



GA Environment

**BASIC ASSESSMENT FOR THE PROPOSED CLOSURE OF THE SHAKAVILLE LANDFILL,
KWADUKUZA LOCAL MUNICIPALITY, KWAZULU NATAL PROVINCE**

CLOSURE AND REHABILITATION PLAN

PROJECT REFERENCE NR: DC29/0025/2017

JANUARY 2018

CLOSURE AND REHABILITATION PLAN

for the

**BASIC ASSESSMENT FOR THE PROPOSED CLOSURE OF THE SHAKAVILLE LANDFILL, KWADUKUZA
LOCAL MUNICIPALITY, KWAZULU NATAL PROVINCE**

Prepared for:

Department of Environmental Affairs

Directorate: Licensing

Private Bag X 447

Pretoria

0001

T: 012 399 9786

Submitted to:

KwaZulu Natal Department of Economic Development, Tourism and Environmental Affairs

270 Jabu Ndlovu Street,

Pietermaritzburg,

3201

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

PROJECT INFORMATION

Title: Closure and Rehabilitation Plan for the Proposed Decommissioning (Closure) of the Shakaville Landfill, KwaDukuza Local Municipality, KwaZulu Natal Province

Competent Authority: KwaZulu Natal Department of Economic Development, Tourism and Environmental Affairs

Applicant: KwaDukuza Local Municipality

Environmental Consultants: GA Environment (Pty) Ltd




Compiled by: Ntsebo Mkhize *BSc (Hons.) cum laude*
Reviewer: Nkhensani Khandlhela (MSc)

Date: 25 January 2018

Document History and Quality Control

Revision	Revision Date	Revision Comments	Originator	Reviewed By
0	13 December 2017	Draft for public review	Ntsebo Mkhize	Nkhensani Khandlhela
1	08 January 2017	Draft for public review	Ntsebo Mkhize	Nkhensani Khandlhela

SIGNING OF THE ORIGINAL DOCUMENT

Original	Prepared by	Reviewed by	Approved by
Date: 08 January 2017	Name: Ntsebo Mkhize	Name: Nkhensani Khandlhela	Name: Nkhensani Khandlhela
Version 1	Signature: 	Signature: 	Signature: 

**THE PROPOSED DECOMMISSIONING (CLOSURE) OF THE
SHAKAVILLE LANDFILL, KWADUKUZA LOCAL MUNICIPALITY, KWAZULU NATAL PROVINCE**

TABLE OF CONTENTS

1	INTRODUCTION	8
1.1	Background.....	8
1.2	Site location and Status quo.....	8
1.3	Landfilling Method at the Shakaville Landfill	11
1.4	Scope and Objectives of the Report.....	12
1.5	Details of Environmental Assessment Practitioner.....	14
1.6	Public Participation Processes undertaken to date	14
1.7	Context and objective of the Closure.....	15
1.8	Content of a closure and rehabilitation plan for a landfill site	15
1.9	Completeness of data for this Closure plan	17
1.10	Approach to and use of this closure and rehabilitation plan	18
2	CLOSURE AND SITE REHABILITATION REQUIREMENTS	19
2.1	Specifications for landfill closure and Rehabilitation.....	19
2.2	Lateral Landfill Gas Migration management.....	20
2.3	Shaping and sloping of the site	20
2.4	End Use Planning.....	21
2.5	General Rehabilitation recommendations for the site	21
2.5.1	Cover Material.....	26
2.5.2	Erosion control	26
2.5.3	Re-vegetation	26
2.5.4	Maintenance of rehabilitation	29
2.5.5	Access Control	30
2.5.6	Stormwater and Leachate Management	30
2.5.7	Post Closure Monitoring.....	30
2.6	Monitoring and Auditing.....	30
2.7	Environmental Management Programme	31
3	FINANCIAL PROVISION FOR CLOSURE AND REHABILITATION	32
4	CONCLUSIONS	33
5	REFERENCES	34
	APPENDIX A.....	35
	APPENDIX B	44

LIST OF ABBREVIATIONS / ACRONYMS _CHECK IF THESE ARE MENTIONED IN THE REPORT

DEA	Department of Environmental Affairs
DWA	Department of Water Affairs and Forestry (now DWS)
DWS	Department of Water and Sanitation
ECA	Environmental Conservation Act (Act 73 of 1989)
EIA	Environmental Impact Assessment
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
IWMP	Integrated Waste Management Plan

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 compiled as part for the decommissioning of the Shakaville landfill of other waste management practices within the KwaDukuza Local Municipality. 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.	DWAF Minimum Requirements for disposal of waste by landfill 2 nd Edition, 1998, Minimum Requirements (1998) hereafter
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)
Compliance Monitoring	Monitoring done in compliance with permit conditions	Minimum Requirements (1998)

Term	Definition	Reference
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-Grave	A policy of controlling of Waste from its inception to its ultimate disposal.	DWAF Minimum Requirements for the handling, classification and disposal of hazardous waste disposal of waste (2 nd Edition, 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 (1998)
Eco-Toxicity	Eco-toxicity is the potential to harm animals, plants, ecosystems or environmental processes.	Minimum Requirements (1998)
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	National Environmental Management Act, 1998 (Act 107 of

Term	Definition	Reference
	(iv) the physical, chemical, aesthetic and cultural properties and conditions of the foregoing that influence human health and well-being.	1998), NEMA, 1998 hereafter
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)
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 weed-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.	DWA 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)
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)

Term	Definition	Reference
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 (1998)
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	means 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)
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 Waste disposal process. Residents or farmers, a whole residential community, or the public at large may represent them.	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 contains final and	Minimum Requirements (1998)

Term	Definition	Reference
	intermediate products of decomposition, various solutes and waste residues. It may also contain carcinogens and/or pathogens. Sporadic/Significant.	
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, body parts, soiled bandages and liner, and spent or outdated medicines or drugs. They have the ability to affect and infect other living organics, and are considered hazardous.	Minimum Requirements (1998)
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 (1998)
Precautionary Principle	Where a risk is unknown; the assumption of the worst-case situation and making provision for such a situation.	Minimum Requirements (1998)
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)

Term	Definition	Reference
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).	ECA
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 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.	White Paper on IP&WM
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	Means any substance, whether or not that substance can be reduced, re-used, recycled and recovered— (a) that is surplus, unwanted, rejected, discarded, abandoned or disposed of; (b) where the generator has no further use of for the purposes of production, reprocessing or consumption; (c) that must be treated or disposed of; or (d) that is identified as a waste by the Minister, but— (i) a by-product is not considered waste; and	NEMWA (2008)

Term	Definition	Reference
	(ii) any portion of waste, once re-used, recycled and recovered, ceases to be waste	
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)
Waste Management Activity	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— (a) the importation and exportation of waste; (b) the generation of waste, including the undertaking of any activity or process that is likely to result in the generation of waste; (c) the accumulation and storage of waste; (d) the collection and handling of waste; (e) the reduction, re-use, recycling and recovery of waste; (f) the trading in waste; (g) the transportation of waste; (h) the transfer of waste; (i) the treatment of waste; and (j) the disposal of waste.	NEMWA (2008)
Waste Management License	Means a licence issued in terms of section 49 of NEMWA (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)
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 KwaDukuza Local Municipality to licence the Shakaville landfill for decommissioning (closure). For this reason, a decommissioning licence must be applied for with the KwaZulu Natal Department of Economic Development, Tourism and Environmental Affairs (EDTEA). DEA has thus appointed GA Environment (Pty) Ltd as independent Environmental Consultants, to undertake the Basic Assessment (BA) process and the Closure Plan for the Waste Management Licence Process for the Shakaville landfill.

The KwaDukuza Local Municipality proposes to close and formally decommission the disused Shakaville landfill site. The Shakaville landfill ceased operations between 2007 and 2010 after approximately 30 years of operation. The landfill was commissioned prior to the establishment of the Minimum Requirements for Waste Disposal by Landfill (DWA, 1998 2nd Edition) and the promulgation of the National Environmental Management Waste Act (NEMWA hereafter), 2008 (Act No. 59 of 2008). The closure and rehabilitation of the landfill will be carried out in accordance with DWAF Minimum Requirements for Disposal of waste by landfill (2nd Edition, 1998).

Delays in implementing the closure and rehabilitation of the Shakaville landfill project will mean that the impacts arising from the current status of the landfill will continue thereby causing adverse environmental problems. This initiative of the licensing of the landfill will also aid in achieving the Minister's service delivery agreement Outcome 10 (Output 1 to 4) deliverable target/indicator that serves to ensure that environmental assets and natural resources are well protected and are continually enhanced.

As part of the Basic Assessment Report and Waste Management Licence Application requirements for the closure of the Shakaville Landfill Site, a closure plan for the site must be compiled to support the application. *This document thus serves as closure and rehabilitation plan for the Decommissioning of the Shakaville landfill site.*

1.2 Site location and Status quo

The Shakaville landfill occupies an area of approximately 80 000m² (8 Ha) and is located on Erf 3595 Stanger within the KwaDukuza Local Municipality. The 21 digit Surveyor General Code for the property is NOFU03200000359500000. Direct access to the site is available from Mbozambo Street which is located to the north west of the site. The site centre co-ordinates are 29°19'48.62"S; 31° 18' 171.19"E. The

boundaries of the site are within the riparian area of a tributary of the Mbozamo River. Refer to **Figure 1** for the Locality Map of the site

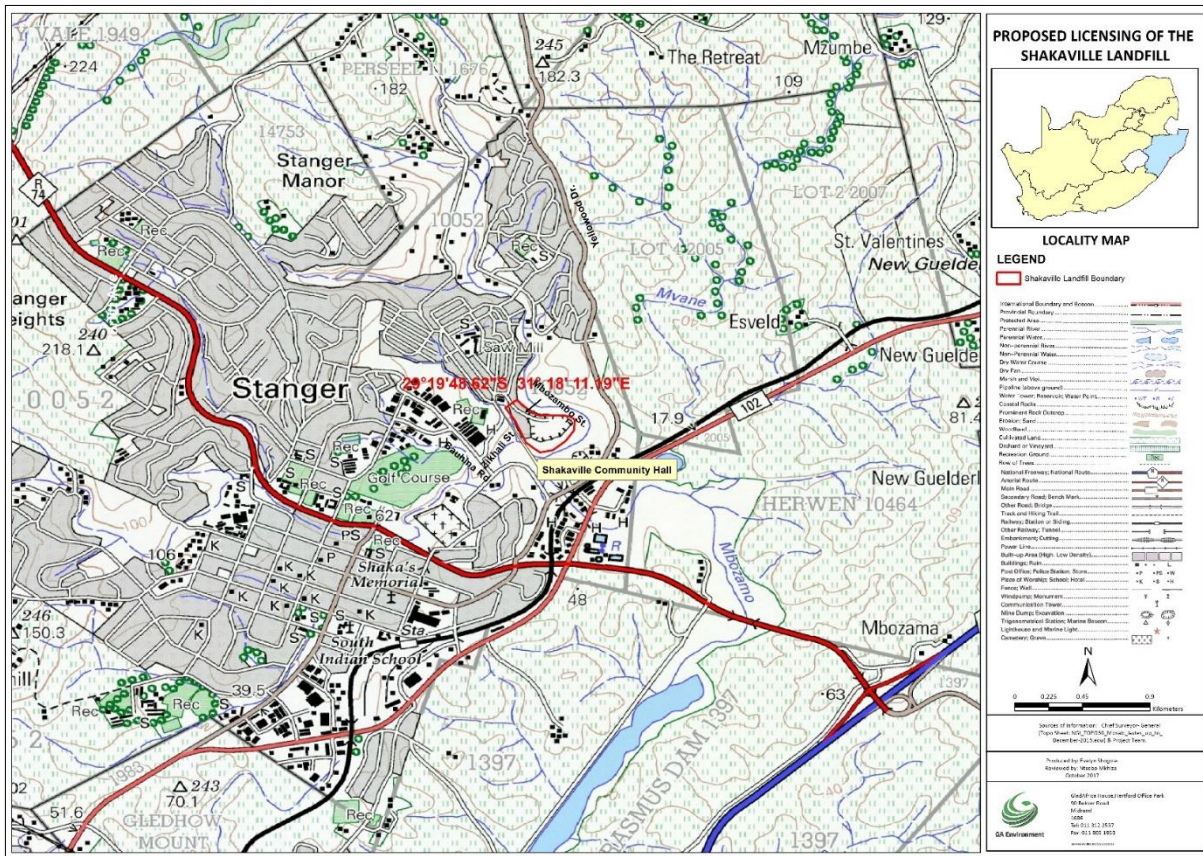


Figure 1: Locality map showing of the Shakaville landfill site

The Shakaville landfill is currently disused as it ceased operations in about the year 2007 after about 30 years of operating without a licence. The KwaDukuza Local Municipality intends to apply for a licence to legally decommission the facility. According to the KwaDukuza Municipality’s Integrated Development Plan (IDP) (2012- 2017), the implementation of the closure and the rehabilitation of the Shakaville landfill was targeted for the year 2014 and was allocated the project number MS/41/2012. As part of the closure of the landfill, a closure and rehabilitation plan must be compiled to guide the proposed activities.

According to the KwaDukuza Local Municipality, only general waste was disposed of at the Shakaville landfill during its time of operation. As access to the landfill was not controlled, it is possible that hazardous waste was also disposed off at the landfill, however no evidence of such was noted during the site visits undertaken by GA Environment during the Basic Assessment. The KwaDukuza Local Municipality currently disposes of waste at the Dolphin Coast Landfill Management (DCLM), however pockets of illegal dumping of waste were evident within the site boundaries.

Current land use on some sections of the landfill, particularly close to the gate and on the western sections of the landfill, includes pockets of informal housing infrastructure. Refer to **Figure 2** for examples of informal housing. The occupants are regarded as historical reclaimers of waste that have since occupied this land when the disposal of waste ceased on the site.



Figure 2: Examples of informal dwellings within the boundaries of the Shakaville Landfill

Although the Shakaville landfill was noted to have naturally rehabilitated as vegetation comprising both indigenous species as well as invasive was noted on site as shown in **Figure 3**, it remains crucial that the landfill is rehabilitated to meet legislative requirements and in turn ensure environmental protection.



Figure 3: Indigenous vegetation (A) and invasive (B) noted on site

1.3 Landfilling Method at the Shakaville Landfill

It assumed based on our observation that the 'end tipping' landfilling method which involves the pushing of waste over a slope was used on site. This was noted to have created instability of the waste body and did not cater for adequate waste compaction. The end tipping method was evident from the site observations as shown in **Figures 4 & 5**.



Figure 4: Historical 'end-tipping' method of landfilling noted on rehabilitated section of the landfill

Evidence of the end tipping of waste was also noted along the riparian area of the tributary of the river as shown in the area close to the gate as shown in **Figure 5**.



Figure 5: 'End-tipping' method of landfilling noted in the section of the landfill in close proximity to the partial fence and gate

1.4 Scope and Objectives of the Report

This report is intended to serve the following purposes:

- Serve a guide for the formal closure and rehabilitation planning for the Shakaville 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 Shakaville Landfill Site.
- Form part of the Environmental Management Programme for the Closure of the Shakaville Landfill site.
- Guide the KwaDukuza Local Municipality to make Financial Provisions for the closure and rehabilitation for the sites.

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 Department of Water Affairs and Forestry (DWAF) Minimum Requirements for Waste Disposal by landfill (2nd Editions, (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 National Environmental Management Act (NEMA) 1998 (Act No. 107 of 1998), Environmental Impact Assessment (EIA) Regulations regarding the (*Content of the Closure Plan*) has also been considered during the compilation of this document.

The aim 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.

1.5 Details of Environmental Assessment Practitioner

This Closure plan was compiled by:

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

Mrs. Ntsebo Mkhize holds a B.Sc. (Hons) Environmental Management (cum laude) degree. She has 5 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 as well as Conservation Planning and Biodiversity Management. She is currently an EAP at GA Environment (Pty) Ltd. Specific to licensing of landfills, she has worked on numerous projects in the Northern Cape and North West.

The 'Engineering Assessment and Designs Report' as well as the 'Geotechnical and Geohydrological Report' compiled for the Decommissioning of the Shakaville landfill are attached to the Basic Assessment Report were consulted in the compilation of the Closure Plan.

1.6 Public Participation Processes undertaken to date

According to Appendix 5 of the National Environmental Management Act (NEMA), 1998 Environmental Impact Assessment (EIA) Regulations, details of the public participation process undertaken as part of a project that involves closure must be indicated in the Closure report.

The project was subjected to a Public Participation Process (PPP) as defined in the NEMA EIA Regulations (2014), as amended. Notification letters, site notices and advertisements were issued out to invite registrations and comments from potential Interested and Affected parties (I&APs). I&APs that responded and submitted comments were registered in the project database and their comments captured in the Comments and Response Report. This Closure Plan forms part of the Draft Basic Assessment report that

has been issued for public review. Comments received during this period will be captured and included in the Final Basic Assessment Report that will be sent to the Authorities for review and consideration. The summary of the PPP that commenced in October 2017 is summarised as follows:

- An advertisement inviting any potential I&APs to register on the project was placed on page 14 of the *Stanger Weekly* newspaper published on Wednesday 18th October 2017;
- On-site notices advertising the Waste Management Licence Process were erected on site and at visible and accessible locations close to the site on Wednesday 18th October 2017;
- Notification Letters were distributed in the Shakaville Area on Wednesday 18th October 2017; Notification Letters were also distributed to other potential I&AP's from the 18th October 2017 to date.

Copies of these Public participation documents, advertisements, site notices, notification letters, proof of communication with I&APs, Project Database, and Comment and response report are attached as Appendices to the draft Basic Assessment report.

It must be noted that meetings were also held with key stakeholders from the Competent Authorities, local and district municipalities and other Interested and Affected parties as per Appendix 5 of the NEMA EIA Regulations, refer to **Appendix A** of this closure Plan for the Minutes of the Meeting that was held between GA Environment, officials from the KwaDukuza Local Municipality, the KwaZulu Natal Department of Economic Development, Tourism and Environmental Affairs and the Department of Water and Sanitation on the 20th September 2017.

1.7 Context and objective of the Closure

The main objective of the current Waste Management Licencing Process is to ensure that the Shakaville landfill is legally decommissioned. It is envisaged that subsequent to the licencing of the Shakaville landfill, the KwaDukuza Local Municipality will source funds for the construction activities associated with the closure of the landfill and to also ensure ongoing monitoring of the rehabilitated areas and investigate options for appropriate end use.

1.8 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 related to the site, is

important. 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 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 available maps (surroundings, topographical, geological, hydrogeological, etc.);
- Interview those directly involved with the landfill e.g. Municipal Officials, adjacent residents, etc.
- 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,
- Provide geotechnical and geochemical properties 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.

It must be highlighted that the information is presented in the Engineering Needs assessment which must be read in conjunction with the '*Geotechnical and Geohydrological Report*' and the '*Engineering and Needs Assessment and Preliminary Closure Design Report*' attached as **Appendix F2** and **Appendix F3** of the Basic Assessment Report respectively.

1.9 Completeness of data for this Closure plan

The completeness of the information indicated in this Closure Plan is shown in **Table 1**.

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)	√		
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		√	To be undertake by appointed Engineers
Identify existing land used around the area	√		
Conduct topographical survey of the dumpsite, extending some distance from its boundaries	√		
Conduct geotechnical investigation to determine stability of the site	√		
Identify sources of soil or other cover material for the site		√	Task to be undertaken by Municipality
Determine if practical, the depth of the dumped sites	√		Task was partially undertaken as test pits were only dug to a depth of no more than 2m. Some waste was encountered at a distance of 2m from the surface

Determine gas leakage within and on the areas surrounding the dumpsite		√	
Conduct leachate and gas sampling (if practical); and		√	Leachate sampling required
Conduct water quality sampling of surface water, water wells, groundwater (if practical)		√	

1.10 Approach to and use of this closure and rehabilitation plan

This closure and rehabilitation plan recognizes the fact that the Shakaville landfill site 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.

2 CLOSURE AND SITE REHABILITATION REQUIREMENTS

2.1 Specifications for landfill closure and Rehabilitation

Table 2 below summarises the specifications for closure, which are applicable to the site, and has been developed in line with Minimum Requirements for Waste Disposal by Landfill (2nd Edition, 1998).

Table 2: 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 primarily 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. • 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.

SPECIFICATION	DESCRIPTION
	<ul style="list-style-type: none"> 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

2.2 Lateral Landfill Gas Migration management

The site is not likely to pose any significant lateral landfill gas migration risk, and therefore no engineering infrastructure for landfill gas migration was considered at this stage. However should evidence of risk be revealed at a later stage, mitigation measures shall be designed.

2.3 Shaping and sloping of the site

The final shaping and capping of the landfill, is aimed at preventing stormwater from coming into contact with the waste and any contamination. Any stormwater on the rehabilitated site could thus be considered clean and runoff from the rehabilitated site will be discharged into the existing natural watercourse. The proposed Shakaville stormwater management system shall at least include:

- Catchwater banks at the top edge of the landfill to prevent erosion and control the runoff down the side slopes;
- Downchutes to direct the runoff down the side slopes;
- A drainage bench midway down the side slope to reduce the flow velocity and further prevent erosion;
- Reno mattresses at all discharge points to prevent scour; and
- Gabion baskets along the toe of the landfill to prevent erosion from the adjacent stream and the tributary of the Mbozamo River.

Refer to the Engineering Assessment and Designs Report in **Appendix F3** of the Basic Assessment Report for drawings indicating the shaping and sloping of the site.

2.4 End Use Planning

An end-use plan shall guide what would be the most suitable land use for the area. 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. 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 longer the time that humans spend at or near the site, the higher the chance on potential exposure to any residual effects of the landfill site and the higher the potential vulnerability.

In meetings held between the KwaDukuza Local Municipality and GA Environment, the Municipality stated that they would like to use the current landfill site area for a large stadium. According to the DWAF 1998 Minimum Requirements for Waste Management, the most common use of an area formally occupied by a landfill is an open space that can be used for sport and recreation although with light and not heavy infrastructure that can be affected by settlement and methane gas that is common in former landfills. However, should the Municipality wish to construct a Stadium with heavy infrastructure on the site, it is imperative that all relevant studies are undertaken to ensure the stability of the proposed infrastructure. Furthermore, all the relevant environmental authorisations must be obtained prior to the construction of the infrastructure.

2.5 General Rehabilitation recommendations for the site

The description of the proposed design layers for the capping of the landfill plato and side slopes is described beginning from the waste body and ending at the final (top) layer. **Figure 6** shows the proposed capping layers on the plato and side slopes of the landfill and results in a maximum layer works thickness of about 1,500mm depending on the final geosynthetic options chosen. This capping design aims to adhere to the latest best practice.

The various levels comprising the capping are graphically represented in **Figure 6**. These will be placed above the waste body which must be shaped and compacted as per the design drawings. The waste should be mixed with and covered with soil and shaped to a final profile that is as smooth as practically possible.

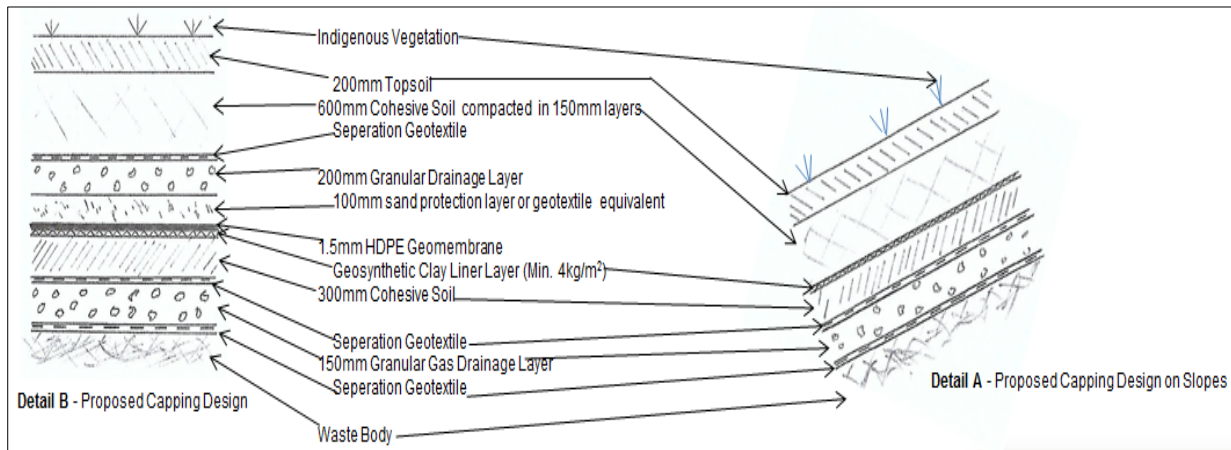


Figure 6: Proposed capping design

The various levels of the capping from the waste body upwards are the following:

- **Separation Geotextile** - separates the waste body from the capping layers and should be a non-woven geotextile with a typical thickness of about 2.5mm and unit weight of at least 1.5kg/m². This layer assists in preventing fine particles from the layer works entering the waste body.
- **150mm Granular Gas Drainage Layer** -This is a landfill gas venting layer having a minimum thickness of 150mm and consisting of single sized stone or gravel of between 25mm and 50mm in size. This layer needs to be connected to a gas management system with gas vents being installed in key areas.
- **Additional Separation Geotextile** - separates the drainage layer from the capping layers
- **Cohesive Soil Layer**- a support layer to the below drainage system and should be 300mm thick consisting of in situ material compacted to a minimum density of 95%
- **Geosynthetic Clay Liner (GCL)** - A GCL is two geotextile layers with a layer of bentonite in the middle that acts as a containment barrier.
- **HDPE Geomembrane Layer (Plato only)** - The High Density Polyethylene (HDPE) Geomembrane (GM) sheet needs to be in direct contact with the GCL. This layer is only considered for the top of the landfill cover and not the side slopes.
- **Sand Protection Layer (Plato only)** - The protection layer is placed directly above the GM to protect it from mechanical damage and can be in the form of a 100mm layer of fine to medium silty sand or a geotextile equivalent able to provide similar protection to the GM.
- **Granular Drainage Layer (Plato only)** - This system is provided to detect and remove any water leakage that has penetrated the layers above it. The granular drainage layer should consist of a 200mm thick layer of granular material (crushed stone) having a size of between 38mm and 50mm with perforated HDPE pipes installed at 20m intervals on the plato of the landfill to direct leakage to the leachate collection system and sump.

- **Separation Geotextile (Plato only)** - The separation geotextile separates the drainage layer from the capping layers and should be a non-woven geotextile with a typical thickness of about 2.5mm and unit weight of at least 1.5kg/m². This layer assists in preventing fine particles from the layer works entering the drainage layer.
- **Geocomposite Drainage Layer (Slopes only)** - There are a number of products on the market that could potentially be used. The final design should replicate the specifications of a geocomposite drainage system similar to the ABG Pozidrain® product which consists of a high strength flexible polyethylene cusped drainage core (at least 4mm thick) with a non-woven geotextile filter fabric bonded onto one or either side. The geotextile filters a wide range of materials and is bonded to the core to ensure that it does not deform into the drainage channels under the load of the backfill material. The drainage composite allows fluids and gases to percolate into the core whilst supporting the backfill material. The collected fluids are then transported along the core to the leachate collection system at the landfill toe.
- **Cohesive Soil Layer** - This is a support layer to the below drainage system and should be 600mm thick consisting of in situ material compacted to a minimum density of 95% Standard Proctor maximum dry density at a water content of Proctor optimum to optimum +2%. The layers are to be placed and compacted in 150mm layers and also assist in providing the required pressure for the GCL/HDPE composite to function optimally. As indicated in the Geotechnical report the soils on site are weathered dolerites and shales with a clay content and fairly low permeability. This soil will work well in conjunction with the other layers of the capping system.
- **Topsoil Layer**- This needs to be a minimum of 200mm topsoil layer to assist in the establishment of vegetative cover as soon as possible. The layer needs to be optimally compacted to assist plant growth and can contain a mixture of hydro seeding if required.
- **Indigenous Vegetation**-The vegetation layer assists with stability and run off and needs to be established as soon after construction as possible. The vegetation needs to be indigenous to the area in order to ensure optimal sustainability of the capping system.

2.5.1 The eradication of alien invasive vegetation

2.5.1 Background

Section 13 of the National Environmental Management: Biodiversity Act, 2004 (No 10 of 2004): Alien and Invasive Species Regulations: Alien and Invasive Species Regulations state that the following restricted activities should not be undertaking in dealing with alien invasive species

(a) Spreading or allowing the spread of any specimen of a listed invasive species;

(b) releasing any specimen of a listed invasive species;

(c) the interbasin transfer of specimens of alien and listed invasive species;

(d) discharging of or disposing into any waterway or the ocean water from an aquarium, tank or other receptacle that has been used to keep a prohibited alien species or a listed invasive species; and
 (e) importing into the Republic, including introduction from the sea, any peat or peat products.

As these restricted activities will not be undertaken, there will be no need for an application of a permit as discussed in Sections 87- 93 of the National Environmental Management: Biodiversity Act, 2004 (No. 10 of 2004).

2.5.2 Timing of the removal of alien invasive species

The removal of alien invasive vegetation must be undertaken in the dry winter months so that the bare patches of ground will not be easily eroded by stormwater associated with the summer months. As dust will most likely be generated during the removal, the area to be cleared must be sprayed prior to conducting the removal.

2.5.3 Methods of eradicating the alien invasive vegetation on site

The removal of invasive vegetation can be through mechanical and chemical means (Department of Water and Sanitation, Undated; Invasive Species South Africa, Undated).

2.5.3.1. The general removal methods for removal of alien vegetation.

The removal of alien vegetation can be **mechanical** or **chemical** and must be suitable to the specific type of alien vegetation (Department of Environmental Affairs, Undated; Department of Water Affairs, Undated).

Mechanical (physical) methods of removing invasive alien vegetation

These include:

- Hand pulling of small plants and seedlings and their roots
- Cutting plant to a level closest to the ground and then completely removing the roots of the plant

Chemical Methods of removing invasive alien vegetation

These include

- The use of herbicides - expert advice on the most appropriate method must be acquired and must be applied (by spraying or painting) on plants that are less than 2m in height, either naturally or after cutting. In addition to this, the herbicide can be injected into the plant (Department of Water and Sanitation, Undated).

Although these two methods are generally used in the eradication of alien species, *only the mechanical methods* must be used for in the proposed Stone River's Arch as these cause less environmental harm than chemical methods.

2.5.4 Phases in the control of alien vegetation

This must be undertaken with the use of a long term plan of three phases. These are:

- Undertake Initial Control - high level of the reduction of existing populations of alien species;
- Follow up control - control of seedlings, root sucker and coppice growth; and
- Maintenance control - sustain low alien plant numbers with annual control.

2.5.5 Maintenance control of eradicated alien invasive vegetation

All plants that have been eradicated/treated must constantly be checked and there must be repetition of the method initially used for eradication.

2.5.6 Disposal of alien invasive vegetation

The disposal method of the plant species will depend on factors such as species, quantity and growth stage. The alien invasive plant species removed as part of the rehabilitation plan must be handled in a manner that will not create additional problems in the environment. The first method of preference is the reuse of the material on other parts of the proposed development where it can be chipped and used for mulch (Conservation at Work, undated). Plant species such as trees may be cut into large pieces and used whole or in landscaping.

However, care must be taken to ensure that seeds do not spread during the removal. Where the seeds are collected, they must be placed in sealed plastic bags and allowed to dry on site as high temperatures will destroy most seeds (Dahlquist et al, 2007; McSorley and Gill, 2010).

If material cannot be reused, it must be disposed of at a registered landfill after being dried on site.

2.5.7 The revegetation of bare ground after the removal of alien invasive species

Vegetation is useful in rehabilitation as it binds and stabilises soil and slows the velocity of stormwater water. This reduces soil erosion and in turn prevents the deposition of sediment in the nearby watercourse. Despite this however, measures such as Erosion Control Blankets must be used to provide immediate protection to soil after the soil has been left bare. The Erosion Control Blankets are useful for slopes in sensitive areas close to watercourses (Thabakholo Environmental Solutions, Undated).

2.5.8 Principles to be ensure successful rehabilitation with the use of vegetation

In order to ensure successful rehabilitation by vegetation, the following must be adhered to:

- Alien species may not be used for re-vegetation;
- Only indigenous plants must be used;
- There must be a diversity of species as this will ensure greater chances of survival;

2.6 Cover Material

According to the findings of the Geotechnical and Geohydrological Study undertaken for the Shakaville landfill, the quality of the soil tested on site is suitable for cover based on laboratory test results. The cover material is however inadequate for capping. Cover material will therefore need to be sourced from other areas. Refer to the Geotechnical and Geohydrological Study Report attached as **Appendix F2** of the Basic Assessment Report.

2.7 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:

- Maximum slope angle of 1v:3h implemented across the landfill.
- Complete vegetative covering of waste bodies (ideally indigenous flora).
- Selection of non-erodible and non-dispersive topsoil to avoid erosion.

Creation of sufficient horizontal channels along outer slopes of waste bodies to decrease flow rate of surface runoff and minimise erosion.

- Concrete drainage channels surrounding cells to be maintained to avoid clogging and possible overflowing of storm water and leachate resulting in continued erosion along base of waste bodies.

2.8 Re-vegetation

Once the final topsoil layer has been placed on the site, it must be seeded with indigenous grass species (see Section 3.6.3.3 for further details) and monitored to ensure that it successfully grows. Grassing must be used for revegetation.

Grassing is the covering of the ground with grass. It is crucial that all grassing be undertaken by a suitably qualified Contractor, making use of the appropriate equipment. Where seed is used in grassing, all seed supplied should be labelled in accordance with the Government Seed Act (Act No. 20 of 1961). One of the

ways in which grassing can be undertaken is through hydroseeding or sodding. Each of these will be discussed in the next sections. It is expected that the KwaDukuza Local Municipality will use the most cost and time effective method for the revegetation of the Shakaville landfill subsequent to the application of the capping layer.

2.9 Hydroseeding

Hydro-seeding entails adding a specified seed mix to a slurry containing water, seed, fertilizer 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. Hydroseeding is a quick and cost-effective method of seeding and is especially suited to slopes associated with landfills. It provides homogenous cover which is key in rehabilitation efforts and also prevents possible erosion. The following must however be borne in mind for hydroseeding:

- 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).

Companies such as Hydromulch (<http://www.hydromulch.co.za>) and Instaturf <http://www.instantturf.co.za/> can be consulted to obtain quotes for hydroseeding.

2.10 Sodding

Sodding is defined as the laying of grass sods. Sodding may be done at any time of the year, but seeding must be done during the summer when the germination rate is better. The following is key for sodding:

- 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;
- 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; and
- Irrigate as required until the grass is able to survive independently (i.e. depending on the rainfall).

2.11 Grassing mix for vegetative cover

The vegetative cover must comprise grasses that are indigenous to the Shakaville area. According to SANBI Vegetation Data, the Shakaville landfill is located within CB3- KwaZulu Natal Coastal Belt Vegetation Type. The Graminoids that naturally grow in this area and which can form part of the grassing mix include the following:

- *Themeda triandra*;
- *Melinis repens*;
- *Aristida junciformis* subsp. *Galpinii*;
- *Digitaria eriantha*;
- *Panicum maximum*;
- *Alloteropsis semialata* subsp. *Eckloniana*;
- *Cymbopogon caesius*;
- *Cymbopogon nardus*;
- *Eragrostis curvula*;
- *Eulalia villosa*; and
- *Hyparrhenia filipendula*,.

Local nurseries must be consulted to check the availability of seeds or sods for any of the above. Where these are not available, equivalent and suitable indigenous species can be used subject to the approval of a reputable nursery and/or Contractor or Hydroseeding Company. Instructions for application must also be checked with these persons prior to the commencement of grassing.

Furthermore, an indigenous seed mixture, such as Mayford's Biomosone Grassveld Reclamation Mixture, at a density of 24kg/ha to prevent erosion and ensure adequate vegetation cover. [Contact details online available: <http://mayford.co.za/veld-grass/>];

Based on the map Mayford Grassmix Map in **figure 7**, it must be noted that the Shakaville landfill is located in an area in which Mayford's 'Sour Bushveld Mix' can be utilised for the rehabilitation (MayFord, 2016)

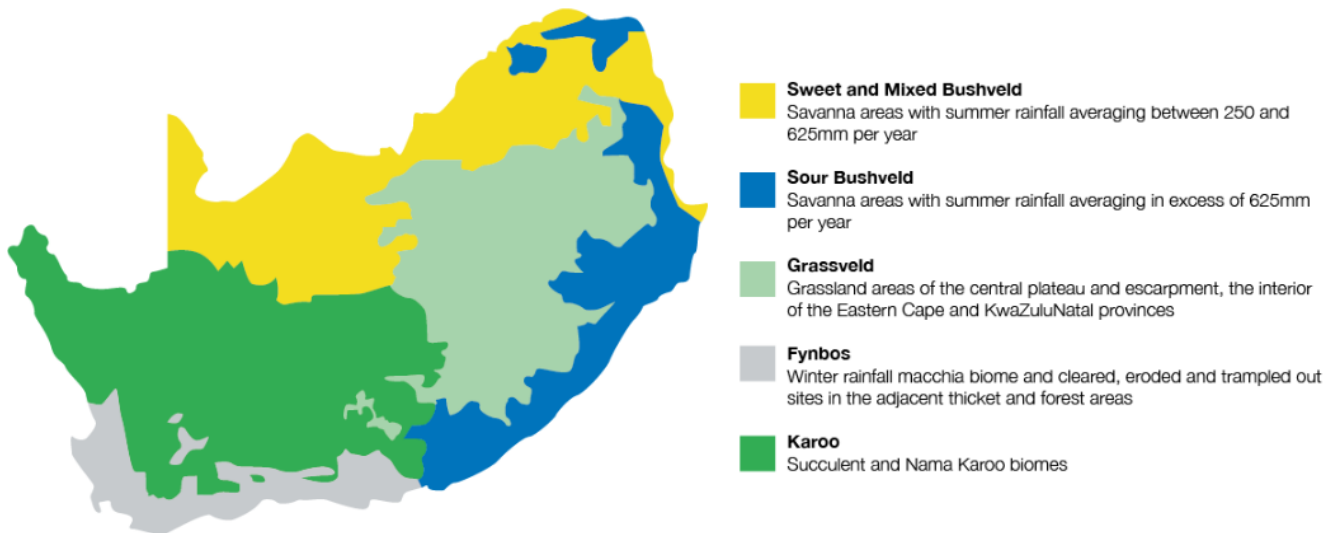


Figure 7: MayFord grass mix map

2.12 Maintenance of rehabilitation

- Allow for a maintenance period of at least one year following practical completion,
- 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.
- 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-hydroseeded.

2.12.4 Access Control

A 1,8m high wired fence and lockable gate should be constructed for access control purposes.

2.12.5 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 in accordance with the design measures proposed. Once the site is properly vegetated the management of stormwater becomes less problematic. The site does not generate any significant amount of leachate at this stage but the proposed leachate management system of collection, trenching and storage should be monitored regularly and the leachate sump cleaned out at regular intervals.

2.12.6 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 3**.

Table 3: Specifications for Monitoring

Environmental Aspect	Description	Frequency and record keeping 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.	<ul style="list-style-type: none"> Weekly inspection for the first 2-3 months after establishment of vegetation Photographic record
Water quality	Surface and groundwater monitoring in accordance with the site permit conditions for closure.	A scientist must take samples at the timeframes specified in the Waste Management Licence The analysis must be undertaken by an accredited laboratory.
Landfill gas	Most likely not applicable	Timeframes specified in the Waste Management Licence
Fire break	A 5 meter fire break must be maintained around the site	<ul style="list-style-type: none"> Monthly inspection Photographic record
Alien vegetation	Alien vegetation must be eradicated from the site	<ul style="list-style-type: none"> Monthly inspection Photographic record
Access control	The fence and gate should remain intact and the site must not be accessed by unauthorized persons.	<ul style="list-style-type: none"> Monthly inspection Photographic record

2.13 Monitoring and Auditing

In order to monitor the rehabilitation of the Shakaville landfill, the KwaDukuza Municipality must either undertake internal audits or appoint an external party. A checklist relevant to the aspects that will be

monitored must be created and used during the audit. Furthermore, photographs must be taken to indicate site conditions. In order to record the findings of the audits, monthly reports with photographic records must be compiled. The reports must indicate the following minimum information:

- Date/s of audit;
- Name of auditor;
- Areas audited;
- Areas of concern and suggested corrective measures accompanied by timeframes;
- Feedback on previous requests for the implementation of corrective measures;

2.14 Environmental Management Programme

The Environmental Management Programme (EMPr) is attached **Appendix I** of the Draft Basic Assessment Report.

3 FINANCIAL PROVISION FOR CLOSURE AND REHABILITATION

As the closure and rehabilitation of the Shakaville landfill will involve numerous activities in order to ensure that legislative requirements are met, the KwaDukuza Local Municipality has to ensure that funds are available for the planned activities.

Capping designs that adhere to the legislative framework can be considered expensive and even with the best efforts of the design engineer and construction contractor, this could result in high budget allocations. There are sources of funding that the municipality can use, other than its own funds and these have been widely used with great success. A large number of most small municipal landfill sites, such as the Shakaville landfill have no base liner which is mostly due to the age of the facility (liners became a requirement from 1998) and /or the budgets of the municipality at the time of the establishment of the landfill. The requirements of capping designs for landfills with no base liner is stricter than for facilities with operational base lining systems.

The costs given in this chapter is an **estimate** of construction costs for the establishment of the landfill cap and is not be considered a final value since it needs to be confirmed during the detail design stage prior to development of tender documentation for municipal procurement of construction contractors. The breakdown of the cost estimate is attached as **Appendix B**.

4 CONCLUSIONS

The closure of the Shakaville landfill must adhere to the following requirements:

- The Municipality must adhere to all conditions of the Waste Management Licence and read the conditions along with the contents of this Closure report.
- Ongoing monitoring and maintenance of rehabilitated areas must be undertaken as per the timeframes specified in this report;
- There must be ongoing monitoring of the groundwater, surface water, leachate must be undertaken
- The site must be fenced to: prevent possible disposal of waste and unauthorized access to the site as this can compromise the rehabilitation process;
- The recommended end use for the site is as an open space that can be used for sport and recreation although with light and not heavy infrastructure that can be affected by settlement and methane gas that is common in former landfills. However, as the KwaDukuza Local Municipality has stated that they wish to construct a Stadium with heavy infrastructure on the site, it is imperative that all relevant studies are undertaken to ensure the stability of the proposed infrastructure. Furthermore, all the relevant environmental authorisations and other permits and/or licences must be obtained prior to the construction of the infrastructure.
- A detailed cost breakdown for the proposed activities must be undertaken prior to the commencement of construction.

5 REFERENCES

- 1) Bolton N, 1995. Handbook of landfill operations a practical guide for landfill engineers, owners and operators.
- 2) Dahlquist RM, Prather TS and Stapleton JJ. 2007. Time and Temperature Requirements for Weed Seed Thermal Death. *Weed Science*,55, 619–625.
- 3) Department of Environmental Affairs, 2017, NEMA EIA Regulations (2014, as amended) Appendix 5 (Closure plan).
- 4) Department of Environmental Affairs, Undated. *Invasive Alien Plants*. <https://www.environment.gov.za/projectsprogrammes/wfw/invasiveplants> (accessed 15 January 2018)
- 5) Department of Water Affairs and Forestry (DWAF), Minimum Requirements for Waste Disposal by landfill (Second Edition, 1998).
- 6) Mayford, 2016. Biosome Eco- Matched veld seed. <http://mayford.co.za/wp-content/uploads/2016/12/MayFord-MAP.png> (accessed 15 January 2018)
- 7) McSorley R and Gill HK. 2010. *Introduction to Soil Solarization*. University of Florida. <http://edis.ifas.ufl.edu/pdffiles/IN/IN85600.pdf>.
- 8) RAPIenaar Consulting (Pty) Ltd, 2017. Dr Shakaville Waste Landfill: Engineering Needs Assessment and Preliminary Closure Design Draft report.
- 9) 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.
- 10) Water Research Commission Report TT48/89, 1989. Water and waste water management in the red meat industry.

APPENDIX A

MINUTES OF THE MEETINGS HELD BY THE EAP WITH INTERESTED AND AFFECTED PARTIES AND
OTHER ROLE PLAYERS

MINUTES OF MEETING

PROJECT NAME: Basic Assessment for the proposed Decommissioning (Closure) of the Shakaville Landfill, KwaDukuza Local Municipality

MEETING: Project Inception

CHAIRPERSON: Ntsebo Mkhize

RECORDED BY: Nyaladzi Nleya

DATE: 20 September 2017

TIME: 10:30-12:30

VENUE: KwaDukuza Local Municipality (No. 2 Industria Crescent, Lavoipierre Building, KwaDukuza)

ATTENDANCE			
Name	Organization	Email address	Office Contacts
Njabulo Ngwane (NN)	KwaDukuza Local Municipality	njabulon@kwadukuza.gov.za	032 437 5176
Wilson Mhlongo (WM)	KwaDukuza Local Municipality	wilsonm@kwadukuza.gov.za	078 683 6427
Lindokuhle Gingwana (LG)	Ward 18 Councillor	lindokuhleg@kwadukuza.gov.za	073 280 2300
Chuma Gushu (CG)	DEA-LGS (iLembe)	Chuma.Gushu@ilembe.gov.za cgushu@environment.gov.za	078 567 4246
Nomusa Xaba (NX)	EDTEA	Nomusa.xaba@kznedtea.gov.za	032 551 0904
Makwena Makgolane (MM)	Department of Water and Sanitation (DWS)	makgolane@dwa.gov.za	012 336 8601
Nkhensani Khandlhela (NK)	GA Environment (Pty) Ltd	nkhensanik@gaenvironment.com	011 312 2537
Nyaladzi Nleya (NN2)	GA Environment (Pty) Ltd	nyaladzin@gaenvironment.com	011 312 2537
Ntsebo Mkhize (NM)	GA Environment (Pty) Ltd	ntsebom@gaenvironment.com	011 312 2537
APOLOGIES			
Masupha	iLembe District Municipality	Masupha.Mathenjwa@ilembe.gov	032 437 9300

MINUTES OF MEETING

Item	Description	Responsible	Due Date
	<p>Municipality (KDM) council in order to alert them of the proposed activity.</p> <ul style="list-style-type: none"> - NK responded to WM that a meeting was held in Pietermaritzburg where representatives from various municipalities were expected to highlight all their requirements. NK also added that the KwaDukuza Municipality was not represented in that meeting. NK further advised that there would be other platforms during aligned site visits to present additional information if prior arrangements are made. - NN noted the question presented by WM and highlighted the need for this meeting to take place as soon as possible. Further to that, the municipality would like to receive monthly progress reports to enable the municipality to report to the council. - NN also extended an apology for the lack of representation from KwaDukuza Municipality at the meeting held in Pietermaritzburg. - NM reiterated that the meeting was to introduce the project team and obtain background information on the Shakaville Landfill site. - NK provided background to the overall project and past experience obtained on other Landfill applications. She stated that the current status of many landfills in South Africa is a concern due to the danger they pose to livestock, communities and other various other aspects of the biophysical environment. This has led the minister to formalize all unlicensed landfills according to the 	<p>GA</p>	<p>Between the 09th and 13th October 2017</p>

MINUTES OF MEETING

Item	Description	Responsible	Due Date
	National Environmental Management Act, 1998 (Act No 107 of 1998 (NEMA) and the National Environmental Management Waste Act (Act No 59 of 2008).		
3.	Site information		
	<ul style="list-style-type: none"> - WM highlighted that waste disposal on site ceased around the year 2000 after almost 30 years of operation. The KwaDukuza Local Municipality currently disposes of their waste at the Licensed and Privately-Owned Dolphin Coast Landfill. WM added that there is no regional landfill within the iLembe District Municipality. - WM stated the KDM's IWMP is in the final stages - WM stated that the site is naturally rehabilitated LG mentioned that approximately 20 families reside within the boundaries of the landfill and at least 13 of these were unable to be provided with formal housing during the last cycle of housing provision. - <i>-Studies undertaken-</i> NN mentioned that the landfill designs provided by the Municipality to GA Environment were not vetted and new closure designs must therefore be compiled. - LG mentioned that additional information on the site can be obtained from Mr JK Naidoo who previously worked for the KDM and is currently employed by the Mhlathuze LM. 	Info.	
4.	Responsibilities and Scope of Work		

MINUTES OF MEETING

Item	Description	Responsible	Due Date
	<ul style="list-style-type: none"> - NM stated that GA Environment’s appointment for the undertaking of the Basic Assessment Process for the proposed Decommissioning (Closure) of The Shakaville Landfill is from the National Department of Environmental Affairs. (DEA). She highlighted that the urgency of the project was highlighted by Mr BR Dlamini of DEA in the Inception Meeting held at the KZN Department of Economic Development, Tourism and Environmental Affairs (EDTEA) offices in Pietermaritzburg on the 01st September 2017. - WM highlighted that they are committed to ensuring that GA Environments receives all the required support to meet DEA’s requirements. - NX mentioned the importance of the submission of complete and good quality reports to EDTEA in order to avoid any rejections that can delay the issuing of the Waste Management License. She further added that they are however highly reliant on the Department of Water and Sanitation’s input on the license. - MM mentioned the importance of ongoing water quality post closure monitoring which may be up to (30 years) as one of the conditions. She further indicated that the closure application should be accompanied by a closure plan indicating the drainage control systems and capping design drawings that should be presented to DWS to prevent delays in processing the RoD requests, MM indicated a need for project managers to liaise with Mr Noe Malise for available dates of 	<p>Info.</p>	

MINUTES OF MEETING

Item	Description	Responsible	Due Date
	<ul style="list-style-type: none"> - NM requested contributions from attendees on what information should be incorporated in the presentation to the council. These were said to be the proposed end use of the project - NM indicated that the GA Environment team will proceed to the site for a site visit. The site visit delegation will include members from KDM and DWS. - LG highlighted the importance of this project and thanked the DEA and GA Environment for their involvement. - MM highlighted the need for skill transfers to take place during this project and for the Municipality to gain in the technical knowledge that is shared for this type of project. - NN added that items that must support the closure and rehabilitation of the Landfill must be part of the presentation to council to also assist with budgeting and planning. NN further added that the municipality was willing to assist where it can and must be consulted at all times to ensure that the project adheres to deadlines. - WM indicated that the forms he received from NM had been completed and the forms and have been forwarded to the Municipality's Legal Department for vetting before submission to the Municipal Manager for signing and provision to GA Environment 	<p>WM</p>	<p>Ongoing</p>

MINUTES OF MEETING

Item	Description	Responsible	Due Date
7.	Closure		
	<ul style="list-style-type: none">- GA Environment will provide meeting minutes and advise on any future meetings- NK thanked the KDM for their involvement in the project and for availing themselves for the meeting.- Meeting was closed at 11h55		

APPENDIX B

FINANCIAL PROVISION FOR THE REHABILITATION, CLOSURE AND ONGOING POST DECOMMISSIONING
MANAGEMENT

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
1.0		<u>PART 1: PRELIMINARY AND GENERAL</u>				
1.1	SANS 1200A	GENERAL				
	8.3	Scheduled Fix-charge and Value-related Items				
1.1.1	8.3.1	Contractual Requirements	Sum			2 000 000.00
	8.3.2	Establishment of Facilities on the Site				
1.1.2	PSA- 8.3.2.2	Facilities for Contractor	Sum			
1.1.3	8.3.3	Other Fixed-charge Obligations	Sum			
1.1.4	8.3.4	Removal of Site Establishment	Sum			
	8.4	Scheduled Time-related Items				
1.1.5	8.4.1	Contractual Requirements	Sum			900 000.00
	8.4.2	Operation and Maintenance of Facilities on Site, for Duration of Construction, except where otherwise stated				
1.1.6	PSA- 8.4.2.2	Facilities for the Contractor	Sum			
1.1.7	8.4.3	Supervision for Duration of Construction	Sum			
1.1.8	8.4.4	Company and Head Office Overhead Costs for the Duration of the Contract	Sum			
1.1.9	8.4.5	Other Time-related Obligations	Sum			
	8.5	Sums Stated Provisionally by Engineer				
	(PSA)	(c) Additional Tests				
1.1.10		1) Additional tests ordered by the Engineer	Prov Sum	1		20 000.00
1.1.11		2) Handling cost and charges on (c)(1)	%	20 000		
		(d) Survey in terms of Land Survey Act				
1.1.12		1) Provisional allowance for survey	Prov Sum	1		30 000.00
1.1.13		2) Handling cost and charges on (d)(1)	%	40 000		
TOTAL CARRIED FORWARD TO SUMMARY						2 950 000.00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
2.0		<u>PART 2: EARTHWORKS: SHAKAVILLE</u>				
2.1	SANS 1200D	SECTION: EARTHWORKS				
	8.3.1	Site Preparation				
2.1.1	8.3.1.1	Clear and Strip Site	m ²	56 000	7	392 000.00
	8.3.2	Bulk Excavation				
2.1.3	PSD 8.3.2	a) Excavate in all materials and use for embankment or backfill or dispose, as ordered	m ³	10 000	40	400 000.00
		b) Extra over for				
2.1.4		1) Intermediate Excavation	m ³	100	100	10 000.00
	PSD 8.3.4	Importing of Materials				
2.1.5		a) Extra over for importing materials from commercial sources or from Borrow pits for use in capping	m ³	10 000	80	800 000.00
2.1.6		b) Opening up and closing down designated borrow pits	Sum	1	50000	50 000.00
	8.3.6	Overhaul				
2.1.7		a) Limited Overhaul	m ³	200	100	20 000.00
2.1.8	PSD 8.3.14	Stormwater chutes as shown on drawings	m	200	1500	300 000.00
2.1.9	PSD 8.3.14	Gabion Basket as shown on Drawings, Full Construction	m ³	3 500	1200	4 200 000.00
2.2	SANS 1200 DE	<u>PART 2: SECTION : SMALL EARTH DAMS</u>				
	PSDE-8.3.5	Forming embankment				
		(i) Cut from excavation and/or stockpile				
2.2.1		(1) Suitable as fill material for stormwater berm	m ³	1 200	120.00	144 000.00
	PSDE- 8.3.11	Forming Site Capping				
2.2.2		(a) Shape and Compact In situ Waste Material	m ³	57 000	20.0	1 140 000.00
2.2.3		(b) Cut to fill from commercial sources a Drainage layer comprising of single sized crushed stone or gravel having a size of between 38 mm and 50 mm as shown on drawings	m ³	7 500	250.00	1 875 000.00

2.2.4		(c) Cut to fill from commercial sources silty sand material for use in protection layer as shown on drawings	m ³	2 000	300.00	600 000.00
2.2.5		(d) Cut to fill from commercial sources Topsoil layer as shown on drawings	m ³	10 000	120.00	1 200 000.00
2.2.6	PSDE- 8.3.12	160 mm dia perforated HDPE pipes placed inside gravel drainage layer on plato as shown on drawings including all bends, tees, corrections etc.	m	320	250.00	80 000.00
2.3	PART SPEC PCI	<u>PARTICULAR SPECIFICATION PCI: GEOTEXTILES</u>				
	PCI-5.1	Supply and install geotextile				
2.3.1		(a) Separation Geotextiles in capping works as shown on drawings, 2.5mm thick, minimum 1.5kg/m ²	m ²	120 000	12.00	1 440 000.00
2.3.2		(b) Around drainage pipes	m ²	1 240	12.00	14 880.00
2.4	PART SPEC PDI	<u>PARTICULAR SPECIFICATION PDI : GEOSYNTHETIC MEMBRANES</u>				
	PDI-15.1	Supply and Installation of geosynthetic membranes				
2.4.1		(a) 1.5mm HDPE geomembrane for use in plato capping	m ²	20 000	55.00	1 100 000.00
2.4.2		(b) Geosynthetic Clay Liner (GCL) as per drawings	m ²	50 000	60.00	3 000 000.00
2.4.3		(c) Geocomposite Drainage Layer (ABG Pozidrain® or similar)	m ²	30 000	65.00	1 950 000.00
2.4.3	PDI-15.2	Geomembrane Guarantee	Sum	1	20 000.00	20 000.00
2.5	PART SPEC PNE	SECTION: ESTABLISHMENT OF VEGETATION ON LANDFILL				
2.5.1	PNE-7.1	The preparation, application and maintenance of vegetation	m ²	50 000	25	1 250 000.00
TOTAL CARRIED FORWARD TO SUMMARY						19 985 880.00

ITEM NO	PAYMENT	DESCRIPTION	UNIT	QTY	RATE	AMOUNT
3.0		<u>PART 3: DAYWORKS</u>				
3.1	DW-1	Labour				
3.1.1		(a) Net cost of labour	Prov Sum	1		100 000
3.1.2		(b) Contractor's charges and profit associated with administration of the above item 3.1.1	%	100 000	15	15 000
3.2	DW-2	Plant				
3.2.1		(a) Net cost of plant (including operator, assistance, fuel, oil, maintenance, etc)	Prov Sum	1		100 000
3.2.2		(b) Contractor's charges and profit associated with administration of the above item 3.2.1	%	100 000	15	15 000
3.3	DW-3	Material				
3.3.1		(a) Net cost of material	Prov Sum	1		100 000
3.3.2		(b) Contractor's charges and profit associated with administration of the above item 3.3.1	%	100 000	15	15 000
TOTAL CARRIED FORWARD TO SUMMARY						345 000.00

SUMMARY OF BILL OF QUANTITIES

PART	DESCRIPTION	AMOUNT
		R-c
PART 1	PRELIMINARY AND GENERAL	2 950 000.00
PART 2	EARTHWORKS: SHAKAVILLE LANDFILL	19 985 880.00
SUB-TOTAL A		22 935 880.00
PART 3	DAYWORKS	345 000.00
SUB-TOTAL B		23 280 880.00
CONTINGENCIES Add 10 % for Sub-total B (Provisional sum)		2 328 088.00
SUB-TOTAL C		25 608 968.00
VALUE ADDED TAX Add 14 % for Sub-total C (Provisional sum based on current rate of VAT)		3 585 255.52
ESTIMATE TOTAL AMOUNT (INCL VAT)		29 194 223.52