



GA Environment

**WASTE MANAGEMENT LICENCE APPLICATION AND
BASIC ASSESSMENT PROCESS FOR THE PROPOSED
LICENSING FOR THE LICENSING OF THE TOPLINE
LANDFILL, !KHEIS LOCAL MUNICIPALITY; NORTHERN
CAPE PROVINCE**

CLOSURE PLAN

FEBRUARY 2016

CLOSURE PLAN

For

THE PROPOSED LICENSING OF THE TOPLINE LANDFILL, !KHEIS LOCAL MUNICIPALITY, NORTHERN CAPE PROVINCE

Prepared for:

!Kheis Local Municipality

97 Orange Street ,
GROBLERSHOOP,
8850

Submitted to:

Northern Cape Department of Environment and Nature Conservation

Private bag X 6120
Kimberley
8301

Prepared by:

GA Environment (Pty) Ltd

P.O. Box 6723
Halfway House,
MIDRAND
1685

Tel. No.: (011) 312 2537

Fax. No.: 011 805 1950

e-mail: environment@gaenvironment.com

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PROJECT INFORMATION

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Competent Authority: Northern Cape Department of Environment and Nature Conservation

Applicant: !Kheis Local Municipality

Environmental Consultants: GA Environment (Pty) Ltd

Compiled by: Ntsebo Mofoka *BSc (Hons.) cum laude*
Reviewer: Hlengiwe Thusi, Cert. Sci. Nat

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SIGNING OF THE ORIGINAL DOCUMENT

Original	Prepared by	Reviewed by	Approved by
Date: 5 February 2016	Name: Ntsebo Mofoka	Name: Hlengiwe Thusi	Name: Nkhensani Khandhela
Version 0	Signature:	Signature:	Signature:

Distribution List

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**THE CLOSURE PLAN FOR THE LICENSING OF THE TOPLINE LANDFILL, !KHEIS LOCAL
MUNICIPALITY, NORTHERN CAPE PROVINCE**

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LIST OF ABBREVIATIONS / ACRONYMS

DEA	Department of Environmental Affairs
DWA	Department of Water Affairs
ECA	Environmental Conservation Act (Act 73 of 1989)
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMPR	Environmental Management Programme Report
G	General Waste
GCB	General Communal Landfill
GSB	General Small Landfill
GMB	General Medium Landfill
GLB	General Large Landfill
H	Hazardous Waste
HDPE	High-Density Polyethylene
H:H	Hazardous Landfill (Hazard Rating 1-4)
H:H	Hazardous Landfill (Hazard Rating 3-4)
IAP's	Interested and Affected Parties
IRD	Initial Rate of Deposition
IWMP	Integrated Waste Management Plan or Industry Waste Management Plan
KPI	Key Performance Indicators
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended
NEMWA	National Environmental Management Waste Act (NEMWA hereafter), 2008 (Act No. 59 of 2008), as amended

GLOSSARY OF TERMS

This section provides a catalogue of terms and Definitions, which may be used in this report and, or other future waste management plans and documents. Where more than one definition for a term exists in the literature, additional definitions have been provided for clarity:

Term	Definition	Reference
Audit	A site inspection at which the condition of the site on that day is appraised in terms of a number of predetermined criteria.	Minimum Requirements (1998)
Buffer Zones	Buffer Zones are separations between the boundaries of registered landfill sites and residential developments. They may vary between 500m and 1000m in width, depending on the classification of the landfill. No residential development may take place within a proclaimed buffer zone. At the discretion of the local authority and the state departments, however, developments such as industrial development may be permitted.	Minimum Requirements (1998)
Cell	This is the basic landfill unit of compacted solid waste which, when completed at the end of each day, is entirely contained by cover material. The sides may be typically formed by 1,5m or 2,0m high soil or rubble berms, or sloped covered waste. Cell width is determined by the manoeuvring requirements of vehicles depositing waste at the working face.	Minimum Requirements (1998)
Co-Disposal	Co-disposal (General and Hazardous waste): The mixing and joint disposal of Hazardous (H) and General (G) waste in the same landfill. The co-disposal of general waste with hazardous waste as a means of facilitating disposal on a hazardous waste landfill is acceptable, whereas the co-disposal of any significant quantity of hazardous waste with general waste on a general waste landfill is unacceptable.	Minimum Requirements (1998)
Co-Disposal	Co-disposal: (Liquid with Dry waste): The mixing of high moisture content or liquid waste with dry waste. This affects the water balance and is an acceptable practice on a hazardous waste landfill site. This is only acceptable on a general waste landfill site when the liquid is not hazardous and the site is equipped with leachate management measures.	Minimum Requirements (1998)

Term	Definition	Reference
Compliance Monitoring	Monitoring done in compliance with permit conditions	Minimum Requirements (1998)
Cover	The material used to cover waste. Cover material is usually soil, but may comprise builders' rubble, ash or other suitable material. Daily cover is usually 150mm thick, intermediate cover is usually 300mm thick and final cover or capping usually 500mm thick. Final cover may form part of a special capping design and, as is the case with intermediate cover, must be able to support vegetation.	Minimum Requirements (1998)
Cradle-To-Cradle	A philosophy and principle of industrial ecology involving the design of systems such that materials and waste products move in a cyclical process with zero wastage.	
Cradle-To-Grave	A policy of controlling of Hazardous Waste from its inception to its ultimate disposal.	Minimum Requirements (1998)
Development Plan	A plan indicating the phasing of the development of a landfill from the landfill preparation, through the operation (which is usually divided into areal phases), to the final closure, rehabilitation and end-use. The phasing, and hence the Development Plan, forms part of the design.	Minimum Requirements (1998)
Disposal Site	A site used for the accumulation of waste with the purpose of disposing or treatment of such waste;	ECA
Duty Of Care	This requires that any person who generates, transports, treats or disposes of waste must ensure that there is no unauthorised transfer or escape of waste from his control. Such a person must retain documentation describing both the waste and any related transactions. In this way, the person retains responsibility for the waste generated or handled.	Minimum Requirements
Eco-Toxicity	Eco-toxicity is the potential to harm animals, plants, ecosystems or environmental processes.	Minimum Requirements (1998)

Term	Definition	Reference
End-Use Plan	The purpose for which the area of the rehabilitated and closed landfill is used. This may be as a park, playing fields, or other suitable land-use.	Minimum Requirements (1998)
Environment	the surroundings within which humans exist and that are made up of— (i) the land, water and atmosphere of the earth; (ii) micro-organisms, plant and animal life; (iii) any part or combination of (i) and (ii) and the interrelationships among and between them; and (iv) the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being.	NEMA
Extended Producer Responsibility	Means measures that extend a person’s financial or physical responsibility for a product to the post-consumer stage of the product, and includes— (a) waste minimisation programmes; (b) financial arrangements for any fund that has been established to promote the reduction, re-use, recycling and recovery of waste; (c) awareness programmes to inform the public of the impacts of waste emanating from the product on health and the environment; and (d) any other measures to reduce the potential impact of the product on health and the environment.	NEMWA (2008)
Fatal Flaw	A factor or situation which prevents the development of an environmentally acceptable waste disposal facility, except as prohibitive cost.	Minimum Requirements (1998)

Term	Definition	Reference
General Waste	Waste that does not pose an immediate threat to man or to the environment, i.e. household waste, builder’s rubble, garden waste, dry industrial and commercial waste.	White Paper on IP&WM
General Waste	Waste that does not pose an immediate threat to man or the environment, i.e. household waste, builders’ rubble, garden waste, and certain dry industrial and commercial waste. It may, however with decomposition, infiltration and percolation, produce leachate with an unacceptable pollution potential.	Minimum Requirements (1998)
General Waste	All urban waste that is produced within the jurisdiction of local authorities. It comprises rubble, garden, domestic, commercial and general industrial waste. It may also contain small quantities of hazardous substances dispersed within it such as batteries, insecticides and week-killers discarded on domestic and commercial premises. General waste may be disposed of in a permitted landfill and may be equated to what is commonly referred to as domestic, solid waste and municipal waste, i.e. that which is normally managed by a local authority.	DWAF Waste Generation Baseline Studies
General Waste	Means waste that does not pose an immediate hazard or threat to health or to the environment, and includes— (a) domestic waste; (b) building and demolition waste; (c) business waste; and (d) inert waste.	NEMWA (2008)
General Waste Landfill	A landfill designed to accept only general waste. Depending on the Site Water Balance, it may or may not have a leachate management system.	Minimum Requirements (1998)

Term	Definition	Reference
Generator	An industry or other party whose activities result in the production of waste. The responsibility for hazardous waste remains from cradle-to-grave with the generator of the waste and the generator is held liable for any damage that the waste may cause to humans or to the environment.	Minimum Requirements (1998)
Guidelines	While not requirements, guidelines are recommended actions, which represent good practice. They are not enforceable, but may form the basis for site specific permit conditions in which case they become mandatory.	Minimum Requirements (1998)
Hazard	a source of or exposure to danger.	NEMA
Hazardous Waste	Waste that may, by circumstances of use, quantity, concentration or inherent physical, chemical or infectious characteristics, cause ill-health or increase mortality in humans, fauna and flora, or adversely affect the environment when improperly treated, stored, transported or disposed of.	Minimum Requirements (1998)
Hazardous Waste	Waste, other than radioactive waste, which is legally defined as hazardous in the state in which it is generated, transported or disposed of. The definition is based on the chemical reactivity or toxic, explosive, corrosive or other characteristics, which cause, or are likely to cause, danger to health or to the environment, whether alone or when in contact with other waste.	Minimum Requirements (1998)
Hazardous Waste	Waste, including radioactive waste, which is legally defined as “hazardous” in the state in which it is generated. The definition is based on the chemical reactivity or toxic, explosive, corrosive or other characteristics which cause, or are likely to cause, danger to health or to the environment, whether by itself or when in contact with other waste.	White Paper on IP&WM
Hazardous Waste	This refers to any waste that contains organic or inorganic elements of compounds that may, owing to the inherent physical, chemical or toxicological characteristics of that waste, have a detrimental impact on health and the environment.	NEMWA (2008)

Term	Definition	Reference
Incineration	Incineration is both a form of treatment and a form of disposal. It is simply the controlled combustion of waste materials to a non-combustible residue or ash and exhaust gases, such as carbon dioxide and water.	Minimum Requirements (1998)
Infectious Waste:	Any waste which is generated during the diagnosis, treatment or immunisation of humans or animals; in the research pertaining to this; in the manufacturing or testing of biological agents – including blood, blood products and contaminated blood products, cultures, pathological wastes, sharps, human and animal anatomical wastes and isolation wastes that contain or may contain infectious substances.	Minimum Requirements (1998)
Interested And Affected Parties (IAP's)	Interested and Affected Parties are those people who will be affected in some way by the Hazardous Waste disposal process. Residents or farmers, a whole residential community, or the public at large may represent I&APs	Minimum Requirements (1998)
Landfill (V)	To dispose of waste on land, whether by use of waste to fill in excavations or by creation of a landform above grade, where the term “fill” is used in the engineering sense.	Minimum Requirements (1998)
Landfill (N)	The waste body created by land filling. This may be above or below grade, or both.	Minimum Requirements (1998)
Leachate	An aqueous solution with a high pollution potential, arising when water is permitted to percolate through decomposing waste. It contained final and intermediate products of decomposition, various solutes and waste residues. It may also contain carcinogens and/or pathogens. Sporadic/Significant.	Minimum Requirements (1998)
Litter	Any object or matter discarded or left behind by the person in whose possession or control it was.	ECA
Medical Waste or Health Care Waste	Wastes emanating primarily from human and veterinary hospitals, clinics and surgeries, also from chemists and Sanitary Services. They may comprise, inter alia, sharps (used hypodermic needles and scalpel blades), malignant tissue,	Minimum Requirements (1998)

Term	Definition	Reference
	body parts, soiled bandages and liner, and spent or out dated medicines or drugs. They have the ability to affect and infect other living organics, and are considered hazardous.	
Minimum Requirement	A standard by means of which environmentally acceptable waste disposal practices can be distinguished from environmentally unacceptable waste disposal practices.	Minimum Requirements (1998)
Monitoring	The process of checking for changes in status or trends over time. This may be achieved by compiling successive audit or water quality analyses results.	Minimum Requirements (1998)
Operating Plan	A site-specific document which describes the way in which the landfill is operated. The Operating Plan commences at the level and detail of daily cell construction and continues through to the development and excavation sequence, access and drainage within a given phase of the Development Plan.	Minimum Requirements (1998)
Permit	The Permit issued by the Department of Water Affairs, & Forestry for the operation or closure of a landfill, in terms of Regulation 1549, promulgated under the Environment Conservation Act (Act 73 of 1989).	Minimum Requirements (1998)
Pollution	Any change in the environment caused by— (i) substances; (ii) radioactive or other waves; or (iii) noise, odours, dust or heat, emitted from any activity, including the storage or treatment of waste or substances, construction and the provision of services, whether engaged in by any person or an organ of state, where that change has an adverse effect on human health or well-being or on the composition, resilience and productivity of natural or managed ecosystems, or on materials useful to people, or will have such an effect in the future.	NEMA
Precautionary Principle	Where a risk is unknown; the assumption of the worst-case situation and making provision for such a situation.	Minimum Requirements (1998)

Term	Definition	Reference
Recycle	The use, re-use, or reclamation of material so that it re-enters the industrial process rather than becoming a waste.	Minimum Requirements (1998)
Remediation	The rectification of problems, caused by bad practices, through the implementation of remedial measures.	Minimum Requirements (1998)
Responsible Person	The Permit Holder or his legally appointed representative who takes responsibility for ensuring that all or some of the facets of any of the following are properly directed, guided and executed, in a professionally justifiable manner: investigatory work, design, preparation, operation, closure and monitoring.	Minimum Requirements (1998)
Standard	A criteria/measure by which the accuracy or quality of others is judged or a model for imitation, or the degree of excellence required.	Minimum Requirements (1998)
Toxic Waste	A form of hazardous waste that causes death or serious injury, such as burns, respiratory diseases, cancer or genetic mutations.	White Paper on IP&WM
Transporter	A person, organisation, industry or enterprise engaged in or offering to engage in the transportation of waste.	Minimum Requirements (1998)
Treatment	Treatment is used to remove, separate, concentrate or recover a hazardous or toxic component of a waste or to destroy or, at least, to reduce its toxicity in order to minimise its impact on the environment.	Minimum Requirements (1998)
Waste	Any matter, whether gaseous, liquid or solid or any combination thereof, which is from time to time designated by the Minister by notice in the Gazette as an undesirable or superfluous by-product, emission, residue or remainder of any process or activity (definition of 'waste' substituted by s. 1 (h) of Act 79 of 1992).	Environment Conservation Act (Act 73 of 1989)
Waste	An undesirable or superfluous by-product, emission, or residue of any process or activity which has been discarded, accumulated or been stored for the purpose of discarding or processing. It may be gaseous, liquid or solid or any	White Paper on IP&WM

Term	Definition	Reference
	combination thereof and may originate from a residential, commercial or industrial area. This definition includes industrial waste water, sewage, radioactive substances, mining, metallurgical and power generation waste.	
Waste	Any matter, whether gaseous, liquid or solid or any combination thereof, originating from any residential, commercial or industrial area or agricultural area identified by the Minister of Environment Affairs as an undesirable or superfluous by-product, emission, residue or remainder of any process or activity.	DWAF Waste Generation Baseline Studies
Waste	<p>Means any substance, whether or not that substance can be reduced, re-used, recycled and recovered—</p> <p>(a) that is surplus, unwanted, rejected, discarded, abandoned or disposed of;</p> <p>(b) where the generator has no further use of for the purposes of production, reprocessing or consumption;</p> <p>(C) that must be treated or disposed of; or</p> <p>(d) that is identified as a waste by the Minister,</p> <p>but—</p> <p>(i) a by-product is not considered waste; and</p> <p>(ii) any portion of waste, once re-used, recycled and recovered, ceases to be waste.</p>	NEMWA (2008)
Waste Body	This refers to the body of waste (and cover) that is contained in the landfill. Because it is subject to decomposition, it has the potential to generate leachate and must therefore be adequately separated from the water regime.	Minimum Requirements (1998)
Waste Disposal Facility	Means any site or premise used for the accumulation of Waste with the purpose of disposing of that waste at that site or on that premise.	NEMWA (2008)

Term	Definition	Reference
Waste Management Activity	<p>Means any activity listed in Schedule 1 or published by notice in the <i>Gazette</i> under section 19 of the NEM Waste Act, and includes—</p> <p>(a) the importation and exportation of waste;</p> <p>(b) the generation of waste, including the undertaking of any activity or process that is likely to result in the generation of waste;</p> <p>(c) the accumulation and storage of waste;</p> <p>(d) the collection and handling of waste;</p> <p>(e) the reduction, re-use, recycling and recovery of waste;</p> <p>(f) the trading in waste;</p> <p>(g) the transportation of waste;</p> <p>(h) the transfer of waste;</p> <p>(i) the treatment of waste; and</p> <p>(j) the disposal of waste.</p>	NEMWA (2008)
Waste Management License	Means a licence issued in terms of section 49 of the NEM Waste Act (2008) for waste management activities listed under section 19 of the Act.	NEMWA (2008)
Waste Management Facility	All wastes or products stored on a temporary or permanent basis, that could impact on surface or groundwater quality, by leaching into or coming in contact with water, are referred to a “Waste Management Facilities”. See also the Waste Management Documents, “Minimum requirements for waste disposal sites” and “Minimum requirements for the handling and disposal of hazardous waste”.	Minimum Requirements (1998)
waste management Services	Means waste collection, treatment, recycling and disposal services.	NEMWA (2008)
Waste Minimisation programme	Means a programme that is intended to Promote the reduced generation and disposal of waste.	NEMWA (2008)

Term	Definition	Reference
Waste Transfer Facility	Means a facility that is used to accumulate and temporarily store waste before it is transported to a recycling, treatment or waste disposal facility.	NEMWA (2008)
Waste Treatment Facility”	Means any site that is used to accumulate waste for the Purpose of storage, recovery, treatment, reprocessing, recycling or sorting of that Waste.	NEMWA (2008)

1 INTRODUCTION

1.1 Background

The Department of Environmental Affairs (DEA) is assisting the !Kheis Local Municipality to licence various waste facilities within its jurisdiction. The Topline landfill is one of the sites that will require an operational licence from the Northern Cape Department of Environment and Nature Conservation (DENC). As part of this process however, a preliminary closure plan is presented in this document for inclusion in the Closure Report once the Topline landfill has almost reached capacity and a Closure Licence required from the Northern Cape Department of Environment and Nature Conservation (DENC).

1.2 Scope and Objectives of the Report

This report is intended to serve a guide for the formal closure and end use planning for the future closure of the Topline landfill site. The closure and end use plan are intended to be implemented along with the rehabilitation of the site. This report is thus intended to:

- Serve a guide for the formal closure and rehabilitation planning for the Topline Landfill Site.
- Used as a framework document, which shall guide the development of more detailed specifications for the implementation of engineering scope of works for the closure and rehabilitation of the Topline Landfill Site.
- Form part of the Environmental Management Plan for the Closure of the Topline Landfill Site.
- Guide the !Kheis Local Municipality to make Financial Provisions for the closure and rehabilitation for the site.

This report has been prepared in line with the guidance documents on best practice for Closure of Waste Management Facilities, some of which can be found in the Minimum Requirements for Waste Management 2nd Editions, Department of Water Affairs and Forestry (1998), and is intended to ensure compliance with legal and other requirements within the context of Environmental Management Systems and Planning. Appendix 5 of the NEMA EIA Regulations (*Content of the Closure Plan*) has also been considered during the compilation of this document.

1.3 Details of Environmental Impact Assessment Practitioner

This report has been prepared in line with the guidance documents on best practice for Closure of Waste Management Facilities, some of which can be found in the Minimum Requirements for Waste Management 2nd Editions, Department of Water Affairs and Forestry (1998), and is intended to ensure compliance with legal and other requirements within the context of Environmental Management Systems and Planning. *Appendix 5 of the NEMA EIA Regulations* (Content of the Closure Plan) has been considered during the compilation of this document.

This Closure Plan was compiled by:

Company Name: GA Environment (Pty) Ltd
Contact person: Ms. Ntsebo Mofoka
Postal Address: P.O Box 6723, Midrand, 1685
Telephone Number: (011) 312 2537
Fax Number: (011) 805 1950
E-mail: ntsebom@gaenvironment.com

Ms. Ntsebo Mofoka is an Environmental Assessment Practitioner (EAP) who holds a B.Sc. (Hons) Environmental Management (cum laude). She has 3 years of working experience in the Environmental Management Field and a year in the field of Landscape Architecture. Ntsebo specialises in, among various environmental management tools, Integrated Environmental Management (IEM), Environmental Impact Assessments (EIAs), Basic Assessments (BAs). Miss Mofoka also specialises in Spatial Analyses and Mapping with the use of ArcGIS. She has been involved in projects related to Waste Management, Linear Infrastructure, Mixed-Use developments and Conservation Planning and Biodiversity Management. Ntsebo is currently an EAP at GA Environment (Pty) Ltd.

1.4 Context and Objective of the Closure and Rehabilitation Plan

The objective of the closure plan is to steer the use of the site during its lifetime 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 landfill closure plan aims to specify the implementation of requirements for closure of the landfill and would typically include details of rehabilitation measures. The closure report also seeks to specify details of management, inspection, monitoring and maintenance of the site after it is closed.

It is important to bear in mind that this Closure Plan serves as a template to the future closure plan that will accompany the relevant Environmental Assessment report that will need to be undertaken when the site is licenced for closure.

1.5 Content of a closure and rehabilitation plan for a landfill site

Before any closure plan can be developed, a site assessment/investigation is conducted to assess the existing conditions of the site. The site investigation process is a necessary step in the development of a better and more comprehensive closure and post-closure plan as knowledge of the actual conditions at the site, the operational procedures practiced during its operation, and other issues relative to the site,

are studied. Site investigation may also help in identifying the extent of potential contamination and the likely pathways of contaminants. Site investigation includes the following activities which are to:

- Review of pertinent data such as the geology of the site, depth of groundwater, volume and types of wastes disposed, reports, studies, historical records concerning the dumpsite (operations, unusual events such as fires, dumping of hazardous wastes, etc.);
- Review of pertinent available maps (map of the dumpsite and its surroundings, topographical, geological, hydrogeological, etc.);
- Interview with those directly involved with the operation of the dumpsite, waste pickers, and residents near site;
- Inventory of existing settlements, structures, surface water bodies, water wells, etc.;
- Determine points of leachate seepage and ponding within and beyond the disposal facility;
- Identify existing land uses around the area;
- Conduct topographic survey of the dumpsite, extending some distance from its boundaries;
- Conduct geotechnical investigation to determine stability of slopes;
- Identify sources of soil or other cover material for the site;
- Determine, if practical, the depths of the dumped wastes;
- Determine gas leakage within and on the areas surrounding the dumpsite;
- Conduct leachate and gas sampling (if practical); and
- Conduct water quality sampling of surface waters, water wells, groundwater (if practical).

Based on the above Investigations, the Closure and Rehabilitation Plan must then:

- Specify the final site topographic plan.
- Include a site drainage plan.
- Provide appropriate cross-sections of the closed site.
- Specify source of cover material, especially for any required clay cover that may be necessary.
- Provide geotechnical and geochemical prosperities of appropriate cover material and determine the soil's permeability of the capping layer.
- Specify procedures for compaction testing of the "barrier layer" during its installation.
- Specify measures to minimize soil erosion and of the materials.
- Identify the vegetative cover and
- Provide landscaping plan for the final capped Cells

1.6 Completeness of data for this Closure plan

In order to compile a suitable Closure Plan for the project, certain information must be available. This information will be filled into the table below.

Table 1: Information Completeness

Required information	Status		Comment
	Yes	No	
Review of pertinent data such as the geology of the site, depth of the ground water, volume, and types of wastes disposed, reports, studies, historical records concerning the dumpsite (operations, unusual events such as fires, dumping of hazardous wastes	<i>TO BE ADDED DURING THE UNDERTAKING OF THE CLOSURE OF THE SITE</i>		
Review of pertinent available maps, a map of the landfill and its surroundings, topographical, geological, hydrogeological etc.	<i>TO BE ADDED DURING THE UNDERTAKING OF THE CLOSURE OF THE SITE</i>		
Interview with those directly involved with the operation of the dumpsite, waste pickers, and residents near site	<i>TO BE ADDED DURING THE UNDERTAKING OF THE CLOSURE OF THE SITE</i>		
Inventory of existing settlements, structures, surface water bodies, water wells, etc.	<i>TO BE ADDED DURING THE UNDERTAKING OF THE CLOSURE OF THE SITE</i>		
Determine points of leachate seepage and ponding within and beyond the disposal facility	<i>TO BE ADDED DURING THE UNDERTAKING OF THE CLOSURE OF THE SITE</i>		
Identify existing land used around the area	<i>TO BE ADDED DURING THE UNDERTAKING OF THE CLOSURE OF THE SITE</i>		
Conduct topographical survey of the dumpsite, extending some distance from its boundaries	<i>TO BE ADDED DURING THE UNDERTAKING OF THE CLOSURE OF THE SITE</i>		
Conduct geotechnical investigation to determine stability of the site	<i>TO BE ADDED DURING THE UNDERTAKING OF THE CLOSURE OF THE SITE</i>		
Identify sources of soil or other cover material for the site	<i>TO BE ADDED DURING THE UNDERTAKING OF THE CLOSURE OF THE SITE</i>		
Determine if practical, the depth of the dumped sites	<i>TO BE ADDED DURING THE UNDERTAKING OF THE CLOSURE OF THE SITE</i>		
Determine gas leakage within and on the areas surrounding the dumpsite	<i>TO BE ADDED DURING THE UNDERTAKING OF THE CLOSURE OF THE SITE</i>		
Conduct leachate and gas sampling (if practical); and	<i>TO BE ADDED DURING THE UNDERTAKING OF THE CLOSURE OF THE SITE</i>		
Conduct water quality sampling of surface water, water wells, groundwater (if practical)	<i>TO BE ADDED DURING THE UNDERTAKING OF THE CLOSURE OF THE SITE</i>		

1.7 Approach to and use of this closure and rehabilitation plan

This closure and rehabilitation plan recognizes the fact that the Topline landfill S faces a number of critical issues, which are not mutually exclusive and requires an integrated holistic engineered solution to address the current problems facing the site.

1.8 Public Participation Processes undertaken to date

At the time of the compilation of this report, Public Participation for the closure of the site had not been undertaken as the closure of the landfill will be an activity that the Local Municipality will need to apply for. This Closure Process will be accompanied by a Public Participation Process that will be outlined in this report.

2 SITE DESCRIPTION

The Topline landfill site falls within the jurisdiction of Dr ZF Mgcau District Municipality and the !Kheis Local Municipality. The Topline landfill is located on Erf 2681, Saalskop in Topline, Gannaput which is located approximately 100 km South East of Upington and approximately 20km north west of the Groblershoop town. The site is located south west of the Topline township. The boundaries of the area indicated as that to be licenced is approximately 0.2 km from the edge of the informal settlement and approximately 0.5 km from the boundaries of the residential area.

Access to the landfill site can be gained from the N10 road, which connects Topline to Upington. From the N10, the site can be accessed from internal Streets. Numerous gravel roads then connect landfill to the Topline Township. The site is approximately one kilometre from the N10. Wastewater treatment works are located immediately west of the site. Topline Primary School is located about 600m south-south west of the site and a cemetery is located approximately 500m from the site. The site co-ordinates are 28°45'30.15"S; 21°50'14.46"E. The location of the site is indicated in **Figure 1**.

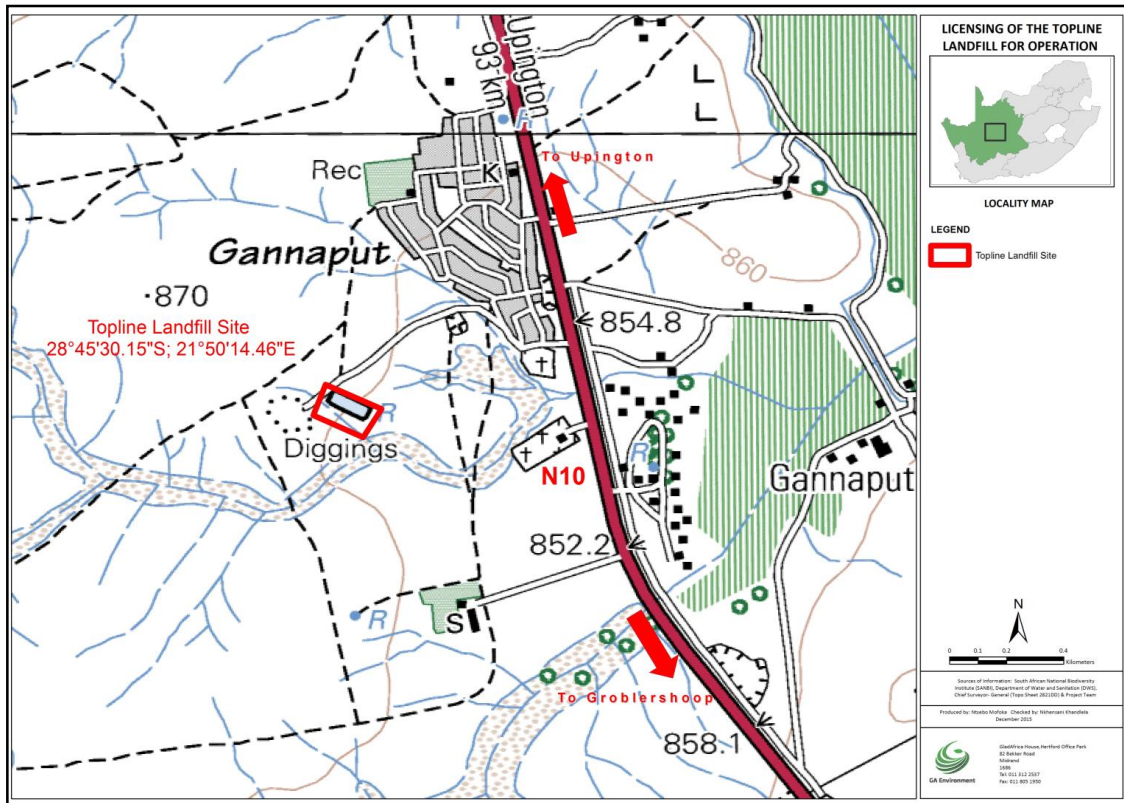


Figure 1: Locality Map of the Topline Landfill Site

The four corner point co-ordinates for the Topline landfill site are indicated in **Table 2** below:

Table 2: Corner points of the Topline landfill

Corner	Latitude	Longitude
Corner 1	28°45'27.98"S	21°50'14.39"E
Corner 2	28°45'31.41"S	21°50'12.99"E
Corner 3	28°45'33.90"S	21°50'18.62"E
Corner 4	28°45'30.74"S	21°50'20.73"E

2.1 Status Quo

According to DWAF Minimum Requirements (MR) for Waste Disposal by Landfill (1998), landfill sites are classified according to the type and volume (volume = maximum amount of waste handled/treated/stored per day for which the facility was designed) of waste handled/treated/stored at the specific facility per day. Permitting of a site for waste disposal by landfill as per these MR requires the determination of waste class, size of operation, and potential for significant leachate generation,

all of which influence the risk it poses to the environment. The quantities of various types or categories of waste that will be disposed off at the Topline Landfill will have a direct impact on the type, class, size and nature of the landfill site.

Table 3 presents the landfill size classification system based on the Maximum Rate of deposition (MRD). General waste landfills are divided into four categories, i.e.: communal; small; medium and large. Landfill size is dependent on the daily rate of deposition which is affected by several factors including the size of the population served. A measure referred to as the ‘Maximum Rate of Deposition’ or ‘MRD’ is applied. This is a measure of the projected maximum average annual rate of waste deposition, expressed in tonnes per day, during the expected life of a landfill. The MRD is calculated by establishing the Initial Rate of Deposition (IRD), which is a measurement of the existing waste stream in tonnes per day. The IRD is then escalated at a rate that is usually governed by population growth projections over the anticipated life of the landfill. The maximum average daily rate of deposition is then the MRD.

Table 3: Table taken from the Minimum Requirements for Waste Disposal by Landfill (Second Edition, 1998)

Landfill Size Class	Maximum Rate of Deposition (MRD) (Tonnes per day)
Communal	<25
Small	>25 < 150
Medium	>150 >500
Large	>500

NOTE: Assuming a 5-day week and therefore 260 days per year

It is anticipated that records of waste disposed of at landfill during its lifespan will be kept and managed as per the NEWMA requirements and that such records will assist in determine the closure requirements.

2.2 Daily Cover and Capping

The status of the daily cover and capping must be reported in this section. At the time of the compilation of this report, there was no evidence of covering and capping of the waste body-

2.3 Size of the Rehabilitation Area and site status quo

The area where waste has been dumped and must be rehabilitated. The size of this area must be added in this section. At the time of the compilation of this report, the size that required licensing was approximately 20,403 m² (2 hectares).

It must be borne in mind that as there may be an application for the expansion of the site, the final area to be rehabilitated must then be added in this section of the report. The site photos taken in 2015 are indicated below. Photos of the site at the time of closure will be added to this report.



Figure 2: View towards Topline showing the informal housing immediately north of the site. Note the waste strewn across the site (July 2015)



Figure 3: View north east towards the cell indicated by red arrow. Note waste strewn outside the cell (July 2015)



Figure 4: View towards the south west showing the interior of the cell. Note the vegetation growing inside the cell (September 2015)

3 CLOSURE AND SITE REHABILITATION REQUIREMENTS

3.1 Specifications for landfill closure and Rehabilitation

The table below summarizes the specifications for closure, which are applicable to the site, and has been developed in line with Minimum Requirements for Waste Disposal by Landfill (Second Edition, 1998).

Table 4: Specifications for closure

Specification	Description
Landfill Class	The Minimum requirements set out specific requirements for the design of closure for different classes of landfill sites.
End Use Plan	<p>The closure design must take into account the planned end use of the landfill. There are many different 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:</p> <ul style="list-style-type: none"> • 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
Identification of Impacts of Closure	<p>The final closure design is primary informed by the risk assessment process of the dumpsite, and should:</p> <ul style="list-style-type: none"> • 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.
Public Participation on End use Plan	It is required that the public and stakeholders are consulted during the process of closure and determining the final end use of the site.
Design and landscaping	<ul style="list-style-type: none"> • The site must be surveyed by a professional land surveyor. • 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.

	<ul style="list-style-type: none"> • The final elevation of the site shall be determined following the survey, but it must not exceed the background topographical features. • The plateau of the site must be graded to 2 - 3% slope and the sides to a minimum of 3:1 slopes; and the final shape of the site must be approved by the regulating authorities.
Final Cover and Capping	<ul style="list-style-type: none"> • 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.
Vegetation Cover	<ul style="list-style-type: none"> • Once the final layer of topsoil has been placed, the site must be seeded with a mixture of indigenous grasses, and allowed to propagate to form a health grass community on the site. • The grassing and vegetation must commence immediately after final capping in order to prevent soil erosion.
Storm-water Diversion	<ul style="list-style-type: none"> • 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. • Permanent Storm water diversions must be designed around the site.
Anti-erosion measures	<ul style="list-style-type: none"> • Measures to control soil erosion especially erosion of the slopes must be developed.
Monitoring	<ul style="list-style-type: none"> • Water quality monitoring • Gas monitoring • Fire monitoring • Vegetation monitoring • Security and access control monitoring

3.2 Specific Recommendations for closure and rehabilitation

The main engineering components of the closure and rehabilitation of the site must include at least the following:

- Landscaping of the waste body
- Capping of the waste body

- Construction of a stormwater management and pollution control area in form of a reed bed.

Table 5: Closure and Rehabilitation Programme

Proposed Actions	Timeframe
Clean up. and Landscaping	(1 - 2 years)
Cover and Cap	(2 – 5 years)
Reed bed construction	(1 - 2 years)

The purpose for the systematic progressive closure approach is to provide sufficient time for the !Kheis Local Municipality to source funds and resources for implementation of the closure and rehabilitation of the site.

3.3 Lateral Landfill Gas Migration management

As part of the closure of the site, the landfill gas must be monitored during the various stages of the closure process.

3.4 Shaping and Sloping of the site

The site should be shaped to allow for gentle flows of surface water off the site towards the stone pitched v-drains around the site. The final topographical height of the site shall be determined following a Topographical survey of the site as part of the detailed engineering design required prior to closure of the site.

3.5 End Use Planning

The choice of type of end use is dependent on the urban or rural spatial planning of the area in which the landfill is situated. Landfill end-use possibilities are categorized from low-graded re-use to high-graded end-use. The type of end-use can also related to the potential vulnerability, expressed in the average number of hours per day that people are spending at the location. The more spending hours, the higher the chance of potential exposure to the landfill site and the higher the potential vulnerability. The table shows the relation between vulnerability of the type of end-use and the environmental risk-levels of the landfill.

Table 6: End Use Planning Risk Matrix

Landfill Type	Type of End-Use	
	Low Vulnerability	High Vulnerability
Low Risk ¹		
High Risk ²		

Based on the green polygon in **Table 6** above, it is evident that redevelopment projects can be initiated and carried out without great hindrances. The red polygon represents the opposite situation. For example from a psychological point of view, the end use of the landfill site for housing would not be feasible and is not recommended. The yellow polygon indicates that various types of end-use are possible, but the feasibility is dependent on the local situation. It is believed that at the time of the closure of the site, the Kheis Local Municipality will have explored the various options for the use of the site.

3.6 General Rehabilitation recommendations for the site

The following provides the standard rehabilitation measures that may be implemented on the site.

- The site is cleaned up and all the residual waste remaining of the site is removed and disposed of at a legal landfill site.
- The cover material that has been placed on the site should be used to rehabilitate the areas, which have been damaged, by soil erosion and loss of ground cover.
- A vegetative layer of approximately 200mm should be laid down in these scarred areas on the site and spread and lightly compacted.
- The site should then be grassed with the same type of indigenous grass mixtures as per specifications.
- The grassing and maintenance should follow the same specifications as described in this report.
- A site landscape design is prepared and this must be supervised by an engineer and environmental scientist, and is designed such that the site does not sharply contrast against the local

¹ Low risk site here mainly refer to Communal sites, and small sites

² High Risk sites in this case refer to Medium, Large and Hazardous landfill sites.

geomorphology and background. The site shall have a slight cross-fall allowing easy drainage off the site away from any potential risk areas.

- Site capping layer works: Since the site will most likely be classified as G:C:B, the capping should be conservatively constructed according to Figure A.8.10 of Appendix 8.2 of the Minimum Requirements for Waste Disposal by landfill (Second Edition, 1998). This diagram is reproduced below as **Figure 3**:

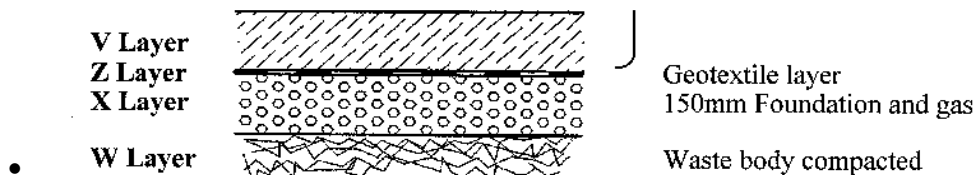


Figure 3: Cross section of capping layer taken from Figure A.8.10 of Appendix 8.2 of the Minimum Requirements for Waste Disposal by landfill (Second Edition, 1998)

The capping or final cover layer shall be designed to maximise run-off of precipitation, while minimising infiltration and preventing ponding of water on the landfill. The specifications for layer works design are indicated in the table below.

Table 7: Specification for layer works design

Layer Type	Description	Permeability	Thickness
Vegetative layer (U Layer)	Topsoil of specific thickness, which is prepared and seeded preferably with indigenous grasses and shrubs. This layer may also be substituted with natural gravel.	$3 \times 10^{-4} - 3 \times 10^{-2}$ Hydraulic Conductivity K(m/s) after compaction.	200mm
Waste Body (W Layer)	Shaped and compacted upper surface of waste body. (If available, it may prove useful to cover the waste surface with builders' rubble before compacting).	Not required	Cells to be built Maximum of 1m above normal ground on centreline of each cell.

3.6.1 Cover material

The cover material on the site has to be tested to indicate its permeability. This will inform if the application of an additional layer of low permeability will be required. However, should the permeability of the current cover indicate low permeability the only additional application of cover material will be a layer of top soil not less than 200mm thick.

3.6.2 Erosion control

Erosion is one of the major sources of damage to both natural and man-made slopes. Erosion on slopes can be caused by detachment and movement of soil particles due to raindrop impact and surface runoff.

Specification for protection of the site from erosion may include but not limited to the following:

- Cover the sloped edge of the waste body and the top of the waste body with the capping layer at 1:2 slope;
- Cover the capping layer with the top soil and compact at above slope;
- Cover the top soil with rocks from the area, filling it from 500mm below the toe of the waste body to the top at a layer thickness of minimum 500mm thick to protect the bank (edge) from erosion;
- Seed all surfaces and banks with indigenous grass to allow vegetation growth and further protection and natural look.

3.6.3 Re-vegetation

Once the final topsoil layer has been placed on the site, it must be seeded with indigenous grass species and monitored to ensure that it successfully grows: the following specifications must be considered to ensure successful re-vegetation of the site.

3.6.4 Grassing and Sodding

- Grassing must be undertaken by a suitably qualified Contractor, making use of the appropriate equipment.
- Grass areas using the method specified on the plant plans.
- Trim³ areas to be grassed to the required level.
- Sodding may be done at any time of the year, but seeding must be done during the summer when the germination rate is better.
- Hydro-seeding with a winter mix will only be specified where re-grassing is urgent, and cannot wait for the summer.
- Sodding is defined as the laying of grass sods.
- The soil should be uniformly wet to a depth of at least 150mm before planting of grass sods.
- Protect sods against drying out: keep these moist from the time of harvesting until final placement.
- Rake or spike the area to give a loose surface to a depth of 100mm.
- Lay the first row of sods in a straight line, starting at the bottom of a slope, where possible.
- Place the next row of sods in the same way, tightly against the bottom row with the joints staggered, until the full area is covered with sods.
- Tightly butt sods together, taking care not to stretch or overlap sods.
- Where a good fit cannot be obtained, the intervening spaces may be filled with parts of sods or topsoil.

³ Preparation of an even surface for grassing.

- On steep slopes the sods must be secured using timber stakes of at least 300 mm in length.
- After planting, water sods to prevent drying out.
- Irrigate as required until the grass is able to survive independently (i.e. depending on the rainfall).

3.6.5 Hydro-seeding

Hydro-seeding entails adding a specified seed mix to a slurry containing water and other approved materials to enhance plant growth potential. This mixture is applied by means of a spraying device onto the prepared ground areas to be seeded. The following must be borne in mind in the undertaking of hydro-seeding:

- All seed supplied should be labelled in accordance with the Government Seed Act (Act No. 20 of 1961).
- The soil should be loose and uniformly wet to a specified depth before any seeding commences.
- Add the specified seed mix and necessary fertiliser to the required amount of water and apply using an approved hydro-seeding machine.
- Unless otherwise specified, the rate of application of the slurry will not be less than 30 cubic metres per hectare and will be applied in such a manner as to ensure even distribution of seed and fertiliser throughout.
- Additional ingredients to be added to the slurry may be specified.
- In certain cases, the specification may require that mulch be applied by hand to the area to be hydro-seeded, prior to hydro-seeding.
- If possible, keep the seedbed moist after hydro-seeding, to ensure good germination.
- Irrigate as required until the grass is able to survive independently (i.e. depending on the rainfall).

3.6.6 Grassing mix for vegetative cover

The vegetative cover must use indigenous grasses and these will mainly be of the Sour grassland type which is the predominant vegetation type in this area. The following grass mixes must be used:

Table 1 Northern Cape, Free State, North West and Gauteng (Source: Plant Protection Research Institute Handbook No.11.

Summer mix:

GRASS SPECIES	COMMON NAME	APPLICATION RATE (kg/ha)
<i>Cynodon dactylon</i>	Couch grass	4
<i>Eragrostis curvula</i>	Weeping lovegrass	4
<i>Eragrostis tef</i>	Teff	8
<i>Panicum maximum</i>	Guinea grass	4
<i>Paspalum notatum</i>	Bahia grasss	20
TOTAL		40

Winter mix:

GRASS SPECIES	COMMON NAME	APPLICATION RATE (kg/ha)
<i>Eragrostis curvula</i>	Weeping lovegrass	4
<i>Paspalum notatum</i>	Bahia grasss	20
TOTAL		24

Central Grassveld

Summer mix:

GRASS SPECIES	COMMON NAME	APPLICATION RATE (kg/ha)
<i>Anthephora pubescens</i>	Wool grass	5
<i>Cenchrus ciliaris</i>	Blue buffalo grass	4
<i>Chloris gayana</i>	Rhodes grass	5
<i>Cynodon dactylon</i>	Couch grass	4
<i>Digitaria eriantha</i>	Smutsfinger grass	4

<i>Eragrostis curvula</i>	Weeping lovegrass	4
<i>Panicum maximum</i>	Guinea grass	4
<i>Paspalum notatum</i>	Bahia grasss	20
TOTAL		50

Winter mix:

GRASS SPECIES	COMMON NAME	APPLICATION RATE (kg/ha)
<i>Cenchrus ciliaris</i>	Blue buffalo grass	4
<i>Chloris gayana</i>	Rhodes grass	5
<i>Digitaria eriantha</i>	Smutsfinger grass	4
<i>Eragrostis curvula</i>	Weeping lovegrass	4
<i>Paspalum notatum</i>	Bahia grasss	20
TOTAL		37

3.6.7 Maintenance

- Allow for a maintenance period of one year following practical completion, unless otherwise specified.
- Cordon off areas that are under rehabilitation as no-go areas using danger tape and steel droppers. If necessary, these areas should be fenced off to prevent vehicular, pedestrian and livestock access.
- Delay the re-introduction of stock to all rehabilitation areas until an acceptable level of re-vegetation has been reached. Fencing may be used, or the area may be covered by branches.
- Re-vegetation must match the vegetation type which previously existed.
- A minimum grass cover of 80% is required, and individual plants must be strong and healthy growers at the end of the Maintenance Period.
- In the case of sodding, acceptable cover entails that 100% cover is attained by the specified vegetation.
- Bare areas that show no specified vegetation growth after three months of the Rehabilitation Work are to be spread with additional topsoil, ripped to a depth of 100mm and re-planted, re-sodded, re-hand sown or re-hydro seeded.

3.6.8 Access Control

A 1,8m high wired fence and lockable gate constructed for the landfill must be maintained for access control during the rehabilitation process. This is because uncontrolled access can jeopardize the rehabilitation efforts.

3.6.9 Stormwater and Leachate Management

- Storm water management shall be by means of proper landscaping, allowing the surface run off to flow naturally away off the site. The site will be grassed and hence we do not anticipate any significant problems.
- The site does not generate any significant amount of leachate at this stage, and once it has been cleaned and all waste removed. Leachate shall not be an issue of concern.
- However provisions for a leachate and contaminated water management holding pond should be made. See site closure plan drawing for possible locations.

3.6.10 Post Closure Monitoring

A post closure monitoring plan shall be developed to ensure that certain critical aspects are monitored continuously even after closure as may be required by the waste permit or license for the site. These aspects may include but are not limited to the following as listed in **Table 8**:

Table 8: Specifications for Monitoring

Environmental Aspect	Description	Method
Soil erosion	Monitoring of the site to ensure that topsoil is not eroded especially on the slopes of the capped cells and in other vulnerable areas.	Monthly inspection Photographic records
Water quality	Surface and groundwater monitoring in accordance with the site permit conditions for closure.	A scientist must take samples at the specified timeframes and analysis must be done by an accredited laboratory.
Landfill gas	Most likely not applicable	Not applicable at this stage.
Fire break	A 5 meter fire break must be maintain around the site	Monthly inspection Photographic record

Alien vegetation	Alien vegetation must be eradicated from the site	Monthly inspection Photographic record
Visual screen	Any indigenous trees around the site should remain in place to form a visual screen.	Monthly inspection Photographic record
Access control	The fence and gate should remain intact and the site must not be accessed by unauthorized persons.	Monthly inspection Photographic record

3.7 Monitoring and Auditing

Following each site inspection, a brief internal site audit report must be prepared with mitigation or recommended actions for mitigating any observed negative impacts on the site. Such measures may include but not be limited to the following:

- Any eroded material on site will have to be excavated;
- The eroded area must be filled with excavated material and re-compacted;
- Cover with capping impermeable material, compacted and top soiled as per specification;
- Seeded with indigenous grass and vegetation;
- Cover with netting and protected until vegetation blanked re-established

Generally the mitigation measures will depend on the nature, extent and significance of the impacts observed during the site audits.

3.8 Environmental Management Programme

See the Environmental Management Programme (EMPr) as an Appendix of the Draft Basic Assessment Report.

4 CONCLUSIONS

The closure of the Topline landfill is subject to the following requirements:

- Further site investigations must be undertaken and these must then become part of the Closure Plan and the End Use Plan.
- The site must be surveyed and cross-sections and layouts must be developed and submitted to aid the design of the site.
- The final shaping and capping of the landfill should be carried out according to the Closure Designs that must be compiled as part of the Closure Plan.
- Ongoing monitoring of 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 subjected to ongoing inspection and maintenance.

5 REFERENCES

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

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

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

DEA, NEMA EIA Regulations (2014) Appendix 5 (Closure plan)

U.S. EPA, 1991. Design and Construction of RCRA/CERCLA Final Covers. Report Number EPA/625/4-91/025. U.S. Environmental Protection Agency, Cincinnati, OH. May 1991.

Water Research Commission Report TT48/89, 1989. Water and waste water management in the red meat industry.