-old calves (Wenge *et al.,* 2014).

4.3.2 Feed

Minimum Standard 6a requires that dairy cattle receive sufficient quantities of feed and nutrients to enable them to maintain good health, meet their physiological requirements and minimise metabolic and nutritional disorders.

All classes of dairy cattle have feed and nutrient requirements specific to age, live weight, rate of growth and, for the adult dairy cow, feed that adequately supports the nutrient demands of pregnancy and lactation. Provision of adequate quantities of feed and the appropriate balancing of dietary energy, protein, minerals and vitamins is central to the health and wellbeing of dairy cattle.

Advice on preventative strategies to reduce the risk of nutritionally mediated diseases in dairy cattle can be provided by veterinarians or qualified ruminant nutritionists. Professional advice should be sought when designing feeding plans for dairy cattle being feed crops, cereal grains, concentrates and /or by-products.

Pasture, based on various temperate species including grasses (short rotation and perennial ryegrass, and in drier regions cocksfoot and tall fescue), legumes and / or herbs, forms a large part of the diet for most New Zealand dairy cattle. Rotational grazing permits appropriate allocation of pasture to dairy cattle including building of pasture mass to carry feed through into cooler or warmer months of the year when pasture growth rates slow. To ensure that dairy cattle are adequately fed within a pasture-based grazing system, farmers must have a sound knowledge of expected pasture growth rates to ensure sufficient quantities of high-quality dry matter (DM) are produced to adequately match the feed demands of dairy cattle.

Clovers, plantain or chicory are companion pasture species commonly included in dairy pastures alongside grass species and can provide valuable quantities of high-quality feed during warmer months of the year when the quantity and/or quality of grass does not meet the needs of dairy cattle. Multiple pasture species allow cows to browse and choose different feeds, offering variety in the cow's diet. Animal health challenges, predominantly rumen bloat, may become more of a challenge in clover and herb-dominant swards.

Pasture growth rates vary during the year and throughout different regions of New Zealand (DairyNZ, 2017a, p34-39). Pasture deficits increase the risk of cattle being underfed and can lead to animal health and welfare issues unless supplementary feed is provided. Feed shortages increase the risk of short post-grazing residues that not only underfeed cattle, but increases the risk of ingestion of *Pithomyces chartarum* spores (which contain sporidesmin toxin and cause facial eczema) (Parkinson *et al* 2010), increases the risk of ryegrass staggers and possibly *Fusarium*-associated health and productivity issues

Pasture quality varies through the year (DairyNZ, 2017a p65). The nutritional value of pasture is high during autumn, winter, and early to mid-spring. Pasture quality declines during late spring and summer when grasses flower and produce seed head and may not contain enough energy or protein to support the nutritional needs of lactating cows, and dairy replacement heifers. Clovers and herbs, and summer forage crops deliver relatively more high-quality nutrients to cattle than grasses during the late spring/summer period[13].

The risk of hypocalcaemia, hypomagnesaemia and/or ketosis increases in late gestation and for lactating cattle that consume extremely digestible, high quality grass-dominant pastures. Low levels of calcium and magnesium combine with high levels of potassium and protein to increase the risk of clinical and subclinical metabolic disease (Parkinson *et al.,* 2010). Abrupt dietary changes as cattle transition from poor to very high-quality pastures increase the risk of diseases including polioencephalomalacia ('PEM' or vitamin B1 deficiency) (Parkinson *et al.,* 2010) and clostridial diseases in young cattle, particularly (Parkinson *et al.,* 2010). Another risk for cattle on ryegrass pasture is toxicity from endophytes resulting in ryegrass staggers (Prestige, 1993).

Many dairy farmers save surplus pasture as silage or baleage, particularly in late spring, as feed for cows when pasture growth rates are low. Silage is made from a range of pastures and forage crops including lucerne, cereal crops and whole crop, direct chopped maize. Maize grain in silage and grain in whole crop silage must be adequately cracked or crushed for appropriate utilisation by all classes of dairy cattle. Baleage is commonly produced from pasture, lucerne and cereal crops (either greenfeed or whole crop). The nutritional quality of silage and baleage depends on how the feed is made. When well made, and stored to prevent contamination by fungi, yeasts, moulds and mycotoxins, utilisation of the feed by cattle is better and the risk of silage associated diseases is reduced.

Hay in New Zealand is made from either pasture or lucerne, or occasionally whole crop oats. Hay made from high quality forage provides a useful source of high fibre feed for dairy cattle and an effective fibre source for pre- and post-weaned dairy calves.

Straw is a by-product produced during the harvest of barley, oats, wheat and pea crops and is a low energy, low protein, high fibre feed source for dairy cows. Straws are unsuitable for feeding as a high proportion of a dairy diet. Pea and barley straws are readily accepted by cattle particularly when dietary fibre is lacking. Wheat straw is a sharp, unpalatable and poorly accepted feed for dairy cattle and should only be fed to cattle as part of a partial or total mixed ration through a mixer wagon.

Hay and straw should be stored carefully and kept dry to prevent spoilage and deterioration.

Maize silage can be fed at up to 40% of the diet for milking cows and up to 50% of the diet for dry cows, however high intakes require supplementation with calcium, magnesium, and sodium, and for high performance lactating

[13] https://www.dairynz.co.nz/feed/crops/

dairy cows or young, growing heifer replacements, a supplemental source of protein is often required (DairyNZ, 2017a).

Low quality products such as cereal straws, and poor-quality hay and baleage are not typically included in the diets of lactating cows but may, on occasion, be included as a useful source of dietary fibre when diets contain high rates of cereal grains and/or high starch by-products. Poorer quality straws and hays are more commonly used as part of a ration for pregnant, dry cows, particularly for fodder beet and brassica-fed cows.

Silage, baleage, hay and straw should be of appropriate quality for dairy cattle and be free of fungi, mould and yeast contamination. Mouldy silage, baleage, hay and straw reduces feed quality and increases feed refusal by cattle that may result in the underfeeding of cattle. Risk of mycotic abortion increases when mouldy, spoiled baleage, hay and/or straw are fed to pregnant cattle (Parkinson *et al.,* 2010). Decomposing, wet, rotten silages contain butyrate, a compound that may cause ketosis in late gestation and early lactation dairy cattle (Parkinson *et al.,* 2010). Spoiled and decomposing forages should be disposed of and not fed to lactating or dry, pregnant cows.

Pasture hay and silage or baleage may occasionally contain harmful toxins. Ergot toxicity in dairy cattle may occur if ergot grows in seed heads of grass species or cereals harvested for whole crop silage. Seedheads from older ryegrass cultivars that contain wildtype endophyte perennial ryegrasses may contain lolitrem B or ergovaline associated with ryegrass staggers and heat stress in cattle, respectively (Parkinson *et al*., 2010).

Crops such as brassicas, fodder beet, lucerne, chicory, plantain, sorghum hybrids, sudangrass and greenfeed maize are commonly grown to provide additional feed to dairy cows during the summer and/or winter months. Feed may be directly grazed by cattle. Alternatively, crops may be lifted and stored (e.g., fodder beet bulbs), ensiled (lucerne, maize, sorghum) or conserved as hay (lucerne).

Dairy cattle that graze high quality forage crops typically require a gradual, stepwise transition from pasture-based feeds to novel, high quality forages. This transition should be carried out over 10 days to 3 weeks depending on the crop and ample high fibre feeds including pasture, baleage, silage, hay or straw must be fed during the transition period to maintain stable rumen fermentation and to prevent rumen acidosis. Transitioning allows time for rumen microflora to gradually adjust populations of microbes from those that digest fibre to microbes capable of digesting high levels of water-soluble carbohydrates or starch (Parkinson *et al*., 2010). Cattle must be observed closely for signs of nutritionally mediated disease during the transition from pasture to high quality forage crops.

The correct allocation of amount of crop offered to cattle is essential for cattle productivity, health and wellbeing. The DM yield of crop (kgDM of crop/hectare) should always be measured. This can be done by sending crop samples to a feed laboratory to measure DM%. It is inappropriate to estimate crop yields and/or the DM% of crop. Underfeeding or overfeeding, and risk of nutritionally mediated health challenges will increase if crop DM yield is unknown or is inaccurately assessed. Electric fencing can be used to break feed crops to control the correct daily allocation of crop to cattle. Adequate power through the fencing system is required to prevent cattle breaking over fencing to access large areas of crop. Cattle should be shifted to an appropriate allocation of crop at least once daily and pasture and/or silage, hay or straw provided before moving onto the daily allocation of crop, particularly brassica and fodder beet crops.

The diet of forage crop-fed dairy cattle may require adjustment and nutritional balancing for protein, fibre, minerals and vitamins to prevent nutritional deficiencies and animal health disorders. Crop-specific nutritional opportunities and challenges exist for all crop types (DairyNZ, 2013). For example, brassicas contain low levels of iodine, copper and selenium and high levels of sulphur. Rumen bloat is a particular challenge for cattle that graze lucerne. Chicory milk taint may occur when lactating dairy cattle eat chicory and the intake of chicory for lactating cattle should be no more than 35% of the diet on a DM basis. Depending on the size of the bulb, choke is a risk when feeding bulb crops.

Other challenges for crop feeding include nitrate toxicity, brassica associated liver disease (BALD) and kale anaemia (SMCO toxicity). Nitrate toxicity is a relatively common risk for dairy cattle that graze most green feed crops, including but not limited to brassicas. Nitrate accumulation commonly occurs following recent applications of high rates of N fertiliser and/or when crops or grasses grow rapidly after periods of slow or zero crop or pasture growth: for example, following drought or hard frosts. Poor transitioning onto brassica crops and feeding too much brassica crop as a percentage of the total dietary DM increases the risk of BALD, as does grazing flowering brassicas. The proportion of brassica crop fed as a percentage of total dietary DM (once transition is complete) should not exceed 70% of the diet on a DM basis for calves, rising two-year-old heifers and pregnant dry dairy cows. For lactating dairy cows, no more than 33% of the diet on a DM basis should be brassicas or brassica milk taint may occur (de Ruiter *et al.*, 2009).

Kale anaemia (SMCO toxicity) is occasionally a risk to dairy cattle that graze forage brassicas and cases are almost always when cattle graze elongating and flowering brassica crops during late winter and early spring. Late gestation and lactating dairy cows, and yearling dairy heifers should not be fed flowering brassica plants of any type.

Fodder Beet

NAWAC has concerns about the potential health and welfare impacts of feeding fodder beet to lactating and dry dairy cattle, evidence for which is outlined below. Accordingly, it has added a minimum standard to address concerns with transitioning of animals onto crops, requiring that where a change of feed is incorporated into the diet it must be introduced gradually and abrupt dietary changes must be avoided. It has also added a specific example indicator for MS6a highlighting that in order to meet the minimum standard, fodder beet must not be fed in excess of 30% or 60% DMI, respectively, for lactating and dry dairy cattle.

The health and welfare risks associated with the use of fodder beet relate to its low fibre, protein and minerals (calcium and phosphorus) content and its high concentrations of water-soluble carbohydrates (Fleming *et al.,* 2021a). The fermentation of water-soluble carbohydrates causes volatile fatty acids to accumulate and reduce rumen pH (Fleming *et al.,* 2021a). As summarised by Fleming *et al.* (2021a), suboptimal rumen pH prevents microbial degradation of structural carbohydrates and causes anorexia, reduced rumination and reduced secretion of saliva and has been associated with potentially compromised animal health and welfare that result from ruminitis, hyperkeratosis, and lung and liver abscessation secondary to rumen acidosis (RA) and subacute RA (SARA). Saliva contains pH neutralising buffers and will restore rumen pH provided there is sufficient rumination, and the pH drop is not extreme. In SARA, pH is restored without intervention and symptoms often pass undetected. In acute RA, rumen pH is prevented from stabilising and without intervention, metabolic acidosis will occur that can be fatal if not diagnosed and treated.

Waghorn *et al.* (2018) assessed the impact of fodder beet on dry cows. They found while feeding non-lactating dairy cows 65% fodder beet and 35% pasture silage provided adequate nutrition some risk of acidosis remained. 85% fodder beet with barley straw resulted in lower DM intake, poor rumen function and negative N balance. A diet in excess of 60% fodder beet for dry cows is considered to pose a risk to the health and welfare of dairy cattle and is an indicator for failing to meet MS6a.

Fleming *et al.* (2020) assessed the impact of fodder beet on lactating cattle. Acidosis was observed in late-lactation cows transitioned to a diet of 45% and 60% fodder beet. They suggest that fodder beet bulbs should not exceed 30-40% of DM intake during lactation due to the low nitrogen in the bulb. Where cows were supplemented with 40% of dry matter intake of fodder beet during early lactation 25% of cows developed severe ruminal acidosis following transition to 40% daily intake. A diet in excess of 30% fodder beet for lactating cows is therefore considered a risk to the health and welfare of dairy cattle and is an indicator for failing to meet MS6a.

Fleming *et al.* (2021a) compared grazing lactating dairy cows fed herbage only with cows supplemented with approximately 40% DMI as harvested fodder beet. The results indicated that supplementing spring herbage with moderate amounts of fodder beet bulb during early lactation reduces the pH of ruminal fluid and ruminal degradation of perennial ryegrass herbage. The increased time that cows spent ruminating and the increased chewing intensity plus ingestive mastication observed with fodder beet supplementation indicates that cows respond to low ruminal pH by increasing oral processing. The increase in oral processing with fodder beet supplementation may also increase salivation of neutralising buffers. Conclusions from this study are that supplementing spring herbage with harvested fodder beet reduces grazing time, causes some individuals to develop SARA, and does not benefit early lactation milk production.

Fleming *et al.* (2021b) consider that dairy cows may be at greater risk than beef cattle of developing SARA and RA from fodder beet probably due to the increased energy requirement of lactation, and the increased risk of RA and SARA when fodder beet is fed during early lactation or to primiparous heifers compared with late lactation or multiparous cows.

Although mineral deficiencies of a winter fodder beet diet can be mitigated by correct management of prepartum mineral supplements and feeding of moderate to good quality pasture, baleage or silage to fodder beet-fed cows, there is still inherent risk to animal welfare and health due to limited capacity for individualised feeding of mineral supplements.

It is likely that the proposed advice to reduce the proportion of fodder beet in diets, as well as management of mineral deficiencies, sits outside of normal farm practice. A survey of farmers conducted by Edwards *et al.* (2020) reported that non-lactating cows were commonly given 66% of their diet as fodder beet. Sixteen percent of these farmers were not providing any mineral supplementation to animals being fed fodder beet. Reported feeding rates for young stock were R1 heifers 74% fodder beet, and R2 heifers 66% fodder beet, with young stock fed fodder beet for longer periods of time than mixed age cows. This raises concern that currently a significant proportion of New Zealand young stock that are receiving high proportions of fodder beet in their diet during winter are not receiving adequate nutrition to maintain good health, meet their physiological requirements and minimise risk of metabolic and nutritional disorders.

The long-term impact of fodder beet feeding for cows, as well as for unborn calves, has not yet been fully investigated. Feeding fodder beet may have other long-term health and wellbeing impacts, in particular, the increased incidence of spontaneous humeral fractures observed over the past 7-8 years in 2-year-old dairy heifers in New Zealand dairy herds (de Jong, 2019). Given these unknowns, and the paucity of information categorizing RA and SARA incidence, ketosis, hepatic lipidosis, and mineral imbalance by region or feeding practices, NAWAC has concern for the welfare of animals fed fodder beet at any physiological stage and has added an example indicator specifically relating to fodder beet feeding as outlined above.

Cereal grains, concentrate feeds and by-products

Concentrates such as cereal grains (e.g., barley, oats, wheat, maize and triticale), bran, broll and blended and pelleted meals generally contain ample energy. Starch-containing concentrates increase risk of RA and SARA and cattle must be transitioned onto these feeds carefully over a period of 10 days to 3 weeks depending on concentrate type and other components of the diet (Parkinson *et al*., 2010). The protein content of concentrates is often variable. Cereal grains contain high levels of starch, moderate levels of protein and low levels of fibre and the calcium and sodium content is typically low (DairyNZ, 2017a).

Cereal grains must not be offered to cattle 'free choice' in open troughs or on the ground due to the high risk of RA and SARA. Risk is reduced if processed grains are blended with other non-starch dry by-product feeds. Dairy cattle require cereal grain to be processed before feeding and the risk of rumen acidosis increases when cereal grains are overprocessed particularly if cereal grains are fed as a high proportion of the total diet.

Blended and pelleted concentrate feeds manufactured by commercial companies will often contain minerals, vitamins and other dietary additives, and information about additives should be provided to the farmer. Particular care is required when dairy cattle consume blends or concentrates that contain additives such as zinc oxide or ionophores. These products are likely to have been formulated to be fed at a specified rate (kg per head per day) and feeding rates should not be changed unless under instruction from a veterinarian or qualified nutritionist.

All concentrate feeds must be managed and stored in dry, cool conditions to prevent deterioration, and minimise growth of yeast, fungi and moulds. Presence of fungi and mycotoxins may reduce the utilisation of the feed by cattle and may be associated with a range of animal health disorders as well as give rise to milk residues. Contaminated feed may spread disease or transfer contaminants into the food chain.

Many by-product feeds are highly desirable for dairy cattle, including the protein meals soybean and canola, commonly used to balance low protein diets for lactating cows. By-product feeds are categorised as wet or dry by-products. Dry by-products include PKE, soya bean hulls, tapioca, broll or bran, dried distiller's grains, canola and soybean meals and biscuit waste. Wet by-product feeds include fruit and vegetable waste, apple pomace, wet brewer's grain and feed grade molasses. Challenges associated with wet by-products include potentially variable DM% content of some but not all wet by-products which increases the risk of inconsistent feeding rates of by-products to dairy cows. Wet by-products are prone to spoilage, yeast and mould growth and may accumulate mycotoxins that are harmful to dairy cattle (DairyNZ, 2017a).

As a general rule, every by-product used is characterised by product-specific nutrition or anti-nutritional attributes. Examples include the high copper content of PKE and the very high and rapidly rumen degradable starch content of tapioca. Some by-products may cause milk taint or change milk fat profiles, and dairy processors may have limits on the proportion of the diet that can consist of by-products.

Mineral and Vitamin Supplementation

Macro-mineral, trace mineral and vitamin supplementation is frequently required to balance the diet of New Zealand pasture and forage crop-fed dairy cattle. A veterinarian or qualified nutritional consultant should be engaged to provide advice specific to each class of dairy cattle. Supplementary minerals and vitamins should be provided to animals in such a way that each animal receives an appropriate dose. Cattle must not be placed at risk of under or excessive supplementation with minerals and vitamins.

Body Condition Score

The Committee considered that provision of immediate remedial action when BCS falls below 3, as required by the 2019 code, was too late to address the underlying issues and, in fact, allowed for lower BCSs. It also considered that this situation would not change by simply increasing the BCS limit in the minimum standard. NAWAC therefore reviewed the wording of this standard which now states that BCS must not fall below 3.5 or go above 8 (on a scale of 1-10).

The minimum standard that BCS for dairy cattle must not exceed 8 allows for best practice recommendations to avoid animal welfare consequences around calving. NAWAC acknowledges that most animals will sit within a lower range, with the recommended target calving BCS for cows and heifers being 5 and 5.5, respectively, but below 7 to minimise calving difficulties and metabolic problems.

The Committee considers that dairy cattle that fall below a BCS of 3.5 are not fit for transport, especially end-of-life cattle as they are more likely to have underlying health conditions. NAWAC has therefore added an example indicator that dairy cattle with a BCS below 3.5 are not transported unless under veterinary advice.

Some concern has been raised regarding the consistency of scoring, in particular related to 0.5 increments. NAWAC believes that with the appropriate training this should not be an issue.

4.3.3 Winter Grazing

In order to address the recommendations by the WGTF and WGAG, NAWAC is proposing amendments and new minimum standards and recommended best practices. The Committee is also recommending that three regulations be developed to ensure animals in winter grazing systems have access to clean water at all times within the grazing area, that all dairy cattle have sufficient well-drained lying space to meet their lying requirements and to prevent calves being born into surface water or mud. The issues addressed in the following proposed standards have been described elsewhere in this report where relevant.

Proposed minimum standards, example indicators and recommended best practices relevant to winter grazing are outlined below:

MS 5: Drinking Water

(a) All dairy cattle must have easy access to palatable and high-quality drinking water sufficient for their needs and that is not harmful to their health

Example Indicators

- Water sources are within acceptable walking distance (e.g., within 20m in intensive systems and within 250m in more extensive systems).
- Access to troughs is not impeded and troughs are located and managed to reduce mud, manure accumulation and pugging around them.
- For winter grazing systems, drinking water is readily available in the grazing area and portable drinking troughs should be as close to the grazing face as possible.

MS 6: Feed

(a) Dairy cattle of all ages must receive sufficient quantities of feed and nutrients to enable each animal to: i) maintain good health; ii) meet their physiological requirements; and iii) minimise metabolic and nutritional disorders.

(f) Where a change of feed is incorporated into the diet it must be introduced gradually and abrupt changes must be avoided.

Example Indicators

- Dairy cattle do not suffer from feed-related diseases or disorders.
- The appropriate type and amount of supplements are fed and all animals have opportunity to access these.
- Staff understand the risks associated with feeding, especially feeds other than pasture, including
    - nutritional deficiencies and metabolic diseases
    - health disorders that might arise from inappropriate feeding such as toxicities, rumen acidosis or metabolic diseases and implement management strategies to prevent and manage these risks
- Fodder beet does not make up more than 60% of the diet of dry cows and growing cattle and no more than 30% in lactating cows, with the remaining feed provided through supplementary feed and/or pasture.
- A plan is in place for animals that do not adapt to the winter forage crop diet.

Recommended Best Practice

- Professional advice from a veterinarian, farm consultant or nutrition consultant should be sought when designing a supplement/winter grazing feed transition plan, and the plan should be followed.
- Only paddocks which are suitable for stock class and forage type should be used for winter grazing to ensure that an adequate lying surface and shelter can be provided.
- Grazing contracts should be in place where dairy cattle are grazed off-farm and include responsibilities for the grazier relating to feed management, animal health, transport, and animal welfare.

MS 7: Providing for Behavioural Needs

(b) Dairy cattle must have sufficient space for all animals in a herd to lie down and rest comfortably at the same time.

(c) Dairy cattle must have access to a compressible well-drained surface so they are able to lie and rest comfortably for sufficient periods each day to meet their behavioural needs. *(also see below MS on Contingency Planning)*

Example Indicators

- Cattle do not show signs of lying deprivation.
- Lying is not impeded by mud, surface water, effluent accumulation or by the hardness of the surfaces.
- Normal free movement and access to feed, water and lying areas is not impeded by space restrictions, excessive competition, mud, surface water.
- Cattle in intensive winter grazing systems have at least 10m^2 per animal available on a suitable surface to allow for each animal to lie down comfortably.

Recommended Best Practice

- Dairy cattle should be provided with the opportunity to lie and rest comfortably on a compressible, well-drained and clean surface for as long as they choose.

MS 18: Calving

(c) Calving cows must be provided with a compressible well-drained surface and effective shelter at least 14 days prior to the expected calving date to prevent calves being born into unsuitable conditions, including surface water or mud.

Example Indicators

- Calves are not born into mud or surface water.
- Ground conditions are such that calves are not prevented from standing (e.g., slipping in mud).

Recommended Best Practice

- For winter grazing systems, animals should be drafted into mobs according to estimated calving date, and all relevant people should be able to access calving date records, to allow cows to be moved to well-drained areas prior to calving.

MS 24: Contingency Planning

Persons in charge of dairy cattle must have a documented contingency plan in place to address any anticipated adverse events which can negatively affect the welfare of the animals.

Example Indicators

- A plan for protecting stock during adverse weather events is in place including for the provision of compressible well-drained areas for lying so dairy cattle can meet their daily lying needs.

NAWAC's Recommendations for Regulations – Winter Grazing

NAWAC is recommending three new regulations related to wintering of dairy cattle.

- The Committee recommends that a regulation be developed requiring that where animals, including dairy cattle, are managed in intensive winter grazing systems, clean drinking water be available in the grazing area at all times. NAWAC recommends that the regulation should come into force without a transition period, as it does not anticipate any adverse effects that would result in an unreasonable impact on the sector.
- NAWAC also recommends a new regulation requiring that all cattle kept in intensive winter grazing systems must have access to a well-drained (i.e., no surface water pooling) compressible area of at least $10m^2$ /animal so they can meet their daily lying requirements. Cattle reduce lying times when exposed to surface water/mud, which is detrimental to their welfare (see section on behavioural needs below). NAWAC recommends that the regulation should come into force without a transition period, as it does not anticipate any adverse effects that would result in an unreasonable impact on the sector.
- NAWAC considers it to be unacceptable for calves to be born into surface water or mud. Not only will this impact on the calf's welfare by reducing its ability to maintain body temperature and comfort, there is also an increased risk that the calf may not be able to stand and feed due to ground conditions, leaving the animal hungry and increasing the risk of hypothermia and failure of passive transfer of immunity. Mud is also an inappropriate surface for a cow to give birth on. Describing a surface/environment which is unsuitable to a newborn calf/cow giving birth in a prescriptive, enforceable manner would be difficult. Setting a time to move animals to a suitable calving location may be a possible alternative where pregnancy data is available (e.g., standard distribution of expected calving dates means 95% born within 10 days either side of expected calving (Winkelman and Spelman 2001)). Scan-dated calving is commonly

used in the dairy sector and NAWAC considers that farmers should be able to move most of their cows to a suitable calving area before they give birth. However, a percentage of calves would be expected to be born outside the 10- day window despite farmers following due diligence (i.e., pregnancy scanning, managing them according to due dates, monitoring daily for udder development and signs of calving and, in the event of poor weather, collecting calves more often).

The WGAG has recommended that animals should be moved to a suitable birthing area at least 14 days before their expected calving date. This would allow an additional 4 days to capture at least a percentage of calves born outside the 10-day-period.

In addition, NAWAC recommends that the requirement to move calving cows to a suitable calving area at least 14 days prior to scan-dated calving should be moved into a regulation. NAWAC recommends that the regulation should come into force without a transition period, as it does not anticipate any adverse effects that would result in an unreasonable impact on the sector.

Some animals may have to be transported in order for farmers to be compliant with such a regulation. Regulation 41. Restrictions of transporting animals in late pregnancy (Animal Welfare (Care and Procedures) Regulations 2018) restricts the transport of pregnant cattle in late pregnancy unless the animal is accompanied by a veterinary certificate that states that the animal is fit for transport or a veterinary certificate that specifies conditions that must be complied with to manage the animal welfare risks associated with transport. This needs to be taken into consideration when developing this regulation (i.e., transporting animals close to giving birth and potential welfare implications).

4.3.4 Handling

NAWAC acknowledges that calm, relaxed and gentle handling is important to dairy cattle welfare and also improves ease of handling. The importance of taking an animal's senses into consideration also cannot be over-emphasised (e.g., dairy cattle see movement differently and are sensitive to rapid movement and high contrast such as shadows).

The Committee proposes lifting two recommended best practices into the MS, including that cattle must be moved at a pace that allows the animals to see where they are going and where to place their feet and that they must not be moved by being pushed with a vehicle. NAWAC also proposes adding a MS that backing and top gates must be used in a manner that minimises distress, injury or pain.

NAWAC also proposes a minimum standard requiring that animal tails must be handled in a manner that does not cause pain or injury.

Injured and broken tails are a welfare issue. Cattle tails are innervated and sensitive to pain, and pain due to fractured or dislocated tails is considered significant (von Keyserlingk *et al.,* 2009).

The incidence of broken tails in a selection of dairy farms in New Zealand has been presented in a preliminary report, showing an increase from 0.06% between the 2014/2015 season to 4.5% in the 2017/2018 season (Bryan *et al.,* 2019). The survey data showed that around 20% of dairy cattle had experienced some form of tail damage during their lifetime, with the annual herd prevalence of broken tails reported at around 10% in the cows observed.

There appear to be no investigations of the causes of broken tails, but it has been suggested that they are caused by mechanical damage, inappropriate handling or other causes[14].

Manipulation of the tail is commonly used in the dairy industry. Due to the anatomy of the tail, lifting or gently twisting a cow's tail in a U-shape will make the cow move forward requiring very little force or strength (Laven and Jermy, 2020). To prevent a cow from kicking, the tail can be lifted straight up (example shown by Laven and

[14] http://www.assurewel.org/dairycows/brokentails.html - accessed 15 November 2021

Jermy, 2020) to allow for safer examination of the udder and surrounding area, as well as administration of treatments. However, this method should not require significant force, as the cow's response is not dependent on causing the animal pain (Laven and Jermy, 2020).

Pajor *et al.* (2000) assessed the aversiveness of different handling techniques by assessing latency to enter a race and the time it took animals to walk down a race. The relative aversiveness of gently twisting the tail (tail held near its base and carefully twisted in a clockwise manner until slight resistance was felt then held in this position for 3s) was not different from control or from the hit treatment (cow hit on the rump with an open hand every 15sec for 1min). Pajor *et al.* (2003) also assessed preferences for handling practices by allowing dairy cattle to choose between two different handling treatments in a Y-maze. Their results showed that twisting the tail was not significantly different from control (handler standing side on to the animal not interacting with it). Both studies suggest that tail twisting was not aversive to cattle when done gently.

Laven and Jermy (2020) measured the force required to break a cow's tail and, despite the study being based on only 5 tails, observed that significant force was required to dislocate tail vertebrae. They considered it unlikely that breakage could occur unintentionally if a cow's tail was lifted in a controlled and careful manner.

NAWAC has added example indictors to highlight what is expected in order to comply with the proposed new minimum standard including: tails are not forcefully manipulated (e.g., pulled, bent, compressed or twisted) and tails are held at their base to lift and are not lifted higher than spine height or moved beyond their natural range of motion. A recommended best practice has also been added that tails should only be handled where it is unavoidable (e.g., pregnancy scanning) and that an annual tail audit should be undertaken by a veterinarian to assess tail health with relevant action taken as appropriate where there is a concern.

The NZVA has developed a national tail scoring standard to ensure scoring and reporting consistency and DairyNZ provides information on tail management, minimising tail damage and alternatives to handling tails on its website.

4.3.5 Electricity Use to Manage Animal Behaviour

Electric stimulation above a certain threshold is perceived as aversive by humans and animals and, depending on stimulus strength and properties of the current, experience may vary from unpleasant to very painful (Mejdell *et al*., 2017).

Cattle have very low electrical resistance, and even small voltages (0, 5 – 3 V) can cause significant behavioural responses (Lefcourt *et al.,* 1985, 1986). Lefcourt *et al.* (1986) observed some of their experimental cows becoming tense when shocked at low currents, while the experiment was terminated due to the severity of the behavioural responses observed when cattle were shocked at 10-12.5 mA. In another study, dairy cattle shocked at 12 mA became unapproachable (Lefcourt *et al.,* 1985).

When considering the aversive nature of electrical stimulation, NAWAC has concerns around the use of electricity for controlling dairy cattle behaviour, in particular regarding the potential for misuse or abuse and potential malfunction of equipment if not designed, manufactured, used or maintained adequately.

Electric prodders

The use of electric prodders impacts calf behaviour. Croney *et al.* (2000) report that while calves treated with electric prodders required the least time to move into and through a chute compared to other treatments, calves also stumbled and contacted the chute sides more often. They observed that while calf behaviour was not altered when an electric prodder was held without being activated, most calves did react to the sound of the prodder once turned on, presumably because the calves learned to associate the buzzing sound with the unpleasant sensation experienced when the electric prodder was used during the initial experiment a week prior. Pajor *et al.* (2000) studied the impact of different aversive handling methods in cows and found that animals treated with an electric prodder took more time and required more force to walk down a race compared to control cows. Calves have also been shown to avoid handlers that use prodders (de Passillé *et al.,* 1996).

However, a survey of Australian dairy farmers reported that the majority of farmers interviewed (85%) never used electric prodders (Beggs *et al.,* 2015). Electric prodder use on farms in New Zealand is also considered to be low with the exception being transporters loading animals onto stock trucks (DairyNZ, personal communication).

NAWAC's Recommendations for Regulations – Electric Prodders

NAWAC initially discussed a recommendation to change the current regulation to increase the weight limit for prodder use from 150kg to 250kg. It considered that cattle at 150kg are still immature and that the use of electric prodders on these cattle is inappropriate.

However, upon further discussion (see points a-e below) NAWAC agreed that electric prodder use could not be considered appropriate for any liveweight or age class of dairy animal, so determined to propose the current recommendation for prohibition.

In its deliberation, NAWAC also considered possible unintended consequences should the use of electric prodders on dairy cattle be prohibited, including the excessive use of alternative handling aids. It did not consider excessive use of alternative handling aids an issue as Regulation 49 – Prodding animals in sensitive areas already limits the use of goads in that they must not be used in sensitive areas including the udder, anus, genitals or eyes. In addition, other minimum standards of the code also apply, including MS 2 - Animal Handling, which requires that all dairy cattle must be handled at all times in such a way as to minimise the risk of pain, injury or distress to the animals and must not be struck or prodded in sensitive areas. In addition, MS 10 – Farm Facilities, Equipment and Technologies requires that farm equipment used with animals must be used in a manner that minimises the likelihood of distress, pain or injury to animals.

NAWAC also acknowledges the perceived risk to human safety when working with dairy cattle. It considers that the use of electric prodders in circumstances where there is a risk to human life is not impacted by the recommended regulation, as under the Animal Welfare Act 1999 section 30 (2)(b) it is a defence in any prosecution of ill-treatment of an animal that the act or omission constituting the offence took place in circumstances of stress or emergency, and was necessary for the preservation, protection or maintenance of human life.

NAWAC recommends that Regulation 48: Use of electric prodders (Animal Welfare Care and Procedures Regulations 2018) be amended to prohibit the use of electric prodders on all dairy cattle. It considers that this new approach is warranted in light of:

- The potential impact on the welfare and affective state of the animal.
- The likelihood of handling of young animals to affect their fearfulness of humans and associated situations, and hence ease of handling and welfare, later in life (i.e. when animals learn under conditions of fear or distress this tends to be well retained even after only one exposure (Croney et al., 2000) and the use of electric prodders on young animals, especially when in novel situations (e.g. first time being transported, first time being yarded), may therefore lead to cattle trying to avoid structures or objects that they know from past experience provide electric shocks).
- The fact that electric prodder use on farm is generally low.
- Good stockpersonship and the use of appropriate handling facilities which should allow dairy cattle to be moved without the use electric prodders or with alternative suitable handling aids.
- Some existing market access requirements that do not allow the use of electric prodders and cattle being managed successfully in these circumstances.

NAWAC initially considered that a regulation to prohibit the use of electric prodders should be proposed in the review of the Dairy Cattle Code. However, NAWAC has since received advice that the current regulation (Regulation 48: Use of electric prodders), which came into effect in October 2018, was developed after an extensive consultation process and that there has only been one infringement issued under this regulation to date. MPI also does not have any data to show that this regulation requires modification. Therefore, without data to support changes or further consultation with affected industry, a regulation prohibiting electric prodders would not currently be considered.

The use of electric prodders is mainly confined to transporters loading animals onto stock trucks (DairyNZ, personal communication) and at slaughter premises (MPI Verification Services, personal communication). Therefore, consultation with relevant industry bodies is required. Consequently, NAWAC has decided to consider the proposed changes to the regulation as part of the Transport Within New Zealand and Commercial Slaughter Codes of Welfare reviews. This will allow time to gather views and fully consult with industry, especially the sector most effected – livestock transporters.

There was some disagreement and concern amongst the NAWAC committee around causing delays to the progression of this regulation. However, the majority (9 out of 10 committee members) agreed for the regulation to be included in the review of the Transport Within New Zealand and Commercial Slaughter Codes of Welfare rather than the Dairy Cattle Code of Welfare.

NAWAC has nevertheless included its deliberations around electric prodders within this report and referenced its proposal for a review of Regulation 48 in the draft Dairy Cattle Code of Welfare and consultation document, to outline its intended direction. In addition, NAWAC's view on electric prodders will also be shared in the reviews of the Sheep and Beef and Deer code reviews.

Electroimmobilisation

The Dairy Code review working group identified electroimmobilisation (EI) as an area for regulation and recommended that its use should be prohibited. Restrictions on the use of EI devices was also highlighted during pre-consultation feedback from animal welfare organisations.

EI devices are used to temporarily paralyse an animal (or part of an animal) by passing a pulsed, low voltage electrical current through the body (or part of the body), immobilising voluntary muscles. EI devices have been used where there are potential risks to handler safety or animal safety if other forms of restraint were required, or for handler convenience.

The use of these devices is contentious due to doubts about humaneness and the potential for abuse (e.g. major surgery carried out on a fully conscious but immobilised animals, or deliberate overuse). Their use has been banned in some countries (e.g., UK and Ireland).

Several studies have evaluated the physiological effects of EI on livestock (Lambooy, 1985; Pascoe and McDonell, 1986; American Veterinary Medical Association, 2008) indicating that EI is stressful. Furthermore, trials which measured the time taken for animals to move towards an area where they had previously been immobilised with an EI device suggest that EI is sufficiently unpleasant. Cattle exposed to EI showed aversion to entering the stocks in which the EI was applied and this response persisted for up to 9 months (Pascoe and McDonell, 1986). The aversiveness of EI was compared with other methods of physical restraint in sheep and cattle indicating that EI is more stressful and aversive than other physical restraint (Grandin *et al.,* 1986; Rushen, 1986).

NAWAC recommended the prohibition of the sale and use of EI devices due to welfare concerns in 2002. In 2007, NAWAC revised its position, but only with regard to a particular type of device that uses a rectal probe to allow targeted electrical stimulation of particular parts of the body with the ability to regulate current (and thus strength of muscular contractions and immobilisation; device output appears to vary between 0.25 and 7.9 volts, with intensity settings ranging from 0 to 9, and has been reported to deliver a wave-form similar to that used during transcutaneous electrical stimulation (TENS) in humans).

These particular devices are used rectally with the tip of the probe positioned to act on a femoral nerve, which controls the hind legs of the animal. The power can be adjusted to the appropriate strength - individual limbs can be immobilised at a lower setting while a greater strength allows the head to be immobilised. Animals are not paralysed by the effect (e.g., breathing and vocalisations are not impacted).

Use of these devices has been promoted for routine husbandry procedures and minor treatment procedures where cattle are likely to react in a way that could injure the handler, including training dairy heifers for milking, applying mastitis treatments, examining feet and legs, branding, dehorning, castration, tagging, hoof trimming and the administration of oral treatments. The devices do not provide analgesia for painful procedures and are not marketed as such.

The minimum standard in the 2019 Code reflects NAWAC's recommendations from 2007. The minimum standard requires that *Electroimmobilisation devices must be used only in a manner that allows animals to breathe normally, demonstrate normal responses to pain and must not be used in place of pain relief when undertaking painful husbandry procedures or significant surgical procedures.* It therefore excludes the use of traditional EI devices that have shown to have significant impact on breathing and behavioural responses, but currently allows the use of the newer types of devices.

In revising its position in 2007, NAWAC concluded that these devices were significantly different from earlier forms of EI devices, and that the physiological responses of cattle on which it was used indicated there was minimal stress. This recommendation was based on research commissioned by NAWAC which showed that there was minimal disturbance of cortisol concentrations in the blood of dairy cows up to one hour after the device was applied for two minutes at setting 2. When used at setting 4, half the cows had elevated cortisol levels 15 minutes after the procedure, but they were not different from baseline at 30 or 60 minutes. The size of the increase was considered to be lower than those reported for some routine husbandry procedures. However, the impact of the device on other physiological parameters (e.g., heart rate) and behaviour (e.g., aversion tests) was not assessed. It is now commonly accepted that cortisol concentrations on their own may not provide sufficient information to assess stress levels (Broom and Johnson, 1993). A combination of both physiological and behavioural measures are needed to determine the noxiousness of EI devices.

In 2007, NAWAC recognised the potential for misuse of the device, but accepted that its benefits, if properly used, outweighed the risk of misuse. However, recent surveys suggest that the current use of the devices is limited to a small percentage of farms (around 9% of NZ farms surveyed) with few using the devices routinely (DairyNZ, personal communication).

The most common uses identified by DairyNZ's survey were for heifers' first milking and for difficult cows. A member of the working group raised that the device may also be used vaginally by some farmers to facilitate milk let-down, contrary to Regulation 6 Prohibited methods of milk stimulation in cattle, which prohibits stimulation of milk let-down by inserting anything into the cow's vagina.

A subset of farmers were interviewed to gauge how common the use of devices was and openness to change if regulation were to prohibit their use. None of the interviewed farmers apparently used the device on more than 20 animals a year and would easily stop using it. Several comments indicated that gentle stock handling during rearing and a farm team with good stock skills and patience would result in less reliance on the EI devices (DairyNZ, personal communication).

NAWAC's Recommendations for Regulations - Electroimmobilisation

NAWAC is concerned about the use of electricity to control animal behaviour due to the potential for misuse (i.e., use at high settings, use of faulty equipment, prolonged use, use on immature and sick animals) and as there are suitable alternatives to electroimmobilisation available (i.e., only a small number of NZ farms are currently using the devices and only few do so routinely).

NAWAC is recommending a regulation to prohibit the use of all types of EI devices for restraint of dairy animals. While the Committee previously revised its position with regard to the newer EI devices, it considers that this new approach is warranted in light of:

- The potential impact on the welfare and affective state of the animal (in particular due to the lack of control over its own body while being handled).
- The small number of farmers using these devices.
- Available alternatives currently being used by the majority of NZ farmers (in light of point 2 above), and
- concern around the use of the devices for training heifers to the milking shed (in light of proposed Minimum Standard on Milking).
- The potential for misuse of the devices (i.e., use at high settings, use of faulty devices, prolonged use, use on immature and sick animals).
- The limited research to support continued use of these devices.

- The ability of farmers to manage stock with good stockperson skills (see Minimum Standard on Stockpersonship) and patience.

NAWAC recommends that the regulation should come into force without a transition period, as it does not anticipate any adverse effects that would result in an unreasonable impact on the sector.

NAWAC considered the potential use of EI devices for electroejaculation (see relevant section below) and acknowledges that there are situations where this use may be indicated and recommends safeguards for this use.

Electrified Backing and Top Gates

Automated gates help to improve flow of cows through the dairy yards. Backing and top gates are designed to gently move the cows from the collection yards onto the milking platform by taking up empty space in the yard.

The dairy Code review working group discussed the issue of electrified backing and top gates (i.e., those fitted with wires or chain devices that can be electrified to move animals when they come into contact with the gate). There was concern about the risk of misuse (e.g., forgetting to turn them off or using the wrong settings), particularly in light of the large number of animals potentially affected during each milking session.

As already outlined in an earlier section, cattle find electric shock unpleasant and find increasingly powerful electric shock increasingly unpleasant (Lefcourt *et al.,* 1986). Cattle try to avoid structures or objects that they know from past experience provide electric shocks, learning quickly to avoid electric fences, and this is the basis of using such fences on farm (Whiting, 2016; Mejdell *et al.,* 2017). Moving away from the electric fence is the normal behavioural response and provided there is enough room to move away from the fence there are usually no welfare impacts for the cattle (Mejdell *et al*., 2017).

Predictability and controllability of a situation are important influences on animal welfare (Wiepkema, 1987). Not being able to avoid an electric shock, such as might occur when an electrified backing gate is used in dairy yards, would thus be stressful for dairy cattle. It may also set up a strong aversive association between the shock and other events in the milking routine (Christiansen, 2000), such as milking. The use of electrified backing and top gates therefore not only has implications for the welfare of the cows but may also be counterproductive when aiming for a calm and relaxed milking environment.

Misuse of electrified backing and top gates, either by poor management (forgetting to turn them off or using the wrong settings) or if the gate is poorly designed or malfunctioning can result in unintended delivery of shocks to animals. They can have potential to be used in a deliberately abusive manner. In these situations, animals will attempt to move away from the stimuli which can lead to pushing and crowding in the yards. This may result in injury, trampling, contribute to lameness, and cause bullying. The inability to avoid the electric shocks will also cause pain, be stressful and is likely to give rise to fearful behaviour making handling the animals more difficult (DairyNZ, 2021).

The working group therefore recommended that the use of electrified backing and top gates be prohibited via regulation. NAWAC is in agreement with the working group's recommendations.

NAWAC's Recommendations for Regulations – Electrified Backing and Top Gates

NAWAC is recommending a regulation to prohibit the use of electrified top and backing gates.

It considers that this new approach is warranted in light of:

- The impact on the welfare and affective state of the animal (e.g., pain, stress, potential injury and increased risk of lameness, aggressive interactions).
- Available alternatives are currently being used by the majority of NZ farmers (i.e., non-electrified gates).
- The potential for misuse of the devices (i.e., wrong settings, forgetting to turn them off), poor design or malfunctioning and associated impact on animal welfare for large numbers of animals in a single event.

- The ability of farmers to adequately manage stock with good stockperson skills and patience.

Electroejaculation

Semen collection from bulls can be done by four methods, including the aspiration of sperm from a recently mated female, use of an artificial vagina, trans-rectal massage of accessory sex glands or electroejaculation (EEJ).

Semen collection is conducted for artificial breeding and semen banking and is required for veterinary diagnostic procedures for breeding soundness evaluation. Electroejaculation is the only practical way to collect semen from bulls not trained to use an artificial vagina or from those bulls too difficult to handle for manual stimulation of accessory glands (Stafford, 1995).

EEJ involves the stimulation of the hypogastric and parasympathetic nerves by electrical current via a probe inserted into the rectum of the animal to achieve stimulation of emission, erection and ejaculation by electrical current. Most modern intrarectal ejaculation probes use a sine-wave pulse at a frequency of 20-30cycles/second and with most bulls ejaculate at 8-9V (Palmer, 2005). Modern probes have three ventrally oriented electrodes, in contrast to older probes with circumferential electrodes, so reduce unnecessary stimulation of nerves dorsal to the rectum with resultant occasional bruising and stiffness (Palmer, 2005). The current produced by probes used for bulls may be altered and EEJ is stimulated by starting with the probe set at the lowest voltage and gradually increasing the voltage until ejaculation occurs. Many modern bull probes are pre-programed to deliver a series of stimuli considered appropriate for the species (Palmer, 2005).

EEJ is considered a welfare concern as it can cause intense muscle contractions, struggling, vocalisation and occasional recumbency, all of which are indicative of discomfort and likely pain (Palmer, 2005).

Several studies have assessed the impact of EEJ on various parameters to evaluate associated pain. These were reviewed by Palmer (2005) who concluded that, while vocalisations and elevations in serum progesterone in response to conventional EEJ indicate associated pain, the differences observed between studies suggested that pain could be reduced by altering the technique.

More recently, Whitlock *et al.* (2012) assessed the effect of EEJ on cortisol, progesterone, behaviour and substance P, a neurokinin reported to have an important role in pain response as it increases the excitability of neurons in the dorsal horn of the spinal cord and integration of pain, stress and anxiety. They observed significantly higher cortisol and progesterone concentrations and greater vocalisations in EEJ bulls compared to controls and those that had the probe inserted without EEJ. However, no significant differences in substance P were observed. The authors suggest that EEJ in bulls may be acutely stressful, but that this may not associated with nociception.

As caudal epidural lidocaine anaesthesia has no adverse effects on penile protrusion or semen emission, its ability to reduce pain and discomfort associated with EEJ has been studied (Palmer, 2005). While serum cortisol and progesterone concentrations and heart rate tended to be lower in bulls receiving EEJ after epidural lignocaine anaesthesia, the stress response to EEJ was not significantly reduced (Falk *et al.,* 2001). A more recent study by Pagliosa *et al.* (2015) assessed the efficacy of epidural administration of lidocaine, xylazine and xylazine plus hyaluronidase in reducing the discomfort produced by EEJ. Pain scores and discomfort scores in response to EEJ were assessed for each treatment group and a saline control group. The authors observed a severe pain and discomfort score in bulls on the control treatment, while those receiving epidural anaesthesia had mild discomfort and pain scores and behaved more calmly during EEJ. The administration of the treatments did not have any apparent adverse effects on penile protrusion and did not interfere with semen emission during EEJ.

The correct placement and orientation of the EEJ probes also appears to play an important role in minimising the pain response to EEJ (Palmer, 2005; Stafford, 1995).

As outlined in previous sections, NAWAC is concerned about the use of electricity to modify animal behaviour. However, it acknowledges that there may be some situations where its use for EEJ is indicated. While the use of EEJ in dairy bulls appears to be limited, to safeguard the welfare of bulls in these situations, NAWAC has proposed an additional minimum standard (adapted from the Code of Welfare for Sheep and Beef Cattle), that

EEJ can be carried out, but only by a veterinarian or a trained and competent operator using appropriate pain relief to lessen any adverse effects caused by EEJ. Pain relief is defined in the Code as *any anaesthetic, analgesic, or sedation administered with the aim of providing effective and significant alleviation of pain.*

The Committee also proposes an additional recommended best practice that semen should not be collected by EEJ and that least invasive procedures should be used.

Virtual Fencing

Dairy cattle systems in New Zealand are primarily pasture based. Consequently, there is a high dependence on electric fencing to aid pasture allocation and pasture management. Electric fencing is a temporary, flexible and efficient physical barrier to enclose cattle, however, it poses significant labour costs as fencing may need to be moved multiple times per day (e.g., for strip grazing and for the movement of cattle for milking) (Umstatter, 2011).

In contrast to physical electric fencing, virtual fencing (VF) is defined as a boundary, enclosure or area without a physical barrier (Umstatter, 2011). A virtual fence can hold animals' stationary in a virtual paddock or move them across the landscape to provide or prevent access to certain areas of pasture (Anderson *et al*., 2014). VF technology utilises a neck mounted device to deliver a stimulus to deter the animal from passing a defined global positioning system (GPS) virtual boundary. The neck mounted device initially provides an auditory cue, if ignored and the animal continues to move towards the virtual boundary an aversive electrical stimulus is then administered (Lee *et al*., 2018).

VF systems have the potential to be an advantageous tool to improve pasture and cattle management (Umstatter, 2011; Langworthy et al., 2021). A considerable benefit to VF is a reduction in economic costs due to a reduced labour requirement and a reduction in the need for construction and maintenance of conventional fencing (Anderson *et al*., 2014). Furthermore, VF could provide positive environmental impacts as animals may be excluded from certain areas of pastures (e.g., difficult terrain, areas prone to being muddy) allowing for habitat conservation and protection of environmentally sensitive areas such as riparian zones (Campbell *et al*., 2019a; Brier *et al*., 2020). However, concerns have been raised regarding the use of VF systems due to their use of aversive training techniques (i.e., punishment) and the resultant impact on animal welfare. NAWAC deliberated on potential standards for safeguarding the welfare of dairy cattle in VF systems considering the most recent scientific information available as described below.

The electric shocks administered from the neck mounted devices used in VF systems are reported to be less than that of an electric fence (electric fence: 6,000 – 7,000 kV) (Campbell *et al*., 2019b). Nevertheless, concerns have been raised that the kilovolt range of the currently available commercial devices is sensitive information and therefore is not publicly available. The impact of low energy electric shocks on cortisol and beta-endorphin concentrations, heart rate and behaviour have been assessed (Lee *et al*., 2008). For example, in a study by Lee *et al*. (2018) heifers were held in a crush for 10 minutes while receiving one of three treatments: 1) remain in crush with no treatment (control), 2) delivery of three shocks (600V, 250mW) at 2 second intervals, and 3) restraint in a head bail for 3 minutes. There were no significant differences between treatments except that animals receiving a shock were faster to leave the crush than control animals but showed no difference to those in the head restraint treatment group (Lee *et al.,* 2008). This suggests that the electrical shock at the level used in the study was no more stressful than head restraint. However, it should be noted that the shocks were delivered from an electronic dog collar. Therefore, making it difficult to generalise these results to the neck mounted devices used in VF systems. A more recent study compared the effects of a commercially available VF system (eShepherd™) and an electric fencing system on the behaviour and faecal cortisol metabolite concentrations (FCM) of beef cattle (Campbell *et al*., 2019b). There were no differences in FCM concentrations between the treatment groups, and concentrations decreased across time for all cattle. However, the cattle had not been well accustomed to the more intensive handling required for the experiment and all showed their highest FCM levels at the end of the first week of the study. Therefore, it is possible that a stress response to handling may have masked a treatment effect. The cattle in the VF treatment group lay less than the electric fence group ($P < 0.05$). The difference in lying time was small (average < 20min per day) and potential welfare impacts are uncertain. Impacts of VF on lying behaviour have been demonstrated in other short-term studies, with a decrease in lying behaviour (Koene *et al*., 2017) and an increase in lying bouts reported (Campbell *et al*., 2017). Further studies are needed to investigate the long-term impacts of VF on the behaviour and welfare of dairy cattle in an on-farm setting.

The potential negative impacts of VF systems on animal behaviour and stress responses, in particular in relation to training animals to use the technology, raises potential ethical and welfare concerns. For VF to be used, animals need to be trained to associate a non-aversive auditory cue to an aversive electric shock. A correct learnt response is achieved when the animal reacts appropriately to the initial auditory cue (i.e., stops or turns away from the virtual boundary), thus avoiding the shock (Lee *et al*., 2009). This learned association allows the animal to predict a situation and control the occurrence of the aversive stimulus by its own actions, thus inducing a minimal stress response (Kearton *et al*., 2020). Predictability and controllability are important factors that help animals cope with an adverse event (Destrez *et al*., 2013), therefore, when the association between the audio cue and electric shock is not learnt, animals may become stressed, and their welfare compromised. For instance, when an animal lacks an association between the aversive stimulus and its own behaviour due to poor timing of electric shocks it results in signs of stress and increased cortisol levels (rats: Weiss, 1972; dogs: Schalke *et al*., 2007).

Cattle can adapt quickly to avoid shocks from a traditional electric fence due to the visual cue the fencing provides, with the greatest number of shocks received in the first hour of the first day (Martiskainen *et al*., 2008). Typically, cattle learn to avoid electric fences in less than three challenges (Mejdell *et al*., 2017). When considering virtual fencing, studies have demonstrated that cattle (Lee *et al*., 2009; Campbell *et al*., 2018; Langworthy *et al*., 2021) and sheep (Marini *et al*., 2018a) can learn to respond to the audio cue, thus avoiding the aversive electrical shock. However, these studies report large individual differences in the rate of learning. Campbell *et al*. (2018) report the number of electrical stimuli received across eight trials ranged from 3 – 23 shocks. Lomax et al. (2019) report that the mean number of electrical shocks received by cattle ranged from 1 to 6.5 per day over a period of six days. This variation in learning rates suggests that successful containment may have a welfare cost for some animals (Lomax *et al*., 2019; Herlin *et al*., 2021).

The learning environment during the training period needs to be considered as the response of cattle to VF may be socially facilitated through observations of conspecifics. When trained in groups cows were 88% more likely to receive stimuli from the VF system compared to 26% of the cows that were trained as individuals (Colusso *et al*., 2020). While individual training may be impractical, group training needs to ensure that all animals have adequate time to experience and learn the association between the audio cue and the aversive electrical stimulus.

It is expected that while animals are learning to associate the auditory cue to the aversive shock there will be a level of acute stress experienced (Lee *et al*., 2018). A stress response may explain a reported reduction in time spent grazing and ruminating during the training period (McSweeney *et al*., 2020). To be acceptable, once an animal has adapted to interacting with a VF system, the need for the aversive shock stimulus should be minimal, therefore any stress response should also be minimal (Lee *et al*., 2018; Marini *et al*., 2018b). Further studies are needed to investigate the acute and chronic stress responses of dairy cattle while adapting to a VF system, particularly for animals that do not readily learn to avoid the electric shocks (as reviewed by Lee and Campbell, 2021).

Following a training period, studies have shown that animals can be contained by a VF system for short periods of time (Marini *et al*., 2018a; Campbell *et al*., 2019a; Langworthy *et al.,* 2021). Campbell *et al*. (2019a) excluded 10 cattle from a riparian zone for the majority of a 10-day exclusion period. However, four animals did cross into the exclusion zone for approximately 30 mins on one day during the exclusion period. For VF systems to be used to control stock movement the system needs to be completely reliable (Brier *et al*., 2020). However, technical issues with virtual fences (Campbell *et al*., 2017) and non-functional collars (Brunberg *et al*., 2017) have been reported. This is concerning, particularly if the VF boundary is preventing animals from accessing environmentally sensitive areas, or from accessing and gorging on crops that may result in conditions such as bloat, nitrate poisoning and ruminal acidosis. In these latter circumstances, NAWAC is particularly concerned that infrastructure failure during adverse events could result in large numbers of animals being exposed to conditions or experiences which may negatively impact their health and welfare.

It is important to note that several of the trials investigating VF systems have included small sample sizes (Campbell *et al*., 2019a: Lomax *et al*., 2019), simple fencing setups (single linear fencing) (Campbell *et al*., 2019a; Langworthy *et al*, 2021) and are short term trials (Campbell *et al*., 2019a: Lomax *et al*., 2019). Due to the differences in animal group sizes, enclosure sizes and training techniques, comparison between the studies is difficult. For example, studies testing VF have varied from using several hectares of pasture with a single virtual fence line (Campbell *et al*., 2019a) to a 90m^2 testing paddock with VF on each of the four boundary lines (Lee *et al*., 2009). Furthermore, studies have not considered the impacts of wearing neck mounted devices long-term. The eShepherd™ device consists of a strap and hanging counterweight (total weight ~ 1.4kg) and a unit (~ 725g and 17cm L x 12cm W x 14cm H) and have resulted in the development of skin abrasion on the jaws of cattle over a 10-day period (Verdon *et al*., 2021).13cm H). Therefore, the long-term impacts of VF and the neck mounted devices in grazing dairy systems need to be investigated before the suitability of using VF for management of dairy cattle can be determined.

NAWAC considers that there should be safeguards in place to ensure that dairy cows managed in virtual fencing systems do not experience unnecessary pain and distress, either directly from the device or from potential infrastructure failure. NAWAC further considers such safeguards should have more generic application than only VF and apply to any future technology proposed for animal management. NAWAC is proposing the addition of a minimum standard requiring that any equipment or technologies used with animals are designed, constructed, maintained and used in a manner that minimises the likelihood of distress, pain or injury to the animals. Dairy cattle that do not adapt to a new technology (e.g., animals that do not learn to respond to the audio cue in VF systems thus not being able to avoid electric shocks) must be provided with alternative management. As stated previously, NAWAC has concerns around the use of electricity for controlling animal behaviour. Current VF systems appear to have various safeguards in place to prevent operators applying shocks to animals directly and therefore the risk of misuse and abuse would be considered low in comparison to hand-held devices, such as electric prodders or electroimmobilisation devices. However, training animals using aversive techniques is not considered best practice and NAWAC recommends that aversive techniques should not be used.

4.3.6 Behavioural Needs

Feeding

Dairy cattle exhibit diurnal feeding patterns, consume feed intake over several meals per day, and have increased motivation to feed when nutritional requirements are higher (e.g., lactating, after milking) (reviewed by Charlton and Rutter, 2017; Mee and Boyle, 2020; Smid *et al*., 2020). The normal feeding behaviour of dairy cattle is primarily associated with grazing, however feeding ecology includes several distinct behaviours, including foraging, feed selection, consummatory behaviour, and rumination. NAWAC considers it is important to provide dairy cattle with the opportunity to express these normal behaviours but due to the wide range of dairy feeding systems employed by farmers and that provide for behaviour opportunities in different ways, is unable to specify the mode in which these behaviours must be provided for.

Provision of outdoor grazing is a concern often raised when considering normal feeding behaviour of dairy cattle. NAWAC reviewed the question “Do dairy cattle need access to the outdoors?” in their report accompanying the 2019 amendment[15]. A key consideration for this was motivation to access pasture, and whether this motivation was linked to grazing. Dairy cattle have been reported to choose to access pasture from 8% up to 72% of the time it is available to them (reviewed by Smid *et al*., 2020). The multifactorial motivations and potential benefits that pasture access provides means that it is difficult to determine the degree to which grazing behaviour is motivating pasture preference.

Dairy cattle that are provided with total mixed ration (TMR) as well as access to pasture do not always preferentially choose to access pasture. Charlton *et al*. (2011) found that after milking, dairy cattle would preferentially stay indoors, presumably to consume TMR before accessing pasture. Presumably the TMR is satiating a greater nutritional requirement than pasture. There is also a suggestion that dairy cattle may preferentially be accessing TMR *vs* pasture for feed intake due to the faster intake of daily nutritional

[15] https://www.mpi.govt.nz/dmsdocument/41782-Report-to-accompany-an-amendment-to-the-code-of-welfare-for-dairy-cattle-2019

requirements allowing for a greater amount of time for more highly motivated behaviours such as lying down and ruminating.

Dairy cattle are motivated to forage and manipulate feed, demonstrating contrafreeloading, whereby given a choice, they will work for to obtain feed which is simultaneously available for free (Van Os *et al,* 2018). Feed sorting is also commonly observed in dairy cattle when consuming TMR (Miller-Cushon and DeVries, 2017). Feed sorting generally results in dairy cattle selectively sorting through TMR to consume the shorter, more nutrient dense particles, while leaving the longer more fibre dense particles. However, dairy cattle have been observed to preferentially sort for longer particles, suggesting internal cues for self-regulation of nutritional requirements may alter usual preferences (DeVries *et al*., 2007). Dairy cattle are reported to perform oral stereotypes when feed manipulation is restricted (Redbo and Norblad, 1997). However, feeding behaviour is complex, where Kronqvist *et al.* (2021) observed that dairy cattle fed compact total mixed ration, subsequently reducing total feeding time, spent more time resting and ruminating vs another form of oral manipulation. Alternatively, Lindström and Redbo (2000) demonstrated that lactating dairy cows are motivated to orally manipulate feed even when their rumens are filled artificially, suggesting that cattle may have a behavioural need to perform foraging behaviour even when metabolically satiated.

Dairy cattle are well known to have preferences for different vegetation, presumably related to palatability and nutritional value (Horadagoda *et al.,* 2009). Dairy cattle may also prefer to graze selectively to reduce grazing time and increase lying/ruminating time, whereby Arrazola *et al*. (2020) found that dairy cattle with previous pasture experience spent less time grazing, presumably more efficiently, than those with no prior experience with pasture.

NAWAC is proposing to recommend that dairy cattle should be given the opportunity to graze, allowing for a greater opportunity to express a range of feeding behaviours and feed selection. In addition, a new recommended best practice is recommended under the minimum standard for feed that dairy cattle should be allowed to forage and select feed according to individual requirements and preferences and be offered a variety of feed with different tastes and textures providing there is no negative impact on their health and welfare.

Stocking Densities

According to the code writing guideline, minimum standards[16], should, as far as possible, describe intended welfare outcomes for the animal rather than being prescriptive. NAWAC is therefore proposing a minimum standard that outlines the expected outcomes of appropriate space allowances including that animals are able to walk, turn around, lie in a natural position, lie down and rise freely, and express and satisfy a range of normal behaviours. Example indicators, that may be used to measure or assess the achievement of the intended outcome of the minimum standard, are also proposed throughout the Code. With respect to guidance for stocking density, NAWAC proposes to incorporate these into minimum standards both meeting behavioural needs and for managing dairy cattle in off-paddock facilities.

NAWAC is also proposing to lift a recommended best practice for managing dairy cattle in off-paddock facilities into a minimum standard to require 10% more free-stalls be provided than animals housed. Lying time is impacted by the number of available free stalls, with a greater stocking density (cows per free-stall) resulting in increased competition, increased standing time and reduced lying time (Fregonesi *et al*., 2007: Hill *et al*., 2009; Krawczel *et al*., 2012). The provision of extra stalls results in a reduction in competition and enables cattle to have choice around their lying behaviour (Winckler *et al*., 2015). For instance, increased stall availability results in more synchronous lying behaviour with cows choosing to spend more time lying at night than during the day (Winckler *et al*., 2015). As discussed below cows are highly motivated to lie down, thus providing extra free-stalls will better meet both their behavioural and welfare needs.

Lying Requirements

[16] https://www.nawac.org.nz/guidelines/

Lying down is a highly motivated behaviour for cows, whereby cattle will work for the opportunity to lie down (Tucker *et al*., 2018; Jensen *et al*., 2004, 2005), exhibit rebound behaviour when lying is thwarted (Fisher *et al*., 2003; Kull *et al*., 2019; Schütz and Cox, 2014; Schütz *et al*., 2015, 2019b), and prioritise lying over other behaviours when forced to choose (Fisher *et al*.,2003; Munksgaard *et al*., 2005; Schütz and Cox, 2014; Schütz *et al*., 2015, 2019b). Lying down is therefore an important behaviour for dairy cattle and has an influence on welfare and affective state. NAWAC have previously recommended that dairy cattle must be able to lie and rest comfortably for sufficient periods each day to meet their behavioural needs, deliberations on this issue are highlighted in the report accompanying the 2019 amendment[17].

NAWAC is proposing a change to the minimum standard for the provision of compressible well-drained lying surfaces to allow cattle to meet their lying needs, guidance in lying times presented in the indicators. The number of hours that dairy cattle spend lying will vary depending on season, individual cow factors (e.g., parity, stage of lactation, health, lameness), individual cow preferences and how much time animals have available to lie (as reviewed by Tucker *et al*., 2021), and so is difficult to specify. In addition, as discussed by Cook (2021), cow comfort cannot be assessed by lying time alone.

Comfort is reflected by optimal resting behaviour, including lying time, number of lying bouts and lying bout duration as well as sleep, and the provision of facilities and management to allow cows to lie down when they choose to do so for as long as they need to (Cook, 2021).

Given the opportunity, dairy cows will lie for at least 9-12 hours per day depending on the environment, management system, and individual cow factors (reviewed by Charlton and Rutter, 2017; Tucker *et al*., 2021). The average number of bouts that dairy cows lie down per day is reported to be between 9 to 11 bouts per day, with an average of 60 to 90-minute duration per bout (Tucker *et al*., 2021). However, similarly to total duration of lying, the number and duration of lying bouts varies considerably depending on the environment, management system, and individual cow factors.

Sucking in calves

Sucking is a natural behaviour and when left with the dam, calves will suckle on average 3-12 times per day depending on the age and breed, with each bout lasting for approximately 10 minutes (Reinhardt and Reinhardt, 1981; Albright and Arave, 1997). The amount of time calves spend sucking decreases with age (Nolte *et al*., 1990), with the frequency of feeding bouts also decreasing from an average of 4 feeding bouts per day at 1 month of age to a single feeding bout per day at 6 months of age (Das *et al*., 2000). In an artificial rearing system, feeding through an artificial teat allows calves to perform natural sucking behaviours (Hammell *et al*., 1988; Chua *et al*., 2002).

Sucking is also considered to be a behavioural need as the motivation to suck is reduced to a greater extent by time spent sucking than by milk ingestion (Rushen and de Passillé, 1995). Miller-Cushon and DeVries (2015) have reviewed the development and expression of calf feeding behaviour and state that “sucking has functional consequences for the calf, causing the release of hormones involved in postprandial satiety, such as insulin, cholecystokinin and gastrin.”

Cross-sucking is considered an abnormal behaviour defined as non-nutritive sucking directed towards another calf’s head or body (Lidfors, 1993). The behaviour is considered to be a re-direction of natural sucking behaviour stimulated by the ingestion of milk (de Passillé and Rushen, 1997). Unlike calves fed from a bucket, those fed using an artificial teat tend not to cross-suck each other or other objects (Bøe and Havrevoll, 1993; de Passillé, 2001). The decrease in the amount of time spent cross-sucking when fed via a teat is partly associated with the increase in overall feeding times and reduced flow rate compared to a bucket feeding system (Haley *et al.,* 1998). Calves fed *ad libitum* via a teat for example were found to spend approximately 45 min/d drinking milk compared to bucket fed calves who were found to feed for just a few minutes per day (Appleby *et al.*, 2001).

[17] https://www.mpi.govt.nz/dmsdocument/41782-Report-to-accompany-an-amendment-to-the-code-of-welfare-for-dairy-cattle-2019

Jensen and Budde (2006) investigated feeding behaviour and how this was impacted by feeding method (teat versus bucket) and group size (paired versus groups of 6 calves). Irrespective of group size, teat-fed calves were observed taking longer to ingest milk and kept sucking the empty teat after milk was ingested. In comparison, bucket-fed calves turned to cross-suck on calves after the bucket was empty.

In addition to the type of feeding method, studies have also indicated that the amount of cross-sucking which occurs both before and during weaning may relate to inadequate milk or energy intakes and weaning method (Jung and Lidfors, 2001; Roth *et al.,* 2008). Jung and Lidfors (2001), for example observed decreased non-nutritive and cross-sucking when calves were fed 10 L of whole milk per day compared to calves on lower milk allowances of 2 or 5 L/ per day. Whilst increasing milk allowance has been shown to reduce cross-sucking (Jung and Lidfors, 2001), Vaughan *et al.* (2016) note that cross- sucking may still be observed in calves which are provided milk *ad libitum* however it will occur at a much lower intensity that those on lower milk allowances. As demonstrated by Roth *et al*. (2008) weaning method, e.g. individual weaning vs. conventional weaning, can also influence cross-sucking behaviour. Compared to conventionally weaned calves (milk provision ended at 11.5 weeks of age regardless of concentrate intake), Roth *et al*. (2008) demonstrated reduced cross-sucking in calves which were individually weaned (reduction of milk allowance dependent on an increasing intake of concentrates).

NAWAC is proposing to add a requirement that calves' need to suck must be satisfied and an example indicator that cross-sucking is not seen. A recommended best practice is proposed to be added that calves should have a dry teat available at all times to provide an appropriate additional outlet for sucking motivation.

4.3.7 Shelter

The Animal Welfare Act 1999 requires that the physical, health and behavioural needs of animals are met in accordance with good practice and scientific knowledge, including adequate shelter that is appropriate to the species, environment and circumstances of the animal. However, the Act does not inform as to what shelter is considered adequate. NAWAC is therefore required to establish a minimum standard relating to the provision of shelter, and determine what 'adequate' shelter is.

Minimum standards need to be the minimum necessary to ensure that the purposes of the Act will be met. They need to be clear and precise so that people can be certain of what they must or must not do in order to meet their obligations under the Act and an investigator must be able to easily assess or measure non-compliance with a minimum standard.

It is NAWAC's opinion that the main consideration of standards around the provision of shelter should be the protection of animals from climatic extremes that may result in thermal stress, discomfort and associated welfare compromise. In this context it is NAWAC's position that the act of providing such protection (sheltering) has broader meaning than the traditional view of natural shelter in the pastoral farming landscape, and that appropriate provision of artificial means to mitigate thermal stress can have equivalent or better animal welfare outcomes.

Homeothermic animals draw on a number of physiological and behavioural mechanisms to maintain body temperature within normal limits to maintain wellbeing and reduce discomfort, including changes in blood flow to the skin, sweating, panting, shivering and increased metabolism as well as seeking shade or shelter, making postural changes or adjusting feed or water intake (Fisher, 2007). Thermal stress will result when these mechanisms fail to maintain body temperature within normal limits, adversely impacting the animals' welfare.

The occurrence of thermal stress in an individual animal depends on a multitude of environmental (e.g. temperature, humidity, wind speed, solar radiation, precipitation, ground surface conditions) and animal factors (species, breed, sex, age, metabolic state, coat or fleece cover, acclimatisation, nutrition and hydration, disease, and individual variability) (Fisher, 2007).

Shelter provides the animal with an opportunity to moderate the effects of adverse climatic conditions. As highlighted by Fisher (2007), shelter is found in many forms including vegetation (scrub, tussocks, rushes, long grass, trees, plantations), shelter or shade belts, topography (rocks, ridges, gullies), other animals (animals huddling together) and artificial structures (housing, shade cloth, animal covers). The impact of adverse climatic conditions can also be minimised by directly regulating factors in the animal's thermal environment (e.g. using sprinklers, misters and fans, providing plentiful drinking water, provision of dry bedding material), by managing animals according to conditions (providing additional feed, reduced milking frequency, reducing walking distance to milking or milking in the colder part of the day) and by genetic selection of animals that are more tolerant of adverse conditions e.g. heat tolerance. Accordingly, NAWAC considers that adequacy of shelter is specific to regions and, individual farm sites where it needs to be considered at the level of the individual animal.

NAWAC previously discussed shade and shelter within the context of farmed livestock when developing the current code of welfare, as outlined in the associated code report[18]. It took *'adequate' to mean sufficient to maintain core body temperature within a range that does not produce tissue damage that is irreversible and therefore potentially life-threatening damage (i.e., animals can be hot or cold, but not to the extremes of being too hot or too cold that it is noxious or damaging to their health*).

Cold Stress

As already outlined in the previous Code report[12], healthy well-conditioned cattle are relatively robust in their ability to tolerate the extent of cold conditions encountered in a temperate climate. However, where winter conditions are such that dairy cattle are exposed not only to cold, but also wind and rain, heat loss to the surrounding environment increases (Webster et al., 2008, 2015). The provision of dry, insulated bedding helps to reduce the impact of cold conditions by providing a layer of insulation between the animal and the ground (Girma and Gebremariam, 2019; Dewell et al., 2021). Without adequate bedding, the amount of heat loss cattle experience will be greater.

Even though cattle are capable of tolerating very cold, wet or windy conditions, they will seek out shelter if possible. NAWAC proposes that, where practicable in extreme conditions, all dairy cattle be provided with opportunities to reduce their exposure. Some animals are also more susceptible to cold stress due to higher rates of heat loss and/or their inability to maintain heat production. These include thinner animals, those that are sick as well as newborn and young animals. Newborn and young calves are subjected to high rates of heat loss due to their high surface to body weight ratio (Randall, 1978), and this is exacerbated by a number of factors including wind, moisture, breed, coat and bedding. The thermoneutral zone for a newborn calf is 10-26 ºC, the range of which increases to 0-26 ºC by one month of age (Nonnecke et al., 2009; Cullens et al., 2013). Cold temperatures have also been reported to prolong the time taken to stand after birth (Diesch et al., 2004) which may delay colostrum intake and thus further reduce the animal's ability to maintain adequate heat production in addition to increasing the risk of failure of passive transfer of immunity thus increasing disease susceptibility and mortality rates.

Behavioural responses of dairy cattle to cold and wet conditions include seeking shelter or microclimates to mitigate the impact of weather (Schütz et al., 2010a), standing with lowered heads, reducing feed intake and time spent lying, and adopting postures that reduce heat loss (Tucker et al., 2008; Webster et al., 2008; Schütz et al., 2010b). Reduced lying times are likely associated with the reluctance of dairy cattle to lie on wet or muddy surfaces (Fisher et al., 2003; Fregonesi et al., 2007; Tucker et al., 2008; Reich et al., 2010; Chen et al., 2017). While dairy cattle have been reported to lie down on wet surfaces eventually, lying postures that reduce the area exposed to surroundings, and hence reduce heat loss, are common (i.e., lying with front legs in a tucked position) (Tucker et al., 2008). The quality of lying when on wet or muddy surfaces is also likely affected with less time being spent in postures that have been associated with sleep (Schütz et al., 2019b).

The provision of shelter, or suitable cold mitigation strategies including provision of additional feed and water to maintain heat production and access to suitable well-drained lying surfaces to reduce heat loss, is important to ensure dairy cattle do not experience adverse welfare impacts as a result of cold stress. NAWAC is proposing to add a recommended best practice that dairy cattle should be able to access effective shelter freely when they choose to. It should be noted that to be effective, the design of artificial shelters should encourage their use by

[18] https://www.mpi.govt.nz/dmsdocument/46087-Dairy-Cattle-Animal-Welfare-Code-of-Welfare-Review-of-Submissions-and-Update

dairy cattle. NAWAC recognises however that individual animals may have different preferences for shelter and not all animals may use shelter provided.

Heat Stress

Within the New Zealand climatic range, dairy cattle are more affected by heat stress than cold stress. Heat stress imposed by the environment depends on the internal heat load (e.g., digestion of feed, milk production) and on the factors that govern heat exchange (ability to lose heat). Heat loss occurs via conduction, convection, radiation, evaporation of water and through expired air (Silanikove, 2000; Kadzere *et al*., 2002).

Physiological and behavioural changes in response to warm ambient conditions have been observed by a range of studies (Schütz *et al*., 2010b; Ratnakaran *et al*., 2017; Becker *et al*., 2020), including increased respiration rate, sweating and decreased lying time, feed intake and rumination as well as seeking shade and increasing water intake. During thermoneutral conditions cattle core body temperature ranges from 38.0-39.3 ºC (Idris *et al*., 2021).

As outlined in the previous Code's report:

"Conditions that cause heat stress operate by increasing core body temperature towards the Upper Critical Limit (UCL) (about 40.5 °C), and when unable to be managed result in hyperthermia. Cattle rely to a large extent on evaporation from the lungs and to a lesser extent from the skin to lose excess heat, so increased respiratory rate is evidence that core body temperatures are under threat of heat loading. Factors such as the ambient humidity and also coat colour will influence the extent of heat loading. NAWAC noted that weather conditions that can generate heat stress for dairy cattle occur more frequently than those that generate cold stress.

Studies in New Zealand have shown that grazing cows without voluntary access to shade produce less milk when ambient conditions are hot, and that cows offered shade will adjust their grazing patterns to eat more at night (Fisher et al., 2008; Kendall et al., 2006). Grazing cows with access to shade had lower core body temperatures during the middle of the day but this advantage was lost when cows walked to the dairy for milking. Individual cows in these studies experienced core body temperatures above 40 °C and so approached the UCL for hyperthermia to occur. Heat stress may be managed in a number of ways other than merely the provision of shade. Cattle may not always choose shade, even on hot days. Where shade is limited in hot conditions, it is particularly important that water supplies are plentiful. Heat stress can become a problem in dairy yards, after the herd has been walked in on hot summer afternoons, and it may be difficult to dissipate the heat. The thermal environment can be directly regulated e.g. by mist or water spraying or by provision of shade or fans to create air movement. Sprinklers and shade provided at the dairy yard were both effective in reducing core body temperature and respiration rates (Kendall et al., 2007)".

Animal welfare is negatively impacted when cows experience heat stress (Becker *et al*., 2020), and can compromise affective state for example by inducing feelings of hunger, thirst, frustration, aggression and malaise (Polsky and von Keyserlingk, 2017). Heat stress is recognised as one of the main challenges affecting cattle in pasture-based systems as a result of the significant environmental variability to which they are exposed (Deniz *et al*., 2021). The susceptibility of cattle to heat stress depends on a number of intrinsic (e.g., genotype, coat colour, coat type, sex, body condition, total mass, surface area to mass ratio, health, physiology, and metabolic heat production) and extrinsic factors (e.g. temperature, humidity, solar radiation, wind speed, cloud cover, rainfall, and management) (Gaughan *et al*., 2002). When the environmental temperature exceeds that of their internal body temperature cattle are unable to effectively dissipate heat and are at risk of experiencing heat stress (Becker and Stone, 2020). Heat stress can dramatically alter a cow's productivity, physiology and behaviour (West, 2003; Schütz *et al*., 2010b; Tao *et al*., 2018; Herbut *et al*., 2020) leading to increased body temperature and respiration rate, and decreased feed intake, rumination, milk production, time spent lying and fertility, and in severe instances can result in mortalities (Brown-Brandl *et al*., 2005; Mader *et al*., 2006; Cook *et al*., 2007; Abeni and Galli, 2017).

Shade appears to be a resource which is highly valued by dairy cattle as a strategy for mitigating heat stress. Dairy cattle display high levels of motivation to use shade during hot weather and will often increase the amount of time spent in shaded areas as ambient temperatures and levels of solar radiation increase (Kendall *et al*., 2006; Tucker *et al.,* 2008; Schütz *et al*., 2008). Compared to cows without access to shade, the provision of shade has been shown to be beneficial for dairy cattle in terms of reducing respiration rate and body temperature

(Roman-Ponce *et al*., 1977; Blackshaw and Blackshaw, 1994). Roman-Ponce *et al*. (1977) also reported that cows provided access to shade produced 10% more milk than cows without access to shade. Compared to cows with access to shade, those without access have been shown to reduce the time spent grazing in order to seek relief from the heat (Becker and Stone, 2020). Cattle without access to shade may also compensate for the increased heat load by increasing the amount of time they spend standing and increasing the amount of time they spend around the water trough (Widowski, 2001; Schütz *et al*., 2010b; Nordlund *et al*., 2019). Palacio *et al*. (2015) for example, reported that cows with access to shade were observed at the water trough on average 34.2% less than cows with no access to shade. The reason for cattle increasing the time spent around the water trough in hot conditions is considered to relate to evaporation from the trough creating an ideal microclimate which helps the cows reduce the level of heat stress they are experiencing (Palacio *et al*., 2015).

It is important to note that the use of shade as a heat mitigation strategy is only effective if a sufficient amount of shade is provided. Furthermore, the amount of shade provided is important in ensuring not only that cattle are able to cool down efficiently but also that they can do so without the negative effects of aggression. Schütz *et al*. (2010b) for example, demonstrated that cows that had access to nearly 9.6m^2 of shade per cow spent more than twice as much time in the shade compared to cows that had access to 2.4m^2. Additionally, the provision of greater areas of shade resulted in lower respiration rates and less aggressive behaviour (Schütz *et al*., 2010b). As suggested by Schütz *et al*. (2010b), areas of shade may have to be large enough to enable all cows to make use of it at the same time.

The type of shade is also a factor which influences how effective it is as a strategy for preventing discomfort and thermal stress, with the type of shade influencing the microclimate created under the shadow cast by the shade structure (Tucker *et al*., 2008). It is important to note that the amount of shade trees can provide throughout the day will be impacted by how they are orientated relative to the sun (Becker and Stone, 2020). Shade from trees also provides variable protection against solar radiation and wind speed, and is contingent on tree height, spacing and the density of the various species (Hawke and Wedderburn, 1994). Shade structures are effective at providing protection against solar radiation, however, due to a lack of air movement under the structure they may not improve the air temperature or humidity around cows, which may inhibit their natural ability to dissipate heat (Flamenbaum *et al*., 1986; Gaughan *et al*., 2004; Renaudeau *et al*., 2012). However, the provision of shade has been shown to reduce the radiant heat load of an animal by 30% and reduce black globe temperature by approximately 8 ºC (Bond *et al*., 1967; Roman-Ponce *et al*., 1977).

Evaporative cooling (reviewed by Becker and Stone, 2020; Becker *et al*., 2020) such as the use of sprinklers or misters can also act as an effective method to reduce heat load and enable cows to dissipate heat (Schütz *et al*., 2011). Compared to providing shade, fans or sprinklers alone, a combination of fans and sprinklers were found to be more effective at reducing body temperatures and respiration rate by enhancing the ability for cows to dissipate heat (Correa-Calderon *et al*., 2004). Schütz *et al*., (2011) reported that when given a choice, 62% of cows chose shade over the use of sprinklers and that 65% also chose shade over no form of heat mitigation. However, whilst shade was the preferred option over sprinklers or no heat abatement, sprinklers were found to better reduce respiration rates and decrease both skin and core body temperatures (Schütz *et al*., 2011). Similarly, Kendall *et al*. (2007) noted reduced respiration when cows were given a choice between 4 treatment groups: shade, sprinklers, shade and sprinklers, and no heat abatement. They reported that used separately, sprinklers and shade reduced respiration rates by 60% and 30% respectively compared to the no heat abatement treatment group, and that a combination of shade and sprinklers was the most effective treatment in reducing respiration rate.

In addition to the provision of shade, nutritional management, genetics, and altering milking times may also offer themselves as potential heat mitigation strategies. For example, adjustments to the diet which may act to reduce heat generation associated with increased metabolism (Kanjanapruthipong *et al*., 2015). To cope with high ambient temperatures, nutritional strategies such as the use of a high energy diet which balances decreased feed intake and increased energy requirements for thermoregulation have been investigated (Das *et al*., 2016). Other nutritional strategies have focused on using feed additives, managing the proportion of roughage, and altering feeding time to reduce metabolic heat loads during the hottest periods of the day (Dunshea *et al*., 2019; Moallem *et al*., 2009; Calamari *et al*., 2011; Mader *et al*., 1999; Brosh *et al*., 1998). An animal's genotype is also a major factor which influences their susceptibility or tolerance to heat load, and the genetic selection of heat tolerant breeds has progressed with varying levels of success (Roland *et al*., 2016; Lees *et al*., 2019). Compared to New

Zealand Jersey cattle, New Zealand Holstein Friesian cattle are more sensitive to impacts of heat or cold (Bryant *et al.,* 2007). In a study by Bryant *et al*. (2007) it was reported that performance reductions of >10 g of milk solids day^{-1} per unit increase in 3-day average THI, started to occur at a 3-day average THI of 68 in Holstein Friesian, 69 in Holstein Friesian x Jersey, and at 75 in Jersey cattle. In southern parts of America Jersey cattle are often preferred over Holstein Friesians due to their superior abilities to maintain feed intake, milk production and reproduction at >78 THI (Keister *et al.,* 2002). As stated by Hansen (2020), there are opportunities for the impacts of heat stress to be reduced by identifying genetic mutations responsible for genetic variation in thermotolerance and transferring specific alleles that confer thermotolerance to breeds which are not adapted to hot climates. A specific mutation identified which has been found to increase the ability of cattle to regulate body temperature is the group of frame-sift mutations in the prolactin receptor gene (PRLR) (Hansen, 2020). This mutation referred to as the slick gene results in cattle having a short, sleek hair coat and is a mutation which has been identified in several extant breeds derived from criollo cattle (Hansen, 2020). The slick gene mutation identified in Senepol cattle has been transferred to dairy cattle in Puerto Rico, Florida and New Zealand (Hansen, 2020). The motivation to select for heat tolerant cows may continue in response to the increasing impacts of climate change (Hoffmann, 2010). There has been some suggestion that selection for heat tolerance may impact negatively on production (Rhoads *et al*., 2013; Ghahramani and Moore, 2015). However, as proposed by Hansen (2020), the impacts of heat stress on cattle production can be reduced by a genetic strategy involving transfer of specific alleles that either increase ability of animals to regulate body temperature or to stabilise cellular function when hypothermia occurs. Hansen (2020) further suggested that this approach is advantageous over crossbreeding as you can avoid the losses in production that are often associated when breeds are highly selected for factors such as milk yield, growth or carcass quality.

Technologies to Assess Heat Stress

Thermal indices have been developed to model the association of thermal parameters (e.g., temperature, humidity, wind speed, and solar radiation) with animal responses to assess the impact of heat stress on animals (Ji *et al*., 2020). The likelihood that heat stress may occur can be estimated by considering a calculated temperature-humidity index (THI) that may also incorporate black globe temperature as an estimate of radiant heat input. When the THI moves towards 72 (Ravagnolo *et al*., 2000), as occurs with an ambient temperature of 25°C and relative humidity above 50%, lactating cows will initiate homeostatic heat control mechanisms to protect core body temperature (Buffington *et al*., 1981; Blackshaw and Blackshaw, 1994). Whilst earlier research has suggested an upper threshold THI value of 72 for cattle thermal comfort (Bohmanova *et al*., 2007), recent research has suggested a lower value of 60-68 as the upper threshold THI value for high-producing cattle (Carabaño *et al*., 2016). However, THI will underestimate heat load in grazing animals as it does not account for solar radiation. NAWAC therefore recommends use of an index that does take solar radiation into account. The development of a Heat Load Index (HLI) specific for New Zealand conditions is currently underway.

Heat stress can also be indicated by measuring surface and core body temperatures, although surface temperature may not provide a true representation of core body temperature (Islam *et al*., 2021). Rectal temperature is considered a robust indicator of core body temperature but there are issues associated with defaecation and with being able to keep monitoring sensors in place (Lea *et al*., 2008). Collecting rectal temperatures also requires the animals to restrained which can cause stress and influence the body temperature recorded, rectal temperatures are also not collected continuously. Vaginal temperature is highly associated with rectal temperature, and sensors can be attached to CIDR devices to monitor core body temperature in female cattle (Lees *et al*., 2018). Another method of measuring body temperature is through the use of rumen boluses (Koltes *et al.,* 2018). Whilst measuring rectal or vaginal temperatures is a more suitable measure for research purposes, rumen boluses are a technology which offer themselves as a technology which is more suitable for use on-farm. Rumen boluses provide a method of measuring rumen (or reticulum) temperature, but recordings can be influenced by fluid intake or by the bolus shifting from the reticulum to the rumen (Davison *et al*., 2020). However, rumen or reticular temperature has been correlated with rectal temperature and respiration rate in beef cattle and has been assessed as an indicator of heat stress in dairy cattle (Boehmer *et al.,* 2015; Ammer *et al.,* 2016). A further example of current technology which is being investigated in terms of its suitability for identifying heat stress are accelerometer-based neck-mounted collars (Davison *et al*., 2020). Davison *et al*. (2020) reported that during periods of high ambient temperatures accelerometer-based neck-mounted collars were able to identify cattle exhibiting signs of heat stress through the detection of periods of high respiration rates but noted further studies would be needed to determine the accelerometers precision for detecting heat stress. Ear temperature monitoring systems have been developed for use in cattle (e.g., Cow Manager BV, Gerverscop, NL; DoggTag, Herddogg systems, Longmont, CO; Fever Tags, Amarillo, TX; SenseTag, Quantified Ag, Lincoln, NE; TekVet Health Monitoring System, East Palmetto, FL) (Koltes *et al*., 2018). These devices are mounted on the ear and have a temperature sensor that is placed within the ear canal to measure body temperature and whilst they are primarily used for monitoring illness, they can also be applied for monitor heat stress (Koltes *et al.,* 2018).

As technology continues to advance, future monitoring and mitigation of heat stress will be based on minimally invasive smart technologies which can be used either singularly or as part of a larger integrated system. Continued technological developments will enable real-time solutions to monitoring animal responses across a range of production systems and environmental conditions (Islam *et al*., 2021). NAWAC encourages the uptake of monitoring technologies including those capable of providing weather alerts to enable early mitigation and prevent heat stress.

NAWAC's Considerations and Recommendations Relating to Shelter

Minimum standards should, as far as possible, describe the intended outcome for the animal and be capable of measurement or assessment. NAWAC is therefore proposing to include expanded minimum standards that all dairy cattle must be provided with shade/shelter or other means to minimise the risk of heat/cold stress due to warm and/or humid/cold and/or wet conditions. Example indicators have been added to highlight how persons in charge can assess whether or not they are meeting the standards.

NAWAC considers that shade and shelter are essential for the well-being of animals but allows that there are difficulties in setting standards providing specific thresholds for thermal stress in pastoral environments at which management action becomes necessary (i.e., standards that will be suitable and effective for all dairy cattle in every farming system and that are enforceable).

The inclusion of standards and indicators with defined thresholds for heat loading, at which point remedial action would be required to mitigate any heat stress, was debated at some length by NAWAC. Development of a HLI specific to New Zealand summer conditions that takes account of solar radiation as well as temperature and humidity is feasible and can be validated against behavioural indicators of the onset of heat stress. This tool has value in meteorological predictions of risk of heat stress to allow farmers to adjust their management. To support farmers in meeting such a standard it could be combined with practical monitoring of behaviours expressing thermal stress such as high respiration rates and open-mouth breathing.

NAWAC has concluded that the emerging HLI technology is not sufficiently mature for it to be used as the basis for formulating a mandatory threshold, but that it represents future opportunity to improve animal welfare. This is a specific topic for which the Committee will be canvassing opinion in the public consultation phase on whether a regulatory threshold can be set, with an appropriate transition period. Specific requirements for the provision of shelter for those classes of animals at greater risk (e.g., newborn, sick, removed from dam) and a requirement that priority be given to remedial action when weather conditions result in animals developing health problems, are already in place in the current Code and have been carried across, with only minor amendments.

NAWAC proposes to include a requirement for planning for shelter provision during adverse weather conditions to the contingency section of the Code such that persons in charge of dairy cattle must have a plan for such situations.

NAWAC's Recommendations for Regulations – Heat Stress

NAWAC considers that heat stress is a serious animal welfare issue, especially for lactating dairy cattle. The Committee would like to recommend a regulation to address this issue pending feedback from public consultation on whether this area should be regulated and, once sufficiently advanced, a HLI threshold could be used to regulate a cut-off for when shade or heat mitigation strategies must be provided.

4.3.8 Off-Paddock Facilities

Provision of Appropriate Lying Surfaces and Time on Hard Surfaces

In New Zealand, cows are predominantly kept on pasture. However, there are situations where cows are stood off (i.e., kept on other surfaces such as yards) for short-term periods (e.g., overnight for several subsequent days). This occurs particularly during wet weather to reduce soil damage and ground water contamination and reduce cows' exposure to the welfare impacts of wet and muddy surfaces. Dairy cattle may also be kept in specialised off-paddock facilities for longer periods, especially in the wetter and colder areas of New Zealand.

An important welfare consideration where dairy cattle are kept in off-paddock facilities is the hardness of surfaces. Hard surfaces directly impact on the time cows can spend lying down comfortably. Prolonged periods standing and walking on these surfaces affect cow comfort and leg health (reviewed by Tucker *et al*., 2021), as the bovine foot is not made for permanent use on hard surfaces (Mülling and Greenough, 2006).

As outlined in the above section on lying requirements, lying down is a very important behaviour for cows. This has also been reviewed extensively by Tucker *et al.* (2021).

The impact of hard stand-off surfaces has also been assessed under New Zealand conditions. Schütz and Cox (2014) investigated the behavioural and physiological effect of different types of surfaces during weather-induced short-term stand-off. Cows were stood-off on concrete, rubber matting at two different thicknesses and wood chips for 18hrs a day for 4 consecutive days, with the remaining time spent on pasture. They observed that cows on concrete spent less time lying than cows on the other surfaces and had a greater deterioration in gait score and decrease in stride length compared to cows on other surfaces.

NAWAC has reviewed the minimum standard related to the provision of suitable lying surfaces for cattle in off-paddock facilities. The 2019 amendment required that where dairy cattle are kept in off-paddock facilities for more than 16 hours a day for more than 3 consecutive days, a compressible well-drained lying area must be provided. The Committee considered at the time that emergency situations may arise that may require farmers to keep cattle off-paddock for more than 16 hours a day for a number of days to minimise damage to soil and to protect cows (e.g., during extreme wet weather). NAWAC considered that cattle can only be managed off-paddock in these situations without the provision of drained lying areas for up to 3 days.

NAWAC is now proposing revisions to include a minimum standard requiring contingency planning such that farmers need to plan ahead for emergency situations. As highlighted by the relevant example indicator, a plan for protecting stock during adverse weather events must be in place including for the provision of compressible well-drained areas for lying so dairy cattle can meet their daily lying needs. NAWAC acknowledges that extreme weather with resultant severe flooding, as can occur in New Zealand, is an emergency situation. When considering any shortfalls in animal management during these events, compliance officers would take the special circumstances into account, further negating the need for a specific minimum standard.

Nevertheless, due to the impact of hard surfaces on cattle comfort and leg health and the increasing motivation of cows to lie down after 3 to 4 hours (reviewed by Tucker *et al*., 2021), NAWAC considers that time spent on hard surfaces should be limited. An amendment to the minimum standard for off-paddock facilities is therefore proposed. The proposed amendment will require that all dairy cattle kept in off-paddock facilities for more than 12 hours a day for more than 3 consecutive days be provided with a well-drained lying area with a compressible surface or bedding, that is maintained to avoid manure accumulation, to ensure Minimum Standard 7(c) is satisfied. NAWAC agreed that in situations where dairy cattle are off pasture for a short period (e.g., less than 12 hours a day) lying requirements can be met when cattle are returned to pasture. NAWAC is also proposing to add a recommended best practice that dairy cattle should not be stood off on hard surfaces and that the surface of walking and standing areas in off-paddock facilities should be compressible and non-slip.

NAWAC has previously recommended a new minimum standard that where dairy cattle are kept in off-paddock facilities for more than 150 days they must be provided with daily or frequent access to an outdoor area with a compressible surface (see below section on outdoor access). This will provide dairy cattle with the opportunity to spend time standing and walking on compressible surfaces should these not already be available within the off-paddock facility.

The Use of River Stones in Off-Paddock Facilities

The use of river stones as an alternative bedding substrate for calves has been observed on some farms in New Zealand. Use of stones now appears to be an emerging practice for adult dairy cattle being stood off pasture and crops. There is a view that, being biologically inert, stones (and sand) may assist with disease control. The issue of stones for calf rearing has been discussed in NAWAC's report on the 2019 amendment to the Code of welfare for dairy cattle[14] and is addressed again in the current review.

Research is limited in this area. Al-Marashdeh *et al.* (2017) studied lying behaviour of cows kept on different stand-off surfaces for 17 hours a day, including 50mm and 70mm round-stones. While not significantly different, cows held on stones had a higher percentage of cows lying between 5 and 8 hours (15%) compared to other treatments (4-9%) and had a higher number of cows lying down for less than 5 hours (2-3%) compared to control (0.2%). The authors suggest that the hardness and unevenness of the stone surface may have resulted in these differences, supported by reluctance of the cows to enter the stone stand-off areas and cope with the unstable footing when moving onto the pad. A more recent study by the same group assessed cows kept on a stand-off pad with stones (40-60mm) for 16 hours. While cows on stones had longer lying times compared to other treatments (including wood-chip), they had fewer lying bouts and longer bout duration, suggesting that standing up and/or walking on stones posed difficulties (Al-Marashdeh *et al.,* 2019). Increased bout duration and reduced bout frequency, albeit in addition to lower lying time, was also observed in cattle on hard surfaces by Rushen *et al.* (2007). Al-Marashdeh *et al.* (2019) observed that cows appeared reluctant to enter the stand-off area with stones (i.e., they took longer to enter the stone area than other treatment areas), however, this was not statistically assessed. They also observed lower activity once cattle were on the stones. The impact on physiological responses and hoof health, such as bruising, was not assessed by the study.

NAWAC considers that there are alternative substrates for dairy cattle with better welfare outcomes than stones. The current minimum standard on off-paddock facilities already requires provision of a well-drained lying area with a compressible surface or bedding that is maintained to avoid manure accumulation. NAWAC considers that stones do not fit this criterion. It does not consider stones an acceptable lying or walking surface for any dairy cattle and is therefore proposing an additional standard to clarify that river stones must not be used in off-paddock facilities as flooring surfaces or those intended for cows to lie upon.

Outdoor Access

In 2019, NAWAC recommended to the Minister a regulation requiring daily or frequent access to the outdoors, either to pasture or a suitable outdoor area, be provided to dairy cattle kept in off-paddock facilities for more than 150 days per year (longer than the normal wintering period). NAWAC also recommended a delayed commencement date for the provision of outdoor access to allow time for farmers to change current practices and facilities in order to become compliant. MPI is currently progressing these recommendations by bringing the two minimum standards into effect by way of regulations under s 183A.

NAWAC is proposing additional recommended best practices under the minimum standard for meeting behavioural needs: that cows should be given the opportunity to graze and that dairy cattle held in off-paddock facilities are provided the choice to access pasture on a daily basis where weather and ground conditions are suitable.

Further discussion of NAWAC's deliberations on the issue of the long-term confinement of dairy cattle is available in the report accompanying the 2019 amendment[19].

[19] https://www.mpi.govt.nz/dmsdocument/41782-Report-to-accompany-an-amendment-to-the-code-of-welfare-for-dairy-cattle-2019

4.3.9 Calves

Colostrum

NAWAC deliberated on the standards for provision of colostrum to newborn calves, considering the most recent scientific information available as described below.

Colostrum is the first secretion produced by the mammary gland following calving and is known for being a particularly rich source of immunoglobulins (IgGs), functional proteins, lipids, carbohydrates, growth factors, vitamins and minerals (Besser and Gay, 1985; Hammon and Blum, 1997; Bielmann *et al.,* 2010). Colostrum promotes intestinal development, supporting the colonisation of beneficial bacteria and inhibiting the colonisation of pathogens in the small intestine (Corley *et al*., 1977, Roffler *et al.,* 2003; Malmuthuge *et al.,* 2015). Ultimately, the key benefits of feeding colostrum include reducing morbidity and mortality (Wells *et al.,* 1996), promoting weight gain (Swanson and Gorman, 1967; Hammon *et al*., 2002) and providing calves with a source of energy to enable them to maintain body temperature which is especially important during cold conditions (Hammon *et al.,* 2013; Contarini *et al.,* 2014).

Passive Immunity

Due to the inability of the bovine placenta to transmit maternal IgGs *in utero*, calves are born immune deficient (agammaglobulinemic) (Weaver *et al*., 2000; Chigerwe *et al*., 2008a; Godden, 2008) with passive immunity providing their only source of early immunity (Richter and Gotze, 1993; Baintner, 2007; Heinrichs and Elizondo-Salazar, 2009; Sutter *et al*., 2020). To achieve passive immunity, newborn calves are reliant upon the ingestion and absorption of maternal IgGs through the consumption of colostrum to ensure they are protected against infectious diseases (Weaver *et al*., 2000; Quigley 2002; Reber *et al*., 2008a; Reber *et al*., 2008b; Godden, 2008; Cuttance *et al*., 2017a; Godden *et al*., 2019). Achieving passive immunity is essential for providing calves with immune protection during the initial weeks of life until their own immune system becomes functional at approximately 3-6 weeks of age (Besser and Gay, 1985; Robison *et al*., 1988; Pakkanen and Aalto, 1997; Weaver *et al*., 2000).

To achieve passive transfer, calves rely on an adequate and timely consumption of good quality colostrum and consequently this is recognised as the single most important management factor in reducing morbidity and mortality in preweaned calves and ensuring their development and future production (Wittum and Perino 1995; Godden, 2008; Heinrichs and Elizondo-Salazar, 2009; Bielmann *et al*., 2010; Raboisson *et al*., 2016; Saldana *et al*., 2019). Long-term, achieving passive transfer is beneficial for increasing weight gain and feed efficiency, reducing age at first calving, and improving milk production (Godden, 2008; Godden *et al*., 2019).

Failure of Passive Transfer

Failure of passive transfer (FPT) results from an insufficient absorption of maternal IgG and is defined as a serum IgG concentration of <10 mg/mL in calves 24-48 hours old (Weaver *et al*., 2000; Calloway *et al*., 2002; Quigley, 2004; Wallace *et al*., 2006; Godden, 2008; Hogan *et al*., 2015; Cuttance, 2017a). A serum IgG concentration of <10 mg/mL has been widely accepted as a threshold for FPT for a number of years with trials using the threshold to determine calves with FPT (Gelsinger *et al*., 2015; Cummins *et al*., 2017; Lago *et al*., 2018; Saldana *et al*., 2019). Other studies have also demonstrated an increased risk of mortality in heifer calves with serum IgG concentrations <10 mg/mL (Gay, 1983, Besser *et al*., 1991; Wells *et al*., 1996; Godden, 2008; Furman-Fratczak *et al*., 2011). Increasing the risk of calf mortality and morbidity, FPT has been associated with an increased prevalence of diarrhoea, respiratory disease, and septicaemia (Wells *et al*., 1996; Tyler *et al*., 1999; Virtala *et al*., 1999; Barrington *et al*., 2002; Godden *et al*., 2012; Pardon *et al*., 2015; Arsenopoulos *et al*., 2017). Additionally, FPT can lead to under-development of the digestive system and lower feed intake, which contributes to a reduction in growth rates (Furman-Fratczak *et al*., 2011; Windeyer *et al*., 2014). In the long-term FPT has been associated with reduced lifetime production, with decreased milk production during the first and second lactation, and an increased culling rate during the first lactation (DeNise *et al*., 1989; Donovan *et al*., 1998; Faber *et al*., 2005; Furman-Fratczak *et al*., 2011; Chuck *et al*., 2018).

Factors contributing to an increased risk of FPT include calves not receiving colostrum within the initial 12-24 hours of life, receiving an inadequate amount of colostrum during this period, being fed colostrum with low levels of IgGs, or being provided colostrum that is contaminated with bacteria (Virtala, 1999; Godden *et al*., 2012; Gelsinger *et al*., 2014). Therefore, colostrum management is considered a key preventive measure for reducing FPT.

Despite the importance of achieving passive immunity for ensuring the health and future productivity of dairy cattle, the prevalence of FPT varies widely and has been reported as being 19-40% in dairy herds from studies conducted across North America, the UK, and Australia (Stott *et al*., 1979; Donovan *et al*., 1998; Trotz-Williams *et al*., 2008; Beam *et al*., 2009; Vogels *et al*., 2013; Macfarlane *et al*., 2015). In New Zealand, whilst research on FPT is limited, similar to overseas studies the prevalence of FPT has been reported as being approximately 25-45% (Vermunt *et al*., 1995; Wesselink *et al*., 1999; Lawrence *et al*., 2017; Cuttance *et al*., 2017b). In a group of 144 bobby calves sampled before slaughter at 4-7 days of age for example, Vermunt *et al*. (1995) reported a 33% prevalence of FPT. The largest study of FPT in replacement heifer calves in New Zealand which assessed FPT in 230 calves from 11 farms in the Manawatu region of the North Island reported a 25% prevalence of FPT (Lawrence *et al*., 2017). In a wider scale study, Cuttance *et al*. (2017b) assessed FPT in 107 dairy herds across nine New Zealand regions and reported the average prevalence of FPT as 33% but noted FPT varied widely within herds from 5-83% (Cuttance *et al*., 2017b).

Timing of Colostrum Feeding

The timing with which an adequate quantity of quality colostrum is provided to calves is a key factor for ensuring successful passive transfer (Weaver *et al*., 2000; Godden *et al*., 2009; Moran, 2012; Godden, 2017; Kertz *et al*., 2017). This is largely due to the efficiency with which calves can absorb IgGs decreasing rapidly after birth up to the point of gut closure which occurs approximately 24-36 hours after birth (Bush and Staley, 1980; Butler, 1983; Weaver *et al*., 2000; Barrington and Parish, 2001; Godden, 2008; Hart, 2016; Fischer *et al*., 2019; Puppel *et al*., 2019). Following the first 24 hours of life, the abomasum begins producing acids which improve the functioning of the milk-digestive proteins; however, these same acids degrade IgGs and impact their effectiveness (Moran, 2012). Therefore, it is important for colostrum to be fed promptly following birth whilst the intestines still have the ability to absorb IgGs to make the most of the colostrum being provided (Jaster, 2005; Puppel *et al*., 2019). Moran *et al*. (2012) reported that following birth for every 30 minutes that colostrum feeding is delayed the ability to absorb IgGs is reduced by 5%. Similarly, the decrease in the efficiency of absorption has also been demonstrated by Puppel *et al*. (2019) who found that the ability to absorb colostrum decreases by 1/3 in the first 6 hours following birth, and by 2/3 12 hours from birth. Additionally, Cuttance *et al*. (2018) found the prevalence of FPT is greater in calves which do not receive colostrum promptly within the first 12-24 hours of life.

Previous studies have recommended that the first feed of colostrum should be fed within 4 to 6 hours of birth and that an amount of 4-5 L should be fed during the first two meals or within the initial 8 hours of life (Godden *et al*., 2003; Heinrichs and Elizondo-Salazar, 2009; Vasseur *et al*., 2009). In line with this suggestion, it is a legal requirement in England for calves to receive colostrum within 6h from birth (The Welfare of Farmed Animals [England] Regulations 2007) (Heinrichs and Elizondo-Salazar, 2009). However, in most dairy systems in order to reduce the risk of FPT, there is a focus on ensuring that calves receive an adequate amount of quality colostrum within 4 hours from birth (Morin *et al*., 1997; Godden 2008; Beam *et al*., 2009). On most New Zealand farms calves are only collected from the paddock once per day (Vogels *et al*., 2013; Lawrence *et al*., 2017). As discussed by Cuttance *et al*. (2018) this characteristic of pasture-based systems means that it is not always possible to ensure that calves receive colostrum in the first 4 hours from birth.

Amount of Colostrum

In addition to the timing with which calves are provided colostrum the amount of colostrum they are fed is a key factor to ensure successful passive transfer. To achieve passive transfer, it has been suggested that a calf needs to consume at least 150-200g of IgGs within the first 2 hours of life (Chigerwe *et al*., 2008c). A consumption of 150-200g of IgGs can generally be achieved by providing calves with 3-4 L of high-quality colostrum which has an IgG concentration of >50 mg/mL (Godden *et al*., 2009). Additionally, several studies have shown that a consumption of 4 L of colostrum is necessary at the first feeding to reach the recommended serum concentration of >10 mg/ml IgG (Besser *et al*., 1991; Hopkins and Quigley, 1997; Kaske *et al*., 2005). The suggestion that calves should consume 3-4L of high-quality colostrum is based on this amount equating to at least 10% of their body weight at birth (based on a 30-40kg birth weight) (Godden, 2008). In overseas systems a key recommendation to reduce FPT is to ensure calves are fed an amount of colostrum that is equivalent to 10–15% of their bodyweight within 2–3 hours of birth (Morin *et al*., 1997; Godden, 2008). Previous studies have demonstrated that Holstein heifer calves will voluntarily consume between 2.2-3.3 L ± 1·3 L of colostrum within 6 hours of birth (Urday *et al*., 2008; Vasseur *et al*., 2009; Chigerwe *et al*., 2012). In the study by Vasseur et al. (2009) during the first feed, 42% of calves consumed 4 L or more of colostrum, 25% consumed 3-4 L, 11% consumed 2-3 L, and 22% consumed <2 L. Vasseur *et al.* (2009) further reported that the level of consumption was not significantly affected by time since birth but was however best predicted based on birth weight, and vigour during feeding and the first hour of life. It is important to note that most of this research relates to overseas indoor systems as opposed to New Zealand pastoral-based systems. This overseas research is also generally based on Holstein calves which are typically larger than New Zealand calves, which are predominantly Holstein-Friesian, Jersey or Kiwi-cross breeds (Hickson *et al*., 2015), and may not be able to consume the same volumes of milk in a single feed.

Colostrum Quality

Traditionally, the concentration of IgG in colostrum has been considered the most important component for evaluating colostrum quality, with high-quality colostrum considered to have a concentration >50mg/ml IgG (Lorenz *et al*., 2011). The prompt feeding of high-quality colostrum is essential for achieving the threshold serum IgG concentration of >10 mg/mL of IgG to prevent FPT (Wallace et al., 2006). Colostrum quality depends on several factors, including the volume produced, the time of collection, the IgG concentration, maternal vaccination schemes and the level of bacterial contamination (Hodgins *et al*., 1996; McGuirk and Collins, 2004; Godden, 2008; Conneely *et al*., 2013; Quigley *et al.,* 2013).

Before being fed to calves it is recommended that the colostrum quality be assessed (Bielmann et *al*., 2010). A range of methods can be used to assess colostrum quality based on the concentration of IgGs present with methods such as: immune-nephelometry, radial immunodiffusion (RID), turbidimetric immunoassay (TIA), and enzyme-linked immunosorbent assay (ELISA) considered the most accurate (Gapper *et al.,* 2007; Quigley *et al.,* 2013). The gold standard for assessing colostrum quality is RID, however, this method is time consuming and requires specialist laboratory analysis and consequently is not suitable for on-farm use (Fleenor and Stott, 1981; Lee *et al*.,1983). Colostrometry and refractometry are also used as methods for assessing colostrum quality (Bielmann *et al*., 2010). Although they offer a quick assessment of colostrum quality, colostrometers are often considered inaccurate as they are influenced by factors such as colostrum temperature, breed, month of calving and parity (Mechor *et al*., 1991; Mechor *et al*., 1992; Morin *et al*., 2001). However, refractometry using a Brix refractometer offers itself as a method which is inexpensive, readily available, less sensitive to colostrum temperature, month of calving, and is a practical and feasible method to be used on-farm (Moore *et al.,* 2009; Bielmann *et al*., 2010; Quigley *et al.,* 2013; Bartens *et al.,* 2016; Stojić *et al.,* 2017). Brix refractometers have also been found to be highly correlated with the gold standard RID method of assessing colostrum IgG concentration which validates their suitability for assessing colostrum quality (Chigerwe *et al.,* 2008b; Bielmann *et al*., 2010; Quigley *et al.,* 2013; Elsohaby *et al.,* 2017; Stojić *et al.,* 2017).

A Brix reading ≥22% is widely considered to represent good-quality colostrum (Bartier et al., 2015; Buczinski and Vanderweerd, 2016; van Keulen *et al*., 2020). From a survey of New Zealand dairy herds, Denholm et al. (2018) reported that 78% of the colostrum samples collected from individual cows had a Brix reading <22% which suggests that a majority of New Zealand dairy calves are receiving colostrum which is of suboptimal quality.

Colostrum quality is affected by the amount of time that milking is delayed post-partum with reduced intervals between the time of birth and milking associated with higher colostrum IgG concentrations (Moore *et al.,* 2009; Morin *et al*., 2010; Conneely *et al*., 2013; Denholm *et al.,* 2018; Kessler *et al*., 2020). The time at which IgG concentrations start to decline is debated with Kessler *et al.* (2020) for example, reporting that compared to later milkings, milking colostrum within 3 hours post-partum resulted in significantly higher IgG concentration compared to milking colostrum within 3 to 12 hours post-partum which resulted in similar IgG concentrations (Kessler *et al.,* 2020). Conneely *et al*. (2013) found similar IgG concentrations in milkings which occurred between 0-3, 3-6 or 6-9h post-partum and noted a significant reduction following 9h post-partum. For every hour that milking is delayed post-partum, Morin *et al.* (2010) and Conneely *et al*. (2013) reported a decrease in IgG concentration by 3.7%

and 1.1% respectively, which highlights the importance of providing colostrum promptly following birth and suggests milking directly after calving is optimal.

The practice of pooling colostrum from multiple dams is not recommended as this can reduce IgG concentrations (Weaver *et al.,* 2000) and increase the risk of disease (Godden, 2008). This was demonstrated in a recent New Zealand based study of dairy herds in which the pooled colostrum being provided to calves from a majority of the herds was of poor quality and contaminated with high levels of bacteria (Denholm *et al*., 2017a). An additional study also reported that the quality of pooled colostrum declined by up to 8.5-9.5% after being stored for 3 and 7 days respectively (Denholm *et al.,* 2017b) a finding which further highlights the importance of promptly feeding colostrum to maintain quality. Furthermore, pooling colostrum with transition milk has also been found to detrimentally impact on calf health as demonstrated by van Keulen *et al*. (2020) whilst assessing the benefits of providing calves with high-quality colostrum (first milking, 23% Brix), compared to low-quality colostrum (mixed colostrum and transition milk (2-8 milking's after calving), 12% Brix). Based on their findings, in order to promote development of the small intestine, increase feed conversion and reduce the prevalence of scours, van Keulen *et al*. (2020) suggested that upon collection from the paddock calves should be offered high-quality (23% Brix) first milking colostrum.

In the event maternal colostrum is of poor quality or unavailable, colostrum replacers (CRs) may be an alternative option which can be used in such situations. Calves which were provided CR compared to calves which were fed high-quality maternal colostrum were found to perform similarly regarding the health of the calf (Lago *et al.,* 2018). Lago *et al.* (2018) suggested that CR had a lesser probability of becoming contaminated which is beneficial in ensuring the absorption of IgGs is not impacted but still promoted the use of high-quality maternal colostrum as the recommended option over colostrum replacers (CRs).

Bacterial contamination

The consumption of contaminated colostrum can interfere with a calf's ability to absorb IgGs due to the presence of bacteria in the small intestine (James *et al*., 1981; Kacskovics *et al*., 2004; Stewart *et al.,* 2005). Using strict hygiene practices to ensure feeding equipment such as buckets, bottles and calfeterias are kept clean is one way to prevent bacterial contamination (Meganck *et al.,* 2014). Additionally, storing colostrum at warmer temperatures results in greater quantities of bacteria (Cummins *et al*., 2017), therefore, other management strategies for preventing bacterial contamination include methods such as freezing and refrigeration (Stott *et al.,* 1981; Cummins *et al.,* 2017). Cummins *et al*. (2017) reported that by storing colostrum at 4°C for 2 d, whilst the levels of bacteria present were greater than pasteurised or fresh colostrum, the absorption of IgGs was not negatively affected. Cummins *et al*. (2017) further demonstrated that compared to colostrum that was untreated, pasteurised or stored for 2 days at 4°C, storing colostrum at warmer temperatures (22°C) resulted in >42 times greater levels of bacteria which led to decreased absorption of IgG from colostrum by the calf, even though all colostrum was >50 g/L and fed promptly after birth. Additionally, pasteurisation offers itself as another method which can be used to minimise or reduce the level of bacterial contamination, increase IgG absorption, and reduce the prevalence of FPT (Morin *et al* 1997; Heinrichs and Elizondo-Salazar, 2009). A majority of studies have demonstrated that heating colostrum at the recommended level of 60°C for 30 to 60 minutes will either not or only slightly affect IgG concentration (McMartin *et al*., 2006; Elizondo-Salazar and Heinrichs, 2009a; Elizondo-Salazar and Heinrichs, 2009b; Elizondo-Salazar *et al*., 2010; Godden *et al.,* 2012; Gelsinger *et al*., 2014; Gelsinger and Heinrichs, 2017; Elsohaby *et al.,* 2018). Some studies have shown that pasteurisation improves the calf's absorption of IgGs (Kehoe *et al.,* 2007; Heinrichs and Elizondo-Salazar, 2009; Godden *et al*., 2012). Kehoe *et al.* (2007) for example, found that calves fed pasteurised colostrum had significantly greater serum total protein and IgG concentrations at 24 h of age and greater levels of IgG absorption (total protein = 63 g/L; IgG = 22.3 g/L; efficiency of IgG absorption = 35.6%) compared with calves fed raw colostrum (total protein = 59 g/L; IgG = 18.1 g/L; efficiency of IgG absorption = 26.1%). These results are also similar to other studies (Hagiwara *et al*., 2000; Kryzer *et al.,* 2015) which similarly demonstrated a greater efficiency of IgG absorption in calves fed with pasteurised colostrum. As suggested by Cummins *et al*. (2017) if the feeding of fresh or pasteurised colostrum is not possible, storing the colostrum at ≤4°C for 2 d sufficiently minimises bacterial growth which enables the absorption of IgGs to ensure successful passive transfer can occur once the colostrum is consumed by the calf.

Tubing

Feeding colostrum using an esophageal feeder provides a quick method of ensuring calves receive a feed of IgGs (Arthington 2001; Lateur-Rowet and Breukink, 1983). Tube feeding calves provides a way of feeding those particular calves which have not developed their sucking reflex or have other health problems, to ensure that they are fed promptly and obtain adequate quantities of IgGs to ensure passive immunity (Poborska *et al*., 2021). However, using an esophageal feeder has been associated with lower IgG absorption and slightly lower serum IgG concentration compared to feeding colostrum using a nipple bottle (Lee *et al.* 1983; Godden *et al*., 2019). Feeding colostrum using a nipple bottle is more acceptable for calves since it enables colostrum to be consumed in a natural manner (Poborska *et al.,* 2021). Compared to a nipple bottle, feeding with an esophageal feeding tube requires experience of trained personnel to avoid irritation or even injury of the calf and to ensure the tube is guided into the calf correctly. This feeding method may be quicker, but from a physiological point of view, can be too fast, stressful, and potentially dangerous for the calf. It is suggested that for healthy calves colostrum should be fed using a nipple bottle. Being an invasive procedure, an esophageal tube feeder should only be used when calves do not voluntarily consume enough colostrum (Robbers *et al*., 2021).

NAWAC's Considerations on Colostrum

Based on the information described in detail above, NAWAC is proposing a variety of amendments to the Code to ensure calves receive sufficient good quality colostrum/commercial colostrum substitute as soon as possible after birth and that their welfare is further protected through appropriate hygiene processes, colostrum and colostrum replacer management and relevant competence of persons feeding calves colostrum by tube where indicated. The Committee has also added a variety of example indicators to highlight how persons in charge can assess whether or not they are meeting the standards. The Recommended Best Practices have also been updated with proposals for feeding colostrum or transition milk for at least a week after birth, recommended colostrum quality (BRIX >22%) and testing for the success of passive transfer of immunity.

Artificial (Hand) Rearing

Dairy calves must be fed adequately in order for their nutritional needs to be met to ensure they achieve optimal growth and development (Palczynski *et al.,* 2020). For many decades it has been standard practice for calves to be provided a daily milk allowance equivalent to 10% of their BW, which equates to being fed 4-6L milk/d (Maynard and Norris, 1923; Kahn *et al.,* 2011; Vasseur *et al.,* 2012; Hötzel *et al.,* 2014; Staněk *et al.,* 2014). However, when fed *ad libitum* calves have been found to consume 10-16L milk/d in multiple feeding bouts, equivalent to 20% of their BW (Jasper and Weary, 2002; Khan *et al.,* 2007a; Borderas *et al*., 2009b; Sweeney *et al*., 2010; Khan *et al*., 2011; Miller-Cushon *et al.,* 2013; Jongman *et al.,* 2020). The standard practice of providing calves a milk allowance equivalent to 10% BW is widely used as a strategy to reduce the feeding and labour costs associated with rearing young calves (Yavuz *et al.,* 2015). Additionally, feeding low volumes of milk have typically been used as a way of increasing starter intake, promoting rumen development and lowering weaning age (Khan *et al.,* 2011). However, the standard practice of providing calves with a daily milk allowance equivalent to 10% BW is increasingly being viewed as a restrictive feeding program with calves reared using such strategies considered more likely to experience prolonged hunger (Rosenberger *et al*., 2017). Studies have demonstrated that calves reared on restrictive feeding programs show increased signs of hunger for example through increased vocalisations (Thomas *et al*., 2001; Yavuz *et al.,* 2015), increased unrewarded visits to the milk feeder (Jensen and Holm, 2003; de Paula Vieira et al., 2008) and reduced play behaviour (Krachun et al., 2010). Unrewarded visits to the milk feeder have been associated with calves' motivation to obtain milk (de Passillé *et al*., 2011) and are considered to be a suitable measure for assessing calf hunger levels (De Paula Vieira *et al*., 2008). In a previous study by Rosenberger *et al.* (2017), calves were assigned to 6, 8, 10 or 12L/d milk allowances (equivalent to 15%, 20%, 25% and 30% BW respectively) and it was observed that milk intake increased relative to increasing milk allowance. Consistent with other studies (Jensen and Holm, 2003; Jensen, 2006; Nielsen *et al.,* 2008), Rosenberger et al. (2017) also demonstrated an increased number of unrewarded visits to the feeder by those on lower milk allowances which further supports the suggestion by de Paula Vieira et al. (2008) that calves on lower milk allowances experience hunger. The number of unrewarded visits to the milk feeder also increased during the weaning period, however, these visits were still greatest for calves on lower milk allowances (Rosenberger *et al*., 2017).

Research over the past decade has demonstrated the benefits of providing greater milk allowances in improving calf health and welfare (Khan *et al*., 2011). Feeding programs which aim to improve the amount of nutrients supplied to calves through greater volumes of milk and more frequent meals are often referred to as accelerated early nutrition, accelerated growth, enhanced nutrition, intensified nutrition or biologically appropriate feeding programs (Drackley, 2008; Yavuz *et al*., 2015). Compared to calves which are restrictively fed, calves provided greater milk allowances or fed *ad libitum* have increased growth rates (Jasper and Weary, 2002), are quicker to reach first calving weights (Rincker *et al*., 2011) show greater milk yields at first calving (Soberon *et al.,* 2012) and express more natural behaviours (Khan *et al.,* 2011). Rosenberger *et al.* (2017) demonstrated that feeding greater milk allowances resulted in higher weight gains both prior to weaning and throughout the post-weaning period. Additionally, calves fed *ad libitum* have been found to increase the amount of time spent resting which may enable them to conserve energy (De Paula Vieira *et al*., 2008). Restrictively fed calves also appear to reduce play behaviour with calves fed 6L/d found to perform fewer bouts of running (a form of play behaviour) than those provided 12L/d (Krachun *et al*., 2010). Furthermore, low milk allowances may also increase disease susceptibility due to a lack of sufficient nutrition (Nonnecke *et al.,* 2003). Although some studies have reported a negative impact of increased milk allowance on the health of dairy calves in terms of diarrhea or an impaired response to vaccination (Huber *et al.,* 1984; Pollock *et al*., 1994; Quigley *et al*., 2006), other studies have demonstrated no increase or even a decrease in illness when calves are provided with greater milk allowances (Appleby *et al*., 2001; Jasper and Weary, 2002; Khan *et al*., 2007b; Borderas *et al*., 2009b).

In addition to the volume of milk calves are provided each day it is also important to consider the frequency with which they are fed. Once-a-day feeding is often used as a strategy to reduce labour (Palczynski *et al*., 2020). Studies have previously suggested that once-a-day feeding of individual or group housed calves prior to 4 weeks of age can reduce labour requirements with no apparent negative effects on health or performance (Kehoe *et al*., 2007; Kienitz *et al*., 2017). In contrast to this, as reported by Van Der Burgt and Hepple, (2013) once-a-day feeding in the first month of life has been associated with abomasal disorders such as abomasitis and bloat. However, research regarding the effects of once-a-day feeding on measures of calf behaviour are limited, and once-a-day feeding is deemed a controversial practice (Palczynski *et al*., 2020). Current guidelines for the European Union indicate that calves should be fed twice-a-day with feed appropriate for their age and physiological development (Council Directive 2008/119/EC, 2008), which in calves <4 weeks of age is considered to be milk or milk replacer (Van Der Burgt and Hepple, 2013). In England, the Welfare of Farmed Animals (England) Regulations 2007 and EU Directive 2008/119/EC on the minimum standards for the protection of calves requires that calves be fed at least twice-a-day up to six months of age (Palczynski *et al*., 2020). Twice-a-day milk feeding is considered necessary to meet calves' nutritional requirements prior to 28 days of age (Van Der Burgt and Hepple, 2013; Farm Animal Welfare Committee, 2015). It is unclear which research the authors have based this age recommendation on, but it may be related to the inability of calves to ingest appropriate volumes of milk/milk replacer in a single feed before 4 weeks of age and/or the inability of calves to consume and digest sufficient quantities of calf starter in the first three weeks after birth to provide sufficient nutrients for their growth and developmental needs when on a low milk-volume diet (Drackley, 2008; Borderas *et al*., 2009a; Farm Animal Welfare Committee, 2015).

The consolidation of two milk feeds per day into one may act as a potential stressor (Hulbert *et al*., 2011). Further research is required to investigate the impact of age for implementing a once-a-day feeding regime (Van Der Burgt and Hepple, 2013).

Calves rely primarily on milk or milk replacer for nutrition during the first few weeks of life, where they typically begin to consume measurable amounts of solid feed at around 2 weeks of age (Khan *et al*., 2008). Solid feed can consist of concentrates or forages (Govil *et al*., 2017). The consumption of solid feeds particularly concentrates or high carbohydrate diets is an important factor in stimulating the metabolic and physical development of the rumen including rumen microbial proliferation and volatile fatty acid production (Baldwin *et al*., 2004; Khan *et al*., 2011; Govil *et al*., 2017). The provision of roughage or forage is important in promoting the growth of the muscular layer of the rumen and for maintaining the health of the epithelium (Quigley, 1997). Although forage has less influence on rumen papillae development, forage intake is beneficial promoting rumination and maintaining the integrity and health of the rumen wall (Zitnan *et al*., 1998). Research on veal calves has demonstrated that the provision of even a small amount of solid feed results in demonstrable progression of forestomach development (Cozzi *et a*l., 2002). Having fibrous solid feed available from one week of age therefore promotes rumen development. Calves must not be weaned off liquid feed until the rumen has developed sufficiently to utilise solids as the sole feed source (i.e., until they consistently eat 2kg of pasture or 1kg of meal daily).

Increased solid feed consumption during the weaning process contributes to rumen development, permitting higher starter intake and BW gain after weaning (Khan *et al*., 2011). When restrictively fed, calves may attempt to compensate by increasing their intake of calf starter (Khan *et al*., 2007a, 2016). Calves fed milk or replacer equivalent to 10% BW typically consume twice as much starter as calves fed higher amounts in the weeks prior to weaning (Jasper and Weary, 2002; Cowles *et al*., 2006; Raeth-Knight *et al*., 2009). Reduced solid feed intake for higher milk fed calves likely relates to these calves feeling less hungry due to the increased satiety (Khan *et al*., 2011). Calves fed 4L/d of milk are not able to consume enough starter (at least for the first 2 months) to match the nutrient intakes of calves fed milk *ad libitum* or to match their nutrient requirements for growth and development (Jasper and Weary, 2002; Sweeney *et al*., 2010). Young calves fed restricted amounts of milk are unable to meet their daily energy requirement through milk and starter intake, even though these calves typically consume twice the amount of starter as calves provided a high milk allowance (Nielsen *et al*., 2008).

Abrupt weaning of calves fed high volumes of milk is associated with increased signs of hunger in response to low energy intake (Nielsen *et al*., 2008). To ease the transition to solid feed, techniques such as step-down feeding can be used to increase the intake of solid feed intake prior to weaning and help maintain BW both pre- and post-weaning (Rosenberger *et al*., 2017). Gradual weaning encourages starter intake during the preweaning period, and both weaning age and the duration over which weaning occurs influences starter consumption (Khan *et al.,* 2011). A feeding programme that allows a smooth transition from milk to solid feed is vital for successful heifer-rearing programs (Khan *et al*., 2011). This smooth transition is also important for minimising weight loss and distress during the weaning period (Weary *et al*., 2009). Whilst the provision of milk equivalent to 20% may present a challenge around weaning if the intake of solid feeds is not sufficient prior to weaning, appropriate management of the weaning process via a gradual weaning programme can allow sufficient rumen development.

The composition (e.g., fat content, carbohydrates, vitamins, minerals, and proteins) of milk replacers can vary considerably (Barrington *et al*., 2002). Conventional milk replacers contain 20-22% crude protein (CP) (Bartlett *et al*., 2006; Hill *et al*., 2008, 2010), however, calves benefit most from increased milk volumes when milk replacers contain higher protein and less fat (e.g., up to 30% CP with 15-20% fat) (Diaz *et al*., 2001; Cowles e*t al*., 2006; Bascom *et al*., 2007; Hill *et al*., 2010). Due to the differences in composition, some milk replacers can result in poor growth rates and inadequate nutrition (Fisher, 1976; Bartlett *et al*., 2006), and can increase calves' susceptibility to disease (Barrington *et al*., 2002). It is therefore important that the quality of milk replacer is considered to ensure calves are receiving adequate nutrition. The quality of milk replacer also differs to that of whole milk. This variation was demonstrated in a study by Godden *et al.* (2005) in which calves were fed equal volumes of pasteurized milk and a conventional milk replacer but differences in composition of the 2 liquid feeds meant that calves receiving milk ingested about 17% more energy than those being fed milk replacer.

Having considered the literature above, NAWAC has concluded that feeding young calves liquid feed only once a day while they are unable to consume and digest sufficient quantities of calf starter, does not meet their nutritional needs (i.e., calves cannot ingest sufficient volume in one milk feed). In addition, sucking has been identified as a behavioural need (see section on behavioural needs above) and calves kept on the dam suck 3-12 times a day depending on age and breed. NAWAC is proposing an expanded minimum standard that calves must be fed a suitable good quality liquid feed at a rate of no less than 20% of their body weight divided into no less than two feeds per day for the first 3 weeks after birth. In addition, a recommended best practice is proposed that calves should have *ad libitum* access to liquid feed until weaning and that weaning should be undertaken gradually in a stepwise process by removing milk slowly over 1-2 weeks.

4.3.10 Cow-Calf Separation

In dairy farming systems worldwide, it is common practice for dairy calves to be separated from their dam shortly after birth at >48h of age (Johnsen *et al*., 2016; Neave *et al.,* 2021). The standard practice in New Zealand is for calves to be removed from the dam within 24 hours from birth (Neave *et al.,* 2021). Traditional reasons for separating calves from their dam include protecting the health of the dam and her calf, reducing the stress of later separation once a bond has been established, ensuring adequate colostrum intake, and increasing the amount of saleable milk (Flower and Weary 2003, Sumner and von Keyserlingk 2018; Beaver *et al*., 2019). However, the practice of separating calves from their dams shortly after birth is a subject of increasing public concern (von Keyserlingk and Weary 2007; Ventura *et al*., 2013; Agenäs, 2017; Busch *et al.,* 2017; Meagher *et al*., 2019; Neave *et al.,* 2021), and rearing systems that allow for extended cow-calf contact (cow-calf systems) are being investigated (Johnsen *et al.,* 2016; Ventura *et al.,* 2016).

One benefit of cow-calf systems is that calves can regulate their frequency and time of feeding, and the amount of milk they consume, which allows them to ensure their physiological needs are being met (Fröberg and Lidfors 2009; Jensen 2011; Johnsen *et al.,* 2016). Studies have shown calves will drink substantially greater volumes of milk when allowed free access to voluntarily suckle from the dam compared to the amount they will consume in traditional rearing systems (Grøndahl *et al.,* 2007; Khan *et al*., 2011). However, it is important to note that high milk intakes can also be achieved in conventional calf rearing systems (Johnsen *et al*., 2016). The higher growth rates of calves reared in cow-calf systems (Flower and Weary, 2001; Fröberg and Lidfors, 2009; Roth *et al.,* 2009; Meagher *et al.,* 2019) are beneficial and improve the feasibility of beef production as a potential outcome for calves that have been reared using such systems, however, further research is needed to determine economic feasibility (Haskell, 2020). Contact with their dam and with other cows and calves in the herd also provides benefits in cow-calf rearing systems (Johnsen *et al.,* 2016). This contact enables important natural behaviours to be carried out including caretaking behaviours by the dam, nursing, and cow-calf bonding including affiliative behaviours such as licking, rubbing and staying close to one another (Wagenaar and Langhout, 2007). Calves reared in cow-calf systems displayed fewer abnormal behaviours such as tongue-rolling and cross-suckling compared to calves reared without the dam and fed conventional restricted amounts of milk (Johnsen et al., 2016). Cross-sucking behaviour is stimulated by the consumption of milk and is associated with an unsatisfied motivation to suck, insufficient oral stimulation, and hunger (de Passillé, 2001; Herskin *et al.,* 2010; Vaughan *et al.,* 2012). As little as 4 days of contact between cow and calf has been found to reduce abnormal behaviour and increase normal social behaviour weeks later (Krohn *et al.,* 1999; Stěhulová *et al.,* 2008), with similar observations reported for calves with 2 weeks of contact (Flower and Weary, 2001). Long-term benefits for dam-reared calves include improvements in milk production, health and longevity (Johnsen *et al*., 2016). As achieved in cow-calf systems, higher milk intakes and additionally feeding whole milk rather than milk replacer has been shown to result in higher milk production during first lactation (Bar-Peled *et al*., 1997; Shamay *et al.,* 2005; Moallem *et al.,* 2010; Soberon *et al.,* 2012). Furthermore, whilst traditionally there have been concerns around the potential disease impact of rearing calves with their dam, a review of relevant studies found evidence for altered disease prevalence to be equivocal (Beaver *et al.,* 2019). This suggests that careful disease management may be required in cow-calf systems, but that the overall challenges associated with disease can be overcome if given consideration (Haskell, 2020).

In a New Zealand based study by Neave *et al.* (2021), 63 conventional farmers were interviewed regarding their views on cow-calf systems and the potential barriers they felt prevent the adoption of such systems. Many of the concerns held were associated with challenges related to the nature of large-scale seasonal-calving pasture-based dairy systems (Neave *et al.,* 2021). The key areas of concern related to 1) poor animal welfare, especially the risk of mastitis and udder damage in the dam, inadequate colostrum for the calf, increased stress from delayed separation, and lack of shelter for calves while outdoors with the dam; 2) increased labour and stress on staff; and 3) system-level changes required, including changes to infrastructure and herd management. In relation to the concerns regarding potential teat damage in cow-calf systems, Thomas *et al*. (1981) reported an increased likelihood of teat damage in suckling cows, particularly in dams nursing several calves. However, in a recent review suckling cows in cow-calf systems were found less likely to develop mastitis than non-suckling cows (Beaver *et al.,* 2019). Over 75% of farmers interviewed felt cow-calf systems would require substantial increases in labour and that this would have significant complications for farm management and staff health and well-being. Regarding infrastructure and herd management, farmers felt the system would require significant changes including additional fencing, creating smaller and calf-proof paddocks for the new dams and their calves each day as well as more shelter and housing for calving and calves. Farmers also had concerns that cow-calf systems would result in a decrease in milk yield as demonstrated by Barth (2020) where milk yield was reduced in cows that suckled calves. However, a review by Meagher *et al.* (2019) found no consistent evidence to support a negative effect of cow-calf systems on milk production during the suckling period or in the long term and suggested instead a lower milk yield is more likely due to consumption by the suckling calf and therefore should not be viewed as a loss. Some conventional farmers did note that in theory they preferred cow-calf systems but did not see it as something that was realistic or practical to implement and felt this type of system would have implications not only on the calf rearing process but ultimately their farming system as a whole.

In New Zealand, it is currently estimated that there are fewer than 10 farmers operating a cow-calf system. As part of the study by Neave *et al.* (2021), 4 small-scale farmers (herd sizes of 14-140 cows) operating a cow-calf system were interviewed in addition to conventional farmers. All cow-calf farmers interviewed permitted cow-calf contact for at least 4 weeks with three of the farmers rearing both male and female calves. Two of the farmers kept calves on cows and milked the cows in a milking shed, one used mobile milking machines and the fourth kept replacement heifer calves on nurse or foster cows and milked the rest of the herd conventionally. Similar approaches are also evident in European indoor housing systems, including nurse cow systems and calves being reared with their mothers and then separated either through an abrupt or gradual weaning. The different methods used to operate a cow-calf contact system suggest that there is flexibility with how these systems could operate in a pasture-based system. These particular farmers felt that animal health and welfare were important and that animal health and welfare are promoted in cow-calf systems. They were also motivated to adopt a cow-calf rearing system due to the ease of the system, having the required infrastructure, public perception and consumer demand and their personal ethical beliefs. These farmers did not raise issues relating to mastitis or colostrum; however, they did emphasise the importance of needing to consider additional infrastructure and shelter in cow-calf systems.

NAWAC notes increasing discussion and public concern about the practices of cow-calf separation and recommends further research be undertaken to find solutions in the context of the New Zealand dairy industry. NAWAC has concluded that cow-calf systems offer benefits to the overall welfare of the animals particularly through the opportunities they provide for positive affective states. Cow-calf systems support the development of a strong cow-calf bond offering both nutritional and behavioural benefits. They are often considered as having highest ethical and welfare standards (Haskell, 2020). NAWAC is proposing two new recommended best practices to promote progress in this area: that where the management system allows, consideration should be given to rear calves on cows if there are no adverse implications for animal welfare, and that where calves reared on cows should be weaned before separation from their dam (i.e., two-stage weaning process; Loberg *et al*., 2007, 2008).

4.3.11 Milking

Cow nutrition and health as well as positive human-animal interactions are important factors in milk production and milking.

Stock person behaviour has a direct impact on the animals with fear of humans being low when a high proportion of the interactions are positive such as patting, talking (not shouting) and making slow deliberate movements (Hemsworth *et al*., 2002). If cows are nervous or frightened, adrenaline will be released and this blocks the release of oxytocin, the hormone responsible for milk let down[20]. A calm, consistent and predictable milking environment is therefore not only essential for reducing fear and distress for animal welfare reasons, but also ensures oxytocin is released, leading to higher milk yields, shorter milking times, and less effluent production (Seabrook, 1994). Familiarising first calving heifers and new cows with the farm dairy and milking routines prior to calving therefore assists in reducing the aversiveness of the milk harvesting process once the animals have calved. NAWAC is proposing to include familiarisation training as a requirement to the minimum standard for milking.

Teat and udder condition and health as well as cow behaviour can indicate problems with milking machines. Machines that are not functioning optimally or being used correctly can contribute to new intramammary infections by spreading bacteria from teat to teat and cow to cow and by reducing teat health and the natural defence mechanisms of the teats by damaging the skin of the teat and teat canals (O'Shea, 1987; Mein *et al*., 2004). Problems such as vacuums that are too high, pulsator or lining issues, blocked air vents and over-milking all increase the risk of mastitis (Hamann et al., 1994). In light of this, NAWAC considers that milking machine maintenance is critical for udder health and is proposing a requirement for milking equipment to be tested at least yearly. The mechanical components and rubberware of milking machines should be checked frequently and systematically however to ensure problems are detected as early as possible and preventative maintenance is undertaken.

[20] https://www.dairynz.co.nz/milking/dairy-stockmanship/milk-let-down/

Teats which are swollen or hard after milking, show signs of oedema or cyanosis (blue in colour), or are thickened, have cracks, or small haemorrhages can be early warning signs of a problem with the milking machine and indicate an increased risk of mastitis (Hamann *et al*., 1994). Cows stepping while in the milking stall, or kicking, especially when cups are put on or taken off indicate discomfort with the milking process and should alert staff to check the milking machine, cow handling routines and udder and teat health. NAWAC is proposing to add a minimum standard requiring lactating cows to be inspected for udder problems at every milking and remedial action to be taken where indicated.

Much of the walking and standing that cows do is associated with daily milking schedules and affects their ability to allocate time to other important behaviours like grazing, rumination and lying. In pasture-based dairy systems cows walk from the paddock to the farm dairy for each milking and then walk back. The distances walked can be several kilometres, and cows may stand for an hour or more waiting to be milked, with associated impact on daily lying times (Tucker *et al*., 2005; Beggs *et al*., 2018; Neave *et al*., 2021).

In light of the increasing understanding of the impact of milking management practices to limit cows' time budgets and consequently their affective state, NAWAC is proposing to add a recommended best practice to the behavioural needs section of the code that walking distances and milking routines should provide dairy cattle with sufficient time to eat, lie down and socialise appropriately each day. The condition of farm laneways, the layout of access points to yards and paddocks, and how cows are managed while standing waiting to be milked impacts on hoof health and the incidence of lameness, therefore is an important consideration for milking management and routines.

4.3.12 Drying-off

Dairy cows require a dry period of at least 6 weeks (and preferably 8 weeks) between lactation and calving to allow for udder tissue to repair and rejuvenate (Sawa *et al*., 2012; Kok *et al*., 2017). The aim of the drying off process is to shut down milk production and to allow the teat canal to seal as quickly as possible, the process usually taking about two weeks.

As outlined in the 2010 code report the period around drying-off can present some challenges to ongoing cow welfare. Feed restriction as a recommended management practice associated with the potential for pain from udder congestion when milking ceases are both potential concerns for animal welfare. In addition, Zobel et al., (2013) have suggested that cows are motivated to be milked and that changes to milking routines, such as occur during abrupt cessation of milking, may present a negative experience for dairy cattle.

Industry advice (DairyNZ, 2012a) is to reduce the dry matter allowance for high producing cows (producing more than 1.0kg milks solids or 10 litres of milk per day) by 30-50% during the last 1-2 weeks prior to drying off and for up to 2 weeks after cessation of milking. Reductions in milk yield of up to 30% can be achieved within a short time period, along with reduced udder firmness and leakage. Reducing milk production prior to drying off accelerates udder involution and reduces the risk of new intramammary infections developing (Zhao *et al.,* 2019). There is also evidence that lowering milk production prior to the final milking increases the daily lying time and lying bout length, indicating cows are more comfortable (Tucker *et al*., 2009; Rajala-Schultz *et al.,* 2018). Cows that are producing less than 1.0kg of milk solids per day can be dried off without prior reduction in dry matter intake.

Restricting feed intake in cows can lead to signs of hunger (Franchi *et al*., 2021), and if extreme to metabolic disorders. Giving lower energy feed, such as hay, *ad libitum,* is one method used, however cow behaviour on some of these diets does indicate hunger is present (Valizaheh *et al*., 2008; Franchi *et al*., 2019). The protein content of the feed may be important for satiety, as cows vocalised less when fed grass hay compared to oat hay, which has a lower protein content (Valizaheh *et al*., 2008). When calculating feed requirements for cows at drying off sufficient energy must be supplied for cows that are 6-8 months pregnant.

Regardless of production, all cows need to be managed appropriately prior to and after their final milking so that udder involution is optimised, and the risk of mastitis minimised. The number of bacteria on teats should be minimised by applying an approved disinfectant teat spray after the last milking and not allowing cows to lie down on bare ground or areas soiled with manure within 2 hours of any drying off treatment (dry cow therapy or internal teat sealant) being given. Cows should be put in clean dry paddocks for 7-14 days after drying off and well away from the milking herd and milking area to prevent the possibility of stimulating milk let-down which will interfere with the development of the keratin plug in the teat canal. Restricting feeding to maintenance levels only for 7-14 days helps with the udder involution process. These recommendations have been incorporated into the current draft code.

If cows receive antibiotic dry cow therapy and/or internal teat sealants, then these must be given by people trained and competent (see regulation 55I Occlusion of Cattle beasts' teats; Animal Welfare (Care and Procedures) Regulations 2018) to do so to prevent bacteria being introduced into the udder. Severe mastitis can occur if hygiene is poor during the preparation and insertion process.

Complete involution of the udder and full closure of the teat canal can take up to 40 days after drying off. During this time, and particularly in the first week after drying off, cows are at greater risk of developing mastitis. Industry advice (DairyNZ, 2012b) is to visually check cows daily in the paddock for swollen udders and other signs of discomfort for the first 2 weeks after drying off. Any swollen udders seen should be checked manually, and all cows should have their udders manually checked fortnightly for the first 4-6 weeks of the dry period. It is important to identify and treat any cases of mastitis that develop during the dry period so that these do not persist and cause problems after calving. NAWAC proposes to incorporate the above industry recommendations in the Code as recommended best practices.

Farmers should plan appropriately for drying off to ensure cows do not experience unnecessary discomfort and hunger and should consult a veterinarian to select the most appropriate treatment for cows at drying off to minimise the risk of mastitis.

NAWAC endorses the position taken by the New Zealand Veterinary Association that the use of antibiotic dry cow therapy in non-infected cows is no longer appropriate due to effective alternatives being available, such as internal teat sealants and improved management practices.

4.3.13 Unwanted Calves

Of the total calves born each year, approximately 30-50% will be reared as replacements or enter the beef industry. Alternative options must be sought for the remaining surplus calves (Bolton and von Keyserlingk, 2021).

The number of surplus dairy calves produced each year is an ongoing and considerable concern to the public and poses significant reputational risk to the dairy industry. Such concern regarding surplus calves stems from ethical, economic, environmental and animal welfare perspectives in relation to, for example, societal or moral values which influence the outcomes for such calves, and in terms of whether these calves experience a life worth living. As stated by (Bolton and von Keyserlingk, 2021) achieving widespread adoption of socially acceptable, financially viable, and environmentally sustainable alternatives to surplus calf management is an immediate requirement to ensure the continued viability of the dairy industry. Options which could act to reduce the number of surplus calves in the industry are a matter of current investigation.

In New Zealand, since 2017 approximately 4.5 million dairy calves have been born each year (Statistics New Zealand, 2021).

The term 'surplus calves' relates to any dairy bull calves or heifer calves that are not needed as replacements for the milking herd (Bolton and von Keyserlingk, 2021).The options for surplus calves in terms of whether they are euthanised on the farm of origin, transported for processing at several days of age, or alternatively reared for veal or beef, is dependent on factors such as the country, dairying system, calf price, and consumer preferences for veal or beef products (Haskell, 2020). The term 'bobby calf' refers to those intended for processing within approximately the first week of life for human consumption or pet food (Boulton *et al.,* 2018). In New Zealand, of the total number of calves born each year, approximately 40% will be sent for processing as bobby calves between 4-7 days of age (Ministry for Primary Industries, 2017b).

Improved semen technology has been one approach to decreasing the proportion of surplus calves that become bobby calves. Improved conception rates using sexed semen have been achieved (de Vries *et al*., 2008; Vishwanath and Moreno, 2018). Use of sexed semen reduces the number of cows requiring to be bred to generate herd replacements, allowing the balance to be bred by AI to terminal beef sires allowing calves (male and female) to enter the beef industry. This is one solution to reduce the number of surplus calves of a dairy type unsuitable to rear, that enter the bobby calf chain (Haskell, 2020). Nevertheless, this does not eliminate the problem, and other strategies need to be considered to reduce the number of female calves (Haskell, 2020).

In countries where there is a consumer preference for beef products, there are options for surplus dairy-bred calves to be reared for beef. In countries such as New Zealand, Australia and Ireland which operate pasture-based dairying systems, calving predominantly occurs during spring (Haskell, 2020). The concentrated period of calving in these countries often means that the number of surplus calves exceeds the number which beef rearing systems can cope with and thus is a factor which influences the demand for dairy-bred calves in such systems (Haskell, 2020). Dairy calves contribute for 66% of New Zealand's beef production on a per head basis, and around 44% of calves reared in the beef industry were born on a dairy farm (Beef & Lamb, 2019; Davison, 2020; Van Selm *et al*., 2021). In other countries, such as the Netherlands, France and Italy where there is a stronger consumer preference for veal products, surplus calves are reared for veal (Sans and de Fontguyon, 2009). The seasonality of calf births means that pasture-based systems are generally incompatible with a veal industry based in the same country, as veal production relies on calf availability all-year-round (Boyle and Mee, 2021).

The choice of sire may also be a factor which influences the number of surplus calves. Whilst the use of particular breeds of beef sire in dairy herds still results in both male and female calves being born, these calves are generally considered to be of greater value to both beef and veal markets with improved growth rates, carcass quality and fat levels (Morris *et al*., 1992; Dal Zotto *et al*., 2009; Coleman *et al*., 2016; FVE, 2017; Martin *et al*., 2021). Jaborek *et al*. (2019) for example has previously reported improved carcass quality and yield in crossbred Jersey-beef calves compared to purebred Jersey calves. Whilst the eating quality (e.g., taste and tenderness) of meat from dairy-beef bred calves may be similar to that of meat from pure beef bred calves, there may be visual aspects such as the colour of the meat which make it less desirable to consumers (Coleman *et al*., 2016). However, if for example meat from dairy-beef calves was used in processed food products this may help to improve uptake by consumers (Haskell, 2020). The ability to develop products from veal or dairy-beef calves would help to improve the value and demand for such calves which in turn would likely increase the level of care and welfare they experience and would reduce the number of calves being euthanised on farm (Sans and de Fontguyon, 2009, Haskell, 2020). The ability to produce beef from the dairy herd is also considered to have a lower carbon footprint (Mogensen *et al*., 2015; Nguyen *et al*., 2010; Tichenor *et al*., 2017; van Selm *et al*., 2021) which sees this method of beef production particularly attractive in light of the challenges associated with increasing climate change (Bolton and von Keyserlingk, 2021).

High growth rates demonstrated in calves reared in cow-calf systems (Flower and Weary, 2001; Fröberg and Lidfors, 2009; Roth *et al*., 2009) improves the feasibility of beef production as a potential outcome for calves that have been reared under such systems, but further research is needed to determine the economic feasibility of this option (Haskell, 2020).

NAWAC acknowledges the wide opposition to the slaughter of bobby calves within society on ethical grounds, and questions whether social licence for the bobby calf industry will continue. As mentioned, alternative options for surplus calves are currently being investigated. NAWAC recognises that the use of sexed semen offers an opportunity to divert more calves into the beef industry, but acknowledges the difficulties of absorbing these extra animals into existing beef systems, and that this technology may still result in a considerable number of surplus female calves being born. NAWAC supports the DairyNZ focus that all animals have a use, and its investigation of alternatives for surplus calves (e.g., use in beef systems).

In support of these considerations, NAWAC is proposing to add a recommended best practice that calves not reared as replacements should be raised for beef production wherever possible.

4.3.14 End-of-Life Management

For some time NAWAC has had concerns about the management of end-of-life animals as they leave the farm and progress through the supply chain to slaughter. Reports received by the Committee from MPI Compliance and Verification Services support this concern. NAWAC is therefore proposing that the codes of welfare for production animals include a specific section to cover end-of-life management and highlight the importance of animal welfare considerations for these vulnerable animals at the end of their productive lives.

Dairy cows are removed/culled from the herd for various reasons including reproductive issues, low milk production, lameness, mastitis or other ill-health. Culling may be voluntary (e.g., a cow may be removed from the herd due to low milk production), or involuntary (e.g., a cow may be removed from the farm due to health reasons). It is rare to remove dairy cows from the herd due to old age as economic interests require cows to achieve production levels, to reproduce regularly and to stay healthy (Dallago *et al.,* 2021). The average productive life of cows in NZ is higher than that in countries that use more intensive (housed) systems and has increased over time (Dallago *et al.,* 2021). However, longevity *per se* does not ensure that animals experience improved welfare as older animals are more likely to develop health problems. Increased cow longevity should be accompanied by farmers' ability to keep animals healthy and comfortable (Dallago *et al*., 2021). An effective Health and Wellbeing Plan, as proposed under MS 24 – Disease and Injury Control, should assist with this.

NAWAC also considers that early decision-making is essential to ensure that welfare risks are minimised for cows to be culled from the herd. Animals that are identified for culling early will be in better body condition and the risk of increased severity of conditions such as lameness will be reduced (Cockram, 2021). Walker *et al.* (2019) introduced the practice of "proactive culling" as a deliberate, timely practice of identifying cattle for sale based on their welfare state, likelihood of recovery, and quality for beef production rather that their state of milk production or market value.

Early culling decisions to prevent animal welfare issues from developing or worsening is especially relevant where cull animals are transported off farm for sale or slaughter. Although a cull animal may be considered fit for transport[21], it may have underlying conditions that could compromise its welfare during transport or increase the risk of injury or suffering during the journey, at saleyards and/or at lairage at processing premises.

NAWAC is therefore proposing a minimum standard that animals to be culled from the herd must be identified in a timely manner so they can be selected and prepared for transport appropriately. In addition, new requirements for the pre-transport selection and preparation of end-of-life animals are proposed and relevant regulations recommended (see section below).

4.3.15 Pre-Transport Selection and Preparation

The process of transport, especially loading and unloading, is stressful to animals (Broom *et al*., 1996). Animals therefore need to be fit when being selected for transport in order to withstand the journey without suffering unreasonable or unnecessary pain or distress (see MS 23a and b). The Animal Welfare (Care and Procedures) Regulations 2018 contain several regulations relating to the transport of dairy cattle and have been referred to in the Code to ensure persons in charge of dairy cattle are aware of their obligations relating to the selection of dairy cattle for transport.

Proposed changes to MS 2 (in 2019 Code) - Feed will require that BCS of dairy cattle does not fall below 3.5 or go above 8, and it is anticipated that this additional body condition over the current allowable minimum will improve the robustness of animals being transported. Animals at higher risk of experiencing welfare compromise as a result of transport, include lactating, pregnant and end-of-life dairy cows as well as those cows having recently given birth. Even cows that appear fit and healthy or show only mild symptoms before the journey may experience welfare compromise due to their vulnerable physiological status. In extreme cases, animals may give birth, become recumbent or die during or after transport. Selection and preparation prior to transport, duration/distance of transport and time spent in lairage all play critical roles in managing welfare risks for those animals.

[21] https://www.mpi.govt.nz/dmsdocument/1454-Fitness-for-transport-guidance-brochure

NAWAC is proposing to add to and strengthen the minimum standards related to the preparation of dairy cattle for transport, in particular to support the Committee's recommendations to address the persistent problem of recumbency in end-of-life dairy cattle via a suite of regulations (see section below).

End-of-Life Cattle Proposals

During the Code review working group meetings, MPI Verification Services made the group aware of significant numbers (700-1000 animals per year: Wild 2012, Clatworthy 2021) of dairy cows becoming recumbent during transport to slaughter or in lairage. Concern was also expressed that for any cow becoming recumbent in a group there were likely others experiencing varying degrees of welfare compromise. Despite a concerted education programme by MPI and the Farm to Processor Animal Welfare Forum, this number has not reduced over the years. Despite the minimum standards that relate to end-of-life cattle in the Codes of welfare for dairy cattle, transport and commercial slaughter, the welfare of these animals is currently not adequately protected.

NAWAC has noted the analysis by MPI and the Farm to Processor Animal Welfare Forum which has allowed this problem to be unbundled in some depth. In support of the educative process, NAWAC proposes that further regulatory management is required. It is also apparent that for a successful outcome, the regulatory approach needs to be addressed in a coordinated fashion through the supply chain (i.e., that the responsibilities are recognised and shared appropriately by farmer, transporter and slaughter company).

End-of-life cows are a very heterogenous group of animals tending to differ in age, parity, physiological state and type of clinical findings (Dahl-Pedersen *et al.,* 2018) and in terms of physical fitness (Nielsen *et al.,* 2011). Cull animals may be in poorer condition than their herd mates and suffer from production diseases while others, culled due to infertility or low production for example, may be healthy and in good condition (Nielsen *et al.,* 2011) (see also above section on end-of-life management).

Transportation can represent a significant challenge for end-of-life animals. As highlighted by Cockram (2021), some animals may have underlying pathology that may not be apparent before loading as the animals do not show any obvious clinical signs of disease or injury and as a result will be more susceptible to injury during transport because they are weak or diseased (Dahl-Pedersen *et al.,* 2018).

Cockram (2021) reviewed the risk factors for suffering in end-of-life dairy cows and highlighted the impact of on-farm management procedures including whether or not early decision making on culling are made before health and physical condition of the cow deteriorates, assessing cows for fitness for transportation, preparing end-of-life cows for the journey to slaughter and reducing the prevalence of conditions likely to make end-of-life cows unfit for transport.

A study by Laven (2016), investigating the causes and mitigating factors of recumbency in end-of-life cattle in New Zealand as they move along the supply chain from the farm to the slaughterhouse, identified a combination of long transport distance, time in lairage and hypocalcaemia as contributing factors. The provision of calcium supplementation, a reduction in transport distances and reduced lairage times were recommended to reduce the risk of recumbency.

While recumbency is a serious welfare concern, it represents the worst outcome across the spectrum of outcomes that end-of-life cows experience through the supply chain. For any recumbent cow in a group there will be others likely suffering varying degrees of discomfort, stress and pain due to various factors including fatigue, dehydration, low energy levels and underlying conditions. In addition, extended journey times, ferry crossings and excessive lairage times do not provide cows with opportunity to rest, eat or drink. Impaired welfare may also have a psychological origin such as social disturbance from mixing with unfamiliar animals or enforced close contact due to stocking density, and fear from unfamiliar environments, loud noise and odours (Terlouw *et al*., 2008; Hultgren *et al*., 2014).

Preparation for Transport

End-of-life dairy cattle need to be adequately prepared for the intended transport in order to reduce the risk to the animals' welfare. In order to achieve this, suppliers need to understand transport times and distances. For this reason, NAWAC is proposing a recommendation that suppliers/farmers ask for their end-of-life cattle to be sent to the nearest premises and should be prepared to accommodate them a little longer until their nearest premises can take them.

Feed and Water

Depriving cows of feed and water prior to transport will lead to a decline in energy supply from the rumen and depending on how long feed is removed, to a range of metabolic disorders such as hypocalcaemia, hypomagnesaemia and ketosis, as well as to dehydration. Modern dairy cows have a high metabolic rate due to their potential for milk production and in general are expected to be more sensitive to feed and water deprivation than other classes of stock (Nielsen *et al*., 2011).

As highlighted in the 2011 transport code report[22], livestock are often held off green feed prior to transport to limit the gastrointestinal contents and hence reduce excretion in the transport truck (to reduce slipping), to reduce faecal contamination if the animals are destined for slaughter (Wesley *et al*., 2005). The Code of Welfare for Transport within New Zealand recommends that ruminants should be held off pasture for a minimum of four hours, but for no more than 12 hours before travel (taking into account the condition of the animals). The industry recommendation for dairy cattle is to stand cows off green feed for no more than 6 hours when lactating and for no more than 12 hours when dry prior to transport[23].

NAWAC is proposing a new minimum standard requiring dairy cattle to undergo suitable preparation for the intended journey including a requirement that lactating dairy cattle must not be held off green feed for more than 6 hrs prior to transport and dry cattle for more than 12 hours prior to transport. The Committee also proposes a minimum standard that dairy cattle must have water and roughage available at all times in collection areas until the point of loading.

Supplementation

Reduced feed intake and fasting prior to transport can lead to hunger and weakness, but in lactating dairy cattle hypocalcaemia and hypomagnesaemia may also occur increasing the risk of recumbency during and after transport (Robertson *et al*., 1960; Warnock *et al*., 1978, Fisher *et al*., 1999, Laven, 2016). Calcium and magnesium are important for normal physiological processes in the body, with calcium important for muscle function and magnesium important for energy production, maintaining electrolyte balance and for normal neuromuscular function. Magnesium is also essential for the efficient absorption and resorption of calcium.

Warnock *et al*. (1978) compared data from 36 recumbent cows which became recumbent between the sale yards and the slaughter premises with those of 40 cows that remained ambulatory. The key differences found were that the recumbent cows had significantly lower mean serum calcium concentration, better mean body condition score, were at a later stage of pregnancy and had been feed deprived for a longer period.

Laven (2016) found similar results that low calcium rather than magnesium is the major metabolic contributing factor. He suggested that calcium supplementation, preferably over a period of at least one week before culling, should be recommended as a method for reducing the risk of recumbency at slaughter, particularly when grass growth is lush or when a high proportion of low calcium supplements are being fed.

Fisher *et al.* (1999) observed a significant decline in serum magnesium concentrations in pregnant non-lactating cows after long-haul transport despite magnesium supplementation for several days prior to transport. This highlights that supplementation with magnesium appears to be necessary to prevent dangerously low concentrations of blood magnesium as a result of transport. Indeed, the authors suggest that additional supplementation with magnesium during or after transport may also be necessary.

[22] https://www.mpi.govt.nz/dmsdocument/1408-Transport-within-New-Zealand-Review-of-Submissions-and-Update-Animal-Welfare-Code-of-Welfare-2011

[23] https://www.dairynz.co.nz/media/5793862/checklist_for_transporting_cows_dnz50_005_november_2020_update.pdf

NAWAC is proposing a further minimum standard relating to preparation for the intended journey that requires dairy cows transported to saleyards or slaughter receive sufficient and effective mineral supplementation prior to transport to prevent metabolic complications.

Milking

Lactation is a risk factor for reduced welfare during transport (Cockram, 2021). Where lactating cows are not milked at regular intervals milk will accumulate in the udder and increase the intramammary pressure that can result in tissue damage, discomfort and pain (Vilar and Rajala-Schultz, 2020; Cockram, 2021). Engorged udders may also be kicked or stood on during transport on resulting in bruising and pain. In addition, lactating cows have higher energy and nutritional requirements than dry cows and may experience hunger and weakness, and associated metabolic conditions, earlier than dry cows.

NAWAC debated at some length whether there should be a requirement for end-of-life cows to be dried off for a period of several weeks before they leave the farm. While concurring that this approach reduces the welfare risks for end-of-life cows moving through the supply chain it was not considered a practical approach by the industry working group who perceived negative welfare outcomes from putting animals through the process of drying off (see below).

NAWAC is instead proposing a new minimum standard as part of journey preparation for any lactating dairy cows being transported to saleyards or slaughter to be milked as close to transport as possible. Ensuring cows are milked within 2 hours of pick-up for transport is proposed as an example indicator for this minimum standard, however this will require effective communication between the supplier (farmer) and the transporter regarding pick-up times.

NAWAC is further proposing a recommended best practice is that end-of-life cows are dried off at least 3 weeks prior to transport. To protect the welfare of the animals, drying off is a process that needs to be carefully managed (see section on drying off), including keeping cows being dried off well away from the milking herd and farm dairy, and identifying and treating any cases of mastitis. Even when well-managed, drying off can be stressful for cows due to udder discomfort from not being milked, and changes in diet (generally lower energy and higher fibre content) leading to lack of satiety and/or hunger. Managing separate groups of cows on farm, especially at busy times of the year, may impact on the farmer's ability to provide good care to all animals on farm. If cows need mastitis treatment that has a meat withholding time, then transport to slaughter may be delayed placing further pressure on the farm system. Due to the significance of the change to farm management and the potential welfare impacts of requiring all dairy cows to be dried off prior to transport to saleyards or slaughter NAWAC is including this as a recommended best practice in the Code.

Rest

Lying down is an important behavioural need as it allows rest and rumination necessary for feed utilisation. Welfare is compromised when lying is restricted for extended periods and as cattle rarely lie down once on a transport vehicle (Tarrant and Grandin, 2000) opportunity to rest should be provided while animals are waiting to be transported. NAWAC is proposing a new recommended best practice that animals should have time and opportunities to lie down and rest before being transported.

Transport Duration

There is considerable literature on how vulnerable cull dairy cows are to the stress of transportation (Dahl-Pedersen *et al*., 2018). End-of-life dairy cattle are a very heterogeneous group in terms of physical fitness. However, they are regarded as more vulnerable than other classes of cattle to the stress of transportation due to age (often older animals), body condition (may be in lighter condition) and suffering from health conditions that can affect the cow's ability to handle the stress of transportation (Romero *et al.,* 2020). The welfare of cows during transport may also have a psychological origin from social disturbance due to mixing with unfamiliar animals or enforced close contact due to stocking density, and fear from unfamiliar environments, loud noise and odours (Terlouw *et al*., 2008; Hultgren *et al*., 2014).

In a review of the welfare impacts of transport duration, Nielson *et al*., (2011) concluded that increasing transport duration impacts negatively on the welfare of the animals transported by prolonging the impacts of transport such as feed and water deprivation, lack of rest and exposure to extreme temperatures. For lactating cows, longer journeys increase the risk of udder distension that is associated with pressure and pain. In a review of long haul transport of cattle in Canada, González *et al*. (2012) found that cull cattle were at greatest risk of becoming lame at the time of loading and unloading, becoming non-ambulatory or dying during the journey compared to feeder calves and fat cattle, and that the likelihood of death, becoming lame or non-ambulatory increased the longer animals were in transit. A comparison of mortality rates during transport over an 8-year period in the Czech Republic (Malena *et al*., 2007) found a mortality rate of 0.007% in fattened cattle and 0.038% in dairy cattle, with a significant difference between short (< 100km) as compared to long (> 100km) transport distances, with long distances of over 300 km exhibiting substantially higher rates of up to 0.183%.

Laven (2016) investigated cases of recumbency in dairy cattle transported to slaughter in New Zealand and of the risk factors evaluated, only distance travelled was significantly associated with recumbency; the odds of a cow being recumbent rather than ambulatory when it had travelled the longest distance seen in this study (825 km) were >10 times that of the cow that travelled the shortest distance (1.5 km). This suggests that reducing the distance travelled by end-of-life cows could be a simple but effective method of reducing the risk of recumbency at slaughter premises.

EU regulations now restrict journey times to a maximum of 8 hours except where certain additional requirements are met. These include provisions for an insulated and reflective roof, adjustable partitions, sufficient bedding, a ventilation system capable for maintaining temperature at 5-30 degrees C within the vehicle, and specific feeding equipment, a water supply and devices capable to provide drinking water instantly to each animal while on the vehicle. In Denmark, 8 hours is the legal maximum time for the transport of end-of-life dairy cows.

NAWAC is proposing a recommended best practice which highlights concerns regarding the long travel distances or travel times experienced by some high-risk animals. Stockpersons are encouraged to request that high risk animals (e.g., calves, pregnant, lactating and end-of-life dairy cows) be transported to the closest processing facility and for the shortest possible time, and that they are processed on the same day.

NAWAC is proposing that limits to transport time (maximum of 8 hours for end-of-life cows) and transport of lactating end-of-life cattle to slaughter across the Cook Strait and via saleyards be considered for regulatory development (see below).

Lairage Duration

The Commercial Slaughter code includes minimum standards with regards to the management of cattle in lairage. MS 4(l) requires that cattle must be fed after 36 hours in lairage, and MS 4(i) requires that lactating dairy cattle with distended udders must be slaughtered within 24 hours of arrival unless milked. However, these times relate to time of arrival at the slaughter premises and do not include duration of transport or any holding time on farm prior to pick-up, therefore actual time of no access to feed (water is required to be provided at all times in lairage) and since the last milking for lactating cows could be considerably longer if cows are held for these maximum times before slaughter, feeding or milking.

Lairage is also likely to be a novel environment for end-of-life cows and this may be stressful in itself. Such factors as mixing groups of animals, standing for long periods on concrete, inability to rest, loud noises, unfamiliar odours and different handlers (Terlouw *et al*., 2008; Hultgren *et al*., 2014) may add to the stress caused by lack of feed, water and rest resulting from transport.

Data from MPI Verification Services shows that 63% of cows becoming recumbent at slaughter premises have been in lairage overnight rather than being slaughtered on the day they arrive. Many of these animals have been off feed for 20-24 hours. Even if cows do not go down during extended periods in lairage, the cumulative effect of the stressors is likely to lead to some degree of fatigue, hunger, thermal and respiratory discomfort, fear and pain for the animals (Terlouw *et al*., 2008; Hultgren *et al*., 2014).

In order to reduce the welfare impact of holding end-of-life cows in lairage, NAWAC is proposing a limit of time to slaughter from last milking (no more than 24 hours) to be considered for development as regulation (see below).

NAWAC's Recommendations for Regulations – End-of-Life Cattle Proposals

NAWAC is recommending that there should be a suite of regulations that address matters occurring along the supply chain in a coordinated fashion i.e., to address the issue of transporting high risk end-of-life dairy cattle to slaughter, requiring farmers to prepare end-of-life cattle for the intended journey and animals to be slaughtered within a set time (i.e., limited transport and lairage times).

The further development of NAWAC's recommendations for regulatory mechanisms to improve the welfare of end-of-life cows moving through the supply chain may not be fully addressed until the Codes of Welfare for Transport and Commercial Slaughter are reviewed, but NAWAC considers that the new minimum standards proposed in the current draft code relating to selection and preparation for transport represent first steps in the development of such regulations. It is likely that implementation of some aspects of proposed changes require infrastructure development (e.g., transport limit of 8 hours and the proposal that end-of-life cows are not transported across the Cook Strait), and so may need transitional regulations.

Hence NAWAC is seeking feedback on the following general proposals that might be considered for regulation:

(1) End-of-life dairy cattle need to be adequately prepared for transport to reduce the risk to animal welfare in this group of cattle.

NAWAC is recommending a regulation be developed requiring farmers/ persons in charge to prepare end-of-life cattle for the intended journey:

- By providing feed (which can be roughage) and water up until the time of loading.
- By providing sufficient and effective mineral supplementation (as per example indicator this would require sufficient and effective calcium and magnesium supplementation) prior to transport.
- By milking any lactating cows as close to transport as possible (as per example indicator this would require milking within 2 hours prior to transport).

NAWAC recommends that the regulation should come into force without a transition period, however, would like further feedback from the industry.

(2) The process of transport, especially loading and unloading, is stressful to animals (Broom *et al*., 1996). Feed and water deprivation, heat or cold stress, lack of rest, aggression from other animals, poor handling, or injuries from the truck may cause fatigue, hunger, thirst, thermal and respiratory discomfort, fear and pain. Impaired welfare may also have a psychological origin such as social disturbance from mixing with unfamiliar animals or enforced close contact due to stocking density, and fear from unfamiliar environments, loud noise and odours (Terlouw *et al*., 2008; Hultgren *et al*., 2014). Longer journeys prolong these stressors. End-of-life cows are a very heterogenous group of animals tending to differ in age, parity, physiological state and type of clinical findings (Dahl-Pedersen et al., 2018) and in terms of physical fitness (Nielsen *et al*., 2011) and transportation can represent a significant challenge. As highlighted by Cockram (2021), some animals may have underlying pathology that may not be apparent before loading as the animals do not show any obvious clinical signs of disease or injury and as a result will be more susceptible to injury during transport because they are weak or diseased (Dahl-Pedersen *et al*., 2018).

Research suggests that reducing the distance travelled by end-of-life cows could be a simple but effective method of reducing the risk of recumbency at slaughter premises (Laven, 2016). Distance travelled is a proxy for travel time.

EU requirements are for travel times to be capped at 8 hours in a standard truck (no provision of water or feed during the journey) and NAWAC is recommending an 8-hour limit for transporting end-of-life dairy cows. As this would be a significant change for the industry a transition period of some years would be required for implementation.

(3) Lairage is likely to be a novel environment for end-of-life cows and this may be stressful in itself. Such factors as mixing groups of animals, standing for long periods on concrete, inability to rest, loud noises,

unfamiliar odours and different handlers (Terlouw *et al*., 2008; Hultgren *et al*., 2014) may add to the stress caused by lack of feed, water and rest resulting from transport.

Data from MPI Verification Services shows that 63% of cows becoming recumbent at slaughter premises have been in lairage overnight rather than being slaughtered on the day they arrive.

Lairage time has been identified by a New Zealand study as one of 3 main factors contributing to cows becoming recumbent and a reduction in lairage times to reduce the risk of recumbency has been recommended.

A study by Laven (2016), investigating the causes and mitigating factors of recumbency in cull cattle in New Zealand identified time in lairage as one of 3 main contributing factors and recommended reduced lairage times to reduce the risk of recumbency.

In order to reduce the welfare impact of holding end-of-life cows in lairage, NAWAC is recommending a limit on the time from last milking to slaughter of 24 hours. It is important the time limit starts at the point of the last intervention carried out on farm as part of the preparation for transport process (milking) as this is the starting point for the welfare impact for the animals of the process from leaving the farm to slaughter.

In order to reduce the welfare impact of holding end-of-life cows in lairage, NAWAC is recommending a regulation be developed setting a limit on the time from last milking to slaughter of 24 hours.

NAWAC recommends that the regulation should come into force without a transition period, however, would like further feedback from the industry.

(4) Transport of lactating end-of-life cows to slaughter that involves a Cook Strait crossing adds time to the journey prolonging exposure to the stresses of transport and increasing the number of loading and unloading events which are also stressful and increase the risk of injury.

To reduce the welfare impact of transport for lactating end-of-life cows, journeys from farm to the processing premises should be as short as possible and this may be difficult to achieve if the journey includes a Cook Strait crossing.

NAWAC is recommending a regulation be developed prohibiting the transport of lactating end-of-life cattle to slaughter across the Cook Strait as part of the suite of regulations for end-of-life dairy cattle transported to slaughter.

NAWAC acknowledges that there may be situations when transport to slaughter of lactating end-of-life cattle via the Cook Strait would currently be necessary to prevent worse welfare outcomes (e.g. reduced space at processing plants and inability of farmers to hold on to and feed animals until slaughter space is available as may be the case during drought conditions).

NAWAC anticipates that a transition period would be required to allow the industry to put necessary infrastructure and processes in place to prevent these situations.

(5) As with journeys that involve a Cook Strait crossing, travelling via saleyards to slaughter adds time to the journey prolonging exposure to the stresses of transport. Such a journey also adds loading and unloading events which are recognised as stressful in themselves and increase the risk of injury. Standing in a saleyard pen is likely to be a similar experience to lairage at slaughter premises with factors such as mixing groups of animals, standing for long periods on concrete, inability to rest, loud noises and unfamiliar odours adding to the stress caused by lack of feed, water and rest resulting from transport.

To further protect the welfare of end-of-life cows, NAWAC is recommending a regulation be developed to prohibit the transport of lactating end-of-life cattle to slaughter via saleyards.

NAWAC anticipates that a short transition period would be required to allow the industry to put necessary infrastructure and processes in place.

Calf Transport Age

In New Zealand, amongst other regulations introduced in 2016, calves must be a minimum of 4 days of age before they can be transported. By that age, with proper preparation, calves are sufficiently robust to withstand transport. However, the transport of bobby calves remains a topic of public interest and concern, largely due to the calves' young age and their perceived vulnerability from leaving the farm to enter the supply chain including transport (Jongman and Butler, 2014; Bolton and von Keyserlingk, 2021) and ultimately slaughter.

With an underdeveloped immune system, low body fat reserves and developing physiological stress responsiveness, young calves are vulnerable to transport stress (Bell, 1979; Trunkfield and Broom, 1990; Knowles *et al*., 1997; Swanson and Morrow-Tesch, 2001; Schwartzkopf-Genswein *et al*., 2007; Stull and Reynolds, 2008). Transport exposes calves to a variety of stressors which impact their biochemical, hormonal and metabolic functioning (Trunkfield and Broom, 1990). Factors such as loading/unloading, overcrowding, limited ventilation, being in a novel environment, social stress, fasting and an inability to rest can negatively impact calf health and welfare, contributing to increased injuries, disease and mortalities (Kent and Ewbank, 1986; Trunkfield and Broom, 1990; Todd *et al*., 2000; Grigor *et al*., 2001; Lensink *et al*., 2001; Stafford *et al*., 2001; Cave *et al*., 2005; Uetake *et al*., 2011; Nielsen *et al*., 2011; Goldhawk *et al*., 2014; Jongman and Butler, 2014; Hulbert and Moisá, 2016; Boyle and Mee, 2021; Roadknight *et al*., 2021).

As calves do not develop a herding instinct until approximately 20 days of age, handling groups of younger calves can be difficult particularly during loading and unloading (Fraser and Broom 1997; Thompson, 1996; Jongman and Butler, 2013). This may increase the risk of poor handling in relation to transport (Roadknight *et al*., 2021). Calves that are approximately 8-10 days old have been reported as being easier to handle at the abattoir than younger calves. The ease of handling is thought to be due to the calves being more developed, stronger, more responsive to stimuli from the environment, and beginning to develop a herding instinct (Fraser and Broom 1997; Thompson, 1996). When handled individually, it has also been reported that there is a significant effect of age on the ease with which calves can be handled, with calves becoming easier to handle as their age increased from 3 to 11 days of age (Jongman and Butler, 2013). In a study by Jongman and Butler (2013), 9 to -11-day-old calves were quicker to move through an obstacle course and required less assistance than 3 day-old calves. The results from 5-day-old calves were intermediate between these two age groups (Jongman and Butler, 2013).

A recent New Zealand based study investigating the perceptions of veterinarians about calf welfare found that transportation was considered the greatest risk to welfare followed by issues such as inadequate housing, disbudding, mistreatment of bobby calves, malnutrition, inadequate pain management and poor husbandry management (Van Dyke *et al*., 2021). The study by Van Dyke *et al*. (2021) indicated that 58.2% of veterinarians supported a higher age of transport than the current minimum 4 days of age. Furthermore, a majority (65.7%) of veterinarians did not support the transport of young calves under 10 days of age (Van Dyke *et al*., 2021).

Whilst improvements have been made to reduce bobby calf mortality (Ministry for Primary Industries, 2017a; 2018; 2020), NAWAC considers that further improvements are possible and that age at selection for transport offers a key opportunity to achieve these improved welfare outcomes. The Committee anticipates that continuing to transport calves at 4 days of age will become increasingly unacceptable to the New Zealand public and overseas markets.

To ensure calves are more robust during transport, NAWAC is proposing a recommended best practice that calves should be at least 7-10 days old before being transported. NAWAC considers this will have significant benefits for calf welfare but acknowledges there are significant logistical issues across the supply chain that need to be resolved before it could be a minimum standard. Farmers would be required to rear calves for longer, with increased costs and risk of disease, and it may lead to more calves being euthanised on farm. Changes to transport configurations may be required and there may be implications for the ability of processors to process larger calves.

4.3.16 Health

NAWAC was concerned about an inconsistency in the 2019 Code which addresses lameness specifically, but not other conditions, including mastitis. As there are relevant minimum standards, example indicators and recommended best practices throughout the Code for prevention of lameness NAWAC proposes to remove the section on lameness and for the information to be added to the section on disease and injury control which now covers all diseases including lameness and mastitis.

Lameness

Lameness in dairy cows usually comes from an injury or disease affecting the hoof or leg and is one of the most important welfare issues on New Zealand dairy farms (Laven, 2012). Lameness is a painful and often long-lasting condition with significant economic loss for the farmer arising from treatment costs, withholding milk from supply because of antibiotic use, reduced milk production from lame cows, poorer reproductive performance, and increased culling rates for lame cows (Laven, 2012; Dairy Australia, 2019).

There are a number of risk factors for lameness including time since calving, body condition score, cow genetics, hoof damage from race surfaces and twisting and turning, soft hooves from wet conditions, and inflammation caused by some diets. Farm management factors are important such as stock handling practices, the condition of yards and laneways, layout of paddock and yards access points, use of backing gates, time spent standing on concrete, and walking speed and distances (DairyNZ, 2017b). Early identification and treatment of lameness can improve outcomes for animals as this prevents permanent damage to the hoof and predisposition to further lameness (DairyNZ, 2017b). A number of minimum standards address lameness management, for example MS 2d and MS 10a, as well several example indicators.

Mastitis

Udder health and milk quality are important for farm productivity and profitability. Mastitis is inflammation of the udder mostly caused by microbial penetration of the teat canal and is generally considered the costliest production disease of dairy cows through both direct and indirect costs to the farmer (Parkinson *et al*., 2010). Mastitis can vary from subclinical with no impact on the cow, to acute with significant impact, including pain and swelling, on the cow, and can cause death. Teat and udder condition should be monitored at each milking (MS 16d) to check for such conditions as teat end damage which may predispose cows to mastitis, and for identification of clinical mastitis (Parkinson *et al.,* 2010). Regular bulk milk somatic cell count testing can be useful for giving an estimation of the level of subclinical infection in a herd and individual cow somatic cell counts obtained during herd testing will identify cows with raised somatic cell counts (SCC), which is an indirect measure of mastitis. This information enables farmers and veterinarians to monitor mastitis infection at both a herd level and at a cow level, and therefore develop management plans to reduce the level of infection with both welfare and economic benefits on farm.

Other Diseases

NAWAC recognises that lameness and mastitis are important diseases in the dairy industry but considers that other diseases are also serious. NAWAC considered that the Code should not highlight one disease over another but reference to both diseases remains in the example indicators and recommended best practice. In this way, NAWAC is proposing that the minimum standards apply in more general terms to all health issues and diseases present within New Zealand, including emerging health risks.

A wide range of other diseases and health conditions can affect animals on dairy farms. Some of these are infectious, others are caused by conditions in the environment, some may be due to diet, and some are more likely to affect certain age groups. A number of these diseases are zoonotic, they can affect people as well, and their control has implications for human health and safety. Bovine tuberculosis, subject to a national control programme, is no longer widespread but has implications for human and animal health, and for the export of meat and milk products from New Zealand[24]. Mycoplasma bovis, which causes significant animal health issues overseas, is subject to an eradication programme[25].

Other diseases that NAWAC considers to be of importance for adult cows include, but are not limited to, Bovine Viral Diarrhoea (BVD), Johnes Disease, salmonellosis, theileriosis, facial eczema, and leptospirosis. Diseases and conditions that are directly related to feed, such as acidosis and bloat, are covered in the feed section.

[24] https://www.ospri.co.nz/our-programmes/the-tbfree-programme/

[25] https://www.mpi.govt.nz/biosecurity/mycoplasma-bovis/

BVD is a serious and widespread viral disease in New Zealand with 15 to 25% of dairy farms having animals that are actively infected with the virus[26]. Infection with BVD can cause reproductive losses, an increase in general disease, reduced growth rates, and lowered milk production.

Johnes Disease is a chronic, contagious and sometimes fatal infection caused by Mycobacterium avium subspecies paratuberculosis (MAP). The disease can affect cattle, sheep, deer, goats and wildlife, and in 2016 was estimated to cost New Zealand $98 million in lost production each year[27].

Salmonellosis is a common intestinal infection and is manifested clinically in animals and humans as an acute or chronic enteritis, or as an acute septicaemia or as abortion. Large numbers of animals can be affected during a disease outbreak on farm, and some of these animals will become carriers. Death will occur in severe cases or when animals are left untreated due to irreversible damage to the intestinal lining (Parkinson *et al.,* 2010).

Theileriosis is a disease caused by a blood-borne parasite that affects cattle and is primarily transmitted by ticks. The disease is widespread over the North Island and northern South Island and causes anaemia which can be severe enough to cause death[28].

Facial eczema is caused by a toxin (sporidesmin) produced by the spores of the fungus *Pithomyces chartarum* growing on pasture. The fungus grows in the dead litter at the base of pasture in warm moist conditions. Sporidesmin, when ingested by cattle, damages the liver and bile ducts. The damaged liver cannot rid the body of wastes and a breakdown product of chlorophyll builds up in the blood causing sensitivity to sunlight, which in turn causes inflammation of the skin. Badly damaged liver tissue will not regenerate. Chronic wasting and/or death may occur at the time of damage or months later when the animal is under stress (e.g., calving)[29].

Leptospirosis is a bacterial disease, with strains (serovars) that affect almost all mammals. The severity of disease is dependent on the host and the serovar and can vary from very mild to severe with the main signs in cows being mastitis and a drop in milk production. This is also a disease that can affect calves with depression, high fevers, jaundice and blood in the urine leading to death. Leptospirosis is one of the most important zoonoses in New Zealand affecting people who work on farms, in forestry and in the meat processing industry, and potentially leading to long-term debilitating illness[30].

Diseases of importance for calves and younger animals include various forms of scours, coccidiosis and parasitism, as well as diseases that affect adult animals.

Scours is a broad term referring to diarrhoea in calves. There are many causes of scours and these can be divided into non-infectious or nutritional scours and infectious scours caused by agents such as Rotavirus. Scours occurs when normal movement of water into and out of the digestive tract is disrupted, resulting in water loss and dehydration. Loss of body fluids through diarrhoea is accompanied by loss of body salts which can lead to severe depression in the calf and eventual death if untreated[31].

Coccidiosis is most commonly a disease of cattle aged three to eight months and is caused by parasites that infect the cells lining the animal's intestine. This causes diarrhoea and can lead to dehydration and death. The parasites are widespread in the environment and clinical signs are seen when animals are exposed to high levels of infestation or if their resistance is lowered through stress such as poor weather or overcrowding, poor nutrition or severe concurrent disease (Parkinson *et al.,* 2010).

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26 https://www.bvdfree.org.nz/

27 https://www.jdrc.co.nz/what-is-johnes

28 https://www.dairynz.co.nz/animal/cow-health/theileria/

29 https://www.dairynz.co.nz/animal/cow-health/facial-eczema/

30 https://leptospirosis.org.nz/Leptospirosis.aspx

31 https://www.dairynz.co.nz/animal/cow-health/scours/

Parasitism, especially from internal parasites, can have a significant impact on animal health, reducing growth rates and in some cases causing death. This is particularly so in younger animals who have yet to build up any immunity to the parasites. There are a range of drenches available for treating animals, however drench resistance is widespread so the farm drenching programme should be developed with advice from a veterinarian to ensure it is effective and does not lead to further drench resistance (McAnulty and Cook, 2019).

For all the diseases and health conditions mentioned above, as well as others that occur on farm, there are a range of testing, preventative and treatment options available to monitor and manage them. NAWAC takes the view that in all cases preventative measures, such as vaccination programmes and good biosecurity measures, are preferable and usually more effective than treating sick animals. Farm specific measures to reduce the incidence of relevant diseases should be covered in animal health and wellbeing plans (see below).

Farmers and those directly caring for animals are most likely to be the first to identify an emerging health issue or new disease to New Zealand (as seen with the emergence of the Ikeda strain of *Theileria orientalis*). Monitoring animals regularly, keeping health records and assessing these records regularly will enable earlier identification of any emerging or new diseases.

Spontaneous Humeral Fractures

Spontaneous humeral fractures in first-calving dairy heifers are a recent syndrome with an increase in numbers over the past 7-8 years (de Jong, 2019). They are reported to have occurred in about 4% of New Zealand dairy herds, with incidents where as many as 25% of replacement heifer herds have been affected representing a significant animal welfare issue (Gibson, 2021). It appears that most of the fractures occur between late pregnancy and mid-lactation. Investigation by Massey University has shown that bones from heifers with fractures have growth arrest lines indicating a period of nutritional deficit (Gibson, 2021). As indicated by Gibson (2021), the humerus is sensitive to changes in diet for the first 2 years of life and the second winter is crucial for heifers as they are still growing and also partitioning energy to the fetus. The ability to optimise growth can be further challenged by poor-quality and restricted winter pasture (Gibson, 2021).

Over recent years it has been suggested that fodder beet may be contributing to the increased risk of spontaneous humeral fractures in rising 2-year-old replacements. Phosphorus and nitrogen, both low in fodder beet, are associated with bone growth *in utero*. Initial data from a pilot study show that there are differences in some bone parameters and that calves born to dams fed on fodder beet were 9% lighter at birth and shorter in wither height and length from shoulder to tail than those wintered on kale[32]. Further research is currently underway.

Edwards *et al.* (2020) reported that 16% of farmers did not feed mineral supplements to non-lactating cows on fodder beet and yearling and rising two-year-old heifers could be fed diets with high proportions of fodder beet (74% and 66%, respectively) for up to 10 weeks in winter. The authors suggested that the differing intake patterns of young stock may reduce their risk of developing rumen acidosis from these higher levels of fodder beet, but also noted that where these diets are fed to growing cattle they must be appropriately balanced with sufficient protein and minerals to overcome deficiencies and risks to animal health (Edwards *et al.,* 2020).

NAWAC is very concerned about these reports of an extremely painful condition which appears to be emergent, and with links to New Zealand winter management systems. NAWAC supports research efforts to understand the associated nutritional and management factors so as to better equip farmers to manage and preferably avoid the disease.

Pain Management

[32] https://www.southerndairyhub.co.nz/wp-content/uploads/2020/10/SDH-Oct-2020-handout-FINAL.pdf

NAWAC maintains the view that pain has a strong negative impact on the affective state of an animal, and that steps must be taken to provide pain relief where a condition causes pain[33]. Indeed, NAWAC encourages the routine use of pain relief for sick and injured animals in order to improve health outcomes, animals' mental state and quality of life.

Animal Health and Wellbeing Plans

NAWAC is proposing a Minimum Standard requiring farm businesses to have a documented animal health and wellbeing plan that is regularly updated with veterinary oversight. This plan would be required to cover health and wellbeing issues specific to the farm and include management plans for the diseases outlined above. Plans should include prevention measures and monitoring for relevant diseases to reduce the incidence of disease and give early warning allowing earlier intervention to protect animal health and wellbeing.

NAWAC proposes that persons in charge of dairy cattle be required to have a working relationship with a practising large-animal veterinarian. It takes the term 'working relationship' to mean one where the person in charge of dairy cattle is a bona fide client of a large animal veterinary practice within reasonable distance of the farm and where the veterinarian comes onto the farm at least once a year and sights all animals.

Veterinary Medicines and Antibiotics

Veterinary medicines must be used in accordance with registration conditions and following manufacturer's instructions, or in accordance with veterinary directions. Veterinary medicines are important for the prevention and management of animal health conditions, however inappropriate use can lead to animal welfare issues such as ineffective treatment, residues in animal products (milk or meat), and may contribute to the development of antimicrobial resistance for products used to treat infectious conditions. Antimicrobial product use on dairy farms is greatest for the prevention and treatment of mastitis, accounting for around 85% of antibiotics used[34], therefore the animal health and wellbeing plan should provide details on how mastitis is monitored and managed, including preventative measures for each farm, so that the risk of antimicrobial resistance developing is minimised especially for the critically important antimicrobials.

As highlighted in the section on drying-off in the draft Code, NAWAC endorses the position taken by the New Zealand Veterinary Association that the use of antibiotic dry cow therapy in non-infected cows is no longer appropriate in light of effective alternatives such as internal teat sealants and improved management practices.

4.3.17 Painful Husbandry Procedures

Painful husbandry procedures are covered under the code of welfare for painful husbandry procedures, and hence no changes have been made in the current draft code. In addition, new regulations came into force in May 2021 regulating surgical procedures on animals. Reference to relevant regulations is included in the Code.

The regulations clarify who can carry out certain procedures and how they should be done. They mostly allow competent people to continue doing routine procedures on animals. Other procedures can only be performed by a veterinarian, and some are banned, meaning no one can carry them out.

For some surgical procedures, the regulations require the use of pain relief, authorised by a veterinarian for that particular procedure. For some procedures, pain relief is not a mandatory requirement, but is encouraged as part of best practice. Under the regulations, "pain relief" means any anaesthetic, analgesic, or sedation administered with the aim of providing effective and significant alleviation of pain. It is up to the veterinarian to determine the type of pain relief to be used to ensure effective and significant alleviation of pain. The veterinarian also decides whether to allow a competent person who is not a veterinarian to administer it, or to administer it themselves.

[33] https://www.mpi.govt.nz/dmsdocument/46045-Code-of-Welfare-Painful-husbandry-procedures

[34] https://www.dairynz.co.nz/animal/cow-health/mastitis/drying-off/antibiotic-use-on-dairy-farms/

Regulation 53 (Castrating cattle beasts and sheep) is based on current recommendations in the Code of Welfare for Painful Husbandry Procedures. NAWAC proposes that regulation 53 be amended to review the age limit for pain relief, as the age of 6 months after which pain relief is mandatory, is arbitrary and is not in line with regulation on dehorning and disbudding. Technology for the provision of pain relief, particularly by non-veterinarians, has been developed in recent years, and processes for enabling greater provision of pain relief on farm by non-veterinarians are now more established since regulation 57 and 58 were put in place. Hence regulation 53 should be reviewed in light of developments in technology, scientific knowledge, and accepted good practice.

Regulation 53 applies to all cattle, i.e., dairy and beef cattle, as well as sheep. NAWAC believes that a full review of the regulation should be undertaken. Since the sheep and beef sector would be more affected by any changes to this regulation (i.e., dairy sector is already working with veterinarians for pain relief for dehorning/disbudding and small numbers of bull calves are castrated in the dairy sector), NAWAC considers that recommendations for changes of regulation 53 should be considered under the review of the Sheep & Beef Cattle Code of Welfare currently being progressed.

4.3.18 Selection and Breeding

As highlighted in NAWAC's opinion piece on selective breeding[35] "the dairy industry uses a balanced selection index that includes not only production factors, but also aspects of animal health and welfare, to ensure that "fit for purpose" animals are being bred for the industry".

Nevertheless, NAWAC discussed the inclusion of a minimum standard to ensure that selective breeding would not lead to routine compromises in animal welfare. The idea of a minimum standard was generally supported. However, minimum standards need to be clear and precise so that people can be certain of what they must do or must not do to meet their obligations under the Act and an investigator should be able to easily assess or measure non-compliance with a minimum standard. Likewise, a defendant should be clear about what must be done to demonstrate that a minimum standard was met or exceeded.

Anything that is uncertain can therefore not be put into a minimum standard. The problem of avoiding a bad result in selective breeding is that a lack of certainty may not be overcome and the ability to assess or measure non-compliance will be limited. In addition, unfavourable breeding outcomes may occur even when following processes that are meant to prevent negative impacts on the animals.

NAWAC has therefore included a MS that the animal welfare impacts of animal selection and breeding objectives must be monitored for favourable and unfavourable consequences, and the results incorporated into future objectives, so as to minimise the risks to animal welfare. Recommended best practices to encourage persons in charge to ensure that selective breeding practices minimise the risk of adverse welfare impacts, that breeding selection should include qualities to improve the welfare of animals, that animal genotype should be suitable for the environment and that breed and sire selection should minimise birthing difficulties have also been added.

4.3.19 Contingency planning

NAWAC considers that it is essential for persons in charge of animals to have a plan in place to be prepared for adverse events that pose risks to the welfare of the animals under their care.

Accordingly, NAWAC is proposing that expanded sections regarding contingency planning be included in all codes of welfare as these are reviewed.

NAWAC is further proposing to add a minimum standard requiring that persons in charge of dairy cattle must have a documented contingency plan in place to address any anticipated adverse events which can negatively affect the welfare of the animals.

[35] https://www.mpi.govt.nz/dmsdocument/17053-NAWAC-Opinion-on-animal-welfare-issues-associated-with-selective-breeding

The Committee considers that adverse events include natural events such as floods, droughts, earthquakes, and storms, but also infrastructure failures and biosecurity/disease events. It also recommends forward planning for situations for individual animals in difficulty (e.g., animals fallen down banks).

NAWAC is also proposing to add reference to planning for human disease outbreaks with potential factors to be considered including the impact of persons in charge becoming sick, restrictions on personnel movement, feed and other shortages, supply-chain issues, limitations to animal transport and processing capacities at slaughter premises and financial and mental health impacts, following the learnings from the COVID-19 pandemic (Baptista *et al.,* 2021).

In short, contingency plans should cover any events that pose a direct threat to the animals' welfare or have the potential to disrupt animal care.

5 Regulations

Under section 71(1)(d) of the Animal Welfare Act 1999, NAWAC must indicate any matters that it considers should be dealt with by regulations under the Act.

As noted in the relevant sections of the Code Review Evaluation Report above and the consultation document, NAWAC is proposing regulations with respect to the following:

- Prohibit the use of all types of electroimmobilisation devices.
- Prohibit the use of electrified top and backing gates used for moving dairy cattle in dairy yards.

NAWAC is also asking for further discussion on the following issues which it would like to see under greater regulatory control:

- A whole-of-supply chain suite of regulations for transport of end-of-life dairy cattle to slaughter including requirements of preparation on farm, restriction of transport time to 8 hours, maximum time from last milking to slaughter of 24 hours, prohibition of transport of lactating dairy cattle for slaughter across Cook Strait and via saleyards.
- Regulations for intensive winter grazing for dairy cattle to require access to water in the grazing area at all times, require at least $10m^2$ per animal of suitable lying area free of surface water pooling and moving cows in calf on to appropriate surfaces 14 days prior to scan-dated calving to reduce the risk of calves being born into unsuitable conditions. Regulations specific to beef cattle, sheep and deer will be addressed as part of respective code reviews.
- NAWAC is recommending a regulation be developed to address heat stress pending feedback from public consultation.

NAWAC is proposing two existing regulations be amended during the review of the relevant codes of welfare:

- Regulation 48. Use of electric prodders – NAWAC recommends a change to this regulation to prohibit the use of electric prodders on all dairy cattle. NAWAC recommends that Regulation 48 be re-assessed as part of the review of the Transport within New Zealand and Commercial Slaughter Codes of Welfare as the majority of animals impacted will be covered under these codes (i.e. electric prodders are primarily used by transporters to load and unload animals and at meat processing premises).
- Regulation 53. Castrating cattle beasts and sheep – NAWAC will assess potential proposals for changes to this regulation as part of the sheep and beef code review as the majority of animals impacted are covered under that code including dairy animals reared for beef production (i.e. they are only covered under the dairy code until weaning).

6 Further Research

NAWAC would like to take the opportunity to highlight areas it considers for further research. These include:

- Reducing the number of bobby calves.
- Cow-calf separation.
- Causes and prevention of humeral fractures - NAWAC supports research efforts to understand the associated nutritional and management factors so as to better equip farmers to manage and preferably avoid the disease.
- Development of the Heat Load Index as a management tool for farmers and establishment of a threshold beyond which mitigation is required.

Appendix 1: Timeline of Stakeholder Consultation and Subcommittee (SC) Meetings

(6) **October 2019:** A report drafted by the dairy working group of the Farm to Processor Animal Welfare Forum (FPAWF) was submitted to NAWAC. This report examines the 2018 code of welfare for dairy cattle to determine whether the standards are up to date, adequately reflect best practice, and well implemented. This report was one of the key documents used to inform the code report and work of the code working group.

(7) **20 February 2020:** Email to LIC and CRV to request feedback on 2019 code relating to animal breeding practices to supplement information provided by FPAWF report

(8) **5 October 2020:** Letters sent to NZALA, SPCA NZ, SAFE, WAP and Guardianz Animal Law to invite feedback (in person or written) on the 2019 Code of Welfare for Dairy Cattle.

(9) **20 and 23 October 2020:** The introductory working group meetings held to outline the proposed codes review process. The members of the working group were representatives of: DairyNZ, DCANZ, Federated Farmers, NZVA Dairy Cattle Veterinarians, Beef & Lamb, NAWAC liaison (2 members); and MPI staff members from the Science, Sector Liaison, Policy, Verification, and Compliance teams.

(10) **Feedback from NZALA, SPCA and WAP received on the code.** Meeting requested by SPCA NZ with meeting held on 27 November 2020 via Teams, meeting requested by Guardianz Animal Law and meeting held on 15 December 2020 via Teams.

(11) **1 and 3 December 2020:** First working group meeting (split over two days).

(12) **29 March 2021:** Second working group meeting.

(13) **31 May 2021:** NAWAC chair meeting with LIC representatives

(14) **1 June 2021:** First NAWAC Dairy Code Review Subcommittee (SC) meeting

(15) **28 July 2021**: NAWAC chair meeting with representatives of the WGAG

(16) **16 August 2021:** NAWAC chair presentation to FPAWF regarding end-of-life cattle transport to slaughter and winter grazing regulations

(17) **31 August 2021:** Introductory meeting with working group, NAWAC SC and FPAWF representatives regarding regulation proposals for end-of-life dairy cattle

(18) **6 September 2021:** Second NAWAC Dairy Code Review SC meeting

(19) **13 September 2021:** Meeting with Halter representatives

(20) **14 September 2021:** End-of-life cattle regulations working group workshop (members included DairyNZ, Fonterra, NZVA, RTF, MIA, livestock agents, DINZ, Beef & Lamb, Federated Farmers, MPI)

(21) **24 September 2021:** Meeting NAWAC SC, dairy code review working group and end-of-life working group regarding all proposed regulations - feedback on potential proposals from all groups

(22) **1 October 2021:** Dairy Review SC meeting to discuss regulations

(23) **4 October 2021**: NAWAC chair meeting with ANZCO representatives

(24) **12 October 2021:** Dairy Review SC meeting - finalise regulation proposals, discussion around shelter with NAWAC liaisons for Sheep and Beef Cattle Code and Deer Code reviews

(25) **20 October 2021**: Dairy Review SC joining MPI (Legal, VS, Compliance, Safeguarding) meeting to discuss suitability of end-of-life proposals for regulations

(26) **20 Oct 2021**: NAWAC chair's report to WGAG close-out meeting

Appendix 2: Recommendations from Stakeholders during Pre-Consultation

Feedback and proposals relating to the Code of Welfare: Dairy Cattle are detailed below.

Report for the Farm to Processor Animal Welfare Forum[36]

A report written in response to a meeting by the livestock sector identifies gaps and opportunities to improve the animal welfare system in New Zealand - specifically focusing on the 2018 Dairy Cattle Code of Welfare (prior to the 2019 amendment). A summary of recommendations is presented in the Appendix 2.

This project was established as an action arising from the Primary Industry Chief Executives' Animal Welfare Forum held in Wellington in December 2018.

The Farm to Processor Animal Welfare Forum and MPI had been tasked with examining the codes of welfare to review the application of current standards within them. Each code would be examined to determine whether they:

- Are up to date;
- Adequately reflect our expectations of what we think is best practice; and
- Can be more effectively communicated and implemented.

Regulations suggested by Farm to Processor Animal Welfare Forum Report on the Dairy Cattle Code identified the following potential regulations:

- Electroimmobilisation

Animal Welfare Organisations

SPCA NZ

NAWAC sought early feedback on the Code of Welfare for Dairy Cattle from several animal welfare organisations. Summary of the SPCA NZ recommendations:

- SPCA believes that all calves should be reared with their mothers and notes that a small number of New Zealand dairy farmers, predominantly boutique operators, are either already doing this or have plans to do so in the near future. SPCA would like to see natural maternal rearing included as a Recommended Best Practice in the Code. This would help send a message to the industry that change is needed and indeed supported by NAWAC.
- SPCA strongly opposes the ongoing bobby calf trade. Our organisation believes that despite the attempts that have been made to improve practices relating to this issue in recent years, routinely killing young animals because they are of little or no value to an industry is repugnant in the extreme and ethically unjustifiable. SPCA would therefore like to see a Recommended Best Practice in the Code, advocating for such animals to be raised for beef or for dual purpose breeds to be used.
- Include a Recommended Best Practice supporting two-stage weaning or other methods for de-coupling weaning and cow-calf separation.
- Check the source used for the statement suggesting that naturally weaned calves do not consume sufficient colostrum.
- Make it explicit that colostrum should be fed warm and not cold.
- Increase the recommended feeding levels for calves, to reflect new research findings.

[36] Not available online.

- The minimum standard must include a clear requirement for access to natural or artificial shelter for all animals. Unrestricted access to shade and shelter should be available to protect cows from the elements such as extreme temperatures, solar radiation, and inclement weather including rain, wind, hail, and snow.
- Current intensive winter grazing practices have been a source of acute embarrassment and shame for the New Zealand dairy industry. NAWAC needs to incorporate the recommendations of the Winter Grazing Taskforce as appropriate.
- SPCA requests the inclusion of a Minimum Standard to prevent cows from having to lie or give birth in excessively muddy conditions.
- Address the issue of overstocking on dairy farms.
- Require grooming brushes to be available for all cows kept in indoor housing.
- Require cows to have daily access to an outside area when being housed. SPCA advocates that all cattle should have access to pasture and grazing in the grass-growing season, and opposes the permanent indoor housing of dairy cows.
- Include a Minimum Standard prohibiting the use of permanent indoor housing.
- Increase the threshold for electric prodder use from 150kg, to a minimum of 200kg, even though it would require an amendment to the Animal Welfare (Care and Procedures) Regulations 2018. SPCA believes that the threshold needs to be raised to at least 200kg, if not 300kg, in order to minimise the risk to younger animals from being handled in this highly distressing manner.
- Prohibit the use of electro-immobilisation devices as an accepted method of restraint.
- Amend Minimum Standard 9 to include adequate stall width and lunge space.
- Restrict or prohibit the feeding of 'high risk' supplements to dairy cattle.
- Consider including a threshold for lameness in the Code.
- Include an annual milking machine test as a Minimum Standard.
- Include a requirement for shade and shelter in all holding pens used to contain animals.
- Include 'palatability' in the Minimum Standard on water.
- Include a requirement to keep the area around water troughs well maintained.
- Prohibit the use of electrified backing gates to move cattle.
- Make Animal Health Plans a mandatory requirement.

New Zealand Animal Law Association

NAWAC sought early feedback on the Code of Welfare for Dairy Cattle from several animal welfare organisations. Summary of the New Zealand Animal Law Association (NZALA) recommendations[37]:

- As a general comment, we consider that the Code is very vague, and that a lack of clarity and detail for many of the standards makes them difficult to follow and enforce.
- NZALA are concerned that, for a number of issues covered by the Code, the Code sets Recommended Best Practice (RBP) but not minimum standards (MSs). This includes Parts 5.2 (Floods, Storms and Droughts); 6.6 (Drying-off); 6.10 (Mothering Calves onto Cows); 6.11 (The Selection of Animals for Mating); 6.12 (Pregnancy Examinations); 7.1 (Inspection and Treatment); 7.2 (Lameness); and 8 (Quality Management).
- NZALA has concerns that a number of standards set by the Code are, or may be, inconsistent with the Act. For this reason, NAWAC should give particular consideration to the following matters, and whether they should be the subject of recommendations made under section 183A(2) of the Act:
- inadequate provision for the expression of dairy cows' behavioural needs (e.g. lying down, playing, grooming, maternal behaviours and foraging to explore, consume and select feed);
- using stones for calf bedding;
- inadequate provisions relating to stocking density of dairy cattle (4.1);
- inadequate provision for managing the mixing of dairy cattle (4.2);
- lack of access to shelter in both summer and winter conditions (5.1);
- inadequate provision for extreme weather events on dairy farms (5.2);

37 https://nzala.org/w/wp-content/uploads/2020/11/dairycattlecodeofwelfare.pdf

- use of off-paddock facilities and lack of access to pasture compromising animal health and frustrating the behavioural needs of dairy cattle (5.4);
- permitting high (25 ppm) levels of ammonia;
- practices associated with winter-grazing;
- a lack of adequate limitations on the use of electric prodders on dairy cows (e.g. that they be applied for only very short durations, that multiple applications be adequately spaced and that use not continue to be used if the animal fails to respond) and no limitation on the use of goads on sensitive parts of the dairy cow, including the ears and nose (6.1);
- issues associated with restraint (e.g. in relation to the use of electroimmobilisation devices and tethering of dairy cattle) (6.3);
- inadequate provision for drying off in dairy cattle (6.6);
- ability of untrained operators to conduct pregnancy examinations and high rates of dystocia (6.7);
- lack of minimum standards preventing premature birthing induction in pregnant cows;
- permitting hot branding;
- inadequate provision for preventing lameness in dairy cattle, or other health issues such as metabolic disease, mastitis, Johne's disease and broken shoulders; and
- selective breeding of dairy cattle for high milk yield, which causes health issues.

The NZALA also published a report "Farmer Animal Welfare Law in New Zealand: Investigating the Gap Between the Animal Welfare Act 1999 and its Delegated Legislation" in February 2021, Chapter 4 of which covers the Dairy Cattle Code of Welfare.

World Animal Protection

NAWAC sought early feedback on the Code of Welfare for Dairy Cattle from several animal welfare organisations. Summary of the World Animal Protection (WAP) recommendations:

- World Animal Protection, with other global farm animal protection organisations advocate for the Farm Animal Minimal Responsible Standards (FARMS) as outlined in the FARMS Initiative.
- Code leadership for the industry to address genetic balance of welfare outcomes, positive welfare opportunities, welfare outcome monitoring and further investment into sexed semen or other approaches to avoid calf wastage and associated welfare issues.
- Clear prohibition of individual confinement systems – for cows and calves and to require unrestricted group housing.
- Minimum Standards for shelter, shade, winter grazing, outdoor and non-permanent indoor systems designed around the needs of dairy animals including number and design of cubicles, provision of specifications of bedding, exercise areas and enrichment.
- Minimum Standards for adequate feeding and drinking systems to ensure adequate body condition, avoid feeding and drinking competition and contamination, clearly provide adequate calf nutrition and housing for the most robust calves to avoid unnecessary infections and use of antibiotics.
- Minimum Standards that are aligned with current science on painful husbandry procedures, in particular prohibiting dehorning of older animals and disbudding of all animals only with use of anesthesia and analgesia. No electric prodders, electroimmobilisation, hot branding or udder flaming.
- Minimum Standards for milking and drying off dovetailing with strengthen health plans and set clear targets for lameness and mastitis to translate a reduction of antibiotic use and risk of resistance. Consideration of automated technologies.
- We also note a number of transport aspects for calves that must be strengthened.

Table 1: Summary of written feedback on the Code of Welfare: Dairy Cattle and associated NAWAC proposals.

Written feedback relating to the 2018 and 2019 versions of the Code of Welfare for Dairy Cattle is summarised in the following table organised by section of the Code.

These are the assigned codes for the sources of feedback:

(1) Farmer to Processors Animal Welfare Forum Code Review Working Group for the Dairy Code of Welfare - feedback on the 2018 version of the Code

(2) NAWAC

(3) Animal Welfare Science Team MPI (issues with interpretation or other issues noted over the years through enquiries from the public, MPI or industry)

(4) MPI Animal Welfare Compliance and MPI Verification Services

(5) Breeding companies

(6) Winter Grazing Taskforce/Action Group report and recommendations

(7) Shelter Report

(8) Animal Welfare Organisations - written feedback

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
Purpose	3	Add purpose/use of codes to the Preface or Introduction. It'll acknowledge the diverse 'interest' people have in them and remind us that they're not just about regulation. For example, Articulate aspirations of society, Raise awareness by drawing attention, Regulatory mechanisms, Gives public et al an idea of what they could expect, Self-promoting standards, outsiders are charlatans (i.e. a defining and excluding role)		
	8	No specific requirements and courses offered can be as short as a couple of weeks. This gap should be addressed.		Courses *versus* on-the-job learning…courses may not make a better stockperson – some people learn better on the job than in a classroom setting and may have the same or better stockperson ability compared to someone trained in a classroom. However, RBP was added that stockperson capability should be assessed by an accredited training provider. An example indicator has been added that persons receive appropriate training and expert assistance when dealing with situations outside their expertise.
Legislative background	8	Would be helpful for intro to code to include references to relevant section of the Act so code users are directed to the statutory purposes the code serves and the statutory requirements it is required to meet.		
Part 2: Stockmanship				
MS 1 Stockmanship	1	Review wording	MS Consider adding	Definition of competency has been added according to SPP definition.

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
			• Competency of staff, depending on the definition in the new SSP regulations • Including bankruptcy, economic and/or psychological breakdown of a person in charge of animals as situations where regular inspection of the animals is particularly important	Bankruptcy and economic breakdown have been added to a RBP; psychological breakdown has not been included as affected persons are most likely not in a position to act upon this
	8	Mention of "common sense" – not appropriate as assumes commonplace practices are appropriate from an animal welfare perspective when this is not always the case. Code should direct that persons in charge of animals receive appropriate training, and expert assistance when dealing with situations that are outside of their expertise.	MS should prescribe more specific training requirements.	Reference to common sense removed. This standard is outcome based and if persons can demonstrate competency etc as required by the standard it should not matter whether these have been obtained by learning on the job or through courses. Not considered minimum required under the Act – e.g. staff can be competent from learning on the job. RBP added that stockperson capability should be assessed by an accredited training provider. An example indicator has been added that persons receive appropriate training and expert assistance when dealing with situations outside their expertise.
	8	Systematic or aberrant abuse by staff or farmers not always due to incompetence or lack of training. Modern technologies now and into the future incl implications for animal observation/interaction with animals and decisions made using technology.	Add "a positive attitude" to MS.	Included reference to empathy and respect for animals. Included reference to modern technologies under Section 5.2 Farm facilities, Equipment and Technologies
Part 3: Feed and Water				

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
	1	Add additional info re factors to consider for storing and management of supplementary feed and consideration of micronutrient deficiencies or excesses in relation to geographical location		Included
MS 2 Food	1	Have trigger point of BCS 3.5	MS add on BCS 3.5. trigger point	MS changed now requiring BCS to not fall below 3.5 or go above 8.
MS 2 Food	1	Preventable deaths on crop	Rewrite elements of introduction of section 3 and section 3.1 to place greater emphasis on management of feeds other than pasture including crop as a sole diet and balancing needs for dairy cows	MS/example indicators added
MS 2 Food	1		Add to MS 2 – Add bullet point regarding feeding and management to reduce risk of metabolic disorders Review section on feed and amend to cover wider range of considerations for feeding animals in particular feeds other than pasture	MS already addresses metabolic diseases, included MS on transition between feeds and example indicators specific for fodder beet
MS 2 Food	3	Does body condition need to be in a different scale? Industry using what? Highlight link between BC and welfare, in line with beef?	Check which scale is used - comments by industry above suggest 1-10	Scale is 1-10, MS changed - BCS must not fall below 3.5 or go above 8.
MS 2 Food	3	Consider the contribution of providing differences in individual nutritional requirements for animal health and welfare (c.f. the monoculture of ryegrass, fodder beet, or total mixed ration)		RBP added to allow variety and choice
MS 2 Food	6	Access to adequately balanced diet including supplementary feeding for animals on fodder beet and other crops, that keep animals warm and doesn't cause acute or chronic malnutrition and metabolic problems		MS already addresses metabolic diseases, included MS on transition between feeds and example indicators specific for fodder beet

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
MS 2 Food	8	Include winter grazing taskforce recommendations, especially overstocking and lying or giving birth in mud needs to be addressed. Restrict or potentially prohibit the use of high-risk supplementary feeds such as fodder beet or PKE to safeguard welfare during times of insufficient pasture noting that low risk supplements such as good quality silage, are available.		Added recommendations in relevant sections. Added MS on feed transition and example indicator relating to fodder beet
MS 2 Food	8	Adapt Winter Grazing Taskforce recommendations! Animals should have access to an adequately balanced diet that keeps animals warm and doesn't cause acute or chronic malnutrition or metabolic problems". Variety of feed facilitates exploratory behaviour. Note that 2 on BCS scale is "emaciated" and as such more appropriate that urgent remedial action must be taken when BCS falls below 4; standard should provide remedial action when BCS goes to 8 or above, 9 which is considered "obese". Variety of feed for dairy cattle facilitates exploratory behaviour for some member of the herd, this should be acknowledged in the Code.	RBP on abrupt changes to diet …..prohibited under MS. MS: Urgent remedial action must be taken when BCS falls below 4 as opposed to 3! MS does not provide remedial action when conditions goes to 9 or above, which is considered obese. Add to MS.	MS added to address abrupt changes and require feed transition BCS must not fall below 3.5 or go above 8. MS covers diet requirements (i.e., maintain good health, meet physiological requirements and minimise metabolic and nutritional disorders) – added example indicators Added RBP around feed selection according to individual requirements and preferences and being offered a variety of feeds
MS 2 Food	8	Winter grazing needs to be carefully considered as involves high stocking density.	Outcomes of the WGAG translated into MS e.g. close and adequate water, feed, feeding	WGAG recommendations included in relevant sections

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
			station design, comfortable lying areas, monitoring, ensuring suitable calving determination, preparation and location. MS outlining a ratio or number of feeders and water troughs must also be required (or space at troughs) to mitigate competition in a herd, damaged facilities and fecal contamination and ensure all animals can drink to fill and prevent thirst. Avoidance of diets with greater than 40% grain must be required. A body condition score of 5 or 5.5. out of 10 should be maintained as recommended by DairyNZ. This is key to anticipation and prevention of collapse and metabolic disease particularly in peri-parturient and highest producing animals and the RBP could be advanced to an MS.	MS outcome based so ratio of feeders versus animals not covered Example indicator includes that level of competition at feed sources is low and all animals can access sufficient feed by providing sufficient feeder and spacing them appropriately MS covers diet requirements (i.e. maintain good health, meet physiological requirements and minimise metabolic and nutritional disorders) – grain not extensively fed in NZ but have specified fodder beet limits for growing, lactating and dry cows in example indicators and reference to grain in introduction BCS for calving example indicator added
MS 3 Feeding newborn calves MS 4 Hand rearing calves	1	Failure of passive transfer of immunity important factor in welfare and ongoing health of calves	RBP More information about importance of colostrum quality and what good quality colostrum is (first milking, adequate BRIX reading) Requirement for all pre-weaned calves to receive liquid feed in a way that their need to suckle is met Requirement to feed pre-weaned calves at least twice a day (defined as calves up to 3 weeks of age)	Added 'good quality", including definition, to MS and relevant example indicators RBP on BRIX to be above 22%, collecting colostrum within 12-24 hours and feeding to calves promptly MS to meet calves' need to suck added MS to feed calves up to 3 weeks twice daily and at least 20% of bodyweight added.

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
MS 3 Feeding newborn calves MS 4 Hand rearing calves	3		RBP into MS Colostrum issue and quality of colostrum Minimum for food provision (eg at least 8L/day) – NZ farms feed 5L/day other parts of world 10L/day; calves fed ad lib drink ~12L/day	Added 'good quality', including definition, to MS and example indicators. RBP on BRIX to be above 22%, collecting colostrum within 12-24 hours and feeding to calves promptly Ms to feed calves up to 3 weeks twice daily and at least 20 % of bodyweight and example indicators added.
MS 3 Feeding newborn calves	4		MS: Calves must receive sufficient colostrum or good quality commercial colostrum substitute to ensure their welfare. RBP: Feeding equipment should be hygienically maintained Liquid feed should be fed at the appropriate temperature Solid feeds should be gradually introduced to encourage rumen development.	Added 'good quality', including definition, to MS and RBP on BRIX to be above 22%, collecting colostrum within 12-24 hours and feeding to calves promptly MS for equipment for handling and feeding colostrum and milk to be kept clean RBP regarding milk/colostrum temperature kept. MS that calves must have daily access to appropriate solid food from one week of age
MS 3 Feeding newborn calves	8		10-15% of bodyweight/day likely to leave calves hungry, recommended feeding levels for calves increased to reflect this. Make it explicit that colostrum should be fed warm not cold. Opposed bobby calf trade and would like to see a RBP to advocate such animals be raised as beef or dual-purpose breeds to be used.	MS to feed calves with liquid feed up to 3 weeks twice daily and at least 20% of bodyweight RBP regarding milk/colostrum temp kept RBP added

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
MS 3 Feeding newborn calves	8		RBP under 3.3 should be made part of MS as the health and welfare of calves should be paramount and these practices are important for avoiding welfare issues. Sufficient colostrum is vague. RBP moved into MS and form obligation not discretionary option. This is appropriate as code details importance of calves receiving colostrum and how it affects their ability to fight disease Provide a specific time for feeding liquid e.g. 6 weeks to ensure the rumen has developed in all cases to allow the calf to digest solid feed.	Relevant RBP moved into MS or example indicators Example indicator added to specify amount of colostrum MS added to feed liquid feed until calves rumen has sufficiently developed to allow it to utilise solids as the sole feed source but at least until 6 weeks of age.
MS 3 Feeding newborn calves	8	Feeding and housing of calves should be an area of the code that tightens considerably. Current standards are vague.	FARMS: At least 4.5.L (or 10% of body weight whichever is greater of good quality colostrum (50mg/L of IgG) within 6 hrs of birth including all calves born on farm irrespective their destination. All non-suckled calves must receive liquid food daily at least for the first 8 weeks of life. Fibrous food must be provided for each calf over 2 weeks and they must receive sufficient dietary iron to maintain blood haemoglobin level of at least 9g/dl. Bobby calves can be legally left on farm without feeding for 24 hours and transported for up to 12 hours, which is completely unacceptable.	4.5L too much for smaller calves (e.g. Jersey). Have added example indictor: depending on body weight calves fed 2-4L within 6 hours after birth. Some calves are left on the dam for up to 24 hours and receive colostrum from dam, so have specified from dam or farm staff depending on management system RBP: further 2-4L between 6-12 hours MS requires twice daily feed for first 3 weeks and provision of solid feed from week 1. Haemoglobin not an issue in NZ Dairy Industry. Iron deficiency anaemia is a problem in the white veal industry due to dietary iron restriction. There is no white veal industry in NZ.

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
				Added twice daily feed requirement up to 3 weeks. As per animal welfare regulations calves must be fed half a day's ration no more than 2 hours before transport.
MS 5 Water	3	Drinking water standards for NZ revised in 2018	RBS into MS palatable water, troughs cleaned regularly, water quality monitored Explicitly state calves require water access	MS now requires palatable and high-quality water Example indicators include troughs being cleaned and maintained regularly RBP for regular water testing Calves added to MS
MS 5 Water	4	Define acceptable standard for water availability i.e. how long is too long without water on farm? (probably more relevant to saleyards etc)	MS: Clean water available at all times.	MS now requires easy access to palatable and high-quality water
MS 5 Water	6	Continuous access to fresh clean water		
MS 5 Water	8		MS should include reference to palatability of water given to animals and include a statement about keeping area around water troughs in good condition so as not to provide a barrier to access for thirsty animals.	Palatable added to MS Example indicator added regarding managing troughs to reduce mud and manure accumulation and pugging
MS 5 Water	8	Winter grazing recommendations – there should be continuous convenient access to fresh, clean water	RBP into MS. MS: clean troughs regularly, ensure water is palatable, ensure water supply meets peak demand and monitor water quality	Added cleaned and monitored to example indicators Added peak demand to MS Monitor water quality is RBP Regulation recommended for intensive winter grazing to have clean drinking water in the grazing area at all times.
Part 4: Behaviour				

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
	1	Manage behavioural needs including need to lie and rest	Covered by MS 6 but maybe expand	Expanded
	1	Calves to be raised in groups, there is no hutch rearing RBP		MS on behaviour includes appropriate social interactions; example indicator that dairy cattle kept with at least one suitable companion and group sizes appropriate for available space
	1		Minimum space allowance for housed calves MS	Example indicators added that group sizes appropriate for available space; under off-paddock facilities that calves are kept in groups limited to 10-12 calves per pen and that all calves in a group can lie down comfortably and engage in activities such as vigorous play running and bucking at the same time.
	1		Minimum space for intensively grazing animals MS	MS added that dairy cattle must have sufficient space for all animals in a herd to lie down and rest comfortably at the same time. Example indicators added that stocking density is managed according to feed available on farm and cattle in intensive winter grazing systems have at least 10m^2 per animal available on a suitable surface to allow for each animal to lie down comfortably
	8		Overstocking not just a winter grazing issue needs to be addressed to protect long-term sustainability of industry.	MS added that dairy cattle must have sufficient space for all animals in a herd to lie down and rest comfortably at the same time. EIs added that stocking density is managed according to feed available on farm and cattle in intensive winter grazing systems have at least 10m^2 per animal available on a suitable

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
				surface to allow for each animal to lie down comfortably
	8	Ensure code sets standards for meeting behavioural needs; code highlights importance for providing for natural behaviour including for room to play for young animals. Should be a requirement for calves of all ages to have room to express this behaviour. Systems should enable cattle to express their natural behaviours as much as possible. Use of adapt suggests the code contemplates cattle changing their behaviour to meet the environment. Emphasis should be given to the point of minimising impact on the expression of natural behaviour. Introductory paragraph states cattle need to be able to perform a range of other behaviours. These are not included in the MS effectively making them optional. Variety of feed for dairy cattle facilitates exploratory behaviour.	Appropriate social interactions – more examples needed or more precise definition as not covered under EIs. Benchmark should be given to normal feeding behaviour (e.g. the behaviour expressed by cattle in pasture without area allowance restrictions). Minimum standard as is means farmers appear free to determine what the minimum standard means “i.e. sufficient periods”. Even if farmers elected for follow RBP of 10-12 hours lying on clean, dry and compressible surface cows could still be standing on concrete or hard surfaces for 12-14 hours a day before they have access to a comfortable surface to lie on. Cattle standing on concrete for 12 or more hours a day is problematic due to risk of lameness and stress. Play not included in any MS (behaviour or off-paddock).	Reworded MS “included, but not limited to” Adapt removed – replaced with “allowed to get used to” Reworded MS – now foraging and opportunity for food selection RBP added for food variety under MS food MS for lying reworded slightly now requires that dairy cattle must have access to a compressible well-drained surface so they are able to lie and rest comfortably for sufficient periods each day to meet their behavioural needs. No minimum hours added as lying times are variable depending on various factors (see additional info added to introduction of this standard). It is important that cows are not lying deprived (do not show signs of lying deprivation (see Example indicator). RBP changes to recommend dairy cattle should be provided with the opportunity to lie and rest comfortably on a compressible, well-drained and clean surface for as long as they choose to.

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
				MS in off-paddock facilities sections added to limit time on stand-off on hard surfaces to 12 hours per day. RBP in off-paddock facility section added to recommend that cattle should not be stood off on hard surfaces (concrete/stones). Playing and grooming added to MS.
	8	Current code silent on positive welfare and does not require provision of enrichment at all for cows or calves. In light of trend to indoor housing warrants significant review.	The new code must include an MS on a range of enrichment including mechanical brushes indoors and potentially outdoors if no suitable grooming substrate is available, and other items for calves. Suitable enrichment and supplementary roughage for calves are also recommended to facilitate dietary transition and prevent abnormal behaviours seen with cow-calf separation and redirected suckling behaviour seen in group housing as well as opportunities for retreat.	MS updated with grooming and play and example indicator added, MS requiring grooming opportunities for off-paddock facilities added. RBP for other enrichment for calves added to MS for colostrum, hand rearing and weaning. Reference to sentience added; reference to positive welfare/experiences added and reflected in RBP. EI added that dairy cattle are able to groom using natural materials or artificial devices
MS 6 Providing for behavioural needs	3	Large herds – ability/opportunity to behave normally?		EI added that stocking density is managed according to feed available on farm.
MS 6 Providing for behavioural needs	3	Ability to lie down – mud!		MS requires access to a compressible well-drained surface to lie and rest comfortably for sufficient periods each day. Recommendation for regulation: 10m^2 per cow free of surface water pooling for dairy cattle in intensive winter grazing situations.

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
				Example indicator added that lying is not impeded by mud, surface water, effluent accumulation or by the hardness of the surfaces
MS 6 Providing for behavioural needs	6	Provision for all animals to lie comfortably on compressible dry substrate for as long as they want to	Lying bouts and quality of lying to be considered!	Reworded MS on lying to provide access to a compressible well-drained surface so dairy cattle are able to lie and rest for sufficient periods each day to meet their behavioural needs. MS requiring sufficient space for all animals in a herd to lie down and rest comfortably at the same time. RBP updated – dairy cattle should be provided with the opportunity to lie and rest comfortably on a compressible, well-drained and clean surface for as long as they choose to.
MS 6 Providing for behavioural needs	8	Introduction and RBP refers to suitable soft lying surfaces. Examples for both pasture and artificial environments of these surfaces would be useful. Importance of stocking density recognised throughout the code but there are no provisions outlining what these should be in relation to dairy cattle. Failure to address stocking density explicitly in the code deprives farmers of clear guidance as to what is acceptable and may allow a huge variety of stocking densities. High stocking densities have a range of welfare implications for cattle.	Grooming still not covered under MS6 despite being a behavioural need. Inadequacy failing to require that cattle be provided with sufficiently compressible surfaces to lie down for an adequate period each day and permitting cattle to be left standing on concrete or other hard surfaces for 12 to 14 hours a day, despite the impact this might have on health and that this frustrates their behavioural need to lie down. NAWAC report recognised importance of play for calves. Note reference of play in MS 9 under EIs and RBP, but not in an MS.	Grooming added, play added WGAG recommendations incorporated throughout code where relevant MS added limiting stand-off to 12 hours RBP added to off-paddock MS that dairy cattle should not be stood off on concrete/hard surfaces or wet surfaces. Adverse conditions covered under contingency planning section.

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
		Adopt recommendations of Winter Grazing Taskforce/Action Group. Cows should always be able to lie down comfortably (on a soft dry substrate) for as long as they want; there should always be an ability to readily move animals to shelter/dry land in adverse weather before harm occurs	RBP on rest and lying for 10-12 hours should be MS – and at all times, not just under usual conditions! Address stocking density.	EI on stocking density added to MS as well as MS on off-paddock facilities, 10m^2 for intensive situations. See also off-paddock facilities MS. MS for lying reworded slightly now requires that dairy cattle must have access to a compressible well-drained surface so they are able to lie and rest comfortably for sufficient periods each day to meet their behavioural needs. No minimum hours added as lying times are variable depending on various factors (see additional info added to introduction of this standard). It is important that cows are not lying deprived (do not show signs of lying deprivation (see Example indicators)). RBP updated – dairy cattle should be provided with the opportunity to lie and rest comfortably on a compressible, well-drained and clean surface for as long as they choose to.
MS 6 Providing for behavioural needs	8		Mechanical grooming brushes recommended in paddocks that don't have natural grooming substrates Advance this RBP (rest and lying for 10-12 hours) into MS.	Grooming added to MS. Example indicator added that dairy cattle are able to groom using natural materials or artificial devices Access to grooming opportunities now required under MS for off-paddock facilities

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
				MS for lying reworded slightly, now requires that dairy cattle must have access to a compressible well-drained surface so they are able to lie and rest comfortably for sufficient periods each day to meet their behavioural needs. No minimum hours added as lying times are variable depending on various factors (see additional info added to introduction of this standard). It is important that cows are not lying deprived (do not show signs of lying deprivation (see Example indicator). RBP updated – dairy cattle should be provided with the opportunity to lie and rest comfortably on a compressible, well-drained and clean surface for as long as they choose to. RBP added that where outdoor management systems do not provide natural materials for enrichment (e.g. opportunities for grooming/scratching) appropriate enrichment should be provided (e.g. mechanical brushes in paddocks or at the milking parlour).
Section 4.2 Mixing cattle	1		Add - management of horned/polled cattle - separation of animals showing aggressive behaviour	MS on horned cattle added MS to remove cattle that do not adjust to a new group
	8	Nothing in introduction emphasises the need to minimise introduction of new cattle into a herd so as to avoid increased aggression, but should emphasis this. RBP "the introduction	Why are the RBP not MS? Include following recommendations:	New MS and associated example indicators

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
		of new animals into the herd should not occur more frequently than is necessary". Examples should be given of what is necessary in the content of animal welfare practice. Code states it applies to any bull brought onto farm or kept on breeding centre but code itself does not say anything about the management of bulls or mating procedures. Should have MSs	Mixing if need to remove lame cattle from the herd to facilitate recovery May be mixed if farmer sorting cows according to BCS to better attend to nutritional needs of thinner cows.	
	8		RBP a) should be advanced into MS in relation to space and non-slip flooring to prevent injury and establish a calm herd as soon as possible or when transitioning to indoor housing.	Moved into MS
Part 5: The physical environment				
General introduction	1		Should state that physical environment should allow comfortable resting, safe and comfortable movement, and opportunities to perform natural behaviours that animals are motivated to perform in all situations (see Part 4 though!) RBP Physical environment should allow opportunities for animals to achieve positive welfare states.	See MS on behaviour
MS 7 Shelter	1	Planning for adverse weather Shade and shelter risk (heat and cold complaints)	MS Set heat load index limit	See contingency MS for planning for adverse weather

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
				Changed MS to read that all dairy cattle must be provided with shade/shelter or other means to minimise the risk of heat/cold stress due to warm and/or humid/cold and/or wet conditions. Plus example indicators Feedback requested on potential heat stress regulation.
MS 7 Shelter	3	Shelter – mud and overheating		Changed MS to read that all dairy cattle must be provided with shade/shelter or other means to minimise the risk of heat/cold stress due to warm and/or humid/cold and/or wet conditions. MS behaviour requires that dairy cattle must have access to a compressible well-drained surface so they are able to lie and rest comfortably for sufficient periods each day to meet their behavioural needs. Added example indicator that lying is not impeded by mud, surface water, effluent accumulation or by the hardness of the surfaces
MS 7 Shelter	4		More MS and RBP around management of animals on muddy crop or sacrifice paddocks	Added recommendations by WGAG into relevant sections.
MS 7 Shelter	6	Winter grazing	There are no enforceable regulations that directly address access to water, shelter and requirements for lying, depth of mud, and proper nutrition when winter grazing	Regulation recommendations for access to water, lying surfaces and preventative measures to cows giving birth in mud. MS added for transition between feeds.
MS 7 Shelter	7	Farmers understand the cold and its physiological impact on livestock but less understanding of consequences of heat	Rename to "Shade and shelter"? More information around production impact in general information section?	Shelter is defined in the code to include shelter and shade.

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
			No single shelter solution that will work for every farmer for every paddock – difficult to enforce shelter requirement - outcome based?	
MS 7 Shelter	8	Plans as outlined under RBP in old shelter (storms, floods and droughts) MS: useful to outline a suggested process or template for carrying out this assessment and to identify which are the main warning signs or factors to look out for. Having no Ms relating to extreme weather events means that the code does not require farmers to have contingency plans in relation to such events. That the code does not prescribe access to shelter is contrary to the AWA which includes shelter in the definition of physical, health and behavioural needs. MS 7 does not have a requirement to regularly monitor cattle for signs of weather exposure and does not refer to minimising the time that dairy cattle spending the yard, no reference to technologies which could be included in the RBP. The code also does not recognise that shade and shelter can mean multiple things, e.g. barns, trees, landscape features. MS 7 states "means to minimise effects of adverse weather" If not shelter (which is RBP)	MS currently does not require shelter (only RBP) which these animals need in cold and hot conditions. That this issue persists highlights the inadequacy of the MS which impose only vague requirements for farmers to "minimise effects of adverse weather". Provision of shelter should be a MS. Further RBP or MSs should be included to assist with reducing heat and cold stress including minimising time spent in the yard, use computerised collars to measure temperature of dairy cattle and clarification of what shade and shelter can mean. Contingency plans should be mandatory to ensure welfare in extreme weather events. There should be stringent requirements on this: e.g. shelter in each paddock, shelter when milking, adequate shelter for calves up to a certain age at all times. MS should be amended to provide all cattle at all times including calves of all ages, must have access to shelter at all times. MS re health problems: This does not do enough to protect cattle and would be better expressed as "remedial action must be	New MS on contingency planning Changed MS to read that all dairy cattle must be provided with shade/shelter or other means to minimise the risk of heat/cold stress due to warm and/or humid/cold and/or wet conditions. Added additional info on types of shelter to introduction section, RBP points added on mitigation strategies.

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
		it is unclear what these “means” are. Provision of shelter seems to be fairly fundamental to the lay person and it is unclear why this does not meet the standard. MPI-led and industry initiatives have not managed to solve this issue through education alone and amending code to make provision of shelter mandatory would address issues.	immediately taken that will minimise the consequences of such exposure.”	
MS 7 Shelter	8	Code is silent on MS for shade and shelter, adequate shade and shelter is a key concern. Winter grazing can be done poorly and end up with cows knee deep in mud which restricts grazing and lying area. Outcomes of Winter Grazing Action Group could be translated into MS.	Advance RBP to MS to ensure adequate shelter, shade or equivalent for all dairy animals and include structured assessment of risks and preventative approaches to mitigate for regular and extreme weather patterns, incl floods, storms and droughts likely to increase due to climate change. Alerts could be established as RBP for heat-stress – possibly 21 degrees and 75% humidity – for on and off pasture.	Winter grazing recommendations incorporated into MS, example indicators and RBP. MS added for contingency planning for adverse weather events.
Section 5.2 Floods, storms, droughts	1		Dry lying surface for animals in crops Principles for managing stocking density and behavioural needs in pasture systems	See additions to MS on behaviour and off-paddock facilities.
Section 5.2 Floods, storms, droughts	1	Align with Sheep and Beef code	RBP - alternative power source for milking cows and operating water pumps and feeding systems - adverse event plan for every farm - prepare for regional events (bush fire, volcanic eruption etc) - consideration of pre-emptive destocking and humane killing for animals not able to be moved	See contingency plan MS and relevant sections of code (e.g. milking, off-paddock)

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
			- stock should be inspected at least once every 48 hours or as soon as possible when there is an event that may impact animal welfare e.g. storm, flooding etc	
	8	Current RBP states farmers should make an assessment of the risks of their susceptibility to floods, etc. It may be useful to outline a suggested process or template for carrying out this assessment and to identify which are the main warning signs or factors to look out for.	Having no MS related to extreme weather events means code does not require farmers to have contingency plans in relation to such events. This is in contrast to MS9.	MS on contingency planning added
Section 5.3 Farm facilities	3	General public: Electric backing gates in cowsheds		Recommended regulation to prohibit use of electrified top and backing gates
MS 8 Farm facilities	8		Prohibit use of electrified backing gates.	Recommended regulation to prohibit use of electrified top and backing gates
	8		MS for maintaining walking tracks essential in light of lameness continuing.	Added walking tracks to MS
MS 9 Managing dairy cattle in off-paddock facilities	1		Minimum space allowance per cow – MS 6 and 9 Placement of and access to water troughs and feeders to ensure all animals can drink/feed and that these do not cause injury or contaminate the water/feed – MS 9 Considering natural periodicity of lighting requirements – MS 9 Hygiene of animal areas in particular calving areas – MS 9 Management of noise in housing Management of manure systems (not just bedding)	Added example indicators on stocking density to both MSs Water and feed covered under MS Food and MS Water, but example indicators added for off-paddock facilities Changes to lighting MS and MS on ammonia levels. Calves covered by MS requiring well-drained compressible lying area as applies to all dairy cattle.
MS 9	3	Calves on stones	Move RBP into MS	MS added that river stones cannot be used as surface cover or bedding material.

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
Managing dairy cattle in off-paddock facilities				Calves covered by MS requiring well-drained compressible lying area as applies to all dairy cattle.
MS 9 Managing dairy cattle in off-paddock facilities	4	Calves spend 80% of their time lying down so the type and quality of bedding is important to minimise heat loss and protect against disease	MS Bedding well-drained and absorbent calves to be raised in an environment that is clean, dry, well drained with sufficient bedding and draught-free and well ventilated	Calves covered by requirement of provision well-drained lying area with a compressible surface or bedding that is maintained to avoid manure accumulation, as applies to all dairy cattle. MS added to clarify that river stones cannot be used in off-paddock facilities as bedding or surface cover material MS requires ventilation to maintain temp and humidity that does not cause heat or cold stress, that prevents draught onto animals and build-up of harmful concentrations of dust or noxious gases.
MS 9 Managing dairy cattle in off-paddock facilities	8		MS requiring sufficient brushes for grooming for all housed cattle Include MS requiring opportunity to go outside daily or even just onto a stand-off pad or loafing area; include MS preventing 24/7/365 housing. Cows may not go outside but at least have a choice. Provision of sufficient lunge space and sufficient width to enable comfortable lying in free stalls in MS	MS for access to grooming devices added plus example indicators that there are sufficient troughs, feeders and grooming devices and they are spaced appropriately so that all cattle have access to them without undue competition MS for outdoor access (either pasture or a suitable outdoor area) was recommended to Minister in 2019 and MPI working on regulation to implement this standard. Added to MS sufficient lunge space and width to lie down comfortably

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
MS 9 Managing dairy cattle in off-paddock facilities	8	Concern that revised code of welfare 2019 will in fact adequately protect the welfare of dairy cattle. NAWAC has acknowledged that cattle prefer pasture under certain conditions and are motivated to access pasture. However considered that scientific understanding on what motivates cattle to access pasture is limited and that justified not requiring such access. This is problematic as NAWAC should take an approach to minimise harm and which is based on the purpose of the Act to meet physical, health and behavioural needs of animals. The mere fact that dairy cattle have indicated a preference for pasture suggests that this could be associated with physical, health and/or behavioural needs. At the very least, prolonged frustration of this preference can be expected to impede quality of life. It is unclear whether alternative outdoor environments will provide cattle with the same benefits as pasture-based systems so as to meet their physical, health and behavioural needs, including in relation to space, grazing and foraging and reduced lameness and mastitis. New provisions of the code encourage the use of intensive indoor systems in NZ.	Stocking density recognised as important throughout the code but no provisions. Why would a calculation for space contribute to worse welfare outcomes e.g. pigs? Failure to address stocking density in the code deprives farmers of guidance as to what is acceptable and may allow for a huge variety in stocking densities. High stocking densities have a range of welfare implications for dairy cattle. DairyNZ have identified issues with high stocking density. Differing stocking density recommendations in industry and can cause confusions – this is problematic as high stocking densities have a range of welfare implications for dairy cattle. Providing for grooming still not mandatory despite having an importance that means it should be. Cite paper referring to 20ppm as harmful and recommend change. Also, unclear how exactly ammonia levels are measured on farm and whether farmers actually do this on a regular basis. Current suggestion not very precise and code should require farmers to measure this regularly or to document their measurements. New standard relaxes previous standard which provided where on hard surface for more than 12 hours or more per day for 3 days they had to be provided at least one full day on a suitable alternative surface. 2018	Example indicators on stocking density added. MS added for access to grooming devices. Ammonia limit changed to 15 ppm and RBP to have ammonia meter available. MS added to prevent river stones as surface cover or bedding substrate. MS changed to remove time allowances now requiring: Provision of compressible lying surfaces where dairy cattle kept in off-paddock facilities for more than 12 hour a day for more than 3 consecutive days to ensure MS for meeting behavioural needs satisfied. MS - no river stones as surface cover or bedding material in off-paddock facilities (includes short-term stand-off as per off-paddock facility definition) RBP added that dairy cattle should not be stood off on hard surfaces such as concrete/stones.

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
			code provided further protection by referring to the kind of surface on which cattle are kept rather than referring to the off-paddock facility. Removal is difficult to reconcile with need to have access to compressible surfaces for lying down. Where hard surfaces such as concrete or raceways are used for periods of 12 hours or more each day for consecutive days welfare will be compromised. No restrictions on the type of surface dairy cattle may be kept on. Practice of using stones for bedding in relation to calves is still an option permitted by the code, this should not be the case. The importance of play should be recognised in a MS and use of stones for bedding should not be permitted so as to avoid limiting play.	
MS 9 Managing dairy cattle in off-paddock facilities	8	MS re 16 hours for more than 3 consecutive days. This is a long time for cows to experience suboptimal lying conditions or inability to lie. This is neither a welfare oriented standard nor preventative of injury and infection and we recommend the standard to be improved.	Prohibit tie stalls explicitly; Code silent on individual housing of calves; FARMS offer: calves housed in groups or, at a minimum, pairs until 8 weeks of age. Minimum light and dark duration – cows require 6-8 hours sleep so this should be supported in the housing system. Opposes zero grazing where temporary indoor housing is employed then a MS for exercise areas is recommended. Overstocking cubicles provides benefits while understocking has significant impacts in	MS clarified no tethering other than for routine procedures. Example indicator added to behaviour MS to state calves reared with at least one suitable companion. MS on lighting reviewed MS for access to pasture or suitable area where off-paddock long-term (longer than traditional wintering) – 2019 amendment; RBP changed so that dairy cattle should be given the choice to access pasture on a daily basis.

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
			displacing cows. We recommend MS for ratio of cows to cubicles be aligned with FARMS which advocate at least 5-10% more cubicles than cows. RBP says 10% and NZ Farm Advisory says 20% so farmers appear pre-socialised to this advance. Existing MS very basic in terms of housing, cubicle design, dimensions and bedding although there is substantial science recommending cubicle design and minimal depth, preferable substrates and of course maintenance of bedding.	MS adjusted to require 10% more cubicles than animals housed, and RBP 20% MS outcome-based hence not prescriptive regarding cubicle design, but have added "including sufficient width to lie comfortably and sufficient lunge space" and clarified that other MS for off-paddock facilities also apply to free-stalls.
Part 6: Husbandry Practices				
MS 10 Stock handling	1		Consider adding: • Handling should foster positive relationship between animals and humans • More emphasis on herd management and husbandry procedures that do not unnecessarily compromise social activity or isolate animals • Check lactating animals for abnormal milk and udder health at every milking (under health?) • Hoof trimming to be done by competent trained operator or farrier if hoof length or shape is abnormal and causing lameness • Freeze branding should not be used for permanently identifying animals • Appropriate BCS for cows and heifers at calving and preparation and management	RBP added for fostering positive relationship MS to not unnecessarily isolate animals MS for lactating cows to be checked for udder problems at every milking MS health requires persons in charge to be competent in prevention, identification and treatment incl lameness and mastitis and example indicators added RBP on freeze branding not to be used BCS for calving in example indicators MS off-paddock facilities requires that the stocking density and facility design and

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
			for the transition between pregnancy and lactation • Provide quiet and hygienic place where cows can give birth (see MS 9)	management must allow dairy cows to separate themselves for calving, or they must be separated to another area for calving RBP behaviour MS recommends dairy cattle should have the choice to access meaningful places to separate for calving, such as appropriate hides in intensive pasture settings or separate calving pens in off-paddock situations.
MS 10 Handling	8		Electric prodders - current threshold not acceptable. Limit should be 200-300kg. Prohibit use of electrified backing gates.	Proposal to amend prodder regulation as part of Transport and Commercial Slaughter codes review. Electrified top and backing gates suggested for prohibition via regulation
MS 10 Stock Handling	8		Should prescribe specific training requirements. We understand that other less painful and dangerous methods can achieve the same effects as lifting or twisting animal tails or pushing them with vehicles. Put RBP into MS. …must not be prodded in sensitive areas … including udder, anus, genitals, ears, nose and eyes. The use of electric prodders should be much more closely regulated including specifying max voltage and requiring multiple applications to be spaced in line with Humane Slaughter Association.	MS are outcome based and if person is competent should not matter whether training via a course or on the job. Added RBP that stockperson competency should be assessed by an accredited training provider. MS to address tail treatment and example indicators added. RBP that should only be handled where unavoidable and that annual tail audits should be undertaken by a veterinarian. Added MS that dairy cattle must not be prodded or struck in sensitive areas in general (without reference to goads specifically).

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
			RBP on electric prodders unclear. It could be interpreted as allowing the use of electric prodders on animals under 150kg if they are stubborn or recalcitrant.	Proposal to amend prodder regulation as part of Transport and Commercial Slaughter codes review
MS 10 Stock Handling	8		Add positive attitude to dairy animals into MS in addition to competence etc. RBP on tail twisting into MS and excessive use of electric prodders into MS as easily abused. Opposed udder flaming as unnecessary and substituted with other hygiene tools.	Added RBP that handling should foster a positive relationship between the animals and persons in charge and other staff. Added example indicator for calm patient behaviour MS to address tail treatment and example indicator and RBP added Proposal to amend prodder regulation as part of Transport and Commercial Slaughter codes review Udder flaming covered under equipment use MS requiring that farm facilities, equipment and technologies used with animals must be designed, constructed, maintained and used in a manner that minimises the likelihood of distress, pain or injury to animals. Example indicator under MS 16 - Milking added that udder hair removal does not cause injury
MS 10 Stock Handling	8	Code needs to encompass modern technologies now and into the future and the interplay or lack such have with stockpersons, welfare and disease monitoring. Benefits and advantages of such technologies must be		Information added to introduction section and under MS on facilities, equipment and technologies.

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
		understood and considered in light of motivations and the threshold and decisions for actions		MS added where dairy cattle do not adapt to new technologies they must be provided with alternative management.
MS Droving	8		Inserting following sentence into MS would be helpful: Animals must be moved at such a pace where they can see where they are going and where to place their feet.	Added to MS on stock handling
MS 12 Restraint	1		Suggest remove reference to electro-immobilisation and consider banning via regulation, OIE state it should not be used	Recommend to prohibit via regulation.
MS 12 Restraint	3	Re-assess electroimmobilisation devices? Ensure electromobilisation is clearly considered i.e. the physio-like husbandry aids versus the more aversive StockStill system.		Recommend to prohibit via regulation
MS 12 Restraint	8		Electroimmobilisation devices should be prohibited or at the very least restricted to vet only use to reduce risk of incorrect use and the temptation to use as substitute for appropriate pain relief.	Recommend to prohibit via regulation
MS 12 Restraint	8		It is very problematic that cows may be tethered indefinitely and only inspected every 12 hours. There should be limits to how long a cow can be tethered. Problematic that electroimmobilisation devices may be used by those not fully conversant with safe operating procedures. EI devices are designed and used to prevent animals from exhibiting normal responses to pain…temporarily paralyse animals to allow handlers to carry out painful husbandry procedures. Reference to demonstrating normal responses to pain is contradictory.	MSs added to clarify requirements around tethering including inspection times and time limits where animals cannot exercise. Recommend to prohibit via regulation

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
			Recommend EI devices be prohibited or at the least RBP should be modified and incorporated into MS: operators must be fully conversant with and follow safe operating procedures, EI devices must only be used in adult cattle. RBP should include that EI devices be checked by registered electrician at least once a year and must not be used if found to be faulty (MS).	
	8		Opposed electroimmobilisation; archaic and unnecessary technologies can readily be replaced by chemical restraint.	Recommend to prohibit via regulation
MS 13 Identification	8		Hot branding must not be used without first administering effective pain relief and allowing for sufficient time for it to come into effect. Animals must not be branded on sensitive areas such as the head, prohibit hot branding in situations where less painful alternatives are suitable. Competent operator should be clarified along with training or skills required.	Hot branding prohibited via regulation from 9 May 2021 MS includes not to be freeze branded on the head or udder. MS clarifies competency requirement for identification techniques, competent added to schedule of interpretations and definitions.
	8		Oppose hot branding	Hot branding prohibited via regulation from 9 May 2021
MS 14 Milking	8		Include requirement for an annual milking machine test as MS	Yearly test of milking equipment included in MS
MS 14 Milking	8	MS silent on mastitis and drying off	Mastitis key concern and code should provide key leadership (minimum national targets for mastitis)	MS on disease and injury control also covers mastitis, relevant example indicators added

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
Section 6.6 Drying off	8		RBP should be new MS. Recommendations in science publications and by industry such as DairyNZ have not been incorporated, despite the risk such as mastitis e.g. teats disinfected during dry-off, drying off cows if milk yield below 5L/day and maintaining same milking frequency up until dry off	New MS added to cover drying off
Section 6.6 Drying off	8		MS for preparation for drying off and phasing out blanket dry cow therapy.	New MS added
MS 15 Calving in dairy cattle	1	Suggest remove all mention of inductions		MS requiring inductions be done for therapeutic purposes only and after veterinary diagnosis
MS 15 Calving in dairy cattle	6	Prevent animals giving birth on mud		Regulation recommendation added to provide calving cows with a compressible well-drained surface and effective shelter at least 14 days prior to the scan-dated calving date to prevent calves being born into mud.
MS 15 Calving in dairy cattle	8	Consider RBP to be incorporated into MS. Dystocia significant issue in dairy industry as high as 10-15%. Code of Welfare should specifically address the issue of dystocia and how this may be addressed.	Heifer mating as large calves can cause significant damage. RBPs into MS: inspect once every 12 hours. MS should include inspection by trained and competent operator as issue of dystocia is not addressed in the code but is prevalent in dairy cows and needs adequate and competent supervision. BP to inspect cows around calving every 6 hours Into MS that induction must not be used for non-therapeutic reasons.	MS changed to require inspection by a trained and competent person once every 12 hours MS added under Mating, Semen Collection and Reproductive Procedures that dairy cattle must be of suitable age, size, health and condition to experience pregnancy and calving. MS on inductions for therapeutic purposes only after veterinary diagnosis. Regulation recommendation added to provide calving cows with a compressible well-drained surface and effective shelter at least 14 days

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
			Include MS requirement that inductions not be undertaken to manipulate calving patterns and only used to treat particular health problems in individuals. RBPs into Ms! Animals should never be giving birth on mud.	prior to the scan-dated calving date to prevent calves being born into mud.
MS 16 Caring for recumbent cows	1		Suggest providing more information about time spent lifting, using chest strap, moving a down cow with a tray etc Cows unable to stand must be kept on compressible ground.	MS updated to include care of recumbent cows and additional requirements around moving cows and use of lifting devices.
MS 16 Caring for recumbent cows	3	Recumbent cows – hip clamps – clarify that cows cannot be transported even over short distances – use alternatives to get them into shelter		MS updated to include care of recumbent cows and additional requirements around moving cows and use of lifting devices
MS 16 Caring for recumbent cows	8		Incorporate RBP into MS: must receive veterinary attention within 48 hours if not able to stand and must be kept on compressible ground	MS updated to include care of recumbent cows and additional requirements around moving cows and use of lifting devices 24 hours added
MS 17 Calf management	8		Cow-calf separation contentious issue. Calves should be reared with their mothers and would like to see natural rearing as recommended best practice. And to include RBP on two-stage weaning or other proven method for de-coupling weaning and separation to reduce stress.	Calf management section incorporated into other relevant sections throughout the code, including reference on cow-calf separation.
MS 17 Calf management	8	RBP "Cows should be kept out of sight, sound and smell of newly weaned calves." This was thought to minimise distress through	The standard of competency required for handling and killing calves should be set out and specified.	Calf management section incorporated into other relevant sections throughout the code, including reference on cow-calf separation.

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
		encouraging the early separation of cow and calves as separation distress was argued to be greater the longer the cows and calves are allowed to stay together. This is contested.	Despite new regulations there are still major unaddressed welfare issues pertaining to bobby calves: separation, slaughter. Many of them do not appear to be fit for transport (20% prevalence of dehydration, faecal soiling, increased respiratory rate and ocular/nasal discharge).	Some new MS added to transport selection to ensure fit for intended journey. New MS related to colostrum management and feeding of calves, twice daily inspections under MS on Disease and Injury Control
Section 6.11 Selection of Animals for Mating	1		RBP Add health and welfare considerations to point a	MS added that dairy cattle must be of suitable age, size, health and condition to experience pregnancy and calving.
Section 6.11 Selection of Animals for Mating	8		Code to address selectively breeding dairy cattle in order to maximise milk yield and the health impacts of this. None of the issues identified by selective breeding paper are addressed in the code. Code states it applies to any bull brought onto farm or kept on breeding centre but code itself does not say anything about the management of bulls or mating procedures. Should have MSs. RBP should form MS.	MS on selection and breeding added that the animal welfare impacts of animal selection and breeding objectives must be monitored for favourable and unfavourable consequences, and the results incorporated into future objectives. MSs added for bull management under Mating, semen collection and reproductive technologies.
Section 6.11 Selection of Animals for Mating	8	Proactive and measured approach to genetic selection and balance welfare traits such as reduced lameness, mastitis, better udder conformation, calm temperament and avoid excessive production, increased risk of infection, antibiotic use and early and high culling rates.		MS on selection and breeding added that the animal welfare impacts of animal selection and breeding objectives must be monitored for favourable and unfavourable consequences, and the results incorporated into future objectives. RBPs added

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
		Suggest use of FARMS standard: Dairy cows must not be bred for excessive milk yield and should be well adapted to the local climatic, nutritional and disease conditions. Other issue industry must tackle is wastage and welfare issues associated with unwanted female and male calves.		RBP under Calf rearing added: calves not raised as replacements should be raised for beef production wherever possible.
Section 6.12 Pregnancy Examinations	1, 5	Align with sheep and beef code	Suggest to expand to • include reproductive procedures, including semen collection (bulls and teasers) that are not going to be covered by regulations • Should be undertaken by trained and competent operators	MSs added for bull management under Mating, semen collection and reproductive technologies.
Section 6.12 Pregnancy Examinations	5	Focus on the outcomes for the animal by the code reflecting the following: • The specialised training, skill and competency of personnel undertaking the activity with the animals. The training and handling of animals to maintain their safety and minimise their stress during the activity.		MS added that pregnancy examinations must be undertaken by trained and competent operators in a manner that does not cause unnecessary injury, pain or distress to dairy cows/heifers.
Section 6.12 Pregnancy Examinations	8		Reference to trained and competent operator but no guidance as to what is required in order for someone to be considered trained and competent. MS in light of potential issues such as rectal perforation No MS but should have one. RBP could form MS.	MS added that pregnancy examinations must be undertaken by trained and competent operators in a manner that does not cause unnecessary injury, pain or distress to dairy cows/heifers. Definition for competent person added

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
Section 6.13 Painful husbandry procedures	8		Castration younger than 6 months without local anaesthetic problematic due to pain caused. Code permits use of hot branding but does not specify what the pain relief should consist of, which is problematic in view of NAWAC's comment that it should be addressed by regulations. NAWAC did not discuss science behind including ear tagging and freeze branding in the code without requiring pain relief or anaesthetic and did not discuss the science behind pain relief required in relation to hot branding. Where pain relief is to be provided code should expressly stipulate that it must be given in a quantity that actually provides relief from pain.	Castration regulation will be reviewed as part of the Sheep and Beef Code review. Hot branding prohibited via regulation from 9 May 2021 Added RBP that freeze branding should not be used and effective pain relief should be provided for identification procedures.
Section 6.13 Painful husbandry procedures	8	Current Ms woefully behind current science, the current code allows for the following practices all shown to generate substantial pain and or tissue damage: caustic/chemical techniques, disbudding without analgesia, dehorning by lay person up to 9 months without analgesia, dehorned older than 9 months by lay person without analgesia;	MS needed to prohibit dehorning unless required for animal's health/welfare; and then only by qualified veterinarian MS should prohibit use of caustic chemicals for disbudding is strongly recommended. Permit disbudding only to a certain age; science shows pain management best achieved with analgesia and anaesthesia better still sedation prior for best placement. Should use to polled animals	Regulations 57 and 58 require pain relief for dehorning and disbudding. Covered under Painful Husbandry Procedures Code.

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
			FARMS: Anaesthesia and prolonged analgesia must always be used when disbudding which must be carried out at an early age (i.e. by 3 weeks of age)	
Section 6.14 Pre-Transport selection	1		RBP Clarify and expand on point c Add recommendations regarding standing off, recommend drying off cows Suggest add info on veterinary certificates	RBP expanded, rest period and drying off prior to transport added
	3	Transport and late pregnancy – from run-off back to farm		Late pregnancy covered under regulation
	8		Add MS for shade and shelter to be provided for all animals while in holding pens (not just calves), especially during extremes of weather.	MS added that adequate shelter must be provided for dairy cattle in collection areas during extremes of weather
	8		RBP into MS: Collection areas must provide shelter and comfort for all animals and easy access.	MS added that adequate shelter must be provided for dairy cattle in collection areas during extremes of weather
	8		Duration of journeys and length of time calves can be without food is inappropriate and inhumane	Regulation requires calves to be fed 2 hours prior to transport and regulation limits time to slaughter. Comments noted for Transport and Slaughter code reviews
Part 7: Health				

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
MS19 Health	1		Consider adding: • more emphasis on seeking veterinary advice when animals are sick or injured	MS requiring animal health and well-being plans and working relationship with vet required.
MS19 Health	1	Tail condition: don't know level of tail issues and how much damage	Recommend farmers to keep a record of tail damage and associated vet care and further research into incidence and cause of tail injuries and provision of advice to famers on tail management	RBP under Handling MS that an annual herd tail audit should be undertaken by a veterinarian to assess tail health and relevant action should be taken as appropriate.
MS19 Health	6	Prevent mass mortality events on winter grazing systems		Updated MS Food to require transition between feed and no abrupt diet changes. Relevant EIs added
MS19 Health	8		MS to have an animal health plan including for lifestyle properties	MS added
MS19 Health	8	A range of health issues are not addressed including in relation to lameness, metabolic diseases, mastitis, Johne's disease and broken shoulders.	Provision of adequate training to staff in relation to identifying and acting on lameness should be included in the MS.	MS updated and relevant example indicators and RBPs added Disease and Injury control section applies to all issues
MS19 Health	8	Note global and long standing welfare concerns of lameness and mastitis and related antibiotic use and bacterial resistance risk. Underling issues should be resolved as overuse of antibiotics is of concern.	Recommends MS targets for farms for mastitis and lameness to achieve national improvement FARMS: Effective management programmes must be in place to minimise mastitis and lameness Lameness prevalence should be kept below 10% Mastitis incidence should be kept below 25 cases per 100 cows per year.	Added comment on antibiotics use. Example indicators refer to mastitis and lameness

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
			This suggested MS can be bolstered with others recommending a welfare balance with genetics, improved facilities, husbandry and strengthened farm health plans with antibiotic use targets.	
Section 7.2. Lameness	1		MS on lameness including separation and limited walking, getting professional advice when no response to initial treatment or condition worsens; RBP competence in lameness scoring or proficiency in identifying lame cows	Lameness covered under MS Disease and Injury Control and relevant EIs and RBPs
	8	Lameness serious welfare concern. Code should specify target threshold for acceptable level of lameness in a herd. Although setting such a threshold may result in unintended consequences (resulting in lame animals on farm when there should be none).		Added to example indicators in Disease and Injury Control section
	8	No MS provided. Problematic given lameness is clearly contrary to a cow's physical and health needs. Code does not recognise that spending too much time off-paddock on a hard surface during pregnancy and early lactation can lead to lameness.	Provision of training staff in relation to identifying and acting on lameness could be included as a minimum standard. Animals close to shed gives space and reducing amount of walking. This could be included as a MS.	Covered under MS disease and Injury control with relevant EIs and RBPs. RBP in off-paddock facilities section to recommend dairy cattle not stood off on hard surfaces.
Section 7.3 Animal Health Plan	1		MS Requirement for primary care relationship with one vet practice Consider adding: More details under health plans including prevention and control of disease through	MS added

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
			biosecurity measures, adequate farm layout and good management including monitoring and prophylaxis	
MS 20 Emergency humane destruction	1		Add information on non-emergency euthanasia especially where animals are not fit for transport	MS on humane on-farm killing updated
MS 20 Emergency humane destruction	3	Do animals need to be bled out post-shot or blow to the head or do biosecurity and pelt concerns still stand? Do we need MS?		Added secondary procedure into MS but may be pithing, bleeding or shot.
MS 20 Emergency humane destruction	3	On-farm slaughter euthanasia – update all best practices		MS updated, example indicators added,
MS 20 Emergency humane destruction	4	Clarification around captive bolts – currently refers to firearms does that mean need a license?		
MS 20 Emergency humane destruction	4	Death confirmed as “no sign of heart beat”, lack of rhythmic breathing, no blinking, fixed dilated pupils and no muscle tone more accurate signs		Covered in introduction of on-farm humane killing section
Part 8: Quality Management				
	1		RBP: Consider instituting a whistle blowing process	RBP added to MS Welfare Assurance system
	3	Update/upgrade welfare assurance sections – can we require “systems to ensure compliance”?		
	8		Very vague and uncertain and should impose at least some high level MS. Suggest that if there is a situation where more than one cow has died under what seems to be similar circumstances then the quality	New MS added including example indicators and new RBPs

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
			assurance system should state that the report should be forwarded to the appropriate body to explain what happened and how this can be avoided in the future. It would be helpful to have further guidance or examples of what is meant by “implications for current industry management practices”.	
	8		Recommend FARMS: Demonstrate compliance with the above standards via annual third-party auditing and annual public reporting on progress towards this commitment. To bolster the RBP the AssureWel dairy information could be helpful as it provides useful explanations of the main welfare outcomes relevant to farmers and assurance. The new code could demonstrate leadership to connect Quality Management with consumer	New MS added including example indicators and new RBPs
Suggested additional sections				
Emergency preparedness	3	Emergency procedures – extraction from mud	International best practice which specifically highlights the risk and animal welfare issues with using neck, leg and tail traction. Best practice is to use wide strops around the torso of the animal to spread the load as well as using water/air to release the suction of the mud before trying to extract them. If suction isn’t released it can cause significant injuries to the hoof and legs.	MS on emergency management added including relevant example indicators and RBPs

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
			Also assess what else is going on, how did they get stuck? Metabolic issues?	
Emergency preparedness	6	Avoidable deaths in adverse weather events Prevent mass mortality events on winter grazing systems Ability to readily move animals to shelter/dry land in adverse weather before harm occurs		MS on emergency management added including relevant example indicators and RBPs
Saleyards		In line with sheep and beef code and others where animals go to saleyards (goats? Deer? Horses? Pigs? Alpaca/llama?)	Include section on saleyards?	Stated that code applies to dairy cattle in saleyards.
Selective breeding	2	Selective breeding paper		Added section on selection and breeding including a MS, example indicators and RBP
Climate change	1	More heat stress for longer/humidity; increased disease eg facial eczema, risk new vector borne diseases, droughts and lack of reliable water supply	Covered under shelter, health management and adverse events Do not need separate section	MS on emergency management added including relevant example indicators and RBPs
	1	Relevance to climate change?	Suggest adding: • Animals chosen for introduction should be suited to the local climate and adapted to or able to adapt to local diseases and parasites	RBP for MS Selection and Breeding Animal genotype should be appropriate for its environment and adapted to or able to adapt to local climate, diseases and parasites.
Climate change	3	Impact of climate change effects to be considered in standards (see UK RSPCA dairy cattle standards) heat, drought, flooding, sea level risk, storms disease/parasites impacted		MS on emergency management added including relevant example indicators and RBPs
Sentience and good welfare	1		More behavioural indicators of good welfare in all relevant parts of the code	Added
	1		• More emphasis on meeting behavioural needs and the use of animal-based	Added

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
			measures is included in all sections of the code • code updated to include behavioural considerations, information to ensure that cows get sufficient time to eat, lie down and socialise each day	
	2	Inclusion of animal sentience, positive experiences		Added
	8	MS to provide for positive behaviour and mental states to move towards opportunities for a good life for dairy animals, clear prohibition of the scientifically proven negatively impacting aspects of certain dairy systems and areas where welfare issues underlie overuse of antibiotics and risks for antibiotic resistance as well as environmental concerns.		Added several MS, example indicators and RBP
Cow-calf separation	1	Cow welfare versus calf welfare/emerging reputational issue/little information available on pros and cons, on health and welfare/sentience of cows and calves in response		Issue covered in code review evaluation report
More attention to calves	4	Current codes provisions for calves centred as only a by-product of milk production and as such, are limited to bobby calves; their slaughter and transport. The majority of dairy farms raise calves for replacement heifers or grow them as beef cattle. There are also commercial scale calf rearing farms that purchase calves at a few days old and raise them. Currently there is a large gap in the Codes of Welfare when it comes to calf health, environment and their welfare.	Consideration should be given to the future production type (dairy or beef) and the application of minimal standards for calves to both Codes of Welfare.	Separate calf rearing section to highlight relevance of code to calves; EIs related to calves added throughout code to highlight that full code applies to calves

Code section	Source	Support/issue/ suggestions	Recommendation for MS/RBP/general info or comments	NAWAC Proposals
Emerging technologies	1	Don't know enough, too early to consider		MS on Facilities, equipment and technologies and reference to emerging technologies
Certification scheme	1	NZ MSs need to be met and if aligned with international standards will assist in ensuring NZ standards sufficient to meet requirements of most certification schemes		New MS added for Quality Assurance System, including EIs and new RBPs
Farm planning	6	Animal welfare to be considered as part of farm planning alongside environmental management (begin planning before winter season begins and before crops are planted)		Included MSs on health and well-being plans, contingency plans and quality assurance systems
Lifestyle blocks	8	Main issues are that owners/persons in charge are not aware of their obligations under the Act and lack of basic awareness of cow husbandry (not knowing what to provide/look out for or when to take appropriate action).		

Appendix 3: References

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