LEAP

Livestock Environmental and Planning

Wyatt Piggery Application: Proposed Expansion of Farrow-to-Finish Piggery to 500 Sows

Information to Support Development Application, Works Approval & Licence Application

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Notes:

Version 1 This is a draft report for client comment.
Version 2 This is a second report for client comment.
Version 3

This report has been compiled to provide detailed information for the Shire of Cuballing, DWER and other interested agencies to use in assessing an application for the expansion of an existing 200 sows farrow-to-finish piggery located at 15983 Great Southern Highway, Yornaning to 500 sows farrow-to-finish.

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1. Introduction

The Wyatt family is currently operating a 200-sow farrow-to-finish piggery on their property at 15983 Great Southern Highway, Yornaning, Western Australia. They would like to expand to 500 sows farrow-to-finish. Like the existing unit, the expanded piggery will consist of a combination of conventional sheds and deep litter housing. Development approval will need to be obtained before the piggery can expand. Under the Environment Protection Regulations 1987, the expanded piggery is classed as a category 2 operation which is an intensive piggery with 1000 animals. As such, it is a prescribed premise and regulated by the Department of Water and Environmental Regulation under Part V of the "Environmental Protection Act 1986". It will require a works approval for construction and a licence to operate.

This report provides information about the site and the proposed design, operation and management of the piggery so that the Shire of Cuballing, DWER, other interested agencies and nearby land holders can be confident that the piggery will operate in an environmentally sustainable way. The siting, design and management guidance is based primarily on:

- National Environmental Guidelines for Indoor Piggeries (Tucker 2018)
- Department of Planning & Western Australian Planning Commission "Piggeries Fact Sheet"
- Department of Planning & Western Australian Planning Commission (2016) "Rural Planning Guidelines, Version 3" SPP 2.5
- Department of Water and Environmental Regulation, 2018, "Industry Regulation Fact Sheet: Intensive Piggery", Department of Water and Environmental Regulation, Perth
- Edge Planning and Property, 2018, "Draft Cuballing Shire Local Planning Strategy"

2. Contact Details

The contact details for the proposal are:

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3. Property Description and Land Use

3.1. Location

The subject property is situating near the locality of Yornaning which is between Popanyinning and Cuballing on the Great Southern Highway (see Figure 1 – Google Earth). The site is approximately 7 km north of the closest town, Cuballing.

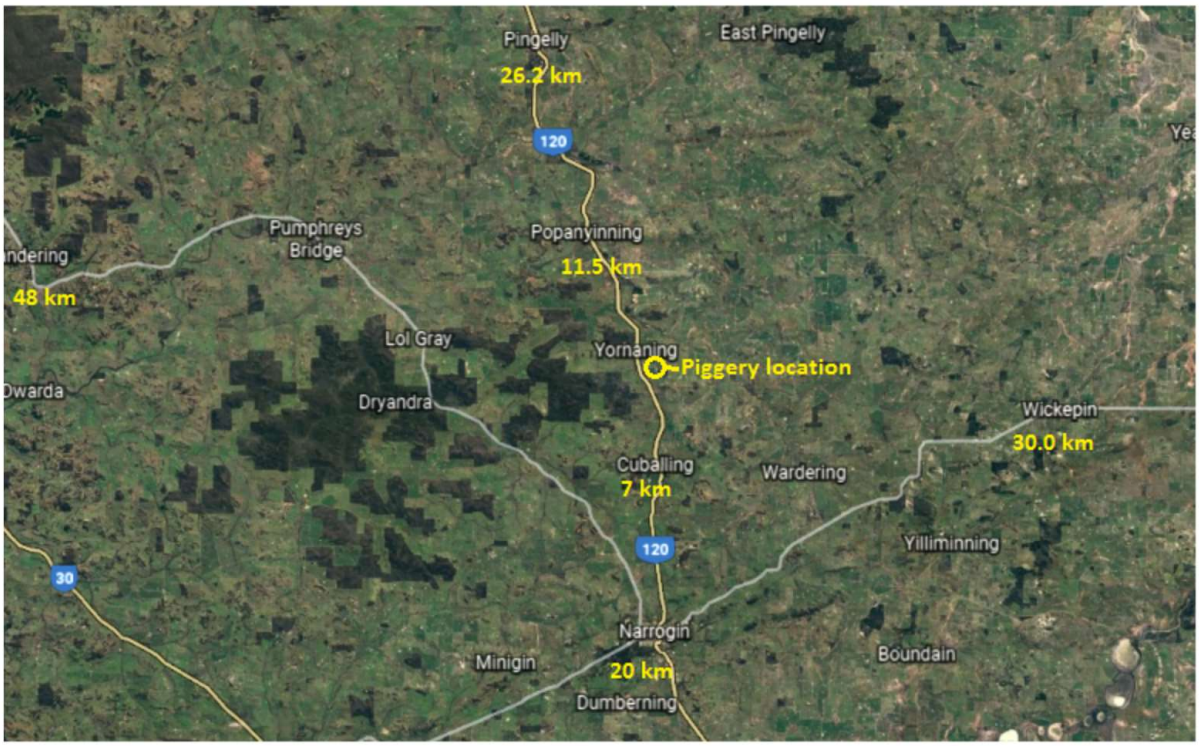


Figure 1 – Location of Piggery in Relation to Towns

Figure 2 (Google Earth) shows the location of the closest houses (within 2 km) to the piggery complex. Separation distances have been measured from a building pad to the north of the existing sheds, the existing effluent ponds and the compost pile to the south of the piggery. There are no houses within a kilometre of the site. This figure also shows the nearest land uses. Most of the surrounding land is used for wheat production or mixed farming. Yornaning nature reserve is the heavily treed area about 500 m to the north-east of the site. There is another heavily timbered area immediately to the east.

Figure 2 – Closest Houses Within 2 km of Expanded Piggery Complex

3.2. Cadastral Details

The subject land includes the property IDs 1441950, 1332020 and 3220210.

Lots making up the total farm include:

- Lot 2909, Shire of Cuballing (piggery is located on this lot)
- Lot 2979, Shire of Cuballing
- Lot 3785, Shire of Cuballing
- Lot 10129, Shire of Cuballing
- Lot 16097, Shire of Cuballing
- Lot 1664, Shire of Cuballing

Lots currently being purchased to add to the farm:

- Lot 6461, Shire of Cuballing
- Lot 6030, Shire of Cuballing
- Lot 14043, Shire of Cuballing

The property boundary is shown on Figure 3 and Figure 4 (both sourced from Google Earth).

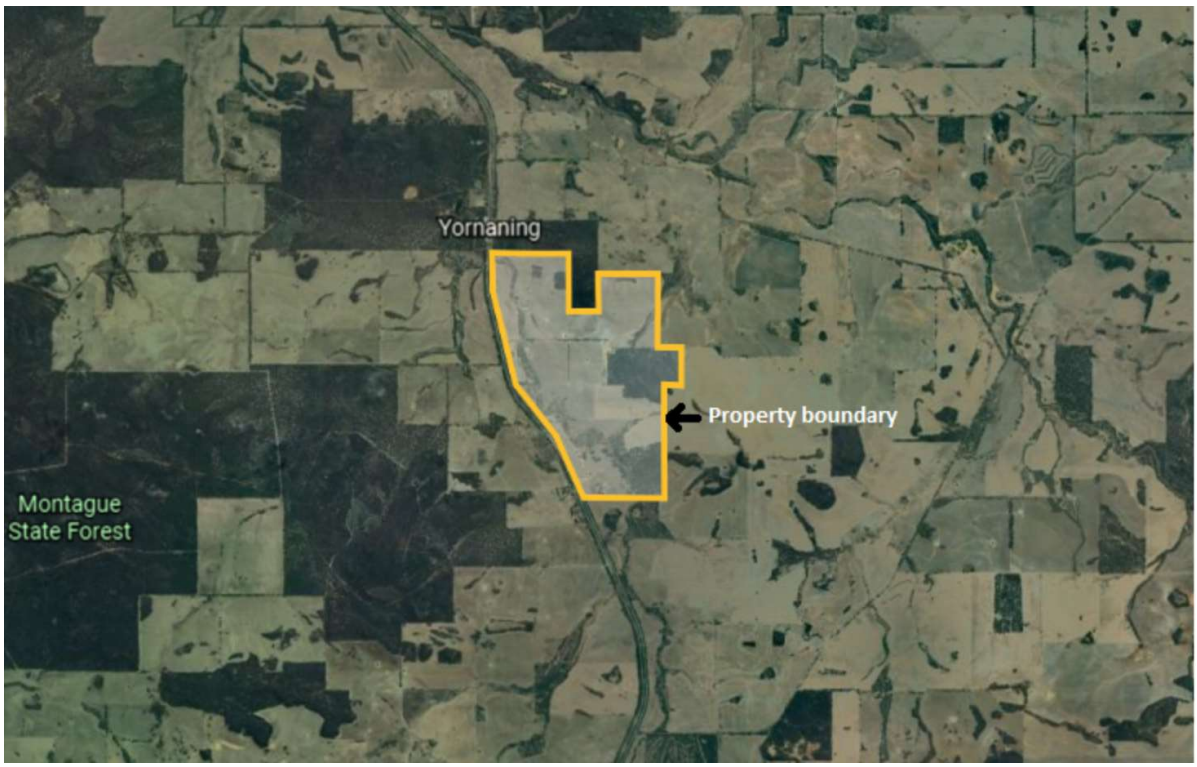


Figure 3 – Property Boundary

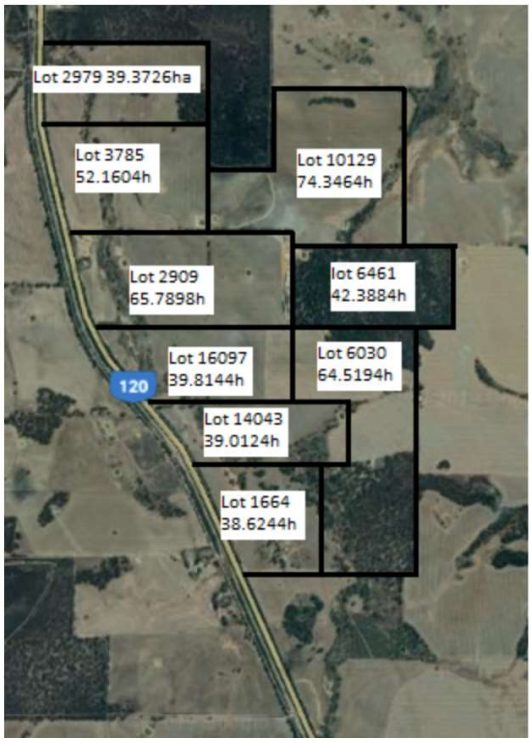


Figure 4 – Lot Details

3.3. Draft Cuballing Shire Local Planning Strategy

The draft Cuballing Shire Local Planning Strategy (Edge Planning and Property 2018) sets out the longer-term planning direction for the shire, applies State and regional planning policies and provides the rationale for the zones and provisions set out in the local planning scheme.

Key environment and conservation issues identified by the draft local planning strategy are:

(i) Surface and groundwater resources need to be protected.
(ii) Salinity continues to be a major land management challenge.
(iii) Areas of remnant vegetation, significant conservation, landscape and biodiversity value should be protected.
(iv) Endangered fauna, including the Carnaby's Black Cockatoo, need to be protected.
(v) The Dryandra Woodland requires protection through relevant management practices which are complemented by planning policies and strategies. The promotion of effective farming practices on properties adjoining the Dryandra Woodland is essential to the long-term sustainability of the area.

The draft local planning strategy recognises that the district's economy is dominated by agriculture, which should be protected. It also recognises that there is on-going potential for rural uses other than broad acre farming, including diversification to more intensive operations including piggeries. It is noted that some rural uses have potential impacts and that suitable measures are needed to protect nearby land uses. Strategies include:

(i) Support existing agriculture pursuits, while encouraging the establishment and adoption of new farming practices.
(ii) Promote a range of rural and associated uses compatible with the capability of the land and where it appropriately addresses off-site impacts.
(iii) Support animal premises and rural industries where relevant site-specific matters are addressed and appropriate buffers are provided.
(iv) Require proponents of animal premises and rural industries to address management considerations near the Dryandra Woodland.
(v) Control the number of dwellings on rural lots.

3.4. Climate

The Cuballing district has a Mediterranean climate featuring warm to hot dry summers and cool, wet winters. Climatic statistics for Narrogin, from www.bom.gov.au are summarised in Table 1. Rainfall statistics for Cuballing, taken from the Rainman program, are shown in Table 2. Site specific rainfall intensity-frequency-duration data from www.bom.gov.au is provided in Table 3.

Wind direction data for Narrogin was sourced from www.bom.gov.au. Figure 5 shows the mean annual wind direction and speeds at 9 am and 3 pm. In the summer, morning and afternoon winds tend to be from the south east. In the winter, morning winds are from north to north-west, tending to be north-west to west in the afternoons.

Table 1 – Monthly and Annual Climate Data - Narrogin

Statistics	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual	Years	
Temperature															
Mean maximum temperature (°C)	31.0	30.2	27.4	23.1	18.6	15.5	14.6	15.4	17.8	21.2	25.7	29.0	22.5	100	1913 2020
Mean minimum temperature (°C)	14.2	14.3	13.1	10.5	7.8	6.3	5.2	5.2	6.0	7.5	10.2	12.4	9.4	100	1913 2020
Rainfall															
Mean rainfall (mm)	13.0	16.8	21.2	29.2	62.0	85.4	85.9	67.9	46.2	30.9	18.2	14.1	492.3	127	1891 2020
Decile 5 (median) rainfall (mm)	3.4	6.4	14.0	24.1	57.6	76.4	77.8	65.5	42.4	24.6	14.6	7.6	500.9	114	1891 2020
Mean number of days of rain ≥ 1 mm	1.4	1.7	2.3	3.7	7.1	9.5	10.1	9.1	7.0	5.1	3.1	1.8	61.9	114	1891 2020
Other daily elements															
Mean daily sunshine (hours)															
Mean number of clear days	15.8	12.3	11.5	7.7	6.5	5.6	5.6	5.2	5.5	6.8	8.4	13.4	104.3	44	1965 2010
Mean number of cloudy days	3.9	4.8	6.5	9.2	10.7	11.2	11.5	11.2	11.0	9.4	8.6	4.6	102.6	44	1965 2010
9 am conditions															
Mean 9am temperature (°C)	20.9	20.5	18.8	16.0	12.6	10.0	9.2	9.9	11.9	14.7	17.7	20.0	15.2	43	1965 2010
Mean 9am relative humidity (%)	57	59	63	71	79	85	84	82	74	65	57	54	69	29	1972 2010
Mean 9am wind speed (km/h)	10.9	11.6	10.8	8.7	7.6	7.8	7.8	8.2	9.9	11.3	11.6	10.5	9.7	41	1965 2010
3 pm conditions															
Mean 3pm temperature (°C)	29.5	28.8	26.3	22.0	17.8	14.8	13.9	14.3	16.5	20.2	24.2	27.7	21.3	43	1965 2010
Mean 3pm relative humidity (%)	30	32	36	45	56	63	64	61	56	44	35	29	46	29	1972 2010
Mean 3pm wind speed (km/h)	10.0	10.8	9.6	9.3	9.6	11.0	11.0	10.9	11.5	11.6	11.7	10.2	10.6	39	1965 2010
Evaporation (mm/d)	9.7	8.1	5.9	3.4	2.1	1.3	1.6	1.9	2.6	4.4	6.5	8.9	4.6		
Evaporation (mm/mth)	301	229	183	102	65	39	50	59	78	136	195	276	1679		

Table 2 – Monthly and Annual Rainfall Data - Cuballing

Monthly rainfall (mm) recorded at CUBALLING POST OFFICE
Statistical summary

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Mean	13	15	20	30	63	89	90	69	45	31	20	14	499
Median	4	6	11	26	60	77	80	66	40	25	17	6	498
Standard deviation	24	25	27	23	34	46	45	33	23	22	16	19	106
Highest on record	138	196	129	124	143	331	285	233	119	102	70	103	800
Lowest on record	0	0	0	0	5	9	10	10	5	0	0	0	270
Mean raindays	2	3	3	6	10	14	15	13	11	8	5	3	93
No. of years	102	102	101	101	101	101	101	101	101	101	101	101	101

Probabilities of monthly rainfall recorded at CUBALLING POST OFFICE
Amounts of rain (mm) received or exceeded in 100%, 90% ... 0% of years.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Lowest on record	0	0	0	0	5	9	10	10	5	0	0	0	270
90% yrs at least	0	0	0	5	24	44	45	37	22	9	3	0	360
80% yrs at least	0	1	2	8	32	50	51	41	25	13	5	1	399
70% yrs at least	1	2	5	15	40	62	63	50	30	18	8	2	445
60% yrs at least	2	4	7	20	49	71	71	56	34	20	12	4	487
median, 50% yrs	4	6	11	26	60	77	80	66	40	25	17	6	498
40% yrs at least	9	10	15	33	67	88	94	73	49	28	22	10	516
30% yrs at least	12	14	18	41	79	105	108	79	57	38	26	15	538
20% yrs at least	18	24	26	49	92	126	120	93	63	48	30	23	575
10% yrs at least	38	45	55	60	117	146	146	110	71	58	42	30	637
Highest on record	138	196	129	124	143	331	285	233	119	102	70	103	800
Mean	13	15	20	30	63	89	90	69	45	31	20	14	499
Standard deviation	24	25	27	23	34	46	45	33	23	22	16	19	106

Table 3 – Rainfall Intensity-Frequency-Duration Data

	Annual Exceedance Probability (AEP)						
Duration	**63.2%**	**50%#**	**20%***	**10%**	**5%**	**2%**	**1%**
1 min	1.35	1.52	2.11	2.57	3.08	3.85	4.51
2 min	2.30	2.59	3.56	4.30	5.09	6.27	7.28
3 min	3.09	3.48	4.80	5.81	6.90	8.53	9.93
4 min	3.75	4.22	5.84	7.10	8.46	10.5	12.3
5 min	4.31	4.85	6.73	8.19	9.79	12.2	14.3
10 min	6.27	7.05	9.82	12.0	14.4	18.1	21.2
15 min	7.53	8.46	11.8	14.4	17.3	21.7	25.5
20 min	8.47	9.52	13.2	16.2	19.4	24.3	28.5
25 min	9.23	10.4	14.4	17.6	21.0	26.3	30.9
30 min	9.87	11.1	15.4	18.7	22.4	28.0	32.8
45 min	11.4	12.8	17.7	21.5	25.7	32.0	37.5
1 hour	12.6	14.1	19.5	23.7	28.3	35.2	41.1
1.5 hour	14.4	16.2	22.4	27.2	32.5	40.3	47.1
2 hour	15.9	17.9	24.7	30.1	35.9	44.6	52.2
3 hour	18.3	20.5	28.5	34.8	41.6	51.8	60.7
4.5 hour	21.1	23.7	33.0	40.4	48.5	60.7	71.3
6 hour	23.3	26.2	36.6	44.9	54.0	67.9	80.0
9 hour	26.7	30.1	42.3	52.0	62.8	79.3	93.9
12 hour	29.4	33.2	46.6	57.4	69.4	88.0	105
18 hour	33.4	37.7	53.0	65.2	78.8	100	120
24 hour	36.4	41.0	57.5	70.6	85.1	109	130
30 hour	38.7	43.6	60.9	74.5	89.6	114	136
36 hour	40.6	45.6	63.6	77.6	92.9	118	141
48 hour	43.5	48.9	67.6	82.0	97.6	124	147
72 hour	47.7	53.4	73.0	87.6	103	129	153
96 hour	50.9	56.9	76.9	91.6	107	133	156
120 hour	53.7	59.9	80.3	95.3	111	136	159
144 hour	56.4	62.7	83.7	99.1	115	140	163
168 hour	59.0	65.5	87.2	103	120	145	167

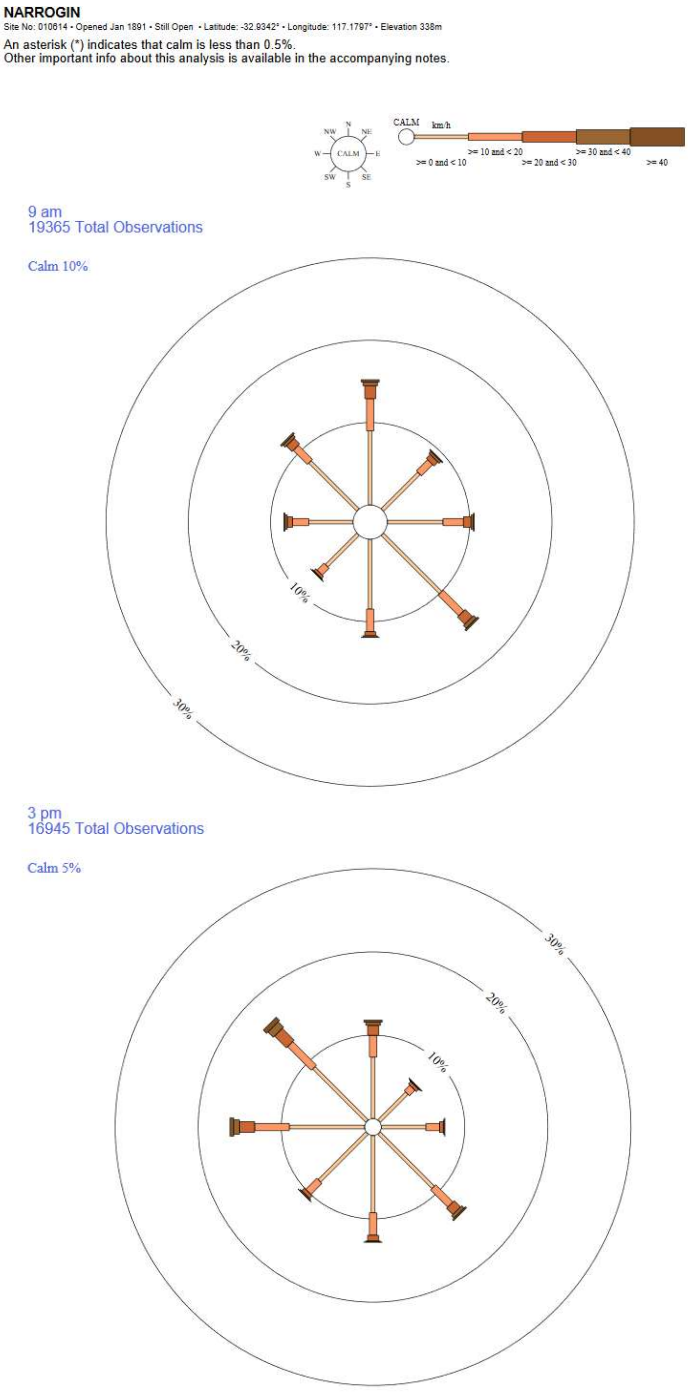
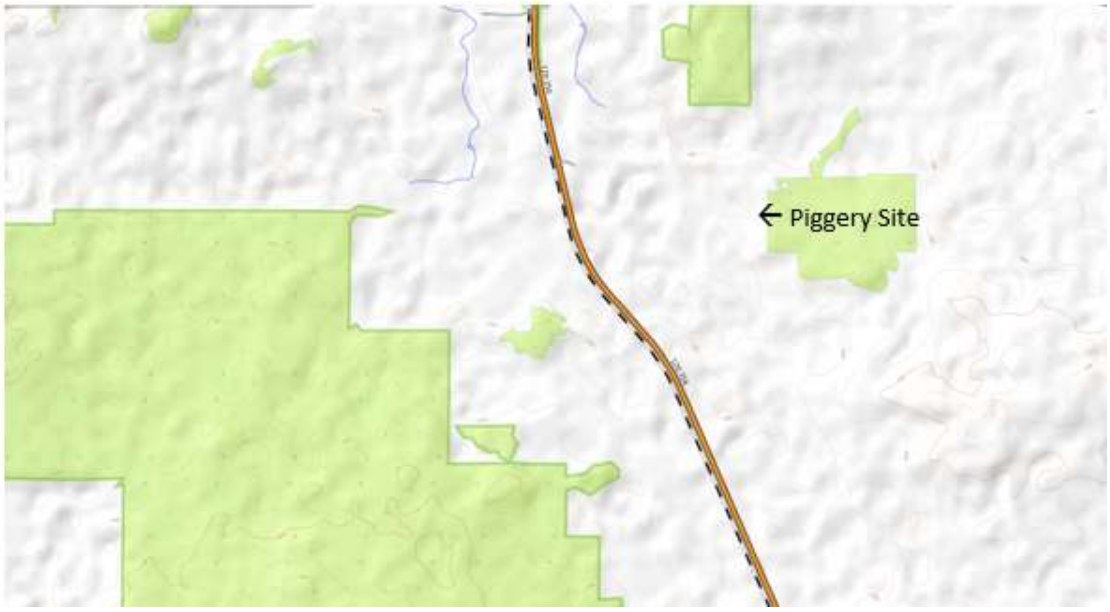


Figure 5 – Mean Annual Wind Directions at Narrogin at 9 AM and 3 PM

3.5. Topography and Waterways

The topography of the farm and surrounds is gently undulating to gently sloping (see Figure 6 and Photograph 1). The piggery sits near the top of a rise that slopes down to the west. Intermittent drainage lines to the west of the site drain to the Hotham River South (which is an intermittent waterway on the property that drains to the Hotham River), while those to the north of the site ultimately drain to the Hotham River (see Figure 7). The Hotham River is a major tributary of the Murray River system and the site is close to the margin of the Murray River proclaimed surface water protection area. The piggery is located on an elevated site that is not prone to flooding.



Source: https://elevationmap.net/narrogin-height-australia

Source: https://www.google.com/maps/

Figure 6 – Site Topography

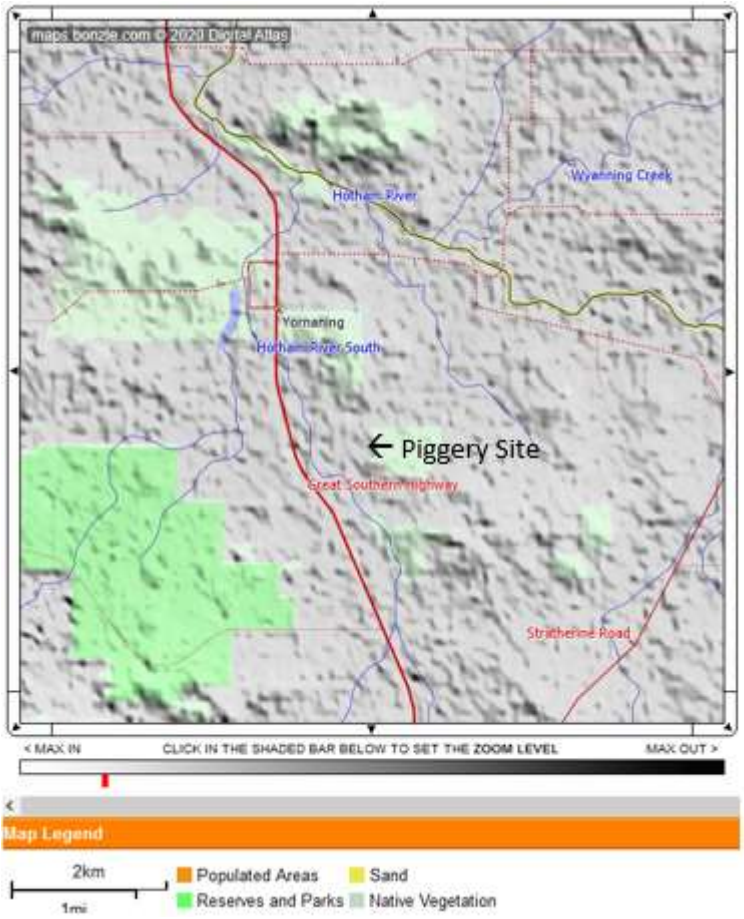


Figure 7 – Hotham River

Photograph 1 - Topography

3.6. Soils

Soils mapping for the property is available at https://maps.agric.wa.gov.au/nrm-info/. It is shown on Figure 8. There are three main soil subsystems:

- Noombling subsystem (Dyandra) 257 DyNB: this mapping unit covers the piggery, and most of the eastern part of the property. It consists of long, gentle and undulating hillslopes and divides. The indigenous vegetation is Marri-Wandoo woodland with a Jam-Sheoak understorey. The soils are derived from colluvium or weathered granite, gneiss and some dolerite. They are yellow/brown and deep grey sandy duplexes, brown deep loamy duplexes, sandy gravels and shallow duplexes.

  Topsoil acidity may be a concern and subsoil acidity is a common concern. Some 3-10% of the mapping unit has a high susceptibility to salinity. These soils are somewhat susceptible to waterlogging. Some 30-50% of the area mapped is prone to subsurface compaction. Some 10-30% of the area mapped is prone to extreme wind erosion. Some 10-30% of the area mapped has a high to extreme risk of phosphorus export. Over 70% of the land is considered to have moderate to very high capability for annual horticulture if water were available, and for cropping.

- Biberkine subsystem (Dyandra) 257 DyBK: this mapping unit covers the central and western part of the property. It consists of valley floors with gently undulating rises and low hills. The indigenous vegetation is Wandoo-Flooded Gum woodland with a Jam-Sheoak understorey. The soils are derived from alluvium and colluvium over granite. They are yellow/brown sandy duplexes, wet and semi-wet soils and brown deep loamy duplexes.

  Topsoil acidity may be a concern and subsoil acidity is a common concern. Some 30-50% of the mapping unit has a high susceptibility to salinity. Over 70% of the area mapped is prone to subsurface compaction. Some 10-30% of the area mapped has very poor to poor site drainage and is prone to waterlogging, with 30-10% having a moderate to high risk of flooding. Some 3-10% of the area mapped has a high to extreme risk of phosphorus export. Nevertheless, some 50-70% of the land is considered to have moderate to very high capability for annual horticulture if water were available and over 70% of the land mapped has a moderate to very high capability for cropping.

- Norrine Subsystem (Dyandra) 257DyNO: this mapping unit covers the area of native trees to the east of the piggery. This is a complex of lateritic residuals and associated soils: gravely sand, sand, duplex yellow soils and duricrust. This area will not be cleared or used in any way for construction of the piggery A very small area of this soil type in the north of the property could be used for reuse.

Source: https://maps.agric.wa.gov.au/nrm-info/

Figure 8 – Soil Mapping

3.7. Vegetation

A consistent vegetation classification system for Western Australia was developed by John Beard and associated ecologists from the mid-1960s. From https://maps.agric.wa.gov.au/nrm-info/, the Beard vegetation association of the area is 947, so the original vegetation of the property was likely a medium woodland of powderbark and mallet.

Powderbark (*Eucalyptus accedens*) is also known as smooth bark wandoo or powderbark wandoo. Brown mallet (*Eucalyptus astringens*) and silver mallet (*Eucalyptus falcata*) may both be present, along with salmon gum (*Eucalyptus salmonophloia*) and Drummond's mallee (*Eucalyptus drummondii*) with an understorey of rock sheoak / sighing sheoak (*Allocasuarina huegeliana*), jam tree (*Acacia acuminate*), wait-a-while / pin bush / spine bush (*Acacia colletioides*), *Banksia cirsoides*, thick-leaved poison (*Gastrolobium crassifolium*), sandplain poison (*Gastrolobium microcarpum*), prickly poison (*Gastrolobium spinosum*), one-sided bottlebrush (*Calothamnus quadrifidus*) and *Hakea spp.*

Based on data for the soils of the site, the indigenous vegetation over much of the property was likely Wandoo-Flooded Gum woodland with a Jam-Sheoak understorey. However, most of the farm has been cleared for farming for many years. Figure 9 shows the remnant vegetation on and near the property from https://maps.agric.wa.gov.au/nrm-info/.

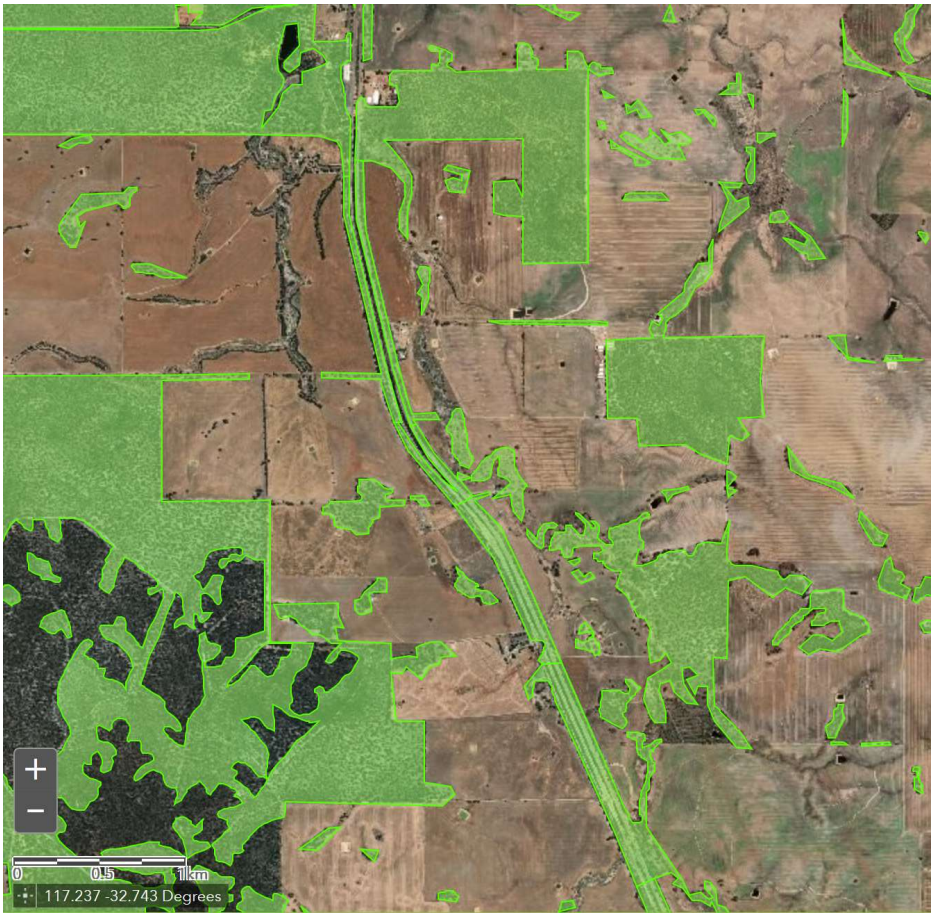


Figure 9 – Remnant Native Vegetation

3.8. Groundwater

It is understood that there is no particularly shallow groundwater beneath the site. The piggery is not within a groundwater protection area. A bore on the property is ~13.7 m (45 feet) deep. It produces a low yield but the water is good quality.

4. Proposed Piggery Development

4.1. Existing Operation and Housing

The Wyatt piggery currently operates as a 200-sow farrow-to-finish piggery consisting of a combination of conventional sheds and deep litter shelters. Most of the breeding herd is kept in conventional sheds. 72 dry sows and all the growers and finishers are in deep litter shelters. Approximately half the progeny leave the site as 16-week-old porkers, with the balance remaining until bacon weight at ~22 weeks of age.

Conventional housing accommodates pigs within steel-framed sheds. These typically have walls that are half solid and half nylon curtain, iron roofing and slatted flooring over concreted under-floor pits. The farrowing shed has under-floor pits that are flushed with a blend of groundwater and treated, recycled effluent. The new dry sow shed has slatted flooring with pull plug pits. However, the old dry sow shed has a solid concrete floor that is hosed out as required. An existing conventional shed is shown as Photograph 2. The conventional sheds produce liquid effluent that is treated in a two-pond system, with the second pond acting as an evaporation pond.

Deep litter housing accommodates pigs in hooped structures similar to the plastic greenhouses used in horticulture. The floor of the shelters is concreted and straw bedding (or similar absorptive material) is placed over the base to absorb manure and spilt feed and water. These sheds produce spent bedding but no liquid effluent. An example of this type of housing is shown as Photograph 3. The spent bedding is stored on a prepared pad adjacent to the shelters until it can be spread onto cropping land.

Figure 10 shows the current and proposed layout. The piggery currently consists of:

- one farrowing shed
- two dry sow sheds
- one dry sow shelter
- three weaner shelters
- six grower shelters
- one weigh shelter
- anaerobic pond (see Photograph 4)
- evaporation pond (see Photograph 5)
- spent bedding storage pad.

Photograph 2 – Conventional Shed

Photograph 3 – Deep Litter Housing

Photograph 4 – Anaerobic Pond

Photograph 5 – Evaporation Pond

4.2. Proposed Herd Composition and Housing

Table 4 provides a summary of the proposed herd composition and pig housing. The number of standard pig units (SPU) has been estimated using standard multipliers from the National Environmental Guidelines for Piggeries for the breeding stock and a liveweight regression formula included in the Pigbal 4 model for growing stock.

PigBal 4 is the national industry standard tool for estimating piggery manure production. However, it also estimates pig feed usage, production, a breakdown of water usage, various options for sizing effluent treatment ponds and baseline methane emissions estimates. PigBal 4 was developed by Skerman, Collman et al. (2013) for the Queensland Department of Agriculture and Fisheries. Skerman, Willis et al. (2014) developed the PigBal 4 User Manual.

Table 4 – Herd Composition and Housing

Pig Class	Head	SPU	Housing
Gilts	37	67	Conventional
Boars	6	10	Conventional
Dry sows	271	434	Conventional
Dry sows		224	Deep litter
	140		
Lactating sows	89	223	Conventional
Suckers	878	96	Conventional
Weaners	1230	647	Deep litter
Growers	1010	1106	Deep litter
Finishers	1390	2232	Conventional
Total	5051	5039	2671 hd / 3062 SPU in conv. sheds 2380 hd / 1977 SPU in deep litter

From PigBal 4, it is expected that the piggery will produce some 10,253 finisher pigs with a combined weight of 1025 t annually. In addition, there will be some 267 cull breeding stock with a combined weight of ~43 t. In total, each year there will be ~10,520 sale pigs weighing ~1068 t.

Figure 10 is a plan of the proposed layout of the expanded piggery, showing the different shed types. A combination of conventional sheds and deep litter housing will be used. All of the housing has been designed to effectively contain the pigs and to provide for easy removal of manure.

Conventional housing has been selected for farrowing sows, some dry sows and finishing pigs. This housing has a relatively high capital cost but provides the best environmental conditions for lactating sows and piglets and provides for even finishing of pigs. Because some of the existing conventional housing is designed for dry sows, the use of the sheds for these pigs will continue. All of the new conventional housing will have partially slatted flooring with underfloor pull-plug pits to collect the effluent.

Deep litter housing provides low cost housing with lower greenhouse gas (GHG) emissions than conventional housing. It is suitable for housing dry sows, weaners and growers and will be used to accommodate some of the dry sows and all weaners and growers. It is less suitable for finishing stock, producing more variable liveweights at the same age than conventional housing due to the ad lib

feeding. Consequently, the pigs will transfer back to conventional housing for finishing. The bedding required for the deep litter shelters will be grown on-farm or else sourced from nearby farmers.

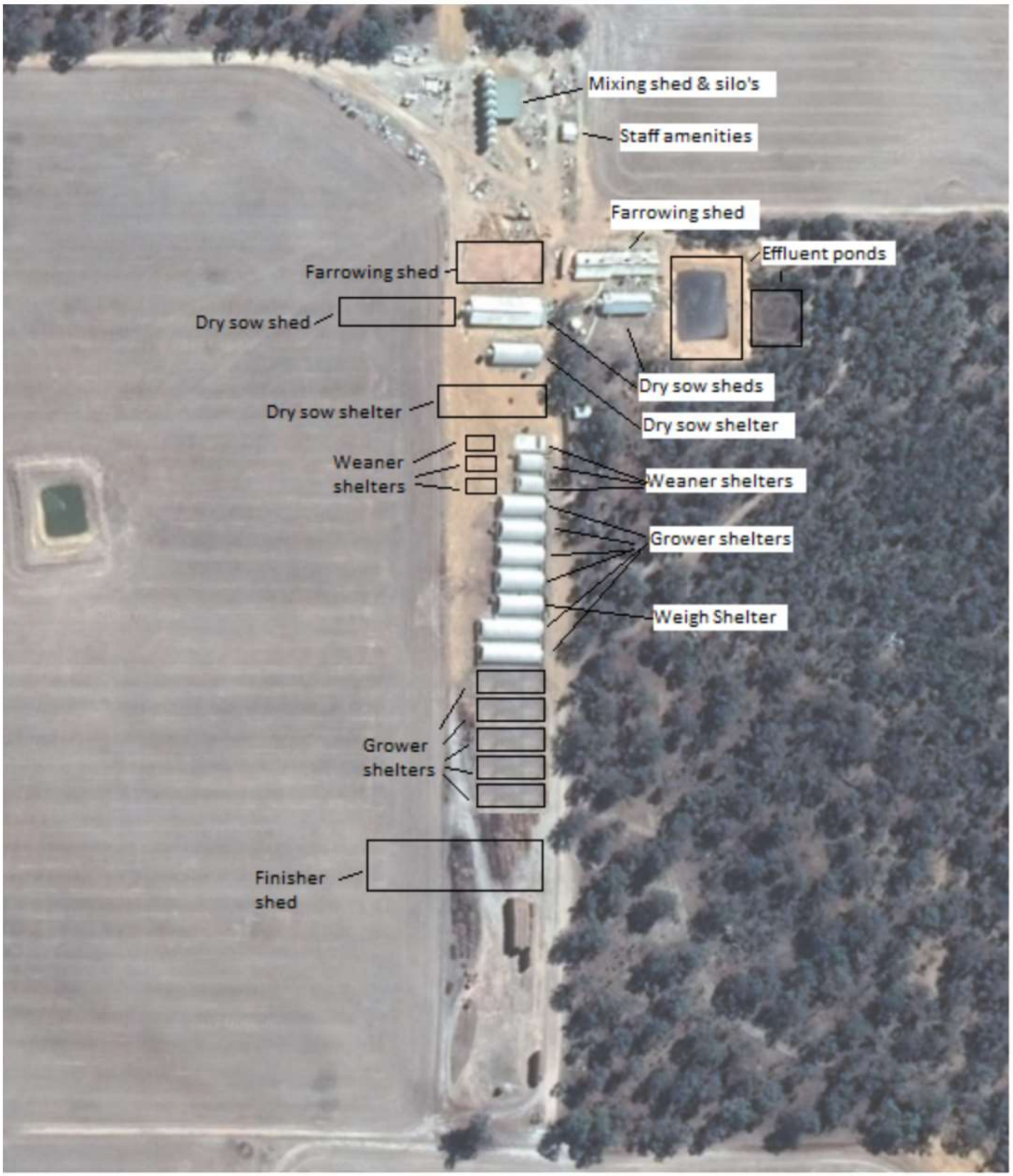


Figure 10 – Proposed Layout

4.3. Water Usage

The piggery will need water for stock consumption and for cleaning the conventional sheds (although some treated effluent will be recycled as flush water).

Water for the piggery will be sourced through the Great Southern Town Water Supply Scheme, as it is currently. This is high quality water and suitable for the purpose.

Water use has been estimated using PigBal 4 for drinking requirements.

Drinking water wastage has been estimated at 25% of drinking water usage. This water will form part of the effluent stream along with manure, waste feed and hosing water.

Cleaning water use is based on the current usage for the conventional sheds scaled up for the increase in pig numbers. Currently, one of the dry sow sheds is cleaned by hosing out. The existing farrowing shed has flush channels, although these are operated more like pits. About 100 mm of water is retained in the bottom after each flush and they are generally flushed once per cycle of the crate (~5 weekly intervals) or more frequently if required to maintain low odour conditions. The newer dry sow shed has pull plug channels topped up from drinking water spillage. There are currently ~272 SPU in conventional sheds and cleaning water use is about 8000 L every 4 weeks, or 1.05 L/SPU/day. This is a very low usage volume probably due to the use of some hose-out cleaning. Assuming usage of 2 L/SPU/day across the conventional sheds for the expanded piggery, the cleaning water volume will be ~6124 L/day or 2.24 ML/yr. Any additional cleaning water needed (e.g. to cover the floor of pull plugs after emptying) will use treated, recycled effluent.

The breakdown and total water usage for the whole herd is summarised in Table 5. The piggery is expected to use about 14.32 ML/yr of fresh water.

Table 5 – Water Usage

Water Usage	Volume (L/d)	Volume (ML/yr)
Drinking	26,496	9.67
Drinker waste	6624	2.42
Cleaning conventional sheds	6,124	2.24
Total	39,244	14.32

4.4. Feed Usage

The expected feed usage of the expanded piggery, based on current usage scaled up, is 3266 t/yr. Most of the grain will be produced on-farm. The remainder will be sourced from local farmers.

4.5. Straw Usage

Straw will be used as bedding in the deep litter shelters. The National Environmental Guidelines for Indoor Piggeries suggest straw usage of 0.5-1 kg/SPU/d. Given the relatively dry environment, straw use of 0.5 kg/hd/d is expected, so some 361 t/yr will be needed. The straw will be produced on land farmed by the Wyatt family.

4.6. Pig Production

The expanded piggery will produce about 10,253 finished pigs per year. These will weigh approximately 1025 t.

4.7. Traffic

The proposed piggery will generate additional vehicles movements. Grain and bedding for the piggery will be produced on-farm. Hence, these will not generate traffic. However, trucks will be needed to transport finished pigs to market and to take surplus spent bedding and sludge to nearby farms.

The expanded piggery will produce about 10,253 finished pigs per year (see section 4.6). Pigs will be sold weekly, so there will be about 200 pigs per week, or one truck load. Currently about half the pigs go to Linley Valley as porkers at ~16 weeks with the remainder going to Bunbury as baconers at ~22 weeks. For the expanded piggery, it is planned that all pigs will be grown out to bacon weight. Hence, all the pigs would go to Bunbury. The route would be south along the Great Southern Highway to Narrogin, then southwest via the Williams-Kondinin Road, Narrogin Road, Pinjarra Williams Road, Collie-Williams Road, Coalfields Highway, Raymond Road and National Route 1 as shown in Figure 11. All of the roads to be used are sealed roads in good condition.

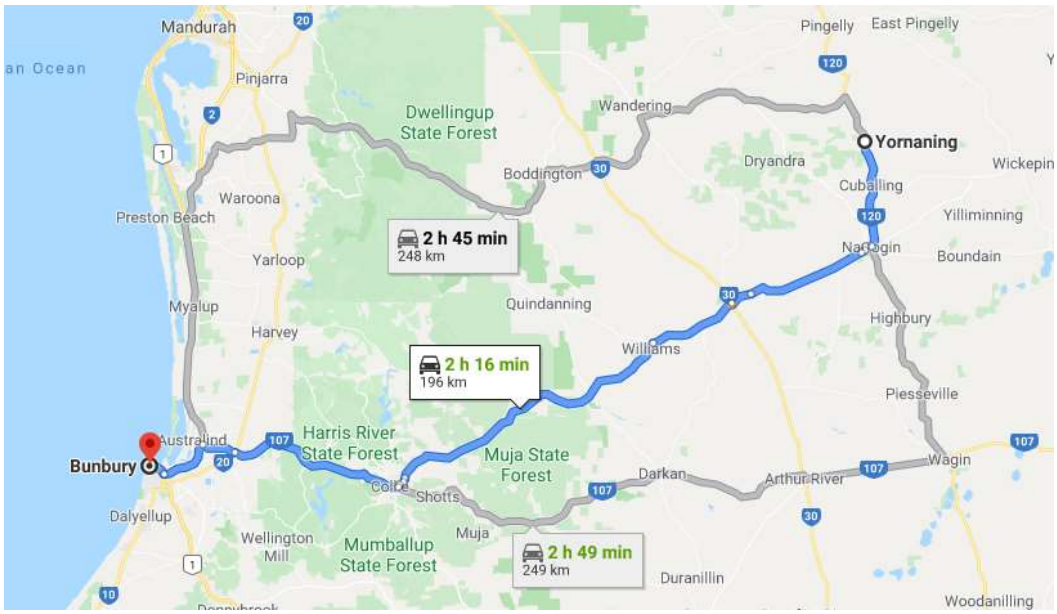


Figure 11 – Truck Route to Bunbury Abattoir

Spent bedding and sludge would be transported to local farms via the Great Southern Highway. The pig farm will produce some 160 m^3/yr of sludge (see section 5.1.2). If all of this material goes off-farm and is transported in 15 m^3 tankers, some 11 tanker loads will be generated annually. In total, some 735 t/yr of spent bedding will be produced (see section 5.1.2). If this is transported in 20 t loads, and all the material goes off-farm, this will generate about 37 truck movements.

Hence, total truck movements are expected to be about 100 per year or 2 per week into the piggery and out of the piggery.

The property entrance point onto the Great Southern Highway is shown on Figure 12. There is excellent visibility from both directions. The location of the property entrance is suitable.

Figure 12 – Property Entry Point

5. Effluent, Manure and Mortalities

5.1. Effluent and Manure Production

The conventional sheds at the piggery will produce liquid effluent, while the deep litter shelters will produce spent bedding containing a mixture of manure and straw. The PigBal 4 model was used to estimate the quantity and composition of the effluent and manure.

5.1.1. Conventional Sheds

The effluent from the conventional sheds is made up of hosing water, wasted drinking water, manure and waste feed. The effluent from the breeding herd will be treated by the existing pond system. It is proposed that new ponds will be built to handle the effluent from the new finisher shed.

Table 6 – Effluent Production – Breeder Sheds and Finisher Shed

Component	Breeder Sheds		Finisher Shed	
	L/d	ML/yr	L/d	ML/yr
Cleaning	1660	0.61	4464	1.63
Drinking water wastage	1116	0.42	2950	1.08
Manure	3213	1.17	7648	2.79
Total	5989	2.19	15,062	5.50

The daily and annual masses of solids and nutrients in effluent ex-sheds are provided in Table 7. PigBal 4 is a validated model so the masses of solids and nutrients in the manure can be considered good estimates.

Table 7 – Solids and Nutrients in Effluent Ex-Sheds

Component	Breeder Sheds		Finisher Shed	
	kg/d	kg/yr	kg/d	kg/yr
Total solids (TS)	321	117,253	765	279,166
Volatile solids (VS)	259	94,697	614	224,092
Nitrogen (N)	26.2	9,576	69	25,192
Phosphorus (P)	6.6	2,423	19.2	7023
Potassium (K)	6.6	2,393	17.5	6404

Note: The values in Table 7 are post-decomposition losses that would occur during manure breakdown in the sheds. From PigBal 4, it could be expected that 10% of TS, 12% of VS and 10% of nitrogen would be lost.

5.1.2. Spent Bedding Production

The spent bedding from the deep litter shelters will consist of a mixture of straw, manure and waste feed. Bedding management will vary depending on the type of shed, but bedding will be managed to ensure that low odour conditions are maintained. Bedding will be replaced approximately every two

months and will be topped up as required between clean-outs to ensure there are always clean, dry areas for the pigs to rest.

Some decomposition will occur within the sheds; PigBal 4, assumes that 20% of TS, 25% of VS and 17% of nitrogen are lost at this stage. From PigBal 4, the solids and macro-nutrients remaining in the spent bedding removed from the sheds are estimated at:

- 735 t/yr (~60% moisture based on data presented in the Australian Pork Ltd (2015) Piggery Manure and Effluent Management and Reuse Guidelines)
- 440 t/yr total solids
- 367 t/yr volatile solids (83% of dry matter)
- 20,721 kg/yr nitrogen (4.7% of dry matter)
- 4820 kg/yr phosphorus (1.1% of dry matter)
- 12,455 kg/yr potassium (2.8% of dry matter).

5.1.3. Mortalities

Some mortalities are expected from any piggery. At this unit, it is expected that there will be about 1916 mortalities (mostly piglets) annually, with a combined weight of about 40.7 t. These will be composted in bays the spent bedding area which is a bunded, hardstand area (see section 5.3). Composting in this area is the most environmentally-friendly method for mortalities disposal. It poses a very low risk of groundwater or surface water contamination. Composting uses micro-organisms to break-down organic matter to form a humus-like substance. Spent bedding or other similar high carbon materials will provide the carbon and cover material for the process. Providing sufficient cover material is used, composting is a low odour, aerobic process and it yields a valuable soil amendment.

5.2. Effluent Treatment

5.2.1. Anaerobic Ponds

Anaerobic effluent treatment ponds have been widely used in the Australian pig industry for many years. These effectively remove solids from the effluent stream and reduce some pathogen levels, thereby reducing environmental and health risks when the effluent is reused for land irrigation.

It is proposed that the existing anaerobic pond at the piggery will be desludged and used to treat the effluent from the conventional farrowing and dry sow sheds. A new anaerobic pond will be built for the finisher shed.

Breeder Site Anaerobic Pond

Approximate dimensions for the breeder site anaerobic pond are given in Table 8. The pond has been designed to have 1 m freeboard above top water level. Internal batters are estimated to be 2.5 horizontal to 1 vertical. This table also shows the estimated dimensions of the wet weather pond. Currently this pond has no freeboard due to the height of the inlet pipe. It is proposed to build the pond walls up by 0.5 m to provide freeboard, so these are the dimensions shown in Table 8. It is assumed that the wet weather pond has 2.5 horizontal to 1 vertical internal batters.

Table 8 – Estimated Dimensions of Existing Effluent Ponds

Dimension	Anaerobic Pond			Wet Weather Pond		
	Inside Crest	Top Water Level	Base	Inside Crest	Top Water Level	Base
Depth (m)	6	5	-	3.0	2.5	-
Length (m)	45	39	15	20	17.5	5.0
Width (m)	33.5	27	3.5	16	13.5	1.0
Volume (m^3)	-	2460	-	-	240	-

Anaerobic ponds need to be designed to provide sufficient capacity to treat the effluent stream, and space to store the sludge deposited as part of the treatment process. The volatile solids (VS) and total solids (TS) are used to size the active volume and sludge storage volume, respectively. The estimated quantities of solids remaining in the liquid after solids removal are shown in Table 6.

The required treatment capacity of an anaerobic pond is determined from the volatile solids load and the site's climate. The baseline VS loading rate for sizing the treatment capacity of a heavily loaded anaerobic pond is 0.75 kg/m^3/d (Pigbal 4). Since Cuballing is in a cool location, a lighter loading rate is warranted. Pigbal 4 recommends an adjustment factor of 0.71 for Narrogin. This value is about midway between the National Environmental Guidelines for Indoor Piggeries factors of 0.6 for cool and 0.8 for warm. After adjustment, the target VS loading rate is 0.533 kg/m^3/d. For the breeder site, the VS load to the pond is 259 kg/d so the minimum treatment volume required is 486 m^3.

The sludge accumulation factor in PigBal 4 is 0.00137 m^3/kg TS (from ASABE 2011). Annual desludging of anaerobic ponds with a vacuum tanker is recommended to prevent sludge from accumulating and compacting making it difficult to remove from the pond. This desludging method also reduces the risk of damage to the pond liner. For the breeder site pond, the TS load is 321 kg/day so the sludge accumulation rate is 161 m^3/yr. To provide contingency in case desludging needs to be delayed, four years sludge storage capacity will be provided, or 644 m^3.

Taking the treatment and sludge volume into account, the required anaerobic pond capacity is 1130 m^3.

According to McGahan et al. (2010), some 23.5% of nitrogen, 90% of phosphorus and 5% of potassium in the effluent going into an anaerobic pond would deposit to sludge with the remainder staying in the liquid fraction. Table 11 shows the estimated partitioning of nutrients between effluent and sludge in the pond.

Table 9 – Partitioning of Nutrients in Pond Effluent Between Sludge and Pond Liquid

Component	Total Effluent Nutrients (t/yr)	Nutrients to Sludge (t/yr)	Nutrients to Pond Liquid (t/yr)	Nutrients Post Gaseous Losses (t/yr)
Nitrogen	9.58	2.25	7.33	3.66
Phosphorus	2.42	2.18	0.24	0.24
Potassium	2.39	0.12	0.27	2.27

Finisher Site Anaerobic Pond
The design parameters used for the breeder sheds pond will also be used for the finisher shed pond. The VS load to the pond is 614 kg/d. With a target VS loading rate of 0.533 kg/m^3/d, the minimum treatment volume is 1152 m^3.

For the finisher site pond, the TS load is 765 kg/day so the sludge accumulation rate is 382.5 m^3/yr. To provide contingency in case desludging needs to be delayed, four years sludge storage capacity will be provided. This is 1530 m^3 for the finisher site.

Taking the treatment and sludge volume into account, the required anaerobic pond capacity will be 2700 m^3 for the finisher site. The finisher site anaerobic pond design parameters are given in Table 10. The pond has been designed to have 0.6 m freeboard above top water level and internal batters of 3 horizontal to 1 vertical.

Table 10 – Finisher Site Anaerobic Pond Design Parameters

Dimension	Inside Crest	Top Water Level	Base
Depth (m)	4.6	4	-
Length (m)	50	46.3	22.3
Width (m)	34	30.3	6.3
Volume (m^3)	-	1850	-

The new anaerobic pond will be lined with a 600 mm deep clay liner, compacted for a permeability of 1 X 10^{-9} m/s. The clay subsoil is a dense, low permeability material. Nevertheless, it will be tested to ensure that the desired permeability can be met.

Nutrient partitioning between sludge and liquid fraction is shown in Table 11.

Table 11 – Partitioning of Nutrients in Pond Effluent Between Sludge and Pond Liquid

Component	Total Effluent Nutrients (t/yr)	Nutrients to Sludge (t/yr)	Nutrients to Pond Liquid (t/yr)	Nutrients Post Gaseous Losses (t/yr)
Nitrogen	25.19	5.92	19.72	9.64
Phosphorus	7.02	6.32	0.70	0.70
Potassium	6.40	0.32	6.08	6.08

5.2.2. Wet Weather Ponds

The Wyatt's would like to irrigate effluent from the wet weather ponds in order to use the nutrients in their cropping program. However, when the soil is too wet for irrigation to occur, the effluent must be held to prevent other losses to the environment. Hence, it will be temporarily stored in a wet weather pond adjacent to each anaerobic pond.

The dimensions of the existing wet weather pond at the breeder site are provided in section 5.2.1 and Table 8.

For the finisher site, the proposed dimensions and volume of the pond is provided in Table 12.

Table 12 – Dimensions and Volume of Proposed Finisher Sheds Effluent Wet Weather Storage Pond

Dimension	Inside Crest	Top Water Level	Base
Depth (m)	3.5	3.0	-
Length (m)	36	33.5	18.5
Width (m)	35	32.4	17.4
Volume (m^3)	-	2,000	-

The wet weather pond will be lined with a 600 mm deep clay liner, compacted for a permeability of 1 X 10^{-9} m/s. Like the anaerobic pond, the clay subsoil will be tested to ensure that the desired permeability can be met.

There is a three-month period (June-August) when rainfall exceeds evaporation and irrigation may not always be possible. Hence, the ponds need to be able to store the effluent and net rainfall during this period. The adequacy of the existing wet weather pond at the breeder site to provide wet weather storage was assessed using the Watbal Pond Design tool which was developed Skerman and Simpson (2015) for Australian Pork Ltd. The tool was also used to size the wet weather pond for the proposed finisher sheds.

Watbal Pond Design was developed to assist pork industry service providers and consultants in designing, evaluating and managing effluent reuse systems to limit effluent pond spills to an acceptable frequency, thereby protecting the environment from potential contamination. It performs a daily water balance on effluent storages, accounting for pond inflows resulting from shed cleaning, rainfall and runoff from several different catchment areas, in addition to pond outflows resulting from evaporation, effluent reuse and use of recycled effluent for shed cleaning (not applicable in this instance).

Daily SILO climate data for Cuballing from 1900 to 2020 was used in the Watbal Pond Design model. For the two runs (breeder site and finisher site), the model was set up so that the effluent flow matched that expected from the expanded piggery. The anaerobic pond inputs were as per section 5.2.1. The soil type selected was average sandy loam PAWC 80. The cropping system was winter reduced till. The sizes of the effluent reuse areas were matched to the minimum areas determined in section 5.2.3. It was assumed that effluent was irrigated undiluted using a low-pressure travelling irrigator. Irrigations were triggered by a 10 mm soil water deficit and ceased following 10 mm of rain. The drawdown depth would leave 0.3 m of effluent in the base of the wet weather pond.

The pond water balance for each site is shown in Table 12.

Table 13 – Pond Water Balance for Effluent Wet Weather Storage Ponds

Water movement (m^3/yr)	Breeder Sheds	Finisher Sheds
Inflow from anaerobic pond	1,064	4,128
Inflow from rainfall onto pond	552	616
Total inflows	1,616	4,744
Outflow from irrigation	1,285	4,107
Outflow from evaporation from pond	343	623
Outflow from overtopping	0	21
Total outflows	1,628	4,751
Difference in storage volume	+12	+7

5.2.3. Effluent Reuse

The land areas available for reuse are shown on Figure 13. In accordance with the National Environmental Guidelines for Indoor Piggeries Buffers, a 50 m wide buffer is provided to waterways (Category 2: mechanical spreaders and irrigators that project the discharged material to a height of less than 2 m above ground level, and irrigators with downward facing nozzles. A 20 m buffer to boundaries has also been provided to minimise the likelihood of drift or runoff onto neighbouring land. In total, there is ~241 ha of land available on-farm.

All of the reuse areas will be used to grow hay, grain or canola. Table 14 sets out the typical yields and nutrient removal rates for crops to be grown on the farm. The yield data was provided by Tim Wyatt and is considered average data. The crop nutrient concentration values were taken from Table 12.4 of the National Environmental Guidelines for Indoor Piggeries (2018).

Table 14 – Nutrient Removal Rates for Different Crops

Crop	Yield (t/ha)	Nutrient mass (kg/ha)		
		Nitrogen	Phosphorus	Potassium
Oaten hay	5	100	15	80
Oats + straw	3 + 3	66	11	89
Barley + straw	3 + 3	78	11	89
Canola	1.25	41	4	15
Av. of Rotation	-	71	10	66

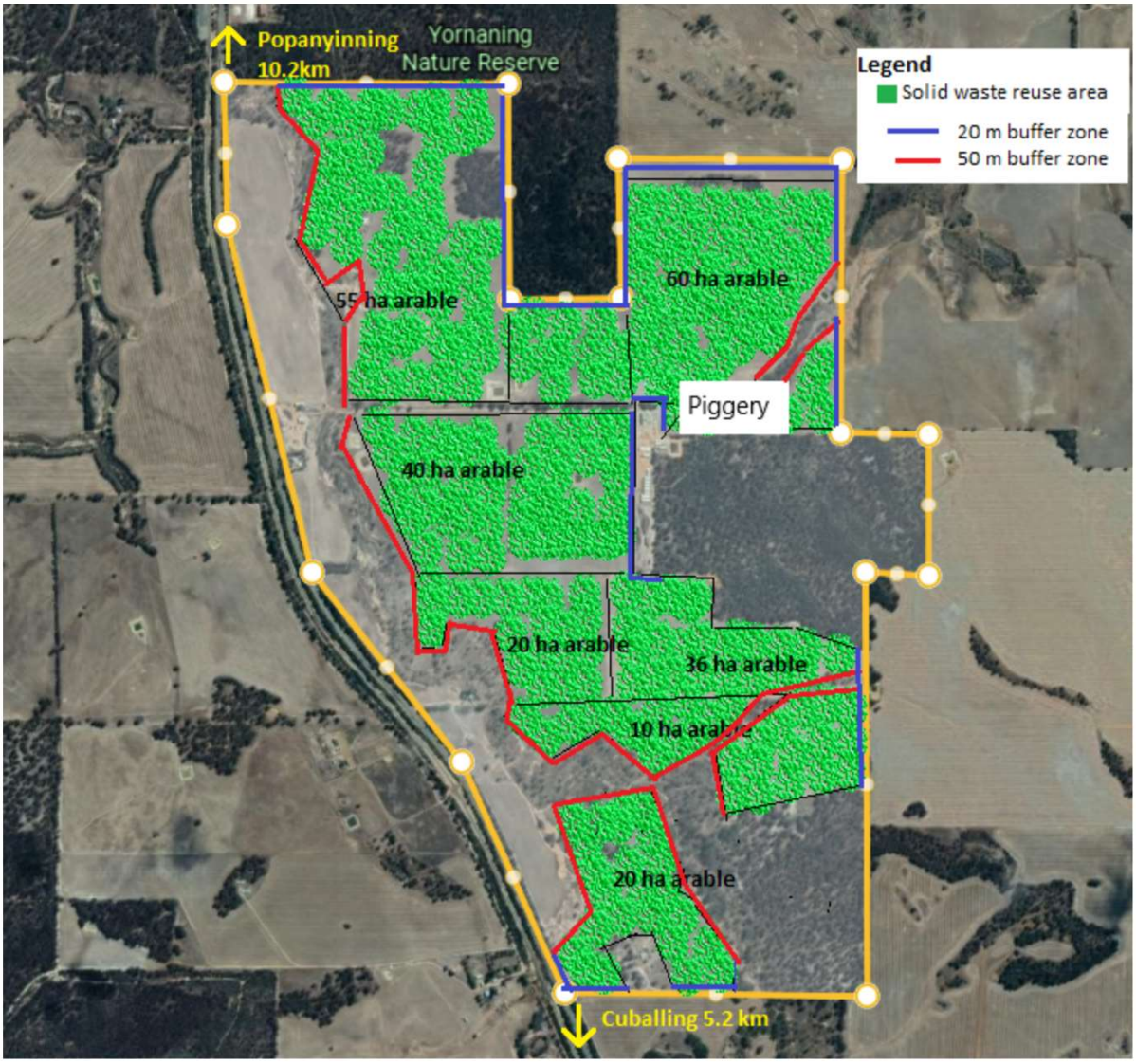


Figure 13 – Reuse Areas and Environmental Buffers

The area of land needed for reuse of each nutrient under the cropping rotation is shown in Table 15.

Table 15 – Effluent Nutrients for Reuse and Area Needed Under Rotation

Component	Breeder Sheds			Finisher Shed		
	Nutrients Post-Pond Losses (t/yr)	Nutrients Post-Irrigation Losses* (t/yr)	Area Needed (ha)	Nutrients Post-Pond Losses (t/yr)	Nutrients Post-Irrigation Losses* (t/yr)	Area Needed (ha)
Nitrogen	3.66	2.93	41	9.64	7.71	108
Phosphorus	0.24	0.24	24	0.70	0.70	69
Potassium	2.27	2.27	35	6.08	6.08	93

* 20% nitrogen losses by spray irrigation as per National Environmental Guidelines for Piggeries

The minimum area needed will be 41 ha for the breeder sheds and 108 ha for the finisher sheds or a total of 149 ha. In years when canola is grown, there will be a small nutrient surplus but this will be absorbed by the oaten hay crop that follows. Given that there is ~241 ha of on-farm land available for reuse, all the effluent can be safely used on-farm.

5.2.4. Sludge Reuse

Sludge will be spread using the vacuum tanker that will also extract it from the anaerobic ponds. It is intended that sludge will be drawn from each pond annually, although additional storage is provided as a contingency measure. Some sludge will be spread on-farm, with the balance offered to nearby landholders as an alternative fertiliser. Sludge will typically be spread shortly before crop planting, to maximise nutrient uptake opportunities for the crop and minimise nutrient leaching risks.

Sludge will be extracted from both the existing and proposed ponds. The masses of nutrients in sludge are shown in Table 9 and Table 11. Table 16 summarises the nutrient masses in the sludge, the nutrients remaining after nitrogen volatilisation losses and the area required for sustainable reuse under the cropping rotation. In total, after nitrogen losses, there are 7.35 t of nitrogen, 8.5 t of phosphorus and 0.44 t of potassium. If this is spread onto land used under the rotation, the total area needed is 103 ha for nitrogen, 830 ha for phosphorus and 7 ha for potassium.

Table 16 – Sludge Nutrients for Reuse and Area Needed Under Rotation

Component	Breeder Sheds			Finisher Sheds		
	Nutrients in sludge (t/yr)	Nutrients Post-Spreading Losses* (t/yr)	Area Needed (ha)	Nutrients in Sludge (t/yr)	Nutrients Post-Spreading Losses* (t/yr)	Area Needed (ha)
Nitrogen	2.25	2.03	28	5.92	5.35	75
Phosphorus	2.18	2.18	213	6.32	6.32	617
Potassium	0.12	0.12	2	0.32	0.32	5

* 10% nitrogen losses through ammonia volatilisation during spreading as per National Environmental Guidelines for Piggeries

In total, some 830 ha of land is needed for sustainable reuse of the phosphorus in sludge. Some of this sludge could be spread on-farm, while the remainder will be made available for others. Phosphorus is a valuable nutrient for croppers so it will not be difficult to find nearby landholders willing to receive this product. Not all of the phosphorus in sludge is readily available for plant uptake and most soils have the capacity to store significant quantities of phosphorus. Application of the sludge over 170-210 ha once every 4-5 years will apply nutrients at a sustainable rate and at a practical spreading rate.

5.3. Spent Bedding Management

5.3.1. Volume of Material for Management

Spent bedding removed from the deep litter housing and composting mortalities will be stored on a hard-stand area to the south of the proposed finisher shed. Since manure is generally spread just prior to crop planting, storage for 12 months spent bedding and composting mortalities will be provided. From section 5.1.2, there will be about 735 t/yr of spent bedding ex-sheds, assuming a moisture content of 60%. The bedding will contain about 440 t of total solids and 367 t of volatile solids.

Assuming a bulk density of 0.7 t/m^3, this material will have a volume of about 1050 m^3. It could be expected that some 30% of the total solids in this material would be lost during the extended aging period, leaving about 308 t of solids in the material for spreading. The moisture content is also likely to drop to say 40%, so this material would reduce down to about 513 t/yr of wet material for spreading, or 642 m^3/ yr (at a bulk density of 0.8 t/m^3). Just prior to spreading, there would be 12 months' material under storage. Assuming 10% of the material has undergone no decomposition and that 90% has undergone all solids and moisture losses, there would be a total of ~683 m^3 of material under storage at this time. If this is stored in windrows that are 4 m wide at the base and 2 m tall, ~170 m of windrow length is needed.

5.3.2. Manure Storage Pads

The base of the manure storage pad will be lined with material compacted to achieve a permeability of 1 X 10^{-9} m/s for a minimum depth of 300 mm. The compaction of the base will prevent nutrient leaching, protecting groundwater. The storage area will also be surrounded by 0.3 m high bunding to prevent the ingress of clean stormwater runoff from surrounding areas and to allow for the collection of contaminated runoff from within the area in a runoff collection pond. The pad will have a slight longitudinal slope (2-4%) towards its runoff collection pond. The runoff collection pond will be lined with material compacted to achieve a permeability of 1 X 10^{-9} m/s for a minimum depth of 300 mm. The clay subsoil in the vicinity of the spent bedding storage pad and runoff collection pond will be tested to ensure that the desired permeability can be met.

Space for 170 m of windrow length is needed, assuming the windrows are 4 m wide at the base and 2 m tall. Working on 5 windrows at a time, this equates to a 34 m windrow length. With 4 m between windrows to provide for vehicle manoeuvring for turning of windrows and material transport, the minimum space required to store and handle the material is 44 m X 42 m. Additional length will be needed for composting mortalities (see section 5.4). The mortalities composting space will back onto one end of the composting pad and will occupy a depth of about 8.4 m. A little extra space will be provided to allow for contingency storage. Hence, a 55 m X 50 m pad will be constructed.

5.3.3. Manure Storage Pad Runoff Collection Pond

To protect surface water quality, the runoff from the manure storage pad will be captured in a runoff collection pond. This will be sized to catch the runoff from the 1 in 20-year, 24-hour storm event and have sufficient capacity to accommodate the runoff from periods of persistent rainfall. Freeboard of 0.5 m will be provided to allow for wave action. The pond will be clay lined to provide a permeability of less than 1 x 10^{-9} m/s for a depth of 300 mm to prevent nutrient seepage to groundwater.

From Table 3, the 1 in 20-year, 24-hour storm for the site is 85.1 mm. From Goyen et al 2014, the runoff coefficient for clay surfaces, poor paving and sandstone rock in urban settings is typically about 0.85 at this rainfall intensity. This equates to a runoff rate of 72.3 mm. It is worth noting that the runoff rate from the manure piles will be much lower, however there will be times when the storage pad will be close to empty so the runoff rate of 72.3 mm will be adopted. A 55 m X 50 m pad will have an area of 2750 m^2. Hence, a 200 m^3 pond is needed to contain the runoff from 1 in 20 year 24-hour rainfall event.

As the rainfall pattern at Yornaning is winter dominant, the pond also needs to be able to collect the runoff from the manure storage pads in months when rainfall exceeds evaporation. From Table 1, in a 1 in 10 wet year rainfall exceeds mean monthly evaporation from May to August. However, four 1

in 10 wet year rainfall months would never occur consecutively. A 1 in 10 wet year has an annual rainfall of 637 mm. Based on historical monthly rainfall data for Cuballing from 1912 to 2017, there are three years with annual rainfall very similar to this. They are: 1917 (634.9 mm) and 1923 (635.9 mm) and 1951 (631.9 mm). The rainfall from May to August in each of these years is 388.9 mm in 2017, 394.9 mm in 1923 and 256.2 mm in 1951. The 1923 year has been used as it has the most similar rainfall to the 1 in 10 year and the highest rainfall for the target set of months. Table 17 shows a monthly water balance prepared using the monthly rainfall data for 1923. It is assumed that the pond is empty at the start of the water balance. The pond dimensions used for calculating rainfall onto the pond and evaporation from the pond are shown in Table 18. The crest dimensions were used to calculate rainfall, and the length and width at the mid-point between base and top water level were used to calculate evaporation.

Table 17 – Runoff Collection Pond Sizing Based on 1 in 10-year Rainfall

Month	May	June	July	August	Total
Monthly rainfall (mm)	93.0	179.3	67.0	56.6	395.9
Monthly runoff (mm)	79.1	152.4	57.0	48.1	336.5
Monthly evaporation (mm)	65.0	39.0	50.0	59.0	213
Pad runoff (m^3)	217.4	419.1	156.6	132.3	925.4
Rainfall into pond (m^3)	102	197	74	62	435.0
Evaporation (m^3)	51	31	40	47	168
Balance (m^3)	268	585	191	148	1192
Cumulative (m^3)	268	853	1044	**1192**	-

Table 18 – Runoff Collection Pond Internal Dimensions

Dimension	Value
Volume (m^3)	1200
Depth to top water level (m)	1.5
Freeboard (m)	0.5
Total Depth	2.0
Inside batters	3:1
Inside crest length	47
Inside crest width	27.5
Base length (m)	35
Base width (m)	15.5
Top water level length (m)	44
Top water level width (m)	24.5

5.3.4. Manure Windrow Management

The windrows of spent bedding and separated manure solids will be occasionally turned to introduce air, expose more of the material to the hot temperatures within the pile that are known to kill pathogens, and to improve the consistency of the material. This may also involve consolidating two windrows into one, since the composting process will breakdown solids and remove moisture, significantly reducing the volume of material in each windrow. Aging with occasional turning, rather

than composting, has been selected as this reduce nitrogen losses and operating costs while still achieving a relatively stable, consistent, low odour product. Manure will be aged for at least two months before being spread onto land.

From section 5.1.2, the spent bedding ex-sheds is likely to contain some 20.7 t/yr of nitrogen, 4.8 t/yr of phosphorus and 12.5 t/r of potassium. Nitrogen losses would also be expected during storage. If 40% of the nitrogen volatilises, some 12.4 t/yr of nitrogen would remain.

5.4. Mortalities Management

Some mortalities are expected from any piggery. At this unit, it is expected that there will be about 1916 mortalities (mostly piglets) annually, with a combined weight of about 40.7 t. These will be composted in bays the spent bedding area which is a bunded, hardstand area (see section 5.3). Composting in this area is the most environmentally-friendly method for mortalities disposal. It poses a very low risk of groundwater or surface water contamination. Composting uses micro-organisms to break-down organic matter to form a humus-like substance. Spent bedding or other similar high carbon materials will provide the carbon and cover material for the process. Providing sufficient cover material is used, composting is a low odour, aerobic process and it yields a valuable soil amendment.

The following composting procedure will be used for composting mortalities as it has been proven to produce low odour levels while effectively breaking-down the carcasses:

- place at least 0.3 m of carbon material over the base of the active composting bay before placing the carcasses.
- cover each carcass with at least 0.5 m of high carbon material before placing the next carcass. (Stack up to two carcasses high with good coverage between and around each carcass)
- ensure the carcasses are always well covered. Good coverage promotes composting by adding a carbon source, and is essential for controlling odours and in vermin control
- active composting will typically occur over a 3-4 month period.

It is proposed that three composting bays will be used. Together, these will provide sufficient space to store 12 months mortalities. To ensure appropriate maturation times, and to avoid the possibility of cross-contamination between new and old mortalities, one compost bay will be filled before the next and then the next. Hence, by the time the third bay is being filled, all material in the first bay will have undergone several months of composting and maturation. Emptying of the first bay will occur only after filling of the third bay has commenced, and so on.

As a guide, 4 m^3 of storage is needed per tonne of mortalities annually, or about 163 m^3. Square bales are typically 4' X 3' X 8' (1.2 m X 0.9 m X 2.4 m) or 4'X 4''X 8' (1.2 m X 1.2 m X 2.4 m) in dimensions. A bay with sides three bales long and ends three bales wide will provide about 43 m^2 (i.e. ((3 X 2.4 m) - 1.2 m) = 6 m long) X ((3 X 2.4 m = 7.2 m)) of floor area. If the bays are two bales high, then the bin height is 2.4 m making a total volume of 103 m^3. Assuming a usable volume of 67%, the storage volume is about 69 m^3. Hence, three bays would be sufficient for all the mortalities. These would have a total footprint of 7.2 m (3 bales X 2.4 m) X 26.4 m ((9 bales X 2.4 m) + (4 wall bales X 1.2 m)) or 190 m^2. Figure 14 shows a schematic plan view of the possible mortalities composting bays.

Compost produced from mortalities will be spread on land on farm. From the Piggery Manure and Effluent Management and Reuse Guidelines (Tucker 2015), mortalities compost typically contains 1.5% nitrogen, 0.5% phosphorus and 0.3% potassium. Assuming 4 m^3 (or 2.8 t) of spent bedding is used to compost each tonne of mortalities, some 114 t/yr of spent bedding will be used for this purpose and there will initially be ~155 t/yr of material composting.

The material will initially have a moisture content of ~68% (i.e. 40.7 t mortalities at 90%, 114 t of bedding @ 60%). If it has a final moisture content of 40%, and that there is a 50% loss of solids (from 105 t to 52.5 t), the finished mass will be about 88 t/yr. Using the data from the Piggery Manure and Effluent Management and Reuse Guidelines (Tucker 2015), this could contain about 1320 kg of nitrogen, 440 kg of phosphorus and 264 kg of potassium.

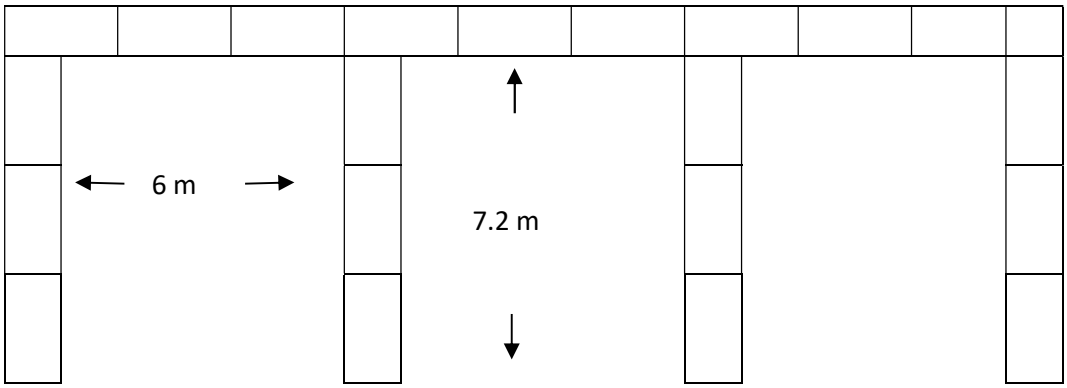


Figure 14 – Plan View Configuration of Bays for Mortality Composting

The composting pad may also be used to compost mortalities in the event of mass deaths. The total weight of stock in the piggery at any time will be approximately 281 t. If 10% of pigs were lost, there would be ~28 t of mortalities to manage. Assuming 4 m^3 of storage is needed per tonne of mortalities this equates to 28 m of windrow length (assuming the windrow is 4 m wide at base X 2 m high). A significant quantity of spent bedding would be used to compost these mortalities, or straw if insufficient spent bedding were available. If necessary, aged spent bedding could be formed into a pile to make space for mortalities composting. Mortalities windrows would be placed at the lower end of the manure storage pad to avoid contamination of other material.

5.5. Spent Bedding and Mortalities Compost Reuse

5.5.1. Spent Bedding

The spent bedding ex-sheds is likely to contain some 20.7 t/yr of nitrogen, 4.8 t/yr of phosphorus and 12.5 t/r of potassium. Nitrogen losses would also be expected during storage. If 40% of the nitrogen volatilises, some 12.4 t/yr of nitrogen would remain.

Table 19 – Spent Bedding Nutrients for Reuse and Area Needed Under Rotation

Nutrient	Nutrients in aged spent bedding (t/yr)	Nutrients Post-spreading losses* (t/yr)	Area Needed (ha)
Nitrogen	12,433	11,189	157
Phosphorus	4820	4820	471
Potassium	12,455	12,455	189

* 10% nitrogen losses by spreading as per National Environmental Guidelines for Piggeries

About 471 ha of land would be needed for sustainable reuse of spent bedding under the proposed cropping rotation as shown in Table 14. Spreading the material over ~157 ha once every three years would result in a more practical application rate and meet the nitrogen requirement in that year. Not all the surplus phosphorus would be available for plant uptake in the first year, and it can be expected that the surplus could be stored in the soil for uptake by later crops. This rate would apply more potassium than the first year's crop would need, although this is unlikely to result in any environmental impacts and the second years' crop would take up the surplus.

5.5.2. Mortalities Compost

It is expected that the mortalities compost will be spread on-farm. The mass of nutrients in the finished compost, the nutrients for plant uptake after spreading losses and the area needed for sustainable reuse using the crop rotation described in Table 14.

Table 20 – Mortalities Nutrients for Reuse and Area Needed Under Rotation

Nutrient	Nutrients in finished compost (kg/yr)	Nutrients Post-spreading losses* (kg/yr)	Area Needed (ha)
Nitrogen	1320	1188	17
Phosphorus	440	440	43
Potassium	792	792	4

* 10% nitrogen losses by spreading as per National Environmental Guidelines for Piggeries

There is sufficient land on-farm for sustainable reuse of the mortalities compost.

5.6. Off-Site Reuse Management and Duty of Care

As detailed above, some of the sludge and spent bedding will need to be spread off-farm. This material would be provided to nearby farmers. The reuse will occur on nearby land with a similar farming capability, similar land uses (cereal and oilseeds) and similar environmental risks to the on-farm land.

Reuse of this material will follow the same principles as on-farm reuse. The manure products will be used to amend soil used to grow grain, straw and hay crops. A manure spreader will be used to disperse spent bedding and a tanker will spread the sludge. The material will be spread at rates aimed at achieve a long-term balance between nutrients applied and removed by crop harvest. A representative analysis of the products for spreading will be provided to the off-site reusers. The manure recipients will be made aware of the need to provide a 50 m buffer to watercourses. Recipients will also be advised that they should provide a 21-day withholding period between reuse and any grazing. Off-site reusers will be provided with a copy of the Duty of Care Statement included as Appendix 2.

6. Normal Operating Condition Management Practices

This section describes the effluent and manure management practices that will be adopted under normal operating conditions.

6.1. Staff Numbers

The piggery currently employs 2 full-time equivalent employees (FTE). It is expected that numbers will increase to 4 FTE after the expansion of the piggery.

6.2. Operating Hours

The piggery will generally be staffed from 7 AM to 5 PM. Truck movements will generally be scheduled to occur during this time frame but will occasionally occur at other times of the day or night. In particular, during very hot weather pigs may be transported at night for welfare reasons. At peak harvest time, trucks may transport grain at night (standard industry practice).

6.3. Shed Management

The sheds will be kept clean to maintain low odour, comfortable conditions for pigs and staff. Pens in the conventional sheds will be hosed out as needed to keep the sheds hygienic. For sheds with pits, the effluent will collect in under-pen pull plug pits that are regularly emptied. Each time the pits are emptied, they will be recharged with a few centimetres of water. This stops manure from sticking to the bases and also suppresses ammonia releases from the manure.

Bedding in the deep litter housing will be maintained for welfare reasons and to minimise odour. For all pigs, a generous layer of bedding will be provided after each clean-out, which will occur approximately every seven weeks. Straw will be topped-up as needed. This aligns with best practice.

6.4. Effluent Treatment

To optimise the function of the effluent treatment system, the effluent flow to each of the anaerobic ponds will be kept regular by pulling pull plugs sequentially (not all on the one day). To maintain active capacity within the anaerobic ponds, it is intended that these will be desludged annually although there is spare storage capacity if this is not possible. The ponds have been designed to have a suitable width to allow for desludging with a vacuum tanker.

Each anaerobic pond will overflow into a wet weather pond. These ponds have been sized to minimise the likelihood of a spills. However, to ensure the pond system is ready to cope with wet weather conditions, treated effluent will be irrigated whenever soil moisture and crop conditions allow for this.

6.5. Spent Bedding

Spent bedding will be kept on a bunded, hardstand area until they can be spread onto cropping land. While this material will not be actively composted, it will occasionally be turned to yield a more consistent product. This is common practice within the Australian pig industry since the costs associated with composting are very difficult to recoup. This also results in less gaseous losses of nitrogen compared with composting.

6.6. Mortalities Management

Mortalities will be composted on the bunded, hard stand area used to store spent bedding. Composting represents best practice management for mortalities. Specific details of mortalities management are provided in section 5.1.3.

6.7. Reuse of Manure Products

Effluent, spent bedding and mortalities compost are valuable fertilisers and soil amendments. However, they need suitable management to minimise the risk of impacts to amenity, public health and the environment.

Effluent, spent bedding, sludge and mortalities compost will be applied at rates that achieve a long-term balance between the nutrients they contain and the expected nutrient removal by crop harvest (refer to sections 5.2.3, 5.2.4 and 5.5). Effluent, sludge and spent bedding will be analysed ahead of the main reuse period so suitable reuse rates can be determined. To maximise nutrient uptake, and minimise runoff and leaching losses, effluent will only be applied when the soil is dry enough to absorb the irrigation, with a low-pressure spray or drip travelling irrigator or tanker that allows for application at low rates, throughout the growing season to meet the demands of the crop. A vacuum tanker will disperse the sludge. A spreader will apply manure products ahead of planting. The irrigator, tanker and spreader will be operated in a way that spreads the material evenly. Regular soil testing will be used to confirm the system is in balance.

To prevent amenity impacts, reuse will be scheduled to occur from mid-morning to mid-afternoon when odour dispersion is likely to be enhanced. Weather and wind conditions will be considered when scheduling reuse. Because different areas can be irrigated, areas close to houses will be avoided when the wind is carrying towards them. Reuse will also be avoided under heavy, overcast conditions, if rain is imminent, if the atmosphere is very still or gusty, or if there are gentle winds towards the nearby neighbours. As secondary protection, the buffers shown on Figure 13 will be adopted.

To guard against any animal or human health risks, a 21-day withholding period will apply between reuse and harvest or grazing. This will allow for drying of applied effluent and manure products and desiccation of microorganisms these contain.

Off-site reusers will be provided with a hand-out detailing duty of care responsibilities (Appendix 2 is a Duty of Care Statement for manure recipients). They will also be made aware of the Australian Pork Ltd resources that can be used to ensure sustainable reuse of manure products occurs. Each year they will be provided with analysis results for the manure products they are reusing.

6.8. Fly and Rodent Breeding

Flies and rodents are attracted to the feed used at piggeries and the manure, waste feed and mortalities generated. All reasonable steps will be taken to minimise fly and rodent breeding. In particular, the sheds will be built to minimise cavities that could provide a rodent home, low wastage feeding equipment will be installed, feed spills will be promptly removed, the sheds will be kept clean and composting mortalities will be kept well covered at all times. Baits will be used strategically to control fly and rodent numbers.

Tall vegetation can provide a habitat for flies and rodents. The grass around the pig sheds will be kept short.

6.9. Traffic

Heavy vehicles will be needed to transport feed and bedding to the piggery, and finished pigs from the facility. All trucks will enter and exit the property via the Great Southern Highway which is a sealed dual-lane road in good condition. The access point to the property provides good visibility in both directions. Hence, there should be no issues with road safety. Nor should dust from traffic movements be an issue.

From section 4.7, the expanded piggery will generate about 100 trucks per year or 2 per week into the piggery and out of the piggery. This is a small number of trucks that is in keeping with surrounding farming uses. Truck movements will generally be scheduled to come in the day, except under extreme hot conditions when night transportation of pigs will be needed for welfare reasons or during the busy harvest period when night transportation is common. Scheduling vehicle movements for day time hours reduces the likelihood of noise nuisance and light spill for nearby residents.

Two cars per day could transport staff to the piggery on weekdays. This equates to 10 vehicles per week or 520 per year.

7. Resource and Waste Minimisation

7.1. Water

The piggery will need water for pig consumption and to maintain shed cleanliness. However, water use will be minimised by:

- selecting low wastage drinkers for the new sheds
- choosing pull plug effluent pits rather than flush channels for the new conventional sheds
- installing deep litter shelters as part of the housing
- using an irrigation system that does not require dilution

7.2. Feed

Feed is a major input and expense for the piggery. Minimising feed wastage reduces operating costs, helps in maintaining low odour conditions within sheds and reduces the organic and nutrient load to the effluent pond. Feed wastage will be minimised by selecting low-wastage feeders for the new housing.

7.3. Bedding

It is important to provide sufficient bedding to maintain dry, sanitary conditions within the deep litter housing. Hence, bedding usage is not minimised. As spent bedding is reused as a fertiliser and soil amendment, this is not seen as wasteful.

7.4. Power

Power can be a significant cost for a piggery of this size. Deep litter housing does not require mains power or gas to operate, so the choice of this housing for some classes of pig significantly reduces power usage. Elsewhere, power usage will be minimised by choosing power-efficient pieces of equipment and maintaining these. To minimise costs, facilities that don't need to be used at high tariff times (e.g. pumps) will be used at off-peak times.

7.5. Effluent, Sludge and Spent Bedding

Effluent, sludge and spent bedding are not seen as "wastes" but as sources of nutrients and soil amendments for the overall farming system. Nevertheless, the piggery will operate most profitably when the quantity of organic matter, nutrients and water going to effluent and spent bedding are minimised, so every effort will be taken to avoid water and feed wastage.

7.6. Rubbish and General Wastes

Rubbish is kept to a minimum by handling feed and other inputs in bulk. General rubbish will be collected in suitable bins. Where practical, wastes will be designated for reuse or recycling. However, wastes like syringes and needles undergo proper disposal via return to suppliers.

8. Assessment of Environmental Impacts and Risks

The operation of a piggery has the potential to impact upon surface waters, groundwater, soils and amenity. A risk assessment identifies whether the siting, design and management of the piggery will provide adequate safeguards to protect all aspects of the environment. Table 21 provides a generic risk assessment matrix showing the level of risk (low, moderate, high or critical) depending on the likelihood of occurrence and the severity of consequences.

Table 21 – Risk Assessment Matrix

Likelihood	Consequences				
	Insignificant – < $1000 environmental damage	Minor – low environmental damage <$10,000	Moderate – medium environmental damage <$100,000	Major – high environmental damage <$1,000,000	Catastrophic – toxic environmental damage >$1,000,000
Almost certain (100%)	Moderate risk	High risk	High risk	Critical risk	Critical risk
Likely (10%)	Moderate risk	Moderate risk	High risk	High risk	Critical risk
Possible (1%)	Low risk	Moderate risk	High risk	High risk	Critical risk
Unlikely (0.1%)	Low risk	Moderate risk	Moderate risk	High risk	High risk
Rare (0.01%)	Low risk	Low risk	Moderate risk	Moderate risk	High risk

In developing the proposal, all risk areas have been considered, and details of mitigation measures and the assessed risks are provided below.

8.1. Surface Waters

The quality of surface water could be impacted if there were effluent pond spills, direct entry of irrigated effluent into waterways or runoff of nutrient-rich stormwater from effluent or manure product reuse areas into waterways. The piggery sits near the top of a rise that slopes gently down to the west towards Hotham River South which is an intermittent waterway on the property. Drainage lines on the north of the site ultimately drain to the Hotham River.

The piggery complex is well separated from the drainage lines, which provides primary protection. However, stormwater from the piggery and surrounds will be carefully managed to prevent contamination of runoff to other areas. All facilities that are in contact with effluent will be designed to prevent uncontrolled releases. The flooring of the pig sheds and shelters will be raised above ground level and enclosed to prevent ingress or outflow, it will also be impervious. The underfloor effluent pits will be impervious. The effluent ponds and the spent bedding storage area will be impervious with banks that prevent uncontrolled stormwater ingress and contaminated water releases. The effluent pond system is sized to contain pond spills to an acceptable frequency. Hence, the risk of spills or leakage from this area is acceptably low and surface waters would be well protected.

Effluent and manure reuse will occur on land that has previously been cleared and farmed for many years. Waterways have been excluded from the reuse of effluent and manure products with suitable

buffers in place. Sustainable effluent irrigation and manure spreading rates, determined from effluent and manure analysis results, soil test results and expected crop nutrient removal rates, will be used. The proposed low-pressure irrigator will apply effluent at low rates, avoiding direct runoff. The good management practices proposed and the significant buffers between both the piggery and the reuse areas to the waterways offer further protection. Surface water contamination by nutrients or sediment is not expected to result from the operations of the piggery. Nor is runoff likely to be generated so no impacts to flows or erosion are expected. The existing values of the waterbodies and immediate surrounds will be protected by buffers.

Taking into account the site features, proposed design and management and secondary protection measures (buffers), it is considered that surface water contamination, impacts to flows and adverse effects on habitats adjacent to surface water features are very unlikely to occur, with minor environmental harm, equating to a moderate risk.

8.2. Groundwater

Although there is unlikely to be particularly shallow groundwater beneath the site, groundwater could be impacted through leaching of nutrients from sheds, the spent bedding storage area, ponds or reuse areas. Within the piggery complex, groundwater will be very well protected through good design and construction. The sheds and effluent pits will all have concreted floors. The manure storage area and the effluent ponds will be lined for a design permeability of 1 X 10^{-9} m/s to prevent nutrient leaching. Hence, there is little chance of nutrient leaching through these facilities. *Rare likelihood X minor consequences – low risk.*

Good management will be the key to groundwater protection within the reuse areas. This will need to be supported by monitoring aimed at early detection of risks. Almost all of the land to be used for reuse of effluent, sludge and spent bedding consists of duplex soils with a sandy or loamy topsoil underlain with heavier soil that is prone to compaction and is likely to offer good protection for groundwater. However, it is possible that there could be a perched water table at times and that this water could be contaminated through nutrient leaching as a consequence of effluent or manure reuse. Application of nutrients at sustainable rates is the main check to minimise nutrient leaching. Nutrient mass balances were prepared to ascertain suitable nutrient loading rates and required land areas for reuse of each effluent and manure product. In practice, effluent and manure solids will be analysed periodically and the results used in conjunction with soil test results and expected crop nutrient removal rates to determine appropriate reuse rates. The soils of the reuse areas will be regularly tested to ensure the nutrients are in balance and at suitable levels. Taking all of this into account, the proposal is expected to offer good groundwater protection. Piggery: *Unlikely likelihood X minor consequences – moderate risk*. Reuse areas: *Unlikely likelihood X minor consequences – moderate risk*.

8.3. Soils

The duplex soils of the reuse areas have sandy to loamy topsoils that will benefit from the addition of carbon and nutrients. A nutrient mass balance was used to ascertain suitable nutrient loading rates and required land areas for reuse of effluent, sludge and spent bedding. The effluent will be spread using a low-pressure travelling irrigator able to apply the effluent evenly and at low rates. The manure spreader will also apply the spent bedding at controlled, even rates. Effluent and manure solids will be analysed annually before the main spreading activity and the results used to determine appropriate reuse rates. The soils of the reuse areas will also be regularly tested to ensure the nutrients are in

balance and at suitable levels. Both topsoil and subsoil sampled will be collected. These will be sampled and analysed in accordance with the National Environmental Guidelines for Indoor Piggeries. *Rare likelihood X minor consequences – low risk.*

8.4. Amenity

Piggeries have the potential to impact on amenity through odour, dust or noise nuisance and fly and rodent breeding. Reuse of effluent and manure products may also pose a risk of health impacts if not carefully managed. Suitable siting, design and management can be used together to prevent amenity impacts. The piggery complex site is well separated from sensitive land uses, as demonstrated in section 8.5.

Nevertheless, to ensure amenity is protected, good management is essential. This will include maintaining a suitable piggery environment (regular cleaning of conventional sheds, regular changing of bedding in shelters), promptly cleaning up spilt or wasted feed, ensuring mortalities and afterbirth are managed daily and kept covered during composting), minimising fly and rodent habitats and strategically using insect and rodent baits if needed.

Dust can be generated through feed preparation and delivery, from handling and spreading of dry spent bedding and from the movement of vehicles along unsealed roads. Dust from feed processing and delivery will be relatively small and confined to the piggery complex. Hence, it will not create off-farm impacts. Turning of dry bedding material will be avoided. The public roads to be used are all sealed and the on-farm access is well separated from houses. Hence, road dust is unlikely to pose an issue.

Noise from the piggery complex is unlikely to be audible at nearby houses. Truck movements will be scheduled to occur during the day whenever practical which will minimise the risk of nuisance from noise of light spill.

W*hile odour, dust and noise nuisance from the piggery complex is considered unlikely to possible (0.1-1%), the resulting environmental harm would be insignificant or minor, amounting to a low-moderate risk.*

Reuse of treated effluent, sludge and spent bedding will be managed to prevent odour nuisance, dust or public health impacts at nearby sensitive land uses. Because the effluent will be irrigated using a low-pressure spray method, aerosols that can transport odour will be minimal. It is expected that spreading of spent bedding will mostly occur over a short period during late summer or early autumn. To minimise the likelihood of odour and dust nuisance, reuse will generally occur from mid-morning to mid-afternoon. It will not occur if rain is imminent, if the soil is wet, it is windy or if there is a gentle breeze towards the closest neighbours. For both effluent and sludge, the recommended buffers will be provided between reuse areas and the closest houses and roads. As various parts of the property can be used for effluent irrigation or spent bedding, areas closer to houses will be avoided when the wind is carrying towards them, minimising the likelihood of odour or health impacts. A complaints-handling processing is in place, including ongoing consultation and corrective and preventative actions. *It is unlikely but possible that odour or dust nuisance would occur, with insignificant consequences – low risk.*

Along with all the management practices described in section 6.7, a 21-day withholding period will be observed between reuse and any grazing or harvest of crops. This will protect grazing stock from any pathogens and prevent contamination of the part of the crop that will be used for human food consumption. *The risk of an animal or human health concern from reuse of effluent or manure products is considered rare X minor consequences = low risk.*

8.5. Separation Distances

Separation distances need to be provided between piggeries and nearby houses and other sensitive land uses to minimise the risk of odour, dust and noise nuisance. Figure 2 shows the closest houses within 2 km of the site in each direction. The nearest houses in each direction are ~1150 m to the south-west of the piggery complex (with a second house at ~1680 m), ~1450 to the south-south-west, ~1860 m to the north-west and ~1950 m to the east.

The methodology in the National Environmental Guidelines for Indoor Piggeries has been used to assess the adequacy of the available separation distances.

The formula for determining the required separation distances is:

Separation distance (D) m = $N^{0.55}$ X S1 X S2 X S3

The following values have been used in the determination for all nearby receptors except the house to the east:

- $N^{0.55}$ = 108.715 where N is the number of standard pig units (5,039 SPU) and $^{0.55}$ is the piggery size exponent determined using the results of modelling.
- S1 = 0.854834 where S1 = $S1_R$ X $S1_T$.
    - $S1_R$ = 1 which is the product of 1.0 for the pigs in conventional sheds (3062 SPU of 5039 SPU) multiplied by 1.0 for pigs in the deep litter system with pigs on single batch of litter > 7 weeks (1977 SPU of 5039 SPU).
    - $S1_T$ = 0.854834 which is the product of 1.0 for a pond with <25% volatile solids removal pre-pond (3062 SPU of 5039 SPU) and 0.63 for spent bedding stored near sheds (1977 SPU of 5039 SPU).
- S2 factor = 25 for a town, 15 for a rural residential zone and 11.5 for a rural dwelling where $S2_R$ = 25 for a town, 15 for rural residential and 11.5 for a rural dwelling and $S2_S$ = 1 for limited ground cover / short grass.
- S3 factor = 1 for flat land. Figure 15 shows that the land is gently undulating between the piggery and the house. A value of 1 is appropriate since the elevation of the piggery is ~325 m AHD and the house is at ~321 m AHD, for an elevation difference of 4 m in 1150 m or ~0.35%.

Figure 15 – Topography Between Piggery and Closest House

The minimum separation distances determined are:

- house 1069 m
- rural residential zone 1394 m
- town 2323 m

Note, this is a conservative appraisal as it is expected that bedding will be changed at least once every 7 weeks. Under this assumption (bedding removed and replaced at intervals of ≤7 weeks), the S1 changes to 0.730742 (due to a change of $S1_R$ to 0.854834 which is the product of 1.0 for the pigs in conventional sheds (3062 SPU of 5039 SPU) multiplied by 0.63 for pigs in the deep litter system with pigs on single batch of litter <7 weeks (1977 SPU of 5039 SPU)) and the required separation distances reduce to :

- house 914 m
- rural residential zone 1192 m
- town 1986 m

There is significant woodland vegetation between the piggery and the house to the east which can be seen in Figure 8 and Photograph 5 in particular. With the adoption of an $S2_R$ value of 0.5 for forest with significant mid and lower storey vegetation, the required distance to this house reduces to 534 m. (Based on bedding replacement at >7 week intervals).

In all cases, the minimum separation distances to the houses, closest rural residential zone and town are comfortably provided.

It is also work recognising that wind direction plays a part in the carriage of odour. The predominant wind direction in the summer tends to be from the south-east. There are no close houses to the north-west of the piggery. In the winter, morning winds are from the north to north-west, tending to be north-west to west in the afternoons. The only close houses directly to the south, south-east or east of the piggery is the house ~1950 m to the east of the piggery which is likely to be protected through both distance and increased dispersion by the thick patch of trees between the piggery and the house.

9. Emergency Situations and Contingency Plans

Non-routine situations that may pose a risk to the environment can occasionally arise at piggeries. Environmental impacts could occur in the unlikely event of:

- a disruption to the power supply affecting the ability to clean sheds and pump effluent
- blockage of the effluent transfer pipes
- upset conditions in the anaerobic ponds
- wet weather ponds full and likely to spill with further rain
- crop failure
- surplus spent bedding
- mass mortalities
- difficulty sourcing bedding
- water supply issues
- fire

Following is a description of the management that would be used to address each of these situations in order to prevent or minimise the risk of environmental harm.

9.1. Power Supply Disruption or Pump Failure

Reliance on mains power is minimised through the use of diesel or petrol pumps and equipment which limits impacts due to power supply failure. Water is accessed from a mains supply. Nevertheless, a minimum of two-days back-up water is stored on site. Prepared feed is also stored. Tools and spare parts for repairing the feedmill and pumps are kept on-site. Other on-farm pumps can also be accessed as needed.

9.2. Blockage of Effluent Pipes

A blockage in the effluent pipes would be obvious and quickly detected. An air compressor would be used to clear this.

9.3. Upset Conditions in Anaerobic Ponds

Anaerobic ponds rely on having sufficient active volume, and a steady inflow of organic matter to function optimally. Pond upsets can result from sludge encroachment on active volume reducing treatment capacity, shock loading resulting in a drop in pH that prevents complete digestion, or the addition of antibiotics and disinfectants that are harmful to the treatment microorganisms. Good management is the key to preventing upset conditions.

In the event of a pond upset, the cause would need to be identified. If sludge accumulation were a concern, desludging using a vacuum tanker would commence as soon as practical. At the same time, clean water would be added to the influent to dilute the remaining effluent. This should also happen if the problem is caused by shock loading or chemical contamination. If necessary, effluent would be drawn from the wet weather pond for irrigation to ensure the pond system has capacity to store the extra water and any rainfall without spilling. Every effort would be made to provide a uniform inflow to the anaerobic pond to allow the microbial populations to stabilise. If the pH of the pond was low, lime could be added to the pond. Cleaning agents and veterinary chemicals used at the piggery are carefully selected taking pond function into account. Nevertheless, there is a risk of adverse impacts to pond function if too much chemical is inadvertently added to the effluent stream. An investigation

into cleaning agents and veterinary chemicals would be instigated if an anaerobic pond failed and initial troubleshooting did not detect a cause. Initially this would involve a desktop assessment of actual chemical use rates (and hence addition to the pond). It would be followed up with testing if a risk were identified. If the treatment micro-organisms have been killed by chemicals or antibiotics it may be necessary to empty the pond and recharge it with clean water and possibly effluent from the pond of a piggery with a similar health status.

The piggery manager will be responsible for investigating any pond upsets, taking corrective and preventative action, documenting the cause of the problem and actions taken, and ensuring procedures change (SOPs) so as to prevent the problem arising in the future.

Should the pond upset result any off-site impacts (e.g. odour nuisance), the piggery manager will report all details of the incident to the Shire of Cuballing by phoning 08 9883 6031.

9.4. Wet Weather Ponds Full and Threatening to Spill

The effluent treatment system is designed to provide adequate wet weather storage under most circumstances. Proactive management will be the main measure used to prevent pond spills. In particular, the wet weather ponds will be kept close to empty by the end of summer each year (i.e. before the start of the expected wet season). Throughout the autumn and winter, effluent will be drawn from the ponds in accordance with weather conditions and plant nutrient needs.

9.5. Crop Failure

While crops can fail for a range of reasons, the most common reason is weather. It will usually be possible to at least harvest something but nutrient removal will be compromised. To address this, effluent, sludge and spent bedding spreading rates may be adjusted and crops with a higher nutrient removal rate (e.g. hay crops) may be grown the following year to compensate. Areas that did not receive effluent or spent bedding in the previous year, or that did not experience crop failure, will be identified and these will have reuse at suitable rates. It is important to note that average crop yields were used to determine the nutrient balances. Hence, a crop failure is not a cause for alarm.

The piggery manager will be responsible for identifying suitable land areas for reuse and for determining suitable reuse rates.

9.6. Surplus Sludge and Spent Bedding

Sludge and spent bedding are good sources of organic matter and nutrients, and particularly beneficial for light soils. For this reason, the proponents will use what they can on-farm, with the surplus being made available for other nearby farmers. It is most unlikely that there will be problems finding farmers to take this material, although it is possible. If necessary, the proponents may compost the sludge with the spent bedding to ensure pond performance in not compromised by sludge accumulation. For a limited time, spent bedding can be temporarily stored on-farm until a new reuser is found. If this is not possible, this material could be sent off-farm to a commercial composter.

9.7. Mass Mortalities

In the event of a large number of mortalities at the piggery, the piggeries consulting veterinarian would be contacted along with relevant government authorities who would investigate the cause of death and advise and assist with disease control (if applicable) and the most suitable disposal method. Composting is the preferred method, providing it is considered suitable taking the cause of

death into account. The process would be managed in accordance with AUSVETPLAN along with relevant government bodies. The following entities will be contacted:

- Emergency Animal Disease Hotline on 1800 675 888
- WA Chief Veterinary Officer Unit 08 9368 3342
- Shire of Cuballing 08 9883 6031
- EPA 08 6364 7000

Depending on the cause of death, it may be possible for the mortalities to be dispatched to a rendering plant which would ensure environmental protection and enable recovery of some of the carcass value that would otherwise be lost. However, if composting is necessary, space is available in the spent bedding storage area and the stored material in it could be used as a carbon source. If burial is deemed necessary, this will be done under instruction from the Chief Veterinary Officer and EPA. Buried mortalities will be promptly covered with at least 1 m of soil after placement. The pit/s will be mounded slightly after back-filling to allow for settling as the mortalities break down.

9.8. Difficulty Sourcing Bedding

It is intended that all of the bedding needed will be sourced from crops grown on-farm, so any upcoming supply issues will be known about well in advance. The proponents will keep at least 12 months straw requirement on-hand at the end of each harvest. In the event of a shortage, additional straw will be purchased from local farmers or from further afield, if necessary. If necessary, alternative bedding materials such as sawdust or wood shavings could be used.

9.9. Water Supply Issues

Some 14.32 ML/yr of water will be needed to operate the piggery. This is a very small quantity in an agricultural context. The water supply is very secure, being from the Great Southern Town Water Supply Scheme. In the event of a short-term supply issue, water stored on-site would be used with top-up from an on-farm bore if necessary. While the yield of the bore is low, the water is good quality. If this were not possible, water would be tankered to the site.

9.10. Fire

In the event of a fire, staff safety will be the primary concern. All buildings will be evacuated and the fire brigade called by phoning 000. If it is safe to do so, staff may fight the fire from outside of the sheds using fire-fighting pumps.

10.Environmental Monitoring & Record Keeping

An Environmental Management Plan for the piggery is provided as Appendix 1 of this report. However, as part of its duty of care, piggery management proposes to routinely monitor:

- complaints
- available water storage capacity in wet weather ponds
- composition of effluent, sludge and spent bedding
- effluent, sludge and spent bedding reuse on-farm
- soils of on-farm reuse areas
- details of sludge and spent bedding going off-farm for third-party reuse

10.1. Monitoring

10.1.1. Complaints

It is important for the proponents to fit in with their local community. Consequently, the piggery manager will facilitate proactive, ongoing communication with surrounding land owners. Any complaints about the piggery will be taken very seriously. The piggery manager will be responsible for ongoing investigation, action and communications with the complainant. In the event of a complaint, the following will be recorded:

- date received
- details of complaint and complainant
- name of person who took the call
- response time and date and actions taken
- details of follow-up with complainant

All complaints received by staff will be immediately reported to the piggery manager. He will promptly initiate an investigation into possible causes. He may also wish to collect more information from the complainant. This will be done in a positive way, with a clear emphasis on investigating and resolving the issue. He will initiate corrective and / or preventative action and will confirm that the issue has been resolved through follow communication with the complainant. Staff training and operating procedure revision will be undertaken as appropriate to prevent a reoccurrence of the issue.

Details of complaints, findings of investigations and follow up actions will be promptly provided to the Shire of Cuballing upon request.

10.1.2. Available Water Storage Capacity in Wet Weather Ponds

The spare capacity in the wet weather ponds will be visually assessed after significant rainfall events. Effluent will be irrigated from the wet weather ponds when weather conditions permit and at suitable times during the crop growth phase to enable usage of the nutrients it contains and to prevent pond spills. If it is necessary to draw water from the ponds to prevent a likely spill, this will occur as soon as suitable soil water conditions allow for irrigation.

Details of any spills that result in effluent leaving the property boundary will be reported to the EPA.

The piggery manager will be responsible for ensuring the available water storage in the wet weather ponds is monitored and for scheduling effluent irrigations.

10.1.3. Composition of Effluent, Sludge and Spent Bedding

Treated effluent will be sampled and analysed annually before the main irrigation event. Initially, sludge and spent bedding will also be analysed annually although the monitoring frequency may be able to reduce if there is consistency to the analysis results.

All samples for analysis will consist of a minimum of 10 sub-samples that are bulked to produce a composite sample. Treated effluent will be sampled from the irrigation discharge point. Sludge will be extracted using a vacuum tanker. The spent bedding will be sampled from the centre of the windrow/s.

Analysis parameters will include:

Effluent

- total nitrogen or TKN
- ammonium nitrogen
- nitrate nitrogen
- total phosphorus
- available phosphorus
- potassium
- EC
- chloride
- SAR

Sludge and Spent Bedding

- dry matter content
- pH
- total nitrogen or TKN
- ammonium nitrogen
- nitrate nitrogen
- total phosphorus
- available phosphorus
- potassium
- organic carbon
- EC
- chloride
- sodium

The piggery manager will be responsible for organising this sampling and analysis. Analysis results will be kept on-site.

10.1.4. Effluent, Sludge and Spent Bedding Reuse – On-Farm

Reuse activities will need to be carefully managed to ensure protection of waterways, the seasonally herbaceous wetlands that may be present and groundwater. Hence, the piggery manager will be responsible for maintaining the following records of on-farm reuse:

- the date/s reuse occurs
- weather conditions at time of irrigation or spreading
- the type of material that was reused
- quantity of material spread
- reuse methods
- paddocks or areas spread
- application rates (mm or t/ha)
- crops grown on each paddock or area
- yield of grain and / or forage harvested from each paddock / area.

10.1.5. Soils of Reuse Areas – On-Farm

The soils of on-farm reuse areas will be tested annually in years when reuse area occurred on these. Composite samples of topsoil (0-10 cm) will consist of at least 10 bulked samples taken across the paddock. Composite samples of subsoil (30-60 cm) will consist of at least 5 bulked samples taken from across the paddock. Samples will be tested for:

Topsoil

- pH
- EC
- nitrate nitrogen
- available phosphorus
- potassium
- copper
- zinc
- organic carbon
- CEC and exchangeable cations

Subsoil

- pH
- EC
- nitrate nitrogen
- available phosphorus
- potassium
- CEC and exchangeable cations

Soil properties will be considered when determining reuse rates. Where deficiencies exist, it will be appropriate to address these by adding additional nutrients. Where surpluses exist, reuse rates will be adjusted down.

10.1.6. Sludge and Spent Bedding Reuse – Off-Farm

Off-site reusers will be provided with the duty of care statement included as Appendix 2 of this report.

The piggery manager will be responsible for maintaining the following records of off-farm reuse:

- the date/s manure solids were supplied to the reuser
- the name of the recipient
- the type of manure product/s provided
- quantity supplied
- dates that manure product analysis results were provided.

10.2. Record Keeping

The piggery manager will be responsible for ensuring monitoring occurs correctly and at the specified time intervals. He is also responsible for reviewing monitoring results as they come in (periodic measurements) and at least monthly (for ongoing measurements) to identify any trends or concerns. The piggery manager will initiate an investigation, which may include further sampling and analysis, where there are concerns with the results. He will be fully responsible for initiating corrective and / or preventative measures as needed.

All environmental monitoring records will be kept in the piggery office for a period of at least four years. A report will be provided to the Shire of Cuballing upon request.

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https://maps.agric.wa.gov.au/nrm-info/

Appendix 1 – Environmental Management Plan

INTRODUCTION

This Environmental Management Plan (EMP) is for a 500-sow farrow-to-finish piggery located at 15983 Great Southern Highway, Yornaning, Western Australia. The piggery consists of a combination of conventional sheds and deep litter housing.

This report provides information about the site; the design, operation and management of the piggery; environmental risks and the monitoring proposed to enable those risks to be effectively managed.

The contact details for piggery management are:

Name: Mr Tim Wyatt

Address: 15983 Great Southern Highway
YORNANING WA 6311

Email: wyattt@outlook.com.au

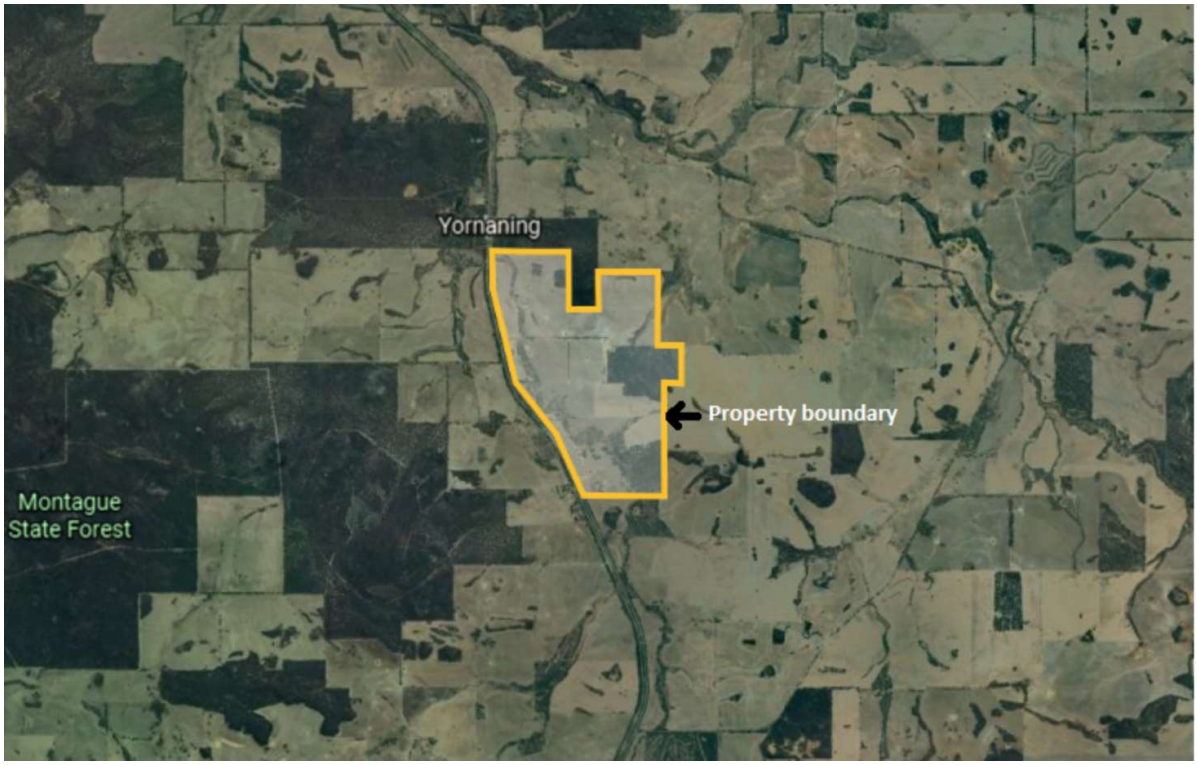
Phone: 0428 520 334

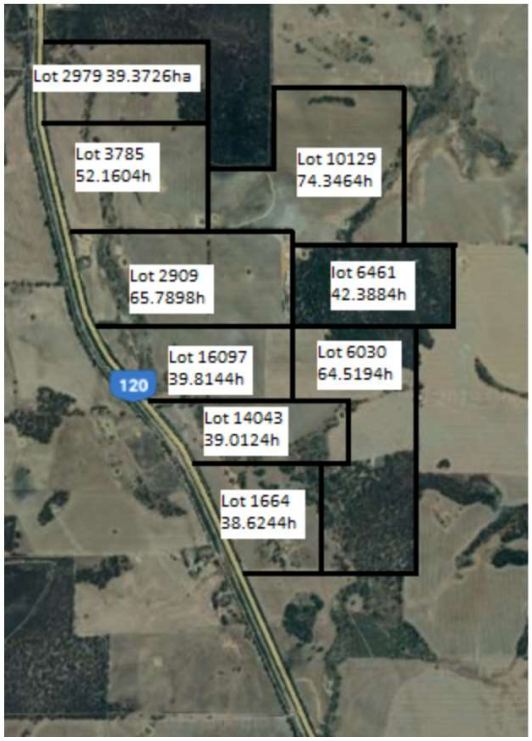
PROPERTY DESCRIPTION

Location

The subject property is situating approximately 7 km north of the closest town, Cuballing. Most of the surrounding land is used for wheat production or mixed farming. Yornaning nature reserve is the heavily treed area about 500 m to the north-east of the site. There is another heavily timbered area immediately to the east. The locations of the closest houses (within 2 km) to the piggery complex are shown below.

The property boundary and details are shown below.





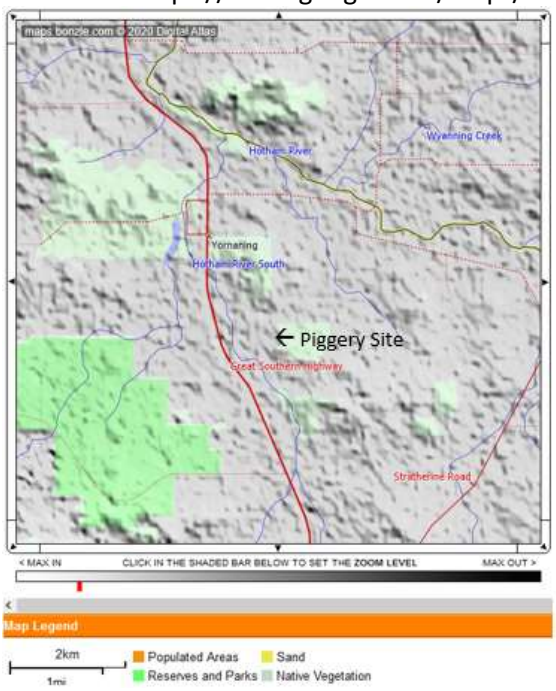
Climate

The Cuballing district has a Mediterranean climate featuring warm to hot dry summers and cool, wet winters. In the summer, morning and afternoon winds tend to be from the south east. In the winter, morning winds are from north to north-west, tending to be north-west to west in the afternoons.

Topography and Surface Waters

The topography of the farm and surrounds is gently undulating to gently sloping. The piggery sits near the top of a rise that slopes down to the west. Intermittent drainage lines to the west of the site drain to the Hotham River South, while those to the north of the site ultimately drain to the Hotham River (see below). The piggery is located on an elevated site that is not prone to flooding.

Source: https://www.google.com/maps/



Soils and Native Vegetation

Soils mapping for the property is available at https://maps.agric.wa.gov.au/nrm-info/. It is shown below.

Source: https://maps.agric.wa.gov.au/nrm-info/

There are three main soil subsystems:

- Noombling subsystem (Dyandra) 257 DyNB: this mapping unit covers the piggery, and most of the eastern part of the property. It consists of long, gentle and undulating hillslopes and divides. The indigenous vegetation is Marri-Wandoo woodland with a Jam-Sheoak understorey. The soils are derived from colluvium or weathered granite, gneiss and some dolerite. They are yellow/brown and deep grey sandy duplexes, brown deep loamy duplexes, sandy gravels and shallow duplexes.

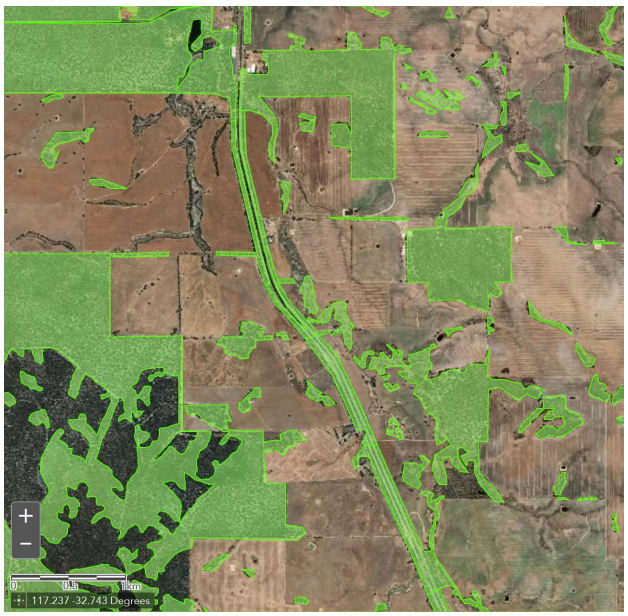
  Topsoil acidity may be a concern and subsoil acidity is a common concern. Some 3-10% of the mapping unit has a high susceptibility to salinity. These soils are somewhat susceptible to waterlogging. Some 30-50% of the area mapped is prone to subsurface compaction. Some 10-30% of the area mapped is prone to extreme wind erosion. Some 10-30% of the area mapped has a high to extreme risk of phosphorus export. Over 70% of the land is considered to have moderate to very high capability for annual horticulture if water were available, and for cropping.

- Biberkine subsystem (Dyandra) 257 DyBK: this mapping unit covers the central and western part of the property. It consists of valley floors with gently undulating rises and low hills. The indigenous vegetation is Wandoo-Flooded Gum woodland with a Jam-Sheoak understorey. The soils are derived from alluvium and colluvium over granite. They are yellow/brown sandy duplexes, wet and semi-wet soils and brown deep loamy duplexes.

  Topsoil acidity may be a concern and subsoil acidity is a common concern. Some 30-50% of the mapping unit has a high susceptibility to salinity. Over 70% of the area mapped is prone to subsurface compaction. Some 10-30% of the area mapped has very poor to poor site drainage and is prone to waterlogging, with 30-10% having a moderate to high risk of flooding. Some 3-10% of the area mapped has a high to extreme risk of phosphorus export. Nevertheless, some 50-70% of the land is considered to have moderate to very high capability for annual horticulture if water were available and over 70% of the land mapped has a moderate to very high capability for cropping.

- Norrine subsystem (Dyandra) 257DyNO: this mapping unit covers the area of native trees to the east of the piggery. This is a complex of lateritic residuals and associated soils: gravely sand, sand, duplex yellow soils and duricrust. This area will not be cleared or used in any way for construction of the piggery A very small area of this soil type in the north of the property could be used for reuse.

Very little native vegetation remains, with most of the farm having been cleared for farming for many years. The remnant vegetation on and near the property is shown below.



Groundwater

It is understood that there is no particularly shallow groundwater beneath the site. The piggery is not within a groundwater protection area. A bore on the property is ~13.7 m (45 feet) deep. It produces a low yield but the water is good quality.

PIGGERY DESCRIPTION

The pigs are kept in a combination of conventional sheds and deep litter shelters. The table below provides a summary of the herd composition and pig housing. The piggery layout is shows overleaf.

Pig Class	Head	SPU	Housing
Gilts	37	67	Conventional
Boars	6	10	Conventional
Dry sows	271	434	Conventional
Dry sows		224	Deep litter
	140		
Lactating sows	89	223	Conventional
Suckers	878	96	Conventional
Weaners	1230	647	Deep litter
Growers	1010	1106	Deep litter
Finishers	1390	2232	Conventional
Total	5051	5039	2671 hd / 3062 SPU in conv. sheds 2380 hd / 1977 SPU in deep litter

Water

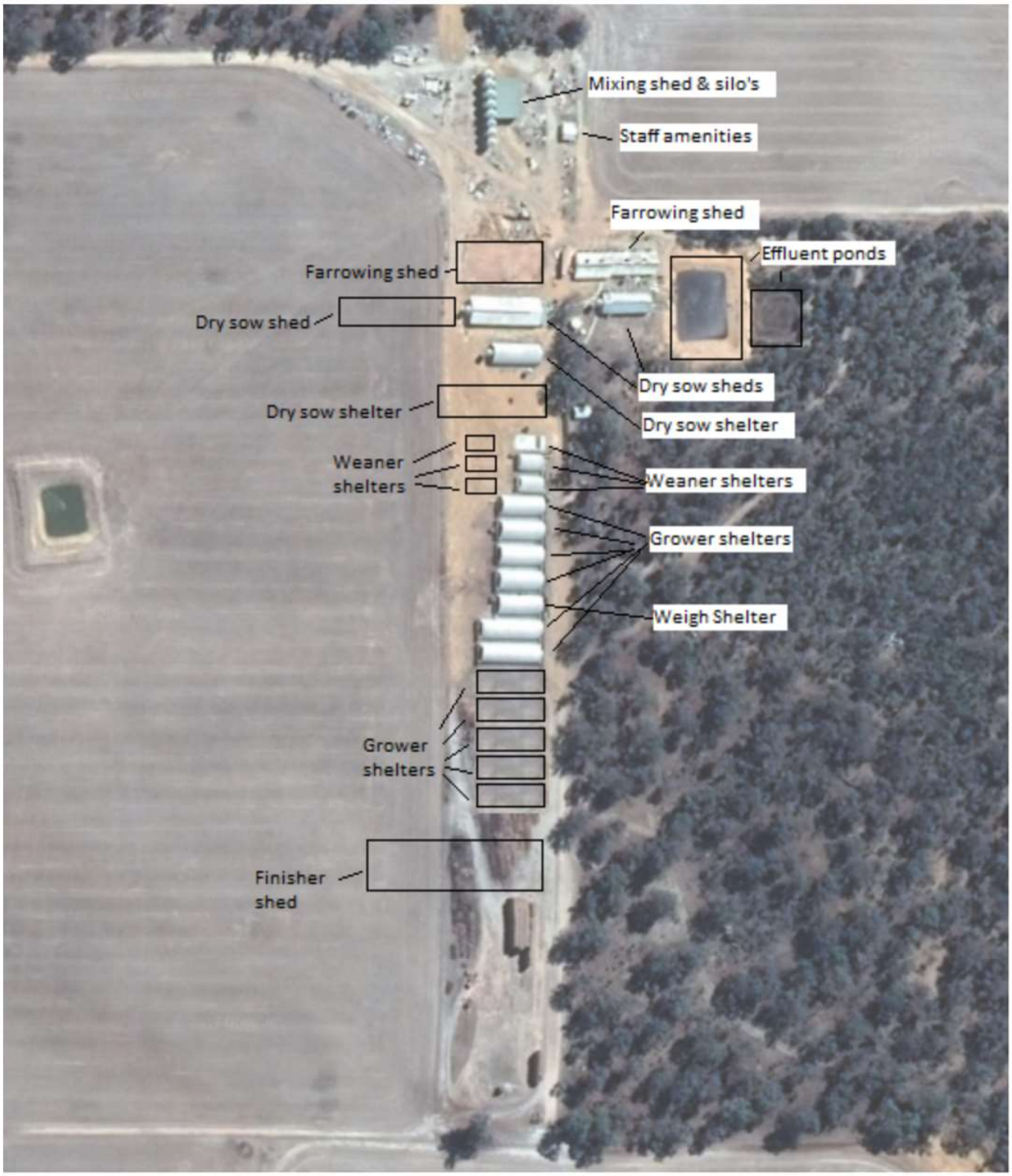
The piggery will need water for stock consumption and for cleaning the conventional sheds. Water will be sourced through the Great Southern Town Water Supply Scheme. This is high quality water and suitable for the purpose. The piggery is expected to use about 14.32 ML/yr of fresh water.

Feed

The expected feed usage of the expanded piggery is 3266 t/yr. Most of the grain will be produced on-farm. The remainder will be sourced from local farmers.

Straw

Straw will be used as bedding in the deep litter shelters. The straw will be produced on land farmed by the Wyatt family. Bedding will be managed to ensure each shelter has a dry area for pigs to lie. Bedding will be regularly replaced to maintain low odour conditions.

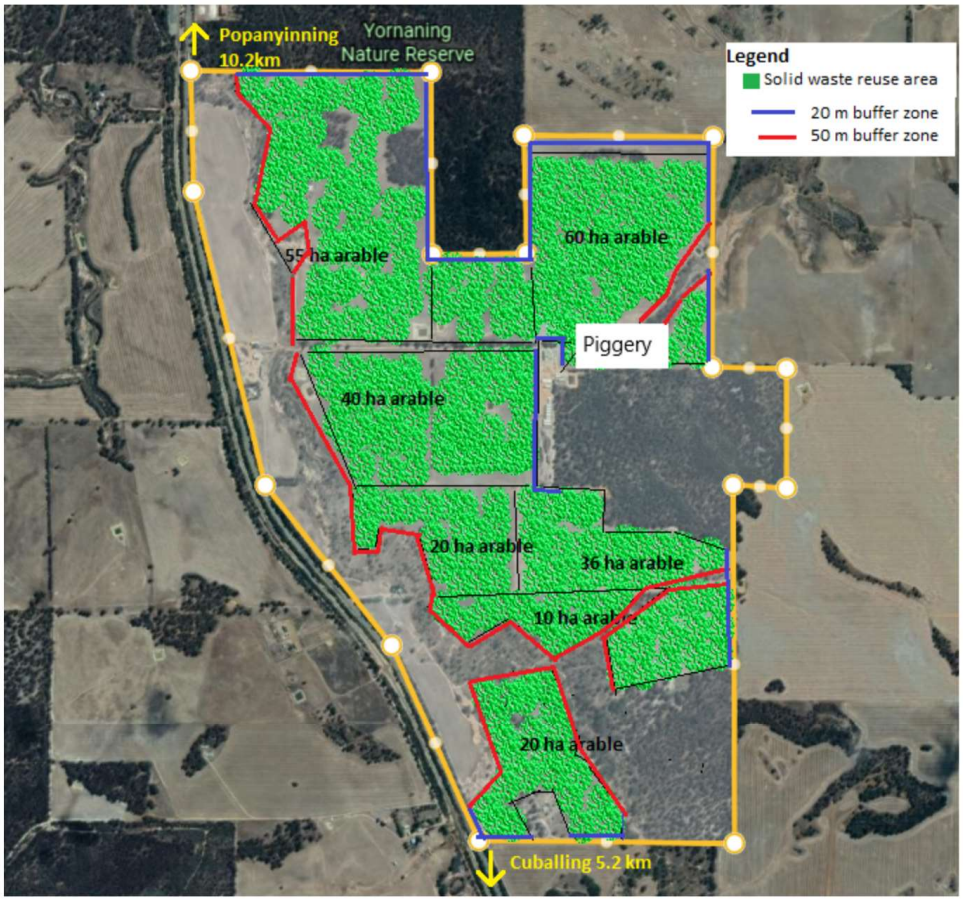

Mixing shed & silo's
Staff amenities
Farrowing shed
Effluent ponds
Farrowing shed
Dry sow shed
Dry sow sheds
Dry sow shelter
Dry sow shelter
Weaner shelters
Weaner shelters
Grower shelters
Weigh Shelter
Grower shelters
Finisher shed

Effluent

The conventional sheds at the piggery will produce liquid effluent made up of shed hosing water, wasted drinking water, manure and waste feed. This will be treated by an anaerobic pond and contained in a wet weather pond near the breeder sheds and the finisher shed.

Anaerobic effluent treatment ponds have been widely used in the Australian pig industry for many years. These effectively remove solids from the effluent stream and reduce some pathogen levels, thereby reducing environmental and health risks when the effluent is reused for land irrigation. The anaerobic ponds at the piggery have sufficient capacity to treat the effluent stream, and space to store the sludge deposited as part of the treatment process. The treated effluent from each anaerobic pond will pass into a wet weather pond. The ponds are constructed using a low permeability clay material. Freeboard of at least 0.5 m is provided on all ponds.

Surplus effluent will be irrigated onto cropping land on-farm using a low-pressure travelling irrigator. The land areas available for reuse of effluent, sludge and spent bedding are shown below. In accordance with the National Environmental Guidelines for Indoor Piggeries Buffers, a 50 m wide buffers is provided to waterways (Category 2: mechanical spreaders and irrigators that project the discharged material to a height of less than 2 m above ground level, and irrigators with downward facing nozzles. A 20 m buffer to boundaries has also been provided to minimise the likelihood of drift or runoff onto neighbouring land. In total, there is ~241 ha of land available on-farm.



Effluent will be irrigated at rates designed to prevent excessive nutrient accumulation in the soil. Over the long-term, nutrients applied will be matched or exceeded by nutrient removal by crop harvest.

Sludge

Sludge will be extracted from the anaerobic ponds annually using a vacuum tanker. Some sludge will be spread on-farm (on areas not used for effluent irrigation), with the balance offered to nearby landholders as an alternative fertiliser. Sludge will typically be spread shortly before crop planting, to maximise nutrient uptake opportunities for the crop and minimise nutrient leaching risks. Sludge will be spread at rates designed to prevent excessive nutrient accumulation in the soil.

Timing of Reuse / Selection of Areas for Reuse

To prevent amenity impacts, reuse will be scheduled to occur from mid-morning to mid-afternoon when odour dispersion is likely to be enhanced. Weather and wind conditions will be considered when scheduling reuse. As different areas are available, areas close to houses will be avoided when the wind is carrying towards them. Reuse will also be avoided under heavy, overcast conditions, if rain is imminent, if the atmosphere is very still or gusty, or if there are gentle winds towards nearby houses.

To guard against any animal or human health risks, a 21-day withholding period will apply between reuse and harvest or grazing. This will allow for drying of applied effluent and manure products and desiccation of microorganisms these contain.

Mortalities

Mortalities will be composted in bays the spent bedding area which is a bunded, hardstand area. Spent bedding or other similar high carbon materials will provide the carbon and cover material for the process. Providing sufficient cover material is used, composting is a low odour, aerobic process and it yields a valuable soil amendment. Mortalities compost will be spread on-farm.

Off-Site Reuse Management and Duty of Care

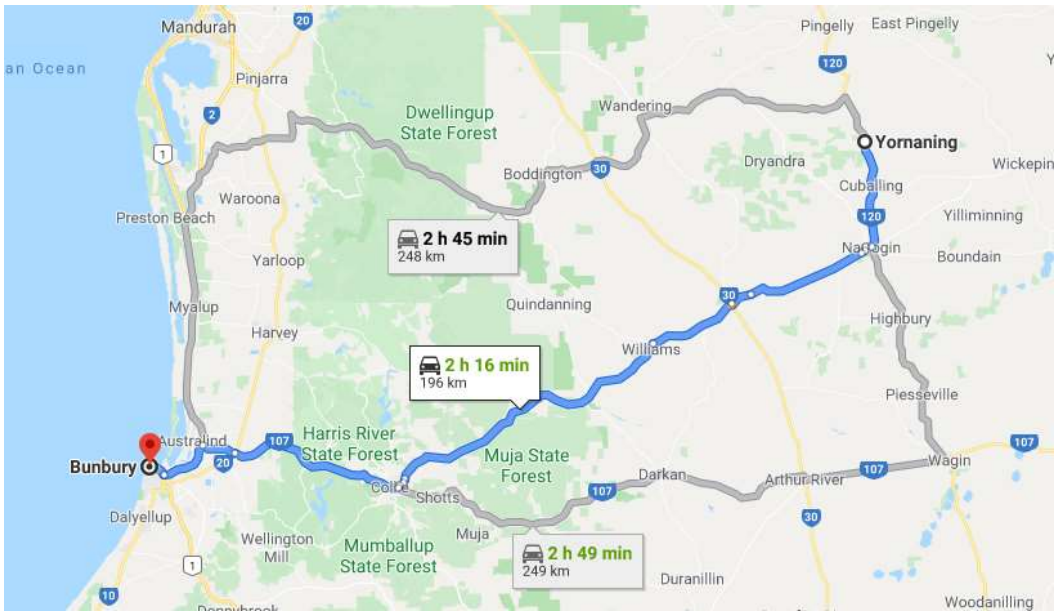
Some of the sludge and spent bedding will need to be spread off-farm. This material would be provided to nearby farmers. The reuse will occur on nearby land with a similar farming capability, similar land uses (cereal and oilseeds) and similar environmental risks to the on-farm land.

Reuse of this material will follow the same principles as on-farm reuse. The manure products will be used to amend soil used to grow grain, straw and hay crops. A manure spreader will be used to disperse spent bedding and a tanker will spread the sludge. The material will be spread at rates aimed at achieve a long-term balance between nutrients applied and removed by crop harvest. A representative analysis of the products for spreading will be provided to the off-site reusers. The manure recipients will be made aware of the need to provide a 50 m buffer to watercourses. Recipients will also be advised that they should provide a 21-day withholding period between reuse and any grazing.

Off-site reusers will be provided with a Duty of Care Statement. They will also be made aware of the Australian Pork Ltd resources that can be used to ensure sustainable reuse of manure products occurs.

Truck Movements

The piggery will produce about 10,253 finished pigs per year which will leave the farm as one truckload per week. It is expected that finished pigs would go to Bunbury for slaughter via the route shown below. All of the roads to be used are sealed roads in good condition. Hence, there should be no issues with road safety. Nor should dust from traffic movements be an issue.



Spent bedding and sludge would be transported to local farms via the Great Southern Highway. All of the spent bedding could be transported in 37 truckloads per year and all of the sludge could be transported in 11 tanker loads per year. Since some of this material will be spread on-farm, this equates to less than one truck movement per week.

Truck movements will generally be scheduled to come in the day, except under extreme hot conditions when night transportation of pigs will be needed for welfare reasons or during the busy harvest period when night transportation is common. Scheduling vehicle movements for day time hours reduces the likelihood of noise nuisance and light spill for nearby residents.

Operating Hours

The piggery will generally be staffed from 7 AM to 5 PM. Truck movements will generally be scheduled to occur during this time frame but will occasionally occur at other times of the day or night. In particular, during very hot weather pigs may be transported at night for welfare reasons. At peak harvest time, trucks may transport grain at night (standard industry practice).

Fly and Rodent Breeding

Flies and rodents are attracted to the feed used at piggeries and the manure, waste feed and mortalities generated. All reasonable steps will be taken to minimise fly and rodent breeding. Cavities in buildings will be filled, low wastage feeding equipment will be used, feed spills will be promptly

removed, the sheds will be kept clean and composting mortalities will be kept well covered at all times. Baits will be used strategically to control fly and rodent numbers. As tall vegetation can provide a habitat for flies and rodents, the grass around the pig sheds will be kept short.

Rubbish

Rubbish is kept to a minimum by handling feed and other inputs in bulk. General rubbish will be collected in suitable bins. Where practical, wastes will be designated for reuse or recycling. However, wastes like syringes and needles undergo proper disposal via return to suppliers.

ASSESSMENT OF ENVIRONMENTAL RISKS AND IMPACTS

the operation of a piggery has the potential to impact upon surface waters, groundwater, soils and amenity. A risk assessment identifies whether the siting, design and management of the piggery will provide adequate safeguards to protect all aspects of the environment. The table below provides a generic risk assessment matrix showing the level of risk (low, moderate, high or critical) depending on the likelihood of occurrence and the severity of consequences.

Likelihood	Consequences				
	Insignificant – < $1000 environmental damage	Minor – low environmental damage <$10,000	Moderate – medium environmental damage <$100,000	Major – high environmental damage <$1,000,000	Catastrophic – toxic environmental damage >$1,000,000
Almost certain (100%)	Moderate risk	High risk	High risk	Critical risk	Critical risk
Likely (10%)	Moderate risk	Moderate risk	High risk	High risk	Critical risk
Possible (1%)	Low risk	Moderate risk	High risk	High risk	Critical risk
Unlikely (0.1%)	Low risk	Moderate risk	Moderate risk	High risk	High risk
Rare (0.01%)	Low risk	Low risk	Moderate risk	Moderate risk	High risk

The assessed risks for major environmental areas are provided below.

Surface Waters

The quality of surface water could be impacted if there were effluent pond spills, direct entry of irrigated effluent into waterways or runoff of nutrient-rich stormwater from effluent or manure product reuse areas into waterways. The piggery is well separated from all drainage lines. All facilities used to contain effluent and manure (shed flooring, pits, manure storage pad, effluent ponds) are impervious and appropriately designed to prevent uncontrolled releases.

Effluent and manure reuse will occur on land that has previously been cleared and farmed for many years. Waterways have been excluded, with suitable buffers in place. Sustainable effluent irrigation and manure spreading rates, determined from effluent and manure analysis results, soil test results and expected crop nutrient removal rates, will be used. The proposed low-pressure irrigator will apply effluent at low rates, avoiding direct runoff. The good management practices proposed and the significant buffers between both the piggery and the reuse areas to the waterways offer further protection. Surface water contamination by nutrients or sediment is not expected to result from the operations of the piggery. Nor is runoff likely to be generated so no impacts to flows or erosion are expected. The existing values of the waterbodies and immediate surrounds will be protected by buffers.

Taking into account the site features, proposed design and management and secondary protection measures (buffers), it is considered that surface water contamination, impacts to flows and adverse effects on habitats adjacent to surface water features are very unlikely to occur, with minor environmental harm, equating to a moderate risk.

Groundwater

Although there is unlikely to be particularly shallow groundwater beneath the site, groundwater could be impacted through leaching of nutrients from sheds, the spent bedding storage area, ponds or reuse areas. Within the piggery complex, groundwater will be very well protected through good design and construction. The sheds and effluent pits will all have concreted floors. The manure storage area and the effluent ponds will be lined for a design permeability of 1 X 10^{-9} m/s to prevent nutrient leaching. Hence, there is little chance of nutrient leaching through these facilities. *Rare likelihood X minor consequences – low risk.*

Good management will be the key to groundwater protection within the reuse areas. This will need to be supported by monitoring aimed at early detection of risks. Almost all of the land allocated for reuse of effluent, sludge and spent bedding consists of duplex soils with a sandy or loamy topsoil underlain with heavier soil that is prone to compaction and is likely to offer good protection for groundwater. However, it is possible that there could be a perched water table at times and that this water could be contaminated through nutrient leaching as a consequence of effluent or manure reuse. Application of nutrients at sustainable rates is the main check to minimise nutrient leaching. In practice, effluent and manure solids will be analysed periodically and the results used in conjunction with soil test results and expected crop nutrient removal rates to determine appropriate reuse rates. The soils of the reuse areas will be regularly tested to ensure the nutrients are in balance and at suitable levels. Taking all of this into account, the proposal is expected to offer good groundwater protection. Piggery: *Unlikely likelihood X minor consequences – moderate risk*. Reuse areas: *Unlikely likelihood X minor consequences – moderate risk*.

Soils

The duplex soils of the reuse areas have sandy to loamy topsoils that will benefit from the addition of carbon and nutrients. The effluent is spread using a low-pressure travelling irrigator able to apply the effluent evenly and at low rates. The manure spreader also applies the spent bedding at controlled, even rates. Effluent and manure solids will be analysed annually before the main spreading activity and the results used to determine appropriate reuse rates. The soils of the reuse areas will also be regularly tested to ensure the nutrients are in balance and at suitable levels. Both topsoil and subsoil sampled will be collected. These will be sampled and analysed in accordance with the National Environmental Guidelines for Indoor Piggeries. *Rare likelihood X minor consequences – low risk.*

Amenity

Piggeries have the potential to impact on amenity through odour, dust or noise nuisance and fly and rodent breeding. Reuse of effluent and manure products may also pose a risk of health impacts if not carefully managed. Suitable siting, design and management can be used together to prevent amenity impacts. The piggery complex site is well separated from sensitive land uses.

Nevertheless, to ensure amenity is protected, good management is essential. This will include maintaining a suitable piggery environment (regular cleaning of conventional sheds, regular changing of bedding in shelters), promptly cleaning up spilt or wasted feed, ensuring mortalities and afterbirth are managed daily and kept covered during composting), minimising fly and rodent habitats and strategically using insect and rodent baits if needed.

Dust can be generated through feed preparation and delivery, from handling and spreading of dry spent bedding and from the movement of vehicles along unsealed roads. Dust from feed processing and delivery will be relatively small and confined to the piggery complex. Hence, it will not create off-farm impacts. Turning of dry bedding material will be avoided. The public roads to be used are all sealed and the on-farm access is well separated from houses. Hence, road dust is unlikely to pose an issue.

W*hile odour and dust nuisance from the piggery complex is considered unlikely to possible (0.1-1%), the resulting environmental harm would be insignificant or minor, amounting to a low-moderate risk.*

Reuse of treated effluent, sludge and spent bedding will be managed to prevent odour nuisance, dust or public health impacts at nearby sensitive land uses. Because the effluent will be irrigated using a low-pressure spray method, aerosols that can transport odour will be minimal. It is expected that spreading of spent bedding will mostly occur over a short period during late summer or early autumn. To minimise the likelihood of odour and dust nuisance, reuse will generally occur from mid-morning to mid-afternoon. It will not occur if rain is imminent, if the soil is wet, it is windy or if there is a gentle breeze towards the closest neighbours. For both effluent and sludge, the recommended buffers will be provided between reuse areas and the closest houses and roads. As various parts of the property can be used for effluent irrigation or spent bedding, areas closer to houses will be avoided when the wind is carrying towards them, minimising the likelihood of odour or health impacts. A complaints-handling processing is in place, including ongoing consultation and corrective and preventative actions. *It is unlikely but possible that odour or dust nuisance would occur, with insignificant consequences – low risk.*

A 21-day withholding period will be observed between reuse and any grazing or harvest of crops. This will protect grazing stock from any pathogens and prevent contamination of the part of the crop that will be used for human food consumption. *The risk of an animal or human health concern from reuse of effluent or manure products is considered rare X minor consequences = low risk.*

EMERGENCY SITUATIONS AND CONTINGENCY PLANS

Non-routine situations that may pose a risk to the environment can occasionally arise at piggeries. Environmental impacts could occur in the unlikely event of:

- a disruption to the power supply affecting the ability to clean sheds and pump effluent
- blockage of the effluent transfer pipes
- upset conditions in the anaerobic ponds
- wet weather ponds full and likely to spill with further rain
- crop failure
- surplus spent bedding
- mass mortalities
- difficulty sourcing bedding
- water supply issues
- fire

Following is a description of the management that would be used to address each of these situations in order to prevent or minimise the risk of environmental harm.

Power Supply Disruption or Pump Failure

Reliance on mains power is minimised through the use of diesel or petrol pumps and equipment which limits impacts due to power supply failure. Water is accessed from a mains supply. Nevertheless, a minimum of two-days back-up water is stored on site. Prepared feed is also stored. Tools and spare parts for repairing the feedmill and pumps are kept on-site. Other on-farm pumps can also be accessed as needed.

Blockage of Effluent Pipes

A blockage in the effluent pipes would be obvious and quickly detected. An air compressor would be used to clear this.

Upset Conditions in Anaerobic Ponds

Anaerobic ponds rely on having sufficient active volume, and a steady inflow of organic matter to function optimally. Pond upsets can result from sludge encroachment on active volume reducing treatment capacity, shock loading resulting in a drop in pH that prevents complete digestion, or the addition of antibiotics and disinfectants that are harmful to the treatment microorganisms. Good management is the key to preventing upset conditions.

In the event of a pond upset, the cause would need to be identified. If sludge accumulation were a concern, desludging using a vacuum tanker would commence as soon as practical. At the same time, clean water would be added to the influent to dilute the remaining effluent. This should also happen if the problem is caused by shock loading or chemical contamination. If necessary, effluent would be drawn from the wet weather pond for irrigation to ensure the pond system has capacity to store the extra water and any rainfall without spilling. Every effort would be made to provide a uniform inflow to the anaerobic pond to allow the microbial populations to stabilise. If the pH of the pond was low, lime could be added to the pond. Cleaning agents and veterinary chemicals used at the piggery are

carefully selected taking pond function into account. Nevertheless, there is a risk of adverse impacts to pond function if too much chemical is inadvertently added to the effluent stream. An investigation into cleaning agents and veterinary chemicals would be instigated if an anaerobic pond failed and initial troubleshooting did not detect a cause. Initially this would involve a desktop assessment of actual chemical use rates (and hence addition to the pond). It would be followed up with testing if a risk were identified. If the treatment micro-organisms have been killed by chemicals or antibiotics it may be necessary to empty the pond and recharge it with clean water and possibly effluent from the pond of a piggery with a similar health status.

The piggery manager will be responsible for investigating any pond upsets, taking corrective and preventative action, documenting the cause of the problem and actions taken, and ensuring procedures change (SOPs) so as to prevent the problem arising in the future.

Should the pond upset result any off-site impacts (e.g. odour nuisance), the piggery manager will report all details of the incident to the Shire of Cuballing by phoning 08 9883 6031.

Wet Weather Ponds Full and Threatening to Spill

The effluent treatment system is designed to provide adequate wet weather storage under most circumstances. Proactive management will be the main measure used to prevent pond spills. In particular, the wet weather ponds will be kept close to empty by the end of summer each year (i.e. before the start of the expected wet season). Throughout the autumn and winter, effluent will be drawn from the ponds in accordance with weather conditions and plant nutrient needs.

Crop Failure

While crops can fail for a range of reasons, the most common reason is weather. It will usually be possible to at least harvest something but nutrient removal will be compromised. To address this, effluent, sludge and spent bedding spreading rates may be adjusted and crops with a higher nutrient removal rate (e.g. hay crops) may be grown the following year to compensate. Areas that did not receive effluent or spent bedding in the previous year, or that did not experience crop failure, will be identified and these will have reuse at suitable rates. It is important to note that average crop yields were used to determine the nutrient balances. Hence, a crop failure is not a cause for alarm.

The piggery manager will be responsible for identifying suitable land areas for reuse and for determining suitable reuse rates.

Surplus Sludge and Spent Bedding

Sludge and spent bedding are good sources of organic matter and nutrients, and particularly beneficial for light soils. For this reason, the proponents will use what they can on-farm, with the surplus being made available for other nearby farmers. It is most unlikely that there will be problems finding farmers to take this material, although it is possible. If necessary, the proponents may compost the sludge with the spent bedding to ensure pond performance in not compromised by sludge accumulation. For a limited time, spent bedding can be temporarily stored on-farm until a new reuser is found. If this is not possible, this material could be sent off-farm to a commercial composter.

Mass Mortalities

In the event of a large number of mortalities at the piggery, the piggeries consulting veterinarian would be contacted along with relevant government authorities who would investigate the cause of death and advise and assist with disease control (if applicable) and the most suitable disposal method. Composting is the preferred method, providing it is considered suitable taking the cause of death into account. The process would be managed in accordance with AUSVETPLAN along with relevant government bodies. The following entities will be contacted:

- Emergency Animal Disease Hotline on 1800 675 888
- WA Chief Veterinary Officer Unit 08 9368 3342
- Shire of Cuballing 08 9883 6031
- EPA 08 6364 7000

Depending on the cause of death, it may be possible for the mortalities to be dispatched to a rendering plant which would ensure environmental protection and enable recovery of some of the carcass value that would otherwise be lost. However, if composting is necessary, space is available in the spent bedding storage area and the stored material in it could be used as a carbon source. If burial is deemed necessary, this will be done under instruction from the Chief Veterinary Officer and EPA. Buried mortalities will be promptly covered with at least 1 m of soil after placement. The pit/s will be mounded slightly after back-filling to allow for settling as the mortalities break down.

Difficulty Sourcing Bedding

It is intended that all of the bedding needed will be sourced from crops grown on-farm, so any upcoming supply issues will be known about well in advance. The proponents will keep at least 12 months straw requirement on-hand at the end of each harvest. In the event of a shortage, additional straw will be purchased from local farmers or from further afield, if necessary. If necessary, alternative bedding materials such as sawdust or wood shavings could be used.

Water Supply Issues

The water supply is very secure, being from the Great Southern Town Water Supply Scheme. In the event of a short-term supply issue, water stored on-site would be used with top-up from an on-farm bore if necessary. While the yield of the bore is low, the water is good quality. If this were not possible, water would be tankered to the site.

Fire

in the event of a fire, staff safety will be the primary concern. All buildings will be evacuated and the fire brigade called by phoning 000. If it is safe to do so, staff may fight the fire from outside of the sheds using fire-fighting pumps.

ENIRONMENTAL MONITORING & RECORD KEEPING

As part of its duty of care, piggery management proposes to routinely monitor:

- complaints
- available water storage capacity in wet weather ponds
- composition of effluent, sludge and spent bedding
- effluent, sludge and spent bedding reuse on-farm
- soils of on-farm reuse areas
- details of sludge and spent bedding going off-farm for third-party reuse

Monitoring
Complaints

It is important for the proponents to fit in with their local community. Consequently, the piggery manager will facilitate proactive, ongoing communication with surrounding land owners. Any complaints about the piggery will be taken very seriously. The piggery manager will be responsible for ongoing investigation, action and communications with the complainant. In the event of a complaint, the following will be recorded:

- date received
- details of complaint and complainant
- name of person who took the call
- response time and date and actions taken
- details of follow-up with complainant

All complaints received by staff will be immediately reported to the piggery manager. He will promptly initiate an investigation into possible causes. He may also wish to collect more information from the complainant. This will be done in a positive way, with a clear emphasis on investigating and resolving the issue. He will initiate corrective and / or preventative action and will confirm that the issue has been resolved through follow communication with the complainant. Staff training and operating procedure revision will be undertaken as appropriate to prevent a reoccurrence of the issue.

Details of complaints, findings of investigations and follow up actions will be promptly provided to the Shire of Cuballing upon request.

Available Water Storage Capacity in Wet Weather Ponds

The spare capacity in the wet weather ponds will be visually assessed after significant rainfall events. Effluent will be irrigated from the wet weather ponds when weather conditions permit and at suitable times during the crop growth phase to enable usage of the nutrients it contains and to prevent pond spills. If it is necessary to draw water from the ponds to prevent a likely spill, this will occur as soon as suitable soil water conditions allow for irrigation.

Details of any spills that result in effluent leaving the property boundary will be reported to the EPA.

The piggery manager will be responsible for ensuring the available water storage in the wet weather ponds is monitored and for scheduling effluent irrigations.

Composition of Effluent, Sludge and Spent Bedding

Treated effluent will be sampled and analysed annually before the main irrigation event. Initially, sludge and spent bedding will also be analysed annually although the monitoring frequency may be able to reduce if there is consistency to the analysis results.

All samples for analysis will consist of a minimum of 10 sub-samples that are bulked to produce a composite sample. Treated effluent will be sampled from the irrigation discharge point. Sludge will be extracted using a vacuum tanker. The spent bedding will be sampled from the centre of the windrow/s.

Analysis parameters will include:

Effluent

- total nitrogen or TKN
- ammonium nitrogen
- nitrate nitrogen
- total phosphorus
- available phosphorus
- potassium
- EC
- chloride
- SAR

Sludge and Spent Bedding

- dry matter content
- pH
- total nitrogen or TKN
- ammonium nitrogen
- nitrate nitrogen
- total phosphorus
- available phosphorus
- potassium
- organic carbon
- EC
- chloride
- sodium

The piggery manager will be responsible for organising this sampling and analysis. Analysis results will be kept on-site.

Effluent, Sludge and Spent Bedding Reuse – On-Farm

Reuse activities will need to be carefully managed to ensure protection of waterways, the seasonally herbaceous wetlands that may be present and groundwater. Hence, the piggery manager will be responsible for maintaining the following records of on-farm reuse:

- the date/s reuse occurs
- weather conditions at time of irrigation or spreading
- the type of material that was reused
- quantity of material spread
- reuse methods
- paddocks or areas spread
- application rates (mm or t/ha)
- crops grown on each paddock or area
- yield of grain and / or forage harvested from each paddock / area.

Soils of Reuse Areas – On-Farm

The soils of on-farm reuse areas will be tested annually in years when reuse area occurred on these. Composite samples of topsoil (0-10 cm) will consist of at least 10 bulked samples taken across the paddock. Composite samples of subsoil (30-60 cm) will consist of at least 5 bulked samples taken from across the paddock. Samples will be tested for:

Topsoil

- pH
- EC
- nitrate nitrogen
- available phosphorus
- potassium
- copper
- zinc
- organic carbon
- CEC and exchangeable cations

Subsoil

- pH
- EC
- nitrate nitrogen
- available phosphorus
- potassium
- CEC and exchangeable cations

Soil properties will be considered when determining reuse rates. Where deficiencies exist, it will be appropriate to address these by adding additional nutrients. Where surpluses exist, reuse rates will be adjusted down.

Sludge and Spent Bedding Reuse – Off-Farm

Off-site reusers will be provided with the duty of care statement.

The piggery manager will be responsible for maintaining the following records of off-farm reuse:

- the date/s manure solids were supplied to the reuser
- the name of the recipient
- the type of manure product/s provided
- quantity supplied
- dates that manure product analysis results were provided.

Record Keeping

The piggery manager will be responsible for ensuring monitoring occurs correctly and at the specified time intervals. He is also responsible for reviewing monitoring results as they come in (periodic measurements) and at least monthly (for ongoing measurements) to identify any trends or concerns. The piggery manager will initiate an investigation, which may include further sampling and analysis, where there are concerns with the results. He will be fully responsible for initiating corrective and / or preventative measures as needed.

All environmental monitoring records will be kept in the piggery office for a period of at least four years. A report will be provided to the Shire of Cuballing upon request.

Appendix 2 – Duty of Care Statement for Off-Site Reusers

Manure products can provide a great source of carbon and nutrients for plant growth. However, like inorganic fertilisers, they need to be spread on suitable areas and applied at sustainable rates to ensure the environment is protected.

Manure products are suitable for reuse on land used to produce grain, oilseed, silage, hay and fibre crops. Reuse on areas that are grazed is not recommended since this land use removes nutrients only at very low rates. If this does occur, lower spreading rates should be used. A withholding period of at least 21 days must be observed prior to grazing or harvest.

Those utilising manure products must take all reasonable and practical steps to prevent harm to the environment. To that end, reuse needs to be managed to avoid:

- odour, noise and dust nuisance
- land degradation (e.g. soil erosion, decline in soil structure, nutrient overloading, weeds)
- surface water and groundwater pollution with nutrients and sediment

To minimise the likelihood of these potential impacts:

- avoid manure transport and spreading close to sensitive neighbours in the evenings, at night or early in the morning when noise and odour may create nuisance.
- minimise the risk of spillage during transportation by not overfilling the truck and by ensuring the load is contained.
- plan to spread manure products from mid-morning to mid-afternoon when good odour dispersion is likely. Avoid spreading from mid-afternoon to evening. Avoid spreading just before weekends or during holiday periods, particularly if close to a public area. Also check the wind speed and direction to ensure the prevailing wind is not blowing directly towards nearby residences. Dispersion is limited under very still conditions, so consider a delay if this is the case.
- avoid reuse on sensitive land use or areas that are flood-prone or where there is a significant risk of nutrient transfer to watercourses (e.g. sloping land immediately abutting a watercourse) or impacts to amenity.
- use a suitable spreading rate based on the nitrogen and phosphorus content of the manure product, soil properties and the intended land use of the reuse area. The rate should be consistent with the ability of soils and plants grown on the area to sustainably use the applied nutrients, salts and carbon in the spent bedding. You will be provided with typical analysis results for the manure product that can be used to calculate suitable rates depending on the crop/s you plan to grow. The Australian Pork Ltd publication "Piggery Effluent and Manure Reuse – Glovebox Guide (http://australianpork.com.au/wp-content/uploads/2013/10/pocket-guide_08.pdf) can be used to calculate suitable reuse rates.
- calibrate the spreader to apply the spent bedding at the target rate.
- check the soil moisture and the weather forecast before spreading manure products. Delay reuse if heavy rain is expected or the soil is still very wet following heavy rain.

- monitor reuse areas for weeds and control these if necessary.
- test the soils of reuse areas annually to identify any nutrient surpluses or imbalances. Recommended analysis parameters are:

  Topsoil (0-10 cm)

  - pH
  - EC
  - nitrate nitrogen
  - available phosphorus
  - potassium
  - copper
  - zinc
  - organic carbon
  - CEC and exchangeable cations

  Subsoil (30-60 cm)

  - pH
  - EC
  - nitrate nitrogen
  - available phosphorus
  - potassium
  - CEC and exchangeable cations

Should you need further guidance, please don't hesitate to contact Tim Wyatt on 0428 520 334.