



PROPOSED CONSTRUCTION OF AN ESKOM GENERAL LANDFILL SITE AND A HAZARDOUS WASTE STORAGE FACILITY IN LEPHALALE

CLOSURE PLAN AND END USE PLAN

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1 INTRODUCTION

1.1 Project Background

Eskom is presently constructing a 6 x 800MW (4 800MW total capacity) coal fired power station known as the Medupi Power Station. The power station is located 15km from the town of Lephalale, Limpopo Province.

The construction and future operation of the Medupi Power Station as well other results ESKOM installations in the areas both current and future generate and will continue to waste (both general and hazardous). This combination of general and hazardous waste derives from both the construction process and associated activities as well as from the inhabitants of the construction village, set up to house those individuals and employees actively involved in the day to day construction activities. Eskom has proposed the establishment of a landfill site specifically tailored to handle the waste emanating from the construction activities and waste expected to be generated during the lifelong operation of the Medupi power station. Further, as part of its long term plans, Eskom will be establishing two new power stations in the vicinity (currently designated Coal 1 and Coal 2). Eskom has proposed that the landfill design considerations take account of the fact that this selfsame facility serves as a disposal site during the construction and operation of Coal 1 and Coal 2 power stations and during operations of the currently operational Matimba power station.

The proposed location for this development would be within the boundaries of Eskom-owned property. These power plants are anticipated to have a life span of 50 years. The total anticipated waste generated from the four power stations over their total life i.e. 50 years, is expected to be approximately 1 200 000 m³ of waste split between general and hazardous waste. Given the approximate waste volumes that will be generated from the four power stations and the construction village, the proposed development is a strategic response to address current waste management challenges facing Eskom in the Lephalale area, adhere to the legal requirements as well as combating current operating costs (Envirolution EIA, 2009).

1.2 Context of Closure Plans

Closure plans are best developed before a landfill is put into service. The final use of the site should be kept in mind during the daily operation of the facility to minimize the final cost of site closure. Sites that have been adequately planned generally cost less for reclamation at closure of the site than facilities that have not been carefully thought through and planned. The objective of the closure plan is to steer the use of the site during its life time toward a desirable end use state that minimizes environmental risk, social risk, and financial or economic risk. The closure plan takes all closure requirements into account. The closure plan therefore must:

- Specify the final site topographic plan.
- Include a site drainage plan.
- Prepare appropriate cross-sections of the closed site.

- Specify source of cover material, especially for any required clay cover that may be necessary.
- Laboratory testing of the cover material should be completed to determine the soil's permeability when properly compacted.
- Specify procedures for compaction testing of the "barrier layer" during its installation.
- Specify measures to minimize soil erosion and of the materials.
- The Closure Design should also identify the vegetative cover and landscaping plan.

1.3 Scope of Work and Methodology

The closure design was prepared in accordance with the Minimum Requirements for Waste Disposal by Landfill (Second Edition, 1998). Specifications for closure design are included in Table 12 in the Minimum Requirements for Waste Disposal by Landfill and is attached as Appendix 3. Section 12.4 of these minimum requirements deals with the closure design. Table 8 summarizes the minimum requirements for landfill design, and is attached as Appendix 4. These requirements were also incorporated in the closure design.

In terms of the Minimum requirements, at the minimum the closure design must include the following:

- Remedial design to address identified problem areas
- Final shaping, landscaping and revegetation
- Final landfill cover or capping design
- Permanent storm water diversion measures run-off control and anti-erosion measures
- Any infrastructure relating to the End-use Plan.

2 SPECIFICATIONS FOR CLOSURE AND END USE

Table 8 of the Minimum Requirements for Waste Disposal by Landfill (Second Edition, 1998) summarizes landfill design requirements based on the classification of the landfill. Table 12 of the Minimum Requirements for Waste Disposal by Landfill (Second Edition, 1998) includes requirements for the closure design, based on the classification of the landfill.

2.1 Landfill Site Classification

From the waste stream analysis and climatic water balance calculation:

- The landfill is classified for general waste handling and is designated G:M:B⁺.
- Hazardous waste handling also needs to be considered.
- The site is to be considered as a general waste facility with a cell for disposing low hazard rating waste landfill (H:h) (PDNA, Conceptual Design report, 2009).

2.2 Requirements and Specifications for Closure and End Use

The closure plan and design must take into account the planned end use of the landfill. According to the Minimum Requirements for Waste Disposal by Landfill (Second Edition 1998), the end use of a landfill is determined by the following:

- The permit application report
- The permit conditions
- The department (DAAF)
- Interested and affected parties

There are a number options and alternatives for end use of landfills including agricultural use, ecological uses, recreational and amenity uses etc, and the choice of the desired end use is typically influenced by a number of factors including:

- Type of waste and associated operational constraints;
- Size, location and access;
- The development plan or framework;
- The aspirations of local residents, interest groups, etc.;
- Scheme economics;
- Long-term management requirements.

Given that;

- The site is located within an industrial area i.e. within the property of ESKOM Medupi Power Station, the site cannot be used for public amenities;
- Due to the fact that the site is classified has got a general and a hazardous components it is recommended that, post closure, the site remains non operational and not accessible to public in order to minimise potential health risks and hazards from the site.

The recommended end use for the landfill should be the '**No Use**' option and must be properly rehabilitated in order to leave the site to stabilise and allow the vegetation cover to properly go through the ecological succession phases.

2.3 Other considerations

Other issues that need to be considered in terms of the closure design are the following:

- The proposed site is adjacent to an unpermitted waste disposal site, which was used by Eskom for an unspecified period of time with no clarity regarding the type of waste disposed. Eskom is in the process of rehabilitating this site. (EIR, Conceptual Design report, 2009)
- The results of the geohydrological study indicate a aquifer system of *High Vulnerability* to the entire Site 5, that therefore require a *High Level* of protection.
- The *High Vulnerability* class allocated to the aquifer system is confirmed by the results of chemical analyses of water samples collected from boreholes located on Site 5. All boreholes show signs of pollution (Enviroolution EIA, 2009).
- In terms of the above considerations as well as recommendations as per the Conceptual Design Report, it is recommended that the landfill design which includes the closure design consider more stringent specifications for the closure requirements.
- It is therefore proposed that the closure design be specified as per the requirements for a G:M:B+ landfill site, as per the Minimum Requirements for Waste Disposal by Landfill (Second Edition,1998).
- The capping of the low hazard waste cell shall be considered in terms of the closure requirements for a H:h site as per the Minimum Requirements for Waste Disposal by Landfill (Second Edition,1998).

2.4 Specifications for Closure Design

The final closure design is primary informed by the risk assessment process of the dumpsite, and should:

- Ensure that the identified pollution Risk is mitigated and managed. Pollution control is the primary function of the closure design;
- Reduce the infiltration of precipitation into the landfill to control leachate generation;
- Minimise fugitive emissions of landfill gas through the surface of the cap;
- Separate the waste in the landfill from its surrounding environment.

The following steps and measures need to be implemented at the time of site closure in terms of the closure design:

1. Surveying
 - The site must be surveyed by a professional land surveyor.
2. Design

- Once site survey diagrams, cross-sections and layouts have been generated and other site risk assessment have been completed, the design engineer shall develop a final closure design which must be submitted to the department;
3. Final Elevation
 - The final elevation of the site shall be determined following the survey, but it must not exceed the background topographical features.
 4. Slope and Grading
 - The plateau of the site must be graded to 2 - 3% slope and the sides to a minimum of 3:1 slopes; however the final shape must be approved by the regulating authority.
 5. Final Cover and Capping
 - The final covering and capping of the site must undertaken based on recommendations from the risk assessment and design.
 - Before final capping, the waste must be compacted and shaped in such a way as to promote run-off and to prevent any ponding of water on the landfill site.
 - Filling and landscaping may be necessary to achieve this. This is very important in order to prevent any pooled water from seeping through the capping layer and in to waste below.
 - The final shaping of the landfill should comprise a gentle slope and must incorporate any existing berms. The final sloping of the landfill should not exceed 1 in 2.5.
 - The capping needs to keep the waste in the landfill as dry as possible and to prevent any further contamination leaching into the ground water. It should also be continuous with any existing berms.
 - The capping should be constructed according to Figure A.8.11 of Appendix 8.2 of the Minimum Requirements for Waste Disposal by landfill (Second Edition, 1998). This diagram is reproduce below:

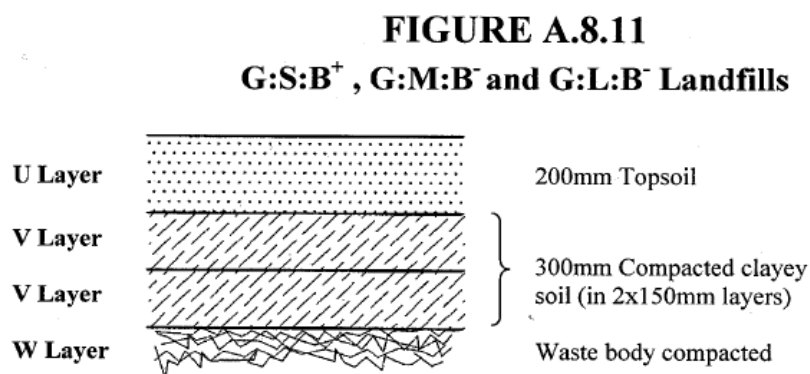


Figure 1: Cross section of capping layer taken from Figure A.8.11 of Appendix 8.2 of the Minimum Requirements for Waste Disposal by landfill (Second Edition, 1998)

- The final capping of the low hazard waste cell must be considered differently from the rest of the site in terms of the construction of the capping layer.
- The capping of this cell should be constructed according to the requirements of a H:h site as per Figure A.8.12 of Appendix 8.2 of the Minimum Requirements for Waste Disposal by landfill (Second Edition, 1998). This diagram is reproduced below:

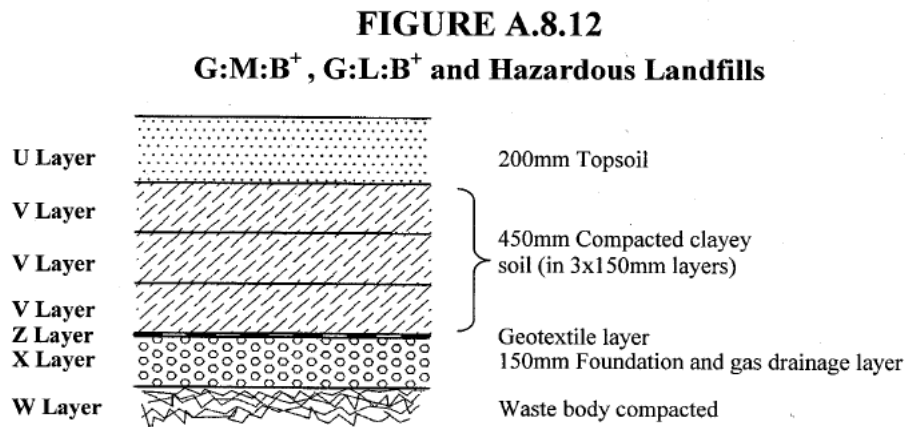


Figure 2: Cross section of capping layer taken from Figure A.8.12 of Appendix 8.2 of the Minimum Requirements for Waste Disposal by landfill (Second Edition, 1998)

- Laboratory testing of the cover material should be completed to determine the soil's permeability when properly compacted.
 - Capping layers should be compacted according to Appendix 8.2 in the Minimum Requirements for Waste Disposal by Landfill (Second Edition, 1998).
6. Vegetation cover
- Once the final layer of top soil has been placed on the cap, the site must be seeded with a mixture of indigenous grasses, and allowed to propagate to form a healthy grass community on the site.
 - The grassing and vegetation must commence immediately after final capping in order to prevent soil erosion.
7. Leachate and Storm water Management
- According to the water balance calculation as per the Conceptual Design Report The proposed site lies in an area where sporadic or no significant leachate is expected to be generated from landfilling.
 - If the landfill site can be shaped and capped in such a way as to prevent any pooling or damming of storm water over the landfill, it will not be necessary to construct a lined pond for collection of the run-off or leachate. If properly constructed the shaping and capping of the landfill should prevent water from coming into contact with the waste.
8. Gas Management

- Gas management is not required for G:M:B⁺ Landfill sites. For the H:h cell, special consideration should be given, at the time of site closure, as to whether a gas management system is required or not.

8. Site Access

- It is recommended that when the site is to be closed, that the site be fenced off and isolated and that no further development or dumping of additional waste of any kind be carried out.
- Signage in at least 3 applicable languages in the region, must be placed at the fences and entrance of the site indicating that the site is out of bounds for public, closed and that no disposal or dumping is allowed on this site.

2.5 Environmental Management Plan

It is recommended that standard ESKOM Environmental Management Plan specification for construction projects be included as part of this plan to provide a framework for general environmental management and good housekeeping during the construction works for closure of the waste disposal site.

2.6 Monitoring Plan

Recommendations made in the geohydrological report in terms of ongoing monitoring, inspection and maintenance are here incorporated. The specifications made under this section address the requirements as per the Minimum Requirements for Waste Disposal by Landfill (Second Edition, 1998).

2.6.1 Post Closure Monitoring Plan

The following specifications are made in terms of the ongoing water monitoring:

- Future water table measurements and sampling should be analysed by the same accredited laboratory to avoid variations in results attributable to analytical techniques which can mask variations over time.
- Static water tables and the water chemistry of all boreholes must be monitored at three monthly intervals. Once stable trends have been established, the interval can be extended to a longer period in consultation with the Department.
- The same elements as those analyzed for in the geohydrological study should be analyzed for in future. These include all the determinants analyzed for in the certificate of analysis attached as Appendix 6. Table 4 from the geohydrological report showing the results of the chemical analysis is attached as Appendix 5.
- Changes can only be instituted once stable trends for certain elements can be established.
- Subsequent to measuring the water tables and collecting the water samples, the boreholes should be pumped empty or if this is not possible a volume equal to the

column of water in the borehole should be pumped out of it to prevent re-analyses of stagnant water in the borehole.

- It is recommended that stable isotopes oxygen-18 and deuterium as well as tritium analysis be done to gather more information about groundwater interconnection and recharge dynamics.
- The results of the monitoring program should be submitted to the Department of Water Affairs before they are included in the annual audit report.

2.6.2 Post Closure Site Inspection

The following specifications are important in order to meet the requirements of ongoing site inspections, maintenance and management:

The site should be fenced and isolated so that no further development or dumping of additional waste of any kind can be carried out.

- The security of the site should be maintained at all times to prevent illegal access and dumping.
- The site must be inspected at 3 monthly intervals. Once the stability of the site has been established, the inspection interval can be extended in consultation with the Department.
- Inspection of the cover integrity must include the following: the presence of any depressions, evidence of ponding, evidence of erosion.
- Any breach in cover integrity needs to be reported, the cause identified and the situation restored by infilling.
- Any issues of subsidence must be filled.
- Evidence of ponding or poor drainage must be corrected.
- Fires need to be identified, exposed and covered with soil.
- The vegetation that has been established on the landfill needs to be maintained in order to prevent erosion.

3 CONCLUSION AND RECOMMENDATIONS

The closure design of the planned Eskom waste disposal site is incorporates the following:

- The recommended end use is the 'NO USE' option once the site has been fully remediated or rehabilitated.
- At the time of site closure, the site must be surveyed and cross-sections and layouts must be developed and submitted to aid the implementation of the closure design.
- The final shaping and capping of the landfill should be carried out as per the Closure Design.
- Ongoing monitoring of the groundwater should continue according to the requirements and recommendations stipulated in this report.
- The site should be fenced off to prevent unauthorized access and further dumping.
- The site should be subject to ongoing inspection and maintenance as stipulated in this report.

REFERENCES

Bolton, Neal; Handbook of landfill operations a practical guide for landfill engineers, owners and operators.

DWAF, Minimum Requirements for Waste Disposal by landfill (Second Edition, 1998).

DWAF, Minimum Requirements for Handling, Classification and Disposal of Hazardous Waste (Second Edition, 1998).

www.envirolution.co.za/escommedupieir/ Appendix C1: Conceptual Design Report.pdf

www.envirolution.co.za/escommedupieir/ Appendix D3: Geohydrology.pdf

www.envirolution.co.za/escommedupieir/, Appendix C1: Draft Environmental Impact Report

U.S. EPA, November 1993, Technical Manual for Solid Waste Disposal Criteria - 40 CFR Part 258, Subpart F (Chapter 6).