Final report

Feedlot animal welfare benchmarking

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1. Abstract

The objective of the project was to develop a framework of animal welfare benchmarking measures that can then be used by beef cattle feedlots to measure their welfare performance and track it over time, enabling animal welfare validation and improvement. Following a scientific review and consultation with the industry, a pilot framework of welfare measured was trialled over 7 months in eight feedlots in Queensland, Western Australia, and South Australia. Feedback from the feedlots involved and analysis of the data were used to refine a final proposed framework of animal welfare benchmarking measures to be available to the feedlot industry. Further research and development was recommended to enable electronic data collection and subsequently adoption for wider data collection to analyse industry-level data from welfare benchmarking and to identify target thresholds or the development of standards for feedlots. The implementation of an evidence-based and broadly accepted animal welfare benchmarking framework will enable feedlot producers to track their performance in animal welfare over time, and for the feedlot industry to further demonstrate its commitment to good animal welfare management.

2. Executive summary

2.1 Background

There is a perception that animal welfare is reduced under intensive animal farming systems compared with extensive or free-range systems. Because beef feedlots are an intensive system, in which cattle are confined and stocked much more closely together than pasture-fed animals, the feedlot industry is at risk of being presented and targeted on the basis of adverse animal welfare perceptions. One strategy to respond to such conceptions is to have evidence-based animal welfare benchmarking. This can be either outward-facing – where data are provided to customers and beyond; inward-facing – where data are used by a feedlot operation to track its own performance and enable improvements; or a combination of both.

2.2 Objectives

The project objectives were to:

i) Review major systems for animal welfare benchmarking in feedlot and relevant intensive livestock industries including their adoption rates, strengths & weaknesses. Note that this objective will include review of the current live export projects as discussed above, and their suitability to be adapted to a feedlot environment.
ii) Determine in consultation with ALFA and MLA the adoptable outcome for animal welfare benchmarking for the Australian feedlot industry.
iii) Determine in consultation with ALFA and MLA the transparency of the system to wider industry and customers.
iv) Determine the certification requirements in consultation with ALFA and MLA.
v) Consult industry, retailers, and animal welfare experts for appropriate criteria for objective measurement of animal welfare.
vi) Determine a list of measures and potential metrics, and potential thresholds (where possible) that encompasses animal welfare requirements and address key consumer concerns. These measures will be initially derived from the scientific literature and be evidence-based where possible and refined by consultation with feedlot stakeholders.
vii) Determine an index for meeting appropriate animal welfare on Australian feedlots.
viii) Develop pilot 'manual capture templates' and protocols in consultation with an experienced feedlot manager and train feedlot staff on collection of measures prior to commencement of the pilot.
ix) Pilot measures in seven feedlot supply chains and recommend the final framework to industry.
x) After completion of piloting make recommendations (where possible) of standardised assessment protocols for facilities, handling, transport, feeding including number of cattle/pens/trucks to be assessed.

2.3 Methodology

Following a scientific literature review of animal welfare benchmarking measures and relevant international programs, extensive industry consultations were held, including receiving feedback on a draft framework of welfare measures for feedlots. Once this set of measures was refined, a Pilot

program was undertaken, involving the research team collecting monthly data across four feedlots in southern Australia, and feedlot operations separately piloting the data measurement themselves (three feedlots in Western Australia and four feedlots in Queensland). Data from the pilot program were examined and analysed to identify the most appropriate measures (in terms of relevance to welfare, practicality, and feasibility), and to determine the appropriate sampling frequency and sample sizes to assess animal welfare within a feedlot operation.

2.4 Results/key findings

Despite delays and logistical challenges imposed by COVID-19 restrictions, the pilot program was enacted over seven months across a total of eight feedlots in Queensland, Western Australia, and South Australia. Four to seven sets of monthly data were collected, depending on the feedlot and location. From the data and analysis, a proposed welfare benchmarking framework was identified. This framework reduces the frequency for collections of some measures compared with the pilot program, based on feedlot feedback around practical challenges in allocating staff time for data collection, but with appropriate data collection timepoints identified through analysis of the overall data for those measures. Recommendations are made for the number of pens, number of handling events to be observed, and the optimal time for collection of data. Due to the variation in feedlot sizes, locations, cattle class and feeding programs in the pilot program, the data derived was not deemed suitable to identify target thresholds for every welfare metric, other than those that are binary in nature, or where established handling criteria target thresholds have been developed in other programs, such as for livestock transport.

2.5 Benefits to industry

The implementation of an evidence-based and broadly accepted animal welfare benchmarking framework will enable feedlot producers to track their performance in animal welfare over time, and for the feedlot industry to further demonstrate its commitment to good animal welfare management and a culture of enabling welfare assessment and improvement.

2.6 Future research and recommendations

Further research and development should focus on developing an electronic data capture platform (e.g., tablet-based), as well as research to analyse data captured over the first 1 – 2 years, based on monthly data capture of the benchmarking program, in order to identify target thresholds for key measures.

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3. Background

There is a perception that animal welfare is reduced under intensive animal farming systems compared to extensive or free-range systems. Many animal interest groups have strong positions against intensive systems where animals are confined, using these conditions as the focus of campaigns. In addition, societal demands for sustainable and ethical animal production systems and practices exist and will likely continue, and therefore the livestock industry must remain proactive in their effort to ensure the welfare of the animals (Ferguson et al. 2014).

Because feedlots are an intensive system, in which cattle are confined and stocked much more closely together than pasture-fed animals, the feedlot industry is at risk of being presented and targeted as a system in which there is inherent animal suffering due to the nature of the production system itself. One of the strategies to respond to such conceptions is to have evidence-based animal welfare benchmarking. This can be either outward-facing – where data are provided to customers and beyond; inward-facing – where data are used by an operation to track its own performance and enable improvements; or a combination of both.

Animal welfare benchmarking itself is not new, and team members involved in this project have been involved in welfare benchmarking projects within the Australian pork and live export industries, and in the development of national and international animal welfare standards and guidelines for various sectors. The feedlot industry itself has systems available through consultant veterinarians that incorporate animal health benchmarking, and there is a close relationship between animal health and animal welfare.

The Australian feedlot industry has been proactive within the red meat sector in developing animal welfare systems, including animal welfare components of the National Feedlot Accreditation Scheme, accredited Animal Welfare Officer training courses, and guidelines for managing animal welfare issues such as pregnant animals. MLA, together with ALFA, have sought to develop an animal welfare benchmarking framework to support feedlot staff and managers in ensuring good animal welfare and ongoing improvement.

Colditz et al. (2014) proposed a Unified Field Index (UFI) which considers a list of welfare measures used by the European Union and modified for Australian industries. Utilising this index as a background can inform the development of a system applicable to the feedlot sector. There is potential for a feedlot-specific benchmarking platform to be developed utilising categories to evaluate the welfare of feedlot cattle; including environment-, management- and animal-based factors. In pre-existing work, a welfare dashboard was developed in prototype by Murdoch University in the live export chain (Project W.LIV.3047; Dunston-Clarke et al. 2020) with the indicators utilised based on the literature and a survey (Project W.LIV.3032) where approximately 74 measures were identified.

Identifying welfare measures that are applicable to the Australian feedlot context is critical. For instance, the Australian climate means that hot environmental conditions may occur, and many environmental, management and animal-based factors influence how cattle cope during a heat stress event (Gaughan et al. 2008; Klopatek et al. 2018). There is a heat load forecast service available to Australian feedlots that allows location, breed, diet, health status and alleviation strategies to be considered over a six-day forecast (Gaughan et al. 2008). However, despite extensive research, the impact of heat stress on cattle and the extent to which heat events impact the affective state, or the emotional dimension of animal welfare remains unknown (Colditz et al. 2014). One approach to try to evaluate this is through Qualitative Behavioural Assessment (QBA) and

derivations, where the affective state of animals can be evaluated (Fleming et al. 2016). Such approaches have been used to assess cattle under land transport (Stockman et al. 2011; Stockman et al. 2013), and extensive and intensive farming systems and lairage (Stockman et al. 2012; Miller et al. 2018), and could be extended to use in feedlots to consider the effect of heat stress, and other feedlot specific factors. Thus, formulating a list of indicators that consider both physical and emotional aspects of cattle are relevant to achieve a holistic, evidence-based, best-practice approach to measuring animal welfare.

This project fits within the framework of the Meat Industry Strategic Plan (Red Meat 2030; RMAC, 2019), whereby capturing and reporting animal health and welfare data is part of the goal of setting a world-class standard for animal health, welfare, biosecurity and production practices. The MLA Strategic Plan to 2025 has an associated key performance indicator of objective measures of animal welfare for feedlots and other production systems, with year-on-year improvement. Moreover, the MLA Meat Industry Strategic Plan (MISP2020; RMAC, 2016) identified "the need to secure consumer and community support, and that demonstrating the 'welfare of animals within our care' has the highest combined forecast value of approximately $3.5 billion through addressing risks to markets and ceasing opportunities".

The ALFA strategic document *Initiatives 2020-2023* outlines a goal of continual improvement of animal welfare practices in the Australian feedlot industry. Thus, the enaction of animal welfare benchmarking, addresses the goals of these industry strategic plans.

4. Objective

4.1 Project objectives

This project addressed ten objectives.

4.1.1 Review major systems for animal welfare benchmarking in feedlot and relevant intensive livestock industries including their adoption rates, strengths & weaknesses. Note that this objective will include review of the current live export projects as discussed above, and their suitability to be adapted to a feedlot environment.

This project objective was addressed within the supplied literature review (Milestone 2; 01-Jul-2020) and the draft of refined benchmarking framework (Milestone 4; 15-Nov-2021) documents.

4.1.2 Determine in consultation with ALFA and MLA the adoptable outcome for animal welfare benchmarking for the Australian feedlot industry.

This project objective is to be addressed by Milestones 6 and 7. The information presented in the current milestone (Milestone 5), specifically Section 7 and 8 that reports the revised protocol and key recommendations, will open dialogue between the research team and both ALFA and MLA, with formal feedback provided from these stakeholders likely via Milestone 6 (01-Oct-2022) facilitating the achievement of this objective. Given the large variety in breed, facility management and environment, focus should be on creating a benchmarking system that categorizes data systematically to better analyse any relationships between outcomes and facilities. Earlier consultations through this project involving the research team and organised by ALFA and MLA produced some clear industry feedback that an internally-focussed framework was preferred in the

first instance, with individual feedlot operations using the benchmarking protocol to measure their own welfare performance over time and target appropriate improvements.

4.1.3 Determine in consultation with ALFA and MLA the transparency of the system to wider industry and customers.

This project objective is ongoing, addressed at the foundation level in the current milestone (Milestone 5), with the concepts presented to be built upon depending on the feedback provided by ALFA and MLA in Milestone 6 (01-Oct-2022). At this point, it is recognised that there are different options for adoption of the revised Protocol outlined in Milestone 5 (Sections 7 – 9) within the Australian lot fed cattle industry, with the feedback provided by stakeholders essential to guide overall direction of this project. At a basic level, it is considered that the steps required to meet transparency to the wider industry and consumers includes three stages:

i. Internal adoption of the revised Protocol for 1 – 2 years (see Section 8) to allow for collection of data representative of the national industry leading to the establishment of appropriate thresholds.
ii. Reporting internally on data using the revised Protocol for benchmarking purposes between feedlots on a national level.
iii. Reporting externally, which can provide transparency to wider industry and customer, and society as required.

As described above, the industry preference that came through the consultation processes during the project, was for an internally focussed framework in the first instance, managed by each feedlot operation to track and enhance its welfare performance.

4.1.4 Determine the certification requirements in consultation with ALFA and MLA.

There exists a variety of certification systems, and further discussion with ALFA and MLA is required to clarify their objectives in terms of certification type that meets the Australian feedlot industry needs. Any assessment protocol can be an on-site educational tool that allows for reporting and benchmarking indictors of welfare and feedlot conditions. It is recognised that applying such protocols under commercial conditions is challenging. To be successful, certification must address both consumer priorities and producer concerns, and should allow for voluntary participation initially with progression to third party audit. All metrics included in any certification must be meaningful with respect to welfare, while being reliable and repeatable, with a protocol that captures the cause of compromised welfare.

The proposed protocol could be utilised in 1) a detailed welfare assessment program where metrics map to welfare principles such as, in the Welfare Quality audit system. 2) an industry driven program such as the US National Cattlemen's Beef Association (NCBA) Beef Quality Assurance (BQA) Program providing certification of animal handling and assessment tools, or 3) certification within a multi-level assurance program using third party verified programs such as Global Animal Partnership (GAP) and Professional Animal Auditor Certification Organization (PAACO). Importantly, the protocol should be utilized as a self-assessment, completed by a second party (i.e., consulting veterinarian, nutritionist, feedlot staff, or another team member) or conducted by a third-party assessor. A key component is that the assessment is repeated on a periodic basis so that comparisons may be made, trends observed, and management actions be taken to maximize animal welfare and feedlot efficiency.

Another discussion point for consideration is how each welfare component could be weighted, e.g., each metric or principle can be signed-off with appropriate vs. inappropriate rating; use of a traffic light system or a score that sums to provide an overall score.

Given the initial industry preference for an internally managed process within each feedlot operation, certification decisions are not currently relevant, unless or until there is a collective decision to move to a more externally-focussed program.

4.1.5 Consult industry, retailers and animal welfare experts for appropriate criteria for objective measurement of animal welfare.

This project objective was addressed within the process that resulted in the finalised draft of refined benchmarking framework (Milestone 4; 15-Nov-2021) in which feedback was received from:

i. Project steering committee;
ii. Specialised ALFA panel;
iii. Private industry consultant; and
iv. Industry consultation following the webinar on 22nd October.

4.1.6 Determine a list of measures and potential metrics, and potential thresholds (where possible) that encompasses animal welfare requirements and address key consumer concerns. These measures will be initially derived from the scientific literature and be evidence-based where possible and refined by consultation with feedlot stakeholders.

This project objective was addressed within the supplied literature review (Milestone 2; 01-Jul-2020) and draft of refined benchmarking framework (Milestone 4; 15-Nov-2021) documents. Components are also addressed within the present document (Milestone 5), with details present under Milestone Objectives 3 and 4 (Section 4.2).

4.1.7 Determine an index for meeting appropriate animal welfare on Australian feedlots

This project provided a suite of measures to provide a holistic assessment tool for capturing welfare per premises; however, further standardised data is needed to develop relevant thresholds, or standards that feedlots can compare their self-assessments or third-party audits with.

4.1.8 Develop pilot ‘manual capture templates’ and protocols in consultation with an experienced feedlot manager and train feedlot staff on collection of measures prior to commencement of the pilot.

This project objective was addressed within the process that resulted in the finalised draft of refined benchmarking framework (Milestone 4; 15-Nov-2021) in which the ‘Feedlot welfare benchmarking framework: Draft for consultation’ document was prepared and published by MLA ahead of the commencement of the Pilot in Nov-2021.

4.1.9 Pilot measures in seven feedlot supply chains and recommend the final framework to industry.

This project objective was addressed within the present Milestone (Milestone 5). The pilot of the 'Feedlot welfare benchmarking framework: Draft for consultation' by seven feedlots commenced Nov 2021 and was completed June 2022 providing six months of data. In addition, the pilot of the proposed 'research measures' outlined in Milestone 4 (15-Nov-2021) by the research team at four feedlots within the same time period provided seven months of data. The results and recommendations based on the outcomes of these two Pilots are outlined in the present document in Sections 5 – 7.

4.1.10 After completion of piloting make recommendations (where possible) of standardised assessment protocols for facilities, handling, transport, feeding including number of cattle/pens/trucks to be assessed.

This project objective was addressed within the present Milestone (Milestone 5), with details present under Milestone Objectives 3 and 4 (Section 4.2).

4.2 Milestone objectives

This milestone (Milestone 5) contains six objectives, which are complete.

4.2.1 Abstract, introduction, objectives, material and methods, statistical analysis, results, and discussion

These components are detailed under the relevant sections:

i) Abstract: supplied in Section 1.
ii) Introduction: supplied in the form of 'Background' in Section 3 as required under the MLA final report template.
iii) Material and methods: supplied in the form of 'Methodology' in Section 5 as required under the MLA final report template. Methodology for the Pilot was separated into two components to address the collection of information by feedlots using the 'Feedlot welfare benchmarking framework: Draft for consultation' protocol (Section 5.1) and the research team using the 'research measures' Protocol outline in Milestone 4 (Section 5.2).
iv) Statistical analyses: supplied in Section 5.3.
v) Results and Discussion: supplied in Section 6 and Section 7.

4.2.2 Results of the pilot program

The results of the Pilot are outlined in Section 6. The Pilot was separated into two components:

i. Feedlot Pilot: results detailed in Section 6.1.
ii. Research Pilot: results detailed in Section 6.2.

4.2.3 Recommendations of the final benchmarking framework to industry

Recommendations of the final benchmarking framework to industry are outlined at two levels:

i. Recommendations related to individual metrics collected on the basis of the two Pilots are presented and discussed in detail within the relevant Results sections (Section 6.1 and Section 6.2).
ii. Overall recommendations regarding the Protocol including overview of metrics incorporated within a revised Protocol and key details on sample size are detailed within Section 7.

4.2.4 Recommendations of standardised assessment protocols for facilities, handling, transport, feeding including number of cattle/pen/trucks to be assessed

Recommendations of standardised assessment protocols are outlined in the following sections:

i. Recommendations related to Feedlot Pilot sections (facilities, handling, transport, feeding) are presented and discussed in detail within Section 6.1.
ii. Recommendations related to standardised pen-side assessment protocols including the number of pens and timing of pen assessments are presented and detailed in Section 6.2.
iii. Overall recommendations regarding the Protocol including overview of metrics incorporated within a revised Protocol and key details on sample size and frequency are detailed within Section 7.

4.2.5 All project data and meta-data delivered to MLA in Microsoft Excel format

The project data and meta-data are available to be supplied to MLA

4.2.6 Statistical analysis files

The statistical analysis files (data files and output reports) are available to be supplied.

5. Methodology

5.1 Feedlot collected data

Seven beef cattle feedlots, three sites in Western Australia and four sites in Queensland, were selected to participate in the Feedlot Welfare Benchmarking Framework Pilot. Five feedlots had capacities < 10,000 head, and two feedlots had capacities close to 20,000 head. The sites were selected to be a representative sample of enterprises in eastern and western Australia. Industry contacts allowed for initial contact to be made with the feedlot owners and managers by members of the research team. Feedlots were enthusiastic in their willingness to be involved. Feedlot veterinarians were also contacted to help with the rollout of the pilot on Queensland sites and to provide onsite guidance and technical assistance to feedlots, although feedlot staff undertook all the data collection.

The Pilot involved the collection of data by way of filling out questionnaires, observing animal behaviour and workplace operations and logistics performed by feedlot staff. Some of the data involved was already collected by feedlots as part of their operations. The intention with the pilot was for participating feedlots to complete all the Sections objectively without fear of negative consequences. The pilot was pitched to feedlots as being a ‘self-assessment tool’.

The Pilot framework, outlined in the 'Feedlot welfare benchmarking framework: Draft for consultation' document created by MLA was divided up into nine sections:

1.0 Static feedlot information – collected once
2.0 General facilities – collected twice, 6 months apart
3.0 Transportation
    3.A Loading assessment – collected monthly
    3.B Unloading assessment – collected monthly
4.0 Feedlot induction – collected monthly
5.0 Definition for monthly pen assessments
    5.A Pen welfare measures – collected monthly
    5.B Pen static information – collected monthly
    5.C Monthly assessments at feedlot level – collected monthly
6.0 Husbandry welfare practices – collected monthly
7.0 Nutrition and feeding information – collected monthly
8.0 Other animals – collected monthly
9.0 Abattoir feedback – collected monthly

The number of times that specific sections needed to be repeated was dependent on the size of the feedlot (see Appendix 1 for details).

Sections 1.0, 2.0, 6.0, 7.0, 8.0 and 9.0 mostly involved collating electronic data records, assessing plant and facility functionality, and confirming the presence and use of protocols. Animal observations were a minimal part of these sections, and many items were scored as 0/1 or Yes/No.

Sections 3.0, 4.0 and 5.0 involved the most animal observations. In section 3.0, animals were observed when loading or unloading from transportation. Section 4.0 involved the observation of animals moving through laneways, races, and crushes. Section 5.0 involved the observation of animal behaviour in their home pens at four timepoints throughout the day, with the number to be assessed dependent on feedlot size.

Feedlot staff were trained in the collection of the data and the structure of the recording tables before the pilot commenced.

The full measurement template is presented in Appendix I.

5.2 Research collected data

The piloting of the draft Protocol by the research team under field conditions was conducted to address Project Objectives 9 and 10 (see Section 4.1). Specifically, this Pilot enabled the reduction of the total number of metrics through the removal of duplicative or redundant metrics, and the simplification of metrics where appropriate to present a revised Protocol. In addition, this Pilot allowed:

i) Determination of appropriate pen sample size,
ii) Suggestion of appropriate timing of pen-side assessments,
iii) Enabled comment and, where appropriate, recommendations on select metrics,
iv) Testing of alternative and/or novel approached to capture welfare relevant information.

5.2.1 Feedlots and focal pens

Piloting of metrics by the research team was conducted at four commercial feedlots from November 2021 to June 2022 (referred to as the Pilot from here, Fig. 1). Three sites were located in WA and the remaining site in SA. The WA sites enrolled in the Pilot were those enrolled in the feedlot pilot (see Section 5.1). Feedlots A – C were visited each month for the duration of the pilot resulting in seven visits per feedlot, whereas delays resulting from COVID-19 travel restrictions resulted in only four visits to Feedlot D (Fig. 1). During each feedlot visit, six to nine focal pens were assessed resulting in a total of 208 observed pens over the duration of the Pilot (Table 1).

Figure 1. Monthly pilot visits to Feedlots A – D.

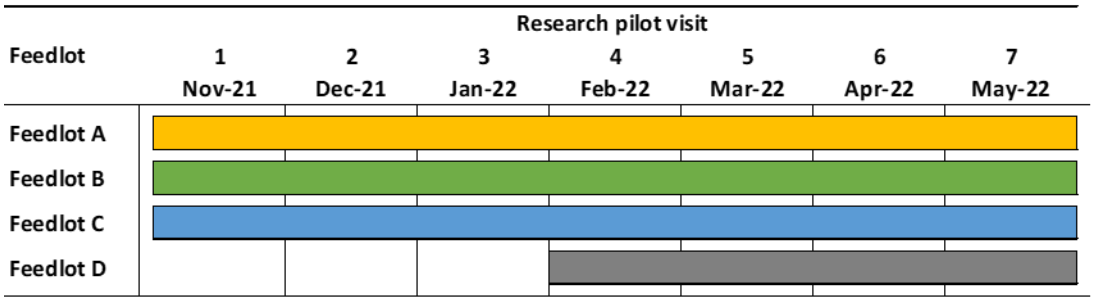


Table 1. Number of research pens by visit number for to Feedlots A – D.

Pilot visit	Sample month	Feedlot				Total
		A	B	C	D	
1	Nov -21	8	9	7	-	26
2	Dec - 21	9	8	9	-	26
3	Jan - 22	9	9	9	-	27
4	Feb - 22	8	9	9	6	32
5	Mar - 22	9	9	9	6	33
6	Apr - 22	9	9	9	6	33
7	May - 22	9	9	9	6	33
Total		***61***	***62***	***61***	***24***	***208***

Considering the animals within the observed pens across different visits (i.e., repeated observation of a pen of animals), a total of 94 'individual' pens were observed across the pilot (Table 2). Briefly, observed pens that contained all or a large number (> 30%) of the same animals observed during the previous visit were considered to be repeated pens, and thus allocated the same 'individual' pen for analysis (Table 2). Efforts were made to monitor the same observed pens across consecutive visits, however, cattle movement within feedlots occurred and many cattle completed their feeding program and exited the feedlots during the Pilot. Consequently, of the 94 individual pens, only 56 individual pens containing the same animals were observed at over more than one visit (range: 2 – 7 visits). The remaining 38 individual pens were observed only once during the Pilot.

Feedlot-specific commercial and infrastructure constraints meant that the total number of head per observed pen varied within and between feedlot sites, averaging 128.4 ± 52.9 head/pen (range: 34 – 265 head/pen). A maximum of 16,286 head of cattle were monitored during the Pilot. This does not completely capture the extent of repeated observations of the same individual cattle within observed pens across the seven visits with the exact individual cattle numbers in each observed pen, or lot no. within the observed pen, not always made available to the research team. An estimated

10,000 head of cattle (61%) were observed once, with the remaining 39% of cattle observed during multiple visits. Due to differences in livestock management and targeted market categories, observed pens consisted of cattle of mixed class, age, and background. All routine feedlot operations were conducted as per their normal commercial activities, with the management of observed pens undisrupted by research activities.

Table 2. Pens observed during the Pilot including description.

Pens	Number (no.)	Description
Observed pens	208	The total number of pens observed across all four feedlots over the duration of the Pilot. Each observed pen was assessed at four time points per visit resulting in a total of 803 pen observations. Pens considered when discussing pen-side behavioural observations.
Individual pens	94	The number of pens considering repeated observations of the same cattle within observed pens across the seven visits. Pens considered for the analysis pen-side data to address questions surrounding sample size and assessment time point.
Physical feedlot pens	69	The number of physical pens at the four feedlots in which the observed pens were housed. Pens considered when discussing static pen and resource information metrics with the exception of metrics calculated on the basis of head in pen (e.g., stocking density/feed access/water access).

A research pen was selected at the beginning of each feedlot research visit, prior to commencement of any assessments. Pens were chosen to capture a representative range of:

i) Breeds;
ii) Feeding programs;
iii) Time within feeding program; and
iv) Conditions within the feedlot environment.

Feeding programs during the Pilot were categorised into short-fed (<70 day-fed; *n* = 7), short/medium-fed (70 – 120 day-fed; *n* = 134) and long-fed (>180 day-fed; *n* = 68) (Table 3), with observed pens ranging in the time spent in a feeding program (i.e., start, middle, end). The breeds of the enrolled pens included: i) *Bos taurus* (*n* = 101), ii) *B. indicus* and crossbred *B. indicus* (≥25% *B. indicus*; *n* = 37), iii) *Wagyu* and crossbred *Wagyu* (*n* = 47), and iv) Mixed (*n* = 23). Observed pens containing multiple breed types were classified by the dominant breed if ≥ 90% single breed type existed or classified as 'Mixed' when ≥ 10% of a second breed type existed in the pen. The breakdown of observed pens by feeding program, breed, and time in feeding program is outlined in Table 4.

Given the initial study design was to monitor pens between site visits, the method of pen selection required adaptation following Visit 1. If a pen observed in the previous visit was not available (e.g., cattle no longer on the premise), further discussion with the feedlot manager enabled selection of an appropriate alternative of the same feeding program and breed to the previous pen. In the instance that some, or all, of the animals from a pen were still present on the premises but mixed with other lots (as indicated by feedlot records by tracking lot numbers), whether the pen was retained as an observed pen was based on number of head remaining from the original pen (> 30% cut-off) and type of cattle with which they were mixed.

Table 3. Pens by feeding program, breed, and state.

Feeding program	Breed	WA	SA	Total
Short (<70 days)	Taurus	7	0	7
	Indicus	0	0	0
	Wagyu	0	0	0
	Mixed	0	0	0
	Subtotal	*7*	*0*	*7*
Short/Medium (70-120 days)	Taurus	70	4	74
	Indicus	37	0	37
	Wagyu	0	0	0
	Mixed	23	0	23
	Subtotal	*130*	*4*	*134*
Long (>180 days)	Taurus	0	20	20
	Indicus	0	0	0
	Wagyu	47	0	47
	Mixed	0	0	0
	Subtotal	*47*	*20*	*67*
Total		***184***	***24***	***208***

Table 4. Pens by feeding program, time in feeding program and breed.

Feeding program	Time in feeding program	Breed				
		Taurus	Indicus	Wagyu	Mixed	Total
Short (<70 days)	Start (<25 days)	2	0	0	0	2
	Middle (25-50 days)	5	0	0	0	5
	End (>50 days)	0	0	0	0	0
	Subtotal	*7*	*0*	*0*	*0*	*7*
Short/medium (70-120 days)	Start (<40 days)	22	7	0	5	34
	Middle (40-80 days)	29	10	0	12	51
	End (>80 days)	23	20	0	6	50
	Subtotal	*74*	*37*	*0*	*23*	*134*
Long (>180 days)	Start (<100 days)	6	0	9	0	15
	Middle (100-200 days)	14	0	8	0	22
	End (>200 days)	0	0	30	0	30
	Subtotal	*20*	*0*	*47*	*0*	*67*
Total		***101***	***37***	***47***	***23***	***208***

5.2.2 Assessment protocol

5.2.2.1 Pen-side assessments

In total, 58 metrics were collected during pen-side assessments. Metrics from six categories were collected for each observed pen per visit;

i) Static assessment information;
ii) Static animal information;
iii) Climate metrics;
iv) Behavioural metrics;
v) Static pen and resource information; and
vi) Pen health metrics.

The metrics listed by category are outlined in Table 5 with descriptions and protocol for assessment for each metric detailed in Section 6.2.1. For data collection, each metric was loaded onto a data collection platform using the mobile phone application Kizeo Forms (Kizeo 2017). The Kizeo application has been previously trialled and considered appropriate to capture pen-side observations under similar conditions (Willis et al. 2021b; a).

Table 5. Pen-side metrics collected by i) static assessment, ii) static animal, iii) climatic, iv) behavioural, v) static pen resource, and vi) pen health metrics. Unless specified, measures were recorded at the pen level.

Static assessment information (*n* = 8)	**Static animal information (*n* = 4)**	**Climatic metrics (*n* = 8)**	**Behavioural metrics (*n* = 12)**	**Static pen and resource information (*n* = 17)**	**Pen health metrics (*n* = 9)**
- Assessor - Feedlot - State - Date/time - Pen I.D. - Lot number/s - Head in pen (no.) - Days on feed (days)	- Breed - Class (sex) - Coat colour (grey or white/red/red and white/black/black and white/spotted) - Mixing (Y/N)	- Cloud cover (%) - Dry bulb temperature (°C) - Web bulb globe temperature (°C) - Relative humidity (%) - Precipitation (mm) - Wind speed (km/hr) - Temperature humidity index (THI) - Heat Load Index (HLI)	- Reactivity index (No reaction/look/stand up/retreat/approach; %) - Approach test (No reaction/look/retreat/approach and sniff; % head at feeder per category at human approach)[A] - Feeding behaviour (not observed/disinterested/keen/pushing and competitive; % per category)[A] - Posture (standing/lying lateral/lying sternal in shade vs. sun; %) - Grouped (dispersed/grouped at feeder/at water/under shade or not at resource; % per category) - Agitation associate with flies (Y/N if N = %) - Ethogram (eating/drinking/ruminating/walking/positive social/negative social/self-groom/abnormal/engaged/resting/vigilant; % per category) - Demeanour (10 descriptive terms = score 0-100 per term) - Panting score (score 1-4.5; % per score)[B] - Drinking behaviour (description of majority of pen = score 1-5)[B] - Shivering (%)[C] - Huddling (%)[C]	- Pen type (home/hospital) - Pen size (m^2) - Water trough/s (no.) - Water trough/s length (m) - Feed bunk length (m) - Feeding program (short/short-medium/medium/long) - Pen surface (description of pen = sandy/clay/rocky/gravel) - Structures in pen - Enrichment (Y/N, if Y = comment) - Feed out time - Feed bunk contamination (score 1-4) - Water trough contamination (score 1-5) - Water trough fill (score 1-4) - Faecal pat consistency (description of majority of pen = score 1-5) - Surface moisture (score 1-3) - Mud depth (score 1-5) - Animal mud depth (score 1-4)	- Body condition score (BSC; description of majority of pen = score 1-5) - Nasal discharge (no.) - Ocular discharge (no.) - Coughing (no.) - Lame (no.) - Ill-thrifty (no.) & reason for ill-thrift - Non-ambulatory (no.) - Coat cleanliness 1 (score 1-5) - Coat cleanliness 2 (score 1-10)

[A]Metric collected at the most recent time point (TP) after observed pen was fed out.

[B]Metric collected only if Panting Score 2 or above observed.

[C]Metric collected only if cold stress conditions (windy and/or cold) were observed.

Pen-side assessments were conducted at four time points per pen, per visit (Fig. 2): 08:00 h (TP 1), 11:00 h (TP 2), 14:00 h (TP 3), and 17:00 h (TP 4). Exceptions occurred during site visits 6 – 7 that took place over late autumn/winter months, where TP 4 observations were started at approximately 16:30 h to ensure adequate daylight for assessments. Daily feedlot husbandry activities such as performance weighing, treatment of animals, and pen maintenance activities, infrequently resulted in removal of cattle from home pens, meaning that not all observed pens were recorded at all assessment TPs per visit (Table 6). The order of observed pen assessment across TPs was consistent, with the exception occurring when cattle were temporarily absent from their home pen but returned prior to the end of the data collection, or a pen being fed out during a specific TP.

Figure 2. Pen-side assessment procedures at four time points (TP); TP 1 (8:00 h), TP 2 (11:00 h), TP 3 (14:00 h), and TP 4 (17:00 h).

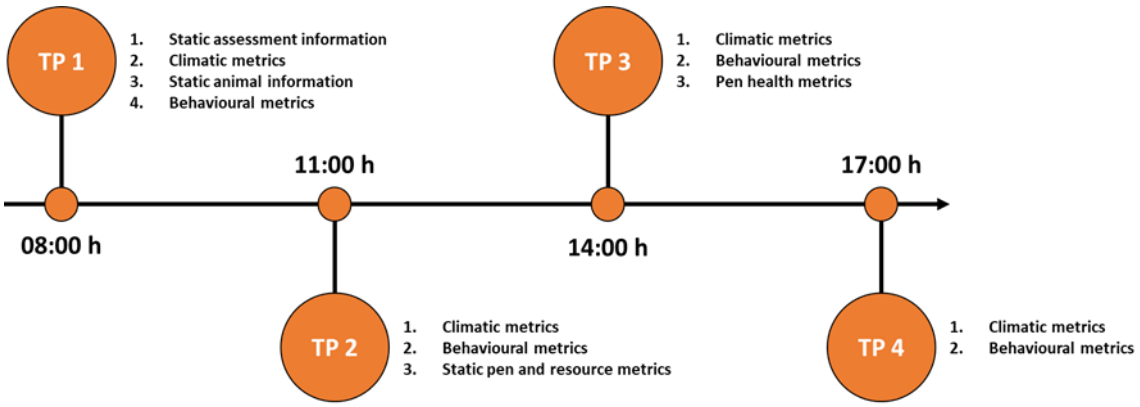


Table 6. Pen assessments by time point, made at four time points (TP); TP 1 (8:00 h), TP 2 (11:00 h), TP 3 (14:00 h), and TP 4 (17:00 h).

Assessment time point (TP)	Pen assessments	
	Missing observations (no.)	Total observations (no.)
TP 1	5	203
TP 2	12	196
TP 3	6	202
TP 4	6	202
Total	***29***	***803***

Static information including assessment, animal, pen, and resource information, and pen health metrics, were collected only once per pen, per visit. Climatic variables were collected only at the beginning of each TP. Behavioural metrics, with the exception of 'Approach test' and 'Feeding behaviour' (which were recorded at the TP that first occurred after the pen was fed out), were recorded at each TP. In order to spread record burden across the day and to ensure consistent data, the procedure outlined in Fig. 2 was adopted across all feedlot sites. It is important to note that the behaviour of livestock can be influenced by the presence of humans, displaying fear-related behavioural responses (Forkman et al. 2007). In this Pilot, the disruption of the animals by assessor presence was unavoidable. However, the response of cattle to human presence is considered important from a welfare perspective, informing Human-Animal Relationship (HAR) (Hemsworth 2003; Waiblinger et al. 2006; Hemsworth and Coleman 2011). To ensure minimal additional disturbance, behavioural metrics were captured at each TP prior to the collection of other metrics that involved the approach to and/or entrance to observed pens (e.g., 'water trough contamination') which were collected at the end of the assessments (see Fig. 2). Pen-side assessments took on

average 12:58 min ± 00:36 min at Visit 1, with assessment times reducing to an average 11:02 min ± 00:23 min during Visit 7. This reduction in time to complete pen assessments reflects the improved efficiency of assessors due to familiarity with assessment protocols and feedlot premises. Assessments at different TP would vary in time taken to record as the addition of 'static information' (TP 1 and TP 2) or 'pen health metrics' (TP 3) to the standard 'behavioural metrics' would increase the time taken to complete assessments, with TP 2 and TP 3 pen assessments taking longer to complete than TP 1 and TP 4 (Table 7).

Table 7. Time taken to complete pen assessments per time point over the Pilot. Assessments were made at four time points (TP); TP 1 (8:00 h), TP 2 (11:00 h), TP 3 (14:00 h), and TP 4 (17:00 h).

Assessment time point (TP)	Average (± S.E.) time to complete pen assessment (mm:ss)	
	Visit 1[A]	Visit 7
TP 1	13:05 ± 1:05	10:38 ± 0:35
TP 2	15:35 ± 1:21	12:50 ± 0:34
TP 3	14:22 ± 1:19	13:26 ± 0:47
TP 4	9:07 ± 0:36	6:51 ± 0:20
Total	***12:58 ± 0:36***	***11:02 ± 0:23***

[A]Includes the first assessments for Feedlot D which occurred in Visit 4.

5.2.2.2 Animal handling assessments

The project aim was to develop and pilot a comprehensive animal welfare assessment protocol that captures welfare outcomes across all relevant aspects of commercial feedlots. To achieve this, the Protocol included assessments of animal handling and human-animal interactions which were undertaken when cattle are processed through the feedlot yards, and during truck events where cattle either entered (unloading) or exited (loading) the feedlot premises. At feedlots, cattle can be processed for many reasons at different times within their feeding program including at the start for induction, partway through feeding programs for performance weighing and/or treatment purposes, and at the end for drafting purposes (e.g., splitting off the tail of the pen prior to exit). Routine handling of cattle in yards offered an opportunity to assess HAR in an unobtrusive manner in the commercial feedlot context.

It is widely considered that the quality of human-animal interaction or HAR is an important aspect of animal welfare (Hemsworth 2003; Waiblinger et al. 2006; Hemsworth and Coleman 2011). Within the Protocol, HAR specifically addressed the welfare principle of 'appropriate behaviour' adopted from Welfare Quality® (Welfare Quality® 2009). Broadly, capturing information relating to HAR and handling activities within the feedlot context will enable the:

- Identification of risk factors (e.g., design of yards/infrastructure in need of repair).
- Monitoring of current handling practices to demonstrate welfare standards.
- Evaluation of the impact practice change on welfare to assist in management decisions.
- Improved understanding of cattle response to humans within intensive industries.

During the Pilot, efforts were made to observe these animal handling events, with visits planned to coincide with a handling or truck (loading/unloading) event per premises. Overall, the research team observed 20 processing and 26 truck events during the Pilot.

5.2.2.2.1 Animal processing events

During animal processing events, assessments captured information related to stockpersonship, yard design and facilities, and animal outcomes to inform ease of handling and HAR. To achieve this, cattle were observed and evaluated within the holding pens, race and upon return of cattle to their home pen, and in the crush.

Specifically, two assessors observed the normal handling of cattle during each event. Assessors were located in a position that facilitated clear view of the process and cattle, yet considerate of feedlot staff activities and cattle so as not to disrupt animal flow through the yards. One assessor was solely focused on evaluating cattle in the crush, with the other observing the cattle moving toward and within the race. These observations encompassed animal outcome, facility, management, and handling or stockpersonship metrics. Assessment duration depended on the number of cattle processed and the reasons for processing, with the larger the number of head processed and the performance of husbandry procedures (routine induction procedures/treatments) extending assessment time. Time taken to complete these assessments was dependent on feedlot operation speed and was approximately 0.5 – 2 h. Where more than 100 head were processed in a single event, for research purposes assessors captured a minimum of 100 head during their assessment.

The metrics collected are outlined in Table 8 with descriptions for assessment for each metric detailed in Appendix 2. Briefly, crush observations were predominantly animal outcome based, capturing cattle responses to handling (e.g., number of animals mis-caught/ slips and falls/chocking). Holding pen observations captured information regarding management (e.g., stocking density), facility (e.g., shade access) and the animal outcomes of thermal stress capturing heat and cold stress (e.g., panting score). Race and general facility observations captured stockpersonship and handling, evaluating human resource use (e.g., use of electric prodders and handling aids/hitting or twisting of tails or dog use), noise (e.g., from staff /facility), and the animal flow through the facility and during return to home pen.

Table 8. Animal handling metrics collected during processing events by location.

Holding yards (*n* = 4)	Race (*n* = 4)	Crush (*n* = 7)	Facility/infrastructure (*n* = 5)
- Panting score (score 1 – 4.5; % per score) - Cattle shivering (no.) - Stocking density (m2/head) - Shade access (Y/N if Y = % cover)	- Cattle slapped/hit, or tails twisted (no.) - Handling aid use (no.) - Electric prodder use (no.) - Electric prodder in hand but not used (no.)	- Mis-caught (no.) - Slips (no.) - Falls (no.) - Chocking (no.) - Sleepers (no.) - Running/jumping out of crush at release (no.) - Fell at release form crush (no.)	- Staff generated noise (score 1 – 3) - Facility generated noise (score 1 – 3) - Animal flow through facility (score 1 – 3) - Animal flow when moving to/ from home pen (score 1 – 3) - Use of dogs (Y/N if Y = indicate whether appropriate)

5.2.2.2.2 Animal truck events

During animal truck events, assessments captured information related to stockpersonship, yard facilities, and animal outcomes to inform ease of handling and HAR. Cattle are observed and evaluated during the loading or unloading process with additional metrics capturing relevant facility information. Assessors also entered the truck (when empty) and conversed with the truck driver to capture relevant input information (e.g., stock crate free from sharp edges/time off water).

Assessment duration was dependent on the number of cattle being loaded or unloaded, with unloading events taking markedly less time; time taken to complete unloading and loading assessments, was approximately 10 – 20 min and 30 – 45 min, respectively.

For unloading/loading observations, one assessor observed the handling of cattle in a position that facilitated clear view of the process yet considerate of cattle, feedlot staff and driver activities so as not to disrupt animal flow onto or off the truck. The metrics collected are outlined in Table 9 with descriptions for assessment detailed in Appendix 2. Briefly, those metrics collected differed between loading and unloading, to ensure capture of all welfare relevant information.

Table 9. Animal handling metrics collected during truck events by type.

Animal outcome (*n* = 8)	**Stockpersonship (*n* = 3)**	**Input (*n* = 3)**	**Facility/infrastructure (*n* = 3)**
- Animals unfit for transport (no.)[A] - Animal unfit for transport on arrival (no.)[B] - Animal dead on arrival (no.)[B] - Tender-footed animals (no.) - Slips (no.) - Falls (no.) - Panting score (score 1 – 4.5; % per score) - Cattle shivering (no.)	- Handling aid use (no.) - Electric prodder use (no.) - Electric prodder in hand but not used (no.)	- Average weight (kg) - Loading density (m2/head) - Time off water (h)[B]	- Stock crate free from sharp edges, holes etc. (Y/N, if N = comment) - Truck well aligned (Y/N if N = comment) - Use of dogs (Y/N if Y = indicate whether appropriate)

[A]Captured for loading events only
[B]Captured for unloading events only

5.3 Statistical analysis

5.3.1 Feedlot collected data

Data collected by the seven feedlots themselves were organised to determine overall completeness and (where applicable) completeness by month. Descriptive statistics (average, standard error, median and range) were calculated for measurement sections that incorporated numerical data. Because comparisons between feedlots were not intended and would not be meaningful given the sample size and the intended variation in feedlot locations and characteristics, further statistical analysis was not performed on the feedlot-collected data.

5.3.2 Research collected data

5.3.2.1 Animal handling

Research measures were collected with the objective to develop additional indicators that may be incorporated in the benchmarking tool. The collected data is not suitable for meaningful analysis across the different feedlots, therefore descriptive data (average, median and range) are presented, and the range of the observed measures is discussed in context of published literature.

5.3.2.2 Pen-side assessments: determining pen sample size and sample timing

To determine both the appropriate pen sample size and the timing of pen observations at a feedlot level, pen-side assessments conducted during the Pilot visits were considered. A total of 803 pen

observations (Table 6) spanning seven visits to four commercial feedlots were available for these analyses. Given the magnitude and range of data available per observed pen (see Table 5), priority for incorporation within the analyses was first given to animal-based outcome metrics (e.g., behavioural metrics), followed by climatic, static pen and resource metrics. Specific details regarding metrics submitted to statistical analysis are outlined in the relevant sections below.

5.3.2.2.1 Reduction of behavioural data

The behaviour of animals is complex in nature, and individual behavioural metrics considered in isolation are insufficient to inform welfare since their interpretation is not always straightforward (Dawkins 1980; Barnett and Hemsworth 1990; Rushen 2000). This necessitated the inclusion of numerous behavioural metrics (*n* = 12) in the piloted Protocol which capture further behavioural data within their categories (e.g., 'ethogram' metric captures the behaviour of cattle from 10 mutually exclusive categories). It was considered appropriate to first reduce and simplify the list of behavioural metrics prior to all statistical analyses.

This reduction and simplification of behavioural data was done first by removing those metrics that were observed infrequently over the project (e.g., 'shivering', 'agitation caused by flies') along with those that collected equivalent or duplicative information. For example, both the 'reactivity index' (RI) and 'approach test' (AT) metrics record the reaction of the pen of cattle to human approach and informs on the Human Animal Relationship (HAR), and, therefore, only RI was retained for formal analysis purposes. Where appropriate, some behavioural metrics were converted to a binary score (0/1) for analysis purposes. This included novel metrics such as 'dispersion', originally collected at a 5-point scale was converted to 0 = dispersed and 1 = grouped, and 'panting score', which was converted to 0 = PS0 and PS1; 1 = ≥ PS2. This occurred for Dispersion to reduce the number of categories entered into the analyses for this metric, and for Panting Score due to PS2> infrequently observed.

The 'refined' behavioural metrics (Table 10; *n* = 28) were reduced statistically using Principal Component Analysis (PCA) (Statistica 2018), where the statistical package automatically corrects for metric scales (meaning standardisation of data prior to analysis is not required). PCA is a multivariate pattern recognising analysis that identifies the underlying patterns of similarity (relationships) between inter-correlated metrics, with the output providing 'dimensions', or axes, that explain the most variation within the dataset. The statistical process is such that the most important information is extracted and simplified, presented as new variables, or 'Principal Components' (PCs). The first of these PCs explains the most variation in the dataset, the second the next highest variation, and so on. In this instance, these PCs are behavioural dimensions defined by those original metrics that hold 'important' information on the basis of loading (or correlation). Those metrics that loaded highly on either end of the dimension (>75% or comparative, of the absolute value of the largest positive or negative correlation coefficient; Mardia et al. 1979) were taken to define each dimension. Components with eigenvalues > 1.5 were considered for further analysis, with each of the 803 pen-side observations allocated a score within each principal component. It is these PC scores that are submitted for further analyses alongside input and environmental data to determine appropriate sample size and time and frequency of observation.

Table 10. Refined behavioural metrics submitted for analysis.

Refined behavioural metric (*n* = 28)	Description
Total lying[A]	Percentage (%) of pen lying down. Combined metric for the percentages of animals within pen sternal or lateral lying in both shade and sun. Calculated based on the number of animals recorded under 'posture' considering the number of animals that 'stood' at approach of the assessor during the 'reactivity index' and/or 'approach test'.
Eating	Percentage (%) of pen eating.
Drinking	Percentage (%) of pen drinking.
Ruminating	Percentage (%) of pen ruminating.
Social[A,B]	Percentage (%) of pen performing social behaviours. Combined metric for the percentages of animals within pen performing positive and negative social behaviours.
Self-groom	Percentage (%) of pen self-grooming.
Abnormal	Percentage (%) of pen performing abnormal behaviours.
Engaged with environment[B]	Percentage (%) of pen engaged with environment. Combined metric for the percentages of animals within pen engaged with the environment and walking.
Resting	Percentage (%) of pen resting.
Vigilant	Percentage (%) of pen drinking.
Reactivity Index: Retreat[A]	Percentage (%) of pen that 'retreated' at the approach of assessor to pen. Combined metric for the percentages of animals within the pen that stood or retreated at the approach of assessor to pen.
Feeding Behaviour: Disinterested	Percentage (%) of pen 'disinterested' in feed at the most recent time point (TP) after fed out.
Feeding Behaviour: Keen[A]	Percentage (%) of pen 'keen' at feeding at the most recent time point (TP) after fed out.
Dispersion/Grouped[B]	Binary (0/1) score for dispersion/social grouping of cattle within pen. Simplified metric for 'dispersion (%)', where 0 = dispersed and 1 = cattle were grouped at one or more of the following within pen; feeder, water, under shade, not at resource.

Demeanour: 1. Active 2. Agitated 3. Alert 4. Content 5. Curious 6. Dull 7. Lively 8. Nervous 9. Settled 10. Uncomfortable	Visual analogue score (VAS; score 0-100) indicates perception of the degree to which each of the 10 descriptive terms are expressed by the cattle in the pen. 0 = term not expressed, 100 = term being expressed to the fullest by all animals in the pen.
Panting score[AB]	Binary (0/1) score for panting score of cattle within pen. Combined and simplified metric for 'panting score' (score 1-4.5; % per score), where 0 = all cattle within pen displayed a panting score 0 or 1, and 1 = some cattle within pen displayed a panting score of 2 or greater.
Drinking behaviour[B]	Binary (0/1) score for drinking behaviour within pen. Combined and simplified metric for 'drinking behaviour' (score 1-5), where 0 = cattle within pen displayed a drinking behaviour score > 2, and 1 = cattle within pen displayed a drinking behaviour score 3 or above (i.e., 'some keen', 'crowding' water trough, or hovering over water trough).
Shade utilisation	Percentage (%) of pen observed under shade. Combined metric for the percentages of animals within pen lying (sternal and lateral) and standing in shade (artificial shade or environmental shade i.e., caused by cloud cover)

[A]Metric simplified (reduced 'level' of recording) to align with that considered feasible for collection under feedlot conditions.

[B]Metric refined due to infrequent observations.

5.3.2.2.2 Pen-side time of day analysis

PCA generated 3 PC dimensions which were Box-Cox transformed for normality prior to analysis using Generalised Linear Mixed Modelling (GLMM). Statistica (2018) was used to investigate the impact of time of day. Each set of PC scores were tested against independent, or 'fixed', factors:

i) Feedlot (A – D)
ii) Visit number (1 – 7)
iii) Time point (1 – 4)
iv) Feeding program (1 – 3)
v) Breed (1 – 4)

'Unique' pen I.D. was included as a random factor to account for repeated measures on pens. The following covariate metrics were also included:

i) Wet bulb globe temperature (WBGT; °C)
ii) Stocking density (m^2/head)
iii) Feed access (mm/head)
iv) Pen shade (0/1)
v) Enrichment provided (0/1)
vi) Pen faecal pat consistency (score; 1 – 5)
vii) Coat cleanliness (score; 1 – 10)

Where significant effect was detected from the GLMM, a Tukey's post-hoc test was used to identify statistical differences.

5.3.2.2.3 Pen sample size

As time of day was previously analysed, to reduce additional variability within the data set, only a single time point (TP 3; 14:00 h) was considered here. TP 3 was selected based on amount of available data (see Table 6) and importance of capturing the impact of climate, specifically WBGT, on behaviour. Consequently, a total of 150 pen observations across the four feedlot sites were analysed. A separate PCA was conducted (from 'pen-side time of day' analysis) and produced 3 PCs, which were Box-Cox transformed for normality prior to GLMM analysis. To test the impact of sample size, pens were grouped into replicates firstly at a feedlot level, then at a dominant breed level (> 50% breed: *taurus/indicus/wagyu*). Pens were then randomly assigned to a Replicate (Replicate 1 – 3; each containing 50 pen observations) for analysis. Groupings meant that each group contained a single random unique pen from each of the three breed groups assessed at each feedlot per visit. The PC scores for these Groups were analysed under three GLMMs per PC, with each consecutive GLMM considering an additional group:

- GLMM 1: Replicate 1 PC scores
- GLMM 2: Replicate 1 and 2 PC scores
- GLMM 3: Replicate 1, 2 and 3 PC scores

For each GLMM, fixed factors included were:

i) Feedlot (A – D)
ii) Visit number (1 – 7)
iii) Feeding program (1 – 3)
iv) Breed (1 – 3)

And covariate metrics included were:

i) Wet bulb globe temperature (WBGT; °C)
ii) Stocking density (m^2/head)
iii) Feed access (mm/head)
iv) Pen shade (0/1)
v) Enrichment provided (0/1)
vi) Pen faecal pat consistency (score; 1 – 5)
vii) Coat cleanliness (score; 1 – 10)

6. Results

6.1 Feedlot collected data

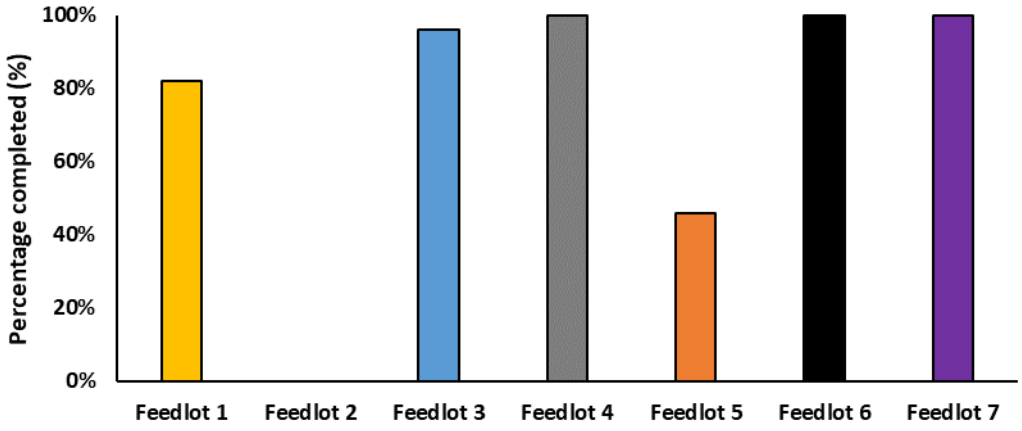
The following sections present the findings from the pilot measurement program on the seven feedlots in which the feedlot operations collected the data themselves. For each measurement section of the protocol, the results include the extent to which the planned protocol was completed by feedlots, some key data for the measures, and a discussion of the measures' relevance, feasibility, and practicality (informed also by feedback from the participating feedlots) and whether is recommended to be a part of the revised benchmarking framework.

6.1.1 Section 1.0 Static feedlot information

6.1.1.1 Outcome of pilot

Section 1.0 as a whole was completed by six of seven participating feedlots, with Feedlot 2 not completing this. Overall, this section was completed effectively, with three feedlots fully completing the table and two others finishing it at 82% and 96% respectively. One feedlot submitted the table 46% complete (Fig. 3).

Figure 3. Completion rates for Section 1.0 – Static feedlot information per feedlot.



Of the 50 questions in this Section, 76% entailed a yes or no response. Of the six feedlots who entered data, only two feedlots recorded 'No' answers indicating that they did not have the indicated protocol/SOP/records etc. (Feedlot 1 = 14%; Feedlot 4 = 7%, no consistent trend across these). It should be noted, that if yes or no questions were left blank, they were not included as answers. In this situation, some slight underestimation of protocol absences may be present.

6.1.1.2 Relevance

This section was useful in making feedlots aware of the numerous industry protocols available. Such protocols help in the everyday running as well as informing decision making in line with industry best practice. The various NFAS protocols should be present at each feedlot, while there were also additional welfare protocols listed which are strongly recommended.

6.1.1.3 Feasibility/Practicality

Feedlots should be familiar with these protocols and have access to them when required. Hence the impost to collect this data is minimal as it was only asked to be completed once at the start of the trial (and for example annually on an ongoing basis). The completion of this section serves as a good annual refresher and a subtle checklist to enable feedlots to ensure that they are keeping up with their obligations.

6.1.1.4 Recommended/Not recommended

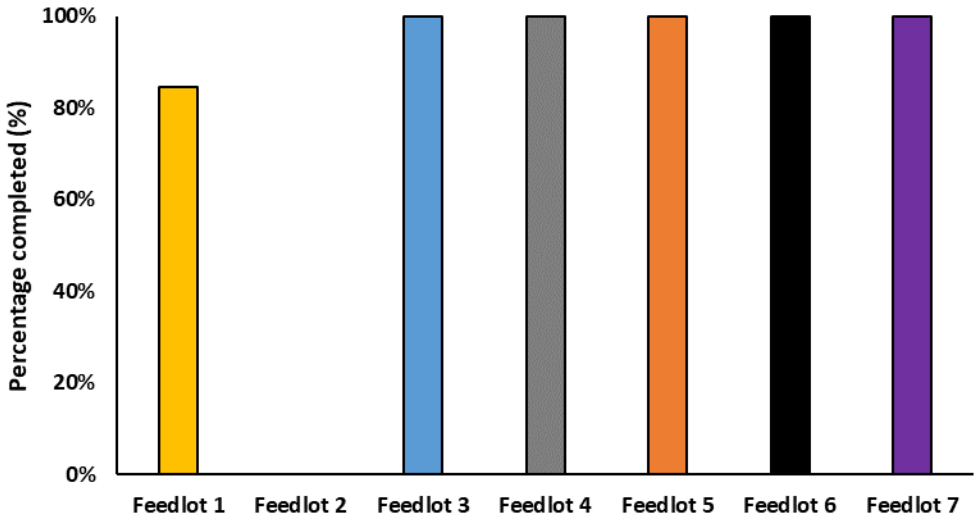
This information should be easy for feedlots to compile and is core to having demonstrated animal welfare practices. It is, thus, recommended on the basis of this component of the pilot.

6.1.2 Section 2.0 General facilities

6.1.2.1 Outcome of pilot

Overall, this Section was completed well by participating feedlots when attempted (Fig. 4). All except one feedlot completed this Section, with 5 of the remaining 6 feedlots doing so fully. Feedlots 1, 3 and 7 only completed this Section once, whereas Feedlots 5 and 6 did so on more than two occasions when only asked to complete it every 6 months, i.e., at the start and end of the trial.

Figure 4. Completion rates for Section 2.0 – General facilities, per feedlot.



6.1.2.2 Relevance

The content of this Section was well received but feedback from the feedlot personnel suggested that animal flow, stockmanship and animal group size scores could be better suited to Section 4.0 Feedlot induction.

6.1.2.3 Feasibility/Practicality

Feedback received from the participant feedlots suggested that although straightforward to collect, many of the metrics asked in this Section were highly likely to be conserved throughout the trial and unlikely to change, particularly those relating to plant and facilities.

6.1.2.4 Recommended/Not recommended

Recommended but at a monthly interval to ensure adequate capture of potential changes due to staff turnover within the system and response to maintenance issues if they arise. Despite some feedback suggesting that it be moved to Section 4.0, it may be better to retain the questions in this section because then it is all at the same collection frequency.

6.1.3 Section 3.A Transportation – Loading assessment

6.1.3.1 Outcome of pilot

Of the three feedlots in WA and four in QLD, five were in the range of 3,000 – 5,000 head, whereas the other two sites were larger enterprises stocking closer to 20,000 head. The recommended sampling frequencies and number of trucks are presented in the Appendix 1. The larger enterprises employed dedicated Animal Welfare Officers whose responsibility was to manage the rollout of the Welfare Benchmarking pilot. These people had autonomy in the role, making them able to complete the data collection without having to immediately juggle other work responsibilities. For the smaller feedlots, many run as small family businesses, there are few employees juggling multiple job descriptions and responsibilities at the same time. This created difficulty in completing all of the tasks asked of them, specifically when asked to complete monthly recording as there were many pressures placed on their time. This is reflected in the completion rates (Fig. 5). Feedlots found it challenging to meet the target number of trucks per month (target was two or five trucks, depending on feedlot size). The two feedlots with a five-truck target met this target on two months and achieved four trucks on another two months. Of the feedlots with a two-truck target, two feedlots met this target on two months and another feedlot met the target on one month of the pilot.

The data showed that scores were generally close to the maximum possible of 13, with no score less than 9 reported for a single handling event (Table 11).

Figure 5. Completion rates for Section 3.A – Transportation – Loading assessment per feedlot and assessment month.

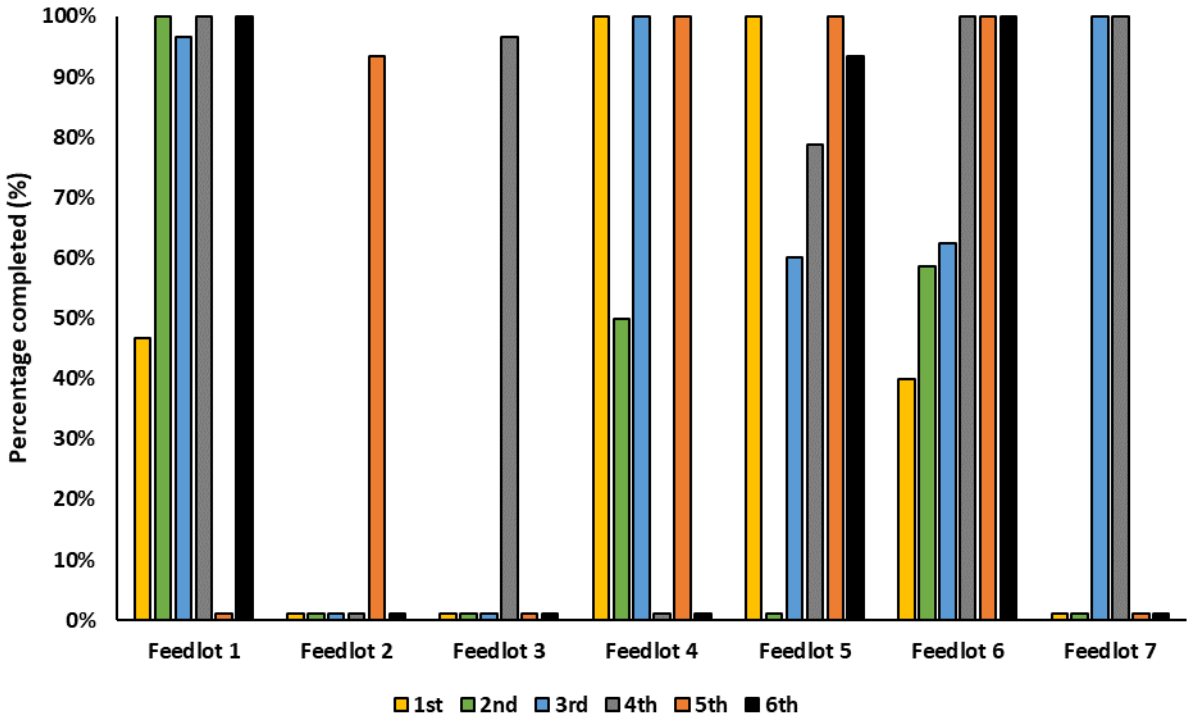


Table 11. Results for recording of data for Section 3.A – Transportation – Loading assessment. Maximum possible score = 13.

Month	Average	Standard error	Median	Range
1	11.2	0.26	11	10 – 12
2	10.9	0.33	11	9 – 12
3	12.3	0.16	12	11 – 13
4	12.4	0.18	12.5	11 – 13
5	11.8	0.54	12	10 – 13
6	11.8	0.22	12	11 – 12
Overall	***11.9***	***0.13***	***12***	***9 – 13***

6.1.3.2 Relevance

As a measure of animal handling and ensuring that cattle are fit to load, the measure was highly relevant to animal welfare. However, there is concern surrounding the practicality of recording this frequently in smaller feedlots.

6.1.3.3 Feasibility/Practicality

This section was straightforward to record and when done so, in general was completed effectively. However, the timing of when trucks arrived, and loading commenced affected the capacity for the data to be collected appropriately, particularly for smaller feedlot operations where staff availability was less. The ability for staff to count handling measures (slips/falls) concurrently with loading the animals was challenging. Ideally, this needs a dedicated person collecting so the data is accurate and so that the observer's attention is not split between the recording sheet and the actual handling of cattle - which could result in injury or mistakes.

6.1.3.4 Recommended/Not recommended

Loading could perhaps be considered more relevant to feedlot animal welfare than unloading because it incorporates feedlot decision-making around 'fit to load' aspects, and the animals are heavier and more at risk of handling incidents than those at unloading. For these reasons it was considered important to carry this measure forward into the revised framework, whilst giving some consideration to the number of loads that need to be recorded, given the need to allocate a dedicated observer to record the information at a busy time. For these reasons, it was considered important to include this within the revised Protocol, and suggest that the following is recorded **per month**, dependent on total feedlot capacity:

- <10,000 head = 2 trucks
- 10,000 – 20,000 head = 3 trucks
- >20,000 head = 4 trucks

6.1.4 Section 3.B Transportation – Unloading assessment

6.1.4.1 Outcome of pilot

As for Section 3.A, some of the smaller feedlot operations found it difficult to find the opportunity to complete this assessment. The data showed that this Section was completed well when undertaken (Fig. 6) and that scores were generally close to the maximum possible of 12, with no score less than 9 for a single handling event (Table 12). Feedlots found it challenging to meet the target number of trucks per month (target was two or five trucks, depending on feedlot size). The two feedlots with a five-truck target met this target on one month and two months, respectively, and the former achieved four trucks on another two months. Of the feedlots with a two-truck target, one feedlot met this target on one two and another two feedlots met the target on one month of the pilot.

Figure 6. Completion rates for Section 3.B – Transportation – Unloading assessment, per feedlot and assessment month.

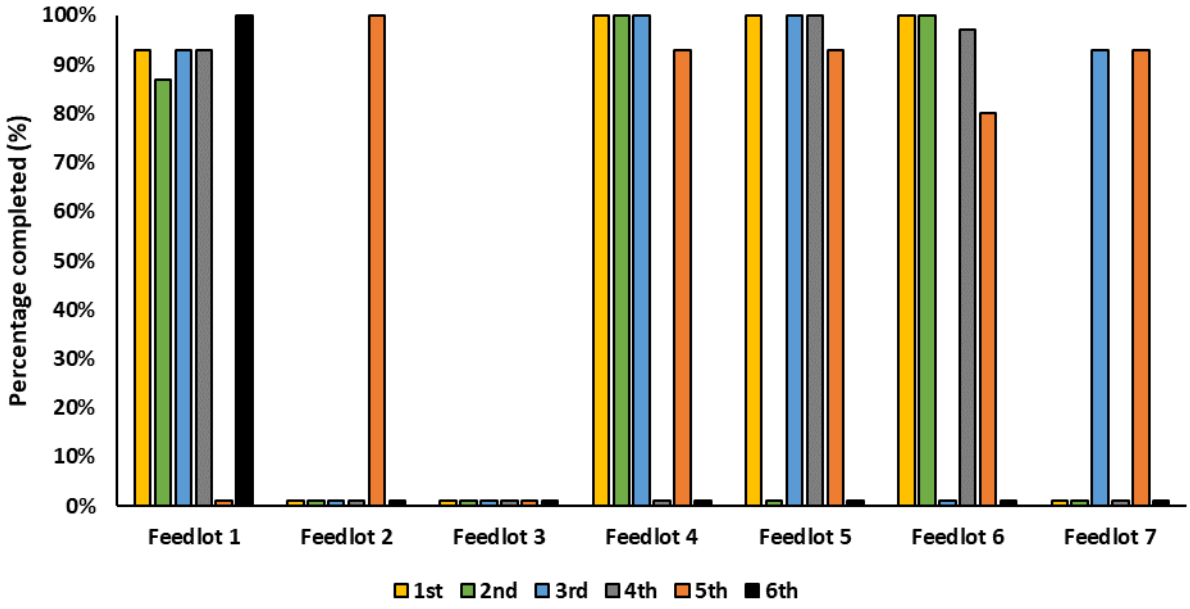


Table 12. Results for recording of data for Section 3.B – Transportation – Unloading assessment. Maximum possible score = 12.

Month	Average	Standard error	Median	Range
1	11.33	0.42	12	8 – 12
2	11.8	0.15	12	11 – 12
3	11.7	0.17	12	11 – 12
4	11.8	0.15	12	11 – 12
5	11.7	0.17	12	11 – 12
6	10	0	10	- [A]
Overall	***11.6***	***0.12***	***12***	***8 – 12***

[A]***n*** **= 1.**

6.1.4.2 Relevance

As for Section 3.A, as a measure of animal handling and ensuring that cattle were in a suitable welfare state on arrival and were appropriately handled at the end of their journey, the measure is relevant to animal welfare. The issue is more around the practicality of recording this data frequently, particularly in smaller feedlots or where there is little staff flexibility to allocate a dedicated observer for the unloading event.

6.1.4.3 Feasibility/Practicality

This was straightforward to record and when done so, on average was done so very well. However, the timing of when trucks arrived and unloading commenced, affected whether the data could be collected appropriately.

6.1.4.4 Recommended/Not recommended

Based on the feedlot collection of data for this measure, ideally this Section should be recorded, if possible, due to the relevance for animal welfare and importance of the condition of animals on arrival to inform appropriate management decisions moving forward (e.g., provide additional rest period to animals prior to induction). For these reasons, it was considered important to include this within the revised Protocol, and suggest that the following is recorded **per month**, dependent on total feedlot capacity:

- <10,000 head = 2 trucks
- 10,000 – 20,000 head = 3 trucks
- >20,000 head = 4 trucks

6.1.5 Section 4.0 Feedlot induction

There was marked variation between feedlots in their capture of this data in relation to the monthly target. All feedlots captured at least one month, and one feedlot recorded 6 monthly data for this Section (Fig. 7). When recorded, the data was mostly completed, and indicated that there were on average 0.7 ± 0.34 slips recorded per handling session and 0.2 ± 0.09 falls, although these data were largely influenced by just 2 – 3 handling events. Summary data are presented in Table 13.

Figure 7. Completion rates for Section 4.0 – Feedlot induction, per feedlot and assessment month.

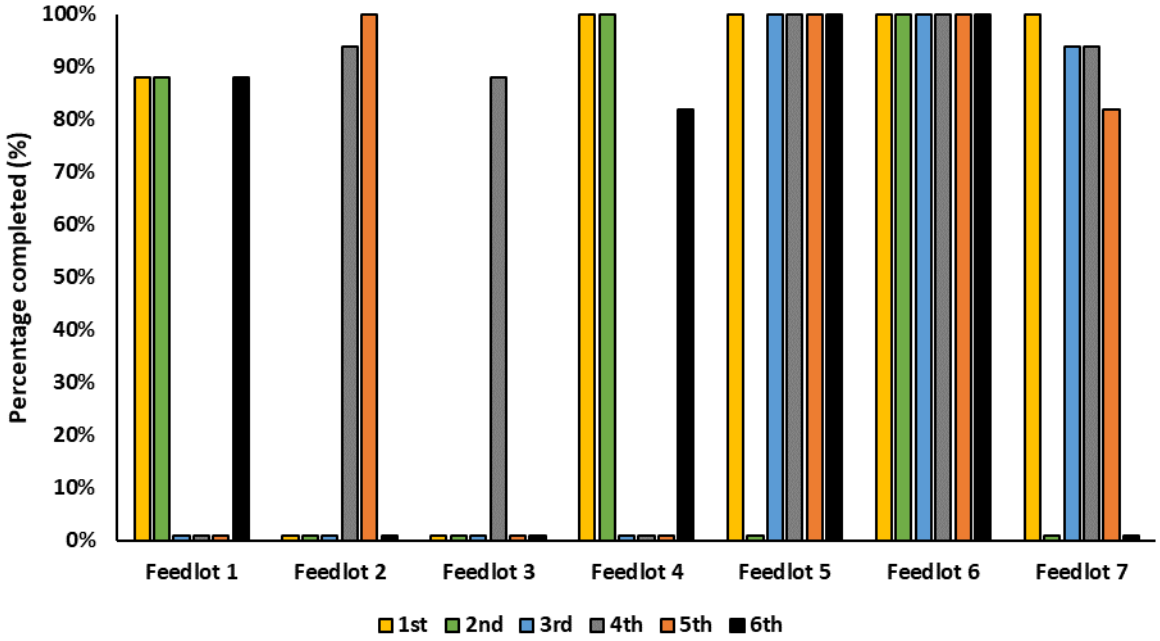


Table 13. Results for recording of data for Section 4.0 – Feedlot induction. Maximum possible score = 12.[A]

Month	Average	Standard error	Median	Range
1	9.6	0.61	10	8 – 11
2	9. 7	1.51	11	6 – 12
3	11. 7	0.27	12	11 – 12
4	9.2	1.86	11	1 – 12
5	12	0	12	-[B]
6	11	0	11	-[B]
Overall	***10.2***	***0.62***	***11***	***1 – 12***

[A]Data presented ignores scoring of surgical husbandry procedures as there were only 7 of these instances, and appropriate pain relief was recorded as having been used on 6 of these occasions.
[B]*n* = 1.

6.1.5.1 Relevance

Good animal handling is viewed as critical to animal welfare, and other animal welfare recording schemes include an assessment of handling events for this reason.

6.1.5.2 Feasibility/Practicality

Feedlots commented that the recording process was easy to follow and implement. The main challenge was that one staff member was required to be allocated to recording whenever a session is being observed, and this may have limited the monthly collection of data for some feedlots where staff were not available.

6.1.5.3 Recommended/Not recommended

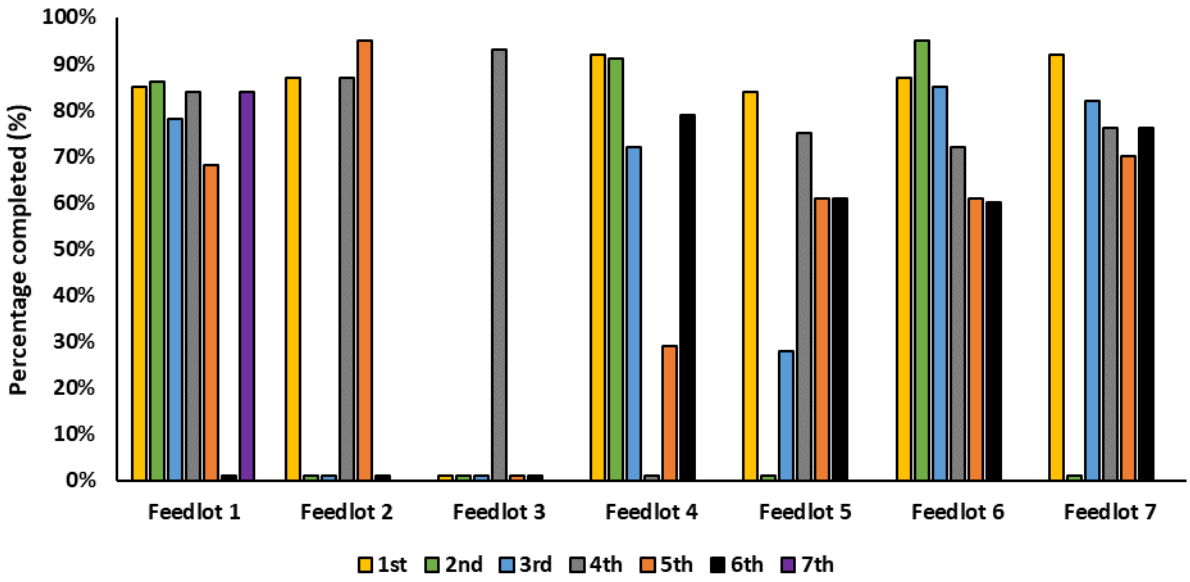
As handling is important to animal welfare, this measure is recommended to be included in the framework. Although having a staff member allocated to record a handling and husbandry procedure event is recognised as difficult, it is still important to collect, providing important information that can demonstrate welfare standards or inform stockpersonship. Based on results of the research collected data (see Section 6.2.4.1.2), it is recommended that the assessment of cattle vocalisations during induction be incorporated within this Section. For details concerning collection method see Section 6.2.4.1.2 and Section 7.1.

6.1.6 Section 5.B Pen welfare measures

6.1.6.1 Outcome of pilot

For these measures, two feedlots collected six monthly sets of data, three feedlots recorded five months, one feedlot recorded three months, and one feedlot collected one month. Where collected, sheets were largely completed or close to completed (Fig. 8), with the main challenge being completing the different time points within a day or two required in a monthly collection. Some measures were also more frequently missed when a pen assessment was undertaken – for example faecal pat consistency. Where the measures for this Section were undertaken within a month, feedlots generally met the target number of pens to be assessed. The two larger feedlots (target = 24 pens per month) achieved a monthly average of 22.5 pens recorded. The five feedlots with a monthly target of 6 pens had an average of 4.9 pens recorded. Of the two larger feedlots, only one of the six months was missed at one location. For the five smaller feedlots, monthly recordings ranged from five (two feedlots) to one (one feedlot).

Figure 8. Completion rates for Section 5.B – Pen welfare measures, per feedlot and assessment month.



6.1.6.2 Relevance

These measures were mostly viewed as central to animal welfare in terms of the animals' daily experience in the feedlot. The demeanour scoring was well received by the feedlots (see feedlot

feedback comments in Section 6.1.12 below), and other measures such as panting were also viewed as central to animal welfare during hot conditions and are commonly assessed by many feedlots anyway. There was some commentary that cleanliness scoring was not easy to score as objectively as some other measures.

6.1.6.3 Feasibility/Practicality

Although the scoring of measures itself was seen as relatively straightforward, including the demeanour assessment, the main challenge for feasibility was the use of multiple time points for collection, which limited some feedlot's capacity to regularly collect and complete the entire section.

6.1.6.4 Recommended/Not recommended

The measures in this Section have been retained in the revised Protocol, which includes additional measures informed by the research Pilot (see Section 7.2). Statistically, it may be preferable to reduce the number of time points of assessment in the day for each pen (informed by analysis of the research Pilot; Section 6.2.2) and aim to maintain a target number of pens to be assessed (see Section 6.2.3).

6.1.7 Section 5.C Monthly assessments recorded at a feedlot level

6.1.7.1 Outcome of pilot

This Section was extracted and recorded over five months by two feedlots, three months by two feedlots, two months by one feedlot, once by one feedlot, and on zero occasions by one feedlot. Where recorded, the majority (11 out of 19) of data sets were 100% complete, and the remainder were 75 to 95% complete. Across the 19 monthly datasets, there were a total of 8 calves born and sold/reared and two calves euthanised. The adult cattle morbidity rate varied widely (by a factor > 70, with a couple of outliers), suggesting that either this measure is highly variable if there is an outbreak of (for example) respiratory disease, or that feedlots may have different ways of recording/organising health information, or that some errors in the raw data held at the feedlot level may have been present. This may not be a problem if the recording is consistent over time within a feedlot but may present challenges for higher aggregation or collation of data in the future.

6.1.7.2 Relevance

The measures on this Section are focussed on animal health as well as recording the (undesirable) birth and fate of calves, and as such are critical to measuring and tracking welfare performance.

6.1.7.3 Feasibility/Practicality

There were no adverse comments about the collection of this Section, but the variation in collection frequency and in the actual data suggests that feedlots have varying levels and systems of record keeping as part of their normal operations, and this in turn caused variation in how easy it was to extract and collate these measures.

6.1.7.4 Recommended/Not recommended

Animal health status and the presence/fate of calves born in the feedlot environment are key attributes of animal welfare and (particularly in the case of calves) risks to the welfare status of the

industry. Animal health data is commonly recorded as a matter of course in feedlots, and it is recommended from the pilot process that these measures proceed. Some verification may be warranted to make sure that feedlots collect and express morbidity statistics in a common format, to allow future comparability.

6.1.8 Section 6.0 Husbandry welfare practices

6.1.8.1 Outcome of pilot

When this Section was completed, it was fully completed on each occasion (Fig. 9). Intended to be done monthly, two feedlots completed it once, three feedlots completed it for four months, and two feedlots completed it for five months. Scored on a 0/1 basis to a maximum of 18 points, the overall average of completed data was 17.6, indicating that feedlots scored their pens as effectively meeting the welfare areas specified (Table 14).

Figure 9. Completion rates for Section 6.0 – Husbandry welfare practices, per feedlot and assessment month.

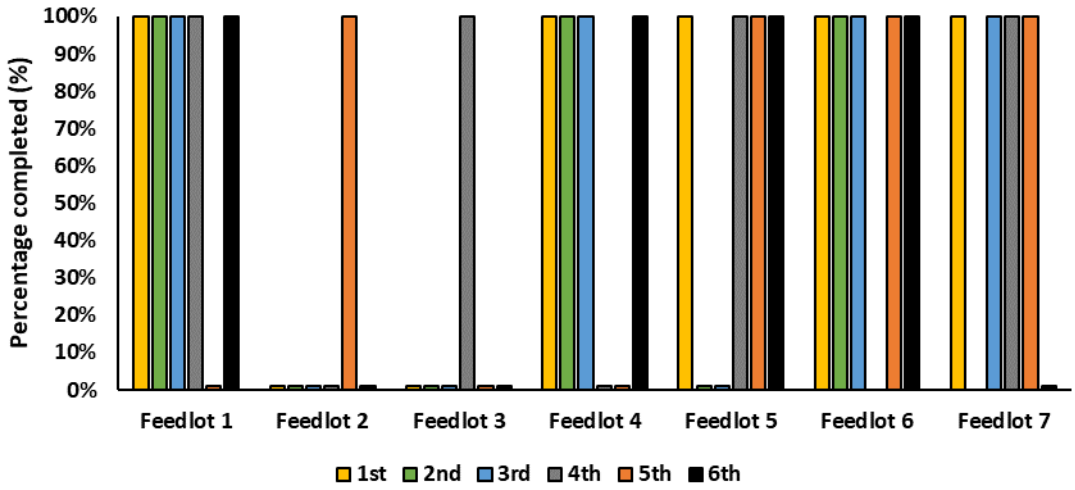


Table 14. Results for recording of data for Section 6.0 – Husbandry welfare practices. Maximum possible score = 18.

Month	Average	Standard error	Median	Range
1	17.4	0.30	18	15 – 18
2	17. 7	0.30	18	16 – 18
3	17.7	0.14	18	17 – 18
4	17.6	0.25	18	16 – 18
5	17.9	0.07	18	17 – 18
6	17.6	0.35	18	13 – 18
Overall	***17.6***	***0.11***	***18***	***13 – 18***

6.1.8.2 Relevance

Although straightforward to collect, many of these measures do not necessarily contribute much value to internal feedlot performance tracking but are of importance in capturing overall feedlot sector performance on key practices.

6.1.8.3 Feasibility/Practicality

When undertaken, this Section was completed effectively by feedlots, with the average completion being 100% for feedlots when completed. Much of this data was readily available and the metrics were quite conserved and unlikely to change over the course of the Pilot.

6.1.8.4 Recommended/Not recommended

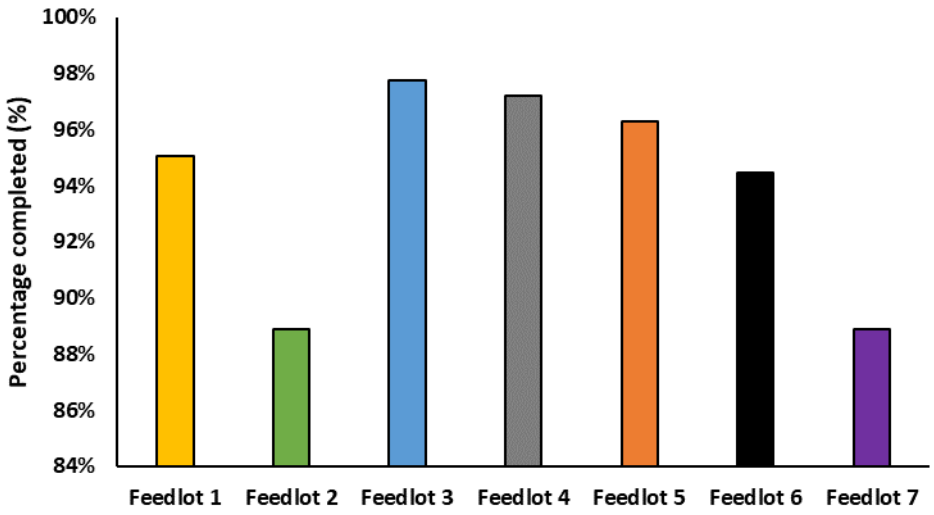
Due to the importance of the measures in terms of welfare practices, this Section would be recommended to proceed at a monthly interval.

6.1.9 Section 7.0 Nutrition and feeding information

6.1.9.1 Outcome of pilot

This Section was completed at some stage by all feedlots (**Fig. 10**). Across all collection points, data indicated that when assessed 1 hour prior to feeding, there were 30% slick bunks, 35% with crumbs, 23% with 0.11-0.50 kg/head, 7.8% with 0.51-1.0 kg/head, and 4.2% with greater than 1kg/head.

Figure 10. Completion rates for Section 7.0 – Nutrition and feeding information, per feedlot.



6.1.9.2 Relevance

Nutritional management is key to feedlot cattle welfare, with significant implications if cattle are without feed for too long before re-alimentation.

6.1.9.3 Feasibility/Practicality

The measures collected in this section were similar to what is often observed (without necessarily being recorded) by many feedlots. The challenge, as for other monthly measures, is to identify the staff time to complete if done monthly, especially given that some of the measures need to be undertaken at a specific timepoint (1 hour before feed-out).

6.1.9.4 Recommended/Not recommended

Because of the importance of nutrition and the ready availability of feed in the bunk for cattle welfare, it is recommended that this measure proceed, noting the challenged present during the pilot with monthly collection for some feedlots.

6.1.10 Section 8.0 Other animals

6.1.10.1 Outcome of pilot

This Section was completed by six of the participating seven feedlots on at least one occasion. When undertaken, this Section was fully completed.

6.1.10.2 Relevance

Two of the participating feedlots did not use either working horses or dogs and the other four respondents only used working horses.

6.1.10.3 Feasibility/Practicality

This data was not difficult to collect mainly due to the fact that when animals were used, they were reported as healthy and in good condition.

6.1.10.4 Recommended/Not recommended

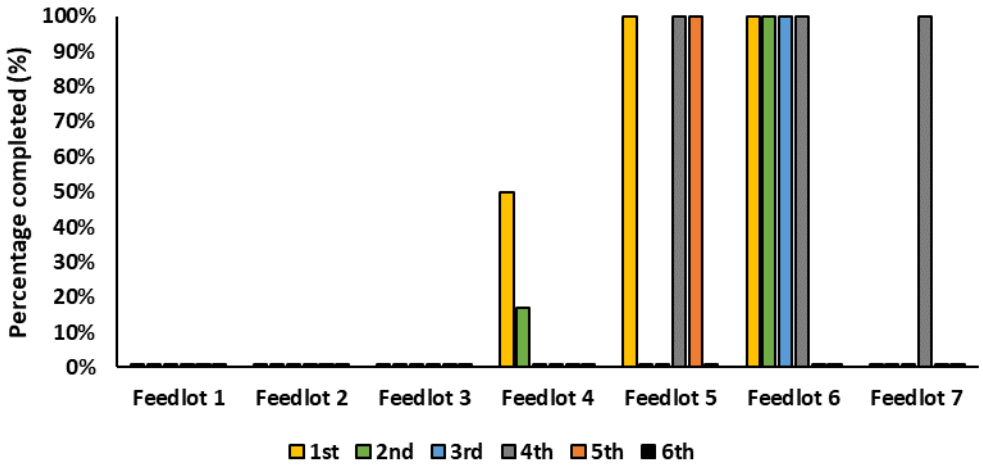
Based on the experiences of the pilot program, this is recommended but perhaps as an annual or 6-monthly collection of data, rather than monthly. If new animals are brought on to the feedlot, this could also prompt an assessment.

6.1.11 Section 9.0 Abattoir feedback

6.1.11.1 Outcome of pilot

This Section was completed by four of the participating seven feedlots on only 10 out of a possible 24 occasions (Fig. 11).

Figure 11. Completion rates for Section 9.0 – Abattoir feedback, per feedlot and assessment month.



6.1.11.2 Relevance

When data was received from the abattoir, no instances of non-ambulatory animals present at the destination, nor any injection site lesions/injury or condemned carcasses in the consignment were recorded. Abattoir offal data was only recorded on one occasion by one feedlot.

6.1.11.3 Feasibility/Practicality

This data was difficult for the participating feedlots to enter as they were not routinely receiving this information from the abattoir.

6.1.11.3.1.1 Recommended/Not recommended

To ensure the capture of appropriate data in this important space, it is recommended that the measures collected incorporates those recorded under the routine ante-mortem inspections conducted at abattoir (AMPC, 2019). This includes the collection of animals per consignment:

- Rejected from slaughter/condemned
- Withheld for further treatment
- Emergency treatment
- Restricted slaughter

This information is considered currently readily available, and it is recommended that more detailed offal data such as those originally proposed in this Sheet be incorporated within future versions of the protocol once a national standardised reporting framework is finalised (currently under review).

6.1.12 General comments

In addition to feedback received from participating feedlots on specific measures, which was used to inform recommendations in the sections above (6.1.1 – 6.1.11), there were also more general comments received from the feedlots regarding the welfare benchmarking project. Because these differed somewhat between large and smaller operations, they are separated on this basis below.

6.1.12.1 Large feedlot feedback

- Need to have clarity on whether the framework is intended as an internal self-assessment process or one designed for external audit.
- Feedlots are asked about welfare, environment, and antibiotics from buyers. The idea of a "welfare monthly scorecard" would be very valuable.
- Indirect benefit of participating → Business now talking about welfare a great deal more and on a regular basis.
- In the future, tablet-based recording would be preferable to paper-based.
- Query whether feedlot staff can be sufficiently objective, especially for some measures (e.g., coat cleanliness) where it was felt that there is a degree of subjectivity.
- The success of this trial has worked when a specific role such as an Animal Welfare Officer is created/already exists, and that is the staff member's sole responsibility → no time pressures.
- Unable to collect all data on the same day due to the sheer number of pens/lots required to be followed. Too much work for one staff member. Instead, it was done over 2-3 days. Some collection times were prioritized over others, for example feed out times over the end of the day measures.
- Should there be a measure for animals vocalizing in the laneway/race/crush?
- Perhaps a more nuanced recording of use of handling aids, rather than 0/1 score, a scaling score should be used.
- Happy with the incorporation of panting scores, as they are very relevant.
- Demeanour scales well received.
- Should there be more focus on at risk animals in hospital pens not those in home pens?
- Question regarding slick bunks was potentially confusing, and it was suggested that faecal scoring would be a better metric to assess.
- Feedout and midday visits overlap too much. Delete midday visit?
- Peak water consumption likely at 3-4pm.
- Consider:
    - Choosing starter pens 0-14d for monitoring (as existing animals are more accustomed to environment and pen mates),
    - Monitor faecals when walking a % of the population,
    - Focus the demeanour scoring on hospital animals, and
    - Recording relapse rates.

6.1.12.2 Smaller feedlot feedback

- Suggestion for externalization of the data: Blind benchmarking report: can see where you are on the ladder but do not know the identity of others.
- Options:
    - Voluntary assessment tool,
    - Independent accredited system for consumers, or
    - Score card.
- The data collection takes a whole day of work for one person, removing them from their normal duties.
- Step by step approach of data collection is too rigid and not user friendly.
- A lot of repetition and backwards and forwards between pens and recording sheets

    - Can be managed in summer but not practical in winter.
- Recommend changing layout to pen/outside measures versus office measures.
- Visits could be grouped by location/area of feedlot than welfare metric.
- Improve layout structure so naturally related measures such as pen welfare and nutrition follow each other on the same sheet/page.
- Some measurements (e.g., Section 6.0) – a sliding scale would be better.
- Section 1.0 – suggestion: Does feedlot have a training protocol in place for new staff?
- Timeline for dead animals to be buried? Or autopsy done within x hours of death?
- Instead of asking about if staff have received training on euthanasia 0/1, a better way of asking may be: is there a trained person to undertake euthanasia?
- Question regarding how/if new staff are inducted.
- Handling – should add metric for animal vocalisations.
- Need to add slips, trips, and falls to table.
- Feed-out time is not uniform and can vary by up to 3 hours between different ends of the feedlot.
- Relevance questioned of capturing bunk score 2-4 times per day.
- Other time points were also questioned - The 2h after feedout and 12 pm measures can both occur at roughly the same time. Suggested timepoints could be:
    - Early morning: 7/7:30am
    - At feed call: roughly 2 hours before feedout
    - 1 hr after feedout
    - Late afternoon: keeping in mind staff are normally gone by 4pm
- Times for pen visits overlap too much;
    - 3 visits may be better e.g., 8am/first, feedout and 1-2 hours post last feed.
- The health information collected at timepoint 4 (2 hrs after feedout) would fit into the feedlot workers' day if collected in the morning when they normally do their pen-walks.
- Alternatively, can pen assessments be simplified to one time point?
- Very impressed with demeanour scale;
    - One respondent: *some irrelevant terms which acclimation makes obsolete e.g., lively, nervous, uncomfortable always tend to be rated minimum (especially after 30 days on feed) and settled and content always rated maximum*.
- Perhaps focus demeanour scoring on higher risk pens or starter pens (longer term fed cattle do not change much).
- Definitions are on opposite side of paper so easily missed/skipped over – need to be on same page.
- Mud depth – should be asking about cleaning intervals e.g., every 65 days.

6.2 Research collected data

6.2.1 Recommendations on metrics

This section details each of the metrics presented in Table 5 that were collected during the Pilot. For each metric, a description and outline of the collection method is provided. Further, the outcome of the Pilot, requirement for any modification and the overall recommendation on whether each metric was then included in the refined Protocol for the Australia feedlot industry is provided (addressing Project Outcome 10; Section 4.1). While each metric is assessed individually,

consideration has been made to remove duplication and provide methods that enable manageable collection, all while ensuring the Protocol provides a holistic approach to assessing cattle welfare.

It should be noted that the interpretation of welfare outcomes from the data collected was out of the scope of this project and would require meta data that is comprehensively analysed prior to metric thresholds being established.

Each feedlot is unique in the environmental conditions it experiences, the management approach adopted, infrastructure present, target market categories and associated cattle breed and feeding programs. For the Protocol to be relevant at a national level it was important that observed pens were selected to capture as much of the diversity evident within the industry as possible. Inevitably, the selection of pens across feedlot sites was complicated, and resulted in not all cattle breeds and feeding programs being fully sampled within the short pilot period (see Section 5.2). Likewise, the Pilot occurred over summer (for feedlots that do not experience high humidity) and autumn, meaning that testing of metrics under all environmental conditions was not possible. While this restricted testing, metrics have been retained provided they address aspects of welfare that are relevant to the feedlot context (e.g., cold stress). Given the range of animal metrics proposed, the revised Protocol contains the necessary components for all welfare outcomes to be captured. However, collection of meta data in the future will be necessary to establish thresholds. This does not preclude the Protocol being useful for feedlots to track and improve their own performance over time, but the addition of thresholds would be informative if the framework is later adapted for use in collecting industry-wide data and setting targets.

6.2.1.1 Static pen assessment information

Static information that provided administrative and pen reference information was collected during the Pilot at the start of each pen assessment, and included:

i) Assessor
ii) Feedlot
iii) State
iv) Date/time
v) Pen I.D.
vi) Lot number/s
vii) Head in pen (no.), and
viii) Days on feed (days; DOF)

Certain information (i – iii) was relevant only to the Pilot for analysis purposes designed to address the objectives outlined in Section 4, and, as such is not discussed further. The remaining information (iv – viii) is recommended to be collected in the revised Protocol. This information either:

- Facilitates the tracking of animals/pen over time (v-vi) which is vital should the industry adopt the Protocol under a benchmarking framework.
- Provides valuable management input information (vii-viii).

For example, the number ‘head in pen’ (vii) allows for calculation of stocking density, an important consideration when assessing welfare of lot fed cattle. Likewise, ‘DOF’ is also an important input metric that informs on numerous output metrics, facilitating the better interpretation and understanding of welfare outcomes within the feedlot context. For example, acidosis in lot fed cattle increases as DOF increases (Nagaraja and Lechtenberg 2007). Further, buller syndrome is normally

an issue at the beginning of feeding programs, in the first 30 DOF (Taylor et al. 1997). Overall, the formal collection of this information in a revised Protocol to assess the welfare of lot feed cattle is warranted.

6.2.1.2 Static animal information

This section details the four static animal metrics collected over the course of the Pilot. These metrics were collected once per pen assessed at the TP 1 (08:00 h).

6.2.1.2.1 Breed

6.2.1.2.1.1 Description and collection of metric in pilot testing

The 'breed' metric was designed to inform interpretation of output welfare metrics. Breed of cattle is widely recognised as a risk factor for various welfare issues as different breeds are known to have different heat tolerances (Brown-Brandl et al. 2006; Belasco et al. 2015), and reactivity to handling and restraint (Grandin 1998). This metric was previously collected by feedlots, with the animal type readily available within feedlot records. However, the level at which this metric was collected within the Pilot was higher than that collected at feedlot.

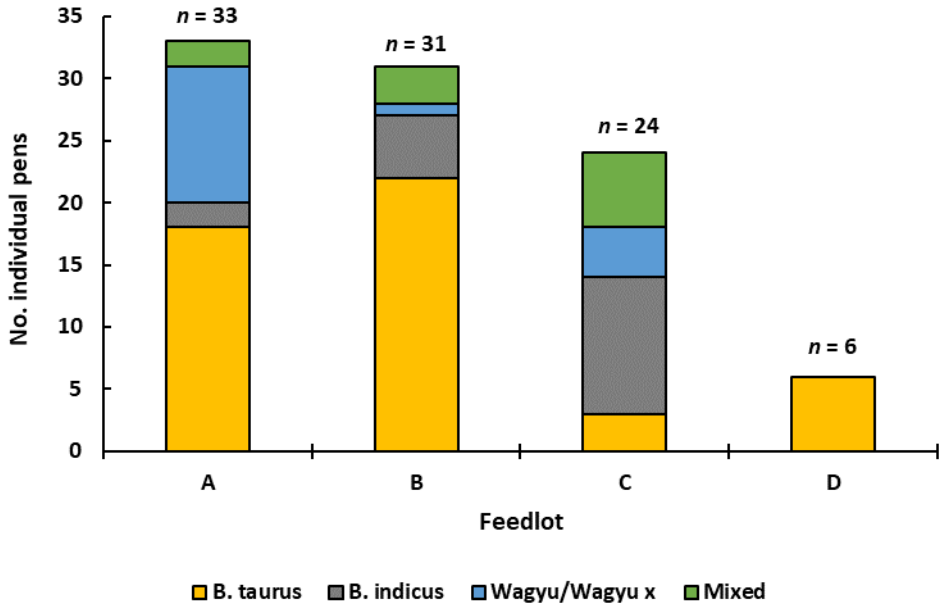
For each pen, the category that best described the cattle was selected:

- *B. taurus*
- *B. indicus*
- *B. indicus* x 25%
- *B. indicus* x 50%
- *B. indicus* x 75%
- *Wagyu/Wagyu* x
- Mixed; indicate breakdown % in preceding categories

6.2.1.2.1.2 Outcome of pilot testing

Across all four feedlots, the collection of 'breed' was necessary to aid in the interpretation of output data given the diverse nature of cattle present at each premise. It was apparent that feedlots are varied in their target market categories and thus breed of cattle present on the premises, however different breeds were not always managed separately, with pens of 'Mixed' category evident at three of the participating feedlots (Feedlots A-C) (Fig. 12).

Figure 12. Cattle breeds observed in pens (*n* = 94) assessed across the four feedlots (Feedlots A – D).



6.2.1.2.1.3 Recommendations

The inclusion of breed at a pen-level is considered necessary to aid in the assessment of cattle welfare. It is recommended that 'breed' be included in the revised Protocol with the collection simplified to indicate only the predominant breed category:

- *B. taurus*
- *B. indicus*
- *B. indicus* x (> 50% *indicus)*
- *Wagyu/Wagyu* x
- Mixed

This modification would ensure relevant information is captured whilst aligning more closely with the information readily available through feedlot records to reduce assessment burden.

It is recommended that this metric be captured once per pen. If mixing of cattle occurs, this metric should be collected again.

6.2.1.2.2 Class

6.2.1.2.2.1 Description and collection of metric in pilot testing

The metric 'class' further informed on cattle type in pens and was relevant to output metric interpretation. This metric was previously collected by feedlots, however, those feedlot records made available to the research team (e.g., bunk sheets) do not delineate the 'mixed' category, requiring visual appraisal of stock.

For each pen, a category was selected:

- Steer
- Heifer

- Cow
- Bull
- Mixed; indicate breakdown % in preceding categories

6.2.1.2.2.2 Outcome of pilot testing

The Pilot indicated that class was a necessary input metric. While it was intended to be captured with more differentiation as outlined above, time restraints and the difficulty in accurate visual identification of sex for all head in each pen necessitated a simpler collection method for this metric.

Regardless of level of collection, it became apparent as the Pilot progressed that the different cattle classes were not always managed independently. Importantly, on only two occasions at separate feedlots, a few bulls were housed in pens with heifers. The housing of bulls with heifers, intentional or not, could be considered a welfare risk factor due to adverse implications of pregnancy within the feedlot context. In general, the presence of pregnant heifers with feedlots is undesirable from both a welfare and management standpoint, mainly due to abortions, calving problems (e.g., dystocia, mortality), and increased management burden, allocation of resources, and reductions in productivity (Rademacher et al. 2015).

6.2.1.2.2.3 Recommendations

The inclusion of 'class' at a pen-level is considered necessary to aid in the assessment of cattle welfare. It is recommended that the metric be included in the revised Protocol in a simplified version where the predominant class category is selected, and for feedlots where bulls are periodically housed with heifers, this information to be captured. In the revised Protocol the following information should be collected:

- Predominant category:
  - Steer
  - Heifer
  - Cow
  - Bull
  - Mixed
- Indicate whether bulls and heifers housed together (Y/N)

These modifications would ensure relevant information is captured whilst aligning more closely with the information readily available through feedlot records to reduce assessment burden on feedlot staff.

It is recommended that this metric be captured once per pen. If mixing of cattle occurs, this metric should be collected again.

6.2.1.2.3 Coat colour

6.2.1.2.3.1 Description and collection of metric in pilot testing

The metric 'coat colour' informed interpretation of output metrics. This metric was not previously collected by feedlots in a formal manner (i.e., records).

For each pen, the percentage (%) of cattle observed per category was recorded:

- Black

- Black and white
- Red
- Red and white
- Grey or white
- Spotted

6.2.1.2.3.2 Outcome of pilot testing

Pilot testing indicated that this metric was necessary to aid in the interpretation of output data, specifically those associated with heat stress (e.g., 'panting score'). It is recognised that coat colour is a risk factor for heat stress in lot fed cattle (Blackshaw and Blackshaw 1994; Brown-Brandl et al. 2006). During the Pilot, low incidence of heat stress occurred, limiting the ability for formal conclusions, with heat stress observed during only 69 of 803 pen observations (8.6%). That being said, a trend appeared evident in the data of those pens observed to display heat stress (PS ≥ 2) with the dominant coat colour of these cattle being either red (*n* = 32; 50%) or black (*n* = 31; 48.4%). However, it should be noted that the specific coat colour of the cattle that were observed to be panting was not recorded and is a recognised limitation within the Pilot.

6.2.1.2.3.3 Recommendations

The inclusion of 'coat colour' at a pen level was considered necessary to aid in the assessment and management of cattle welfare. It is recommended that the metric be included in the revised Protocol, simplified to indicate whether the predominant coat colour of the pen was one of those generally considered 'at risk':

- Black; or
- Red

Such modification to a binomial scoring system would ensure relevant information is captured to inform welfare outcomes and enable the tracking of 'at risk' cattle.

It is recommended that this metric be captured once per pen. If mixing of cattle occurs, this metric should be collected again.

6.2.1.2.4 Mixing

6.2.1.2.4.1 Description and collection of metric in pilot testing

The metric 'mixing' was designed to capture social mixing on arrival to the feedlot to inform specifically on behavioural and health output metrics. Mixing of unfamiliar cattle is known to increase stress and agonistic behaviour at the start of the mixing period (Tennessen et al. 1985; Salvin et al. 2020), and is also associated with increased disease risk (e.g., respiratory disease; (Sanderson et al. 2008)). This metric was considered to be previously collected by feedlots, captured under the records from induction (e.g., lot numbers).

For each pen, whether mixing occurred at arrival was recorded as:

- Yes
- No

6.2.1.2.4.2 Outcome of pilot testing

The outcome of the Pilot with regards to the 'mixing' metric was limited. The appropriate records were not available across all pens and feedlots to enable the consistent and robust collection of the 'mixing' metric as intended. The main reason for this was the protection of sensitive client information at a management level. Furthermore, in those cases where the information was available, it appears that the tracking of lot numbers as a proxy to indicate whether social mixing occurred at entry to feedlot is not appropriate. It became evident that individual lot numbers may not relate directly to the date on which cattle arrive, with lot number routinely left open across intake days. More importantly, it was also noted that cattle that arrived, and were inducted and housed in the same home pen could be allocated a different lot number for management purposes (e.g., delineation of cattle to meet specific market categories based on class or coat colour). Consequently, it was not possible to determine solely on the basis of pen lot numbers whether social mixing had occurred at entry to the feedlot.

Anecdotally it was noted that once the cattle were on the premises, mixing of pens, and thus lot numbers, for management purposes was frequent. This has been recognised above (**see Section 5.2.1)** as a limitation impacting the number of repeated measures on observed pens across feedlot site visits.

6.2.1.2.4.3 Recommendations

Based on the outcome of the Pilot it is recommended that this metric be modified for inclusion in the revised Protocol in a manner to track additional social mixing of animals within the feedlot context, not just at entry. Specifically, it is recommended that the metric be modified to also indicate:

- Time since last social mixing (expressed in days)

The reason for these modifications is the apparent frequency at which the splitting and mixing of lot numbers originally assigned to an observed pen occurred over the course of the Pilot. This mixing was done for management purposes and is unavoidable, thus this modification enables this variability to be captured adequately to inform relevant output metrics e.g., competition at feed or antagonistic social interactions.

To facilitate ease of collection, further discussion with feedlot personnel is warranted to determine the most appropriate way to capture or track this information in a streamlined manner. This will ensure that the reporting burden associated with the collection of the 'mixing' metric is minimised.

It is recommended that this metric be captured once per pen. If mixing of cattle occurs, this metric should be collected again.

6.2.1.3 Climatic metrics

This section details the eight climatic metrics collected over the course of the Pilot. Climatic variables were collected only once per TP, at the first pen assessed to ensure consistent data capture.

6.2.1.3.1 Cloud cover

6.2.1.3.1.1 Description and collection of metric in pilot testing

The 'cloud cover' metric is a climatic measure aimed to give an indication on the amount of sun exposure cattle were experiencing at the time of pen-side assessment. This metric was not already collected at any of the four participating Pilot feedlots.

At the start of each assessment time point (TP 1 – 4: TP 1 = 08:00 h; TP 2 = 11:00 h; TP 3 = 14:00 h; TP 4 = 17:00 h), at the first pen assessed, an estimated percentage of cloud cover was achieved by viewing the sky and estimating the percentage of cloud cover to the nearest 5% interval.

6.2.1.3.1.2 Outcome of pilot testing

Over the course of the Pilot, cloud cover varied with recording ranging from 0 – 100%. It was evident that higher percentages of cloud cover were associated with higher humidity levels, and lower solar radiation which was reflected in the slightly lower wet bulb globe temperature recordings.

6.2.1.3.1.3 Recommendations

It is recommended based of the Pilot that the metric 'cloud cover' not be included in the revised Protocol. The main reason for this is since the information is covered under the 'relative humidity' and 'wet bulb globe temperature' metrics, reporting on this individual measure is not necessary. Further, shade utilisation is captured under 'posture', an animal outcome.

6.2.1.3.2 Dry bulb temperature

6.2.1.3.2.1 Description and collection of metric in pilot testing

The 'dry bulb temperature' metric included in the Protocol is an input metric designed to inform interpretation of the output welfare metrics collected, specifically providing information on the environmental conditions that cattle are experiencing at the time of pen-side assessment. This measure is a critical component of calculating the Heat Load Index (HLI) and Temperature-Humidity Index (THI). This metric was considered to be presently collected at feedlot, with the majority of feedlots having on-site weather stations.

At the start of each assessment time point (TP 1 – 4: TP 1 = 08:00 h; TP 2 = 11:00 h; TP 3 = 14:00 h; TP 4 = 17:00 h), at the first pen assessed, a hand held weather metre, Kestrel 5400 Cattle Heat Stress Tracker (Kestrel AU) was used to capture this metric.

6.2.1.3.2.2 Outcome of pilot testing

While the feedlots included within the Pilot were located in areas that did not experience high humidity, high dry bulb temperatures were captured. Over the course of the Pilot, maximum dry bulb temperatures of 36.1, 38.6, 39.7 and 26.8 °C were seen at Feedlots A – D, respectively. High temperature conditions that resulted in cattle experiencing heat stress were not captured during the Pilot, with cattle panting scores > 2.5 not recorded (see Section 6.2.1.4.9).

6.2.1.3.2.3 Recommendations

It is recommended based of the Pilot that the metric 'dry bulb temperature' be retained in the revised Protocol. For locations that do not experience high humidity such as those enrolled in the Pilot, dry bulb is still a critical measure, as dry bulb temperatures at or above cattle body temperatures will result in cattle needing to use evaporation for heat loss. At high temperatures, this could result in cattle experiencing heat stress.

Many feedlots have weather stations installed on site, which if located in a representative area of the feedlot, would capture the necessary dry bulb temperature information required. However, provisions for feedlots that do not have a weather station would be required. This may involve the installation of an automated weather station or use of a handheld device such as the Kestrel used herein to capture relevant information. Consideration is also needed to ensure the climate of any pens on the feedlot that are located in 'hot areas' (e.g., low wind flow) is captured. If the environmental conditions at the feedlot are variable, it is critical to ensure local environmental conditions at each different pen are adequately captured.

It is recommended that this metric is recorded at least once every time pen-side measures of behaviour or animal outcomes are to be recorded. It is sufficient for the information to be captured from automated weather station records for the time of assessment, it is not a requirement for these measures to be collected pen-side.

6.2.1.3.3 Wet bulb globe temperature

6.2.1.3.3.1 Description and collection of metric in pilot testing

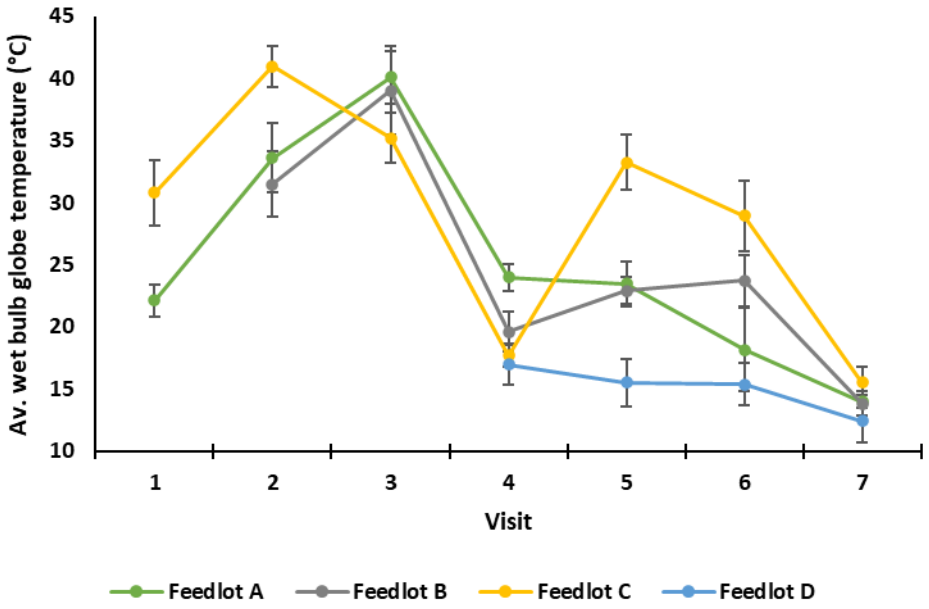
The 'wet bulb globe temperature' (WBGT) metric included in the Protocol is a critical input metric designed to inform interpretation of the output welfare metrics collected, specifically providing information on the environmental conditions that cattle are experiencing at the time of pen-side assessment. This metric incorporates solar radiation, which is of particular importance to cattle with dark coats and those without access to shade and is important in indicating risk of the development of heat stress. This metric was considered to be presently collected at feedlot, with the majority of feedlots having on-site weather stations.

At the start of each assessment time point (TP 1 – 4: TP 1 = 08:00 h; TP 2 = 11:00 h; TP 3 = 14:00 h; TP 4 = 17:00 h), at the first pen assessed, a hand held weather metre, Kestrel 5400 Cattle Heat Stress Tracker (Kestrel AU) was used to capture WBGT.

6.2.1.3.3.2 Outcome of pilot testing

Pilot testing across the four participating feedlots suggests that the collection of the 'wet bulb globe temperature' metric is necessary to aid in the interpretation of output data, specifically metrics associated with heat stress (e.g., 'panting score'). WBGT is vital in capturing the environmental climates the cattle were exposed to and is an important indicator of heat stress conditions, capturing solar radiation. It was evident that WBGT varied between Pilot feedlot (A – D) and Visit (1 – 7), with the highest WBGT experienced in Visit 2 and 3 (Fig. 13). These high WBGT temperatures were associated with some panting observed in cattle with 80.9% of panting scores 2 or above observed in these two Visits (see Section 6.2.1.4.9). However, no extreme heat stress events were observed during the Pilot, with no cattle observed to be 'open mouth' panting (i.e., panting scores 3 or above).

Figure 13. Average (± S.E.) wet bulb globe temperature (°C) recorded by Visit (1 – 7) and Feedlot (A – D).



6.2.1.3.3.3 Recommendations

The inclusion of 'wet bulb globe temperature' as an input metric is considered necessary to aid in the assessment of cattle welfare, particularly thermal stress. Importantly, this metric accounts for both humidity and solar radiation suggesting that this metric is sufficient to capture these environmental factors reducing the collection of duplicative information. It is recommended based on the outcome of Pilot testing that WBGT be included in the revised Protocol.

As for 'dry bulb temperature', provisions need to be made if:

- Feedlots do not have a weather station installed on-site
- The on-site weather station is not located in a representative area of the feedlot
- There are pens located in 'hot areas' (e.g., low wind flow)

It is recommended that this metric is recorded at least once every time pen-side measures of behaviour or animal outcomes are to be recorded. It is sufficient for the information to be captured from automated weather station records for the time of assessment, it is not a requirement for these measures to be collected pen-side.

6.2.1.3.4 Relative humidity

6.2.1.3.4.1 Description and collection of metric in pilot testing

The 'relative humidity' metric included in the Protocol is an input metric designed to inform interpretation of the output welfare metrics collected, specifically providing information on the environmental conditions that cattle are experiencing at the time of pen-side assessment. This measure is an important component of calculating the Heat Load Index (HLI) and Temperature-Humidity Index (THI). This metric was considered to be presently collected at feedlot, with the majority of feedlots having on-site weather stations.

At the start of each assessment time point (TP 1 – 4: TP 1 = 08:00 h; TP 2 = 11:00 h; TP 3 = 14:00 h; TP 4 = 17:00 h), at the first pen assessed, a hand held weather metre, Kestrel 5400 Cattle Heat Stress Tracker (Kestrel AU) was used to capture relative humidity (%).

6.2.1.3.4.2 Outcome of pilot testing

Over the course of the Pilot, high humidity was not observed at any of the feedlots during the Pilot. Specifically, average relative humidity recorded across the Pilot were 52.8%, 49.9%, 41.0% and 57.2% for Feedlots A – D, respectively (Table 15).

Table 15. Relative humidity (%) recorded pen-side by Feedlot (A – D).

Feedlot	Observation no.	Average relative humidity (%)	Relative humidity (%) range
Feedlot A	28	52.8 ± 3.9	22.2 – 100
Feedlot B	24	49.9 ± 4.3	11.6 – 82.6
Feedlot C	28	41.0 ± 4.1	17.6 – 90.6
Feedlot D	16	57.2 ± 3.1	41.2 – 80.3
Total	***96***	***49.3 ± 2.1***	***11.6 – 100***

6.2.1.3.4.3 Recommendations

As the information provided by this metric is captured under the 'wet bulb globe temperature' metric which incorporates both humidity and solar radiation, and used under THI and HLI, it is recommended that reporting on this individual measure is not required.

6.2.1.3.5 Precipitation

6.2.1.3.5.1 Description and collection of metric in pilot testing

The 'precipitation' metric included in the Protocol is a critical input metric designed to inform interpretation of the output welfare metrics collected, specifically providing information on the environmental conditions that cattle are experiencing. This metric was considered to be presently collected at feedlot, with the majority of feedlots having on-site weather stations.

For each Visit (1 – 7), this information was collected from the feedlot weather station or the nearest locally accessible weather records. Specifically, calculated at 9:00 h for the 24 h prior to collection.

6.2.1.3.5.2 Outcome of pilot testing

Over the course of the Pilot, precipitation was not recorded at until Visit 6 and 7 for Feedlot A and C only due to the Pilot finalising data collection in June 2022. Further, during these visits high levels of rainfall were not observed with the maximum precipitation of 8.4 mm recorded for the 24 h period during which pen-side assessments occurred. In many cases, it was mentioned by the feedlot staff that the premises received rain in the preceding days and notes were also made on this by assessors. The feedlots in the Pilot are located in regions that experience high winter rainfall, therefore, outcomes for this measure are minimal.

6.2.1.3.5.3 Recommendations

Precipitation impacts the moisture content of the manure pad and its integrity, while precipitation along with low temperatures can impact cattle behaviour and demeanour. The metrics 'coat cleanliness 2' and 'animal mud depth' retained in the revised Protocol capture, in part, this information. However, it is important to note that precipitation is not the sole determinant of manure pad conditions and coat contamination (e.g., stocking density; Grandin 2016). This information is also useful to inform pen management decisions. As such, to adequately capture the impact of environmental conditions experienced by cattle on these metrics, it is recommended that 'precipitation' be included, with minor modification, in the revised Protocol. Under the modified metric, precipitation is to be collected only when the premises has received rain in the three days preceding pen-side assessments. When such conditions occur, the information collected is:

- Total amount (mm) of rain received in the preceding 72 h in accordance with the feedlot weather station or nearest locally accessible weather records.

6.2.1.3.6 Wind speed

6.2.1.3.6.1 Description and collection of metric in pilot testing

The 'wind speed' metric included in the Protocol is a critical input metric designed to inform interpretation of the output welfare metrics collected, specifically providing information on the environmental conditions that cattle are experiencing at the time of pen-side assessment. This measure is an important component of the HLI, where wind speed greatly impacts an animal's ability to offload heat, but also impacts the integrity of the manure pad in pens and dust levels across a feedlot. This metric was considered to be presently collected at feedlot, with the majority of feedlots having on-site weather stations.

At the start of each assessment time point (TP 1 – 4: TP 1 = 08:00 h; TP 2 = 11:00 h; TP 3 = 14:00 h; TP 4 = 17:00 h), at the first pen assessed, a hand held weather metre, Kestrel 5400 Cattle Heat Stress Tracker (Kestrel AU) was used to capture wind speed (km/h).

6.2.1.3.6.2 Outcome of pilot testing

Over the course of the Pilot, wind speed was variable across time of day (TP 1 – 4) and between Feedlots (A – D; Table 16). Compared to the WA feedlots (Feedlot A – C), Feedlot D was the least windy at the time of pen assessment (Table 16). It is important to note that the Pilot did not occur during months of seasonal high wind conditions (August – September for WA).

Table 16. Average (± S.E.) pen 'wind speed' by assessment time point. Assessments were made at four time points; TP 1 (8:00 h), TP 2 (11:00 h), TP 3 (14:00 h), and TP 4 (17:00 h).

	Average (± S.E.) wind speed (km/h)			
Assessment time point (TP)	Feedlot A	Feedlot B	Feedlot C	Feedlot D
TP 1	8.8 ± 1.7	7.0 ± 2.8	11.0 ± 2.4	2.1 ± 0.7
TP 2	11.6 ± 2.6	8.0 ± 1.9	14.3 ± 2.6	5.3 ± 0.9
TP 3	13.5 ± 2.1	5.9 ± 1.6	11.3 ± 1.7	4.8 ± 1.4
TP 4	9.6 ± 2.2	8.0 ± 3.2	12.3 ± 1.7	3.0 ± 1.3
Total	***10.9 ± 1.1***	***7.2 ± 1.2***	***12.1 ± 1.0***	***3.8 ± 0.6***

6.2.1.3.6.3 Recommendations

The inclusion of 'wind speed' as an input metric is considered necessary to aid in the assessment of cattle welfare, due to the impact on the environmental conditions that cattle experience and also because wind speed impacts the ability of cattle to dissipate heat load thus is an important consideration during heat stress conditions. It is recommended based on the outcome of Pilot testing that 'wind speed' be included in the revised Protocol.

To achieve this, provisions will need to be made if:

- Feedlots do not have a weather station installed on-site
- The on-site weather station that is not located in a representative area of the feedlot
- There are pens located in areas of high or low wind areas (dependent on location of weather station)

It is recommended that this metric is recorded at least once every time pen-side measures of behaviour or animal outcomes are to be recorded. It is sufficient for the information to be captured from automated weather station records for the time of assessment, it is not a requirement for these measures to be collected pen-side.

6.2.1.3.7 Temperature humidity index

6.2.1.3.7.1 Description and collection of metric in pilot testing

The 'temperature humidity index' (THI) metric included in the Protocol is a critical input metric designed to inform interpretation of the output welfare metrics collected, specifically providing information on the environmental conditions that cattle are experiencing at the time of pen-side assessment. This measure was previously used as an indicator and predictor of heat stress but has more recently been replaced by the Heat Load Index (HLI). This metric was considered to be presently collected at feedlot, with the majority of feedlots having on-site weather stations.

At the start of each assessment time point (TP 1 – 4: TP 1 = 08:00 h; TP 2 = 11:00 h; TP 3 = 14:00 h; TP 4 = 17:00 h), at the first pen assessed, a hand held weather metre, Kestrel 5400 Cattle Heat Stress Tracker (Kestrel AU) was used to capture THI. This device automatically calculates the THI from the weather data received by the device.

6.2.1.3.7.2 Outcome of pilot testing

Over the course of the Pilot, the THI data showed expected variations across time points and across feedlot (Feedlot A – D), as seen in the individual climatic metrics recorded and described above. This measure did indicate heat stress conditions for cattle (threshold for moderate heat stress THI > 72; high heat stress THI > 82; extreme THI > 90 (Thornton et al. 2021; Table 17) were occurring despite no animal indicators of heat stress being observed (e.g. open mouth panting). Specifically, the THI threshold was exceeded at Feedlots A – C during Visits 2 and 3 during a total of 22 observations (Table 17). This demonstrates the problems with the utility of this measure. For instance, it is possible that these thresholds are not appropriate for those cattle observed (e.g., cattle could be acclimatised to conditions), or the mitigation actions taken by enrolled feedlots to address heat stress were adequate (e.g., shade and water provision).

Table 17. Temperature Humidity Index (THI) recorded during the summer months by Feedlot (A – D) and assessment time point. Assessments were made at four time points; TP 1 (8:00 h), TP 2 (11:00 h), TP 3 (14:00 h), and TP 4 (17:00 h). Italicised and bold THI indicate recorded THI exceeds the threshold for onset of heat stress.

Feedlot	Visit (month)	Assessment time point			
		TP 1	TP 2	TP 3	TP 4
Feedlot A	Visit 1 (Nov 21)	62.6	66.9	68.9	65.0
	Visit 2 (Dec 21)	***73.6***	***76.7***	***74.7***	69.6
	Visit 3 (Jan 22)	***78.5***	***81.9***	***82.9***	***80.7***
	Visit 4 (Feb 22)	66.6	-	-	-
Feedlot B	Visit 1 (Nov 21)	-	-	-	-
	Visit 2 (Dec 21)	66.6	71.2	***74.1***	71.8
	Visit 3 (Jan 22)	***73.6***	***78.3***	***80.5***	***80.4***
	Visit 4 (Feb 22)	67.8	***73.2***	***75.4***	71.9
Feedlot C	Visit 1 (Nov 21)	62.6	67.9	70.7	71.9
	Visit 2 (Dec 21)	***73.9***	***79.8***	***79.0***	***81.8***
	Visit 3 (Jan 22)	***72.0***	***73.9***	***79.3***	***76.1***
	Visit 4 (Feb 22)	61.5	64.2	69.7	68.5
Feedlot D	Visit 1 (Nov 21)	-	-	-	-
	Visit 2 (Dec 21)	-	-	-	-
	Visit 3 (Jan 22)	-	-	-	-
	Visit 4 (Feb 22)	57.1	63.6	67.3	66.0

6.2.1.3.7.3 Recommendations

Based on the outcome of the Pilot, 'THI' is a less informative indicator and predicator of cattle heat stress under feedlot conditions, when 'HLI' is being used. Thus, it is recommended that the 'THI' metric not be included in a revised Protocol.

6.2.1.3.8 Heat load index

6.2.1.3.8.1 Description and collection of metrics in pilot testing

The 'HLI' metric included in the Protocol is a critical input metric designed to indicate heat stress conditions to inform environmental conditions that cattle are experiencing. Importantly, this metric incorporates solar radiation and wind speed, and is, therefore, considered a more accurate indicator and predictor of cattle heat stress than THI (Thornton et al. 2021).

At the start of each assessment time point (TP 1 – 4: TP 1 = 08:00 h; TP 2 = 11:00 h; TP 3 = 14:00 h; TP 4 = 17:00 h), at the first pen assessed, a hand held weather metre, Kestrel 5400 Cattle Heat Stress Tracker (Kestrel AU) was used to capture HLI. This device automatically calculates the LHI from the weather data received by the device.

1.1.1.1.1. Outcome of pilot testing

Pilot testing across the four participating feedlots supports the position that the collection of the 'HLI' metric is useful for the assessment of heat stress, and is, thus, meaningful from a welfare perspective. Over the course of the Pilot, the HLI data showed expected variations across time points and across feedlot (Feedlot A – D), as seen in the individual climatic metrics recorded and described

above. The HLI threshold depends on cattle genotype and environment (access to shade) with the threshold ranging from 86 for *B. taurus* cattle to 96 for *B*. *indicus* bred cattle (see Gaughan et al. 2010). Taking a precautionary approach by adopting the lowest heat stress threshold (taurus genotype with no access to shade; HLI threshold 86) given the variety of cattle breeds and access to shade within the assessed pens at each Feedlot, the 'HLI' recorded indicates that heat stress conditions occurred less frequently at 14 observations (Table 18) than indicated by the "THI' metric. This appears to reflect the animal-based outcome of panting more accurately, although no extreme heat stress events occurred during the Pilot as reflected by with no panting scores higher than 2.5.

Table 18. Heat Load Index (HLI) recorded during the summer months by Feedlot (A – D) and assessment time point. Assessments were made at four time points; TP 1 (8:00 h), TP 2 (11:00 h), TP 3 (14:00 h), and TP 4 (17:00 h). Italicised and bold HLI indicate recorded HLI exceeds the threshold for onset of heat stress for purebred *Bos taurus* cattle with no access to shade.

Feedlot	Visit (month)	Assessment time point			
		TP 1	TP 2	TP 3	TP 4
Feedlot A	Visit 1 (Nov 21)	56.2	57.2	68.3	52.6
	Visit 2 (Dec 21)	82.5	83.3	***86.1***	72.6
	Visit 3 (Jan 22)	***88.3***	***98.3***	***97.0***	***92.2***
	Visit 4 (Feb 22)	57.2	-	-	-
Feedlot B	Visit 1 (Nov 21)	-	-	-	-
	Visit 2 (Dec 21)	74.2	72.7	***86.4***	73.1
	Visit 3 (Jan 22)	79.1	***91.5***	***98.6***	***87.7***
	Visit 4 (Feb 22)	73.5	78.2	70.2	56.4
Feedlot C	Visit 1 (Nov 21)	61.2	83.8	83.7	79.9
	Visit 2 (Dec 21)	***88.8***	82.5	***91.3***	***94.4***
	Visit 3 (Jan 22)	83.8	***87.8***	***91.8***	85.5
	Visit 4 (Feb 22)	63.5	70.2	66.4	54.3
Feedlot D	Visit 1 (Nov 21)	-	-	-	-
	Visit 2 (Dec 21)	-	-	-	-
	Visit 3 (Jan 22)	-	-	-	-
	Visit 4 (Feb 22)	50.2	68.6	77.5	70.3

1.1.1.1.2. Recommendations

Although the incidence of heat stress conditions was low in the Pilot, the proposed metric is considered helpful to indicate thermal challenge and aid interpretation of animal outcome metrics. However, the accuracy of this calculation to predict heat stress across all Australian feedlots is debated. Scientifically, specific climatic measures such as wet bulb globe temperature correlate with animal outcomes (e.g., panting score). Therefore, for interpreting animal welfare, the use of individual climatic measures is likely to remain important, and HLI to remain an important predictor tool for heat load events. It is recommended that HLI be included in the revised Protocol with the collection without modification. However, for feedlots that do not have on-site weather station or a membership to the computer program that calculates HLI (e.g., Katestone), then provisions could be made to use a portable and hand-held device such as the one used by the assessors during the Pilot.

It is recommended that this metric is recorded at least once every time pen-side measures of behaviour or animal outcomes are to be recorded. It is sufficient for the information to be captured from automated weather station records for the time of assessment, it is not a requirement for these measures to be collected pen-side.

6.2.1.4 Behavioural metrics

This section details the 12 pen-side behavioural metrics collected during the Pilot. It is considered important to incorporate behavioural metrics within welfare protocols as these outcome metrics provide an assessment of the welfare of the animals themselves. Behavioural metrics, with the exception of 'approach test' and 'feeding behaviour' were assessed at all four assessment time points.

6.2.1.4.1 Reactivity Index

6.2.1.4.1.1 Description and collection of metric in pilot testing

The 'reactivity index' metric was designed to measure the response of cattle to human approach, informing on the human-animal relationship (HAR) at a pen level. This metric was not previously collected by feedlots and its application is considered novel.

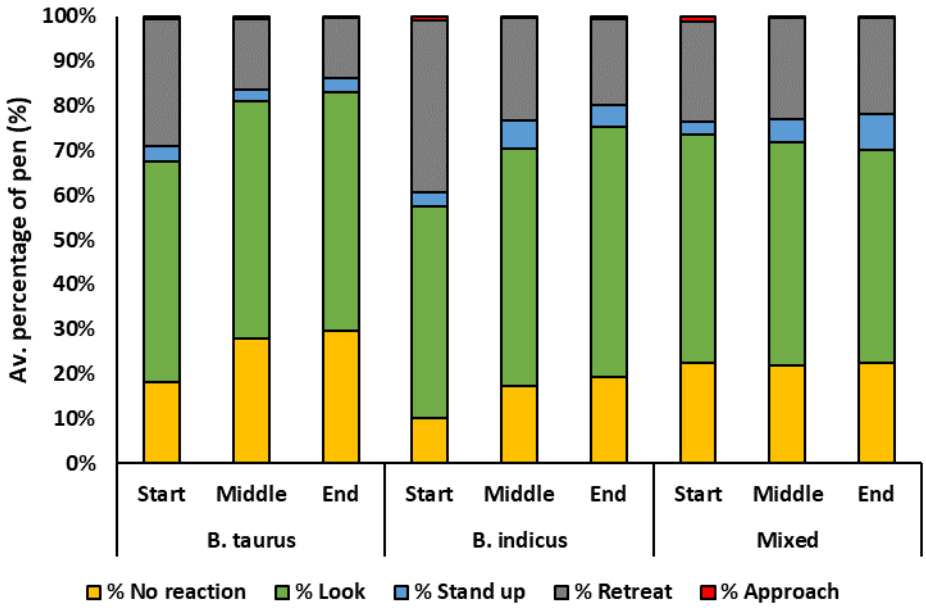
For each pen, an assessor walked along the laneway to the middle of the pen before then approaching the feed bunk, stopping 1m from the bunk and took their broadbrim hat off to wave it back-and-forth twice. Cattle reactions were recorded as:

- % no reaction: percentage of pen that did not react
- % look: percentage of pen that looked at assessor
- % stand up: percentage of pen that stood up in response to assessor approach
- % approach: percentage of pen that approached the assessor
- % retreat: percentage of cattle that retreated in response to assessor approach

6.2.1.4.1.2 Outcome of pilot testing

Pilot testing suggested that this metric captured altered behaviour and reactivity in response to human approach of lot fed cattle of different breeds and feeding programs over time. For example, cattle in short/medium-fed program (70 – 120 day-fed; *n* = 134) had the percentage of cattle that retreated at the approach of the assessor decrease over time, whereas the percentage of cattle had no reaction at the approach of the assessor increased over time, irrespective of breed (Fig. 14). These observations reflect the expected reduction in reactivity of cattle to human presence over time as they acclimate to human presence and approach. Therefore, this metric is suggested to effectively measure cattle reactivity and HAR, and is, thus, meaningful from a welfare perspective.

Figure 14. Average Reactivity Index responses of in a short/medium fed program (70 – 120 day-fed; *n* = 134). Time in feeding program categories: start = < 40 days; middle = 40 – 80 days; end = > 80 days.



6.2.1.4.1.3 Recommendations

The inclusion of the 'reactivity index' was considered to be suitable to inform on HAR and welfare. It is recommended that the metric be included in the revised Protocol, however, simplified from the 5-point scale piloted to a 2-point scale:

- % no reaction: percentage of cattle that did not react
- % reactive: percentage of cattle that retreated (backed away and/or stood up) in response to assessor approach

This modification would ensure capture of relevant information whilst reducing assessment burden.

It is recommended that this metric is recorded at the beginning of each pen assessment (morning and mid-afternoon; see Section 6.2.2). Under heat stress conditions, it is recommended that this measure not be collected to ensure cattle were not unnecessarily stressed further. Likewise, in situations where there is a risk of injury to animals, for example, if an animal is physically within the feed bunk, the measure should not be taken.

6.2.1.4.2 Approach test

6.2.1.4.2.1 Description and collection of metric in pilot testing

The 'approach test' (AT) metric was designed to measure the response of feedlot cattle to human approach informing HAR. Importantly, this could provide valuable information related to the conflict that arises between food motivation and fear response to human presence. This metric was previously collected by any feedlot.

This metric was recorded at the beginning of a pen assessment at the first time point that occurred at or after feed out. For each pen, an assessor walked along the laneway to the middle of the pen

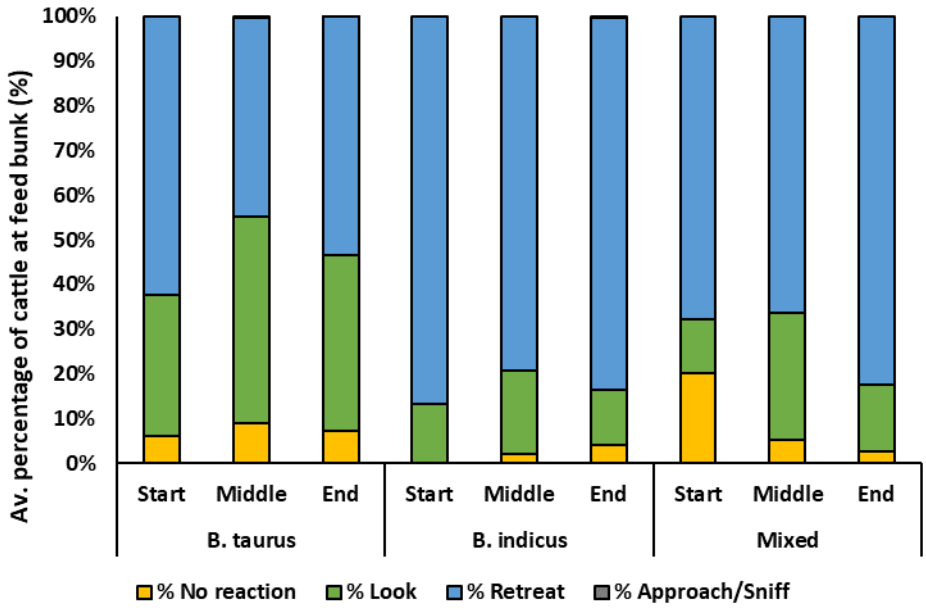
before approaching the feed bunk and stopped 1m from the bunk. The total number of cattle at the feed bunk and their responses to the human approach was recorded per category:

- % no reaction: percentage of cattle that did not react
- % look: percentage of cattle that looked at assessor
- % retreat: percentage of cattle that retreated in response to assessor approach
- % approach and sniff: percentage of cattle that approached the assessor

6.2.1.4.2.2 Outcome of pilot testing

Pilot testing suggested that this metric captured altered behaviour and 'reactivity' in response to human approach of lot fed cattle of different breeds and feeding programs over time. During the Pilot, a total of 204 ATs were conducted, with the number of cattle at the feed bunk at the time of assessment variable (average 21.9 ± 1.2 head; range: 0 – 92 head). Note, an AT was not done if the situation was considered dangerous or likely to cause injury to cattle i.e., cattle in feed bunk. The interpretation of these results from a welfare perspective is not straightforward. For example, cattle enrolled in a short/medium fed program (70 – 120 day-fed; *n* = 129), the percentage of cattle that retreated did not appear to reduce as the cattle progressed through their feeding program (Fig. 15). This was unexpected as cattle typically would become more accustomed to human exposure the longer they are at the feedlot. It could be that the added dimension of the conflict between feed motivation and response to human presence obscures the expected acclimation to human presence. Alternatively, this result may reflect the inconsistencies regarding the timing of collection of this metric relative to pen feed out time.

Figure 15. Average approach test responses of cattle in a short/medium fed program (70 – 120 day-fed; *n* = 129). Feeding program categories: start = < 40 days; middle = 40 – 80 days; end = > 80 days.



6.2.1.4.2.3 Recommendations

It is recommended that the metric 'approach test' not be included in the revised Protocol. There are three main reasons for this recommendation:

i. The information collected by this metric is similar in nature to that collected by the 'reactivity index' and removal reduces the collection of duplicative information.
ii. The information collect by this metric is relevant only to those cattle present at the feed bunk at the time of assessment and is not representative of all animals in the pen.
iii. It is considered less practical under the commercial context to collect a metric relative to feed out time compared to at a single consistent time point**,** given the variable nature of individual pen feed management.

6.2.1.4.3 Feeding behaviour

6.2.1.4.3.1 Description and collection of metrics in pilot testing

The 'feeding behaviour' metric was an animal-based outcome informing on short-term feeding (hunger) and social competition for food. This metric was not previously collect by any of the feedlots and was considered novel while been proposed recently for use in the Australian live export industry (see Dunston-Clarke et al. 2020).

Feeding behaviour was collected at the first time point that occurred at or after feed out. For each pen, the percentage (%) of cattle observed per category was recorded:

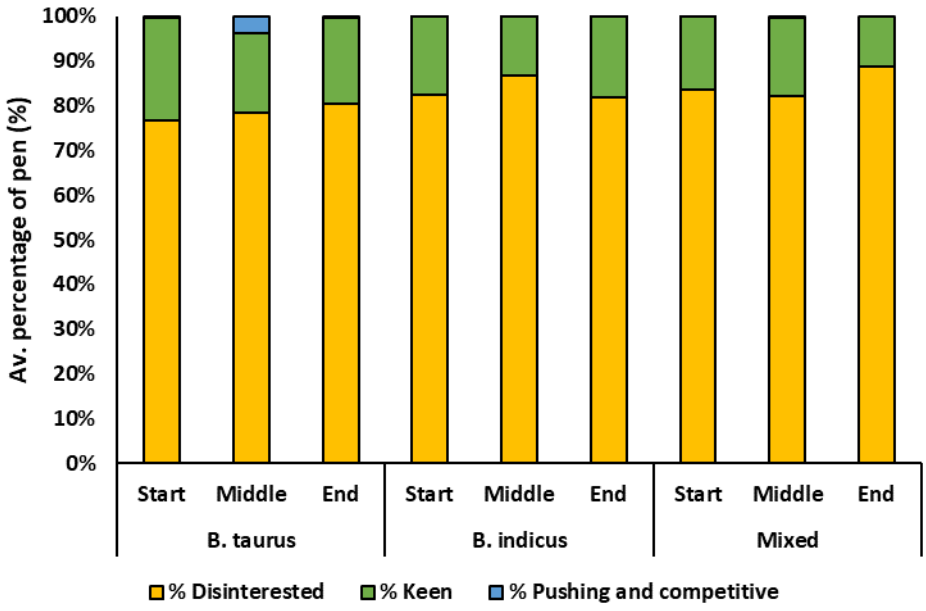
- Disinterested
- Keen
- Pushing and competitive

6.2.1.4.3.2 Outcome of pilot testing

A total of 204 observations of feeding behaviour were collected. The majority of cattle were observed to be 'disinterested' in feed, with 78.3% ± 1.5% head/pen, while 19.4% ± 1.2% head/pen and 0.7% ± 0.5% head/pen were observed as 'keen' and 'pushing and competitive', respectively. Fig. 16 shows the feeding behaviour of the cattle in a short/medium feeding program (70 – 120 day-fed; *n* = 129), illustrating that the percentage of the pen that are disinterested and keen appears relatively consistent across breeds and time in feeding program. Observations of pushing and competitive behaviour at the feed bunk were infrequent, recorded in 38 observations (18.6% observations). This may reflect appropriate feed management across feedlots to minimise competition, being a positive welfare outcome. Alternatively, it could reflect a disinterest in feed as a consequence of ill-health. Given that no incidences of acidosis or BRD, common and important maladies of feedlot cattle associated with reduced appetite and/or feed intake (González et al. 2012; Griffin 2014), were noted, this latter explanation is considered unlikely.

Caution is warranted as inconsistencies in the recording of this metric in relation to pen feed out time is a limitation, and the data may not adequately inform on hunger nor feed competition of the animals within the Pilot.

Figure 16. Average 'feeding behaviour' of cattle in a short/medium fed program (70 – 120 day-fed; *n* = 129). Time in feeding program categories: start = < 40 days; middle = 40 – 80 days; end = > 80 days.



6.2.1.4.3.3 Recommendations

This animal-based metric of feeding is considered important and recommended to be included in the revised Protocol with no modifications. Collection of this metric does need to be strictly recorded immediately after a pen has been feed out to accurately inform on cattle feeding behaviour. Therefore, having a staff member on the feeding team pause immediately after the feed bunk has been filled to record the metric may be more appropriate than tasking this to livestock staff. This would ensure consistent collection and is considered to be less disruptive to normal feedlot staff duties than the previous method. Alternatively, a person outside of the feeding team could monitor the progress of the truck/s and once the sample pen has been fed-out they could capture this measure. To facilitate ease of collection, further discussion with feedlot personnel is warranted to determine the most appropriate way to capture or track this information in a streamlined manner. This will ensure that the reporting burden associated with the collection of the 'feeding behaviour' metric be minimised.

It is recommended that this metric is recorded once per pen, at the time of feed out.

6.2.1.4.4 Posture

6.2.1.4.4.1 Description and collection of metric in pilot testing

The 'posture' metric was designed to measure the proportion of cattle in different postures and whether their utilisation of shade (if present). The metric captures activity and rest patterns at a pen level, allowing capture of synchronised in resting behaviours, which is an important indicator informing on cattle comfort and welfare. For example, synchronous lying is used as an indicator for high levels of welfare in ruminants (Asher and Collins 2012; Mattiello et al. 2019), with postural synchrony reported highest in the morning and evening (Stoye et al. 2012). This metric was previously collected by any of the feedlots and the metric was considered novel.

For each pen, the percentage (%) of cattle observed per category was recorded:

- Shade standing
- Shade lying (lateral)
- Shade lying (sternal)
- Sun standing
- Sun lying (lateral)
- Sun lying (sternal)

6.2.1.4.4.2 Outcome of pilot testing

This metric accurately captured information relating to activity and rest under feedlot conditions. Across all observations (*n* = 803), the majority of cattle were observed standing, with only 24.6% ± 0.8% head/pen on average recorded lying, in either a lateral or sternal recumbency position (range: 0% to 95.1%). Interestingly, when considered on a breed basis, it appeared that a larger percentage of *Wagyu/Wagyu* x cattle were observed lying compared to other breeds (Fig. 17). In addition, a bimodal pattern of activity behaviour was observed in feedlot cattle with two peaks occurring during the day; the first in relation to feeding and the second in mid-afternoon; reported at approximately 16:30 h (Smith et al. 2015; Pillen et al. 2016), appeared to occur, with smaller percentages of cattle lying during the last observation of the day (TP 4) (Fig. 18). Given the variability in feeding time across observed pens (between 07:30 h and 17:10 h), it is likely that the first peak associated with feeding is not obvious within this data.

Figure 17. Average posture of cattle for each time point (TP 1 – 4; *n* = 803) per feeding program, cattle breed, and time in feeding program. Time in feeding program categories: Short-fed (start = < 25 days; middle = 25 – 50 days; end = > 50 days), short/medium-fed (start = < 40 days; middle = 40 – 80 days; end = > 80 days), and long-fed (start = < 100 days; middle = 100 – 200 days; end = > 200 days).

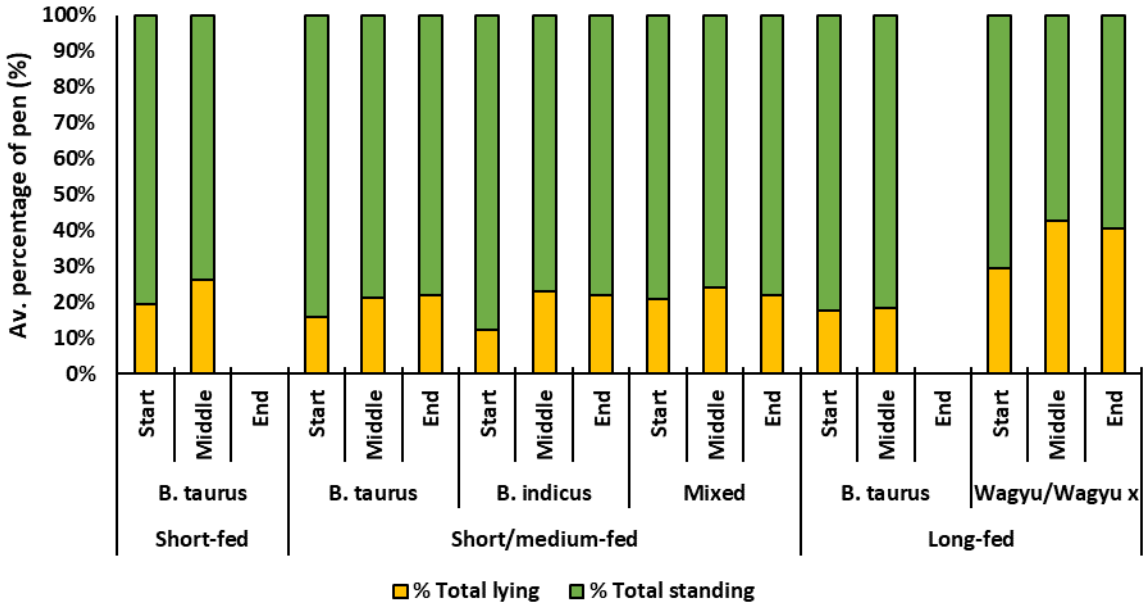
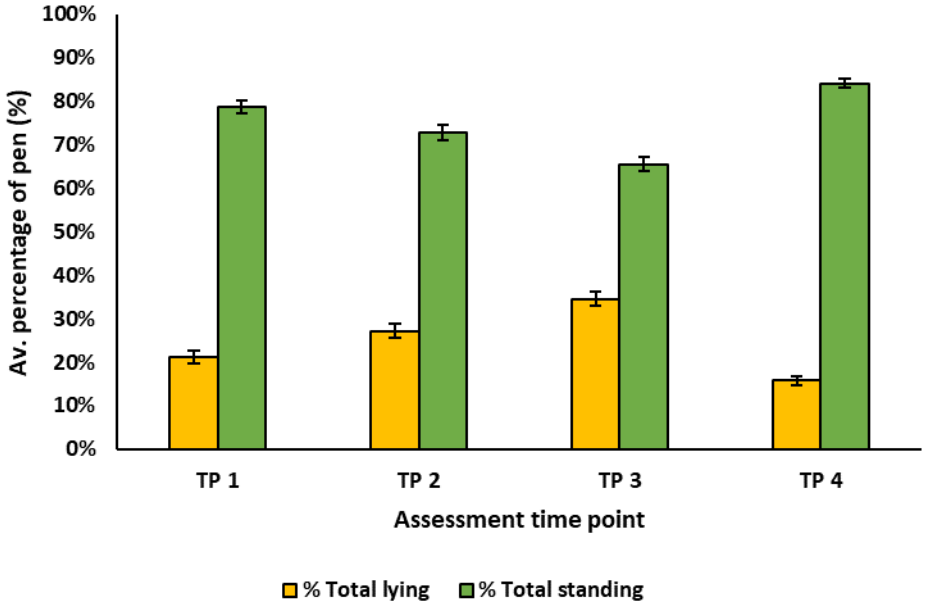


Figure 18. Average (± S.E.) posture of cattle per time point (TP 1 – 4; *n* = 803).



6.2.1.4.4.3 Recommendations

It is recommended that posture be included in the revised Protocol but simplified. This modification includes the reduction of the categories captured to reduce assessment burden and also remove duplicative information collected in the revised protocol. Information relating to shade utilisation has been removed as it is considered to be appropriately collected under the 'dispersion' metric, with the new categories to be recorded:

- The percentage (%) of cattle per category:
  - Total standing
  - Total lying; lateral and sternal recumbent

It is recommended that this metric is recorded twice per pen, once in the morning assessment and again in the mid-afternoon assessment (see Section 6.2.2).

6.2.1.4.5 Dispersion

6.2.1.4.5.1 Description and collection of metric in pilot testing

The 'dispersion' metric was designed to capture how cattle utilise the space and resources within their home pen to inform cattle comfort and thermal stress. The metric offered an animal outcome-based metric for resource use. It was considered to be a novel metric, not already collected under feedlot conditions.

For each pen, the percentage (%) of cattle observed per category was recorded, where a group was defined as a congregation of ≥ 10 individuals:

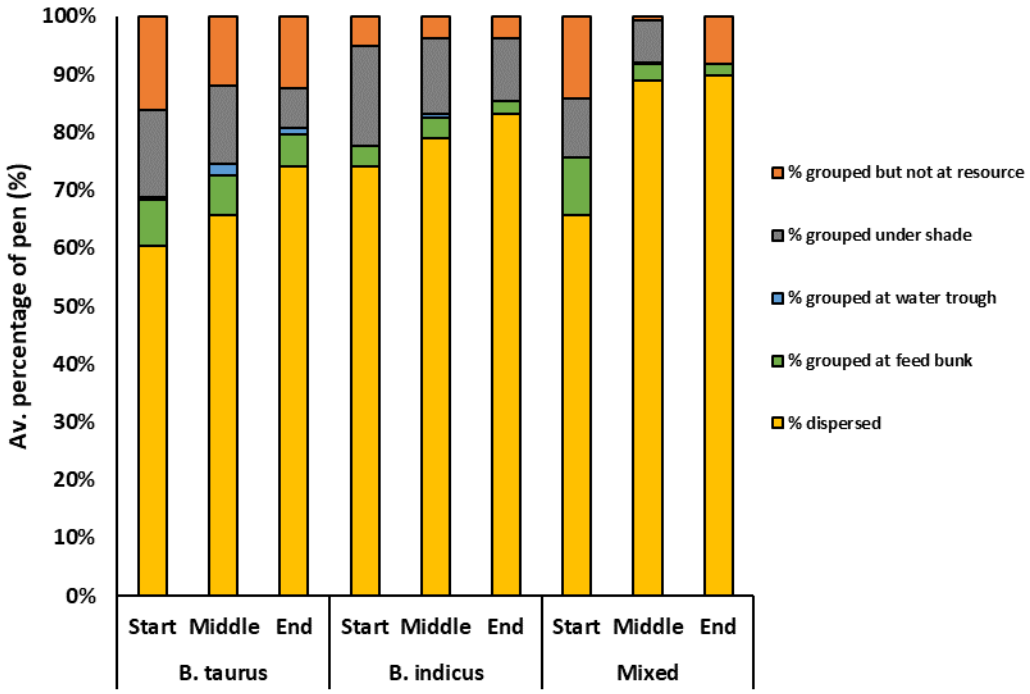
- Dispersed (not grouped)
- Grouped at feed bunk
- Grouped at water
- Grouped under shade

- Grouped but not at a resource

6.2.1.4.5.2 Outcome of pilot testing

This metric successfully captured altered behaviour in the way cattle utilised resources within their home pen. Fig. 19 shows that cattle in short/medium feeding program (70 – 120 day-fed; *n* = 129) utilised different resources within their pen. Responses under this metric may relate to environmental conditions and resource provision and utilisation, however the low incidence of some conditions such as thermal stress was a limiting factor for any detailed statistical analysis of such trends within the data set.

Figure 19. Average dispersion of cattle within their home pen in a short/medium-fed program (70 – 120 day-fed; *n* = 129) per breed within and time in feeding program. Time in feeding program categories: start = < 40 days; middle = 40 – 80 days; end = > 80 days.



6.2.1.4.5.3 Recommendations

It is recommended that dispersion be included in the revised Protocol but simplified. Under the modified metric, for each pen the following is to be recorded:

- The percentage (%) of cattle observed per category:
  - Grouped at water trough
- The percentage (%) of cattle observed:
  - Under artificial shade structures provided

The distinction is made to indicate the percentage of grouping under shade structures, when present, as opposed to the approach adopted in the Pilot which considered cattle grouped both under artificial shade structures and those in shade due to environmental conditions (i.e., cloud cover). The grouping of cattle at feed bunk is considered to be captured under the feeding behaviour metric and the relevance of animal grouping but not at a resource for animal welfare is not straightforward, therefore, these two categories were removed from the metric in the revised

protocol. This proposed modification is considered more useful to inform resource utilisation under thermal stress conditions (e.g., heat stress conditions and wet conditions).

Further clarification was deemed essential regarding the degree of closeness between individual cattle that constitutes a group, and also their association with the resource in question (i.e., feed bunk). The ambiguity of the definition within the Pilot definition of group caused uncertainty potentially leading to variability, reducing the relevance and accuracy of the data collected. To address this, it was considered appropriate to alter the definition of a 'group' to be:

- A congregation of ≥ 10 individuals that are in close (< 1.5 m or a single cattle body length) association with each other.

It is recommended that this metric is recorded twice per pen, once in the morning assessment and again in the mid-afternoon assessment (see Section 6.2.2).

6.2.1.4.6 Agitation associated with flies

6.2.1.4.6.1 Description and collection of metric in pilot testing

The 'agitation associated with flies' metric was specifically designed to capture an animal-based outcome of the impact of flies to evaluate and inform on environmental conditions and management strategies. This metric was not previously collected by any of the feedlots and the was considered novel.

For each pen, the following was collected:

- Whether agitation caused by flies was evident in more than 50% of cattle within the pen:
  - No
  - Yes
- If yes, the percentage (%) of cattle in the pen observed to be agitated due to flies

6.2.1.4.6.2 Outcome of pilot testing

This metric was observed infrequently, with only 28 (3.5%) pen observation recorded which occurred during Visits 1, 2 and 6. This may reflect a positive welfare outcome – the successful management of flies at the Pilot feedlots. However, agitation due to flies was also mentioned in formal comments associated with the collection of cattle 'demeanour' for an additional 11 pen observations in which no agitation with flies was reported. Anecdotal assessor observations indicate that nuisance flies were present at the three WA Pilot feedlots. This suggests that the metric may underestimate the impact of flies when using the cut-off of 50% of pen.

6.2.1.4.6.3 Recommendations

It is recommended that the metric be included in the revised Protocol but modified to ensure meaningful capture of the impact flies under the feedlot context. Under the modified metric, a category that best describes a pen is selected:

- No agitation
- Moderate agitation

- Severe agitation

This modification would ensure the successful identification of both positive and negative welfare outcomes and enables appropriate management decisions and actions to be taken prior to the occurrence of the more welfare aversive situation (i.e., moderate – severe agitation). From a welfare perspective, the collection of information to enable preventative or corrective action to occur early when issues detected at a low threshold, prior to welfare being compromised, is advantageous.

It is recommended that this metric is recorded twice per pen, once in the morning assessment and again in the mid-afternoon assessment (see Section 6.2.2).

6.2.1.4.7 Ethogram

6.2.1.4.7.1 Description and collection of metric in pilot testing

The 'ethogram' metric was designed to measure the behaviour of cattle within a pen and is widely considered to provide valuable information to inform on cattle welfare. The metric captures behavioural patterns which informs on synchronised behaviours, such as feeding and rest, and on engagement with the surrounding environment. This metric is considered particularly important to aid in the interpretation of other animal outcome metrics such as demeanour. This metric was not previously collected by any of the feedlots and was considered novel.

For each pen, the percentage (%) of cattle observed per category was recorded:

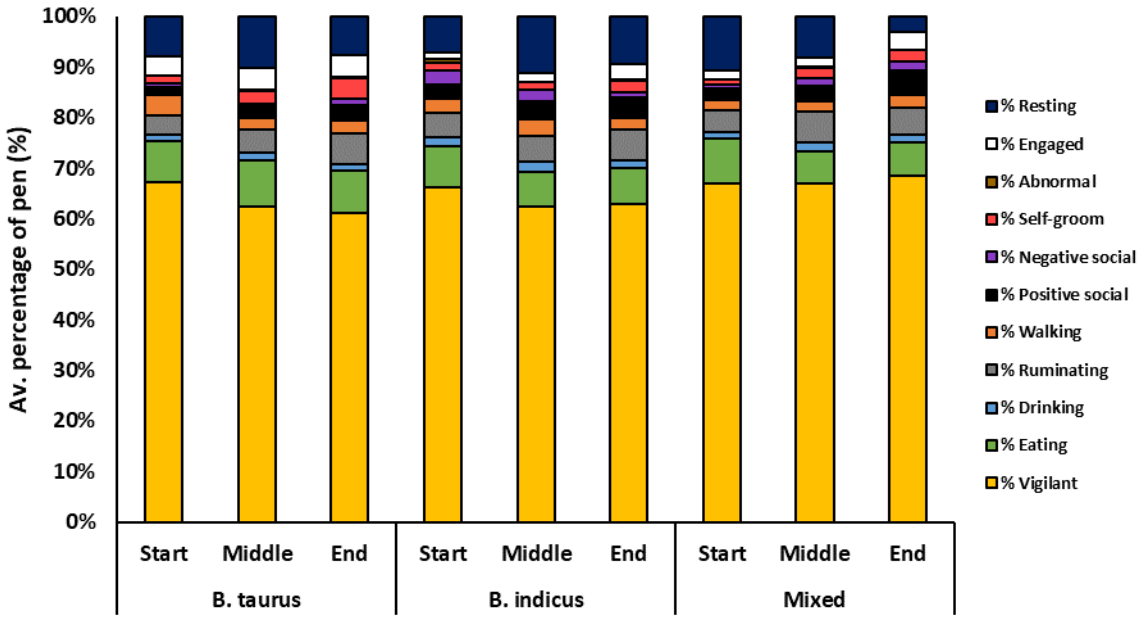
- Eating
- Drinking
- Ruminating
- Walking
- Positive social
- Negative social
- Self-groom
- Abnormal
- Engaged
- Resting
- Vigilant

6.2.1.4.7.2 Outcome of pilot testing

Expected patterns in behaviours were observed across the Pilot. Fig. 20 shows the behaviour of the cattle in a short/medium feeding program (70 – 120 day-fed; n = 129), for each of the 11 behaviours recorded. Trends appeared to occur in relation to maintenance behaviours in these cattle, where a larger percentage of cattle were recorded to be self-grooming as time spent in feeding program increased. For *B. indicus* pens in particular, the incidence of negative social interactions appeared to decrease as time progressed (Fig. 20). These follow the expected patterns in acclimation and demonstrate how this information can inform welfare, particularly to demonstrate welfare standards. Some behaviours were observed infrequently, for example, abnormal behaviour, while a welfare concern of intensively reared cattle, was observed during only 19 (2.4%) of observations. Further, when abnormal behaviours did occur the overall contribution to the pen ethogram was minimal, with 0.05 ± 0.02% of the pen recorded to display these behaviours. The adoption of a scan

sampling approach as piloted was considered achievable in terms of assessor burden, yet still provides meaningful information to inform welfare.

Figure 20. Average ethogram behaviours of cattle in a short/medium-fed program (70 – 120 day-fed; *n* = 129) per breed and time in feeding program. Time in feeding program categories: start = < 40 days; middle = 40 – 80 days; end = > 80 days.



6.2.1.4.7.3 Recommendations

It is recommended that an ethogram be included in the revised Protocol but modified. The inclusion of a full range of behaviours piloted is not necessary, with the percentage of cattle performing the categories below considered sufficient:

- Resting
- Ruminating
- Eating
- Drinking
- Self-groom
- Engaged (interaction with environment or conspecifics e.g., social interactions)
- Abnormal behaviours

It is noted that some may consider some information duplicative, e.g., the 'posture' metric may be considered to capture resting, however, the Pilot suggested that there is a need to further understand the activity patterns of lot fed cattle. Simply put, the collection of 'posture' alone is less informative as it does not capture the detail of *how* an animal is lying. For instance, a lying cow may indeed be resting, but they may also be ruminating or vigilant and these have different connotations from a welfare perspective. The definition for engaged with the environment has been broadened to capture all infrequent behaviours where cattle are engaging with their environment, reducing assessor burden. Social behaviours have been grouped here as a 'sociable' demeanour term will be added to the revised Protocol, as outlined in Section 6.2.1.4.8 below. Abnormal behaviours has been retained, despite being recorded infrequently, due to societal concern for cattle developing such behaviours within a feedlot environment.

It is recommended that this metric is recorded twice per pen, once in the morning assessment and again in the mid-afternoon assessment (see Section 6.2.2).

6.2.1.4.8 Demeanour

6.2.1.4.8.1 Description and collection of metric in pilot testing

The 'demeanour' metric was designed to inform on general body language of cattle to provide a 'whole-animal' assessment, focusing on *how* cattle were interacting and perceiving their environment (Wemelsfelder et al. 2001). This facilitated the assessment of emotional or 'affective' state and welfare. Importantly, this metric offered an assessment of positive welfare outcomes, not just simply the absence of negative outcomes with regard to affective state. This metric was not previously collected by any of the feedlots; however, assessments of cattle demeanour has been performed at cattle feedlots under research contexts (Willis et al. 2021b; a).

For each pen, an assessor observed the cattle for at least 30 seconds prior to scoring terms against a Visual Analogue Scale (VAS; 0 – 100). The extent to which the cattle expressed each of the following descriptive terms (n = 10) were considered, where 0 = term not expressed and 100 = term was expressed to the fullest by all cattle in the pen:

- Active
- Agitated
- Alert
- Content
- Curious
- Dull
- Lively
- Nervous
- Settled
- Uncomfortable

6.2.1.4.8.2 Outcome of pilot testing

The terms piloted appeared to successfully capture the basic range of the expressive repertoire of cattle under feedlot conditions in a time efficient manner. All ten descriptive terms were considered by assessors when scoring cattle demeanour, and notably the frequency this which each term was considered to be not expressed within the pen (VAS score = 0) was variable (Table 19). Assessors used 'dull' and 'uncomfortable' least frequently to describe cattle observed, indicating that these terms captured a dimension of behaviour that was present in feedlot cattle, and which could be considered a negative welfare outcome. There was a trend for 'uncomfortable' to be used by assessors when environmental conditions were not ideal. Specifically, a VAS score > 10 was recorded for 'uncomfortable' for 63 pen observations, of which 23 (36.5%) coincided with the occurrence of panting and 24 (38.1%) occurred coincided with precipitation. Other descriptive terms including 'active', 'alert' and, importantly, the positive 'settled', appeared to be routinely used to describe cattle (> 95% of observations; Table 19).

Table 19. Pen demeanour term use.

Demeanour 'descriptive' term	No. observations	Average (± S.E.) pen VAS score	Range of pen VAS score
Active	801 (99.8%)	31.8 ± 0.7	0 – 97
Agitated	259 (32.3%)	2.2 ± 0.4	0 – 74
Alert	799 (99.5%)	44.5 ± 0.8	0 – 100
Content	560 (69.7%)	16.3 ± 1.0	0 – 96
Curious	707 (88.0%)	13.0 ± 0.5	0 – 84
Dull	135 (16.8%)	0.9 ± 0.3	0 – 51
Lively	493 (61.4%)	6.6 ± 0.5	0 – 96
Nervous	426 (53.1%)	5.5 ± 0.5	0 – 71
Settled	779 (97.0%)	44.6 ± 1.1	0 – 100
Uncomfortable	229 (28.5%)	2.4 ± 0.4	0 – 64

It was considered outside the scope of this report to consider specific metrics for detailed statistical analysis that attempted to define welfare outcomes observed during the Pilot. It was for this reason that no statistical analyses have been incorporated thus far, with this section offering a descriptive overview of the data. 'Demeanour' is the exception, where assessments of animal demeanour, formally assessed using the Qualitive Behavioural Assessment (QBA) methodology, are subject to Principal Components Analysis (PCA) to provide an overall assessment of the pen demeanour pen. The statistical process of PCA was outlined above (see Section 5.3.2.2), but briefly the analysis identifies underlying patterns in observations. The outcome of the PCA for 'demeanour' is presented in Table 20 and is discussed below.

Table 20. Principal Component Analysis (PCA) for pen 'demeanour' (*n* = 803). Variation explained by each PCA component or 'behavioural dimension', and the highest loading 'descriptive' terms taken to define the behavioural dimension (> 75% of the absolute value of the largest positive or negative correlation coefficient) are detailed.

PCA component	Eigen value	Variation explained (%)	Descriptive terms the 'define' behavioural dimensions (highest loading terms)	
			Negative axis	Positive axis
1	2.9	29.4	Active	Settled/Content
2	1.6	16.1	Curious/Lively	Uncomfortable
3[A]	1.2	12.1	-	Alert/Dull/Agitated

[A]PC component 3: term presented applying a 65% cut-off i.e., 65% of the absolute value of the largest positive or negative correlation coefficient).

The expressive behaviour of the cattle observed over the Pilot appeared to follow typical patterns of behaviour in regard to mental state (i.e., positive/negative) and activity (i.e., level of engagement). Fig. 21 illustrates the loading of each demeanour term used to assess pens on the first 2 components. PC1, which explained the most behavioural variation within observed pens (29.4%), captured cattle activity, ranging from 'active' to 'settled/content' (Table 20). PC2, which explained 16.1% of the behavioural variation within pens, captured mental state ranging from 'curious/lively' (i.e., positive mental state) to 'uncomfortable' (i.e., negative mental state) (Table 20). This pattern is commonly found within the literature for QBA studies and demonstrates how assessments of pen demeanour under feedlot conditions offer a metric that appropriately assess cattle mental state. Following a more in-depth analysis, the comparison PC scores of individual feedlots, pens, breeds, etc. are possible, as demonstrated in Fig. 22. Further analysis is outside the scope of this report, but

the validity of assessments of animal 'demeanour' are widely established in the literature (Fleming et al. 2016; Cooper and Wemelsfelder 2020).

Figure 21. Word chart of the 10 descriptive terms used to assess cattle demeanour in the participating feedlots. The relationship of each term on PC 1 and PC 2 are presented.

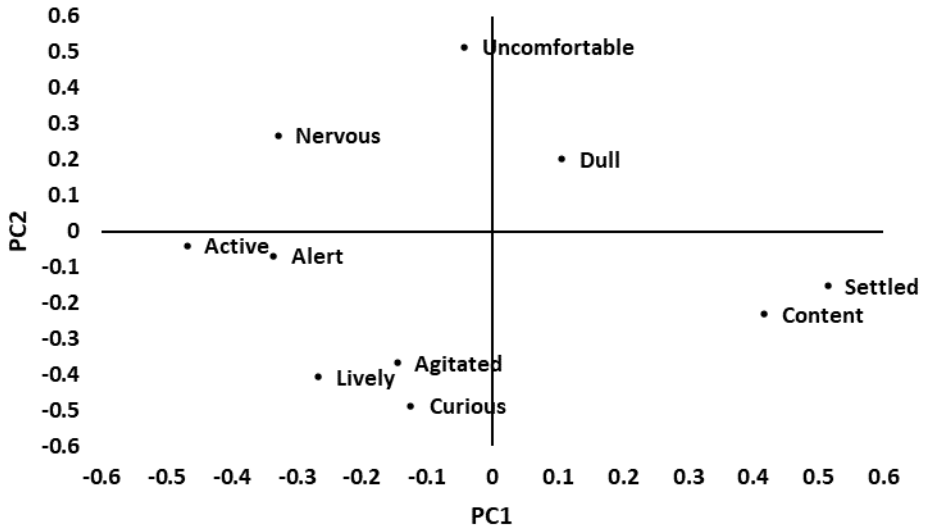
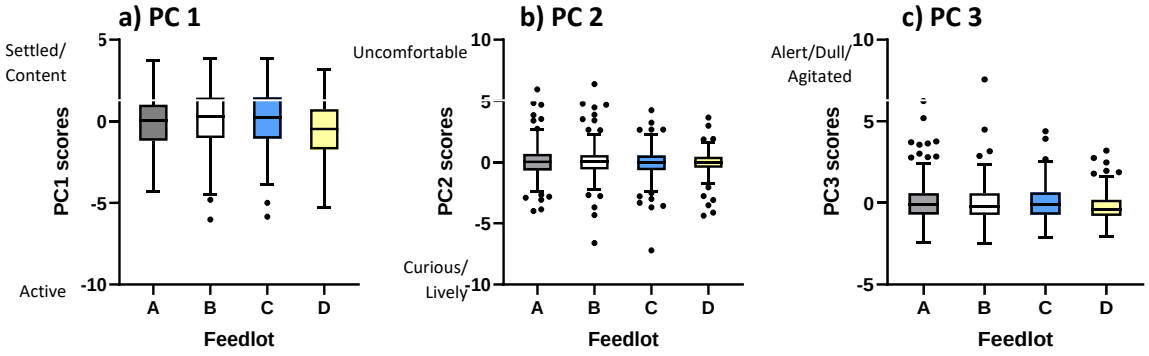


Figure 22. Principal Component (PC) analysis scores for a) PC 1; b) PC 2; and c) PC 3, per Feedlot.



6.2.1.4.8.3 Recommendations

It is recommended that 'demeanour' be included in the revised Protocol but modified.

Firstly, it is suggested that the definition of the term 'lively' be changed to better capture cattle positively engaging with their surrounding environment. During the Pilot, 'lively' appeared to capture the general increase in activity associated with feeding behaviour and engagement with environment (see Section 6.2.1.4.7). Under the modified metric, 'lively' is defined as:

- Animated, energetic, excited, eager, enthusiastic, playful, positively engaged with surroundings and/or other cattle.

Secondly, the definition of 'agitated' be updated to reflect the negative emotional outcome of 'frustration' that could be associated with anticipation of feed when feed out time fluctuates or deviates markedly from expected patterns, or for competition over other resources, and thus does not align with animals' expectations. Under the modified metric, 'agitated' is defined as:

- Restless, frustrated, uneasy, reactive, nervous movement.

Finally, the term 'sociable' is added to the term list, resulting in a total of 11 terms to be collected under the revised Protocol. Feedback from feedlot staff indicated that capturing social cattle behaviour under the ethogram was impractical and time consuming. Therefore, adding this term to the demeanour list allows this important component of animal welfare to be captured. The grouping of this term with other demeanour terms is anticipated to then indicate whether the term is interpreted to be a positive or negative informer of welfare, therefore both positive and negative types of social interactions are included in the definition:

- Actively seeking engagement with conspecifics, friendly, gregarious, hostile, aggressive or angry, may include social grooming, play, antagonistic and displacement behaviours, or mounting/riding.

It is recommended that this metric is recorded twice per pen, once in the morning assessment and again in the mid-afternoon assessment (see Section 6.2.2).

6.2.1.4.9 Panting score

6.2.1.4.9.1 Description and collection of metric in pilot testing

The metric 'panting score' was designed to capture an animal-based outcome of thermal challenges experienced during summer months. In particular, 'panting score' is widely considered a useful measure of heat stress (Mader and Griffin 2015; Lees et al. 2020) and informs on cattle health and comfort. This metric was not previously formally collected at any of the feedlots; however, it is monitored informally by the staff during high temperatures, and most were staff considered to be familiar with this metric.

For each pen, the percentage (%) of cattle observed per category was recorded:

- 2 = Fast panting (RR 70-120) with easy to see breath effort, drool, or foam present. No open mouth panting
- 2.5 = Same as for 2 but with occasional open mouth, tongue not extended (RR 70-120)
- 3 = Panting with open mouth + some drooling. Neck extended and head usually held up (RR 120-160)
- 3.5 = Same as 3 but with tongue out slightly and occasionally fully extended for short periods, excessive drooling (RR 120-160)
- 4 = Open mouth panting with tongue fully extended for long periods with excessive drooling. Neck extended and head up (RR >160)
- 4.5 = Same as 4 but head down, drooling may cease, and RR may decrease

Note, the collection of panting score begins at panting score 2, from an established scale from 1 – 4.5 established for use in the feedlot industry (MLA 2004). The reason for this is to ensure capture of relevant information to enable appropriate risk-management decisions and actions to be taken prior to the occurrence of the more welfare aversive open-mouth panting (panting score ≥ 2.5), whilst reducing assessment burden on feedlot staff. From a welfare perspective, the collection of information to enable preventative action or corrective action to occur at a low threshold, before welfare is compromised highly, is advantageous.

6.2.1.4.9.2 Outcome of pilot testing

During the Pilot, panting scores 2 or above were recorded during 63 pen observations, all of which were observed at Feedlots A – C. Specifically, panting was observed during Visit 2 (12 observations; 19%), 3 (39 observations; 61.9%), 4 (11 observations; 17.5%) and 6 (1 observation; 1.6%). No extreme heat stress events occurred during the Pilot visits (see Section 6.2.1.3), with no panting scores higher than 2.5 recorded, indicating that panting had not progressed to the more aversive 'open-mouth'. Interestingly, panting scores of 2 or greater were observed across all feeding programs and breeds (Fig. 23), and at all assessment TP although the majority occurred during afternoon observations (Table 21). Panting score was a useful metric for the assessment of heat stress, and is, thus, meaningful from a welfare perspective. Altered panting behaviour associated with the early stages of heat stress would allow intervention in a timely manner.

Figure 23. Average panting score of cattle per feeding program, breed and time spent in feeding program. Time in feeding program categories: Short-fed (start = < 25 days; middle = 25 – 50 days; end = > 50 days), short/medium-fed (start = < 40 days; middle = 40 – 80 days; end = > 80 days), and long-fed (start = < 100 days; middle = 100 – 200 days; end = > 200 days).

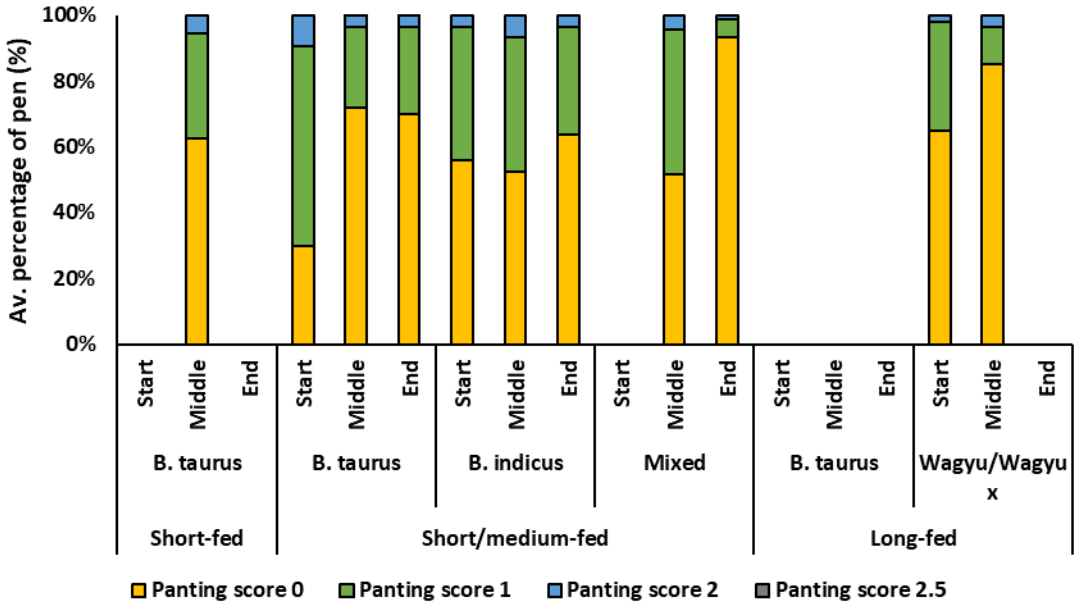


Table 21. Average (± S.E.) pen panting score per time point. Assessments were made at four time points (TP); TP 1 (8:00 h), TP 2 (11:00 h), TP 3 (14:00 h), and TP 4 (17:00 h).

Assessment time point (TP)	Observations of panting score 2 or above				
	Frequency (no. observations)	Average (± S.E.) pen panting score (% pen)			
		0	1	2	2.5
TP 1	1	95.6	3.8	0.6	0.0
TP 2	14	71.8 ± 20.7	23.7 ± 18.3	4.5 ± 3.3	0.0
TP 3	26	55.1 ± 28.8	39.4 ± 26.8	5.3 ± 4.3	0.015 ± 0.1
TP 4	22	59.1 ± 30.5	36.7 ± 28.5	4.3 ± 3.2	0.028 ± 0.1
Total	***63***	***60.9 ± 28.3***	***34.4 ± 26.2***	***4.7 ± 3.7***	***0.02 ± 0.1***

6.2.1.4.9.3 Recommendations

Although the incidence of elevated panting scores was low, the proposed metric adequately described cattle outcomes associated with thermal challenge in a simple and quick manner. It is recommended that panting score is included in the revised Protocol without modification.

It is recommended that when heat stress conditions occur (panting scores > 2), this metric is recorded twice per pen, once in the morning assessment and again in the mid-afternoon assessment (see Section 6.2.2).

6.2.1.4.10 Drinking behaviour

6.2.1.4.10.1 Description and collection of metric in pilot testing

The metric 'drinking behaviour' was designed to capture an animal-based outcome of thermal challenge that occurred during summer months. Specifically, the metric captured information relevant to cattle ability to cope with thermal stress and resource allocation. This metric was not previously collected by any of the feedlots and was considered novel.

For each pen, 'drinking behaviour' was collected only when panting scores 2 or above were observed. When such conditions occurred, the category that described cattle behaviour around the water trough was recorded:

- 1 = Disinterested
- 2 = Some keen
- 3 = Crowding
- 4 = Hovering over water trough

6.2.1.4.10.2 Outcome of pilot testing

As 'drinking behaviour' was only collected under situations in which panting score of 2 or above were observed, only 63 observations (63; 7.8%) are available for consideration. There were only two instances in which a pen of cattle was described as 'crowding', with the majority of pens (51 observations; 81.3%) identified has having cattle 'disinterested' in water trough/s. Further, 'some keen' drinking behaviour was only observed in 10 instances (15.9%). This may reflect appropriate water provision and access to cope with the thermal challenges observed, however, it is important to note that extreme heat stress conditions were not observed.

6.2.1.4.10.3 Recommendations

Presently, given both the novel nature of the metric and the low frequency with which heat stress conditions were observed, no recommendations outside that for further piloting under appropriate and representative feedlot thermal conditions designed to evoke this behaviour can be proposed. Based on the expert knowledge of the research team, it is considered reasonable to suggest that this metric would adequately describe the animal outcomes associated with thermal challenge and indicate whether water access is sufficient, ensuring that possible negative outcomes are captured under the Protocol.

It is recommended that when heat stress conditions occur (panting scores > 2), this metric is recorded twice per pen, once in the morning assessment and again in the mid-afternoon assessment (see Section 6.2.2).

6.2.1.4.11 Shivering

6.2.1.4.11.1 Description and collection of metric in pilot testing

The 'shivering' metric was designed to capture animal-based outcomes of thermal challenges during winter months. This metric was not previously collected by any of the feedlots and was considered novel.

For each pen, 'shivering' was to be collected only under cold stress conditions (i.e., cold, and windy). When such conditions occurred, the following was recorded:

- Percentage (%) cattle in pen observed to be shivering

6.2.1.4.11.2 Outcome of pilot testing

During the Pilot, 'shivering' was not observed during any pen assessments.

6.2.1.4.11.3 Recommendations

Presently, no recommendations outside that for further piloting under appropriate and representative feedlot thermal conditions designed to evoke this behaviour can be proposed. Based on the expert knowledge of the research team, it is considered reasonable to suggest that this metric would adequately describe the animal outcomes associated with thermal challenge, ensuring that possible negative outcomes are captured under the revised Protocol.

It is recommended that this metric is recorded once per pen, in the morning when cold stress conditions are likely.

6.2.1.4.12 Huddling

6.2.1.4.12.1 Description and collection of metric in pilot testing

The 'huddling' metric was designed to capture animal-based outcomes of thermal challenge that occurred during winter months. This metric was not previously collected by any of the feedlots and was considered novel.

Huddling was collected only under cold stress conditions (i.e., cold, and windy). When such conditions occurred, the following was recorded:

- Percentage (%) cattle in pen observed to be huddling together

6.2.1.4.12.2 Outcome of pilot testing

During the Pilot, 'huddling' was observed for only 2 (0.25%) pen observations. Both of these observations occurred at Feedlot D during Visit 7 at TP 1 under the following climatic conditions:

- Cloud cover: 100%
- Dry bulb temperature: 8.5°C
- Wet bulb globe temperature: 7.3°C
- Wind speed: 2.4 km/h

6.2.1.4.12.3 Recommendations

Given the low incidence of observation, piloting of the revised Protocol during winter months is necessary to determine the validity of the 'huddling' metric under the feedlot context. Based on the expert knowledge of the research team, it is considered reasonable to suggest that this metric would adequately describe the animal outcomes associated with thermal challenge, ensuring that possible negative outcomes are captured under the revised Protocol.

It is recommended that this metric is recorded once per pen, in the morning when cold stress conditions are likely.

6.2.1.5 Static pen and resource information

This section details the 17 static pen and resource metrics collected over the course of the Pilot. Metrics to capture resource and management information are important to present a balanced welfare protocol. These input metrics provide valuable information designed to address the appropriate provision of resources such as housing, feed, and water, and often inform outcome metrics such as behaviour. These metrics were collected once per pen per visit, at the TP 2 (11:00 h).

6.2.1.5.1 Pen type

6.2.1.5.1.1 Description and collection of metric in pilot testing

The 'pen type' metric was an input metric designed to inform interpretation of the output welfare metrics collected and track cattle within the feedlots.

For each pen, one category of pen type was selected:

- Home
- Hospital

6.2.1.5.1.2 Outcome of pilot testing

During the Pilot, no hospital pens were assessed. However, cattle were observed in four smaller pens which were described as 'holding' pens (average 724 ± 237.6m^2; range 480 – 1437 m^2). Cattle were held in these pens at the end of their feeding program and were due to exit the feedlot in the immediate future. These were observed because they contained animals that were assessed during previous feedlot Visits. All four were observed in Feedlot A. Only Feedlot A and Feedlot D routinely housed cattle in such pens prior to exiting the feedlot.

6.2.1.5.1.3 Recommendations

It was important to capture pens representative across feedlots to account for differences in pen size, pen environment and resources, and management. Thus, it is recommended that this metric be modified to include an option for all pen types that may be present within Australian feedlots. Under the modified metric, the appropriate category for each pen assessed be selected from the following:

- Home
- Hospital
- Exit
- Induction

6.2.1.5.2 Pen size

6.2.1.5.2.1 Description and collection of metric in pilot testing

The 'pen size' metric is a valuable input metric designed to inform welfare. Together with the 'head in pen' metric, this information is needed to calculate stocking density which is widely considered an important input factor when assessing feedlot cattle welfare. Not only is stocking density an important management input factor known to influence behaviour (e.g., frequency of antagonistic social interactions; (Metz and Mekking 1984)), but inappropriate stocking density is associated with increased competition (Huzzey et al. 2006), and has an aversive impact on pen conditions (e.g., mud depth and manure pad conditions; (Mader and Griffin 2015; Grandin 2016), which are considered welfare concerns in their own right. This metric was previously collected at feedlots, with the pen size available within individual feedlot records.

For each pen, the appropriate pen records were consulted to determine the total pen area (m^2).

6.2.1.5.2.2 Outcome of pilot testing

Over the course of the Pilot, cattle were observed in a total of 69 different feedlot pens. The size was variable within and between feedlots, with the exception of Feedlot C in which all pens were constructed to be the exact same size (1000 m^2; Table 22). This information allowed the calculation of pen stocking density for each observed pen assessed during the Pilot (*n* = 208). As with area, stocking density varied within and between feedlots (Table 23), with the average pen stocking density 16.5 ± 0.5 m^2/head (range: 5 to 53.7 m^2/head).

Table 22. Area (m^2) of feedlot pens (*n* = 69) per Feedlot (A – D).

Feedlot	Pens (no.)	Average (± S.E.) pen area (m^2)	Pen area (m^2) range
Feedlot A	25	2293.9 ± 279.6	480 – 5698
Feedlot B	17	2732.9 ± 296.7	1560 – 5660
Feedlot C	18	1000	1000
Feedlot D	9	1944.4 ± 55.6	1500 – 2000
Total	***69***	***2019.0***	***480 – 5698***

Table 23. Stocking density (m^2/head) of pens assessed (*n* = 208) per Feedlot (A – D).

Feedlot	Pen observations (no.)	Pen stocking density (m^2/head)	
		Average (± S.E.)	Range
Feedlot A	61	17.7 ± 0.9	5 – 37.4
Feedlot B	62	20.1 ± 1.2	7.7 – 53.7
Feedlot C	61	12.4 ± 0.5	8.3 – 29.4
Feedlot D	24	14.5 ± 0.8	12.3 – 24.7
Total	***208***	***16.5 ± 0.5***	***5 – 53.7***

The exact size of each pen at each feedlot was not always known or easily accessible from records. Consequently, the area of some pens had to be calculated by assessors and are, thus, are an estimate rather than the true size. Therefore, assuming that such information is readily available at all feedlots may result in increased information collection at the beginning of Protocol implementation. However, this is considered minor as such static information is only required to be recorded once.

6.2.1.5.2.3 Recommendations

It is recommended that this metric be included in the revised Protocol as it provides valuable input information to inform welfare outcomes.

It is recommended that this metric be captured once per pen.

6.2.1.5.3 Water trough number

6.2.1.5.3.1 Description and collection of metric in pilot testing

The 'water trough number' metric was a valuable input metric designed to inform welfare, specifically resource provision and access. This metric was considered to be presently collected at feedlot, with the water trough number per pen available within individual feedlot records.

For each pen assessed, the following information is recorded:

- Number (no.) of water troughs per pen

6.2.1.5.3.2 Outcome of pilot testing

All pens within the Pilot had at least one water trough (range 1 – 2 water troughs). These water troughs were either 'private', accessible only to cattle within the feedlot pen, or shared between two adjacent pens. Although not detailed under the metric collection, this additional information was noted by assessors, with 15 pens (21.7% pens) noted to share their water trough(s) with another feedlot pen (Table 24).

Table 24. Water trough provision for feedlot pens (*n* = 69) per Feedlot (A – D).

Feedlot	Pens (no.)	Pen water trough (no.)	
		Private	Shared
Feedlot A	25	23	2
Feedlot B	17	11	6
Feedlot C	18	11	7
Feedlot D	9	9	0
Total	***69***	***54***	***15***

6.2.1.5.3.3 Recommendations

The inclusion of the 'water trough number' metric as a resource input metric is considered necessary to aid in the assessment of cattle welfare. It is recommended the metric be included in the revised Protocol with a modification to capture whether water troughs are shared between pens. Under the revised metric, the following information would be collected per pen:

- Number of water troughs (no.)
- Water trough/s shared with adjacent pens?
  - Yes
  - No

This modification facilitates the capture of information considered relevant to resource provision and access, but also can inform on health risk factors (e.g., Bovine Respiratory Disease (Hay et al. 2016)).

It is recommended that this metric be captured once per pen.

6.2.1.5.4 Water trough length

6.2.1.5.4.1 Description and collection of metric in pilot testing

The 'water trough length' metric was a valuable input metric designed to inform welfare, specifically resource provision and access. This metric was considered to be presently collected at feedlot, with the length of water troughs available within individual feedlot records.

For each pen, the following information was recorded:

- Length (m) of water troughs present

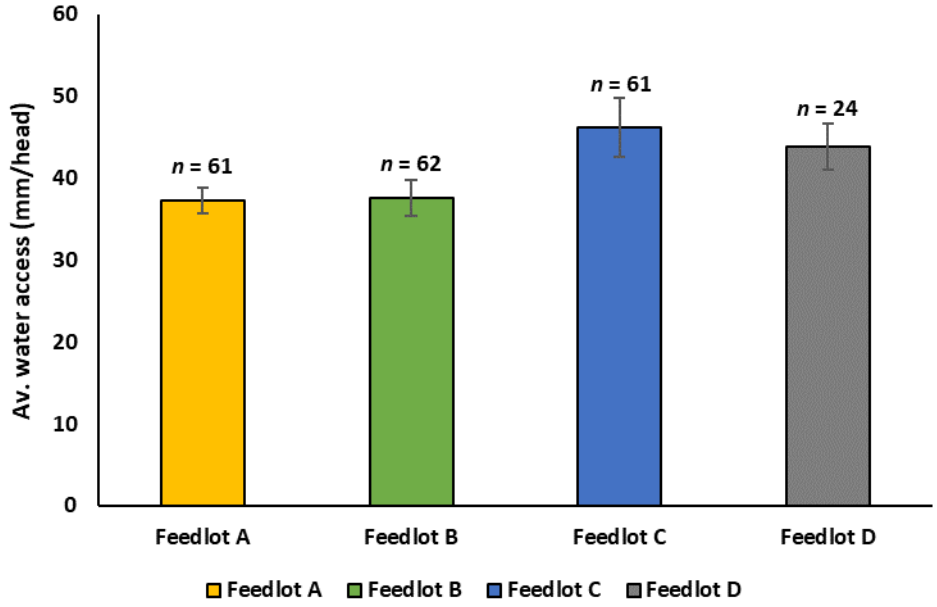
6.2.1.5.4.2 Outcome of pilot testing

A total of 69 different feedlot pens were observed, with average water trough length of 4.6 ± 0.2 m. Size was variable within and between feedlots, with the exception of Feedlot D where all pens had access to water troughs of the same length (6 m; Table 25). This information was used to calculate water access on an individual cattle basis (mm/head) for each observed pen (Fig. 24). All observed pens provided cattle access to water with at least 17 mm/head (average 40.8 ± 1.4 mm/head; range 17.1 – 211.8 mm/head).

Table 25. Water trough length for feedlot pens (*n* = 69) per Feedlot (A – D).

Feedlot	Pens (no.)	Pen water length (m)	
		Average (± S.E.)	Range
Feedlot A	25	4.6 ± 0.3	3.6 – 7.2
Feedlot B	17	4.8 ± 0.3	3.6 – 7.2
Feedlot C	18	3.7 ± 0.4	2.9 – 7.2
Feedlot D	9	6	6
Total	***69***	***4.6 ± 0.2***	***2.9 – 7.2***

Figure 24. Average (± S.E.) water access (mm/head) for pens (*n* = 208) per Feedlot (A – D).



6.2.1.5.4.3 Recommendations

It is considered important to present a Protocol that captures both animal and resource-based information relevant to the welfare principles 'good feeding'. This metric is easy to capture and informative, requiring no modifications prior to being included in the revised Protocol.

It is recommended that this metric be captured once per pen. If the total number head within the pen changes, this metric should be collected again.

6.2.1.5.5 Feed bunk length

6.2.1.5.5.1 Description and collection of metric in pilot testing

The 'feed bunk length' metric was a valuable input metric designed to inform welfare, specifically resource provision and access. This metric was considered to be presently collected at feedlot, with the length of feed bunks available within individual feedlot records.

For each pen, the following information was recorded:

- Length (m) of feed bunk

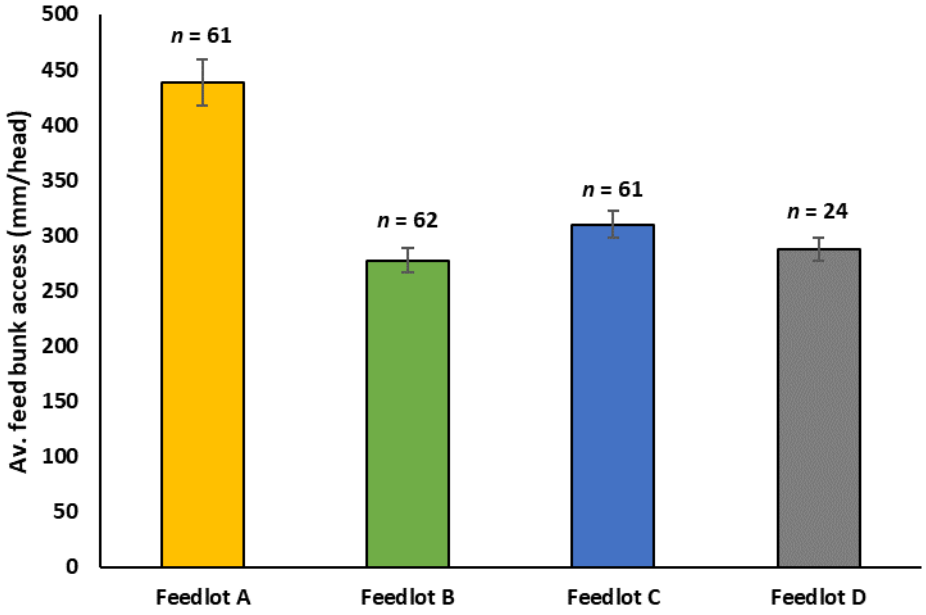
6.2.1.5.5.2 Outcome of pilot testing

Cattle were observed in a total of 69 different feedlot pens in which the average feed bunk length was 40.8 ± 1.6 m. The size was variable within and between feedlots, with the exception of Feedlot C in which all pens were constructed to be the exact same width (25 m; Table 26). This allowed feed bunk access to be calculated on an individual cattle basis (mm/head) for each observed pen (Fig. 25). All observed pens provided cattle with at least 133 mm/head access (average 335.4 ± 9.3 mm/head; range 133.3 – 864.7 mm/head), with Feedlot A providing the most space on average (Fig. 25).

Table 26. Feed bunk length for feedlot pens (*n* = 69) per Feedlot (A – D).

Feedlot	Pens (no.)	Pen feed bunk length (m)	
		Average (± S.E.)	Range
Feedlot A	25	60.3 ± 4.1	17 – 120
Feedlot B	17	37.7 ± 1.2	20 – 54
Feedlot C	18	25	25
Feedlot D	9	39.6 ± 2.0	30 – 40
Total	***69***	***40.8 ± 1.4***	***17 – 120***

Figure 25. Average (± S.E.) feed bunk access (mm/head) for pens (*n* = 208) per Feedlot A – D.



6.2.1.5.5.3 Recommendations

It is considered important to present a Protocol that capture both animal and resource-based information relevant to the welfare principles 'good feeding'. This metric is easy to capture and informative, with no modifications required prior to being included in the revised Protocol.

It is recommended that this metric be captured once per pen. If the total number head within the pen changes, this metric should be collected again.

6.2.1.5.6 Feeding program

6.2.1.5.6.1 Description and collection of metric in pilot testing

The 'feeding program' metric was an input metric designed to inform interpretation of the output welfare metrics collected. Feedlots can target numerous market categories which require different feeding programs that are specific to the breed and market. Here, we focus on the duration of time cattle spend in a feedlot. This metric was considered to be presently collected at feedlot, with the feeding program readily available within individual feedlot records.

For each pen, the one of the following feeding program durations was selected:

- Short fed (< 70 days)
- Short-medium fed (70 – 120 days)
- Medium (120 – 180 days)
- Long fed (> 180 days)

6.2.1.5.6.2 Outcome of pilot testing

Pen feeding programs included short-fed (<70 day-fed; *n* = 7), short/medium-fed (70 – 120 day-fed; *n* = 134) and long-fed (>180 day-fed; *n* = 68) (see Section 5.2.1). The majority of cattle were in short/medium-fed (e.g., 100-day market category for *B. taurus* – black angus) or long-fed programs (e.g., 400-day market category for *Wagyu*). No feedlot had cattle enrolled in a medium-fed program. In some instances, some of the cattle within the short-medium fed category remained on site for longer than their intended feeding program, for two possible reasons:

i) The remaining 'tail' of a pen is routinely retained and put on feed for longer to improve production prior to exit.
ii) Processing schedules at the designated abattoir did not allow for all cattle to exit when intended, resulting in delays.

6.2.1.5.6.3 Recommendations

Although no medium-fed cattle were observed during the Pilot, it is imperative from a welfare perspective for the revised Protocol to be representative of all feeding programs on a national level. This metric is easy to capture and informative and does not require any modification prior to being included in the revised Protocol.

It is recommended that this metric be captured once per pen.

6.2.1.5.7 Pen surface

6.2.1.5.7.1 Description and collection of metric in pilot testing

The 'pen surface' metric is designed to inform interpretation of the output welfare metrics collected and capture relevant differences across feedlot sites. The pen surface at feedlots can vary, and the collection of this information provides an indicator of the risk of mud or could be a risk factor for injury or lameness if pen surface is rocky or hard. This metric was not already collected at any of the four participating Pilot feedlots in a formal manner although the relevant information could be available in relevant records.

For each pen, one category of pen base was selected:

- Clay
- Rocky
- Limestone
- Road base/compacted aggregate
- Sandy

6.2.1.5.7.2 Outcome of pilot testing

Of the four feedlots enrolled in the Pilot, pen surface varied. Briefly, one consisted of pens with a base of road base/compacted aggregate, one with limestone, and the remaining two with a clay pen

base. Lameness and injury were infrequent in the Pilot so the relationship between pen surface and injury cannot be addressed. However, interestingly, the average pen condition, indicated by three metrics ('surface moisture score', 'mud depth score' and 'animal mud depth score') was scored poorer for pens with limestone pen bases (Table 27). Caution is warranted as the climate experienced between the feedlots is different and may likely account for this observed trend.

Table 27. Pen condition for observed pens by pen base.

Feedlot pen base	Pens assessed (no.)	Pen condition metrics		
		Surface moisture score (1 – 3)	Mud depth score (1 – 5)	Animal mud depth score (1 – 4)
Clay	119	1.2 ± 0.04	1.0 ± 0.01	1.1 ± 0.03
Limestone	24	2.1 ± 0.2	2.1 ± 0.3	2.8 ± 0.3
Road base/compact aggregate	61	1.5 ± 0.1	1.1 ± 0.04	1.5 ± 0.1
Total	***204***	***1.4 ± 0.05***	***1.2 ± 0.04***	***1.4 ± 0.06***

6.2.1.5.7.3 Recommendations

The Pilot demonstrated that this metric is both easy to collect and adequate to inform the welfare principle of 'good housing'. It is recommended that the 'pen surface' metric be included, unmodified, within a revised Protocol.

It is recommended that this metric be captured once per pen.

6.2.1.5.8 Structures in pen

6.2.1.5.8.1 Description and collection of metric in pilot testing

The 'structures in pen' metric is designed to inform interpretation of the output welfare metrics collected and capture relevant differences across feedlot sites. Feedlot pens vary with regard to the presence of structures such as shade which impacts the ability of the cattle to cope with thermal stress, or structures that could be considered enrichment and encourage engagement behaviours. This metric was not already collected at any of the four participating Pilot feedlots in a formal manner although the relevant information could be available in relevant records.

For each pen, the information collected was the description of the structures in the pen, if present.

6.2.1.5.8.2 Outcome of pilot testing

In total, 132 (63.5%) of the observed pens did not have any additional structures in their pens. Structures recorded to be present in observed pens included:

- Shade structures (*n* = 70)
- Old fence posts (*n* = 5); with (*n* = 1) and without tyres (*n* = 4)
- Water tanks (*n* = 4)
- Hay racks (*n* =4)

Note that categories are not mutually exclusive, where a single pen could have had more than one of the above listed structures present.

6.2.1.5.8.3 Recommendations

This information, specifically the presence and animal utilisation of pen infrastructure (e.g., shade) and enrichment, is considered collected under the 'posture', 'ethogram' and 'enrichment' metrics. Importantly, under an ALFA initiative the industry is moving towards having shade present across Australian feedlots by 2026. As such, it is recommended to capture shade access here as an input measure to complement the animal utilisation metrics to allow for appropriate interpretation. In addition, the collection of this information will aid in benchmarking efforts for the industry regarding shade, with no current standards or recommendations on the percentage cover of shade provided to pens nor requirements on number of pens with shade access available. It is, therefore, recommended that shade access be retained in the revised protocol.

For each pen, record:

- Artificial shade present: Y/N
- If shade present, indicate shade allocation (m^2/head available at midday)

It is recommended that this metric be captured once per pen.

6.2.1.5.9 Enrichment

6.2.1.5.9.1 Description and collection of metric in pilot testing

The 'enrichment' metric was a valuable input metric designed to inform interpretation of the output welfare metrics collected and capture relevant differences across feedlot sites. Feedlot pens vary with regard to the supply of enrichment and this metric offers the opportunity to capture positive management that is considered by society to impact quality of life. Enrichment is widely consisted beneficial from a welfare perspective. Briefly, the provision of effective environmental enrichment has the potential to reduce aggressive behaviour in feedlot cattle (Park et al. 2019), and may reduce boredom and frustration (Nawroth et al. 2019). This metric was not already collected at any of the four participating Pilot feedlots in a formal manner although the relevant information could be available in relevant records.

For each pen, the information collected was the description of the structures in the pen, if present.

6.2.1.5.9.2 Outcome of pilot testing

In total, 179 (86.1%) of the observed pens were not provided with enrichment. Enrichment recorded to be present in pens included:

- Tyres (*n* = 19)
- Mounds created during routine pen manure maintenance (*n* = 19)
- Old fence posts (*n* = 5); with (*n* = 1) and without tyres (*n* = 4)
- Access to dam outside of home pen (*n* = 1)

Note that categories are not mutually exclusive, where a single pen could have had more than one of the above listed structures present.

It is important when considering enrichment for cattle at feedlot that the characteristics type and novelty of the enrichment is considered, particularly the type (e.g., physical/cognitive/nutritional/sensory/social) and novelty. During the Pilot, cattle were only observed to engage with the mounds present in their pens, with no interactions noted with any of

the other structures present in the pen that could be classified as enrichment. The reason for this is likely that the novelty of the other enrichment items such as tyres had reduced, whereas the mounds were novel, only present in the observed pens for a short time period. It is also possible that the type of enrichment is not suitable or biologically relevant, thus used only occasionally. The tyres present for instance were very small in size and may only afford the cattle something to engage with in an olfactory manner rather than also tactilely (e.g., rubbing against or physically manipulating the object) which in the experience of the research team has been observed when large tyres are provided.

6.2.1.5.9.3 Recommendations

The Pilot demonstrated that this metric is both easy to collect and adequate to inform the welfare principle of 'good housing'. It is recommended that the 'enrichment' metric be included, unmodified, within a revised Protocol.

It is recommended that this metric be captured once per pen.

6.2.1.5.10 Feed out time

6.2.1.5.10.1 Description and collection of metric in pilot testing

The 'feeding out time' was an input metric designed to inform interpretation of the output welfare metrics collected. Feed out time is particularly important to inform animal behavioural outcome metrics, specifically to address the 'good nutrition' aspect of welfare. This metric was not considered to be presently collected at feedlots; although information may be collected by feeding staff but was not made available to assessors.

For each pen, the information collected was:

- The time (hh:mm) at which the pen was fed out

Note if the exact time of feed was not observed, a time period was indicated.

6.2.1.5.10.2 Outcome of pilot testing

It became evident as the Pilot progressed that the collection of this metric was difficult and limited by the fact that assessors were focused on pen assessments conducted at specific time points which did not always coincide with pen feed out times. Subsequently, the exact feed out time was only recorded for 103 of the 208 observed pens (49.5%).

6.2.1.5.10.3 Recommendations

This metric was important to inform the interpretation of animal outcome metrics, particularly those associated with the welfare principles 'good feeding' and 'good behaviour'. For example, this metric could indicate whether pens were being fed out at a timely and consistent manner over time.

As discussed under the 'approach test' and 'feeding behaviour' metrics in Section 6.2.1.4, sampling timing limited assessor ability to record animal outcomes at feed out times when observations did not coincide with feed out time. Therefore, for the Protocol it is suggested that the best placed feedlot staff member to record feed out time and feeding behaviour metrics would be the feeding team. This would ensure metrics are collected in a routine and standardised manner.

It is recommended that this metric be captured once per pen.

6.2.1.5.11 Feed bunk contamination

6.2.1.5.11.1 Description and collection of metric in pilot testing

The 'feed bunk contamination' metric was a resource-based metric designed to inform the 'good feeding' aspect of welfare. This metric was not considered to be presently recorded at feedlot in a formal manner, however it is recognised that feed bunks are routinely inspected for contamination and cleaned if required.

For each pen, the feed bunk was inspected and described as:

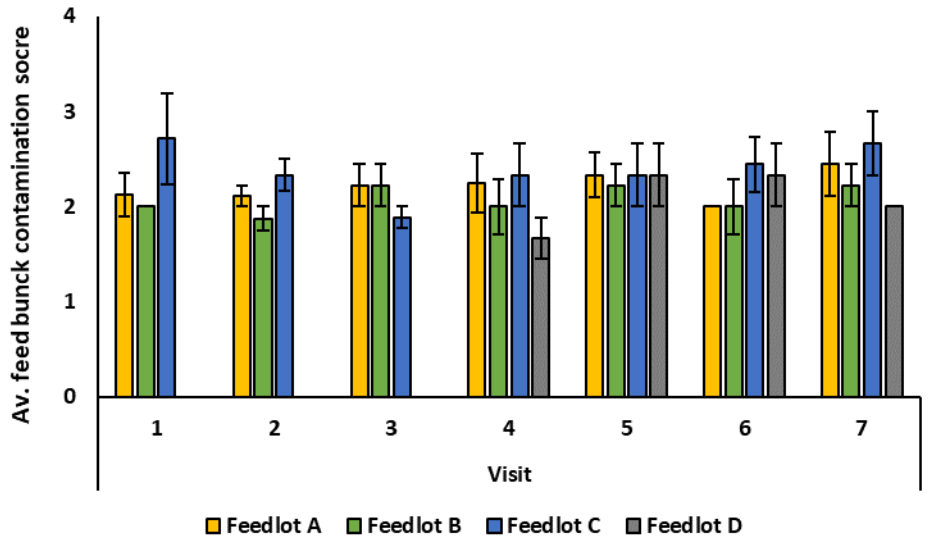
- 1 = Not observed (slick)
- 2 = Clean
- 3 = Foreign bodies (mould)
- 4 = Faecal matter

Note, these scores do not reflect the degree to which contamination is present. It was not considered necessary to indicate the severity of the contamination for scores 3 and 4, given that from a management and welfare perspective any incidence was of concern.

6.2.1.5.11.2 Outcome of pilot testing

Feed bunk contamination was observed to be consistent across Feedlot and Visit (Fig. 26). In most cases, feed was considered 'clean' with only 33 instances (15.9%) in which the feed was considered to have either foreign bodies (score 3; *n* = 9) or faecal matter (score 4; *n* = 24).

Figure 26. Average (± S.E.) feed bunk contamination score (1 – 4) for pens per Visit and Feedlot (A – D). 1 = not observed (i.e., bunk was slick), 4 = Faecal matter present.



6.2.1.5.11.3 Recommendations

The Pilot demonstrated that this score is both easy to collect and adequate to capture both positive and negative welfare outcomes to inform 'good feeding'. It is recommended that the 'feed contamination' metric be included, unmodified, within the revised Protocol.

It is recommended that this metric be captured once per pen.

6.2.1.5.12 Water trough contamination

6.2.1.5.12.1 Description and collection of metric in pilot testing

The 'water trough contamination' metric was a resource-based metric designed to inform the 'good feeding' aspect of welfare. This metric was not considered to be presently collected at feedlot in a formal manner.

For each pen, the water trough was inspected and described as:

- 1 = Not observed (empty trough)
- 2 = Clean
- 3 = Mild (dust/feed/saliva/algae)
- 4 = Moderate (faeces/dust/feed/saliva/algae)
- 5 = Marked contamination (non-potable)

Note, these scores do not reflect the degree to which contamination is present. It was not considered necessary to indicate the severity of the contamination for scores 3 – 5, given that from a management and welfare perspective any incidence is of concern. For those observed pens with more than one water trough (*n* = 43), both were recorded.

6.2.1.5.12.2 Outcome of pilot testing

Water trough contamination varied between Feedlots (Fig. 27). Of the 208 pens observed, 57 (27.4%) were considered 'clean'. No water troughs were recorded as 'non-potable'; however, 18 (8.7%) had moderate contamination which indicated faecal matter was present. The average water trough contamination of pens with shared water troughs was comparable to those that have 'private' water troughs (Table 28). Note that water troughs were not assessed for 14 pens, recorded as score 1 (not observed).

Figure 27. Average (± S.E.) water trough contamination score (1 – 5) for pens per Visit and Feedlot (A – D). 1 = not observed (i.e., water trough was empty), 4 = Market contamination (non-potable).

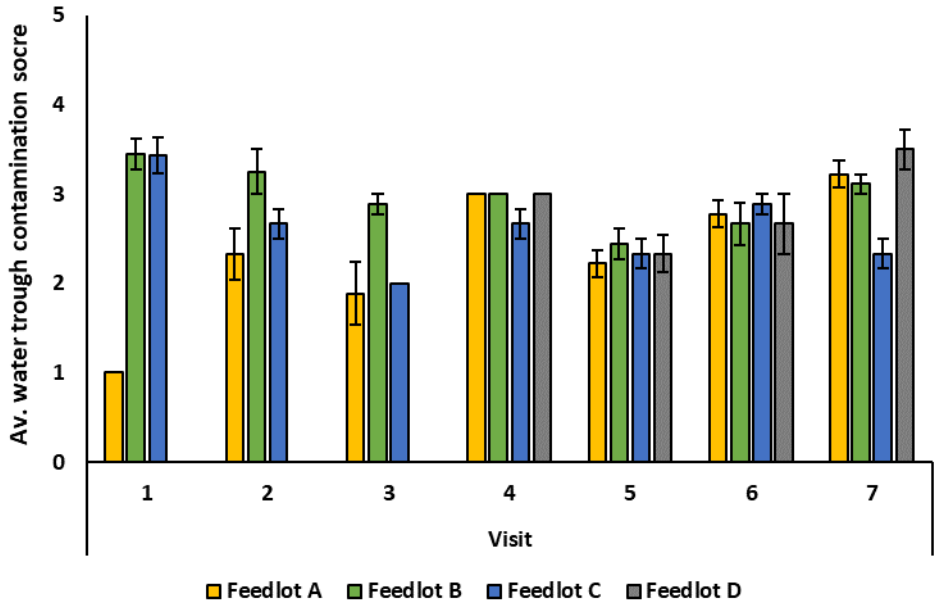


Table 28. Average (± S.E.) water trough contamination score (1 – 5) for observed pens (*n* = 208) per Feedlot (A – D) and type of water trough (private or shared).

Feedlot	Pen water trough contamination score	
	Private (no.)	Shared (no.)
Feedlot A	2.4 ± 0.1 (58)	2.3 ± 0.9 (3)
Feedlot B	3.0 ± 0.1 (41)	2.9 ± 0.1 (21)
Feedlot C	2.5 ± 0.1 (33)	2.6 ± 0.1 (28)
Feedlot D	2.9 ± 0.1 (24)	-
Total	***2.7 ± 0.1 (156)***	***2.6 ± 0.1 (52)***

6.2.1.5.12.3 Recommendations

This metric is both easy to collect and adequate to capture both positive and negative welfare outcomes to inform 'good feeding'. It is recommended that the 'water trough contamination' metric be included, unmodified, within the revised Protocol.

It is recommended that this metric be captured once per pen.

6.2.1.5.13 Water trough fill

6.2.1.5.13.1 Description and collection of metric in pilot testing

The 'water trough contamination' metric was considered a critical resource-based metric designed to inform the 'good feeding' aspect of welfare, specifically resource provision and access. Appropriate water management is critical to manage thermal stress in the feedlot context. This metric was not considered to be presently collected at feedlot in a formal manner, however, it is recognised that water troughs are routinely assessed for leaks or damage during pen walks/rides.

For each pen, the water trough(s) were inspected and described as:

- 1 = empty
- 2 = 25% full
- 3 = >50% full
- 4 = 100% full

For those observed pens with more than one water trough (*n* = 43), both were assessed.

6.2.1.5.13.2 Outcome of pilot testing

Water trough fill was relatively consistent across Feedlots (Table 29). The observation of pens with a water trough that was less than 50% full (scores < 3) was rare and recorded in only 5 pen assessments (2.4%). Of these only a single pen was recorded to have an empty water trough (score 1; Table 29), and it was noted that feedlot staff were aware of the issue and were actively addressing this. Water troughs were not assessed for 14 pens, with only 194 pens were considered here. The reason for this could have been that it was not safe for assessors to enter the pen to collect the metric, or they could not access the pen without disrupting the normal functioning of the feedlot (e.g., moving stock through laneways used to access water troughs).

Table 29. Average (± S.E.) water trough fill score (1 – 4) for the observed pens (*n* = 208) per Feedlot (A – D) and type of water trough (private or shared).

Feedlot	Pens assessed (no.)	Pen water trough fill score (1 – 4)	
		Average (± S.E.)	Range
Feedlot A	47	3.8 ± 0.08	2 – 4
Feedlot B	62	3.2 ± 0.07	1 – 4
Feedlot C	61	3.7 ± 0.06	3 – 4
Feedlot D	24	3.3 ± 0.09	3 – 4
Total	***194***	***3.5 ± 0.04***	***1 – 4***

6.2.1.5.13.3 Recommendations

This metric is both easy to collect and adequate to capture both positive and negative welfare outcomes to inform 'good feeding'. It is recommended that the 'water trough fill' metric be included, unmodified, within the revised Protocol.

It is recommended that this metric be captured once per pen.

6.2.1.5.14 Faecal pat consistency

6.2.1.5.14.1 Description and collection of metric in pilot testing

The 'faecal pat consistency' metric was an animal outcome metric designed to capture cattle health (disease or dietary problems) at a pen level and relates to 'good feeding'. Faecal consistency may inform numerous animal welfare metrics including manure pad condition and coat cleanliness. This metric was not considered to be presently collected at feedlots in a formal manner.

For each pen, fresh faecal pats were observed and a category that best described the majority of pats was recorded:

- 1 = very dry, lumpy pats
- 2 = dry, stiff, semi-formed pats
- 3 = circular, moist raised pat with symmetrical rings around a dipped centre
- 4 = flat, loose, thinly spread pat
- 5 = liquid pool of faeces

Photographs representative of these scores accompanied the scale.

6.2.1.5.14.2 Outcome of pilot testing

Faecal pat consistency appeared consistent across Feedlots (Fig. 28). No pattern between faecal consistency and DOF or 'time in feeding program' were evident (Table 30).

Figure 28. Average (± S.E.) pen faecal pat consistency score (1 – 5) for pens (*n* = 204) per Feedlots A – D. 1 = very dry, lumpy pats; 5 = liquid pool of faeces.

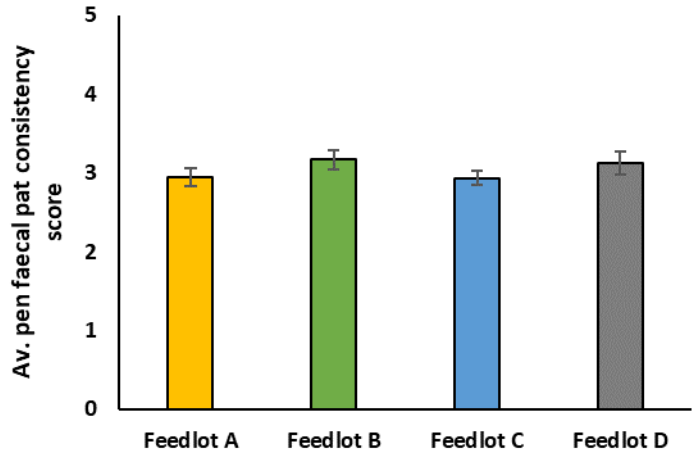


Table 30. Average (± S.E.) pen faecal pat consistency score (1 – 5) for observed pens (*n* = 204) per Feedlots (A – D) and time within feeding program. 1 = very dry, lumpy pats; 5 = liquid pool of faeces.

Feedlot	Time in feeding program	Pens assessed (no.)	Pen faecal pat consistency score (1 – 5)	
			Average (± S.E.)	Range
Feedlot A	Start	17	3.1 ± 0.25	1 – 5
	Middle	18	2.7 ± 0.24	1 – 4
	End	26	3.0 ± 0.20	1 – 4
Feedlot B	Start	18	3.4 ± 0.23	2 – 5

	Middle	24	3.0 ± 0.20	1 – 5
	End	18	3.2 ± 0.23	2 – 4
Feedlot C	Start	9	3.1 ± 0.31	1 – 4
	Middle	17	2.8 ± 0.23	2 – 3
	End	33	3.0 ± 0.16	2 – 4
Feedlot D	Start	7	2.9 ± 0.26	2 – 4
	Middle	16	3.2 ± 0.17	2 – 4
	End	1	4	4
Total		***204***	***3.0 ± 0.06***	***1 – 5***

6.2.1.5.14.3 Recommendations

Collecting faecal pat consistency was both straightforward and quick and provides useful information relating to the 'good feeding' aspect of welfare. Thus, it is recommended that this metric be included, with no modification, within the revised Protocol.

It is recommended that this metric be captured once per pen.

6.2.1.5.15 Surface moisture

6.2.1.5.15.1 Description and collection of metric in pilot testing

The 'surface moisture' metric was an important environmental input metric designed to inform moisture content of the manure pad and aid in the interpretation of animal outcome metrics (e.g., posture, resting, demeanour and coat cleanliness). Assessing the integrity of the manure pad is particularly important when capturing animal outcomes associated with the seasonal rainfall or thermal challenges. This metric was not already collected by feedlots and was considered novel.

For each pen, a score that best described the majority of the pen was selected:

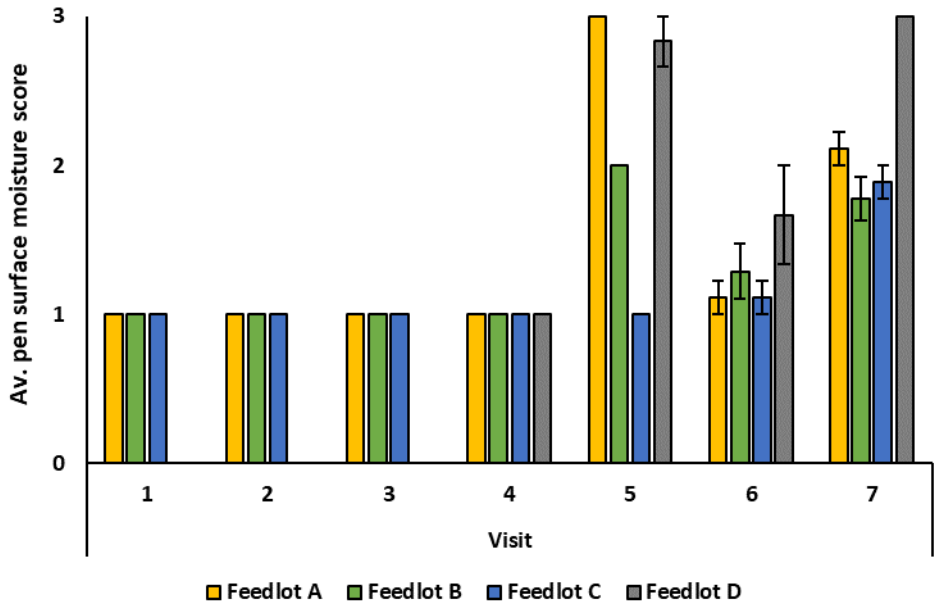
- 1 = dry and firm
- 2 = muddy around resources
- 3 = whole pen muddy

Note that three different metrics to capture manure pad condition were piloted to determine the most meaningful and practical approach to capture this information.

6.2.1.5.15.2 Outcome of pilot testing

All pens at each feedlot were described as 'dry and firm' until Visit 5 – 7 (Fig. 29). This follows the expected pattern of seasonal variation where higher precipitation occurred for the last three Visits. The Pilot finishing in June 2022 was a limitation, with months of high winter rainfall not captured.

Figure 29. Average (± S.E.) pen surface moisture score (1 – 4) for pens by Visit and Feedlot (A – D). 1 = dry and firm, 3 = whole pen muddy.



6.2.1.5.15.3 Recommendations

Although the outcome of the Pilot suggested that this metric captures relevant information, the assessors noted that using this score did not capture information at an appropriate level to adequately inform interpretation of output metrics nor to aid in management decisions surrounding pen maintenance activities. The score did not account for the degree of mud in the pen between 'muddy at resources' and 'whole pen muddy'. Under this system, it is difficult to draw inferences on when bedding should be provided or when pen scrapping should be performed. For these reasons, it is recommended that the 'pen surface' metric not be included in the revised Protocol.

6.2.1.5.16 Mud depth

6.2.1.5.16.1 Description and collection of metric in pilot testing

The 'mud depth' metric was an important environmental input metric designed to capture manure pad conditions to address the 'good housing' aspect of welfare. This metric was not already collected at feedlots and the metric was considered novel.

For each pen, a score that best described the mud depth for the majority of the pen was recorded:

- 1 = 0 – 5 cm
- 2 = 6 – 10 cm
- 3 = 11 – 15 cm
- 4 = 16 – 20 cm
- 5 = > 21 cm

Note that three different metrics to capture manure pad condition were piloted to determine the most meaningful and practical approach to capture this information.

6.2.1.5.16.2 Outcome of pilot testing

Only 19 pens (9.3%) were recorded to have mud depth greater than 5 cm (score > 1) which occurred during Visit 5 – 7. Only 2 pens were observed to have mud depth > 15 cm, both of which were located at Feedlot D during Visit 7. This followed the expected pattern of seasonal variation that reflects environmental conditions experienced at each feedlot.

6.2.1.5.16.3 Recommendations

Mud depth was found to be a less accurate indicator of poor manure pad conditions compared to the 'surface moisture' and 'animal mud depth' metrics. As this metric provides an assessment of the majority of the pen, it does not appropriately capture the level of mud surrounding recourses such as the water trough(s) and feed bunks, where depth can be greater. It is also recognised that it was impractical and difficult to accurately assess average depth in cm under commercial conditions. Thus, it is recommended that this metric not be included in the revised Protocol.

6.2.1.5.17 Animal mud depth

6.2.1.5.17.1 Description and collection of metric in pilot testing

The 'animal mud depth' metric was an important environmental input metric designed to capture manure pad conditions to address the 'good housing' aspect of welfare. This metric was not already collected at any of the feedlots and the metric was considered novel.

For each pen, a mud depth score that best described the majority of the pen was recorded:

- 1 = no cattle with mud at dewclaw level or higher
- 2 = ≤ 10% pen surface with cattle with mud at dewclaw level or higher
- 3 = 10 – 50% pen surface with cattle with mud at dewclaw level or higher
- 4 = > 50% pen surface with cattle with mud at dewclaw level or higher

Note that three different metrics to capture manure pad condition were piloted to determine the most meaningful and practical approach to capture this information.

6.2.1.5.17.2 Outcome of pilot testing

Forty-five pens (22.1%) were recorded to have cattle with mud at dewclaw level or higher (score ≥ 2) which occurred during Visit 5 – 7. This appeared to more accurately represent the pen conditions observed during the Pilot and followed the expected seasonal pattern. The pens are Feedlot A and D appeared to be muddier on average than those from Feedlot B and C during these visits (Table 31). However, it is important to note that although located in a high rainfall region, Feedlot C had already started to provide bedding to manage mud during Visit 7.

Table 31. Animal mud depth metric during Autumn Pilot months (Visit 5 - 7).

Feedlot	Visit (month)	Animal mud depth score (1 – 4)	
		Average (± S.E.)	Range
Feedlot A	Visit 5	2.9 ± 0.3	1 – 4
	Visit 6	1	1
	Visit 7	2.6 ± 0.2	2 – 3
Feedlot B	Visit 5	1	1
	Visit 6	1	1
	Visit 7	1.6 ± 0.2	1 – 2
Feedlot C	Visit 5	1	1
	Visit 6	1	1
	Visit 7	1.6 ± 0.2	1 – 2
Feedlot D	Visit 5	3.7 ± 0.2	3 – 4
	Visit 6	2.5 ± 0.2	2 – 3
	Visit 7	4	4

6.2.1.5.17.3 Recommendations

This metric provided important information that captured the environmental conditions that cattle experienced. Manure pad management is critical as manure pad condition affects cattle welfare outcomes including resting behaviour and posture, cattle demeanour, and coat contamination (collected here under 'coat cleanliness score'). Collection of this metric was more straightforward compared to the other two metrics piloted to capture this information due to it capturing the amount of the pen at each level of loading. Overall, based on the outcome of the Pilot, it is considered reasonable to suggest that this metric:

- Adequately described the animal outcomes associated with the poor environmental and pen conditions expected due to seasonal high rainfall.
- Provided an appropriate level of information to adequately inform interpretation of output metrics.
- Provided useful information to aid in management decisions surrounding pen maintenance activities.

Since this metric was also piloted by feedlot staff with no difficulties, it is recommended that the 'animal mud depth' metric be included in a modified format in the revised Protocol. It is recommended that this metric be modified to a 5-point scale. Under the modified metric, the appropriate category for each pen assessed be selected from the following:

- 1 = no cattle with mud at dewclaw level or higher
- 2 = < 10% pen surface with cattle with mud at dewclaw level or higher
- 3 = 10 – 25% pen surface with cattle with mud at dewclaw level or higher
- 4 = 26 – 50% pen surface with cattle with mad at dewclaw level or higher
- 5 = > 50% pen surface with cattle with mud at dewclaw level or higher

It is recommended that this metric be captured once per pen.

6.2.1.6 Pen health metrics

This section details the nine pen health metrics included in the Pilot to inform on behavioural measures and for identification of early signs of ill-health. It is important to note that feedlots

already monitoring animal health, predominantly on a daily basis. These metrics were only recorded once per pen assessed at the TP 3 (14:00 h).

6.2.1.6.1 Body condition score

6.2.1.6.1.1 Description and collection of metric in pilot testing

The 'Body Condition Score' (BCS) metric informs on long-term feeding and is considered to be important from a welfare perspective as both an input and outcome metric. Previously, this metric was not collected by any of the four participating Pilot feedlots in a formal manner (i.e., records).

For each pen, a score that best described the majority of cattle within the pen was selected:

- 1 = Very low musculature, no evidence of any fat, skeletal structure very pronounced.
- 2 = Backbone, shoulder bones and hips are visible, tail head is slightly less recessed. Ribs are faintly visible.
- 3 = Hip bones are faintly visible, ribs are usually not visible. Tail head is not recessed and body outline is almost smooth.
- 4 = Ribs are well covered and hip bones are not visible. Tail head is slightly bumpy and overall body shape is rounded.
- 5 = Hip bones show fat deposits, tail head has large lumps of fat, rib bones are very well covered and overall shape is bulging.

Photographs of both *B. taurus* and *B. indicus* breeds accompanied the scale to detail breed specific variations.

While BCS can be assessed using different scales, the 5-point scale was selected and found useful during the Pilot.

6.2.1.6.1.2 Outcome of pilot testing

It is understood that the purpose of lot feeding cattle is to increase their body condition. BCS informs on long-term feeding, where comparing the entry and exit scores can inform the feedlot on cattle progression and may identify areas for addressing, especially if cattle do not reach the desired score at the end of their pre-planned feeding program. It is evident from the Pilot that BSC is simple and quick to capture at a pen level.

6.2.1.6.1.3 Recommendations

Based on the outcome of the Pilot, it is recommended that BCS be included, unmodified, in the revised Protocol as an animal outcome to address the welfare principle of 'good feeding'.

Specifically, it is recommended that this metric be collected at entry and exit for cattle on short and short-medium feeding programs. It is also considered that for long-fed cattle, to track progress of the cattle, having a mid-way score conducted may be beneficial.

6.2.1.6.2 Nasal discharge

6.2.1.6.2.1 Description and collection of metric in pilot testing

The 'nasal discharge' metric is a recognised early indicator of respiratory distress or disease. However, discharge from the nasal passage can occur for many reasons. Therefore, recording nasal

discharge in the morning is not required as it is not symptomatic of clinical syndrome. During the Pilot, nasal discharge, along with other health measures, were recorded at the 14:00 h observation time point. This metric was not being previous recorded by the four participating Pilot feedlots in a formal manner.

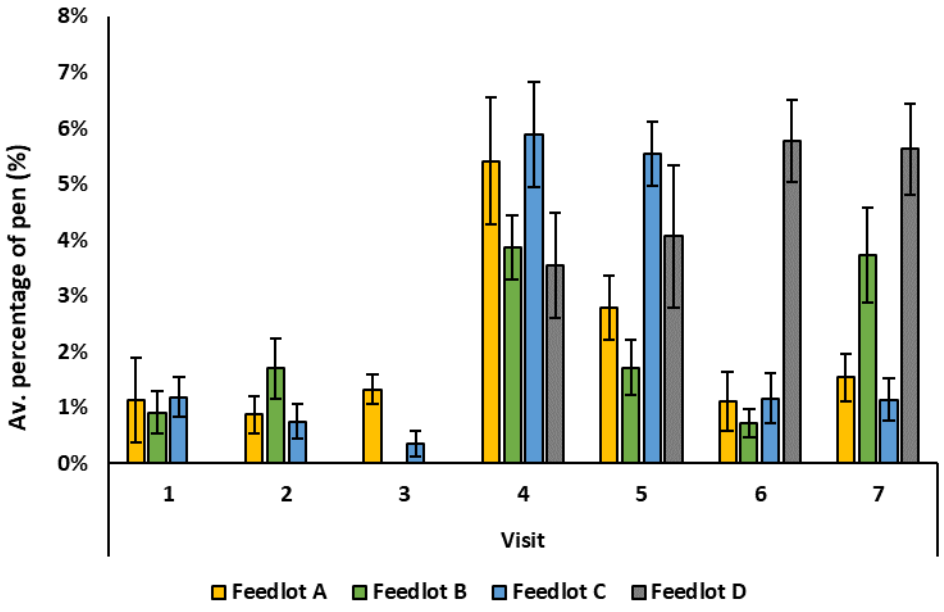
For each pen, the information collected was:

- Percentage (%) pen with nasal discharge

6.2.1.6.2.2 Outcome of pilot testing

Over the course of the Pilot, nasal discharge was observed during 148 pen observations (71.8%). Overall, nasal discharge varied between Feedlot and Visit (Fig. 30), with a maximum of 12.5% of cattle within a pen recorded with nasal discharge. In late Autumn (Visit 6 and 7), it appears that Feedlot D had higher incidence of nasal discharge when compared to feedlots A – C.

Figure 30. Average (± S.E.) percentage of pen (*n* = 208) recorded with nasal discharge per Visit (1 – 7) and Feedlot (A – D).



6.2.1.6.2.3 Recommendations

Based on the Pilot, it is clear that this metric is simple and informative. As nasal discharge can be an early indicator of respiratory distress or disease, recording nasal discharge during pen walks/rides by feedlot staff would be worthwhile, especially during high-risk seasons. Thus, it is recommended that the metric be included, unmodified, in the revised Protocol as an animal outcome to address the welfare principle of 'good health'.

It is recommended that this metric is recorded once per pen.

6.2.1.6.3 Ocular discharge

6.2.1.6.3.1 Description and collection of metric in pilot testing

The 'ocular discharge' metric informs on both animal health and environmental conditions. Ocular discharge involves the expelling of liquid from one or both eyes, which leaves tracks down the face of the animal. Specifically, ocular discharge can be an indicator of eye problems (e.g., pink eye), while also being a response to environmental pressures (e.g., dust, ammonia). High dust conditions can lead to increased incidences of pink eye and other eye problems, while cattle housed under fully or partially shaded environments may be exposed to higher levels of ammonia, which can cause eye irritation, resulting in ocular discharge. This metric was not previously being recorded by any of the four participating Pilot feedlots in a formal manner.

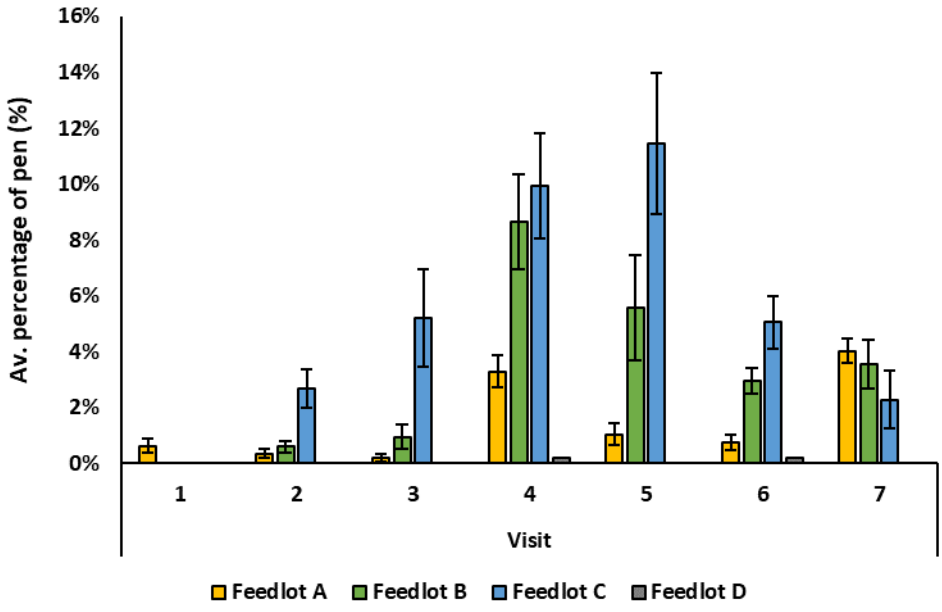
For each pen, the information collected was:

- Percentage (%) pen with ocular discharge

6.2.1.6.3.2 Outcome of pilot testing

Over the course of the Pilot, ocular discharge was observed during 129 pen observations (62.6%). Overall, ocular discharge varied between Feedlot and Visit (Fig. 31), with a maximum of 25% of cattle within an observed pen recorded with ocular discharge. It appears that Feedlot D had the lowest incidence of ocular discharge when compared to the Feedlots A – C, whereas Feedlot C tended to record higher levels.

Figure 31. Average (± S.E.) percentage of pen (*n* = 208) recorded with ocular discharge per Visit (1 – 7) and Feedlot (A – D).



6.2.1.6.3.3 Recommendations

Based on the Pilot, this metric is simple and informative. As ocular discharge can be an early indicator of eye problems and challenging environmental conditions, recording this metric during

pen walks/rides by feedlot staff would be worthwhile, especially during high-risk conditions/seasons. Thus, it is recommended that the metric be included, unmodified, in the revised Protocol.

It is recommended that this metric is recorded once per pen.

6.2.1.6.4 Coughing

6.2.1.6.4.1 Description and collection of metric in pilot testing

The 'coughing' metric was included as an indicator of respiratory distress or disease. The coughing sound being recorded here is deeper than the noise made when cattle are eating and 'cough' due to food being mis-swallowed. This metric was not previously recorded by any of the four participating Pilot feedlots in a formal manner.

For each pen, the information collected was:

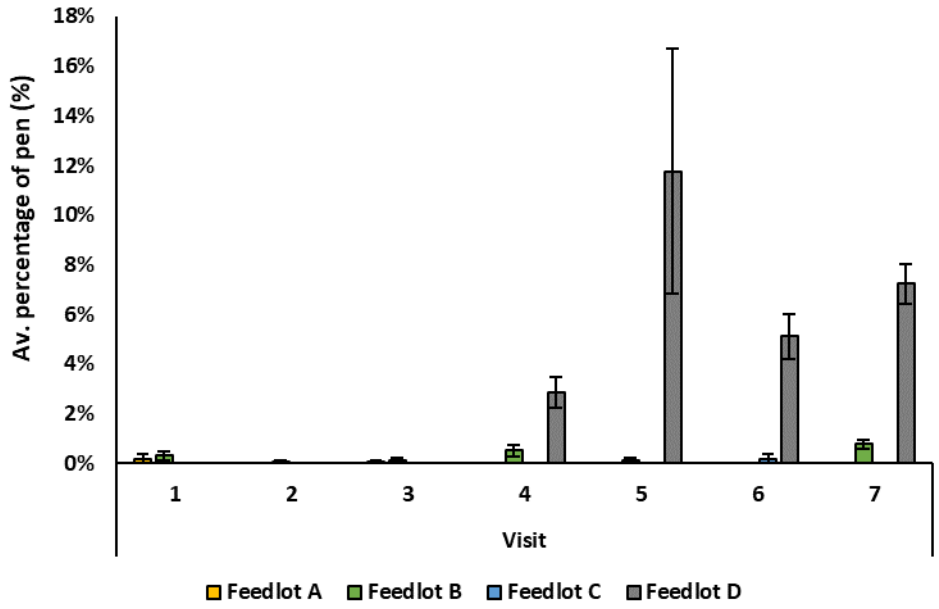
- Percentage (%) pen that coughed during the pen-side assessment

Note that this metric captures any cattle that coughed during the entire pen-side assessment (period of approximately 10 min), not with a scan sample approach adopted for other health metrics.

6.2.1.6.4.2 Outcome of pilot testing

During the Pilot, coughing was observed infrequently, with a total of 45 pen observations (21.8%). Overall, coughing varied between Feedlot and Visit (Fig. 32), with a maximum of 35.8% of cattle within a pen recorded to be coughing. It appears that Feedlot D had the highest incidence of coughing when compared to the other three feedlots.

Figure 32. Average (± S.E.) percentage of pen (*n* = 208) recorded to be coughing (*n* = 208) per Visit (1 – 7) and Feedlot (A – D).



1.1.1.1.3. Recommendations

Based on the outcome of the Pilot, it is clear that the metric captures welfare relevant information that could be used to inform the principal of 'good health'. Further, elevated levels of coughing would be an indication of many animals in a pen experiencing respiratory issues, warranting further investigation, and thus aiding in decision marking at a management level. The identification of the coughing animal(s) is understood to be difficult in large pens/at high densities. Overall, the metric provides valuable information and is recommended that the metric be included, unmodified, in the revised Protocol.

It is recommended that this metric is recorded once per pen.

6.2.1.6.5 Lame

6.2.1.6.5.1 Description and collection of metric in pilot testing

The 'lame' metric was included to inform on both animal health and environmental conditions. Lame cattle were identified to be animals that are limping when walking, to be favouring a foot/leg, to not be weight bearing on a foot, etc. This metric was already being captured by Pilot feedlots with the identification of lame animals for treatment captured during daily pen walks/rides.

For each pen, the information collected was:

- Percentage (%) pen lame

Note that as cattle were observed over multiple time points during each Visit, notes of cattle that were identified to be lame were taken, with the total incidence of lame animals recorded only once per pen, per Visit. Also note that the assessor did not score the animal to indicate level or degree of lameness. A simple binary metric was deemed more considerate of assessment burden under commercial conditions.

6.2.1.6.5.2 Outcome of pilot testing

During the Pilot, lame animals were identified rarely, with only 16 pen observations (7.8%). The highest number of cattle recorded to be lame within a single observed pen was 2, which occurred in a pen of cattle that were newly inducted to the feedlot (< 15 DOF). The remaining 15 instances were singular and were spread across the Feedlots and Visits (Feedlot A *n* = 4; Feedlot B *n* = 3; Feedlot C *n* = 6; Feedlot D *n* = 2). No pattern was apparent with regard to management nor season.

6.2.1.6.5.3 Recommendations

With lame animals already being identified during daily pen walks/rides by feedlot staff, the incorporation of this metric to address the 'good health' aspect of welfare is straightforward. It is recommended that records of animals with lameness are made, specifically for animals that are deemed not yet required to be provided with treatment(s). Overall, the metric provides valuable information and is recommended that the metric be included, unmodified, in a revised Protocol.

It is recommended that this metric is recorded once per pen.

6.2.1.6.6 Ill-thrifty

6.2.1.6.6.1 Description and collection of metric in pilot testing

The 'ill-thrifty' metric was an animal outcome metric designed to inform animal health. Ill-thrifty is an indication of an animal that is a 'poor doer'. An ill-thrifty animal will have a poor demeanour (e.g., described as dull), have hollow-sides indicating it is not eating at volumes it should be, and may have a poor body condition and dull/ruffled coat. Identifying these animals early is important so the appropriate treatments can be provided for underlying health issues, and the animal is provided with the best opportunity to improve and adapt to the feedlot environment.

For each pen, the information collected was:

- Percentage (%) of pen ill-thrifty
- The reason for ill-thrift if known

Note that as cattle were observed over multiple time points during each Visit, notes of cattle that were identified to be ill-thrifty were taken, with the total incidence of ill-thrifty animals recorded only once per pen per Visit.

6.2.1.6.6.2 Outcome of pilot testing

Notably, animals that were ill-thrifty were observed rarely, recorded during only 8 (3.9%) pen observations. Specifically, there appears to be no pattern evident for these pens, with incidence occurring across all Feedlots (Feedlot A *n* = 2; Feedlot B *n* = 1; Feedlot C *n* = 3; Feedlot D *n* = 2), Visit and time in feeding program. For example, 6 of these pens were considered in the middle of their feeding program with the remaining 2 at the beginning (< 30 DOF). The reasons noted for ill-thrift include:

- Underweight compared to rest of pen
- Poor-doer
- Rub marks and/or lesions present
- Unknown

Overall, the low incidence represents a positive welfare outcome.

6.2.1.6.6.3 Recommendations

As ill-thrifty animals are already identified during daily pen walks/rides by feedlot staff, the incorporation of this metric in the revised Protocol is straightforward. The formal recording of the incidence of ill-thrift, and specific treatment actions taken to address the issue, is considered beneficial in demonstrating positive welfare outcomes at a feedlot level. Thus, the metric is recommended for inclusion, unmodified, in the revised Protocol.

It is recommended that this metric is recorded once per pen.

6.2.1.6.7 Non-ambulatory

6.2.1.6.7.1 Description and collection of metric in pilot testing

The 'non-ambulatory' metric was designed to inform on animal health. Non-ambulatory is when an animal is unable to support its own body weight and stand. This possesses a life-threatening risk to the animal.

For each pen, the information collected was:

- Percentage (%) of pen non-ambulatory

Note that as cattle were observed over multiple time points during each Visit, notes of cattle that were identified to be non-ambulatory were taken, with the total incidence recorded only once per pen per Visit.

6.2.1.6.7.2 Outcome of pilot testing

During the Pilot, only a single animal within a pen was observed to be non-ambulatory. It must be noted that the assessor did not act to ensure that every single animal with an observed pen stood and walked as would be done during routine pen walks/rides. However, given the amount of time each pen was observed it is unlikely that any non-ambulatory cattle were missed.

6.2.1.6.7.3 Recommendations

It is considered important from a welfare perspective to capture injuries and diseases when they occur, regardless of frequency, particularly in this situation where it indicates an animal with severely compromised welfare. The outcome of the Pilot suggests that this metric is informative and considering this metric is already identified during daily pen walks/rides by feedlot staff, the incorporation of this metric in the revised Protocol is straightforward. No modifications are required for the 'non-ambulatory' metric.

It is recommended that this metric is recorded once per pen.

6.2.1.6.8 Coat cleanliness 1

6.2.1.6.8.1 Description and collection of metric in pilot testing

The 'coat cleanliness 1' metric was designed to inform on environmental conditions and cattle comfort. The amount of loading on an animal's coat can impact their ability to regulate their body

temperature, in both hot and cold climates. This metric was not previously recorded by any of the four participating feedlots in a formal manner and was considered novel.

For each pen, a score that best described the majority of the pen was selected:

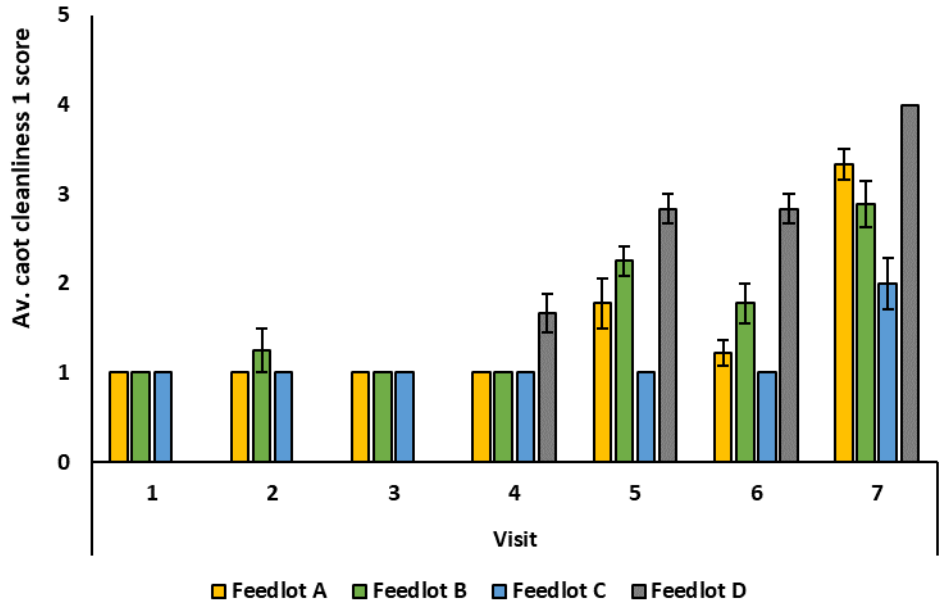
- 1 = 0-14% cover; totally clean
- 2 = 15-34% cover; minor loading on legs and brisket
- 3 = 35-54% cover; reasonable loading on legs, brisket, and belly
- 4 = 55-60% cover; substantial loading on legs, brisket, belly, and flanks
- 5 = >70% cover; heavy loading on legs, brisket, flanks, back and face

Note that two different scoring systems for 'coat cleanliness' were piloted to determine the most meaningful and practical approach to capture this information. Photographs representative of these scores accompanied the scale to detail degree of specific loadings.

6.2.1.6.8.2 Outcome of pilot testing

During the Pilot, scores above 1, indicating that the majority of cattle within a pen were not 'totally clean', were observed during Visits 5 – 7, occurring in late Autumn (Fig. 33), reflecting the expected seasonal variation related to increased precipitation. While some muddy conditions were observed during the Pilot, it is important to note that the Pilot did not observe cattle during months of seasonal high rainfall (June – August for WA) thus, it did not capture the extent to which dirty coats could occur, nor was it possible to fully determine the potential impact this metric had on cattle in terms of behaviour and demeanour, thus welfare.

Figure 33. Average (± S.E.) 'coat cleanliness 1' score (1 – 5) of pens (*n* = 206) per Visit (1 – 7) and Feedlot (A – D). 1 = 0-14% cover; totally clean; 5 = >70% cover; heavy loading on legs, brisket, flanks, back and face.



6.2.1.6.8.3 Recommendations

While this metric captured useful information, it was noted by assessors that this metric was 'confusing' and 'difficult to collect' when compared to the 'coat cleanliness 2' metric. This simplified

metric also raised concerns surrounding how to translate the percentage coat loadings described to a pen-level assessment, with the potential for under reporting of coat loading to occur. This metric is intended to be a description of the majority of the pen, but it was not found to be intuitive nor easy to apply the descriptions in this manner during the research pilot. It is recognised that this score is routinely applied in abattoirs and the inclusion in the protocol would provide a level of continuity of assessment within the supply chain, however, the scoring currently used in abattoir appears to occur at an individual animal level which does not appear applicable here. In addition, it is considered more valuable from a welfare perspective to identify issues earlier to facilitate proactive management decisions to address the issue before it progresses. It is for these reasons that it is recommended that this scoring system not be included in the revised Protocol.

6.2.1.6.9 Coat cleanliness 2

6.2.1.6.9.1 Description and collection of metric in pilot testing

The 'coat cleanliness 2' metric was designed to inform on environmental conditions and cattle comfort. The amount of loading on an animal's coat can greatly impact their ability to regulate their body temperature, in both hot and cold climates. This metric was not previously recorded by any of the four participating Pilot feedlots in a formal manner and was considered novel.

For each pen, the information collected was a description of the majority of the pen:

- 1 = all cattle are clean
- 2 = some cattle with leg and thighs covered
- 3 = most cattle with legs and thighs covered
- 4 = some cattle with thighs and bellies covered
- 5 = most cattle with highs and bellies covered
- 6 = some cattle covered completely - mild
- 7 = most cattle covered completely - mild
- 8 = some cattle covered completely - heavy
- 9 = most cattle covered completely - heavy
- 10 = all cattle heavily covered

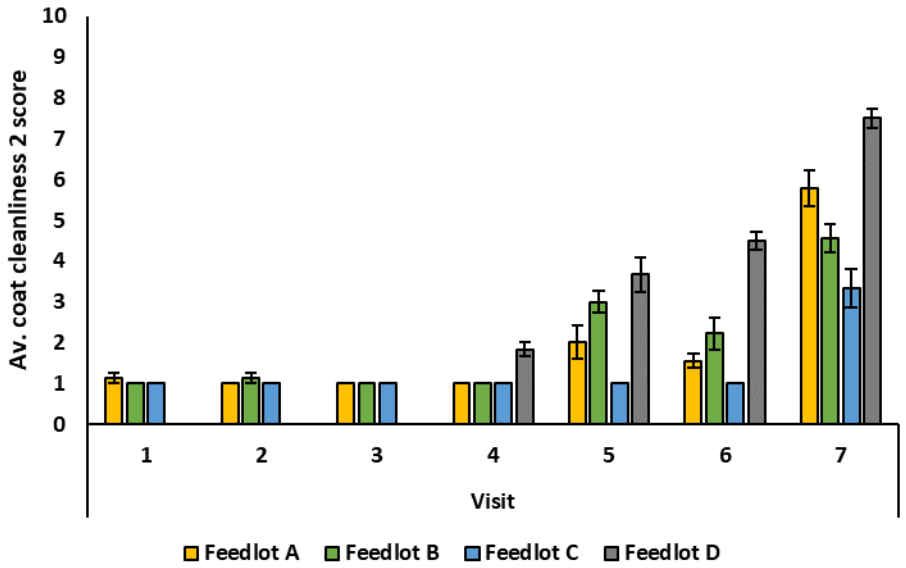
Note that two different scoring systems for 'coat cleanliness' were piloted to determine the most meaningful and practical approach to capture this information. Photographs representative of these scores accompanied the scale to detail degree of specific loadings.

6.2.1.6.9.2 Outcome of pilot testing

As with the 'coat cleanliness score 1' metric, it was evident that higher 'coat cleanliness 2' scores were observed during Visits 5 – 7 occurring in late Autumn (Fig. 34), reflecting the expected seasonal variation related to increased precipitation. It was noted that only Feedlot B had begun to provide bedding to pens by the conclusion of the Pilot.

Importantly, as detailed in Section 6.2.2, this metric was found to correlate meaningfully with animal output metrics (e.g., cattle posture, activity, and demeanour).

Figure 34. Average (± S.E.) 'coat cleanliness 2' score (1 – 10) of pens (*n* = 206) per Visit (1 – 7) and Feedlot (A – D). 1 = all cattle are clean; 5 = all cattle heavily covered.



6.2.1.6.9.3 Recommendations

During the Pilot, this metric provided important information that captured how cattle responded to the environmental conditions they experienced. The assessors found the collection of this metric to be more straightforward, with the scale already capturing the amount of the pen at each score, which was clearly defined. This meant that although the scale was larger when compared to the 'coat cleanliness 1' metric, it was easier and faster to collect. Although not piloted under Winter conditions, given the detailed scale, it is reasonable to suggest that this metric would adequately describe coat loading in poor environmental and pen conditions expected during high rainfall. The larger scale makes this metric more sensitive, thus provides more meaningful information to inform management decisions.

When comparing the two scoring systems, it is important to consider that the assessor burden in using a 5-point scale and a 10-point scale was comparable since the metrics are designed to indicate which category describes the majority of the pen. Therefore, it is recommended that the 'coat cleanliness 2' metric be included in the revised Protocol. No modifications are recommended; however, it is proposed that more extensive piloting of this metric under winter conditions is undertaken to address questions relating to metric thresholds and intervention points to mitigate poor pen conditions.

It is recommended that this metric is recorded once per pen.

6.2.2 Pen-side assessments: time of day

In recognition that collection of pen-side data performed at four time points is likely unfeasible for adoption, here the suggested timing of pen-side assessments for the revised Protocol is detailed. Data analysis along with feedback provided within Section 6.1 were consulted. Here we outline the results of the statistical analyses (PCA and GLMM; Section 5.3.2.2.2) designed to determine whether behavioural outcomes vary according to the collection time. This enables recommendations for the most appropriate collection times for pen-side welfare metrics to be made.

6.2.2.1 Principal Component Analysis (PCA)

PCA identified three components with eigenvalues > 1.5 (Table 32a) which appeared to follow typical patterns of behaviour; *activity and rest* (i.e., level of arousal), *engagement with their environment,* and a level of *mental state* (positive/negative). PC1 accounted for 17.6% of the total variation in the behavioural outcomes of observed cattle, capturing general patterns of activity and rest. PC1 ranged from low to high activity, with 'settled/content/%resting' strongly loading on one end of the axis and 'active/%vigilance' strongly loaded on the opposing end (Table 32a). PC2 accounted for 10.2% of the total variance and captured cattle behavioural metrics related to feeding engagement with environment. Specifically, 'Feeding behaviour: disinterested/%ruminating' were strongly loaded on one end of the axis, and '%engaged/Feeding behaviour: keen/grouped' strongly loaded on the opposing end (Table 32a). PC3 accounted for 7.1% of the total variation in cattle behavioural outcomes and captured mental state, both positive and negative, relating to cattle responses to environmental challenge. Specifically, 'uncomfortable/%alert' were strongly loaded on one end of the axis, with 'lively/%eating/%social' loaded on the opposing end (Table 32a).

Table 32. a) Principal Components analysis results, with variables that were >75% (PC 1 and PC 2) or >70% (PC 2) of the absolute correlation coefficient highlighted and bolded on either end of each PC factor axis. b) F – Values listed for Generalised Linear Mixed Modelling (GLMM) results comparing the effect of several environmental and management measures on each PC factor. F – Values are also listed for GLMM results comparing visit, feedlot, observation time point, feeding program, breed, and pen effect. Significant variations are highlighted in bold (* = p < 0.05, ** = p < 0.01, *** = p < 0.001).

a) PCA Variables	PC1	PC2	PC3
% Vigilant	**-0.6848**	0.3676	-0.2681
% Resting	**0.8147**	0.0086	0.0424
% Social	-0.3045	0.1998	**0.4220**
% Eating	-0.2886	-0.2527	**0.4656**
% Drinking	0.0084	-0.0319	-0.0756
% Ruminating	0.1793	**0.4564**	0.2812
% Abnormal	-0.0203	0.0187	0.0832
% Self-groom	0.1277	-0.0468	0.2670
%Engaged	0.2244	**-0.6465**	-0.1672
% Lying	0.6290	0.4249	0.1455
% Under shade	0.0346	-0.3894	-0.2299
Reactivity Index: Reactive	-0.5604	0.0356	-0.1578
Feeding Behaviour: Keen	-0.0476	**-0.5289**	0.1585
Feeding Behaviour: Disinterested	0.0390	**0.4926**	0.0167
Drinking Behaviour (0/1)	-0.0170	0.1345	-0.2136
Panting Score (2 or above, 0/1)	-0.0062	0.2932	-0.3353
Grouped (0/1)	0.1717	**-0.4651**	-0.2868
Active	**-0.7328**	-0.0699	0.3825
Agitated	-0.1581	-0.2273	-0.0020
Alert	-0.5209	-0.3179	**-0.4121**
Content	**0.7648**	-0.4026	-0.0812
Curious	-0.1825	-0.3638	-0.0015
Dull	0.1492	0.0833	-0.3372
Lively	-0.3521	-0.4015	**0.4304**
Nervous	-0.5147	0.0077	-0.3292
Settled	**0.8552**	-0.0328	0.0031
Uncomfortable	-0.0902	0.2735	**-0.3921**
Total variance (%)	17.61	10.15	7.07
Eigenvalue	4.75	2.74	1.91
b) GLMM results – F-Values and their significant variations			
WGBT (°C)	0.509	**8.929****	**7.080****
Stocking density (m^2/head)	0.310	2.625	**6.688***
Feed access (mm/head)	0.403	**14.336*****	0.538
Shade access (Y/N)	**16.975*****	2.062	0.740
Enrichment (Y/N)	2.332	0.496	2.081
Faecal pat consistency (5pt score)	0.733	0.057	0.000
Coat cleanliness (10pt score)	**21.425*****	1.673	**14.676*****
Visit no.	**14.363*****	**14.311*****	**22.529*****
Feedlot	**19.022*****	**8.653*****	**10.160*****
Observation time	**4.680****	**2.728***	0.605
Feeding program	**4.931****	0.524	0.730
Breed	2.033	0.396	0.775
Pen ID	**2.366*****	**2.775*****	**1.540****

6.2.2.2 GLMM: effect of time of day

6.2.2.2.1 PC 1

The behavioural outcomes for cattle on PC1 showed significant variation between observation times (Table 32b) with cattle being described as more 'settled/content/%resting' at TP3 (14:00 h), and most active ('active/%vigilant') at TP1 (08:00 h) and TP4 (17:00 h) (Fig. 35c). The activity of cattle did not differ between TP 1 and TP 2 (Fig. 35c). This reflects the bimodal patterns of activity and rest typical in feedlot cattle (Smith et al. 2015; Pillen et al. 2016). Hence, to adequately capture variation in the activity and rest patterns of cattle, two assessments, one in the morning and another in the afternoon, are required.

The behaviour of cattle is complex and behavioural outcomes in feedlot cattle may be affected by numerous, often interacting, factors including but not limited to climate (Gonyou et al. 1979; DelCurto-Wyffels et al. 2021), pen surface conditions (Dickson et al. 2022), resource access (e.g., bunk management and feed bunk access; Zobel 2007), and social factors (e.g., Haskell et al. 2019). This is illustrated here (Table 32b), with Visit no., Feedlot, and Feeding program of cattle identified as significant fixed effects, with 'shade access' and 'coat cleanliness score' significant covariates. It was anticipated that PC1 scores would significantly vary across Visits and Feedlots due to differences in location and seasonal variation experienced during the Pilot. It appeared that the effects of Feedlot and Visit number were largely driven by environmental conditions, as indicated by the higher levels of coat cleanliness (i.e., dirtier cattle) recorded for Feedlot D (Fig. 35a-b).

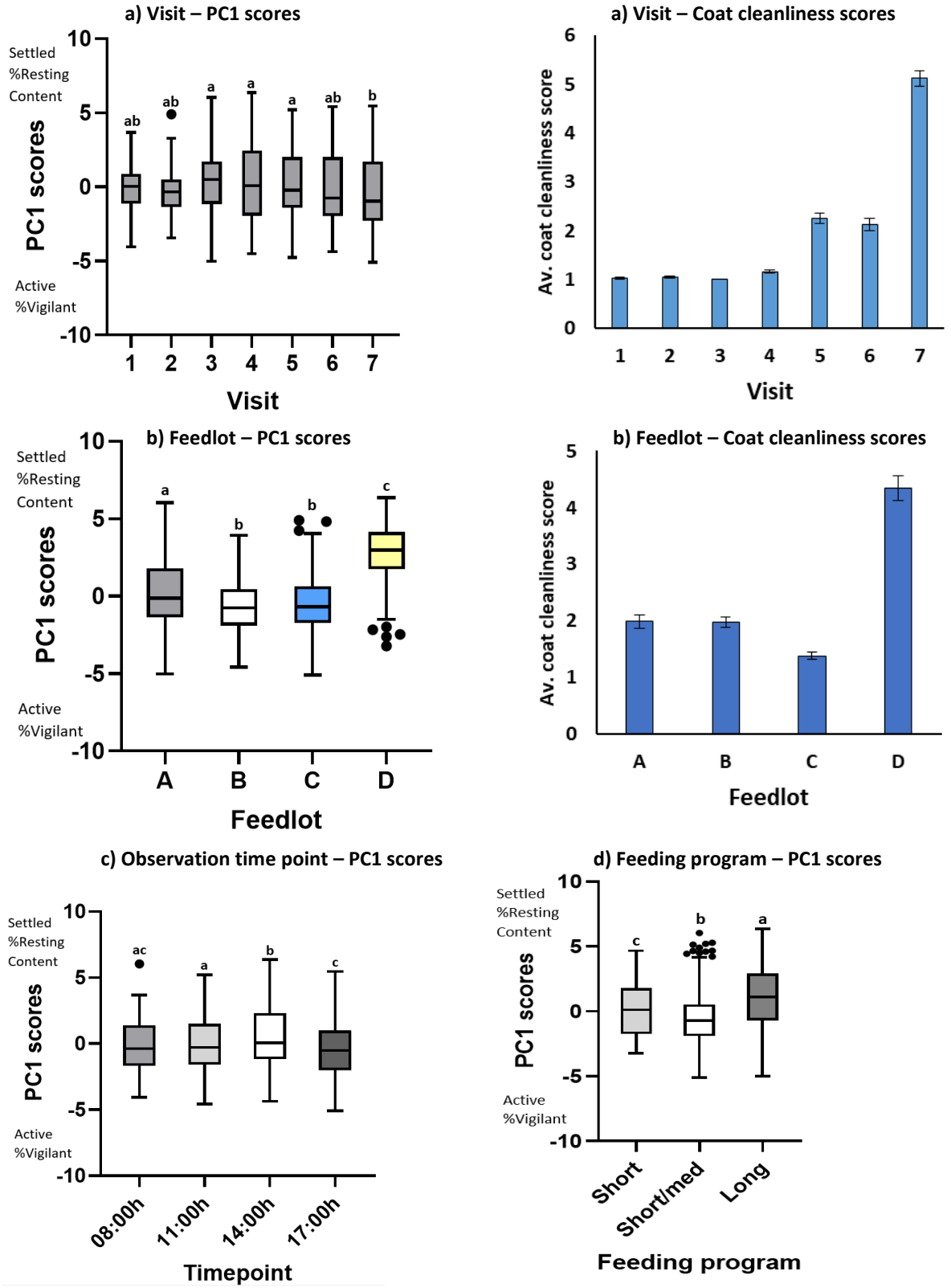
Activity of cattle observed across Visit number was not linear, with cattle being more 'active/%vigilant' on Visit 7 compared to Visits 3 – 5 (Fig. 35a). It is considered likely that the difference in activity and rest behaviours observed during these Visits were related to environmental conditions where Visits 1 – 2 and 6 – 7 reflect more challenging environmental conditions, such as thermal stress (Visits 1 – 2) and increased precipitation, which impacted pen conditions and coat cleanliness (Visits 6 – 7), resulting in cattle during Visits 3 – 5 having more optimal environmental conditions.

Feeding program was found to significantly vary for PC1 scores (Table 32b), where cattle in the three programs (short-, short/medium- and long-fed) differed in their activity (Fig. 35d). This highlights the importance of the ensuring that pens selected for monitoring capture variations in feeding programs.

Overall, PC1 results indicate that:

- the behavioural metrics collected pen-side are sufficient to capture variation in environmental conditions,
- differences due to feeding program need to be accounted for in pen selection within the revised Protocol,
- pen-side assessments at two timepoints, in the morning and afternoon, are required to capture variation in cattle activity and rest.

Figure 35. PC1 scores and average coat cleanliness scores (± S.E.) for a) visit and b) feedlot, and PC1 scores for c) observation time point; and d) feeding program. Letters indicate PC score groupings that were significantly different to each other according to Tukey's post hoc testing ($p < 0.05$).



6.2.2.2.2 PC 2

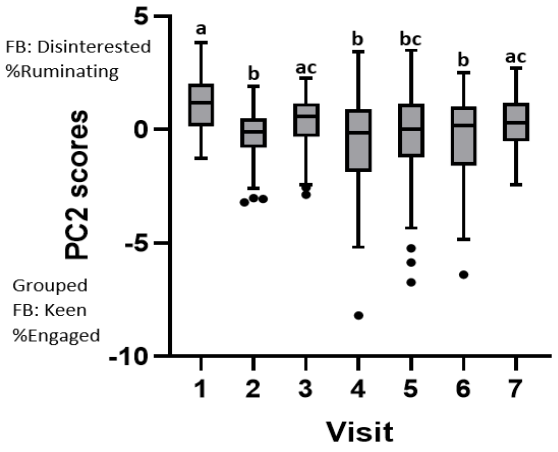
The behavioural outcomes for PC2 showed significant across observation time (Table 32b), with cattle most engaged, grouped and feeding ('engaged/Feeding behaviour: keen/grouping') at TP 4 (17:00 h) (Fig. 36c). The engagement and feeding behaviour of cattle did not appear to differ between TP 1 – TP 3 (Fig. 36c). Overall, these results indicate that to adequately capture high levels of engagement, the ideal assessment time is early evening. However, given that the feeding behaviour of cattle is recommended to be captured by feed staff immediately following pen feed out (see Section 6.2.1.4.3), and it is recognised as impractical for feedlot staff to be conducting assessments at 17:00 h.

Analysis indicated that Visit number and Feedlot were significant fixed effects, with 'feed access' and 'WBGT' significant covariates for PC2 scores (Table 32b). That PC2 was highly variable across Visit (Fig. 36a) indicates that it is likely that multiple factors including 'feed access' and 'WBGT' affected cattle behaviour. The significance of 'feed access' here is likely related to adaptations evident in the feeding behaviour of cattle (i.e., different individual feeding strategies) to mitigate competition (Gibb et al. 1998). Higher levels of access on a pen basis could reflect that more cattle had eaten their fill prior to or in between the four assessment time points, meaning that cattle were more likely to be recorded as 'Feeding behaviour: disinterested/ruminating' during these assessments.

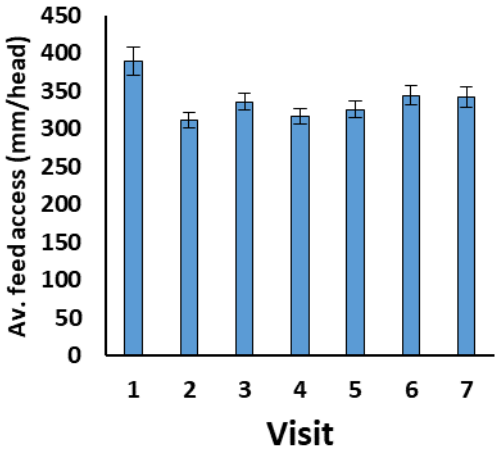
For 'WBGT', the pattern across Observation time, Feedlot and Visit number (Fig. 36a – c) reflect expected patterns of daily, location and seasonal climatic differences. It is important to note that the significant impact of 'WBGT' on PC2 scores appeared to be driven by Feedlot D, in which pen-side observations were not conducted during summer months (Visits 1 – 3) thus experiencing a lower average WBGT compared to Feedlots A – C (Fig. 36b). These results suggest that behavioural metrics collected pen-side were sufficient to capture variation caused by both hot and cold environmental conditions. Further sampling across all seasons is required to fully determine the effect of climatic factors such as WBGT on behavioural outcomes.

Figure 36. PC2 scores, average WBGT (± S.E.) and average access to feed (± S.E.) for a) visit and b) feedlot, and PC2 scores and average WBGT (± S.E.) for c) observation timepoint. Letters indicate PC score groupings that were significantly different to each other according to Tukey's post hoc testing ($p < 0.05$)

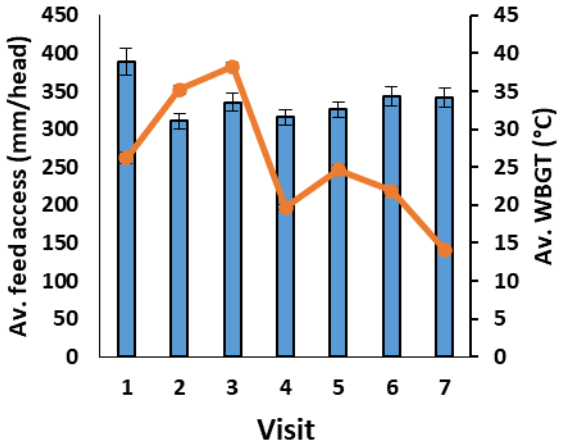
a) Visit – PC2 scores



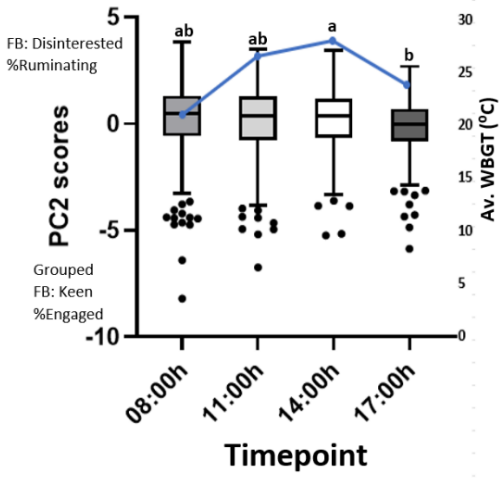
a) Visit – Coat cleanliness scores



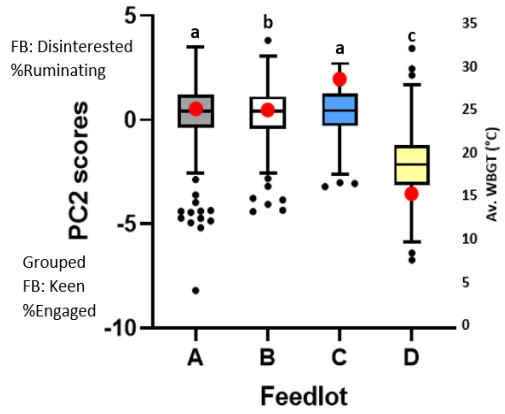
a) Visit – Feed access and WBGT



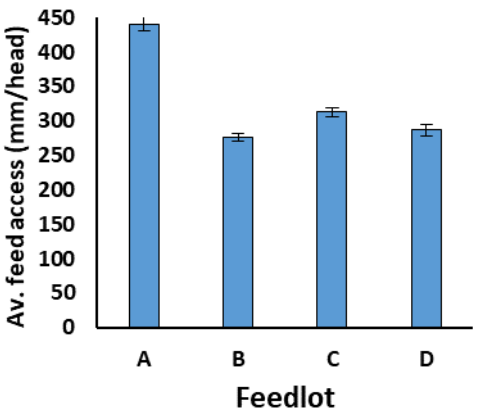
b) PC2 - Observation time point



c) Feedlot – PC2 scores



c) Feedlot – Feed access



6.2.2.2.3 PC 3

The behavioural outcomes for cattle on PC3 (mental state) did not show significant variation across observation time (Table 32b). This suggests that a single pen observation, regardless of time, could be sufficient to inform on cattle mental state. It must be noted that observations were not conducted on cattle during severe environmental challenges (e.g., heat stress), where variation in cattle mental state would be expected to differ across different times of the day. Therefore, it is recommended that the time points suggested by PC1 be adopted.

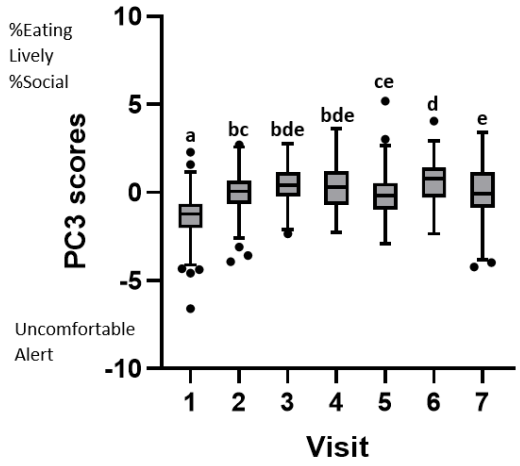
Analysis indicated that Visit number and Feedlot were significant fixed effects, with 'stocking density', 'coat cleanliness' and 'WBGT' significant covariates for PC3 scores (Table 32b). PC3 scores were highly variable across Visit (Fig. 37a), suggesting that multiple factors related to resource and environment were affecting behaviour. The interpretation of these covariates is not straightforward, and it is likely that several other factors additional to the covariates listed in the GLMM analysis could have influenced observed behaviours. For instance, lower WBGT were observed in Visit 1 than Visit 2 – 3, however, cattle were scored to be more 'uncomfortable/%alert' during Visit 1 (Fig. 37a). This could be considered counter intuitive given the expectation that higher WBGT would be associated with lower PC3 scores, reflecting a more negative mental state. It is reasoned that acclimation to the environment involves more than adapting to temperatures, but also livestock source and mixing. Visit 1 corresponded with the start of summer where ambient temperatures are starting to increase, and given that acclimatisation to seasonal variation in animals can take weeks to occur (Collier et al. 2018), it is possible that the lower PC3 scores reflect this. This may also explain why cattle were considered to behave in more positive state ('%eating/lively/%social') for Visits 2 and 3 compared to Visit 1. Considering the lower PC3 scores for Visit 7, this may again reflect the changing climate, where decreased temperatures and increased precipitation caused increases in mud and reduced integrity of pen surface, thus higher coat cleanliness scores. These results indicate that the behaviours may successfully identify the impact of variation in environmental conditions and some sub-optimal conditions on mental state (i.e., cattle comfort), however, the piloting of these metrics under adverse climatic conditions is warranted.

Stocking density appeared to differ by Visit number and Feedlot (Fig. 37a – b), but the significant impact on PCA3 scores (Table 32b) was not straightforward. It is important to note that it is unlikely that stocking density reported accurately reflects the amount of space available or utilised by cattle during summer (Visits 1 – 3) and at the end of autumn (Visits 6 – 7). This is due to cattle in summer utilising less space than indicated by stocking density as they grouped together under shade structures in the pen or used each other for shade as reported in the literature (Castaneda et al. 2004; Gaughan et al. 2010; Lees et al. 2020). Whereas, in late autumn/early winter, cattle may have reduced space use due to muddy conditions limiting full pen utilisation. This could have been exasperated by stocking density where high densities (less space per head) resulted in extra cattle contributing to poor pen conditions through urine and faeces (Grandin 2016).

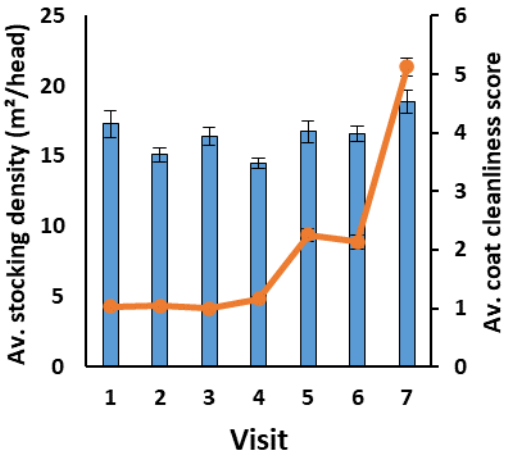
These results highlight the multidimensional and interrelated nature of animal behaviour and welfare, clearly demonstrating the importance of a comprehensive Protocol that captures a variety of input metrics to inform outcomes. While it can be challenging to interpret these relationships, it is considered worthwhile from a welfare perspective.

Figure 37. PC3 scores, average WBGT (± S.E.), average stocking density (± S.E.) and coat cleanliness scores (± S.E.) for a) visit and b) feedlot. Letters indicate PC score groupings that were significantly different to each other according to Tukey's post hoc testing ($p < 0.05$).

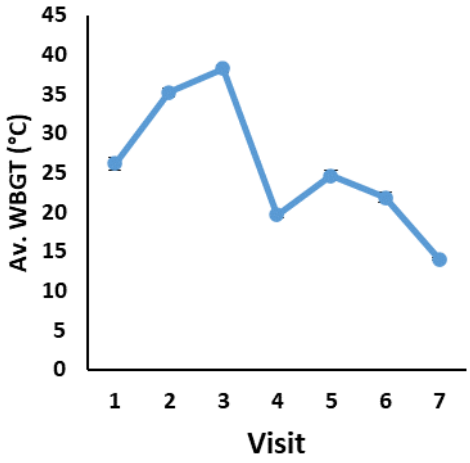
a) Visit – PC3 score



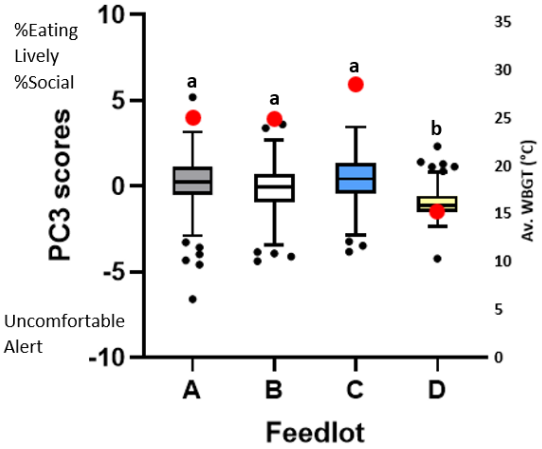
a) Visit – Stocking density and coat cleanliness score



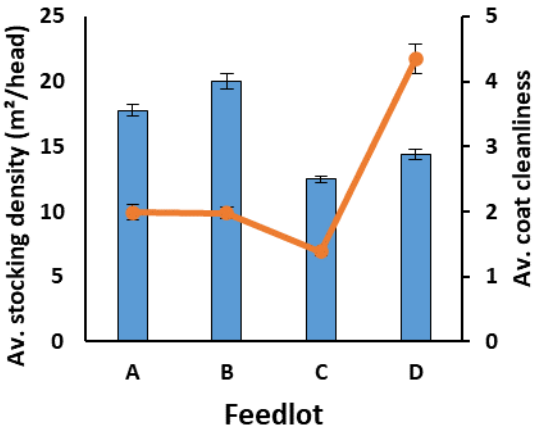
a) Visit - WBGT



b) Feedlot – PC3 scores and WBGT



b) Feedlot – Stocking density and coat cleanliness score



6.2.3 Pen-side assessments: pen sample size

This section considers the appropriate pen sample size for pen-side welfare metrics, addressing Milestone Objective 4 (Section 4.2.4). Here we outline the results of the statistical analyses (PCA and GLMM; Section 5.3.2.2.3) designed to determine whether behavioural outcomes vary depending on the number of pens sampled during the Pilot. This enables comments and recommendations regarding appropriate pen sample size to be made. It is important to note that the data collection during the pilot did not allow for consideration of location of sample pens within the feedlot to be incorporated within this analysis. Therefore, refinement of pen sampling methodology moving forward is recommended to include consideration of the location of selected pens within feedlot premises to ensure appropriate sampling.

6.2.3.1 Principal Component Analysis

PCA identified three components with eigenvalues > 1.5 (Table 33a). PC1 accounted for 17.0% of the total variation in the behavioural outcomes of observed cattle, capturing general patterns of activity or arousal. PC1 ranged from high activity and reactivity ('%vigilant/active/RI: Reactive') to low activity ('settled/active/%vigilant') (Table 33a). PC2 accounted for 12.7% of the total variance and captured cattle behaviour and demeanour metrics related to low engagement ('%lying') to high engagement ('%engaged/lively') (Table 33a). PC3 accounted for 9.2% of the total variation in cattle behavioural outcomes and captured mental state, both positive and negative. Specifically ranging from negative mental state and grouping ('uncomfortable/%alert/grouped') to positive mental state ('active/lively') (Table 33a).

Table 33. Principal Components analysis results, with variables that were > 75% of the absolute correlation coefficient bolded and highlighted on either end of each PC factor axis.

PCA variables	PC1	PC2	PC3
%Social	0.2382	0.0880	-0.2947
%Self-groom	-0.0954	-0.4035	-0.3258
%Engaged	-0.4643	**-0.5631**	0.2135
%Resting	**-0.7680**	0.3386	-0.0802
%Vigilant	**0.8232**	0.1077	0.2215
%Lying	-0.3614	**0.6783**	-0.2391
%Under shade	-0.1185	-0.4980	0.1315
Panting score	0.1272	0.4191	0.3396
Grouped (0/1)	-0.3656	-0.3779	**0.3768**
Reactivity Index: Reactive	**0.6314**	-0.1296	0.1525
Feeding behaviour: Keen	-0.1191	-0.5034	-0.1363
Feeding behaviour: Disinterested	0.1064	0.2954	-0.2492
Drinking behaviour (0/1)	-0.0266	0.1646	0.1435
Active	**0.6847**	-0.1679	**-0.4413**
Agitated	0.1030	0.0192	0.2321
Alert	0.3929	-0.4645	**0.4407**
Content	**-0.8348**	-0.3094	0.1348
Curious	-0.0609	-0.3956	0.0054
Dull	-0.0944	0.2606	0.3026
Lively	0.0332	**-0.5311**	**-0.4046**
Nervous	0.5305	-0.0603	0.2732
Settled	**-0.8558**	0.1793	0.0607
Uncomfortable	0.2076	0.2920	**0.4655**

Total variance (%)	18.02	12.69	9.15
Eigenvalue	4.69	3.30	2.38

6.2.3.2 GLMM: effect of pen sample size

For PC1, 1 and 2 Replicate analysis were found to significantly differ between Visits, however, no Tukey's post hoc significant results were found (Fig. 38a). This could indicate a false significant result for this factor. Tukey's results for 3 Replicates indicated that that Visits 1 and 7 significantly differed from Visit 5, indicating that this sample size provided enough replicates for this anticipated significance to be found. While Replicates 1 and 2 for feedlot were found to have the same significance, it was not sensitive enough to identify that both feedlot A and D significant differed from B and C (3 Replicates, Fig. 38b). For feeding program, no Tukey's significance was found for 1 Replicate, while the same significance and similar data spread was observed between 2 and 3 Replicates (Fig. 38c).

As anticipated from the GLMM analysis for 'time of day', coat cleanliness was a significant covariate for all three Replicate analyses. Wet bulb globe temperature was unexpectedly found to be significant for 1 Replicate, however, as this did not occur for Replicates 2 and 3, it is suspected to be a false significance. Shade unexpectedly was a significant covariate for all three Replicate analyses, which may reflect the time point selected for analysis (14:00 h) which would coincide with more cattle utilising this resource (Table 34a).

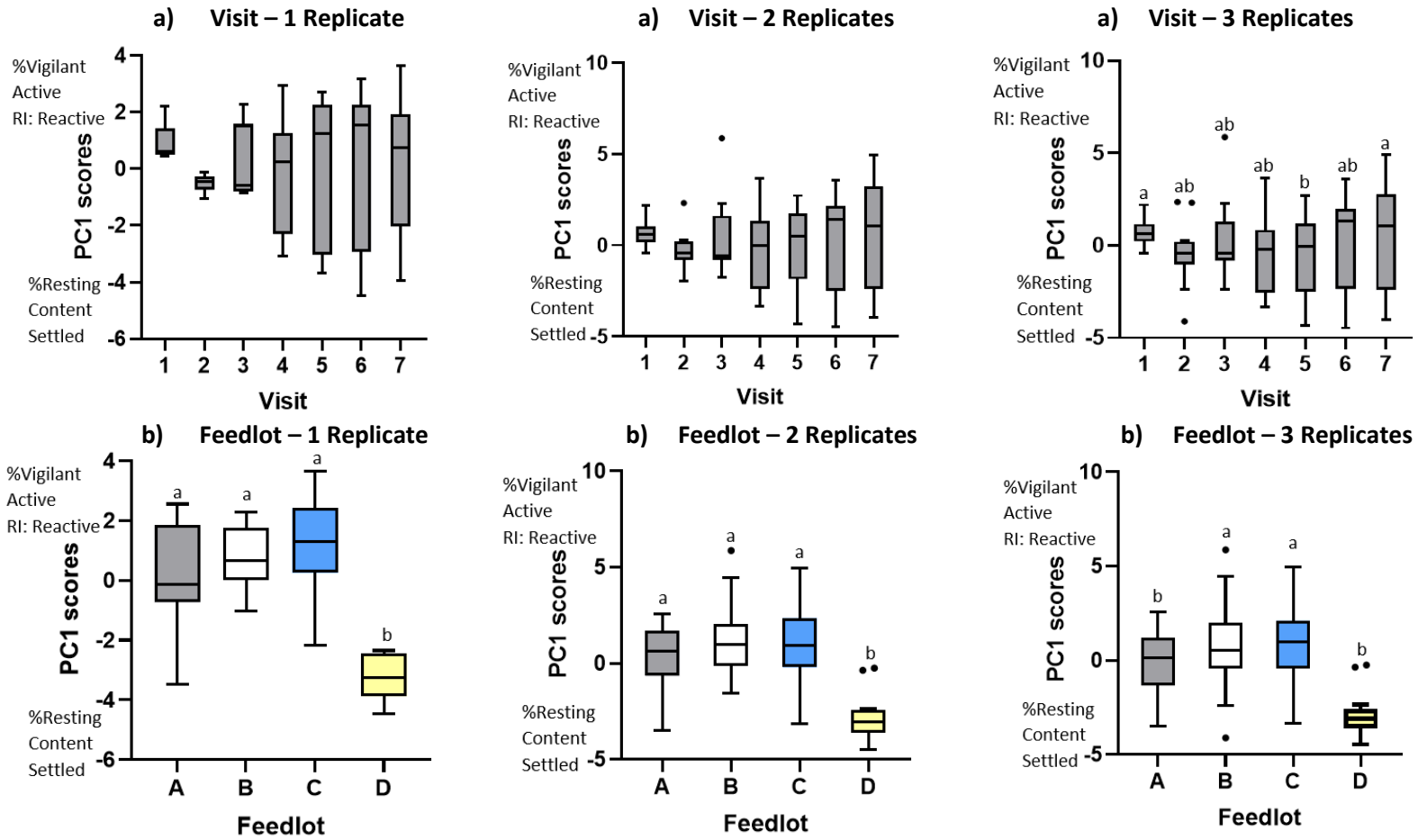
Analyses of PC 1 indicates that a minimum of 2 Replicates, while ideally 3 Replicates is required to capture significance at a fixed factor and covariate level.

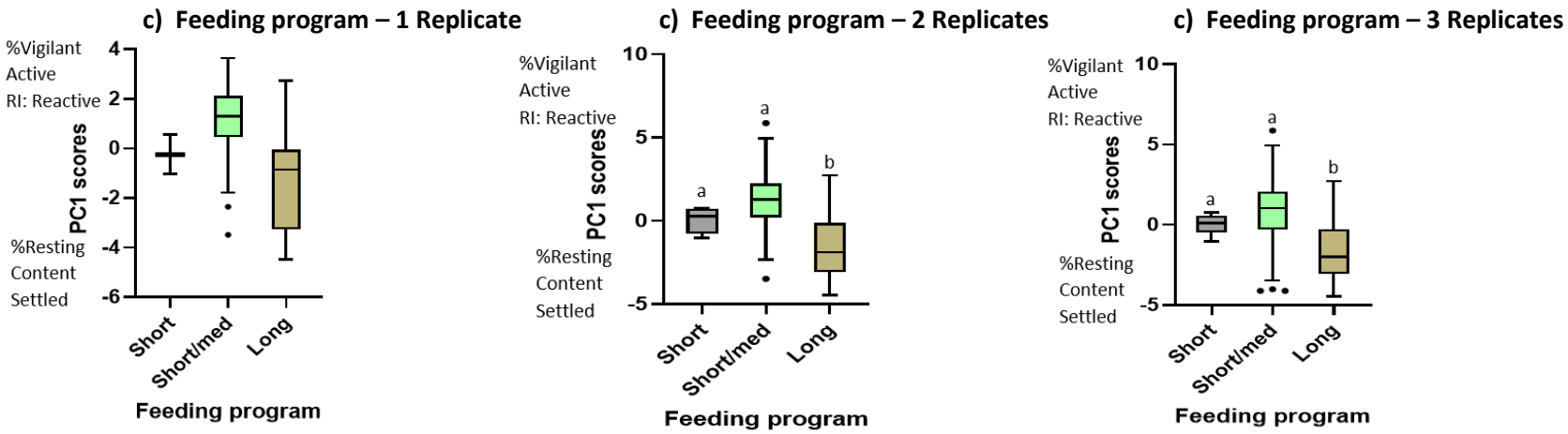
Table 34. Generalised Linear Mixed Modelling results comparing Replicates. The GLMM F-values and *P*-values per Replicate group for a) PC 1, b) PC 2 and c) PC 3, with significant results bolded ($p < 0.05$). The effects of several environmental and management covariates, fixed factors (visit, feedlot, feeding program and breed) and random factor (Pen ID) are provided.

a) PC 1						
Effect	**1 Replicate**		**2 Replicates**		**3 Replicates**	
	F	***P***	**F**	***P***	**F**	***P***
WBGT	**4.787**	**0.038**	3.780	0.058	3.674	0.060
Stocking density	4.052	0.054	3.464	0.070	0.251	0.618
Feed access	0.841	0.367	0.104	0.748	1.589	0.212
Shade	**8.694**	**0.007**	**18.856**	**0.000**	**16.998**	**0.000**
Enrichment	0.464	0.502	0.338	0.563	0.629	0.430
Faecal pat consistency	0.016	0.902	0.361	0.550	0.006	0.936
Coat cleanliness	0.452	0.507	3.152	0.080	**11.637**	**0.001**
Visit	**5.806**	**0.001**	**9.643**	**0.000**	**14.747**	**0.000**
Feedlot	**4.559**	**0.010**	**5.629**	**0.002**	**5.785**	**0.002**
Feeding program	1.253	0.302	**7.225**	**0.002**	**6.161**	**0.004**
Breed	0.315	0.732	0.366	0.695	1.281	0.288
Pen ID			1.715	0.110	**2.337**	**0.001**
b) PC 2						
Effect	**1 Replicate**		**2 Replicates**		**3 Replicates**	
	F	***P***	**F**	***P***	**F**	***P***
WBGT	**10.935**	**0.003**	**57.943**	**0.000**	**86.014**	**0.000**
Stocking density	1.233	0.277	1.011	0.322	1.824	0.183
Feed access	0.511	0.481	2.414	0.126	3.103	0.082
Shade	0.372	0.547	0.505	0.483	0.159	0.692
Enrichment	0.498	0.486	1.548	0.218	0.157	0.693
Faecal pat consistency	0.170	0.684	0.480	0.491	1.438	0.233
Coat cleanliness	1.261	0.271	3.123	0.081	**6.118**	**0.015**
Visit	1.976	0.104	**3.035**	**0.011**	**3.995**	**0.001**
Feedlot	**5.689**	**0.004**	**14.442**	**0.000**	**19.553**	**0.000**
Feeding program	0.956	0.397	0.123	0.885	0.140	0.870
Breed	0.250	0.781	0.292	0.748	0.189	0.830
Pen ID			1.204	0.347	0.896	0.666
c) PC 3						
Effect	**1 Replicate**		**2 Replicates**		**3 Replicates**	
	F	***P***	**F**	***P***	**F**	***P***
WBGT	0.789	0.382	1.951	0.169	2.488	0.120
Stocking density	0.329	0.571	0.174	0.679	0.056	0.814
Feed access	0.093	0.763	0.839	0.364	**7.479**	**0.008**
Shade	1.431	0.242	0.644	0.427	**4.149**	**0.048**
Enrichment	0.430	0.518	0.063	0.803	0.031	0.860
Faecal pat consistency	**4.856**	**0.036**	2.326	0.132	1.308	0.255
Coat cleanliness	0.438	0.514	2.966	0.089	3.367	0.069
Visit	**5.032**	**0.001**	**7.586**	**0.000**	**8.803**	**0.000**
Feedlot	1.460	0.248	**4.028**	**0.013**	**11.265**	**0.000**
Feeding program	**6.846**	**0.004**	**5.861**	**0.006**	**7.044**	**0.003**
Breed	0.6854	0.512462	0.018	0.982	0.785	0.479

Pen ID			1.833	0.084	0.879	0.692

Figure 38. PC 1 scores per Replicate analysis for a) visit, b) feedlot and c) feeding program. Letters indicate PC score groupings that were significantly different to each other according to Tukey's post hoc testing ($p < 0.05$).



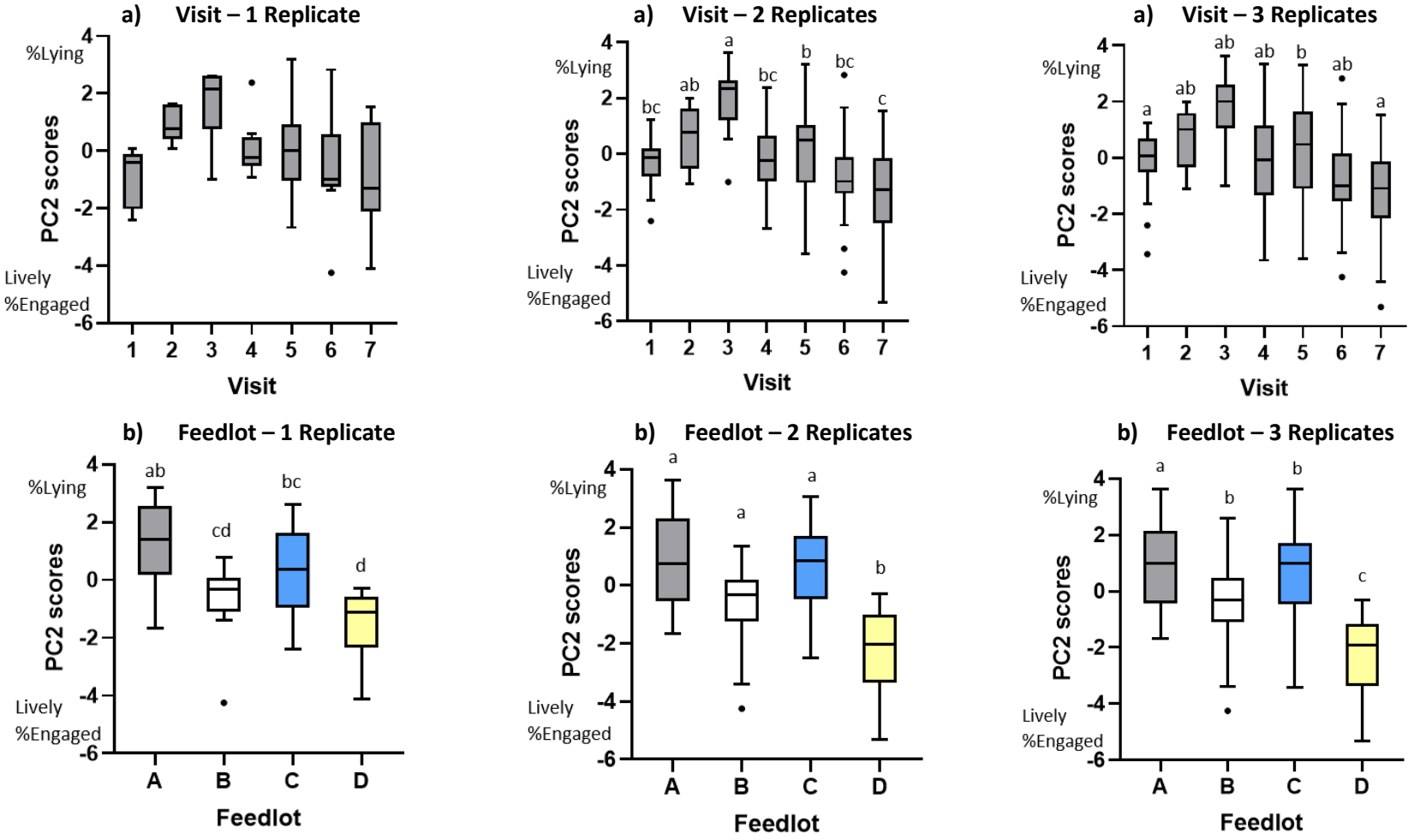


For PC 2, 1 Replicate analysis did not significantly differ between visits. While 2 and 3 Replicates were found to have similar patterns in significance between visits, more significance was found for 3 Replicates (Fig. 39a). While 1 Replicate showed significance between feedlots occurred, for 2 Replicates, some of the significance was lost. 3 Replicates clearly showed that feedlots A and C were significantly different to B and D, while feedlots B and D also differed from each other, a significance which is not detected for 1 or 2 Replicates (Fig. 39b).

As anticipated from the GLMM analysis for 'time of day', WBGT was a significant covariate for all three Replicate analyses. Unexpectedly, coat cleanliness score was also a significant covariate for all three Replicate analyses. Feed access was not found to be significant for this analysis as it previously was for the GLMM 'time of day' analysis. This is likely due to the time point selected for the sample pen analysis, resulting in the PC2 being an engagement with environment dimension that did not include feeding behaviour. Therefore, it is not unexpected that feed access was not a significant covariate in this analysis (Table 34b).

Analyses of PC 2 indicates that ideally 3 Replicates is required to capture significance at a fixed factor level.

Figure 39. PC 2 scores per Replicate analysis for a) visit and b) feedlot. Letters indicate PC score groupings that were significantly different to each other according to Tukey's post hoc testing ($p < 0.05$).

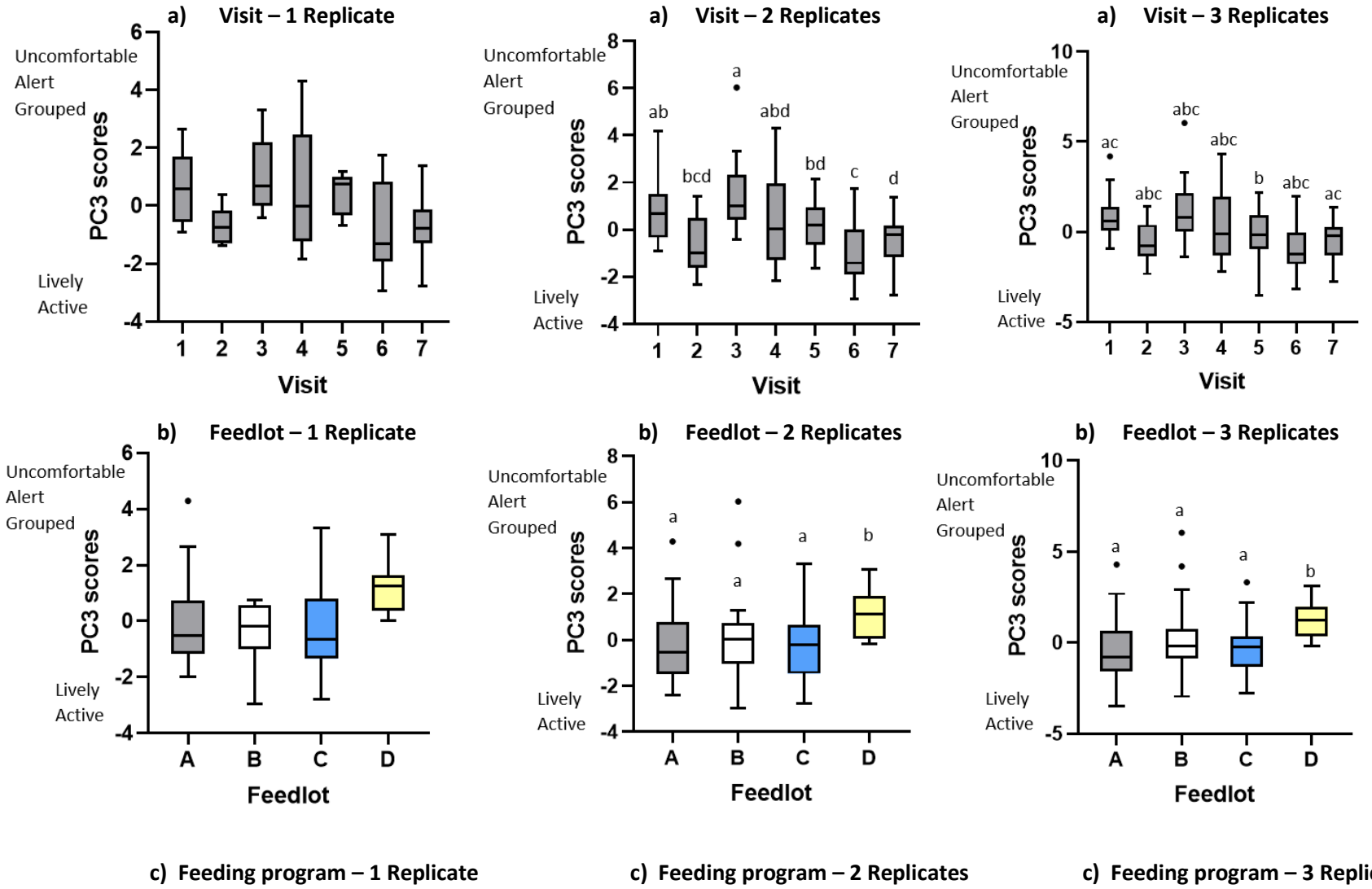


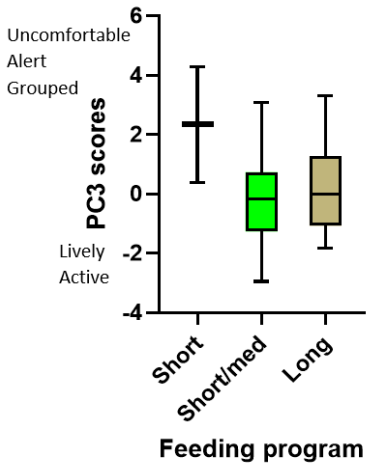
For PC 3, 1 Replicate analysis was found to significantly differ between visits, however, no Tukey's post hoc significant results were found, indicting a false significance for this factor. 2 Replicates identified more significant differences between Visits, where 3 Replicates had a similar patter, median values were closer in value, resulting in less significance between visits (Fig. 40a). For between feedlots, 1 Replicate was found significant, however no Tukey's significance was found, possibly indicating a false significant result for this factor. 2 and 3 Replicates were found to have the same Tukey's results, showing that feedlot D significantly differed from all other feedlots (Fig. 40b). While feeding program was found to significantly differ for all Replicates, no significant Tukey's results were found for any Replicate analysis. The possible false significant result is clear from Fig. 40c, which shows that overall, median values and data spread are similar across Replicates.

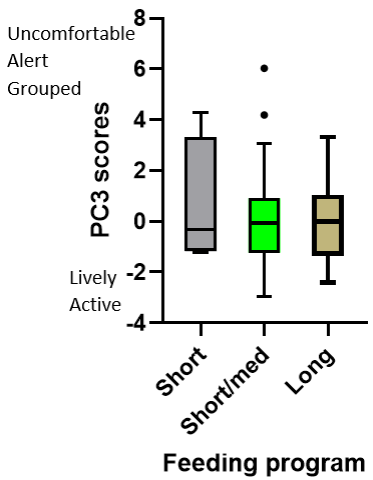
Faecal pat consistency was unexpectedly found to be significant for 1 Replicate, however, as this did not occur for Replicates 2 and 3, it is suspected to be a false significance. Feed access and shade was significant for 3 Replicates, which was unexpected as the PC dimension was identified to describe cattle mental state and did not include feeding behaviour. Stocking density, coat cleanliness and WBGT covariates were not found to be significant for this analysis as it previously was for the GLMM 'time of day' analysis. This is likely due to the time point selected for the sample pen analysis (Table 34b).

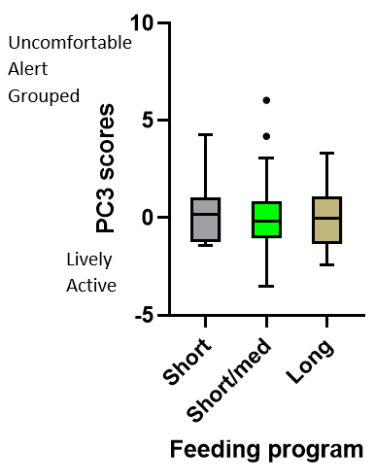
Analyses of PC 3 indicates that ideally a minimum of 2 Replicates, and ideally 3 Replicates are required to capture significance at a fixed factor and covariate level.

Figure 40. PC 3 scores per Replicate analysis for a) visit, b) feedlot and c) feeding program. Letters indicate PC score groupings that were significantly different to each other according to Tukey's post hoc testing ($p < 0.05$).




Uncomfortable
Alert
Grouped
PC3 scores
Lively
Active
6
4
2
0
-2
-4
Short
Short/med
Long
Feeding program


Uncomfortable
Alert
Grouped
PC3 scores
Lively
Active
8
6
4
2
0
-2
-4
Short
Short/med
Long
Feeding program


Uncomfortable
Alert
Grouped
PC3 scores
Lively
Active
10
5
0
-5
Short
Short/med
Long
Feeding program

6.2.4 Animal handling assessments

The following sections present the findings from the animal handling assessments undertaken by the research team in the Pilot across four feedlots. For each measurement section of the Protocol, the results are presented, and a discussion of the measures' relevance, feasibility, and practicality, and whether is recommended to be a part of the revised benchmarking framework.

Overall, animal handling was observed during 20 separate handling events in four different feedlots during the Pilot. Both handling in the race and behaviour of cattle in the crush and on release during induction or treatments were observed during these visits. A total of 2236 head were observed in the race and a total of 3237 head were observed in the crush. In addition, 26 events related to transport were observed during loading (1140 head during 19 events) and unloading (593 head during 7 events).

6.2.4.1 Animal processing events

Handling was observed during 20 separate handling events in 4 different feedlots during the Pilot. Both handling in the race and behaviour of cattle in the crush and on release during induction or treatments were observed during these visits. A total of 2236 head were observed in the race and a total of 3237 head were observed in the crush. In addition, 26 events related to transport were observed during loading (1140 head during 19 events) and unloading (593 head during 7 events).

6.2.4.1.1.1 Outcome of pilot

The main results of the handling observations in the race are summarised in Table 35. The average, median and range are presented. Where the average and the median differ markedly, the data was skewed by outliers. Not all measures were recorded during all visits. Accordingly, the number of recorded events for each indicator is indicated *(n).*

Table 35. Handling observations in the race during 20 separate events and four different feedlots. [A]

Observation	Average ±SE	Median	Range
Number of animals observed (*n* = 20)	112 ± 11.2	103	20 – 226
% slapped/hit or tail twist (*n* = 20)	12.7 ± 2.7	9.6	0 – 45
% handling aid used (*n* = 17)	4.1 ± 1.4	1.2	0 – 9.5
% prodder used (*n* = 20)	0.9 ±0.69	0	0 – 14
% animals where handler has electric prodder in hand but not used (*n* = 20)	Only 1 ob with 84	0	0 – 84
Staff generated noise score 1-3 (*n* = 20)	2.6 ± 0.15	3 (quiet)	1 – 3
Animal flow through facilities score 0-2 (*n* = 20)	1.25 ± 0.16	1.5	0 – 2
Animal flow when moving from home pen to yard score 0-2 (*n* = 17)	1.8 ± 0.1	2 (no intervention)	1 – 2
Stocking density of holding yards (m2/head) (*n* = 13)	3.6 ± 0.92	2.7	0.5 – 12

[A]***n*= number of events this indicator was recorded**

In the race, four observations recorded 0 animals that were slapped or had twisting of the tail, while five observations recorded 0 use of handling aids. Prodder use was only observed during four of seven Visits, with one visit recording nearly 14% of animals prodded. The Beef Quality Assurance (BQA) Feedyard Assessment includes a threshold of 10% prodder use during handling to enter a crush in feedlots (Yost et al. 2020). Similar incidence of prodder use in commercial feedlots in the US were recorded to that in the Pilot (Woiwode et al. 2015; 2016). Excessive yelling and or banging of

gates occurred during 2 observations and during 3 observations there were clear problems with animal flow, resulting in major interventions.

Several indicators were recorded as 0 across all Visits, as they did not occur during any of the visits. These included indicators of heat and cold stress, use of dogs and shade provided in the holding pen. In addition, facility noise was recorded as 2 (minor) for all Visits. Stocking density in the yards were not recorded in one feedlot (*n* = 7), as the size of the yards was unknown.

6.2.4.1.1.2 Relevance

Cattle inducted into feedlots may have limited experience with human handling and previous experience and temperament may affect their response to human contact (Parham et al. 2019a). Inappropriate interactions and frequent use of negative handling not only impact directly on the welfare of the animals but may lead to increased risk of animal and human injuries (Grandin 2014), while positive handling may improve temperament, reduce stress, and improve productivity (Cooke 2014). Therefore, observations of routine handling are a useful measure of human-animal interactions in the feedlot and maybe most relevant if collected during routine procedures such as weighing. The variation in observations across different visits and feedlots indicate the value of these indicators. Regular observation of these measures can encourage intervention to ensure that targets of good handling practices are achieved.

6.2.4.1.1.3 Feasibility/practicality

There is some time commitment involved in collecting this data. A total of 1 h or 100 animals should be observed monthly, although this may be spread out over four 15 min time-periods. The definition of slaps and hits may need to be clarified to ensure that only clearly negative interactions are included.

6.2.4.1.1.4 Recommended/not recommended

Recommended all measures for collection during routine procedures.

6.2.4.1.2 Handling in the crush

6.2.4.1.2.1 Outcome of pilot

The main results of the observations of behaviour of cattle in the crush and on release is presented in Table 36. Both the average and the median, as well as the range are presented. Where the average and the median differ markedly the data was skewed by outliers.

Table 36. Handling observations in the crush during 20 separate occasions and four different feedlots (*n* = 19).

Observation	Average ±SE	Median	Range
Number of animals observed	112 ± 11.9	106	20 – 226
% mis-caught	4.7 ± 1.7	2.8	0 – 14.6
% slips	2.2 ± 0.67	1.2	0 – 10.2
% falls	0.46 ± 0.17	0	0 – 2.5
% animals running out of the crush	20.6 ± 3.24	21.7	1.2 – 42
% animals that fell at release from the crush	2.4 ± 0.66	1.2	0 – 5.6

Mis-caught animals in the crush were observed during all but 2 handling events. Slips were recorded during 12 handling events, while falls were observed during 6 handling events. Where falls were recorded, slips were also observed, although there appeared to be no relation between the frequency of both. Animals were observed to fall after release from the crush in 13 handling events. None of the feedlots scored consistently high or low on these indicators, which suggests that temperament may be the main influence on the behaviour. The BQA Feedyard assessment (BQA, 2010) list a pass threshold of < 2% of falls on release of the crush, which was exceeded on one occasion. The assessment also lists a threshold of < 25% for animals running out of the crush on release, which was exceeded on 5 occasions.

No incidences of choking or sleepers were observed, and these indicators received a score of 0 at every event. Although not one of the indicators listed for observation, 47% of animals were observed drooling in the crush during one observation and 11% during another observation, which may have been the combined effect of heat stress with the additional stress of handling and confinement in a crush. In addition, vocalisations in the crush were also not included as an indicator in the Pilot. However, several instances of vocalisations were noted in the crush during treatment and induction (n = 14), with ranging from 0% to 42% on occasions where vocalisations were included in the additional comments. The average recorded vocalisations were 11±4.5% while the median was 4.7%.

A wide range of values were observed during our observations. While some observations exceeded published thresholds, the behaviour in the crush and on exit was within similar ranges to several surveys in the US, as reported by Grandin (2016).

6.2.4.1.2.2 Relevance

Behaviour in the crush and on exit (exit speed) has been used to assess temperament of cattle (Parham et al. 2019b). Cattle that show more agitation in the crush and on exit have been found to have lower productivity and may find it harder to adapt to a feedlot environment (Anderson and Miller 2019). However, the level of restraint, and presumably the type of handling and treatment received, may also impact these measures (Petherick et al. 2009; Grandin 2014). Therefore, behaviour in the crush and on exit is a useful measure to track the temperament of animals present in the feedlot and may be most useful if collected during induction. The behaviours observed during this pilot are similar to those included in the BQA Feedyard Assessment in the US (BQA, 2010), which includes vocalisations. When this assessment was used to evaluate stockperson behaviour 45% received a perfect or near perfect score (Yost et al. 2020) indicating several applications for these measures. Formal training in particular has been shown to improve both handler and animal behaviour (Ceballos et al. 2018).

6.2.4.1.2.3 Feasibility/practicality

There is some time commitment involved in collecting this data, and smaller operations may not commonly handle 100 cattle at a time. Accordingly, the number of cattle to be observed per event may be adjusted down to a more feasible 50 animals for smaller feedlots, increasing for larger feedlots.

6.2.4.1.2.4 Recommendation/not recommended

Recommended all measures for collection during induction with the addition of drooling (number of cattle salivating when in the crush) and vocalisations (number of cattle that vocalised during

handling, excluding in response to husbandry procedures performed), and with adjustments to animal numbers based on feedlot size.

6.2.4.2 Animal truck events

6.2.4.2.1 Outcome of pilot

The average number of animals observed per visit during loading and unloading events was 67 (median 62 ± 4.4, range 5 – 107). The average loading density on the truck was 2.19m^2/SCU (median 1.42 ± 0.82, range 0.97 – 17.04) or 1.90m^2/head (median 1.23 ± 0.55, range 0.90 – 11.76). At unloading, the stocking density on the truck was 1.35m^2/SCU (median 1.31 ± 0.23, range 0.43 – 2.00) or 1.15 m^2/head (median 1.18 ± 0.099, range 0.66 – 1.50). Stocking density on eleven trucks was above the recommended maximum loading density (corrected for weight) according to the Australian Animal Welfare Standards and Guidelines (AHA, 2012), while on ten trucks it was below the recommended loading density. Recommended loading density could not be determined on 5 trucks as the average weight of the animals was not recorded. Stocking density was more frequently above the recommended maximum density for heavier animals than for lighter animals.

The main results of the observed handling and cattle behaviour during loading and unloading for transport are presented in Tables 37 and 38. The average, median and range are presented. Where the average and the median differ markedly the data was skewed by outliers.

Table 37. Handling observations during loading for transport during 19 occasions.

Observation	Average ±SE	Median	Range
% slips	5.9 ± 1.6	2.0	0 – 22
% falls	0.19 ± 0.13	0	0 – 1.5
% of animals handling aids used	4.6 ± 2.2	0	0 – 42
% prodder used	7.5 ± 2.5	0	0 – 31
% prodder in hand but not used	34.5 ± 11.0	2.5	0 – 87.8

Table 38. Handling observations during unloading after transport during 7 occasions.

Observation	Average ±SE	Median	Range
Time off water (h)	4.1 ± 0.55	4	2 – 6
% slips	9.9 ± 4.0	5.6	0 – 26
% falls	1.4 ± 1.2	0	0 – 8.5
% of animals handling aids used	2.3 ± 1.5	0	0 – 8.8
% prodder used	0.7 ± 0.7	0	0 – 4.9
% prodder in hand but not used	5.6 ± 3.9	0	0 – 25.5

Dogs were not used during loading and unloading on any of the seven Visits. All stock crates were observed to be free from sharp edges, holes etc and did not pose a risk to injury. Trucks were well aligned with the ramp, or at least well enough not to cause any problems. During loading and unloading events, all animals observed appeared to be fit for transport and there were no animals dead on arrival. While no clear lameness was observed, two animals within the same consignment were observed to be tender-footed. Due to climatic conditions no cold stress was observed, however, mild heat stress was observed during two separate unloading events in *Bos taurus* cattle (Event 1: PS1 (*n* = 50), PS2 (*n* = 27), PS3 (*n* = 3) total 100%: Event 2: PS1 (*n* = 91), PS2 (*n* = 10), PS3 (*n* = 1) 100%). In addition, some heat stress was noted during one loading event although panting

scores were not recorded due to early arrival of the truck. Temperature was not recorded during these heat stress observations.

Prodder use during loading varied between observations, with a prodder not used during 10 out of 19 occasions. The AMIC Industry Animal Welfare Standards (AMIC, 2020) includes a target of < 25% prodder use for handling cattle at processing plants. This was exceeded on two occasions, when prodder use was observed on 28 and 31% of animals. Additional observations, all at the same feedlot, recorded prodder use of 22 and 24%. This may indicate an issue with either facility design or handling practices at this particular feedlot.

The AMIC Industry Animal Welfare Standards (AMIC, 2020) includes a target of < 1% falls during unloading at processing plants, which should be comparable to unloading at a feedlot. During this Pilot study, falls exceeded 1% on 2 out of 7 observations (1.1% and 8.5%), while no falls were observed during 5 observations.

6.2.4.2.2 Relevance

Behaviour of cattle during unloading on arrival at the feedlot is largely outside the influence of the feedlot. However, slips and falls may be a good indicator of facility design when temperament is considered. The percentage of falls during unloading are identified as an important animal welfare indicator in the AMIC Industry Welfare Standards (AMIC, 2020). The observation of prodder use during loading, and the observation of slips and falls during unloading are viewed as important risks for animal welfare during these procedures.

6.2.4.2.3 Feasibility/practicality

Duration of unloading of a truck varied from 10 – 20 min while loading took longer from 20 – 40 min, given that animals typically are keener to exit from a truck than to load upon it. In order to observe loading and unloading, the observer needs to liaise with the driver regarding timing and some of the information that is collected. Depending on the organisation at the feedlot this may present some challenges, however, loading is probably more important from a welfare perspective given that the cattle are larger and heavier and require more encouragement to flow on to the truck.

6.2.4.2.4 Recommended/not recommended

The observation and recording of both unloading and loading events are recommended, with a slight reduction in the frequency of recording unloading events given the time imposts involved overall for feedlots in allocating someone for this purpose.

7. Revised feedlot protocol

7.1 Overview of revised feedlot protocol

This section summarises the overall Protocol that is being recommended to the feedlot industry for adoption. Table 39 details the feedlot piloted forms that are being recommended for adoption, the recommended frequency for data collection, and the modifications that have been applied since piloting. In addition, the outcomes of the pilot indicated that some additional metrics, not piloted and thus not discussed in previous sections of this report, could be necessary to capture welfare outcomes within the protocol. Future work is necessary to determine validity of these metrics and

potential refinement of collection, but it is recommended that the following be incorporated within the revised feedlot protocol at this time:

- Section 1 (Static feedlot information):
    - Does your feedlot maintain a record of either pen cleaning interval/dates or manure load per pen? Y/N.
- Section 3B (Unloading assessment):
    - Demeanour: Immediately after unloading, an assessor to observe the cattle in holding pen for at least 2 minutes prior to scoring the following terms against a Visual Analogue Scale (VAS; 0 – 100): Active/Agitated/Alert/Content/Curious/Dull/Lively/Nervous/Settled/Uncomfortable.
    - Flank fill: Immediately after unloading, an assessor to observe cattle in the holding pen and the category that best describes the flank fill, or hollowness of paralumbar fossa due to degree of empty rumen, of cattle to be recorded: 1 = Full, 2 = Slightly sunken, 3 = Sunken, 4 = Severely sunken.
    - Drinking behaviour: Immediately after unloading, an assessor to observe cattle in the holding pen and the category that describes cattle behaviour around the water trough to be recorded: 1 = Disinterested, 2 = Some keen, 3 = Crowding, 4 = Hovering over water trough.
    - Transit time: Time (hh:mm) from which cattle were loaded and then unloaded at destination (feedlot).
- Section 4 (Feedlot induction):
    - Vocalisations: During handling, an assessor to observe cattle in the race and crush, recording in a tally, whether each animal vocalised. This excludes animals that vocalise in response to husbandry procedures performed.
      It is important to note here that while several international thresholds do exist for vocalisations of cattle in response to handling (e.g., 15% (CFACAP, 2018), and 3% (NAMI 2021)), this measure was not formally piloted in the present study and the occurrence of vocalisations during handling under the Australian feedlot context has not yet been studied in a systematic manner. This means that there is insufficient data presently available to set an informed formal threshold.
    - Drooling: During handling, an assessor to observe cattle in the crush, recording in a tally, whether each animal was salivating.
- Section 6 (Husbandry welfare practices):
    - Demeanour: For each individual animal in the hospital pen, an assessor to observe the individual for at least 2 minutes prior to scoring the following terms against a Visual Analogue Scale (VAS; 0 – 100): Active/Agitated/Alert/Content/Curious/Dull/Lively/Nervous/Settled/Uncomfortable. While it is undeniably important to monitor the at-risk animals within hospital pens, it is within expectation that the demeanour of these cattle is likely to be poor. Thus, it is recommended that caution be applied when considering the outcome of this assessment within the overall protocol. In addition, any demeanour score performed on hospital pens should be at the individual level.

Details on the specific pen-side welfare measures that have been derived from the research Pilot are provided below in Section 7.2.

Table 39. Revised Feedlot Welfare Protocol recommended for adoption.

Section	Title	Tested frequency	Recommended frequency	Modification recommended
Section 1	Static feedlot information	Once	Annually in an ongoing benchmarking program	None other than incorporation of pen cleaning records question
Section 2	General facilities	Every 6 months	Monthly	None other than change in frequency of collection
Section 3	A: Transportation – Loading assessment	Monthly: 2 trucks for < 10,000 head; 3 trucks for 10,000-20,000 head; 5 trucks for >20,000 head	Monthly: 2 trucks for < 10,000 head; 3 trucks for 10,000-20,000 head; 4 trucks for >20,000 head	No change to measurements taken. Changes to number of trucks recorded
	B: Transportation - Unloading	Monthly: 2 trucks for < 10,000 head; 3 trucks for 10,000-20,000 head; 5 trucks for >20,000 head	Monthly: 2 trucks for < 10,000 head; 3 trucks for 10,000-20,000 head; 4 trucks for >20,000 head	Incorporation of demeanour, flank fill, drinking behaviour and time in transit measures. Changes to number of trucks recorded
Section 4	Induction	Monthly: 50 animals for <10,000 head, 75 animals for 10,000-20,000 head, 100 animals for >20,0000 head	No change	None other than incorporation of vocalisation and drooling cattle measures
Section 5	A + B: Pen welfare measures	Monthly	Monthly	See **Table 40** in **Section 7.2** for revised pen-side Protocol
	C: Monthly assessments recorded at feedlot level	Monthly	No change	No change
Section 6	Husbandry welfare practices	Monthly	Monthly	None other than incorporation of cattle demeanour measure
Section 7	Nutrition	Monthly	No change	No change
Section 8	Other animals	Monthly	Every 6 months	None other than change in frequency of collection
Section 9	Abattoir feedback	Monthly		None other than change to measures collected

7.2 Revised protocol for pen-side assessments

This section presents the revised measures suggested for integration into the Revised Feedlot Welfare Protocol, and would be inserted into Section 5A and B. Of the 58 metrics piloted, 48 (72.8%) are recommended for inclusion in the revised Protocol. These are either proposed unmodified (*n* = 31; 64.6%), or with modifications designed to ease data collection burden (*n* = 17; 35.4%) (Table 40).

Table 40. Welfare metrics included in the Pilot with welfare principle and recommendation for revised Protocol indicated.

Welfare metric	Welfare principle(s)	Recommendation for inclusion	Modification recommended	Internal or external	Section of this report addressing metric
Static assessment information (*n* = 8)					**6.2.1.1**
Assessor	-	Include in revised Protocol	N	I; E	
Feedlot	-	Do not include in revised Protocol	-	-	
State	-	Do not include in revised Protocol	-	-	
Date/time	-	Include in revised Protocol	N	I; E	
Pen I.D.	-	Include in revised Protocol	N	I; E	
Lot number/s	-	Include in revised Protocol	N	I; E	
Head in pen	Good housing	Include in revised Protocol	N	I; E	
Days on feed	Good feeding	Include in revised Protocol	N	I; E	
Static animal information (*n* = 4)					**6.2.1.2**
Breed	Good housing	Include in revised Protocol	**Y**	I; E	6.2.1.2.1
Class	Good housing	Include in revised Protocol	**Y**	I; E	6.2.1.2.2
Coat colour	Good housing	Include in revised Protocol	**Y**	I; E	6.2.1.2.3
Mixing at entry to feedlot	Good housing	Include in revised Protocol	**Y**	I; E	6.2.1.2.4
Climatic metrics (*n* = 8)					**6.2.1.3**
Cloud cover	Good housing	Do not include in revised Protocol	-	-	6.2.1.3.1
Dry bulb temperature	Good housing	Include in revised Protocol	N	I; E	6.2.1.3.2
Wet bulb globe temperature	Good housing	Include in revised Protocol	N	I; E	6.2.1.3.3
Relative humidity	Good housing	Do not include in revised Protocol	-	-	6.2.1.3.4
Precipitation	Good housing	Include in revised Protocol	**Y**	I; E	6.2.1.3.5
Wind speed	Good housing	Include in revised Protocol	N	I; E	6.2.1.3.6
Temperature humidity index	Good housing	Do not include in revised Protocol	-	-	6.2.1.3.7
Heat load index	Good housing	Include in revised Protocol	N	I; E	6.2.1.3.8
Behavioural metrics (*n* = 12)					**6.2.1.4**
Reactivity index	Appropriate behaviour	Include in revised Protocol	**Y**	I; E	6.2.1.4.1
Approach test	Appropriate behaviour	Do not include in revised Protocol	-	-	6.2.1.4.2
Feeding behaviour	Good feeding/Appropriate behaviour	Include in revised Protocol	**Y**	I; E	6.2.1.4.3
Posture	Good housing/Appropriate behaviour	Include in revised Protocol	**Y**	I; E	6.2.1.4.4
Dispersion	Good nutrition/Good housing	Include in revised Protocol	**Y**	I; E	6.2.1.4.5
Agitation associate with flies	Good housing	Include in revised Protocol	**Y**	I; E	6.2.1.4.6
Ethogram	Appropriate behaviour	Include in revised Protocol	**Y**	I; E	6.2.1.4.7
Demeanour	Appropriate behaviour	Include in revised Protocol	**Y**	I; E	6.2.1.4.8
Panting score	Good housing	Include in revised Protocol	**Y**	I; E	6.2.1.4.9
Drinking behaviour	Good feeding	Include in revised Protocol	**Y**	I; E	6.2.1.4.10
Shivering	Good housing	Future research recommended	N	I; E	6.2.1.4.11
Huddling	Good housing	Future research recommended	N	I; E	6.2.1.4.12
Static pen and resource information (*n* = 17)					**6.2.1.5**

Welfare metric	Welfare principle(s)	Recommendation for inclusion	Modification recommended	Internal or external	Section of this report addressing metric
Pen type	Good housing	Include in revised Protocol	**Y**	I; E	6.2.1.5.1
Pen size	Good housing	Include in revised Protocol	N	I; E	6.2.1.5.2
Water trough no.	Good feeding	Include in revised Protocol	**Y**	I; E	6.2.1.5.3
Water trough length	Good feeding	Include in revised Protocol	N	I; E	6.2.1.5.4
Feed bunk length	Good feeding	Include in revised Protocol	N	I; E	6.2.1.5.5
Feeding program	Good feeding	Include in revised Protocol	N	I; E	6.2.1.5.6
Pen surface	Good housing	Include only if Protocol is applied for external benchmarking	N	E only	6.2.1.5.7
Structures in pen	Good housing	Do not include in revised Protocol	-	-	6.2.1.5.8
Enrichment	Good housing	Include in revised Protocol	N	I; E	6.2.1.5.9
Feed out time	Good housing	Include in revised Protocol	N	I; E	6.2.1.5.10
Feed bunk contamination	Good feeding	Include in revised Protocol	N	I; E	6.2.1.5.11
Water trough contamination	Good feeding	Include in revised Protocol	N	I; E	6.2.1.5.12
Water trough fill	Good feeding	Include in revised Protocol	N	I; E	6.2.1.5.13
Faecal pat consistency	Good feeding /Good health/Good housing	Include in revised Protocol	N	I; E	6.2.1.5.14
Surface moisture	Good housing	Do not include in revised Protocol	-	-	6.2.1.5.15
Mud depth	Good housing	Do not include in revised Protocol	-	-	6.2.1.5.16
Animal mud depth	Good housing	Include in revised Protocol	**Y**	I; E	6.2.1.5.17
Pen health metrics (*n* = 9)					**6.2.1.5**
Body condition score	Good feeding/Good health	Include in revised Protocol	N	I; E	6.2.1.5.1
Nasal discharge	Good health	Include in revised Protocol	N	I; E	6.2.1.5.2
Ocular discharge	Good health	Include in revised Protocol	N	I; E	6.2.1.5.3
Coughing	Good health	Include in revised Protocol	N	I; E	6.2.1.5.4
Lame	Good health	Include in revised Protocol	N	I; E	6.2.1.5.5
Ill-thrifty	Good health	Include in revised Protocol	N	I; E	6.2.1.5.6
Non-ambulatory	Good health	Include in revised Protocol	N	I; E	6.2.1.5.7
Coat cleanliness 1	Good housing	Do not include in revised Protocol	-	-	6.2.1.5.8
Coat cleanliness 2	Good housing	Include in revised Protocol	N	I; E	6.2.1.5.9

7.3 Timing of pen-side assessment: assessment burden

The greatest impediment to routine welfare assessments in feedlots, or in any commercial system, could be considered time efficiency of collection. The major costs associated with the adoption of an animal welfare assessment protocol come from the time needed to perform required assessments, which takes feedlot personnel away from existing tasks required for routine functioning. It can be difficult to determine how well a proposed protocol translates to commercial application, particularly with regard to timing and ease of collection, thus it considered a benefit of this project that estimates of assessment burden for pen-side assessments, a large component of the proposed protocol, can be made. This welfare protocol combined visual observations of cattle at different areas within the feedlot with an array of management, environment, and resource-based measures. Overall, this assessment protocol offers feedlot management an opportunity to gather important information at a pen level in less than 15 min per pen at an estimated average 11 – 13 min (Table 7). On a pen basis, this is comparable with that from live export (Dunston-Clarke et al. 2020) and Welfare Quality® (Welfare Quality® 2009), and is shorter than those proposed under the AssureWel beef cattle assessment protocol (AssureWel 2010-2016) and the proposed assessment protocol for Italian intensive beef cattle systems by Gottardo et al. (2009), estimated to take 24 min/pen and 60 min/pen, respectively. Given the recommendation for Section 5B (Pen welfare measures) that each pen be assessed twice a day at a monthly interval (see Section 6.2.2), this translates to a maximum of 30 min/pen/month. Overall, with feedlots catering to different market categories and housing cattle on different feeding programs, this equates to a maximum estimated assessment burden for pen-side assessments of 4.5 hrs/month with the assessment of 9 home pens based on the recommendation that 2 – 3 pens of cattle per feeding program be captured as outlined in Section 6.2.3 (Table 41). Overall, this burden is considered achievable within the constraints of a commercial feedlot enterprise, however, further piloting will confirm practicality and offer both the opportunity to undertake further refinement of the protocols and to provide an estimation of time to complete the entire assessment.

Table 41. Estimated assessment burden of Section 5B (Pen welfare measures) by number of feeding programs on premises.

	Feeding programs (no.)		
	1	**2**	**3**
Sample pens	2 – 3	4 – 6	6 – 9
Estimated assessment time (month)[A]	60 – 90 min (1 – 1.5 hr)	120 – 180 min (2 – 3 hr)	180 – 270 min (3 – 4.5 hr)
Estimated assessment time (annual)[A]	720 – 1080 min (12 – 18 hr)	1440 – 2160 (24 – 36 hr)	2160 – 3240 min (36 – 54 hr)

[A]***Approximately 15 min/pen. 2 assessments per pen on assessment day as proposed in Section 6.2.2.***

8. Conclusion

8.1 Key findings

A review of current major systems for animal welfare benchmarking relevant to Australian feedlots was completed and in consultation with ALFA and MLA, a pilot benchmarking protocol which included a suite of animal welfare measures was developed. This was piloted across eight commercial feedlots by feedlot staff and researchers over seven months. The project team have refined the metrics and herewith present a set of practical measures including animal, environment, resource and management inputs and outputs under a new protocol that allows standardised reporting.

Overall, the aim of the project was achieved through the pilot of metrics under commercial feedlot conditions, with the evaluation of each metric in terms of:

- Ease of recording and practicality under commercial conditions
- Modification to simplify collection and/or ensure appropriate level of information
- Duplication of information within the Protocol (removal of a metric where information is considered adequately captured by another)

The selection of several representative home pens combined with a number of handling and trucking events was investigated for cattle monitoring and reporting, and recommendations made for consideration. The timing of data collection and sample size requirements were also investigated with significant variability in some cattle outcomes found between visits, feedlot, observation time, and feeding program. Finally, consideration of the feasibility and ease of reporting were included in the recommendations.

Adoption of an evidence-based welfare monitoring protocol is the foundation step for benchmarking that can provide the industry with information to inform welfare and aid decision making processes surrounding animal selection and management actions. Once adopted, such a system can identify potential resource, environment and/or handling factors to inform future mitigation actions or facilitate on-going monitoring over-time to track improvements. This will likely contribute to sustainable industry practice and improved animal welfare outcomes over time.

8.1.1 Overall recommendations

The key recommendations are that the proposed protocol:

- Provides industry with a defensible welfare assessment tool that maps to internationally recognised pillars of welfare: Good Health, Good Housing, Good Feeding and Appropriate Behaviour.
- Facilitates a holistic approach to monitoring and reporting on animal welfare, providing the necessary detail required for risk management and benchmarking,
- Encompasses seven sections tested by feedlot staff and one section developed by the research pilot. Each section has been modified to ensure a viable animal welfare protocol for Australian lot fed cattle and ease of reporting.

- Is composed of standardised data collection sheets, that reduce inconsistencies of data which is key for future benchmarking and metric threshold setting. Complete data sets entered using the protocol by all participating feedlots will permit industry wide analysis.
- Is ready for adoption with data to be collected over a 1 – 2-year period and reports that would facilitate appropriate analysis and determination of metric thresholds. This is required due to variability in cattle outcomes that occur across different seasons, locations, feeding programs and breeds.
- To ease data handling and storage, reduce data inconsistencies and improve the ease of reporting, the collection of data using a secured electronic platform is recommended.

8.1.2 Protocol specific recommendations

- The number loading events to be captured monthly are to be captured monthly, with the number of events dependent on feedlot total head capacity:
    - < 10,000 head = 2 trucks
    - 10,000 – 20,000 head = 3 trucks
    - > 20,000 head = 4 trucks
- The number of unloading events to be captured monthly, with the number of events dependent on feedlot total head capacity:
    - < 10,000 = 2 trucks
    - 10,000 – 20,000 = 3 trucks
    - > 20,0000 head = 4 trucks
- The number of cattle observed during handling and husbandry procedure events to be captured monthly are dependent on feedlot total head capacity:
    - <1 0,000 head = 50 animals
    - 10,000 – 20,000 head = 75 animals
    - > 20,000 head = 100 animals
- For pen-side assessments to be collected under Section 5A and B of the proposed protocol:
    - Pen-side assessments are recorded twice daily:
      - Early morning (07:00 – 08:00 h)
      - Mid Afternoon (14:00 – 15:00 h)
      This will capture desired variation in cattle circadian rhythm (activity and rest) and allow inference on welfare to be made.
    - A minimum of 2 pens and ideally 3 replicate pens are monitored, per feeding program and cattle breed. Two pens capture the minimum variation possible while 3 provide a clearer indication of the effects of covariates (climate, environmental and resource) and factors (feedlot, breed, feeding program etc.) that are known to impact animal welfare. Refinement of pen sampling methodology moving forward includes consideration of the location of selected pens within feedlot premises to ensure appropriate sampling.
    - The frequency of pen-side assessments is dependent on the intended use of the Protocol by industry:
      - Monthly: the minimum frequency to inform on cattle welfare throughout their feeding program. Providing an assessment of cattle at least twice – even for cattle enrolled in a 70-day feeding program – avoids the shortfall of a single point in time reading in relation to interpretation of information from a welfare perspective. This approach will also capture details on cattle at different stages of their feeding

program enabling feedlots to address any concerns. The capture of multiple replicates per season is likely to lessen the impact of potentially inappropriate sampling during one assessment (e.g., day of assessment not representative of standard conditions). Importantly, this frequency will likely result in the same cattle being assessed at different areas of the enterprise (e.g., during handling and transport) providing a more comprehensive assessment and addressing an important area of public interest (human-animal relationship and ongoing monitoring). Overall, this approach is expected to provide details that enable welfare assessments to be made, which over time will assist in informing risk management, change and benchmarking leading to improvements on a national level.

- 3-monthly: provides a snapshot of animal welfare, and for cattle on short or short-medium feeding programs, is likely to provide the only measure of welfare of cattle in their home pen. This approach may reduce assessment burden due to less frequent pen-side observation; however, there are some limitations that need to be considered. First, it is unlikely that cattle enrolled in shorter programs are assessed more than once. Not only does this mean that cattle will not be monitored at different times within their feeding program nor at different areas within the feedlot (e.g., handling/transport), it raises the question of the appropriate time within a feeding program for assessments. There may be specific issues associated with different times within a particular feeding program (e.g., competition and social stress, higher risk of acidosis and BRD at the beginning of the program) and if cattle within different feedlot enterprises are not assessed at a comparable time, then outcomes cannot be used for benchmarking purposes. Second, the reduced frequency limits the usefulness of information captured as it is not simple or easy to interpret animal outcomes from a welfare perspective at a quarterly interval. This is because a large number and interrelatedness of influencing factors may differ between the points. This also means that the information is limited in ability to inform management decisions since it may be impossible to determine whether management actions were effective at reducing impact of any issue on cattle outcomes. Third, this approach captures only one replicate per season. From a methodological standpoint, this has risks given the chosen day of assessment may be inappropriate to capture standard conditions. By chance the assessment for a particular quarter could poorly demonstrate standard operations and conditions, resulting in a negative outcome. On the other hand, the assessment could capture optimal but not standard conditions, providing a positive snapshot but failing to identify issues to aid in improvement efforts. For these reasons, this approach does not easily facilitate risk management, change and benchmarking.
- 6-monthly: provides a snapshot of cattle welfare for all animals that has little application for risk management, change and benchmarking.
- Yearly: indicates that feedlots are considering welfare, but does not facilitate any risk management, change or benchmarking. Allows a ‘tick the box approach’ but is unlikely to inform on cattle welfare at a level expected by society.

- Some measures do not need to be collected year-round, such as shivering, panting scores, mud depth and coat cleanliness, as these are season/climate specific. However, the ability to comment on any of these measures outside their routine collection season is required for any unexpected circumstances leading to these metrics being important (e.g., leaking water trough).

- To reduce reporting burden, sharing metric collection across feedlot staff departments is encouraged. For example, feeding behaviour would be best captured by as soon as a pen has been fed out. Here it may be suitable for feed staff to collect as they feed out or it may be better suited for the feedlot so assign a dedicated staff member to monitor the feed truck as collect information once the sample pen has been fed-out.
- To enable standardised and timely data collection, feedlots may find it easiest to require a dedicated team member to record pen-side, handling and/or loading/unloading events. Whether this is the Animal Welfare Officer, or the like, is dependent on the feedlot, understanding staff shortages could make this difficult.
- Pen-side assessments are to be made on home and hospital pens. This will provide the necessary information required by society to track ill and healthy animals.

8.2 Benefits to industry

This proposed Animal Welfare Feedlot Benchmarking Protocol is aspirational and provides a foundation tool for standardised reporting on animal health and welfare measures for feedlot cattle. The comprehensive structure addresses the current understanding of animal welfare science, is reflective of animal sentience and provides a framework for a holistic evaluation of cattle welfare. The benefits of adopting multiple indicators, representing animal, environment and management factors have been outlined in this report, as have the benefits of different observation frequencies. The full implication for industry will not be evident until large data sets are collected and statistically analysed for benchmarking and threshold setting. The data protocol can be utilised in various ways with data shared across aligned premises or across the industry or contributing to reports to wider stakeholders. Protocol adoption would enable feedlots to track animal welfare outcomes and on-going improvement. Consequently, it can be difficult, but worthwhile, to investigate by more detailed analysis of some of the relationships of input and welfare outcome. For example, the benefit of providing pen enrichment. In addition, it creates a body of evidence to demonstrate good welfare standards.

The data can be collected and/or reported on by feedlot staff (appointed animal welfare officers) or third-party ALFA certified officers with training.

9. Future research and recommendations

- It is recommended the industry should determine the specific purpose for their welfare monitoring and benchmarking before future R&D as the protocol could be tailored for broader benchmarking or the setting of industry thresholds for individual measures.

- Adoption of the protocol across all feedlots, all seasons and feeding programs for a minimum 1-2 years, based on monthly data collection would provide large, standardised data sets suitable for statistical analysis and permit robust industry benchmarking and developing standards.

- Consideration of the development of activities such as a workshop for interested feedlots. This would give a clearer road to adoption and perhaps highlight some further work that needs to be done to ensure consistent and standardised data collection and address any concerns about data security. Any metrics where inconsistencies were identified between feedlots, for example, the collection of health and morbidity data, could be revised. Such

workshops may help to ensure adoption in a timely manner and allow progression to external reporting as required.

- A further study into inter-observer and intra-observer reliability for some of the more novel welfare measures can report on the level of initial and ongoing training required.

- Adoption of the protocol using a digital data capture system over a period could enable standardised data collection that can facilitate industry to better communicate, benchmark, and increase transparency.

- Adoption of the project findings will demonstrate that the cattle feedlot industry takes a progressive and scientific approach to animal welfare and is responding to community concerns.

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11. Appendix

11.1 'Feedlot welfare benchmarking framework: Draft for consultation' document

1.0 Static feedlot information

Collection interval: annually

Protocols refer to written policies that are available to staff. The research pilot will determine the presence/absence of protocols at feedlot pilot sites. NFAS protocols should be present at all NFAS accredited feedlots. A number of welfare protocols are recommended for feedlot sites. Research sites are not required to write these welfare protocols if they are absent – the research project will simply determine the presence/absence of these elements at the beginning of the pilot.

Static information is collected to inform data analysis of existing welfare practices and pen conditions at each pilot site.

NFAS protocols			
Critical incident response plan available including crisis reporting protocol?	Y	N	
NFAS standards and guidelines available to staff?	Y	N	
Feedlot has a Biosecurity Management Plan?	Y	N	
Feedlot has an Emergency Animal Disease Action Plan?	Y	N	
Feedlot has a Risk Assessment and Contingency plan?	Y	N	
Annual internal animal welfare audit has been carried out as per NFAS QM2 requirements?	Y	N	
Incidents of animal cruelty are recorded and action taken/investigated?	Y	N	
Feedlot has protocols to address animal welfare for livestock transportation?	Y	N	
Feedlot keeps records of transportation in and out of the facility?	Y	N	
Feedlot has protocols to address animal handling, transportation and management of animals (in different risk categories) in environmental extremes?	Y	N	
Feedlot keeps records of animal health treatments (physical or digital copies capable of being accessed onsite)?	Y	N	
Feedlot has a Pregnancy and calving management protocol?	Y	N	N/A
Feedlot keeps diet and feed records in an accessible format (e.g., physical or digital copies capable of being accessed on-site)?	Y	N	
Feedlot has a contingency plan for failure in feed and water supply?	Y	N	
Recommended Welfare Protocols			
Feedlot has an animal care policy or mission statement	Y	N	
Australian Welfare Standards & Guidelines – Cattle & Land Transport available to staff?	Y	N	
Feedlot has access to MLA Fit to Load guide?	Y	N	
Accredited Animal Welfare Officer available on site for assessment?	Y	N	
Feedlot has stockmanship training records from the last 12 months	Y	N	
Feedlot has protocols and resources available for euthanasia (e.g., MLA Euthanasia Manual)?	Y	N	
Feedlot has hospital pen and chronic/reject/salvage pen management protocols?	Y	N	
Feedlot hospital treatment protocol documented in consultation with prescribing veterinarian, including criteria for recovery/return to home pen?	Y	N	
Feedlot has Action plan for animals injured/sick/malnourished/dehydrated at arrival?	Y	N	
Feedlot has a wet weather management plan?	Y	N	
Feedlot has protocols to address pen and livestock handling facility cleaning?	Y	N	
Feedlot has infrastructure maintenance protocols and records?	Y	N	
Feedlot has protocols established with consulting veterinarian(s) for preventative vaccination and backgrounding, pre-feedlot entry? (Select one)	☐ No protocols ☐ Protocols established with vet ☐ Protocols established by appropriate other: _____		

Feedlot has protocols/SOPs established with consulting veterinarian(s) for induction, including disease, parasite and pathogen treatment/prevention? (Select one)	☐ No protocols ☐ Protocols established with vet ☐ Protocols established by appropriate other:
Feedlot has feeding management protocols and diet formulations established with qualified nutritionists on an as required basis? (Select one)	☐ No protocols ☐ Protocols established with nutritionist ☐ Protocols established by appropriate other:
Feedlot has protocols for feed quality to prevent residues, toxins, and moulds in incoming commodities?	Y N
Feedlot has protocol for the humane destruction of pest animals?	Y N N/A
Feedlot has records of euthanasia training by consulting veterinarian for technique and decision-making criteria?	Y N
Feedlot has protocols for use of pain relief during husbandry procedures?	Y N
Feedlot has protocols for hygiene during husbandry procedures (e.g., injection, ear tagging, marking, castration, dehorning)?	Y N
Feedlot has protocols for enrichment (e.g., brushes)?	Y N
Feedlot has a maintenance schedule or protocol for the management of other animals (e.g., horses and dogs)?	Y N

Feedlot pen management	
Number of head/SCU feedlot is accredited to house?	Head SCU
Number of pens at feedlot?	
Pen base structure? (Select one)	☐ Clay ☐ Road base/ compacted aggregate ☐ Rocky ☐ Limestone ☐ Sandy
Pen animal monitoring conducted (select one)	☐ On foot ☐ On horseback ☐ By car (outside of pen) ☐ By 4WD ATV
Minimum water trough length (mm/head or mm/SCU)?	
Water troughs cleaned at least once per week (more frequently if required)?	Y N
Enrichment provided (e.g., brushes)?	Y N
Do any pens have shade structures?	Y N
If yes, what is the % of pens with shade structures?	
If yes, what is the % of pen cover offered by shade structures (per pen)?	
Do any pens have shelters (e.g., roofed shelter structures, shelterbelts, wind breaks, temporary shelter)?	Y N
If yes, what is the % of pens with shelters?	
Do the holding yards have shade structures?	Y N
Note the type of health recording software system used by feedlot	

2.0 General facilities

Collection interval: every six months

This template has been constructed for the accredited Animal Welfare Officer (or appropriately trained staff member) to conduct an inspection of general facilities. It is recommended that this is conducted on a six month basis. For the research pilot this will be conducted twice, at the beginning and six months in. In addition during the 6 monthly inspection an assessment of animal flow within the induction facility and whilst moving animals around the feedlot is to be conducted.

(< 10,000 head feedlot capacity = 1 lot; 10,000-20,000 = 2 lots; > 20,000 head = 3 lots)

General facilities			
Facilities for good animal flow (e.g., even lighting, no obstructions, no sharp corners)?	Y		N
Gates swing freely and close securely?	Y		N
Non-slip floor in all handling yards and laneways?	Y		N
Facilities in good repair with no sharp protrusions?	Y		N
Records of action taken for sick or injured animals?	Y		N
Adequate lighting in all handling areas (receival, dispatch and crush)?	Y		N
Facility has adequate handling tools and equipment available to safely handle, restrain, treat and segregate cattle (e.g. equipment design, non-slip surface, no injury points and crush is in reasonable working order)?	Y		N
If applicable, dogs are used appropriately when moving cattle under any circumstance?	Y	N	N/A
Loading ramp has a level dock, non-slip surface and no holes or protrusions?	Y		N
What is the % of pens in dispatch/receive yards at feedlot with shade of at least 1.5m²/head?	Y	N	N/A
Induction facility animal flow score: 0 = major intervention required, clearly problems with flow 1 = minor handling required, some baulking 2 = no intervention needed, easy flow			
Is appropriate stockmanship and animal group sizes utilised in boxes/tubs leading into the crush/chute? 0 = Tub/Box group size or stockmanship causing signficant reduction in calm animal flow into chute/crush 1 = Tub/box group size or stockmanship causing intermittent issues with calm animal flow 2 = Optimal group size and stockmanship is observed.			
Is appropriate stockmanship and group sizes utilised in transferring cattle to and from induction/dispatch/hospital/home pens to ensure calm animal flow 0 = Stockmanship or inappropriate group sizes observed lead to a reduction in calm animal flow when transferring cattle around the feedlot 1 = Intermittent issues with stockmanship and group sizes for cattle transfers. 2 = Optimal stockmanship and group sizes observed for cattle transfers.			

3.A Transportation – Loading assessment

Collection interval: monthly

This template is constructed for the accredited Animal Welfare Officer (or appropriately trained staff member) to assess the welfare status of trucks loading on a monthly basis.

For each month observe 2–5 trucks during loading (<10,000 head feedlot capacity = two trucks, 10,000–20,000 head = three trucks, >20,000 head = five trucks).

This template is scored according to a two-point scale of 0–1, where a score 0 is awarded when the assessment item is not achieved/observed and a score 1 is awarded when the assessment item has been achieved/observed. For example, if there are no animals observed unfit for transport observed, a score 1 is awarded. If there is at least one animal classified as unfit for transport, then a score 0 is awarded.

Truck ID:	
Number of animals Average bodyweight, kg	
*No animals present that are unfit for transport	0/1
Comments (e.g. concerning any injured animals and % of animals that appear foot sore. Also include any animals that are transported under veterinary certificate).	
*Shade provided in all dispatch holding pens	0/1
*Water provided in all dispatch holding pens	0/1
*Holding pen density less than 75% occupied	0/1
*Loading densities as per standards (attached)	0/1
*Truck well aligned (no gaps, level)	0/1
*Handling aid used on less than 50% of animals	0/1
*Electric prodder used on less than 10% of animals	0/1
*No misuse or abuse of handling aids	0/1
*Slips and falls during loading less than 2%	0/1
*No cattle with restricted head room (cattle can freely stand)	0/1
*Stock crate free from sharp edges, holes etc.	0/1
*No open mouth panting (PS greater than or equal to 3) at loading cattle	0/1
Total for truck	**/13**

Fit to load guide
The animal:
☐ can walk on its own by bearing weight on all four legs
☐ is free from visible signs of severe injury or distress or conditions likely to further compromise its welfare during transport
☐ is strong enough to make the journey (i.e., not dehydrated or emaciated)
☐ can see well enough to walk, load and travel without impairment or distress (e.g., it is not blind in both eyes)
☐ is not in late pregnancy or too young to travel (refer to the Standards to determine limits for late pregnancy)
☐ has had adequate access to water prior to loading to meet the maximum time off water standards

Recommended loading densities of adult cattle for road transport		
Mean live weight of cattle (kg)	Floor area (m2 /head)	No. of head per 12.2 m deck*
250	0.77	38
300	0.86	34
350	0.98	30
400	1.05	28
450	1.13	26
500	1.23	24
550	1.34	22
600	1.47	20
650	1.63	18
* Equates to a single-deck trailer.		

Definition – slips and falls
Slipping is any loss of footing as a result of flooring (e.g., not due to behavioural contact with another animal).
Falling is any body contact with the floor, excluding feet and/or legs.
Appropriate handling aids are drafting sticks, rattle paddles and flags. They should be used to encourage an animal to move, but never used to hit an animal.
Electric prodders must only be used to assist movement of cattle when animal or human safety is at risk or as a last resort when all other humane alternatives have failed and only when cattle have a clear path to move.

3.B Transportation – Unloading

Collection interval: monthly

This template is constructed for the accredited Animal Welfare Officer (or appropriately trained staff member) to assess the welfare status of trucks unloading on a monthly basis.

For each month, observe 2–5 trucks during loading (<10,000 head feedlot capacity = two trucks, 10,000–20,000 head = three trucks, >20,000 head = five trucks).

This template is scored according to a two-point scale of 0–1, where a score 0 is awarded when the assessment item is not achieved/observed, and a score 1 is awarded when the assessment item has been achieved/observed. For example, if there are no animals observed unfit for transport on an observed truck, a score 1 is awarded. If there is at least one animal classified as unfit on the truck, then a score 0 is awarded.

Truck ID:	
Number of animals Average body weight, kg	
*No animals present that are unfit post transport	0/1
Comments (e.g. concerning injured animals or % of animals that appear foot sore. Also include any animals that are transported under veterinary certificate).	
*Time off water less than 48 hours	0/1
*Cattle have immediate access to feed and water after unloading	0/1
*Truck well aligned (no gaps, level)	0/1
*Slips and falls during unloading less than 2%	0/1
*No animals dead on arrival	0/1
*Stock crate free from sharp edges, holes etc.	0/1
*Handling aid used on less than 50% of animals	0/1
*Electric prodder used on less than 10% of animals	0/1
*No misuse or abuse of handling aids	0/1
*No open mouth panting (PS equal to or greater than 3) at unloading	0/1
*Loading densities as per standards (attached)	0/1
Total for truck	**/12**

Fit to load guide
The animal:
☐ can walk on its own by bearing weight on all four legs
☐ is free from visible signs of severe injury or distress or conditions likely to further compromise its welfare during transport
☐ is strong enough to make the journey (i.e., not dehydrated or emaciated)
☐ can see well enough to walk, load and travel without impairment or distress (e.g., it is not blind in both eyes)
☐ is not in late pregnancy or too young to travel (refer to the Standards to determine limits for late pregnancy)
☐ has had adequate access to water prior to loading to meet the maximum time off water standards

Recommended loading densities of adult cattle for road transport

Mean live weight of cattle (kg)	Floor area (m2 /head)	No. of head per 12.2 m deck*
250	0.77	38
300	0.86	34
350	0.98	30
400	1.05	28
450	1.13	26
500	1.23	24
550	1.34	22
600	1.47	20
650	1.63	18

* Equates to a single-deck trailer.

Definition – slips and falls
Slipping is any loss of footing as a result of flooring (e.g., not due to behavioural contact with another animal).
Falling is any body contact with the floor, excluding feet and/or legs.
Appropriate handling aids are drafting sticks, rattle paddles and flags. They should be used to encourage an animal to move, but never used to hit an animal.
Electric prodders must only be used to assist movement of cattle when animal or human safety is at risk or as a last resort when all other humane alternatives have failed and only when cattle have a clear path to move.

4.0 Feedlot induction

Collection interval: monthly

This template is constructed for the accredited Animal Welfare Officer (or appropriately trained staff member) to assess feedlot induction (arrival processing) on a monthly basis.

For each month observe animals during handling (< 10,000 head feedlot capacity = 50 animals, 10,000–20,000 head = 75 animals, > 20,000 head = 100 animals).

This template is scored according to a two-point scale of 0–1, where a score 0 is awarded when the assessment item is not achieved/observed, and a score 1 is awarded when the assessment item has been achieved/observed. For example, if less than 2% of animals are observed to slip or fall during handling, a score 1 is awarded. If more than 2% of animals are observed to slip or fall during handling, then a score 0 is awarded. In some cases, a three-point scale (0–2) is used.

For each animal, record H (handling aid) or P (electric prodder). Record X when none are used. Record M for miscaught.									
Number of slips (tally)					**Number of falls (tally)**				

No choking/sleeper/death in crush	0/1
Slips and falls < 2%	0/1
Miscaught 0%	0/1
Handling aid used on less than 50% of animals	0/1
Electric prodder used on less than 10% of animals	0/1
No misuse or abuse of handling aids observed	0/1
Staff generated noise (0 = yelling/loud tapping of race, 1 = moderate noise, 2 = quiet)	0/2
Staff member(s) positioning and movement does not lead to animal baulking	0/1
No excess facility noise (e.g., banging gates, crush operation, machine noise nearby)	0/1
Observe husbandry procedures at induction	
Appropriate pain relief used	0/1/NA
Appropriate hygiene procedures used	0/1
Appropriate handling and restraint used	0/1
Total score (*/12 if no surgical husbandry procedures)	**/13 or /12***

A **sleeper** is an animal that goes down in the crush and becomes unconscious but gains consciousness again.

Score as miscaught if the head stanchion catches an animal around the jaw, a leg is caught in the head stanchion or the head stanchion catches the animal around its body or shoulder.

Appropriate handling aids are drafting sticks, rattle paddles and flags. They should be used to encourage an animal to move, but never used to hit an animal.

Electric prodders must only be used to assist movement of cattle when animal or human safety is at risk or as a last resort when all other humane alternatives have failed and only when cattle have a clear path to move.

An electric prodder should not be used on an animal which has nowhere to go or is already moving in the right direction, such as animals at the back of the mob.

The use of **pain relief** is compulsory for castration and dehorning of animals above certain ages. The Cattle Council of Australia has produced a guide with recommended pain relief strategies (cattlecouncil.com.au/assets/files/201008%20-%20CCA%20pain%20relief%20guide.pdf)

For best pain relief, surgical procedures (e.g., dehorning and castration) should be accompanied by multi-modal pain relief using local anaesthetic (such as TriSolfen) and longer-acting Non-Steroidal Anti-inflammatory Drugs (such as Meloxicam or Buccalgesic).

Good hygiene involves washing hands and instruments, keeping separate containers with antiseptic for washing hands and storing instruments and changing antiseptic solution, blades and needles after every 30 animals or earlier if needles are blunt or burred.

5.A Definitions for monthly pen assessments

Allogrooming	Social grooming, where one or more animals use their tongue to lick another animal.

Demeanour

Term	Description
Active	Energetic, lively, busy body movement and actions
Agitated	Restless, uneasy, reactive, nervous movement
Alert	Wide awake, fully aware, attentive, vigilant, engaged with surroundings, ready to react
Curious	Positive interest, questioning and inquisitive towards surroundings, actively exploring and engaging with environment
Content	Above means met, state of satisfaction, confident, contentment in life situation, appeased, happy, in control and at ease
Dull	Lacking interest, dispirited or wearied, slow moving, tired, may include an element of being unwell
Lively	Animated, energetic, excited, eager, enthusiastic, playful, positively engaged with surroundings
Nervous	Anxious, alarmed, worried, tense, unsure, unable to settle, reactive to stimuli, vigilant or watchful
Settled	Quiet, calm, relaxed and resting
Uncomfortable	Showing signs of physical discomfort, uneasy, irritated

Panting score (MLA Heat Load Index Report FLOT.330 mla.com.au/contentassets/3b3115188 4f14644841f8b66abe07449/flot.330_final_report.pdf)

PS0	No panting, normal breathing. Difficult to see chest movement (respiratory rate less than 40).	
PS1	Slight panting with increased respiratory rate (RR 40–70), mouth closed, no drool or foam, easy to see chest movement.	
PS2	Fast panting (RR 70–120), easy to see chest movement with drool or foam present. No open mouth panting.	
PS3	Panting with open mouth and some drooling. Neck extended and head usually held up (RR 120–160).	

PS4	Open mouth panting with tongue fully extended for long periods with excessive drooling. Neck extended and head up (RR >160).	

Cattle shivering	skin twitching, visibly shaking and uncontrollably as a result of being cold.
Cattle huddling	cattle grouped together with their heads down and rumps orientated towards the wind.

Body condition score (Future Beef, 2021, futurebeef.com.au/knowledge-centre/body-condition-score-for-beef-cattle/)

BCS1	Very low musculature, no evidence of any fat, skeletal structure very pronounced.	
BCS2	Backbone, shoulder bones and hips are visible, tail head is slightly less recessed. Ribs are faintly visible.	
BCS3	Hip bones are faintly visible, ribs are usually not visible. Tail head is not recessed and body outline is almost smooth.	
BCS4	Ribs are well covered and hip bones are not visible. Tail head is slightly bumpy and overall body shape is rounded.	
BCS5	Hip bones show fat deposits, tail head has large lumps of fat, rib bones are very well covered and overall shape is bulging.	

Coat cleanliness score (Clean Livestock Assessment Scheme, 2000)

0	0–14% cover; totally clean	
1	15–34% cover; minor loading on legs and brisket	
2	35–54% cover; reasonable loading on legs, brisket and belly	
3	55–70% cover; substantial loading on legs, brisket, belly and flanks	
4	>70% cover; heavy loading on legs, brisket, flanks, back and face	

Faecal pat consistency score (Hughes, 2001)

1	Very dry, lumpy pats	
2	Dry, stiff, semi-formed pats	
3	Circular, moist raised pat with symmetrical rings around a dipped centre	
4	Flat, loose, thinly spread pat	
5	Liquid pool of faeces	

References:

Hughes, J. (2001). A system for assessing cow cleanliness. In Practice, 23(9), 517-524. Doi: https://doi.org/10.1136/inpract.23.9.517

5.B Pen welfare measures

Collection interval: monthly

This template is constructed for the accredited Animal Welfare Officer (or appropriately trained staff member) to assess pen welfare measures on a monthly basis. The number of home pens to be assessed is based on what is available and the size of the feedlot according to the table below. Where possible follow "single pen lots" through the feeding period. If there are pen changes follow the majority of the lot to their current pen. Once they have completed, enroll more pens.

Cattle from two market categories should be assessed at each premises regardless of size (head) and at least one market category should be from those cattle that would be regarded as 'at-risk' or 'vulnerable' where these are present. Consider location of each home pen to ensure representative data for the premises.

If the feedlot has less than the number of pens specified in the table below, assess all appropriate pens available (e.g., within the cattle market category and location selected). If the feedlot has more than the number of appropriate pens specified in the table below, a random sampling approach should be taken to avoid bias. A random sample could be obtained by selecting every ninth pen from those appropriate pens available, or by drawing numbers 'out of a hat'. Where possible, avoid selecting pens that are all immediately adjacent to each other. Selection of pens should be done prior to commencing assessments.

Sample sizes and approximate time needed for each assessment type based on feedlot size (head)

Assessment type	Feedlot size (head)							
	<5,000		5,000–10,000		10,000–20,000		>20,000	
	Sample size	Approx. time[1]	Sample size	Approx. time[1]	Sample size	Approx. time[1]	Sample size	Approx. time[1]
Home pens (Table 5B)	2 x market categories 3 x home pens per category 1 x locations per category[3] **Total: 6 pens**	30 – 60 min[2]	2 x market categories 3 x home pens per category 2 x locations per category[3] **Total: 12 pens**	60 – 120 min[2]	2 x market category 3 x home pens per category 3 x locations per category[3] **Total: 18 pens**	90 – 150 min[2]	2 x market category 3 x home pens category 4 x locations per category[3] **Total: 24 pens**	120 – 180 min[2]

[1] Time needed is an estimate only based on research team experience.

[2] Initial home pen assessment includes collection of static information (e.g., animal and pen information) and is expected to take ~ 5–10 minutes. Each subsequent assessment on the same pen will take ~ 5 min. The time taken to complete home pens depends on the number of animals within the pen.

[3] The location of the pen within the feedlot should be representative of the premises. If premises has 'at-risk' or 'vulnerable' pens, these should be assessed in addition to examples of 'best' pens.

This document details how the list of behavioural measures included in Section 5B relate to cattle welfare and consumer concerns as derived from consultation with the scientific literature and expert opinion.

Lying

The assessment of lying informs comfort and health, including information related to environmental/physical conditions (e.g., poor lying surface due to climate, adequate stocking densities/space allowances and competition) and disease (e.g., lameness). This assessment also relates to Quality of Life (QoL) and may provide useful information to address consumer concerns surrounding cattle comfort.

Panting score

Panting scores provide an animal-based measure for heat stress to provide useful information regarding cattle health, comfort and QoL. The assessment of panting score throughout the day provides useful information regarding accumulative heat load, which can be used to inform management decisions (e.g., the provision of additional water troughs).

Shivering

The assessment of shivering informs cold stress, providing an animal-based measure to address concerns relating to cattle comfort and QoL. This assessment may also be used to monitor the acclimation of cattle from differing backgrounds (i.e., northern cattle transported to a southern feedlot) and could be used to inform management decisions (e.g., provision of temporary shelter).

Huddling

The assessment of huddling informs cattle comfort and QoL, including information related to thermal stress. Huddling may provide useful information related to both heat stress (e.g., seeking shade provided by conspecifics) and cold stress (e.g., cattle seeking shelter from the wind provided by conspecific).

Approach test

The approach test offers an assessment of human-animal relationship, specifically reactivity to human presence. When assessed over time, reactivity to human presence provides important information relating to cattle's fear of humans, the quality and quantity of human contact and acclimation to the feedlot environment and processes. As highly reactive cattle are at risk of injury and are difficult to handle, this assessment not only provides information on how cattle perceive humans but may also be useful in addressing concerns surrounding cattle health and human safety.

Feeding behaviour

The assessment of feeding behaviour over time provides an animal-based measure for feed intake, with the assessment informing not only immediate hunger levels to provide useful information regarding feed provision and access (e.g., disinterested cattle may indicate they are full; thus feed provision and access is adequate), but also competition and social stress at the feed bunk. The ongoing assessment of feeding behaviour also provides useful information related to acclimation to the feedlot diet and/or environment and disease (e.g., prolonged disinterest), which relate to concerns surrounding QoL, health and cattle comfort.

Drinking behaviours

The assessment of drinking behaviour provides an animal-based measure for heat stress, providing useful information to inform on cattle comfort, health and QoL. As heat stressed cattle alter their behaviour to cool themselves (e.g., increased water intake, standing over water troughs and seeking the shade produced by water troughs), the assessment of crowding or hovering of animals around water troughs may be a useful indicator of early heat stress or thirst. This assessment also provides useful information regarding adequate water provision and access, which can be used to inform management decisions (e.g., the provision of additional water troughs).

Positive engagement behaviours

The assessment of positive engagement behaviours provides useful information regarding both positive and negative welfare to address concerns over cattle comfort, health and QoL. The ongoing assessment of positive engagement behaviours (e.g., play, allogrooming and self-grooming) provides information related to successful acclimation to the feedlot environment, including mixing of unfamiliar animals, but also social stress and competition for resources (e.g., food, water, shelter, shade, bedding and enrichment).

Negative social behaviours

The assessment of negative social behaviours informs negative welfare to address concerns over cattle comfort, health and QoL. The ongoing assessment of negative social behaviours provides information related to social stress and resource access and competition (e.g., food, water, shelter, shade, bedding and enrichment). In doing this, the monitoring of negative social behaviours provides information related to successful acclimation to the feedlot environment and may also inform management decisions (e.g., the provision of additional bedding/shade).

Abnormal behaviours

The assessment of abnormal behaviours informs negative welfare to address concerns over QoL. The ongoing assessment of abnormal behaviours (e.g., bulling, tongue rolling and object licking) provides useful information related to adequate environmental/physical conditions and social stress, and may inform management decisions (e.g., removal of a buller from a pen).

Demeanour

The assessment of cattle demeanour, or body language, informs affective state and both positive and negative welfare. The assessment of demeanour provides information concerning how cattle interact and perceive their environment, which not only provides insight into affective state, but can be used to inform QoL, health and comfort as stress and injury or disease can alter cattle demeanour. The ongoing assessment of demeanour allows for the monitoring of cattle to inform management decisions and also captures positive improvements in the cattle over time.

Body condition score (BCS)

This is a measure that is internationally recognised to be a reliable and objective measure of animal welfare. Taken over the long-term, it informs on the acclimatisation of animals to the feedlot environment.

Pen static information

Collection interval: complete once for each pen monitored in pilot

Pen static information is collected to inform data analysis of existing welfare practices and pen conditions in each pilot pen selected for assessment. This should be completed once for each unique individual lot monitored (market category/pen/location combination).

Pen			
Number of head			
Breed (select one/ provide number per caterogy; note that Bos taurus category includes British and European breeds)	☐ Bos taurus ☐ Bos indicus x (75%) ☐ Bos indicus x (25%) ☐ Bos indicus ☐ Bos indicus x (50%) ☐ Wagyu/Wagyu x		
Class	☐ Steer ☐ Bull ☐ Heifer ☐ Cow ☐ Mix		
Induction	Were cattle mixed? (numerous trucks, saleyard pens, farms)	Y	N
Feeding program (select one)	☐ Short (40–70 days) ☐ Short/medium (70–120 days) ☐ Medium (120–180 days) ☐ Long (>180 days)		
Home pen	Pen size (m^2)		
	Are shade structures provided?	Y	N
	If yes, is the pen fully covered?	Y	N
	If yes, shade provision (m^2 available at midday)		
	Where are structures located?		
	Are shelter structures provided (e.g., roofed shelter structures, shelterbelts, wind breaks, temporary shelter)?	Y	N
	Feed bunk space cm/head		
	Access to water mm/head		
	Are extra water troughs provided during heat stress events?	Y	N
	Is enrichment provided (e.g., brushes)?	Y	N
	If yes, what type?		
	Pen base structure: (select one) ☐ Clay ☐ Rocky ☐ Limestone ☐ Road base/compacted aggregate ☐ Sandy Bedding provided? ☐ Y ☐ N If yes, specify: _____		

Pen welfare measures

Collection interval: monthly

This should be completed once for each unique individual lot monitored (market category/pen/location combination).

NOTE: Different recordings below to occur at different timepoints within the day.

Date:		
Pen:	Days on feed:	Lot:

1. Recordings to take place at feed bunk check/early morning before feeding

Time of assessment:

Are greater than 50% cattle in the pen lying (sternal and/or lateral): Y N

Record panting scores only if PS2 or above was observed the previous day/heat stress conditions are expected today.

Morning panting score (% pen per score). For mixed breed pens, record % per breed per PS				
PS0	**PS1**	**PS2**	**PS3**	**PS4**

Record only if onset of cold/windy conditions occurs

Cattle shivering: ☐ Absent ☐ Observed % cattle:

Cattle huddling: ☐ Absent ☐ Observed % cattle:

2. Recordings to take place at feed out

Time of assessment:

Approach the pen on foot and stand halfway down the fence line, at least 1m back from the bunk, before taking the following measures:

Approach test: Record within 1 hour of feeding out or peak feeding time*

% of animals that retreat from feed trough on approach*: _____%

Feeding behaviour (recording at first feed out):

% of animals disinterested: _____%

% of animals pushing/competitive: _____%

% animals keen/calmly approaching feed bunk: _____% (to add to 100%)

3. Recordings to take place at midday (12pm)

Time of assessment:

Record panting scores only if PS2 or above is observed.

Midday panting score (% pen per score). For mixed breed pens, record % per breed per PS				
PS0	**PS1**	**PS2**	**PS3**	**PS4**

Drinking behaviour (select one): ☐ Normal ☐ Crowding/hovering over water trough

Water trough(s): At peak demand where cattle are drinking, water troughs are (select one):

☐ Empty ☐ 25% full ☐ >50% full ☐ Full

4. Recordings to take place at least two hours after final feeding of the day

Time of assessment:

Drinking behaviour (select one): ☐ Normal ☐ Crowding/hovering over water trough

Record panting score only if PS2 or above is observed.

Afternoon panting score (% pen per score). For mixed breed pens, record % per breed per PS				
PS0	**PS1**	**PS2**	**PS3**	**PS4**

Stand in front of the pen and watch the cattle for 5 minutes and record:

Number of bouts/occurrences of positive engagement behaviours (play, allogrooming (social grooming), self-grooming, play chase)		
Number of bout/occurrences of negative social behaviours (pushing, mounting, head-butting, charging, kicking, aggressive chase)		
Number of cattle engaging in abnormal behaviours, such as tongue rolling (extended tongue outside of mouth and twisting/rolling), object licking/chewing (animal is absent mindedly over-licking/chewing a structure, such as fence) and bulling activity		
Evidence of agitation due to biting flies (hoof stamping, head swinging, tail flicking and tightly huddled group):	**Y**	**N**

Demeanour: place an X along the line for **each term** (Min = term not expressed, Max = term being expressed to the fullest by all animals in the pen)

Active	Min	_____	Max
Agitated	Min	_____	Max
Alert	Min	_____	Max
Curious	Min	_____	Max
Content	Min	_____	Max
Dull	Min	_____	Max
Lively	Min	_____	Max
Nervous	Min	_____	Max
Settled	Min	_____	Max
Uncomfortable	Min	_____	Max

Body condition: % pen per body condition score (1–5)				
BCS1	**BCS2**	**BCS3**	**BCS4**	**BCS5**

Coat cleanliness score: % pen per score (1–4)				
0: totally clean	**1: minor loading on legs and brisket**	**2: reasonable loading on legs, brisket and belly**	**3: substantial loading on legs, brisket, belly and flanks**	**4: heavy loading on legs, brisket, flanks, back and face**

Faecal consistency score:

% of faecal pats with visible signs of diarrhoea (score 5) (Note: see Section 5.A for pat descriptions): _____

Mud depth (select one):

- ☐ no cattle with mud at dewclaw level or higher
- ☐ less than or equal to 10% pen surface with cattle with mud at dewclaw level or greater
- ☐ 10–50% pen surface with cattle mud depth at dewclaw or greater
- ☐ greater than 50% pen surface with cattle with mud at dewclaw level or greater

Non-ambulatory animals:

Number of non-ambulatory animals in pen (not structurally sound, unable to bare weight, walk to feed and water without oppressive pain): _____

Do non-ambulatory animals have easy access to feed and water? (Select one)

☐ No feed and water ☐ Cattle did have feed and water ☐ No non-ambulatory cattle observed

Non-ambulatory cattle (select one):

☐ Did not receive assistance ☐ Did receive assistance ☐ No non-ambulatory cattle observed

Cast animals:

Number of cast animals in pen (animals unable to stand due to weight and position on ground and require human intervention to stand): _____

Water trough(s):

Are there any noticeable leaks/damage to trough(s): ☐ Y ☐ N

Hygiene score (select one that best describes all troughs):

☐ Not observed ☐ Clean ☐ Mild (dust/feed/saliva/algae)

☐ Moderate (faeces/dust/feed/saliva/algae) ☐ Severe (non-drinkable)

Calving heifers/cows:

Since the last recording (select one):

☐ Calving heifers in distress did not receive assistance ☐ Calving heifers in distress did receive assistance

☐ Calving heifers observed but not in distress ☐ N/A

Were nursing heifers/cows provided with a safe and clean environment for calving that promotes survival? ☐ Y ☐ N

For newborn calves/calves in distress (select one):

☐ Newborn calves in distress did not receive assistance ☐ Newborn calves in distress did receive assistance

☐ No newborn calves were observed in distress ☐ N/A

5.C Monthly assessments recorded at a feedlot level

Collection interval: monthly

This template enables accredited Animal Welfare Officers (or appropriately trained staff) to review records of morbidity, mortality, the euthanasia rate and thermal comfort of the entire feedlot population. Data can be extracted from software and data recording systems present at the feedlot to determine the below metrics retrospectively.

Pen management	
Average feedlot occupancy for the past month	
Total head days for the past month	
Number of calves born at premise in past month	Born: Sold/cared for as poddy calf: Euthanised: Dead calves (including still born) in home pen:
Mortality (head)	Found dead in home pen: Emergency euthanasia in home pen or laneway: Moved to hospital pen for treatment then euthanised: Found dead in hospital/reject/chronic pen
Facility injuries during and post induction	
Morbidity rate per 1,000 head days (animals moved out of pen for treatment/total head days for the month)	Cattle treated: Morbidity rate:
Autopsy rate (number of autopsies conducted/number of deaths in the past month)	Cattle autopsied: Number of deaths: Autopsy rate:
Euthanasia rate per 1,000 head days (number of animals euthanised/total head days for the month)	Head euthanised: Euthanasia rate:
In the past month, how many days was open mouth panting observed (panting score greater or equal to PS3)?	
In the past month, how many days of cold (cattle huddling/ shivering) have occurred?	

6.0 Husbandry welfare practices

Collection interval: monthly

This template is constructed for the accredited Animal Welfare Officer (or appropriately trained staff member) to assess welfare practices in hospital pens or in animals undergoing husbandry procedures on a monthly basis. The number of hospital pens to be assessed is based on what is available and the size of the feedlot according to the table below.

Sample sizes and approximate time needed for each assessment type based on feedlot size (head)

Assessment type	Feedlot size (head)							
	<5,000		5,000–10,000		10,000–20,000		>20,000	
	Sample size	Approx. time[1]	Sample size	Approx. time[1]	Sample size	Approx. time[1]	Sample size	Approx. time[1]
Hospital pens[2]	1–2 pens	5–15 min	2–3 pens	15–30 min	3–5 pens	30–45 min	5–7 pens	45–60 min

[1] Time needed is an estimate only based on research team experience.

[2] The number of hospital pens or trucks to be assessed is based on what is available and the size of the premises. If premises has less than the number of hospital pens indicated above in use, all hospital pens that contain cattle should be assessed.

Observe management of animals and procedures

The template below is scored according to a two-point scale of 0–1, where a score 0 is awarded when the assessment item is not achieved/observed and a score 1 is awarded when the assessment item has been achieved/observed. For example, if there is appropriate shelter or shade provided in hospital pens, a score 1 is awarded. If there is no appropriate shelter or shade, then a score 0 is awarded.

Shelter or shade provided	0/1
Pen surface provides a dry and comfortable resting place for cattle	0/1
Pain relief used for painful husbandry procedures	0/1
Appropriate hygiene procedures used	0/1
Appropriate handling and restraint used	0/1
Staff aware of treatment plan and return to pen criteria	0/1
Resources and equipment back-up for euthanasia sighted	0/1
Hospital pens space allowance is greater than 15m2/SCU	0/1
Confirmation of rapid loss of consciousness and animal death utilised	0/1
Humane killing methods utilised (captive bolt or appropriate firearm)	0/1
Staff knowledge/evidence of timeliness of euthanasia (e.g., animal euthanized within four hours of decision to euthanise)	0/1
From protocols and training records:	
Staff have received training and know where protocols are for hospital treatments	0/1
Staff have received training and know where the protocols are for chronic/salvage pens	0/1
Staff have received euthanasia training (technique)	0/1
Staff have received euthanasia training (decision criteria)	0/1
From records:	
Body weight monitored in hospital pen	0/1
No post-induction complications from husbandry procedures	0/1
No post-hospital treatment complications	0/1
Total score:	**/18**

Animals that are sick or injured should be provided with shade or shelter and a dry and comfortable resting place.

Appropriate handling aids are drafting sticks, rattle paddles and flags. They should be used to encourage an animal to move, but never used to hit an animal.

Electric prodders must only be used to assist movement of cattle when animal or human safety is at risk or as a last resort when all other humane alternatives have failed and only when cattle have a clear path to move.

An electric prodder should not be used on an animal which has nowhere to go or is already moving in the right direction, such as animals at the back of the mob.

The use of **pain relief** is compulsory for castration and dehorning of animals above certain ages. The Cattle Council of Australia has produced a guide with recommended pain relief strategies (cattlecouncil.com.au/assets/files/201008%20-%20CCA%20pain%20relief%20guide.pdf)

For best pain relief, surgical procedures (e.g., dehorning and castration) should be accompanied by multi-modal pain relief using local anaesthetic (such as TriSolfen) and longer-acting Non-Steroidal Anti-inflammatory Drugs (such as Meloxicam or Buccalgesic).

Good hygiene includes washing hands and instruments, keeping separate containers with antiseptic for washing hands and storing instruments and changing antiseptic solution, blades and needles after every 10 animals or earlier if blunt or burred.

7.0 Nutrition and feeding information

Collection interval: monthly

This template is constructed for the accredited Animal Welfare Officer (or appropriately trained staff member) to assess nutrition and feeding welfare related measures a monthly basis. The number of home pens to be assessed is based on what is available and the size of the feedlot as outlined in Section 5B. The template should be completed once for each unique individual lot monitored (market category/pen/location combination).

Date:		
Pen:	Days on feed:	Lot:

Nutrition and feeding information	
How often are animals fed?	☐ Not every day ☐ Limit fed ☐ Once daily ☐ Two or more times daily ☐ Self-feeder
For each **home** pen assessed, are animals usually fed within 2 hours of target feeding time?	☐ Y ☐ N
For each home pen assessed, how full is each feed bunk? (Record one hour **before** normal feed out time)	☐ Slick (licked clean) ☐ Crumbs (0-0.1 kg/hd) ☐ 0.11-0.50 kg/hd ☐ 0.51-1.0 kg/hd ☐ Greater than 1 kg/hd
Is there evidence of feed contamination in the feed bunk (e.g., mold, foreign bodies, faecal matter, water etc.) (Record 1 hour **before** normal feed out time)	☐ Y ☐ N
For each home pen assessed, are any bunks slick at 6pm (for cattle that are not limit fed for programmed growth)?*	☐ Y ☐ N
Are bunks slick three hours before feed out for three days in a row (for cattle that are not limit fed for program growth)?*	☐ Y ☐ N

*Excluding limit fed cattle and those provided with an additional food source in the pen.

8.0 Other animals

Collection interval: monthly

This template is constructed for the accredited Animal Welfare Officer (or appropriately trained staff member) to assess welfare of other working animals on a monthly basis.

Other working animals	
Is the body condition score of horses on the feedlot appropriate for working conditions?	☐ Y ☐ N ☐ N/A
Do any of the horses have injuries or are they lame?	☐ Y ☐ N ☐ N/A
Are the vaccination/treatment and worming protocols of the horses up to date?	☐ Y ☐ N ☐ N/A
Is the body condition score of dogs on the feedlot appropriate for working conditions?	☐ Y ☐ N ☐ N/A
Do any of the dogs have injuries or are they lame?	☐ Y ☐ N ☐ N/A
Are the vaccination/treatment and worming protocols of the dogs up to date?	☐ Y ☐ N ☐ N/A
Do all working animals have water available at all reasonable times?	☐ Y ☐ N ☐ N/A
Do all working animals have appropriate housing, including appropriate kennel/stable size, bedding and a cleanliness/cleaning roster?	☐ Y ☐ N ☐ N/A

N/A indicates that a feedlot does not use/house these animals.

Adequate/appropriate body condition score: One which enables the animal to work effectively without the potential for causing excess stress, illness, exhaustion or injury.

9.0 Abattoir feedback

Collection interval: monthly

This template enables accredited Animal Welfare Officers (or appropriately trained staff) to review records of morbidity, mortality, euthanasia rate and thermal comfort of the entire feedlot population. Data can be extracted from software and data recording systems present in feedback sheets from the abattoir to determine the below metrics retrospectively.

The research pilot will assess the consistency of data availability and records in feedback data.

Abattoir feedback	
% of non-ambulatory at destination/total animals in consignment	☐ 0% ☐ >0%
Injection site lesions/injury – % of all carcases sent to retain rail for trimming/total carcases in consignment (from kill sheet data/carcase condemnation report)	☐ N/A ☐ 0% ☐ 1–5% ☐ >5%
% of carcases with bruising/total carcases in consignment	
% of carcases above pH 5.7/total carcases in consignment	
% of condemned carcases in consignment (from kill sheet data/carcase condemnation report)	
Abattoir offal data – % of lot with offal defect (from kill sheet data/carcase condemnation report)	

11.2 Animal handling data research collection protocol

This document provides a summary of the animal handling measures collected by the research team from the University of Melbourne and Murdoch University at those premises enrolled in the Pilot over the duration of the study. Researchers visited each feedlot approximately once per month to collect measures. The animal handling measures are separated into two primary sections; i) animal processing events (including handling in race and in crush); and ii) Animal truck events. Where necessary, a description of the measures have been included.

11.2.1 Animal processing events

Race/Holding yards/Laneways	
Time	
Location (Race/Holding Yard/Laneway)	
Animals (#)	
Heat stress observed in cattle?	Y N If Y, provide the number of cattle per PS (0-4.5): 0: _____ 1: _____ 2: _____ 2.5: _____ 3: _____ 3.5: _____ 4: _____ 4.5: _____
Cold stress observed in cattle?	Y N If Y, provide the number of cattle shivering:
Staff generated noise (1-3)	
Facility noise (1-3)	
Slapping/hitting cattle or twisting tails (#)	
Use of handling aids (#)[A]	
Use of electric prodder (#)	
Electric prodder in hand but not used (#)	
Use of dogs	Y N If Y, appropriate or not?
Stocking density of holding yards (m^2/SCU)	
Shade in holding pens?	Y N If Y, provide an estimate of amount m^2/SCU:
Induction facility animal flow score (1-3)	
Animal flow when moving from home pen to yard (1-3)	

[A]Handling aids include drafting sticks, rattle paddles and flags

Staff generated noise (1-3): Human noise during handling

1 = Yelling/excessive banging/tapping sides of rails 2 = Moderate noise 3 = Quiet

Facility noise (1-3):

1 = None 2 = Minor 3 = Unpleasantly noisy

Animal flow score (1-3):

0 = Major intervention required, clearly problems with flow

1 = Minor handling required, some baulking

2 = No intervention needed, easy flow

Crush	
Time	
Animals (#)	
Mis-caught (#)	
Slips (#)	
Falls (#)	
Vocalisations (#)	
Choking (#)	
Sleepers (#)	
Running/Jumping out of crush (#)	
Fell at release from crush (#)	

Slips:

Any loss of footing as a result of flooring, e.g. not due to behavioural contact with another animal

Falls:

Any body contact with the floor, excluding feet and/or legs

Miscaught:

The head stanchion catches an animal around the jaw, a leg is caught in the head stanchion or the head stanchion catches the animal around its body or shoulder

Sleeper:

An animal that goes down in the crush and becomes unconscious but gains consciousness again.

11.2.2 Animal truck events

Trucks	
Time	
Truck	
Truck loading or unloading?	
Animals on truck (#)	
Average weight (kg)	
Loading density (m^2/SCU)	
For loading trucks only, animals unfit for transport (#)	
For unloading trucks only, animals unfit post transport (#)	
Tender-footed animals (#)	
For unloading trucks only, animals dead on arrival (#)	
Truck well aligned (e.g. no gaps, level)	Y N Comments:
Slips (#)	
Falls (#)	
Use of handling aids (#)[A]	
Use of electric prodder (#)	
Electric prodder in hand but not used (#)	
Use of dogs	Y N If Y, appropriate or not?
Heat stress observed in cattle?	Y N If Y, provide the number of cattle per PS (0-4.5): 0: _____ 1: _____ 2: _____ 2.5: _____ 3: _____ 3.5: _____ 4: _____ 4.5: _____
Cold stress observed in cattle?	Y N If Y, provide the number of cattle shivering:
Stock crate free from sharp edges, holes etc...	Y N Comments:
For unloading trucks only, time off water	
Comments (e.g. concerning injured animals and any animals that are transported under veterinary certificate)	

11.3 Feedlot welfare benchmarking framework: Proposed

This document provides a summary of the revised measures to be collected as part of the animal welfare benchmarking framework protocol. The measures are separated into primary Sections, where each Section (1 – 9) addresses a specific area within the feedlot system. Each Section provides specific details on how the measures within should be captured or scored, with a total section score provided for Tables 3A, 3B and 6. Measures under these sections are collected using a 2-point scale (0/1), with a score of 1 indicating the minimum or specified requirement for that measure has been met by the feedlot. No thresholds have been established for those measures included under the other Sections (Tables 1-2, 4-5C, 7-8) at this time. The establishment of such thresholds together with the minimum scores for each section and overall feedlot score will be considered following collection of meta-data.

11.3.1 Table 1.0 Static feedlot information

Collection Interval: annually

Protocols refer to written policies that are available to staff. NFAS protocols should be present at all NFAS accredited feedlots, and a number of welfare protocols are recommended for feedlot sites. This template is constructed to determine the presence/absences of such elements.

NFAS Protocols	
Critical incident response plan available including crisis reporting protocol?	☐ Y ☐ N
NFAS standards and guidelines available to staff?	☐ Y ☐ N
Feedlot has a Biosecurity Management Plan?	☐ Y ☐ N
Feedlot has an Emergency Animal Disease Action Plan?	☐ Y ☐ N
Feedlot has a Risk Assessment and Contingency plan?	☐ Y ☐ N
Annual internal animal welfare audit has been carried out as per NFAS QM2 requirements?	☐ Y ☐ N
Incidents of animal cruelty are recorded, and action taken/investigated?	☐ Y ☐ N
Feedlot has protocols to address animal welfare for livestock transportation?	☐ Y ☐ N
Feedlot keeps records of transportation in and out of the facility?	☐ Y ☐ N
Feedlot has protocols to address animal handling, transportation and management of animals (in different risk categories) in environmental extremes?	☐ Y ☐ N
Feedlot keeps records of animal health treatments (physical or digital copies capable of being accessed onsite)?	☐ Y ☐ N
Feedlot has a Pregnancy and Calving Management protocol?	☐ Y ☐ N ☐ N/A
Feedlot keeps Diet and Feed records in an accessible format? e.g., physical, or digital copies capable of being accessed on-site	☐ Y ☐ N
Feedlot has a contingency plan for failure in feed and water supply?	☐ Y ☐ N
Recommended Welfare Protocols	
Feedlot has an animal care policy or mission statement	☐ Y ☐ N
Australian Welfare Standards & Guidelines – Cattle & Land Transport available to staff?	☐ Y ☐ N

Feedlot has access to MLA Fit to Load Guide?	☐ Y ☐ N
Accredited Animal Welfare Officer available on site for assessment?	☐ Y ☐ N
Feedlot has stockmanship training records from the last 12 months?	☐ Y ☐ N
Feedlot has protocols and resources available for Euthanasia? (e.g., MLA Euthanasia Manual)	☐ Y ☐ N
Feedlot has hospital pen and chronic/reject/salvage/ pen management protocols?	☐ Y ☐ N
Feedlot hospital treatment protocol documented in consultation with prescribing veterinarian including criteria for recovery/return to home pen?	☐ Y ☐ N
Feedlot has Action plan for animals injured/sick/malnutrition/dehydration at arrival	☐ Y ☐ N
Does Feedlot have a wet weather management plan?	☐ Y ☐ N
Feedlot has protocols to address pen and livestock handling facility cleaning?	☐ Y ☐ N
Feedlot has infrastructure maintenance protocols and records?	☐ Y ☐ N
Feedlot has protocols established with consulting veterinarian(s) for preventative vaccination and backgrounding, pre-feedlot entry? (Select one)	☐ No protocols ☐ Protocols established with vet ☐ Protocols established by appropriate other; _____
Feedlot has protocols/SOPs established with consulting veterinarian for induction, including disease, parasite, and pathogen treatment/prevention? (Select one)	☐ No protocols ☐ Protocols established with vet ☐ Protocols established by appropriate other; _____
Feedlot has Feeding Management Protocols and diet formulations established with qualified nutritionists on an as required basis? (Select one)	☐ No protocols ☐ Protocols established with nutritionist

	☐ Protocols established by appropriate other; _____
Feedlot has protocols for feed quality to prevent residues, toxins, and moulds in incoming commodities?	☐ Y ☐ N
Feedlot has protocol for the humane destruction of pest animals?	☐ Y ☐ N ☐ N/A
Feedlot has records of euthanasia training by consulting veterinarian for technique and decision-making criteria?	☐ Y ☐ N
Feedlot has protocols for use of pain relief during husbandry procedures?	☐ Y ☐ N
Feedlot has protocols for hygiene during husbandry procedures? (e.g., injection, ear tagging, marking, castration, dehorning)	☐ Y ☐ N
Feedlot has protocols for enrichment? (e.g., brushes)	☐ Y ☐ N
Feedlot has a maintenance schedule or protocol for the management of other animals (e.g., horses and dogs)?	☐ Y ☐ N

Feedlot Pen Management	
Number of head/SCU feedlot is accredited to house	Head SCU
Number of pens at feedlot	
Pen base structure (select one)	☐ Clay ☐ Rocky ☐ Limestone ☐ Road base/compacted aggregate ☐ Sandy
Pen animal monitoring conducted by (select one)	☐ On foot ☐ On horseback ☐ By car (outside of pen) ☐ By 4WD ATV
Minimum water trough length (mm/head or mm/SCU)	
Water troughs cleaned at least once per week (more frequently if required)	☐ Y ☐ N

Feedlot maintains a record of either pen cleaning interval/dates or manure load per pen?	☐ Y ☐ N
Enrichment provided (e.g., brushes)	☐ Y ☐ N
Do any pens have shade structures?	☐ Y ☐ N
If yes, % pens with shade structures	
If yes, Pen stocking density in pens with shade structures (m^2/hd)	
If yes, shade allocation (m^2/hd)	
Do any pens have shelters? (e.g., roofed shelter structures, shelterbelts, wind breaks, temporary shelter)	☐ Y ☐ N
If yes, % pens with shelters?	
If yes, pen stocking density in fully covered systems (m^2/hd)	
Do the holding yards have shade structures?	☐ Y ☐ N
Note the type of health recording software system used by feedlot	
Does the feedlot have an automated weather station?	☐ Y ☐ N
If yes, does the automated weather station have annual service/calibration record	☐ Y ☐ N

11.3.2 Table 2.0 General facilities

Collection Interval: monthly

This template is constructed for the accredited animal welfare officer (or appropriately trained staff member) to conduct an inspection of general facilities and an assessment of animal flow within the induction facility and whilst moving animals around the feedlot. It is recommended that this is conducted on a monthly basis.

(< 10,000 head feedlot capacity = 1 lot; 10,000-20,000 = 2 lots; > 20,000 head = 3 lots)

General Facilities	
Facilities for good animal flow (e.g. even lighting, no obstructions, no sharp corners)?	☐ Y ☐ N
Gates swing freely and close securely?	☐ Y ☐ N
Non-slip floor in all handling yards and laneways?	☐ Y ☐ N
Facilities in good repair with no sharp protrusions?	☐ Y ☐ N
Records of action taken for sick or injured animals?	☐ Y ☐ N
Adequate lighting in all handling areas (receival, dispatch and crush)?	☐ Y ☐ N
Facility has adequate handling tools and equipment available to safely handle, restrain, treat, and segregate cattle (e.g. equipment design, non-slip surface, no injury points and crush is in reasonable working order)?	☐ Y ☐ N
If applicable, dogs are used appropriately when moving cattle under any circumstance?	☐ Y ☐ N ☐ N/A
Loading ramp has a level dock, non-slip surface and no holes or protrusions?	☐ Y ☐ N
What is the % of pens in dispatch/receive yards at feedlot with shade at least 1.5m^2/head?	
Induction facility animal flow score: 0 = major intervention required, clearly problems with flow 1 = minor handling required, some baulking 2 = no intervention needed, easy flow	

Is appropriate stockmanship and animal group sizes utilised in boxes/tubs leading into the crush/chute? 0 = tub/box group size or stockmanship causing significant reduction in calm animal flow into chite/crush 1 = tub/box group size or stockmanship causing intermittent issues with calm animal flow 2 = optimal group size and stockmanship is observed	
Is appropriate stockmanship and group sizes utilised in transferring cattle to and from induction/dispatch/hospital/home pens to ensure calm animal flow? 0 = stockmanship or inadequate group sizes observed lead to a reduction in calm animal flow when transferring cattle around the feedlot 1 = intermittent issues with stockmanship and group sizes for cattle transfers 2 = optimal stockmanship and group sizes observed for cattle transfers	

11.3.3 Table 3.A Transportation – Loading

Collection interval: monthly

This template is constructed for the accredited animal welfare officer (or appropriately trained staff member) to assess the welfare status of trucks loading on a monthly basis.

For each month observe 2 – 4 trucks during loading (<10,000 head feedlot capacity = 2 trucks, 10-20,000 = head = 3 trucks, >20,000 head = 4 trucks).

This template is scored according to a two-point scale of 0 – 1, where a score 0 is awarded when the assessment item is not achieved/observed, and a score 1 is awarded where the assessment item has been achieved/observed. For example, if there are no animals observed unfit for transport observed, a score 1 is awarded. If there is at least one animal classified as unfit for transport, then a score 0 is awarded.

Truck ID:	
Number of animals Average bodyweight, kg	
No animal present that are unfit for transport	0/1
Comments (e.g. concerning injured animals and % of animals that appear foot sore. Also include any animals that are transported under veterinary certificate). _____ _____ _____ _____	
Shade provided in all dispatch holding pens	0/1
Water provided in all dispatch holding pens	0/1
Holding pen density less than 75% occupied	0/1
Loading densities as per standards (attached)	0/1
Truck well aligned (no gaps, level)	0/1
Handling aid used on less than 50% of animals	0/1
Electric prodder used on less than 10% of animals	0/1
No misuse or abuse of handling aids	0/1
Slips and falls during loading less than 2%	0/1
No cattle with restricted head room (cattle can freely stand)	0/1
Stock crate free from sharp edges, holes etc.	0/1
No open mouth panting (PS greater or equal to 3) at loading cattle	0/1
Total for Truck	**/13**

Fit to load guide
The animal:
☐ can walk on its own by bearing weight on all four legs
☐ is free from visible signs of severe injury or distress or conditions likely to further compromise its welfare during transport
☐ is strong enough to make the journey (i.e., not dehydrated or emaciated)
☐ can see well enough to walk, load and travel without impairment or distress (e.g., it is not blind in both eyes)
☐ is not in late pregnancy or too young to travel (refer to the Standards to determine limits for late pregnancy)
☐ has had adequate access to water prior to loading to meet the maximum time off water standards

Recommended loading densities of adult cattle for road transport		
Mean live weight of cattle (kg)	Floor area (m2 /head)	No. of head per 12.2 m deck*
250	0.77	38
300	0.86	34
350	0.98	30
400	1.05	28
450	1.13	26
500	1.23	24
550	1.34	22
600	1.47	20
650	1.63	18
*Equates to a single-deck trailer.		

Definition – slips and falls
Slipping is any loss of footing as a result of flooring (e.g., not due to behavioural contact with another animal)
Falling is any body contact with the floor, excluding feet and/or legs

Appropriate handling aids are drafting sticks, rattle paddles and flags. They should be used to encourage an animal to move, but never used to hit an animal
Electric prodders must only be used to assist movement of cattle when animal or human safety is at risk or as a last resort when all other humane alternatives have failed and only when cattle have a clear path to move

11.3.4 Table 3.B Transportation – Unloading

Collection interval: Monthly

This template is constructed for the accredited animal welfare officer (or appropriately trained staff member) to assess the welfare status of trucks unloading and cattle condition at entry to feedlot on a monthly basis.

For each month observe 2 – 4 trucks during loading (<10,000 head feedlot capacity = 2 trucks, 10-20,000 = head = 3 trucks, >20,000 head = 4 trucks).

This template is scored according to a two-point scale of 0 – 1, where a score 0 is awarded when the assessment item is not achieved/observed, and a score 1 is awarded where the assessment item has been achieved/observed. For example, if there are no animals observed unfit for transport on an observed truck, a score 1 is awarded. If there is at least one animal classified as unfit on the truck, then a score 0 is awarded.

Truck ID:	
Number of animals Average bodyweight, kg	
Transit time, hh:mm*	
No animal present that are unfit post transport	0/1
Comments (e.g. concerning injured animals and % of animals that appear foot sore. Also include any animals that are transported under veterinary certificate). _____ _____ _____ _____	
Time off water less than 48 hours	0/1
Cattle have immediate access to feed and water after unloading	0/1
Truck well aligned (no gaps, level)	0/1
Slips and falls during unloading less than 2%	0/1
No animals dead on arrival	0/1
Stock crate free from sharp edges, holes etc.	0/1
Handling aid used on less than 50% of animals	0/1
Electric prodder used on less than 10% of animals	0/1
No misuse or abuse of handling aids	0/1
No open mouth panting (PS equal or greater than 3) at unloading	0/1
Loading densities as per standards (attached)	0/1
Total for Truck	**/12**
*Time (hh:mm) from which cattle were loading and then unloaded at destination (feedlot)	

For each month observe animals in holding yards immediately after unloading (< 10,000 head feedlot capacity = 2 trucks, 10-20,000 head = 3 trucks, > 20,000 = 4 trucks).

Demeanour: observe cattle for at least two (2) minutes prior to scoring the following terms against a Visual Analogue Scale (VAS; 0 -1 00). To score, place an X along the line for <u>each term</u> (Min = term not expressed, Max = term being expressed to the fullest by all animals in the pen)	
Active Agitated Alert Curious Content Dull Lively Nervous Settled Sociable Uncomfortable	Min _____ Max Min _____ Max Min _____ Max Min _____ Max Min _____ Max Min _____ Max Min _____ Max Min _____ Max Min _____ Max Min _____ Max Min _____ Max
Flank fill score (select one)	☐ Full ☐ Slightly sunken ☐ Sunken ☐ Severely sunken
Drinking behaviour score (select one)	☐ Disinterested ☐ Some keen ☐ Crowding ☐ Hovering over water trough

Fit to load guide
The animal:
☐ can walk on its own by bearing weight on all four legs
☐ is free from visible signs of severe injury or distress or conditions likely to further compromise its welfare during transport
☐ is strong enough to make the journey (i.e., not dehydrated or emaciated)
☐ can see well enough to walk, load and travel without impairment or distress (e.g., it is not blind in both eyes)
☐ is not in late pregnancy or too young to travel (refer to the Standards to determine limits for late pregnancy)
☐ has had adequate access to water prior to loading to meet the maximum time off water standards

Recommended loading densities of adult cattle for road transport		
Mean live weight of cattle (kg)	Floor area (m2 /head)	No. of head per 12.2 m deck*
250	0.77	38
300	0.86	34
350	0.98	30
400	1.05	28
450	1.13	26
500	1.23	24
550	1.34	22
600	1.47	20
650	1.63	18
*Equates to a single-deck trailer.		

Definition – slips and falls
Slipping is any loss of footing as a result of flooring (e.g., not due to behavioural contact with another animal)
Falling is any body contact with the floor, excluding feet and/or legs
Appropriate handling aids are drafting sticks, rattle paddles and flags. They should be used to encourage an animal to move, but never used to hit an animal
Electric prodders must only be used to assist movement of cattle when animal or human safety is at risk or as a last resort when all other humane alternatives have failed and only when cattle have a clear path to move

Definition – demeanour	
Active	Energetic, lively, busy body movement and actions
Agitated	Restless, frustrated, uneasy, reactive, nervous movements
Alert	Wide awake, fully aware, attentive, vigilant, engaged with surroundings, ready to act
Curious	Positive interest, questioning and inquisitive towards surroundings, actively exploring and engaging with environment
Content	Above means met, state of satisfaction, confident, contentment in life situation, appeased, happy in control and at ease
Dull	Lacking interest, dispirited or wearied, slow moving, tired, may include an element of being unwell
Lively	Animated, energetic, excited, eager, enthusiastic, playful, positively engaged with surroundings and/or other cattle
Nervous	Anxious, alarmed, worried, tense, unsure, unable to settle, reactive to stimuli, vigilant or watchful

Settled	Quiet, calm, relaxed and resting
Sociable	Actively seeking engagement with conspecifics, friendly, gregarious, hostile, aggressive or angry, may include social grooming, play, antagonistic and displacement behaviours, or mounting/riding
Uncomfortable	Showing signs of physical discomfort, uneasy, irritated

11.3.5 Table 4.0 Feedlot induction

Collection interval: monthly

This template is constructed for the accredited animal welfare officer (or appropriately trained staff member) to assess feedlot induction (arrival processing) on a monthly basis.

For each month observe animals during handling (< 10,000 head feedlot capacity = 50 animals, 10-20,000 head = 75 animals, > 20,000 = 100 animals).

This template is scored according to a two-point scale of 0 – 1, where a score 0 is awarded when the assessment item is not achieved/observed, and a score 1 is awarded where the assessment item has been achieved/observed. For example, if less than 2% of animals are observed to slip or fall during handling, a score 1 is awarded. If more than 2% of animals are observed to slip or fall during handling, then a score 0 is awarded. In some cases, a three-point scale (0-2) is used.

For each animal, record H (handling aid use), P (electric prodder use), M (miscaught in crush). Record X for none above observed.

Number of slips (tally)					**Number of falls (tally)**				
Number of vocalisations (tally)									

Observe handling	
No choking/sleepers/death in crush	0/1
Slips and falls < 2%	0/1
Miscaught 0%	0/1
Handling aid used on less than 50% of animals	0/1
Electric prodder used on less than 10% of animals	0/1
No misuse or abuse of handling aids observed	0/1
Animal vocalisation	0/1
Staff generated noise 0 = yelling/loud tapping of race 1 = moderate noise 2 = quiet	0/2
Staff member(s) positioning and movement does not lead to animal baulking	0/1
No excess facility noise (e.g., banging gates, crush operation, machine noise nearby)	0/1
Observe husbandry procedures at induction	
Appropriate pain relief used	0/1/NA
Appropriate hygiene procedures used	0/1
Appropriate handling and restraint used	0/1
Total score (*/13 if no surgical husbandry procedures)	**/14** **/13***

Definitions – handling at induction
A **sleeper** is an animal that goes down in the crush and becomes unconscious but gains consciousness again
Score as **miscaught** if the head stanchion catches an animal around the jaw, a leg is caught in the head stanchion, or the head stanchion catches the animal around its body or shoulder
Score as **vocalisation** if an animal vocalised at least once during handling while in the race and crush, excluding if vocalisation occurs in response to husbandry procedures performed
Appropriate handling aids are drafting sticks, rattle paddles and flags. They should be used to encourage an animal to move, but never used to hit an animal
Electric prodders must only be used to assist movement of cattle when animal or human safety is at risk or as a last resort when all other humane alternatives have failed and only when cattle have a clear path to move. An electric prodder should not be used on an animal which has nowhere to go or is already moving in the right direction, such as animals at the back of the mob.
The use of **pain relief** is compulsory for castration and dehorning of animals above certain ages. The Cattle Council of Australia has produced a guide with recommended pain relief strategies (https://cattlecouncil.com.au/assets/files/201008%20-%20CCA%20pain%20relief%20guide.pdf). For best pain relief, surgical procedures (e.g., dehorning and castration) should be accompanied by multi-modal pain relief using local anaesthetic (such as TriSolfen) PLUS longer-acting Non-Steroidal Anti-inflammatory Drugs (such as Meloxicam, Buccalgesic).
Good hygiene involves washing hands and instruments, keeping separate containers with antiseptic for washing hands and storing instruments, and changing antiseptic solution and blades and needles after every 30 animals or earlier if needle is blunt or burred.

11.3.6 Table 5.A Definitions for monthly pen assessments

Ethogram

Behaviour*	Description
Resting	Animal has eyes closed, or if eyes open, is not visually engaging/paying attention to the surrounding environment. Animal can be either standing or lying
Ruminating	Animal is chewing its cud
Eating	Animal is at the food bunk or close by, with food in its mouth and is actively chewing and swallowing
Drinking	Animal is at the water trough and consuming water
Self-groom	Animal is using their tongue to like itself, or rubbing a body part against a stationary object
Engaged	Animal is solely engaged with its surrounding environment (e.g., object play, sniffing the ground, investigating licks to pen structure, etc…) and/or with other cattle (e.g., positive and negative social interactions; allogrooming, nuzzling, play, playful chase, displacement, aggressive head butt/push, aggressive chase, mounting, riding, bullying, etc...)
Abnormal behaviours	Animal is performing an unnatural behaviour, or repetitive behaviour, (e.g. tongue twisting/curling, fence/bar chewing, ground chewing/eating etc...)
*All behaviours are mutually exclusive	

Demeanour

Demeanour term	Description
Active	Energetic, lively, busy body movement and actions
Agitated	Restless, frustrated, uneasy, reactive, nervous movements
Alert	Wide awake, fully aware, attentive, vigilant, engaged with surroundings, ready to act
Curious	Positive interest, questioning and inquisitive towards surroundings, actively exploring and engaging with environment
Content	Above means met, state of satisfaction, confident, contentment in life situation, appeased, happy in control and at ease
Dull	Lacking interest, dispirited or wearied, slow moving, tired, may include an element of being unwell
Lively	Animated, energetic, excited, eager, enthusiastic, playful, positively engaged with surroundings and/or other cattle
Nervous	Anxious, alarmed, worried, tense, unsure, unable to settle, reactive to stimuli, vigilant or watchful
Settled	Quiet, calm, relaxed and resting
Sociable	Actively seeking engagement with conspecifics, friendly, gregarious, hostile, aggressive or angry, may include social grooming, play, antagonistic and displacement behaviours, or mounting/riding
Uncomfortable	Showing signs of physical discomfort, uneasy, irritated

Other definitions

Measure	Description
Cattle shivering	Skin twitching, visibly shaking and uncontrollably as a result of being cold
Cattle huddling	Cattle grouped together and have their heads down and rumps orientated towards the wind
Group (for Dispersion assessment)	A congregation of ≥ individuals that are in close (< 1.5 m or single cattle body length) association with each other

Panting score (MLA Heat Load Index Report FLOT.330 https://www.mla.com.au/contentassets/3b31151884f14644841f8b66abe07449/flot.330_final_report.pdf)

PS0	**No panting, normal breathing. Difficult to see chest movement (respiratory rate less than 40).**	
PS1	**Slight panting with increased respiratory rate (RR 40-70), mouth closed, no drool or foam, easy to see chest movement.**	
PS2	**Fast panting (RR 70-120) with easy to see chest movement with drool or foam present. No open mouth panting.**	

PS3	**Panting with open mouth + some drooling. Neck extended and head usually held up (RR 120-160)**	
PS4	**Open mouth panting with tongue fully extended for long periods with excessive drooling. Neck extended and head up (RR >160)**	

Body Condition Score (Future Beef, 2021, https://futurebeef.com.au/knowledge-centre/body-condition-score-for-beef-cattle/**)**

BCS1	Very low musculature, no evidence of any fat, skeletal structure very pronounced		
BCS2	Backbone, shoulder bones and hips are visible, tail head is slightly less recessed. Ribs are faintly visible.		
BCS3	Hip bones are faintly visible, ribs are usually not visible. Tail head is not recessed and body outline is almost smooth.		

BCS4	Ribs are well covered and hip bones are not visible. Tail head is slightly bumpy and overall body shape is rounded.	 
BCS5	Hip bones show fat deposits, tail head has large lumps of fat, rib bones are very well covered and overall shape is bulging.	 

Coat cleanliness score (1-10):

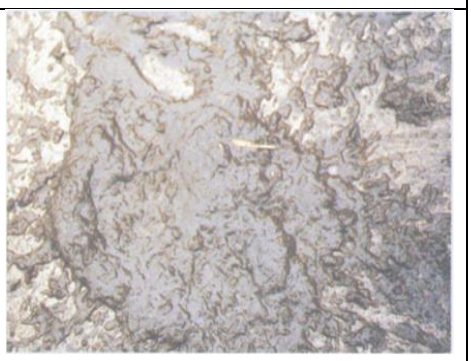
Photos: Clean Livestock Assessment Scheme (2000)

1	All cattle are clean	
2	Some cattle with leg and thighs covered	
3	Most cattle with legs and thighs covered	
4	Some cattle with thighs and bellies covered	
5	Most cattle with thighs and bellies covered	

6	Some cattle covered completely - mild	
7	Most cattle covered completely - mild	
8	Some cattle covered completely - heavy	
9	Most cattle covered completely - heavy	
10	All cattle heavily covered	

Faecal pat consistency score (Hughes, 2001):

1	**Very dry, lumpy pats**	

2	**Dry, stiff, semi-formed pats**	
3	**Circular, moist raised pat with symmetrical rings around a dipped centre**	
4	**Flat, loose, thinly spread pat**	
5	**Liquid pool of faeces**	

Hughes, J. (2001). A system for assessing cow cleanliness. In Practice, 23(9), 517-524. Doi: https://doi.org/10.1136/inpract.23.9.517

11.3.7 Table 5.B Monthly pen assessments

Collection interval: monthly

This template is constructed for the accredited animal welfare officer (or appropriately trained staff member) to assess pen welfare measures on a monthly basis. The number of home pens to be assessed, based on the preliminary outcomes of the pilot, is outlined in the table below. Where possible follow "single pen lots" through the feeding period. If there are pen changes, follow the majority of the lot to their current pen. Once they have completed enrol more pens.

Cattle from each market category on premises should be assessed and at least one market category should be from those cattle that would be regarded as 'at-risk' or 'vulnerable' where these are present. Consider location of each home pen to ensure representative data for the premises, noting that the initial pilot did not allow for location to be considered ensure location of selected pens is representative of the premises i.e., if the premises has 'at-risk' pens due to location, these should be assessed in addition to examples of 'best' pens. It is recommended that refinement of pen sampling methodology moving forward includes consideration of the location of selected pens within feedlot premises to ensure appropriate sampling.

If the feedlot has less than the number of pens specified in table below, assess all appropriate pens available (e.g. within the cattle market category). If the feedlot has more than the number of appropriate pens specified in the table below, a random sampling approach should be taken to avoid bias. A random sample could be obtained by selecting every nth pen from those appropriate pens available, or by drawing numbers 'out of a hat'. Where possible, avoid selecting pens that are all immediately adjacent to each other. Selection of pens should be done prior to commencing assessments.

Sample sizes and approximate time needed for home pen assessments by number of market categories present on premises.

	Market categories present on premises (no.)		
	1	**2**	**3**
Sample pens (no.)	2 – 3	4 – 6	6 – 9
Estimated assessment time (month)[A]	60 – 90 min (1 – 1.5 hr)	120 – 180 min (2 – 3 hr)	180 – 270 min (3 – 4.5 hr)
Estimated assessment time (annual)[A]	720 – 1080 min (12 – 18 hr)	1440 – 2160 (24 – 36 hr)	2160 – 3240 min (36 – 54 hr)

[A]Assessment time is based on the outcome of the research pilot: 1 pen taking researchers approximately 15 min to assess with the recommendation that 2 assessments per pen on assessment day be undertaken.

This section details how the list of behavioural measures included in Table 5.B relate to cattle welfare and consumer concerns as derived from consultation with the scientific literature and expert opinion.

Lying

The assessment of lying informs comfort and health including information related to environmental/physical conditions (e.g., poor lying surface due to climate, adequate stocking densities/space allowances, and competition) and disease (e.g., lameness). This assessment also relates to Quality of Life (QoL) and may provide useful information to address consumer concerns surrounding cattle comfort.

Panting score

Panting scores provide an animal-based measure for heat stress to provide useful information regarding cattle health, comfort and QoL. The assessment of panting score throughout the day provides useful information regarding accumulative heat load which can be used to inform management decisions (e.g., the provision of additional water troughs).

Shivering

The assessment of shivering informs cold stress, providing an animal-based measure to address concerns relating to cattle comfort and QoL. This assessment may also be used to monitor the acclimation of cattle from differing backgrounds (i.e., northern cattle transported to southern feedlot), and could be used to inform management decisions (e.g., provision of temporary shelter).

Huddling

The assessment of huddling informs cattle comfort and QoL including information related to thermal stress. Huddling may provide useful information related to both heat stress (e.g., seeking shade provided by conspecifics) and cold stress (e.g., cattle seeking shelter from the wind provided by conspecific).

Reactivity Index

The approach test offers an assessment of human-animal relationship, specifically reactivity to human presence at a pen level. When assessed over time, reactivity to human presence provides important information relating to cattle's fear of humans, the quality and quantity of human contact, and acclimation to the feedlot environment and processes. As highly reactive cattle are at risk of injury and are difficult to handle, this assessment not only provides information on how cattle perceive humans but may also be useful in addressing concerns surrounding cattle health and human safety.

Feeding behaviour

The assessment of feeding behaviour over time provides an animal-based measure for feed intake, with the assessment informing not only immediate hunger levels to provide useful information regarding feed provision and access (e.g., disinterested cattle may indicate that cattle are full, thus

feed provision and access is adequate), but also competition and social stress at the feed bunk. The on-going assessment of feeding behaviour also provides useful information related to acclimation to the feedlot diet and/or environment, and disease (e.g., prolonged disinterest), which relate to concerns surrounding QoL, health and cattle comfort.

Drinking behaviour

The assessment of drinking behaviour provides an animal-based measure for heat stress providing useful information to inform on cattle comfort, health and QoL. As heat stressed cattle alter their behaviour to cool themselves (e.g., increased water intake, standing over water troughs, and seeking the shade produced by water troughs), the assessment of crowding or hovering of animals around water troughs may be a useful indicator of early heat stress or thirst. This assessment also provides useful information regarding adequate water provision and access which can be used to inform management decisions (e.g., the provision of additional water troughs).

Engagement

The assessment of cattle engagement with their environment and/or conspecifics (other cattle) provides useful information regarding both positive and negative welfare to address concerns over cattle comfort, health and QoL. The on-going assessment of engagement and social behaviours (e.g., object play, social play, grooming, and aggression) provides information related to successful acclimation to the feedlot environment including mixing of unfamiliar animals, but also social stress and competition for resources (e.g., food, water, shelter, shade, bedding, and enrichment) and may also inform management decisions (e.g., the provision of additional bedding/shade).

Abnormal behaviours

The assessment of abnormal behaviours informs negative welfare to address concerns over QoL. The ongoing assessment of abnormal behaviours (e.g., bulling, tongue rolling, and object licking) provides useful information related to adequate environmental/physical conditions, social stress, and may inform management decisions (e.g., removal of a buller from a pen).

Demeanour

The assessment of cattle demeanour, or body language, informs affective state and both positive and negative welfare. The assessment of demeanour provides information concerning how cattle interact and perceive their environment, which not only provides insight into affective state, but can be used to inform QoL, health and comfort as stress and injury or disease can alter cattle demeanour. The ongoing assessment of demeanour allows for the monitoring of cattle to inform management decisions and also capture positive improvements in the cattle over time.

Body Condition Score (BCS)

This is a measure that is internationally recognised to be a reliable and objective measure of animal welfare. Taken over the long-term, it informs on the acclimatisation of animals to the feedlot environment.

Pen Static Information

Collection interval: complete once for each pen monitored

Pen static information is collected to inform data analysis of existing welfare practices and pen conditions in each pen selected for assessment. This should be completed once for each unique individual lot monitored.

Pen		
Number of head		
Breed (select one)	☐ Bos taurus ☐ Bos indicus ☐ Wagyu/Wagyu x ☐ Bos indicus x (> 50% indicus) ☐ Mixed	
Coat colour (select if one of these is predominant coat colour)	☐ Black ☐ Red	
Class	☐ Steer ☐ Bull ☐ Heifer ☐ Cow ☐ Mix	
	Are bulls and heifers housed together?	☐ Y ☐ N
Induction	Were cattle mixed before, during or since?	☐ Y ☐ N
	Days since last social mixing	
Feeding program (select one)	☐ Short (40-70 days) ☐ Short/medium (70-120 days) ☐ Medium (120-180 days) ☐ Long (>180 days)	
Home pen	Pen size (m^2)	
	Pen type: (selection one) ☐ Home ☐ Hospital ☐ Exit ☐ Induction	

	Are artificial shade structures provided?	☐ Y ☐ N
	If yes, shade provision (m^2/head available at midday)	
	If yes, where are structures located?	
	Are shelter structures provided? (e.g. roofed shelter structures, shelterbelts, wind breaks, temporary shelter)	☐ Y ☐ N
	Feed bunk access (cm/head)	
	Number of water troughs	
	Are water trough/s shared with adjacent pen/s?	☐ Y ☐ N
	Water trough/s access (mm/head)	
	Are extra water troughs provided during heat stress events	☐ Y ☐ N
	Is enrichment provided? (e.g., brushes)	☐ Y ☐ N
	If yes, what type?	
	Pen base structure: (select one) ☐ Clay ☐ Rocky ☐ Limestone ☐ Road base/compacted aggregate ☐ Sandy	
	Bedding provided? If yes, specify: _____	☐ Y ☐ N

<u>Pen Welfare Measures</u>

Collection interval: monthly

This should be completed once for each unique individual lot monitored.

NOTE: Different recordings below to occur at TWO different timepoints within the day:**

Early morning (07:00 – 08:00); Mid-afternoon (14:00 – 15:00).

Date:				
Early morning (07:00 – 08:00)	**Dry bulb temperature (°C)**		**Wet bulb globe temperature(°C)**	

	Precipitation (mm)*		**Wind speed (km/hr)**	
	Heat Load Index (HLI)			
Mid-afternoon (14:00 – 15:00)	**Dry bulb temperature (°C)**		**Wet bulb globe temperature(°C)**	
	Precipitation (mm)*		**Wind speed (km/hr)**	
	Heat Load Index (HLI)			
*Total amount (mm) of rain received in the preceding 72 h in accordance with the feedlot weather station or nearest locally accessible weather records **Weather variables collected by automated weather station				

Date:		**Pen:**	
Days on feed:		**Lot number/s**	
Number of head:		**Stocking density (m^2/head)**	
1.A. Early morning (07:00 – 08:00)			
Time of assessment:			
Reactivity Index: from the laneway, approach the mid-point of the feed bunk, stopping 1m from the bunk and take hat off to wave back-and-forth twice, recording the following:			
% cattle with no reaction:		% cattle that retreated (backed away and/or stood up):	
Posture:			
% standing		% lying (lateral and sternal recumbent)	
Is shivering/huddling behaviour present?	☐ Y ☐ N		
Cattle showing signs of agitation due to biting flies (e,g., hoof stamping, head winging, tail flicking and tightly huddled group)? (select one)	☐ No agitation ☐ Moderate agitation ☐ Severe agitation		
Dispersion:			
% grouped at water trough/s		% grouped under artificial shade structures	
Ethogram: observe cattle using a scan sampling approach and record the following:			
% resting:		% ruminating	
% eating		% drinking	
% self-grooming		% engaged	
% abnormal behaviours			

Demeanour: observe cattle for at least 30 seconds prior to scoring the following terms against a Visual Analogue Scale (VAS; 0 -1 00). To score, place an X along the line for <u>each term</u> (Min = term not expressed, Max = term being expressed to the fullest by all animals in the pen)	
Active	Min _____ Max
Agitated	Min _____ Max
Alert	Min _____ Max
Curious	Min _____ Max
Content	Min _____ Max
Dull	Min _____ Max
Lively	Min _____ Max
Nervous	Min _____ Max
Settled	Min _____ Max
Sociable	Min _____ Max
Uncomfortable	Min _____ Max

Record panting scores and drinking behaviour only if PS2 or above was observed the previous day or heat stress condition are expected today			
Morning panting score (% pen per score). For mixed breed pens, record % per breed per PS			
PS0:		PS1:	
PS2:		PS3:	
PS4:			
Drinking behaviour (select score that best described the behaviour of cattle at the water trough)	☐ Disinterested ☐ Some keen ☐ Crowding ☐ Hovering over water trough		

1.B Feed measurement	
Before delivery of fresh feed (feed out):	
Feed trough cleanliness (select one)	☐ Not observed (slick trough) ☐ Clean ☐ Foreign bodies ☐ Faecal matter
At first delivery of fresh feed (feed out):	
Feed out time	
Feeding behaviour (to add up to 100%)	
% cattle disinterested:	% cattle pushing/competitive:
% cattle keen/calmly approaching feed bunk:	

2. Mid-afternoon (14:00 – 15:00)	
Time of assessment:	

Reactivity Index: from the laneway, approach the mid-point of the feed bunk, stopping 1m from the bunk and take hat off to wave back-and-forth twice, recording the following:			
% cattle with no reaction:		% cattle that retreated (backed away and/or stood up):	
Posture:			
% standing		% lying (lateral and sternal recumbent)	
Cattle showing signs of agitation due to biting flies (e,g., hoof stamping, head winging, tail flicking and tightly huddled group)? (select one)	☐ No agitation ☐ Moderate agitation ☐ Severe agitation		
Dispersion:			
% grouped at water trough/s		% grouped under artificial shade structures	
Ethogram: observe cattle using a scan sampling approach and record the following:			
% resting:		% ruminating	
% eating		% drinking	
% self-grooming		% engaged	
% abnormal behaviours			
Demeanour: observe cattle for at least 30 seconds prior to scoring the following terms against a Visual Analogue Scale (VAS; 0 -1 00). To score, place an X along the line for <u>each term</u> (Min = term not expressed, Max = term being expressed to the fullest by all animals in the pen)			
Active Agitated Alert Curious Content Dull Lively Nervous Settled Sociable Uncomfortable	Min _____ Max Min _____ Max Min _____ Max Min _____ Max Min _____ Max Min _____ Max Min _____ Max Min _____ Max Min _____ Max Min _____ Max Min _____ Max		
Record panting scores and drinking behaviour only if PS2 or above was observed the previous day or heat stress condition are expected today			
Afternoon panting score (% pen per score). For mixed breed pens, record % per breed per PS			
PS0:		PS1:	
PS2:		PS3:	

PS4:			
Drinking behaviour (select score that best described the behaviour of cattle at the water trough)	☐ Disinterested ☐ Some keen ☐ Crowding ☐ Hovering over water trough		
Health indicators			
Number of cattle with nasal discharge:		**Number of cattle with ocular discharge:**	
Number of cattle coughing:		**Number of Ill-thrifty cattle:**	
Number of lame cattle:		**Number of non-ambulatory cattle (not structurally sound, unable to bare weight, walk to feed and water without oppressive pain):**	
Do non-ambulatory cattle have easy access to feed and water? (select one)	☐ No feed and water ☐ Cattle did have feed and water ☐ No non-ambulatory cattle observed	**Non-ambulatory cattle (select one):**	☐ Did not receive assistance ☐ Did receive assistance ☐ No non-ambulatory cattle observed
Number of cast animals (animal unable to stand due to weight and position of ground and require human intervention to stand)		**Calving heifers/cows (select one)**	☐ Calving heifers in distress did not receive assistance ☐ Calving heifers in distress did receive assistance ☐ Calving heifers observed but not in distress ☐ No calving heifers observed
Nursing heifers/cows provided with a safe and clean environment for calving that promotes survival?	☐ Y ☐ N	**Newborn calves in distress (select one):**	☐ Newborn calves in distress did not receive assistance ☐ Newborn calves in distress did receive assistance ☐ Newborn calves observed but not in distress

			¨ No newborn calves observed
Water contamination (select one)	☐ Not observed (empty trough) ☐ Clean ☐ Mild (dust/feed/saliva/algae) ☐ Moderate (faeces/ dust/feed/saliva/algae) ☐ Marked contamination (non-potable)		
Water trough fill (select one)	☐ Empty ☐ 25% full ☐ > 50% full ☐ 100% full		
Faecal pat consistency (select one)	☐ Very dry, lumpy pats ☐ Dry, stiff, semi-formed ☐ Circular, moist raised pat with symmetrical rings around a dipped centre ☐ Flat, loose, thinly spread pat ☐ Liquid pool of faeces		
Animal mud depth (select one)	☐ No cattle with mud at dewclaw level or higher ☐ < 10% pen surface with cattle with mud at dewclaw level or higher ☐ 10 – 25% pen surface with cattle with mud at dewclaw level or higher ☐ 26 – 50% pen surface with cattle with mad at dewclaw level or higher ☐ > 50% pen surface with cattle with mud at dewclaw level or higher		
Cattle cleanliness score (select one)	☐All cattle are clean ☐ Some cattle with leg and thighs covered ☐ Most cattle with legs and thighs covered ☐ Some cattle with thighs and bellies covered ☐ Most cattle with thighs and bellies covered ☐ Some cattle covered completely - mild ☐ Most cattle covered completely - mild ☐ Some cattle covered completely - heavy ☐ Most cattle covered completely - heavy ☐ All cattle heavily covered		

11.3.8 Table 5.C Monthly assessments recorded at a feedlot level

Collection interval: monthly

This template enables accredited animal welfare officers (or appropriately trained staff) to review records of morbidity, mortality, euthanasia rate, and thermal comfort of the entire feedlot population. Data can be extracted from software and data recording systems present at the feedlot to determine the below metrics retrospectively.

Pen Management		
Average feedlot occupancy for the past month		
Total head days for the past month		
Number of calves born at premise in past month	Born:	
	Sold/cared for as poddy calf:	
	Euthanised:	
	Dead calves (including still born) in home pen:	
Mortality (head)	Found dead in home pen:	
	Emergency euthanasia in home pen or laneway:	
	Moved to hospital pen for treatment then euthanized:	
	Found dead in hospital/reject/chronic pen:	
Facility injuries during and post-induction (head)		
Morbidity rate per 1,000 head days (animals moved out of pen for treatment/total head days for the month)	Cattle treated:	

	Morbidity rate:	
Autopsy rate (number of autopsies conducted/number of deaths in the past month)	Cattle autopsied:	
	Number of deaths:	
	Autopsy rate:	
Euthanasia rate per 1000 head days (number of animals euthanised/total head days for the month)	Head euthanised:	
	Euthanasia rate:	
In the past month, how many days was open mouth panting observed (panting score greater or equal to PS3)?		
In the past month, how many days of cold (cattle huddling/shivering) has occurred?		

11.3.9 Table 6.0 Husbandry welfare practices

Collection interval: monthly

This template is constructed for the accredited animal welfare officer (or appropriately trained staff member) to assess welfare practices in hospital pens or in animals undergoing husbandry procedures on a monthly basis. The number of hospital pens to be assessed is based on what is available and the size of the feedlot according to the table below.

Sample sizes and approximate time needed for each assessment type based on feedlot size (head).

Assessment type	**Feedlot size (head)**							
	< 5,000		**5,000 – 10,000**		**10,000 – 20,000**		**> 20,000**	
	Sample size	**Approx. time[A]**	**Sample size**	**Approx. time[A]**	**Sample size**	**Approx. time[A]**	**Sample size**	**Approx. time[A]**
Hospital pens[B]	1-2 pens	5 – 15 min	2 – 3 pens	15 – 30 min	3 – 5 pens	30 – 45 min	5 – 7 pens	45 – 60 min

[A]Time needed is an estimate only based on research team experience.

[B]The number of hospital pens or trucks to be assessed is based on what is available and the size of the premises. If premises have less than the number of hospital pens indicated above in use, all hospital pens that contain cattle should be assessed.

Observe management of animals and procedures

The template below is scored according to a two-point scale of 0 – 1, where a score 0 is awarded when the assessment item is not achieved/observed, and a score 1 is awarded where the assessment item has been achieved/observed. For example, if there is appropriate shelter or shade provided in hospital pens, a score 1 is awarded. If there is no appropriate shelter or shade, then a score 0 is awarded.

Cattle and facilities	
Shelter or shade provided	0/1
Pen surface provides a dry and comfortable resting place for cattle	0/1
Pain relief used for painful husbandry procedures	0/1
Appropriate hygiene procedures used	0/1
Appropriate handling and restraint used	0/1
Staff aware of treatment plan and return to pen criteria	0/1
Resources and equipment back-up for euthanasia sighted	0/1
Hospital pens space allowance greater than $15m^2$/SCU	0/1
Confirmation of rapid loss of consciousness and animal death utilised	0/1
Humane killing methods utilised (captive bolt or appropriate firearm)	0/1
Staff knowledge/evidence of timeliness of euthanasia (e.g. animal euthanized within 4 hours of decision to euthanise)	0/1

From protocols and training records:	
Staff have received training and know where protocols are for hospital treatments	0/1
Staff have received training and know where the protocols are for Chronic/Salvage pens	0/1
Staff have received euthanasia training (technique)	0/1
Staff have received euthanasia training (decision criteria)	0/1
From records:	
Body weight monitored in hospital pen	0/1
No post-induction complications from husbandry procedures	0/1
No post-hospital treatment complications	0/1
Total score:	**/18**

Observe animals in hospital pen.

For each month observe animals in hospital pens. For each individual animal, record the following.

Demeanour: Observe each animal for at least two (2) minutes prior to scoring the following terms against a Visual Analogue Scale (VAS; 0 -1 00). To score, place an X along the line for <u>each term</u> (Min = term not expressed, Max = term being expressed to the fullest by all animals in the pen)	
Active	Min _____ Max
Agitated	Min _____ Max
Alert	Min _____ Max
Curious	Min _____ Max
Content	Min _____ Max
Dull	Min _____ Max
Lively	Min _____ Max
Nervous	Min _____ Max
Settled	Min _____ Max
Sociable	Min _____ Max
Uncomfortable	Min _____ Max

Definitions – husbandry
Animals that are sick or injured should be provided with shade or shelter, and a dry and comfortable resting place
Appropriate handling aids are drafting sticks, rattle paddles and flags. They should be used to encourage an animal to move, but never used to hit an animal
Electric prodders must only be used to assist movement of cattle when animal or human safety is at risk or as a last resort when all other humane alternatives have failed and only when cattle have a clear path to move. An electric prodder should not be used on an animal which has nowhere to go or is already moving in the right direction, such as animals at the back of the mob.
The use of **pain relief** is compulsory for castration and dehorning of animals above certain ages. The Cattle Council of Australia has produced a guide with recommended pain relief strategies (https://cattlecouncil.com.au/assets/files/201008%20-%20CCA%20pain%20relief%20guide.pdf).

For best pain relief, surgical procedures (e.g., dehorning and castration) should be accompanied by multi-modal pain relief using local anaesthetic (such as TriSolfen) PLUS longer-acting Non-Steroidal Anti-inflammatory Drugs (such as Meloxicam, Buccalgesic).
Good hygiene involves washing hands and instruments, keeping separate containers with antiseptic for washing hands and storing instruments, and changing antiseptic solution and blades and needles after every 30 animals or earlier if needle is blunt or burred.

Demeanour term	**Description**
Active	Energetic, lively, busy body movement and actions
Agitated	Restless, frustrated, uneasy, reactive, nervous movements
Alert	Wide awake, fully aware, attentive, vigilant, engaged with surroundings, ready to act
Curious	Positive interest, questioning and inquisitive towards surroundings, actively exploring and engaging with environment
Content	Above means met, state of satisfaction, confident, contentment in life situation, appeased, happy in control and at ease
Dull	Lacking interest, dispirited or wearied, slow moving, tired, may include an element of being unwell
Lively	Animated, energetic, excited, eager, enthusiastic, playful, positively engaged with surroundings and/or other cattle
Nervous	Anxious, alarmed, worried, tense, unsure, unable to settle, reactive to stimuli, vigilant or watchful
Settled	Quiet, calm, relaxed and resting
Sociable	Actively seeking engagement with conspecifics, friendly, gregarious, hostile, aggressive or angry, may include social grooming, play, antagonistic and displacement behaviours, or mounting/riding
Uncomfortable	Showing signs of physical discomfort, uneasy, irritated

11.3.10 Table 7.0 Nutrition and feeding information

Collection interval: monthly

This template is constructed for the accredited animal welfare officer (or appropriately trained staff member) to assess nutrition and feeding welfare related measures a monthly basis. The number of home pens to be assessed is based on what is available and the size of the feedlot as outlined in Section 5 B. The template should be completed once for each unique individual lot monitored.

Date:		**Pen:**	
Days on feed:		**Lot number/s**	

Nutrition and Feeding Information	
How often are animals fed? (select one)	☐ Not every day ☐ Limit fed ☐ Once daily ☐ Two or more times daily ☐ Self-feeder
For each **home** pen assessed, are animals usually fed within 2h of target feeding time?	☐ Y ☐ N
For each home pen assessed, how full is each feed bunk? (record 1 hour **before normal** feed out time)	☐ Slick (licked clean) ☐ Crumbs (0-0.1 kg/head) ☐ 0.11-0.50 kg/head ☐ 0.51-1.0 kg/head ☐ Greater than 1 kg/head
Is there evidence of feed contamination in the feed bunk (e.g., mould, foreign bodies, faecal matter, water etc.…) (record 1 hour **before normal** feed out time)	☐ Y ☐ N
For each home pen assessed are any bunks slick at 6pm (for cattle that are not limit fed for programmed growth)? *	☐ Y ☐ N

Are bunks slick 3 hours before feed out for 3 days in a row (for cattle that are not limit fed for program growth)? *	☐ Y ☐ N
*Excluding limit fed cattle and those provided with an additional food source in the pen	

11.3.11 Table 8.0 Other animals

Collection interval: six-monthly

This template is constructed for the accredited animal welfare officer (or appropriately trained staff member) to assess welfare of other working animals on a six-monthly basis. If new animals are brought onto the premises, this template should be filled out again.

Other Working Animals	
Is the body condition score of horses on the feedlot appropriate for working conditions?	☐ Y ☐ N ☐ N/A
Do any of the horses have injuries or are lame?	☐ Y ☐ N ☐ N/A
Are the vaccination/treatment and worming protocols of the horses up to date?	☐ Y ☐ N ☐ N/A
Is the body condition score of dogs on the feedlot appropriate for working conditions?	☐ Y ☐ N ☐ N/A
Do any of the dogs have injuries or are lame?	☐ Y ☐ N ☐ N/A
Are the vaccination/treatment and worming protocols of the dogs up to date?	☐ Y ☐ N ☐ N/A
Do all working animals have water available at all reasonable times?	☐ Y ☐ N ☐ N/A
Do all working animals have appropriate housing including appropriate kennel/stable size, bedding, cleanliness/cleaning roster?	☐ Y ☐ N ☐ N/A
N/A indicates that a feedlot does not use/house these animals.	

Definitions – other animals
Adequate/appropriate body condition score: One which enables the animal to work effectively without the potential for causing excess stress, illness, exhaustion or injury.

11.3.12 Table 9.0 Abattoir feedback

Collection interval: monthly

This template enables accredited animal welfare officers (or appropriately trained staff) to review records provided by processing plant/abattoir from routine ante-mortem inspections. Data can be extracted from software and data recording systems present in feedback sheets from the abattoir to determine the below metrics retrospectively.

Abattoir feedback	
% consignment rejected from slaughter/condemned:	
% consignment withheld for further treatment:	
% consignment requiring emergency treatment:	
% consignment requiring restricted slaughter:	
For more information regarding ante-mortem inspections refer to the Australian Meat Processor Corporation (AMPC) 'Is the animal fit to process?' guide.	