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MEATCO ABATTOIR AND MEAT PROCESSING FACTORY, WINDHOEK

Management Plan 2022-2025



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PROJECT NAME	Environmental Management Plan for Meatco Abattoir and Meat Processing Factory, Windhoek
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ENVIRONMENTAL ASSESSMENT PRACTITIONER DECLARATION

I hereby declare that I do/will:

- (a) Have knowledge of and experience in conducting assessments, including knowledge of the Environmental Management Act (Act 7 of 2007) and the Regulations and Guidelines that have relevance to the proposed activity;
- (b) Perform the work relating to the application in an objective manner, even if these results in views and findings that is not favourable to the applicant;
- (c) Comply with the abovementioned Act, its Regulations, Guidelines and other applicable laws.

I also declare that there is, to my knowledge, no information in my possession that reasonably has or may have the potential of influencing –

- (i) any decision to be taken with respect to the application in terms of the Act and its Regulations; or
- (ii) The objectivity of this report, plan or document prepared in terms of the Act and its Regulations.



Stephanie van Zyl

Environmental Assessment Practitioner

TABLE OF CONTENTS

ABBREVIATIONS	4
1 INTRODUCTION.....	8
1.1 BACKGROUND.....	8
2 THE MEATCO OPERATIONS.....	9
2.1 WHO IS MEATCO?.....	9
2.2 PROCESSING ACTIVITIES	10
2.2.1 SLAUGHTERING	10
2.2.2 MEATPACKING AND PROCESSING.....	11
2.2.3 CANNERY	11
2.2.4 CONSUMPTION OF RESOURCES AND WASTE PRODUCED.....	14
3 CURRENT BASELINE ECOLOGICAL AND SOCIAL CONDITIONS OF THE MEATCO SITE..	15
4 PUBLIC CONSULTATION CONDUCTED	17
5 IMPACT ASSESSMENT OF THE CURRENT MEATCO OPERATIONS.....	18
5.1 ASSESSING THE IDENTIFIED IMPACTS OF THE PROJECT.....	19
6 CONCLUSIONS AND RECOMMENDATIONS	24
7 THE ENVIRONMENTAL MANAGEMENT PLAN (EMP).....	27
7.1 WHAT IS AN ENVIRONMENTAL MANAGEMENT PLAN?	27
7.2 RESPONSIBILITIES	27
7.3 CONTRACTORS	28
7.5 MANAGEMENT REQUIREMENTS.....	29
7.5.1 PERMITS AND RELEVANT LEGAL PROVISIONS.....	29
7.6 MITIGATION DETAILS.....	30
7.6.1 SECTION A: WASTE MANAGEMENT.....	31

7.6.2	SECTION B: HEALTH AND SAFETY	32
7.6.3	SECTION C: ODOUR MANAGEMENT.....	32
7.6.4	SECTION D: ENVIRONMENTAL TRAINING AND AWARENESS.....	35
7.6.5	SECTION E: COMMUNICATION WITH INTERESTED AND AFFECTED PARTIES (I&APS) AND AUTHORITIES	36
7.6.6	SECTION F: WATER CONSERVATION AND WATER QUALITY MANAGEMENT...	37
7.6.7	SECTION G: ENERGY CONSERVATION.....	38

LIST OF TABLES

Table 1:	Monthly consumption of water and electricity	14
Table 2:	Quantities waste produced at Kupferberg	14
Table 3:	Socio-economic and ecological sensitivities	15
Table 4:	Impact assessment table	19
Table 5:	Relevant permit and legal requirements.....	29
Table 6:	Generic and site-specific environmental management actions for the construction phase.....	30

ABBREVIATIONS

AIDS	Acquired Immune Deficiency Syndrome
BOD	Biological Oxygen Demand
DEA	Directorate of Environmental Affairs
COD	Chemical Oxygen Demand
ECC	Environmental Clearance Certificate
EO	Environmental Officer

EA	Environmental Assessment
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EU	European Union
GG	Government Gazette
GN	Government Notice
HIV	Human Immunodeficiency Virus
IFC	International Finance Corporation
I&APs	Interested and Affected Parties
KWH	Kilo Watt Hour
LU	Live Unit
N	Nitrogen
PPE	Personal Protective Equipment
SANS	South African National Standard
SRM	Special Risk Material
Ss	Suspended Solids
TB	Tuberculosis

LIST OF APPENDICES

Appendix A	Specialist Odor Monitoring Report
Appendix B	Letter to Interested and Affected Parties
Appendix C	Effluent Treatment Facility Permit and Conditions

COMPLIANCE OVERVIEW

The table below provides an overview of the requirements of the EMP and the level of compliance for the period 2018-2022. It includes comments for improvement/implementation for the next period:2022-2025.

	Compliance with EMP and legal obligations	Comments
EMP Integrated/ESMS implemented	Partial compliance	Parts of EMP integrated, ESMS compilation planned.
Environmental Officer Appointed	Compliant	EO to review remaining tasks and manage them to complete compliance
Contractors receive and implement EMP		
Permits and legal compliance <ul style="list-style-type: none"> • Health and Safety • Effluent Treatment Permit • Borehole Permit (only as needed) Fitness Certificate	Compliant	Borehole not currently used
Waste Management	Compliant	Continual improvement specific in EMP, which is to be the aim for 2022-2025
Health and Safety	Compliant	Keep up required reporting and aim for improvement on accidents and incidents
Odour Management	Partially compliant. Emissions exceeded close to the plant.	Implement design modifications as suggested to rendering plant by 2023 Continue with management objectives
Training and awareness	Complaint for health and safety. Non-complaint for environmental	Environmental to be integrated with health and safety training.
I&APs	Partially compliant. Grievances kept and maintained.	Pro-active communication to be initiated
Water conservation & Quality Management	Compliant	To be maintained

Energy Management	Compliant	Use energy audits to consider possible improvements. Energy demand analysis completed; thermal imaging done of substations. In progress with installation of energy meters for various departments to enable detailed audits.
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1 INTRODUCTION

1.1 BACKGROUND

Enviro Dynamics is appointed to submit a renewal of the Environmental Clearance Certificate as per the Environmental Management Act (2007) and its Regulations (2012) for the Meatco abattoir and meat processing factory, Windhoek, Sheffield Street (see Figure 1 below). The original EIA and EMP was submitted in 2018, and the first ECC was dated 6 February 2019. This document is an update of the original EMP, showing results of targets and gaps where improvements are required.



Figure 1: Locality of the existing Meatco Abattoir and Factory, Windhoek

2 THE MEATCO OPERATIONS

2.1 WHO IS MEATCO?

Namibia Meat Corporation is a meat processing and marketing entity, established in terms of the Meat Corporation Act (1 of 2001). The company supplies high quality meat products to niche markets, mainly to the international market. Meatco purchases cattle from farmers engaged in extensive livestock farming conditions, after being processed through the value chain.

Meatco operates various slaughter facilities across Namibia and engages in related manufacturing and other production activities by means of production operations which include the Windhoek and Okahandja factories (the Oshakati and Katima Mulilo abattoirs ceased operation March 2015), tannery, feedlot, cannery and wholesale.

This environmental management plan covers the Windhoek site, namely the activities in Sheffield Street, Northern Industrial area.

2.2 PROCESSING ACTIVITIES

The following main activities can be identified at the Meatco plant in Windhoek (see Figure 2):

2.2.1 SLAUGHTERING

Before being slaughtered, the animals are received and kept in a stock yard/lairage. The animals are watered and fed.

The animals are then driven through races from the holding pens through to the slaughtering area where the following activities take place:

- Washing with water and approved chemicals
- Stunning, halaal slaughtering
- Suspension from an overhead rail by the hind leg
- Sticking and bleeding over a collecting trough. The collected blood is processed into dried blood;
- Decapitation
- Hide removal
- Opening of the carcass by cutting
- Evisceration (removal of intestines and internal organs)
- Splitting of the carcass with split saw
- Removal and safe disposal of SRM (specified risk material such as tonsils and the spinal cord¹)
- Carcass and organ inspections
- Grading and weighing

¹ The correct removal, handling, staining and disposal of specified risk material (SRM) in slaughterhouses and cutting plants is necessary to ensure that public health and animal health is protected from the possible risks associated with transmissible spongiform encephalopathies (TSEs) in cattle, sheep and goats.

- Final inspection of the carcass
- Carcass wash and establishment intensification stamp
- Chilling/24 hour maturation above 2° C

These activities are strictly monitored to ensure European Union (EU) Standards, with staff seconded from the EU present daily. There are various checks and balances throughout the process, with thorough data capturing and inspections to achieve this. Animal welfare standards are strictly implemented and monitored.

2.2.2 MEATPACKING AND PROCESSING

Meat processing on site involves the following after 24 hours of maturation:

- -PH-testing
- De-boning, cutting and trimming
- Packing in cartons
- Chilling or freezing of product
- Dispatch of product

2.2.3 CANNERY

On site meat products, e.g. fat, meat and separated chicken meat from suppliers are processed into canned corned meat.

By products processing (rendering)

Raw material, which will be dispatched as by-products, from the production process are deboned and crushed. Cooking and sterilizing takes place in an equa-cooker whereby bone and meat tissues are separated from water and fat, for the production of products such as meat and bone meal and fat (tallow) from animal tissues.

Handling of viscera, paunch and intestines

Viscera can be recovered as edible products (e.g. heart, liver), but some parts are separated for inedible rendering or processing (e.g. condemned material and bones). High risk content notably the spinal cord and tonsils is removed and disposed of at the Kupferberg Waste Disposal site.

The paunch contents, 'paunch manure' (partially digested feed), is estimated to range from 27 to 40 kg. At Meatco, the paunch contents are washed out and the wet slurry is screened for the removal of the solids, which are eventually disposed of at the Kupferberg Hazardous Waste Disposal Site.

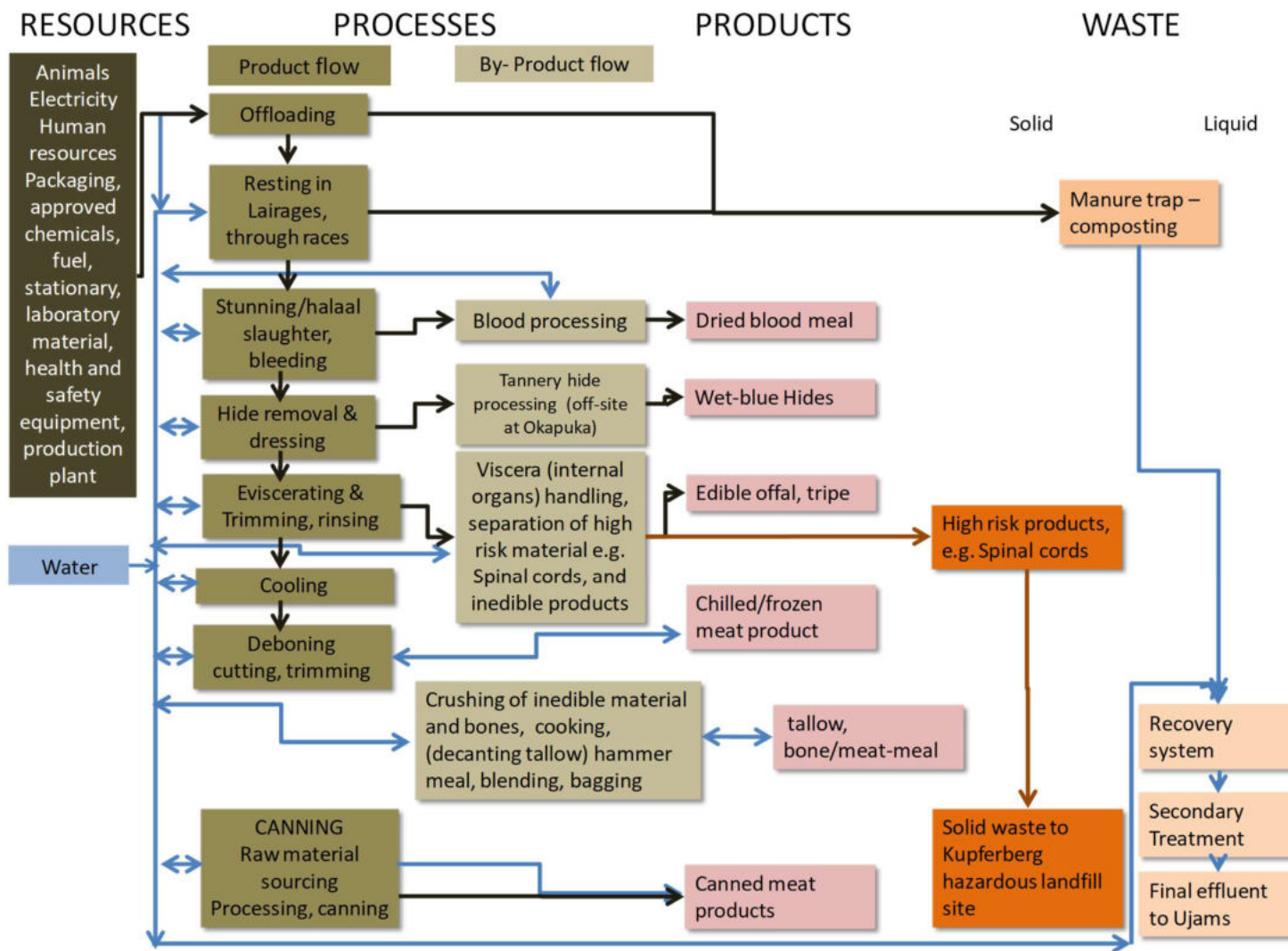


Figure 2: A simplified process flow diagram of the Windhoek Meatco operations (tannery processing at Okupuka not included in this assessment)

2.2.4 CONSUMPTION OF RESOURCES AND WASTE PRODUCED

The following tables show the typical consumption patterns and production of waste (effluent and solid waste) at Meatco for the past three years.

Table 1: Monthly consumption of water and electricity

Resource used	Used per month
Potable water	1.8 -3.9 m ³ /LU (Livestock Unit)
Electricity	85- 385 kWh/LU

Table 2: Quantities waste produced & disposed of at Kupferberg

Kind of waste	Hazardous vs. Non-Hazardous waste	Quantity per Week	Cost of Waste Disposal N\$	Disposed
Paunch Content	NH	60 Tons	395/ton	Kupferberg
Special risk material	H	50 Tons	± 15,000	Kupferberg
Sludge	H	10 Tons	395/ton	Kupferberg
General waste	H	20 Tons	395/ton	Kupferberg
Sludge	NH	30 Tons	395/ton	Kupferberg
Waste water		2000 m ³		Ujams Water treatment Plant
Fat	H	10 Tons /day	395/ton	Kupferberg

3 CURRENT BASELINE ECOLOGICAL AND SOCIAL CONDITIONS OF THE MEATCO SITE

The baseline conditions of the area have not changed significantly since the original Scoping Report was compiled in 2018. Table 3: Socio-economic and ecological sensitivities below provides an overview of the key sensitivities in the area of the factory.

Table 3: Socio-economic and ecological sensitivities

Environmental Feature	Description	Sensitivities/opportunities.
Job creation	Windhoek, the northern industrial area and specifically Meatco play a significant role in employment creation in Windhoek.	Significant employment creator in Windhoek Health and safety of employees and community valued
HIV/AIDS and other diseases	Declined from peak prevalence in the past.	The project facility is in its operational stage is not a contributor to HIV/AIDS, but has an opportunity to educate its workforce regarding this and other diseases. Health and Safety is an area of specific concern which is being controlled by Meatco in terms of the Health and Safety Regulations.
Locality of other sensitive receptors in relation to the plant	The distance and location of sensitive receptors especially residential neighbourhoods (Eros, Eros park, those staying at the Fire Brigade just south of the site, Windhoek North) from the facility	Odours reaching sensitive receptors in the nearby neighbourhoods. (Appendix A)
Surface and groundwater water quality	Locality of the Klein Windhoek River just east of the site	Untreated or inadequately treated water causing pollution of the river or underground sources or putting pressure on the Ujams Effluent Treatment Plant.
Waste creation and disposal	Windhoek's locality on an important aquifer (Windhoek's general and hazardous waste disposal site where Meatco's high risk waste is disposed of)	Pressure on Windhoek's waste disposal systems and increased effort and costs to keep this waste from

Environmental Feature	Description	Sensitivities/opportunities.
	and general pressure on waste systems and disposal sites.	polluting the Windhoek aquifer. Reduction and re-use of waste opportunities
Water consumption	Regional drought and climate change conditions	Water as a resource to be conserved vs opportunities for continual improvement of water conservation
Energy consumption	Regional energy shortages and unsustainable future of non-renewable energy	Opportunities for energy saving and renewable energy projects.
Animals slaughtered	The welfare of animals	Animal welfare in the transport and slaughtering process valued

4 PUBLIC CONSULTATION CONDUCTED

During 2018, a thorough consultation process was undertaken including stakeholder mapping, advertisements in the press, and direct contact with neighbouring properties, as well as residents who are affected by the odour challenge.

Since and prior to 2018, Meatco receives regular feedback from stakeholders particularly regarding the odour issue and there is a feedback mechanism used to respond.

For this submission, Meatco felt confident that the odour issue still remains the key concern for the nearby residents, which becomes an increasing nuisance when production increases. Therefore, it was opted not to repeat a general consultation where people are invited to provide concerns. It is clear that, following ongoing communication, the odour matter still remains the key concern. Rather, communication was sent to the Stakeholder distribution list, informing them of the monitoring done in the past three years, and offering solutions and commitments to mitigate the situation (Appendix B).

5 IMPACT ASSESSMENT OF THE CURRENT MEATCO OPERATIONS

Table 4 below provides a summary of the impact assessment, reviewed since 2018 and updated to reflect changes.

5.1 ASSESSING THE IDENTIFIED IMPACTS OF THE PROJECT

Table 4: Impact assessment table

POTENTIAL IMPACT	NATURE	EXTENT	DURATION	INTENSITY	PROBABILITY	DEGREE OF CONFIDENCE	SIGNIFICANCE	
							PRE-MITIGATION	POST-MITIGATION
Increased burden on Ujams Water Treatment Plant	Incidences of effluent not meeting water quality standards cause an increased burden on the Ujams Water Treatment Plant to function.	Local	Long term, intermittent	Low	Probable	High.	Low (Few incidences of exceeding standards, averages are all within limits)	Low Maintain current management regime, aim for effluent quality standards met constantly (Appendix C) .
Negative impact on the Kupferberg Waste disposal site	Solid biowaste disposal causes increased loads at the waste disposal site, accompanied contributing to the burden on the waste disposal site. This includes increased risk of groundwater pollution, attraction of scavengers,	Local to waste disposal site	Permanent (groundwater pollution practically impossible to rectify)	Low	Probable	High	Medium to low	Low Constantly aim at continued waste reduction, re-use and recycling initiatives. Contracts in place with waste transporters and disposal specialists.

POTENTIAL IMPACT	NATURE	EXTENT	DURATION	INTENSITY	PROBABILITY	DEGREE OF CONFIDENCE	SIGNIFICANCE	
							PRE-MITIGATION	POST-MITIGATION
	increased fly and other pests, bad smells – all these risks require careful management and design practices.							
Impacts related to the handling and disposal of chemicals on site	Increased surface water pollution risk and human exposure to chemicals due to chemicals in run off on site reaching the natural drainage lines.	Local and regional	Long term	Low	Probable	High	Low	Low to negligible. Maintain sound chemical handling, storage and disposal practices. Maintain existing sump which reroutes oils and chemicals back to the ETP.
Increased occurrence of episodes of odour resulting in a nuisance impact At 1) nearby residences	Odour from the rendering plant (predominant) and the effluent treatment plant.	Local (surrounding neighbourhoods)	Long-term	Medium	Probable	Moderate Moderate (some possible daily and seasonal variances not detected)	1) To nearby residences - (Windhoek-north, fire brigade and Eros Manor where set limits are not exceed in monitoring results but certain receptors could be more	Low to negligible

POTENTIAL IMPACT	NATURE	EXTENT	DURATION	INTENSITY	PROBABILITY	DEGREE OF CONFIDENCE	SIGNIFICANCE	
							PRE-MITIGATION	POST-MITIGATION
and 2) nearby industrial area (refer to Appendix A for further details)							sensitive to odour. Medium To nearby industrial areas – limits are exceeded - medium to high Appendix B and EMP for further discussion and mitigation.	Low
Health and Safety of Workforce and exposed community	Exposure to dangerous equipment and/or hazardous substances causing risk to workforce and community health and safety	Site specific	Long-term	Low	Probable	Medium to low	Medium to low Continually review and identify situations of non-compliance (e.g. staff not wearing personal protective clothing), make corrections, disciplinary actions where necessary.	Low
Job Creation	Widespread economic gain to both skilled and unskilled labour as	Regional/ National	Long term	High	Definite	High	Medium	Medium

POTENTIAL IMPACT	NATURE	EXTENT	DURATION	INTENSITY	PROBABILITY	DEGREE OF CONFIDENCE	SIGNIFICANCE	
							PRE-MITIGATION	POST-MITIGATION
	a result of employment and contracting during operations.							
Noise Pollution	Equipment emitting noise to the outside of the buildings create a nuisance to neighbours	Local	Long term	Low	Probable	Medium	Low (currently noise levels seem to be within limits, monitor noise levels and consider specific mitigation depending on the noise source.)	Low
Pressure on the regional water sources	Contribution to increased pressure on the regional water sources due to high volumes of water consumption.	Regional	Long term	High	Highly probable	Medium	Low (significant mitigation already in place), maintain the status quo, and according to City of Windhoek Drought Response Plan and identify further areas of water conservation possibilities.	Low
Pressure on energy source	Pressure on energy source due to high levels	National	Long term	High	Definite	Medium	Medium (renewable energy sources were considered – e.g. solar	Low

POTENTIAL IMPACT	NATURE	EXTENT	DURATION	INTENSITY	PROBABILITY	DEGREE OF CONFIDENCE	SIGNIFICANCE	
							PRE-MITIGATION	POST-MITIGATION
	of energy consumption						installations, bio-gas facility, etc. A solar installation is recommended	

6 CONCLUSIONS AND RECOMMENDATIONS

The screening and impact assessment conducted for the Windhoek Meatco Abattoir, has identified the following impacts. A description is given of the significance of each, with mention made where further work is needed to validate the assessment. Mitigation principles are also mentioned, with elaboration in the Environmental Management Plan (next section).

Incidences of effluent not meeting water quality standards cause an increased burden on the Ujams Water Treatment Plant to function.

These incidences are limited, under the current management regime, and the impact is therefore assessed as low. Management practices aiming at zero incidences of exceeding water quality standards need to be maintained, and incidences showing gaps in the system, addressed.

Solid biowaste disposal contributing to the increased burden on the sound maintenance of the Kupferberg waste disposal site and increased surface and groundwater pollution risks.

Because of the hazardous nature of the biowaste, even though relatively small volumes, this impact is considered to have a medium significance.

Meatco should adapt standards of continued waste reduction, reuse and recycling principles with focus particularly on areas where waste volumes are high and/or potentially polluting as a priority.

Increased surface water pollution risk and human exposure to chemicals due to chemicals in run off on site reaching the natural drainage lines.

This impact is considered of low significance because of the management measures such as those for bunding chemical storage areas, the separation, handling and disposal of chemicals, and the sump with automatic control system already on site. These systems need to be constantly rechecked for effectiveness and maintained.

Episodes of odour emitted from the rendering plant (predominant source) and effluent treatment plant resulting in nuisance to the nearby residential (mainly Rhino Park, Fire Brigade and Eros Manor) and industrial neighbourhoods.

The rendering plant which is the main odour source, is a project to reduce waste products which would otherwise end up on the Kupferberg Waste Disposal Site and increase the risk of groundwater pollution. Significant mitigation of processing and cooking raw waste products are already in place as well as to cover waste water and waste water treatment processes. The residual impact is rated medium for the mentioned nearby residential neighbourhoods and medium to high for the adjacent industrial neighbourhood. Substantial modelling was conducted by independent experts to understand the sources and migration of odours generated by Meatco, and to correlate these with the complaints received from residents in the Eros residence. The modelling was done based on the criteria from the Institute for Air Quality Management (IAQM)) and the Nederlandse Emissierichtlijn Lucht (NeR)) for sensitive receptors. Initial modelling indicated very low migration of odours to the residences beyond Rhino Park, Eros Manor, the Fire Brigade and the immediate industrial areas. Furthermore, the model indicated a low correlation between the nature of smell complained about, and the expected odour source. The complaints indicated the source as the by-product processing plant whereas the modelling suggested that if any, odours from the effluent plant might sporadically reach the Eros residential area. Meatco and the independent air emissions consultant agreed to increase the level of odours at the

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October 2022*

meat rendering plant as a source to 20 times that of what are published in international publications for similar operations. The outcome showed negligible differences in the impacts (still negligible odour migration to residences beyond those mentioned), but the odour from the rendering plant now became the predominant odour source. These ratings reflect standards exceeded for the industry as modelled during the specialist study. Options for mitigation recommended included a phased approach starting with a 2-week sampling programme and an odour management plan, targeted and focused odour-sensitive operational and maintenance practices and further research on the implementation of odour elimination technology at source, should increased management techniques and sampling indicate the need for this. I

Meatco has since these recommendations, implemented the 2-week sampling programme, which indicated that odour and H₂S limits are exceeded at the plant and at the nearby industrial areas. However, these limits are not exceeded in the nearby neighbourhoods, where the majority of the complainants reside. The study does warn that some receptors are more sensitive to odour, and that some variations according to daily and seasonal fluctuations are probably looked over. Further monitoring was recommended. However, Meatco has opted to implement design changes to the rendering plant, which is the main source of the odour. See Meatco's statement regarding this commitment in Appendix B.

The potential emissions from the coal stack at the boiler were also assessed and found to be within acceptable limits and therefore not a concern.

Exposure to dangerous equipment and/or hazardous substances causing risk to workforce and community health and safety.

An in depth assessment was not done for this component. The Meatco Health and Safety Department is regularly inspected and audited. It is recommended that incidences of non-compliance such as the wearing of personal protective clothing be closely monitored and corrected.

Widespread economic gain to both skilled and unskilled labour as a result of employment and contracting during operations.

Meatco makes a significant contribution to the economy through the training, salaries, medical, pension and other benefits received which supports larger family structures and brings secondary economic benefits to communities.

Equipment emitting noise create a nuisance to nearby occupants. No complaints are recorded in this regard that have not been addressed.

Noise level monitoring on the site boundaries are recommended. Generally accepted standards for noise levels in industrial areas is 70dB (daytime and night time) and 45 dB daytime and 40dB night time for residential areas.

Contribution to Increased pressure on the regional water sources due to high levels of water consumption. Currently Meatco is collaborating with the City of Windhoek to achieve water savings according to the Drought Response Plan.

50% savings have already been achieved over the period 2011-2017. This should be maintained and water conservation management measures integrated with the entire operations of the plant. Consider membrane technology and increased recycling possibilities of wastewater.

Pressure on energy source and supply infrastructure due to relatively high levels of energy consumption.

This impact is considered medium and could be reduced so that renewable energy sources are better utilised. Energy saving is to be integrated with the entire operations of the plant. A solar installation is

recommended according to the Environmental Footprint Feasibility Study completed to consider potential alternative energy projects as well as the implementation of Energy Audit practices. Energy audit practices have in the mean time been implemented.

Meatco will continue on the path of continuous improvement with regards to sustainability if they continue with current and proposed new initiatives for managing environmental and social impacts, and if they implement the additional recommendations provided in the following Environmental Management Plan.

It is recommended that environmental clearance be granted on condition that the EMP (following in Section 8) in this document be implemented and maintained further.

7 THE ENVIRONMENTAL MANAGEMENT PLAN (EMP)

7.1 WHAT IS AN ENVIRONMENTAL MANAGEMENT PLAN?

The EMP is the part of the environmental impact assessment which ensures design and management actions are put in place to address environmental risks on the site.

Because Meatco has been in existence for many years, the focus is on the maintenance of existing systems which address environmental and social risks, as well as introducing modifications to existing systems where necessary.

It is recommended that the Environmental Management Plan is to be translated into an Environmental Management System (EMS). The system will enable the company to identify all the parts of the plant which have an ecological or social risk. Management of them is integrated with other management systems in the company, for example the Health and Safety management system.

The EMS should be simple yet effective to address key areas of concern. The management actions below will move the company toward this step.

7.2 RESPONSIBILITIES

The responsibility for the implementation of the EMP ultimately lies with Meatco Management. An Environmental Officer (EO), has been made responsible for the implementation of this EMP and ensures all the steps mentioned in it are taken, also that ongoing maintenance, refinement and adapting of it takes place.

The EO's duties include the following:

- Take responsibility for ensuring all environmental and social related permits are up to date.
- Take responsibility for coordinating and following up (full circle) the initiatives and management actions listed in this EMP.
- Take responsibility for all monitoring actions listed in under each section;
- Take responsibility for continuously reviewing this EMP so that changes in legislation, plant components, designs, operations, technology etc. may be considered and changes made where necessary.
- Take responsibility for maintaining a stakeholders list, complaints register and regular open and constructive communication with such stakeholders, giving feedback of how concerns are being considered.

- Take responsibility for non-compliance on site and devising a penalty/incentive strategy for the company.
- Take responsibility for initiating a record keeping system for keeping track of the implementation of this EMP.
- Consider with Management the need for an EMS, and implement following the decision.

7.3 CONTRACTORS

When Meatco solicits contractors for building projects, the handling and disposal of waste, supplies of chemicals, etc. then they need to adhere to the various permit requirements, environmental management principles and laws as applicable. This needs to be integrated into the various contractors with such suppliers and updated regularly.

7.5 MANAGEMENT REQUIREMENTS

The management requirements in this EMP have the following two main categories:

- Permit and relevant legal requirements (Table 7); and
- Operational and maintenance requirements.

7.5.1 PERMITS AND RELEVANT LEGAL PROVISIONS

Table 5: Relevant permit and legal requirements

THEME	LEGISLATION INSTRUMENT	MANAGEMENT REQUIREMENTS	CONTACT PERSON
Environmental	Environmental Management Act 7 of 2007 EIA Regulations (EIAR) GN 29-30 (GG 4878)	<ul style="list-style-type: none"> • The amendment, transfer or renewal of the Environmental Clearance Certificate "(EIAR, GN 29: S19 & 20). After this specific Clearance Certificate has been obtained, it needs to be renewed every three years. 	Ms Saima Angula Tel: (061) 284 2751
Labour	Labour Act 11 of 2007 Health and Safety Regulations (HSR) GN 156/1997 (GG 1617).	Adhere to all applicable provisions of the Labour Act and the Health and Safety regulations. This requirement is being implemented by Meatco through their Health and Safety Department. This needs to be maintained.	Labour Law Advice: Tel: (061) 309 957
Water	Water Act of 1956 and Water Resources Management Act (not yet regulated) City of Windhoek bylaws	<ul style="list-style-type: none"> • Regularly update the agreement in terms of the City of Windhoek Drought Policy • Maintain the requirements in the Water Effluent Treatment Permit (Appendix C), from the City of Windhoek – monitoring and re-apply annually for a permit renewal (expiry of current permit – 2023) • Maintain the permit for the use of the groundwater on the property as needed (Water Affairs) 	
Fitness Certificate	City of Windhoek Town Planning Scheme General Health Act	<ul style="list-style-type: none"> • Renew fitness certificate when reaching expiry. 	

7.6 MITIGATION DETAILS

The following table provides a large scale overview of all the major environmental management themes pertaining to both generic and site specific construction mitigation details. This table serves to act as quick reference, for the detailed mitigation details that follow below, for the implementation of the construction component of this EMP.

Table 6: Generic and site-specific environmental management actions for the construction phase

THEME	OBJECTIVE	SECTION
Waste management	Avoid and where not possible minimise all pollution associated with construction.	Section A
Health and safety	Safeguard health and safety of labourers and general public.	Section B
Air quality management (Odour)	Manage and maintain air quality management standards	Section C
Environmental training and awareness	Awareness creation regarding the provisions of the EMP as well as importance of safeguarding environmental resources.	Section D
Communication with Interested and Affected Parties (I&APs)	Provide a platform for I&APs to raise grievances and receive feedback and hence minimise negative conflict	Section E
Water conservation and quality management	Minimise negative conflict through legal and fair recruitment practices.	Section F
Energy management	Conservation of energy through pursuing renewable energy alternatives and reducing energy consumption	Section G

7.6.1 SECTION A: WASTE MANAGEMENT

Targets:

- All waste to be as a matter of preference 1) eliminated, 2) reused and 3) recycled, with no waste remaining that does not fall into either of these categories.
- Minimum waste discharged at the Kupferberg Waste Disposal Site, but rather re-used, incinerated (high risk), or recycled (paper, plastics, cardboard, glass).

ASPECT	MANAGEMENT ACTIONS
Waste streams	<ul style="list-style-type: none"> • Identify the various categories of waste on the site, including general waste (paper, cardboard, plastic, tin, etc.), electronic waste, hazardous waste, post-digestive waste and high risk waste. • Identify the source of each category, and record the volumes and/or weight at each source as well as collectively. • Monitor the volumes and/or weight of each category.
Waste disposal methods	<ul style="list-style-type: none"> • Identify the current disposal destination of each category.
Continual improvement of waste reduction, handling, disposal	<ul style="list-style-type: none"> • Bio-waste is to be reused rather than disposed of. • Consider how special risk material and post-digestive waste management may be improved. • Consider other initiatives on how the given targets may be continually improved. • Communicate the policy to each department and the responsibility of each individual to reduce, reuse and recycle waste

7.6.2 SECTION B: HEALTH AND SAFETY

Targets:

- Zero incidences on site
- 100% compliance with Health and Safety Regulations
- Zero complaints about noise and maintenance of standards.

ASPECT	MITIGATION MEASURE
Health and wellness	<ul style="list-style-type: none"> • Maintain current health training and surveillance of the staff.
Health and Safety Regulations	<ul style="list-style-type: none"> • Maintain Health and Safety Regulations currently implemented. • Identify areas of non-compliance and implement incentives and/or penalties for such.
Noise	<ul style="list-style-type: none"> • Conduct annual noise monitoring outside the building – take noise measurements at peak production, daytime and night time at all four boundaries of the site (except at the road). 70dB for industrial areas and 40 db day time for residential areas. • Consider mitigation if limits are exceeded or complaints are received for continued periods.

7.6.3 SECTION C: ODOUR MANAGEMENT

Targets:

- Zero complaints regarding odour
- "Based on the current modelling results, a control efficiency of 40% at the Rendering Plant should result in a significant reduction in odour detection hours at the AQSRs (below 1.5 OUE/m³). A 75% control efficiency should reduce the impacts at all receptors to acceptable levels (below 0.5 OUE/m³)."
(Airshed Planning Professionals, 2018).
- Implementation of design change mitigation strategies at the rendering plant (Appendix B).

ASPECT	MANAGEMENT ACTIONS
Odour management plan	Continue to implement the odour management plan – contents shown in Figure 4 overleaf
Tiered approach – design modifications and management actions, with monitoring to confirm effectiveness.	<ul style="list-style-type: none"> • Implement design modifications according to commitment in Appendix B. • Continue with management actions as per the odour management plan. • Continue to monitor odour complaints – the extent and frequency thereof compared to production rates. • Consider further odour monitoring, depending on the numbers of complaints received once the rendering plant has been modified.
	<p>Effluent treatment plant:</p> <ul style="list-style-type: none"> • Review operational and maintenance practices to become odour-sensitive (aerators currently being switched on and off daily including over week-ends which has improved the management regime. • Emptying and cleaning of fat traps, • Regular cleaning of contaminated areas, • prioritisation of the removal of solid waste before it enters the wastewater stream, • Apply appropriate tank and equipment cleaning procedures – these are useful to reduce chemical, water and energy consumption in cleaning operations. • Should the odour from the EFT still prove problematic, then add antioxidants such as nitrates to stored waste and effluent settling ponds. The nitrates are added in powder or granulate form and the resulting chemical reaction reduces odour levels.

ESSENTIAL SITE DETAILS
A process description, particularly describing odorous, or potentially odorous, activities or materials used (inventory)
Identification of all the release points for each of the activities (plan/map if possible)
Identification of the sensitive receptors within the area of influence that could be impacted (plan/map if possible)
A description of the meteorological conditions prevailing at the site, especially wind direction. A wind rose (from a nearby representative meteorological station or from site sensors if installed) is an ideal format.
ROUTINE CONTROLS UNDER NORMAL CONDITIONS
A description of the <i>routine</i> mitigation/control measures that would be used day-to-day under normal operating conditions in the absence of any unusual risk factors. Examples of routine control measures include receipt, inspection, acceptance/rejection of materials, storage, containment, handling, treatment and timing of activities.
A list of the actions in detail and who is responsible for carrying them out.
REASONABLY FORESEEABLE ABNORMAL CONDITIONS AND ADDITIONAL CONTROLS
Identification of possible risk factors (e.g. adverse weather conditions) and anticipation of reasonably foreseeable odour-related incidents and accidents (e.g., abnormal situations, spillages, power failure, breakdown of doors, equipment or abatement) and a listing of the consequences for odours of these risk factors.
A description of the <i>additional</i> measures (e.g. additional control measures and modifications to site operations, such as diverting odorous waste loads to facilities with less sensitive surroundings during adverse weather conditions) that will be applied during these periods to deal with these risks and any reasonably foreseeable incidents and accidents. If the measures are not sufficient, they need to be tightened further or else possibly ceasing/reducing odorous operations.
A list of the actions in detail and who is responsible for carrying them out.
TRIGGERS FOR ADDITIONAL CONTROLS AND CHECKS ON EFFECTIVENESS
A description of what would trigger this further action/additional measures, such as:
– the results of planned routine checks/inspections/surveys on site;
– the results of on-site measurements of process parameters and surrogate measurements for odour (e.g. pH, temperature, oxygen, etc) exceeding defined trigger levels;
– other metrics, such as particular meteorological conditions (e.g. temperature above a certain value, wind blowing in a particular direction, or calms); and
– odour monitoring on- and/or off-site, including:
• odour complaints monitoring (which should be carried out for all sites);
• monitoring carried out on-site, showing non-compliance with any emission limit values (ELVs) set for controlled point source releases; and
• monitoring carried out off-site (e.g. by sniff testing, odour diary surveys, etc), showing non-compliance with any action levels for ambient odour levels.
MANAGEMENT GOOD PRACTICE
A description of:
- the roles and responsibilities of personnel on site (e.g. organisational chart); and
- the training and competence of staff in odour-critical roles.
Details of how the following will be carried out, and who has been assigned managerial and operational responsibilities for them:
– implementing and maintaining the OMP;
– responding to odour-related incidents and any elevated odour levels from the aforementioned checks/inspections/surveys, monitoring, or on receipt of complaints of odour nuisance; including carrying out investigations and taking appropriate remedial action to prevent recurrence;
– planned maintenance and repair and the keeping of essential odour-critical spares;
– regular review (at least once per year) of the effectiveness of odour controls - including the OMP itself – taking account of complaints, monitoring results, inspections, surveys and other information and feedback received. This interval may be shorter if there have been complaints or relevant changes to your operations or infrastructure;
– engaging with your neighbours and communicating with relevant interested parties (e.g. local community and local authority) to provide necessary information and minimise their concerns and complaints, including methods used, content and frequency of communication; and
– keeping records of all activities and actions relating to odour and the OMP.

Figure 3: Suggested contents of an odour management plan (Source: "Air Quality and Odour Assessment for the Meatco Abattoir in Windhoek, Namibia by Airshed Planning Professionals, 2018.")

7.6.4 SECTION D: ENVIRONMENTAL TRAINING AND AWARENESS

Targets:

- 100% attendance of all staff at environmental induction training.
- 100% attendance of all staff of annual environmental training refresher courses

ASPECT	MANAGEMENT ACTIONS
Environmental induction (Training)	<p>The entire staff complement of Meatco should undergo environmental induction (training) which should include as a minimum the following:</p> <ul style="list-style-type: none"> • Explanation of the importance of environmental management with its legal requirements and implications. • Discussion of the potential environmental impacts of Meatco activities • Employees' roles and responsibilities, including waste reduction, health and safety, correct handling and disposal of waste and hazardous substances. • For each division, the specific environmental, health and safety provisions that are applicable. • Maintain the training for each staff member periodically. <p>The training could be combined with other, etc. Health and Safety, animal welfare, etc.</p>

7.6.5 SECTION E: COMMUNICATION WITH INTERESTED AND AFFECTED PARTIES (I&APS) AND AUTHORITIES

Targets:

- Establish an open communication policy
- List of I&APs compiled and constantly updated as new parties lodge complaints
- Updated complaints register.
- Responses sent within a period of 1 week of receipt of a complaint (acknowledgement of receipt), with a commitment of how the matter will be investigated and when feedback will be given.
- Honouring all commitments made above.
- Communication sent on any changes at the Plant that could affect the stakeholders.

ASPECT	MANAGEMENT MEASURES
General communication matters	<ul style="list-style-type: none"> • List I&APs of Meatco which include the neighbours, those that have complained in the past, those whom have complained in the past, as well as authorities of Meatco. • Continually update this list to include new correspondees, new appointees at Authorities, and new organisations with an interest. • A complaints register should be developed, which includes a record of complaints received (date, time and contents), as well as the details of how the matter is being dealt with. • All communication to stakeholders, particularly when it involves a complaint, is to be channelled through the Environmental Officer. • Complaints are to be acknowledged and referred to the department involved, with a commitment of how the matter will be dealt with and when feedback can be expected. • All decisions which involve complainants directly are to be communicated to them without delay. • Meatco shall communicate to the stakeholders if there are any changes made to the Plant that could affect them.

7.6.6 SECTION F: WATER CONSERVATION AND WATER QUALITY MANAGEMENT

Targets:

- 100% Compliance of City of Windhoek Effluent Treatment Standards
- 100% Compliance with City of Windhoek limits set for water consumption
- Water consumption target 1m³/LU

ASPECT	MANAGEMENT MEASURES
Water Conservation	<ul style="list-style-type: none"> • Stay abreast with the City of Windhoek Drought Policy and what the current standards and limits are • Renew water agreements with City of Windhoek as required, according to the Drought Response Plan • Apply and obtain water abstraction permits for the boreholes from the Ministry of Water Affairs and Forestry if the water is to be utilised during subsequent droughts.
Effluent Treatment	<ul style="list-style-type: none"> • Obtain and Renew effluent treatment discharge permits with the City of Windhoek as required. • Maintain effluent standards provided by the City of Windhoek, according to the Ujams WTP design capacity (Appendix C).

7.6.7 SECTION G: ENERGY CONSERVATION

Targets:

- Energy consumption target 67KWH/LU²
- Optimum non-renewable energy sources

ASPECT	MANAGEMENT MEASURES	
Renewable energy	<ul style="list-style-type: none"> • Consider the solar installation as recommended by the Environmental Footprint Feasibility Study (Mutschler Consult, 2018) which will increase the use of renewable energy sources on the site 	
Energy conservation	<ul style="list-style-type: none"> • Compile an energy conservation plan for the operations. 	
		<ul style="list-style-type: none"> • Maintain energy audit practices throughout the organisation. • Analyse the energy audit to consider possible defects, and to consider and implement solutions and improvements (Energy demand analysis depicts electrical demand of the facility at different times. Thermal imaging help identify & address inefficiency within electrical systems. Hot spots etc.)

² With low cattle numbers, it's currently not viable to achieve 67 kwh/LU until implementation of renewable energy (solar system) on site.

APPENDIX A

SPECIALIST ODOR MONITORING REPORT

Meatco Abattoir in Windhoek Passive Hydrogen Sulphide and Volatile Organic Compounds Sampling Campaign 2019

Project done on behalf of **Meatco Namibia**

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Report Reviewed by:
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Report No: 18EVD04 Rev1 | **Date:** November 2019



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Report Details

Report Title	Meatco Abattoir in Windhoek Passive Hydrogen Sulphide and Volatile Organic Compounds Sampling Campaign
Sampling period	31 July 2019 to 5 September 2019
Report number	18EVD04
Revision	Rev0
Date	November 2019
Client	Meatco Namibia
Prepared by	Hanlie Liebenberg-Enslin, PhD (University of Johannesburg, Johannesburg)
Reviewed by	Lucian Burger, PhD, MSc Eng (Chem) (University of Natal)
Notice	Airshed Planning Professionals (Pty) Ltd is a consulting company located in Midrand, South Africa, specialising in all aspects of air quality, ranging from nearby neighbourhood concerns to regional air pollution impacts as well as noise impact assessments. The company originated in 1990 as Environmental Management Services, which amalgamated with its sister company, Matrix Environmental Consultants, in 2003.
Declaration	Airshed is an independent consulting firm with no interest in the project other than to fulfill the contract between the client and the consultant for delivery of specialised services as stipulated in the terms of reference.
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Revision Record

Revision Number	Date	Revised Sections	Reason for Revision
Rev0	November 2019	Original	For client comment

Abbreviations

Airshed	Airshed Planning Professionals (Pty) Ltd
AQSRs	Air Quality Sensitive Receptors
ATSDR	Agency for Toxic Substances and Disease Registry
Cal EPA	California Environmental Protection Agency
CPVs	Cancer Potency Values
ECA	European Collaborative Action
H₂S	Hydrogen Sulphite
HC	Hydrocarbons
IRIS	Integrated Risk Information System
LOAEL	Lowest observed adverse effect level
MEI	Maximally Exposed Individual
MRLs	Minimal Risk Levels
NOAEL	No observed adverse effect level
NYS DOH	New York State Department of Health
OU	Odour Unit
OT	Odour threshold
PPRTVs	Provisional Peer Reviewed Toxicity Values
RELS	Reference Exposure Limits
ReVs	Reference Values
RfCs	Reference Concentrations
SA NAAQS	South Africa National Ambient Air Quality Standards
TCEQ	Texas Commission on Environmental Quality
TOC	Threshold odour concentrations
TVOC	Total Volatile Organic Compounds
UF	Uncertainty factor
URFs	Unit Risk Factors
US EPA	United States Environmental Protection Agency
VOC	Volatile Organic Compounds
WHO	World Health Organization

Table of Contents

1	Introduction.....	1
2	Methodology.....	3
3	Regulatory Requirements and Assessment Criteria	4
3.1	Criteria Pollutants	4
3.2	Non-criteria Pollutants	4
3.3	Odour Impact Evaluation	6
4	Sampling Campaign Results	8
4.1	H ₂ S Concentrations	9
4.2	VOC Concentrations.....	11
5	Conclusions.....	14
6	Recommendations	14
7	References.....	14
8	Appendix A – VOC group of Pollutants	16
9	Appendix B – VOC Sampling results.....	17
10	Appendix C – Laboratory Certificates of Analysis	26

List of Tables

Table 1: Passive sampling locations at and around the Meatco Abattoir	2
Table 2: National Ambient Air Quality Standards for benzene.....	4
Table 3: Screening criteria for ambient H ₂ S.....	5
Table 4: Screening criteria for species included in ambient VOC monitoring	6
Table 5: Odour threshold and Irritating concentrations for odorous components of VOC and H ₂ S associated with Food Processing Plants (Ruth, 1986)	7
Table 6: H ₂ S ambient concentrations from the two sampling campaigns for annual and 24-hour averages (<i>all coloured cells indicate exceedance of the relevant period limit</i>).....	9
Table 7: H ₂ S hourly concentrations from the two sampling campaigns for (<i>all coloured cells indicate exceedance of the relevant period limit</i>)	10
Table 8: VOC maximum hourly concentrations from the two sampling campaigns (<i>all coloured cells indicate exceedance of the relevant period limit</i>).....	12
Table 9: VOC Sampled concentrations for Sampling Campaign 1	17
Table 10: VOC Sampled concentrations for Sampling Campaign 2	19
Table 11: Calculated Annual average VOC concentrations for Sampling Campaign 1	21
Table 12: Calculated Annual average VOC concentrations for Sampling Campaign 2	23

List of Figures

Figure 1: Local study area and sensitive receptors	1
Figure 2: Location of the passive sampling locations around the Meatco Abattoir	2
Figure 3: Typical setup of Radiello™ passive diffusive tubes	3
Figure 4: Setup of the Meatco Radiello™ passive diffusive tubes	3

1 INTRODUCTION

Airshed Planning Professionals (Pty) Ltd (Airshed) undertook an air quality and odour impact assessment for the existing Meatco Abattoir in Windhoek, as part of an environmental clearance application (Liebenberg-Enslin & Grobler, 2018). Based on the findings from the study, a passive sampling campaign for hydrogen sulphite (H_2S) and Volatile Organic Compounds (VOC) were recommended. The purpose of the sampling campaign is to determine the ambient H_2S and VOC concentrations at and around the Meatco Abattoir in Windhoek, and to assess whether these levels are a nuisance and/or harmful to the surrounding environment.

Meatco is located in the south-eastern corner of the Northern Industrial area of Windhoek, surrounded by industries such as, but not limited to, car dealerships, panel-beaters and spray painters, a beverage distribution warehouse, a manufacturer of aluminium and steel windows; doors and frames, and a sales and distribution company. Air Quality Sensitive Receptors (AQSRs) generally include areas where members of the public may be affected by emissions generated by the facility being studied. The closest residential area is Eros, approximately 425 m to the southeast of Meatco with other residential areas to the east and southwest (Figure 1).



Figure 1: Local study area and sensitive receptors

The sampling locations in relation to the site and the surrounding environment are shown in Figure 2 and listed in Table 1. Four sampling sites are located on the Meatco premise, with four locations in the residential area of Eros to the south east and another two locations at industrial sites.

Table 1: Passive sampling locations at and around the Meatco Abattoir

Location	Description	ID	GPS Co-ordinates	
Meatco – Workshop	On-site, between the effluent plant and the rendering plant	MC01	-22.539	17.0807
Meatco – By Products	On-site, near the boiler	MC02	-22.5385	17.07917
Meatco – Entrance	On-site, at the entrance	MC03	-22.5397	17.07908
Meatco - Abattoir	On-site, near the abattoir	MC04	-22.5406	17.07996
Eros – Manor	~700m to the south east	MC05	-22.5439	17.08579
Eros – Turkoois Str. (Du Pisani)	~780m to the east	MC06	-22.5395	17.08893
Eros – WAP	~1.3km to the south east	MC07	-22.5457	17.09199
Eros – School (River)	~1km to the south south east	MC08	-22.5482	17.08765
N Industry – Wispeco	~710m east north east, at the waste dump	MC09	-22.5371	17.08765
N Industry – Tyres 2000	~500m to the north	MC10	-22.534	17.07769

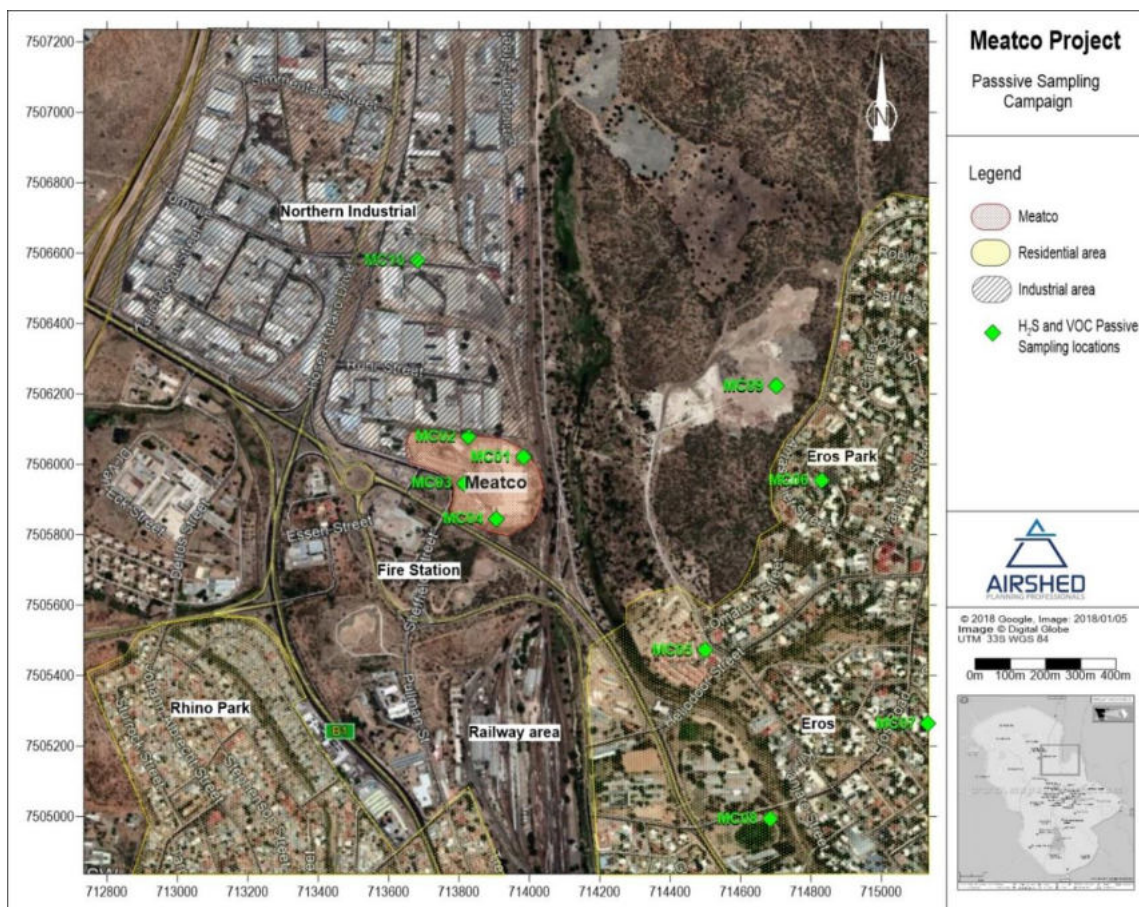


Figure 2: Location of the passive sampling locations around the Meatco Abattoir

2 METHODOLOGY

Five diffusive tubes were exposed to quantify the ambient concentration of VOCs (including benzene) and five for H₂S at and in the vicinity of the Meatco operations. Monitoring was scheduled to be taken over at least a month and included two exposure periods running back to back. The first monitoring period was from 31 July 2019 to 19 August 2019 (19 days), and the second campaign was from 19 August 2019 to 5 September 2019 (17 days). This was considered adequate to determine ambient concentrations that may be resulting from the Meatco operations. The sampling was undertaken using Radiello™ passive diffusive tubes according to ISO 16017 and analysed using gas chromatography/mass spectrometry.

Passive diffusive samplers consist of a shield, an installation plate, a diffusive body and a cartridge. Cartridges are exposed for a minimum period of 14-days, but not more than 30 days. Figure 3 and Figure 4 show the setup of the Radiello™ passive diffusive tubes.



Figure 3: Typical setup of Radiello™ passive diffusive tubes



Figure 4: Setup of the Meatco Radiello™ passive diffusive tubes

3 REGULATORY REQUIREMENTS AND ASSESSMENT CRITERIA

Prior to assessing the sampling results reference needs to be made to the regulations and guidelines governing the allowable ambient concentrations for all the associated pollutants. Air quality guidelines and standards are fundamental to effective air quality management, providing the link between the source of atmospheric emissions and the ambient air quality at the receptor site. The ambient air quality guideline values indicate safe exposure levels for the majority of the population, including the very young and the elderly, throughout an individual's lifetime. Air quality guidelines and standards are normally given for specific averaging periods. These averaging periods refer to the timespan over which the concentration of the pollutant monitored at a location should be estimated. Generally, five averaging periods are applicable, namely an instantaneous peak, 1-hour average, 24-hour average, 1-month average and annual average. The application of the guidelines and standards varies, with some countries allowing a certain number of exceedances of each of the concentration limit per year.

3.1 Criteria Pollutants

Criteria pollutants are considered those pollutants most commonly found in the atmosphere that have proven detrimental health effects when inhaled. Criteria pollutants are often regulated by ambient air quality standards or guidelines. Benzene (part of the VOC group) is a criteria pollutant and it is included in the South African National Ambient Air Quality Standard (NAAQS) published on 13 March 2009 (Table 2) (Government Gazette, 2009). The Namibian Atmospheric Pollution Prevention Act (Act No 45 of 1965) does not include any ambient air standards with which to comply, and in the absence thereof the NAAQS for benzene is used.

Table 2: National Ambient Air Quality Standards for benzene

Pollutant	Averaging Period	Limit Value ($\mu\text{g}/\text{m}^3$)	Limit Value (ppb)	Compliance Date
Benzene	1-year	5	1.6	Currently enforceable

3.2 Non-criteria Pollutants

Air quality criteria for non-criteria pollutants are published by various sources:

1. World Health Organization (WHO) guideline values for non-carcinogens and unit risk factors for carcinogens;
2. Inhalation reference concentrations (RfCs) and cancer unit risk factors (URFs) published by the United States Environmental Protection Agency (US EPA) Integrated Risk Information System (IRIS);
3. RfCs published by the US EPA's Provisional Peer Reviewed Toxicity Values (PPRTVs);
4. Minimal risk levels (MRLs) published by the Agency for Toxic Substances and Disease Registry (ATSDR);
5. Reference exposure levels (RELs) and Cancer Potency Values (CPVs) published by the California Environmental Protection Agency (Cal EPA); and
6. Inhalation reference values ReVs by the Texas Commission on Environmental Quality (TCEQ).

WHO guideline values are based on the no observed adverse effect level (NOAEL) and the lowest observed adverse effect level (LOAEL). Although most guideline values are based on NOAELs and/or LOAELs related to human health endpoints, certain of the guidelines given for 30-minute averaging periods are related to odour thresholds. The short-term ESLs issued by TARA for certain odorous compounds are similarly intended to be used for a screening for potential nuisance impacts related to malodour.

RfCs related to inhalation exposures are published in the US EPA's IRIS database. RfCs are used to estimate non-carcinogenic effects representing a level of environmental exposure at or below which no adverse effect is expected to occur. Non-carcinogenic effects are evaluated by calculating the ratio, or hazard index, between a dose (in this case the dosage) and the pollutant-specific inhalation RfC.

The US ATSDR uses the NOAEL/uncertainty factor (UF) approach to derive maximum risk levels (MRLs) for hazardous substances. These are set below levels that, based on current information, might cause adverse health effects in the people most sensitive to such substance-induced effects. MRLs are derived for acute (1-14 days), intermediate (>14-364 days), and chronic (365 days and longer) exposure durations, and for the oral and inhalation routes of exposure. MRLs are generally based on the most sensitive substance-induced end point considered to be of relevance to humans. ATSDR does not use serious health effects (such as irreparable damage to the liver or kidneys, or birth defects) as a basis for establishing MRLs. Exposure to a level above the MRL does not mean that adverse health effects will occur.

In the assessment of the potential for health risks use will generally be made of the lowest threshold published for a particular pollutant and averaging period. TARA ESLs will however only be used in the event that WHO guideline values, IRIS reference exposure concentrations, ATSDR MRLs or Californian RELs are not available.

Various non-carcinogenic exposure thresholds for pollutants of interest in the current study are given in Table 3 (H₂S) and Table 4 (VOCs). A description of VOCs as a group of pollutants are provided in Appendix A.

Table 3: Screening criteria for ambient H₂S

Pollutant	Acute Exposure Health Effect Screening Level (µg/m ³)	Chronic Inhalation Reference Concentration (µg/m ³)
Hydrogen Sulphide (H ₂ S)	42 (1-hour average) ^(a) 135 (4-hour average) ^(b) 100 (daily) ^(c)	2 ^(d) (US EPA IRIS)

Notes:

- (a) California Environmental Protection Agency Office of Environmental Health Hazard Assessment's Acute Reference Exposure Levels
- (b) Haahtele *et al.* (1992)
- (c) WHO (2003)

Table 4: Screening criteria for species included in ambient VOC monitoring

Pollutant	Chronic Inhalation Reference Concentration ($\mu\text{g}/\text{m}^3$)	Pollutant	Chronic Inhalation Reference Concentration ($\mu\text{g}/\text{m}^3$)
Acetone	30 900 ^(a)	Toluene	5 000 ^(c)
Pentane, n-	1 000 ^(b)	Tetrachloroethylene	40 ^(c)
Hexane, n-	700 ^(c)	Dibromoethane, 1,2-	9 ^(c)
Methyl ethyl ketone	5 000 ^(c)	Chlorobenzene	50 ^(b)
Ethyl Acetate	70 ^(b)	Ethylbenzene	1 000 ^(c)
Chloroform	97.65 ^(a)	Xylenes	100 ^(c)
Trichloroethane, 1,1,1-	5 000 ^(c)	Styrene	1 000 ^(c)
Dichloroethane, 1,2-	7 ^(b)	Nonane, n-	20 ^(b)
Benzene	5 ^(d)	Cumene	400 ^(c)
Carbon Tetrachloride	100 ^(c)	Propyl benzene	1 000 ^(b)
Cyclohexane	6 000 ^(c)	Trimethylbenzene, 1,3,5-	6 ^(b)
Heptane, n-	400 ^(b)	Trimethylbenzene, 1,2,4-	7 ^(b)
Trichloroethylene	2 ^(c)	Dichlorobenzene, 1,2-	200 ^(e)
Dioxane, 1,4-	30 ^(c)	Naphtalene	3 ^(c)
Methyl isobutyl ketone	3 000 ^(c)	Toluene	5 000 ^(c)

Notes:

- (a) ATSDR Final
- (b) PPRTV Current
- (c) US EPA IRIS
- (d) SA NAAQS
- (e) HEAST

3.3 Odour Impact Evaluation

The odour effect of concern in this study is the negative evaluation by a human receptor from the odour exposure. This exposure, occurring over a matter of seconds or minutes, involves many complex psychological and socio-economic factors. Once exposure to odour has occurred, the process can lead to adverse effects such as annoyance, nuisance and possibly complaints. Whereas *annoyance* is the adverse effect occurring from an immediate exposure, *nuisance* is the adverse effect caused cumulatively, by repeated events of annoyance (Bull, *et al.*, 2014).

Odour thresholds (OT) are defined in several ways including absolute perception thresholds, recognition thresholds and objectionable thresholds. At the perception threshold one is barely certain that an odour is detected but it is too faint to identify further. Recognition thresholds are normally given for 50% and 100% recognition by an odour panel.

Table 5 lists the low and high OT for H₂S and all the VOC compounds associated with food processing (Guerra, *et.al.* 2017). The concentrations where irritation would be experienced are also indicated.

Table 5: Odour threshold and Irritating concentrations for odorous components of VOC and H₂S associated with Food Processing Plants (Ruth, 1986)

Pollutant	Low OT ($\mu\text{g}/\text{m}^3$)	High OT ($\mu\text{g}/\text{m}^3$)	Description	Irritating Concentrations ($\mu\text{g}/\text{m}^3$)
Acetone	47 466	1 613 860	Minty, chemical, sweet	474 670
Benzene	4 500	270 000	Sweet, solventy	9 000 000
Carbon disulfide	24.3	23 100	Disagreeable, sweet	N.A.
Ethyl acetate	19.6	665 000	Fruity, pleasant	350 000
Ethyl benzene	8 700	870 000	Aromatic	870 000
Heptane	200 000	1 280 000	Gasoline-like	N.A.
Isopropyl alcohol	7 840	490 000	Pleasant	490 000
Methanol/ Methyl alcohol	13 115	26 840 000	Sweet	22 875 000
Methylethalketone	737.5	147 500	Sweet, acetone-like	590 000
Pentane	6 600	3 000 000	Gasoline-like	N.A.
Propene/ propylene	39 560	116 272	Aromatic	N.A.
Propyl acetate	210	105 000	Sweet, ester	N.A.
Toluene	3 200	17 120	Sweet, fruity, acrid	4 000
Xylene	348	174 000	Sweet	435 000
Hydrogen sulphide ^(a)	N.A.	11 ^(a)	Rotten eggs	2 800 ^(b)

Notes:

- (a) WHO (2003) geometric mean odour threshold
- (b) WHO (2003) WHO lowest observed-adverse-effect level (LOAEL)

The air quality and odour impact assessment study conducted for the Meatco Abattoir (Liebenberg-Enslin & Grobler, 2018) used the United Kingdom (UK) Institute of Air Quality Management (IAQM) which is based on the 98th percentile of hourly mean odour concentrations over a calendar year. This means that an odour concentration of 3 ou_E/m³ should not be exceeded for more than 2% of the hours in a year at any sensitive receptor outside the site boundary, equivalent to approximately 175 hours per annum. It was recommended that Meatco limits its odour impact to **3 ou_E/m³** at nearby industrial areas and **1.5 ou_E/m³** at the nearest residential sensitive receptor. This was based on the receptors surrounding the Meatco facility to be considered as “highly sensitive” based on the number of complaints received from the Eros Park, in specific, residential area.

The approach adopted in the current study includes:

- (a) Calculation of the 1-hour average air pollutant concentrations from the 19- and 17-day sampling periods (it should be noted that this represents the highest (100th percentile) and not the 98th percentile as per the IAQM criteria);
- (b) Recognition of the odour detection for a substance (Table 5);
- (c) Calculation of odour units by calculating ratios between calculated 1-hour average air pollutant concentrations and the respective detection limits (TOC); and
- (d) The application of the odour performance criteria as recommended – **3 ou_E/m³** at nearby industrial areas and **1.5 ou_E/m³** at the residential sensitive receptors.

4 SAMPLING CAMPAIGN RESULTS

H₂S and VOCs (Benzene, Toluene, Ethyl Benzene and Xylene) concentrations were sampled onto passive samplers at selected locations and are reported as a concentration per volume (µg/m³).

To compare sampled concentrations from the two exposure periods of 19-days and 17-days, to short-term (hourly and daily) and annual average guidelines, equivalent average concentrations were extrapolated.

Beychok (2005) recommends the following equation for extrapolating time averaging periods of from days to 1 year:

$$\frac{C_x}{C_p} = \left(\frac{t_p}{t_x}\right)^{0.53}$$

where:

C_x and C_p are concentrations over any two averaging periods between 24 hours and 1 year;

t_x and t_p are corresponding averaging times in days.

For extrapolating time averaging periods of from 24 hours to hourly, the US EPA (1995) guidelines are used:

$$C_p = C_m * \left(\frac{t_m}{t_p}\right)^p$$

where:

C_p = Peak concentration, expressed on the new averaging time (µg/m³)

C_m = Mean concentration on one hour averaging time (µg/m³)

t_m = Averaging time for mean hour (24 hours).

t_p = New averaging time (1 hour).

P = Decay value = 0.2 (non-dimensional).

The mathematical extrapolations for averaging periods shorter than 24 hours should be cautiously interpreted in terms of the number of exceedances of the guideline limit concentrations for hourly and daily averaging periods. These estimates provide conservative hourly and daily concentrations. It should be further noted that the selected odour thresholds (OT) are based on a 98th percentile whereas these calculations represent the maximum (100th percentile) concentration.

The odour unit is based on the 1-hourly calculated concentration using the following equation:

$$D = C/T$$

where:

D – is the odour concentration of a compound (dimensionless, odour units ouE/m³)

C – is the chemical concentration of a compound in µg/m³

T – is the published odour threshold value of a compound in µg/m³.

4.1 H₂S Concentrations

Passive sampling results for H₂S are presented in Table 6, with extrapolated daily and annual concentrations provided. The coloured cells in the table indicate concentrations exceeding the relevant limits. The hourly extrapolated concentrations and odour units, provided as a minimum, average and maximum to indicate the potential range, are provided in Table 7.

Over an annual and daily averaging period, the extrapolated concentrations only exceed the relevant limits on-site at MC01 – between the effluent and rendering plants. During the first sampling campaign the annual limit was also exceeded at the waste dump (MC09). The hourly average extrapolated concentrations, as mentioned above should be regarded as conservative, indicate exceedances of the acute REL at all the on-site sampling locations and the Wispeco industrial site.

Odour threshold exceedances screened against the 3 ou_E/m³ on-site and at nearby industrial areas and 1.5 ou_E/m³ at residential sensitive receptors, occurred most of the on-site locations and at the industrial locations. For the residential areas the odours were below the 1.5 ou_E/m³ during both campaigns.

Table 6: H₂S ambient concentrations from the two sampling campaigns for annual and 24-hour averages (all coloured cells indicate exceedance of the relevant period limit)

Location	ID	Concentration (µg/m ³)	Calculated Concentrations (µg/m ³)	
			Sample Period	Annual Average
Sampling Campaign 1 (31 July to 19 August 2019) – 19 days				
Meatco – Workshop	MC01	85.84	17.92	408.72
Meatco – By Products	MC02	9.38	1.96	44.66
Meatco – Entrance	MC03	3.84	0.80	18.28
Meatco - Abattoir	MC04	0.93	0.19	4.43
Eros – Manor	MC05	0.17	0.04	0.81
Eros – Turkoois Str. (Du Pisani)	MC06	<0.13 ^(a)	0.01	0.31
Eros – WAP	MC07	0.16	0.03	0.76
Eros – School (River)	MC08	0.26	0.05	1.24
N Industry – Wispeco	MC09	11.56	2.41	55.04
N Industry – Tyres 2000	MC10	3.37	0.70	16.05
Sampling Campaign 2 (19 August to 5 September 2019) – 17 days				
Meatco – Workshop	MC01	57.65	11.35	258.78
Meatco – By Products	MC02	3.90	0.77	17.51
Meatco – Entrance	MC03	1.50	0.30	6.73
Meatco - Abattoir	MC04	2.57	0.51	11.54
Eros – Manor	MC05	<0.15 ^(a)	0.01	0.34
Eros – Turkoois Str. (Du Pisani)	MC06	0.21	0.04	0.94
Eros – WAP	MC07	0.16	0.03	0.72

Location	ID	Concentration ($\mu\text{g}/\text{m}^3$)	Calculated Concentrations ($\mu\text{g}/\text{m}^3$)	
Eros – School (River)	MC08	0.46	0.09	2.06
N Industry – Wispeco	MC09	4.95	0.97	22.22
N Industry – Tyres 2000	MC10	1.28	0.25	5.75

Notes:

- (a) Concentration is below detection limit and 50% of the detection limit was assumed

Table 7: H₂S hourly concentrations from the two sampling campaigns for (all coloured cells indicate exceedance of the relevant period limit)

Location	ID	Conc. ($\mu\text{g}/\text{m}^3$)	Calculated Hourly Concentrations ($\mu\text{g}/\text{m}^3$)			Odour Unit (OU/m ³) ^(b)		
			Sample Period	Minimum	Average	Maximum	Minimum	Average
Sampling Campaign 1 (31 July to 19 August 2019) – 19 days								
Meatco – Workshop	MC01	85.84	681.21	1 021.81	2 043.62	61.93	92.89	185.78
Meatco – By Products	MC02	9.38	74.44	111.66	223.31	6.77	10.15	20.30
Meatco – Entrance	MC03	3.84	30.47	45.71	91.42	2.77	4.16	8.31
Meatco - Abattoir	MC04	0.93	7.38	11.07	22.14	0.67	1.01	2.01
Eros – Manor	MC05	0.17	1.35	2.02	4.05	0.12	0.18	0.37
Eros – Turkoois Str. (Du Pisani)	MC06	<0.13 ^(a)	0.52	0.77	1.55	0.05	0.07	0.14
Eros – WAP	MC07	0.16	1.27	1.90	3.81	0.12	0.17	0.35
Eros – School (River)	MC08	0.26	2.06	3.09	6.19	0.19	0.28	0.56
N Industry – Wispeco	MC09	11.56	91.74	137.61	275.21	8.34	12.51	25.02
N Industry – Tyres 2000	MC10	3.37	26.74	40.12	80.23	2.43	3.65	7.29
Sampling Campaign 2 (19 August to 5 September 2019) – 17 days								
Meatco – Workshop	MC01	57.65	431.31	646.96	1 293.92	39.21	58.81	117.63
Meatco – By Products	MC02	3.90	29.18	43.77	87.53	2.65	3.98	7.96
Meatco – Entrance	MC03	1.50	11.22	16.83	33.67	1.02	1.53	3.06
Meatco - Abattoir	MC04	2.57	19.23	28.84	57.68	1.75	2.62	5.24
Eros – Manor	MC05	<0.15 ^(a)	0.56	0.84	1.68	0.05	0.08	0.15
Eros – Turkoois Str. (Du Pisani)	MC06	0.21	1.57	2.36	4.71	0.14	0.21	0.43
Eros – WAP	MC07	0.16	1.20	1.80	3.59	0.11	0.16	0.33
Eros – School (River)	MC08	0.46	3.44	5.16	10.32	0.31	0.47	0.94
N Industry – Wispeco	MC09	4.95	37.03	55.55	111.10	3.37	5.05	10.10
N Industry – Tyres 2000	MC10	1.28	9.58	14.36	28.73	0.87	1.31	2.61

Notes:

- (a) Concentration is below detection limit and 50% of the detection limit was assumed
(b) 3 ou $\mu\text{E}/\text{m}^3$ at nearby industrial areas and 1.5 ou $\mu\text{E}/\text{m}^3$ at the residential sensitive receptors

4.2 VOC Concentrations

The full suite of VOC compounds sampled for is included in Appendix B – VOC Sampling results. The calculated annual average VOC concentrations are listed in Appendix B, Table 11 for Sampling Campaign 1 and in Table 12 for Sampling Campaign 2. None of the VOC compounds exceeded the associated chronic health screening thresholds provided in Table 4, and the benzene concentrations were below the annual average NAAQS of 5 µg/m³. Total VOCs were the highest on-site at MC01, MC02 and MC03, followed by the other two industrial sites (MC09 and MC10) with the residential site reflecting the lowest concentrations – this is true for both sampling campaigns.

The extrapolated hourly concentrations for the odorous VOC compounds associated with food processing plants (Guerra, *et.al.* 2017) are listed in Table 8. The same methodology for calculating hourly concentrations as applied to the H₂S concentrations were used, but only the maximum hourly concentrations are listed (not the minimum and average) and were screened against the lowest odour thresholds (Table 5). This is regarded a very conservative approach, but with the aim to identify possible odorous VOCs from the Meatco Abattoir. None of the identified VOC compounds exceeded the selected odour thresholds on-site, or at the other industrial sites, or at any of the residential areas. The only compounds with the potential to be detected are ethyl acetate, propyl acetate, toluene and xylene. These all have a sweet fruity smell and not the smell that the complaints are about.

The sampled concentrations are provided in Appendix C – Laboratory certificates.

Table 8: VOC maximum hourly concentrations from the two sampling campaigns (all coloured cells indicate exceedance of the relevant period limit)

Location	1MC 01	1MC 02	1MC 03	1MC 04	1MC 05	1MC 06	1MC 07	1MC 08	1MC 09	1MC 10	2MC 01	2MC 02	2MC 03	2MC 04	2MC 05	2MC 06	2MC 07	2MC 08	2MC 09	2MC 10	
Maximum Hourly Concentrations (µg/m³)																					
Pollutant	Sampling Campaign 1 (31 July to 19 August 2019) – 19 days										Sampling Campaign 2 (19 August to 5 September 2019) – 17 days										
Acetone	58.13	108.74	62.42	63.37	41.46	55.37	41.72	42.11	49.93	72.46	71.08	58.88	52.11	48.17	38.25	51.59	50.68	45.43	65.70	39.36	
Benzene	17.85	18.98	26.27	20.13	22.91	11.68	15.18	21.54	19.76	28.06	12.02	10.69	10.32	16.69	16.57	6.97	8.66	13.54	13.00	21.55	
Carbon disulfide	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethyl acetate	4.46	4.46	4.46	4.46	4.46	4.46	4.46	4.46	4.46	4.46	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70	4.70
Ethyl benzene	12.88	43.33	16.60	13.00	16.15	7.68	9.06	13.56	14.55	25.39	12.93	23.77	14.84	11.79	14.37	8.09	8.09	8.24	13.49	16.67	
Heptane	7.50	8.21	7.50	7.50	7.50	7.50	7.50	7.50	7.50	10.23	7.90	7.90	7.90	7.90	7.90	7.90	7.90	7.90	7.90	7.90	7.90
Isopropyl alcohol	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methanol/ Methyl alcohol	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylethalketone	13.20	9.40	4.41	4.41	4.41	4.41	4.41	4.41	4.41	14.16	4.64	4.64	4.64	4.64	4.64	4.64	4.64	4.64	4.64	9.75	
Pentane	46.89	31.36	51.39	45.27	45.86	18.95	22.42	34.16	39.10	34.38	33.53	39.15	35.19	41.48	35.61	26.65	27.38	34.12	25.93	52.44	
Propene/ propylene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Propyl acetate	4.02	4.02	4.02	4.02	4.02	4.02	4.02	4.02	4.02	4.02	4.23	4.23	4.23	4.23	4.23	4.23	4.23	4.23	4.23	4.23	4.23
Toluene	1 348.69	196.76	148.08	85.03	90.78	43.57	48.22	74.84	214.87	164.66	262.38	93.65	69.78	84.53	70.16	27.83	30.58	43.00	66.00	95.63	
Xylene	20.88	60.62	25.19	17.46	22.68	8.03	11.63	18.96	21.44	32.62	18.14	33.74	25.79	14.61	16.85	8.46	8.46	11.16	14.57	27.37	
Odour Unit (OU/m³)^(b)																					
Pollutant	Sampling Campaign 1 (31 July to 19 August 2019) – 19 days										Sampling Campaign 2 (19 August to 5 September 2019) – 17 days										
Acetone	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
Benzene	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Carbon disulfide	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ethyl acetate	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
Ethyl benzene	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Heptane	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Isopropyl alcohol	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Location	1MC 01	1MC 02	1MC 03	1MC 04	1MC 05	1MC 06	1MC 07	1MC 08	1MC 09	1MC 10	2MC 01	2MC 02	2MC 03	2MC 04	2MC 05	2MC 06	2MC 07	2MC 08	2MC 09	2MC 10
Methanol/ Methyl alcohol	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Methylethalketone	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Pentane	0.01	0.00	0.01	0.01	0.01	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.00	0.01
Propene/ propylene	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Propyl acetate	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Toluene	0.42	0.06	0.05	0.03	0.03	0.01	0.02	0.02	0.07	0.05	0.08	0.03	0.02	0.03	0.02	0.01	0.01	0.01	0.02	0.03
Xylene	0.06	0.17	0.07	0.05	0.07	0.02	0.03	0.05	0.06	0.09	0.05	0.10	0.07	0.04	0.05	0.02	0.02	0.03	0.04	0.08

Notes:

- (a) Concentration is below detection limit and 50% of the detection limit was assumed
- (b) 3 ou_E/m³ at nearby industrial areas and 1.5 ou_E/m³ at the residential sensitive receptors

5 CONCLUSIONS

It was determined from calculated concentrations based on the two sampling campaigns that the current operations at the Meatco Abattoir result in high H₂S concentrations on-site and at the other industrial sites, exceeding both the acute health screening limit as well as the odour threshold. Based on the sampled results, the smell of H₂S should be very distinct at the Meatco premises and the surrounding industrial areas. The H₂S concentrations did not exceed any of the health criteria at the residential sites neither did it exceed the assumed odour threshold. However, as indicated in the air quality and odour impact assessment (Liebenberg-Enslin & Grobler, 2018), odours are detected during certain hours of the day which the passive sampling does not show (it is an average over 17- and 19 days). It should be noted that low odour exposures (between 0.5 to <1.5 ouE/m³), which is below the assumed threshold of 50% of the panel identifying the compound, could be detected by sensitive individuals.

The calculated ambient VOC concentrations were below the international health screening criteria for all compounds. The conservative short-term (hourly) calculations indicated no odour exceedances from these compounds at any of the sampling locations. Only four of the VOC compounds associated with food processing indicated a potential for odour nuisance but these all have a sweet fruity smell and not what the complaints are about. Also, the difference in concentrations measured at the industrial sites compared to the residential sites were much smaller compared to the H₂S concentrations, indicating that these may also be from other sources such as vehicle exhaust emissions.

6 RECOMMENDATIONS

Quarterly monitoring campaigns should provide a measure of progress in air quality due to process and management improvements at the facility, such as effective management of the effluent plant which is the main source of H₂S.

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8 APPENDIX A – VOC GROUP OF POLLUTANTS

VOC is the name given to a class of several hundred carbon-based chemical compounds that evaporate easily into the air. VOC sources include fuel additives, fuel evaporation, and incomplete combustion. Some VOC's have little or no known direct human health effects, while others are extremely toxic and/or carcinogenic. Very little is known about how various VOC's combine in the atmosphere or in the human body, or what the cumulative impacts of exposure might be.

As the term VOC refers to a group of pollutants, generally guidelines are not available for comparison to determine the health impacts due to exposure to these pollutants. To estimate the probable health impacts a breakdown of the types of pollutants, which dominate in a specific area is required, whereby their respective toxicities can be determined.

Although standards for exposure to VOC's in non-industrial settings do not exist, a number of exposure limits have been recommended. The European Collaborative Action (ECA) Report No. 11 titled *Guidelines for Ventilation Requirements in Buildings* (European Concerted Action, 1992) lists the following Total VOC (TVOC) concentration ranges as measured with a flame ionisation detector calibrated to toluene. These recommendations are based on Mølhave's toxicological work on mucous membrane irritation (Mølhave, 1990).

Comfort range:	<200 µg/m ³
Multifactoral exposure range:	200 to 3 000 µg/m ³
Discomfort range:	3 000 to 25 000 µg/m ³
Toxic range:	>25 000 µg/m ³

The same European report also lists a second method based on Seifert's work (Seifert, 1990). This method established TVOC guidelines based on the ten most prevalent compounds in each of seven chemical classes. The concentrations in each of these classes should be below the maximums listed below.

Alkanes:	100 µg/m ³ .
Aromatic hydrocarbons:	50 µg/m ³ .
Terpenes:	30 µg/m ³ .
Halocarbons:	30 µg/m ³ .
Esters:	20 µg/m ³ .
Aldehydes and ketones (excluding formaldehyde):	20 µg/m ³ .
Other:	50 µg/m ³ .

The VOC concentration is calculated by adding the totals from each class. Seifert gives a target TVOC concentration of 300 µg/m³, which is the sum of the above-listed target concentrations. The author also states that no individual compound concentration should exceed 50 percent of the guideline for its class or 10 percent of the TVOC guideline concentration. However, Seifert states that "...the proposed target value is not based on toxicological considerations but – to the author's best judgment."

9 APPENDIX B – VOC SAMPLING RESULTS

All blue values in the table point toward the compound being below the detection limit. All concentrations are in µg/m³.

Table 9: VOC Sampled concentrations for Sampling Campaign 1

Pollutant	17-days Concentration (µg/m³)									
	31 July 2019 to 19 August 2019									
	MC01	MC02	MC03	MC04	MC05	MC06	MC07	MC08	MC09	MC10
Acetone	2.44	4.57	2.62	2.66	1.74	2.33	1.75	1.77	2.10	3.04
Pentane	1.97	1.32	2.16	1.90	1.93	0.80	0.94	1.43	1.64	1.44
n-Hexane	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.11
Methylethylketone	0.55	0.39	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.59
Ethyl Acetate	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Chloroform	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58	0.58
1,1,1-Trichloroethane	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
1,2-Dichloroethane	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66	0.66
Isopropyl Acetate	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55	0.55
Benzene	0.75	0.80	1.10	0.85	0.96	0.49	0.64	0.90	0.83	1.18
Cyclohexane	0.48	0.59	0.71	0.46	0.63	0.41	0.41	0.53	0.58	0.81
Carbon Tetrachloride	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76	0.76
Fluorobenzene (IS)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Isooctane	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Heptane	0.63	0.69	0.63	0.63	0.63	0.63	0.63	0.63	0.63	0.86
Trichloroethylene	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64	0.64

Meatco Abattoir in Windhoek Passive Hydrogen Sulphide and Volatile Organic Compounds Sampling Campaign

Pollutant	17-days Concentration ($\mu\text{g}/\text{m}^3$)									
	31 July 2019 to 19 August 2019									
	MC01	MC02	MC03	MC04	MC05	MC06	MC07	MC08	MC09	MC10
1,4-Dioxane	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07	1.07
Propyl acetate	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34	0.34
Methyl Isobutyl Ketone	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33	0.33
Toluene	56.65	8.26	6.22	3.57	3.81	1.83	2.03	3.14	9.03	6.92
Isobutyl Acetate	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46
Tetrachloroethylene	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87	0.87
1,2-Dibromoethane	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62
Butyl Acetate	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49
Chlorobenzene	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32	0.32
Ethylbenzene	0.54	1.82	0.70	0.55	0.68	0.32	0.38	0.57	0.61	1.07
m+p-Xylene	2.11	6.00	2.41	1.81	2.28	0.92	1.15	1.92	2.06	3.56
Styrene	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36
o-Xylene	0.88	2.55	1.06	0.73	0.95	0.34	0.49	0.80	0.90	1.37
Nonane	2.23	8.22	0.77	0.46	0.46	0.65	0.46	0.46	0.76	0.52
Cumene	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38
Propylbenzene	0.38	0.66	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38
1,3,5-Trimethylbenzene	0.44	1.06	0.44	0.44	0.44	0.44	0.44	0.44	0.44	0.44
1,2,4-Trimethylbenzene	0.84	3.91	0.82	0.60	0.73	0.44	0.44	0.55	0.59	0.85
Decane	2.68	10.13	0.80	0.51	0.51	0.51	0.51	0.51	1.03	0.63
p-Cymene (IS)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,2-Dichlorobenzene	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43

Pollutant	17-days Concentration ($\mu\text{g}/\text{m}^3$)									
	31 July 2019 to 19 August 2019									
	MC01	MC02	MC03	MC04	MC05	MC06	MC07	MC08	MC09	MC10
Naphthalene	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88	0.88
TOTAL VOCs	85.92	63.32	33.53	28.25	28.84	23.19	23.35	26.75	34.28	36.00

Table 10: VOC Sampled concentrations for Sampling Campaign 2

Pollutant	19-days Concentration ($\mu\text{g}/\text{m}^3$)									
	19 August 2019 to 5 September 2019									
	MC01	MC02	MC03	MC04	MC05	MC06	MC07	MC08	MC09	MC10
Acetone	3.17	2.62	2.32	2.15	1.70	2.30	2.26	2.02	2.93	1.75
Pentane	1.49	1.74	1.57	1.85	1.59	1.19	1.22	1.52	1.16	2.34
n-Hexane	1.24	1.24	1.24	1.24	1.24	1.24	1.24	1.24	1.24	1.24
Methylethylketone	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.41	0.43
Ethyl Acetate	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42
Chloroform	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65	0.65
1,1,1-Trichloroethane	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79	0.79
1,2-Dichloroethane	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74
Isopropyl Acetate	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62	0.62
Benzene	0.54	0.48	0.46	0.74	0.74	0.31	0.39	0.60	0.58	0.96
Cyclohexane	0.45	0.45	0.46	0.68	0.45	0.45	0.45	0.45	0.45	0.80
Carbon Tetrachloride	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Fluorobenzene (IS)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Isooctane	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45

Pollutant	19-days Concentration ($\mu\text{g}/\text{m}^3$)									
	19 August 2019 to 5 September 2019									
	MC01	MC02	MC03	MC04	MC05	MC06	MC07	MC08	MC09	MC10
Heptane	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70
Trichloroethylene	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71
1,4-Dioxane	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20	1.20
Propyl acetate	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38	0.38
Methyl Isobutyl Ketone	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37	0.37
Toluene	11.69	4.17	3.11	3.77	3.13	1.24	1.36	1.92	2.94	4.26
Isobutyl Acetate	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52	0.52
Tetrachloroethylene	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97	0.97
1,2-Dibromoethane	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69	0.69
Butyl Acetate	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54
Chlorobenzene	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36	0.36
Ethylbenzene	0.58	1.06	0.66	0.53	0.64	0.36	0.36	0.37	0.60	0.74
m+p-Xylene	1.80	3.71	2.24	1.81	1.61	0.90	0.88	1.05	1.85	3.02
Styrene	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
o-Xylene	0.81	1.50	1.15	0.65	0.75	0.38	0.38	0.50	0.65	1.22
Nonane	1.44	6.01	4.84	0.51	0.51	0.51	0.51	0.51	0.96	0.88
Cumene	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42	0.42
Propylbenzene	0.43	0.44	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.43
1,3,5-Trimethylbenzene	0.49	0.69	0.49	0.49	0.49	0.49	0.49	0.49	0.49	0.49
1,2,4-Trimethylbenzene	0.70	2.26	1.16	0.49	0.65	0.49	0.49	0.49	0.50	0.84
Decane	1.82	6.59	4.16	0.57	0.57	0.57	0.57	0.57	0.97	0.78

Meatco Abattoir in Windhoek Passive Hydrogen Sulphide and Volatile Organic Compounds Sampling Campaign

Pollutant	19-days Concentration ($\mu\text{g}/\text{m}^3$)									
	19 August 2019 to 5 September 2019									
	MC01	MC02	MC03	MC04	MC05	MC06	MC07	MC08	MC09	MC10
p-Cymene (IS)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,2-Dichlorobenzene	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48	0.48
Naphthalene	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98	0.98
TOTAL VOCs	40.31	46.64	37.96	29.56	28.16	24.52	24.69	25.82	29.41	33.44

Table 11: Calculated Annual average VOC concentrations for Sampling Campaign 1

Pollutant	17-days Concentration ($\mu\text{g}/\text{m}^3$)									
	31 July 2019 to 19 August 2019									
	MC01	MC02	MC03	MC04	MC05	MC06	MC07	MC08	MC09	MC10
Acetone	0.51	0.95	0.55	0.56	0.36	0.49	0.37	0.37	0.44	0.64
Pentane	0.41	0.28	0.45	0.40	0.40	0.17	0.20	0.30	0.34	0.30
n-Hexane	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23
Methylethylketone	0.12	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.12
Ethyl Acetate	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Chloroform	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
1,1,1-Trichloroethane	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
1,2-Dichloroethane	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
Isopropyl Acetate	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Benzene	0.16	0.17	0.23	0.18	0.20	0.10	0.13	0.19	0.17	0.25
Cyclohexane	0.10	0.12	0.15	0.10	0.13	0.08	0.08	0.11	0.12	0.17
Carbon Tetrachloride	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16

Pollutant	17-days Concentration ($\mu\text{g}/\text{m}^3$)									
	31 July 2019 to 19 August 2019									
	MC01	MC02	MC03	MC04	MC05	MC06	MC07	MC08	MC09	MC10
Fluorobenzene (IS)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Isooctane	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Heptane	0.13	0.14	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.18
Trichloroethylene	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
1,4-Dioxane	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22
Propyl acetate	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Methyl Isobutyl Ketone	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Toluene	11.83	1.73	1.30	0.75	0.80	0.38	0.42	0.66	1.88	1.44
Isobutyl Acetate	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Tetrachloroethylene	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
1,2-Dibromoethane	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
Butyl Acetate	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Chlorobenzene	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Ethylbenzene	0.11	0.38	0.15	0.11	0.14	0.07	0.08	0.12	0.13	0.22
m+p-Xylene	0.44	1.25	0.50	0.38	0.48	0.19	0.24	0.40	0.43	0.74
Styrene	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
o-Xylene	0.18	0.53	0.22	0.15	0.20	0.07	0.10	0.17	0.19	0.29
Nonane	0.46	1.72	0.16	0.10	0.10	0.14	0.10	0.10	0.16	0.11
Cumene	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Propylbenzene	0.08	0.14	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
1,3,5-Trimethylbenzene	0.09	0.22	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09

Pollutant	17-days Concentration ($\mu\text{g}/\text{m}^3$)									
	31 July 2019 to 19 August 2019									
	MC01	MC02	MC03	MC04	MC05	MC06	MC07	MC08	MC09	MC10
1,2,4-Trimethylbenzene	0.18	0.82	0.17	0.12	0.15	0.09	0.09	0.12	0.12	0.18
Decane	0.56	2.12	0.17	0.11	0.11	0.11	0.11	0.11	0.21	0.13
p-Cymene (IS)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,2-Dichlorobenzene	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
Naphthalene	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18	0.18
TOTAL VOCs	17.94	13.22	7.00	5.90	6.02	4.84	4.88	5.58	7.16	7.52

Table 12: Calculated Annual average VOC concentrations for Sampling Campaign 2

Pollutant	19-days Concentration ($\mu\text{g}/\text{m}^3$)									
	19 August 2019 to 5 September 2019									
	MC01	MC02	MC03	MC04	MC05	MC06	MC07	MC08	MC09	MC10
Acetone	0.62	0.52	0.46	0.42	0.34	0.45	0.44	0.40	0.58	0.35
Pentane	0.29	0.34	0.31	0.36	0.31	0.23	0.24	0.30	0.23	0.46
n-Hexane	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
Methylethylketone	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.09
Ethyl Acetate	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Chloroform	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13	0.13
1,1,1-Trichloroethane	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
1,2-Dichloroethane	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
Isopropyl Acetate	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Benzene	0.11	0.09	0.09	0.15	0.15	0.06	0.08	0.12	0.11	0.19

Pollutant	19-days Concentration ($\mu\text{g}/\text{m}^3$)									
	19 August 2019 to 5 September 2019									
	MC01	MC02	MC03	MC04	MC05	MC06	MC07	MC08	MC09	MC10
Cyclohexane	0.09	0.09	0.09	0.13	0.09	0.09	0.09	0.09	0.09	0.16
Carbon Tetrachloride	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17	0.17
Fluorobenzene (IS)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Isooctane	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
Heptane	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
Trichloroethylene	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
1,4-Dioxane	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24
Propyl acetate	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Methyl Isobutyl Ketone	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Toluene	2.30	0.82	0.61	0.74	0.62	0.24	0.27	0.38	0.58	0.84
Isobutyl Acetate	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Tetrachloroethylene	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
1,2-Dibromoethane	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14	0.14
Butyl Acetate	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11	0.11
Chlorobenzene	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.07
Ethylbenzene	0.11	0.21	0.13	0.10	0.13	0.07	0.07	0.07	0.12	0.15
m+p-Xylene	0.36	0.73	0.44	0.36	0.32	0.18	0.17	0.21	0.36	0.59
Styrene	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
o-Xylene	0.16	0.30	0.23	0.13	0.15	0.07	0.07	0.10	0.13	0.24
Nonane	0.28	1.18	0.95	0.10	0.10	0.10	0.10	0.10	0.19	0.17
Cumene	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08

Pollutant	19-days Concentration ($\mu\text{g}/\text{m}^3$)									
	19 August 2019 to 5 September 2019									
	MC01	MC02	MC03	MC04	MC05	MC06	MC07	MC08	MC09	MC10
Propylbenzene	0.08	0.09	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
1,3,5-Trimethylbenzene	0.10	0.14	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
1,2,4-Trimethylbenzene	0.14	0.44	0.23	0.10	0.13	0.10	0.10	0.10	0.10	0.17
Decane	0.36	1.30	0.82	0.11	0.11	0.11	0.11	0.11	0.19	0.15
p-Cymene (IS)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1,2-Dichlorobenzene	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09
Naphthalene	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19
TOTAL VOCs	7.93	9.18	7.47	5.82	5.54	4.83	4.86	5.08	5.79	6.58

CERTIFICATE OF ANALYSIS

R19-16765



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Company : Airshed Planning Professionals (Pty) Ltd
 Address : PO Box 5260, Halfway House, 1685
 Contact : Hanlie Liebenberg-Enslin
 Reference Number : 19EVD01 HLE
 Date Received : 29 October 2019
 Date Completed : 07 November 2019
 Condition of sample(s) : All samples received at room temperature
 Lab Number(s) : B137886 - B137905

Analysis of 20 radiello sample(s) as received:

Test # : Hydrogen Sulfide (H₂S)
 Method : Radiello Method H1

Determinant --	H ₂ S
Sample ID ↓	Result µg/m ³
S961M	85.84
S962M	9.38
S963M	3.84
S964M	0.93
S965M	0.17
S966M	< 0.13
S967M	0.16
S968M	0.26
S969M	11.56
S970M	3.37
N875R	57.65
S972M	3.90
S973M	1.50
S974M	2.57
S975M	< 0.15
S976M	0.21
S977M	0.16
S978M	0.46
S979M	4.95
S980M	1.28

Results in units specified

Approximate quantitation limit signified by "<" followed by the limit value

In-house radiello used for blank correction

Disclaimer:

This report relates to the specific items tested only and may not be reproduced in part or full without the written consent of Biograde.

Tests marked with # in this report are not included in the SANAS schedule of accreditation for this laboratory.

Willem Wepener
 Head of laboratory



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Mossburn, NSW
2578
Tel: 07533 34524
Fax: 07533 31838
Email: info@biograde.com.au

CERTIFICATE OF ANALYSIS

R19-16674



Company : Alsted Planning Professionals (Pt) Ltd
Address : PO Box 5200 11A New House, 805
Contact : Hank Liebenberg 8 mbs
Reference Number : 18EVD01 ILI
Date Received : 22 October 2019
Date Completed : 24 October 2019
Condition of sample(s) : All samples received at room temperature
Lab Number(s) : 18EVD 001-001/001

Analysis of 20 volatile samples as received
Lot : Volatile organic compounds (VOC)
Method : Based on Method 01 and Method 08

Table with 21 columns (Sample ID, NEM01 to NEM20) and 39 rows of chemical compounds. Each cell contains a result value and a detection limit. The table lists various hydrocarbons, alcohols, aldehydes, ketones, and esters.

Notes: 1) 100% 1ppm/ $\mu\text{g}/\text{m}^3$
Approximate equivalent limit displayed as " \times " followed by the limit value.
* Method(s) by this sign are not semi-quantified.
(-) = 100% detection.

Disclaimer: This report refers to the specific test(s) only and does not represent a part or all without the written consent of Biograde.
No warranties are made, express or implied, for the MARS chemistry certificate by this laboratory.

[Signature]
Date: 2019/10/24

Meatco Abattoir in Windhoek Passive Hydrogen Sulphide and Volatile Organic Compounds Sampling Campaign

APPENDIX B LETTER TO INTERESTED AND AFFECTED PARTIES



Head Office
Sheffield Street
P.O. Box 3881
Windhoek Namibia
Tel: + (264) 61 3216400
Fax: + (264) 61 3216401

27 September 2022

TO WHOM IT MAY CONCERN

Dear Sir/Madam

MEATCO ENVIRONMENTAL MANAGEMENT - ODOUR MONITORING AND MITIGATION AT MEATCO

As an important stakeholder of Meatco, specifically in connection with the ongoing odour issues experienced by yourselves, we want to communicate the following to you.

During stakeholder engagements with yourselves in 2018, and as received on an ongoing basis, it is apparent that Meatco's commitment to mitigate the situation is important. Following these consultations, a monitoring campaign was lodged in 2019 to investigate the causes of the odour more closely.

The conclusions of the study were as follows:

"It was determined from calculated concentrations based on the two sampling campaigns that the current operations at the Meatco Abattoir result in high H₂S concentrations on-site and at the other industrial sites, exceeding both the acute health screening limit as well as the odour threshold. Based on the sampled results, the smell of H₂S should be very distinct at the Meatco premises and the surrounding industrial areas. The H₂S concentrations did not exceed any of the health criteria at the residential sites neither did it exceed the assumed odour threshold. However, as indicated in the air quality and odour impact assessment (Liebenberg-Enslin & Grobler, 2018), odours are detected during certain hours of the day which the passive sampling does not show (it is an average over 17- and 19 days). It should be noted that low odour exposures (between 0.5 to <1.5 ouE/m³), which is below the assumed threshold of 50% of the panel identifying the compound, could be detected by sensitive individuals.

The calculated ambient VOC concentrations were below the international health screening criteria for all compounds. The conservative short-term (hourly) calculations indicated no odour exceedances from these compounds at any of the sampling locations. Only four of the VOC compounds associated with food processing indicated a potential for odour nuisance but these all have a sweet fruity smell and not what the complaints are about. Also, the difference in concentrations measured at the industrial sites compared to the residential sites were much smaller compared to the H₂S concentrations, indicating that these may also be from other sources such as vehicle exhaust emissions." (Airshed Planning Professionals, 2019).

**Directors: Mr. A Muremi (Chairperson), Mr. U Kandjii, Mr. M Mulunga, Ms. C Garises, Ms. H Mavetera, Ms. M Kabuku
Mr. S Ndeunyema (Co-opted Member), Mr. S Shakumu (Co-opted Member), Ms. N Lewis (Co-opted Member)**

Chief Executive Officer: Mr. M Mushokabanji, Company Secretary: Ms. N Mhanda

The study recommended that further quarterly odour monitoring be done to track improved management measures at the plant. However, Meatco decided that the main source of the odour problem, being the rendering plant, needs to be addressed. Meatco plans to introduce odour management measures to the rendering plant, as shown in the attached diagram. An extraction fan, damper and exhaust hood will be added, as well as a bio-filter to treat gaseous emissions. These measures will ensure the emission of odour-free gases. Unfortunately, due to the economic downturn exacerbated by the Covid -19 Pandemic in Namibia, the company has undergone significant financial constraints which have resulted in a very limited budget.

Amongst our objectives and commitments and focus areas includes but not limited to:

- Implementation of Environmental Management System (ISO 14000 / OHSAS 45000)
- Meatco Carbon footprint & Implementation of identified recommendations (Mutschler Audit 2018)
- Meatco By Products & Water Treatment Odour & the Eros Community (Airshed Sampling 2019), odor scrubber project

We trust that Meatco's commitment to address the odour situation at the plant meets with your approval as we continuously strive to meet industry standards and to address the grievances of our stakeholders.

Yours faithfully,


CHIEF EXECUTIVE OFFICER
Mwilima Mushokabanji

**Directors: Mr. A Muremi (Chairperson), Mr. U Kandjii, Mr. M Mulunga, Ms. C Garises, Ms. H Mavetera, Ms. M Kabuku
Mr. S Ndeunyema (Co-opted Member), Mr. S Shakumu (Co-opted Member)**

Chief Executive Officer: Mr. M Mushokabanji, Company Secretary: Ms. N Mhanda

APPENDIX C

**EFFLUENT TREATMENT FACILITY PERMIT
AND CONDITIONS**

Department of Economic Development and Community Services

Health and Environment Services Division

☒ 59
80 Independence Avenue
WINDHOEK, NAMIBIA



Fax: (+264) 61 290 2111 Tel. (+264) 61 290 2911

July 2020

WASTEWATER DISCHARGE PERMIT

COMPANY NAME: Meat Corporation of Namibia
NATURE OF INDUSTRY: Abattoir, Deboning and Cannery Plant
PHYSICAL ADDRESS: 1 Sheffield Street, Northern Industrial Area
REPRESENTATIVE: Petrus Kagogo
CONTACT NUMBER: 081 3539951
ASSESSOR: LA !Gaoses

Meat Corporation of Namibia (MEATCO) is hereby authorized to discharge industrial wastewater to the Municipal Council of Windhoek's sewer system in compliance with the Municipality of Windhoek's Sewerage and Drainage Regulation of 2010, Section 42, and in accordance with industrial effluent limits, monitoring requirements, and other conditions set forth herein.

This permit is granted in accordance with the application filed on **21 Nov 2018** with the Health & Environmental Services Division (HESD), of the Department of Economic Development and Community Services (EDCS) and in conformity with plans, specifications, and other data submitted to the Municipal Council of Windhoek in support of the above application. The effective permit period from 12 December 2018 to 30 June 2021 is therefore extended by two (2) years to 31 August 2023 with the updated information.

Effective Date: 30 June 2020

Expiration Date: 31 August 2023

PART I: Limitation regarding Activities/Production/Manufacturing

Manufacturing shall be limited to: **slaughter house, deboning and canning**, which is the main business where effluent is generated.

Other by products generated on site: **blood meal, bone meal, beef offal**

Waste generated: Hazardous waste material (spinal cords and other meat parts not processed)
Manure at lairages and raceway
Fat removed at effluent plant
Dewatered paunch content
All above waste is disposed of at Kupferberg Landfill
Cartons and plastic – collected by Rent-A-Drum
Treated Effluent -- discharged to Ujams Wastewater treatment

Deviation from the above manufacturing activity will warrant a new discharge permit application.
PART II: Water Consumption & Use

Meat Corporation of Namibia (MEATCO) shall not exceed an average of **34 000 m³** water per month.

The Water meter readings for Meatco from the period June 2019 to May 2020 indicate an average water consumption of **18 751.75 m³**.

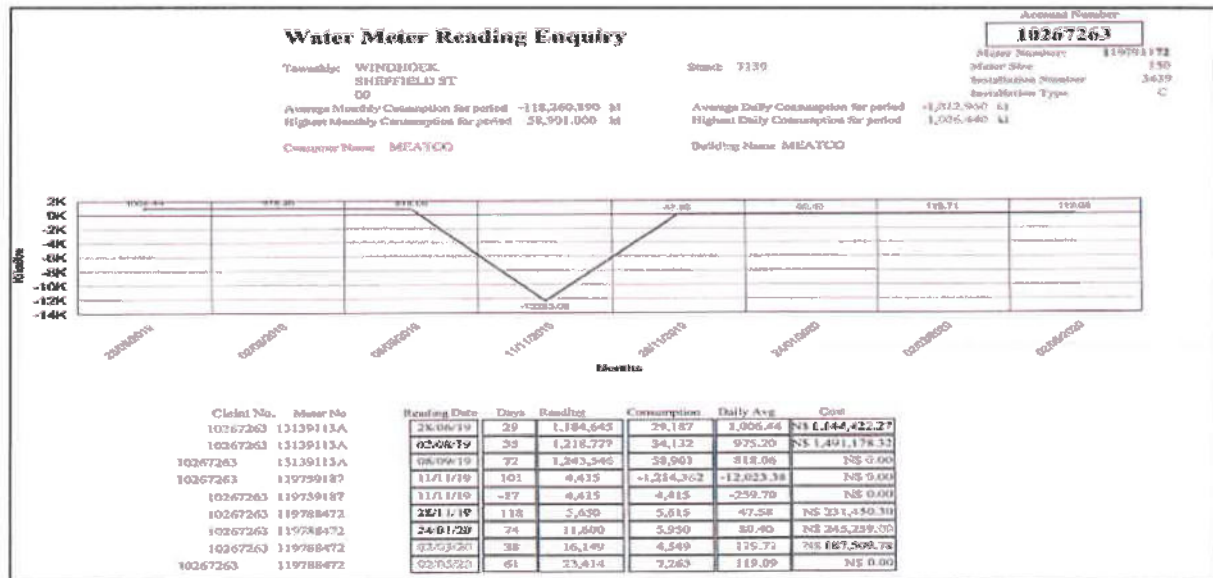


Figure 1: Meatco Municipal Water Consumption

Process Evaluation and Water Balance:

The following Water Balance breaks down the Total Monthly water consumption for the Meat Corporation of Namibia in terms of the effluent uses and non-effluent uses. This is done to ascertain the percentage of effluent of the total incoming water from the Municipality.

Monthly consumption (Average)	22,661	m ³
Average Municipal Water Consumption	18,752	
Average Borehole abstraction	3909	
Boiler ablation + canning warehouse ablation	748	m ³
Admin building water consumption	35	m ³
Average cattle per month:	13000	
Cattle drinking water	520	m ³
Average cans produced	1,650,000.00	
Monthly Water used in cans:	116	m ³

Services - Ablution (shower hot water)	649	m ³
Services - Ablution (shower cold water + toilets etc.)	676	m ³
Abattoir Ablution	1018	m ³
Abattoir Coolers	1385	m ³
Big Cannery cooler	187	m ³
Dispatch Cooler	1541	m ³
Total Coolers make-up water	3113	m ³
Total Ablution consumption	3124	m ³
Boiler Blow down	568	m ³
Total Other non-effluent uses:	7,440.79	m ³
Effluent percentage of incoming water	67%	
Monthly Effluent discharged:	15,220	m ³

According to the Municipal Council of Windhoek's Council Resolution 113/04/2013 no new wet industries will be allowed in the City. Existing industries/users are to implement water saving measures.

No increase in production is allowed for existing industries already over 10 m³ per day and are operating on an industrial area of less than 10 ha, or for industries using 100 m³ a day and are operating on an area of more than 10 ha.

Meat Corporation of Namibia (MEATCO) current consumption is already more than 10 m³ per day (currently at 944 m³ per day) on an area of 6.8 ha. Meat Corporation of Namibia (MEATCO) is therefore not allowed to use more than 34 000 m³ per month.

NB: In the case of severe droughts where the Municipal Council of Windhoek need to implement water restrictions, the Municipal Council of Windhoek will have to reevaluate the allowable water consumptions.

PART III: Effluent Quality and Quantity

Wastewater Pre-Treatment Processes

Raw effluent flows from the factory processes into the following Process units for pre-treatment i.e. **Raw Effluent Sump, Rotary Screening, Fat Separator, Primary Settling Tank, Buffer Sump, Aerobic Reactor, Valve Box and Final Fat Separator.**

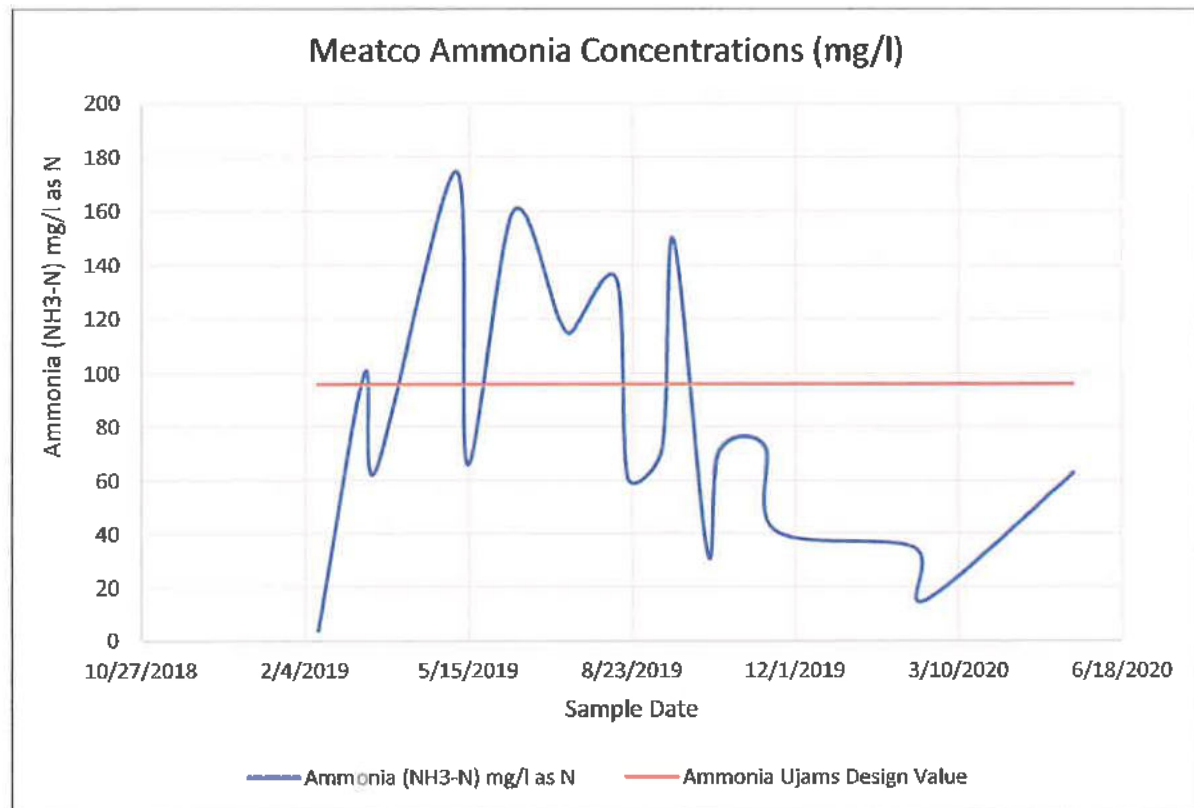
Analytical Data

The following is the Analytical Data for the Meat Corporation of Namibia which was undertaken by grab sampling. The tests were carried out by the Municipal Council of Windhoek's Scientific Services Division. This data is for the Ujams Design Parameters, namely: Ammonia (mg/l as N),

Ortho phosphates in (mg/l), Chemical Oxygen Demand in (mg/l) and Total Suspended Solids in (mg/l).

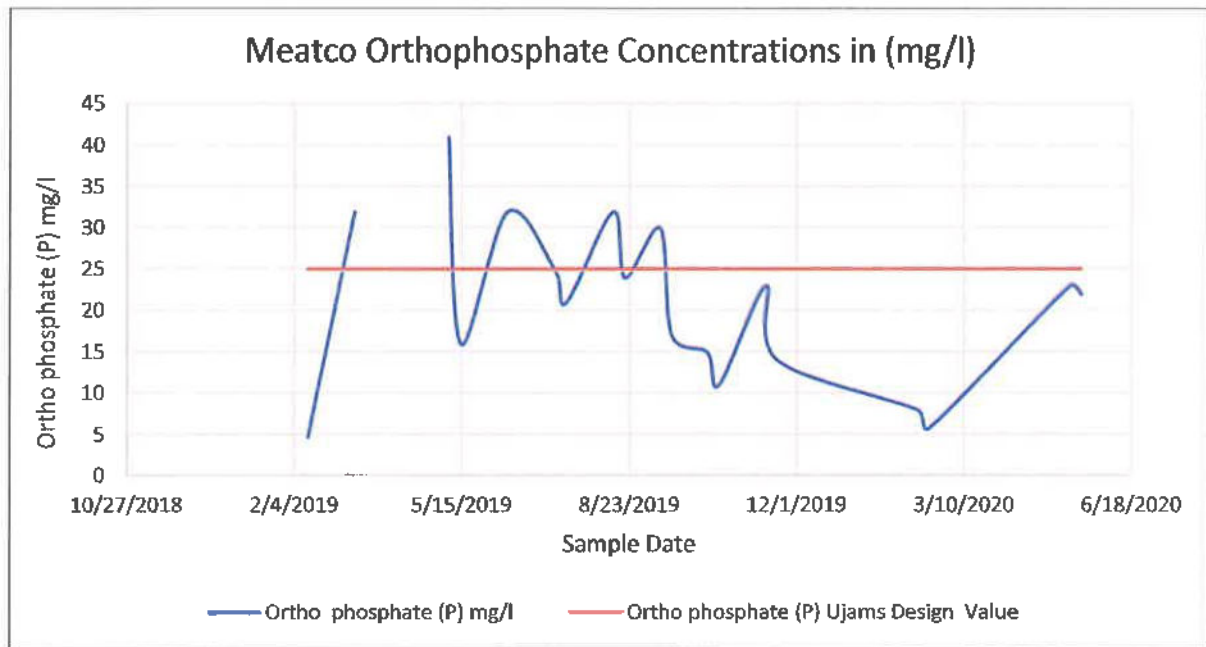
Meat Corporation of Namibia Compliance Report

Graph 1: Meatco Ammonia Concentrations



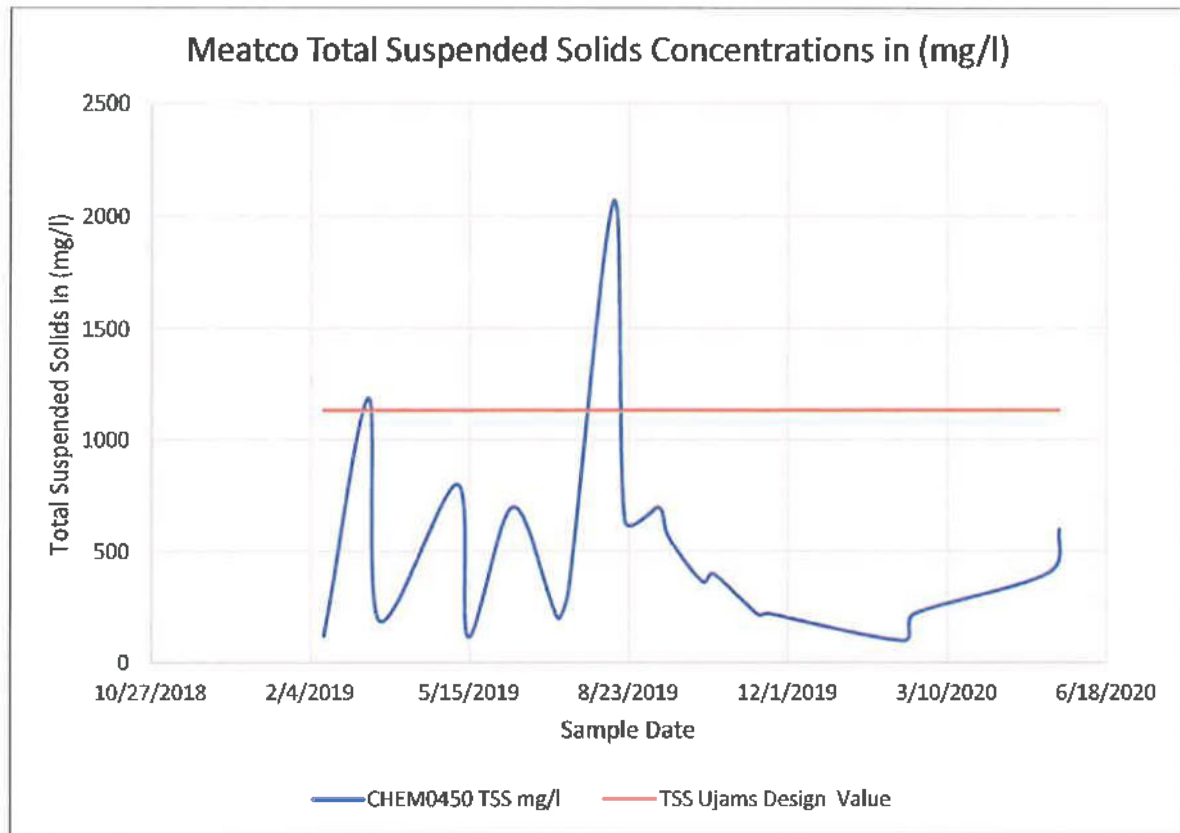
The Meat Corporation of Namibia has an average Ammonia Concentration of **80.60 mg/l** whereas the Ujams Design Value for Ammonia is **96 mg/l**. It can therefore be deduced from **Graph 1** above that the Average Ammonia Concentrations at the Meat Corporation of Namibia meet the Ujams Design Value for Ammonia.

Graph 2: Meatco Orthophosphate Concentrations in (mg/l)



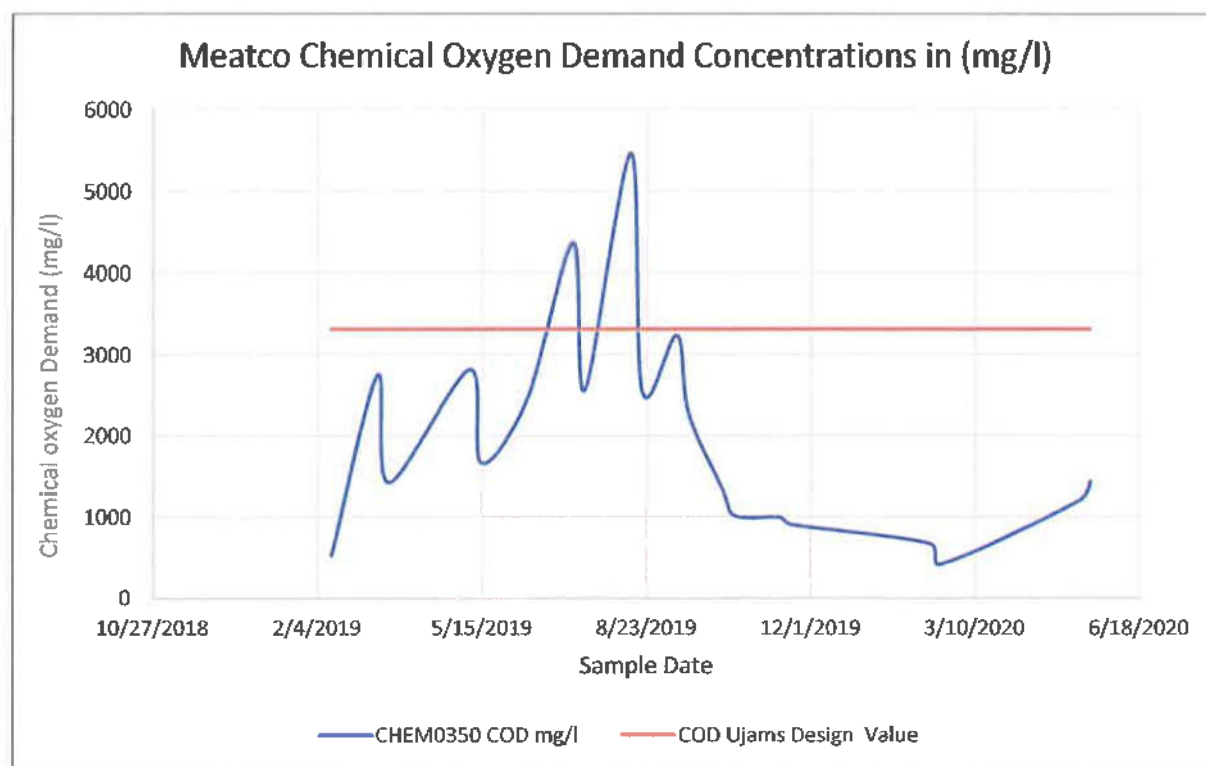
The Meat Corporation of Namibia has an average Ortho phosphate Concentration of **20.87 mg/l** whereas the Ujams Design Value for Ortho phosphate is **25 mg/l**. It can therefore be deduced from **Graph 2** above that the average ortho phosphate concentrations at the Meat Corporation of Namibia meet the Ujams Design Value.

Graph 3: Meatco Total Suspended Solids Concentrations (mg/l)



The Meat Corporation of Namibia has an average Total Suspended Solids (TSS) Concentration of **507.25 mg/l** whereas the Ujams TSS Design Value is **1132.00 mg/l**. It can therefore be deduced from **Graph 3** above that the average TSS at the Meat Corporation of Namibia meet the Ujams TSS Design Value.

Graph 4: Meatco Chemical Oxygen Demand Concentrations (mg/l)



The Meat Corporation of Namibia has an average Chemical Oxygen Demand (COD) Concentration of **2007.50 mg/l** whereas the Ujams COD Design Value is **3314 mg/l**. It can therefore be deduced from **Graph 4** above that the average COD at the Meat Corporation of Namibia meet the Ujams Design Value.

Meat Corporation of Namibia (MEATCO) shall comply with the effluent limitations for UJAMS Water Care Works design values.

Important Note: Self-monitoring is encouraged, and information can be submitted to Environmental Management Division on/before the **5th** of each month.

Knowingly making any false statement on any report or other document required by this permit or knowingly rendering any monitoring device or method inaccurate, may result in punishment under the criminal laws of Namibia, as well as being subjected to civil penalties and relief.

Sample Frequency: to be collected twice a month, until such time that the online monitoring system is functioning.
Sampling frequency may be increased in a case of non-compliance to sample every 10 days until the industry has attained compliance.

	All costs including laboratory costs shall be borne by the permit holder
Type of Sample:	Composite sample or grab sample.
Sample Point:	At the wash water sump/manhole after wash water sump. Sample point can only be altered by Municipal Council of Windhoek's officials. All industrial samples are to be collected prior to reaching the connecting sewer.
Sample tests:	Samples will be collected and analyzed using Scientific Services Methods and SOPs or any other accredited Laboratory.

Meat Corporation of Namibia (MEATCO) shall notify the HESD immediately upon any accidental discharge to the sewer and any introduction of new wastewater or pollutants or any substantial change in the volume or characteristics of the industrial processes. Formal written notification shall follow within 30 days of such introduction.

The effluent quantity determined for **Meat Corporation of Namibia (MEATCO)** for the year 2020 – 2023 is 67% of the water consumption as evaluated in June 2020. MEATCO is required to submit a water balance every six (6) months.

PART IV: Reporting Requirements

Meat Corporation of Namibia (MEATCO) is required to inform the Municipal Council of Windhoek of any deviation from the items/limits set forth in this permit not later than 7 working days of the said deviation.

If over 30 days late, **Meat Corporation of Namibia (MEATCO)** will be considered in significant non-compliance with the Drainage regulations and the Municipal Council of Windhoek will be forced to act appropriately/withdraw this permit.

PART V: Findings

The effluent quality parameters for the **Meat Corporation of Namibia (MEATCO)** comply with the effluent limitations for UJAMS Water Care Works design values.

PART VI: Special Permit Conditions/Compliance Schedules

1. **Meat Corporation of Namibia (MEATCO)** shall provide information with regard to changes in discharge time.
2. **Meat Corporation of Namibia (MEATCO)** is limited to a monthly water consumption of 34 000 m³.
3. **Meat Corporation of Namibia (MEATCO)** is required to ensure their effluent quality is kept within the Ujams Design Parameters and that plant processes are monitored

PART VII: Standard Conditions

Meat Corporation of Namibia (MEATCO) shall comply with all the general prohibitive discharge standards as per Windhoek Municipality Sewerage and Drainage Regulation of 2010.

1. Right of Entry

Meat Corporation of Namibia (MEATCO) shall allow the Municipal Council of Windhoek or its representatives, exhibiting proper credentials and identification, to enter upon the premises of **Meat Corporation of Namibia (MEATCO)** at all reasonable hours, for the purposes of inspection, sampling or records inspection. Reasonable hours in the context of inspection and sampling includes any time the industry is operating any process which results in a process wastewater discharge to the sewage system. Complete facility inspection will be performed by HESD personnel at least yearly.

2. Records Retention

- a. The industry shall retain and preserve for no less than five years, any records, books, documents, memoranda, reports, correspondence and any and all summaries thereof, relating to monitoring, sampling and chemical analyses made by or on behalf of the user in connection with its discharge.
- b. Similarly, the Municipal Council of Windhoek shall retain and preserve for no less than five years, any records, books, documents, memoranda, reports, correspondence and any and all summaries thereof, relating to the industrial monitoring, sampling and chemical analyses made by the Municipal Council of Windhoek in connection with the industrial discharge.
- c. All records that are in the industry's possession that pertain to matters that are the subject of special orders or any other enforcement or litigation activities brought by the HESD, shall be retained and preserved by the industry until all enforcement activities have concluded and all periods of limitation with respect to any and all appeals have expired.

3. Confidential Information

All data and reports required for this permit shall be available for inspection at the Health and Environment Services Division office, at 7th floor, Municipal Council of Windhoek main building.

4. Recording of Results

For each measurement or sample taken pursuant to the requirements of this permit, the industry shall record the following information:

- a. The exact place, date, and time of sampling;
- b. The dates the analyses were performed;
- c. The person(s) who performed the analyses
- d. The analytical techniques or methods used; and
- e. The results of all required analyses.

Dilution – No industry shall increase the use of potable or process water or, in any way; attempt to dilute a discharge as a partial or complete substitute for adequate treatment to achieve compliance with the limitations contained in this permit.

5. Withdrawal of Permit

The permit issued to **Meat Corporation of Namibia (MEATCO)** by this Division may be revoked when:

- after inspection, monitoring or analysis it is determined that the discharge of wastewater to the sewer is in violation of the Drainage Regulation, or local laws, or ordinances.
- falsification or intentional misrepresentation of data or statements pertaining to the permit application or any other required documentation is detected.

6. Limitation on Permit Transfer

The effluent discharge permits are issued to a specific user for a specific operation and period, and are not assignable to another industry or transferable to any other location without the prior written approval of the Municipal Council of Windhoek.

In case of **Meat Corporation of Namibia (MEATCO)** being sold to a different user, **Meat Corporation of Namibia (MEATCO)** shall obligate the purchaser to seek prior written approval of the HESD for continued discharge to the sewage system.

7. Modification or Revision of the Permit

~~The terms and conditions of this permit may be subject to modification by HESD at any time~~

- as limitations or requirements as identified in the Drainage Regulation, are modified or other just cause exists.
- to incorporate special conditions resulting from the issuance of a special order.
- as a result of promulgating a new pretreatment standard.

8. Duty to Reapply

The onus is on the industry to ensure that their discharge permit is valid at all times.



MM Kahitu

Manager: Health & Environment Services Division



PLEASE TAKE NOTE,

In the case of severe drought, the Municipal Council of Windhoek will give preference to human consumption over industrial supply.