TECHNICAL REPORT

PROJECT NO: MISA/MLM/UFLS/006/2018

FRANKFORT: UPGRADING OF THE FRANKFORT LANDFILL SITE IN THE MAFUBE LOCAL MUNICIPALITY, FREE STATE PROVINCE, PHASE 1

January 2019

Prepared for:

MAFUBE LOCAL MUNICIPALITY

64 JJ Hadebe Street
Frankfort
9830

Attention: Mr. I. Ngozo

Prepared by:

DIPABALA CONSULTING ENGINEERS

DIPABALA
CIVIL ENGINEERS & PROJECTS MANAGERS
"We globalise the engineering mindset"

Suite 13, Brandwag Park
Corner Mc Hardy and Melville drive,
Brandwag, Bloemfontein, 9301

Prepared by: Mr. T. Motheane

Title:	*MISA/MLM/UFLS/006/2018: Technical Report - Frankfort: Upgrading of the landfill site in the Mafube Local Municipality, Free State Province, Phase 1*
Client:	***MUNICIPAL INFRASTRUCTURE SUPPORT AGENT / MAFUBE LOCAL MUNICIPALITY***
Author:	*T.Motheane*
Team Members:	*T. Motheane, N. Radiapeng*
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T Motheane – Technologist
Author

Reviewed For Approval:

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MAFUBE LOCAL MUNICIPALITY

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1 INTRODUCTION

1.1 Purpose and Objectives of the Project

Dipabala Consulting Engineers were appointed to provide professional engineering services for the rehabilitation of the existing land fill site and construction of a new waste facility in Frankfort, MAFUBE local Municipality (MLM), and Free State Province.
The report serves to communicate a preliminary design for the proposed new Frankfort waste disposal facility (WDF) as well as presenting some basic requirements for waste disposal facility by landfill. A cost estimate for the total project has also been prepared and included in this report for budgetary purposes.

1.1.1 Purpose

The purpose of this project is to address inadequacies in the current waste management system by implementation of efficient and good waste management practices. This will be achieved through proper planning, execution and commissioning of the project. Training of MLM's workers to be responsible for operations and maintenance will also be conducted in order to ensure that the new landfill site fulfill the intended purpose.

1.1.2 Objective

The objective of this project is to upgrade the landfill site to meet the minimum requirements as per ***"Minimum requirements for Waste Disposal by Landfill, DWAF, 2^{ed} 1998".***
Other project objectives are to develop a landfill site that is: -

- Environmentally acceptable to avoid any degradation of the environment in which the landfill is located.
- Prevent pollution of the surface and ground water.

1.2 Pollution risks

To be addressed by the Environmental Impact Assessment Process (EIA) to be undertaken as part of the Waste Management License and Environmental Authorization Application.

1.3 Relevant documentation

The following documents were used primarily as reference in developing the design of the facility: -

- National Environmental Management: Waste Act (2008).
- Minimum Requirements for Waste Disposal by Landfill: Department of Water Affairs and Forestry, Republic of South Africa, Second Edition 1998 ('Minimum Requirements).

- National Environmental Management: Waste Act (2008): National norms and standards for disposal of waste to landfill:
- Guidelines for Human Settlement Planning and Design: Vol. 2, 2005
- SANS (South African National Standards) 1200 Series (Civil Engineering Specifications).

2 Site location and topography

2.1 Site location

Frankfort is located approximately 350km North East of Bloemfontein,108.2 km north of Bethlehem in the Free State Province of South Africa. The surrounding areas include Heilbron, Tweeling and Cornelia. ***(Refer to figure 1 below).***

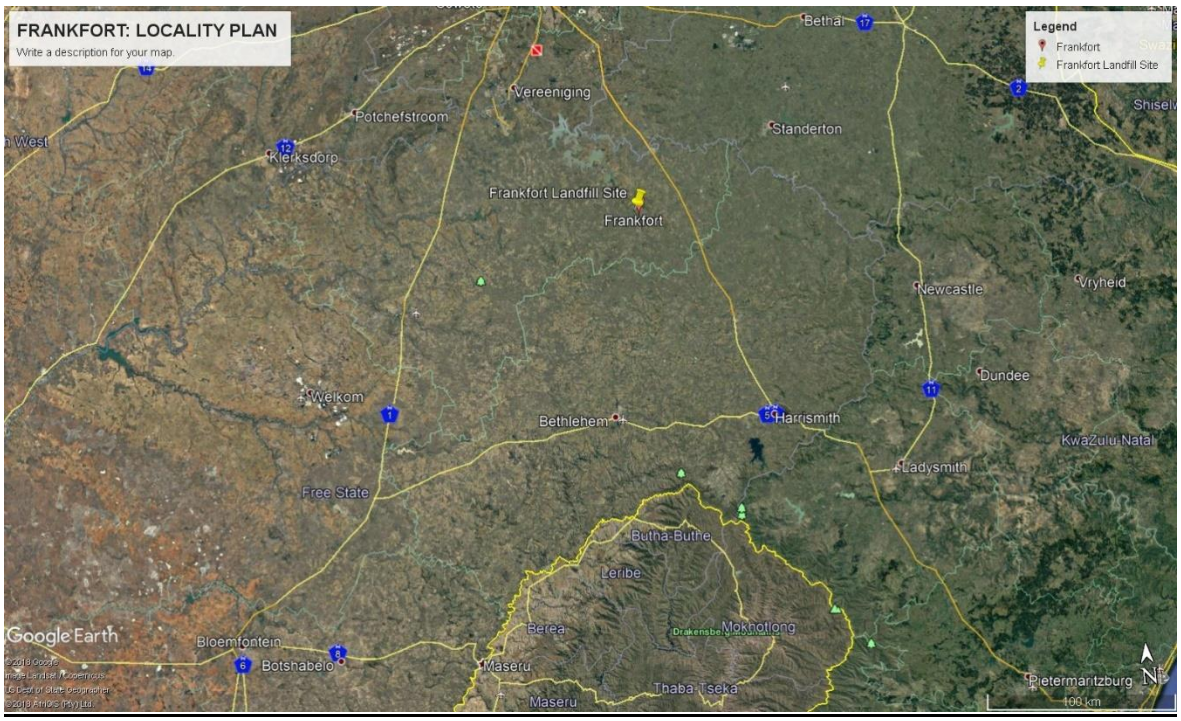

Figure 1: Locality Plan: Google Earth Layout Map (2018).

The study site is located south of Frankfort in the Free State Province of South Africa. The area of investigation is situated at and Latitude -27.293841° and Longitude 28.497422°. The existing landfill site, as illustrated in red on ***figure 2 below***, is about 14 hectares is located on the southern part of Frankfort. The site is approximately 500m from the Wilgerivier which runs south of the site.

Figure 2: Google Earth Aerial Photo: Frankfort existing and proposed WDF locations.

2.2 Topography

The study area that is located south of Frankfort is situated on a topographical slope. In Figure 2, these changes in elevation are shown with an added surface water drainage direction. The study site itself is situated on an elevation of 1545 mamsl whilst the lowest elevation is 1520 mamsl and the highest elevation 1566 mamsl. The difference in elevation between the highest and lowest points on the project site is 46 m.

2.3 Climate

Frankfort is situated within a summer rainfall district whilst receiving 546 mm of rain annually. During July months it receives its lowest rainfall values (0 mm) whilst receiving the most in January (101 mm). Temperatures for this area range from average midday temperatures of 16.3°C in June to 26.8°C in January.

3 Geology and geohydrology

3.1 Geology

From the geological map shown in Figure 4 it is evident that the study area is underlain by a dolerite sill. Other formations that is visible in the area is the sedimentary rock from the Normandien formation of the Adelaide subgroup of the Beaufort Group and alluviums in the lower laying areas.

Figure 4 is a representation of the local geology in relation to the investigated site.

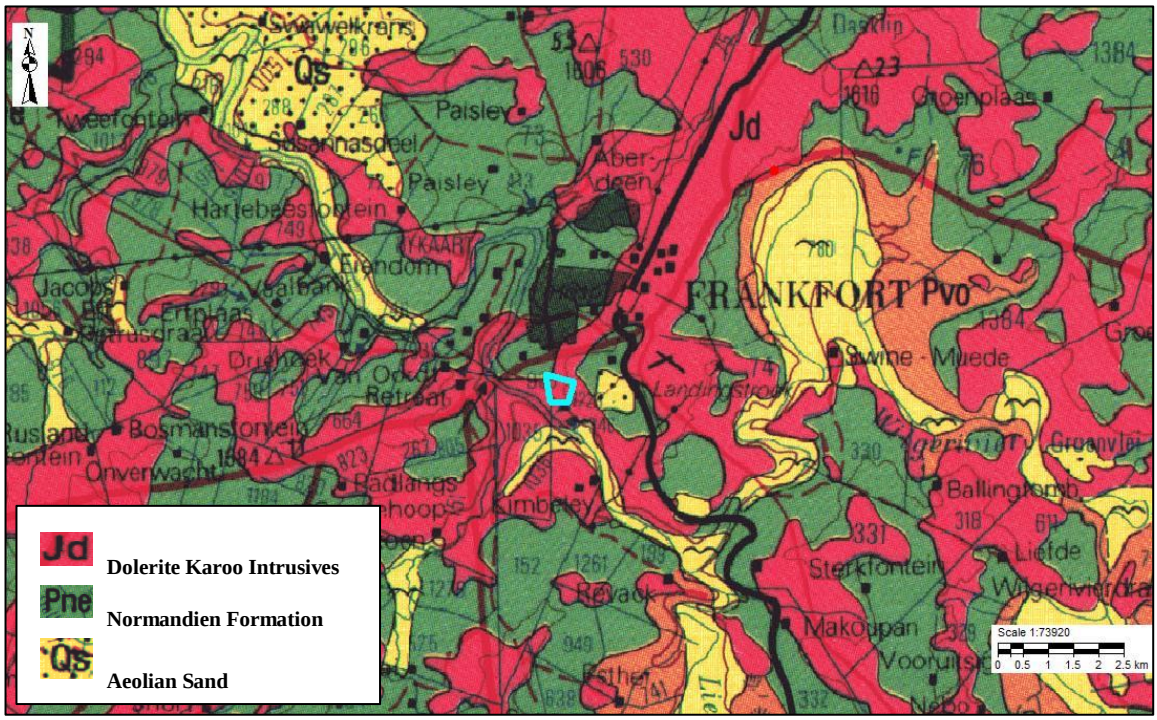

Figure 4: Geological Map Interpretation

The Normandien formation consists of olive green and grey mudstone with subordinate sandstone.

3.2 Geohydrology

In general, the recommended drilling depths are 60 to 100 meters or deeper for the study area. The storage types of the aquifer quantified as fractures, restricted principally to a zone below the groundwater level, pores in disintegrated, decomposed, and partially decomposed rock and fractures which are principally restricted to a zone directly below the groundwater level.

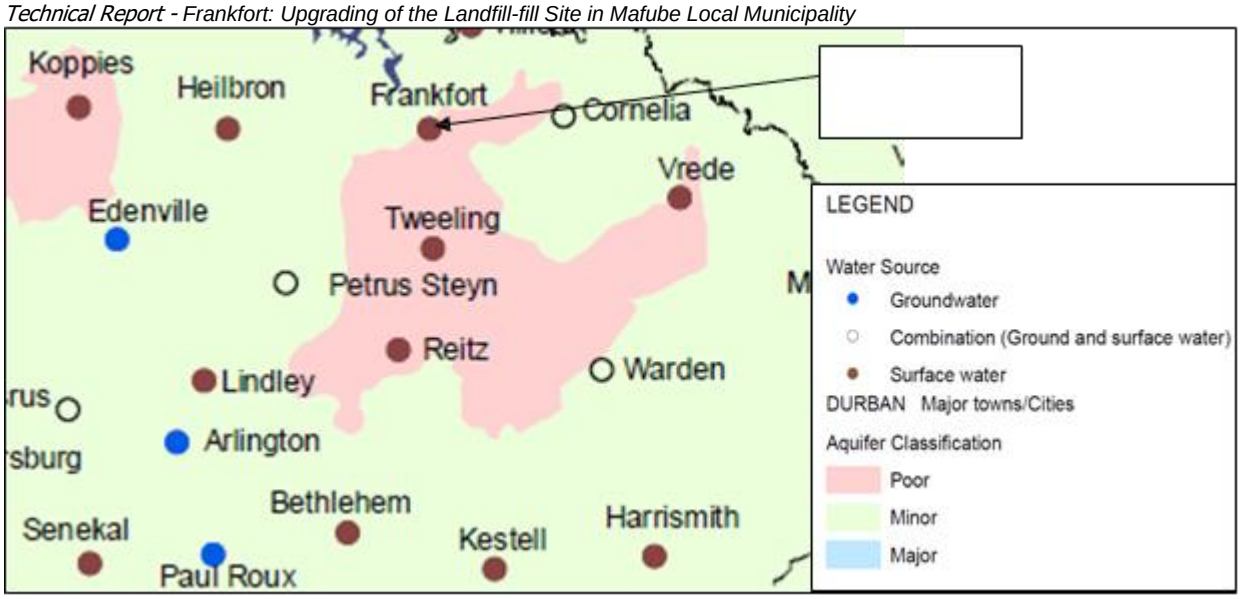

Figure 2: Aquifer Classification Map

The study area is situated on a minor to poor aquifer system where the expected yields of boreholes are <0.4 l/s.

Due to the fact that the project area is situated on a poor aquifer and the aquifer vulnerability is least, it can therefore be assumed that the aquifer has a low susceptibility for contamination.

4 Design Criteria

The waste dump takes in general waste from the town and is poorly managed by the municipality. The current disposal procedure does not incorporate compaction or covering of the waste daily. The dump does not meet the minimum requirements for a waste disposal facility

4.1 Landfill Cells

4.1.1 Waste Classification:

The waste is classified as type 2 waste according to National Environmental Management: Waste Act (NEMWA) ,2008; Regulation 635 of 2013 and should be disposed of in a Class B barrier system (see figure) in accordance with NEMWA, Regulation 636: National norms and standards for disposal of waste to landfill.

(b) Class B Landfill:

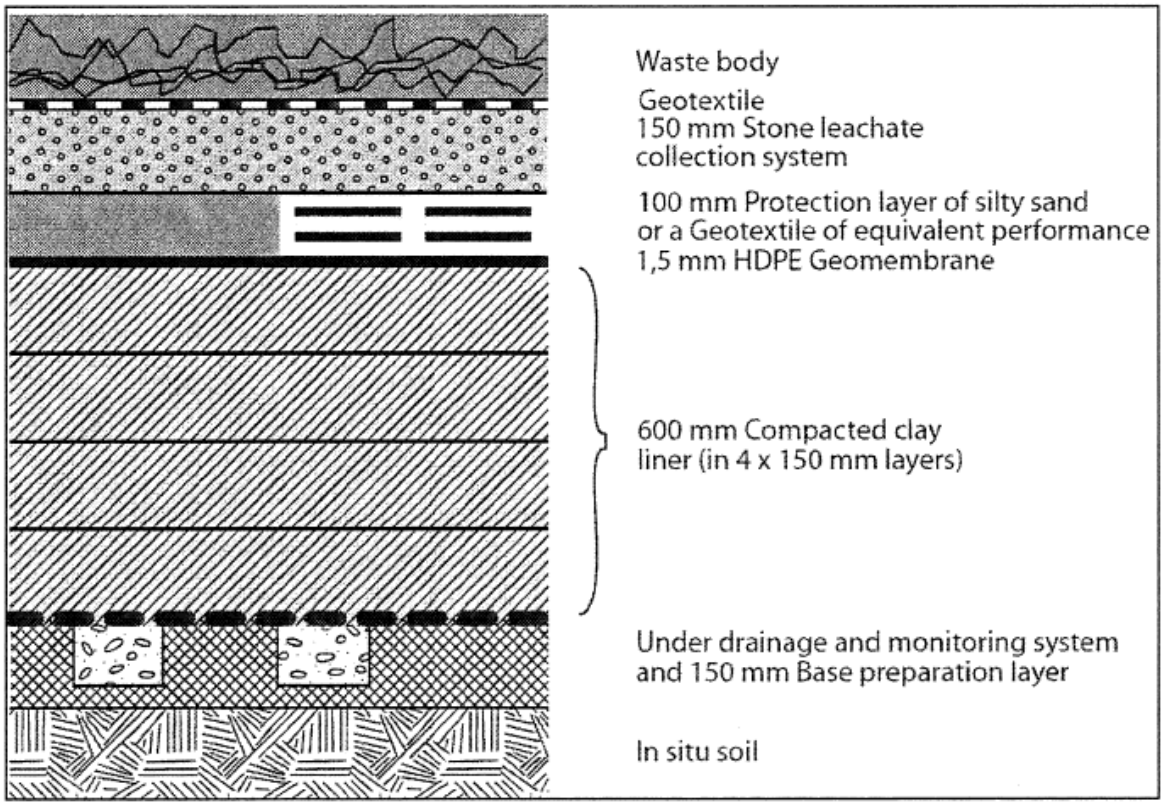

Figure 3: Class B liner detail (source: National Environmental Management: Waste Act (2008): National norms and standards for disposal of waste to landfill)

4.1.2 Service life

The proposed waste containment design will comprise of two cells with a service life of 10 years each making the total service life of the landfill 20 years.

The following assumptions have been made to determine the size and lifespan of the facility:

Table 2 Population and growth rates

Town	Projected Population in 2016	Growth rate (%)	IRD (tons/day)
Frankfort	26 425,00	0,30	13,2
Cornelia	11 000,00	1,20	5,5
Villiers	18 000,00	0,60	9,0
Tweeling	9 000,00	1,10	4,5
Total	64 425,00	3,20	32,21

- Waste generation rate = 0.5 kg/capita/day (Min Req)
- Average density of the compacted waste in the landfill = 1,000 kg/m^3
- Lifespan required = 20 years

Cell	Base Area (m^2)	Cell Depth (m)	Airspace (m^3)	Lifespan (years)
Cell 1	22 500	8	180 000	10
Cell 2	22 500	8	180 000	10
Total	45 000		360 000	20

4.1.3 Material properties

4.1.3.1 Underdrainage

During the geotechnical site investigation groundwater was encountered in one of the test pits (Test pit 6). A finger drain system will be put in place to intercept groundwater and drain it to the stormwater dam.

4.1.3.2 Clay barrier system

According to the geotechnical investigation conducted, there is no suitable clay that meets the required permeability of $1X10^{-7}$cm/s for a compacted clay liner (CCL). A geosynthetic clay liner (GCL) is proposed as an alternative to the CCL and should be compliant to GRI-GCL3 specification.

4.1.3.3 Geomembrane

The geomembrane (GM) should be compliant to SANS1526 (2015) for high density polyethylene (HDPE)

4.1.3.4 Liner protection

The site is overlain by sandy gravel according to the geotechnical report and has no fitting material to serve as a protection layer without posing any puncture risk to the GM. An alternative is proposed in a form of a thick geotextile.

4.1.3.5 Stone leachate

The stone leachate drainage layer will comprise of 50mm stones to ensure that that the leachate collection system continues to function even after precipitate fills up some voids.

4.2 Leachate pond

4.2.1 The design criteria for leachate pond is exactly the same as the landfill cells besides the stone leachate drainage layer. A cover of some sort will be placed above the GM to protect it from UV degradation

5 Design considerations

The proposed landfill in within an old quarry and the design has to take cognisance of that. The vertical face of the quarry is approximately 5m deep. It is proposed that the vertical face is battered back to a slope of 1v:3h to create an embankment. Stone drainage wrapped in geotextile with a 110mm slotted pipe to drain water ingress from the slope. The back drainage forms around the cells and drains out into the stormwater dam under gravity.

The barrier system from the base upwards is 150mm rip and re-compact the in-situ material after excavation to the required depth. Thereafter place a GCL and GM followed by a cushion geotextile protecting the GM from the 150mm thick 50mm size stone leachate.
A separation geotextile will be unrolled as the waste is deposited in the cell. Both cells have sumps at the lowest point of the cell which is maintained at atmospheric pressure via pipe to the leachate pond.

Progressive rehabilitation plan

During operation of the site, rehabilitation is to occur progressively throughout the life of the site on completed areas. It is important that land shaping is undertaken correctly from the beginning to avoid returning at the closure of the landfill to conduct further earthworks as this will compromise vegetation that has established itself to that point.
Progressive rehabilitation will include the placement of capping material, consisting of a 300mm thick layer of clay and a further 150mm thick layer of topsoil. The capping material must be distributed evenly and compaction of the topsoil must be avoided, as this will inhibit vegetation regrowth. The soil should be seeded with indigenous grasses tolerant of methane gas as traces may percolate through the soil from the waste below. The progressive rehabilitation plan will be stipulated in detail in the Landfill Operational Plan.

3.9 Total Project Phase 1: Budget and Expenditure and Phase 2: Cost estimate

Table 6: Phase 1 Budget and Expenditure to date is shown below: -

STAGE OF WORK	**Actual Scheduled Amount**
1. Inception Report and Project Implementation plan	
a) Planning of project execution	
b) Collating of the approved documents	**R 45 386,33**
c) Ratification of the proposed methodology	
d) Compilation of the status Quo(Inception)	
report	
e) Meeting with the client (Municipal Officials)	
2.Scoping / Pre-feasibility Study and Preliminary Engineering Design landfill sites(s) selection from three Sites	**R 450 692,99**
a) Assess Physical and characteristics in terms of topography and visual aspects.	
b) Assess the ecological status quo of the area	
w.r.t flora and fauna	R 60 692,99
c) Identify threatened or affected species	
d) Select a suitable site	
e) Develop mitigation measures	
f) Geotechnical investigations including lab soils	R 80 000,00
g) Topographical and land surveys	R 50 000,00
h) Preliminary Engineering Designs	R 260 000,00
3. Waste License Application	
i) Compilation of the form	
ii) Submission of the application form for waste	R 22 386,33
management license to the relevant competent	
Authority(Provincial government) for approval	
and getting consent.	

4. EIA Application and Basic Assessment Process			**R**	**86 892,99**
a) Public Participation processes			R	15 000,00
b) Basic Assessment Report (EMP)			R	71 892,99
5. Specialist Studies			**R**	**449 207,00**
a) Heritage (Archaelogical and Palaentological) Study			R	14 280,00
b) Ecological and Wetland Delineation			R	19 717,00
c) Geohydrological Investigation and drilling of 3 boreholes			R	415 210,00
tests.				
6. Environmental Management Plan			**R**	**62 098,00**
7. Record of Decision			**R**	**16 186,33**
8. Close out Report			**R**	**60 000,00**
SUB - TOTAL			**R**	**1 192 849,97**
VAT (15%)			**R**	**178 927,50**
Grand Total			**R**	**1 371 777,47**

The table below indicates a summarised cost estimate for the project:

Table 7	Cost for a Upgrading Frankfort Landfill Site	AMOUNT
7,1	**Construction Cost for a New Site**	
	Landfill Cells - Earthworks and Construction of Liner	R 8 593 000,00
	Leachate pond	R 755 857,25
	Boreholes	R 200 000,00
	Guard House and Weight Bridge	R 50 000,00
	Recycling Facility	R 200 000,00
	Ablution block + Kitchen	R 135 000,00
	Fencing	R 2 240 000,00
	Site Monitoring - Tower	R -
	Training	R 150 000,00
	Access Road	R 800 000,00
	Preliminary and General items	R 1 968 578,59
	10% Contingencies	R 1 312 385,73
	Sub-total - DIRECT COST	R 16 404 821,56
7,2	Professional Fees (15%)	R 2 460 723,23
7,3	Site Supervision, Travelling and Accomodation	
	Site Supervision (R40000/month)(Level 3)	R 480 000,00
	Anticipated Construction Period - 12 Months	
	Disbursements (Travelling, Printing, Binding and Accomodation)	R 50 000,00
	Sub-total - INDIRECT COST	R 2 990 723,23
	Sub-total - DIRECT AND INDIRECT COSTS	R 19 395 544,80
	PLUS: VAT (15%)	R 2 909 331,72
	TOTAL ESTIMATED PROJECT COSTS (Including VAT)	**R 22 304 876,52**

The actual, market related cost will be determined by the Tender offers during the contractor procurement stage.

3.10 Construction cost estimate

The total summarized cost of closure of the existing site and construction of the new landfill site, as detailed in is shown on **Table 8 below**.

Table 8	TOTAL PROJECT COST SUMMAY	AMOUNT
7	**Cost for a Upgrading Frankfort Landfill Site**	R 22 304 876,52
	TOTAL PROJECT COST INCLUDING VAT (@15%)	R 22 304 876,52

3.11 Funding plan

The funding plan is that the MISA (Municipal Infrastructure Support Agency) will fund through the Municipal infrastructure grant on all the phases of the projects from EIA applications, registrations, design and project implementation on site as per the programme and revisions made by the Municipality.

. The proposed timeline is presented in Annexure B- Project Implementation Plan.

Refer to Appendix B for Design and Construction programme.

3.13 Acceptance by local authority

All documentation will be forwarded to MAFUBE Local Municipality and all relevant authorities for approval throughout all stages of the project.

6 APPENDICES

6.1 APPENDIX A: PRELIMINARY DESIGN DRAWINGS

6.2 APPENDIX B: PROJECT IMPLEMENTATION PLAN

6.3 APPENDIX C: CLOSURE LICENCE: FRANKFORT SOLID WASTE DISPOSAL SITE

6.4 APPENDIX D: PHOTOGRAPHIC RECORD OF EXISTING LANDFILL SITE