DEPARTMENT OFENVIRONMENTAL AFFAIRS

THE ESTABLISHMENT OF A NEW LANDFILL SITE IN QWAQWA IN MALUTI A PHUFONG LOCAL MUNICIPALITY

DESIGN REPORT

Prepared by

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PRELIMINARY DESIGN REPORT

1 INTRODUCTION

The Department of Environmental affairs has appointed All Green Consultants, a multi-disciplinary engineer consulting firm to establish a new landfill in QwaQwa to services the Maluti-a-Phufong Local Municipality.

Maluti-a-Phufong Local Municipality is an administrative area in the Thabo Mofutsanyane District of the Free State in South Africa. The Municipality extends over the smallest area in the Thabo Mofutsanyana municipal district but has the highest population density. It accommodates almost 54% of the population of the district municipality.

Fig 1: Maluti-a-Phufong Municipal Area

The municipality comprises the towns of Harrismith. Phuthaditjhaba and Clarens, with a combined population of 385 413,

1.1 Purpose of this Report

The aim of this document is to:

- Outline the description of the services proposed for the new landfill site.
- Give approximates sizes for major plant and equipment.
- Confirm the design philosophy, codes and standards referred to meet with the various legislative guidelines.
- Confirm the assumptions and analysis methods used to for the systems design.

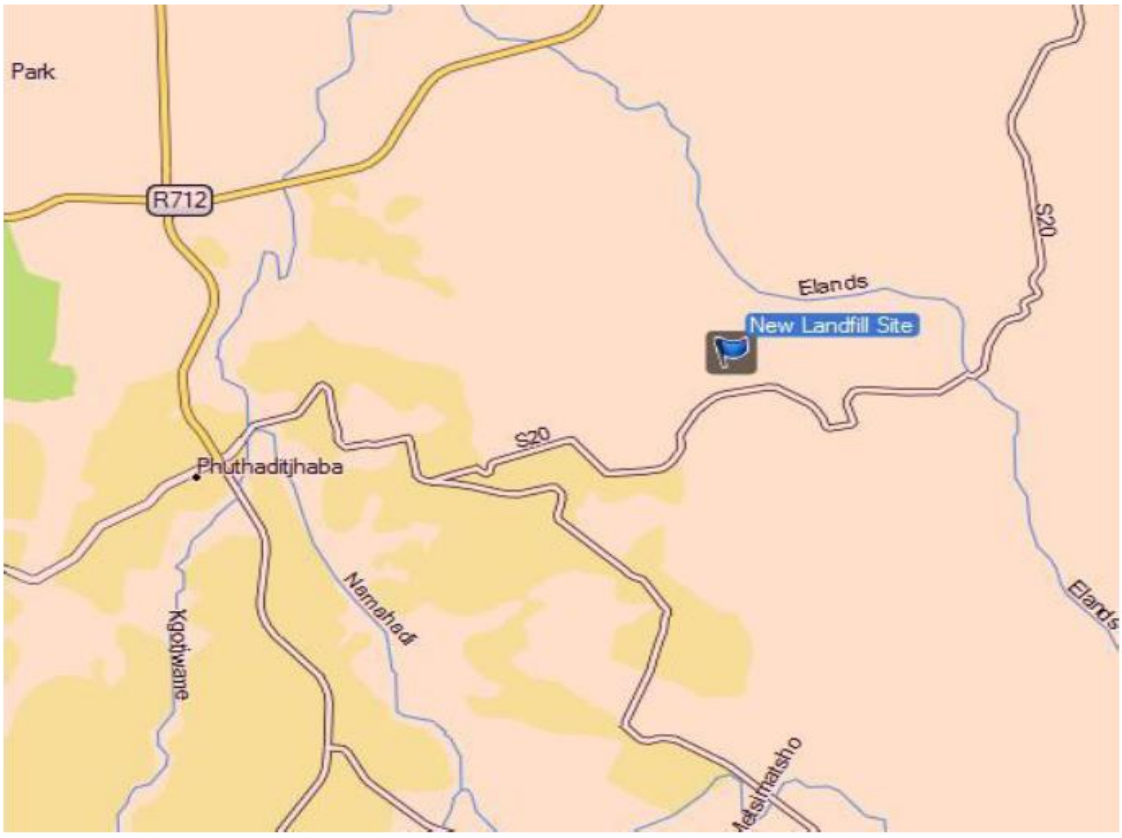
- Produce project cost estimates.

Through careful consideration of the cost of construction, operations and maintenance, we ensure that we develop the most cost efficient end product for our client.

1.2 Site Location

The site is located east of Phuthaditjhaba on previously cultivate land. Access is via paved and gravel roads that goes through the Matsikeng surburb of Phuthaditjhababa. Figure 2 below shows the location of the site.

Fig 2: Proposed Site Location



The proposed site area has been cultivated previously with prominent contours constructed along the slopes of the ridge. There is also an old sand quarry on the northern edge of the site. The detailed description of the site can be found in the geotechnical report prepared separately for this site.

2 CIVIL DESIGNS

This section details the civil design for the planned establishment of new landfill at the Maluti A Phufong Local Municipality waste management site.
The aim of this design report is to:

- Outline the description of all the civil services proposed for the new landfill site
- Give approximates sizes for proposed major civil services.
- Confirm the design philosophy, criteria, assumptions, codes and standards used for the designs.

2.1 Objective

The overall aim of this project is to provide an environmentally acceptable landfill to accommodate the general solid waste disposal generated within the Maluti-a-Phufong municipal area for the next 20years.
The specific aims of the design are detailed below:

- Develop designs for the proposed new landfill site that meets the disposal need and incorporates measures to mitigate the identified environmental impact factors.
- To clarify the waste disposal facility in terms of waste type, size of waste stream and the potential for leachate generation.
- Confirm the suitability of the proposed site for the development of the long term waste disposal facility.

2.2 Design Criteria and Scope

The scope of this report is the design of a waste management facility that meets the waste disposal needs of the Maluti-a-Phufong municipal urban residential areas, commercial and industrial areas and that mitigates the potential impacts the facility might have on the environment.

2.2.1 Design Guidelines

The design of the new landfill is based on the minimum requirements-Waste Management Series, Second edition 1998 with more emphasis on the following documents:

- Document 1: Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste.
- Document 2: Minimum Requirements for the Waste Disposal Landfill.
- Document 3: Minimum Requirements for Monitoring of Waste Management Facilities.

The minimum requirements for waste disposal by landfill addresses landfill classification, site selection, investigation, design, operation and monitoring of landfill

sites. In the landfill classification system a landfill is classified in terms of waste class, size of operation, and potential for significant leachate generation, all of which influence the risk it poses to the people and the environment.
The scope of this report therefore includes:

- Site description including surrounding areas.
- Determine the waste disposal need encompassing the type and quantities of waste to be managed at the site.
- Designs of waste disposal facility which includes access roads, drainage, cell development and sequencing, leachate management and monitoring systems and determine the leachate management requirement.

2.2.2 Waste Type and Origin

The main types of waste are:

- **Hazardous Waste:** Is waste which on account of its toxicity, corrosivity, ignitability and carcinogenicity has the potential to harm people or the environment even in small quantities.
- **General Waste:** Is municipal solid waste consisting of domestic, commercial, institutional, garden, rubble and dry industrial waste. It may contain small quantities of hazardous substances within it such as domestic medical waste, batteries, fluorescent tubes, weed killer etc.

The proposed waste landfill site will mainly receive municipal waste and no hazardous waste is anticipated to be disposed at the landfill. The proposed new landfill is therefore classified as General **(G)** Waste landfill site.
Since the design of waste disposal facility relates to the risk posed by the wastes disposed, design specifications for this site classified as general waste facility would be considerably not strict.

2.2.3 Size of Waste Stream

The municipality in its classification report (see appendix 1) the proposed landfill was classified as GLB+. The initial size of the waste stream on the landfill has been determined to be approximately 350 tonnes per day, based on 260 days (5 working days per week) of deposition in a year. This would therefore represent the initial rate of deposition (IRD) for determining the size classification of the site.
To determine the maximum rate of deposition (MRD) at the end of the site life, a conservative growth rate of 3% per annum was used for calculating the landfill airspace required for 20 years of waste disposal.

Using the minimum requirements procedure for calculating MRD:

MRD= (IRD) (1+d) where IRD=350 T/d, d=3% & t=20 years
= 350(1+0.03)
= 905T/d

Since the MRD is above 500T/d, the site is classified at large **(L)** landfill site.

2.2.4 Landfill Airspace Requirements

Site life is calculated by comparing the total available airspace with annual airspace utilisation.

2.2.5 Calculating Available Airspace in m3

In this case of a proposed land filling operation where the availability of suitable cover material represents a limiting factor, the quantity of cover is used to determine the total available airspace.
Based on the fact that a well run waste operation would require a volumetric ratio of cover material to waste of about 1:4, the total airspace is obtained by:

- Multiplying the volume of available cover material by a factor of 5. Alternatively,
- The total volume of waste that can be accommodated will be given by multiplying the available volume of cover material by a factor of 4.

This represents a somewhat rudimentary approach, as the cover to waste ratio is approximate, the compaction density of the waste is estimated and no allowance is made for the effect of 'bulking' or 'debulking' on the volume of potential cover material.

2.2.6 Calculating Annual Airspace Utilisation

Airspace utilisation is calculated from the IRD. The IRD, expressed in T/day, is multiplied by 260 days (based on a 5 day week) to determine the annual tonnage of waste. By dividing this figure by the average density of the waste (between 0.75 T/m3 to 1.20 T/m3 depending on waste type and compaction efficiency), the volume of waste to be deposited in the first year is determined. By multiplying this volume by 5/4, the total airspace utilisation for the first year is obtained.
Airspace utilisation for subsequent years is obtained by escalating the IRD for each year. This is then cumulated.

2.2.7 Calculating Landfill Site Life

The landfill site life is arrived at by matching the available airspace volume for the landfill, with the cumulative airspace utilisation.

2.2.8 Leachate Generation

The potential for significant leachate generation depends on the water balance associated with a waste disposal site. This is dictated by ambient climatic conditions or by other factors such as moisture content of the incoming waste and ingress of either ground or surface water running off from high ground into the waste body.

2.2.9 Climate Water balance

The climate water balance for the QwaQwa landfill site was calculated as follows:

$B = R-E$

Where B is the climate water alliance in mm

R is rainfall in mm
E is the evaporation from a soil surface in mm, taken as 0.7xA-pan evaporation in mm or 0.88xS-pan evaporation in mm

The value of B is calculated for the wet season of the wettest year on record. It is then recalculated for successive drier years until it is established whether B is positive for less than one year in five years for the years for which data is available. If so the following criteria apply:

- No significant leachate generation
- Classified B-
- No leachate management system necessary.

If B is positive for more than one year in five for the years for which data is available. If so the following criteria apply:

- Significant leachate generation can be expected
- Classified B+
- A leachate management system is a minimum requirement.

For the climate data available for the QwaQwa area (rainfall and evaporation) B was found to be positive for nine of the ten years of climate data used. This means that the landfill is expected to generate significant leachate.

The QwaQwa landfill site is therefore classified as B+ waste disposal facility. In terms of minimum requirements, it is necessary to install a leachate management system.

2.3 Designs

2.3.1 Calculations

The proposed landfill site has a total area of 1000m by 720m available for cover excavation. The average depth of excavatable cover is 1.8m. The initial rate of deposition (IRD) for a new landfill site is 350T/day, and the waste generation area has an expected growth rate of 3%.

Calculate available airspace in m3:

Available volume of cover = 1000m x 720m x 1,8m
= 1 300 000m3

Using a cover to waste ratio of 1:4,
Total available airspace = 1 300 000m3 x 5
= 6 500 000m3

Calculate annual airspace utilisation in m3:

IRD = 350 T/day

Annual rate of deposition = 350 T/day x 260 days/annum
= 91 000 T/annum

Using a compacted density of 0.75 T/m3,
The airspace used by the waste = 91 000 T/annum / 0.75 T/m3
= 121 333 m3/annum

Allowing for the airspace used by both waste and cover, using a cover to waste ratio of 1:4:
= 121 3333 m3/annum x 5/4
= 151 666 m3/annum

This figure is then escalated by multiplying the previous year's airspace total by 1.03 for 3% growth, and these are cumulated, as shown in fig 1 below.
The available airspace is then matched to the closest cumulative airspace used total, to give the approximate site life, as shown in fig 3 below.

Fig 3: Calculating Landfill Site Life

Year	Annual Airspace Utilisation, including cover, per annum [m3]	Cumulative Airspace Utilisation, including cover, per annum [m3]	Available Airspace Match [m3]
1	151666.00	151666.00	
2	245482.99	483815.99	
3	252847.48	736663.47	
4	260432.90	997096.37	
5	268245.89	1265342.27	
6	276293.27	1541635.53	
7	284582.07	1826217.60	
8	293119.53	2119337.13	
9	301913.11	2421250.24	
10	310970.51	2732220.75	
11	320299.62	3052520.37	
12	329908.61	3382428.98	
13	339805.87	3722234.85	
14	350000.05	4072234.90	
15	360500.05	4432734.94	
16	371315.05	4804049.99	
17	382454.50	5186504.49	
18	393928.13	5580432.63	
19	405745.98	5986178.60	
20	417918.36	6404096.96	6500000
21	430455.91	6834552.87	
22	443369.59	7277922.46	
23	456670.67	7734593.13	
24	470370.79	8204963.93	
25	484481.92	8689445.84	9000000

2.3.2 Land Fill Deposal Area

A four cell approach was adopted with cells of approximately 185m x 130m in size. A containment / starter wall was designed which has a crest width of 3.5m which allows sufficient width for vehicular and pedestrian access for maintenance. The wall is 4m in height with embankments sloping at 1:2 and a key with bottom width of 5m and depth of 1.5m to assist in providing sufficient stability to the wall. The basin is also excavated to a death of 0.3m below natural ground level to provide additional capacity and material to be stockpiled for purpose of covering.
Additional two cells for composite and building rubble have been provided.

There is provision for an upstream clean water separation earth channel to divert clean surface water away from the land fill site. The containment wall will keep all dirty water within the cells whilst deposition remains below the crest level. Once deposition occurs

above the crest level a toe drain must then be installed at the outside toe to divert any surface dirty water into the leachate collection tank for disposal.
The landfill cells will have a liner system and a leachate collection system and leak detection system. The liner comprises of waste sacrificial layer, 150mm leachate collection layer, 4 layers of compacted clay with each layer being 150mm and compacted separately, a geo textile layer, a leakage detection and collection layer,150mm compacted clay liner, 150mm base preparation layer and an insitu layer.
The leachate collection and detection layers tie into a perforated pipe network which drains into a leachate collection sump/tank and leachate detection tank respectively and treated accordingly.
The deposition should occur to maximum heights of 4m at which point a 3m step in must occur and the deposition to a further 4m height and then 3m step and continue in this manner. This step in deposition will assist with the stability of the fill as deposition gets higher.
The wall embankment where access is allowed must be constructed and lifted as deposition rises.

2.3.3 Buildings

All buildings are to be founded on strip footing 750mm wide and 250mm deep at a depth of 1m below ground. All surface slabs are to be reinforced with Mesh 888 with a minimum lap length of 600mm and cover of 50mm.
All roof details are to be as per supplier detail and submitted to engineer for review and comment. All openings on walls are to have lintels above them and extend beyond the opening as specified.

2.3.4 Road Network

The road network has roads with different widths which were taken into account during the modelling and design. The road layout has been designed for low speed traffic and speed calming measures are recommended to be in place to regulate traffic speed.
The road has a cross fall to allow water to drain freely towards the storm water reticulation.

2.3.5 Storm water

A storm water reticulation network is in place along the road verge and discharges storm water further downstream. At the discharge point a headwall will be constructed together with gabion blocks and reno mattresses to assist in erosion prevention.

2.3.6 Bulk Water Services

The landfill will be connected to the existing bulk water supply network that is supplying water to the Tebang Township. A 200mm pipe will be used buried underground from the existing water mains to the landfill.

2.3.7 Sewer Bulk Services

The landfill will be connected to the existing bulk sewer line that is servicing the Tebang Township. A 200mm pipe will be used buried underground from the existing sewer water mains to the landfill.

3 ARCHITECTURAL DESIGNS

This section details the space program for the planned new developments at the Maluti A Phufong Local Municipality waste management site.
It is understood that the site had no property line restrictions, and therefore the proposed Site demarcation is a feasible and pragmatic concept from a professional point of view. The buildings are positioned appropriately taking into account the resourceful orientation and as affected by the prevailing site conditions.

3.1 Space Program

3.1.1 Entrance Gate

The following has been provided for at the entrance:

- Two separate 3 metre wide 2.1 metre high mild steel sliding gates opening 2, 4 metres. Gate posts to be steel construction.
- Two 2, 5 metre booms opening 2, 4 metres.

3.1.2 Gate House, 9 square metres (approx 3m x 3m) between the gates.

A guard house will be provided at the entrance and will consist of the following:

- A Guard room with an indoor toilet facility.
- The guard house will be built of face brick and tile roof structure, plastered and painted inside, rhino board ceilings, quarry tile floor finish, steel window frames, burglar gated doors and burglar proofed window opening sections.

3.1.3 Site Office, 92.5sqm

An administration block will be constructed on site close to the entrance and will comprise of the following;

- Boardroom, kitchen, manager's office, an open plan office, staff toilet and two visitors toilets separate for males and females.
- The administration lock will be built of face brick and tile roof structure, plastered and painted inside, rhino board ceilings, quarry tile floor finish, steel window frames, burglar gated doors and burglar proofed window opening sections.

3.1.4 Ablution Facility, 72.15 square metre (19.5m x 3.7m)

An ablution facility will be constructed to service the staff working in the maintenance shed and recycling plant and will comprise of the following:

- Face brick and tile roof structure, plastered and painted inside, rhino board ceilings, quarry tile floor finish, steel window frames, burglar gated doors and burglar proofed window opening sections.
- Three female toilets, two showers and corner bench.

- Two male toilets, two showers, two urinals and corner bench.
- Paraplegic toilet.

3.1.5 Weighbridge Hut, 9 square metre (17sqm)

The weighbridge hut will be constructed of face brick and tile roof structure, plastered and painted inside, rhino board ceilings, quarry tile floor finish, steel window frames, burglar gated doors and burglar proofed window opening sections.

3.1.6 Maintenance Shed and Storeroom 163sqm

Maintenance section essentially a warehouse structure, double volume (h = 4,8m). Store room and office section on one side, double storey with simple external staircase. Allow for 2 Vehicle inspection pits as per specialists specifications.

3.1.7 Sorting Facility (Buy Back Centre), 262 square metre, (4,8m high)

The client has commissioned to create sustainable opportunities in the recycling and waste management sector by setting up a multi recycling Buy-Back Centre. These business- recycling initiatives are intended to play a vital role in implementing “Buyisa-e-Bag” strategy, which aims to encourage the collection, re-use, and recycling of plastic shopping bags and other recyclable materials that are discarded in the waste stream, as well as making provision for the collection of recyclables from environmentally sensitive areas, including rural areas, hotspots, taxi ranks, tourist areas and high density, low socio-economic urban areas.

Buy-Back Centres were originally intended for collection and recycling of only plastic bags, but it became very clear through research that such a business model will not be financially viable and sustainable. In this light the centre has been designed as a multi-recycling facility, for the buying in, sorting and resale of various plastics materials and other recyclables such as paper, cans and glass/bottles.

Warehouse structure, IBR roof sheeting on steel purlins and structural beams. IBR or corrugated iron walling with face brick sections that ties up visually with the face brick buildings where necessary and appropriate.

3.1.8 External Paving

For entrance area, parking lot, weighbridge area, maintenance shed area, and around sorting facility – interlocking concrete brick paving with concrete kerbing and storm-water drainage system.

3.1.9 Access road

6m wide road with spec as for external paving under 8 above. The access road covers a length of some 30 metres outside main gate and road leading to organic waste dumping (and composting) site, to the sorting facility and to the landfill cell.

3.1.10 Fencing

1660 metres of diamond mesh razor wire fence 1, 8 m high, and 5 strands of wire. Corner posts, gate posts and attendant stays in 15 Mpa concrete foundations. Intermediate posts at 30 metre centres and stays with 150mm x 150mm base plates. T-bulg section standards at 10 metre centres with T-section droppers at 2, 5 metre centres.

3.1.11 Water Reticulation

Water reticulation infrastructure to the spaces indicated in space program above. Water supply, sewerage, storm water.

4 ELCTRICAL DESIGNS

The aim of this document is to:

- Outline the description of the Electrical and Electronic services proposed for the new landfill site.
- Give approximates sizes for major electrical plant and equipment.
- Confirm the design philosophy, codes and standards referred to meet with the various legislative guidelines.
- Confirm the analysis methods used to for the electrical systems design.

It is intended that the document be revised during the detailed design development so that it remains a concise record of the current status of the Electrical and Electronic systems design.

4.1.1 Standard and Regulations

- The installation shall comply with the following standards:
  (i.) SANS 10142: 'Code of Practice for the Wiring of Premises
  (ii.) The Occupational Health and Safety Act, 1993 (Act 85 of 1993)
  (iii.) Municipal by-laws and any special requirements of the local supply authority
  (iv.) The Fire Brigade Services Act 2000 (Act 14 of 2000)
  (v.) The National Building Regulations and Building Standards Act 1997 (Act 103 of 97)
  (vii.) The Electricity Act 1996 (Act 88 of 1996)
  (viii.) The Regulations of the local Gas Board, where applicable
  (ix.) The Environmental Conservation Act 1998 (Act 73 of 1989)
  (x.) The National Environmental Management Act 1998 (Act 107 of 1998), and
  (xi.) The relevant SANS publications (such as SANS 10242-1, SANS 10400, etc.).

4.1.2 Main Power Supply

The local municipality will supply the site with an 11kV electrical supply tee off from the existing Municipal power line that is currently passing in front of the landfill site. The Municipality confirmed that the line has capacity to supply the landfill site .A 200kVA mini-substation will be installed at site. The mini-substation will supply a free standing kiosk housing the main LT panel.
From the main LT panel electricity will be reticulated to various buildings around the site as well as external lighting. Reticulation will be through underground cables.
No standby generator or emergency power will e provided

4.2 Electrical Designs

4.2.1 Design Notes

The following will be allowed for, in the Distribution boards:

- Earth leakage units

- Surge arrestors
- Correct cable sizing and circuit breakers.

All boards will have the normal side only. The front panels of normal power supply shall be labelled correctly and painted in distinctive colours as follows:
Normal supply: Light Orange, colour B26 of SABS 1091

4.2.2 Socket Outlet Installations

- A 3 compartment power skirting will be utilized wherever possible to provide maximum flexibility in office space to allow for power, data and telephone.
- Maximum loads per office/administration space have been allowed for in the design, with an allowance of 10 – 12% for future growth.

4.2.3 Lighting Installations

- As an energy conservation measure, all internal lighting will utilize fluorescent or compact fluorescent fittings with electronic ballasts.
- Specialised areas which needs special lighting requirements will be accommodated.

4.2.4 External Lighting

- External lighting has been provided along the perimeter fence of the landfill to serves the two main purposes of general area lighting as well as security lighting.
- The lighting will be designed to provide a general minimum lighting level of 50 lux.
- The lighting will be controlled by photo-sensing devices and switched centrally from the LV distribution board supplying it.

4.2.5 Cable Routes and Wire ways

- Main MV/LV Cables will be indicated by cable route markers.
- All LV cables in the building will be in conduits and cable trays will also be allowed for in this installation.

4.2.6 Lightning Protection System

- A comprehensive Lightning protection system is to be installed. It will include equipotential bonding at each lightning protection zone (LPZ), interface that utilizes bonding conductors, and surge protection devices (SPDs).
- The lightning protection system has to be installed in accordance with the relative national standards.

4.2.7 Earthing System

- A completely new earthing system to be installed.
- Copper conductors to be used to bond all the metallic surfaces in compliance with the respective standards.

4.2.8 Telephone and Data Wiring

- Cableways will be allowed for, in the roof space, to cater for the telephone routes.
- A single telephone point has been allowed for, per work station in the general administration offices.
- The same applies also for the data, one data point has been allowed for, per work station.

4.3 Project Cost Estimate

The total project cost is estimated at R59million including vat, The detailed bill of quantities is attached with the reort. See table below for the project cost breakdown.

Establishment of new Landfill Site in Qwaqwa in Maluti-a-Phufong
Estimated Project
Cost

5	1	SECTION NO.1: PRELIMINARIES AND GENERAL	Page	-17-	R 0.00	R 4,646,000.00
5	2	SECTION NO.2: BUILDINGS	Page	-89-	R 0.00	R 11,805,758.11
5	3	SECTION NO.3: LANDFILL	Page	-92-	R 0.00	R 20,933,930.00
5	4	SECTION NO.4: ROADWORKS AND FENCING	Page	-101-	R 0.00	R 8,023,483.30
5	5	SECTION NO.5: PROVISIONA SUM (MOVEABLE EQUIPMENT FOR PAY BA	Page	-101-	R 0.00	R 568,000.00
5		VALUE OF BUILDER'S WORK	ST	0,00		R 45,977,171.41
5		Add: Contigency amount (5% of Value of Builder's work)	VAT	5,00		R 2,298,858.57
		Add: Professional Fess (7% of Value of Builder's work)				R 3,218,402.00
5		TOTAL BEFORE TAX	ST	0,00		R 51,494,431.98
5		Add: VAT @ 14%	VAT	14,00		R 7,209,220.48
	567	TOTAL				R 58,703,652.46