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Lephalale Railway Yard Waste Management Plan

Report

Version – 3

09 April 2019

Naledzi Group (Pty) Ltd

GCS Project Number: 18-0448

Client Reference: Lephalale Railway Yard

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1 INTRODUCTION

Transnet SOC Limited (herein after Transnet) wish to develop a new railway yard and its associated infrastructure at Steenbokpan near Lephaplale in Limpopo Province

Naledzi Environmental Consultants CC (NEC) have been appointed by Transnet SOC Limited (herein after Transnet) to undertake the Environmental Impact Assessment (EIA) Process in an effort to obtain environmental authorisation for the development of the new Lephalale Railway Yard and its associated infrastructure. Various specialist investigations and report/s are required in support of the application. One of these specialist reports is a waste specialist study in the form of a Waste Management Plan (WMP).

GCS were subsequently appointed by Naledzi to undertake and report on the Waste Specialist Study which forms part of the EIA process.

2 LOCATION

The Lephalale Railway Yard is an existing 100 wagon yard along the existing Lephalale – Thabazimbi railway track in the Waterberg District, which requires extension for it to accommodate 200 train wagons in future for the increase in load and capacity.

The extension of the railway yard will be developed starting at a point along the existing single railway track Lephalale-Thabazimbi railway line on Portion 1 (remaining extent) of the farm Geelhoutkloof 359LQ and Geelhoutkloof 745LQ1. Borrow Areas 1 and 2 will be located on farm Pontes Estate 744LQ2 with an alternative position being investigated for Borrow Area 2 on farm Pontes Estate 712LQ. The study site is situated approximately 30km west of the town Lephalale (Ellisras) in the game farming area of Steenbokpan. It falls within the jurisdiction of Lephalale Local Municipality in the Waterberg District of Limpopo Province.

The purpose of the yard is to allow compilation of 100 wagon strains from the surrounding mines, refuel diesel locomotives, sanding, crew change and on track inspections of rolling stock.

3 SCOPE OF WORK

The scope of work originally anticipated to compile the WMP included and covered the extent of the development.

[1] Geelhoutkloof 745LQ is consolidated from Remainder of farm Geelhoutkloof 359LQ, Portion 1 of Enkeldraai 314LQ and Portion of Portion 3 of the farm Pontes Estate 712LQ.
[2] Pontes Estate 744LQ is consolidated from Portions 2 and 3 of the farm Pontes Estate 712LQ and the Remainder of farm Buffelsjagt 317LQ

Section 28 and 29 of the National Environmental Management: Waste Act (NEM:WA), 2008 (Act no.59 of 2008) requires industries and organs of state to develop waste management plans for their industry. It is therefore assumed the waste management plan/s should be conducted in line with the regulations.

GCS will therefore address the above items and compile a waste management plan accordingly.

4 LEGISLATIVE FRAMEWORK

The project is subject to compliance with the following pieces of legislation:

- National Environmental Management Act, 1998 (Act 107/1998) and its promulgated EIA Regulations of 2014 as amended by GNR 324, 325, 326 & 327 of 7 April 2017);
- National Water Act, 1998 (Act 36 of 1998) and its promulgated WULA Regulations of 2017
- Mineral and Petroleum Resources Development Act 28 of 2002
- National Environmental Management: Waste Act 59 of 2008
- National Forest Act (Act 84 of 1998)
- National Environmental Management: Biodiversity Act 10 of 2004
- National Heritage Resources Act 25 of 1999

The National Environmental Management: Waste Act 59 of 2008, specifically applies to this report and is described below in more detail.

4.1 National Environmental Management: Waste Act (Act 58 of 2008)

Section 28 of the National Environmental Management: Waste Act (NEM:WA), 2008 (Act no.59 of 2008) requires entities or industries to develop waste management plans for their industry. It is therefore assumed the waste management plan/s should be conducted in line with the regulations. Section 30 of NEM:WA specifies the information that must be included the industry waste management plan. Information that needs to be addressed for the Lephalale Railway Yard in terms of Section 30 (2) includes:

- the amount of waste that is generated;
- measures to prevent pollution or ecological degradation;
- targets for waste minimisation through waste reduction, re-use, recycling and recovery;

- measures or programmes to minimise the generation of waste and the final disposal of waste;
- measures or actions to be taken to manage waste;
- the period that is required for implementation of the plan;
- methods for monitoring and reporting; and
- any other matter that may be necessary to give effect to the objects of the Act.

5 WASTE STREAMS

This is a completely new development, hence precise details in terms of the amount/volume of waste of the waste streams that will arise during the two main phases are not available. The development of the yard would be implemented in two phases and the related infrastructure will be developed during each phase. Total development period for the project is estimated at 2 years 6 months, commencement estimated to be year 2021.

The construction and infrastructure will include the following:

- Phase 1: Build a bypass line, decanting arrival and departure line south of the existing track to enable an alternative route for trains to enter and exit Lephalale whilst Transnet is building the new tracks;
- Phase 2: Build the additional arrival-, run around- and spare tracks, conduct the bulk of the earthworks and building of the yard facilities. On completion of the project the yard would have four service tracks.

The facilities to be developed as part of the railway yard include:

- The construction of four new railway lines;
- Construction and extension of culverts from the existing single track railway line to the new tracks;
- Construction of a 7 m wide tarred access road to the railway yard facilities, south of the existing railway line, which would end at the locomotive service area and the end of yard;
- Construction of a gravel service road north of the arrival line within the existing rail servitude;
- North Facility (office and administrative buildings): Provisional Facility, Staff amenities, Store room, Administration Building, Infra Crew Building;
- Water reservoir (steel tank) with a volume of 260m^3;
- Guard house with water storage and septic tank;

- Roads and carports at facilities;
- (x2) 300 000 litres diesel tanks and decanting slabs – There shall be four (4) rail decanting points and one road decanting point provided all at one location. The fuel storage volume is 600 000 litres. The pump rooms for decanting and refueling shall be ventilated and contain fire protection as per the SANS requirements;
- Fire suppression systems which require a foam storage tank, water tank and foam pipelines;
- 1 x 500 litre diesel tanker in the fire pump room;
- Effluent management (water/oil separator); and
- South Facility (maintenance and repair building): Provisional Facility, sanding facilities, 6720 litres of oil storage (32 drums of oil), Parts storage room, Staff amenities;

It is anticipated that the water management for the Lephalale railway yard will be implemented in the following manner:

- Water requirements: Water will be delivered to the site via truck to the reservoir on site and distributed to the facilities via a pressurized network.
- Sewer and Wastewater: Some facilities at the yard will have wash basins, toilets and showers. A Bio-Mite submerged Waste Water Treatment system is proposed for wastewater collection, treatment and discharge into a soak away system. The Bio-Mite system pumps treated content (national standards as required by DWS) to acceptable standards into a soak away system. The initial proposal was to collect wastewater in 12 conservancy tanks (10 x North facility; 2 x South facility) serviced by honey suckers on a regular basis. This is no longer a feasible option due to overload at the Lephalale Waste Water Treatment Works (WWTW). The Bio-Mite system is preferred due to lower set up cost and being more suitable for the volume of wastewater generated at the yard.
- Stormwater: Drainage around the site will comprise table drains in cuttings, pipes, manholes and culverts. Stormwater is directed away from the tracks and buildings and drained to stormwater channels and low-lying areas.
- Effluent: The provisional facilities and oil storage area could potentially have oil/fuel spilled/leaked. To cater for this, the facilities have an oil separator to deal with the contaminated liquids onsite. Once the water has passed through the oil separator and tested, it will then be drained to the sewer network.

Apart from the above the construction of the railway yard will require extensive cutting of the existing topography and management of overburden/spoil material. The project would further require fill material from two borrow pits to be established in close proximity to the new yard. Once operational spillages from trucks, i.e. coal or other minerals may occur which will also have to be dealt with.

Requirements for construction and operations are very similar regarding waste management. The following waste streams are anticipated during construction and operations:

- Organic waste cleared during construction activities;
- Soil overburden;
- Putrescible waste from offices, staffing amenities, etc;
- Paper, cardboard, toner and other office consumables from offices;
- Steel and plastic drums/containers;
- Cement, rubble, wood and metal off-cuts from the construction of buildings;
- Electrical cable and plastic fittings from electrical wiring work;
- Pipework off-cuts;
- Waste oils/grease and obsolete parts from maintenance;
- Scalpings from road construction and maintenance;
- Spillage/Leaks of waste oil and petroleum products;
- Spent process chemical (reagents etc.) used during construction/commissioning;
- Spent domestic chemicals (incl. herbicides, pesticides) plus containers;
- Batteries, fluorescent tubes, etc;
- Obsolete equipment incl. transformers (over time);
- Sewage sludge (treatment not covered in detail in this plan);
- Other wastes as may subsequently be identified.

All of the above anticipated waste streams that could potentially be produced at the proposed Lepalale railway yard during construction and operations can be grouped and described under the following categories of wastes:

- General waste
    - Domestic waste, office waste, organic waste; and

  - Certain items may also fall under this category that include items that could be reclaimed and recycled such as, wood, plastic, pipes, cables, conveyor belts, bricks, building rubble, etc.

- Hazardous waste
  - Hydrocarbons, hydrocarbon contaminated material and potentially hazardous waste emanating from the operational and workshop areas;
  - Polychlorinated Biphenyl (PCB) waste or PCB containing waste (> 50 mg/kg or 50 ppm); and
  - Other hazardous chemical wastes etc.

5.1 General Waste

General waste would include all non-hazardous wastes such as, but is not limited to:

- Domestic waste;
- Office and commercial waste not containing hazardous waste or hazardous chemicals;
- Garden waste;
- Waste packaging;
- Waste tires;
- Building and demolition waste not containing hazardous waste or hazardous chemicals; and
- Excavated earth material not containing hazardous waste or hazardous chemicals.

5.2 Hazardous waste

Hazardous wastes would include waste such as, but is not limited to:

- Hydrocarbons, hydrocarbon contaminated material and potentially hazardous waste emanating from the construction and operational areas, the workshop area.
- Polychlorinated Biphenyl (PCB) waste or PCB containing waste (> 50 mg/kg or 50 ppm);
- Other assorted waste from hydraulic activities;
- Spent process chemical (reagents etc) used during construction/commissioning;
- Spent domestic chemicals (incl. herbicides, pesticides) plus containers;
- Batteries, fluorescent tubes; and

- Other hazardous chemical wastes that may arise during construction and operations.

5.3 Mineral Waste

5.3.1 Spoil material/Overburden

Spoil material or overburden is material excavated on site during construction. It is assumed that the materials are non-contaminating materials and are usually stored in what is called waste rock or overburden dumps. Waste rock dumps are generally shaped and covered with soil and revegetated.

5.3.2 Waste Minerals

Spillages from trucks, i.e. coal or other minerals may occur which will also have to be dealt with. The area may become "contaminated" by these products which could lead to stormwater contamination or even contamination of the ballast and surrounding area.

6 WASTE MANAGEMENT PLAN

The WMP comprises steps to be taken in order to implement the objectives of WMP. It further identifies and recommend efficient drivers in order to manage waste in line with national strategies and legislation.

It provides guidance regarding best environmental practices and provide recommendations to implement good waste management practises and will allow to continually evaluate options to improve on waste management (i.e. continual improvement).

6.1 Waste Management and Storage

General/domestic and hazardous waste produced at the Lepalale railway yard needs to be collected and stored in specifically demarcated areas. Specific areas have been allocated for refuse storage at the Lepalale railway yard once operational. The areas should be enclosed and covered by a roof. Provision should be made for both general and hazardous waste storage.

6.1.1 General Waste

General solid wastes need to be collected from the various office areas and staff facilities and taken to and stored safely at refuse storage areas from where it will be removed off-site by Transnet or an approved waste removal company and disposed of at an approved licensed disposal facility.

General waste should be stored in suitable containers such as 240l wheelie bins or bulk storage bins. This is to ensure minimal environmental and health and safety impact when storing waste until collection.

It is suggested that Transnet investigate and adapt a waste minimisation/recycling strategy to align with South African waste guidelines and legislation. Therefore, it is proposed that waste bins/skips be labelled to separate the waste on-site, i.e. general and hazardous waste, and transported to an approved re-cycling depot or to an approved licensed disposal facility.

Recycling can be done at source or at the refuse storage area wherever is the most suitable. Materials could still be stored in the refuse area until collection. A dedicated reclamation area for reusable non-hazardous materials should be established, these may include areas for paper, wood etc. Other re-usable wastes such as toner cartridges and other office consumables from offices could also be stored in the refuse area in specifically marked containers.

6.1.2 Hazardous Waste

Hazardous wastes, although limited in volume and quantity, should be kept in a closed bin and separate from general waste as a minimum requirement. This will ensure that non-confirming waste does not enter a general landfill site, as well as preventing cross contamination and potential risks to personnel and the environment. The area doesn't necessarily need to be bunded, depending on the type of waste. Smaller enclosed bins could also be utilised for different types of wastes, i.e. printer cartridges, batteries, fluorescent lamps, etc.

Unavoidable hazardous waste is to be handled, stored and disposed of/recovered in a manner that does not result in environmental pollution or health and safety hazards to personnel.

Only suitably qualified waste service providers should be appointed to collect and dispose of such wastes. All hazardous waste transported from the resort should be recorded and kept as proof that it has been handled and disposed of in the correct manner and disposed at an approved licensed facility.

The disposal of hazardous waste is required to comply with all relevant Regulations, Norms and Standards pertaining to waste classification in order to ensure disposal at the correct landfill class.

Other potentially hazardous wastes/materials that require specific attention may include:

- Medical waste and laboratory chemicals, if any, should be stored in specific containers (necessary medical waste containers required);
- It is recommended that all oil and silt traps be cleaned out from time to time and waste be disposed of in the correct manner and at an applicable hazardous waste disposal facility

- New and used oil and grease needs to be stored in drums located in a designed bunded areas (an oil storage area have been provided) with a collecting sump in place in case of any spillages; and
- A designated designed bunded storage with the necessary containers (which could be sealed) for the storage of sewage screenings, packaging for hazardous materials and chemicals or chemical contaminated containers and materials.

6.1.3 Residue Stockpiles and Deposits

Cut and fill requirements for the railway yard is envisaged and there will be substantial excess spoil material. Excess spoil material will be used to construct an earth berm/wall of 2 meters high with a 1:1 slope for 5km on either side of the railway line/yard.

The excess spoil can therefore be used for:

- Earth berms; and
- Stockpiled in the area of the designated borrow pit/s which could later be used for rehabilitation of the borrow areas

6.1.4 Sewage waste

The initial proposal was to collect wastewater in 12 conservancy tanks (10 x North facility; 2 x South facility) serviced by honey suckers on a regular basis. This is no longer a feasible option due to overload at the Lephalale Waste Water Treatment Works (WWTW). DWS requested Transnet to consider a small package plant. Due to high set up cost Transnet considered other alternatives.

Transnet's preferred alternative is to install a Bio Mite submerged Waste Water Treatment System for wastewater collection, treatment and discharge into a soak away system. The Bio-Mite system pumps treated content (national standards as required by DWS) to acceptable standards into a soak away system. This system is preferred to a package plant due to lower set up cost and being more suitable for the volume of wastewater generated at the yard.

Refer to Appendix A for typical information on the proposed system.

6.1.5 General Waste Management

It is recommended that Transnet develop a Waste Manifest System (WMS) with detailed information on the waste generated, collected and transported to the nearest disposal/treatment facility for the applicable waste. This should be implemented as a minimum requirement for at least the Hazardous waste.

It is further recommended that:

- The waste management plan be reviewed and incorporated into the final planning and design. The plan covers the storage, handling, transportation and disposal of waste from the project site. Transnet should ensure that the contractor's responsible for the managing of the waste are made aware of their requirements and procedures.
- The collection and transport of waste should be done as frequently as possible and an approved waste management contractor should be appointed to do the collection and transport of each specific waste stream to the various applicable disposal/treatment facilities. In the case of hazardous waste transport, the appropriate waste manifest system should be implemented.
- Opportunities to recycle both general and hazardous waste should be identified and where possible waste should be recycled. Transnet can develop a recycling plan to manage these criteria, once all the specific waste streams are known.
- Sufficient refuse collection and storage points needs to be identified with adequate capacity and be serviced frequently. These areas need to be properly designed and secured with appropriate pollution prevention measures in place i.e. bunded, roofed, storm water management and control if necessary.
- Oil storage areas should be adequately bunded and lined and should have working oil traps.

6.1.6 Resources and Responsibilities

The development, implementation and review of the Waste Management Plan (WMP) should be the responsibility of Environmental Manager. The monitoring of the day to day operations and proper implementation and management of waste in accordance with the WMP should form part of the Environmental Manager's responsibilities.

During both the construction and operational phases, management, and in particular the Environmental Manager, will work with the various construction contractors and the various operational managers to develop the necessary systems to manage all waste streams.

The Waste Management Plan should be reviewed at regular intervals as a matter of course and when particular events occur that trigger a review, such as a new facility manager or a new activity taking place at site. The status of the Waste Management Plan will be reported each year in the Environmental Managers' report to the Transnet management or board and will contain details of any significant changes to the plans, and whether the plans were reviewed during the reporting period. The report will also quantify the waste streams as far as possible.

6.2 Waste Disposal

Once a full inventory of waste streams has been prepared/obtained, and the wastes categorised in terms of their nature (general or hazardous) according to accepted classification procedures, the final disposal option and route for each can be decided.

6.2.1 General Waste

There is a landfill site in Lepalale which could be used to dispose of the general non-hazardous waste.

It is however proposed that as much of the waste as possible be recycled or reused (onsite or offsite) and that as little waste as possible will have to be disposed of. The volumes of conventional recyclable materials, such as wood, paper, plastics and glass are unknown, but should sufficient space be allocated these could be accumulated to warrant transportation to recycling facilities.

6.2.2 Hazardous Waste

A suitable disposal point would need to be identified for hazardous wastes emanating from the railway yard. At this stage it is proposed that Hazardous wastes be taken to the Holfontein Hazardous Waste Landfill in Gauteng, but Transnet could negotiate with one of the nearby mines to dispose of their hazardous waste a suitable mine's hazardous waste site. The legal requirements of cradle-to-grave principles (duty of care obligations) should be adopted and enforced by Transnet, ensure that only reputable waste transport companies and permitted waste disposal facilities are used.

It is however proposed that as much of the hazardous waste as possible be recycled or reused which in turn could also have a significant impact on costs of transporting these wastes to the Holfontein Hazardous Waste Landfill.

6.2.3 Residue/Mineral Waste

It is assumed that all mineral wastes will be stockpiled/disposed of on-site or at the borrow pits, if feasible, to minimize the costs involved in haulage. Refer to section 6.1.3 for more detail.

It should mentioned that no minerals/stock would be loaded at the railway yard. Trains will be dispatched to the private sidings for loading at mines. Train wagons will not be covered resulting in fugitive coal dust settling along the railway yard, although expected to be minimal.

In order to mediate possible contaminated storm water runoff an earth channel will be established alongside a portion of the track that will serve as storage/evaporation pond. The channel will contain run-off water until it evaporates. The channel will be approximately 575m in length, approximately 1.5 to 3m wide and a maximum of 2m deep. Start point will be from 23°45'41.13"S, 27°27'5.25"E and the end point will be at 23°45'31.13"S, 27°27'22.52"E.

Transnet will clean the channel from any coal sludge from time to time. Coal sludge can be taken to Grootgeluk Coal mine, subject to an agreement with the mine, since the mine have systems in place for handling coal sludge. As mentione the volume of sludge from the yard should be minimal.

Volume of the expected storm water discharge was unfortunately not made available, only the position, length and size of the channel.

6.2.4 Sewage/Effluent

Disposal of sewage effluent/wastewater is no longer a feasible option due to overload at the Lephalale Waste Water Treatment Works (WWTW). DWS therefore requested Transnet to consider alternatives.

Transnet investigated different options and decided on a Bio Mite sewage collection and treatment system for wastewater collection, treatment and discharge of the treated effluent, to national standards as required by DWS, into a soak away system.

Based on the Bio-Mite information, sludge production is low and no sludge re-circulation is required.

There will be two Bio Mite systems with soak aways, one at the North Facility and one at the South Facility. The locations of the two Bio Mite Systems is as follow

- North Bio Mite Facility location is at 23°45'28.95"S, 27°27'25.32"E with a maximum handling volume/capacity per day of 18 060 liters per day
- South Bio Mite Facility location is at 23°45'52.42"S, 27°26'46.53"E, with a maximum handling volume/capacity per day of 4914 liters per day.

7 CONCLUSION AND RECOMMENDATIONS

In terms of NEMA and NEM:WA, everyone is required to take reasonable measures to ensure that they do not pollute the environment. Reasonable measures include informing and educating employees about the environmental risks of their work and training them to operate in an environmentally responsible manner.

If the abovementioned waste management recommendations are adopted, it is anticipated that the majority of negative environmental impacts caused by improper management of the various waste streams can be mitigated.

The following recommendations are made with regards to waste management practices proposed at the Lephalale railway yard:

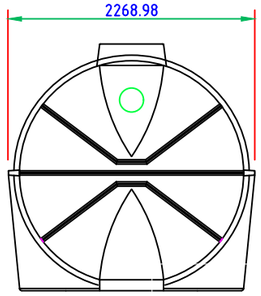
- It is recommended that the waste management plan of the Lephalale railway yard be implemented and enforced. The plan covers the storage, handling and transportation of waste to and from the railway yard. Transnet must ensure that the contractor's responsible, if applicable, are made aware of their requirements and procedures.
- Opportunities to recycle both general and hazardous waste should be identified and where possible waste should be recycled. It is suggested that Transnet develop a recycling plan to manage these criteria.
- Sufficient collection points needs to be identified with adequate capacity and be serviced frequently. These collection areas need to be properly designed and secured with appropriate pollution prevention measures in place i.e. storm water control and used oil, and other chemical storage areas, should be adequately bunded and lined and should have working containment traps.
- The collection and transport of waste should be done as frequently as possible and an approved waste management contractor should be appointed to do the collection and transport to the applicable disposal sites. In the case of hazardous waste transport an appropriate waste manifest system should be developed and implemented.
- Waste management records (ie. Waste manifests, certificate of safe disposal etc.) should be kept by the department responsible for waste for audit purposes.
- Any contaminated soil on site should be remediated. The appropriate remedial measures will be identified in consultation with an appropriately qualified specialist. If remediation of the soil in situ is not possible, the soils will be classified according to NEM:WA and will be disposed of at an appropriate licensed waste facility.

- Care should be taken to ensure that non-hazardous materials does not become polluted. Hazardous and non-hazardous materials should be separated and stored in separate containers to prevent any cross contamination.

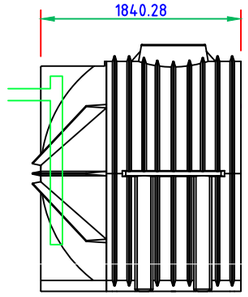
8 REFERENCES

- Environmental Screening Report, Naledzi Group (Pty) Ltd, June 2018.
- Draft Scoping Report, Naledzi Group (Pty) Ltd, October 2018.
- Background Information Document, Naledzi Group (Pty) Ltd.
- Email correspondence received from Naledzi Group (Pty) Ltd, 2018.
- National Environmental Management: Waste Act: (Act 59 of 2008) (NEMWA).
- National Environmental Management: Waste Amendment Act (Act 26 of 2014).

APPENDIX A
CALCAMITE BIOMITE SYSTEM INFORMATION



Typical Domed End
End View



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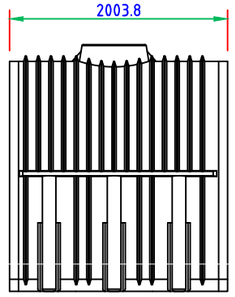
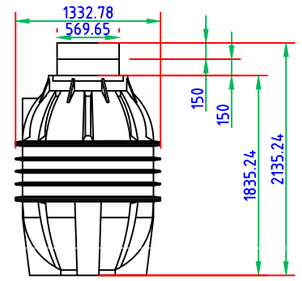
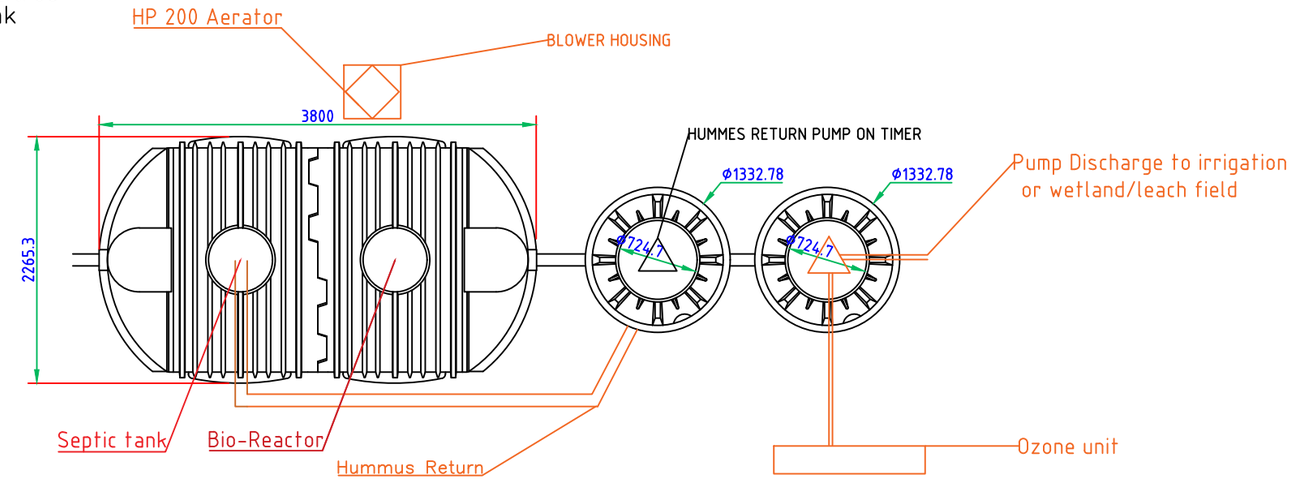
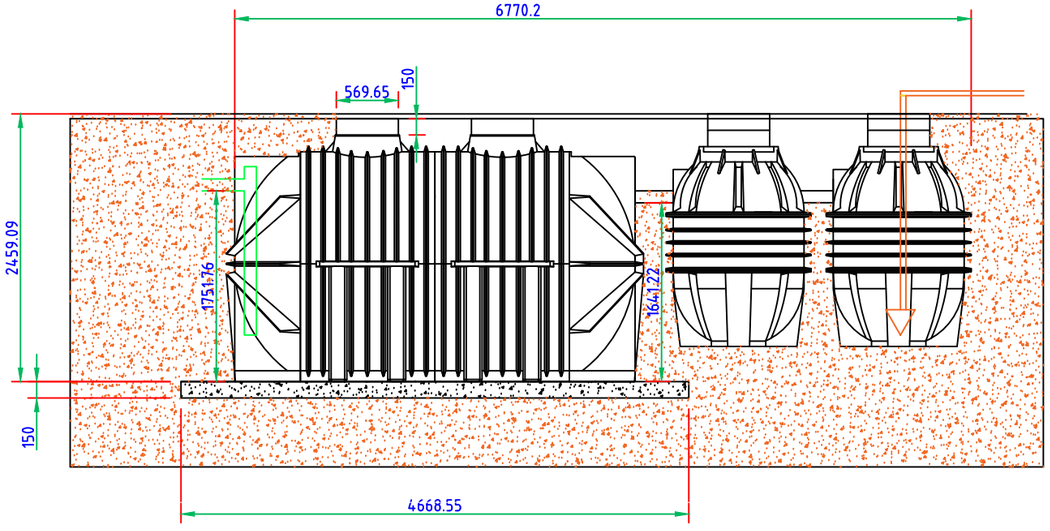


Modular 6000 Litres
Intrmediate Tank
Section







Calcamite Sanitary Services Pty Ltd

DESCRIPTION : Bio-Mite Bm25 Ozone Below Ground

Drawn By: Brandon Havenga | DWG No: CAL/BM/BM25

DATE : 06 / 10 / 2016 | REV-1

CALCAMITE
WATER & SANITATION SOLUTIONS

Bio-Mite Waste Water Treatment Plants

SUMMARY: HOW DOES THE BIOMITE WASTE WATER TREATMENT PLANT WORK?

- The overall objective of the **Bio-Mite Waste Water Treatment Plant** is to provide a Waste Water Treatment System that is capable of coping with a wide range of probable Waste Water conditions while complying with the overall performance requirements which is to meet or exceed the General Standard of the Department of Water Affairs and Forestry (DWAF).
- The Bio-mite Process cleans domestic waste water in three basic steps:
    1. Anaerobic Digestion,
    2. Aerobic Digestion and
    3. Disinfection.
- The **Anaerobic section** reduces the BOD loading of the waste stream by about 40% and provides a suitable buffer/ retention time for complete treatment. Here we utilize SABS approved multi chambered Septic tanks.
- The **Aerobic section** further reduced the BOD loading and reduces Nutrients (mainly Nitrates and Nitrites from the waste stream.
- Lastly the **Disinfection** process kills any remaining Pathogens in the Waste Stream to provide a clarified effluent ready for any non-potable reuse options such as irrigation, car washing and dust control.
- The Bio-Mite plant can be configured for above or below ground installation.

DETAILED: HOW DOES THE BIOMITE WASTE WATER TREATMENT PLANT WORK?

The **Bio-Mite** has been engineered to treat domestic and industrial waste water to a level that conforms to the National Standards as required by DWAF. The process is purely the biological breakdown of organic solids entering the treatment plant. The Bio-Mite process incorporates the advantages of fixed film technologies and combines with them the fine bubble diffused aeration techniques, to get a highly efficient biological treatment unit. It has as its main components, the bio media and fine bubble diffused aeration grid. With the higher surface area of bio media (150m2/m3), higher organic loading rates are enabled, thus reducing the overall size required of the aeration tank. This leads to a considerable reduction in civil and fabrication costs. The Bio-Mite process incorporates the advantages of fixed film technologies and combines with them the fine bubble diffused aeration techniques, to get a highly efficient biological treatment unit. It has as its main components, the bio media and fine bubble diffused aeration grid. With the higher surface area of bio media (150m2/m3), higher organic loading rates are enabled, thus reducing the overall size required of the aeration tank. This leads to a considerable reduction in civil and fabrication costs.

The system configuration enables better oxygen transfer efficiency with plug flow conditions. Submerged fixed film growth in SAFF reactors sustain good microbial growth even in adverse conditions and also handles shock loads very well. Sludge production is low; no sludge re-circulations is required and mean cell residence time is enhanced. Air requirement is based only on the organic load and mixing requirements are not called for, as this system is primarily an attached growth system. The media is a randomly packed polypropylene filter media and has wide application in biological treatment systems. The reactors are up-flow or down-flow fixed film type, based on either anaerobic or aerobic treatment processes.

The media provides optimum effective surface area for biological growth. The three dimensional liquid distribution due to unique dimensional design, increases hydraulic retention time and ensures excellent gas-liquid distribution within packed bed reactors, thus enhancing the treatment efficiency.

The Biological Breakdown Process

- **Primary treatment** is done in the SABS approved septic tanks/anaerobic reactors. The liquid capacity of these septic tanks is determined by the number of users connected to a septic tank. The anaerobic treatment process occurs in enclosed

tanks to prevent access to oxygen. It is not necessary to resettle the effluent on domestic waste water treatment plants to an anaerobic reactor. In the anaerobic reactor solids are intercepted and biologically broken down by anaerobic micro-organisms that are in contact with the waste water. We keep the anaerobic microorganisms (biomass) in our anaerobic treatment process in suspension. This process requires at least twenty-four hours but should be retained for at least forty-eight hours. The longer retention time translates into a higher quality effluent with significant Biological Oxygen Demand **(BOD)** reduction occurring before it flows into the biological reactor for secondary treatment.

- **Secondary treatment** is done in the Aerobic Biological Reactor. In the process, air (oxygen) is pumped into the reactor to mix and supply air to the waste water. The design for the secondary treatment process allows us to circulate the waste water between an aerobic zone and an anoxic zone to facilitate the de-nitrification process. Providing immobilized media for microorganisms to attach and grow on, is known as a fixed film process. Fixed film that has specifically been designed for waste water treatment is incorporated into the aerobic zone. This fixed film provides a surface area of approximately $150m^2/m^3$ waste water. The microorganisms metabolize the organic material into carbon dioxide and other end products and new biomass. The putrescibility and soluble oxygen demand is reduced to a small amount. The two major advantages of this fixed film technology are that diluted waste water can be treated and the bacterial colony will not be flushed out should the system be hydraulically overloaded.

- The **Tertiary treatment** process is a disinfectant/sterilizing process. We subject the treated waste water from the secondary treatment process to chlorination on the domestic treatment plants and ozonising on the bigger and custom built plants. This as a precaution against pathogens that may have passed on from the second stage. For this to be effective a contact period of at least thirty minutes should exist for pathogen destruction. We achieve this with a pumping chamber that has a storage capacity of 200 litres before the submersible pump pumps out the contents for reuse in the garden or on the lawn – not for growing vegetables.

It should be noted that nature is very effective in treating waste water that, once applied to the topsoil, aerobic bacteria in the root zone of plants will consume any remaining organic nutrients in the waste water. Waste water applied to the topsoil is also in contact with the powerful sterilization capabilities of UV rays present in sunlight.