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ABBREVIATIONS

MRD	Maximum Rate of Deposition
DWAF	Department of Water Affairs and Forestry
MR	Minimum Requirements for Waste Disposal by Landfill
MRHW	Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste
GCL	Geosynthetic clay liner

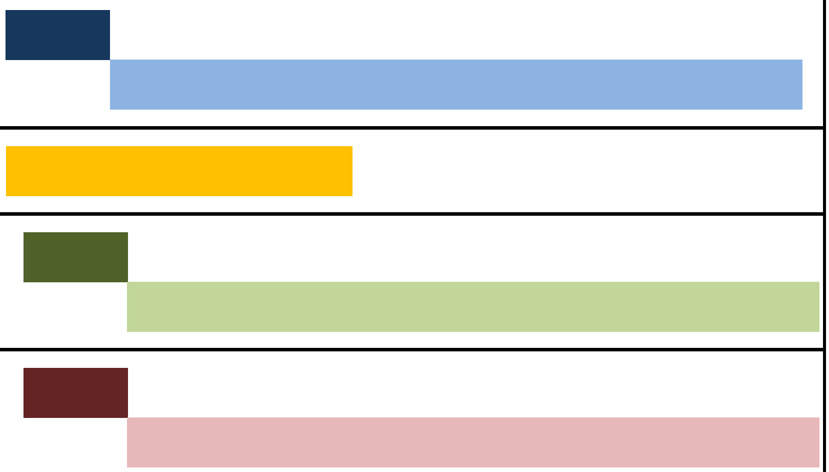
INTRODUCTION

Waste is being generated from the construction of the Medupi power station on the outskirts of the town of Lephalale. This combination of general and hazardous waste derives from both the construction process and associated activities as well as from the inhabitants of the construction village, set up to house those individuals and employees actively involved in the day-to-day construction activities. Currently the waste is being loaded into skips, dotted around the site, and trucked out to a final disposal site. Eskom is concerned that the costs of this approach to the waste handling is prohibitively expensive and has proposed the establishment of a landfill site specifically tailored to handle the waste emanating from the construction activities and expected to be generated during the lifelong operation of the Medupi power station. Further, as part of its long term plans, Eskom will be establishing two new power stations in the vicinity (currently designated Coal 1 and Coal 2). Eskom has proposed that the landfill design considerations take account of the fact that this selfsame facility serves as a disposal site during the construction and operation of Coal 1 and Coal 2 power stations and during operations of the currently operational Matimba power station.

The anticipated timeline for these activities is depicted graphically in Figure 1.

FIGURE 1: ESKOM ACTIVITIES THAT WILL GENERATE WASTE FOR FINAL DISPOSAL AT THE ESKOM LANDFILL IN LEPHALALE

ACTIVITY	START DATE	END DATE	TIMELINE: JANUARY 2009 TO DECEMBER 2055
MEDUPI CONSTRUCTION	01/01/2009	31/12/2014	
MEDUPI OPERATIONS	01/01/2015	31/12/2054	
MATIMBA OPERTIONS	01/01/2009	31/12/2028	
COAL 1 CONSTRUCTION	01/01/2010	31/12/2015	
COAL 1 OPERATIONS	01/01/2016	31/12/2055	
COAL 2 CONSTRUCTION	01/01/2010	31/12/2015	
COAL 2 OPERATIONS	01/01/2016	31/12/2055	



NOTE: CERTAIN ASSUMPTIONS HAVE BEEN MADE ABOUT THE CONSTRUCTION START DATE, CONSTRUCTION PERIOD AND OPERATION START DATE AND OPERATION PERIOD FOR COAL 1 AND COAL 2 POWER STATIONS.

Prior to the establishment of a landfill there is a necessary requirement for determination of the nature and quantities of the waste that will be deposited into the landfill and the impacts the landfilling operation might have on the receiving environment. The Department of Water Affairs and Forestry (DWAF) have developed a series of guidelines that serve as a reference of standards for managing waste and sets minimum requirements that an applicant, wanting to permit a landfill, will have to adhere to to be in compliance with prevailing legislation. These minimum requirements comprise three volumes *viz.*:

- The Minimum Requirements for Waste Disposal by Landfill;
- The Minimum Requirements for the Handling of and Disposal of Hazardous Waste; and
- The Minimum Requirements for Monitoring at Waste Management Facilities.

The Minimum Requirements for Waste Disposal by Landfill (MR) have, as an overall objective of environmentally responsible landfilling, the requirement to "**avoid both short or long term impacts or any degradation of the environment in which the landfill is located."** Short term impacts include problems such as noise, flies, odour, air pollution, unsightliness and windblown litter. Long term impacts include potential pollution of the water regime, landfill gas generation and devaluation of adjacent land holdings. These problems can be mitigated by carefully considered landfill site selection, design, preparation or operation and ensuring that there are adequate buffer zones in place.

From an engineering perspective these considerations and identification of impacts are indicated by supplementary studies including geological and geo-hydrological assessments, social-impact assessments, air-quality impact assessments, visual impact assessments, noise impact assessments, traffic impact assessments and land-use assessments. These inputs are supplied to the engineer who considers this feedback in the design process to mitigate potential negative impacts.

For the purposes of this document, a concept plan is proposed that discusses the main principles and elements of the proposed waste handling facility. These include the classification of the waste facility in terms of the MR classification system as well as general features of the facility. If the general principle and approach is acceptable, further engineering activities will entail detailed site investigation and design with technical specification of the various elements of the facility.

WASTE CLASSIFICATION

Permitting of a site for waste disposal by landfill as per the MR requires the determination of waste class, size of operation, and potential for significant leachate generation, all of which influence the risk it poses to the environment. The quantities of various types or categories of waste generated at Medupi Power Station and associated and/or surrounding Eskom activities, developments and facilities, will have a direct impact on the type, class, size and nature of both the landfill site and the transfer station.

WASTE TYPE

General waste typically refers to all that waste produced within the jurisdiction of a local authority including rubble, garden, domestic, commercial and general industrial waste.

Small quantities of hazardous substances arising from the disposal of batteries, household detergents and insecticides typically constitute some part of general waste.

Hazardous waste refers to that waste that even at low concentrations might impact severely on human health and the environment because of certain inherent properties. Hazardous wastes arise out of a wide range of commercial, industrial, agricultural and domestic activities. According to the Minimum Requirements for the Handling, Classification and Disposal of Hazardous Waste (MRHW), the risks posed by hazardous substances include:

- "Explosion or fire;
- Infections, pathogens, parasites or their vectors;
- Chemical instability, reactions or corrosion;
- Acute or chronic toxicity;
- Cancer, mutations or birth defects;
- Toxicity, or damage to the ecosystems or natural resources;
- Accumulation in biological food chains, persistence in the environment, or multiple effects to the extent that it requires special attention and cannot be released into the environment or be added to sewage or be stored in a situation which is either open to air or from which aqueous leachate could emanate."

The extent of the hazard posed by a particular waster can be determined by applying a hazard rating either from pre-knowledge of the danger posed by a particular waste, manufacture information of after suitable testing has been completed. The approaches to applying hazard ratings differ marginally. The MR applies the following approach (Table 1):

TABLE 1

HAZARD WASTE CLASS	HAZARD RATING
Extreme Hazard Waste	Rating 1
High Hazard Waste	Rating 2
Moderate Hazard Waste	Rating 3
Low Hazard Waste	Rating 4
Very Low Hazard Waste	Rating < 4

A logarithmic progression is applied to this determination where Extreme Hazard is 10 times more toxic than High Hazard and 1000 times more toxic than Low Hazard. Therefore according to the MR, this is broken down further into general waste and two classes of hazardous wastes with facilities designated H;H and H:h (Table 2):

TABLE 2

TYPE OF WASTE (CLASS)		
General (G)	**Hazardous**	
No significant threat to public health or environment if managed properly. Includes waste with a hazard rating less than 4 provided that suitable leachate management systems are in place.	H:H	H:h
	Hazard Rating 1-4	Hazard Rating 3 & 4

KEY: Hazard Rating 1= Extreme Hazard; Hazard Rating 2 = High Hazard, Hazard Rating 3 = Moderate Hazard, Hazard Rating 4 = Low Hazard

Of necessity therefore the choice of disposal approach must take into consideration human health and environmental protection concerns. The first step, therefore is to make an assessment off the type of waste to be disposed of at the proposed waste facility.

The MR makes provision for the “delisting” of certain hazardous wastes for disposal at an H:h landfill or an appropriately lined general waste site. This would be because the hazardous substance in the waste is of low mobility or concentration, or because the substance has been successfully treated to make it less hazardous. It must, however, be demonstrated to the satisfaction of the Department that the waste does not pose a risk to man or the environment. This would involve additional investigative testing.

The types of waste, generated by Eskom in Lephalale, is linked to its activities in the areas. The Medupi power station currently under construction is generating, as part of the general waste stream:

- Land clearing debris
- Wood and wooden pallets
- Broken bricks (builders rubble general)
- Concrete
- Concrete masonry units
- Glass
- Scrap Metal
- Beverage Cans
- Plastics
- Cardboard
- Paper and Newsprint
- Food residue waste

The hazardous waste stream includes:

- Used Oil
- Oil contaminated waste (oily rags, tins etc)
- Grease

- Florescent Tubes
- Used Chemicals
- Chemical contaminated containers
- Cleaning liquids and detergents
- Bituminous substances
- Paints
- Thinners
- E-Waste
- Medical Waste (Health Care Risk Waste)
- Sewage Sludge

Eskom have records of type and volumes of waste generated at its various power stations on a monthly basis. These include: Arnot (Middelburg), Camden (Ermelo), Duvha (Witbank), Grootvlei (Balfour), Hendrina, Kendal (Witbank), Komati (Middelburg), Kriel, Lethabo (Vereeniging), Majuba (Volksrust), Matimba (Lephalale), Matla (Kriel), Tutuka (Standerton) and Koeberg (Cape Town).

The waste generated at the other Eskom power stations within South Africa was assessed and in consultation with the Client it was concluded that the Medupi power station is most likely to resemble the currently operational Matimba power station in terms of the waste type and quantities generated. Waste generation by Eskom for the area took into consideration growth and future potential sources within the area including Eskom expansion projects and new power station construction projects in the area.

The waste composition and quantities of waste generated during daily operations, for April 2008 to February 2009, at the Matimba power station was logged by Eskom and is detailed in Table 3 below.

TABLE 3. WASTE COMPOSITION AND QUANTITIES: GENERATION FIGURES DURING OPERATIONS AT MATIMBA POWER STATION (APRIL 2008 - FEBRUARY2009)

WASTE QUANTITIES - APR 2008 - FEB 2009			TOTAL	NETT WASTE FOR DISPOSAL
Ash	kT	P	4,484.11	4,484.11
	kT	R	0.00	
General waste	m^3	P	4,200.00	4,200.00
	kg	P	840,000.00	840,000.00
Building rubble	m^3	P	124.00	124.00
	Tons	P	186.00	186.00
Garden refuse	m^3	P	124.00	124.00
	kg	P	49,600.00	49,600.00
Waste oil	Litres	P	93,830.00	
	Litres	R	93,830.00	0.00

Paper	kg	R	15,310.00	0.00
Oil contaminated waste	m^3	P	202.00	202.00
Waste grease	Litres	R	23,730.00	0.00
Scrap metals	Tonnes	R	195,453.37	0.00
Asbestos	kg	P	0.00	
Medical waste	kg	P	67.50	67.50
FFB's	m^3	P	0.00	
Fluorescent tubes	210 litre	P	19.00	
Batteries	210 L drum	P	0.00	
Printer cartridges	number	R	287.00	0.00
Used chemicals (from the lab)	Litres	P	26.32	26.32
Sewage (sludge and screens)	kg	P	28.50	28.50

kT: kilo tonne, P: produced, R:recycled

Therefore the Eskom waste handling facility at Lephalale has to take account of both general and low and high hazard rating waste.

WASTE STREAM SIZE

Landfill size is dependent on the daily rate of deposition which is affected by several factors including the size of the population served. A measure referred to as the 'Maximum Rate of Deposition' or 'MRD' is applied. This is a measure of the projected maximum average annual rate of waste deposition, expressed in tonnes per day, during the expected life of a landfill. The MRD is calculated by establishing the Initial Rate of Deposition (IRD) which is a measurement of the existing waste stream in tonnes per day. The IRD is then escalated at a rate which is usually governed by population growth projections over the anticipated life of the landfill. The maximum average daily rate of deposition is then the MRD. As per the MR, once the MRD has been calculated, the disposal facility size can be determined (Table 4):

TABLE 4

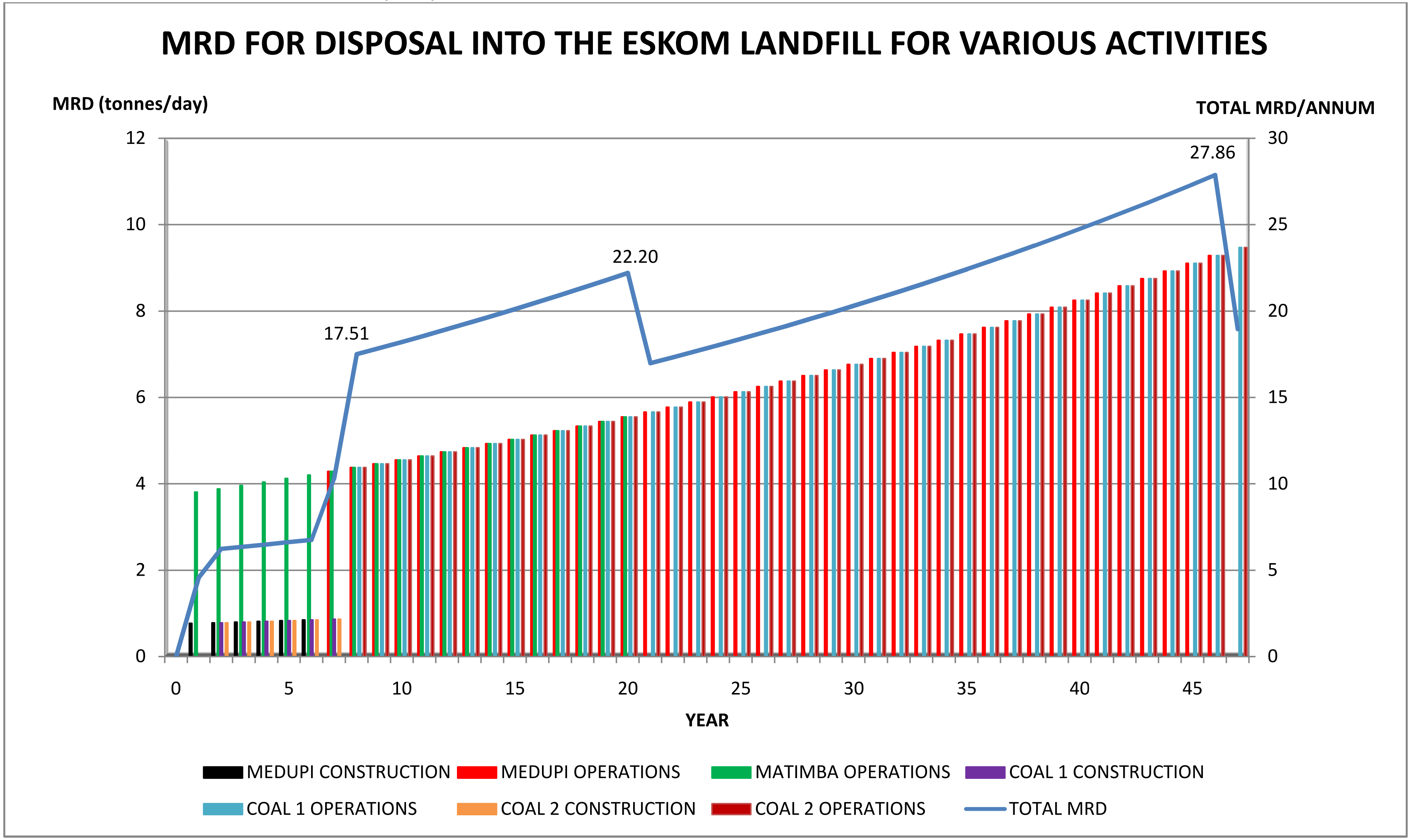
SIZE OF WASTE STREAM			
Communal (C)	Small (S)	Medium (M)	Large (L)
Maximum Rate of Deposition (MRD) in tonnes per day			
<25	>25 <150	>150 <500	>500

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

In the absence of weighbridge figures or estimates of waste, daily tonnages may be arrived at by assuming a per capita waste generation rate and applying this figure to the population served. In general, these rates are very closely tied in to socio-economic standing of the population, with generation rates of 0.5 kg per capita per day in the poor areas, to as much as 3, 5 kg per capita per day in the affluent areas.

The MRD (at 2% annual increase) for the various activities (see Figure 1) was calculated (Annexure 1) and on this basis Figure 2 was generated.

FIGURE 2. MAXIMUM RATES OF DEPOSITION (MRD) FOR GENERAL WASTE OVER THE EXPECTED 50 YEAR LIFESPAN OF THE LANDFILL



The basis for calculations for the different activities are:

MEDUPI CONSTRUCTION

Eskom advised that we consider that 1000m^3 of general waste is currently transported annually to a final disposal site. Assuming a waste density of 200kg/m^3 for uncompacted waste, this equates to 0.769 tonnes/day to be disposed off. For the purposes of calculating MRDs a 260 day year is assumed on the basis that landfill operations might only be carried out on weekdays. After a period of 6 years i.e., the end of construction, assuming annual growth in generation rates of 2%, the MRD would be 0.85 tonnes/day.

MATIMBA OPERATIONS

During April 2008 and February 2009, 890 tonnes of general waste were generated during Matimba operations. Matimba waste generation rates are used as a benchmark for expected generation rates during operations at the other power stations. Matimba operations are expected to continue for 20 years at the end of which the MRD, assuming a 2% annual increase in generation rate, is expected to be 5.55 tonnes/day.

COAL 1 & 2

The MRD figures for Coal 1 and Coal 2 power stations are modelled on the figures obtained for Medupi construction and Matimba operations for the respective periods.

The calculations above do not take into consideration the waste being generated by the construction villages. Several indicative values can be calculated for this waste generation rate (Table 5):

TABLE 5

FOR THE 7000 VILLAGERS FOR 8 YEARS, ASSUMING				
0.5	1.0	1.5	2.0	
3750	7500	11250	15000	Kg/per day
26250	52500	78750	105000	Kg/per week
1365000	2730000	4095000	5460000	Kg/per year
1365	2730	4095	5460	Tonnes/year
10920	21840	32760	43680	Tonnes/8 years

NOTE: Actual waste generation figures per individual are likely to be closer to 1 kg than 2 kg. Typically indications in South Africa suggest that values of 2 kg/person obtain in very affluent communities. The MRD at 1 kg/person over 8 years assuming a 2% annual increase in waste generation is 1.17 kg.

On the basis of these calculations, and considering the waste to be generated by the inhabitants of the construction village, in terms of the MR classification for size, the Eskom landfill at Lephalale would be classified as a small landfill because the MRD lies between 25-150 tonnes/day.

WATER BALANCE

As part of the MR, there is a requirement that the potential for leachate emanating from a waste body be assessed. To this end, a water balance calculation is made. Water balance typically refers to the inflows and outflows of water from a system. Several elements contribute to water balance and include additionally in the case of landfilling, rainfall, evaporation, moisture content of incoming waste and water, ingress into the waste, this last factor arising most likely from poor landfill site selection, design and operation.

The MR define a Climatic Water Balance which needs to be calculated (Table 6).

TABLE 6. CLIMATIC WATER BALANCE CALCULATION AND LEACHATE POTENTIAL DETERMINATION PARAMETERS

POTENTIAL FOR LEACHATE GENERATION	
Sporadic	Significant
Climatic Water Balance: **B = R – E**	
B is positive for less than one year in five for the years for which data is available	B is positive for more than one year in five for the years for which data is available
There should be no significant leachate generation on account of the climate	There should be significant leachate generation.
$\mathbf{B^-}$	$\mathbf{B^+}$

KEY: **B** is the Climatic Water Balance in mm of Water; **R** is The Rainfall in mm of Water; **E** is the Evaporation from a Soil Surface in mm of Water. The value of B is calculated for the wet season of the wettest year on record, B is then recalculated for successively drier years, because the wettest year on record may only be so on account of unseasonal rainfall, i.e. the wettest wet season does not always occur in the wettest year. This calculation is repeated until it is established whether: B is positive for less than one year in five or positive for more than one year in five for the years for which data is available.

In all, ten classes of landfill are possible:

- G:C:B-, G:C:B+(General, communal)
- G:S:B-, G:S:B+ (General, small)
- G:M:B-, G:M:B+ (general, medium)
- G:L:B-, G:L:B+ (general, large)
- H:h and H:H (hazardous)

The rainfall and evaporation figures (using the weather station A4E001, Vaalwater) were examined and negative figures obtained for every season from 1973 to 1966 for which reliable and complete data was kept. The calculations are detailed in Table 7. The raw data used to make these calculations is attached hereto as Annexure 2. The proposed site therefore lies in an area where sporadic or no significant leachate is expected to be generated from landfilling.

TABLE 7. RAINFALL AND PRECIPITATION FIGURES FOR VAALWATER IN LEPHALALE AND THE RESULT OF THE CLIMATIC WATER BALANCE CALCULATION

PERIOD	PRECIPITATION	A-PAN	B=R-E
1974/75	1050.80	1752.1	-701.30
1973/74	899.20	1835.1	-935.90
1999/00	888.50	1728.9	-840.40
1970/71	868.50	1979.7	-1111.20
1966/67	831.60	1973.8	-1142.20
1980/81	796.30	1777.6	-981.30
1976/77	789.50	1841.7	-1052.20
1995/96	782.70	1712.9	-930.20
1975/76	760.50	1842.7	-1082.20
1993/94	725.30	1669	-943.70
1979/80	705.00	1834.4	-1129.40
1977/78	701.20	1893.4	-1192.20
1984/85	689.00	1851.1	-1162.10
1986/87	672.90	1606.9	-934.00
1987/88	647.60	1481.5	-833.90
1988/89	646.00	1302.9	-656.90
1971/72	643.10	2084.6	-1441.50
1998/99	622.20	1797.2	-1175.00
1994/95	547.90	1886.6	-1338.70
1989/90	541.70	1397.5	-855.80
1985/86	519.60	1633.5	-1113.90
1972/73	498.60	2251.8	-1753.20
1983/84	487.30	1900.6	-1413.30
1981/82	481.00	1957.4	-1476.40
1967/68	474.70	2089.9	-1615.20
1968/69	471.00	2058.3	-1587.30
1969/70	468.90	2032.5	-1563.60
1990/91	468.80	1450.9	-982.10
1964/65	451.30	2151.7	-1700.40
1982/83	442.00	1945.8	-1503.80
1992/93	427.40	1705.4	-1278.00
1997/98	426.00	1932.2	-1506.20
1991/92	391.20	1787	-1395.80
1963/64	370.60	2276	-1905.40
2000/01	344.80	1740.2	-1395.40
1965/66	297.70	2273.8	-1976.10

CONCEPT DESIGN

From the waste stream analysis and climatic water balance calculation the Eskom landfill classification for general waste handling is $G:S:B^-$. However the hazardous waste handling also needs to be considered.

Eskom have advised that in order to make allowance for all possible eventualities e.g., extension of some of the activities through possible delays, that the disposal facility be designed for the handling of 1,200,000.00m^3 of general and hazardous waste over the lifespan of the landfill. This will account for waste generated during the construction and operation of the Waterberg Coal 1 and Coal 2 power stations, the remaining period of operations of the Matimba Power station as well during the remaining period of construction and the full period of operation of the Medupi power station. The waste emanating from the construction villages established during the power stations construction will also be deposited into this landfill (assuming 1kg/person/day). For design purposes, it is assumed that the waste comprises equal quantities of general and hazardous waste.

In consideration of the allowance in the MR that certain hazardous waste might be delisted, it is proposed that Eskom adjust the design brief to that of a general waste facility with a cell for disposing low hazard rating waste landfill. As before the high hazard rating waste would be disposed of at a licensed H:H facility. The initial indications are that the bulk of the hazardous waste is of low hazard rating though confirmatory testing will be necessary.

There are very specific requirements that have to be considered as part of the disposal facility design including site classification, site layout, access, hydrology and drainage design, containment, leachate management, leachate detection, monitoring systems and rehabilitation plan

SITE CLASSIFICATION

Site classification has already been considered in detail above.

SITE LAYOUT

The general waste landfill and the hazardous waste cell will be physically separated at a distance to be determined in the final design. Additionally there will be necessary services and permanent infrastructure at the site.

HAZARDOUS WASTE HOLDING FACILITY

High hazard rating waste will be temporary stored at the disposal facility for onward transport and disposal to a permitted H:H facility i.e. a facility accepting high hazard rating waste. The high hazard rating waste is not expected to constitute a high proportion of the hazardous waste and therefore this transfer station for the high hazard waste is not expected to be very large. The final design and size will be determined after consideration of inputs from the department, IAPs and after the necessary confirmatory testing to determine the hazard rating of the waste is completed.

The hazardous waste will be contained in skips or drums (to be determined on final assessment of the hazardous waste) in a reinforced concrete area that is surrounded by a bunded wall and that is cordoned off. The site design will ensure that the area is designed to be waterproof and with drainage that captures any contaminated leachate in the event of a breach. Any encapsulation procedures of the hazardous waste will require departmental approval. Logistical measures for transport to a final disposal site will take account of the hazardous nature of the waste and will ensure that the transportation company contracted to carry out the transport complies with the minimum requirements for the transport of hazardous waste. Ideally the hazardous waste will be removed from the temporary storage facility as regularly as possible and at a minimum within a period of less than three months after emplacment. Any hazardous waste not permitted to be disposed of a disposal facility but which is permitted for temporary storage must not be held at the storage site for a period exceeding three months. Failure to remove the waste during this three month period will result in the facility automatically qualifying as a Waste Disposal Site, and will necessitate that the site than be registered as such and meet all the requirements of a hazardous disposal site. Records of all hazardous waste brought to the site will be kept including the type of waste, the hazard rating, the containment used and the date of delivery. Any contaminated leachate arising from this facility will be collected and treated.

Site Laboratory

All waste arriving at the site will be examined by suitably qualified staff to ascertain whether it should be routed to the general or hazardous cells. A site laboratory will be set up with the necessary equipment and suitably qualified personnel for testing the waste if necessary. Alternatively, the precautionary principle will be applied and the waste will be treated as highly hazardous until otherwise determined. The laboratory facility used must be capable of producing accurate and precise results that can, if necessary, withstand scrutiny in a court of law.

SITE SERVICES AND INFRASTRUCTURE

Site services will include water and sewerage services, electricity, telephones and security. The permanent infrastructure will include weighbridges, site offices, an ablution block, a workshop, a guardhouse and the recycling facilities discussed below. Wastewater treatment might be by installation on site of a septic tank. The entire site will be cordoned off by fencing. Eskom are building a haul road adjacent to the site and with weighbridges. Weighbridges are costly and to install and expensive to maintain and it might be prudent to utilise these facilities rather than installing weighbridges at the site. However, if this is not a viable option, design considerations will include weighbridge facilities.

All access roads into the site will be surfaced to minimise dust and be aesthetically pleasing. A gravel road will also be constructed around the landfill and along the fence perimeter to provide access to security staff for monitoring of breaches of the site.

A weather station will be installed on site to monitor rainfall, temperature, wind speed and wind direction.

RECYCLING

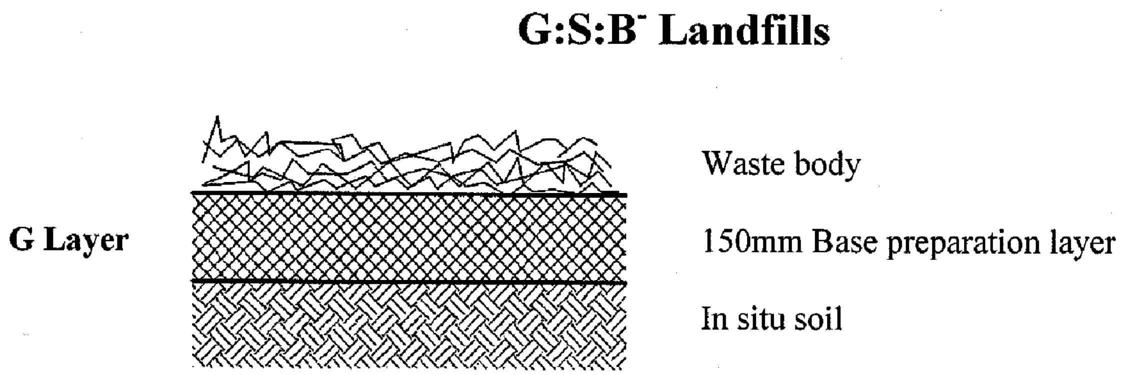
Large quantities of building rubble are generated during the construction activities. This is valuable material and it is proposed that Eskom appoint a sub-contractor to or perhaps even the operator to establish a small facility on site for primary crushing of the building rubble. Options for the material include using it for rehabilitation in other areas, recycling the crushed material or selling it for e.g. for use in road construction.

Oil contaminated waste such as old oil filters and oily rags require collection and specialised treatment and disposal. This can range from small drummed waste collections to large bulk movements. Eskom already have a good record of recycling including paper, printer ink cartridges and oil. It is proposed that a small recycling area be established to temporarily store and for sorting of any recyclables that arrive at the disposal facility. Fluorescent tubes contain mercury and become hazardous wastes when they no longer work. These are placed in drums for final disposal at an H:H hazardous waste facility.

LANDFILL LINING: GENERAL WASTE

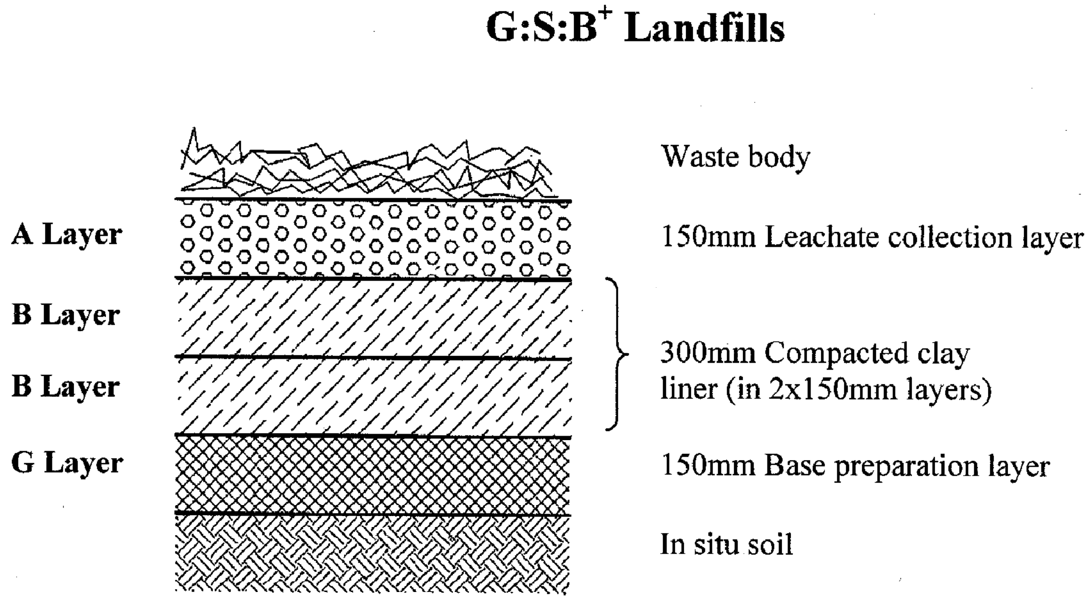
In order to create a separation or physical barrier between the landfill and the environment in which it is placed, there is a requirement that the landfill be lined. The extent and nature of lining is defined by the expected impact the waste body might have on its environment. The MR specifies liner design for different classes of landfill. The proposed lining for small landfill designated B^- is indicated in Figure 3.

FIGURE 3



The proposed site is adjacent to an unpermitted waste disposal site, which was used by Eskom for an unspecified period of time with no clarity regarding the type of waste disposed. A DWAF communiqué (17 August 2005)[1] to Eskom highlighted concern that the groundwater monitoring boreholes were incorrectly sited to detect groundwater contamination and Eskom is therefore in the process of rehabilitating this site. It might be prudent, given this consideration to consider more stringent lining to ensure that in the event of any potential contamination emanating from the newly site disposal facility, that the source of the contamination be unambiguously identified. Off course of necessity, leachate monitoring boreholes will be sited both upstream and downstream of the site. It is therefore proposed that a liner design specified for a G:S:B$^+$ landfill, as per the MR, be specified instead (Figure 4).

FIGURE 4



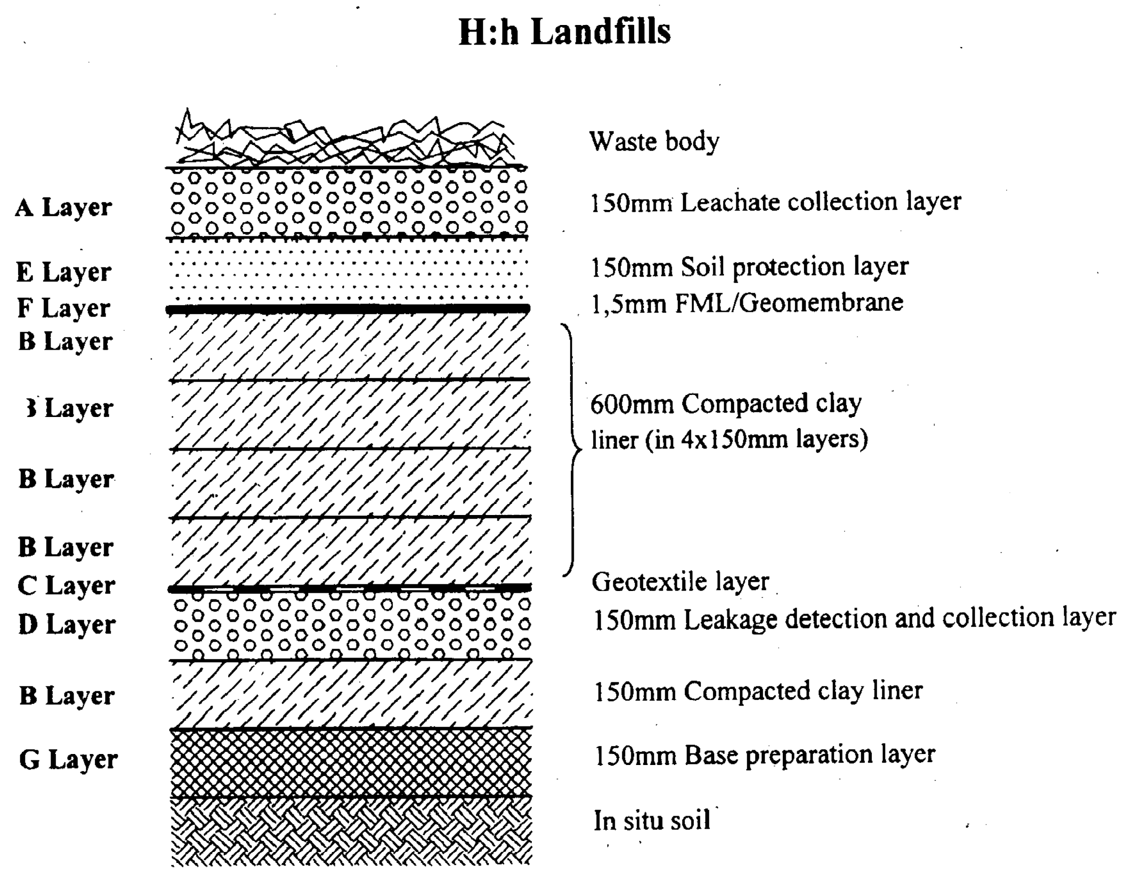
Preliminary indications are that there is a shortage of clay material in the area and the clay component of the liner (300 mm compacted clay liners) will be replaced by a geosynthetic clay liner (GCL).

HAZARDOUS WASTE CELL: LINING AND GENERAL FEATURES

The liner requirements for the hazardous waste cell are, as expected, substantially more stringent (Figure 5). As for the general waste lining the clay liner would also be substituted with a GCL liner. Anchor trenches will be constructed to hold the liner down and the hazardous cell will be separated from the general waste landfill and suitable access roads will be constructed. Additionally control berms will be built to manage operations at the hazardous cell.

1 DWAF Communique. 17 August 2005. Addressed to the Manager, Matimba Power Station. 16/2/7/A400/B21/1

FIGURE 5



LEACHATE COLLECTION

Although the general waste landfill site is designated B^-, it has the potential to generate sporadic leachate and a leachate collection system will be incorporated into the design. A leachate collection systems will of necessity be incorporated as part of the hazardous cell design. Any leachate emanating from the general and hazardous landfill will be diverted by appropriately designed drainage systems into a lagoon. The size of the lagoon will depend on several factors which will be included in the design. A geomembrane is a minimum requirement for lining all lagoons that might receive leachate from hazardous waste landfills. The size and placement of the lagoon will be designed to suit the circumstances at the time and be designed in consideration of the survey information. It is not always necessary to build the entire lagoon that might be specified as part of the lagoon design at the outset and it is feasible that only part of the designed lagoon be built and that remaining sections of the lagoon be built at later stages if necessary. It is not anticipated that much leachate will emanate from the general waste landfill and given the high temperatures it is very likely that this leachate will evaporate before it reaches the leachate dam. The leachate in the dam will then be treated and discharged.

GROUNDWATER MONITORING

A groundwater monitoring system will be in place to measure any contamination arising from either the general waste landfill or the hazardous cell. As part of detailed geophysical testing, the geohydrologist will engage in several activities including:

- Carrying out geophysical surveys in the areas surrounding the proposed site to the north of the existing waste site and also in the areas surrounding the existing waste site to identify faults and fracture zones and hence potential aquifers in the bedrock.
- Drilling rotary percussion boreholes at strategic locations where fracture zones and zones of deep weathering that may represent potential aquifers have been identified. These should be located at positions indicative of groundwater flow. These boreholes can also be used to establish the extended groundwater monitoring system for the new waste site. Monitoring boreholes should be drilled to monitor water flow in the area envisaged for general and for hazardous waste on the new site

Groundwater monitoring will be carried out twice a year.

OPERATIONS AND STORMWATER MANAGEMENT

The final site shape will be determined after the site survey has been completed. The site design and operations will be optimised to ensure that as much of the clean stormwater arriving at the site is immediately diverted off and away from the site and not exposed to any contaminated leachate. Any stormwater that does run onto the site has to be managed. To this end a contaminated stormwater dam will be specified in the design with a 0.5m freeboard and designed to withstand a 1 in 50 year flood event. Any clean uncontaminated water, which has not been in contact with the waste but has ended up on the site, must be allowed to flow off the site into the natural drainage system. Drains for clean water run-off will be designed to this end. These drains must be maintained to ensure that that they are not blocked by silt or vegetation.

COVER MATERIAL

At the farm Grootestryd i.e. the proposed site, the sequence of sandstone and mudstone and shale rocks is overlain by dark brown sandy transported soils that extend to depths of 4m to 5m below the surface level. Furthermore, highly to completely weathered soft rock sandstone underlies the soils and extends to depths varying between 13m and 15m.[2] This means that the potential for securing cover material is fairly good at this site and excavation operations are likely to be easier here. If necessary, cover material may need to be imported from elsewhere or even purchased and stockpiled on the site. Given the small daily disposal volumes and requirement for daily covering, cover material requirements are expected to be high at the site. Soil profiles exposed in test pits excavated for the geotechnical

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2 *Ibid.*

investigation at the site should be investigated to determine the composition geohydrological properties of the materials overlying the bedrock and the materials used for cover.

OTHER DESIGN CONSIDERATIONS

It cannot be determined at this stage what the final site footprint, shape, and design will be and what the final shape of the landfill will be. It is not anticipated, given the waste volumes that the landfill height will be higher than 10m above natural ground level. In the event that the landfill site does exceed this height, benches will be built at 10 m intervals and will incorporate stormwater management considerations in the design. The landfill design will be specified for slopes of I in 3. Landfilling is done in cells which are built to last about four to five years. The landfill design will specify the final number of cells to be constructed. Landfilling site design and operation will insofar as is possible be optimised to start on the uphill side of the valley with the cells and working face as small as possible so as to minimise run-off and odour. It is preferable insofar as is possible that rehabilitation of waste cells be carried out immediately after completion of filling of a particular cell. This is not always possible because the final cell shape might not be exactly what is envisaged in the final shape of the landfill. If this is the case, then intermediate cover will be applied. The costs of capping are very high and therefore as far as is possible capping is preferable during the life span of the landfill rather than at the end so that the economic burden of capping is spread out during the life of the facility. If capping is not possible on cell completion, it is recommended that the permit holder set aside funds during the lifespan of the landfill to ensure that funds are available for final capping during closure stages. All landfill operations are screened from the public by screening berms.

AESTHETICS

The trees/vegetation on the site will be cleared to allow for construction of and daily operations at the facility. The only vegetation and tress that may remain will be those that do not impact on the construction or operation activities. Typically at the approach to the site, trees and grass might be planted so that the site appears aesthetically pleasing and some might even be planted around the site for screening. Whilst all waste handling activities have as a first requirement protection of the environment, engineering design considerations do, insofar as is possible, consider public perceptions and the impact such facilities might have on the surrounding communities. Additionally flytraps will b placed around the site.

ANNEXURE 1

		ACTIVITY							
	YEAR	1	2	3	4	5	6	7	
2008	0	0	0	0.00	0	0	0	0	0
2009	1	0.77	0.00	3.81	0.00	0.00	0.00	0.00	4.58
2010	2	0.78	0.00	3.89	0.78	0.00	0.78	0.00	6.24
2011	3	0.80	0.00	3.96	0.80	0.00	0.80	0.00	6.36
2012	4	0.82	0.00	4.04	0.82	0.00	0.82	0.00	6.49
2013	5	0.83	0.00	4.12	0.83	0.00	0.83	0.00	6.62
2014	6	0.85	0.00	4.21	0.85	0.00	0.85	0.00	6.75
2015	7		4.29	4.29	0.87	0.00	0.87	0.00	10.31
2016	8		4.38	4.38		4.38		4.38	17.51
2017	9		4.46	4.46		4.46		4.46	17.86
2018	10		4.55	4.55		4.55		4.55	18.21
2019	11		4.64	4.64		4.64		4.64	18.58
2020	12		4.74	4.74		4.74		4.74	18.95
2021	13		4.83	4.83		4.83		4.83	19.33
2022	14		4.93	4.93		4.93		4.93	19.71
2023	15		5.03	5.03		5.03		5.03	20.11
2024	16		5.13	5.13		5.13		5.13	20.51
2025	17		5.23	5.23		5.23		5.23	20.92
2026	18		5.33	5.33		5.33		5.33	21.34
2027	19		5.44	5.44		5.44		5.44	21.77
2028	20		5.55	5.55		5.55		5.55	22.20
2029	21		5.66			5.66		5.66	16.98
2030	22		5.77			5.77		5.77	17.32
2031	23		5.89			5.89		5.89	17.67
2032	24		6.01			6.01		6.01	18.02
2033	25		6.13			6.13		6.13	18.38
2034	26		6.25			6.25		6.25	18.75
2035	27		6.38			6.38		6.38	19.13
2036	28		6.50			6.50		6.50	19.51
2037	29		6.63			6.63		6.63	19.90
2038	30		6.77			6.77		6.77	20.30
2039	31		6.90			6.90		6.90	20.70
2040	32		7.04			7.04		7.04	21.12
2041	33		7.18			7.18		7.18	21.54
2042	34		7.32			7.32		7.32	21.97
2043	35		7.47			7.47		7.47	22.41
2044	36		7.62			7.62		7.62	22.86
2045	37		7.77			7.77		7.77	23.32
2046	38		7.93			7.93		7.93	23.78
2047	39		8.09			8.09		8.09	24.26
2048	40		8.25			8.25		8.25	24.74
2049	41		8.41			8.41		8.41	25.24
2050	42		8.58			8.58		8.58	25.74
2051	43		8.75			8.75		8.75	26.26
2052	44		8.93			8.93		8.93	26.78
2053	45		9.11			9.11		9.11	27.32
2054	46		9.29			9.29		9.29	27.86
2055	47					9.47		9.47	18.95

1: MEDUPI CONSTRUCTION, 2: MEDUPI OPERATIONS, 3: MATIMBA OPERATIONS, 4: COAL 1 CONSTRUCTION, 5: COAL 1 OPERATIONS, 6: COAL 2 CONSTRUCTION, 7: COAL 2 OPERATIONS. 8: TOTAL MRD

ANNEXURE 2