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Odour Assessment

Wellard's Darwin Integrated Livestock Export Facility

Report Number 23919.79976



Prepared for



Wellard Rural Exports Pty Ltd

1A Pakenham Street
FREMANTLE WA 6160
Telephone: (08) 9432 2800
ABN: 31 109 866 328

Prepared by



PO Box 1197
MILTON QLD 4064
Telephone: (07) 3367 0001
ABN: 56 135 005 999

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Executive Summary

EnviroAg Australia Pty Ltd has been engaged by Wellard Rural Exports Pty Ltd (Wellard) to provide an Odour Assessment for the operations associated with the Livingstone Integrated Live Export Facility (ILEF).

The proposed ILEF is located on the property known as “Livingstone Valley” (Lot 5544 Hundred of Strangways) located on the Stuart Highway at Livingstone, Northern Territory. It has an area of 90.5 ha (or 220 acres) and is situated 50 km south-south east (SSE) of Darwin; 40 km south east of the Darwin harbour, and about 8 km west of Berri Springs.

The selected site is immediately adjacent to the “Santavan” Pre-Export Quarantine (PEQ) holding yard which is currently leased to Wellard. The “Santavan” live export facility has not had any odour complaints report against its PEQ operations.

The recently constructed and commissioned Australian Agricultural Company (AA Co.) meat processing facility is located to the south and adjacent to the proposed ILEF and the “Santavan” live export depot. It has caused some reported odour nuisance. The odours from the AA Co. meat processing facilities have a different odour signature to that of the proposed ILEF and those odours are not additive.

Odour emissions from an intensive livestock development such as the ILEF can potentially be a contentious and emotive issue. Technologically, it would appear impracticable, if not impossible, to entirely prevent the generation of odour from confined animal operations. Consequently guidelines regarding odour management and separation distances have been developed. The most applicable current guideline is the National Guidelines for Beef Cattle Feedlots in Australia (MLA, 2012). While promoting management practices known to minimise odour emissions, they seek to ensure that feedlots are displaced from receptors by distances that minimise the risk of odour nuisance at these locations.

The ILEF operation is very dissimilar to a traditional ‘fattening’ feedlot in odour generation. The cattle are “empty” when they arrive and this means they have to fill their gut; they are only in the yard for a few days, and consequently the level of manure production is reduced. The diet they are fed is a “maintenance diet” and as such there is less protein and other by product nutrients in the manure which substantially reduces the nutrient content available to microbes.

The pre-quarantine export yard is covered. The open feedlot will not be operated during the wet season (per se) and will be cleaned prior to the wet so there will be no manure pack to generate significant amounts of offensive odours.

Odour nuisance can be mitigated in a number of ways. A key mitigation factor is an appropriate separation distance. Feedlot national guideline principles have been applied to the site and modified calculations for the same have been provided. Wind Roses have been compiled from the Darwin Airport in conjunction with separation distance calculations to determine the suitability of the proposed ILEF site.

The facility will be designed and managed to minimise odour and dust. The crux of both issues stems from manure management. Manure on the pen floors will be managed well. The object is to ensure that no wet manure that accumulates causes odour nuisance. With good manure management, and dust suppression systems, no extremely dry powdery manure is generated that can give rise to dust when strong winds occur.

The design of the ILEF and the management of the cattle within the facility mitigate many of the design and management issues identified in this Odour Assessment. The odour assessment considers the use of buffer distance and management practices. It found that the separation distance for the ILEF will be 429.5m when fully developed, and 496.4m when an upgraded Santavan is taken into account. No residences are within this separation distance, with the nearest sensitive receptor found 800m from the facility.

The Darwin ILEF is a well-planned project. It is generally compatible with current adjacent land uses. It currently has sufficient separation distances for process upsets and the ILEF has adopted the principles of waste minimisation, cleaner production and best practice odour control technology. A further odour assessment will be undertaken before the development commences the Stage 2 development to reassess the design and management of the facilities.

Planning instruments should be applied to the development so that it is not unduly “built out” in the future.

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1. Introduction

1.1 Background

Wellard sells and exports livestock to overseas markets. Currently Wellard lease a pre-export quarantine (PEQ) holding yard, “Santavan”, 50 km south-south east of Darwin. Wellard aims to develop a state of the art and modern facility that delivers much improved and positive animal welfare outcomes for the next 40 years on their own land. Wellard do not have sufficient capacity at the “Santavan” facility to meet its export demands from Darwin.

The voyage cycle of a live export ship is about 4-20 days. Livestock for shipping are aggregated in the PEQ yard over a 2-8 day period with the average holding time of just 4 days. This means that the yard fills quickly and then empties quickly; and, on average, the yard holds about 25% of its peak capacity over the shipping cycle.

Cattle have an empty gut when they arrive having been yarded from the paddock, held and then transported. They are fed a high roughage, low protein and energy diet on arrival to restore gut function and prepare the animal for the voyage. They are not fed a “production” diet for fattening, as found in feedlots designed to feed and fatten for slaughter in local meat processing facilities.

Sick cattle or cattle that do not make the shipment have to be held for a short period of time. These cattle are fed a maintenance diet. Again, the diet is high in fibre and is relatively low in energy and protein. The diet is not a production diet for fattening purposes. These cattle are held in a short term feedlot until the next shipment occurs.

1.2 Project Description

Odour emissions from an intensive livestock development such as the Integrated Livestock Export Facility (ILEF) can be a contentious and emotive issue. Technologically, it would appear impracticable, if not impossible, to entirely prevent the generation of odour from confined animal operations.

Feedlots, piggeries and poultry operations have various guidelines regarding odour management and separation distances. The most applicable current guideline is the National Guidelines for Beef Cattle Feedlots in Australia (MLA, 2012). While promoting management practices known to minimise odour emissions, they seek to ensure that feedlots are displaced from receptors by distances that minimise the risk of odour nuisance at these locations.

Pre-Export Quarantine (PEQ) yards or depots are explicitly excluded from these guidelines (MLA, 2012, p. 1). The exclusion was at the request of the Northern Territory Government on the basis that they are not designated to the production but rather the transportation of beef. (NT EPA Statement of Reasons, 16 June 2015)

“Buffer”, “set-back” or “separation distance” approaches can never entirely eliminate the occurrence of odour nuisances. Rather, the primary aim is to reduce the probability of such occurrences to levels consistent with the likely sensitivity of the receptor.

This odour assessment aims to define likely odour generated from the ILEF and a determination of the minimum separation distances.

1.3 Objectives of the Odour Assessment

The Objectives of this odour assessment are to:

- Define the potential sources of odour of the ILEF;
- Define the factors that contribute to odour generation, emission, dispersion and impact;
- Normalise the capacities of the ILEF so a separation distance can be determined;
- Account for Cumulative Impacts of the Neighbouring PEQ yard at “Santavan”;
- Describe Best Practices in environmental management of odours;
- Assess Impacts on Receptors; and,
- Define mitigation measures and described required monitoring.

2. Odour Assessment Methods

2.1 Current Guidelines for Undertaking Odour Assessments

2.1.1 Queensland State Government Guidelines

The 2013 Queensland DEHP guideline “Odour Impact Assessment from Developments” sets out various approaches to assess potential impacts from new development proposals.

The guidelines state that wherever possible, the odour emission record of the facility (in the case of modifications) or industry type should be included in the assessment along with any practical experience in using odour management techniques. Tools such as odour field surveys, odour diaries, complaints data and compliance history provide additional relevant information for assessing the impact of odour from modifications to existing facilities.

Guidance is provided on the use of air dispersion modelling as a tool to predict ground level odour concentrations. Comparison is made with guideline values to determine the likelihood of adverse odour impacts. Alternatively, an industry or facility-specific odour intensity approach may be used to assess the likelihood of odour impacts. A practical example of this is the approach of the Department of Agriculture, Fisheries and Forestry for feedlot facilities.

2.1.2 New South Wales State Government Guidelines

The NSW EPA (2013) states that for large area sources like sewage treatment farms, cattle feedlots, composting, household or industrial tips and manure spreading, there are only two proven methods that can be used to reduce odour complaints. These are:

- Excluding development close to the site; and,
- Ensuring that the operation is carried out under best management practice.

Further, the NSW EPA notes that if development close to the site is to be excluded, a reasonable 'buffer zone' around the area source has to be determined. The actual size of this zone will depend upon a number of factors, including the size of the area from which the odour emanates, the intensity of odours being emitted, the duration and frequency of the odour emissions, the actual process being undertaken, the topography of the site, the weather conditions that prevail at the site and the neighbours' perception of offensiveness of the odours being produced.

The NSW EPA expectation is that for all new developments, best management practices will start with the site selection and the building of the facility. Best Management Practices (BMPs) vary according to the industry producing the odour. In the case of the ILEF, BMP's are still being defined at an industry level. The ILEF will adopt BMP's for the saleyard, beef cattle and livestock transport industries.

2.1.3 Approaches to Odour Assessment for Areal Sources

NSW Odour policy on odour assessment generally provides three different approaches to establishing the appropriate displacement of a feedlot development from likely receptors:

- Level 1 – A largely generic, variable separation distance (“S” factor) approach that is based on dispersion theory supplemented by experiential or empirically derived variables to account for site specific topographic or management factors. This approach is generally limited in application to feedlots accommodating less than 5,000 SCU's;
- Level 2 – A site specific, odour dispersion modelling approach using a synthetic “worst case” meteorological dataset; and,
- Level 3 – A site specific, odour dispersion modelling approach using a year-long, on-site or site representative, meteorological dataset.

2.2 FIDOL Factors

There is general agreement by all State EPA's that frequency, intensity, duration, offensiveness and location (FIDOL) are factors that ought to be considered when attempting to judge the likelihood of odour nuisance. These so called FIDOL factors are not easy to quantify individually, let alone when they interact.

The multifarious nature of the factors at the site presents too many unknowns to conceivably attempt to model the dynamics of the site and its operations and interactions with the surrounds.

2.3 Odour Dispersion Modelling

The Queensland and NSW State Government EPA's both set out guidelines for the use of odour dispersion modelling for odour impact assessment.

The use of odour dispersion modelling to assess likely odour impact, or not, is predicated on having available the following key data:

- Emissions data for the proposed land uses / aerial sources; and,
- Local Meteorological data.

It is important and significant to note that:

- While odour emission data are available for "production" feedlots, no odour emissions data are available for;
 - Live export yard aerial sources with manure with a low protein and high roughage content;
 - For manure covered surfaces or compost from live export facilities with sporadic use; and,
 - Live export cattle shed facilities.
- While meteorological data are available for the Darwin airport these data cannot be confidently applied to a site 50 km to the south and inland of the coast.

It is thus reasonable to conclude that the application of odour dispersion modelling is inappropriate in the absence of useable data and alternate methods for undertaking the odour assessment should be adopted (see QLD DEHP, 2013).

It is further contended that:

- Given the FIDOL variables and disparate nature of the ILEF land uses, operations, possible seasonality of odour generation rates, and large unknowns it is simply nonsensical to attempt odour dispersion modelling; and,
- It is now well considered that the odour separation distance calculation methods provide a very conservative approach to the determination of buffer zones (Skerman, 2004). This approach has proven to be effective in management of odour between source and receptor.

2.4 Site Specific Complaint Data

EnviroAg Australia has sought advice from the Northern Territory EPA regarding a complaints history for the existing "Santavan" live export facility (LEF). This 12, 065 head (@ 500kg per head) facility is 925 m from its immediate rural residences (to the north). No odour complaints have been received by the Northern Territory EPA with regard to the operations of the "Santavan" LEF.

EnviroAg Australia has contact and had discussions with the site managers of "Santavan" and immediate neighbours (pers. comm, B Brosnan; M Dench, 2015). The only recently reported instance of odour nuisance from a near neighbour was the result of a dead animal in a grazing paddock close the boundary fence. This instance cannot be attributed to the live export facility but rather a grazing operation.

Given the following factors it is reasonable to assume that the zero (0) complaints record provides evidence that sufficient buffer exists between near neighbours and the existing facility and thus the new facility is not likely to cause impact if the buffer or separation distance can be maintained.

2.5 Use of Buffer or Separation Distances

The proposed development aims to follow the air management hierarchy under the Queensland EPA Environmental Protection Policy (Air) 2008. This includes adopting the following measures, in the following order of preference:

- Using management techniques to avoid creation of odours (e.g. using less odorous materials, managing anaerobic ponds to avoid malodours);
- Reusing or recycling the air emissions in another industrial process (e.g. using vapour recovery technologies in refineries, using biogas as fuel);
- Minimising the creation of odours and using the best practice technologies to collect and treat odorous emissions (e.g. scrubbers, afterburners, bio-filters, adsorption technologies, ozonation); and,
- Relying on buffer zones, winds, and stacks to disperse emitted odours.

The aim of the development is to design and manage the development so that it can operate within a buffer zone with causing odour nuisance.

It is on this basis that the following figure is applied in the odour assessment process.

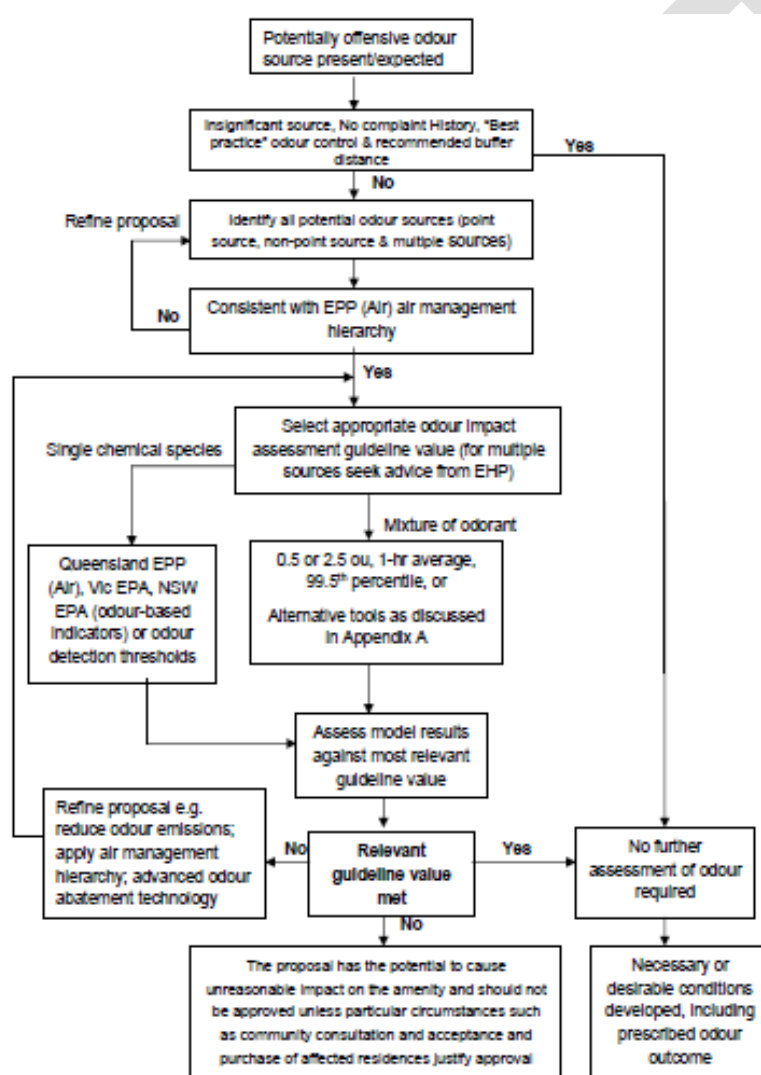


Figure 1 Odour Assessment Flowchart for New Developments (Queensland DEHP, 2013)

3. Planning Considerations

The Northern Territory Government is able to proactively manage future planning of land uses so that agricultural development such as the ILEF and rural and residential developments can co-exist. Many examples of planning in rural zones for the same exist.

3.1 Planning Instruments

As one example; the Griffith City Council has approved the Griffith Local Environmental Plan (GCC, 2002) under the NSW Environmental Planning and Assessment Act 1979. This local environmental plan provides for buffer zones between large wineries, being an intensive and potentially odorous agricultural industry, and residential lands. This applies to lands near activities requiring odour or noise buffers or near Zones 1 (e) and 4 (a).

	2002 No 893
Griffith Local Environmental Plan 2002	Clause 28
Special provisions	Part 3
Hazards and buffers	Division 4

28 Land near activities requiring odour or noise buffer or near Zones 1 (e) and 4 (a)

- (1) This clause applies to land:
 - (a) that is within the recommended buffer distance listed in Schedule 4 from the building, work or place in or at which an activity described in that Schedule is being carried out or from a building, work or place described in that Schedule, or
 - (b) that is within 40 metres of land within Zone 1 (e) or 4 (a) other than land on which such an activity is being carried out or from any such building or work.
- (2) Consent must not be granted to development on land to which this clause applies unless the consent authority is satisfied that measures can be taken for odour or noise control that will be sufficient to mitigate any adverse impacts on the proposed development and on surrounding existing activities from:
 - (a) in the case of land described in subclause (1) (a)—activities, buildings, works or places described in Schedule 4, or
 - (b) in the case of land described in subclause (1) (b)—activities allowed within Zone 1 (e) or 4 (a).

Note. When considering noise or odour mitigation measures, Council has formulated a policy known as *Development Control Plan No 28—Landuse Buffer Controls*, which sets out “deemed-to-comply” provisions.

The Griffith City Council developed this plan and its associated policies to allow continued development of its lands whilst protecting specific industries clearly benefiting the community.

It is recommended that this approach is applied by the Northern Territory Government in approval of this development and subsequent future development control of the development and its surrounds. This can be considered a precinct of “agri-business” and be afforded a buffer zone to protect its future operations and prevent them being “built out”.

It is further noted that NSW State Government legislation (Local Government Act, etc.) and planning policies put the onus on new developments adjacent to existing development to prove that an existing development will not unduly be affected by the proposed new development operations.

The current land use is rural and the surrounding land uses to the proposed development are rural. The proposed development is sited with similar land uses. These common land uses should be acknowledged as an agri-business precinct with a recognised buffer zone. Any future development adjacent to the development, and within the buffer,

ought to be subject to the new proponent (e.g. subdivision of land for residences within the Strategic Plan ((NT DLPE, 2015)) demonstrating that their development would not be impacted by existing development.

3.2 Equity in Planning and Environmental Regulation

The ILEF development application and environmental assessment has followed the formal planning and assessment processes duly set out by the NT Government. It is noted that the “Santavan” PEQ is an existing facility that is not encumbered by current planning and environmental regulations.

Potentially the ILEF odour assessment could be undertaken on the basis that no cumulative assessment be undertaken since no separation distance would be applicable for an existing development on a retrospective basis.

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4. Factors Influencing Odour Generation, Emission and Dispersal

4.1 Odour Generation

Malodours are generated when organic matter is decomposed in a manner that results in the formation of gaseous compounds in sufficient concentration to be not only detected but cause offense to a person. Emissions from an intensive livestock facility, are highly dependent upon factors such as animal stocking density, animal size and age, the diet fed, manure production, manure harvesting techniques, pen surface and soil characteristics, and ambient environmental conditions (i.e., temperature, wind, humidity, precipitation) (Cole et al., 2012).

Alternately, when dry conditions occur and dust is generated and becomes air borne, the organic dusts received can create a chemical reaction on the receptor's olfactory functions and a sense of odour can result.

4.2 Sources of Odour from the ILEF

The sources of odours from the cattle holding and ancillary facilities of the ILEF include:

- Pen surfaces (odour and dust);
- Cattle handling facilities (odour and dust);
- Sedimentation basins (odour);
- Waste water holding ponds (odour);
- Manure storage and composting areas (odour and dust); and,
- Irrigation of waste waters (odour).

4.3 Management of Dust

Key sources of dust are:

- Road traffic on gravel roads;
- The feed mill and processing of feed;
- Spreading of compost;
- Milling of cattle in dry pens; and,
- Wind entrained dust (high winds).

The ILEF has included a dust suppression system in its design. High pressure sprinklers will be used to wet dry areas to prevent dust generation.

4.4 Odour Emission from Cattle Pen Areas

There is a sizeable body of experimental and empirical data to suggest that odour emissions from a feedlot manure pad do not occur at the same uniform rate. Ormerod and Zeise (1995) and Lunney & Smith (1995) suggest that in feedlot pens the odour emission rates are dependent upon:

- The depth of the manure pad;
- The moisture content of the manure pad;
- The temperature of the manure pad; and,
- The elapsed time since rainfall.

The depth of the manure pad can be shown to be a function of:

- The stocking density of the cattle;
- The live mass of the cattle and subsequent feed intake, gut fill and excreta; and,
- The pen cleaning interval.

Further, the moisture content of manure pad can be shown to be a function of:

- The live mass of the cattle per unit area;
- Rainfall;
- Evaporation; and
- Rainfall runoff.

The mass balance of a steer in a beef cattle feedlot situation is presented in Figure 2.

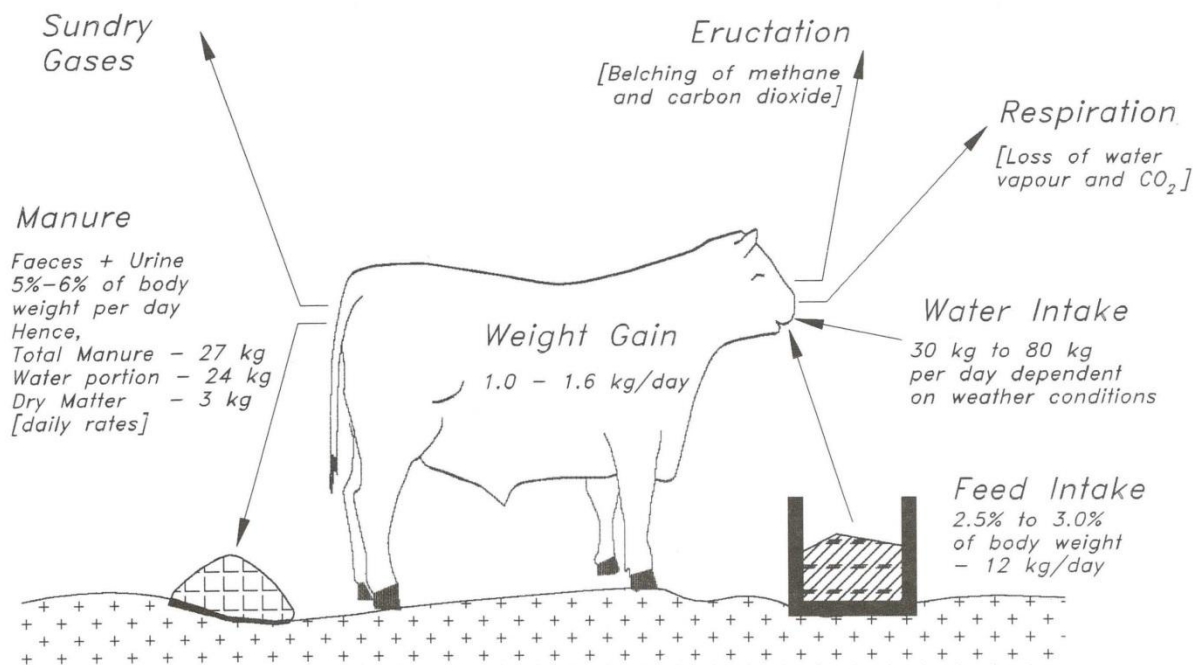


Figure 2 Mass balance of a steer.

It is noted that pen surfaces in a PEQ yard are similar to a feedlot pen surface in that the pen surface receives manure from cattle held within the pen. The key differences are;

- The animals have an empty gut on arrival at the PEQ yard from defecating in pre-transport stock yards and on transport trucks over a long period of time. As such they have a gut fill to compensate for when they do return to feed on induction to the yard. This can take 24-48 hours; and,
- The ration consumed in the PEQ yard is a “maintenance ration” which is relatively low in energy and protein and consequently the amount of nutrient that bypasses the digestive systems is substantially less than a production feedlot.

4.4.1 Manure Moisture Content

Watts and Tucker (1994) describe odour generation for pen manure covered surfaces. They note that odour concentrations from dry feedlot pads are low and result from low bacterial activity due to a lack of moisture. Upon wetting, bacterial metabolism and growth accelerates. Initially, aerobic bacteria proliferate and rapidly utilise the oxygen in the pad leading to anaerobic conditions.

The anaerobic bacteria that survive the dry periods in a moist, anaerobic layer at the base of the pad can now proliferate causing the level of odours to rise. The anaerobic organisms ferment substrates such as undigested plant material and dead microbes to form Volatile Fatty Acids (VFA's) and sulphurous compounds, some of which are regarded as unpleasant odours. After a couple of days, the pad may have dried out and overall bacterial activity declines. Also, as the pad dries, a crust forms over the surface limiting emissions of odours from layers deeper in the pad. After significant wetting of the pad, there can be strong odours emitted because of anaerobic fermentation of waste. Odour generation and emission decline as the pad dries.

The level of VFA's is directly linked to excess nutrients that bypass the digestive system of cattle. It is thus logical that due to the lower levels of nutrients that bypass the digestive system of the cattle in the ILEF compared with a normal feedlot situation, livestock in the ILEF will typically produce lower levels of VFA's and thus generate and emit less odour with a less offensive odour profile.

4.5 Odour from Open Pen Surfaces Following Wetting by Rainfall

The response of odour over time and the magnitude of the odour concentrations measured using simulated feedlot pads were similar to those described by Watts et al. (1993) for a commercial feedlot. Odour concentration peaked about 48 hours after significant wetting of the pads. The peak odour concentration was about 68 times higher than the odours from dry pads.

It is important that pens are kept as dry as possible. Open pens should be sloped to drain rainfall runoff as quickly as possible. The ILEF will cover some pen areas so that they do not get wet by rain. This directly alters the pen water balance.

4.6 Effects of Ration on Odour Generation

Watts and Tucker (1994) found that cattle fed dry-rolled sorghum rations had higher faecal starch contents and lower faecal pH values than cattle fed the other rations such as barley rations. Starch content, pH and mineral composition of manure are important determinants of odour generation in cattle feedlots. The study further found that odour measurements from faeces from cattle fed barley rations produced significantly less odour than that from sorghum rations. This was directly attributed to the significantly lower starch and protein that was bypassed in the faeces.

McGinn et al. (2002) assessed odour generation from cattle fed different rations with the same protein content (12.7%). There was a positive relationship ($P < 0.05$) between level of intake protein and ammonium-N content of the surface-sampled pen manure. They found that the least odour occurred from the faecal matter that had the least ammonia, which was associated with the most digestible ration and thus the least amount of nutrient bypassing the animals gut.

The hypothesis that protein level (as opposed as protein type) is linked to the level of odour generation is further supported by Cole et. al. (2012), who state that the primary source of feedlot odours is the fermentation of starch in faeces, followed by protein fermentation (Miller and Berry, 2005; Miller et al. 2006). Thus, decreasing starch in faeces can decrease odorant production.

Tucker and Watts (1993) and Cole et. al. (2012) state that decreasing crude protein (CP) in beef cattle diets can decrease odour by reducing nutrients, such as faecal starch, protein and lipids, in excreted manure, and that, incomplete fermentation of this faecal starch in livestock manure is the driving force of malodours.

McCarthy (2003) stated that dietary manipulation is considered the “best bet” odour reduction measure for sheep on live export ships. Dietary manipulation aims to reduce the level of rumen degradable protein and include more digestible ingredients in the feed. McCarthy noted that protein levels have already been reduced in shipping pellets to effect this.

Rations fed to livestock in “production” feedlots have a ME of $> 10\text{kJ}$ and a protein generally of greater than 12% (by dry matter). The rations fed to the cattle in both the ILEF short term feedlot and the PEQ yard is low in starch (ME approximately 6-8kJ) and protein (6-8%). This includes shipping pellets that are at times fed to introduce the livestock to conditions expected on ships.

These levels of starch and protein are about 50-75% of those in a production diet in a feedlot producing slaughter cattle for slaughter. The amount of nutrient absorbed by the stock means that the relative percentage retained versus defecated is not linear. It is estimated that, comparatively, less than 40% of the ME and protein would be bypassed from a “maintenance diet”.

4.7 The FIDOL factors

The FIDOL factors are described as;

- F = Frequency
- I = Intensity
- D = Duration
- O = Offensiveness
- L = Location

These factors combine to distribution curve for impact on a receptor. Obviously a continuously wet, poorly drained and managed feedlot with a ration fed for production purposes close to a sensitive receptor will cause significant impact. Alternately, in a well-run, dry PEQ yard where rainfall is excluded from the pen, the pens are occupied only some of the time, and the animals are fed a maintenance diet, it will be largely continuously dry, produce little odour and have low potential for impact.

Design and Management of the ILEF is aimed at minimising the frequency, duration and offensiveness of any odour generation.

4.8 Cattle Occupancy in the PEQ Yard

The voyage cycle of a live export ship is about 4-20 days (average of 16 days). Livestock for shipping are aggregated in the PEQ yard over a 2-8 day period with the average holding time of just 4 days. This means that the yard fills quickly and then empties quickly. Generally, the yard holds about 25% of its peak capacity over the shipping cycle.

The “standard cattle unit” (SCU) is for a 600kg animal held full time in a yard. The SCU unit is used to define manure build up rates, manure moisture contents and likely odour generation rates from pen surfaces. It is important that the occupancy is normalised so that it can be properly equated to a pen that is continuously stocked.

Wellard currently lease the “Santavan” PEQ yard next door to the “Livingston Valley” property. It has an AQIS license for 12045 head at 500kg. Given the occupancy, the PEQ would have a normalised capacity of some 1851 SCU’s. This is shown in the graph (Figure 3).

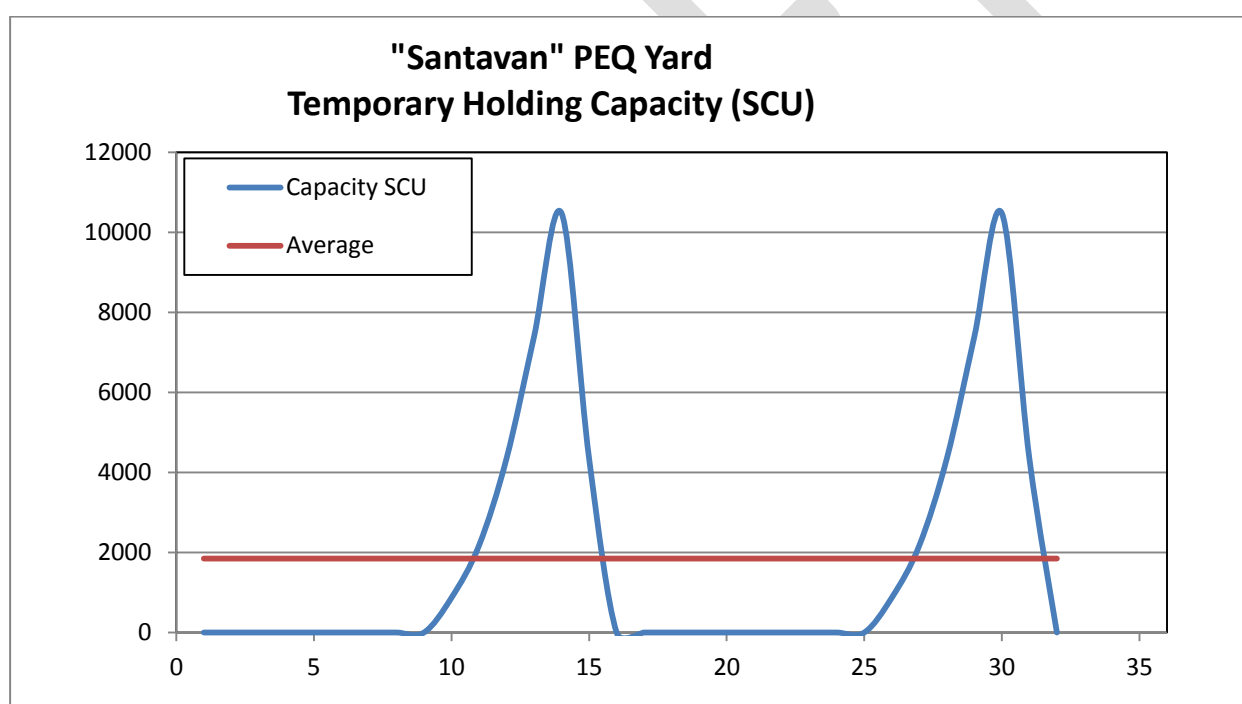


Figure 3 Normalised Stocking Rate "Santavan" PEQ

The proposed “Livingstone Valley” PEQ yard will have a Stage 1 capacity of some 12,000 head at about 500kg; in a similar fashion to the current operations at “Santavan”. The final capacity of the ILEF PEQ yard will be some 20,000 head at about 500kg. Given a peak holding capacity of 12,000 head (Stage 1) then the real full time equivalent capacity of the PEQ yard is 1,851 SCU and when developed to 20,000 head it will have an equivalent capacity of 3,078 SCU.

Figure 4 presents a graph of the cattle occupancy in the proposed Livingston Valley PEQ.

The total capacity of the ILEF is the combination of the short term feedlot (1000 SCU) plus the normalised (equivalent capacity) of the PEQ yard, which is 4,078 SCU.

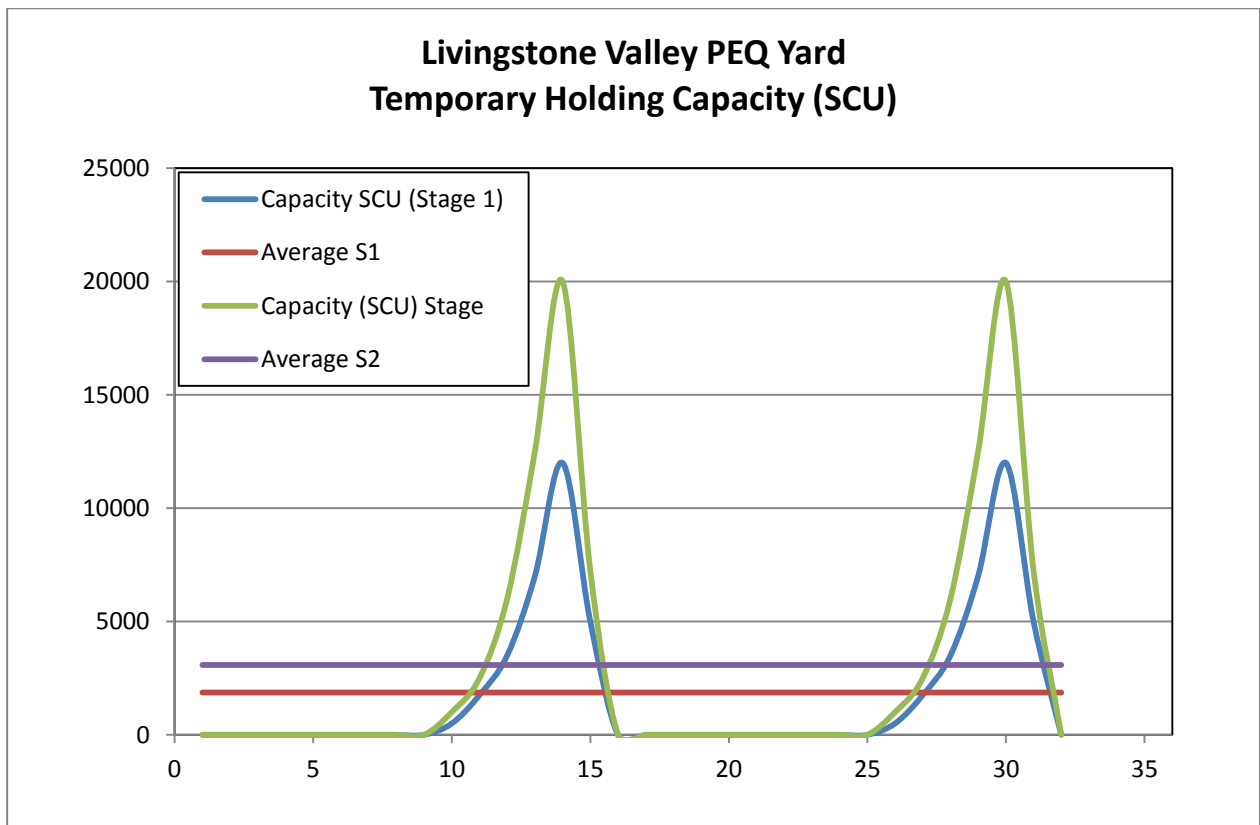


Figure 4 Normalised Stocking Rate Livingstone Valley PEQ

Given that the total full development capacity is about 4,078 SCU it is appropriate to apply a simple Level 1 assessment (per NSW Government (2006) guidelines).

4.9 Housing Systems and Control of the Animal Environment

The PEQ yard on “Livingstone Valley” will be partially covered. About 50 percent of the pens will be covered and the back of the yard configured so that the open area can be shut off should there be rain.

The shed area protects both the feed from spoilage and also the cattle in inclement weather. The open “loafing” yard at the back of the pen can be “opened up” to allow stock to spread out when conditions are dry.



Figure 5 Cattle held in a semi-Confined PEQ Yard (courtesy of the Live Export Diaries) Similar to the Proposed “Livingstone Valley” PEQ Yard.

4.10 Odour Emissions from the Wastewater Holding Ponds

Waste water ponds that hold contaminated water can create odour. Typically this occurs when runoff enters ponds suddenly loading the pond water with organic material. This destabilises the pond environment and causes odours to be generated. (Lott, 2004).

Little runoff is expected at the proposed “Livingstone Valley” site through the dry season. If and when dry season runoff occurs, the collected water will be rapidly pumped to the irrigable area. The lateral move irrigator will be able to apply 25mm across the irrigable area in a 24 hour period. Thus over 10 ML can be pumped to the irrigation area in a single day. This will allow rapid dewatering of the holding ponds.

Continued cleaning of the open pens, use of sedimentation systems and recovery of solids will provide the runoff with the least load of organic matter and nutrient.

Generally, open pens will not be used at the height of the wet season with stock to be confined under the sheltered pen areas. The open pens will be cleaned prior to the wet season to remove the manure load (November). This will ensure that the holding ponds will capture, essentially, clean water that is unlikely to cause odour. Should odour occur, the pump will be used to recirculate water with an input of lime that will both adjust the pH and remove odorants. Water will then be pumped to the irrigable area as soon as a water deficit occurs in the soils.

Odour from waste water ponds are considered to be part of the feedlot complex that is assessed in any separation distance calculation.

4.11 Odour Emissions from Waste Water Irrigation

Odour from irrigation of waste waters occurs most when waste waters are sprayed and aerosols are generated. The irrigation design for the ILEF uses a poly lined lateral move irrigator with drop hoses that place the waste water directly on the ground. The low pressure irrigation that will be used does not generate aerosols.



Figure 6 Direct Application of Waste Waters to Irrigation Land Through a Centre Pivot with Droppers

4.12 Manure Composting

When properly managed, composting windrows produce little odour (Cole et al., 2012).

The composting area will be used over the dry season (only). All compost will be removed off site prior to the wet season. It will be sold offsite or used as a soil condition / fertiliser on the irrigable area to bolster soil organic matter contents and retention of moisture and nutrient.

Compost wind rows will be placed up and down the slope of the composting area so they shed any rainfall and do not trap any runoff. Composting turning will be undertaken with a tractor and mechanical windrower. The turning will be done in the middle of the day when maximum dispersion occurs.

4.13 Summary

In summary the ILEF (small short term holding feedlot plus the PEQ yard) is dissimilar from a production feedlot where cattle are fattened for slaughter in the following respects;

- The cattle are “empty when they arrive and this means they have to fill their gut and consequently the level of manure production is reduced;
- The diet is a “maintenance diet” and as such there is significantly less protein and other by product nutrients in the manure which substantially reduced the nutrient content available to microbes; and,
- Generally, the open short term feedlot will not be operated during the wet season (per se) and will be cleaned prior to the wet so there will be no manure pack to generate significant amounts of offensive odours.

The design of the ILEF and the management of the cattle within the facility mitigate many of the design and management issues identified so far in this Odour Assessment.

The summary of mitigation measures being applied in the design and management of the ILEF are set out in Section 6.4 below.

5. Separation Distance Calculations

A level 1 assessment process was carried out consisting of a largely generic, variable separation distance (“S” factor) approach that is based on dispersion theory supplemented by experiential or empirically derived variables to account for site specific topographic of management factors. This approach is generally limited in application to feedlots accommodating less than 5,000 SCU’s.

5.1 Beef Cattle Feedlot Separation Distance Calculation

The separation distances necessary to mitigate odour impacts are based on the capacity of a feedlot, receptor sensitivity, feedlot design, feedlot management and site specific variables. For feedlots the applicable separation distances are determined using the following equation (Skerman, 2004; MLA, 2012):

Equation 1. Separation Distance Equation.

$$D = \sqrt{N} \times S_1 \times S_2 \times S_3 \times S_4 \times S_5$$

This standard equation is reasonably applicable to the short term feedlot. It is not applicable to the PEQ yard. The standard separation distance equation can be modified to accommodate the design and management changes that are expected and that have been discussed in Section 4 above.

Equation 2. Modified Separation Distance Equation.

$$D = \sqrt{N} \times S_1 \times S_2 \times S_3 \times S_4 \times S_5 \times S_6$$

Where:

- D = separation distance (m) from feedlot pens and manure stockpiles,
- N = feedlot capacity (head of cattle),
- S_1 = a feedlot stocking factor,
- S_2 = a receptor type factor,
- S_3 = a terrain factor,
- S_4 = a surface roughness (vegetative cover) factor,
- S_5 = a wind frequency factor, and,
- S_6 = a ration fed factor.

5.2 Derivations of S Factor

5.2.1 S1 Factor – Design and Management

The short term feedlot will be stocked at 15m²/SCU and will be operated as a Class 1 facility. Thus it will have a S1 factor of 65 (as it is in a high rainfall zone).

The PEQ yard will be stocked at a higher stocking density of 5m²/SCU. However, the facility is 50 percent covered and thus significant positive benefit is gained with regard to management of the water balance of the pen surface. It will exclude all rainfall and has a roof structure that promotes passive ventilation upwards through the roof cap. Given that the water balance is significantly changed it is considered that the S1 factor would be equivalent to 40.

5.2.2 S2 Factor – Receptor Factor

The proximate receptors are single residences on farms in a rural zone. Thus the receptor factor in all cases is equal to 0.3.

5.2.3 S3 Factor – Terrain Factor

The landscape is generally “undulating – low relief” land. The S3 factor is consequently 0.9. The roof structures “roughen” the land surface and contribute to an increase in terrain factor.

5.2.4 S4 Factor – Vegetation Factor

The surrounds of the “Livingstone Valley” property is variously grass with trees or treed. The S4 Factor is 0.9 (open grassland, few trees). It is noted that tree lines will be grown on site to support and better this factor.

5.2.5 S5 Factor - Wind Direction Factor

There are no local dominant winds. Seasonal influences do provide some dominant winds but these tend to exceed the variance of $\pm 40^\circ$ of the direct line of the wind. Wind rose data are provided for the Darwin Airport to support this assertion. Darwin airport is close to the coast. Because it is close to the coast it is more likely to have a constant prevailing wind than inland areas where landscape and landform features alter wind patterns.

Wind roses for Darwin Airport are presented in Appendix A.

5.2.6 S6 Factor – Ration Fed Factor

The S1 Factor was developed to accommodate variance in stocking densities and manure depths associated with the cleaning frequency of pens and removal of manure. It does not consider that nutrition can significantly reduce the availability of starch and protein in that manure and potential odour generation.

Section 4.6 shows that starch and protein directly influence odour generation rates. The ILEF is using a maintenance diet which will result in significant less faecal starch and protein being placed in the pen surface. It is estimated that it may be less than 40% of that normally expected at a feedlot with a production diet (cattle fed to fatten for slaughter).

A S6 factor is proposed in accordance with the following table. This table sets out a function between crude protein fed and likely generation of VFA's that contribute to odour and offensive odours. It provides a very conservative approach to the use of ration and reductions in protein content to reduce odour. It assumes that the crude protein fed is digestible.

Table 1 S6 Factor - Ration Fed

Protein Content (%)	S6 Factor
12% or greater	1
10	0.9
8	0.75
6	0.6

On the basis that a ration of hay and nuts with less than 6% protein is fed to livestock in the ILEF (both the short term feedlot and PEQ yards) a S6 factor of 0.6 has been applied.

5.3 Modified S Factor Calculation to Adjust Sites with Cumulative Effect

The ILEF has a 1,000 SCU short term feedlot and a PEQ Yard equivalent to 3,078 SCU when completely developed. This facility is adjacent to an open PEQ yard at “Santavan” of some 1,851 SCU.

The combined capacity of the facilities is 5,929 SCU. Each facility has a different S factor. To obtain a composite S factor an integration calculation was performed to obtain the buffer distance.

Table 2 Receptor Separation Distance Calculation (Full Development) - Rural residence

S Factor	Notes	Short Term Feedlot 1000 SCU	Covered PEQ Yard	“Santavan” PEQ Yard 1,851 SCU	Upgraded “Santavan”	Combined Facilities (SCU)
N (Stage 1)			1,859	1,851	1851	3,710
N (Stage 2)		1,000	3,078	1,851	1851	5,929
S1		65	40	65	40	Composite S Factor
S2	Rural residential receptor	0.3	0.3	0.3	0.3	
S3	Undulating low relief terrain	0.9	0.9	0.9	0.9	
S4	Grass and Trees	0.9	0.9	0.9	0.9	
S5		1	1	1	1	
S6		0.6	0.6	0.6	0.6	
S Factor	Normalised and integrated	9.48	5.83	9.48	5.83	
<i>Normalised S Factor for Stage 1 Excluding Santavan</i>						
<i>Normalised S Factor for Stage 2 (Full development) Excluding Santavan</i>						6.73
<i>Normalised S Factor for Stage 1 + Current Santavan</i>						7.65
<i>Normalised S Factor for Stage 2 (Full Development) + Current Santavan</i>						7.58
<i>Normalised S Factor for Stage 2 (Full Development) + Upgraded Santavan (to Best Practice)</i>						6.45
Distance (m) – Stage 1 Excluding Santavan						251.5
Distance (m) – Stage 2 (Full Development) Excluding Santavan						429.5
Distance (m) – Stage 1 + Current Santavan						466.0
Distance (m) – Stage 2 (Full Development) + Current Santavan						584.0
Distance (m) – Stage 2 (Full Development) + Upgraded Santavan (Cumulative Impact Separation Distance)						496.4

For ease of assessment of potential odour impacts and community engagement it has been assumed, for the purposes of community consultation, that the distance, around the combined facilities, for consultation would be 1000m (1 km) or less. Community Consultation has been progressed on this basis.

The minimum separation or buffer distance for a small township (30-125 persons) such as Berri Springs is 1,655m. Berry Springs is located about 8 km away.

6. Buffer Zone

The ILEF is located in a current rural zoning. It has neighbours that are rural in nature and operation. These include the “Santavan” PEQ and grazing property, and the Australian Agricultural Company (AA Co.) meat processing facility.

The selected site is immediately adjacent to the “Santavan” PEQ holding yard which is currently leased to Wellard. It has an area of 90.5 ha (or 220 acres). The “Santavan” live export facility has not had any odour complaints report against its PEQ operations.

The recently constructed and commissioned Australian Agricultural Company (AA Co.) meat processing facility is located to the south and adjacent to the proposed ILEF and the “Santavan” live export depot. It has caused some reported odour nuisance. The odours from the AA Co. meat processing facilities have a different odour signature to that of the proposed ILEF and those odours are not additive.

6.1 Receptors

Table 3 Receptor types and locations

Site ID	Receptor Type	Contact Name	Address	Distance (m)	Buffer (m) – Stage 2 (Full Development) + Current Santavan	Buffer (m) – Stage 2 (Full Development) + Upgraded Santavan
1	Industrial	AA Co. Mr Steve Rutter	2660 Stuart Highway, Livingston NT 0822	530m	- NA -	- NA -
2	Intensive Livestock	“Santavan” Matt Dench	Manager’s residence 2500 Stuart Highway, Livingstone	200m	- NA -	- NA -
3	Residential		42 Townsend Road, Acacia Hills	800m	584m	496.4m
4	Residential		23 Affleck Road, Acacia Hills	1230m	584m	496.4m
5	Residential		63 Affleck Road, Acacia Hills	1150m	584m	496.4m
6	Residential		89 Affleck Road, Acacia Hills	1092m	584m	496.4m
7	Residential		125 Bradley Road, Livingstone	950m	584m	496.4m
8	Residential		120 Bradley Road, Livingstone	1061m	584m	496.4m
9	Residential		105 Bradley Road, Livingstone	1210m	584m	496.4m
10	Residential		110 Bradley Road Livingstone	1150m	584m	496.4m
11	Small Township	Berri Springs	Berry Springs, NT	~8000m	1,947m	1,655m

Table 3 shows the nearest sensitive receptors in relation to the calculated buffer zone. The buffer zone that will be used is 496.4m – the full ILEF development and upgraded Santavan. The reason this buffer was used is because it is reasonable to assume that Santavan should be required to upgrade to meet today’s best practice and that the approval of a new development not be impacted by neighbouring properties on regulatory and planning inequity.

A map of the combined facilities with a 496.4m buffer (dotted line) is shown in and Figure 7 below. Given the 496.4m separation distance calculated for the facility no residents are within the buffer zone.

On a precautionary basis, community consultation has been undertaken specifically with residents within the 1000m radius of the site; and areas adjacent to it.

6.2 Existing Buffers

The site has several existing land uses adjacent to it that provide a natural buffer zone. These are;

- Railway easement to the west of the site;
- Swamp to the south – north west of the site;
- Stuart Highway to the east;
- “Santavan” grazing property to the North; and,
- AA Co. meat processing facility to the South.

Other forms of buffer exist between the site and the proposed Weddell development area (Darwin Regional Land Use Plan 2015). A large tract of native remnant vegetation exists to the north, east and south east of the site.

This vegetation should be retained to protect the proposed development and any future residential development zone.

6.3 Additional Buffering Mitigation

The proposed development intends to place tree lines to the North, West and East of the facility. These tree lines will take some time to become established. It is expected that the existing vegetated area that separates the receptors from the Stuart Highway will minimise the potential odour impacts from the ILEF.

6.4 Mitigation Measures

Key design and management mitigation measures that will be applied include;

Design - Best Management Practices

- All weather pens are covered by shed rooves.
- Sloping pens to allow good drainage and maximise drying and dry manure conditions.
- Free draining drains and sediment basins.
- Significant pump and irrigation capacity to rapidly dewater holding ponds.
- Lime dosing systems to treat waste waters if they become malodorous.
- Direct placement of wastewater onto irrigation grounds to negate aerosol generation. (Low pressure irrigation systems that will not create aerosols.)

Operations - Best Management Practices

- Continuous cleaning of pens to maintain a depth of (dry) manure of 50mm or less.
- Management of pen stocking densities to regulate moisture levels.
- Low starch rations to reduce nutrient ‘bypass’.
- Use dust suppression systems to “lay” dust as soon as it is noticed. The dust suppression systems will be used early in the morning and late in the afternoon to minimise humidity and impact on livestock. Application rates will not exceed 6mm at one time.
- Monitoring of compost moisture and temperature levels.
- All compost will be removed (sold) off site prior to the wet season.
- Recirculation of holding water with an input of lime to adjust the pH and remove odorants.

An Odour Management Plan is provided as part of the Environmental Management Plan.

In an emergency the following measures will be applied:

- Gypsum (or lime) will be applied to pen surfaces;
- Gypsum or lime will be added to anaerobic manures in compost windrows; and
- Lime dosing will be used to rapidly alter pH and conditions in waste water storages.

6.5 Monitoring

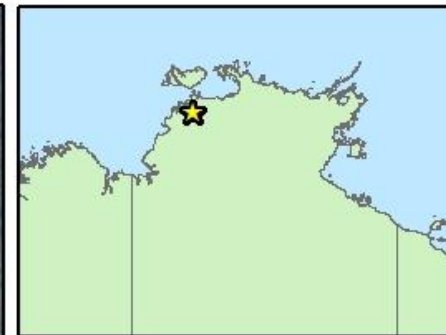
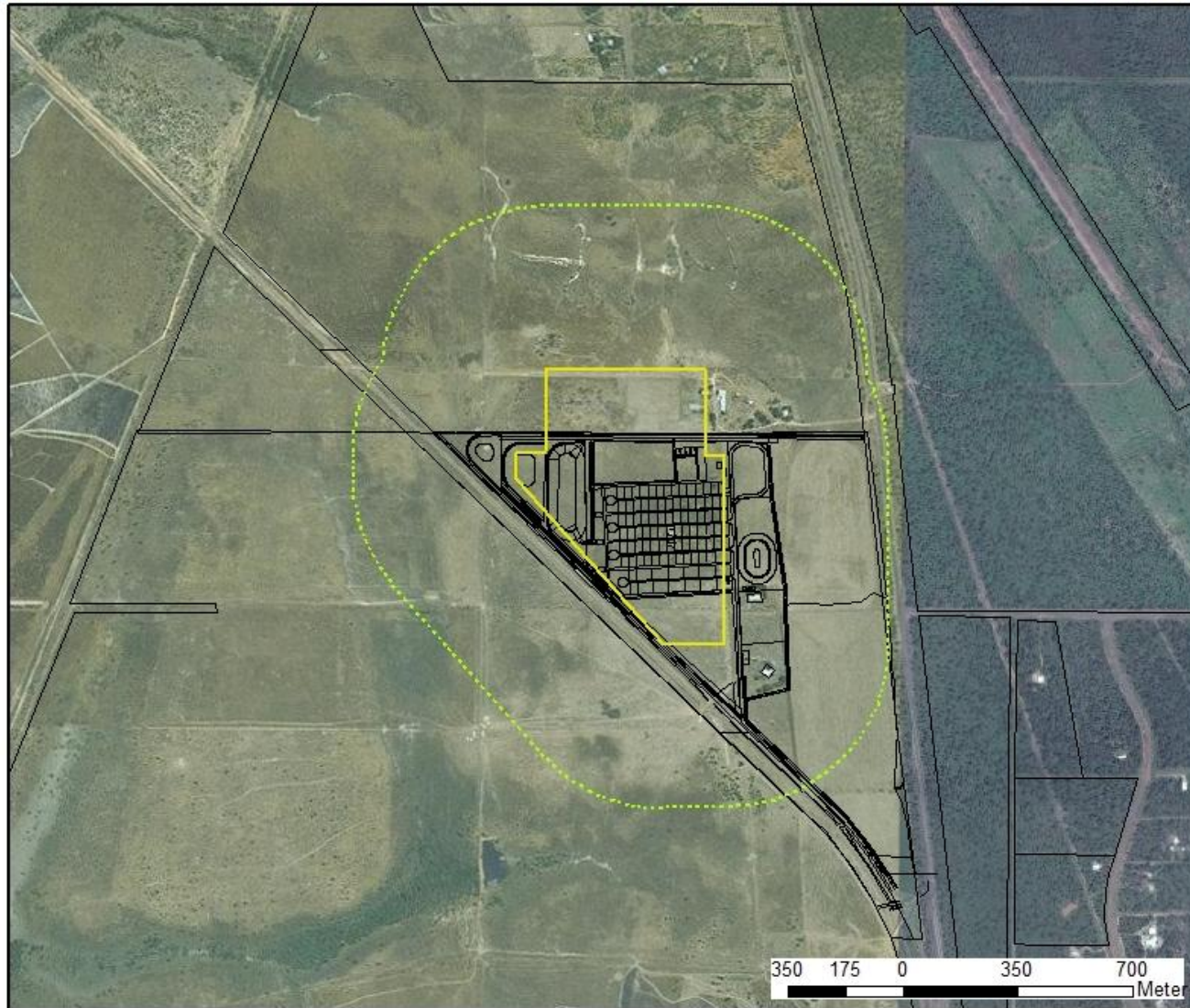
Monitoring of air quality and potential for odour and dust nuisance will include:

- Recording of daily cattle numbers;
- Certification of ration compositions (to demonstrate reduced protein and ME);
- Recording of feed fed;
- Record of complaints;
- Record of dust suppression systems use; and
- Records of any emergency use of gypsum or lime to treat sources of odour.

6.6 Odour Assessment Prior to Commencement of Stage 2

Wellard propose to undertake an odour assessment upon completion of the Stage 1 development and 12 months operations and prior to the development of Stage 2. This assessment will allow the operations of the facility to be benchmarked by direct survey of the community and assessment of complaint data from its records and that from the NT EPA.

Wellards Odour Base_RevC_Full Dev_Upgraded Santavan



Legend

- OB_RevC_497m_Buffer
- Odour_base_RevC
- Darwin_ILEF



Prepared By: Sarah Grady
Date: 09/09/2015
MGA Zone 52

EnviroAg
Australia

Disclaimer:
The information in this map has been provided in good faith. While all effort has been made to ensure the accuracy and completeness of the information and images, the data providers take no responsibility for any errors or omissions that may occur or losses or damage that may result from the use of this information.

Figure 7 Close up of Odour buffer

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7. Summary

The ILEF can be developed at the site without undue odour nuisance. Whilst some odour may be generated from time to time the existing environment and existing separation distances and buffers will adequately mitigate against odour nuisance.

7.1 Conclusions

It is concluded that the ILEF design and management minimises odour generation and subsequent emissions.

A separation distance of 496.4m is applicable for the full development of the Livingstone Valley short term feedlot and PEQ, as well as an upgraded “Santavan” PEQ. Together these facilities have a normalised total capacity of 5,929 SCU (at full development).

The ILEF will establish the treed buffer area as part of Stage 1. A large tract of native remnant vegetation exists to the north, east and south east of the site. This vegetation should be retained to protect the proposed development and any future residential development zone.

No residences are within the Stage 1 and Stage 2 separation distances. Only one (1) residence is found at 800m from the facility. The ILEF will undertake a further odour assessment prior to commencement of increasing the size of the yards from Stage 1 to Stage 2; on a precautionary basis, and to allow for assessment and improvement of its operations.

The current land use is rural and the surrounding land uses are rural. The development is sited with similar land uses. These common land uses should be acknowledged as an agricultural business precinct with a recognised buffer zone. Any future development adjacent to the development, and within the buffer, ought to be subject to the new proponent (e.g. subdivision of land for residences) demonstrating that their development would not be impacted by existing development.

7.2 Recommendations

It is recommended that;

- The NT Government regulate existing intensive livestock facilities so they are properly and fully acknowledged in planning and environmental law; thus providing equity to all development proponents, the community and industry;
- The NT Government regulate the clearing of remnant native vegetation such that the clearing of native vegetation in current rural zones close to the proposed site cannot be cleared (without an approval) such that the action may increase the likelihood of impacts of odour nuisance;
- That the NT Department of Planning place a buffer zone around the agricultural business precinct of the “Livingstone Valley” ILEF, “Santavan PEQ Depot” and the AA Co. Meat processing Facility;
- The key design principles and management practices outlined in this odour assessment be applied in the development consent conditions; and,
- An odour assessment is undertaken to reassess the performance of the development in odour management before it progresses from Stage 1 to Stage 2.

8. References

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9. Appendices

Appendix A. Darwin Airport, Wind Rose

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Appendix A. Darwin Airport, Wind Rose

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Rose of Wind direction versus Wind speed in km/h (01 Jan 1942 to 30 Sep 2010)

Custom times selected, refer to attached note for details

DARWIN AIRPORT

Site No: 014015 • Opened Jan 1941 • Still Open • Latitude: -12.4239° • Longitude: 130.8925° • Elevation 30.m

