final report

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Performance data collection – scoping study

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Abstract

This project has involved consideration of the current and likely future regulatory environments, external drivers, and current industry practices in relation to collection and management of data on animal health and welfare outcomes across the livestock export supply chain. It is recommended that the livestock export industry consider the development of a web-based, industry-owned, data management system to provide animal identification and traceability capability and associated functions limited to regulatory compliance and industry QA requirements.

Executive Summary

This project has involved consideration of the current and likely future regulatory environments, external drivers, and current industry practices in relation to collection and management of data on animal health and welfare outcomes across the livestock export supply chain.

In addition to the regulatory requirements in place at the commencement of this project, exporters must now comply with ESCAS requirements including traceability and reconciliation of animal records and providing audit reports against defined standards.

ASEL and the broader regulatory environment is under review and a new ASEL is likely to be released for comment within the next several months. It is likely that there will be a move towards performance based monitoring and extension of ESCAS type requirements more broadly across the supply chain. An industry QA program incorporating first and third party certification, verification and audit procedures is also under consideration to provide assurance of performance against standards.

This project began with a motivation to present options for industry collection and management of data on animal health, welfare and performance for a range of possible applications including strategic operational decisions, R&D and QA. Preliminary findings from consultations yielded little support for an industry system to collect data on animal performance through the export chain. This was largely because such data are viewed as commercially sensitive and many exporters were concerned about data being stored in any system that was not under the direct and exclusive control of the individual operator.

This interim finding shifted the focus for this project towards options for industry use of animal performance data to support QA and regulatory reporting requirements. The responsibility for managing data and information to document regulatory compliance lies with each exporter. There are significant technical and practical challenges in complying with these requirements and while some exporters appear to be managing this effectively there is variability between exporters. There are whole-of industry risks if an individual exporter experiences a serious adverse event particularly where that event might have been detected earlier or even avoided if there had been more effective monitoring and QA.

Development of an industry information management system that is based on animal performance data as part of a QA program has the potential to provide useful risk mitigation benefits at the industry level. It also has the potential to contribute to a co-regulatory framework where effective QA and performance that meets or exceeds required standards may be rewarded with a reduction in regulatory compliance burdens for exporters.

There are other important benefits to industry from an effective whole-of-chain QA system including the use of aggregated data for industry QA (documenting good performance and early detection and response to deviations) and for strategic purposes such as R&D prioritisation and improving routine operational practices.

Industry concerns over privacy and commercial sensitivity are recognised and in our view mean that the system scope should be limited to just those functions and data required for regulatory and QA applications.

The most effective solution for managing animal traceability across a supply chain starting in Australia and ending in a foreign country, is an internet-based solution that is built around web-enabled database technology.

While animal traceability is identified as the base or core functionality requirement, there are other functions related to regulatory compliance and industry QA that can then be added on to a system once traceability is achieved. These functions would lever additional benefit at marginal cost.

At the time this report was prepared there were limited software options available for the livestock export industry that provide functions related to animal traceability and QA. There is one commercial product providing animal traceability and reconciliation in compliance with ESCAS auditing requirements (LIRS^{TM}) and there are other products that may be able to be adapted or modified to meet industry needs.

Decisions about the creation, design and management of an information management system will depend on the outcomes of future deliberations within industry and between industry and other stakeholders including government including decisions concerning changes to ASEL and ESCAS and any industry QA program.

Recommendation:

> ***That the livestock export industry consider the information and options outlined in this report in any decisions relating to development of an information management system that may form part of an industry QA program.***

Abbreviation	Explanation
AAV	AQIS accredited veterinarian
AEP	Approved Export Plan
AHA	Animal Health Australia
AHCPLL	Application for Health Certificate and Permission to Leave for Loading
ALPA	Australian Livestock and Property Agents Association
AMLI Act	Australian Meat and Livestock Industry Act
AMSA	Australian Maritime Safety Authority
AQIS	Australian Quarantine and Inspection Service
ASEL	Australian Standards for the Export of Livestock
CRMP	Consignment Risk Management Plan
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAFF	Department of Agriculture, Fisheries and Forestry
DAFWA	Department of Agriculture and Food Western Australia
EC Act	Export Control Act 1982
EC(MMP)O	Export Control (Meat and Meat Products) Order
EID	Electronic IDentification
EOP	End of Processing report
ESCAS	Exporter Supply Chain Assurance System
FAO	Food and Agriculture Organisation
FMD	Foot and Mouth Disease
HACCP	Hazard Analysis and Critical Control Points
HSRA	Heat Stress Risk Assessment
ID	Identification
IPAR	Independent Performance Audit Report
IT	Information Technology
LNC	Consignment Reference Number
LTS	Land Transport Standards
MLA	Meat and Livestock Australia
MICOR	Manual of Importing Country Requirements
NLIS	National Livestock Identification System
NOI	Notice of Intention
NTLEA	Northern Territory Livestock Exporters' Association
NVD	National Vendor Declaration
OAGM	Operations and Governance Manual for registered premises
O&G	Operations and Governance
OIE	World Organisation for Animal Health

PC	Personal Computer
PHP	PHP: Hypertext Preprocessor
PIC	Property Identification Code
PIRSA	Department of Primary Industries and Resources of South Australia
QA	Quality Assurance
R&D	Research and Development
RFID	Radio Frequency IDentification
RP	Registered Premise
SMS	Short Message Service
SOP	Standard Operating Procedure
SQL	Structured Query Language
ToR	Terms of Reference
TRACE	Tracking Animal Certification for Export

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1 Introduction

There is increasing interest amongst live export industry stakeholders in improving methods for routine collection and more effective utilisation of data and information relating to animal health and performance during the export process.

There is value in defining various terms that are used in this document because of variability in interpretation of these terms between different individuals.

Data refers to a measurement or observation that can be recorded on paper or electronically in a spreadsheet or database. Examples include animal ID or bodyweight. Data can be thought of as raw ingredients and may not be immediately useful by decision makers in the form in which it is collected.

Information can be produced by processing or analysing data and interpreting the results. Information is of direct value to decision makers. In the export industry for example, data relating to animal health (occurrence of particular diseases or deaths) or performance (feed intake, weight gain or loss, market price/profit), may be processed to produce information that operators can use to identify drivers of business profitability and sustainability. These may include identifying animal characteristics (source, breed, age, condition, weight) and management decisions (vaccination, management during weaning/transport/assembly) that are associated with better outcomes (lower morbidity/mortality and higher profit).

The term ***Information Management System (IMS)*** is used in this report to describe a system that collects routine data in a business enterprise, processes or analyses data in some way and then delivers information to decision makers to allow more effective decisions.

There are several broad drivers that may be contributing to interest in better utilisation of data on animal health and performance.

From a business management perspective, improved collection and use of data (and information) on animal health and performance will allow operators to better fine tune routine management of operations to ensure optimal animal health, welfare and performance.

There are also a range of strategic benefits from this information. Early identification of problems will allow rapid implementation of management strategies to minimise adverse impacts and prevent future adverse events. Monitoring can allow identification of practices that may be associated with beneficial (or adverse) impacts on outcome measures and can allow effective management of these practices to ensure continual improvement. The long-term benefit of these approaches is likely to be reduced costs and improved returns through reduction in adverse health events and losses and delivery of a healthy, fit-for-purpose animal to the destination.

Information on performance and identification of knowledge gaps can also be used to guide R&D investment decisions and may centralised data collection may contribute directly to R&D data requirements.

There is also increasing public scrutiny associated with quality assurance (QA) that has been largely driven by concerns over animal welfare for animals that are exported from Australia to other countries. The recently completed Independent Review into Livestock Export Trade (Farmer Review)[1] provides a detailed assessment of the export industry and makes a number of recommendations concerning whole-of-chain quality assurance. The report identifies an opportunity for industry to demonstrate a proactive leadership role in the development of more effective monitoring and QA with the implication that regulatory enforcement of procedures might follow if industry does not demonstrate progress in this area. Other recent reports (Schuster 2013; Shiell et al 2013) have also discussed options for industry QA programs.

This project was developed as a scoping study based on consultation with industry stakeholders to identify needs and constraints/concerns for routine collection of animal health and performance data during export.

2 Changing export environment

A number of circumstances occurred in the period between finalisation of the Terms of Reference for this project and completion of the project.

The first was the development of ESCAS regulatory requirements and the growing interest amongst stakeholders for whole-of-chain quality assurance. ESCAS presented major challenges to exporters with respect to managing data for animal traceability.

There was also increasing interest in QA programs with associated uncertainty over what data might be collected and managed under a QA program and what opportunities there might be along the supply chain to collect data for QA purposes.

Preliminary discussions with exporters conducted as part of the initial process of stakeholder consultation for this project produced a clear message indicating that exporters were generally not in favour of a centralised information management system that might collect and store animal health, welfare and performance data. This was mainly because of concerns over commercial sensitivity.

These factors have impacted some of the findings for the current study and have shifted the focus of the work. The result has been a move away from any industry system that might be justified based on general benefits to operational and strategic decisions and to focus on systems that might support industry risk management through a QA program.

3 Project objectives

The purpose of this project was to develop a discussion document that summarises current understanding of methods used by industry operators for collecting, storing, analysing and using data related to animal health and performance during export. The document will also summarise a range of related issues identified in the background to this proposal and present brief descriptions of opportunities for improvements associated with systems built to take advantage of advances in hardware and software.

[1] http://www.livestockexportreview.gov.au

3.1 Project objectives

Describe findings from a review and consultation process with export industry stakeholders that includes:

1. Current systems used by exporters for collecting and using data/information related to animal health and performance, for animals that use individual animal identification (cattle) and animals that do not use individual animal identification systems (sheep).
2. Following industry consultation a description of exporters' expectations and potential benefits from an integrated information management system.
3. Opportunities offered by advances in technological capacity (hardware and software) for more efficient and effective collection and use of data related to animal health and performance.
4. Development of a baseline list of measurements and information outputs that might be of most value to individual operators and industry for routine business management and strategic purposes.
5. Opportunities for collection of data at various steps along the export chain from property of origin in Australia to assembly feedlot, export vessel, port of unloading at a foreign country, and final destination (property/feedlot/slaughter facility) in a foreign country.
6. Recommendations for long term data storage and analysis including suggested outputs from annual reporting.
7. Constraints and concerns regarding any matter related to collection of animal health and performance data (technical issues, confidentiality/commercial sensitivities, security, ownership).
8. Lessons learned from relevant project activities such as Live.123 and W.LIV.0252.
9. Options for designing, building, implementing and maintaining system components that can offer improved data collection and information management for export operators.

4 Consultation activities

Consultation with industry stakeholders was conducted through a combination of face-to-face site visits in combination with telephone and email discussion.

Multiple visits were made by the project team to office, port and assembly depot locations in Western Australia and Northern Territory. A visit was also made to DAFF offices in Canberra to speak to Department staff with responsibility for aspects of the live animal export trade. Telephone and email consultations were conducted with a much broader range of stakeholders. During the course of this project we have engaged with exporters, assembly depot management personnel, third party veterinarians, government veterinary officers at national and regional levels, transport operators, agents, buyers, researchers, producers, and peak body representatives.

Both project team members have also participated in recent R&D projects that have involved visits to assembly depots and ports in Victoria, South Australia, Western Australia, and Northern Territory to observe routine management practices including management of data relating to animal health, welfare and performance measures.

Details of consultation activities are provided in an appendix.

5 Results

Some of the objectives in the original ToR were considered to be less relevant as a result of the changing regulatory and operating environment. The results are therefore presented under headings that are considered to reflect the findings and the current export environment rather than attempting to report strictly to the original objectives.

5.1 Current systems for managing animal performance data

Methods and systems used by exporters and other stakeholders for managing data on animals through the supply chain are variable and changing over time, particularly in recent years since introduction of ESCAS requirements.

It is difficult to report a precise description of any details for software design and functionality because industry operators tend to view these issues as being commercially sensitive.

Systems for management of data and other information about animals have to meet multiple purposes for the exporter or other operators in the supply chain (RP manager, ship master etc). These include business management including logistics and financial information, management of animal health and welfare and management of regulatory requirements.

Over time these systems have generally been developed in an ad hoc fashion.

It is our understanding that exporters use multiple systems in combination to manage animal performance data through the chain including any combination of paper records, spreadsheet files, database files and custom developed business management solutions generally built around database technology.

Some exporters have extended business systems by building web-based interfaces that allow authorised users to access the system from remote locations through the internet, either to upload new data or just access current records. Users may be accessing these systems through hand-held devices such as tablets or through desktop computers with internet access.

All exporters have developed systems for managing individual animal ID for cattle using NLIS scanning and electronic ID records. All systems are built around the use of commercial hand-held wands and fixed panel readers that are used for reading NLIS electronic tags and generating lists of tag numbers that can then be imported into a database or spreadsheet program for data management.

Management of ESCAS traceability and reporting requirements has involved either modification of existing programs (spreadsheet and database) or development of new programs for collecting and managing animal data.

Existing off the shelf software solutions that can handle animal ID records are mainly developed for other applications (feedlot, saleyard, abattoir and producers) and are not generally designed for specific activities related to livestock export traceability and reconciliation, particularly when animals from one consignment may be moved to multiple different end locations.

A recent example of a commercial software product being marketed specifically for live export management purposes is *Live Import Reporting System (LIRS^{TM})*[2]. LIRS is advertised as providing animal traceability and reconciliation from point of shipping through to slaughter in an export destination.

5.2 Findings from industry consultation

Industry operators (exporters and operators of assembly depots) view data on animal health and performance through the chain as being commercially sensitive and part of their day-to-day business management. There is little support for a centralised industry-managed system that may collect and manage animal performance data on behalf of the broader industry.

Those operators that have developed more sophisticated systems for managing animal performance data (including traceability) see this functionality as part of their potential competitive market advantage.

There are perceptions amongst industry that a centralised information management system may pose additional risk to industry because of possible release of data or information to any individual or entity that may use that information for purposes that include campaigning against the continued existence of the trade or to support calls for further regulatory control.

Industry stakeholders (industry and government) expressed concern about the complexities and lack of standardisation and clarity in trying to understand and follow the current regulatory environment. There are concerns over conflicting information presented in different regulatory documents and also over the amount of paper forms that have to be completed at different steps along the chain.

[2] LivestockExchange www.livestockexchange.com.au

Many of these issues have been described in more detail in a recent report by Shiell, Perkins and Hewitt (2013).

Exporters acknowledge challenges in developing efficient traceability systems that are capable of meeting ESCAS requirements and frustration at the practical difficulties in achieving perfect traceability in other countries when dealing with imperfect biological systems, particularly when those same systems appear unlikely to be capable of delivering perfect traceability under routine Australian management practices. There are relatively large volumes of data on animal ID, collected by many different people using different methods. Records are collected at multiple different locations and have to be accurately reconciled. Problems are being encountered with data entry errors, NLIS tags that are lost or that fail to read, and management and maintenance of hardware (tag reading devices) in remote locations.

The recent implementation by DAFF of a web-based system for managing records associated with livestock export – called Tracking Animal Certification for Export (TRACE) – represents a move towards electronic record management but it still relies heavily on uploading files as attached documents rather than entering data directly into a database. These attributes mean the system may be considered to serve more as an archive rather than a more dynamic system with the ability to process data and offer current and searchable information in real-time.

There are concerns over the balance between government imposed certification, inspection and/or audit procedures and the role of industry or independent QA systems in providing confidence of performance against standards. An increased level of activity for government officers in providing services relating to inspection/certification/audit or other regulatory purposes since the implementation of ESCAS, appears to be viewed by some stakeholders as difficult to sustain without changes to staffing levels (increasing numbers of DAFF officers with export responsibilities) and rising government fee scales for cost recovery. At the same time there is public and government support for continued involvement of government officers in these activities in order to provide confidence of performance against standards.

Government and industry have identified QA systems as having the potential to provide an important contribution into assurance of performance against standards. At the time this report was prepared, a separate report by Peter Schuster had just been completed on development of a risk management and quality assurance program in relation to ESCAS (Schuster 2013).

Industry QA that is based on independent audit and certification systems and that offers continuous, rigorous and auditable evidence of performance has the potential to support moves for improved social licence to operate in the longer term. It also has the potential to support moves towards reduced direct involvement of government officers in inspection and audit functions under a co-regulatory environment with increased industry responsibility for performance monitoring.

Industry consultation during this project indicated general support for QA but with competing drivers related to scope and implementation. Commercial drivers support decisions based on minimising cost through a streamlined and simplified regulatory environment while recognising the need to optimise welfare outcomes. Community concerns support decisions based on optimising welfare outcomes as a priority. Government regulatory reform over the past several years suggests that a co-regulatory model is likely to be favoured with increased industry ownership and responsibility for performance achievement against a defined set of standards.

While there are differences in views, a notable underlying commonality is the commitment to animal welfare and documentation of performance against defined standards that underpins a sustainable live export industry.

5.3 Technology and applications

There are a number of capabilities offered by mainstream, commercially available technology that offer benefits to industry for management of animal performance data.

Individual animal ID systems for cattle based on RFID are now well established through the Australian NLIS and tag reading hardware is widely available. These systems form the basis for all individual animal traceability. RFID tags do fail over time and there is interest in robust back-up systems that provide animal ID in cases where RFID tags are lost or fail to read.

RFID tags for sheep (and goats) are available and are being used by some producers and researchers at the current time. There are a number of problems being reported for RFID tags in sheep and at the current time these tags do not appear to offer sufficiently robust and reliable individual animal traceability for sheep and goats to suggest that this system may offer a traceability solution for livestock export. While this may change in the future it is suggested that sheep and goat traceability continue to be based on visual tags.

There are a number of mainstream technical capabilities that offer major benefits in the implementation and operation of any information management system that may handle animal performance data:

- Web-based systems can be accessed from anywhere around the world and at any time through the internet.
    - Web-based systems are independent of computer platform (PC, Apple) and can be accessed by any instrument that can load a web-browser (smartphone, tablet, hand-held device, computer).
    - As soon as data are uploaded and verified, a user can access these data, providing the capacity for real-time updates so the system should always be capable of displaying the latest information.
- Open-source database solutions offer free software platforms that are capable of building powerful, scalable solutions that can handle large and complex data.
    - Many of the world's largest online databases are built using open source database software based on forms of structured query language or SQL (MySQL or PostgreSQL) in combination with server-side scripting software such PHP (PHP: Hypertext Preprocessor) that allows processing of database content through a web-interface. The combination provides a cost-effective, powerful and scalable solution for managing complex datasets.
- RFID tag scanners can be used to read tags and transmit data via cable or wireless (WiFi or Bluetooth technology) to another device capable of uploading data into a web-based system (hand-held device or computer).
- Mapping and advanced analytical capabilities can be incorporated into these systems also using open-source software to produce pre-programmed, automated analyses and outputs on a web interface or to allow interactive analyses that can be developed to answer specific queries.
- It is possible to extend the web-based system so it can interact with mobile phones via SMS (short message system). This is completely different to internet-based access and requires a

functional mobile phone service instead of internet. Developing this capacity means that a user can interact with the system via a mobile phone from a location where there is mobile phone coverage but no internet access. From a practical point of view a user in a remote location has the potential to enter animal data (individual animal ID or consignment ID and count), status update (location or whether or not the animals have been processed or some other specific code) and send that to the web-based database via SMS. A user could also query the system by sending an animal ID for example and a code defining a specific question. The web-based system can then receive the query via SMS, process it and send a reply via SMS so the user gets an immediate response.

- Systems can be built using a two-stage process that ensures core speed while allowing for flexible development over time:
  - A fixed database structure can be used for the back end comprising the major tables for storing core data and information. These tables would be based on fields that are unlikely to change over time such as those related to animal traceability and other core functions. Having these in a separate fixed structure results in performance advantages so that these tables can be heavily used and accessed without interfering with performance.
  - The second level of functionality involves separate linked table structures that provide for flexible functions. These tables may draw on data from the fixed table structure but may run queries or interim analyses to produce more complex or user defined outputs. The purpose of this flexible functionality is that it can then be modified or extended at any time to meet user needs. This combination provides maximal flexibility and functionality without compromising performance and allows future extension and development of functions without requiring complex restructuring of the entire database. An example of additional functionality is the addition of a full range of QA functions including certification and audit procedures and recording of performance monitoring at any step along the chain.
- Web-based systems can incorporate multiple languages in look-up tables so users may change language on the fly and have the system display in their own language.

It will be important for any system to have adequate security measures in place to ensure data integrity and also to prevent any unauthorised access to or use of the system. Security can be developed to a high level for web-based systems and the widespread adoption of internet banking and other secure systems is a testament to this. Security based functionality is likely to include:

- Registration of all users within the system so that any user will require appropriate authentication to access the system.
- Provision of different levels of access so that specific users can be allowed to access only those parts of the system that they need to be able to access to complete defined task(s). The same approach means that users from one organisation will only be able to view or access records and information from their own entity.
- Any time a specific user accesses the system their activities can be recorded for subsequent audit purposes.
- Data redundancies can be built into the system so that any time a field is changed in any way, the original value is stored in a date-stamped record along with the current value, time and date of change and a record of the registered user making the change. This sort of approach ensures that it is not possible to completely remove or delete data from the system and that any changes are able to be reversed if required.

It is possible to extend coverage for an information management system to include voyages. For ships without internet access, systems may involve collection of data onto a handheld device or

laptop during the voyage and then uploading data to the web-based system once internet access is available. It is understood that ships are increasingly likely to provide satellite access in shared crew areas meaning that it should be possible to incorporate voyage activities into the system and have voyage data uploaded to the system through intermittent access to satellite based internet. Given that land-based parts of the supply chain within Australia can be expected to have access to a web-based system, this means that any system can effectively be deployed across the entire supply chain from receival in the assembly depot to point of slaughter in a foreign country provided that all areas have either internet or mobile phone coverage.

5.4 Is there a need for an industry system?

There have been mixed responses to issue of whether or not there is justification for collection of animal-level performance data in an industry-level information management system.

The livestock export industry is competitive and individuals may rightly view data management systems as being commercially sensitive areas that may contribute to market competitiveness. There is also a very high level of concern generally held by all industry operators about any system that requires industry operators to provide data on commercially sensitive operations where the system is not under the direct and exclusive control of the individual operator. These two factors are seen as acting against the development of any industry owned management system.

The major justifications for an industry management system are based on the likely need for whole-of-industry QA and the risks to the industry if an effective system is not developed.

At the moment the expectation is that individual exporters will develop their own systems to manage compliance with ESCAS and other regulatory requirements. The regulatory requirements are common for all exporters and there are significant technical and practical challenges in complying with these requirements.

Future changes in the regulatory environment are likely to extend ESCAS-type monitoring and reporting activities over the entire supply chain from receival at a registered premise in Australia through the voyage in addition to current ESCAS coverage post-discharge. Development of an industry QA program is also likely to add certification, verification, audit and other QA procedures are various points across the supply chain. There are also suggestions that efficiencies may be gained in QA programs through sharing certain activities. An example may be where two different consignments or exporters are using the same supply chain and may share various QA activities. Again, this reinforces the concept of industry-wide standards and QA responsibilities.

Meeting current ESCAS traceability and reporting requirements is difficult. While some exporters appear to be managing these processes effectively there is variability between exporters. There are major industry-wide risks if an individual exporter experiences a serious adverse event particularly where that event might have been detected earlier or even avoided had been more effective monitoring and QA in place. A major adverse event has the potential to result in impacts beyond the exporter(s) and supply chain(s) directly involved and in a worst case scenario has the potential to threaten the entire industry.

Development of an industry-wide, standardised platform that is capable of managing QA program data to a common standard provides an option for risk mitigation. Currently exporters with the very

best systems already in place are bearing additional risk as a result of the actions of any one exporter that does not have effective systems in place.

There are other important benefits to industry from an effective whole-of-chain QA program including the use of aggregated data for industry QA (documenting good performance and early detection and response to deviations), social licence to operate, reduced regulatory burden in a co-regulatory environment, and for strategic purposes such as R&D prioritisation and improving routine operational practices. Most of these benefits are expected to be difficult to achieve if each industry operator is left to develop their own systems for regulatory compliance and QA.

It is also important to note that an industry owned information management system will require resources for development, training and implementation and will require additional resources for ongoing support, maintenance and further development over time.

5.5 What is the suggested scope of an industry system?

It is suggested that the scope of an industry information management system be confined to meeting industry QA and regulatory requirements.

This scope ensures that the system is able to mitigate industry wide risk by providing a standardised platform capable of supporting effective QA and regulatory compliance.

The major reason for proposing this defined scope is to allay industry concerns over uploading commercially sensitive data and information onto an industry wide system and to limit the collection of data and information into the system to those field that are already being made available to authorities as part of existing compliance and reporting requirements.

5.6 What capabilities might an industry system deliver?

Capabilities and applications directly related to QA and regulatory compliance include:

1. Being able to provide animal traceability through the supply chain and deliver the associated ESCAS performance audit and end-of-processing requirements relating to reconciliation of animals at each step along the chain through to point of slaughter.
2. Being able to provide the same animal traceability and audit reporting over those portions of the supply chain falling under ASEL (assembly depot, load-out, voyage), based on a likelihood that these reporting requirements will be extended to cover all parts of the supply chain.
3. Being able to manage all activities related to initial independent audits that are currently conducted as part of ESCAS to document control of the supply chain.
4. Being able to manage all activities related to a future industry QA program including:
    a. certification and verification records;
    b. records of any other performance monitoring against standards;
    c. records of corrective actions;
    d. repository of procedures, protocols, manuals, training and competency records and any other documentation required for the QA program.

If an industry system were developed with the above capabilities, then it would be possible to draw on data from this system to meet compliance requirements including generating various reports or other documents at different steps along the chain.

It is assumed that animal ID records may be entered into the system on receival at the assembly depot. From that point on, any update of animal status (location, health, treatments) that is stipulated in a standard and that therefore falls under a QA program or under various defined reports that must be lodged to the Commonwealth (daily voyage reports, performance audit reports etc), may be created by the system for submission to relevant authorities.

Industry aggregated data may also be used for broader industry benefit. Any such use would require development of appropriate protocols and permissions and de-identification of data and would fall under control of an industry QA program.

Examples of applications for information derived from use of aggregated industry data include:

- Serving as the primary source of data for annual livestock export performance reports as are currently produced by Dr Richard Norris and Greg Norman through the national data recording system.
- Documentation of good performance with regular reporting backed up by analyses from the data management system.
- Development of a QA-based early detection and response capacity that recognises that biological systems are inherently unpredictable and that events will occur. The potential to use the data management system to detect and respond to deviations or potential issues before they become large problems and appear in mainstream media reports provides the most powerful message possible to regulator and public stakeholders that industry is committed to QA and sustainable performance in the face of natural uncertainty.
- Aggregated industry data provide a powerful tool for industry bodies to use for research, strategic and business purposes.
    - Research applications for aggregated data include using results from analyses of stored data to identify potential performance problems or knowledge gaps that can be addressed with specific research projects. Collected data may also be of research value itself.
    - Strategic applications involve the use of the data to determine factors that may be associated with good outcomes and others that may be associated with suboptimal outcomes and use this information to fine-tune operational decisions and make longer term strategic decisions.

5.7 Ownership and governance

Schuster (2013) has recently completed a report that presents options for industry QA programs and Shiell et al (2013) have also described options for management of industry QA as part of their report on a review of ASEL. Both these reports provide options for ownership and governance of industry QA program.

The data management system described in this report would most logically be developed as part of a broader industry QA program. It is understood that at the time this report was prepared industry groups were considering options with regard to QA programs.

5.8 Options for development of an industry system

Three options have been identified.

5.8.1 Do not develop an industry information management system

This option is based on maintenance of the status quo. Support for this option may be based on a view that data on animal health and performance should remain the property of each individual exporter and should not be contributed to an industry system.

Under this scenario, individual exporters would be responsible for developing the capacity to manage their own data in order to meet regulatory reporting requirements and any future QA program requirements.

The specific capabilities (or functionalities) and possible technical solutions described in this report may be of value to individual exporters as a source of information on attributes that they may choose to develop for their own needs.

5.8.2 Modify existing software or other systems

At the time this report was developed we were aware of one commercial software provider that appeared to be offering a software product specifically developed for meeting traceability and audit requirements for livestock export. This product is called *Live Import Reporting System (LIRS™)* and is developed by Livestock Exchange (www.livestockexchange.com.au).

There are a wider range of commercial software products that provide animal traceability functionality in conjunction with other applications (feedlot management or general beef cattle management).

Commercial software developers have strong incentives to develop applications that meet customer needs. Industry discussion with commercial software developers may result in incorporation of specific additional functionality into software products depending on cost and market impact.

There are a range of other non-commercial software products that may have functionalities that could be adapted to meet industry needs. Further decisions are likely to be required for development or modification of this type of system to resolve issues like ownership and governance, development costs, access, and on-going costs related to maintenance, support and further development.

Meat and Livestock Australia (MLA) has recently developed *Livestock Data Link (LDL)*[3] as a linked extension to the NLIS database. The LDL is understood to involve a partnership with processors so that carcass data recorded at the time of processing can be uploaded and linked to an individual animal NLIS record. Producers logged into the NLIS database can then use LDL to retrieve carcass performance data linked to their individual animal records. This type of system could be modified to incorporate the functionalities described in this report.

[3] http://asp-au.secure-zone.net/v2/index.jsp?id=804/885/2562&startPage=2

AusVet Animal Health Services has recently developed a prototype information management system called *Asian Livestock Identification and Traceability System (ALIATS)* through an FAO-funded project aiming to deliver proof of concept ideas to stakeholders in discussions about options for use of animal traceability in the Asian region for improved control of transboundary animal diseases Cameron and Madin (2011a b). This system has a number of features that are directly applicable to the capabilities outlined in this report and the underlying code could be adapted to contribute to a system tailored for livestock export needs.

5.8.3 Develop an industry information management system

If the export industry develops a QA program then this is considered highly likely to incorporate some form of centralised information management system to underpin and support the program.

Any such information management system would be developed with capabilities based on reports such as Schuster (2013), Sheill et al (2013), this report and subsequent industry decisions about the structure and function of the QA program.

An industry owned system could involve de-novo development of a full system or modification of an existing system (LDL or ALIATS or others).

The scope and detailed specifications of any industry owned system would need to be agreed on by industry stakeholders.

At one end of the spectrum of capabilities is the development of extensive data capabilities to meet all the functionalities described in this report as part of a range of QA functions.

At the other end of the spectrum of capabilities is the development of a centralised information management system underpinning an industry QA program that may focus mainly on procedures and protocols, templates and related documents. Under this sort of approach data related to animal health and performance and measures of performance for individual exporters against defined standards or QA targets may be managed by individual exporters.

There may then be a range of alternatives in between these two extremes. An industry information management system may provide specific functions related to QA procedures such as recording certification, verification and / or audit records but may not involve exporters uploading animal-level data for all animals in an export consignment.

6 Conclusions and Recommendations

This project has involved consideration of the current and likely future regulatory environments, external drivers, and current industry practices in relation to collection and management of data on animal health and welfare outcomes across the livestock export supply chain.

In addition to the regulatory requirements in place at the commencement of this project, exporters must now comply with ESCAS requirements including traceability and reconciliation of animal records and providing audit reports against defined standards.

ASEL and the broader regulatory environment is under review and a new ASEL is likely to be released for comment within the next several months. It is likely that there will be a move towards performance based monitoring and extension of ESCAS type requirements more broadly across the supply chain. An industry QA program incorporating first and third party certification, verification and audit procedures is also under consideration to provide assurance of performance against standards.

This project began with a motivation to present options for industry collection and management of data on animal health, welfare and performance for a range of possible applications including strategic operational decisions, R&D and QA. Preliminary findings from consultations yielded little support for an industry system to collect data on animal performance through the export chain. This was largely because such data are viewed as commercially sensitive and many exporters were concerned about data being stored in any system that was not under the direct and exclusive control of the individual operator.

This interim finding shifted the focus for this project towards options for industry use of animal performance data to support QA and regulatory reporting requirements. The responsibility for managing data and information to document regulatory compliance lies with each exporter. There are significant technical and practical challenges in complying with these requirements and while some exporters appear to be managing this effectively there is variability between exporters. There are whole-of industry risks if an individual exporter experiences a serious adverse event particularly where that event might have been detected earlier or even avoided if there had been more effective monitoring and QA.

Development of an industry information management system that is based on animal performance data as part of a QA program has the potential to provide useful risk mitigation benefits at the industry level. It also has the potential to contribute to a co-regulatory framework where effective QA and performance that meets or exceeds required standards may be rewarded with a reduction in regulatory compliance burdens for exporters.

There are other important benefits to industry from an effective whole-of-chain QA system including the use of aggregated data for industry QA (documenting good performance and early detection and response to deviations) and for strategic purposes such as R&D prioritisation and improving routine operational practices.

Industry concerns over privacy and commercial sensitivity are recognised and in our view mean that the system scope should be limited to just those functions and data required for regulatory and QA applications.

The most effective solution for managing animal traceability across a supply chain starting in Australia and ending in a foreign country, is an internet-based solution that is built around web-enabled database technology.

While animal traceability is identified as the base or core functionality requirement, there are other functions related to regulatory compliance and industry QA that can then be added on to a system once traceability is achieved. These functions would lever additional benefit at marginal cost.

At the time this report was prepared there were limited software options available for the livestock export industry that provide functions related to animal traceability and QA. There is one commercial product providing animal traceability and reconciliation in compliance with ESCAS auditing requirements (LIRS^{TM}) and there are other products that may be able to be adapted or modified to meet industry needs.

Decisions about the creation, design and management of an information management system will depend on the outcomes of future deliberations within industry and between industry and other stakeholders including government including decisions concerning changes to ASEL and ESCAS and any industry QA program.

Recommendation:

> ***That the livestock export industry consider the information and options outlined in this report in any decisions relating to development of an information management system that may form part of an industry QA program.***

7 Bibliography

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8 Appendices

8.1 Consultations completed for this project

Prior to the start of this project (July 2012), preliminary discussions about topics related to this project had been held with export industry stakeholders during annual face-to-face meetings held in Fremantle as part of a separate project (W.LIV.0252). In February 2012, one team member (NP) delivered a presentation to a LERDAC meeting held in Fremantle specifically on this project.

In the period immediately after this project was implemented a series of visits were conducted in relation to W.LIV.0171 (Review of sheep pre-embarkation inspection procedures) including three visits to Fremantle and one to Adelaide. At these visits team members visited registered premises and the ports (Fremantle and Adelaide) and observed activities in relation to animal inspections, receivals, load-out and inspections at the port. At the same time discussions were held with industry personnel about data and information flows for animals being managed through the supply chain. These visits were funded through the W.LIV.0171 budget.

A number of visits have been conducted specifically in relation to this project. These have included multiple visits to Perth and Fremantle to meet with representatives from DAFWA, DAFF, exporters and assembly depot staff as well as third party veterinarians. A visit was made to Canberra to meet with Commonwealth personnel with responsibility for live exports and to Darwin to meet with both regional DAFF staff and with NTLEA staff.

Table 8.1: Summary of visits during which project team members discussed this project with industry stakeholders (NP=Nigel Perkins, BM=Ben Madin)

Date	Location	Activity
February, 2012	Fremantle	NP: Attend LERDAC, industry stakeholder consultation
July-Aug 2012	Fremantle	BM: visits to assembly depot & port of loading
September, 2012	Fremantle	NP: Industry consultation
October, 2012	Adelaide	NP: visit to assembly depot and port of loading
November, 2012	Fremantle & Perth	BM: meetings with exporters, feedlot operators, third party vets and DAFF
March, 2013	South Perth	NP & BM: Meeting at DAFWA, South Perth
April, 2013	Canberra	NP: Meeting at DAFF, Canberra
May, 2013	Darwin	NP: Meeting at DAFF & NTLEA

In addition to these face-to-face visits there have been a number of consultations made by phone and email including discussions with producers, veterinarians, exporters, livestock agents and buyers, and researchers involved in animal production and biosecurity research.

8.2 Overview of the supply chain

An understanding of animal flows through the export supply chain is useful in order to understand opportunities for data collection at various points in the chain.

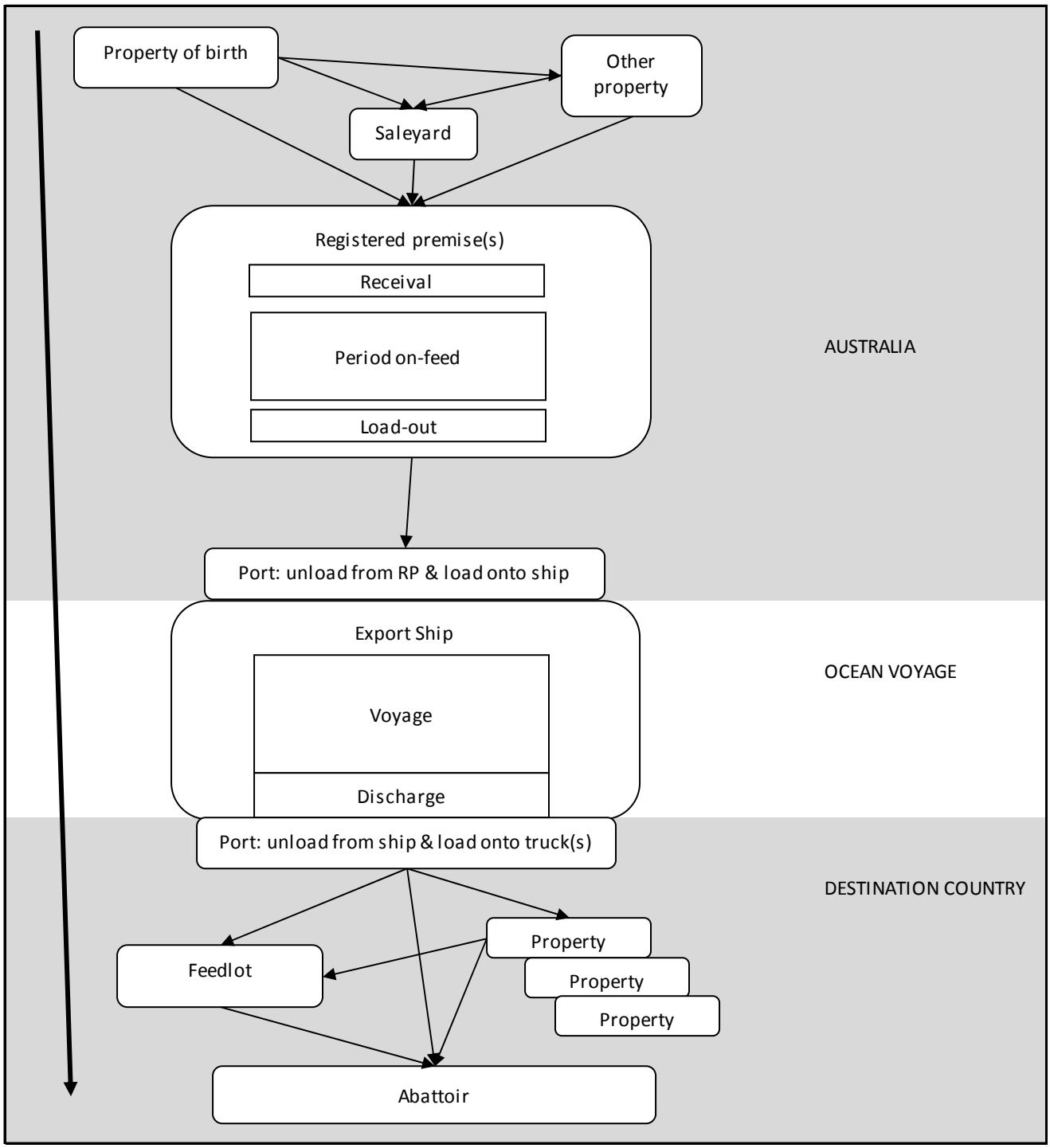

Figure 8.1: Diagrammatic representation of a livestock export supply chain

Figure 8.1 shows a simplistic representation of the livestock supply chain.

It is assumed that livestock intended for export will have been residing on a rural property immediately before they enter the export chain. The figure starts with animals either on the property where they were born or on a property other than the one where they were born. Animals may then move either from a rural property direct to the registered premise (RP) or via a saleyard to the RP.

From the RP animals are transported to the port where they are loaded on an export ship. The ship sails from Australia to an overseas port where animals are unloaded and transported either direct to a processing centre (abattoir or slaughter plant) or to another location (property or feedlot) before being sent on to the processing plant.

8.3 Animal identification and the need for back-up systems

Traceability systems require effective animal identification. This section provides information on existing animal identification systems in Australian livestock and particularly on options for managing tag loss in a supply chain requiring 100% traceability.

8.3.1 Cattle (and buffalo)

Under NLIS requirements all Australian cattle must be individually identified with either electronic (RFID) ear tags or rumen boluses. It is understood that very few Australian cattle are identified using rumen boluses (perhaps as few as 1% or less) and that almost all cattle are identified with NLIS compliant ear tags.

NLIS tags have a displayed number (alpha-numeric) called the visual tag number and a stored electronic number. The electronic number may be read with a hand-held wand or other type of reader or by some form of plate reader, often installed in a race or ramp or crush set up so animals can be scanned as they are loaded or unloaded or as they are handled.

Scanned animal ID records are handled as electronic files and may be downloaded to spreadsheets or databases for management.

Because cattle are individually identified with lifetime traceability, the individual animal ID record can be used in livestock export systems as the primary identifier and can be linked to a variety of other data or information (exporter, consignment, management records, test results etc).

Under export management systems individual animals are scanned at multiple steps along the export chain, resulting in relatively large amounts of data that must be managed for reconciliation and traceability. The most effective way to approach management of these records is through some form of database and preferably a web-based system that allows access for uploads or querying from anywhere in the world and that can handle large amounts of data with built in integrity checking and the potential for automated checking and analytical procedures.

Animal traceability requirements in the livestock export supply chain are based on aiming for 100% traceability and reconciliation of animals through the chain.

An important component of this requirement is the readability of NLIS tags. Various documents describing NLIS functionality describe the possibility of data recording failure with occasional mention of an expectation of 1% or less reading failures per year.

Reasons for failure to read include:

- Loss of tag from the ear (or rumen);
- Tag failure meaning that the tag is still present in the ear but it does not read when scanned;
- Scanner failure;
- Some temporary problem generally associated with head positioning or animal movement that results in failure of reading for an animal at a point in time but when the animal is re-presented or re-positioned it may scan successfully.

Where animals have lost a tag or where the tag is deemed to have failed, a replacement tag can be inserted into the animal and the NLIS record updated.

Most Australian jurisdictions require cattle to be scanned when they are transported, generally on arrival at the destination. In some cases they may be scanned at both ends of a transport event. Movement records are then required to be uploaded to the NLIS database to provide for traceability. Cattle are likely to be scanned on multiple occasions during the export process prior to the time when they are loaded onto the ship including one or more of: property of origin, entry into assembly depot or RP, exit from RP to transport to the port.

There are generally three broad options for handling failure to read i.e. where an animal is physically present at a scanning point but where the NLIS ID value for that animal is not recorded:

- Reconciliation of the count of scanned ID records against a visual or expected count of animals should indicate a difference in counts with the difference indicating the number of animals that failed to read. Where animals are moving from one location to another, this information can be passed forward to the next location when animals will be scanned to ensure that care is taken to either ensure that all animals do scan successfully or to detect any failures and correct the reason (insert a new tag if required).
- Sometimes it is possible to run a group of cattle around the yard and scan them again to detect any failures to read and correct the problem while the animals are still in the yard. This may be possible if the initial error is detected for example while animals re being scanned into the assembly depot or RP.
- Where animals are being restrained either for inspection or for treatment it may be possible to determine immediately that an individual animal has failed to read and then either try and reposition the animal and obtain a successful reading of the tag or to identify a lost or failed tag and insert a replacement. Under routine export management it is common for cattle to receive some form of treatment at the RP while being loaded out (drench or vaccination) and it may be possible to manage failures to read at this time.

Information is available from other sources about likely tag replacement rates under routine cattle management in northern Australia. One of the authors (NRP) was involved in a large scale project funded by Meat and Livestock Australia and run across northern Australia to assess beef cow production and fertility performance measures (Cash Cow project). Part of this project involved assessment of tag replacement rates. Cattle enrolled in this project were generally tagged with NLIS tags either as part of the routine management of cattle (i.e. unrelated to the project) or were tagged in part due to the specific recording requirements for the project. The project collected data on tag

replacements. Detailed data on reasons for tag replacement were not available so we were unable to distinguish between tag losses and tag read failures for example.

The overall annual incidence of tag replacement per year in the Cash Cow study was 2.6% (95 confidence interval from 1.5% to 3.7%). There was an association between time since NLIS tags were inserted and tag replacement risk. Where animals were known to have had their NLIS tags inserted within the previous 12 months, the tag replacement rate per year was 1.3% compared to 3.8% for all other cattle where the time since tag insertion was unknown.

As the time since tag insertion increased the risk of tag replacement increased: 1.5% replaced at 18 months, a further 2.7% replaced between 18 months and 30 months and a further 4.1% replaced between 30 months and 42 months. The cumulative effect was a total replacement rate of 8.3% within 3.5 years of when the tag for that animal was first recorded in the NLIS database.

There was individual variation between properties with 75% of properties having annual tag replacement rates of less than 3.5% per year but individual properties had tag replacement rates as high 7 to 10%.

> *In summary, under routine animal management conditions in extensive beef operations in northern Australia, we can expect to see NLIS tag failure to read rates of 2.6% per annum, rates are expected to rise with increasing time since tag insertion and furthermore rates may be as high as 10% per annum for cattle from some properties.*
>
> *The impact of these findings for the export industry is that while individual animal identification systems based on electronic tags are very useful for traceability, there is a definite need to have a secondary identification system for back-up in the expectation that there will be a meaningful failure to read rate over time.*

The most effective secondary identification system may be based on insertion of a second NLIS tag or in a more practical approach, using insertion of one or perhaps two visual ID ear tags. Insertion of a visual ear tag in each ear is an option that allows for loss of one tag over time and still provides animal identification.

Application of ear tags should be managed in accordance with best practice since there appears to be evidence to support reduced tag loss rates depending on the location of the tag within the ear and a range of other factors associated with insertion including general hygiene.

A simple, robust and reliable method for using visual tags to provide individual animal ID within the livestock export system is described here. The system is based on conventional ear tags but with custom designed alpha-numeric values:

- Two digit (letters suggested but may be numeric) initial code to identify the exporter, assigned at the time the exporter is registered or licensed to export livestock.
- 8-9 digit number (or alphanumeric combination) to be used at the exporter's discretion to identify animals.

The basis of this system is that it be as simple and as practical as possible. Logos or images should be avoided and the use of hindu-arabic numerals and to a lesser extent English alphabet characters minimises the difficulty reading the tags in non-english speaking destination countries.

The key performance requirement is that the system has to be able to identify an individual animal. There are two parts to this. In the field, the system should allow immediate and effective identification of an animal to a consignment preferably without needing to look the tag number up in a database. The second performance requirement is that the tag number is recorded in a database and linked to any other required information (exporter, consignment, other animal ID values, treatment, breed, health status etc). All of this information can be accessed by searching in the database using the tag number for an individual animal.

The simplest system to distinguish animals is a visual display of numeric digits on the tag.

The practical requirement is that the system needs to be as easy and as flexible as possible so that exporters can order tags and not have any risk of discarding tags. This means that more complicated systems that may display codes linked to a year or voyage are ruled out because an exporter could order fewer or more tags than they require in a given period and then either have to rush order additional tags or have left over tags that are unable to be used.

The system is therefore based on a numeric code running from 1 to as many digits that are required. An 8 digit number means that one exporter may issue or assign tags to animals from AA1 to AA99999999 such that up to 99 million individual animals could be assigned individual animal ID before the 8 digits are exhausted and the exporter would then need to restart by issuing AA1 again.

A 9-digit number would mean 999 million consecutive tags could be assigned before the run is exhausted. More digits does have a downside – it requires smaller type (or a larger tag) and probably makes errors more likely when someone is trying to read and record a tag number.

The principle behind the system is that once an exporter uses all the digits, they just revert to the start and order a new batch starting at number 1 again.

Since the system needs to provide individual animal identification (unique number), the number of digits and the length of each print-run needs to be sufficient to provide a zero (or effectively zero) likelihood of the previous run of any one number still being on a live animal when the next run is implemented.

A ten-year interval may provide an effective zero likelihood. This means that the likelihood that an animal exported in 2013 would still be alive in a foreign country in 2022 would be expected to be zero. The interval needs to be long enough (and no longer) to provide an effective zero likelihood of redundant ID.

At the time that the visual tag is inserted it is assumed that the animal will also have an NLIS tag present and the visual tag number can then be linked in a database to the NLIS tag (either the electronic NLIS number or the NLIS visual tag number). At any time in the future that individual animal may then be identified either by scanning the NLIS tag or by reading a visual ear tag number.

8.3.2 Sheep and goats

Under current NLIS requirements, sheep and goats must have a visual ear tag inserted that displays the PIC (property identification code) for the property of birth for that animal. NLIS tags are typically colour coded to indicate year of birth but it may not be mandatory in all states and territories to use the colour coded tags. The intent of the sheep/goat NLIS is to allow identification of animals to mobs based on property and year of birth.

Where animals are no longer on the property where they were born (property of origin), and the current owner wishes to move them to another location, the animals may have a post-breeder NLIS tag inserted to identify their new location or the current owner may have a choice of recording all possible PIC numbers on a movement record (NVD or waybill).

Where animals are aggregated from different sources (saleyards and often in export premises) it is common to find mobs of sheep where animals may have different NLIS tags and where individual animals may even have more than one NLIS tag inserted.

There are concerns over the ability of sheep NLIS to meet traceability standards intended for biosecurity preparedness and response capacity[4]. Over recent years there has been considerable interest and discussion about the feasibility of mandating individual animal NLIS electronic tagging for sheep. Victoria has in recent years provided subsidies to support producers moving to electronic NLIS tags for sheep and there have been various research and development initiatives aimed at trialling and developing systems (tags and associated hardware including race designs and readers) that may be suitable for sheep.

In consultations during this project the authors have discussed these issues with individuals with direct experience in electronic ID systems in Australian sheep including trial work looking at performance of different systems as well as real world use of existing systems by commercial producers in Australia.

Problems that are reported for electronic ID systems in sheep at the time this report was prepared included:

- Relatively high tag loss rates and failure to read rates that are typically of the order of 5% per annum and may be as high as 15 or even 30% per annum.
    - Major reasons for tag loss are infection at the site of insertion even when care is taken at insertion and applicators are disinfected between sheep, and tag loss resulting from sheep inadvertently catching tags on race panels or loading ramps when they are being forced into yards or being loaded or unloaded.
- Relatively high failure to read rates because of either poor or variable tag quality and performance and problems with hardware and just getting sheep positioned so that tags can be reliably read.
- Lack of availability for appropriate hardware in destination countries to allow electronic tag reading in sheep.

The views encountered by the authors when preparing this report suggested that in recent years as more producers have trialled electronic tags in sheep under commercial conditions, the level of

[4] http://www.animalhealthaustralia.com.au/programs/biosecurity/national-livestock-identification-system/national-traceability-performance-standards/

concern over failure to read and tag loss has resulted in a widespread erosion of support for electronic systems in the last 1-2 years compared with 2-5 years ago.

It seems likely that the problems identified above for EID systems in Australian sheep will be overcome through further research-led developments in tags, application systems and associated hardware for reading EID tags in sheep. In the long term it seems highly likely that electronic tags will be adopted for sheep. They are already mandated in some other countries including EU countries. There are important benefits for traceability in the use of electronic systems.

However, at the time this report was prepared electronic systems that have relatively high levels of tag loss and reading failure (up to 30%) are not considered to provide an effective ID solution for the current traceability requirements associated with livestock export.

As a result, electronic tags are not deemed suitable at the current time for individual animal identification for sheep and goats under Australian conditions. Until such time as equipment and procedures can be developed to provide high levels of confidence in tag readability, it is suggested that sheep ID should be based on visual tag systems.

Under existing export regulations, exporters of sheep and goats must implement a system of accountability based on the counting and reconciliation of sheep and goats at points along the supply chain.

It is also noted that while the current sheep NLIS tag system may be reasonable for tracing sheep to property of origin, it is not a very effective option for tracing sheep to a consignment in the livestock export supply chain.

There are two reasons for this:

- The same NLIS tag number may be present in sheep from different classes in the same consignment and in sheep from different consignments. This is because the NLIS number simply reflects property of origin or property where the sheep was re-tagged.
- Individual sheep may have more than one NLIS tag inserted, leading to potential for confusion and error in data recording.

Conventional practice in livestock export for sheep is to divide animals into groups based on breed and class and the main reason for this categorisation is because it is directly related to transaction contracts. An importer or buyer will generally specify that they wish to purchase a defined count of sheep with a particular specification based on breed and class. The importer and exporter will negotiate a price and then these contractual terms dictate how animals are grouped in the RP and throughout the supply chain. Animals will be drafted into these breed-class lines after receival and then managed in these lines throughout the supply chain.

Managing traceability of sheep/goats is then dependent on tracking groups of animals based on descriptive information about management groups (breed and class) and a count of animals expected to be in that group. The ability to effectively manage traceability is therefore completely dependent on maintenance of segregation of these groups throughout the supply chain.

Within any one class-breed grouping there are generally sufficient animal numbers that they cannot be maintained in one group through the supply chain but have to be divided into smaller groups for

management within pens in the RP, on trucks and on the voyage and again in trucks or holding facilities post discharge. Provided animals are only grouped with other animals from the same breed-class category, it doesn't matter how they are divided into pen groups at any one point in the supply chain. The key requirements are that accurate counts be kept at every point and that animals are only grouped with other animals in the same breed-class group. At any one point, reconciliation is based on aggregating the counts of all the pens of animals in the same breed-class group to reach an overall count for that consignment and then comparing that number with the expected number based on a prior count or export records (load plan etc).

Current ESCAS requirements include the clearly stated requirement to maintain segregation of sheep from different consignments, acknowledging the importance of this physical separation in maintaining mob-level traceability. In ESCAS documentation this requirement is first defined for sheep during the voyage i.e. from the time when sheep are loaded onto the ship.

It is our opinion that NLIS tags are of limited value as an aid for traceability of sheep in the livestock export supply chain because they do not allow sheep to be identified with confidence to a breed-class group within one consignment or even to identify sheep as belonging to one consignment and not another.

If ear tags are to be used as an aid in traceability for sheep then it appears that the most effective option may be to consider adopting a separate system of visual tags that would allow robust and reliable traceability of sheep to exporter, consignment and breed-class within a consignment, throughout the export supply chain.

A visual tag system for sheep is suggested based on similar considerations as described for cattle in the previous section.

The system is based on a 2 letter (or digit) code assigned to each exporter at the time they are licensed to export livestock, and an 8-9 digit number (or alphanumeric combination) to identify animals.

Exporters would have to use the assigned two digit identifier but they would be free to use the subsequent 8-9 digits in any way they wish provided that the same number has a negligible likelihood of occurring in two separate animals.

As an example, imagine one exporter (two letter code=AA) orders tags in consecutive number sequence from AA1 to AA99999999. This allows up to 99 million animals to be individually identified before the run is exhausted and a new order would result in AA1 being assigned again.

An 8-digit number means that an exporter could be responsible for exporting 5 million sheep per year for almost 20 years before they reach the end of a run of available numbers. If a 10-year interval is considered likely to result in an effective zero likelihood of a redundant number (2 live animals with the same ID), then this system would be effective.

The exporter could then just assign tags in consecutive order to each animal exported. At some point provided there was an effective zero interval of redundant numbers, the exporter can re-start the print run and begin assigning tags from ##1 again.

Exporters could choose to use digits in a number of different ways for example by assigning one or even two digits to identify consignment or voyage within a year and then using the remaining digits for animals within consignment. This is not necessary but may be useful for some exporters.

This system has the potential to provide individual animal traceability but there is no intention to reconcile individual animal ID values at any step in the supply chain. The purpose of this visual tag system would be to provide clear and simple traceability to exporter and consignment levels right throughout the supply chain. When combined with existing requirements for segregation of animals by consignment throughout the chain and with general management principles that mean animals in different classes are managed in separate groups, it provides a reliable system for traceability.

8.4 Animal data flows through the supply chain

This section attempts to summarise major animal-related data flows at each of the steps along the chain.

The reason for outlining animal flows through the chain and relevant standards or guidelines is that these offer opportunities for performance monitoring to be conducted as part of a QA program that might allow independent documentation of performance against standards.

8.4.1 Specification of target consignment

The term consignment may have different meanings for different users. The approach taken in this report is based on an attempt to use a similar meaning as is understood to be applied by the regulator (DAFF).

A consignment is defined as those animals that are being assembled for export under one NOI. This generally means animals assembled by one exporter, where the animals are of the same species (ie sheep), and are being assembled for loading onto one ship at a single port of loading within Australia. A single consignment may include a relatively large number of animals (large export vessels may be capable of loading more than 100,000 sheep for example) and may include animals of different class (sex and weight), breed and intended for different destination ports.

Animals must meet market (purchaser) requirements, importing country protocol requirements and any additional requirements stipulated in the ASEL in order to be eligible for transport to the registered premise.

8.4.2 On-farm selection.

On-farm selection of animals is against criteria outlined in the importing country requirements, market specification (what the exporter wants to aggregate), and ASEL.

8.4.3 Transport of animals to registered premise

Animals are transported from the property of origin (or saleyard) to the registered premise.

Transport must be conducted in compliance with state and territory regulatory requirements concerning land transport and animal welfare and also with ASEL (Standard 2).

Animals must be removed from the group prior to loading on to a truck if they are deemed to be **not fit to load**.

The total count of animals loaded onto a truck at the property of origin (or saleyard) is identified as the first opportunity for collection of performance data in the export chain. This count serves as the starting count for subsequent performance measures along the chain.

8.4.4 Records while animals are held at an RP

Animals are held for varying times at an RP prior to export as defined in the ASEL. Management of sheep records while in the RP is more complex than for cattle because there are larger numbers of animals and no individual animal ID records. Cattle reconciliation is based on scanning and reconciling individual animal NLIS records. Sheep reconciliation requires more effort to understand complexities in animal flows and data recording on animal numbers during the period spent in the RP. Standardisation and clarification will be necessary to ensure data on animal traceability and welfare outcomes can be measured and monitored in a whole-of-chain QA program. This section focuses on sheep records.

The *Export Control (Animals) Order 2004* requires that an RP must have an Operations Manual and specifies that while animals are housed in the RP there will be daily reconciliation of animals and animal movements and daily monitoring and reporting of animals' health and mortality. There is also a requirement for the operations manual to describe how reject animals are handled including isolation and removal of any animal suffering from inanition. ASEL (S3.16) provides additional details on daily inspections in the RP.

There have been recent reviews of pre-embarkation inspection regimes for sheep (Perkins and Madin 2012; DAFF 2012). There are multiple opportunities in the RP for inspection of livestock and identification and removal of unfit animals (DAFF 2012). These include:

- During unloading at receivals;
- During daily routine monitoring at the RP;
- During the AAV flock inspection;
- During the AQIS flock inspection;
- During preparation for loading and at time of loading out of the RP.

The DAFF report also noted that current requirements do not stipulate that information on animals rejected at each of these stages be recorded in a standardised or consistent manner. The report further noted that accurate information on numbers and types of rejections at each stage of the livestock assembly process is essential in order to be able to assess the capacity of the system to identify and remove unfit animals (assessing performance against the required standards).

The DAFF report recommended:

> *Recommendation 3: Outline in the ASEL what record keeping must be done throughout the different stages of the inspection process starting from receipt of the animals at the registered premises, how often, who keeps the information and who it must be made available to when required. In particular:*
>
> *- DAFF to develop templates to support the record keeping requirements for AAVs as stated in Export Control (Animal) Orders 2004 part 4A 14*
>
> *- The requirement for record keeping of rejection at unloading set out in ASEL S3.17 to be expanded to cover animals rejected at all stages of the assembly process*
>
> *- A consignment report summarising animal health issues, reasons for rejections, adverse events and treatments, and should be provided to DAFF and the onboard AAV prior to issuing the export permit.*

Recommendation 5: The primary point for individual inspection should be at the registered premises and the facilities and inspection process must be designed to reliably assess each animal for fitness to travel and against all of the ASEL rejection criteria.

The intention of these developments is in alignment with the move initiated through the Farmer review to implement whole-of-chain quality control measures.

A logical place to start recording animal numbers is at the time of receival with the count of animals being unloaded from trucks for assessment and receival into the RP.

In order to reconcile animal counts in the RP it will be necessary to track animal flows into and out of a notional consignment group, defined as the ***consignment eligible*** cohort

The consignment eligible cohort is defined as the intended group of animals of the same species being prepared at one RP for one exporter and for loading onto one vessel.

The concept of accurately tracking animal numbers while animals are in the RP is more challenging than it may initially seem and it will be important to not require undue effort to un-necessarily track the status of animals while they are in the RP.

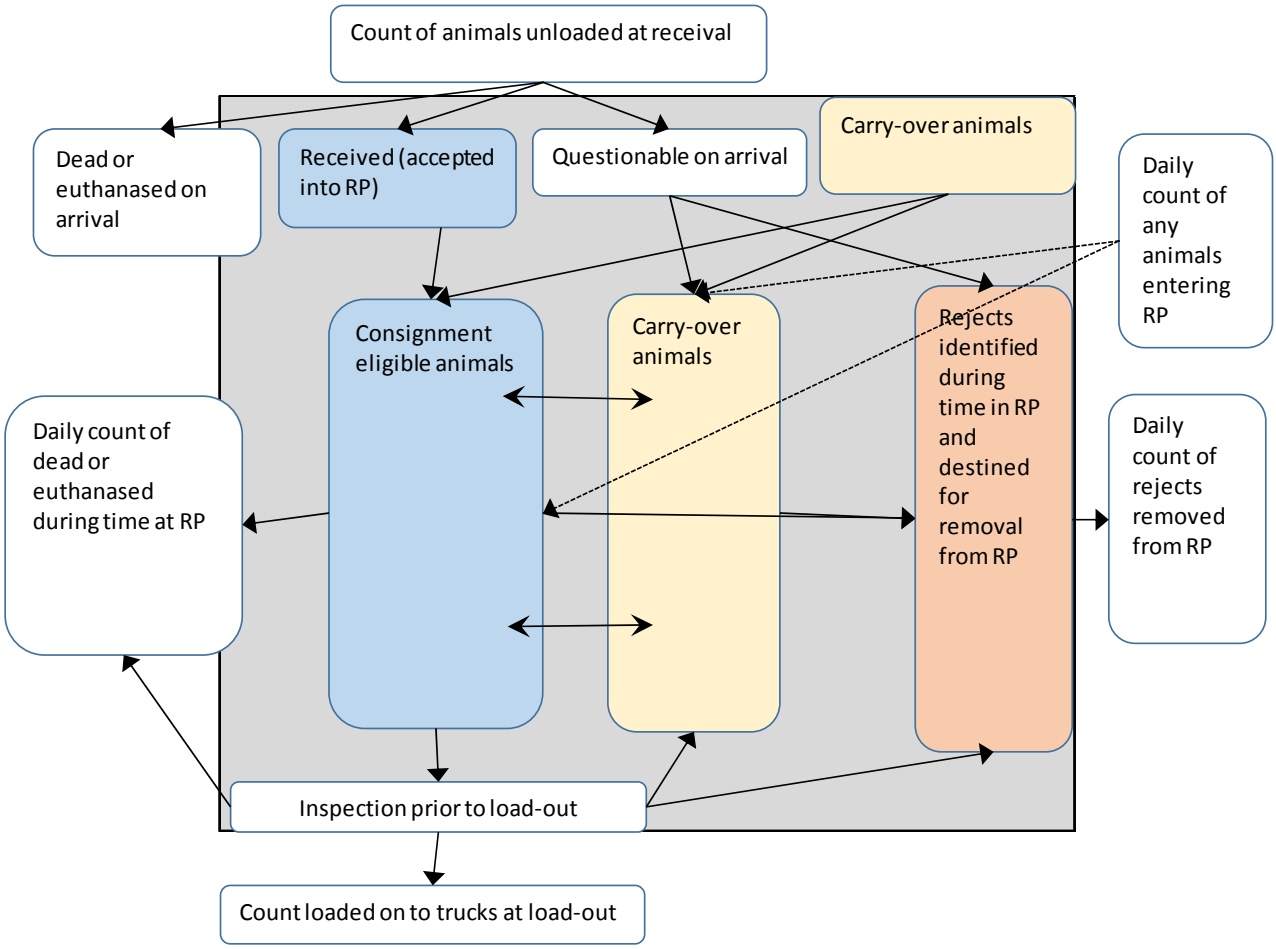

Figure 8.2: Diagrammatic view of data flows for sheep into and out of the RP during preparation for export

Figure 8.2 highlights possible animal flows during time in an RP.

The central grey-shaded area represents the physical boundary of the RP and on any given day it should be possible to produce a total count of animals by species that are being held within the RP. The RP is defined as a closed system and any animal that enters the RP should be recorded and all animals that exit the RP (deaths or rejects) should be recorded along with a reason (cause of death or reason for rejection).

At receival, the total count of unloaded animals can be assigned without error to one of several destination classes:

- Dead on arrival or euthanased immediately after arrival
- Received into the consignment eligible cohort (animals that meet all the criteria for export in this consignment)
- Questionable on arrival. Within a reasonable time period (up to 48 hours post arrival) animals classified as questionable on arrival should be classified into either
    - Rejects – permanently removed from the consignment, unable to re-enter the consignment pool and must be removed from the RP within a reasonable time period.

- Carry-over – includes any animal that is present within the RP boundary and that is not suitable for inclusion within the consignment population because it does not meet one or more of the specifications or requirements.
- Consignment eligible group for animals that may have recovered from temporary conditions.

A report on receivals is expected to reconcile the total count unloaded from trucks without error into the categories identified above.

In the past there has on occasion been some confusion over reconciling numbers of animals received into the RP and the number loaded out, because of the possibility of having animals already present on the RP (carry-over animals), some of which may be moved into the consignment group during the time in the RP.

Accurate reconciliation of animal numbers on the RP requires that all animals on the RP be accounted for by recording them and classifying them in the same way as above (consignment eligible, carry-over, reject, dead).

During the time on feed in the RP, there can be two way flow of animals between the consignment eligible group and the carry-over group and at any one time it may be difficult to assign animals to one group or the other. Examples of various situations include:

- Animals in the consignment group that are classified as showing signs that require further observation or treatment such as reduced feed intake, eye discharges, mild lameness etc. These animals may be separated, provided with additional feed or treated in some way and may recover in time to be loaded out with other animals in the consignment.
- Animals in the consignment group that have any condition that make them ineligible to remain in the consignment group (wethers in a ewe consignment or vice versa, scabby mouth or other condition that is unlikely to resolve in time to allow the animal to be exported).
- Animals in the carry-over group that meet all the criteria for inclusion in the consignment eligible group and that may be moved from the carry-over to the consignment group.

There appears to be some uncertainty about records of rejects identified at the RP or at the port. There are three main occasions when animals are subjected to individual animal inspection for the purpose of removing animals that are not fit to export: at receival, prior to load-out and at the port. When these inspection procedures occur, animals are generally marked as rejects and then removed either by catchers or by drafting. Individual animal inspections involve handling large numbers of sheep (up to 50-80,000) through the yards. Rejects are marked without any indication of the actual reason for rejection and once they are removed they are generally run as one mob of rejects.

There is no simple way to record actual counts of rejects by reject reason as inspection is occurring. The point of this is that rejection occasions produce an accurate count of total rejects but they do not produce an accurate count of rejects by reason.

The current practice is for the inspectors to estimate the proportion of rejects in each of several major reasons for rejection. The same process may be applied in assigning rejects to classes of sheep. It is reasonable to manage the flow of animals through the inspection process by breed-class

groups and to separately count rejects by breed-class and estimate proportions by reject category separately for each breed-class group.

The principles of an RP recording system that would allow accurate accounting of all animals in the RP are outlined for consideration:

- Every animal on the RP needs to be counted and recorded into standardised categories within 48 hrs of receival of animals for a new consignment.
    - Consignment-eligible animals include all animals that meet criteria for export in that consignment and includes animals that may be under observation or treatment provided these conditions do not immediately make them ineligible under the standards. It is expected that consignment eligible animals will be recorded by class.
    - Carry-over animals include all animals on the RP of the same species that are not being considered for export in this consignment and that do not meet rejection criteria. These animals may be considered for a future consignment.
    - Mortalities.
    - Reject animals include animals meeting rejection criteria and that need to be removed from the RP within a reasonable time period.
- During the time on feed, movements into and out of the consignment population and the RP as a whole must be recorded on a daily basis (mortalities, rejects, carry-over).
- Results of individual animal and flock inspections by AAV or DAFF Officer are expected to be recorded as they currently are. Where these inspections result in animals moving into or out of the consignment pool or RP as a whole, these changes need to be recorded.
- At the time of load-out the key measures will be the count of animals loaded by class. Animals removed from the consignment pool up to the time of loading (deaths and rejects or carry-overs), will be recorded.

An RP recording system that accurate accounts for all animals in the RP using these principles can then be used to produce a limited number of defined performance measures that are considered suitable for using in a QA program for monitoring of performance against standards or targets.

The following performance measures are suggested at each of several steps in the chain that occur at the RP or at the port:

- Transport performance at receival
    - Denominator 1= total count of animals unloaded from trucks at receival for inclusion in this consignment
    - Mortality proportion= count of mortalities at unloading divided by total count of animals unloaded
    - Reject count by reason = total count of rejects by reason
    - Reject proportion by reason = total count of rejects by reason divided by denominator 1
- RP reconciliation at 48 hrs post receival (up to 72 hrs?)
    - Total count of all animals on RP at end of receival and divided into
        - Denominator 2= Eligible consignment group – arranged by class
        - Carry-over animals
        - Rejects
- Daily reconciliation while on feed (not reported but necessary for accounting purposes)

    - Mortalities reported by class and RP group (consignment, carry-over, rejects) using the RP reconciliation counts as a denominator for estimation of proportions
    - Movements off the RP reported by RP group
    - Any movements on to the RP
- Individual animal inspection
    - Rejects reported by class and consignment as a count and proportion (using Denominator 2 as the denominator for estimating proportions or percentages)
    - AAV report to describe reasons for rejection since there is not expected to be a precise count of rejects by reason within each class. Rejects are raddled and removed without counting them by specific reason as the inspection is occurring.
- At load-out
    - Denominator 3= Count of animals loaded onto trucks by class.
    - Mortality during time on feed expressed as count of mortalities by class and cause
        - Mortalities can be expressed as a proportion of Denominator 2
        - Mortalities can be expressed as a daily proportion/rate and a cumulative proportion/rate
    - Proportion loaded = Denominator 3 divided by Denominator 2
    - Proportion lost from consignment eligible group during time on feed= 1-proportion loaded (includes rejects + carry-over + mortalities)
- At port
    - Count of mortalities by class
    - Denominator 4= Count of animals loaded onto ship by class
    - Count of rejects by reason
    - Ship loading as proportion of RP loadout group proportion = Denominator 4 divided by Denominator 3 (performance during transport to wharf)
    - Ship loading as proportion of consignment eligible total = Denominator 4 divided by Denominator 2 (performance during time in RP and transport to wharf)
    - Port rejects & mortalities by class = Denominator 3 – Denominator 4 divided by Denominator 3

The purpose of these proposed summary counts and reconciliation points in the RP is to provide confidence that all animals on the RP can be accounted for and that standardised measures can be used to measure performance for QA and regulatory compliance requirements..

8.4.5 Class of livestock

Within one species of livestock and within one consignment, animals are typically managed and recorded in categories or classes based on attributes such as breed, sex, age and weight or condition.

These categories may change over time as market forces alter animal supply.

There appears to be no single standardised list of classes or categories and there is inconsistent reference to these attributes in the regulations.

As an example:

- ASEL (S5) defines shipboard mortality as being estimated at the level of each species loaded on to the ship.

- The template for the Daily Voyage Report available on the DAFF website defines mortality as being reported for each class of livestock and deck.
- It is understood that common practice is to record mortality separately for each consignment if there are multiple consignments on a ship but there is little available information to confirm this and no clear definition of a consignment.

HotStuff software uses the following classifications for livestock:

- Cattle class
    - Bull
    - Bullock
    - Cow
    - Heifer
    - Steer
- Cattle breed
    - Bos Taurus beef
    - B Taurus dairy
    - Bos indicus
    - 25% B indicus
    - 50% B indicus
- Sheep class
    - Ewe
    - Hogget
    - Lamb
    - Ram
    - Ram lamb
    - Wether
- Sheep breed
    - Wassi
    - Merino
    - Crossbred
    - Damara
    - Karakul
- Goats
    - Billy
    - Kid
    - Nanny

TRACE has the following categories for recording livestock

- Alpacas
    - Female
    - Male
    - Unknown
- Buffalo
    - `Bull
    - Cow
    - Heifer

    - Steer
- Camels
    - Female
    - Male
    - Unkown
- Cattle
    - Bull
    - Cow
    - Heifer
    - Steer
- Deer
    - Female
    - Male
    - Unknown
- Goats
    - Buck
    - Doe
    - Kid
    - Wether
- Llama
    - Female
    - Male
    - Unknown
- Sheep
    - Ewe
    - Lamb
    - Ram
    - Wether
    - Young wether

Examination of receival records from exporters for sheep indicates that industry practices may involve two to four variables covering the following information on sheep arriving at the RP for receival:

- Breed
    - Awassi, Merino, Dorper, Damara, Xbred and possibly others
- Class
    - Ewe: may be classed as 1, 2, or 3 (A, B, C) based on weight/condition
    - Lamb: may be classed as 1, 2, or 3 based on weight/condition
    - Ram: may be classed as 1, 2, or 3 based on weight/condition
    - Wether: may be classed as 1, 2, or 3 based on weight/condition
    - Young wether
- Weight
- Fleece length

The records system developed over many years by Greg Norman (DAFWA) as part of recording of

voyage mortality in the Yellow Book for annual livestock export performance reports has the following categories:

- Sheep
    - Breed
        - Merino = M
        - Awassi = A
        - Karakal = K
        - Damara = D
        - Crossbred = X
        - Other = O
        - Dorper = P (new addition suggested in consultation for this project)
    - Sex
        - Wether = W
        - Ram = R
        - Ewe = E
    - Age
        - Adult = A
        - Hogget = H
        - Lamb = L
- Cattle
    - Steer adult = SA
    - Steer calf = SC
    - Steer weaner = SW (new addition suggested in consultation for this project)
    - Bull adult = BA
    - Bull calf = BC
    - Bull weaner = BW (new addition)
    - Dairy cow = CD
    - Beef cow = CB
    - Dairy heifer = HD
    - Beef heifer = HB

The way these codes work in the Yellow Book is that a recorder can enter a 3-4 letter acronym eg XRL = Crossbred ram lamb, OEH = Other ewe hogget and so on.

There is a need to define a standardised set of variables that can be used to describe key animal related attributes that may be used for industry recording with an emphasis on those variables that are considered required for QA and compliance purposes.

A minimal set of variables is suggested as breed and class

Table 8.2: Proposed set of breed and class variables suitable for standardised recording of animal numbers during livestock export

BREED	
SHEEP	**CATTLE**
Merino	*Bos taurus* beef
Awassi	*B taurus* dairy
Karakal	*Bos indicus*
Damara	<= 25% *B indicus*
Crossbred	50% *B indicus*
Dorper	
Other	
CLASS	
SHEEP	**CATTLE**
Ewe	Bull
Ewe hogget	Cow
Ram	Heifer
Ram lamb	Steer - young
Wether hogget	Steer
Wether	
Mixed sex hogget	
Mixed sex	
Other species	
Male entire	Adult
Male castrate	Young
Female	
Mixed	

8.4.6 Records at port of loading

There are existing systems for recording counts of animals as they are unloaded from trucks at the port, inspected and then loaded onto the ship.

It has been noted (DAFF 2012; Perkins and Madin 2012) that inspection procedures do not generally allow for accurate counting of rejects by reject reason. This issue was discussed in relation to inspection procedures at the RP.

Procedures should be standardised to define categories based on common reasons for removal of animals and recording rejects as a total count and a percentage by reason.

The total count of animals unloaded from trucks at the port can then be divided into:

- Dead and euthanased animals;

- Rejects and reason for rejection;
- Animals loaded onto the ship.

8.4.7 Records during the voyage

The daily voyage reports and end of voyage reports are defined in several sources.

There are regulatory requirements during the voyage relating to management of animals and reporting of performance:

- If a notifiable incident occurs DAFF must be notified as soon as possible and within 12 hours and a report provided (ASEL S5.11).
- If a notifiable incident occurs (as defined by the ASEL), the master of a ship must send a copy of the notifiable incident report to the Manager, Ship Inspections, AMSA (Marine Orders Part 43, S37).
- Livestock and livestock services must be regularly inspected (day and night) to ensure that the health and welfare of the livestock are maintained (ASEL S5.6 and subsequent components).
- Section 4A.15 of the *EC (Animals) Order 2004* specifies that AAVs when accompanying a voyage must make a written report to the Secretary of DAFF each day during the voyage (daily report) and within 5 days of the end of the voyage (end of voyage report). The section also states that the AAV must provide the reports in the form approved by the Secretary for that purpose and provides a list of matters about which information may be required.
- ASEL S5.12 states that for journeys greater than or equal to 10 days, the AAV (or accredited stock person if an AAV is not accompanying a voyage) must provide daily reports and further stipulates that the reports must provide information as defined in Appendix 5.1 of the ASEL.
- ASEL S5.13 states that regardless of the journey duration within 5 days of completion of discharge at the final port of discharge the AAV or accredited stock person (if an AAV does not accompany the voyage) must provide an end of voyage report and the report must include information outlined in Appendix 5.2 of the ASEL.
- The DAFF website provides two template forms for download[5], titled *Daily Voyage Report* and *End of Voyage Report (Sea Transport)*. These templates provide similar but not identical lists of required information to those stipulated in the ASEL and in the *EC (Animals) Order 2004.*
- The master of a ship is required to make a report in writing (Master's Report) after completion of a voyage (other than a voyage that is less than 24 hours in duration) in accordance with the template in Appendix 1. The Master's Report is sent to the DAFF and to the Manager, Ship Inspections, AMSA (Marine Orders Part 43, S19).
- Twice annually, the Secretary of DAFF is required to table a report to Parliament on performance of livestock export voyages over the preceding 6-month period[6] (AMLI Act, Division 5, S57AA).

It is our understanding that an increasing number of export vessels are capable of providing regular internet access during the voyage, providing opportunity for access to web-based recording systems to upload daily voyage reports or end of voyage reports. However, it seems prudent to develop

[5] http://www.daff.gov.au/biosecurity/export/live-animals/livestock/forms
[6] http://www.daff.gov.au/animal-plant-health/welfare/export-trade/mortalities

systems that do not rely on internet access to ensure that reports can be provided even when access is not regularly available.

The details of the daily voyage report can be incorporated into one or more of the following:
- Paper based reporting systems that can later be uploaded into TRACE or faxed to DAFF.
- Recording on a hand-held device that is capable of backing up to a laptop carried on the ship using Bluetooth or USB connectivity with subsequent submission of a report via email, web-based upload or fax at any time depending on available technologies.

It is suggested that the data requirements outlined in the DAFF daily voyage report template[5] be used to inform the design of data recording within a web-based system for daily voyage reporting. The same process can be used for end of voyage reporting.

8.4.8 National data recording system

In the late 1980s and early 1990s researchers from DAFWA (Richard Norris, Barry Richards, Tony Higgs and others) were involved in a series of studies investigating morbidity and mortality and general health and welfare issues in livestock exported from Australia. Part of this research program involved the development of a national data recording system to provide ongoing collection of data to describe livestock health and welfare performance during export voyages. The first report from this recording system was produced in 1989 (Higgs 1989).

The system involved the collection of daily mortality data by class of livestock and deck.

The intent described in this initial report was to produce three types of reports:
- A report to the ship's officers after each voyage that contained comparisons of mortality by class and deck.
- A report summarising findings across the industry during a period of about 6 months that would be distributed to various organisations associated with the livestock export industry.
- Specific findings would then be included in technical reports and scientific publications.

Mr Greg Norman and Dr Richard Norris have continued to support this work and each year produce an annual report based on the data collected through this program. This report provides summary information about mortalities in sheep and cattle during sea transport from Australia. The information is obtained from ship masters' reports which record livestock deaths and environmental data each day aboard ship and also from "Yellow Books" which record more detailed information about numbers of sheep deaths. The Yellow Books were designed in consultation with exporters and ships' Officers as small pocket books with standardised formatting and abbreviations for Officers to carry during the voyage. These books would be picked up when ships returned to Australia and data entered into a spreadsheet for subsequent analysis. Over time the Yellow Book was then used to guide the development of spreadsheets and currently the data collection process involves a small number of ships that still use printed Yellow Books and most ships using electronic spreadsheet files and emailing the completed files to Mr Greg Norman (DAFWA) at the end of each voyage.

Mr Norman also may obtain some data from ship masters' reports separate to the Yellow Books but over time the amount of detail contained within the ship masters' reports has reduced considerably and these reports are of limited value currently as a source of animal performance data during the voyage.

The design of the Yellow Book has provided a useful example of efficient data collection.

Ship:	Beef cattle											**Voyage No:**			1				
Deck	10F	10F	10A	9F	9F	9F	9F	9A	8F	8F	8A	7F	7A	6	5	4	3	TOTAL	Comment
Load Port	Fremantle	Fremantle	Fremantle	Fremantle	Fremantle	Fremantle	Fremantle	Fremantle	Fremantle	Fremantle	Fremantle	Fremantle	Fremantle	Fremantle	Fremantle	Fremantle	Fremantle		
Class	Steer weaner	Bull Adult	Bull weaner	Bull weaner	Bull Adult	Steer weaner	Steer Adult	Cows	Beef Heifer	Bull Adult	Steer weaner	Cows	Bull weaner	Steer Adult	Steer Adult	Beef Heifer	Beef Heifer		
Load No	750	350	700	900	600	350	150	800	420	500	175	300	200	450	200	250	100	**7195**	
Date																		0	
10-Jan-12																		0	Load Fremantle
11-Jan-12	1																	1	
12-Jan-12																		0	
13-Jan-12																		0	
14-Jan-12																		0	
15-Jan-12																		0	
16-Jan-12											1							1	
17-Jan-12				1				1						1				3	Storm
18-Jan-12																		0	
19-Jan-12																		0	
20-Jan-12	1																	1	
21-Jan-12															1			1	Discharge XXXX
TOTAL	2	0	0	1	0	0	0	1	0	0	1	0	0	1	1	0	0	**7**	
%	0.27	0.00	0.00	0.11	0.00	0.00	0.00	0.13	0.00	0.00	0.57	0.00	0.00	0.22	0.50	0.00	0.00	**0.10**	

Figure 8.3: Example of a Yellow Book spreadsheet page with a simulated voyage entered to show how the system is intended to work.

A user can enter relevant data and information to describe the voyage, species and details of counts of animals loaded by class and deck. Each voyage day is one row and deaths are entered by class and deck on each row. There is space for comments.

Load Port	Fremantle
Start date	12-Jan-15
Start Time	0755
End Date	12-Jan-15
End Time	1445

Discharge Port	XXXXXX
Start date	21-Jan-15
Start Time	0836
End Date	22-Jan-15
End Time	0144

SHEEP TYPE - BY BREED, SEX AND AGE		
BREED	MERINO	**M**
	AWASSI	**A**
	KARAKAL	**K**
	DAMARA	**D**
	CROSSBRED	**X**
	OTHER	**O**
SEX	WETHER	**W**
	RAM	**R**
	EWE	**E**
AGE	ADULT	**A**
	HOGGET	**H**
	LAMB	**L**
	EXAMPLES	
	XRL	
	CROSSBRED RAM LAMB	
	OEH	
	OTHER EWE HOGGET	

CATTLE TYPE - 8 ONLY	
STEER ADULT	**SA**
STEER CALF	**SC**
BULL ADULT	**BA**
BULL CALF	**BC**
DAIRY COW	**CD**
BEEF COW	**CB**
DAIRY HEIFER	**HD**
BEEF HEIFER	**HB**

Figure 8.4: Second part of the Yellow Book data form

The continued operation of the national data recording system has produced a valuable series of reports describing industry performance and has increased our understanding of factors influencing welfare outcomes during export voyages.

The national data recording system and the annual reports that are derived from this activity is considered to be valuable to industry worth supporting.

The national data recording system is heavily reliant on the commitment and dedication of Mr Greg Norman. Mr Norman has developed effective interpersonal relationships with ships' officers and exporters over a prolonged period of time. The success of the data collection process is in large part due to the personal efforts of Mr Norman in visiting ports to speak with officers and to collect copies of the Yellow Book (in electronic or paper form) and following up with individuals via phone and email to obtain electronic copies of Yellow Book data where ships are unlikely to dock at Fremantle port for a period of time.

A future data recording system that can meet the needs for monitoring performance against standards and any other QA requirements, has the potential to provide a more sustainable system for producing the type of annual reports that have been delivered by the national data recording system. It is suggested that the functionality of the Yellow Book and the data requirements of the annual reports be considered when developing data recording systems that might apply to the voyage part of the chain.

8.4.9 ESCAS data requirements

ESCAS is required for all exported livestock. The ESCAS scope covers the period from disembarkation of Australian origin livestock in a foreign country to the time when they are slaughtered.

ESCAS details are described in material and documents available on the DAFF website[7] and related information is presented in a recent report by Schuster (2013) on aspects of quality assurance systems for ESCAS.

This section is confined to those ESCAS requirements that are most pertinent to animal performance data requirements that might be necessary for in an industry QA program.

ESCAS documentation stipulates the following traceability requirements at each step along the chain from the time the animals arrive in the RP:

- RP: record keeping described above
- Transport from RP to port: count of animals loaded onto trucks and count unloaded at port
- Port: count of animals into three broad categories
    - Dead and euthanased at port
    - Rejects at port (recorded by category)
    - Count of animals loaded onto ship
    - Numbers to reconcile with load-out count
- Load-plan

[7] http://www.daff.gov.au/biosecurity/export/live-animals/livestock/escas

    - At time of loading of vessel the load plan provides a detailed summary of where animals are housed on the ship by deck.
    - At this time animals are expected to be recorded by individual ID (cattle) or mob ID (sheep and goats) and these IDs will then be linked to other attributes such as breed, class, consignment, purchaser etc.
- During voyage
    - Animals in different consignments must continue to be segregated during the voyage including animals moving into and out of sick pens.
    - Animals can therefore continue to be traced with accuracy to consignment throughout the voyage.
    - Records as defined for Daily Voyage Report and End of Voyage Report
        - Animal health and welfare recording to be recorded for each class of livestock and for each consignment on the ship
    - All mortalities will need to be recorded by animal ID (cattle) or by mob ID (sheep).
- Destination port
    - Count animals off the ship by class (and possibly breed), consignment and by destination enterprise.
    - Record details of any deaths or animals requiring special attention at time of discharge.
    - Trucking dockets are to be issued as animals are loaded onto trucks. Dockets will include ship name, consignee name and number of head and class and consignment.
    - In this way all animals that are taken off the ship at a destination port should be counted and their enterprise destination recorded.
- Enterprise destination (feedlot, farm, holding facility)
    - Enterprise destination is the location where animals travel to once they leave the destination port.
    - Truck dockets will be collected as animals are unloaded and counts reconciled against the docket.
    - Animals must be segregated by consignment and exporter within the enterprise.
    - At the enterprise destination animals will be recorded by individual ID (cattle) or mob ID (sheep) and by class and consignment.
    - Any mortalities (euthanasias) and animals requiring separation for diagnosis or treatment of conditions will be recorded separately using the same attributes.
- Transport from enterprise to abattoir
    - Truck dockets to accompany each truck as above
- Abattoir
    - Truck dockets to be held as animals are unloaded at abattoir
    - Animals must be segregated by consignment and exporter.
    - As animals go to the slaughter box they must be registered as deceased.

ESCAS documentation then provides additional points concerning risk mitigation for animal traceability:

- Processes must be implemented to ensure that animals from different consignments are segregated at all times both on-board ship (including in hospital pens) and at all points in the supply chain following discharge at a foreign port (feedlot, holding facility and abattoir).
- Management procedures must be implemented to ensure traceability is maintained even when tags are lost or not readable. The most effective way to manage this is through visual tags as

secondary identification systems that are linked in the database to underlying electronic animal ID or to other information such as class, consignment etc.
- Staff across the supply chain must have adequate training and support to ensure the traceability system is implemented effectively.

8.4.10 Compliance with international animal welfare standards

ESCAS documentation[8] includes a requirement that animal handling be managed in a way to ensure that international (OIE) animal welfare standards are met.

The guidelines provide a detailed template that can be used by internal QA or by independent auditors for verification and auditing to ensure that international welfare standards are met. The template is arranged in six elements:
- Supply chain element 1: Handling of livestock
- Supply chain element 2: Land transport of livestock
- Supply chain element 3: Feedlot/holding facility
- Supply chain element 4: Lairage
- Supply chain element 5: Slaughter with stunning
- Supply chain element 6: Slaughter without stunning

Within each of elements the guidelines present either a description of a process that can be checked (are staff observed to be working in accordance with SOPs for the facility) or a measurable outcome that can be compared to a defined target (less than 3% of animals slipping in a race or less than 1% of animals falling during unloading/loading/movement).

The template is suitable for use by first-party QA officers (internal QA processes) or by independent verification or audit officers. The principles of this approach could be extended more broadly across the supply chain as part of a QA program.

[8] http://www.daff.gov.au/biosecurity/export/live-animals/livestock/escas#report

8.4.11 ESCAS audit requirements

The DAFF ESCAS website provides details of audit report requirements that must be arrangted by exporters at different times in the export supply chain.

8.4.11.1 Initial independent audit

The initial independent audit of an ESCAS must be completed and submitted at the time that an NOI is submitted (prior to any livestock being exported). An initial independent audit is required whenever a new supply chain is being proposed or when an existing supply chain is being modified in some way (changed from a prior approved supply chain).

The initial audit is a certification process to ensure that the exporter can meet all of the requirements outlined under ESCAS.

8.4.11.2 Independent performance audit report (IPAR)

IPARs are intended to provide evidence of performance against the standard.

The IPAR template includes the following:

- LNC number (consignment reference number)
- Exporter
- Importer
- Auditor
- Date of audit
- Names and addresses of all supply chain facilities that are included in the approved supply chain (holding facilities, feedlots, abattoirs)
- Names and addresses of all supply chain facilities that were assessed as part of this audit report
- Description of supply chain elements covered by this audit
    - Discharge from ship
    - Transport to holding facility
    - Holding facilities or feedlots
    - Transport to the abattoir or slaughter facility
    - Abattoir or slaughter facility
    - Exporter control of the supply chain
    - Traceability / accountability
- Summary of outcomes of the audit
    - Animal welfare
    - Control
    - Traceability
    - Non-compliance

For cattle/buffalo, IPARs are provided at the same time as the exporter's End of Processing (EOP) report for the first 5 consignments.

For sheep/goats IPARs are required every 3 months for the first 6 months.

It is understood that the intention as outlined on the DAFF ESCAS website[9] is to have IPARs performed at a higher frequency for an initial period (as defined above) in order to establish a performance history for each supply chain and exporter and then to have a record of good performance to be potentially rewarded by a reduced IPAR frequency. If supply chains or exporters have less than optimal performance based on initial IPARs then there may be corrective actions required or there may be ongoing high frequency requirements for IPARs.

At the time this report was prepared it is not clear whether exporters are continuing to provide IPARs at a higher frequency or whether there has been any reduction in auditing and reporting requirements based on performance history.

8.4.11.3 End of processing report (EOP)

EOPs are required for cattle and buffalo only and not for sheep/goats. The requirement appears to be limited to those animals where individual animal traceability is part of the ESCAS.

Interim EOPs are required at 6-monthly intervals while there are still animals alive in a foreign country from that consignment. The final EOP is then submitted once all animals from a consignment have been processed.

The EOP template provides a reconciliation of cattle numbers through the supply chain.

In a perfect system, every individual animal would be recorded at each step along the supply chain to one of two end-points: mortality at some defined point along the supply chain due to reasons other than normal slaughter at the abattoir or slaughter facility, or a record of animals being killed at the designated abattoir or slaughter facility.

There are then two broad pathways by which one or more animals may fail to meet traceability requirements across the supply chain:

- Animals that remain in the supply chain but where the animal ID at some point becomes decoupled such that the animal can no longer be traced back to the original tag list. The main reason for this scenario is a lost tag and no effective back-up identification method. These animals may remain in the supply chain and be processed along with other animals. This situation represents a failure of traceability but since animals are still being housed with their normal cohort it does not represent a failure of management of the animal group.
- Animals that are lost to the supply chain and that can no longer be counted. It is presumed that reasons for animals leaving the supply chain may be because of unrecorded mortality or animals that have for some reason become separated from their normal group. This situation represents a failure of effective animal management such that animals have been allowed to leave the supply chain and the location and status of missing animals may be unknown.

[9] http://www.daff.gov.au/biosecurity/export/live-animals/livestock/escas#report

8.5 Quality assurance

A recent report (Schuster 2013) has been completed on the development of a risk management and quality assurance program for the ESCAS component of the export supply chain (W.LIV.3014).

The report noted that all exporters had systems in place to facilitate compliance with ESCAS requirements but that some of these systems may be informal in nature and that there are concerns about compliance during periods between mandated ESCAS audits. The report was based in part on general acknowledgement that an industry-initiated QA program may be an effective way to address concerns about performance between audits.

The report recommended that an industry QA program be implemented with the following characteristics:

- The Program would incorporate certification procedures
- The Program be applicable at the unit level and, as such, allow individual units within a supply chain to achieve certification.
- The Program use a combination of first-party and third-party verification methods.
- The Program use a combination of remote and on-site assessment methods.
- The frequency of surveillance activities be determined based on risk.
- A set of standards be developed that has two compulsory elements; QA and risk management.
- ESCAS requirements become normative elements under the Program Standards.
- A series of rules and conformance measures be developed relating to the Program requirements and governing the use of any Program certification marks.
- Other relevant Program related reference material, such as record keeping templates, training, procedures and manuals, be produced or modified from existing material.
- A centralised management system be introduced that will assist units in the adoption of and conformance with the Program Standards and Rules.

The report described eight elements of the Program:

1. Quality management system
2. Risk management system
3. Handling of livestock
4. Land transport of livestock
5. Feedlot / Holding facility operations
6. Lairage operations
7. Abattoir with stunning
8. Abattoir without stunning

The report acknowledged industry concerns about self-managed QA programs particularly where self-reporting of non-compliance may be perceived as leading to punitive action. A key element of QA programs is the need to link detection of non-compliance with corrective or preventive action to ensure that adverse events either are detected early enough to be avoided or elicit an effective response such that they do not occur again. The report describes an approach based on assessment of both non-compliance and corrective action in order to determine whether or not there may be regulatory impacts associated with these matters.

Where non-compliance is deemed to minor or major but is detected and addressed in a timely manner then there may be no additional punitive action. Where non-compliance is deemed to be

important (based on assessment of severity) and either not effectively detected or not effectively corrected in a timely manner there is more justification for considering additional punitive action including the possibility of suspending or revoking an export licence.

The report suggests that certification processes may be developed and applied to units within the export supply chain including units responsible for managing discharge from a port and transportation to a holding facility or feedlot, holding facilities and feedlots, and abattoirs.

The report provides a brief description of a centralised management system but this section does not provide any information about a computer- or web-based information management system for collecting, storing and analysing data through the chain. The objectives listed in the report for the centralised management system suggest that the description is more focused on a centralised office that may provide a repository for protocols and documentation and provide advice and control for units and stakeholders seeking guidance on certification or operation of the QA Program.

In summary the report by Schuster (2013) supports the development of a risk-based industry-managed QA program that is based largely on documenting performance against the ESCAS standards and that includes certification of supply chain units. The report does not provide any recommendations concerning software or computer-based systems for managing data and other information collected as part of the QA program.

Shiell, Perkins and Hewitt (2013) have also reported on QA options for the parts of the export supply chain covered by ASEL (property of origin to port of discharge).

8.6 Current data management practices

8.6.1 DAFF records management

Until recently application and reporting forms to the regulator (NOI, CRMP, ESCAS, AHCPLL, voyage reports etc) were all managed through a combination of paper based records and spreadsheets. There was (and still is) a lack of standardisation of forms and terms and this has led to variation in how individuals manage the reporting of some of these activities such as reports of inspection activities in the RP and at the port.

DAFF have now implemented a new web-based system for management of much of the regulatory activities associated with livestock export. The system is called *Tracking Animal Certification for Export (TRACE)*.

TRACE has the capability to accept electronic completion of some regulatory requirements by exporters directly logging into the system and entering data and information into a web-based system with back-end database structures for housing information. Other related information and some forms are then uploaded as scanned documents and linked to a consignment or exporter record. For example, NOI information can be directly uploaded in electronic while the CRMP and ESCAS documents must be uploaded as scanned documents. In some cases forms are modified and created through interaction with the online system and then printed out by the exporter and completed and signed as a paper record and then uploaded as a scanned document.

Other reports such as the daily and end of voyage reports may be uploaded in electronic form or completed in paper form and uploaded as a scanned document.

Discussion with representatives from DAFF at both state and national office levels has indicated general support for progressive move towards electronic management of data and information including the use of either direct electronic entry or upload of data and information and possibly the use of technology such as optical character recognition to allow paper-based forms to be scanned in and then processed to produce text or numeric data entered into database fields.

The current functionality of systems like TRACE offer the benefit of a single, centralised information management system that should link all relevant information about a consignment in a repository. This means that authorised users should be able to access any relevant information in either paper-based form (as uploaded documents) or in electronic form, leading to more efficient and effective regulatory management of livestock exports. Uploaded documents that are attached to an export record remain relatively inefficient because of problems with inability to search for specific information, variability in records and variation in completeness or legibility of information.

Over time moving to a fully electronic system will improve efficiency in regulatory management but will require standardisation of terminology and fields.

8.6.2 Industry data management

Methods and systems used by exporters and other stakeholders for managing data on animals through the supply chain are variable and changing over time, particularly in recent years since development of ESCAS requirements. In some cases systems are treated as commercially sensitive and therefore it is not easy to provide accurate descriptions of current systems.

Systems for management of data and other information about animals has to meet multiple purposes for the exporter or other operators in the supply chain (RP manager, ship master etc). These include business management including logistics and financial information, management of animal health and welfare and management of regulatory requirements.

Systems have largely been based on a combination of paper records and spreadsheets for managing sourcing of animals and for managing animal counts by class and consignment through the chain.

Larger exporters have implemented web-based front end interfaces to custom developed databases for managing animal records and related business operations (logistics, finance, etc). Export staff and other authorised users such as buyers may then have access either through hand-held devices such as tablets or through desktop computers with internet access to upload information into the database from a remote location. These systems are generally customised solutions built in-house and therefore while they may have commonalities in functionality because they are all operating in the same industry and under the same regulatory environment, they are likely to have variable additional functions that may be commercially sensitive and particularly information about financial transactions (purchase and sales prices) and management information such as treatments and ration management.

All exporters have developed systems for managing individual animal ID for cattle using NLIS scanning and electronic ID records. These may be based on custom developed database systems as described above or commercial software/hardware platforms developed for feedlot/abattoir or general animal management applications. All systems are built around the use of commercial hand-held wands and fixed panel readers that are used for reading NLIS electronic tags and generating lists of tag numbers that can then be imported into a software platform.

The risk of failure to read is a recognised issue for managing cattle records through the export chain. It is our impression that issues associated with poor technique at tag application (tag placement or lack of hygiene) are less common now than in the initial years of NLIS adoption but as indicated elsewhere in this report, failure to read remains an issue for a small but important proportion of cattle (average of 2.6% per annum and up to 10% within a property).

It is also our impression from discussions with industry operators that many exporters are applying one and occasionally two visual ear tags to cattle at some point early in the supply chain (on property of origin or at the RP) to provide increased certainty that individual animals remain traceable through either electronic tag reading or through visual tags at any point along the supply chain. We also understand that exporters have developed systems for detecting failure to read or tag loss in overseas facilities and inserting new tags (either visual tags or new NLIS tags) and where possible linking these new ID numbers to the existing records for those animals.

Management of sheep/goat data is understood to be more variable and more problematic. Sheep must have NLIS tags but as explained earlier in this report NLIS tags are relatively inefficient as a way of tracing animals to class or consignment once they have entered the RP and been drafted into mobs based on class. It is understood that some exporters may be using visual tags in sheep but this issue appears to be under active discussion at the time this report has been prepared.

Industry operators have expressed concern during the consultations undertaken for this project about the complexities and lack of clarity in trying to understand the current regulatory requirements as defined in different regulations and standards and the amount of separate paper forms that have to be generated under existing regulations:

- NOI, CRMP, ESCAS
- AEP issued
- HSRA
- Property of origin certificates, declarations about isolation at RP
- AHCPLL
- Various forms associated with animal inspections at RP and port and including declarations about any testing or treatments
- Feed and water space calculations
- Voyage reports
- IPARs and EOPs

Many of these issues have been described in more detail in the recent report by Shiell, Perkins and Hewitt (2013).

There appear to be particular challenges for exporters in managing traceability and reconciliation of animal counts in foreign countries in order to comply with ESCAS requirements. The technical challenges here require that accurate counts and records of animals either by individual animal ID (cattle) or breed-class groups (sheep) be collected at each step in the supply chain and then reconciled.

From a data management perspective, existing off the shelf software solutions do not appear to be well suited to these particular challenges.

Exporters are understood to be using a variety of approaches to managing this issue. Custom web-based database systems are understood to be used by some exporters and multiple spreadsheets by others. Cattle data derived from electronic reading of NLIS tags are developed as electronic lists of records and therefore are invariably managed in spreadsheets or database systems.

Sheep data are generated as counts by breed-class combination and may be managed through paper records, email, fax or in electronic form in spreadsheets and database systems.

In overseas countries there are additional challenges in accessing the internet reliably and in tracking animals through what may become a spider-web network of small separate shipments of animals moving to many different locations for slaughter.

8.7 Attributes of an information management system for QA

This section describes attributes considered useful if a decision were to be made to support the development of an information management system that was built on recording animal-level performance data through the supply chain for QA and compliance purposes.

8.7.1 Animal traceability

The base functionality for a data/information management system that can meet industry QA and regulatory needs is effective management of animal traceability across the export supply chain.

The structural and functional requirements are best met by a system that is built around a back-end database platform that is capable of handling large amounts of data, and a web-based front end.

Open source software such as PostgreSQL offers a cost-effective (free), powerful, scalable database solution that can be mounted as a web-accessible data solution.

A web-based system has the additional significant advantage that it is independent of computer platform (Apple, PC etc) and independent of operating systems, software and other challenging issues for stand alone computer software such as firewalls and anti-virus software etc.

It is suggested that the most efficient approach is likely to involve two separate components:

- Fixed database structure for the back end comprising the major tables for storing core data and information. In the design of a system these tables would include field and functions that are unlikely to change over time and related to animal traceability and other core functions. Having these in a separate fixed structure results in performance advantages so that these tables can be heavily used and accessed without interfering with performance.
- The second level of functionality involves separate linked table structures that provide for flexible functions. These tables may draw on data from the fixed table structure but may run queries or interim analyses to produce more complex or user defined outputs. The purpose of this flexible functionality is that it can then be modified or extended at any time to meet user needs. This combination provides maximal flexibility and functionality without compromising performance and allows future extension and development of functions without requiring complex restructuring of the entire database.

It is suggested that the system be built with language look-up tables directly incorporated into the design. This means that authorised users in different countries can log on to the same system via an internet connection but can have the system display and operate in their own native language by simply clicking on a button on the web page.

The system needs to have the capacity to accept bulk upload or import of multiple animal ID records (delimited list of cattle NLIS ID values imported from a scanner or computer) or a more complex file containing NLIS ID values and other linked data (multiple ID fields including visual NLIS, electronic NLIS, visual tag etc as well as exporter, consignment, breed, class, weight, treatment, certification status and other fields). The same approach needs to be available for uploading mob-based animal data for sheep and goats.

The system also needs to be able to accept individual animal ID entry and updating of animal or mob records through a web interface.

The system also needs to allow entry of records for people (exporters, importers, transporters, unit managers, etc) and enterprises or supply chain units (vessel, port, holding facility, feedlot, abattoir etc).

There are then a variety of base functions that are necessary for traceability:

- Ability to unassign one animal or a group of animals from their ID values or assign a new ID value to one animal or a group of animals
  - Useful for when an animal loses its NLIS tag or the tag becomes unreadable and is replaced with either a new NLIS tag or a visual tag.
- Record animal death for any animal
- Record animal movements for individual or groups of animals
  - Date, from, to, entered by, etc
- Create any event and link one or a group of animals to that event
  - Abattoir processing
  - Movement
  - Welfare compliance issue
  - Treatment
  - Morbidity (disease diagnosis)
- Change of ownership
- Certify or verify status or event or audit and verify compliance.
- Create reports
  - Summary reports including movement arrows on a map for all animals in one mob, or on one voyage
  - Individual status or summary reports given an entered value for one or more animal ID values
  - Animal history
  - Reconciliation for all animals in a voyage/consignment at a point in time
  - Creation of a compliance report based on pre-defined fields to meet ESCAS requirements

The development of capacity to allow mobile phone texting (using SMS) for data upload and download is identified as a useful option to allow system functionality in remote regions where there is mobile phone coverage but no internet access. Our experience in Asian countries in particular is that most countries (including poorer Asian countries such as Cambodia, Lao PDR and Myanmar) have excellent cell phone coverage across the entire country even though they may have less reliable internet coverage.

There are a number of ways to allow SMS interaction with a web-based platform:

- Using a basic mobile phone and a pre-defined arrangement of characters and delimiters (comma or space), users can generate a text message and send this to a receival number linked to the web system. The text message may provide one or more animal ID values and a count of animals (if it is a mob ID value) and a status update code. Sending this sort of text into the system could result in an immediate update to assign a new location or status to the designated animals eg to indicate that the animals had been slaughtered.
- For smartphones or tablets with a sim-card and cell phone access, it is possible to design a simple app that can be downloaded onto the device and that can then be opened even when the

user is not able to access the internet. The app could then display fields with drop down lists and built in functions. The user could enter animal or mob ID values and other relevant information and then click send. The app then turns the entered information into a text with appropriate formatting and delimiters and sends it as an SMS to the web system.

- The same process can be used to query the system and receive information back to the hand-held device in the form of a text. Using pre-defined codes and characters this may allow a user to enter an animal or mob ID and then query the system to determine the consignment ID for that animal or to check some other attribute stored in the system.
- A number of security and QA functions would need to be developed for this system to work. Users would need to register their cell phone with the web system and with a specific user. This may then limit the activities that a specific user van perform. Users would then be given a pin or password. When they link to the system via SMS the text would need to include the pin. The system would record the time and date of the SMS and through the pin it would identify the mobile phone and user details so that every update of the system can be linked to a specific user.
- This functionality could be developed to allow animal traceability and status/QA functions to be maintained in a timely manner even when internet access is patchy or unavailable. It ensures that status reports can be delivered from the field in almost any location with the only requirement that there be cell phone coverage.

There are benefits in having embedded mapping functionality in the system. This presents problems in that mapping requires positional data (latitude and longitude or detailed address details) to be provided or entered. A suggested approach that is simple and effective is to build on the requirement that the supply chain be fully described and approved before animals are exported. Given that this is already required, it is relatively easy to add a location for each supply chain point (port, holding facility, feedlot, abattoir etc). The location could be a latitude and longitude or it could be a physical address or the nearest defined village.

Incorporating mapping functionality then means that at any point in time, a mapping display can be called that may show the current location and status of an individual animal (dot on a map), a group of animals (dots representing either a group or multiple dots representing clusters of individuals) and even lines or arrows connecting movement pathways over time. The same system could display the intended movement (end destinations) and current location.

Once the attributes described above have been implemented then at any point in the supply chain, a user can query the system and obtain a variety of traceability related reports or displays:

- Current location of an animal or mob of animals
- Movement history of one or more animals
- Future movements of one or more animals
- Real-time reconciliation, location and current status report of all animals in a mob or breed-class group or consignment
- Number of animals slaughtered from a consignment at any point in time and number remaining alive

8.7.2 Extending traceability with additional QA activities

Once the system has the capacity to manage traceability effectively it can relatively easily be extended to provide a range of other functions that may be of interest to industry, particular other QA functions such as audits, verification/certification procedures or other measures of performance that may be developed as part of a QA program.

Certification outcomes may be applied to units for example a holding facility or feedlot may be audited and certified as being compliant with regulatory standards for a range of outcomes (SOPs, staff training, procedures, facilities inspection, etc). The system could handle these events by recording the type of event (audit inspection of facility), location and type of facility, date, who did the inspection, and the result (passed, failed etc) and any corrective action required (action, date required, who is tasked with doing it etc).

QA processes may then involve internal QA officers performing checks of performance at various locations while animals are being handled or processed. These same processes may be inspected by third party verification officers or independent auditors. All of these events can be managed by the system in the same way. This might for example involve a QA officer observing animals being unloaded at a holding facility and recording the number of times an animal slipped or fell in a specific time period and then submitting that information to the system as an internal QA check before moving on to another QA activity at a different spot in the same facility and uploading QA measures from that spot. Each entry can be linked to unit/facility, consignment, breed-class group and recorded by date/time/userID etc.

A variety of reports can be defined and even automated to meet regulatory reporting requirements as well as QA reports and other outputs.

The biggest need and the primary scope of the traceability and QA/compliance functions described in this report apply to the ESCAS part of the supply chain i.e. post-discharge activities.

There is little difficulty in extending the scope to cover the entire supply chain from receival in to the RP on Australian soil, transport to the port, loading on to the ship and the voyage.

The RP and loading port would be handled as supply chain units or enterprises in the same way as similar units are handled in other countries.

Ships and voyages may also be incorporated into the same system. If there is unreliable or no internet access during the voyage then it will be possible to develop a stand-alone system component that functions on a hand-held device or on a laptop during the voyage. This would allow daily voyage report data to be collected in a standardised way and then when the ship reaches port or a location where internet access is available the data can be uploaded or imported into the web system.

The concept of a single integrated system that can handle regulatory requirements from RP to point of slaughter allows maximal efficiency in meeting reporting and QA needs across the supply chain.

8.7.3 Examples of system capabilities related to traceability and QA

A draft list of possible operations is provided below that would be possible on an information management system built around the attributes described above:

- Register people (owners of animals, exporters, owners of enterprises, …) and related details
- Record animal id and additional information about animals
    - Batch uploading of NLIS tags and visual tags if present and other animal information (species, breed, class etc)
    - May be done at individual animal level (cattle) or group level (sheep/goats)
    - Include link to person (owner of animals, exporter, voyage, …)
- Record tag replacement or back-up ID systems
    - Date, link to old NLIS tag and data on new tag (RFID or visual tag details)
- Record animal movements
    - Date, from, to
    - Once locations are entered with geographic reference details, this information can be presented in map form showing a line (arrow) linking origin and destination.
- Record transfer of ownership
- Record change in animal status
    - Lost, stolen, dead, slaughter (processing)
    - Disease diagnosis for sick animals
    - Date, location
- Record animal treatments
    - Vaccination, other treatments (antibiotic, parasite control etc)
    - Date, animal or group, treatment details (batch number, dose, withhold, etc)
- Record data necessary to generate daily voyage reports and end of voyage reports
- Record necessary data / information for any event defined under a QA program
    - Animal status at a location or inspection point
    - Export certification/approvals
    - Certification of units in the supply chain
    - QA or verification/audit checks and performance measures
    - Welfare status
    - End of processing records
- Reporting capabilities
    - Individual animal ID query
        - Full history of movements and events for any animal
    - Batch query for group of animals, consignment, voyage etc
    - Forward and backward tracing for any animal or batch of animals
    - Movement pattern analyses
    - Reconciliation reports – current status and location for all animals in a consignment
    - Generation of information for compliance reporting
        - Daily voyage reports
        - End of voyage reports
        - Audit reports (ESCAS) and End of Processing reports
    - Ad-hoc queries