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ENVIRONMENTAL IMPACT ASSESSMENT
Environmental Management Plan (EMP) for Mariental Piggery
Operations, Hardap Region, Namibia

ENVIRONMENTAL MANAGEMENT PLAN

CLIENT:

Mariental Piggery Pty Ltd.



PREPARED BY:



PROJECT INFORMATION

PROPONENT:	Mariental Piggery Pty Ltd. P.O Box 460 Mariental Namibia
PROJECT TITLE:	Environmental Management Plan (EMP) for Mariental Piggery Operations, Hardap Region, Namibia
PROJECT TYPE:	Environmental Impact Assessment Study
PROJECT LOCATION:	Mariental Piggery, Mariental, Hardap Region, Namibia
COMPETENT AUTHORITY:	Office of the Environmental Commissioner (Ministry of Environment, Forestry and Tourism)
ENVIRONMENTAL ASSESSMENT PRACTITIONER	Turnix Environmental Consulting cc Contact person: Mr. Olavi Makuti Cell: 0811405033 E-mail: olavi.makuti@gmail.com P.O Box 27488, Windhoek, Namibia
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EXECUTIVE SUMMARY

Mariental Piggery started operations in 2006 and has been in operation for the last 12 years. The piggery only farms with pigs which are mainly supplied to the local market. The operation of a piggery is a listed activity in the *Environmental Management Act No.7 of 2007* and the *Environmental Assessment Regulations* (February 2012). Since this is an existing operation an Environmental Management Plan is required to address the environmental impacts of this operation.

It is against this background that Mariental Piggery appointed Turnix Environmental Consulting cc to develop this Environmental Management Plan for this operation and apply for an Environmental Clearance with the Environmental Commissioner's Office.

Mariental Piggery Pty Ltd. Is located on a site of 23 hectares, approximately 1.5 kilometres south of Mariental just off the national road (B1) between Mariental and Keetmanshoop. The farm is bordered by the Fish River to the west, brick factory to the south and a small holding (date farm) to the north.

Mariental Piggery is located near the banks of the Fish River approximately 20 kilometers from downstream of the Hardap Dam. The groundwater table in this area is typically shallow, particularly along the banks of the Fish River, which is applicable to the pig farm site. According to Engels (2002), water quality downstream of the irrigation scheme (and from the present pig farm site) is both saline and has high concentrations of nutrients. Nitrate levels and total dissolved salts (TDS) levels in the vicinity of Mariental Piggery range from 9 to 13 mg/l nitrate and from 700 and 900 mg/l TDS. This renders the water in this area unsuitable for human consumption.

The environmental impacts identified for this operation are generic concerns associated with a piggery operation. It is thus recommended that Mariental Piggery put more effort in ensuring that issues such as pollution and public nuisances such as odors are

addressed and contained on an ongoing basis. Other impacts identified in the report can be satisfactorily mitigated through the full implementation of the mitigation actions recommended in this report and through proper housekeeping.

It can thus be concluded that this project does not cause any significant impacts. Most of the impacts identified for this operation are generic concerns associated with the operation of a piggery which can be satisfactorily mitigated through the full implementation of the Environmental Management Plan (EMP).

It is therefore recommended that this project be issued with an Environmental Clearance on condition that the provisions of the Environmental Management Plan are fully implemented.

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1. INTRODUCTION

1.1 BACKGROUND

Mariental Piggery started operations in 2006 and has been in operation for the last 12 years. The piggery only farms with pigs which are mainly supplied to the local market. The operation of a piggery is a listed activity in the *Environmental Management Act No.7 of 2007* and the *Environmental Assessment Regulations* (February 2012). Since this is an existing operation an Environmental Management Plan is required to address the environmental impacts of this operation.

It is against this background that Mariental Piggery appointed Turnix Environmental Consulting cc to develop this Environmental Management Plan for this operation and apply for an Environmental Clearance with the Environmental Commissioner's Office.

1.2 NEED AND DESIRABILITY

Mariental Piggery is one of the two biggest piggeries in Namibia and accounts for a big portion of the Namibian pork market. The Meat Board of Namibia approved a "Pork Market Share Promotion Scheme" in 2012. The scheme has the intention to promote the local production of pork meat as well as the protection of the industry against the importation of low priced pork meat and products. The scheme is also aiming at ensuring a constant supply of pork meat in the case of disease outbreak in countries Namibia imports from. It is against this background that as a country we need to promote and protect local pork farming.

1.3 TERMS OF REFERENCE

The proponent required the consultant to carry out this study as per the requirements of the *Environmental Management Act No.7 of 2007* and the *Environmental Assessment Regulations* (February 2012).

1.4 ENVIRONMENTAL ASSESSMENT PRACTITIONER (EAP)

Turnix Environmental Consulting cc (Reg. No. CC/2012/7856) is a wholly Namibian owned company, established in 2012 to provide consulting services to various public and private sectors in areas such as Strategic Environmental Assessments (SEA) & Environmental Impact Assessments (EIA), development of Environmental Management Systems, Environmental Auditing, Monitoring and Evaluation, Water Management, Solid Waste Management and Project Management.

The Environmental Assessment Practitioner (EAP) for this study was Mr. Olavi Makuti. Mr. Makuti's main area of expertise includes Urban Environmental Management, Biodiversity Conservation, Strategic Environmental Assessments (SEA), Environmental Impact Assessments (EIA), and Environmental Management Systems (EMS). Olavi has 14 years' experience in the field of environmental management and has a Master's Degree in Environmental Management (University of the Free State), B.Tech Degree in Natural Resources Management (Polytechnic of Namibia) and National Diploma in Nature Conservation (Polytechnic of Namibia). He has also done the MDP (Management Development Program) with the University of Stellenbosch and other short courses. His CV is attached for further information on his educational qualifications and experience.

2. DESCRIPTION OF THE CURRENT PIGGERY OPERATIONS

2.1 SITE LOCATION AND SURROUNDING LAND USES

Mariental Piggery Pty Ltd. Is located on a site of 23 hectares, approximately 1.5 kilometres south of Mariental just off the national road (B1) between Mariental and Keetmanshoop. The farm is bordered by the Fish River to the west, brick factory to the south and a small holding (date farm) to the north. Figure 1 below indicates the location of Mariental Piggery in relation to the Mariental Town.



Figure 1: Location of Mariental Piggery.

2.2 GENERAL LAYOUT OF THE PIGGERY



Figure 2: General overview of facilities at Mariental Piggery.

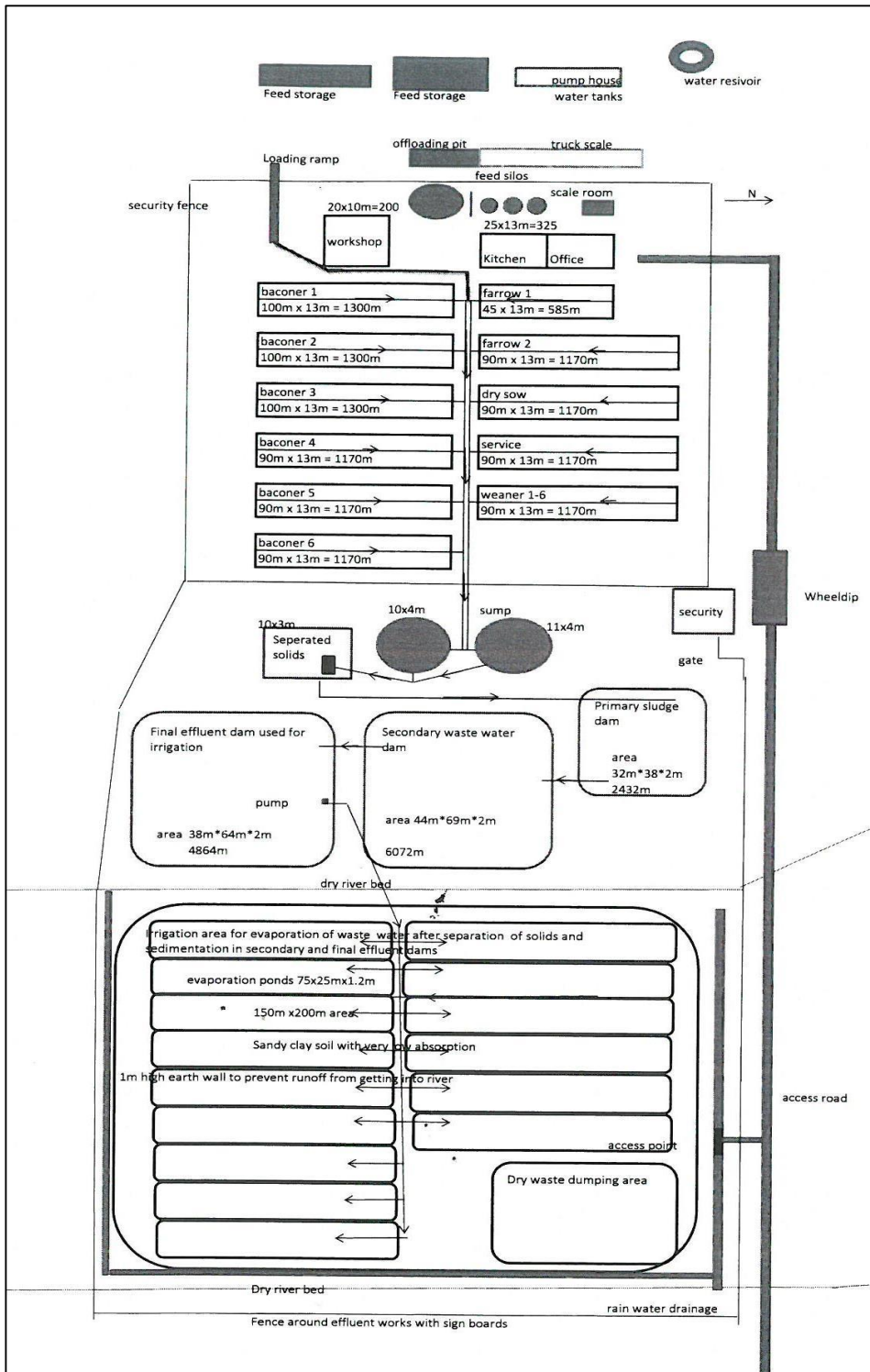


Figure 3: Dimensions and layout of the various facilities at the piggery

Mariental Piggery is a 1,200 sow unit. As shown on figure 2 and 3 above the pigs are separated in the various houses depending on their growth stage. The main reason for the separation of pigs during their different growth stages is to avoid disease transmission, especially from the older to younger pigs. By separating pigs at their different stages of growth, producers can also sterilize breeding houses once all the stock moves along to the next facility, thereby reducing the risk of disease even further. This batch system also simplifies management and feeding requirements.

In addition to the pig houses, the farm also has an office and kitchen as well as a dumping pit, grain silos and other feed storage facilities and a workshop. The farm is also equipped with a truck scale and a loading ramp and offloading pit.

As part of the farm's biosecurity measures, there is a security gate at the entrance to the facility to control movements to the facility. There is also a wheel dip at the entrance gate to ensure that all vehicles and passengers entering the facility are disinfected to prevent the spread of diseases.



Picture 1: Securing gate and wheel dip at the entrance to the piggery

2.3 STAFFING AND SUPPORT

The piggery employees about 36 people on a full time basis and they are all residents of Mariental. This operation thus contributes to the alleviation of unemployment which rife in Mariental like many other parts of the country. Most of the workers commute from their houses in Mariental to come and work at the piggery. However, there is provision for some staff to stay on site. The piggery has 2 managers houses and communal single room flats that can house about 12-15 people.

2.4 SERVICES

Services to the piggery are supplied as follow:

- **Water:** the operation is supplied with about 15% of the water requirement from the Hardap Namwater Scheme and remainder is supplied by the municipality. There is a borehole at the piggery but the water is too salty. Nitrate levels and total dissolved salts (TDS) levels in the vicinity of Mariental Piggery range from 9 to 13 mg/l nitrate and from 700 and 900 mg/l TDS. This renders the water in this area unsuitable for human consumption.
- **Electricity:** Grid electricity is supplied directly by Nampower.

2.5 WASTE MANAGEMENT

2.5.1 General Waste

The Mariental Municipality provides both refuse and sewage treatment services. The Municipality runs a dump site approximately 5 kilometers east of the town. According to Catherine Boois of the Mariental Municipality, this site does not

conform to the requirements of Namibia's Environmental Management Act No.7 of 2007, but they are in the process of securing funds to enable them to subject the site to the requirements of the Act and other minimum requirements for such a site.

The general waste (papers, plastics, glass and other household waste) generated at piggery is collected in appropriate bins and it's disposed of at the Mariental Municipal Dump Site on a regular basis.

2.5.2 Effluent and Manure Management

- **Effluent Management**

The effluent emanating from the piggery is managed through a network of ponds. The ponds consist of a primary pond, secondary pond, tertiary pond and 16 evaporation ponds.

The flooring in the pig houses is slatted and spilt feed and water, urine and faeces fall through the slats into concreted underfloor channels. Usually the flooring is regularly hosed to dislodge dried manure. To remove effluent from the sheds the under-floor channels are regularly flushed or drained to the sump. The effluent is then pre-treated by removing some of the solids. The liquid component is then pumped to ponds to treat before the effluent is evaporated.



Picture 2: Primary pond



Picture 3: Evaporation ponds

- **Manure**

Manure that is generated by the piggery is stored at the site. The storage area for manure is located to the east of the piggery plot as shown on figure 2. The manure is sold to farmers in the area. The manure is kept on site till it's collected by the farmers.

Manure stored in static piles may decompose aerobically or anaerobically, depending on its moisture content. Wet solids break down anaerobically, which can release strong odours. This can be a problem during the rainy season and can cause a nuisance to nearby areas. Drier manure decomposes aerobically, which is a low odour process. Adding bulky, dry substrates e.g. sawdust and/or turning the manure reduces the moisture content, although turning may temporarily increase odour levels. Manure that is very dry will produce dust, although this is rarely an issue provided the manure is left undisturbed.



Picture 4: Manure removed from slurry using a separator



Picture 5: Manure heaped at the piggery waiting to be collected.

2.5.3 Dead pigs

The piggery lose about 20-30 pigs per month. In the pig industry, most carcasses are disposed of by landfill, on-farm burial, rendering, or incineration. Decaying carcasses can release offensive odors if they are stored too long for disposal or pickup, or when they are transported. At Mariental Piggery the dead pigs are buried at the piggery site. The carcasses are buried immediately before they start to rot and cause a nuisance.

3. LEGAL REQUIREMENTS

This section provides an analysis of the policies and legislations that are relevant to the operation of Mariental Piggery. The table below lists the various environmental and developmental policies and legislations that have relevance to the project.

Table 1: Legal framework of Mariental Piggery

LEGISLATION	PROVISION	REGULATORY AUTHORITY	APPLICATION TO THE PROJECT
The Constitution of the Republic of Namibia	Article 91 (c) and 95 (i) which commit the state to actively promote and maintain environmental welfare of all Namibians by promoting sustainable development	Government of the Republic of Namibia	The project should not pose a threat to the natural and human environment.
Environmental Management Act No.7 of 2007 and EIA Regulations (2012)	Provides a list of listed activities that may not be undertaken without environmental clearance	Ministry of Environment and Tourism (Office of the Environmental Commissioner)	An Environmental Clearance will be required for the operation of a brick plant.
Water Act 54 of 1956	Control of disposal of sewage, the purification of effluent, the prevention of surface and groundwater pollution, and the sustainable use of water resources.	Ministry of Agriculture, Water and Forestry (Department of Water Affairs)	The effluent disposal system used at the site must adhere to the provisions of this Act.
The Water Resources Act 24 of 2004	Control of disposal of sewage, the purification of effluent, the prevention of surface and groundwater pollution,	Ministry of Agriculture, Water and Forestry (Department of Water Affairs)	Septic tanks used at the plant must adhere to standards.

	and the sustainable use of water resources.		
The Labour Act of 1992	Employees are subject to the terms of the Labour Act. With special reference to Regulation 156, 'Regulations Relating to the Health and Safety of Employees at work'.	Ministry of Labour	Health and safety conditions provided by the Act should be adhered in the day to day operation of the brick plant.
Public Health Act ,1969	The Act addressed public health and sanitary provision	Ministry of Health and Social Services	Occupational hygiene promotion. The operation of the brick plant should not cause any nuisance which might affect public health.
Atmospheric Pollution Prevention Ordinance (1976)	This Ordinance generally provides for the prevention of the pollution of the atmosphere. Part IV of this ordinance deals with dust control.	Ministry of Environment and Tourism.	This Ordinance requires that any person carrying out industrial activities which is liable to cause a nuisance to persons residing in the vicinity or to cause dust pollution to the atmosphere, shall adopt the best practicable means to prevent such dust from becoming dispersed and causing a nuisance. Activities at the brick plant needs to be properly controlled to ensure dust is not a nuisance.

4. DESCRIPTION OF THE RECEIVING ENVIRONMENT

4.1 CLIMATE

Climatic variables of significance to large scale piggeries include temperature, humidity and wind direction. Temperature and humidity are important as pigs need to be maintained under optimal temperature and humidity conditions and these variables also potentially affect the formation of dust and odors. Wind direction is important as this variable influences the scale of potential odour impacts.

Namibia's climate is generally characterized by scarce and unpredictable rainfall. Namibia's climate is second in aridity only to the Sahara. The climatic elements of the receiving environment are summarized below:

- **Rainfall:** This area receives about 200-250 mm average annual rainfall.
- **Temperature and humidity:** Moderate climate with peaks temperatures in summer exceeding 36 °C. Average maximum temperatures are between 34 °C and 36 °C, whilst average winter minimum temperatures are around 2 °C to 4 °C. Humidity levels average 10-20% during winter months but average between 50-60% during summer.
- **Wind:** Winds in the Mariental area are moderate and mostly from the east, throughout the year.

4.2 SURFACE AND GROUNDWATER HYDROLOGY

Mariental Piggery is located near the banks of the Fish River approximately 20 kilometers from downstream of the Hardap Dam. The present capacity of the Fish River is approximately 900 M³/s, down from approximately 1400 m³/s in 1972 (Engels, 2002). Factors attributed to the reduction in the capacity of the Fish River since 1972 include siltation and the formation of thick reed beds, which together result a reduction in the capacity of the Fish River of approximately 200 and 300 m³/s respectively.

The Aub and Sandberg Rivers are both tributaries to the Fish River and have their confluence with the Fish River to the north of the town of Mariental.

The groundwater table in this area is typically shallow, particularly along the banks of the Fish River, which is applicable to the pig farm site. Groundwater levels at the site are less than 3 meters. The shallow depth of the water table precludes any waste disposal methods by burial.

According to Engels (2002), water quality downstream of the irrigation scheme (and from the present pig farm site) is both saline and has high concentrations of nutrients. Nitrate levels and total dissolved salts (TDS) levels in the vicinity of Mariental Piggery range from 9 to 13 mg/l nitrate and from 700 and 900 mg/l TDS. This renders the water in this area unsuitable for human consumption. The salinity levels (TDS) also make this water unsuitable for irrigation, especially for the irrigation of maize, which is reasonably salt sensitive crop.

4.3 FAUNA AND FLORA

The vegetation in the Mariental area is classified as dwarf shrub savanna dominated by low shrubs. Mariental Piggery is however located near the Fish River and the vegetation here is thus dominated by riparian vegetation. Extensive agriculture and in particular irrigation practices on the banks of the Fish River has ensured that nutrient rich run-off continually enter the Fish River system. This has promoted the

proliferation of alien invasive species such as *Prosopis* trees and reeds which are common vegetation along the river course.



Picture 6: Some vegetation found at the Mariental Piggery plot.

The area has a moderate to high diversity in all faunal species. The unique human induced ecology host many bird species. The Fish River is home to 14 fresh water fish species, all of which are common in the Hardap Dam.

4.4 SOCIO-ECONOMIC SETTING

Mariental falls within the Hardap Region of Namibia, one of the 14 regions of Namibia. The population of Mariental is estimated at 12,478 people (Namibia Statistics Agency, 2012). Mariental is the administrative capital of the Hardap Region.

Namibia is currently faced with a high unemployment rate and Mariental is no exception. The national average unemployment rate is 37%. Any form of employment creation such as the jobs created by Mariental Piggery is highly welcomed. The piggery employs around 36 employees on a permanent basis who

are all residents of Mariental. The piggery supplies a stable and long-term working chance to local residents. The piggery also provides secondary business opportunities to other local and Namibian companies in the sector of transportation and feed supply.

Mariental has very good road infrastructure. The main B1 Road (the main road between Windhoek and South Africa) runs past the town. This makes it easier to transport the products from the piggery to other parts of the country. Mariental has an airstrip for local and small aircraft.

5. ENVIRONMENTAL IMPACT ASSESSMENT

5.1 METHOD OF ASSESSMENT

The significance of the identified impacts of the Mariental Piggery operations was assessed using the criteria discussed on table 2 below.

Table 2: Criteria used to determine the significance of impacts and their definitions.

CRITERIA	DESCRIPTION
NATURE	This criteria indicates whether the activity has a positive or negative impact on the environment (environment comprises both socio-economic and biophysical aspects).
EXTENT	This criteria measures whether the impact is site specific; local (limited to within 15 km of the area); regional (limited to about 100 km radius); national (limited to within the borders of Namibia) or international (beyond Namibia's borders).
DURATION	This criteria looks at the lifetime of the impact, as being short (days, less than a month), medium (months, less than a year), long (years, less than 10 years), or permanent (more than 10 years).
INTENSITY	This criteria is used to determine whether the magnitude of the impact is destructive and whether it exceeds set standards, and is described as none (no impact); low (where the environmental functions are negligible affected); medium (where the environment continues to function but in a noticeably modified manner); or high (where environmental functions and processes are altered such that they temporarily or permanently cease).
PROBABILITY	Considers the likelihood of the impact occurring and is described as improbable (low likelihood), probable (distinct possibility), highly probable (most likely) or definite (impact will happen regardless of prevention measures).
DEGREE OF CONFIDENCE IN PREDICTION	This is based on the availability of information and knowledge used to assess the impacts.

The significance of the impacts identified for this project is determined using a combination of the criteria discussed on the above table. The significance of impacts is described on the table below.

Table 3: Definition of the various significance ratings

SIGNIFICANCE RATING	CRITERIA
Low	Where the impact have a negligible influence on the environment and no mitigations are required.
Medium	Where the impact could have an influence on the environment, which require some modifications on the project design and/or alternative mitigation.
High	Where the impact could have a significant influence on the environment and, in the case of a negative impact, the activity causing it, should not be permitted.

5.2 IMPACTS IDENTIFIED AND ASSESSED

- **ODORS**

Odors generated from pig farms primarily result from the anaerobic decomposition of pig manure. Anaerobic decomposition result when bacteria that do not use oxygen, slowly degrade pig manure. The major odorous compounds that form as a result of the anaerobic decomposition of manure include ammonia (NH₃) and hydrogen sulphide (H₂S). Other gases formed include carbon dioxide (CO₂) and methane (CH₄). Ammonia gas produces a sharp, pungent odor whilst hydrogen sulfide gas produces a characteristic “rotten egg” odor.

The same anaerobic process, however also releases volatile fatty acids, whose odors people often find more offensive than either ammonia or hydrogen sulfide.

Odorous compounds are carried by airborne dust and other particles, some of which, in the confines of a pig house, may also contain pathogens or physical irritants. Odorous mixtures vary with location, the size and type of pig operation, production practices, season, temperature, humidity, time of day, and wind speed and direction. With so many compounds and environmental variables, it's often difficult to determine which compounds are responsible for the nuisance odor.

To complicate matters further, human sensitivities and reactions to odors are individual and specific. They are influenced by personal preferences, opinions, experiences, and the varying sensitivities of our olfactory systems.

The nuisance impact of odor is therefore a complex issue and is best remedied by a clean and effective operation. The pig farm's close proximity to town and, more importantly its close location to sensitive receptors (for example the Wimpy Fast Food restaurant and neighboring residential dwellings) makes this an issue of concern that need to be monitored and addressed through the mitigation measures recommended in this report. The following are the main sources of odor in a piggery operation:

- **Buildings and holding facilities**

If manure accumulates in pig houses or holding facilities, anaerobic decomposition begins and odors intensify. Buildings may release odors should manure build up inside. As animals become dirty with urine, manure and feed dust, their body heat radiates odor.

Many of the volatile fatty acids and other compounds associated with odor attach themselves to dust. When dust from feed and other sources is allowed to coat animals, walls, and ventilation systems, virtually every surface releases odors. In a poorly ventilated building, these odors build up, and they may

escape in a concentrated dose. It is therefore essential that dust levels in and around a piggery is maintained at a minimum.

- **Manure and effluent storage and treatment**

When anaerobic sludges are spread across an area, odorous compounds may volatilize rapidly. Until the materials are dry and stable, volatiles rise and move off-site in the wind. Odors usually subside in one to three days, unless humidity is high or the layer of sludge is too thick.

- **Carcass disposal**

Poor management of dead pigs can result in odors. For instance decaying carcasses can release offensive odors if they are stored too long before disposal.

Table 4: Assessment of impacts associated with odors.

IMPACT	NATURE	EXTEN T	DURATION	INTENSITY	PROBABILITY	DEGREE OF CONFID ENCE	SIGNIFICANCE		
							PRE MITIGATION	PRESCRIBED MITIGATION	POST MITIGATION
Offensive odors can affect the well-being and health of people in surrounding areas	Operation of a piggery can result in odors from the handling of various wastes such as manure.	Local	Varies from short term to medium depending on how waste is managed.	Medium	Probable	High	Medium	See list of mitigation measures in section 6.3 of this report.	Low

- **POLLUTION**

Poor manure and effluent management can result in detrimental effects if it gains entry to water resources such as the underground water resources of the area.

Table 5: Assessment of impacts associated with pollution.

IMPACT	NATURE	EXTEN T	DURATION	INTENSITY	PROBABILITY	DEGREE OF CONFIDE NCE	SIGNIFICANCE		
							PRE MITIGATION	PRESCRIBED MITIGATION	POST MITIGATION
The disposal of effluent can pollute underground water sources	The operation of a piggery generates effluent which can be a source of pollution	Local	Varies from short to medium depending on how effluent is managed.	Medium	Probable	High	Medium	See list of mitigation measures in section 6.3 of this report.	Low

- **FLOODING**

Mariental is very prone to flooding which is mainly triggered when the Fish River breaks its banks and during the backflooding of the Aub and Sandberg rivers, which are tributaries to the Fish River and have their confluences with the Fish River immediately north of the town.

Heavy flooding was experienced in Mariental in 2000. Flooding was mainly as a result of the back flooding of the Aub and Sandberg rivers. As the Fish River has reached its full capacity as a result of the release of approximately 2400 cumecs from the Hardap Dam, this river was not able to accommodate the additional flood waters of these two tributaries. The result was that the Aub and Sandberg backflooded and the resultant floodwaters flooded those areas downstream of the confluence with the Fish River.

The flooding of the piggery can result in pollution as various pollutants from the piggery will be introduced in the water body resulting in the pollution of underground water and the ecosystem downstream.

However, various efforts have been undertaken by the authorities to ensure that future flooding of the town and surrounding areas is minimized. One such initiative is the programme to spray reeds annually in an attempt to increase the capacity of the Fish River both upstream and adjacent to the town. This was necessitated by the fact that the capacity of the Fish River has been diminished by the excessive growth of reeds as well as silt deposition.

Table 6: Assessment of impacts associated with floods.

IMPACT	NATURE	EXTEN T	DURATION	INTENSITY	PROBABILITY	DEGREE OF CONFIDE NCE	SIGNIFICANCE		
							PRE MITIGATION	PRESCRIBED MITIGATION	POST MITIGATION
Flooding of the piggery can introduce various pollutants in the water body.	The piggery is located in an area that's prone to flooding.	Local	Short	Medium	Probable	High	Medium	See list of mitigation measures in section 6.3 of this report.	Low

- **OCCUPATIONAL HEALTH IMPACTS**

Employees working at the piggery are potentially exposed to a number of occupational hazards, including harmful levels of gases, dust, infectious agents, airborne bacteria and noise. The most common and serious occupational hazards include exposure to gases and dust. Although noise might not be a major source of nuisance to surrounding areas of the piggery, it can affect the well-being of workers working at the piggery. Noise levels in the dry sow house as well as during feeding times can potentially reach levels

as high as 110 decibels. The Labour Act stipulates that no employee should be exposed to a noise level exceeding 85 decibels over a period of 8 hours.

The most common gases produced in a piggery include ammonia, methane, hydrogen sulfide, and carbon monoxide, each of which affects the lungs. Most of these gases result from the decay of fecal material. In people and pigs, gases may irritate the mucus membranes, and exposure to high levels may lead to pulmonary edema and death. Chronic exposure to low levels of pig house gases may lead to airway inflammation and a decrease in lung function.

Agricultural dusts contain molds, bacteria, insect parts, pollen, grain particles, mineral ash, animal feed, animal fluid and excreta. About a quarter of this dust is usually composed of proteins, some of which can become allergenic. This dust also tends to be very fine, as much as half of the dust may be respirable. Long-term exposure to such dusts has been found to cause respiratory damage.

Table 7: Assessment of impacts associated with Occupational Health Impacts.

IMPACT	NATURE	EXTEN T	DURATION	INTENSITY	PROBABILITY	DEGREE OF CONFIDE NCE	SIGNIFICANCE		
							PRE MITIGATION	PRESCRIBED MITIGATION	POST MITIGATION
Exposure to various occupational health hazards can affect the health of employees of the piggery.	Employees working at the piggery are potentially exposed to a number of occupational hazards, including harmful levels of gases, dust, infectious agents, airborne bacteria and noise.	Local	Short	Medium	Probable	Medium	Medium	See list of mitigation measures in section 6.3 of this report.	Low

6. ENVIRONMENTAL MANAGEMENT PLAN (EMP)

An Environmental Management Plan (EMP) describes the processes that the management of the operation and associates will follow to maximize compliance and minimize harm to the environment. The EMP comprises of a list of actions needed to mitigate the potential negative environmental impacts identified in this report.

The development of an EMP is a requirement for any EIA project as per Namibia's *Environmental Management Act No.7 of 2007*. Therefore this EMP is a legal document that must be complied with.

The main purpose of this EMP is therefore to:

- Minimize adverse impacts on the environment;
- Protect the environmental quality of the area surrounding the piggery;
- Meet the requirements of all national and local legislations;
- Provide detailed specifications for the management and mitigation of activities that have the potential to impact negatively on the environment.

6.1 EMP ADMINISTRATION

For the general provisions of this EMP to be fully implemented there is a strong need to clearly outline the roles and responsibilities of all stakeholders. There is also a need for the management of Mariental Piggery to appoint an overall responsible person to ensure the successful implementation of the EMP.

6.2 TRAINING

All key role players such as the workers at the piggery must be informed about the contents of this EMP through structured training programs. This can form part of the regular site meetings.

6.3 MANAGEMENT ACTIONS OF ENVIRONMENTAL ASPECTS

- **Odors**

DESCRIPTION	Odors generated from pig farms primarily result from the anaerobic decomposition of pig manure. Anaerobic decomposition result when bacteria that do not use oxygen, slowly degrade pig manure. The major odorous compounds that form as a result of the anaerobic decomposition of manure include ammonia (NH ₃) and hydrogen sulphide (H ₂ S). Other gases formed include carbon dioxide (CO ₂) and methane (CH ₄). Ammonia gas produces a sharp, pungent odor whilst hydrogen sulfide gas produces a characteristic “rotten egg” odor.
MITIGATION MEASURES	<ul style="list-style-type: none"> • Floors in pig houses should be kept clean and dry. Pigs soiled with manure, urine, dust, and grime emit intense odors. Animals are cleaner when floors are kept clean and dry. • Ventilation in pig buildings should be adequate to prevent the buildup of dust, gases, moisture, and heat, all of which can intensify odor. • Dense stands of trees and bushes should be established and maintained as vegetative buffers around the piggery. These buffers can reduce or redirect winds, helping to contain or disperse odors. In addition, trees act as natural air filters by collecting particles on needles and leaves. • Manure should not be kept long on the site especially during the rainy season. • Burry carcasses immediately to avoid decaying and production of odors.
MONITORING	<ul style="list-style-type: none"> • Monitor how odors are affecting surrounding areas.
RESPONSIBLE PARTY	Site Manager

- **Pollution**

DESCRIPTION	Poor manure and effluent management can result in detrimental effects if it gains entry to water resources such as the underground water resources of the area.
MITIGATION MEASURES	<ul style="list-style-type: none"> • The clay used to line the ponds should be further tested for permeability to ensure that the waste water does not reach underground water resources.
MONITORING	<ul style="list-style-type: none"> • Boreholes should be drilled locally to monitor any potential pollution emanating from the evaporation ponds.
RESPONSIBLE PARTY	Site Manager

- **Flooding**

DESCRIPTION	Mariental is very prone to flooding which is mainly triggered when the Fish River breaks its banks and during the backflooding of the Aub and Sandberg rivers, which are tributaries to the Fish River and have their confluences with the Fish River immediately north of the town. The piggery is located in an area that is prone to flooding.
MITIGATION MEASURES	<ul style="list-style-type: none"> • Construction and maintenance of well-engineered culverts. • No further development below the 995m contours.
MONITORING	
RESPONSIBLE PARTY	Site Manager

- **Occupational Health Impacts**

DESCRIPTION	Employees working at the piggery are potentially exposed to a number of occupational hazards, including harmful levels of gases, dust, infectious agents, airborne bacteria and noise. The most common and serious occupational hazards include exposure to gases and dust. Although noise might not be a major source of nuisance to surrounding areas of the piggery, it can affect the well-being of workers working at the piggery. Noise levels in the dry sow house as well as during feeding times can potentially reach levels as high as 110 decibels. The Labour Act stipulates that no employee should be exposed to a noise level exceeding 85 decibels over a period of 8 hours.
MITIGATION MEASURES	<ul style="list-style-type: none"> • Comply with exposure limits as stipulated in the Labour Act and its Regulations. • Use wet feeding system to reduce the generation of dust. • Ensure all sites are maintained in a clean condition. • Institute and maintain a hearing conservation programme for the workers. • Provide Personal Protective Equipment (PPE) in areas where noise levels are continuously high. • Provide PPE to any person handling slurry.
MONITORING	<ul style="list-style-type: none"> • Measure noise and gas levels at regular intervals.
RESPONSIBLE PARTY	Plant Manager

7. CONCLUSIONS AND RECOMMENDATIONS

Mariental Piggery is an existing operation that makes a contribution to the socio-economic development of Mariental and the country as a whole. The operation also helps to alleviate poverty in Namibia by providing jobs and much needed skills to Namibians. Furthermore, the piggery contributes to food security and can also further provide secondary business opportunities to Namibians such as in the transportation and meat processing sector.

The environmental impacts identified for this operation are generic concerns associated with a piggery operation. It is thus recommended that Mariental Piggery put more effort in ensuring that issues such as pollution and public nuisances such as odors are addressed and contained on an ongoing basis. Other impacts identified in the report can be satisfactorily mitigated through the full implementation of the mitigation actions recommended in this report and through proper housekeeping.

It can thus be concluded that this project does not cause any significant impacts. Most of the impacts identified for this operation are generic concerns associated with the operation of a piggery which can be satisfactorily mitigated through the full implementation of the Environmental Management Plan (EMP).

It is therefore recommended that this project be issued with an Environmental Clearance on condition that the provisions of the Environmental Management Plan are fully implemented.

8. REFERENCES

Australian Pork Limited. 2015. Piggery Manure and Effluent Management and Reuse guidelines.

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APPENDICES

APPENDIX A: CV OF THE ENVIRONMENTAL ASSESSMENT PRACTITIONER
