June 2010
Authorisation Phase

Tutuka Waste Disposal Site: Proposed extension of the existing General Waste Disposal Site (and associated infrastructure) at the Tutuka Power Station

DEA REF NO: 12/12/20/1553 - Environment
DEA REF NO: 12/9/11/L217/6 – Permitting

Proponent: Eskom Generation

FINAL EIA REPORT

Project: 12333

ZITHO LELE CONSULTING

PURPOSE OF THIS DOCUMENT

Eskom is currently operating Tutuka Power Station as part of its electricity generation fleet. Throughout the operational life of the station, general waste, inclusive of garden waste and building rubble, is being generated at the station. A general waste disposal facility was authorised and established within the Tutuka power station boundaries for disposal. This waste was disposed of in an authorised general waste disposal site within the Tutuka Power Station premises, until the site reached its capacity, by which stage the waste had to be transported to Kriel for disposal.

The current waste disposal site provides disposal services to New Denmark Colliery, Thuthukani Township, Tutuka Power Station, selected contractors and some neighbouring farmers. This particular disposal site has, subsequent to its establishment, reached its capacity, and as of the end of October 2008, the waste has been transported to a waste disposal site at Kriel town, which is approximately 200 km away. The associated transportation costs and the associated environmental risks are high and therefore an alternative, sustainable, means of waste disposal needs to be put in place.

To minimise the potential environmental impacts and operational costs of the distant waste disposal process, potential sites have been identified within the Tutuka Power Station premises, one of which is located immediately adjacent (contiguous) to the existing waste disposal site and would result in an extension of the existing general waste disposal site. As a means to comply with the necessary legal requirements, the extended waste disposal site and waste disposal activities must be appropriately designed and licensed, in line with the requirements of the EIA and NEMWA legislation.

Eskom Generation has appointed Zitholele Consulting (Pty) Ltd, an independent company, to conduct the appropriate Environmental Impact Assessment (EIA) studies to evaluate the potential environmental impacts of the proposed project, and to undertake the Waste Management Licencing processes. The Environmental Assessment Practitioner (EAP) is Mr Konrad Kruger.

Summary of what the EIA Report Contains

This report contains the following for approval by the Department of Environmental Affairs:

- A description of the proposed development;
- A description of the pertinent legislation;
- A description of the baseline environment;
- A description of the stakeholder engagement process followed to date;
- A description of the Waste Management License Application Report and its contents;
- A quantification of the potential impacts that the development may have; and
- An environmental management plan to minimise these potential impacts.

AN EIA CONSISTS OF SEVERAL PHASES

Scoping Phase	Impact Assessment Phase	Environmental Impact Report and EMP	Decision-making Phase
To identify issues to identify sites, to classify the waste site, to focus the EIA	Detailed studies of potential impacts, positive and negative, Detailed design of the waste site	Consolidate findings of impact assessment studies	Proponent and authorities use EIA findings to decide if project goes ahead

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ABBREVIATIONS

DMR .....Department of Mineral Resources
DEA..... Department of Environmental Affairs
DWA.....Department of Water Affairs
DWEA (Ministry).....Ministry of Water and Environmental Affairs
EA..... Environmental Authorisation
EAP..... Environmental Assessment Practitioner
ECA .....Environment Conservation Act
EIA..... Environmental Impact Assessment
EIR.....Environmental Impact Report
FEL ..... Front End Loader
GNR..... Government Notice Regulation
HDPE liner .....High Density Polyethylene liner
HDI.....Historically Disadvantaged Individuals
I&APs ..... Interested and Affected Parties
IEM.....Integrated Environmental Management
IEP .....Integrated Energy Plan
ISEP .....Integrated Strategic Electricity Planning
LAR .....License Application Report
NEMA .....National Environmental Management Act
NEM: WA .....National Environmental Management: Waste Act
NERSA ..... National Energy Regulator of South Africa
NIRP .....National Integrated Resource Plan
SIA.....Social Impact Assessment
SR ..... Scoping Report
ToR ..... Terms of Reference
WMLA.....Waste Management License Application

1 INTRODUCTION

1.1 Who is the proponent?

Eskom Holdings (Ltd) is the South African utility that generates, transmits and distributes electricity. Eskom supplies ~95% of the country's electricity, and ~60% of the total electricity consumed on the African continent. Eskom plays a major role in accelerating growth in the South African economy by providing a high-quality supply of electricity.

1.2 Tutuka Waste Disposal Site Project

Eskom is currently operating Tutuka Power Station as part of its electricity generation fleet. Throughout the operational life of the station, general waste, inclusive of garden waste, office waste, general waste and building rubble, is being generated. This waste was disposed of in an authorised general waste disposal site within the Tutuka Power Station premises.

The current waste disposal site provides general waste disposal services to New Denmark Colliery, Thuthukani Township, Tutuka Power Station, selected contractors and some neighbouring farmers. This particular disposal site has reached its capacity, and as of the end of October 2008, the waste has been transported to a licensed waste disposal site at Kriel town, which is approximately 200 km away from the power station. The associated transportation costs are high and therefore an alternative means of waste disposal needs to be put in place.

Two options are available to Tutuka Power Station. The first would be to extend the current waste disposal site and to apply for a permit amendment to a Waste Management License in line with the requirements of the NEMWA. The second option is to establish a new waste disposal site within close proximity to the power station property and the current site. A site selection exercise in line with the Minimum Requirements for the Disposal of Waste by Landfill, Draft 3rd edition 2005 was undertaken to identify the most suitable alternative. The EIA and site selection identified the extension of the current waste disposal site as the most feasible alternative and this report substantiates that finding,

1.3 Context of this Report

This report is the final Environmental Impact Report. This report details the findings of the Environmental Impact Assessment Phase of the project. This includes all the specialist studies that were identified during the scoping phase, the second round of public participation, the assessment of the project impacts and the Environmental Management Plan (EMP).

Furthermore this report also supports a waste management license application report; and therefore there will be a strong emphasis on all the waste license related aspects in the report.

1.4 Environmental Impact Assessment Practitioner (EAP) Details

In terms of the National Environmental Management Act (NEMA, No 107 of 1998) Environmental Impact Assessment (EIA) regulations, the proponent must appoint an Environmental Assessment Practitioner (EAP) to undertake the environmental assessment of an activity regulated in terms of the aforementioned Act. In this regard, Eskom appointed Zitholele Consulting to undertake the EIA for the proposed extension of the Tutuka General Waste site, in accordance with the EIA Regulations promulgated in April 2006 in terms of the NEMA which became effective on 1 July 2006. This process will also comply with the NEM Waste Act requirements for licensing of waste disposal facilities.

Zitholele Consulting is an empowerment company formed to provide specialist consulting services primarily to the public sector in the fields of Water Engineering, Integrated Water Resource Management, Environmental and Waste Services, Communication (public participation and awareness creation) and Livelihoods and Economic Development.

Zitholele Consulting has no vested interest in the proposed project and hereby declares its independence as required by the EIA Regulations. The details of the EAP representative are listed below.

Name:	Konrad Kruger
Company Represented:	Zitholele Consulting (Pty) Ltd.
Address:	P O Box 6002, Halfway House, 1685
Telephone:	011 207 2079
Fax:	011 805 2100
E-mail:	konradk@zitholele.co.za

Mr. Konrad Kruger graduate from the University of Pretoria with a BSc. in Environmental Science and BSc Honours in Geography in 2003. Over the past six years Konrad has been involved in a variety of environmental projects and has specialised in environmental management and auditing. Konrad has undertaken environmental authorisations for mining, conservation, residential as well as industrial developments. He is also an experienced ecologist and will provide expertise for this project in terms of soil surveys and wetland delineation.

1.5 Objectives of the EIA Report

This report addresses the requirements for the Impact Assessment Phase for the EIA and waste licensing as outlined in the NEMA regulations. The aim of this final Environmental Impact Report (EIR) is to:

- Provide information to the authorities as well as Interested and Affected Parties (I&APs) on the proposed project; including details on the:

- Alternatives that are being considered;
- Receiving environment;
- Assessing and ranking methodology

- Indicate how I&APs were afforded the opportunity to contribute to the project, verify that the issues they raised to date have been considered, and comment on the findings of the impact assessments;
- Provide proposed mitigation measures in order to minimise negative impacts and enhance positive impacts; and
- Present the findings of the Impact Assessment Phase in a manner that facilitates decision-making by the relevant authorities.

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2 LEGAL REQUIREMENTS

Environmental legislation in South Africa was promulgated with the aim of, at the very least, minimising and at the most preventing environmental damage and degradation. The following Acts and Regulations are applicable to the Tutuka Waste Disposal Site Expansion Project:

2.1 The Constitution of the Republic of South Africa (Act 108 of 1996)

Section 24 of the Constitution states that: "Everyone has the right

(a) to an environment that is not harmful to their health or well-being; and

(b) to have the environment protected, for the benefit of present and future generations, through reasonable legislative and other measures that-

- prevent pollution and ecological degradation;
- promote conservation; and
- secure ecologically sustainable development and use of natural resources, while promoting justifiable economic and social development"

The current environmental laws in South Africa concentrate on protecting, promoting, and fulfilling the Nation's social, economic and environmental rights; while encouraging public participation, implementing cultural and traditional knowledge and benefiting previously disadvantaged communities.

2.2 National Environmental Management Act (Act 107 of 1998)

The EIA for this proposed project will be conducted in terms of the EIA Regulations that were promulgated in terms of Section 24 (5) of the NEMA. The National Department of Environmental Affairs (DEA) is the competent authority responsible for issuing environmental authorisation for the proposed project. The Mpumalanga Department of Agriculture, Rural Development and Land Administration (MDARDLA) is a key commenting authority along with the Lekwa District Municipality.

2.2.1 Environmental Impact Assessment Regulations: 385 - 387 of 21 April 2006

In terms of Government Notice Regulation (GNR) 387, activity 1(e), 2 and 10, a full Environmental Impact Assessment comprising both Scoping and Impact Assessment, is necessary for the proposed construction of a waste disposal site. The main activities identified under the NEMA are listed as follows:

Activity 1 (e): Any process or activity which requires a permit or licence in terms of legislation governing the generation or release of emissions, pollution, effluent or waste which is not identified in Government Notice No. R. 386 of 2006.

The following activities in accordance with Regulation GNR 386 (Basic Assessment activities) are also included in the EIA application, to provide for supporting infrastructure associated with the proposed construction of the waste disposal site.

Activity 1 (m): Any purpose in the one in ten year flood line of a river or stream, or within 32 metres from the bank of a river or stream where the flood line is unknown, excluding purposes associated with existing residential use, but including -

(i) canals;
(ii) channels;
(iii) bridges;
(iv) dams; and
(v) weirs.

Activity 16 (b): The transformation of undeveloped, vacant or derelict land to residential, mixed, retail, commercial, industrial or institutional use where such development does not constitute infill where the total area to be transformed is bigger than 1ha (10,000 m^2).

Activity 25: The expansion of or changes to existing facilities for any process or activity, which requires an amendment of an existing permit or license of a new permit or license in terms of legislation governing the release of emissions, pollution, effluent.

Since the project comprises activities that require both a Basic Assessment and EIA levels of investigation, all activities will be assessed to the detail required for a full EIA process.

The NEMA can be regarded as the most important piece of general environmental legislation. It provides a framework for environmental law reform and covers three areas, namely:

- Land, planning and development;
- Natural and cultural resources, use and conservation; and
- Pollution control and waste management.

The law is based on the concept of sustainable development. The objective of the NEMA is to provide for co-operative environmental governance through a series of principles relating to:

- The procedures for state decision-making on the environment; and
- The institutions of state which make those decisions.

The NEMA principles serve as:

- A general framework for environmental planning;
- Guidelines according to which the state must exercise its environmental functions; and
- A guide to the interpretation of NEMA itself and of any other law relating to the environment.

2.2.2 What are the NEMA principles?

Some of the most important principles contained in NEMA are that:

- Environmental management must put people and their needs first;
- Development must be socially, environmentally and economically sustainable;
- There should be equal access to environmental resources, benefits and services to meet basic human needs;
- Government should promote public participation when making decisions about the environment;
- Communities must be given environmental education;
- Workers have the right to refuse to do work that is harmful to their health or to the environment;
- Decisions must be taken in an open and transparent manner and there must be access to information;
- The role of youth and women in environmental management must be recognised;
- The person or company who pollutes the environment must pay to clean it up;
- The environment is held in trust by the state for the benefit of all South Africans; and
- The utmost caution should be used when permission for new developments is granted.

2.3 National Environmental Management: Waste Act (NEM:WA) (Act 59 of 2008)

With the recent proclamation (July 2009) of the National Environmental Management Waste Act (NEM: WA) all waste related activities previously listed under the NEMA EIA regulations have been repealed and are now listed in the ambit of the NEM:WA. The Minister of Environmental Affairs published Regulation 718 in terms of Section 19 (1) of the NEM: WA. These regulations highlight the waste management activities that require environmental licensing. The regulations comprise two Categories, namely Category A, which identifies activities that require a Basic Assessment process and Category B, which identifies activities that require a full scoping and EIA process to be followed. In terms of these regulations the following activities require authorisation:

Regulation 718 - Category B

Activity 10:	The disposal of general waste to land covering an area in excess of 200m^2.
Activity 11:	The construction of facilities for activities listed in Category B of this Schedule.

The two activities listed above both fall into Category B of Section 19 of the regulations, and therefore this development requires a full scoping and EIA process to be undertaken under the NEM:WA in order to receive a waste license.

2.4 Environment Conservation Act (Act 73 of 1989)

The Environment Conservation Act (ECA) is a law that relates specifically to the environment. Although most of this Act has been replaced by the NEMA there are still some important sections that remain in operation. These sections relate to:

- Protected natural environments;
- Special nature reserves;
- Limited development areas;
- Regulations on noise, vibration and shock; and

2.5 Additional Acts and Frameworks

In addition to the ECA, NEMA and NEM: WA, the following Acts have some bearing on the proposed activities:

The National Heritage Resources Act (No. 25 of 1999)

The proposed construction of the waste disposal site comprise certain activities (e.g. changing the nature of a site exceeding 5 000 m^2 and linear developments in excess of 300 m) that require authorisation in terms of Section 38 (1) of the Act. Section 38 (8) of the Act states that, if heritage considerations are taken into account as part of an application process undertaken in terms of the ECA, there is no need to undertake a separate application in terms of the National Heritage Resources Act. The requirements of the National Heritage Resources Act have thus been addressed as an element of the EIA process, specifically by the inclusion of a Heritage Assessment.

Occupational Health and Safety Act (Act No 85 of 1993)

This Act makes provisions that address the health and safety of persons working at the proposed site. The Act addresses amongst others the:

- Safety requirements for the operation of plant machinery;
- Protection of persons other than persons at work against hazards to health and safety, arising out of or in connection with the activities of persons at work;
- Establishment of an advisory council for occupational health and safety; and
- Provision for matters connected therewith.

The law states that any person undertaking upgrades or developments for use at work or on any premises shall ensure as far as is reasonably practicable that nothing about the manner in which it is erected or installed makes it unsafe or creates a risk to health when properly used.

Department of Environmental Affairs and Tourism[1] Integrated Environmental Management Information Series

The Department of Environmental Affairs (DEA) Information Series of 2002 and 2006 comprise 23 information documents. The documents were drafted as sources of information about concepts and approaches to Integrated Environmental Management (IEM). The IEM is a key instrument of the NEMA and provides the overarching framework for the integration of environmental assessment and management principles into environmental decision-making. The aim of the information series is to provide general guidance on techniques, tools and processes for environmental assessment and management.

Department of Water Affairs Minimum Requirements for Waste Disposal by Landfill

The Department of Water Affairs published 3 versions of the Minimum Requirements Document Series from 1994 to 2005. These documents were compiled to provide guidance as to the minimum requirements that waste facilities had to meet in order to comply with the Department's standards for waste facilities. The latest edition (2005) of the series has only been published in draft, but does however offer an integrated approach to waste site classification, site selection design and implementation.

[1] The Department of Environmental Affairs and Tourism is now referred to as the Department of Environmental Affairs.

3 ENVIRONMENTAL IMPACT ASSESSMENT AND WASTE MANAGEMENT LICENSING PROCESS

The EIA and Waste Licensing process can be divided into the following phases:

- The Scoping Phase;
- The Impact Assessment and Waste Management License Application Phase; and
- The Environmental Authorisation / Waste Management Licensing Phase.

Each of these phases is explained in detail below.

3.1 Scoping Phase

The Scoping Phase consists of a technical process and a public participation process. Although these processes are interlinked and cannot be undertaken in isolation, in order to provide a detailed explanation the steps within each of these processes they are explained separately below.

3.1.1 Technical (EIA) Process

For the Scoping Phase of this EIA, the following technical process was followed:

Consultation with authorities, application forms and landowner consent

The DEA EIA application form (Appendix B) for the proposed project was submitted to the DEA on 6th July 2009. Copies of the application form and notification of this application form were forwarded to the MDARDLA and Lekwa District Municipality as commenting authorities. As a point of departure, the I&AP database developed by the Tutuka Power Station was used for initial project notification and groundtruthed by the Zitholele team to identify additional I&APs. During the Scoping Phase the list of landowners were confirmed.

In addition a waste license application form was submitted to DEA Permitting upon request from the Department on the 1st of February 2010. The Department confirmed receipt of the application form and issued a reference number for the project.

Site Visit

An initial site visit was conducted by on 14 July 2009 with the objective of familiarising the project team with the study area.

Draft Scoping Report and Plan of Study for EIA

The Draft Scoping Report (DSR) was prepared with information and issues identified during the Scoping Phase activities. The Plan of Study (PoS) for EIA and the Terms of Reference (ToR) for the envisaged specialist studies were also included in the report.

During the same time the waste specialist undertook a classification of the waste site in order to determine the type of application to be submitted to DEA.

Final Scoping Report

The DSR and PoS were updated based on comments obtained from I&APs and were consolidated into the Final Scoping Report and the PoS for EIA. This report was submitted to the DEA for acceptance on the 29th January 2010 and approval which was received on the 17th March 2010.

3.1.2 Public Participation Process (PPP)

Public participation is an essential and legislative requirement for environmental authorisation processes. The principles that demand communication with society at large are best embodied in the principles of the National Environmental Management Act (Act 107 of 1998, Chapter 1), South Africa's overarching environmental law. In addition, Section 24 (5), Regulation 56 of GNR 385 under the National Environmental Management Act, guides the public participation process that is required for an Environmental Impact Assessment (EIA) process.

The public participation process for the proposed Tutuka waste disposal site has been designed and undertaken to satisfy the requirements laid down in the above legislation and guidelines. Figure 3-1 provides an overview of the EIA technical and public participation processes, and shows how issues and concerns raised by the public were used to inform the technical investigations of the EIA at various milestones during the process. This section of the report highlights the key elements of the public participation process to date.

Objectives of public participation in the Scoping Phase

The objectives of public participation in an EIA are to provide sufficient and accessible information to I&APs in an objective manner so as to:

- During Scoping:
  - Encourage the I&APs to provide of issues of concern and suggestions for enhanced benefits and alternatives.
  - Contribute their local knowledge and experience.
  - Verify that their issues have been considered and to help define the scope of the technical studies to be undertaken during the Impact Assessment.

The key objective of public participation is to ensure transparency throughout the process and promote informed decision making.

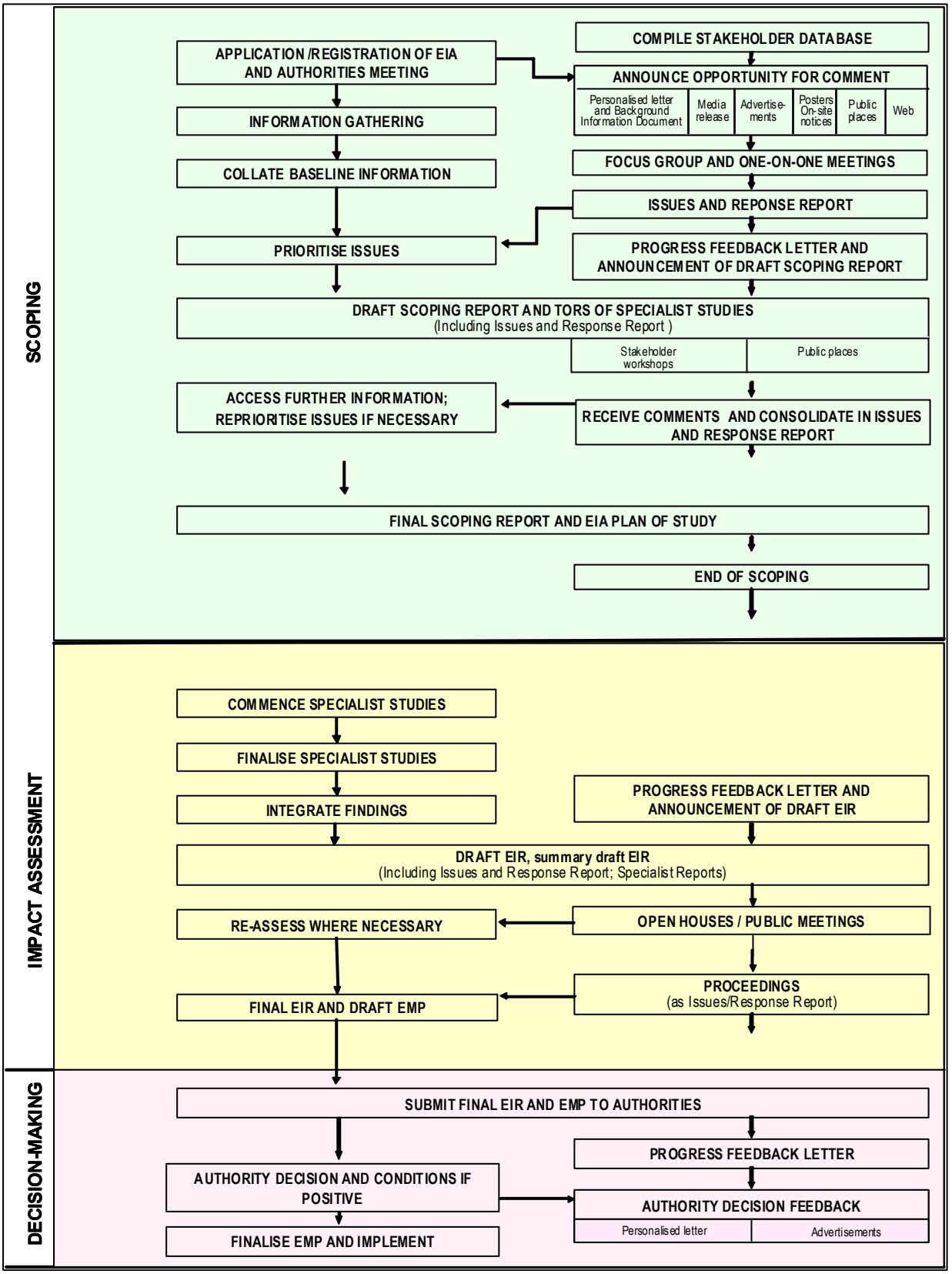

Figure 3-1: Technical and public participation process and activities that comprised the Environmental Impact Assessment for the proposed Tutuka waste disposal site.

Identification of Interested and Affected Parties

The identification of stakeholders is ongoing and is refined throughout the process. As the on-the-ground understanding of affected stakeholders improves through interaction with various stakeholders in the area the database is updated. The identification of key stakeholders and community representatives (land owners and occupiers) for this project is important as their contributions are valuable in informing the EIA process. The identification of key stakeholders was done in collaboration with Eskom (through the I&APs database from the Tutuka Power Station), the local municipalities and other organisations in the study area. In addition stakeholders were invited to participate through media adverts, sites notices and BID flyers.

The stakeholders' details are captured on Maximiser 9, an electronic database management software programme that automatically categorises every mailing to stakeholders, thus providing an ongoing record of communications - an important requirement by the authorities for public participation. In addition, comments and contributions received from stakeholders are recorded, linking each comment to the name of the person who made it.

According to the NEMA EIA Regulations under Section 24(5) of NEMA, a register of I&APs is compiled, updated and kept by the public participation practitioner throughout the process (See Appendix D)

Announcement of opportunity to become involved

The initial opportunity to participate in the EIA was announced in August – September 2009 as follows:

- Distribution of a letter of invitation to become involved, addressed to individuals and organisations, accompanied by a Background Information Document (BID) containing details of the proposed project, including a map of the project area and the alternative sites, and a registration/comment sheet (Appendix F). Copies of the BID were placed at the entrance of the existing waste disposal facility, at the power station's reception area as well as at the community centre in Thuthukani Village.

- Advertisements during the announcement phase were placed in the following newspapers (Appendix C):

Table 3-1: Advertisements placed during the announcement phase.

NEWSPAPER	DATE
Beeld	25 August 2009
Citizen	27 August 2009
Standerton Advertiser	28 August 2009
Highveld Tribune	1 September 2009

- Notice boards were positioned at prominent localities (the main road intersections from New Denmark, Tutuka power station and Thuthukani township) during June 2009. These notice boards were placed at conspicuous places and at various public places (Appendix C).

- Site notices were placed prominently to invite stakeholder participation (**Figure 3-2**).

Figure 3-2: Site notice boards were put up in the study area.

Obtaining comment and contributions

The following opportunities were available during the Scoping phase for contribution from the I&APs:

- Completing and returning the registration/comment sheets on which space was provided for comment.

- Providing comment telephonically or by email to the public participation office.

- Provide comment to project team while visiting homesteads to hand out BIDs and making stakeholders aware of the proposed project.

- Attending the stakeholder meeting on the 18th November 2009 at the Thuthukani Community Centre that was widely advertised (Table 3-2) and raise comments there. The minutes of the meeting was attached to the Final Scoping Report (FSR).

Issues relevant to the current project configuration were considered and were carried forward into the Impact Assessment phase.

Issues and Response Report (IRR) and acknowledgements

The issues raised during the announcement, were captured in an Issues and Response Report Version 1, which was appended to the Draft Scoping Report (DSR). This report was updated to include additional I&APs contributions that were received as part of the Scoping phase process. The issues and comments raised during the public review period of the DSR were added to the report as Version 2 of the Issues and Response Report which was appended to the FSR.

Draft Scoping Report

The purpose of the Public Participation Process (PPP) in the DSR was to enable I&APs to verify that their contributions have been captured, understood and correctly interpreted, and to raise further relevant issues. At the end of Scoping, the issues identified by the I&APs and by the environmental technical specialists, were used to define the Terms of Reference for the Specialist Studies conducted during the Impact Assessment Phase. A period of 30 days was made available for public review of the DSR (from 11 November to 10 December 2009).

In addition to media advertisements and site notices that announced the opportunity to participate in the EIA, the opportunity for public review of the DSR was announced as follows:

- In the Background Information Document (August 2009).
- In advertisements published (see **Table 3-2** below and Appendix C) to announce the review of the DSR and inviting stakeholders to attend a stakeholder meeting.
- In a letter sent out in September 2009, and addressed personally to all individuals and organisations on the stakeholder database.

Table 3-2: A stakeholder meeting was advertised and was held as part of the public review period of the Draft Scoping Report

NEWSPAPER	DATE
Standerton Advertiser	13 November 09
Highveld Tribune	12 November 09
Citizen	9 November 09
Beeld	9 November 09

The DSR, including the Issues and Response Report Version 1, has been distributed for comment as follows:

- Left in public venues within the vicinity of the project area (these are listed in **Table 3-3** below);
- Published on the Eskom and Zitholele websites;
- Mailed to authorities;
- Mailed to I&APs who requested the report; and

- Copies were made available at the stakeholder meeting.

I&APs could comment on the report in various ways, such as completing the comment sheet accompanying the report, and submitting individual comments in writing or by email.

Table 3-3: List of public places where the Draft Scoping Report was available

PLACE	CONTACT PERSON	TELEPHONE
Thuthukani Public Library, Thuthukani Village	Ms Ntombithini Ngubo	073 723 3678 073 135 8047
Tutuka Power Station	Mr Claude Naicker	(017) 749 5823 (017) 749 5413

Final Scoping Report

The Final Scoping Report was updated with additional issues raised by I&APs and contained new information that was generated as a result of the process. The FSR was submitted to the Authorities (DEA) and key I&APs, as well as to those individuals who requested a copy.

3.2 Impact Assessment Phase

As with the Scoping Phase, the Impact Assessment Phase consists of a technical process and a public participation process. These processes are explained separately below.

3.2.1 Technical Process

Specialist Studies

In the Impact Assessment Phase of the EIA, specialist studies were conducted to assess the potential positive and negative impacts of the proposed project, and to recommend appropriate measures to enhance positive impacts and avoid or reduce negative ones. The specialist reports are appended to this final EIR as Appendices G – T.

Final Environmental Impact Report, Waste Management License Application (WMLA) and Environmental Management Plan

The Final Environmental Impact Report (EIR) and Waste Management License Application (WMLA) was prepared with information and issues identified during the Scoping Phase activities, comments from the DEA and other commenting authorities and the findings from the specialist studies. Appended to this final EIR is the Environmental Management Plan and final Waste Management License Application Report and Application Form.

The Environmental Impact Assessment Phase comprises of:

- The completion of the specialist studies and reports;

- The finalisation of the impact assessment;
- The compilation of the draft Environmental Management Plan (EMP); and
- The submission of the Environmental Impact Assessment Report.

The final EIR includes:

- A detailed description of the proposed development;
- A description of the environment that may be affected by the activity and the manner in which physical, biological, social, economic and cultural aspects of the environment may be affected by the proposed development;
- The methodology of the stakeholder engagement process is described;
- The Issues Report and Stakeholder Database is provided as an appendix to the EIR;
- A description of the need and desirability of the proposed development and the identified potential alternatives to the proposed activity;
- A detailed description of the design of the waste facility as well as the waste related documents such as the waste classification, closure of the current site and licensing of the new site;
- A summary of the methodology used in determining the significance of potential impacts;
- A description and comparative assessment of all alternatives identified during the environmental impact assessment process;
- A summary of the findings of the specialist studies;
- A summary of the Waste Management License Application Report and the Application Form;
- A detailed assessment of all identified potential impacts;
- A list of the assumptions, uncertainties and gaps in knowledge;
- An opinion by the consultant as to whether the development is suitable for approval;
- An Environmental Management Plan that complies with regulation 34 of Act 107 of 1998;
- Copies of all waste related designs, reports and plans; and
- Copies of all specialist reports appended to the EIR.

Environmental Management Plan

The Environmental Management Plan highlights the most significant potential impacts and provides mitigation measures for these impacts to ensure that the risk of impact is reduced and that the activity generating the impact is suitably managed. The EMP includes:

- Recommended management plans and detailed measures for environmental objectives identified to manage impacts, in order to facilitate the monitoring and control of the activity generating the impact;
- The identification of the responsible person for the mitigation and monitoring of impacts; and
- Suggest timeframes for monitoring programmes.

3.2.2 Public Participation Process

Objectives of public participation in the Impact Assessment Phase

The objectives of public participation in an EIA are to provide sufficient and accessible information to I&APs in an objective manner so as to:

- During Impact Assessment:
  - Verify that their issues have been considered either by the EIA Specialist Studies, or elsewhere.
  - Comment on the findings of the EIA, including the measures that have been proposed to enhance positive impacts and reduce or avoid negative ones.

Public participation during the impact assessment phase of the EIA mainly involves a review of the findings of the EIA, presented in a Draft Environmental Impact Report (DEIR), the Draft Environmental Management Plan (EMP) and the specialist studies.

Public review of the Draft Environmental Impact Report and Environmental Management Plan

A period of 30 days was made available for public review of the DEIR and DEMP (from 7 May – 7 June 2010).

The opportunity for public review of the DEIR and DEMP was announced as follows:

- In advertisements published (see Appendix C) to advertise the public review period of the DEIR and DEMP.

Table 3-4: Advertisements placed TO ANNOUNCE THE PUBLIC REVIEW OF THE DRAFT EIR and EMP.

NEWSPAPER	DATE
Standerton Advertiser	7 May 2010
Cosmos News	4 May 2010
Citizen	5 May 2010
Beeld	6 May 2010

- In a letter distributed on 30 April 2010, and addressed personally to all individuals and organisations on the stakeholder database.

The DEIR and DEMP, including the Issues and Response Report Version 3, was distributed for comment as follows:

- Left in public venues within the vicinity of the project area. (these are listed in Table 3-3 above – the same venues were used as during the scoping phase);
- Mailed to authorities;
- Mailed to I&APs who requested the report;
- Available on the Eskom (www.eskom.co.za) and Zitholele websites (www.zitholele.co.za); and
- Copies were made available at the Open House and Public meeting.

I&APs could comment on the report in various ways, such as completing the comment sheet that accompanied the report, at the Open House and Public Meeting (18 May 2010 at the Thuthukani Village Hall) and submitting individual comments in writing or by email.

Final Environmental Impact Report, Waste Management License application and Environmental Management Plan

The Final EIR, WML and EMP was updated with additional issues raised by I&APs and contains new information that was generated as a result of the public review process. The FEIR, WMLA and EMP is hereby submitted to the Authorities (DEA), and to those individuals who specifically requested a copy. I&APs will be notified of the availability of the final reports in a letter that will be distributed to all stakeholders towards the middle of 2010.

Announce authorities' decisions on Environmental Authorisation/Waste Management License

Once the DEA has provided Environmental Authorisation/Waste Management License for the proposed project, stakeholders will be notified according to the requirements set by DEA in their authorisation letter. A personalised letter will be faxed and emailed to the list of stakeholders and those without email or fax facilities will be contacted telephonically.

4 PROJECT DESCRIPTION

The proposed project is the extension of the general waste disposal site and associated infrastructure at the Tutuka Power Station. The waste disposal site as well as its infrastructure is briefly described below, and in detail within Section 8 as well as the design report, which is attached in **Appendix L**.

4.1 Need for the Proposed Waste Disposal Site

Eskom has a permitted general waste disposal site within the premises of the Tutuka Power Station complex that receives general waste (including building rubble, office, garden and other general waste) from the power station itself, as well as from the nearby township of Thutukani and the New Denmark colliery. The landfill site was permitted in terms of Section 20 of the Environment Conservation Act in August 1994 as a Class 2 Domestic Waste Disposal Site, with Permit No B33/2/3/310/45-P129. The landfill has reached its maximum size in terms of the permit conditions, and waste is currently being sent to the permitted Kriel landfill, which poses additional cost, environmental and safety risks. Eskom would therefore like to extend the footprint of the existing landfill, to provide an additional disposal capacity for the next 40 years. There is a need for a nearby facility for disposal of general waste as the nearest permitted site is the site at Kriel, about 200 km away.

4.1.1 The Integrated Waste Management Hierarchy

When considering the licensing of a waste management activity, NEMWA section 48 (a) states that a number of matters must be taken into account including "*the need for, and desirability of, the waste management activity and alternatives considered, including similar waste management activities, if any, that have already been licensed*."

The first option to consider would be whether there is a more environmentally acceptable option to waste management than landfill disposal. Tutuka Power Station is currently practising recycling and therefore any waste disposed of by means of landfilling is waste that is not practically or economically feasible to recycle. The volumes of waste received and recycled are indicated in **Appendix G**.

General waste that cannot be recycled is currently disposed at Kriel (General) landfill site. For sustainable logistical reasons a closer landfill site is required.

4.1.2 Disposal need and waste streams generated

The waste that requires disposal on the disposal site originates from four main sources:

- Tutuka Power Station domestic and garden waste;
- Tutuka Power Station contractor domestic and building rubble waste;
- Thuthukani township domestic waste; and
- New Denmark Colliery domestic and garden waste.

Waste volumes vary from month-to-month; however a detailed register of all the waste entering the site is kept at the station. Statistics are available for the total volumes of all wastes received by the waste disposal site to date. The average is between 484 and 754 m^3 per month. It is anticipated that the new site will have to take the same types and quantities of waste for the estimated life of the Tutuka Power Station, which is estimated at another 40 years.

4.1.3 Classification of waste streams

In terms of the Minimum Requirements, the Tutuka Site Classification (for both the current site as well as the proposed extension), was done as a first step in the authorisation process in order to determine the requirements in respect of further investigations and specialist studies pertaining to the license authorisation process.

The purpose of site classification is:

- To assess each waste disposal scenario in respect of waste class, waste stream size and potential for significant leachate generation; and
- To use the landfill class to select the prescribed set of Minimum Requirements for the cost-effective investigation, design, operation and closure of a specific class of landfills.

Site classification system is done by determining:

- The class of waste disposed of;
- The size of the waste stream; and
- The potential for significant leachate generation.

<u>Site classification in respect of waste class</u>

In order to determine the class of site (Hazardous or General) the type of waste to be accepted at the site must be established. General (G) waste includes domestic, commercial and inert waste and poses an insignificant threat to the environment if correctly managed. Hazardous (H) waste is material that

can, even in low concentrations, have an unacceptable adverse effect on public health and/or the environment and if not managed properly cause mortality.

No dedicated hazardous waste streams, for example oils from workshops or chemicals reagents from laboratories, were allowed onto the Tutuka Site. This was based on the data in the permit application forms that was submitted by SRK in 1991, which did not make any mention of hazardous waste received at the site, as well as site investigations.

The Tutuka site was classified as a Class II disposal site at the time of permitting by the then Department of Water Affairs and Forestry in terms of Section 20(1) Environment Conservation Act, 1989 (Act 73 of 1989). Class II is based on the fact that the site receives general waste only.

Based on the above and existing information, the current Tutuka site as well as the proposed extension will classify as General.

Site classification in terms of size

The ultimate physical size of a site is a function of the amount of waste it receives over a lifetime. The size classification focuses on the size of the waste stream and as a result hereof the size of the operation.

The classification is determined from the following formula:

$$MRD = (IRD)(1 + d)^t$$

Where:

MRD = "Maximum Rate of Deposition" (MRD) in tonnes per day, during the expected life of the site;

IRD = in initial rate of deposition of refuse on site in T/day;

d = expected development rate, based on expected population growth rate in the area served by the landfill; and

t = years since the deposition started at IRD.

The application forms submitted by SRK in 1991 recorded the Initial Rate of Deposition (IRD) as 13 000 m^3 per annum of which 5 500 m^3 is of domestic origin. This was converted to 18 t/d by the previous DWAF.

Three sets of data were available for the classification of the site; however it was decided to use the third Tutuka set, using values from January 2004 to December 2008. This gives a growth rate of 3.7%. It was decided that the 3,7% growth rate should be used to calculate site class in respect of its size. The reasons for using this growth rate were as follows:

- It was based on the most complete set of data (January 2004 until December 2008);
- This set of data did not portray figures that provide reason not to accept its correctness; and

- It was based on an IRD of 18 t/d which is on record with the Regulator and at the same time provides growth rates that appear the most reasonable.

A life of 40 years was selected which resulted in the site being classified as **Small**.

After consideration of various waste stream growth rates during the life of the existing landfill site, it was decided to use a growth rate of 3.7% per annum, for determining the Maximum Rate of Deposition (MRD) at the end of the site life, and for calculating the landfill airspace required for 40 years of waste disposal.

Since the MRD is between 25 T/d and 150 T/d, the site would classify as a Small (S) landfill site.

Site classification in respect of water balance

General waste landfills are classified in terms of their potential to generate leachate. This depends on the water balance associated with the site. Climate is the most common cause of leachate generation. The Climatic Water Balance is used as the first step in determining the potential for significant leachate generation.

Other factors that could affect the water balance of a waste site include the moisture content of the incoming waste, and the ingress of groundwater and/or surface water into the waste body due to poor siting, design and maintenance of the site.

No high moisture content wastes are expected to be received at the site. Provided that upslope surface water drainage systems are installed to prevent the ingress of stormwater runoff onto the waste body, the site water balance should not be affected and significant leachate generation should not be expected.

Based on the water balance calculations performed from data of the 10 wettest years for the site and S-pan evaporation data, it is indicated that the waste disposal site will be classified as B^- that is that the site is in a water deficit area and is therefore not expected to generate significant leachate.

In terms of the Minimum Requirements, it should not be necessary to install a leachate management system.

Landfill airspace requirements

For the 40 year life of the site, the total mass of general waste to be disposed of would be approximately 845 000 tonnes, assuming no reduction due to composting or recycling. With an assumed *insitu* landfill density of 1 000 kg/m^3 and a cover to waste ration of 1:5, the total landfill airspace required is 1 014 000 m^3. This would require approximately 167 000 m^3 of cover material for a proper sanitary landfill operation.

4.1.4 Conclusion on site classification

The new site will be:

- General in terms of the waste it receives;
- Small in respect of the size of the waste stream if the operation life of the site was reduced to 39,9 years from now (using the lowest calculated growth rate i.e. 3,7%); and
- B- in terms of the Site water balance.

The existing site as well as the proposed extension therefore classified as a G:S: B^- (for Site life of 39.9 i.e. 40 years) based on the Second Edition of the DWAF Minimum Requirements. It is highly unlikely that the size classification of the extension to the site will change should more accurate waste generation data become available.

4.2 Proposed Waste Disposal Site

The following components of the waste disposal site were taken into consideration throughout this EIA and the design of the site:

- The Lifespan of the site;
- Footprint of the facility (groundspace);
- Height of the facility (airspace);
- Type of waste to be disposed as well as the volumes (waste stream analysis);
- Geotechnical, hydrogeological conditions and foundation design; and
- Capping of the site.

Lifespan of the facility

The lifespan of the facility will be linked to the lifespan of the Tutuka Power Station and the New Denmark Colliery. At present the station indicated that the anticipated life of the waste disposal site will be for another 40 years.

Footprint of the facility

The existing permitted waste disposal site has an approved footprint of 3.2 ha. The new facility will have a footprint of approximately 8.54 ha excluding the supporting structures like the access road and security building.

Height of the facility

The present permitted waste disposal site is restricted to 5 m in height above ground level. The new site will be designed to a height of 30 m above ground level.

Waste to be disposed

The waste that requires disposal on the waste disposal site originates from four main sources:

- Tutuka Power Station domestic and garden waste;
- Tutuka Power Station contractor domestic and building rubble waste;
- Thuthukani township domestic waste; and
- New Denmark Colliery domestic and garden waste.

The waste volumes in turn influence the size of landfill site required. This aspect is described in more detail in Section 8 and 9.

The waste received by the current site is transported via skips and a tractor to the disposal site from the various source areas. The skips (**Figure 4-1**) are placed strategically throughout the source areas, such as Thuthukani Township. The waste is transported by a contractor employed jointly by New Denmark Colliery and Tutuka Power Station.

Figure 4-1: Transport of waste skips to current waste disposal site.

Geotechnical Conditions and Foundation Design

The current site is situated in an area that was previously utilised for the mining of dolerite. The dolerite weathers easily and provides material for road construction. Prior to the establishment of the existing site the area comprised several dolerite borrow pits. The current disposal site was placed inside one of these borrow pits in order to avoid a highly visible waste disposal site. A geotechnical

investigation was undertaken (Section 5) in order to establish whether the extension can be constructed on the geological conditions that prevail on site. This in turn influenced the foundation design of the disposal facility.

Capping of the Waste Disposal Site

The current permit requires the existing site to be capped with soil material in order to cover the waste and to allow vegetation to re-establish on the site. This process has to date been very successful as illustrated in figure 4-2.

Figure 4-2: Existing waste disposal site with capped and rehabilitated area in the foreground

4.3 Associated services and Infrastructure (As per the Min. Requirements)

4.3.1 Access and Roads

Access to the site is directly from the existing Tutuka Power Station eastern access road. The road to the waste disposal site from this road is a gravel road which will have to be maintained regularly according to weather and traffic conditions. A gravel ring road is to be constructed around the facility to allow for maintenance and monitoring, as well as to form a firebreak.

Incoming vehicles would be checked at the gatehouse for the type of waste being delivered. From there, the vehicles would be directed to active tipping area on the waste disposal site.

4.3.2 Weighbridge

Due to the small quantities of waste expected, it does not justify the installation of a weighbridge. In exceptional circumstances where vehicle weighing is necessary, this can be arranged at the Power Station.

4.3.3 Laboratory

For a small general waste disposal site, a laboratory is not required on site. Water quality analyses are to be conducted at commercial laboratories or at the Power Station laboratory.

4.3.4 Fencing

The entire perimeter of the site is to be fenced to prevent unauthorised access. Lockable vehicle access gates are to be provided at the entrance to the site, which should also be manned 24 hours per day by a security guard.

4.3.5 Water

For the small size of operation and small number of site personnel, there is no need to pipe potable water to the site. Potable water can be brought to the site in containers for drinking purposes.

For dust control purposes on the waste disposal site, water from the contaminated water pond is to be used however, if this is insufficient, additional water from the nearby gravel borrow pits will have to be used.

4.3.6 Electricity

There is no need for electrical power at the site. Lighting is not required as the site is only operated during daylight hours.

4.3.7 Staff facilities

The only building required on the site for the size of the current operation is the existing gatehouse. When the site entrance is moved to accommodate the southern extension of the waste disposal site, the new gate house should be larger to include a mess room for the site staff.

4.3.8 Plant maintenance facilities

Due to the waste disposal site's close proximity to the Tutuka Power Station, there is no need to establish a plant and equipment maintenance facility on the site, as the plant and equipment would be sent to the Station workshops for maintenance.

5 ALTERNATIVES CONSIDERED

Alternatives being assessed for the construction of the Tutuka waste disposal site can be divided into the following categories:

- Project alternatives;
- Site alternatives;
- Operation alternatives; and
- The No-Go (no development) alternative.

These are discussed in the sections below.

5.1 Project Alternatives

The following project alternatives were assessed during the planning phase. A technical team devised site alternatives for the proposed project. An environmental team was commissioned to undertake a screening exercise in the area to determine the most feasible alternatives from an environmental, cost and technical perspective to take into the EIA:

- Alternative sites available to dispose the waste; and
- Permanent road transportation to Kriel Town/Disposal Site.

These project alternatives were considered and the following was concluded:

- There are no other general waste disposal sites available in close proximity to the Tutuka Power Station;
- Transporting the waste to the disposal site at Kriel is not cost effective, and provides environmental risks during the transportation; and
- The only feasible options were to either extend the existing site or to establish a new site in close proximity to the power station.

It was therefore decided in the planning phase that, for the purposes of ensuring environmental compliance, the required disposal space should be identified in the immediate vicinity of the power station.

The potential options in terms of the use of the existing site were evaluated in detail in the specialist report attached in **Appendix U**. This report found that the best alternative in terms of waste management would be to extend the current site and to apply to the DEA for an amendment of the current waste permit into a new waste license.

5.2 Site Alternatives

Initial Site Identification

The Tutuka Power Station, Thuthukani Township and the New Denmark Colliery require a licensed general waste disposal site as the current licensed site at Tutuka Power Station has reached the end of its life. It was proposed to either extend the existing site or to establish a new site within the property of the Tutuka Power Station. A site selection exercise was undertaken in line with the requirements of the Minimum Requirements (draft 3rd edition, 2005).

The requirements that had to be met by the site were:

- It must be located on Eskom Property;
- It cannot interfere with the existing operations at the Tutuka Power Station or the New Denmark Colliery;
- It must be within a 2 km radius of the existing site to minimise travelling distance of the waste;
- Had to have a minimum size of 12 ha to accommodate the calculated waste volume.

Twelve site alternatives were identified as part of the site identification process of the project, all within the power station property. The alternatives are illustrated in **Figure 5-1** below. The twelve sites were selected following a conceptual design of the space required for the 50 year life of the waste disposal site. It was calculated that using the "worst case[2]" growth rate in waste volumes the site would be approximately 12 ha in size (footprint) and 10 – 15 m in height. The available space within the power station properties was analysed using the above dimensions that the 12 alternatives resulted.

The environmental requirements for the site alternative were:

- Avoid any water features, wetlands or sensitive habitats and
- Avoid existing infrastructures from the power station.

[2] The "worst case" scenario was calculated by using the current waste volumes and applying a annual growth rate similar to the natural growth rate of the population to all the waste streams.

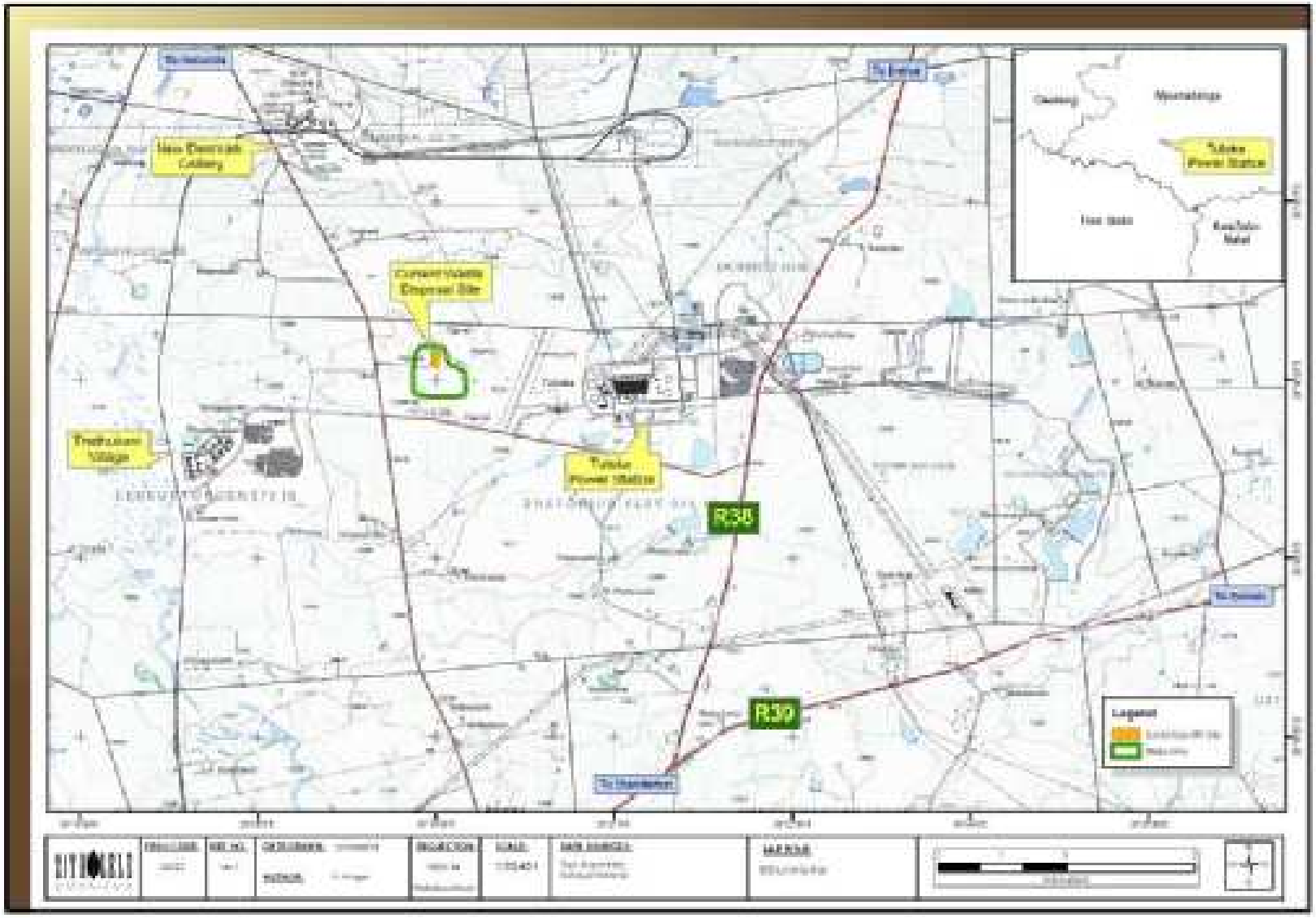

Figure 5-1: Locality of the disposal site alternatives.

These twelve sites were then subjected to a more detailed site screening according to the Minimum Requirements, where the sites have to be ranked according to selection criteria. The first of these are fatal flaws, followed by economic, environmental and public criteria. Each of these is described in more detail below.

Fatal Flaw Identification

Fatal Flaws

Fatal flaws are features that would prevent the site alternative being utilised for a waste disposal site. These were adapted from the Minimum Requirements and are shown in **Table 5-1** below.

Table 5-1: Fatal Flaws used in the site selection (Minimum Requirements, 2005)

	Ranking Component
Fatal Flaws	500m from an airfield
	Below 1:100 year floodline
	Areas in close proximity to significant surface water bodies
	Unstable areas
	Sensitive ecological and/or historical areas
	Areas of flat gradients, shallow or emergent ground water
	Areas within the secure power station area (National Keystone Infrastructure)
	Areas characterized by shallow bedrock with little soil cover
	Areas in close proximity to land-uses that are incompatible with land filling
	Areas immediately upwind of a residential area in the prevailing wind direction(s).
	Areas over which servitudes are held that would prevent the establishment of a waste disposal facility e.g. Eskom, Water Board

All the fatal flaws shown above would make the alternative site unfeasible for use as a landfill site. These flaws have been identified by the Department of Water Affairs (DWA) in their Minimum Requirements Document. Of the flaws mentioned above Alternative 10 – 12 were within 500 m of the Tutuka Airstrip and Alternatives 8 and 9 were within the secure power station area that cannot be accessed by the public or any waste contractor as it is a National Key Point Infrastructure. Therefore these sites were eliminated from the further screening process.

Detailed Site Selection

The detailed site selection was limited to the seven sites that did not have any of the fatal flaws presented above. The analysis was done by undertaking a site investigation and workshop with key Tutuka Power Station personnel. A matrix was compiled to highlight the ranking of the sites and is shown in **Table 5-2** below. A rating system of -3 to +3 was used to score the sites. Furthermore the sites were ranked according to Economic (economic and technical feasibility), Environmental and Public criteria, each of which is described in more detail below.

Economic Criteria

The economic criteria area focussed on the cost of the alternative if that alternative would have to be established and operated. This includes the distance to the site from the waste generators, the accessibility of the site, the ease of operations, the availability of cover material, the cost to establish the site and security concerns.

Under the economic criteria Alternatives 2, 3 & 4 was the most suitable with Alternative 7 being the least suitable. This was expected as Alternatives 2, 3 & 4 are located very close to the existing site, which is within the Alternative 3 boundary.

Environmental Criteria

The environmental criteria that were identified as important ranking components include the distance to ground or surface water features, the depth of the soils on site and the sensitivity of the receiving environment where the site will be established.

When considering the environmental criteria several sites were rated equal top with no apparent distinction between the sites. This is due to the close proximity of the site to each other with only subtle differences in the surrounding environment over such short distances.

Public Criteria

The public criteria that were considered during the site selection was the possible displacements of local habitants, the visibility of the site, the sensitivity at the access road and the distance to the nearest residential area.

According to the evaluation of the public criteria, Alternatives 2, 3 & 4 again were the most suitable sites, as these sites will present the least visibility from the main roads and settlements in the area. In addition these sites will avoid the displacement of local habitants and sensitivities around the access road.

Table 5-2: Site Selection Matrix for the Suitable Alternatives

Ranking Component		Alt 1	Alt 2	Alt 3	Alt 4	Alt 5	Alt 6	Alt 7
Economic	The distance of the site from the waste generation areas	1	1	1	1	1	1	-1
	Access to the landfill site	3	3	3	3	1	1	-1
	The availability of on-site soil to provide low cost cover material	1	1	1	1	1	1	1
	Ease of operation	1	1	1	1	1	1	1
	Cost to establish infrastructure	1	1	3	1	1	1	-1
	Security Concerns	-1	1	1	1	-1	-1	1
Total Economic		6	8	10	8	4	4	0
Enviro	The distance to ground or surface water	1	-1	-1	1	1	-1	-1
	The depth of soil on the site	1	1	1	1	1	-1	-1
	The sensitivity of the receiving environment e.g. vegetation, conservation areas or sensitive animals	1	1	3	1	1	1	1
Total Environmental		3	1	3	3	3	-1	-1
Public	The displacement of local inhabitants.	1	1	1	1	1	1	1
	Exposed sites with high visibility	-1	1	1	1	-1	-1	1
	The sensitivity of the environment through which the access road(s) passes	1	1	1	1	1	1	-1
	The distance to the nearest residential area	1	1	1	1	1	1	1
Total Public		2	4	4	4	2	2	2
	Overall Site Scoring	**11**	**13**	**17**	**15**	**9**	**5**	**1**

+3	Very suitable
+1	suitable
0	unknown
-1	unsuitable
-3	very unsuitable

Overall Site Scoring

When all of the abovementioned scores are added a clearer picture of the suitability of the sites emerge. Alternative 3 comes out as the most preferred site, closely followed by Alternative 4 and then Alternative 2. Alternative 3 is located in the proximity of the current site and therefore all the infrastructure and support services are in place including roads, security, monitoring boreholes and some fences. In addition the site carries the existing impact of the current site and therefore would not be as highly impacted upon by the new waste site as any of the other "greenfields" sites.

Is was therefore decided on the basis of the site selection exercise to investigate the combined areas of Alternatives 2, 3 & 4 during the EIA phase of the project. In order to avoid confusion, the sites were re-named Alternative A - C as shown in **Figure 5-2** below. Below follows a short description of each alternative. These three alternatives were taken to the EIA phase and are evaluated in this report.

Alternative A:

Alternative A represents the alternative to extend the current site westwards or southwards, or both. Due to the river on the north of the site the waste disposal site cannot extend in that direction. This site has the added benefit of having all the already existing infrastructure in place.

Alternative B:

Alternative B is located southeast of the current site in an open veldt area. This site has not been disturbed by previous borrow pit activities and presents an alternative to establish a new waste disposal site, away from the current site.

Alternative C:

Alternative C is located south of the current site and is closer to the Tutuka tar road. This location alternative can link into the existing services as they pass through the site on the way to the current site. This alternative also provides an alternative to establish a new site rather than extension.

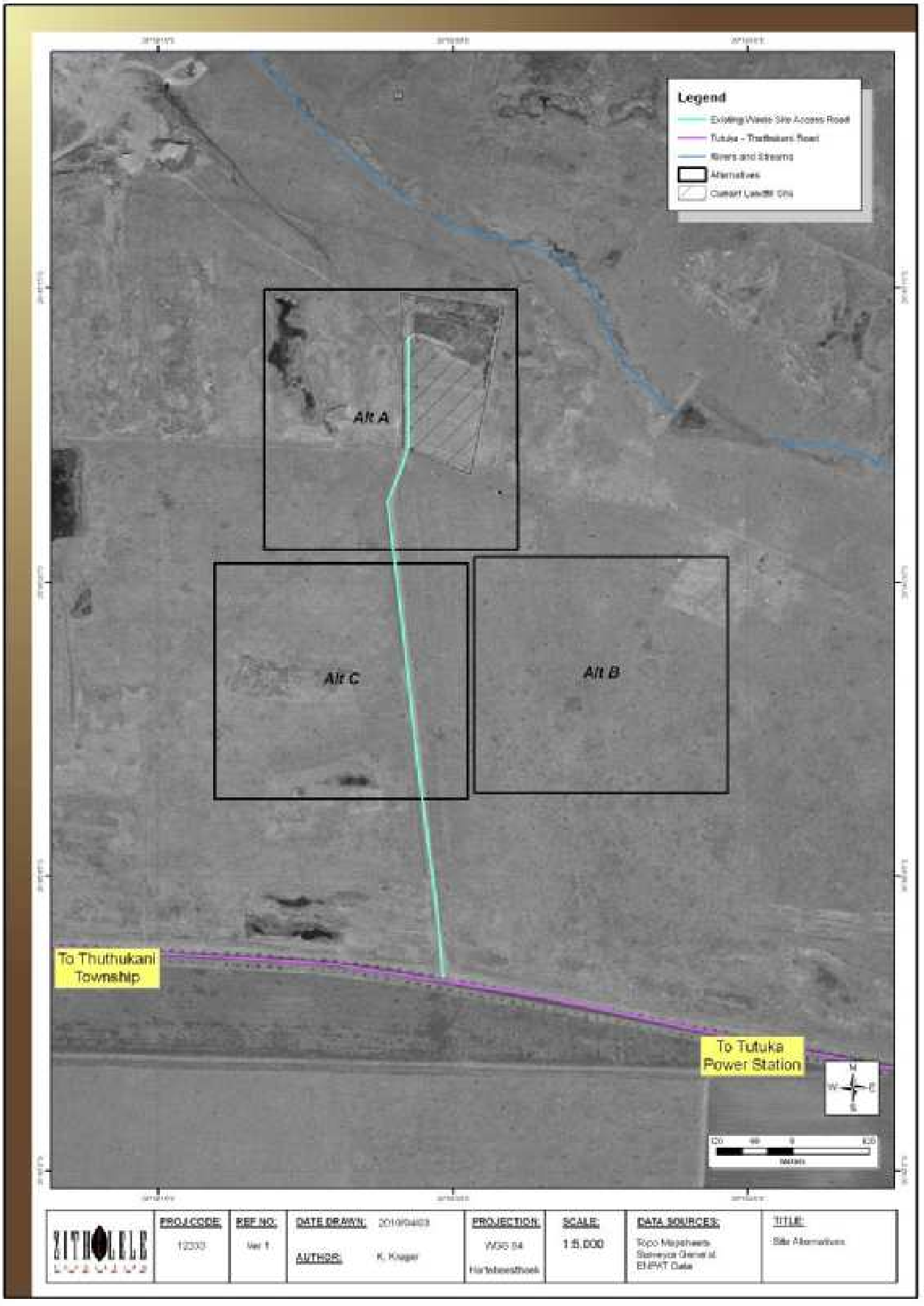

Figure 5-2: Site Alternatives

5.3 Operational Alternatives

At present the bulk of the Thuthukani area is serviced by centrally placed skips that are collected by a tractor that deliver the waste to the existing site. Furthermore trucks of various sizes also transport waste from the New Denmark Colliery and Tutuka Power Station. Currently there are no feasible alternatives to road transport of the waste, due to the short distances that are covered. An example of the skips is shown in **Figure 5-3** below.

Figure 5-3: Waste skips used to store waste for collection of the waste.

5.4 "No Go" Alternative

The "No-Go" alternative is assessed in detail further in the report. This alternative presents that, in the case that the project does not take place, the status quo will remain and the waste will continue to be transported by road to the Kriel waste disposal site, at huge operational costs and environmental risks. Should the "No-Go" alternative be the preferred alternative, Eskom will close of the existing waste disposal site and large costs incurred as a result of the transportation of waste will persist. The environmental and social impacts will be assessed and compared to the aforementioned alternatives.

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6 ISSUES AND CONCERNS RAISED

The proposed Tutuka waste disposal site is anticipated to impact on a range of biophysical and socio-economic aspects of the environment. The main purpose of the EIA process is to evaluate the significance of these potential impacts and to determine how they can be minimized or mitigated.

It should be noted that a comprehensive Environmental Management Plan (EMP) was developed and will be implemented to regulate and minimize the impacts during the various project phases. Furthermore an Operational Management Plan (OMP) was compiled to manage the operations of the waste disposal site and a Closure and End-Use Plan has been compiled to manage the required activities for the decommissioning phase. The potential environmental impacts identified during the Scoping Phase, which are being investigated further in this phase of the project are summarised below.

Issues raised to date by stakeholders:

- Waste management;
- Surface and ground water pollution;
- Registration of additional stakeholders; and
- Site must be properly designed.

In turn the Scoping Report identified the following specialist studies that were undertaken as part of the EIA in order to determine any potential impacts from this development:

- Disposal Site Design;
- Topographical Survey;
- Geotechnical Assessment;
- Soil and Agricultural Assessment;
- Surface and Groundwater Assessment;
- Heritage Impact Assessment;
- Ecological Assessment;
- Visual Assessment;
- Noise Opinion;
- Air Quality Opinion; and
- Traffic Opinion.

7 RECEIVING ENVIRONMENT

The regional environment is described in the section below. For the context of this report the regional environment refers to a 20 km radius around the Tutuka Power Station.

7.1 Geology

7.1.1 Methodology and Data Sources

A geotechnical investigation was undertaken by Peter Legg Consulting Geo-Environmental Engineers for the proposed project and the detailed report is attached in **Appendix H**. The methodology followed is outlined below.

Soil Profiling

Ten test pits were excavated on the site using a Case 580 TLB excavator. All test pits were excavated to refusal. The positions of the test pits were determined using a GPS.

Each test pit was entered by a geotechnical engineer and profiled in-situ in terms of the standard descriptors of moisture condition, colour, consistency, structure, soil type and origin (MCCSSO)[(3)].

7.1.2 Regional Description

According to the 1:1 000 000 "*Geological Map of the Republic of South Africa and the Kingdoms of Lesotho and Swaziland 1997*" as prepared by the Council for Geoscience, the site is located within the Vryheid Formation of the Ecca Series of the Karoo Supergroup. This formation consists principally of dark-grey shale, which is carbon rich in places (coal), together with interbedded sandstone units. The shale is laminated and, on weathering, breaks up into plates and flakes. In the greater Tutuka area, the Karoo shales are overlain by a large dolerite sill of significant thickness.

A geological map showing the site location is included as **Figure 7-1** below.

7.1.3 Regional Description

Engineering Geology

According to Brink[(1)], in areas where the Weinert climatic N-value[3] is between 2 and 5, the weathering of the dolerite results in the primary minerals decomposing into secondary minerals of the smectite group, mainly montmorillonite, occurring in the form of grey to black, highly active clays. These clays are best developed in poorly drained areas or flat terrain. The depth of clay is therefore

[3] The N-value is calculated as $N = 12xE_j/P_a$, where E_j = Evaporation during January, P_a = Annual precipitation

related to the topography, being thicker in flat areas and thinner in steeper areas. The Tutuka Power Station and surrounds fall within the zone of 2 < N-value < 5. Therefore highly active black clays, commonly referred to as "black turf" would be expected in the area of the waste disposal site.

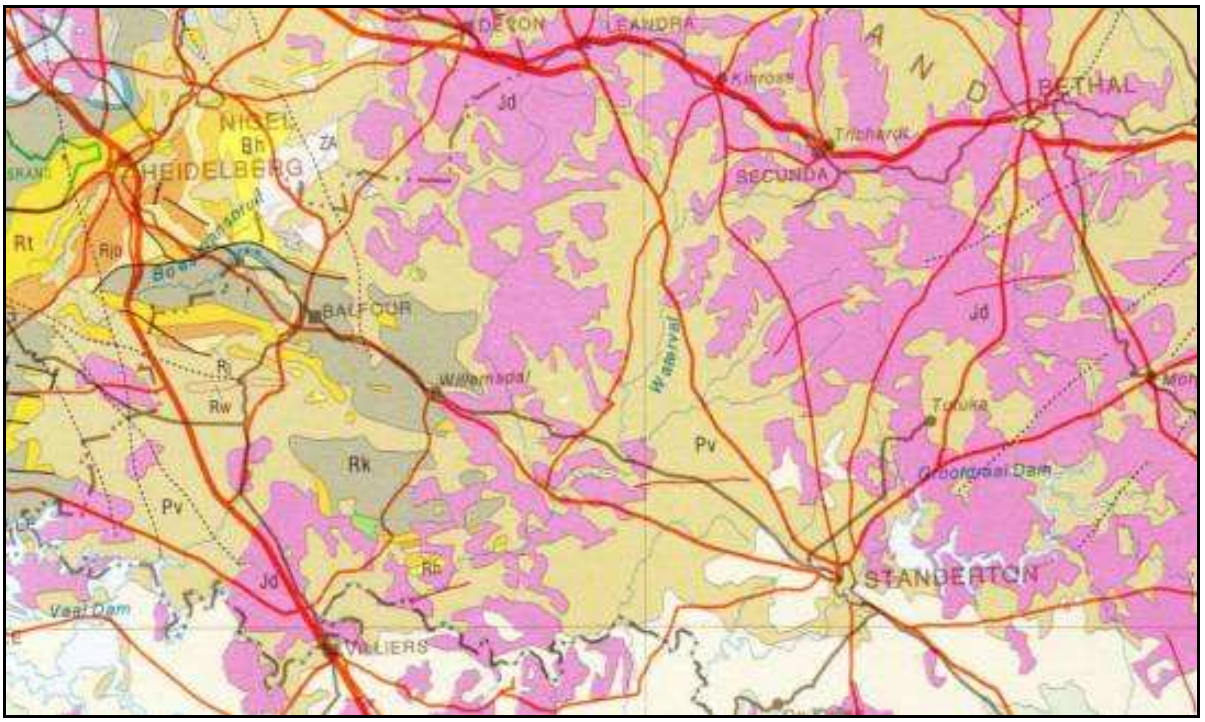

Figure 7-1: Geological Map showing the study area.

Legend: Jd = Dolerite
Pv = Karoo Vryheid Formation

Geotechnical Soil Evaluation

The test pit profiles indicated the following generalised soil profile across the site, as summarised in **Table 7-1** below.

Table 7-1: Test pit summary showing depths of the different soil horizons.

Test Pit No	Black Clay (Turf)	Light brown sand/gravel/clay Pebble marker	Weathered dolorite	Testpit depth (m) (refusal)
TP1	0.45 – 0.8	0.8 – 1.4	1.4 – 2.0	2.0
TP2	0 – 0.4	0.4 – 0.7	0.7 – 1.5	1.5
TP3	0 – 0.25	0.25 – 0.55	0.55 – 1.0	1.0
TP4	0 – 0.45	0.45 – 0.6	0.6 – 1.9	1.9
TP5	0 – 0.45	0.45 – 0.75	0.75 – 2.1	2.1
TP6	0 – 0.5	0.5 – 0.8	0.8 – 1.7	1.7
TP7	0 – 0.4	0.4 – 0.55	0.55 – 1.35	1.35
TP8	0 – 0.4	0.4 – 0.55	0.55 – 1.65	1.65
TP9	0 – 0.3	0.3 – 0.5	0.5 – 1.0	1.0
TP10	0 – 0.45	0.45 – 0.55	0.55 – 1.0	1.0

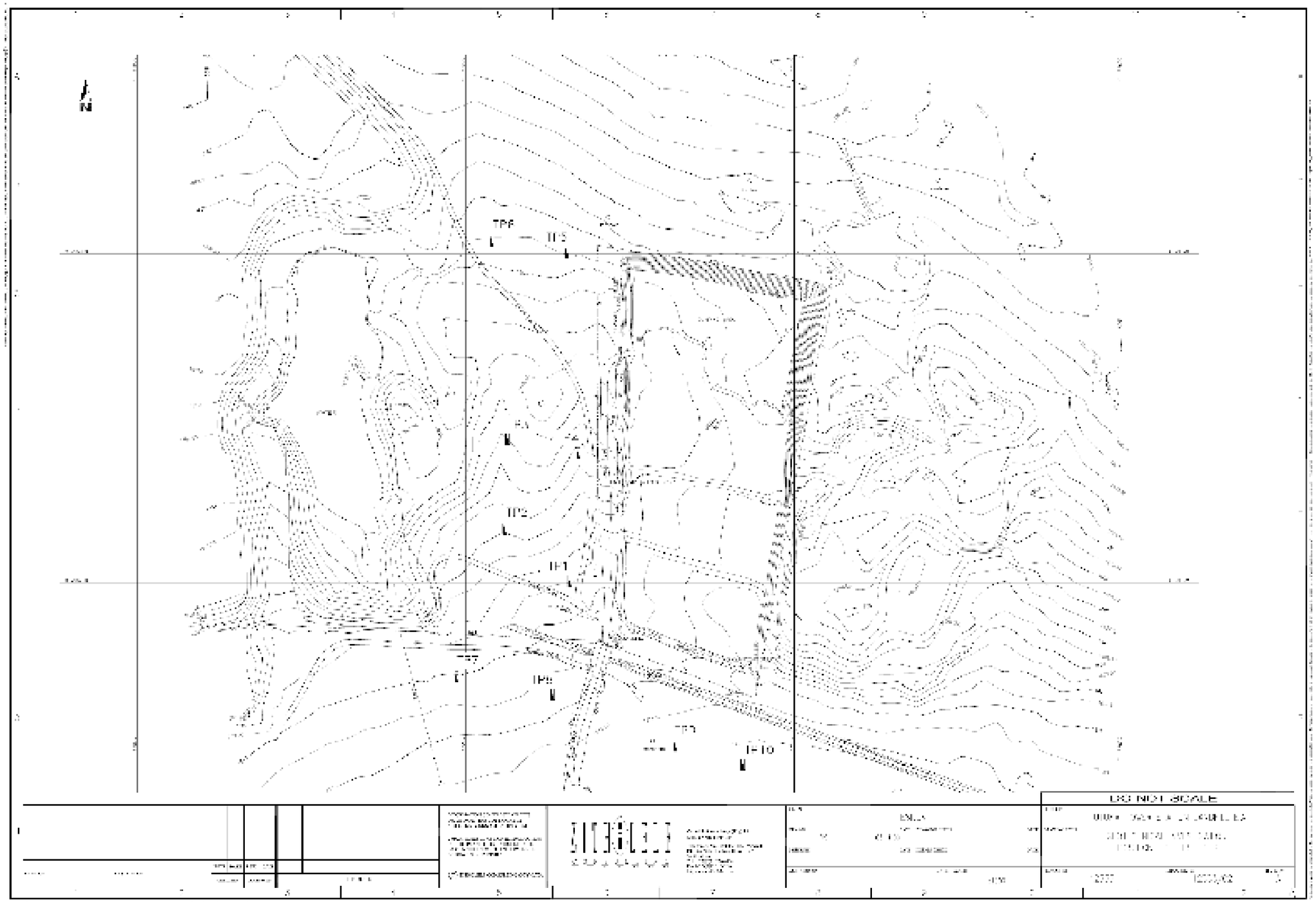

Figure 7-2: Location of the Test Pits

From the soil profile summary (**Table 7-1**), it is seen that refusal on weathered dolerite occurred in all 10 test pits, with the deepest (2.1 m) being at the lower end of the site, and the shallowest (1.0 m) being at the higher end of the site. This is consistent with the literature, with increased erosion of weathered materials on the higher slopes and increased in-situ weathering of rocks lower down the slope.

Fill (waste)

In test pit TP1, there was a thin layer of waste materials – building rubble (0.45 m), however waste was not found in any of the other test pits, so that it would appear to be an isolated "pocket" of waste. However during construction of the landfill liner, care will have to be taken to remove any waste that has been deposited and backfill the areas with compacted selected fill material.

Colluvial Soil (black clay)

There is a layer of expansive colluvial black clay that is the product of decomposed transported dolerite. This black clay layer varies in thickness across the site from 0.25 m to 0.8 m. Because of its highly expansive nature, this clay is totally unsuitable as a founding stratum or for use in a compacted clay liner. As the site investigation was carried out during the summer rainfall period and because there had been significant rain in the weeks prior to the investigation, the black clay was moist to very moist, and did not show desiccation cracking. However, the very high linear shrinkage of the black clay results in large shrinkage cracks on desiccation. It should therefore be removed from the site before the landfill liner is constructed and stockpiles for use as landfill cover material.

Residual dolerite

Beneath the black clay there is a layer of light brown (yellow to orange brown) medium dense to dense, residual dolerite that varies from gravely sand, to sandy gravel, to sandy clay in places. This material should form the base of the landfill liner. It could also be used as a founding stratum for lightly loaded buildings with foundation bearing pressures up to 200 kPa.

It is also noted that this soil is the material that has been exploited from the area for use in roads and construction fill.

Weathered Dolerite

Beneath the residual dolerite soil is a layer of weathered dolerite that increases in strength with depth. The weathered dolerite appears as "granular (sugar) dolerite" in the upper zones of the soil profile with typical "onion" shell cobbles and small boulders. There is evidence of decomposition of the dolerite. Lower down in the profile, the weathered dolerite becomes more like "gravel dolerite" with a disintegrated and fractured nature. The consistency of this horizon is dense to very dense, which indicates a safe bearing capacity of about 400 kPa. This material would provide a suitable founding stratum and would also be suitable for use in engineered fill and pavement layers.

Bedrock

Depth to weathered dolerite bedrock increases down the slope from about 1.0m on the upper side of the site to 2.1 m on the lower side of the site. If required as a founding stratum, the weathered dolerite bedrock would provide a safe bearing capacity of about 500 kPa. The weathered rock would be excavatable by means of a large hydraulic excavator or dozer ripper, without the need for blasting.

7.1.4 Sensitivities and Geotechnical Evaluation

The overlying black clay cannot be used for liner construction or for foundation loading as the clay swell and shrinks, cracking and therefore needs to be removed. It should be stockpiled for use in waste disposal cover operations. As the isolated ash and rubble fill (fill/waste) overlies the black clay identified within test pit 1, it will also need to be removed.

The underlying sandy residual dolerite soil should be shaped to form a subgrade surface for a geosynthetic landfill liner system. This material could also be used as a subgrade material for the site roads.

7.2 Topography

7.2.1 Data Collection

The topography data was obtained from the Surveyor General 1:50 000 toposheet data for the region, namely 2629CB and CD. Contours were combined from the topographical mapsheets to form a combined contour layer. Using the Arcview GIS software the contour information was used to develop a digital elevation model of the region as shown in **Figure** 7-3 below.

7.2.2 Regional Description

The topography of the region is gently undulating to moderately undulating landscape of the Highveld plateau. Some small scattered wetlands and pans occur in the area, rocky outcrops and ridges also form part of significant landscape features in the area. Altitude ranges between 1 550 – 1 665 metres above mean sea level (mamsl). **Figure 7-3** provides an illustration of the topography of the site. There are no ridges in the immediate study area of the waste disposal site.

From the figure it can be seen that the proposed study area is located between two drainage lines on a slight plain that slopes towards the northeast.

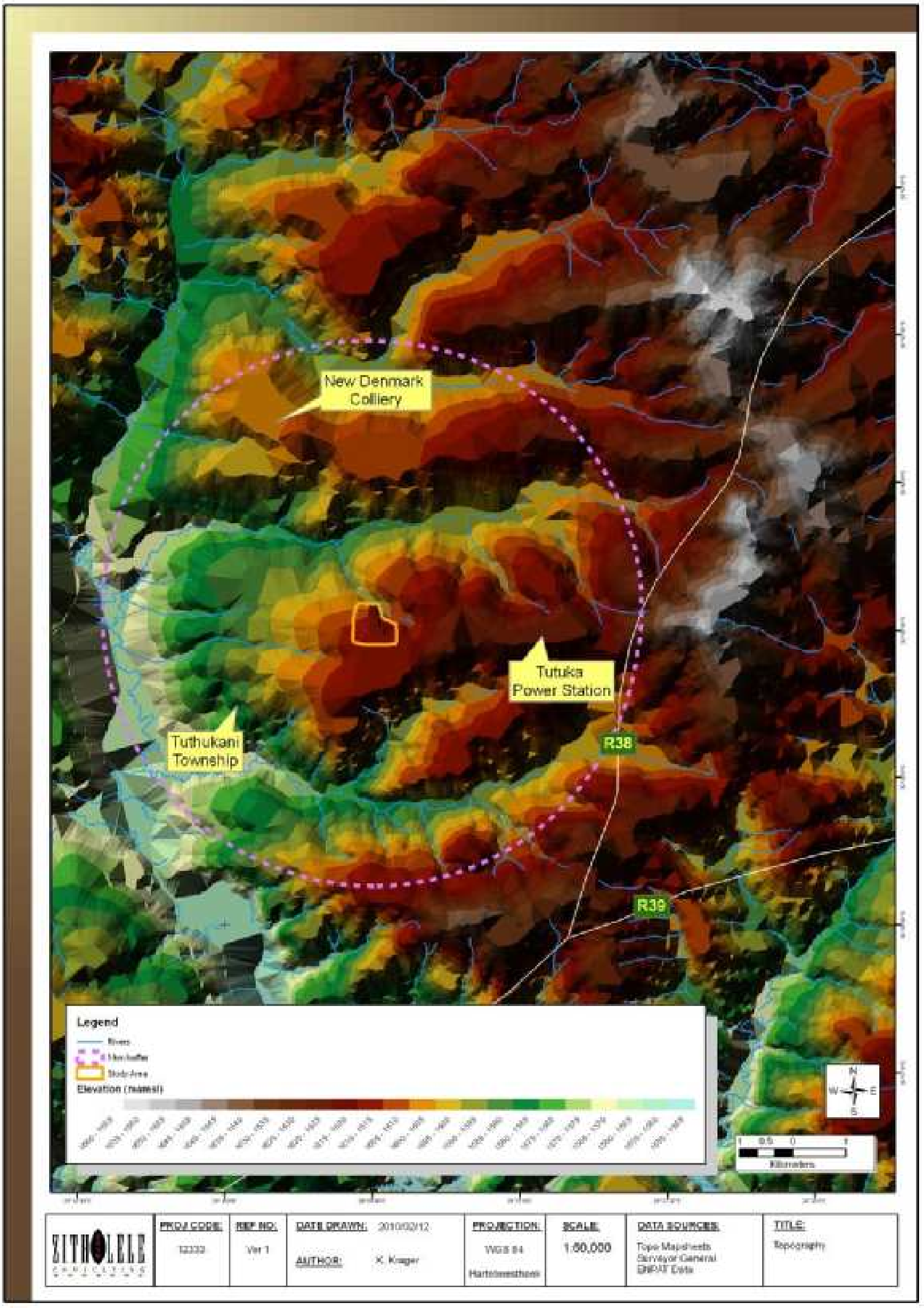

Figure 7-3: Topography of the area.

7.3 Soils and Agricultural Potential

7.3.1 Methodology

Internal resources at Zitholele Consulting undertook the soil specialist study through a site visit, and by desktop investigations using GIS software. The entire area was surveyed and soil samples were taken for characterising.

7.3.2 Data Collection

The site visit was conducted in January 2010. Soils were augered at 150m intervals along the proposed railway line routes using a 150 mm bucket auger, up to refusal or 1.2 m. Soils were identified according to Soil Classification; a taxonomic system for South Africa (Memoirs on the Natural Resources of South Africa, no. 15, 1991). The following soil characteristics were documented:

- Soil horizons;
- Soil colour;
- Soil depth;
- Soil texture (Field determination);
- Wetness;
- Occurrence of concretions or rocks; and
- Underlying material (if possible).

7.3.3 Regional Description

The soils in the region are mostly derived from the geology of the region namely; shale, sandstone conglomerate and dolerite intrusions which feature prominently in the area. The soils are generally shallow with a dark brown colour.

7.3.4 Site Description

During the site visit it was noted that only soils originating from dolerite were identified and Figure 7-4 illustrates the location of the soil types. The land capability (agricultural potential) of the abovementioned soil form is described in more detail in Section 1.4.

Dark Soils

The dark soils are characterised by the dark colour of the topsoil which in this case originates from the weathering Dolerite, which produces dark clays. Generally these soils are not suitable for cultivation and in most cases are only usable as light grazing. The soil forms found was the Milkwood and Inhoek Soil Forms, which are described below.

Figure 7-4: Soil Type Map

Milkwood soil form

The Milkwood soil form is characterised by a Melanic A – horizon overlying hard rock. Milkwood soil is characterised by the dark colour of the topsoil and the shallow Dolerite in the soil profile. In several places the Dolerite is so shallow that it is visible on the surface. Figure 7-5 illustrates a typical Milkwood soil form.

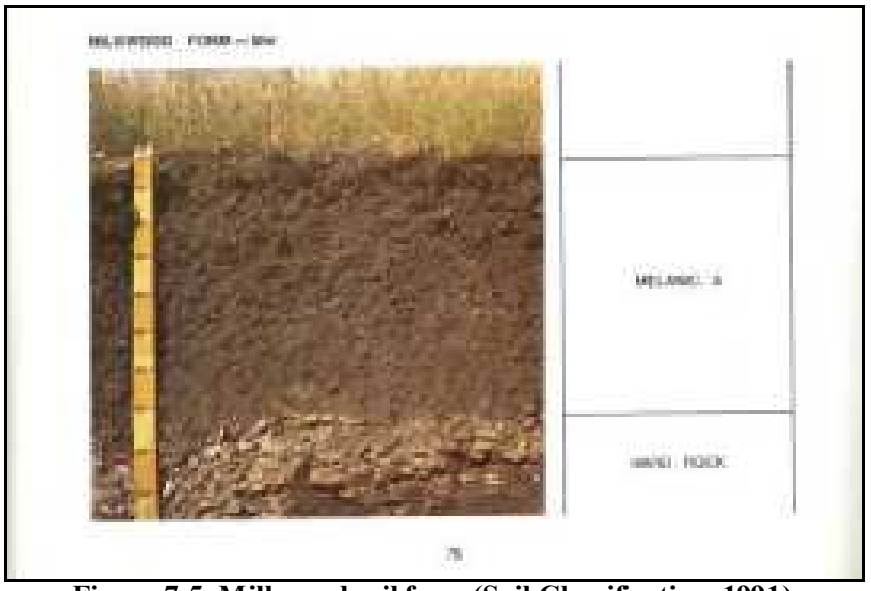

Figure 7-5: Milkwood soil form (Soil Classification, 1991).

Inhoek Soil Form

Inhoek soils are typical in areas underlain by Dolerite. The dark topsoil with no further subsoil horizons is typical of the lower reaches of the slopes in the study area. This soil type is indicated in Figure 7-6 below.

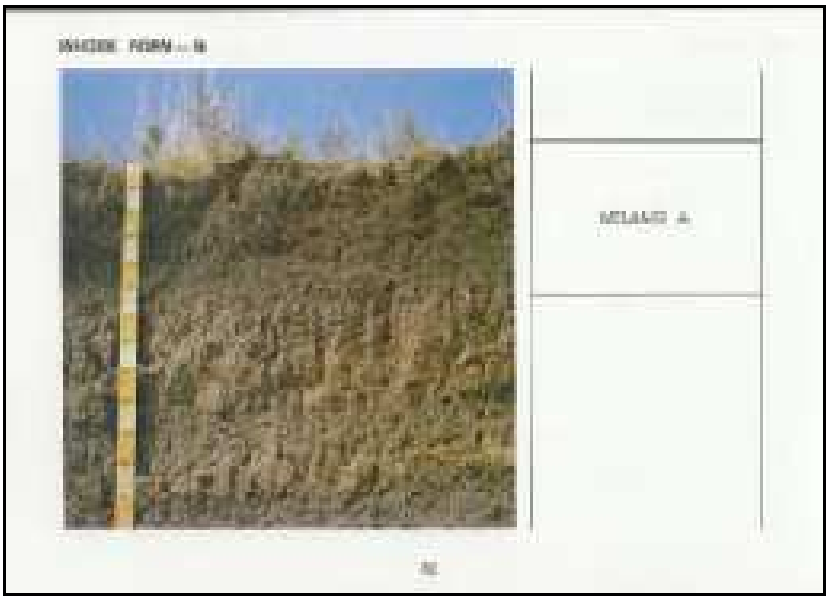

Figure 7-6: Inhoek soil form (Soil Classification, 1991)

Disturbed Soils

In the soil classification system there is a distinctive Soil Form called the Witbank form, which allows for the classification of soils that have been formed by human actions. On site the current waste disposal site is a perfect example of just such a case, where the domestic waste has been mixed with natural soil. The soil is made up of an Orthic A horizon over a man-made deposit, as indicated in Figure 7-7 below.

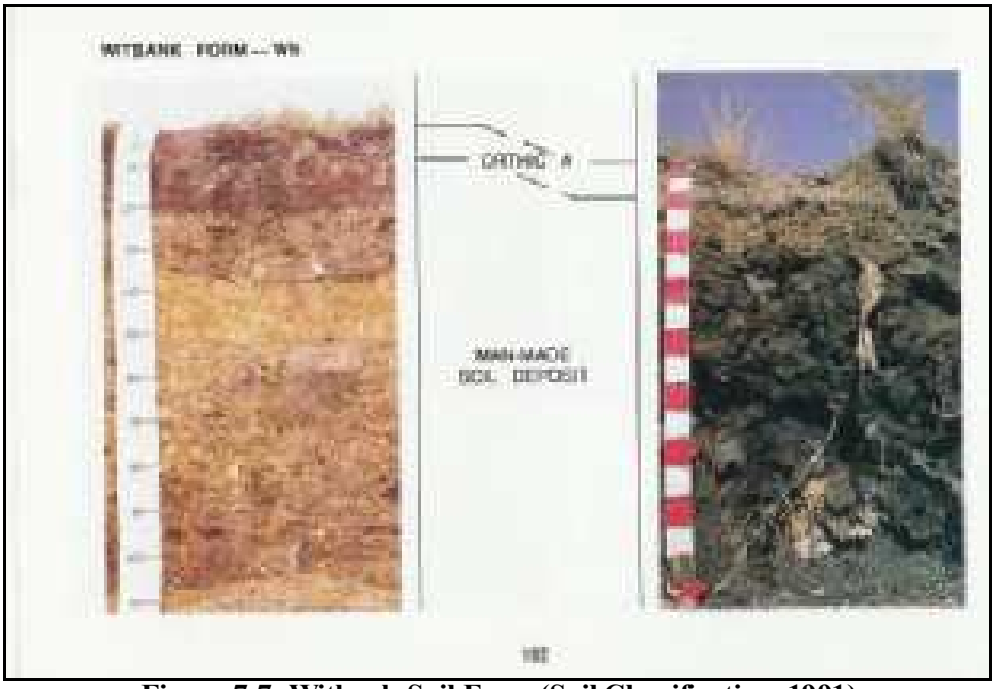

Figure 7-7: Witbank Soil Form (Soil Classification, 1991)

Clay Soils

The clay soil management unit is found in areas where clays have accumulated to such an extent that the majority of the soil matrix is made up of clay particles. These soils are usually indicative of seasonal or permanent wetland conditions. The main soil form found was the Willowbrook Soil Form as described below.

Willowbrook Soil Form

Willowbrook soils are characterised by Melanic A-horizon over a G-horizon. The G-horizon is invariably firm or very firm and its characteristics are described above. The Melanic horizon has several unique diagnostic criteria as a horizon, namely:

- Has a dark colour in the dry state.

- Lack slickensides that are diagnostic of vertic horizons.
- Has less organic carbon than required for diagnostic organic O horizon.
- Has structure that is strong enough so that the major part of the horizon is not both massive and hard or very hard when dry.

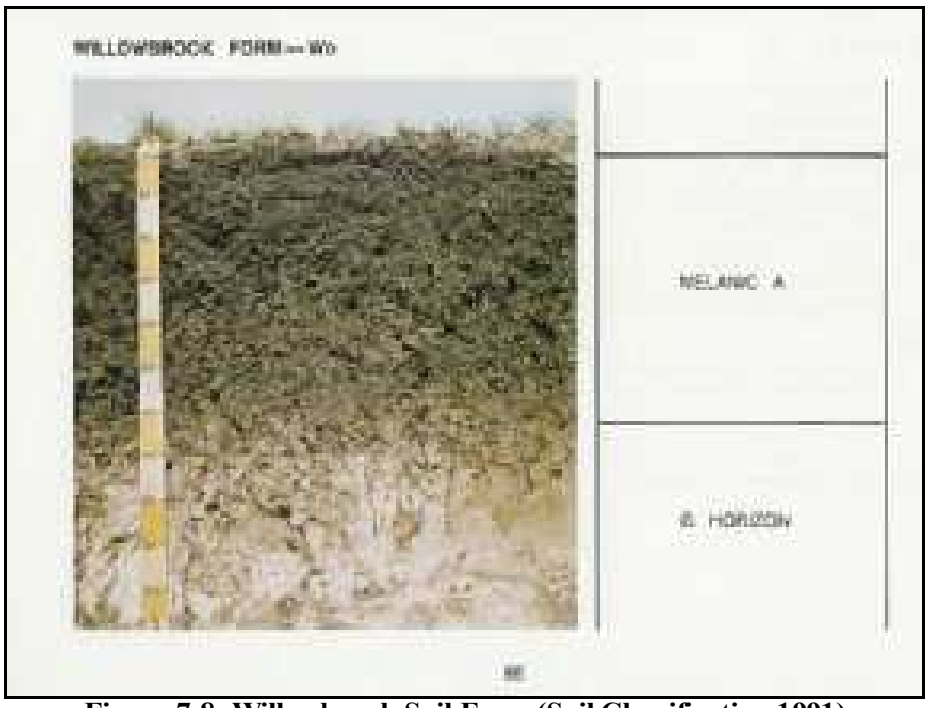

Figure 7-8: Willowbrook Soil Form (Soil Classification 1991)

7.4 Agricultural Potential (Land Capability)

7.4.1 Data Collection

A literature review was conducted in order to obtain any relevant information concerning the area, including information from the Environmental Potential Atlas (ENPAT), Weather Bureau and Department of Agriculture. Results from the soil study were taken into account when determining the agricultural potential also known as the land capability of the site. The land capability assessment methodology as outlined by the National Department of Agriculture was used to assess the soil's capability to support agriculture on site.

7.4.2 Regional Description

The regional land capability is mostly class IV soils with limitations. This is evident from the large number of grazing land as opposed to cultivated lands found in the region. This is due to the fact that the effective soil depth is too shallow or too wet to cultivate, and livestock is grazed instead.

7.4.3 Site Description

According to the land capability methodology, the potential for a soil to be utilised for agriculture is based on a wide number of factors. These are listed in **Table 7-2**along with a short description of each factor.

Table 7-2: Agricultural Potential criteria

Criteria	Description
Rock Complex	If a soil type has prevalent rocks in the upper sections of the soil it is a limiting factor to the soil's agricultural potential
Flooding Risk	The risk of flooding is determined by the closeness of the soil to water sources.
Erosion Risk	The erosion risk of a soil is determined by combining the wind and water erosion potentials.
Slope	The slope of the site could potentially limit the agricultural use thereof.
Texture	The texture of the soil can limit its agricultural use by being too sandy or too clayey.
Depth	The effective depth of a soil is critical for the rooting zone for agricultural crops.
Drainage	The capability of a soil to drain water is important as most grain crops do not tolerate submergence in water.
Mechanical Limitations	Mechanical limitations are any factors that could prevent the soil from being tilled or ploughed.
pH	The pH of the soil is important when considering soil nutrients and hence fertility.
Soil Capability	This section highlights the soil type's capability to sustain agriculture.
Climate Class	The climate class highlights the prevalent climatic conditions that could influence the agricultural use of a site.
Land Capability / Agricultural Potential	The land capability or agricultural potential rating for a site combines the soil capability and the climate class to arrive at the sites potential to support agriculture.

The soils identified in Section 7.3 above were classified according to the methodology proposed by the Agricultural Research Council – Institute for Soil, Climate and Water (2002). The criteria mentioned above were evaluated against the soils identified, as reflected in **Table 7-3**. **Figure 7-9** illustrates the various land capability units on site.

Table 7-3: Land Capability of the soils on site for agricultural use

Soil type	Inhoek	Willowbrook	Witbank	Milkwood
% of Site	7	10	3	80
Rock Complex	None	None	Yes – man made waste	Yes – hard rock
Flooding	Occasional	Yes	None	None
Erosion	Low	Low to moderate	Low to moderate	Low to moderate
Slope	15 degrees	5 – 10 degrees	15 degrees	15 degrees
Water Erosion	Low to moderate	High	Low to moderate	Low to moderate
Wind Erosion	Low	Low	Low	Low
Texture (% clay)	15 – 45	40 +	15 – 45	15 – 45
Depth (mm)	> 800	100 - 399	100 - 399	100 - 399

Soil type	Inhoek	Willowbrook	Witbank	Milkwood
Drainage	Indifferent	Indifferent	Indifferent	Indifferent
Mechanical Limitations	Clay content high	Clay content too high	Very Shallow soils on rock	Very Shallow soils on rock
pH	>5.0	>5.0	>5.0	>5.0
Climate Class	Slight			
Soil Capability	V	VI	VIII	VI
Land Capability	V - Grazing	VI - Grazing	VIII - none	VI - Grazing

No limitation	Low to Moderate	Moderate	High	Very Limiting

The site is made up of one main land capability class, namely class VI – grazing. None of the soils on site are suited to cultivation due to the high clay contents in the soils. The dominant class VI soils have continuing limitations that cannot be corrected; in this case rock complexes, clay content, stoniness, and a shallow rooting zone constitute these limitations.

Therefore the soils on site have the potential to support light grazing, as it is doing at present.

Figure 7-9: Agricultural Potential Map

7.5 Surface Water

7.5.1 Data Collection

A site visit was conducted in January 2010 where notes were taken on the surface water situation. In addition a desktop surface water resource survey was undertaken to investigate the potential surface water bodies that could be affected by the proposed waste disposal site. Data from the WRC database (DWA) as well as the Surveyor General 1:50 000 topographical maps were utilised as part of the analysis.

7.5.2 Regional Description

Regionally the site is located within the C11K quaternary catchment that drains southwards towards the Grootdraai Dam via the Leeuspruit (Figure 7-10). The Grootdraai Dam is the largest surface water body in the region. The description below was obtained as a comment from the Department of Water Affairs:

"Grootdraai Dam is situated in the upper reaches of the Vaal River less than 10 km upstream of Standerton. It has a catchment area of 8 195 km^2, a mean annual precipitation of approximately 750 mm, a mean annual potential evaporation at the dam site of 1 400 mm and a natural inflow of 580 million m^3/annum. The full supply capacity of the reservoir is 364 million m^3, making it a 0.7 MAR dam.

Grootdraai Dam is a composite structure comprising a central concrete gravity section 360 m long and two earthfill flanks giving a total crest length of 2 180 m and a maximum wall height of 42 m above lowest foundation level. The dam was completed in 1982 and was built primarily to support the water needs of the SASOL I, II and III coal to petrol plants at Secunda, Eskom's Tutuka Power Station as well as the Matla, Duvha, Kendal and Kriel Power Stations located on the coal fields in the adjacent Olifants River basin.

The dam also provides some flood attenuation for Standerton and stores up to 100 million m^3/annum of flood water pumped into the upper reaches of the Vaal River basin from Heyshope Dam in the Usutu basin."

7.5.3 Site Description

The proposed waste disposal site is located just south (50 – 75 m) of an unnamed non-perennial stream. This stream drains north-westwards towards a tributary of the Leeuspruit known as the Racesbult spruit. After approximately 4 km the Racesbult spruit enters the Leeuspruit which then drains southward towards the Grootdraai Dam. The unnamed stream has two small earthen dams located within the stream that was constructed prior to 1982. It is possible that these dams were used by farmers as a water source for livestock, as the main land use in the area is grazing land. These dams are not in use at present as they have silted up.

In addition to the dams in the stream several old borrow pits are located within the dolorite sill in the vicinity of the waste disposal site. These old pits were used during the power station and road construction in the area as a source of base material prior to 1982. The pits have through time accumulated water and at present provide small ponds in which some aquatic life has established itself. These pits are closed units that do not link up with any of the streams or dams in the area.

All the features described above are illustrated in **Figure 7-11** below. As shown on the map, there are two borrow pit areas within the potential study site for the waste disposal site. As these are currently functioning as natural water features in spite of their anthropogenic origin, it is suggested that they be avoided.

Currently there are two surface water monitoring points adjacent to the current waste disposal site and two surface water monitoring points within the Racesbult spruit, one above and one below the confluence of the unnamed tributary with the Racesbult spruit. Any surface water impacts should be picked up in the results from the quarterly monitoring undertaken at the power station. As shown in the **Figure 7-11** there is also a ground water monitoring network present on site. Unfortunately the monitoring points within the unnamed stream very often cannot be used due to the fact that there is no surface water available to monitor. Indications from the Racesbult spruit monitoring points are that for the following monitoring criteria there is no significant impact to surface water as the monitored levels over the last eight years are within South African drinking water standards;

- Electrical Conductivity;
- Sodium;
- Calcium;
- Chlorine; and
- Sulphates.

These results from the GHT report are attached in **Appendix I**.

In addition to these points mentioned the Tutuka Power Station has an extensive monitoring network covering all the potential downstream water bodies including the Leeuspruit, in order to monitor impacts to regional users such as the Grootdraai Dam.

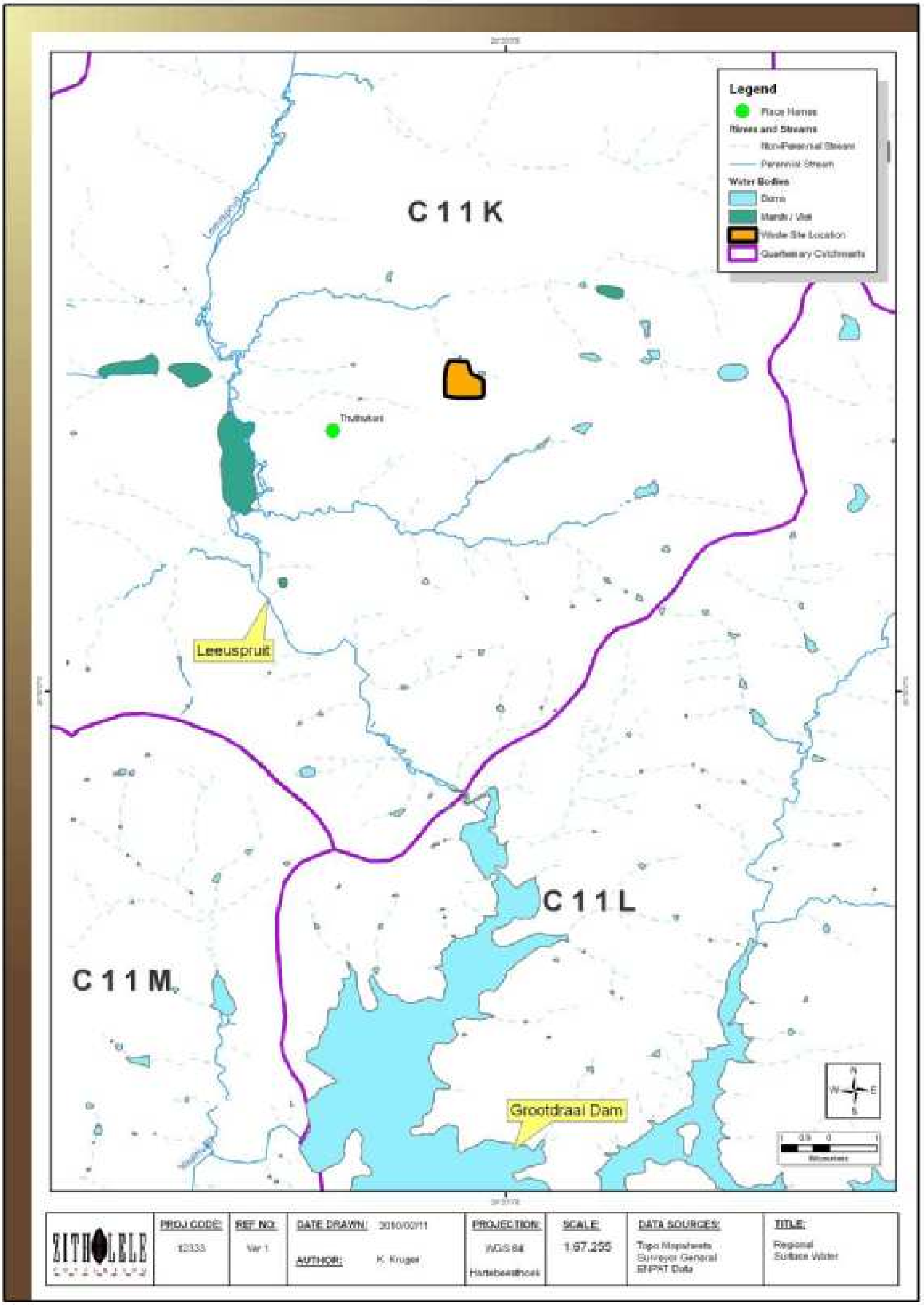

Figure 7-10: Regional surface water and drainage features.

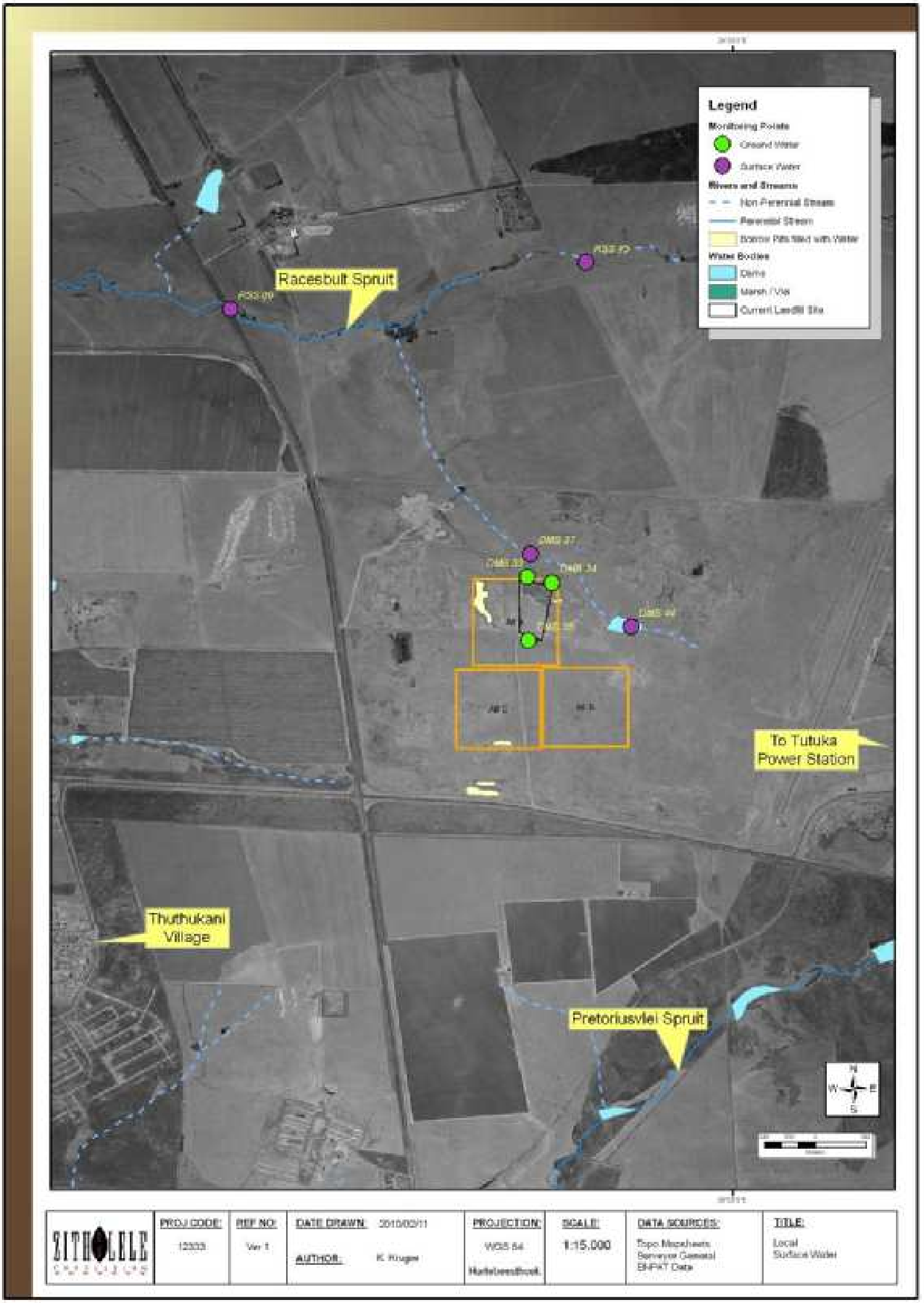

Figure 7-11: Local Surface Water Map

7.6 Ground Water

The ground water assessment was undertaken by GHT consulting and this section is extracted from the specialist report attached in **Appendix M**.

7.6.1 Data Collection and Methodology

GHT Consulting was commissioned to investigate the surface and groundwater impacts of a proposed project with a view of collecting sufficient geotechnical data to allow an assessment of site suitability. The approach taken to the investigations was sub-divided into the following phases:

- Preliminary site walkover and assessment;
- Geological mapping;
- Geophysical investigations;
- Installation of monitoring boreholes;
- Sampling of representative soil / unsaturated zone profiles during the drilling phase;
- Hydrocensus and collection of background surface and groundwater samples for laboratory analysis; and,
- Geohydrological assessment.

Field investigations commenced during the first week of February 2010, revisited in April 2010 and subsequently completed by the 24th April 2010.

7.6.2 Site Description

Logging undertaken during the different drilling phases indicates that perched and regional aquifer systems are associated with the Karoo sediments at the site. The upper aquifer appears to be perched on an impermeable dolerite sill and has a relatively localised occurrence depending on the thickness of the weathered dolerite zone, while the deeper aquifer is restricted to minor fractures, cracks and joints interfaces within the fresh dolerites. While unconfirmed, it seems likely that the deeper aquifer forms part of the regional groundwater system. There is, however, little apparent difference between the Submerged Water Level (SWL) of the respective groundwater systems, although available evidence does suggest that the SWL is slightly deeper in the regional system.

The fluctuations in the groundwater and piezometric levels that have been observed since 1995 in the boreholes near the waste disposal site are shown in Figure 7-12 and Figure 7-13 (respectively water level depths and water level elevations). Relative stable trends in the water table depths with some seasonal fluctuations in the groundwater levels of all the existing boreholes are observed. The three new boreholes water levels were measured eight days after drilling and again on the 14 April 2010 a month after drilling. The water levels in these three newly drilled boreholes had risen since it was measured the first time (DMB87 0.38 m– 0, DMB88 – 2.22 m, DMB89 – 0.05 m) which is a clear indication of the low permeabilities of the aquifers in the area.

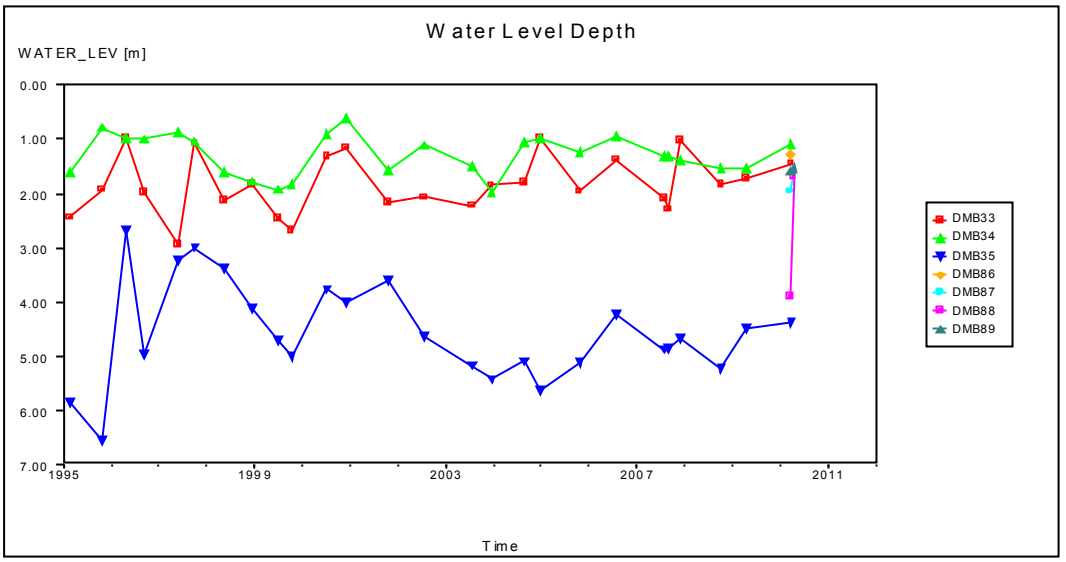

Figure 7-12: Water level depths of boreholes in the waste disposal site area – (mbgl).

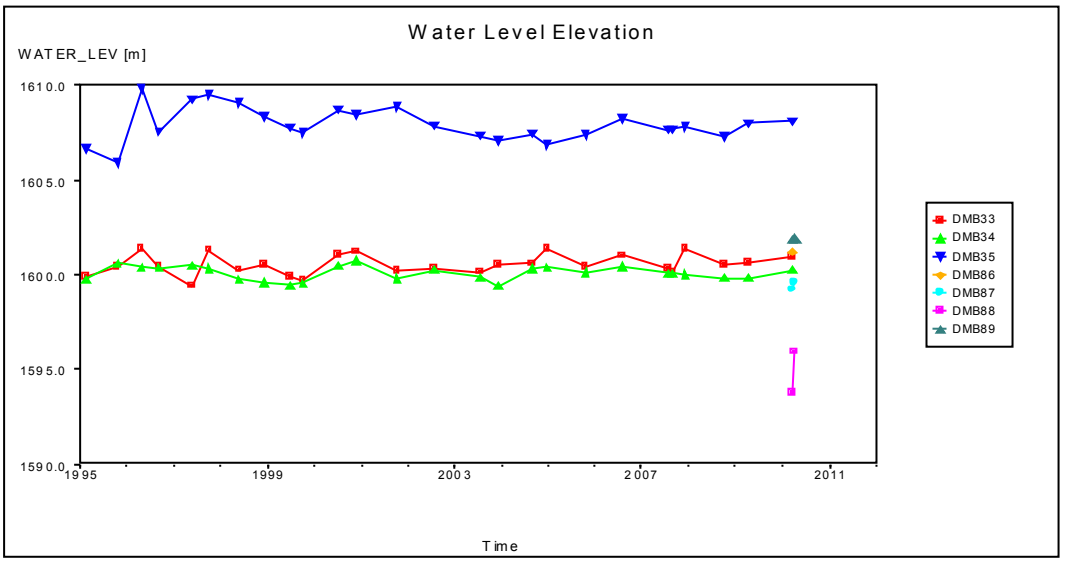

Figure 7-13: Water level elevation of boreholes in the waste disposal site area – (mamsl).

The observed relationship between the groundwater table and site topography suggested that the Bayesian interpolation method could be used to estimate the depth to the water table on a regional scale. The method allows SWL contours to be generated using available SWL and surface elevation data. A representative set of SWL contours generated using measurements taken during the hydrocensus and 5 m contours from 1:10 000 topographic contour data is shown in **Figure 7-14**. The plot confirms the presence of major natural groundwater divides (essentially flow boundaries) to the northeast and north of the site, following the course of the non-perennial spruit and the Racesbult Spruit, respectively.

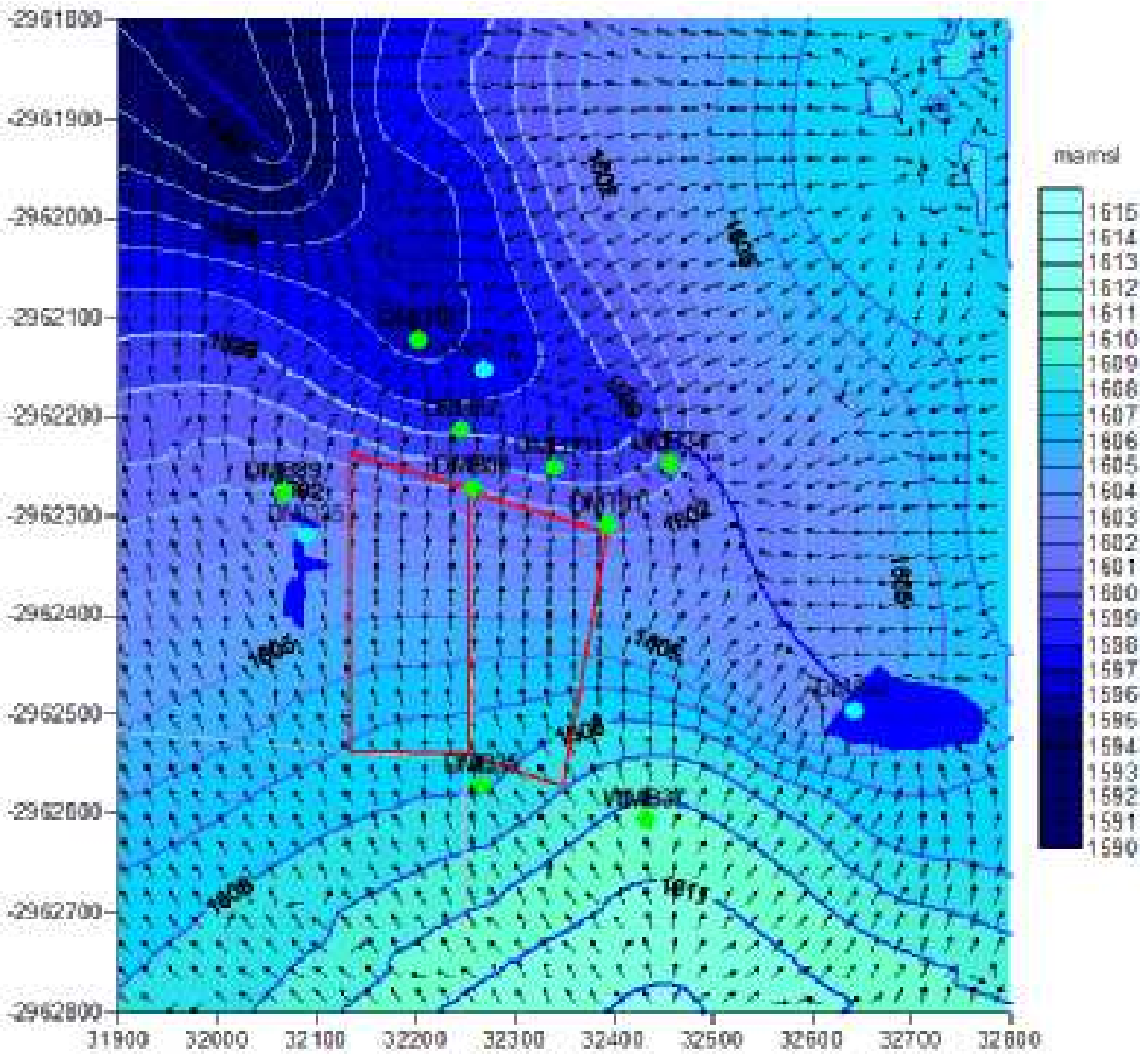

Figure 7-14: Groundwater level contour map measured in meters above mean sea level.

Dolerites observed at borrow pits and outcrops were typically fractured throughout, with the presence of Fe and Mn oxides along fracture faces suggesting water movement through a permeable medium. Similar characteristics were observed throughout the top few meters of the dolerite sill intercepted by the monitoring boreholes, which implies that aquifers within these structures are essentially unconfined and purged on top of the impermeable dolerite sill. This is confirmed by the depth to groundwater table underneath the proposed extension varied from approximately 3 mbgl in the south to less than 1 mbgl in the north (**Refer Figure 7-15**). These aquifers can be recharged directly from rainfall or from surface water bodies, with the rate of recharge influenced by site hydraulic conductivity.

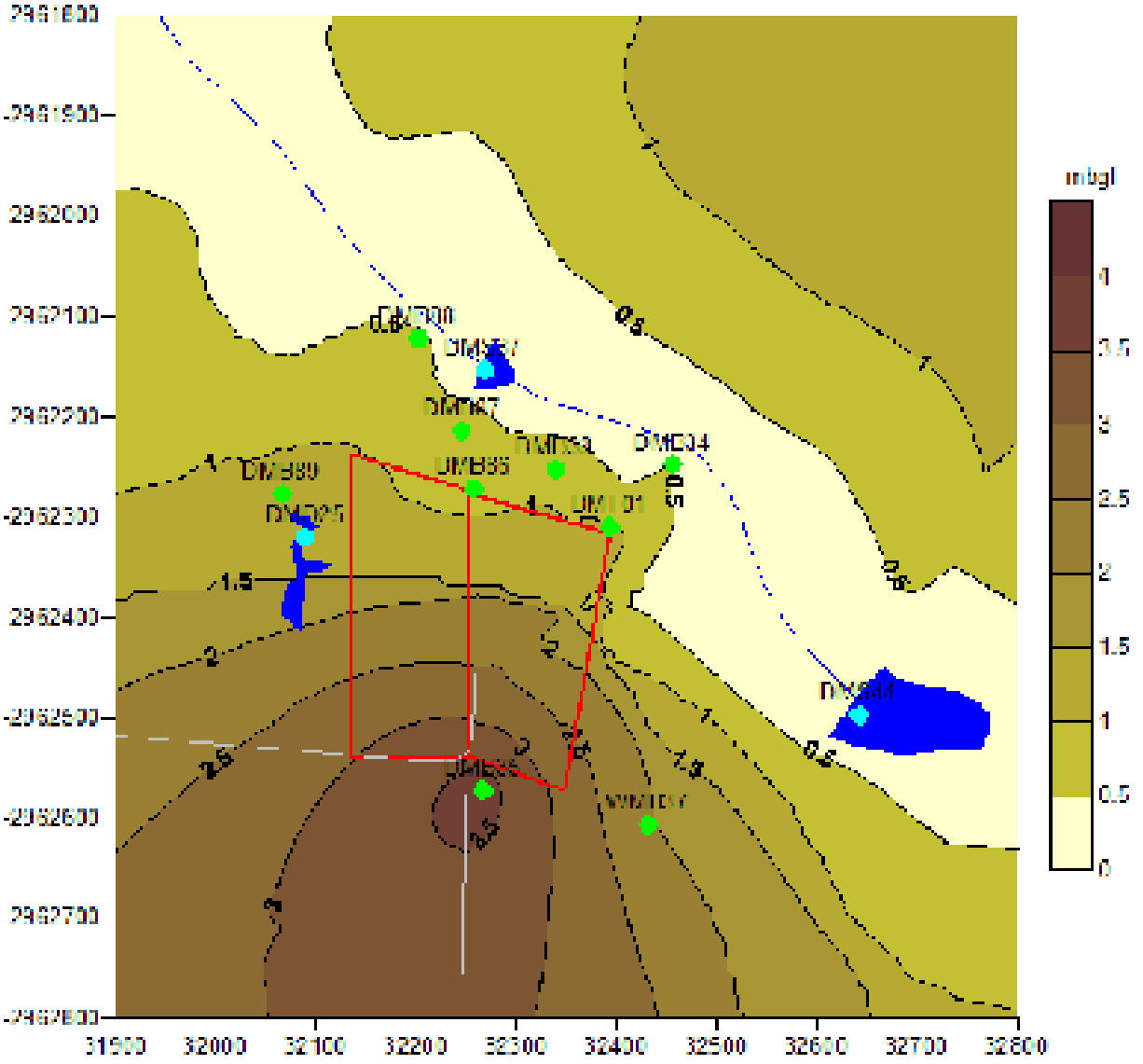

Figure 7-15: Unsaturated zone / depth to top of groundwater table measured in meters below ground level.

Slug tests were performed at all the monitoring borehole sites during different detailed investigations from 1994 (refer Appendix M and **Table 7-4**). The field measurements obtained during the slug tests were analysed using the Bouwer and Rice (1976) method. This method provides an indication of aquifer permeability in the immediate vicinity of a tested borehole. In this instance, the line of best fit through slug test data was taken through later values to allow for drilling induced increases in aquifer permeability in the area immediately adjacent to the borehole.

Table 7-4: Results of slug testing when analysed using the Bouwer and Rice (1976) method.

Site	K m/d	K m/s	Dh/Dl	Porosity h	Real velocity of flow m/s	Real velocity of flow m/d	Yield calculated	Blowyield measured	Waters striles
Formation Tested - Fresh solid dolerite									
DMB33	0.0058	6.713E-08	0.028	0.05	3.729E-08	1.1761	~	~	dry
DMB88	0.0091	1.053E-07	0.027	0.05	5.626E-08	1.7744	0.0381	<0.01	3
Averages	0.0075	8.623E-08			4.678E-08	1.4752			
Formation Tested - Weathered fractured dolerite									
DMB34	0.1860	2.153E-06	0.013	0.1	2.691E-07	8.4863	~	<0.1	4 & 12
DMB35	0.0720	8.332E-07	0.015	0.1	1.272E-07	4.0106	~	<0.1	12 & 18
DMB87	0.0104	1.204E-07	0.027	0.1	3.215E-08	1.0139	0.0435	<0.1	2
DMB89	0.2018	2.336E-06	0.021	0.1	4.911E-07	15.4869	0.8072	0.1	4.5
Averages	0.1061	1.228E-06			2.616E-07	8.2504			

The presence of perched aquifers in the area is to be expected. Laboratory testing suggests that in situ soils are more permeable than the underlying dolerites. For example, the lowest K value (hydraulic conductivity) measured for in situ soil/weathered dolerite was 1.2×10^{-7} m/s, a value an order of magnitude higher than that determined for a site aquifer within the dolerites (6.7×10^{-8} m/s). Thus, water will preferentially flow through the soil profile which mainly consists of weathered fractured dolerites. Furthermore, once a moisture front reaches the weathered/fresh dolerite interface, lateral as opposed to vertical flow will predominate.

The higher permeability of weathered dolerites can also be expected to influence recharge and discharge behaviour at the site. The unconfined, relatively un-permeable character of the these rocks make them not only ideal recharge zones for regional aquifers in the Karoo, but also points for discharge in lower lying areas.

Potential flow velocities within some aquifers can be estimated by adapting Darcy's Law (1856) and considering flow effects through aquifer pores as shown below:

$$V = \frac{K(\Delta h/\Delta l)}{n} \quad \text{where,}$$

V = real flow velocity;
K = hydraulic conductivity;
$\Delta h/\Delta l$ = hydraulic gradient at site; and,
n = porosity.

Estimates of aquifer K were obtained during slug testing, while site aquifer porosity was assumed to be 5%, a typical value of porosity in fractured rocks (Driscoll, 1986). Porosities for overlying soil profiles were assumed to be 10%. Field estimates of hydraulic gradient for respective sites are shown in **Table 7-4**.

Real groundwater flow velocities calculated on the basis of estimated values are also shown in **Table 7-4**. These calculations suggest that there is little variation between field aquifer hydraulic conductivity and real groundwater flow velocities. Based on a real groundwater flow velocity of 1.5 m/y and a distance between the proposed waste disposal site and the groundwater divide in the north of between 300 m, it is estimated that it will take at least 200 years for pollutants to reach the non-perennial spruit. The rate of pollution migration would be higher, however, along more permeable dolerite in areas that have steeper hydraulic gradients.

Calculated real flow velocities through weathered dolerites were also included in **Table 7-4** for comparison purposes. These values suggest that the rate of groundwater movement through perched aquifers has the potential to be significantly higher than through deeper aquifers within weathered rock units. It is therefore estimated that it will take at least 37 years for pollutants to reach the non-perennial spruit.

7.6.3 Background water quality

In order to assess the background water quality, surface and groundwater samples were taken around the time of the hydrocensus. While surface water samples were taken at selected strategic sites around the proposed waste disposal site, an attempt was made to sample all boreholes located during the census although in some cases this was not possible. All water samples were sent to the laboratories of the Institute of Ground Water Studies at the University of the Free Sate in Bloemfontein for analyses.

Although the concentrations of more than 20 inorganic chemical parameters in the water samples were determined during the chemical analyses, only five parameters are used as indicators of contamination in the monitoring of the pollution potential in this system. These five parameters are: the electrical conductivity (**EC**) and the major ions **Na**, **Ca**, **Cl** and **SO_4**. The suitability of these parameters to act as *indicator elements* in the evaluation of water contamination was determined by GHT during a previous investigation. The additional information on the concentrations of the other elements is required to evaluate the accuracy and reliability of the chemical analyses.

Chemical Data Presentation Formats

The results of the inorganic chemical analyses are presented in various formats in the specialist report (Appendix M). These formats include Data Tables, Pollution Index Tables, MMAC plots, Time Graphs and Bar Charts. The formats used are not exhaustive and any special requirements could be incorporated if suggested by the client or if shown necessary as the monitoring program progresses. The formats of data presentation used in the specialist report are discussed in detail in the specialist report.

Monitoring Sites

The water samples from each monitoring site are classified according to the classification system described in "Quality of Domestic Water Supplies Volume 1: Assessment Guide, Second Edition, (1998)" and "South African Water Quality Guidelines – Volume 1 Domestic Use (1993 and 1996)". These guidelines are used

for reference as they are the most stringent set of guidelines available, and used as per the precautionary approach. The sites are illustrated in **Figure 7-16** below.

Groundwater (DMB33, DMB34, DMB35, DMB86, DMB87, DMB88, DMB89, DMB37)
The groundwater of the waste disposal study area is generally of a good (Class 1) to poor (Class 3) quality. The poor water quality is derived from the elevated nitrate (**NO_3-N**) concentrations at site DMB35 (up-gradient from the site). The nitrates and **NH_4** may possibly be derived from the decomposing processes of organic matter. Classification of water from the newly drilled borehole ranges from Marginal (Class 2) to Poor (Class 3) due to the concentrations of **NH_4.**

Background Sites

Groundwater (FBB20, FBB205)
The groundwater qualities of site FBB20 and FBB205 respectively ranges from Marginal (Class 2) to Good (Class 0) at sites FBB20 and FBB205. This is mainly due to the concentrations of **NO_3.**

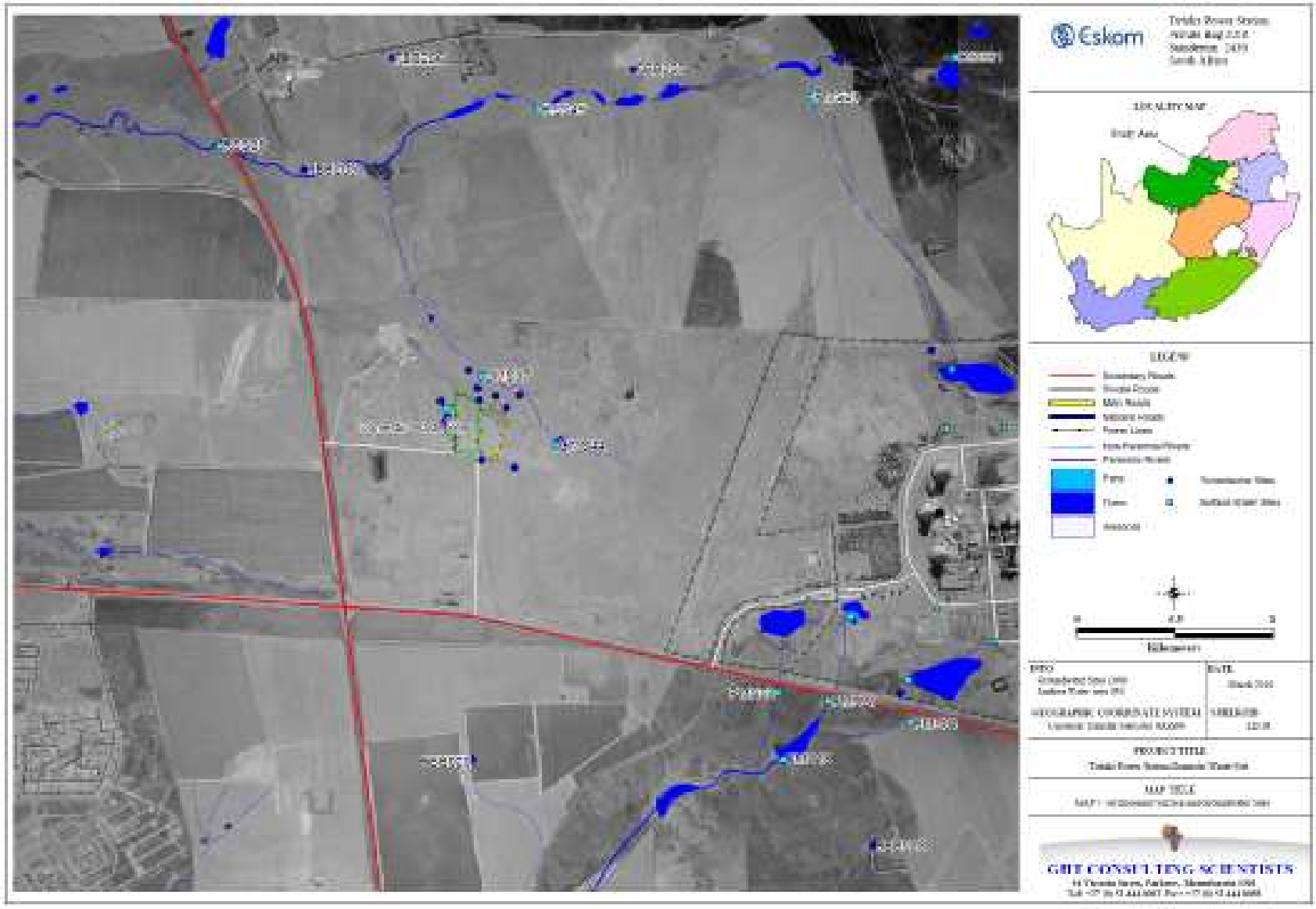

Figure 7-16: Monitoring Points

7.6.4 Sensitivities

While groundwater is used mainly for stock watering and to a lesser extent for domestic purposes by farmers in the area surrounding the domestic waste site, the number of people dependent on the resource is limited to residents on adjoining farms. This appears highly unlikely to change in the near future due to the proximity of large, reliable surface water bodies such as The Leeu Spruit, Vaal River and Grootdraai Dam to the nearby communities of Thuthukani, Standerton, and Sakhile as well as large industries such as Tutuka Power Station and New Denmark Collieries.

There is a significant risk of perched aquifer contamination and a slight risk of pollution to migrate to the adjacent surface water body, the non-perennial stream to the east and north of the site, during waste disposal operations if site drainage is not considered during the design stage, and indeed there is evidence to suggest that past waste disposal activities have already degraded site water quality to the north of the current waste disposal site. In this instance, surface drains could perhaps best control the migration of leachate. Ponding within these drains and any associated dams constructed within in situ material should be prevented as testing undertaken to date suggests that site soils are not suited for use as a liner material.

7.7 Land Use

7.7.1 Data Collection

The land use data was obtained from the CSIR Land Cover database and supplemented with visual observations on site.

7.7.2 Regional Description

The land use in the region is dominated by maize, grazed fields, coal mines and power stations. From the map below (**Figure 7-17**) it can be seen that the proposed alternatives are located in areas of unimproved grassland and some water bodies. Water bodies are the only land use regarded as sensitive. It should be noted though that these areas are not used for cultivation at present and that the site is covered by grassland with scattered aliens. The map has four main categories of land use namely cultivation, unimproved grassland, water bodies and lastly mining, industrial and residential.

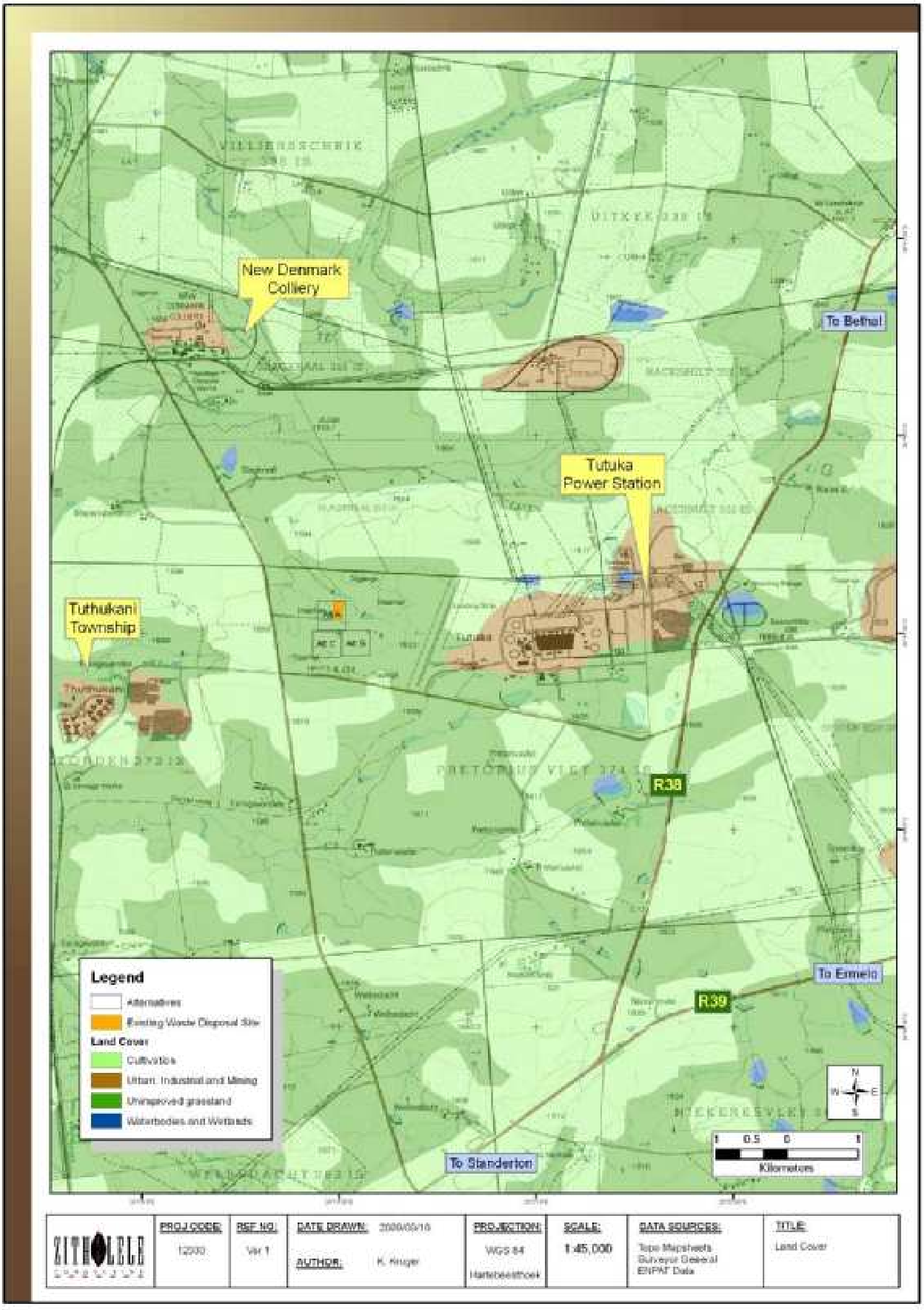

Figure 7-17: Land Use Map.

7.8 Faunal Biodiversity

This section is based on the specialist study conducted by Golder Associates Africa. The study was undertaken in January 2010. The detailed specialist report is attached in **Appendix N**.

7.8.1 Methodology

In order to enable characterisation of the environment, as well as of floral and faunal species that may be impacted on by the proposed mining activities, faunal and floral groups were investigated. These species were then later used to determine the possible magnitude of the impact of the proposed activities. The groups of species investigated included:

- Vegetation
- Arthropoda
- Avifauna
- Mammals
- Herpetofauna (Reptiles)
- Amphibia

All methods used were based on standard scientific investigative techniques. A detailed methodology for each ecological element assessed is provided in the detailed specialist report attached in **Appendix N**. The site was visited in January – February 2010.

7.8.2 Site Description

The species identified on site are described below.

Arthropoda (Bugs)

A total of 34 arthropods were recorded during the site investigation and are provided in (**Table 7-5**). Only two species of Lepidoptera were recorded and 32 species of other arthropods. The low floral diversity in the majority of the area may be responsible for reduced arthropod diversity during the time of the survey. All of the species recorded during the survey were common Savanna species and are not restricted in terms of habitat or distribution.

Table 7-5: Arthropod species recorded during the 2007 surveys.

Superclass	Class	Order	Family	Genus	Species	Common Name
	Insecta	Isoptera	Termitidae	*Trinervitermes*		
				Amitermis	*hastatus*	
		Mantodea	Hymenopodidae	*Harpagomantis*	*tricolor*	
			Mantidae	*Sphodromantis*	*gastrica*	
		Dermaptera	Libiduridae	*Labidura*	*riparia*	
		Orthoptera	Bradyporidae	*Hetrodes*	*pupus*	

Superclass	Class	Order	Family	Genus	Species	Common Name
			Tettigonidae	*Phaneroptera*		
			Gryllidae	*Gryllus*	*bimaculatus*	
			Pamphagidae	*Hoplolopha*		
			Pyrgomorphidae	*Phymateus*	*morbillosus*	
			Acrididae	*Acrida*	*acuminata*	
				Locustana	*pardalina*	
		Hemiptera	Reduviidae	*Etrichodia*	*crux*	
			Alydidae	*Mirperus*	*faculus*	
			Pyrrhocoridae	*Scantius*	*fosteri*	
			Nemopteridae	*Nemia*	*costalis*	
		Coleoptera				
			Melirydae			
				Melyris		
			Tennebrionidae	*Psammodes*	*striatus*	
				Stenocara	*dentata*	
		Diptera	Tabanidae	*Tabanus*	*taeniatus*	
			Bombyliidae	*Exoprosopa*		
			Calliphoridae	*Chrysomya*	*chloropyga*	
				Chrysomya	*albiceps*	
		Lepidoptera	Saturniidae	*Bunaea*	*alcinoe*	
		Hymenoptera	Apidae	*Apis*	*mellifera*	
			Formicidae	*Tetraponera*		
				Messor	*capensis*	
				Camponotus	*fulvopilosus*	
		Scorpiones	Buthidae			
		Araneae	Arachnidae			
Myriapodia						Centipede
						Millipede

Reptilia (Reptiles)

A total of 38 reptile species are known to occur within the quarter degree grid in which the study site is located based on the Mpumalanga Tourism and Parks Agency (MPTA). Of these 38 species, only one, *Homoroselaps lacteus*, is listed as a Red Data species, this species is also not listed nationally, but is recorded according to the MPTA species listings as near-threatened. Eight of the 38 possibly occurring species are listed as endemic.

Only three reptilian species were found on site during the 2010 surveys (**Table 7-6**). None of the recorded species are restricted in terms of habitat and distribution, or classified as Red Data Species. It is likely that more species could occur in the area but due to the shy nature of the taxon it is usually

impossible to record all taxon in an area during a study of less than a month. The confidence in the data collected during this study is such that it is deemed to accurately indicate the majority of the species occurring in this specific study area. It is therefore unlikely that, even with a longer term study, many more species of reptiles would be recorded.

Table 7-6: Reptile species recorded during the 2010 survey.

Biological Name	Common Name	Red Data Status
Lamprophis fuliginosus	Brown House Snake	NL
Bitis arietans	Puff Adder	NL
Mabuya striata	Striped Skink	NL

The relevant IUCN status categories are:
All species without a category are shown as Not Listed (NL)

Amphibia (Amphibians)

A total of 16 amphibian species are known to occur within the region in which the study was conducted. Of these 16 species, none are listed as a Red Data species. Only four species were found on site and one is listed as endemic, therefore is restricted in terms of habitat and distribution (Table 7-7). These species are not restricted in terms of habitat or distribution within South Africa and none of the species recorded are classified as Red Data species (MPTA).

Table 7-7: Amphibian species recorded during the 2010 survey

Species	Endemic status	Red Data status
Schismaderma carens	0	NL
Kassina senegalensis	0	NL
Afrrana fuscigula	1	NL
Bufo garmanii	0	NL

Species list for the region spanning South Africa, Lesotho and Swaziland. Endemic status:
0 indicates no endemism to southern Africa
1 indicates endemism to southern Africa;
2 indicates endemism to the region (South Africa, Lesotho and Swaziland).
The relevant IUCN status categories are:
All species without a category are shown as Not Listed (NL)

Avi-fauna

Thirty species were found on site during the time of the study (Table 7-8). Although this is a considerable number of species, it is less than one third of the 368 species known to occur in the grid square (MPTA). The birds occurring in the area are dominated by grassland bird species, especially granivorous (seed eating) grass nesting species. The reason for this is that the habitat is most suited for these species and the absence of tree and shrub nesting can be attributed to the lack of the vegetation growth forms in the area. Of the 30 recorded species, none are listed as Red Data species (Table 7-8). With the exception of waterfowl, waders and other species associated with water bodies

or rivers, bird guilds are well distributed indicating good diversity of habitat in the study area as a whole.

Table 7-8: Avifaunal species recorded during the 2010 survey.

Roberts No.	Common Name	Biological Name	Red Data Status
62	Heron Grey	*Ardea cinerea*	NL
71	Egret Cattle	*Bubulcus ibis*	NL
94	Ibis Hadeda	*Bostrychia hagedash*	NL
255	Plover Crowned	*Vanellus coronatus*	NL
258	Plover Blacksmith	*Vanellus armatus*	NL
356	Dove Namaqua	*Oena capensis*	NL
493	Lark Monotonous	*Mirafra passerina*	NL
494	Lark Rufousnaped	*Mirafra africana*	NL
497	Lark Fawncoloured	*Mirafra africanoides*	NL
498	Lark Sabota	*Mirafra sabota*	NL
507	Lark Redcapped	*Calandrella cinerea*	NL
589	Chat Familiar	*Cercomela familiaris*	NL
595	Chat Anteating	*Myrmecocichla formicivora*	NL
601	Robin Cape	*Cossypha caffra*	NL
615	Robin Kalahari	*Cercotrichas paena*	NL
664	Cisticola Fantailed	*Cisticola juncidis*	NL
665	Cisticola Desert	*Cisticola aridulus*	NL
681	Neddicky	*Cisticola fulvicapillus*	NL
713	Wagtail Cape	*Motacilla capensis*	NL
716	Pipit Grassveld	*Anthus cinnamomeus*	NL
723	Pipit Bushveld	*Anthus caffer*	NL
743	Tchagra Threestreaked	*Tchagra australis*	NL
760	Starling Wattled	*Creatophora cinerea*	NL
764	Starling Glossy	*Lamprotornis nitens*	NL
779	Sunbird Marico	*Nectarinia mariquensis*	NL
803	Sparrow Cape	*Passer melanurus*	NL
804	Sparrow Southern Greyheaded	*Passer diffusus*	NL
814	Weaver Masked	*Ploceusvelatus*	NL
824	Bishop Red	*Euplectes orix*	NL
826	Bishop Golden	*Euplectes afer*	NL

Mammalia

Three hundred and ninety-nine indigenous mammal species occur in Southern Africa, of these 66 species historically occur in the quarter degree grid in which the study area is situated (MPTA). Of the 66 historically occurring species in the area, 16 species are locally extinct and only four species were recorded during the survey. Of the remaining 46 species, 16 have a high probability of occurrence, 8 have a moderate probability of occurrence and 22 a low probability of occurrence. Many of these species are restricted in range to formally and informally protected areas.

Mammal species diversity was low in the study area, with only four species being recorded (Table 7-9) during the time of the study. The reasons for the low mammalian species diversity may be due to degradation of habitat in the study area from anthropogenic impacts such as grazing, over utilisation of natural resources and the disposal of waste. It was, however, noted that *Mus musculus* (House mouse) and *Rattus rattus* (Brown Rat) were not seen during the site investigation although these species are often attracted to waste disposal areas and may be present in the area.

All the mammal species found during the study are common species that occur in a wide range of habitats, none of the species recorded are classified as Red Data species.

Table 7-9: Mammal species recorded during the 2010 survey

Biological Name	Common Name	Red Data
Lepus saxatillis	Scrub Hare	**NL**
Hystrix africaeaustralis	Cape Porcupine	**NL**
Rhabdomys pumilio	Four-striped Grass Mouse	**NL**
Mastomys natalensis	Natal Multimammate Mouse	**NL**

The relevant IUCN status categories are:

All species without a category are shown as Not Listed (NL)

7.8.3 Red Data Faunal Species

According to the Red Data faunal species data from the MPTA only one Red Data faunal species has been recorded in the 2629CC quarter degree square and that is *Homoroselaps lacteus* (Spotted Harlequin Snake). This species was however recorded on the farm Rietpoort 405 IS (according to the MPTA) approximately 29km from the site (**Figure 7-19**), and the probability of occurrence in the study area is considered low.

7.9 Floral Biodiversity

The floral assessment was undertaken by Golder Associates Africa and the specialist report is attached in **Appendix N**.

7.9.1 Methodology and Data Sources

The methodology is the same as described in Section 7.8.1.

7.9.2 Regional Description

According to the South African National Biodiversity Institute (SANBI), the study area falls within the Grassland Biome, where most of the country's maize production occurs. The vegetation of the area is classified as Soweto Highveld Grassland as classified by Mucina and Rutherford[4]. The Soweto Highveld Grassland is found in the Mpumalanga and Gauteng Provinces in a broad band roughly delineated by the N17 Highway in the north, Perdekop in the southeast and the Vaal River in the south. The landscape is typical of the gently undulating Highveld plateau which supports dense tufted grassland dominated by *Themeda triandra, Elionurus muticus, Eragrostis racemosa, Heteropogon contortus and Tristachya leucothrix*.

This vegetation type is endangered as almost no conservation of the vegetation type occurs. An estimated 45% of the vegetation type has already been transformed by cultivation, urban sprawl and mining.

7.9.3 Site Description

The following vegetation communities (**Figure 7-18**) were identified during the study, and are named according to the area in which they occur, physiognomy and/or dominant floral species occurring within the vegetation communities:

- *Themeda triandra* grassland;
- *Themeda – Hyparrhenia* mixed grassland ;
- Natural Riparian Wetland;
- Artificial wetland associated with diggings; and
- Existing waste disposal site.

[4] The Vegetation of South Africa, Lesotho and Swaziland, Muccina and Rutherford 2006.

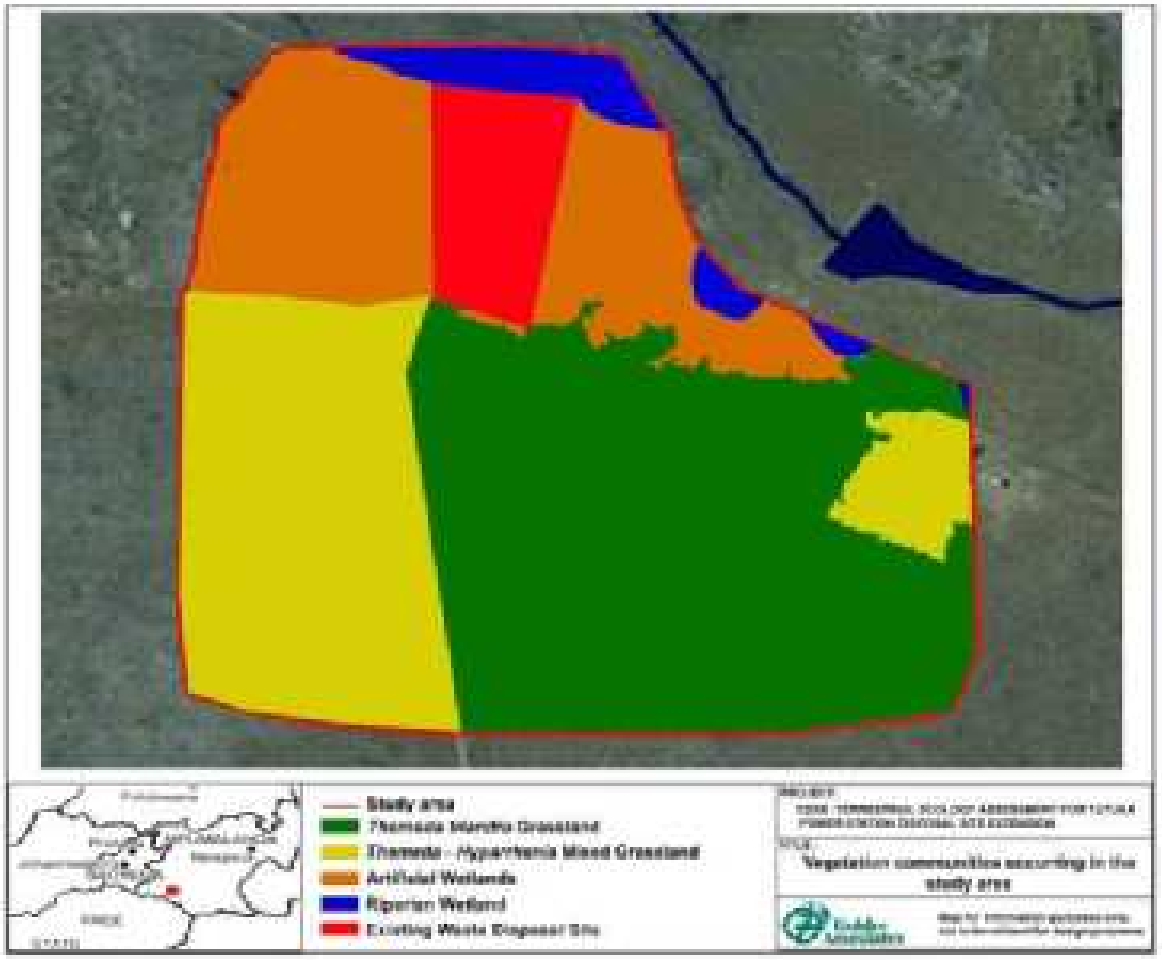

Figure 7-18: Map indicating the study area and associated vegetation communities.

Themeda triandra grassland

This vegetation community covers the majority of the study area and occurs mostly in the south-eastern quarter of the study area. The substrate of this vegetation community, although no geological studies were done as part of the ecological study, can be characterised as dark clay by visual observation for the purpose of this study.

The most common grasses on the plains belong to the genera *Themeda, Eragrostis, Heteropogon, Aristida, Digitaria, Tristachya and Elionurus*. A number of herbs, especially *Asteraceae* are also found. Invasive species occurring in this area are, *inter alia*, *Cirsium vulgare* and *Datura ferox*

Woody species are absent throughout the entire study area, but woody species do occur in this vegetation type although these are often dominated by exotics such as Eucalyptus spp and *Acacia mearnsii*.

A total of 30 plant species were found to occur in this vegetation community. Of these species 13 were classified as graminoids and 16 as herbs and one as a climber. The *Themeda triandra grassland* vegetation community is dominated by grass species, with a lack of trees when compared with other vegetation types, this is however characteristic of communities in the grassland biome.

The thirty species that were recorded during the site visit are typical of this type of vegetation. This area can be considered as slightly degraded primary grassland. Please refer to the specialist report in Appendix N for a detailed species list.

The area is currently grazed by cattle. No utilisation of tree and plant species for fuel, crafts or medicinal/traditional purposes was evident during the surveys as the site is fenced off, however this could occur due to the close proximity of the township to the west of the study area. Grazing pressure in this vegetation community can be considered as low to moderate.

No Red Data species were recorded during the study, although the habitat is considered moderately suitable for the presence of Red Data species. This vegetation type is well represented in the region.

Sensitivity aspects

- This variation is situated within a very large habitat type making it a less important area for conservation of biodiversity;
- The vegetation of the area is moderately disturbed;
- Moderate species diversity;
- Floristic status of this variation is moderate;
- Suitability of Red Data flora and faunal species is moderate;
- No floral Red Data species were recorded during the survey, but the possibility of Red Data species occurring in this vegetation type cannot be ruled out;
- Likely impacts on the vegetation will be insignificant to moderately significant on a local scale;
- Ecological function of this community is high;
- The Conservation importance of this community is moderate to high due possibility of occurrence of Red Data species or protected species.

Themeda – Hyparrhenia mixed grassland

The disturbed grassland or other disturbed areas such as road reserves or fallow fields, not cultivated for some years, are also usually *Hyparrhenia* dominated. However, while *Hyparrhenia* – is present in this vegetation unit, it is not dominate. This grassland is a result of historical disturbance as a result of

over-grazing, sand mining and cropping. This grassland mostly has low species richness, with only a few other species able to establish or survive in the shade of the dense sward of taller grass. Most of these species are relict pioneers or early seral species. The most prominent species include the grasses *Cynodon dactylon, Eragrostis plana, E. racemosa, E. curvula and E. capensis*. Herbaceous species such as *Anthospermum rigidum, Conyza podocephala, Crabbea angustifolia and Helichrysum rugulosum* are present. Alien species such as *Verbena bonariensis* have also invaded this vegetation unit.

The area delineated as *Themeda – Hyparrhenia* mixed grassland occurs to the far eastern and western parts of the study area The substrate of this area does not differ from the surrounding areas and, although no geological studies were done as part of this specific study, is characterised by dark clay. The area is currently grazed by cattle, although the most perturbation of the area is due to the area being used for the purposes of cropping, grazing or sand mining at some stage in the past. A number of exotic species occur in this area, but for the most part do not dominate the vegetation communities. Many of the species occurring in this vegetation type are similar to that of the surrounding grassland, but the occurrence of these species is greatly reduced due to historic perturbation.

A total of 25 plant species were found to occur in this vegetation community. Of these species 13 were classified as grasses, 11 as herbs and one climber. This site was also the site at which the highest number of annual species was recorded due to the fact that competition in the previously cleared areas is lower than that in the other vegetation types.

The area has been considerably impacted by previous management practises, and although the invasion of exotic species is limited, a considerable amount of species diversity change is evident.

Diversity is poor in this vegetation type, indicating that the area has been extensively disturbed in recent times. Twenty five species were recorded during the site visit and this community can be described as secondary vegetation. Invasive species occurring in this area are, *inter alia*, *Verbena bonariensis, Bidens pilosa* and *Tagetes minuta*

Grazing pressure in this vegetation community can be considered as moderate. No Red Data species were recorded during the study, and the habitat is considered unsuitable for the presence of Red Data species. This vegetation type is well represented in the general region.

Sensitivity aspects

- This variation is situated within a very small area;
- The vegetation of the area is highly disturbed, and can be classified as secondary vegetation;
- Low species diversity;
- Floristic status of this variation is low;
- Suitability of Red Data flora and faunal species is low;

- No floral Red Data species were recorded and it is unlikely that Red Data species will be found in this vegetation community;
- Likely impacts on the vegetation will be insignificant on a local scale;
- Ecological function of this community is moderate to low;
- Conservation importance of this community is moderate to low.

Natural Riparian Wetland

Wetland and Riparian communities are seasonally wet areas that occur in sandy areas where water seeps into low lying drainage lines after rains. In this study such a wetland was found to the north-east of the study area. These areas are usually covered by hygrophytes such as sedges and reeds. The dominant sedge in the study area is *Cyperus fastigiatus*. Sometimes bulrush (*Typha capensis*) and reeds (*Phragmites australis*) also occur.

Wetlands are of a more permanent nature and occur in low-lying areas such as tributaries of streams and rivers. Wetlands are typically found in flat landscapes or shallow depressions filled with (temporary) water bodies supporting zoned systems of aquatic and hydrophillous (water loving) vegetation of temporarily flooded grasslands and ephemeral herblands. Typical plants are the *Crinum bulbispermum*, *Typha capensis* and reeds *Phragmites australis*, sedges such as the *Cyperus and Bulbostylis* genera also occur. These wetlands are one of the most sensitive vegetation units found in the region and have been extensively modified by mining and industrial activities in the region.

A total of 20 plant species were found to occur in this vegetation community. Of these species 7 were classified as grasses, 4 as sedges, 1 hydrophyte and 8 as herbs. The grass layer is species poor and contains relatively low biomass possibly due to historic overgrazing and the competition by hardier species.

This vegetation community can be considered as an example of lightly disturbed natural vegetation. Invasive species occurring in this area make up 40% of the total number of species and are, *inter alia*, *Cirsium vulgare, Datura ferox* and *Xanthium strumarium*.

Grazing pressure in this vegetation community can be considered as historically average to high, due to the accessibility of the area, as well as proximity to permanent water and the palatability of the vegetation itself. At present the area does not appear to be very overgrazed.

No Red Data species were recorded during the study. This habitat is considered moderately suitable for the presence of Red Data species. This vegetation type is well represented in the general region.

Sensitivity aspects

- The vegetation of the area is moderately disturbed;
- Low species diversity;
- Floristic status of this vegetation community is moderate;
- Suitability of Red Data flora and faunal species is moderate;
- No floral Red Data species were recorded during the study;
- Likely impacts on the vegetation will be moderately significant on a local scale;
- Ecological function of this community is high although some degradation, due to overgrazing and other anthropogenic impacts, has occurred in this vegetation community;
- The Conservation importance of this community is high as this vegetation community is characterised as a wetland community.

Artificial wetland associated with diggings

These isolated patches of standing water appear to be seasonal and therefore only form after good rainfall events within manmade excavations. They can currently be regarded as artificial wetlands, but interpretations from historic aerial photographs may contribute to a better understanding of their nature and origin. Artificial wetlands are any type of wetland constructed by man. The main type of wetland included in this group is dams and weirs. These wetlands are not included in the definition of a wetland as supplied by DWAF (DWAF 2003a), it is however included under the RAMSAR wetland definition. An artificial wetland appears in the Mpumalanga Parks and Tourism Association Conservation Plan as an important and necessary area. The identified artificial wetland area, within the study area is heavily disturbed by historical impacts and dominated by exotic species, mainly *Datura ferox* which forms dense stands in the area. Very little natural vegetation occurs in this area and the few indigenous species occurring there are pioneer grasses and some annual species. This area may have been mistakenly identified as a wetland area from aerial or satellite photographs during the compilation of the MTPA C-plan. Species include *Bulbostylis contexta, Cyperus fastigiatus, Aristida bipartita, Panicum coloratum, Hyparrhenia hirta, Datura ferox, Datura stramonium, Cirsium vulgare, Solanum sisymbriifolium, Verbena bonariensis, Cannabis sativa* and *Xanthium strumarium*

A total of only 14 plant species were found to occur in this vegetation community, indicating the inhibiting effect of the previous impacts and exotic species in this vegetation community. Of these species, 3 were classified as grasses, 2 as cyperoids and 9 as herb species.

Present grazing pressure in this vegetation community can be considered as low, due to the unpalatability of the species occurring in the area, as well as the fact that pressure in the general area is greatly reduced from the historical impact, although the area may have been under very high grazing pressure in the past.

No Red Data species were recorded during the study within this area. The habitat is considered poorly suited for the presence of Red Data species, therefore it is highly unlikely that any Red Data species occur within this vegetation community.

Sensitivity aspects

- This vegetation community is situated within a severely impacted habitat type making it unimportant area for conservation of biodiversity;
- Disturbance in this vegetation type is, and has historically been, severe;
- Low species diversity;
- Floristic status of this vegetation community is very low;
- Suitability of Red Data flora and faunal species is low;
- No floral Red Data species are likely to occur in this vegetation community;
- Impacts on the vegetation will be insignificant;
- Ecological function of this community is low;
- The Conservation importance of this community is low.

Existing waste disposal site

The existing waste disposal site was only scanned for the presence of Red Data species and protected species and a short list made of observed species. The reason for this is that this area can be considered as completely transformed and therefore not part of the natural vegetation of the area. The fact that this area is currently impacted in the same way that the future development will impact the surrounding area leads to the natural conclusion that this area cannot be further impacted by the development.

The area is considered as completely transformed by historical impacts, and is severely invaded by exotic species type. A total of only 15 plant species were found to occur in this vegetation community, indicating the inhibiting effect of the previous impacts and exotic species in this vegetation community.

A total of 15 plant species were found to occur in this vegetation community, indicating the high species diversity of the area. Of these species 6 were classified as grasses and 9 as herbs. It is difficult to identify dominant species in this vegetation community as no particular species, or group of species dominates the area as was the case with many of the other vegetation communities. Six of the nine herbaceous species recorded in this vegetation community are exotics, further alluding to the disturbed nature of this area of the study area.

Present grazing pressure in this vegetation community can be considered as low, with the area being utilised as a waste disposal site and few if any palatable species occurring there. The grasses that do occur in this area are also sparse making this area unattractive for any grazers in the area.

No Red Data species were recorded in this area during the study and, due to transformation of the habitat, it is considered poorly suited for the presence of Red Data species.

Sensitivity aspects

- The vegetation of the area can be considered as completely transformed;
- Low species diversity;
- Floristic status of this vegetation community is low;
- Suitability of Red Data flora and faunal species is low;
- If impacts were to occur in this vegetation type they would be insignificant as the area is currently impacted by a similar activity;
- Ecological function of this community is low;
- The Conservation importance of this community is low.

7.9.4 Red Data Floral Assessment

The Red Data plant species list for the 2629CC grid square obtained from the Mpumalanga Tourism and Parks Agency (MPTA), shows only one species of concern recorded in the relevant grid square (700 km^2). The species recorded is the Near –threatened *Gladiolus robertsoniae* which was recorded on the farm Grootverlangen 409 IS which is approximately 21km from the study site and at the Vaal Train Station in Standerton itself, approximately 20km from the study site (**Figure 7-19**). This species was not found within the study area but, although very unlikely its presence cannot be dismissed based on a single survey of the area.

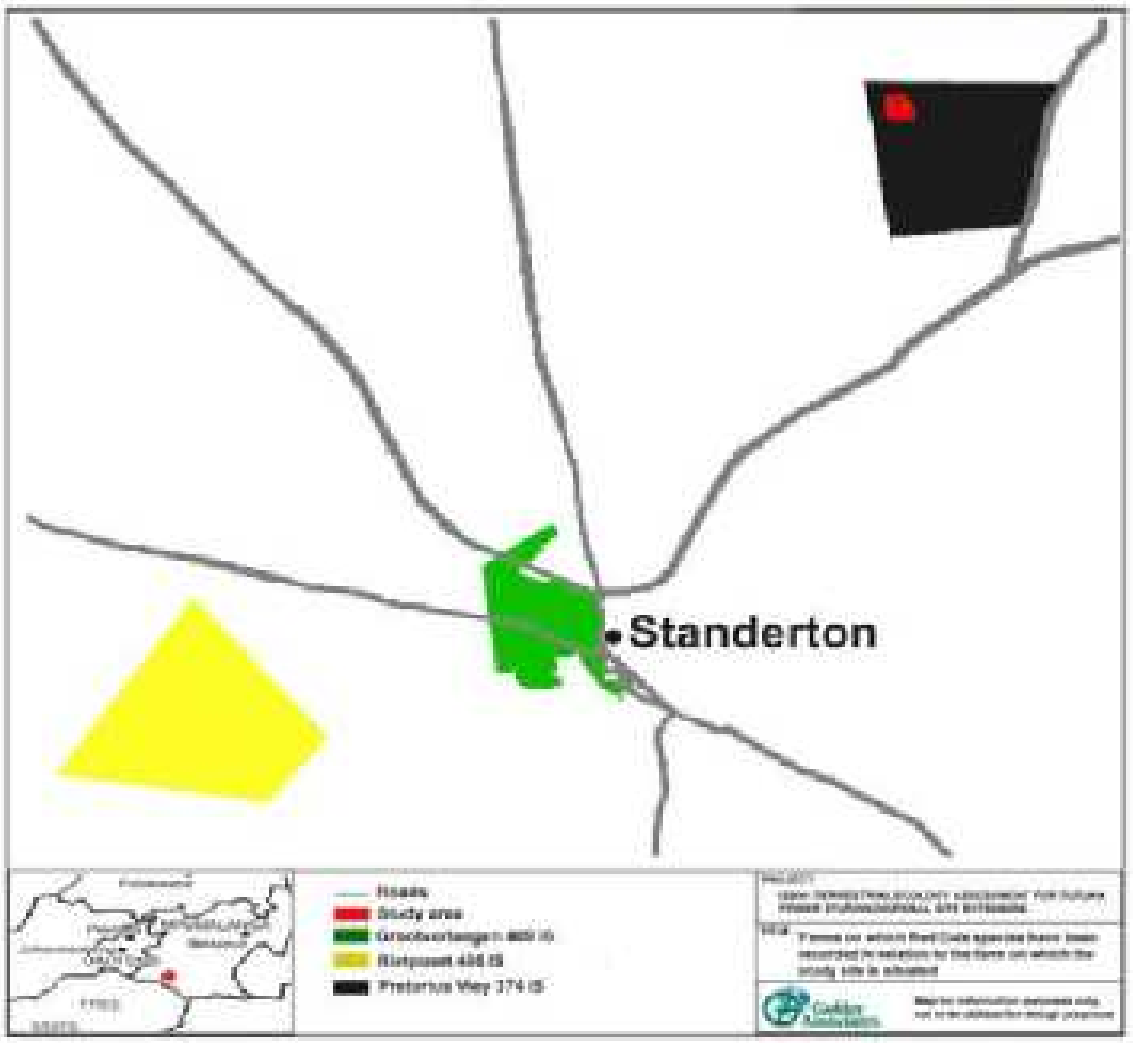

Figure 7-19: Know Farm locations of recorded Red Data species in relation to the study area

7.10 Climate and Air Quality

The air quality assessment was undertaken by Airshed Planning Professionals and their detailed report is attached in **Appendix J**. The methodology described below is extracted from the Air Quality report[5].

7.10.1 Methodology and Data Sources

A weather station is located at Standerton, approximately 18 km to the south-west of the site measuring hourly average meteorological data, including wind speed, wind direction and temperature. Mixing heights was estimated for each hour, based on prognostic equations, while night-time

[5] QUALITATIVE AIR QUALITY IMPACT ASSESSMENT FOR THE PROPOSED EXTENSION OF THE EXISTING GENERAL WASTE DISPOSAL SITE AT THE TUTUKA POWER STATION, Report No.: APP/10/ZIT-01 Rev 0.0, February 2010

boundary layers were calculated from various diagnostic approaches. Wind speed and solar radiation are used to calculate hourly stability classes.

Existing sources of emission was identified as part of the desktop study and available ambient monitored data was evaluated and included in the study to reflect the ambient air quality of the area. In addition, topographical data was extracted and included for discussion. A comprehensive and current legislative and regulatory review was undertaken for inclusion in the desktop study. The air quality data was analysed and compared to both local and international guidelines and standards.

Types of emissions expected to result from a general waste disposal site was identified and reviewed based on available emissions data from similar disposal sites. Buffer and odour management zones was recommended based on local meteorology and operational procedures as well as local and international guidance on impact zones around waste disposal sites.

7.10.2 Meteorological Description

The analysis of meteorological data observed for the site provides the basis for the parameterisation of the meso-scale ventilation potential of the site. Parameters that need to be taken into account in the characterisation of meso-scale ventilation potentials include wind speed, wind direction, extent of atmospheric turbulence, ambient air temperature and mixing depth. Meteorological data for the period 2006 - 2008 was obtained for the closest South African Weather Service Station of Standerton. The meteorological equipment at Standerton was stolen in November 2008 and the station was discontinued.

Wind

The vertical dispersion of pollution is largely a function of the wind field. The wind speed determines both the distance of downward transport and the rate of dilution of pollutants. The generation of mechanical turbulence is similarly a function of the wind speed, in combination with the surface roughness.

Wind roses comprise 16 spokes which represent the directions from which winds blew during the period. The colours reflect the different categories of wind speeds, the grey area, for example, representing winds of 1 m/s to 3 m/s. The dotted circles provide information regarding the frequency of occurrence of wind speed and direction categories. For the current wind roses, each dotted circle represents 5% frequency of occurrence. The figure given in the centre of the circle described the frequency with which calms occurred, i.e. periods during which the wind speed was below 1 m/s. The period, day-time and night-time wind roses for Standerton are provided in **Figure 7-20**.

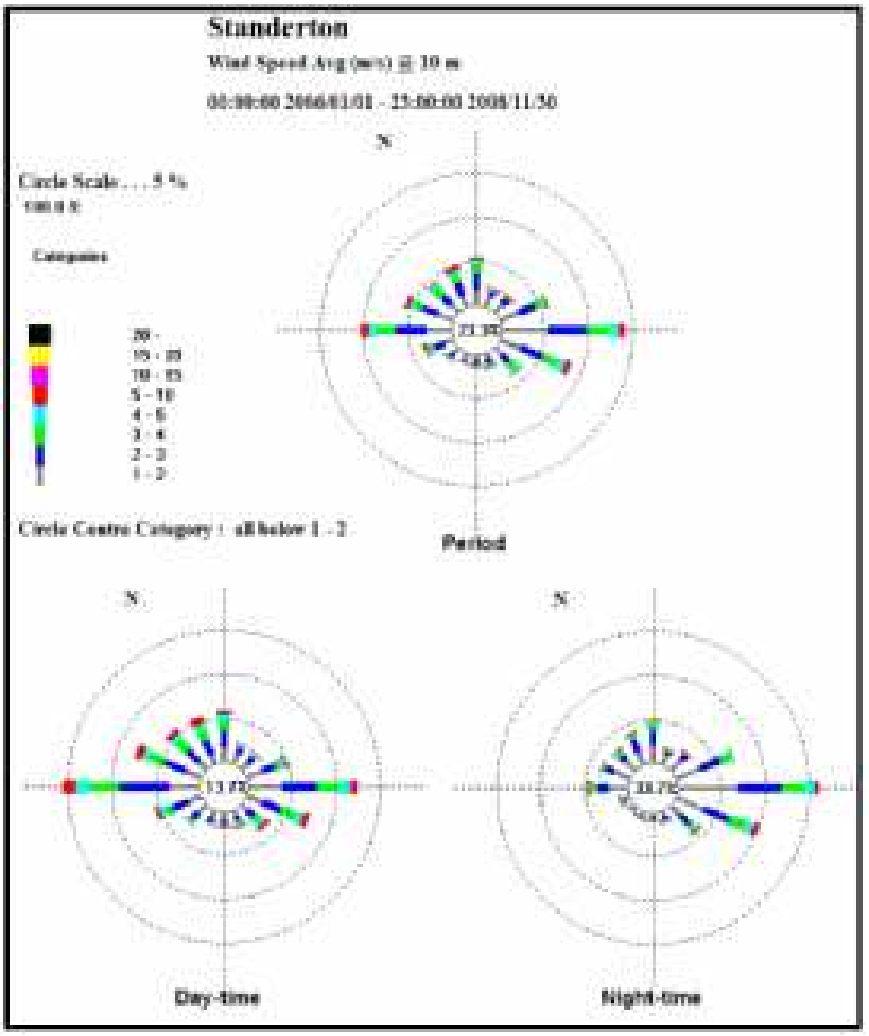

Figure 7-20: Period, day-time and night-time wind roses for Standerton (2006-2008).

The dominant wind direction at Standerton for the period 2006 – 2008 is from the east (~14% frequency of occurrence) and from the west (~10% frequency of occurrence). Wind speeds are predominantly moderate (2-4 m/s) with relatively high calm condition (23.3%). Day-time conditions are characterised by an increase in westerly winds (~15% frequency of occurrence) with night-time conditions reflecting an increase in easterly winds and high calm conditions (33.7%).

Seasonal wind roses are provided in **Figure 7-21**. The seasonal wind roses at Standerton largely reflect the synoptic conditions with increase in easterly waves occurring during summer and spring and with the increase in westerly waves shown in the winter months. An increase in calm conditions are also characteristic of the winter and autumn months (>30%).

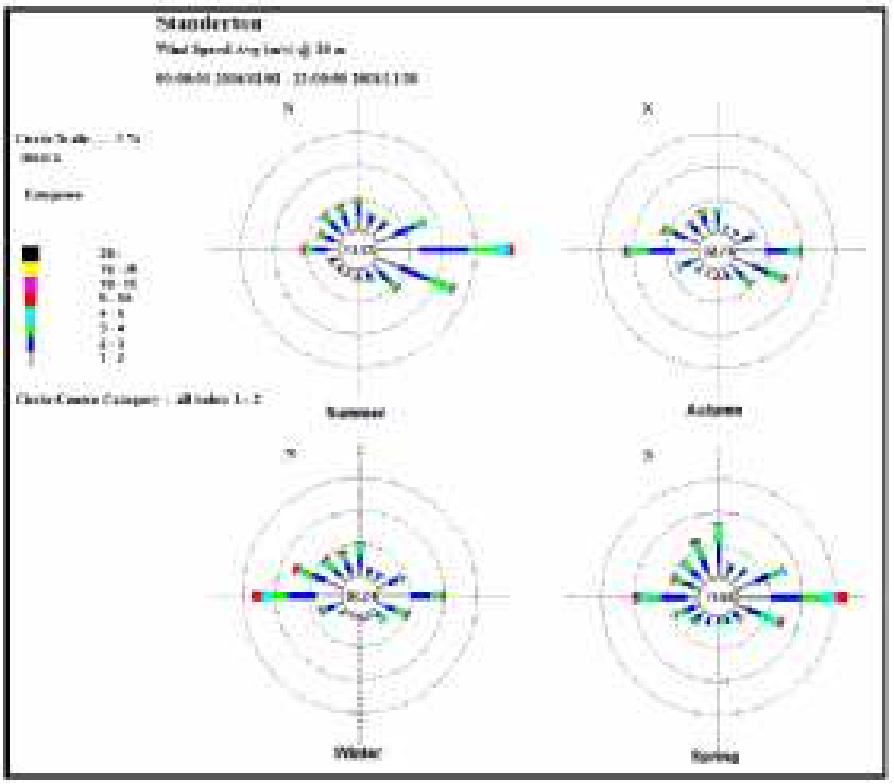

Figure 7-21: Seasonal Wind Roses for Standerton (2006 – 2008).

Temperature

Air temperature is important, both for determining the effect of plume buoyancy (the larger the temperature difference between the plume and the ambient air, the higher the plume is able to rise), and determining the development of the mixing and inversion layers.

As the earth cools during night-time the air in direct contact with the earth's surface are forced to cool accordingly. This is clearly evident from **Figure 7-22**, reflecting the diurnal temperature profiles at the site. The coldest time of the day appears to be between 04:00 and 07:00, which is just before or after sunrise. After sunrise surface heating occurs and as a consequence the air temperature gradually increases to reach a maximum at approximately 14:00 in the afternoon.

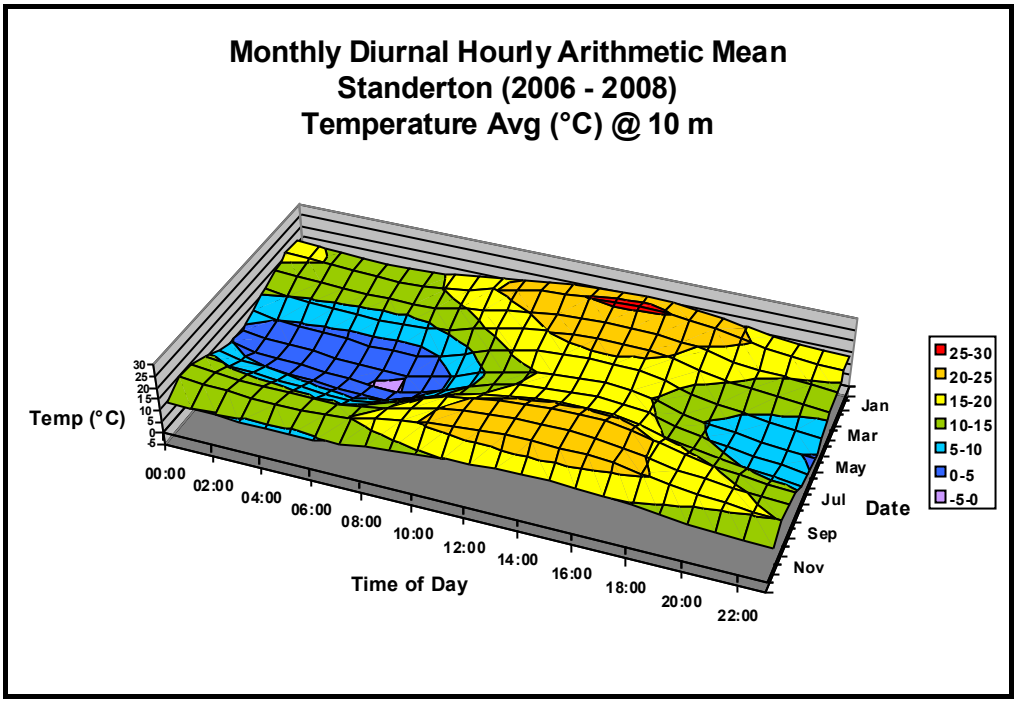

Figure 7-22: Diurnal and monthly variation of ambient air temperatures at Standerton for the period 2006-2008

The annual average maximum, minimum and mean temperatures are given as 21.9°C, 8°C and 14.5°C respectively (Table 1-10). An average monthly maximum temperature of 25.6°C for Standerton was recorded during February and a minimum temperature of -0.6°C was recorded in July.

Table 7-10: Maximum, minimum and mean monthly temperatures at the Standerton monitoring station (2006-2008).

Temperature °C	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Ann
Monthly min (°C)	14.0	13.8	11.7	8.4	2.3	0.1	-0.6	2.6	6.5	11.2	12.8	13.7	7.7
Monthly mean (°C)	18.6	19.4	16.6	14.2	10.0	7.6	8.1	10.5	15.0	16.9	17.9	18.7	13.9
Monthly max (°C)	24.1	25.6	22.7	21.5	19.1	17.1	17.8	19.5	24.0	23.5	23.5	24.1	21.2

7.10.3 Existing Air Quality

The contribution of various sources of emission to ambient particulate concentrations within the proposed Tutuka General Waste Disposal Site (GWDS) is of interest given the potential for elevated concentrations in the area. The most significant sources located in close proximity to the proposed Tutuka GWDS include:

- Stack, vent and fugitive emissions from industrial operations - industrial emissions include various criteria pollutants (as SO_2, NO_x, CO and particulates), greenhouse gases (CO_2 and CH_4), volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), various heavy metals and other toxins. The closest industrial activity to the proposed

Tutuka GWDS includes the Tutuka Power Station (~1.5km to the east). Sources of emission at these operations typically include boiler stack emissions (i.e. particulates, NO_x, SO_2 and CO_2), and fugitive emissions from windblown sources (i.e. ash dump) and vehicle entrainment.

- Fugitive emissions from mining operations - comprising mainly dust releases, with small amounts of NO_x, CO, SO_2, methane, CO_2 being released during blasting operations and vehicle exhaust. The closest mining operations to the proposed Tutuka GWDS are the New Denmark Colliery (~4.5km to the northwest).
- Vehicle tailpipe emissions - significant primary pollutants emitted by motor vehicles include CO_2, CO, hydrocarbons (HCs), SO_2, NO_x, particulate matter and lead. The regional road R38 runs to the east of the Tutuka Power Station.
- Household fuel combustion (coal, wood) - coal burning emits a large amount of gaseous and particulate pollutants including SO_2, heavy metals, total and respirable particulates including heavy metals and inorganic ash, CO, polycyclic aromatic hydrocarbons (PAHs), NO_2 and various toxins such as benzo(a)pyrene. Pollutants from wood burning include respirable particulates, NO_2, CO, PAHs, particulate benzo(a)pyrene and formaldehyde. Particulate emissions from wood burning have been found to contain about 50% elemental carbon and about 50% condensed hydrocarbons. The Thuthukani Township where domestic fuel burning may take place is ~1.5km to the west-southwest of the proposed Tutuka GWDS.
- Biomass burning - major pollutants from veld fires are particulates, CO and VOCs. The extent of NO_x emissions depends on combustion temperatures, with minor amounts of sulphur oxides being released.
- Various miscellaneous fugitive dust sources, including: agricultural activities, wind erosion of open areas, vehicle-entrainment of dust along paved and unpaved roads.

The pollutants listed above are released directly by sources and are therefore termed 'primary pollutants'. 'Secondary pollutants' which form in the atmosphere as a result of chemical transformations and reactions between various compounds include: NO_2, various photochemical oxidants (e.g. ozone), hydrocarbon compounds, sulphuric acid, sulphates, nitric acid and nitrate aerosols.

Ambient air pollutant concentrations within the region occur not only be due to local source but also as a result of emissions from various remote sources. Regionally- transported air masses comprising well mixed concentrations of 'aged' (secondary) pollutants are known to represent a significant component of ambient fine particulate concentrations within the South African interior. Such air masses contain pollutants released from various remote sources including elevated releases from distant industrial operations and power generation facilities and large scale biomass burning in neighbouring countries. Typical pollutants which circulate within such regionally-transported polluted air masses include nitrates, ammonium nitrate and sulphates.

The quantification of background particulate concentration, which is of particular importance given the nature of the proposed development, is complicated due to the large number of sources of this

pollutant. Sources of particulates also include a significant proportion of fugitive emissions from diffuse sources (e.g. vehicle-entrained dust from roadways, wind-blown dust from stockpiles and open areas, dust generated by materials handling) which are more difficult to quantify than are emissions from a point source.

The characterisation of existing air quality is crucial for assessing the potential for cumulative impacts due to the emissions of a proposed development. As part of the Highveld Air Quality Monitoring Network, ambient monitoring stations have been placed over the Highveld region to monitor the ambient air quality. The closest monitoring station to the proposed Tutuka GWDS is located at Standerton. Although permission to obtain this data from the Department of Economic Development, Environment and Tourism was requested, the data was not provided to date and thus could not be included in the current study. The detailed specialist study is attached in **Appendix J**.

7.11 Noise

This section is based on the noise impact assessment opinion compiled by Francois Malherbe Acoustic Consulting as attached in Appendix K.

7.11.1 Methodology and Data Sources

This professional opinion is based on:

- A study of the available information on the new waste disposal site;
- The estimation of current ambient noise levels at the noise sensitive receptors utilizing tabulated values given in SANS 10103;
- The results of sample calculations to estimate the effect of the noise emissions caused during construction and operation of the waste site under neutral and adverse meteorological conditions; and
- The assessment of the noise impact in terms of the regulations applicable in Mpumalanga [2] and the guidelines given in SANS 10103.

7.11.2 Regional Description

General information

The topography of the site is for all practical purposes flat. Therefore, there will be no acoustical screening against the propagation of noise from source to receiver.

The vegetation of the area is that of cultivated fields and unimproved grassland. This will provide some sound absorption of propagated noise. For the purpose of calculations it is proposed that 50%

soft ground conditions are assumed, which describes the amount of noise absorbed by the ground and vegetation over distance.

Major existing sources of noise

Major existing sources of noise are:

- The Tutuka power station;
- Road traffic on the R38 and the road that leads to New Denmark;
- Localised road traffic; and
- Community generated noise in Thuthukani village.

Estimated existing ambient noise level

Despite the presence of the Tutuka power station, the New Denmark colliery and the R38 the general character of the area is rural. The typical ambient noise level during the day (06:00 to 22:00) in a rural area is 45 dBA. This was assumed to be the current ambient noise level in the general area during the day. It must be noted that this is a conservative estimate, i.e. one that will tend to overestimate rather than underestimate the noise impact caused by the construction and operation of the waste disposal site.

7.11.3 Site Description

Noise sensitive receptors

The identified noise sensitive receptors are:

- Tutuka power station and Thuthukani villages at distances of approximately 2000 m or more from the site; and
- The farmsteads on the farms Meyersvallei, Slagkraal and Pretoriusvlei, all at distances of approximately 2000 m or more from the site.

Construction and operation of the waste disposal site

The following noise related aspects were identified:

- The alternatives for the proposed new waste disposal site are all in close proximity to the present site.

- During construction a bulldozer will clear the area and prepare the waste disposal site. It is further assumed that the soil on the site will be compacted by a vibrating roller and topsoil will be stacked using a front end loader (FEL) and truck.
- Construction of the new waste disposal site will only require a short period of time.
- During operation the waste is collected in skips which are then transported to the waste disposal site by tractors. There the waste is dumped, spread and covered with topsoil by a FEL.
- The waste collection method, i.e. the deposit of waste into skips which are then transported by tractors to the waste disposal site, already forms part of the present ambient noise climate in the area. Therefore, the operation of the new site will not be a new source of noise.
- Construction and operation of the new waste disposal site will only take place during the day and not during the night and weekend.

7.12 Heritage

The Heritage Assessment was prepared by Gaigher and Associates and was undertaken in January 2010. The detailed report is attached in **Appendix O**.

7.12.1 Site Description

The proposed waste disposal site is located within a rural/industrial landscape. Parts of the site are being used for formal waste disposal activities. During the site investigation no resources with cultural historical significance were found.

Heritage Indicators

The area under investigation has not yet been extensively developed. This landscape is typical of the southern Highveld. Most of the area consists of turf and sponge areas. Traditionally these areas are not found to be consistent with human occupation. The modern character of this area is dominated by the development of large power stations and associated collieries.

7.13 Traffic

This section is based on the traffic impact opinion conducted by WSP. The report is attached in **Appendix P**.

7.13.1 Methodology

The traffic opinion was undertaken by conducting a one-day site visit during a typical work day in February 2010. The traffic engineer visited the site and visual observations were made about the traffic levels as well as the road conditions.

7.13.2 Site Description

Existing Road Network

The relevant elements of the existing road network in the vicinity of the study area are illustrated on the locality plan (Figure 7-23) and include the following:

- The R39 provincial road from Standerton to Ermelo;
- The R38 provincial road from the R38 to Bethal;
- The district road which runs westward from the R38 past the main entrance to the Tutuka Power Station; and
- The district road which runs northward from the R39 past the main entrance to the New Denmark Colliery.

Operational Analysis

Direct observations undertaken in the study area revealed volumes of traffic that are too low to analyse in terms of Levels of Service (LOS). The direct observations indicate that on all critical elements of the roads in the study area the peak levels of service are LOS A. Even if peak hour traffic volumes are doubled, levels of service will remain at LOS A. Level of service indicates the level to which a road is available for use by a motorist i.e. how long it takes you to use/cross a road. LOS A is the best while LOS E is the worst.

7.14 Infrastructure

7.14.1 Methodology and Data Sources

Infrastructure was identified using the 1:50 000 topocadastral map of the area, and information provided by Eskom regarding existing services. A site visit to the area was undertaken to verify this information.

7.14.2 Regional Description

Access to the proposed project area is via the R 38 regional road east of the study site. The primary infrastructure within a radius of 20 km from the study area is:

- The Tutuka Power Station, substations and cooling towers;
- The R 38 regional road between Bethal and Standerton;
- The R 39 road between Standerton and Ermelo;
- The R 546 between Standerton and Evander;
- The Tutuka tar road linking Thuthukani and Tutuka with the R 38;
- The existing conveyor belts between the Tutuka Power Station and New Denmark Colliery and between Tutuka and the Tutuka ash dump;
- Numerous 400 kV power lines traversing the area;
- Several dirt farm roads;
- Thuthukani township;
- Tutuka air strip; and
- The New Denmark Colliery.

7.14.3 Sensitivities

All the services linking the power station, the coal mine and the existing power grid are seen as sensitive features that should be avoided. Therefore all conveyors, power lines, substations, roads and the air strip are seen as sensitive features.

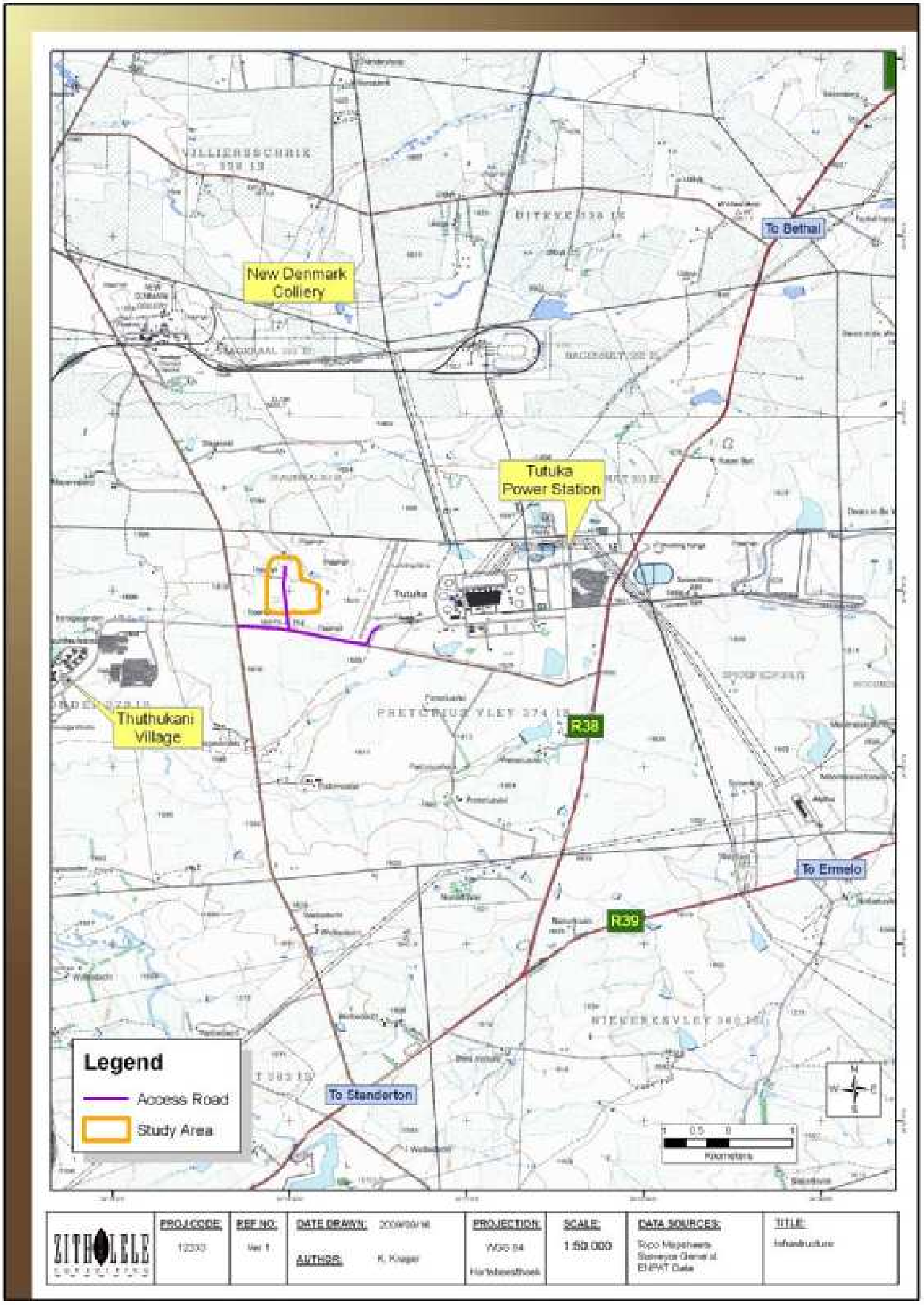

Figure 7-23: Infrastructure in the area

7.15 Visual Environment

7.15.1 Methodology

The methodology adopted for the visual assessment includes the following tasks:

- Examine the baseline information (contours, building dimensions, vegetation, inter alia);
- Determine the area from which the proposed disposal site may be visible (viewshed);
- Identify the locations from which views of the proposed waste disposal site may be visible (observation sites), which include buildings and roads;
- Analyse the observation sites to determine the potential level of visual impact that may result from the proposed waste disposal site; and
- Identify measures available to mitigate the potential impacts.

Each component of the assessment process is explained in detail in the attached specialist report (**Appendix Q**).

7.15.2 Regional Description

The site and surrounding area may be characterised as agricultural land utilised mainly for the grazing of cattle. The topography of the region and study site is gently undulating to moderately undulating landscape of the Highveld plateau.

7.15.3 Site Description

The proposed waste disposal site is located in the area immediately west of the Tutuka Power Station with the power station and other infrastructures like New Denmark Colliery, existing power lines, conveyor belts, water towers and roads featuring prominently in the landscape.

Landscape Character

The site and the surrounding area can be described as an agricultural landscape with intermittent mining, townships and power generation activities. The proposed waste disposal site will be located on a slight slope moving towards an unnamed non-perennial stream to the west of the Tutuka Power Station. Elevations along the slope range from 1 665 mamsl and 1 550 mamsl. Very little screening is available from the topography or natural grassland vegetation. Trees have however been established along the Thuthukani – Tutuka road in an effort to screen the current waste disposal site. Please refer to **Figure 7-3** for the topography of the site.

There are no major rivers in the area, but the unnamed tributary to the Racesbult Spruit and non perennial Racesbult Spruit are found to the north of the proposed waste disposal site.

The landscape surrounding the proposed waste disposal site can be described as open grassland with some cultivated fields. In addition current developments include the Tutuka Power Station and the New Denmark Colliery and their associated structures. The natural vegetation does not provide any screening for the proposed waste disposal site. There are also several existing power lines close to the site to the north of the Power Station. **Figure 7-24** below provides a view of the existing waste disposal site looking east from the New Denmark – Standerton road.

Figure 7-24: View of the existing waste disposal site from the west of the study area.

8 WASTE DISPOSAL SITE DESIGN

8.1 Constraints and factors affecting the design

Taking into consideration the waste disposal need, the physical conditions of the site, and discussions with various Eskom, Tutuka and project personnel, there are several factors that affect the design philosophy adopted. These are as follows:

- The Tutuka waste disposal site design needs to comply with the Minimum Requirements for a G:S:B$^-$ waste disposal site.
- The design of the waste disposal site needs to cater for a total waste stream of 845 000 tonnes over the 40 year site life. With a 20% allowance for soil cover material, a total waste disposal site airspace of 1 014 000 m^3 is required.
- The domestic or municipal solid waste will not be co-disposed with hazardous waste but will be disposed separately, with separate leachate management systems.
- The northern boundary of the site is defined by the ephemeral stream, whilst the western boundary is defined by the borrow pit with ponded water. The existing waste disposal site defines the eastern boundary of the new waste disposal site. Although the site fence and stormwater drain define the southern boundary of the site, it is possible to move this boundary southwards to achieve the required airspace.
- The soils on the site are not suitable for use in the waste disposal site liner construction. The liner design is therefore based on a geocomposite waste disposal site liner.
- The existing waste disposal site has impacted negatively on the groundwater environment and must therefore be closed and capped without delay.
- The design of new waste disposal site should be integrated with the closure and capping of the existing waste disposal site in terms of liner and drainage.
- The design must make provision for the sequential phased development of the waste disposal site, such that leachate flows from the lowest point of the waste disposal cell can discharge into the leachate pond under gravity.

8.2 General site layout

Based on the aforementioned constraints and factors, the overall layout of the initial phase of the Tutuka waste disposal site has been developed. The arrangement of the various facilities and the sequence of development have been determined according to topography, drainage requirements, geology and distribution of soils over the site, access to the various portions of the site, and the possible impacts on surrounding land users. This design has been based on the preferred alternative which is Alternative A.

Initially a strip of land adjacent to the western toe of the existing waste disposal site is to be developed together with the shaping and capping of the existing waste disposal site as indicated on **Figure 8-1**. This area (0.68 ha) is still within the originally permitted footprint of the waste disposal site and can proceed under the existing waste disposal site permit. Thereafter the remainder of the area (1.77 ha) on the west of the existing waste disposal site is to be developed up to the borrow pit as indicated on **Figure 8-2**. Once this waste disposal site footprint (including the existing waste disposal site) has filled with waste up to its maximum design height, the area to the south of the site would be developed as shown on **Figure 8-3** to give the 1 million m^3 of total waste disposal site airspace required for the 40 years of site life. The total final footprint area would be approximately 8.54 ha.

The entrance to the site would remain in its current position at the south western corner of the existing waste disposal site for the Phase 1 waste disposal site operation. The existing gravel access road off the Tutuka Power Station road would continue to be used for waste deliveries to the site. The existing gate house at the entrance would also continue to be used for Phase 1 operations. Once the Phase 2 area is developed on the south side of the existing waste disposal site, the southern fence, site entrance and gate house would have to be relocated further south on the access road.

The Phase 1 waste disposal cells are to be developed adjacent to the western side of the existing waste disposal site with the contaminated water and leachate ponds located downslope to the north of the waste disposal site to facilitate gravity drainage of contaminated run-off and leachate. The waste disposal cells are to be developed generally according to the footprint shapes shown on the drawings. The initial development of the strip alongside the western toe of the existing waste disposal site and the shaping of the surface of the existing waste disposal site up to its maximum permitted height of 5 m above natural ground level would give approximately 4 years of operational life.

Once the new waste disposal site licence is obtained the remainder of Phase 1 would be developed and disposal would take place up to a height of 30 m above natural ground level. Development sequence would be from south to north, starting at the higher elevation to enable gravity drainage of leachate and contaminated water away from the waste body. A starter berm is to be constructed around the perimeter of the waste disposal site by means of a cut-to-fill operation.

At the lower end of the site on the northern side, the contaminated water and leachate ponds would be constructed and lined to the Minimum Requirements standards. Provision is to be made at the ponds to extract excess leachate and water either for disposal at the nearby sewage works or for spraying over the waste disposal site for dust control. This would facilitate reduction of the contaminated water and leachate through evaporation of the water component whilst retaining the contaminants within the lined waste disposal site.

A ring road would be constructed around the perimeter of the site, as well as storm water drains to divert clean up-slope run-off away from the facility.

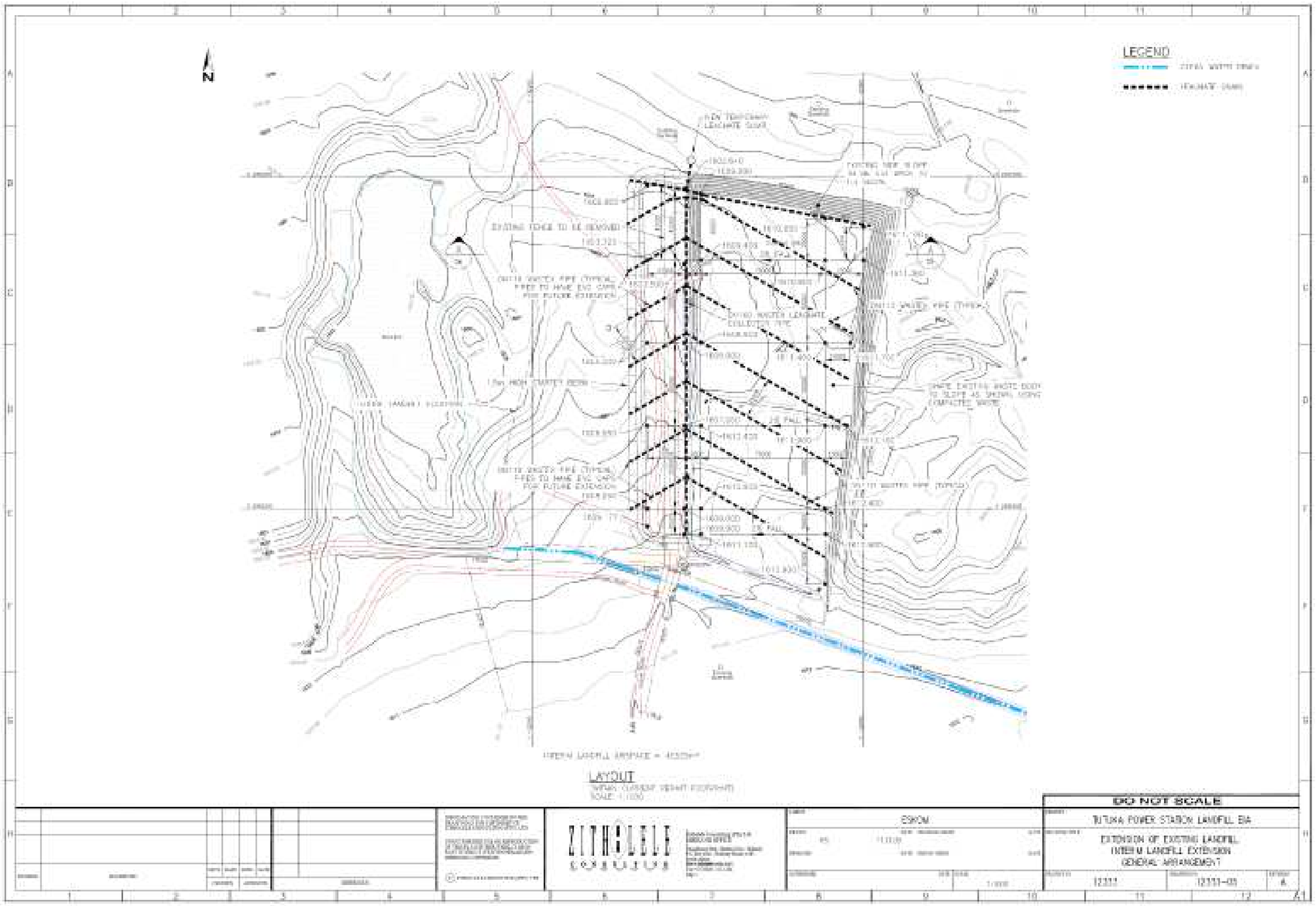

Figure 8-1: Existing Waste disposal site and Interim Extension

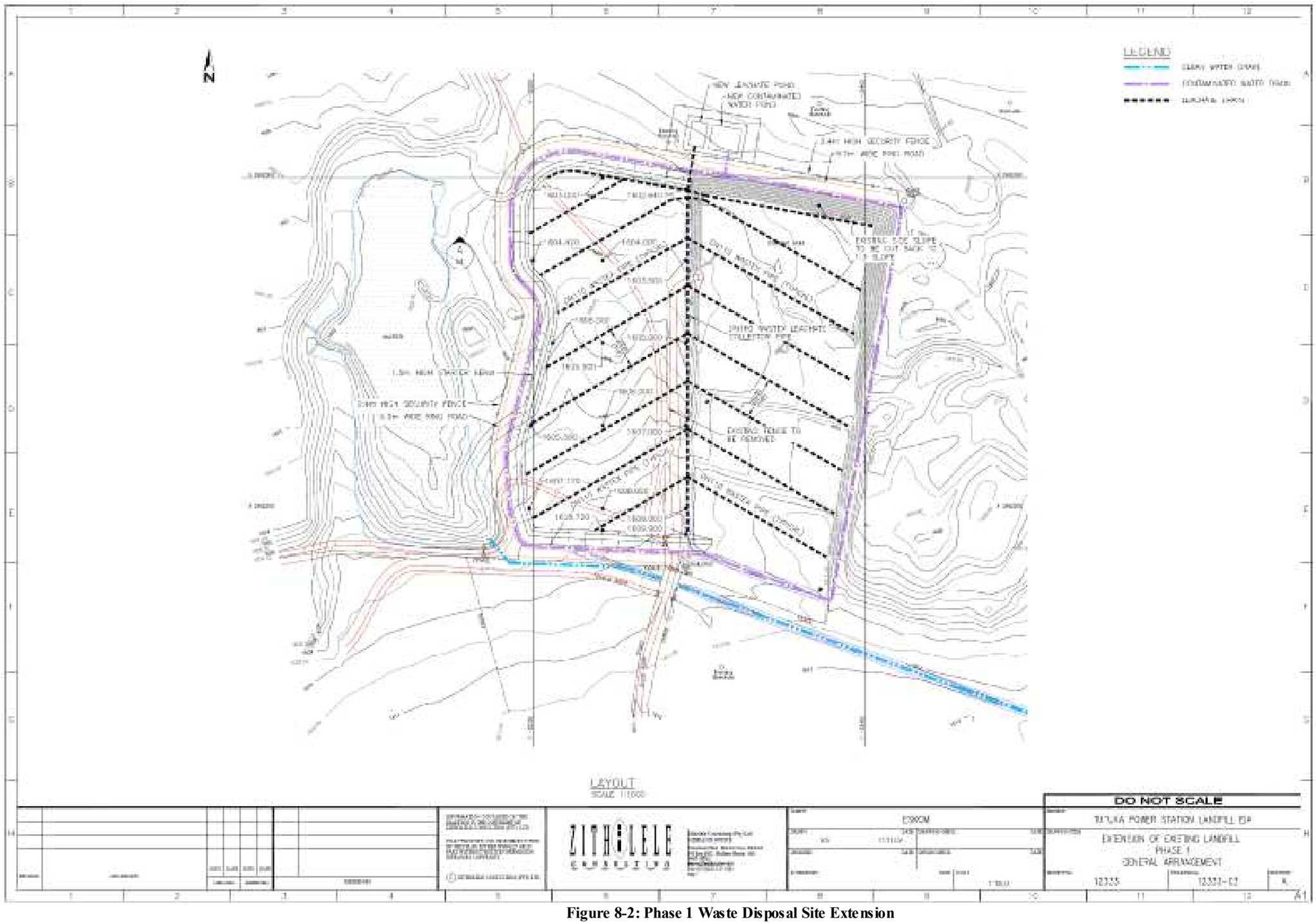

Figure 8-2: Phase 1 Waste Disposal Site Extension

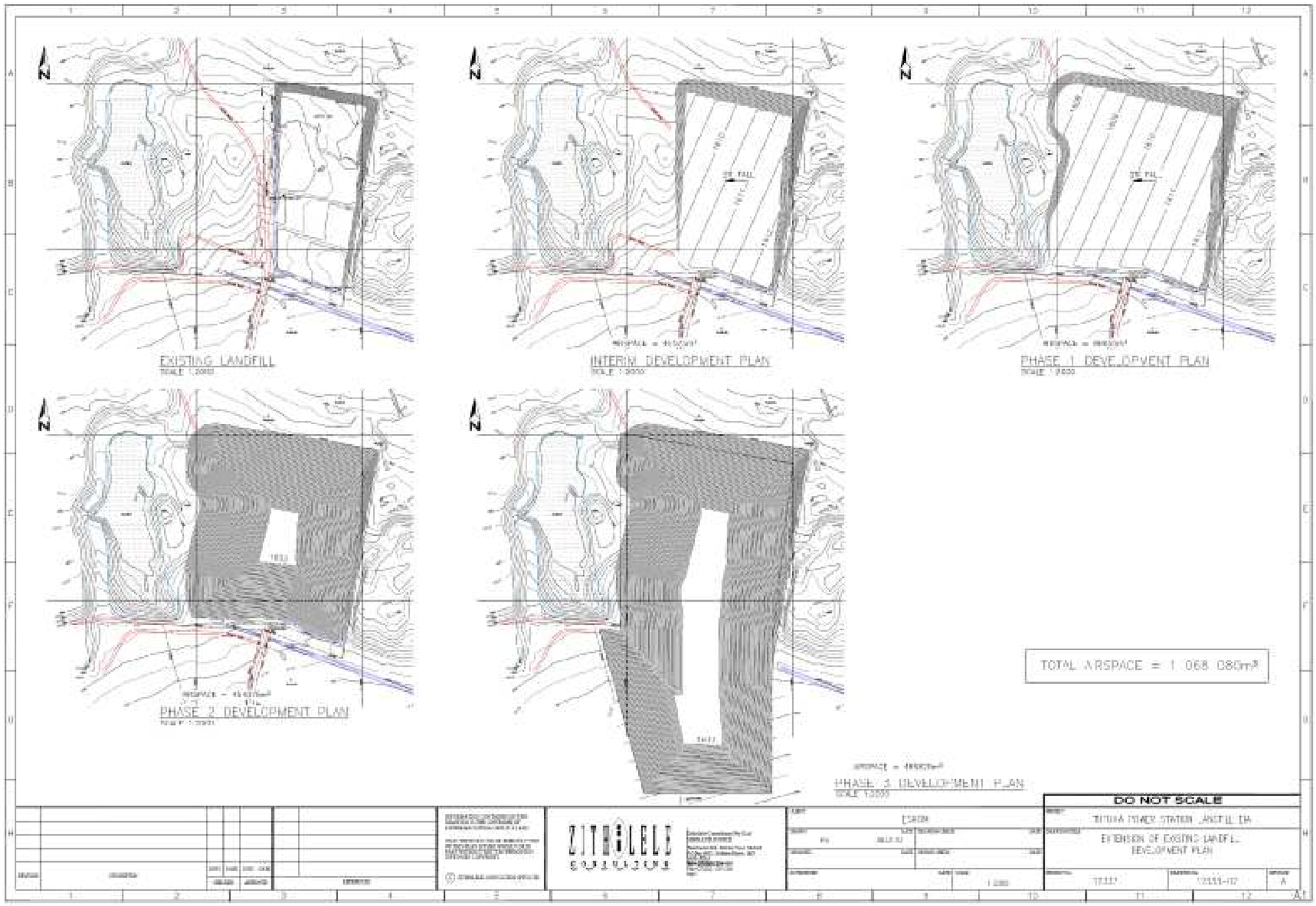

Figure 8-3: Phase 2 and 3 Waste Disposal Site Development

8.3 Waste disposal site design

8.3.1 Design approach

As stated in Section 4, the Tutuka waste disposal site has been classified as a G:S:B$^-$ waste disposal site. The Minimum Requirements for this class of waste disposal site calls for only a recompacted base preparation layer beneath the waste disposal site rather than a proper liner, and no leachate management system. However, based on the fact that the existing waste disposal site has already impacted on the groundwater environment and that the fractured/weathered dolerite is highly permeable, it is believed that an engineered waste disposal site liner is required at the site.

Although the climatic water balance suggests that there should not be generation of significant leachate, a leachate detection and collection system, as well as a small leachate sump pond is to be constructed as per the requirements listed in the Minimum Requirements for Waste Disposal (DWAF). This is a precautionary mechanism required by the government to ensure that any potential leachate is captures.

The existing waste disposal site needs to be capped without delay. It is proposed that this cap would double as a bottom liner for extending the waste disposal site on top of the existing waste disposal site. This "piggy-back" liner would tie in to the new waste disposal site liner and leachate collection system.

8.3.2 Existing waste disposal site capping and initial waste disposal site development

In order to address the short-term disposal needs, the remaining permitted waste disposal site footprint is to be developed for waste disposal. This development is to be done in conjunction with the construction of a waste disposal site capping / "piggy-back" liner over the existing waste disposal site. In addition, a leachate sump is to be installed as part of this development. The extent and details of this development are shown on **Figure 8-2** and **Figure 8-4**.

The surface of the existing waste disposal site is to be raised and shaped to create a cross-fall in a north-westerly direction using deposited waste, to the levels indicated on Drawing **Figure 8-1**. The "piggy-back" liner is to be constructed on this shaped surface as described in Section 9.7. Perforated HDPE leachate collector pipes are to be installed on the "piggy-back" liner as detailed, to connect into the main leachate drain running along the western toe of the existing waste disposal site. The outer slopes of the waste disposal site are to be cleared of vegetation, trimmed and the outer capping constructed as detailed.

Along the western side of the existing waste disposal site, a strip approximately 30 m wide is to be developed for waste disposal as shown on **Figure 8-1**. The area is to be stripped of black clay, and a 1 m high perimeter berm constructed to clearly demarcate the extent of the waste disposal site footprint. The waste disposal site liner is to be constructed as shown on **Figure 8-4**.

A 315 mm dia HDPE leachate main drain is to be installed along the toe of the existing waste disposal site, to drain into an HDPE leachate sump installed to the north of the site. Perforated leachate collector pipes are to be installed "herring-bone" fashion on top of the waste disposal site liner to drain into the leachate main drain.

By deposition on the area with waste up to the raised levels of the existing waste disposal site, it will give an airspace of approximately 40 500 m^3, which would give an operational site life of about 4 years.

8.3.3 Phase 1 waste disposal site development

Once the waste disposal site licence has been issued, the remainder of Phase 1 can be developed. The layout and details of this development are shown on **Figure 8-2** and **Figure 8-5**.

The area is to be stripped of black clay and a 1.5 m high starter berm is to be constructed around the perimeter of the new waste disposal site. The waste disposal site liner is to be constructed as detailed, and a "herring-bone" system of perforated HDPE leachate collector pipes installed diagonally down the slope, to connect into the leachate pipes beneath the initial development area. A lined contaminated water drain is to be constructed along the outside of the waste disposal site toe, to drain into the contaminated water pond to the north of the site.

The existing upslope stormwater cut-off drain is to be extended in a westerly direction to drain into the western borrow pit water body.

By depositing waste on this entire Phase 1 area with waste up to the raised levels of the existing waste disposal site, it will give an airspace of approximately 86 500 m^3, which would give an operational site life of about 7 years. If the waste disposal site is then taken up to its maximum practicable height of approximately 30 m above natural ground level, it will give an airspace of approximately 454 000 m^3, which would give an operational site life of about 25 years

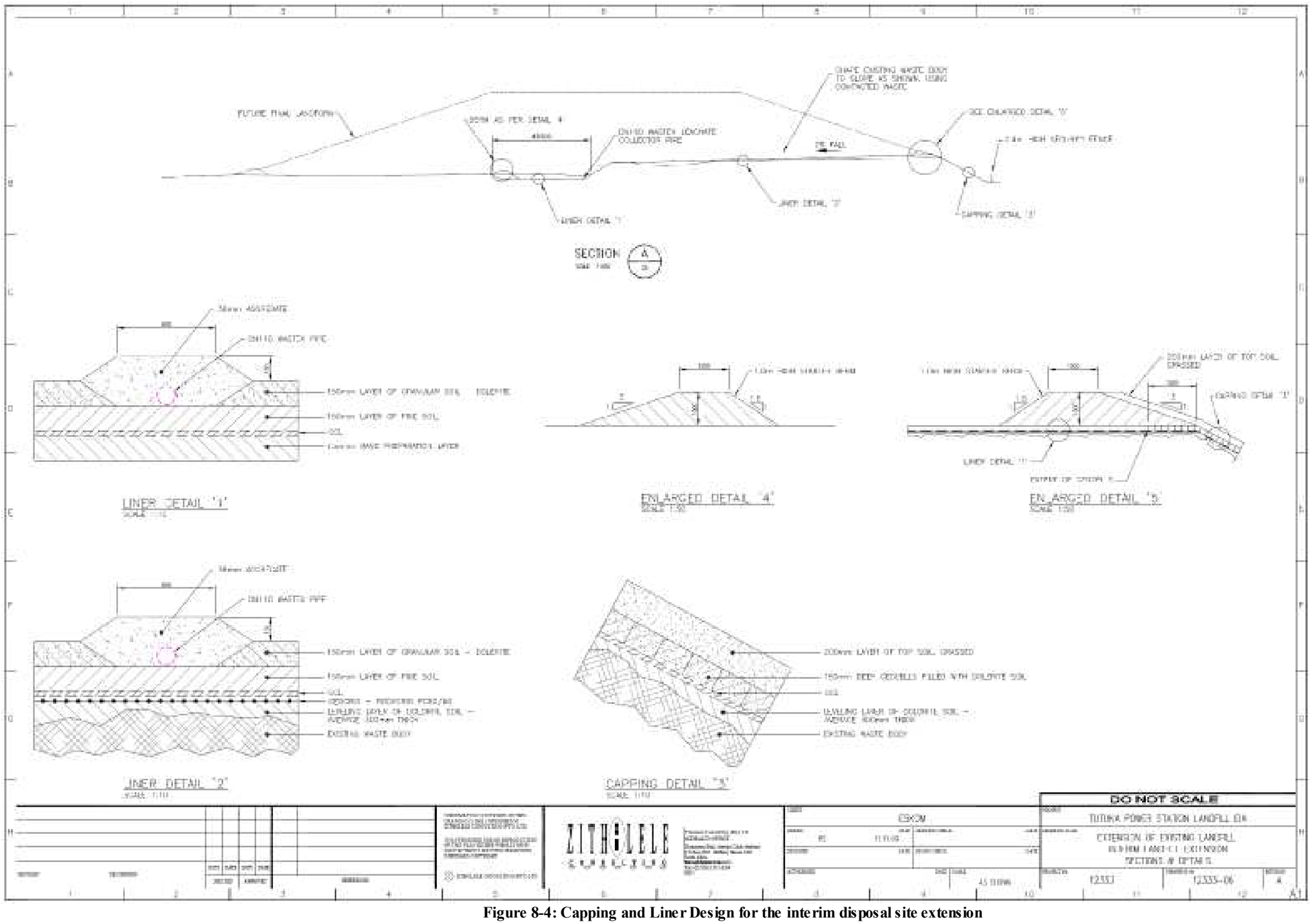

Figure 8-4: Capping and Liner Design for the interim disposal site extension

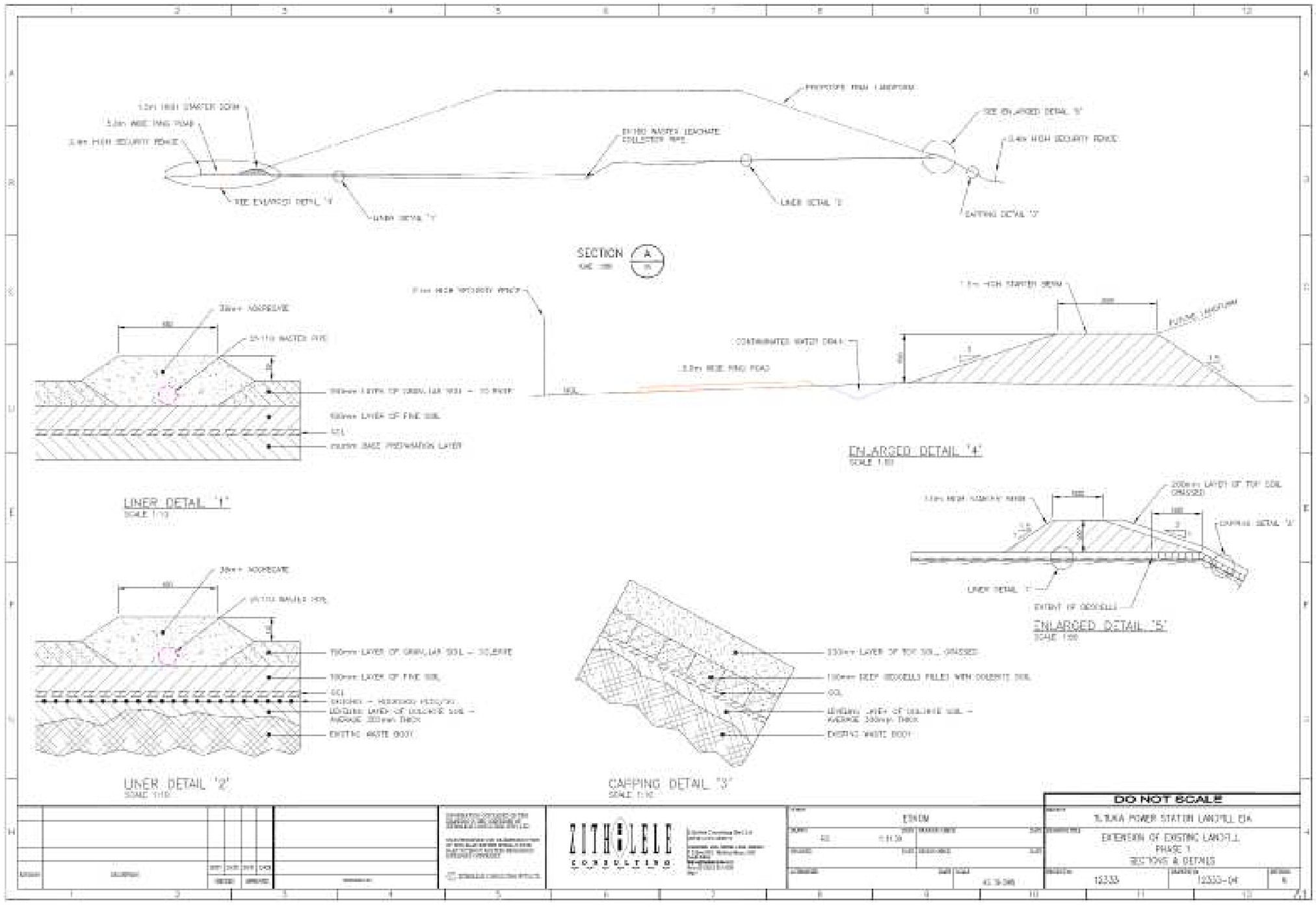

Figure 8-5: Capping and Liner Design for phase 1 of the disposal site development

8.3.4 Development plan

The aim of the Development Plan is to develop the waste disposal site from its initial constructed state, to its proposed final landform.

Waste disposal is to commence on the existing waste disposal site to achieve the required cross falls for drainage, and in the initial development area at the higher end of the cell, and is to proceed downslope in a northerly direction. Initially, a pioneering layer of waste at least 600 mm thick is to be placed over the liner by means of end tipping and spreading to protect the installed liner.

The working surface of the waste disposal site is to be sloped towards the leachate collector drains at the lower end of the cell. Waste disposal is to be taken up to maximum practicable height (approximately 5 m above natural ground level) before moving downslope to the next deposition area. The outer slopes of the waste disposal site are to be taken up at a slope of 1V:3H.

Once the Phase 1 area has been developed, waste disposal can be taken up to final height of approximately 30 m above natural ground level. Once this area has been filled with waste, the operation would move into the southern extension area.

As each section of the waste disposal cell is completed to final height, the outer slopes of the waste disposal site are to be graded and final cover applied on an ongoing basis. This will help to minimise leachate generation and will also make the waste disposal site more aesthetically pleasing.

Drawing No 12333/07 shows the sequential development plan for the various stages of development from the initial development through to the final landform after 40 years.

8.4 Leachate and drainage management

The drainage systems normally associated with a waste disposal site site address three components:

- Uncontaminated upslope run-off
- Contaminated run-off from the waste disposal site itself
- Highly contaminated leachate generated within the waste disposal site

All upslope run-off water must be diverted away from the waste, to prevent water contamination and minimise leachate generation. Surface run-off from uncovered waste on the waste disposal site and waste handling areas is considered to be potentially contaminated, and should not enter natural drainage courses without prior treatment or sufficient dilution. Highly contaminated

leachate should similarly not enter the natural water regime without prior treatment or purification.

The different drainage streams are discussed separately below.

8.4.1 Upslope storm water drainage

Uncontaminated upslope run-off is to be prevented from entering the waste disposal facility area by means of a diversion drain along the higher southern side of the waste disposal site. The existing drain will have to be extended in a westerly direction past the Phase 1 waste disposal area. When the waste disposal site development moves into the southern extension area, a new upslope drain will have to be constructed.

In addition, due to the presence of the perched aquifer within the fractured/weather dolerite, a "fin drain" is to be constructed upslope of the waste disposal site to intercept and divert groundwater seepage away from the waste body. This "fin drain" would comprise of a perforated HDPE pipe with a geonet vertical fin, all wrapped in a geotextile, set in a trench through the fractured/weathered dolerite, and backfilled with granular soil (dolerite gravel). The "fin-drain" would daylight on either side of the waste disposal site. In addition, the perimeter road around the waste disposal site will also act as a drainage diversion berm. At the side of the waste disposal site, the upslope cut-off drains would discharge into the open fields or into the adjacent water bodies. The drains are to be sized to handle peak flows from the 1 in 50 year recurrence interval design storm.

The layout and details of the storm water drainage system are shown on the drawings (Figure 8.1 – 8.3).

8.4.2 Contaminated surface run-off

Potentially contaminated run-off from the outer surfaces of the waste body and site roads is to be directed towards an open V-drain along the outer toe of the starter berm. This contaminated water drain would discharge into the contaminated water pond located next to the north of the site. The working surface of the waste disposal site is to slope towards the outer berms so that water drains away from the working face towards the toe drains. As portions of the waste disposal site reach final height and final cover has been applied, run-off from these areas would be considered as uncontaminated, and the toe drain would then be directed to link up with the clean storm water system.

The contaminated water pond has been sized to contain the runoff from half of the exposed waste body for the 1 in 50 year recurrence interval 24 hour duration storm. The run-off pond has been sized at 1 880 m^3, plus a 500 mm freeboard. The contaminated water pond is to be 50 m x 25 m x 3 m deep, with a geocell lined spillway to discharge overflow water during extreme rainfall events. The liner design for the contaminated water pond is discussed in Section 4.7.

8.4.3 Leachate Management

The three main components of a leachate management system include the following:

- The liner beneath the waste disposal site to prevent infiltration into the ground water.
- The collection system to transfer leachate to the treatment system.
- The leachate treatment system to prevent surface water pollution by leachate.

Any leachate emanating from the waste in the waste disposal site would appear in the 150 mm thick granular soil layer overlying the composite liner and would flow downslope beneath the waste disposal site towards the leachate collector drains. These drains would consist of 110 mm diameter perforated HDPE pipes placed within a zone of 38 mm aggregate approximately 1 m wide.

These primary leachate collectors would discharge into a 315 mm dia. Main leachate gravity drain running along the centre of the waste disposal site, to discharge into the leachate sump located to the north of the facility. Manholes are to be provided at the top and bottom of this leachate main drain for inspection and maintenance purposes. Manholes on all leachate drains are to have vented manhole covers to prevent the build up of waste disposal site gas in these manholes.

Leachate emanating from the waste disposal site is to be contained in an HDPE sump, located to the north of the waste disposal site. Leachate from the leachate sump is to be removed by tanker and taken to the nearest sewage treatment works for treatment. The leachate sump will have a manhole to facilitate leachate removal and an overflow into the contaminated water pond.

Since the waste disposal site is located within a water deficit area with a negative climatic water balance, significant leachate generation is not expected. However, during the early stages of waste desposition over the exposed liner, there would be significant run-off that will enter the leachate system. This run-off would tend to be a very weak contaminated water rather than actual leachate, so there should be no problem allowing it to overflow from the leachate sump into the contaminated water pond. The leachate sump is to consist of a “Weholite” HDPE pipe 1.8 m dia by 6 m long laid horizontally and with blank flanges welded to both ends. The leachate inlet and outlet pipes will be welded through the end flanges, and a vertical manhole is to be welded into the top of the sump. The effective volume of the leachate sump would be approximately 12 m^3.

8.5 Liner designs

The liner designs for the waste disposal site and the contaminated water pond have been developed in accordance with the Minimum Requirements, although various modifications and improvements have been made to address site specific conditions. The various liner designs are shown on **Figure 8-4**, **Figure 8-5** and 12333/08.

8.5.1 Waste disposal site liner (G:S:B$^-$)

In terms of the Minimum Requirements, an G:S:B$^-$ waste disposal site liner would normally comprise of only a recompacted base preparation layer of in-situ soil. However, in view of the fact that the in-situ dolerite soils and fractured dolerite are highly permeable, and because the existing waste disposal site, that does not have a bottom liner, has contaminated the groundwater, an upgrade liner is proposed for the waste disposal site extension. As there is no suitable clay in the area for the construction of a compacted clay liner, a geosynthetic clay liner (GCL) is proposed. The liner proposed for the waste disposal site extension would therefore comprise of the following components, working from the top downwards:

- Leachate detection and collection drains at 25 m centres, comprising of 110 mm dia perforated HDPE pipes, set in 1 m wide strips of 38 mm aggregate 300 mm deep.
- 150 mm layer of granular soil (blocky, "sugar" dolerite).
- 150 mm layer of fine soil.
- Geosynthetic clay liner (GCL) (3 600 kg/m^2).
- 150 mm base preparation layer (recompaction of in-situ sandy soil).

8.5.2 Existing waste disposal site "Piggy-back" liner

As stated earlier, the top of the existing waste disposal site is to be brought up to the required levels to achieve gravity drainage in a north westerly direction by means of depositing further waste on top. Thereafter, the surface is to be compacted and shaped to receive the "Piggy-back" liner system over the existing waste disposal site surface, comprising of the following components, working from the top downwards:

- Leachate detection and collection drains at 25 m centres, comprising of 110 mm dia perforated HDPE pipes, set in 1 m wide strips of 38 mm aggregate 300 mm deep.
- 150 mm layer of granular soil (blocky, "sugar" dolerite).
- 150 mm layer of fine soil.
- Geosynthetic clay liner (GCL) (3 600 kg/m^2).
- 150 mm layer of fine soil.
- Geogrid (RockGrid PC50/50 or equivalent) to address localised differential settlement of the waste.
- 150 mm base levelling layer of dolerite soil on compacted waste.

8.5.3 Contaminated water pond liner (G:S:B$^-$)

The liner design for the contaminated water pond would be similar to the waste disposal site liner, except that the leachate drainage layer would not be required. The liner layers on the base and walls of the pond would therefore comprise of the following components, working from the top downwards:

- 500 mm soil protection and confining layer
- Geosynthetic clay liner (GCL) (3 600 kg/m^2).
- 150 mm base preparation layer (recompaction of in-situ silty soil)

8.5.4 Existing waste disposal site final cover

The outer slopes of the existing waste disposal site will have to be capped and rehabilitated. As these slopes are steeper than 1:3 (V:H), it will be necessary to retain the soil on the slopes. The final cover for the eastern and northern slopes of the existing waste disposal site includes the following components, working from the top downwards:

- 200 mm topsoil with indigenous grass
- 150 mm deep geocells filled with dolerite soil.
- Geosynthetic clay liner (GCL) (3 600 kg/m^2).
- 150 mm base preparation and levelling layer of soil

8.5.5 Construction Quality Assurance

The main risk to the performance of a geosynthetic liner system is mechanical/physical damage, during and after installation. For this reason, it is imperative that the liner is supplied and installed by a competent and reputable contractor, and in accordance with a strict quality assurance programme. In particular, extreme care must be taken when placing the cover soil over the installed GCL so as not to damage the liner. Strict supervision is required.

8.6 Waste Disposal Site Gas Management

On account of the organic content of the general waste it is highly likely that the waste disposal site will produce waste disposal site gas. Since the site is to be operated according to sanitary waste disposal principles with daily covering of waste, proper ventilation must be provided. This is necessary to prevent the lateral migration of gas and uncontrolled venting from the site, causing odour problems and explosion hazards in confined structures such as manholes, etc. To achieve this, rock filled gabion chimneys are to be constructed within the waste body, extending upwards as the waste disposal site rises. Each chimney is to be wrapped in geotextile filter fabric and a small mound of soil is to be placed around it to prevent ingress of surface run-off,

and to stabilise the chimney. These gas chimneys are to be spaced at approximately 1 per 0,1 hectare.

When the final capping is applied to the waste disposal site at various stages of completion, appropriate capping structures would be constructed over the gas chimneys to enable passive venting to continue. Although active gas extraction and flaring of waste disposal site gas would be preferable to passive venting, it is not considered to be appropriate or cost effective for such a small waste disposal site located in a remote area.

Notwithstanding the above, the gas management system at the site must incorporate a gas monitoring system, including the following:

- Monitoring of waste disposal site gas concentrations on a regular basis on the waste disposal site during operation and after closure.
- Regular monitoring of safe practices to avoid hazardous concentrations of gases at temporary or permanent working areas of the site.

8.7 Closure and End-use

The objectives of the end-use design of the waste disposal site are as follows:

- To create an aesthetically acceptable landform with gentle slopes (not exceeding 1:3) that, as far as possible, blends in with the surrounding terrain.
- To maximise the waste disposal site airspace available for waste disposal and hence the site life.

8.7.1 Final Landform and End-use

At this stage, the proposed final shape of the waste disposal site would be determined according to the surrounding terrain, and to maximise the airspace from the available footprint. It would also be designed to meet drainage and end-use requirements. It is recommended that the end-use of the waste disposal site be considered as restricted open space, on account of the waste disposed on it. Other forms of development could also be considered. The end-use of the site should, however, be discussed with all stakeholders to ensure that the rehabilitated site is acceptable to them.

Based on the surrounding topography and land use, the maximum height of the waste disposal site would be about 30 m above the original natural ground level. The upper surfaces of the waste disposal site must have general slopes of at least 1:50 to promote rapid drainage of the waste disposal site surface.

8.7.2 Closure and Rehabilitation

As the different sections of the waste disposal site are completed to final height, they are to be appropriately shaped, graded and capped in accordance with the Minimum Requirements. As the new waste disposal site would have a bottom liner, the final capping for a G:S:B$^-$ waste disposal site would only need to include a 200 mm layer of topsoil, appropriately grassed.

Vegetation of completed areas is to commence as soon as possible after capping. Indigenous shrubs are to be planted around the site for screening purposes, as well as in any areas where the substrate will support tree growth. Over the rest of the site, grass is to be established using indigenous grass types. The intention is to implement what is known as "the rising green wall effect" by progressively grading and vegetating the side berms and then working behind them.

Provided the vegetation is always maintained during operation, there should be no need for later rehabilitation. After closure, ongoing maintenance of the waste disposal site capping and vegetation will be required.

9 IMPACT ASSESSMENT METHODOLOGY

In order to ensure uniformity, a standard impact assessment methodology has been utilised so that a wide range of impacts can be compared. The impact assessment methodology makes provision for the assessment of impacts against the following criteria:

- Significance;
- Spatial scale;
- Temporal scale;
- Probability; and
- Degree of certainty.

A combined quantitative and qualitative methodology was used to describe impacts for each of the aforementioned assessment criteria. A summary of each of the qualitative descriptors along with the equivalent quantitative rating scale for each of the aforementioned criteria is given in **Table 9-1**.

Table 9-1: Quantitative rating and equivalent descriptors for the impact assessment criteria.

RATING	SIGNIFICANCE	EXTENT SCALE	TEMPORAL SCALE
1	VERY LOW	*Isolated corridor / proposed corridor*	Incidental
2	LOW	*Study area*	Short-term
3	MODERATE	*Local*	Medium-term
4	HIGH	*Regional / Provincial*	Long-term
5	VERY HIGH	*Global / National*	Permanent

A more detailed description of each of the assessment criteria is given in the following sections.

9.1 Significance Assessment

Significance rating (importance) of the associated impacts embraces the notion of extent and magnitude, but does not always clearly define these since their importance in the rating scale is very relative. For example, the magnitude (i.e. the size) of area affected by atmospheric pollution may be extremely large (1000 km^2) but the significance of this effect is dependent on the concentration or level of pollution. If the concentration is great, the significance of the impact would be HIGH or VERY HIGH, but if it is diluted it would be VERY LOW or LOW. Similarly, if 60 ha of a grassland type are destroyed the impact would be VERY HIGH if only 100 ha of that grassland type were known. The impact would be VERY LOW if the grassland type was common. A more detailed description of the impact significance rating scale is given in Table 9-2 below.

Table 9-2: Description of the significance rating scale.

RATING		DESCRIPTION
5	VERY HIGH	Of the highest order possible within the bounds of impacts which could occur. In the case of adverse impacts: there is no possible mitigation and/or remedial activity which could offset the impact. However this impact is not a fatal flaw. In the case of beneficial impacts, there is no real alternative to achieving this benefit.
4	HIGH	Impact is of substantial order within the bounds of impacts, which could occur. In the case of adverse impacts: mitigation and/or remedial activity is feasible but difficult, expensive, time-consuming or some combination of these. In the case of beneficial impacts, other means of achieving this benefit are feasible but they are more difficult, expensive, time-consuming or some combination of these.
3	MODERATE	Impact is real but not substantial in relation to other impacts, which might take effect within the bounds of those which could occur. In the case of adverse impacts: mitigation and/or remedial activity are both feasible and fairly easily possible. In the case of beneficial impacts: other means of achieving this benefit are about equal in time, cost, effort, etc.
2	LOW	Impact is of a low order and therefore likely to have little real effect. In the case of adverse impacts: mitigation and/or remedial activity is either easily achieved or little will be required, or both. In the case of beneficial impacts, alternative means for achieving this benefit are likely to be easier, cheaper, more effective, less time consuming, or some combination of these.
1	VERY LOW	Impact is negligible within the bounds of impacts which could occur. In the case of adverse impacts, almost no mitigation and/or remedial activity is needed, and any minor steps which might be needed are easy, cheap, and simple. In the case of beneficial impacts, alternative means are almost all likely to be better, in one or a number of ways, than this means of achieving the benefit.
0	NO IMPACT	There is no impact at all - not even a very low impact on a party or system.

9.2 Spatial Scale

The spatial scale refers to the extent of the impact i.e. will the impact be felt at the local, regional, or global scale. The spatial assessment scale is described in more detail in Table 9-3.

Table 9-3: Description of the spatial rating scale.

RATING		DESCRIPTION
5	Global/National	The maximum extent of any impact.
4	Regional/Provincial	The spatial scale is moderate within the bounds of impacts possible, and will be felt at a regional scale (District Municipality to Provincial Level). The impact will affect an area up to 50 km from the proposed site.
3	Local	The impact will affect an area up to 5 km from the proposed site.
2	Study Area	The impact will affect a route corridor not exceeding the boundary of the Eskom property.
1	Isolated Sites / proposed site	The impact will affect an area no bigger than the site.

9.3 Duration Scale

In order to accurately describe the impact it is necessary to understand the duration and persistence of an impact in the environment. The temporal scale is rated according to criteria set out in Table 9-4.

Table 9-4: Description of the temporal rating scale.

	RATING	DESCRIPTION
1	Incidental	The impact will be limited to isolated incidences that are expected to occur very sporadically.
2	Short-term	The environmental impact identified will operate for the duration of the construction phase or a period of less than 5 years, whichever is the greater.
3	Medium term	The environmental impact identified will operate for the duration of the waste disposal site.
4	Long term	The environmental impact identified will operate beyond the life of operation.
5	Permanent	The environmental impact will be permanent.

9.4 Degree of Probability

Probability or likelihood of an impact occurring will be described as shown in Table 9-5 below.

Table 9-5: Description of the degree of probability of an impact accruing.

RATING	DESCRIPTION
1	Practically impossible
2	Unlikely
3	Could happen
4	Very Likely
5	It's going to happen / has occurred

9.5 Degree of Certainty

As with all studies it is not possible to be 100% certain of all facts, and for this reason a standard "degree of certainty" scale is used as discussed in Table 9-6. The level of detail for specialist studies is determined according to the degree of certainty required for decision-making. The impacts are discussed in terms of affected parties or environmental components.

Table 9-6: Description of the degree of certainty rating scale.

RATING	DESCRIPTION
Definite	More than 90% sure of a particular fact.
Probable	Between 70 and 90% sure of a particular fact, or of the likelihood of that impact occurring.
Possible	Between 40 and 70% sure of a particular fact or of the likelihood of an impact occurring.
Unsure	Less than 40% sure of a particular fact or the likelihood of an impact occurring.
Can't know	The consultant believes an assessment is not possible even with additional research.

9.6 Quantitative Description of Impacts

To allow for impacts to be described in a quantitative manner in addition to the qualitative description given above, a rating scale of between 1 and 5 was used for each of the assessment criteria. Thus the total value of the impact is described as the function of significance, spatial and temporal scale as described below:

$$\textit{Impact Risk} = \frac{(\text{SIGNIFICANCE} + \textit{Spatial} + \text{Temporal})}{3} \times \frac{\text{Probability}}{5}$$

An example of how this rating scale is applied is shown below:

Table 9-7: Example of Rating Scale.

IMPACT	SIGNIFICANCE	SPATIAL SCALE	TEMPORAL SCALE	PROBABILITY	RATING
	LOW	*Local*	Medium Term	*Could Happen*	
Impact to air	**2**	***3***	**3**	**3**	**1.6**

Note: The significance, spatial and temporal scales are added to give a total of 8, that is divided by 3 to give a criteria rating of 2,67. The probability (3) is divided by 5 to give a probability rating of 0,6. The criteria rating of 2,67 is then multiplied by the probability rating (0,6) to give the final rating of 1,6.

The impact risk is classified according to 5 classes as described in the table below.

Table 9-8: Impact Risk Classes.

RATING	IMPACT CLASS	DESCRIPTION
0.1 – 1.0	**1**	**Very Low**
1.1 – 2.0	**2**	**Low**
2.1 – 3.0	**3**	**Moderate**
3.1 – 4.0	**4**	**High**
4.1 – 5.0	**5**	**Very High**

Therefore with reference to the example used for air quality above, an impact rating of 1.6 will fall in the Impact Class 2, which will be considered to be a low impact.

9.7 Notation of Impacts

In order to make the report easier to read the following notation format is used to highlight the various components of the assessment:

Significance or magnitude- IN CAPITALS

Duration – in underline

Probability – *in italics and underlined*.

Degree of certainty - **in bold**

Spatial Scale – *in italics*

10 IMPACT ASSESSMENT

The Impact Assessment highlighted and described the impact to the environment following the above mentioned methodology and assessed the impacts to the biophysical elements described in the baseline environment. In addition the impact assessment will aim to identify the most suitable site of the three alternatives identified.

The impact assessment was undertaken for the construction, operational and decommissioning phases of the domestic disposal site project. The waste disposal site will consist of a waste dump with a single access point and an access road (**Figure 10-1**). It should be noted that there is currently a waste disposal site on the terrain and it is anticipated that the activities of the proposed site would be identical to the current operations.

Figure 10-1: Example of what the waste site would look like while operating

10.1 Geology

Baseline Impact

The study site is highly disturbed as a result of extensive gravel excavation for the power station site and road building in the area. The current waste disposal site itself was sited within a previous borrow pit. This is due to the weathered Dolorite that occurs in the area, this material is easy to excavate, and provides good road building and fill material. This material is widely available as much of the south western Mpumalanga is covered in either underlain or dolorite. In addition the material does not really have an economic value. There is also no difference between the various alternatives as the impacts are identical.

The Baseline impact to Geology is rated as a MODERATE negative impact occurring in *isolated sites* over the long term. This impact *has occurred* and is therefore rated as a **Moderate** negative impact.

Additional Impact

The additional impact from this development would be very limited. The base of the new waste disposal site will require some preparation but this should be limited to the soil layer on top of the geology. This impact is rates as a VERY LOW negative impact, occurring in *isolated sites* and would be incidental. This impact is rated as a **Very Low** negative impact that *could occur*.

Once the site is established and operating there will be no impact on the geology. The same is relevant for the closure and decommissioning phase.

Cumulative Impact

The cumulative impact of the construction phase and the Baseline impact will remain as assessed in the Baseline impact assessment as the additional impact is so low it will not increase the baseline impact.

Mitigation Measures

The chances of an impact to geology are so low that no mitigation measures are proposed.

Residual Impact

With no mitigation measures to lower the impact, the residual impact remains as assessed for the Baseline impact and remains a **Moderate impact**. It should be noted though that this is illustrative of the **existing impact** to the surrounding environment and not the impact as a result of this development.

Table 10-1: Impact Rating Matrix for Geology

Construction phase					
Impact Type	**Significance**	**Spatial**	**Temporal**	**Probability**	**Rating**
Baseline	Moderate	Isolated sites	Long Term	Has Occurred	**2.67 Moderate**
Additional	Very Low	Isolated sites	Incidental	Could Occur	**0.8 – Very Low**
Cumulative	Moderate	Isolated sites	Long Term	Has Occurred	**2.67 Moderate**
Residual	Moderate	Isolated sites	Long Term	Has Occurred	**2.67 Moderate**
Operational Phase					
Impact Type	**Significance**	**Spatial**	**Temporal**	**Probability**	**Rating**
Additional					**No Impact**
Cumulative	Moderate	Isolated sites	Long Term	Has Occurred	**2.67 Moderate**
Residual	Moderate	Isolated sites	Long Term	Has Occurred	**2.67 Moderate**
Closure and Rehabilitation Phase					
Impact Type	**Significance**	**Spatial**	**Temporal**	**Probability**	**Rating**
Additional					**No Impact**
Residual	Moderate	Isolated sites	Long Term	Has Occurred	**2.67 Moderate**

10.2 Soils and Agriculture

Baseline Impact

At Alternative A the study site presently has an operating waste disposal site. The soils underneath the waste site have been covered with up to 5 m of waste and soil. This has rendered this area (±4 ha) sterile for agricultural use. Due to the relatively low agricultural potential of the natural soil in the area this impact is **low**.

Further impacts to soils in the study area for Alternative A and C include the use of soil as cover material at the waste disposal site or for road building material. This material is obtained from shallow borrow pits around the area to the south and west of the current waste disposal site. It has been indicated by the power station personnel that the current practises for obtaining cover material will continue.

At Alternative B the soil is still relatively undisturbed as the borrow activities did not extend to this area. Most possibly due to the hardness of the Dolerites in this area preventing them being excavated easily.

In terms of agricultural use the study site is currently used as grazing land by cattle farmers, and as such the land is reaching its maximum agricultural potential.

In view of the discussion above the baseline impact to soils and land capability for Alternative A is rated as a MODERATE negative impact that occurs on the *study site* and will remain for the long term. The impact *has already occurred* and is therefore rated as a **Moderate** impact**.**

The baseline impact to soils and land capability for Alternative C is rated as a LOW negative impact that occurs in *isolated sites* and will remain for the long term. This impact *has already occurred* and is therefore rated as **Moderate** negative impact.

The baseline impact at Alternative B is significantly less as the soils have not been used for borrow material. Therefore the baseline impact to soils is rated as a VERY LOW incidental negative impact acting on *isolated sites*. This impact is *likely* to occur and the therefore rated as a **Very Low** impact.

Additional Impact

The additional impacts to soils and agricultural potential during construction of the waste disposal site include the clearing of vegetation in the area of the extended disposal site, compaction and levelling of the soil, covering of the soil by the liner and drainage systems and the installation of the storm water runoff control system. The clearing of the soil could potentially result in erosion as the vegetation is removed, exposing the soil to the erosion elements. Furthermore the construction vehicles have the potential to compact the soil by their movements or pollute the soil by spilling hydrocarbons. Both of these impacts reduce the agricultural potential of soils, but these soils already have a low potential. The placing of the waste site on the soil creates a long term impact that renders the underlying soil sterile and useless in terms

of land capability. It should be noted though that the soils in this area have a low agricultural potential and are mostly only suitable for grazing purposes.

The additional impact to soils and agricultural potential during the construction phase is a MODERATE negative impact occurring in the *study area* and acting in the long term. This impact *will occur* and as such is rated as a **Moderate** impact. This is the same for all three Alternatives.

During the operational phase the impacts described above will remain, but the construction vehicles will be replaced with the vehicles transporting the waste to the site with the potential to generate hydrocarbon spillages. In addition more and more soil material will be removed from the adjacent landscape to be used as cover material on the waste disposal site. An indirect impact from the waste disposal site will be the formation of leachate that could pollute the underlying soils. It should be noted that this impact describes the unmitigated scenario. All these impacts are rated as a MODERATE negative impact occurring in the *study area* and acting in the long term. This impact *will occur* and is therefore rated as a **Moderate** impact.

During the rehabilitation and closure phase the waste site will be capped. This should remove the potential to generate leachate but the soils under the waste site will remain for all purposes sterile. This impact is rated as a LOW negative impact acting on the *study area* in the long term. This impact will occur and is therefore rated as a **Moderate** impact as show in **Table 10-4**.

Cumulative Impact

For Alternative A the cumulative impact during the construction phase remains as assessed above as the additional impact and the baseline impact occur in the same area. Therefore the impact remains a **Moderate** impact. The same is applicable for the closure and operational phases.

When moving to Alternative B and C the scenario changes as these sites do not have an existing impact from a waste disposal site. As the additional impact from the development is rated as a **Moderate** negative impact the cumulative impact increases in both cases to be a **Moderate** residual impact.

Mitigation Measures

- Ensure that the waste disposal site is lined and a leachate collection system is installed to prevent leachate from entering the underlying soil;
- Ensure that the waste body has a storm water drainage system that prevents dirty water from contaminating the adjacent soil;
- Ensure that all machinery on site is in a good working order and that no servicing of machinery will be allowed on site;
- Limit all activities to the proposed waste disposal site;
- Ensure that adequate storm water control measures are in place to prevent erosion;

- Spread absorbent sand on areas where oil spills are likely to occur, such as the refuelling area in the hard park (if present);
- Oil-contaminated soils are to be removed to a contained storage area and bio-remediated or disposed of at a licensed facility;
- If soils are excavated for the levelling operations, ensure that the soil is utilised elsewhere for cover material in the waste site;
- Ensure that soil is stockpiled in such a way as to prevent erosion from storm water; and
- When closing the site ensure that the site is properly capped to prevent the infiltration of water into the waste body.

Residual Impact

The residual impact with the successful implementation of the mitigation measures mentioned above will be slightly less significant as the probability reduces slightly. Therefore the rating remains **Moderate.** This is relevant for both the construction and operational phases. In the case of the closure phase it is standard procedure to cap and close the site without removing the final waste body. In so doing the soil will remain sterile under the waste body. This is rates as a **Moderate** impact.

Table 10-2: Impact Rating Matrix for soils and agricultural potential

Construction phase					
Impact Type	**Significance**	**Spatial**	**Temporal**	**Probability**	**Rating**
Baseline – Alt A	Moderate	Study site	Long Term	Is occurring	**3.0 – Moderate**
Baseline – Alt B	Very Low	Isolated sites	Short Term	Incidental	**0.5 – Very Low**
Baseline – Alt C	Low	Isolated sites	Long Term	Has occurred	**2.67 – Moderate**
Additional	Moderate	Study site	Long Term	Will occur	**3.0 - Moderate**
Cumulative	Moderate	Study site	Long Term	Will occur	**3.0 - Moderate**
Residual	Low	Study site	Long Term	Will occur	**2.67 - Moderate**
Operational Phase					
Impact Type	**Significance**	**Spatial**	**Temporal**	**Probability**	**Rating**
Additional	Moderate	Study site	Long Term	Will occur	**3.0 - Moderate**
Cumulative	Moderate	Study site	Long Term	Will occur	**3.0 - Moderate**
Residual	Moderate	Study site	Long Term	Very Likely	**2.4 – Moderate**
Closure and Rehabilitation Phase					
Impact Type	**Significance**	**Spatial**	**Temporal**	**Probability**	**Rating**
Residual	Low	Study site	Long Term	Very Likely	**2.13 - Moderate**

10.3 Ecology

In order to determine the impact on the ecology of the study area one has to rate the sensitivity of the ecological units on site. This is done by evaluating the ecological function and the conservation importance of the units. A discussion on each of these is given below.

The precautionary principle was applied throughout the determination of the ecological function and the conservation importance of the vegetation types and in instances where a vegetation type was found to be borderline between two categories; the community was classified in the higher category.

Ecological Function

The variations in ecological function occurring within the study site are shown in **Figure 10-2**. Although impacted, the *Themeda triandra* grassland and the natural wetland vegetation types are considered of high ecological function as the patterns and processes within this community are still present and the functions as they would in a natural state.

The *Themeda- Hyparrhenia* grassland vegetation type can be considered as being of moderate ecological status as some of the patterns and processes in these areas have been diminished or eliminated by anthropogenic impacts. Further extensive impacts in these areas could cause rapid and perhaps irreversible degradation of these areas.

The artificial wetlands and existing disposal areas have low ecological function due to anthropogenic impacts. Natural patterns and processes in these areas have been severely reduced or, in extreme cases, almost completely eliminated. These areas can be considered as irreversibly or close to irreversibly degraded. Further impacts in these areas are unlikey to cause further degradation with regard to the vegetation, but some effects of degradation such as the invasion of exotic species may infiltrate the surrounding vegetation types.

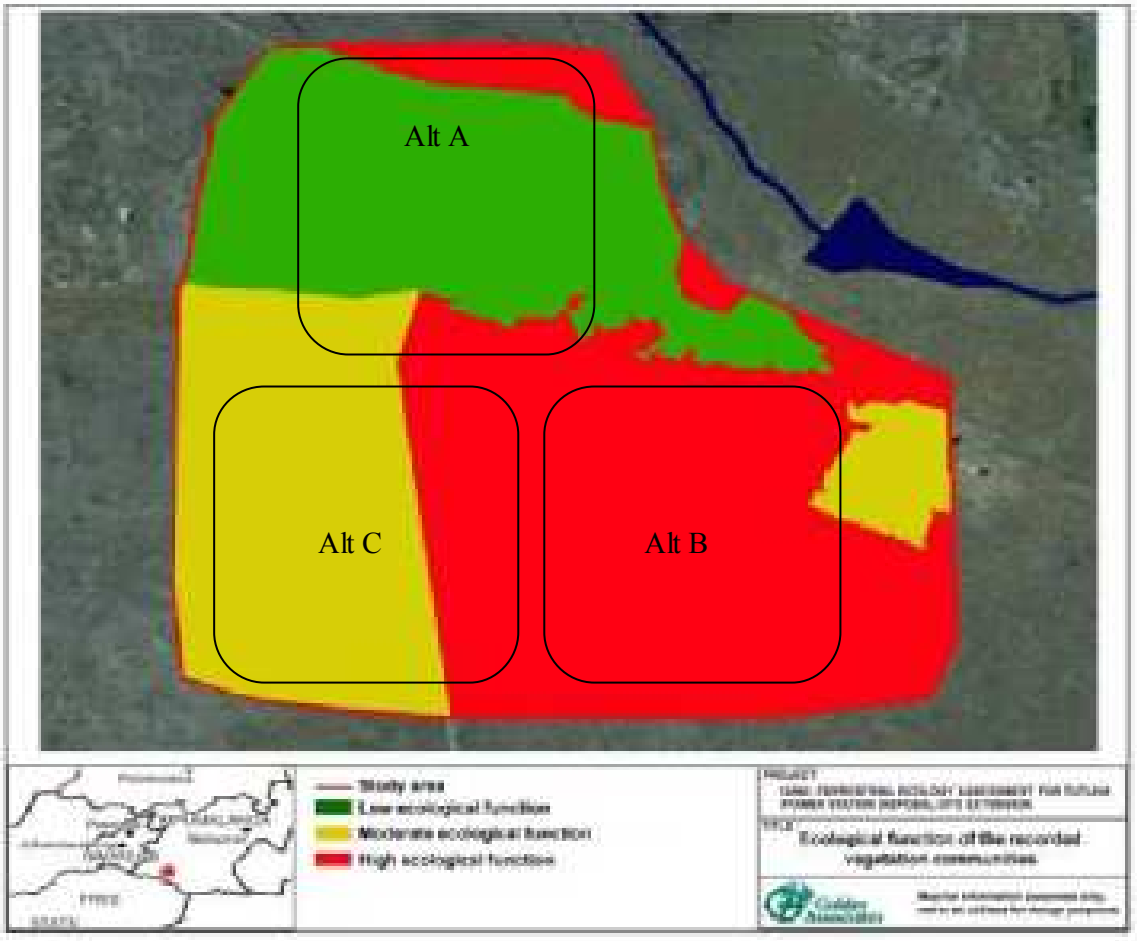

Figure 10-2: Ecological function of the study area.

Conservation Importance

The variation in conservation importance of the different vegetation types, falling within the study area, is shown in **Figure 10-3**. The areas with high conservation importance are the *Themeda triandra* grassland and the natural wetland vegetation types due to the fact that these areas are the least impacted areas. These vegetation types also have a far higher level of biodiversity than the surrounding areas and the likelihood of Red Data species occurring in these areas is also considered moderate, however none were found.

The *Themeda-Hyparrhenia* grassland (which includes the previously cultivated areas and road reserves) vegetation type can be considered as being of moderate conservation importance as, although invaded by some exotic species and disturbed in some areas, these vegetation types support a large number of species and are not severely degraded. The communities were classified as being of moderate conservation importance.

Due to the severe impacts, the artificial wetlands and existing disposal areas are classified as being of low conservation importance. These areas are in close proximity to the areas of high conservation importance thereby creating edge effects into the areas of high conservation importance through a number of ecological

(invasion of exotics, erosion etc.) and anthropogenic factors. These factors all reduce the connectivity of the areas of high conservation importance.

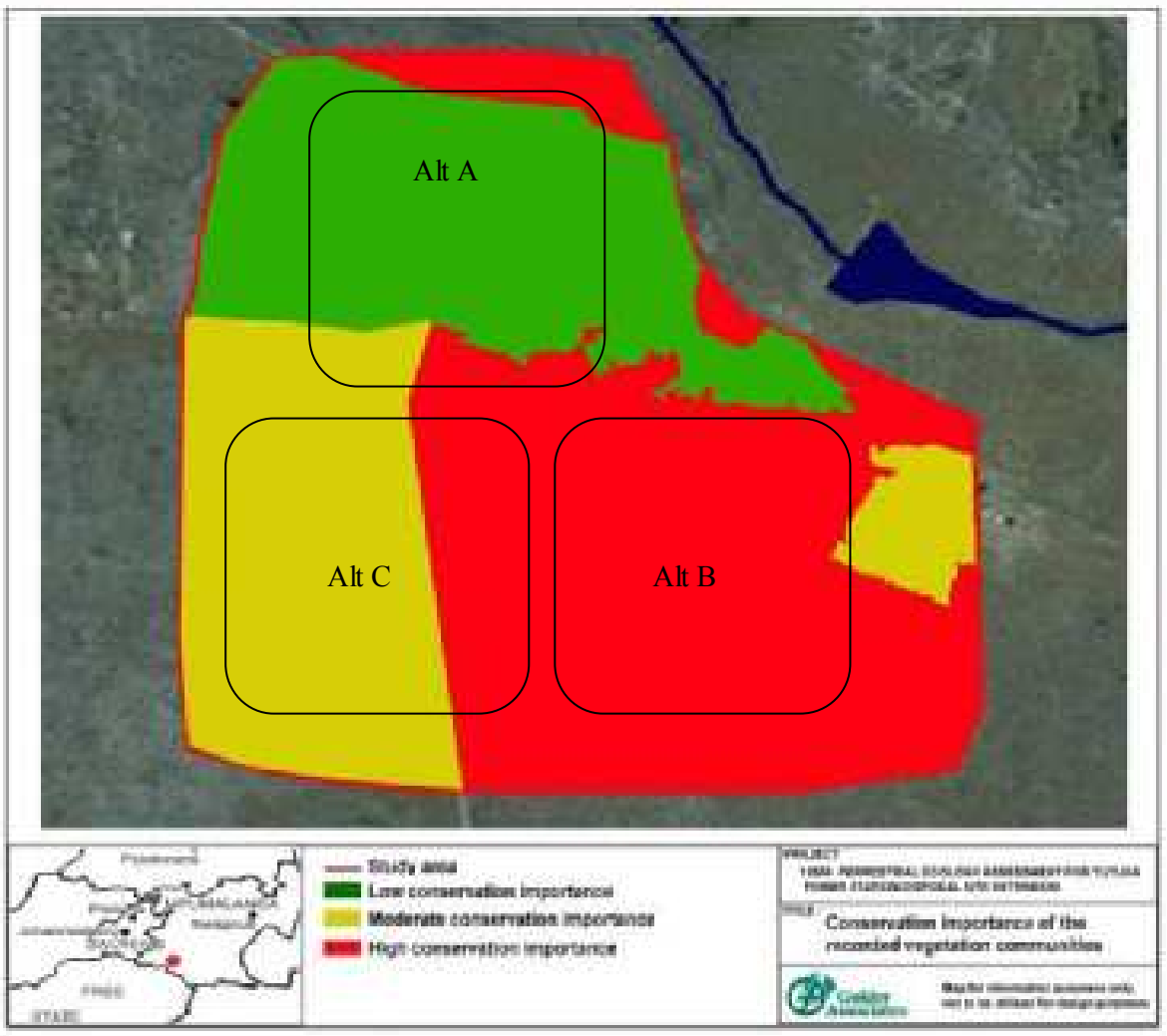

Figure 10-3: Conservation importance of the study area.

Baseline Impact

The baseline impact to the ecology as discussed above is mostly in the form human activities on site. These include old fields, grazing of the land by cattle, the current waste disposal site, site infrastructure and the borrow pits.

For the area of Alternative A the baseline impact is rated as a MODERATE negative impact acting on the *study site* in the medium term. This impact *is occurring* and therefore is rated as a **Moderate** impact.

For Alternative B the vegetation on site is in relatively good condition and the human impacts are limited. Here the impact is rated as a LOW negative impact acting on *isolated sites* in the short term. This impact *is occurring* and therefore is rated as a **Low** impact.

Alternative C has a MODERATE negative impact acting on *isolated sites* in the short term. This impact *is occurring* and therefore is rated as a **Low** impact.

Additional Impact

The first action of the waste disposal site construction will be to clear the vegetation on site in order to establish the foundations. Thereafter the area will be covered with the liner and the waste, not allowing vegetation to establish again. In addition the construction activities will disturb the fauna on site due to the noise and vibration.

This additional impact is rated as a LOW negative impact acting on the *proposed site* in the short term. This impact *will occur* and therefore is rated a **Low** impact. This is the case for Alternative A where the vegetation is not regarded as high conservation value and ecological function. For Alternative C the impact is rated as a HIGH negative impact (due to the high conservation value of the vegetation in this area) acting on the *proposed site* in the short term. This impact is rated as a **Moderate** impact. In the case of Alternative B the significance ranking is rated as MODERATE while the rest of the rating remains the same. This results in a **Low** additional impact rating.

During operation the site will be demarcated and new waste will be brought to site daily. Using the current operations as an example there is some propagation of alien weeds around a waste disposal site. There is a potential for these weeds to infiltrate the surrounding vegetation types. In most cases the natural vegetation will out-compete weeds over the long run. This potential impact is rated as a VERY LOW negative impact that *could happen* in the *study site* over the Short Term. This results in a **Low** additional impact rating.

Cumulative Impact

The construction cumulative impact is calculated for the proposed development and the baseline impacts put together. In this case the cumulative impact for Alternative A and C remains **Moderate**, while Alternative B rises from a Low to also be a **Moderate** impact.

The operational phase additional impact is so low that the cumulative impact remains as assessed for the additional impact.

Mitigation Measures

- Keep vegetation clearing to a minimum, investigation and translocation of any protected species that may occur in the area will have to be investigated;
- No impact is allowed to the wetland area to the north of the site;
- Unnecessary noise must be kept to a minimum, precautions can be put in place to minimise vibration and noise during construction;
- Use existing roads and keep the construction of roads to a minimum;

- All construction areas should be demarcated prior to construction to ensure that the footprint of the impacts are limited (including areas where vehicles may traverse);
- All alien invasive species on site should be removed and follow up monitoring and removal programmes should be initiated once construction is complete; and
- Ensure that natural grasses are used as part of the site rehabilitation and closure phase.

Residual Impact

The residual impact to the ecology of the study sites should be well contained if the mitigation measures prescribed above are implemented. During the construction phase the impact rating remains is rated as a LOW negative impact, acting on the *proposed site* over the medium term. This impact *will happen* and is therefore rated as a **Low** impact.

For the operational and closure phases the impact remains as assessed for the cumulative impact.

Table 10-3: Impact Rating Matrix for Ecology

Construction phase					
Impact Type	**Significance**	**Spatial**	**Temporal**	**Probability**	**Rating**
Baseline – Alt A	Moderate	Study site	Medium Term	Is occurring	**2.67 – Moderate**
Baseline – Alt B	Low	Isolated sites	Short Term	Is occurring	**1.67 – Low**
Baseline – Alt C	Moderate	Isolated sites	Short Term	Is occurring	**2.0 – Low**
Additional – Alt A	Low	Proposed site	Short Term	Will occur	**1.67 - Low**
Additional – Alt B	High	Proposed site	Short Term	Will occur	**2.3 – Moderate**
Additional – Alt C	Moderate	Proposed site	Short Term	Will occur	**2.0 - Low**
Cumulative	Moderate	Study site	Medium Term	Is occurring	**2.37 - Moderate**
Residual	Low	Proposed site	Medium Tern	Will occur	**2.0 - Low**
Operational Phase					
Impact Type	**Significance**	**Spatial**	**Temporal**	**Probability**	**Rating**
Additional	Very Low	Study Site	Medium Term	Could happen	**1.2 Low**
Cumulative	Very Low	Study Site	Medium Term	Could happen	**1.2 Low**
Residual	Very Low	Study Site	Medium Term	Could happen	**1.2 Low**
Closure and Rehabilitation Phase					
Impact Type	**Significance**	**Spatial**	**Temporal**	**Probability**	**Rating**
Residual	Very Low	Study Site	Medium Term	Could happen	**1.2 Low**

10.4 Surface Water

Baseline Impact

As mentioned above, the site currently has an operating waste disposal facility on site. The runoff from the site is controlled by means of storm water cut-off trenches around the waste body. Other existing impacts to surface water in the area are mainly in the form of dirty storm water runoff from the Thuthukani village, but this is some distance away (>2 km). As indicated in Section 5, the current operations form part of a surface and ground water monitoring campaign. There are 4 surface water monitoring points around the

current waste disposal site that can identify any impact from the site on the surface water (unnamed tributary and the Racesbult spruit).

The current monitoring results from these monitoring points indicate that the two points in the unknown stream do not have enough surface water to have a reliable data pool. The two points in the Racesbult spruit however, provide a long term scenario as depicted in the results in Appendix A. Currently the surface water conforms to the South African drinking water quality guidelines, and with the exception of Calcium, all the constituents monitored are lower in concentration after the water from the unnamed stream site joins the Racesbult spruit.

There is evidence of some impact from the Tutuka Power Station onto the Racesbult spruit upstream of the current waste disposal site, but these impacts have dissipated by the time the spruit reached the current waste disposal site.

The baseline impact to surface water is therefore rated as a LOW negative impact occurring in the *study area* and acting in the short term. This impact *could occur* and as such is rated as a **LOW** impact.

Additional Impact

The additional impact during the construction phase of the development of the new site will be mostly from the earthworks and earth-moving equipment. This process will mobilise dust that can be transported via surface runoff to the nearby stream. This could increase the turbidity levels in the downstream surface water bodies, impacting on aquatic life and water quality. In addition the earth-moving equipment could spill hydrocarbons and lubricants if they are not in a good working order. This impact should however be very limited in extent and only for a short period of time.

The additional impact to surface water resources during the construction phase is a MODERATE negative impact occurring in the *study area* and acting in the short term. This impact *could occur* and as such is rated as a **Low** impact.

During the operational phase the impact to surface water will derive from precipitation coming into contact with uncovered domestic waste. Due to the random composition of the waste, it is uncertain as to the potential pollutants that could be transported via runoff to the nearby surface water bodies. This could impact on the surface water quality and in extreme cases the pollutants could enter the larger river system, from where it will end up in the Grootdraai Dam. This dam supplies industrial water to not only Tutuka Power Station but several other industries such as Sasol Secunda and other power stations in the area. During the operational phase the additional impacts described above will be a HIGH negative impact occurring in the *regional* scale and acting in the Long Term. This impact *could occur* and is therefore rated as a **Moderate impact.**

During the closure of the site the waste will be capped and the site will be re-vegetated. The capping will also involve vehicle and material movements, so the potential impact is similar to the construction phase impacts. This impact is therefore rated as a MODERATE negative impact occurring in the *study site* and

acting in the short term. This impact *could occur* and is therefore rated a **Low** impact as indicated in **Table 10-4**.

Cumulative Impact

The cumulative impact during the construction and operational phases remains as assessed above. Therefore the impact remains a **Low** impact during construction and a **Moderate** impact during operation. The same is applicable for the closure phase.

Mitigation Measures

- Ensure that all machinery on site is in a good working order and does not have leaks;
- Hydro-carbons should be stored in a bunded storage area or in designated facilities at the Tutuka Power Station;
- No refuelling shall take place on site;
- No maintenance of machinery to be done on site, but to be done at the station's demarcated area for this;
- Spill-sorb or a similar type of product must be used to absorb hydrocarbon spills in the event that such spills should occur;
- Care must be taken to ensure that in removing vegetation adequate erosion control measures are implemented;
- Ensure that storm water control measures are incorporated into the waste disposal site designs prior to the start of construction;
- A storm water management plan, including sufficient erosion-control measures, must be compiled in consultation with a suitably qualified environmental practitioner / control officer during the detailed design phase prior to the commencement of construction;
- The propagation of low-growing dense vegetation suitable for the habitat such as grasses, sedges or reeds is the best natural method to reduce erosion potential in sensitive areas;
- Limit all activities to the proposed waste disposal site;
- Extend the current surface water monitoring plan to include turbidity monitoring during the construction phase of the disposal site;
- Ensure that the operational storm water system is maintained and monitored;
- Cover waste on a daily basis; and
- Ensure that soil is stockpiled in such a way as to prevent erosion from storm water.

Residual Impact

The residual impact with the successful implementation of the mitigation measures mentioned above will be slightly less significant as the probability reduces slightly. Therefore the rating reduces to **Low.** This is relevant for both the construction and operational phases.

With the rehabilitation and capping of the disposal site, the potential for surface water contamination will be removed. The area will be re-vegetated and the runoff will not come into contact with the waste.

Table 10-4: Impact Rating Matrix for Surface Water

Construction phase					
Impact Type	**Significance**	**Spatial**	**Temporal**	**Probability**	**Rating**
Baseline	Low	Study site	Short Term	Could Occur	**1.0 Very Low**
Additional	Moderate	Study site	Short Term	Could Occur	**1.4 - Low**
Cumulative	Moderate	Study site	Short Term	Could Occur	**1.4 - Low**
Residual	Moderate	Isolated sites	Short Term	Could Occur	**1.2 - Low**
Operational Phase					
Impact Type	**Significance**	**Spatial**	**Temporal**	**Probability**	**Rating**
Additional	High	Regional	Long Term	Could Occur	**2.4 - Moderate**
Cumulative	High	Regional	Long Term	Could Occur	**2.4 - Moderate**
Residual	Moderate	Study site	Long Term	Could Occur	**1.8 – Low**
Closure and Rehabilitation Phase					
Impact Type	**Significance**	**Spatial**	**Temporal**	**Probability**	**Rating**
Additional	Moderate	Study site	Short Term	Could Occur	**1.4 - Low**
Residual	Low positive	Study site	Short Term	Could Occur	**1.2 – Low Positive**

10.5 Ground Water Impact

Baseline Impact

The following are the main findings from the ground water assessment

- Ground water is used predominantly for stock use in the surrounding area, although there is also some rural domestic water use. This appears unlikely to change in the near future due to the proximity of large, reliable surface water bodies, such as Leeu Spruit, Vaal River and Grootdraai Dam to the nearby communities of Thuthukani and Standerton.
- Available evidence suggests that aquifers in the area surrounding the domestic waste site be classified as “Low / No significance”. This is due to the fact that there is insignificant volumes of groundwater present underneath the site and that the groundwater quality to the north of the proposed facility has already been slightly degraded by past disposal activities at the disposal site;
- Geohydrological assessment of the site using WASP (Parsons and Jolly, 1994) suggests the site be classified “marginal” to “suitable” for solid waste disposal, with available data suggesting that aquifer pollution on adjoining properties is highly unlikely;

Based on the statements above the baseline impact to ground water is rated as a LOW negative impact occurring in the *study site* over the long term. This impact *has occurred* and is therefore rated as a **Moderate** impact.

Additional Impact

The additional impact to ground water will be identical for all three proposed alternatives.

During construction the impact to ground water should be negligible as none of the construction related activities can impact on the ground water. This impact is therefore rated as **no impact.**

The waste disposal site without any mitigation measures installed has the potential to leach pollutants into the ground water system and into the nearby stream during operations. The water in this area is used for livestock drinking water and in some places rural domestic use (further downstream abstracted from boreholes). If the pollutants enter the natural system there is a potential health concern if the water is ingested by animals or humans.

The additional impact to ground water during operations is rated as a HIGH negative impact occurring in the *local area* for the long term. This impact *could occur* and is therefore rated as a **Moderate impact.**

Cumulative Impact

The cumulative impact during construction and operational phases remains as assessed for the baseline impact.

Mitigation Measures

- Extend the current ground water monitoring plan to include the larger disposal site and investigate the ground water plume movement;
- Ensure that the leachate collection and monitoring system is maintained and monitored;
- Install an appropriate liner under the waste site extension;
- Install a capping layer over the existing waste body to prevent further infiltration of water and leachate generation from the existing site;
- Ensure that ponding is prohibited in any water conduits or unlined ponds.
- Ensure that the extended site is properly capped on closure to prevent the infiltration of any water and the associated leachate generation.

Residual Impact

The residual impact during construction remains as assessed during the cumulative impact assessment. During operations however the mitigation measures proposed above greatly reduce the probability of the impact occurring. The impact is therefore rated as a HIGH negative impact acting on *local site* over the long term. The probability of this impact occurring reduces to *unlikely* and therefore the rating reduces to a **Low impact.**

During the closure and rehabilitation phase the site will be capped, effectively ensuring that the impact is contained within the waste body and that no water infiltrates. This impact is also assessed as a **Low impact.**

Table 10-5: Impact Rating Matrix for Ground Water

Construction phase					
Impact Type	**Significance**	**Spatial**	**Temporal**	**Probability**	**Rating**
Baseline	Low	Study site	Long Term	Has occurred	**2.67 - Moderate**
Additional					**No impact**
Cumulative	Low	Study site	Long Term	Has occurred	**2.67 - Moderate**
Residual	Low	Study site	Long Term	Has occurred	**2.67 - Moderate**
Operational Phase					
Impact Type	**Significance**	**Spatial**	**Temporal**	**Probability**	**Rating**
Additional	High	Local	Long Term	Likely	**2.9 – Moderate**
Cumulative	High	Local	Long Term	Likely	**2.9 – Moderate**
Residual	High	Local	Long Term	Unlikely	**1.47 – Low**
Closure and Rehabilitation Phase					
Impact Type	**Significance**	**Spatial**	**Temporal**	**Probability**	**Rating**
Residual	High	Local	Long Term	Unlikely	**1.47 – Low**

10.6 Visual Impact

The impact assessment was undertaken for the construction and operational phases of the project. The waste disposal site will consist of a waste dump with a single access point and an access road (**Figure 10-1**). It should be noted that there is currently a waste disposal site on the terrain and it is anticipated that the activities would be identical to the current operations.

Figure 10-4: Operations at the current waste disposal site with rehabilitated area in the foreground and New Denmark in the background

The visual simulations (**Figure 10-5**) illustrate the extent to which the waste disposal site will be visible from key observation points (static and dynamic views). The vertical form/dimensions of the structures would be hidden by their location among existing buildings and within a well vegetated area. The visual contrast is increased by the "shape" and scale of the structures, which generally will not be viewed along the skyline.

Baseline Impact

In the case of the Tutuka general waste disposal site it is pertinent to mention the existing infrastructures and visual impacts found on site. In this case the visual environment is impacted by a power station, the Thuthukani Township and the New Denmark Colliery and its associated structures as can be seen in **Figure 10-4**. Therefore the baseline impact is rated as a MODERATE negative impact acting on the *local area* in the long term. This impact *is occurring* and is therefore rated as a **High** negative impact.

Additional Impact

Static Views

The proposed waste disposal site would potentially be visible from the surrounding farmland and the high-lying areas to the north and west. The potential number of viewers from this area should be low as the farmlands are quite sparsely populated but the views would vary greatly depending on site specific conditions like the orientation of the homes as well as the location of other buildings, fences, vegetation and localized landforms. All these elements have the potential to block views from the buildings to the proposed waste disposal site. In terms of the three main developments in the area i.e. Tutuka Power Station, New

Denmark Colliery and Thuthukani Village, the site will be visible from Tutuka and New Denmark, but only slightly visible from Thuthukani.

Viewshed

It should be noted that the viewshed, which is plotted on Figure 10-5 is an approximation that may vary in some locations. Potential views to the proposed waste disposal site are likely to be blocked in some localised situations by buildings, vegetation or local landform features at specific locations within the viewshed. Similarly, glimpses of the proposed waste disposal site may be available from some isolated high-elevation locations outside the plotted viewshed. The coloured areas indicate areas that are visible with the blue areas having very high visibility and the brown having lower visibility.

Notable features of the viewshed are summarised by the following points:

- The viewshed extends approximately 9 km to the north of the proposed waste disposal site;
- In an easterly direction the viewshed is generally limited by higher ground approximately 7 km from the site;
- To the west the viewshed extends approximately 14 km with isolated views on high outcrops; and
- Potential views from the south are blocked by the flowing hills located south from the proposed site, and the viewshed extends about 9 km.

It should be noted that the average person can only distinguish features up to 5 km. Thereafter atmospheric effects and the curvature of the earth start to reduce visual perception. Therefore a 5 km buffer has been added to the map below.

Dynamic Views

The waste disposal site will be visible to a moderate number of viewers, mainly those travelling along the Thuthukani – Tutuka road and some travellers along the New Denmark – Standerton road. Views from the New Denmark – Standerton road extend approximately 6 km and represent a view period of approximately 22 seconds travelling at 100 km/h. The level of visibility should not be influenced by the view distance and the resulting atmospheric effects that reduce the contrast between the waste disposal site and the surrounding landscape, as the road is relatively close to the site. The effects are similar for the Thuthukani – Tutuka road. Please refer to **Table 10-6** and **Figure 10-6** for a summary of the dynamic impacts.

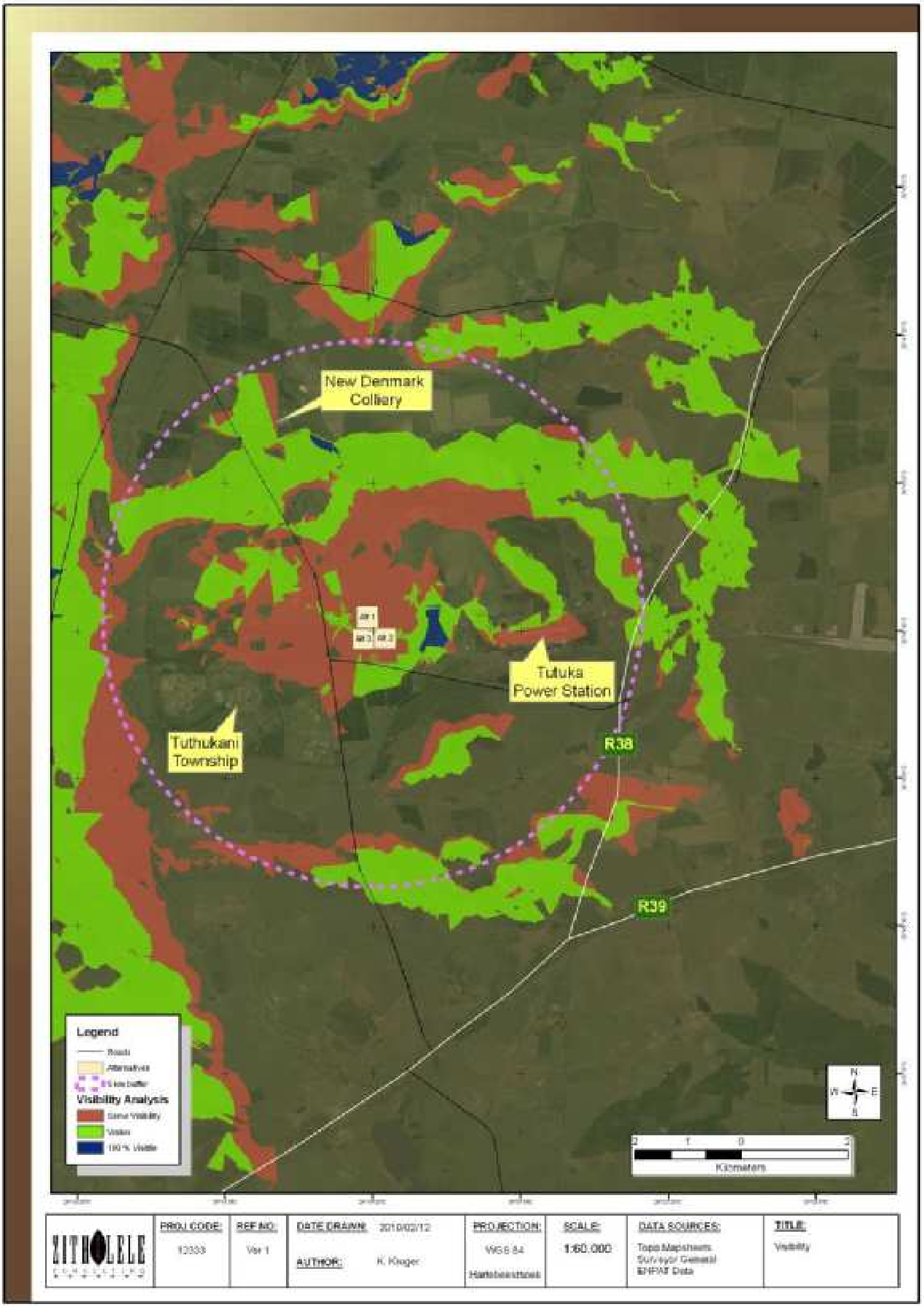

Figure 10-5: Visual Impact from the proposed waste disposal site.

The proposed waste disposal site is also visible from the R 38 road from Bethal to Standerton, but with a viewing distance on the 5 km mark and the entire Tutuka Power Station in between, it is unlikely that a traveller would be able to distinguish the waste disposal site from the surrounding landscape. Therefore the potential visual impact would be considered as low from the R38.

Table 10-6: Dynamic Impact Table

Road Name	Speed limit (km/h)	Length of Road (km)	Approximate Period of View (min)	View Distance
New Denmark – Standerton	**100**	**6**	**22 seconds**	**0 – 4 km**
Thuthukani – Tutuka	**80**	**3**	**2.25 minutes**	**0 – 4 km**

Figure 10-6: View from the New Denmark – Standerton Road illustrating the view of the completed disposal after 40 years.

Table 10-7 lists the observation points together with the category of viewer, context of view, relative numbers of viewers and approximate distance of observation point to the proposed site.

Table 10-7: Visual Impact Matrix

Potential Observation Point	Category of Receptor	Context of View	Approximate View Distance	Period of View	Visibility Rating
Surrounding Farmland	Static	Level	0 – 8 km	Long Term	**High**
Tutuka Power Station	Static	Level and above	2.5 km	Long Term	**High**
New Denmark Colliery	Static	Level and above	4 km	Long Term	**High**
Thuthukani Township	Static	Level below	2.5 km	Long Term	**High**
Gravel Roads	Dynamic	Above & below	0 – 8 km	Medium	**High**
Tar Roads	Dynamic	Level - Above	0 – 4 km	Short	**High**

The visual impact of the waste disposal site in a landscape characterised by a power station, coal mines, roads and farmlands will have an impact, but not as high as in an unimpacted area. It is also very important to note that there is an existing waste disposal site on the terrain and therefore a similar though smaller visual impact is already occurring. This site is however only 5m high (refer **Figure 7-24** and **Figure 10-1**) and the extension will be up to a height of 30 m, making it much more visible.

The additional impact from the proposed project during construction is rated as a LOW negative impact acting on the *local area* in the short term. This impact *will occur* and is therefore rated as a **Moderate** impact.

During the operational phase the waste disposal site will grow to its maximum height of 30 m. This impact is rated as a HIGH negative impact, acting on the *local area* in the long term. As this impact *will occur* the impact is rated as a **High** negative impact.

Cumulative Impact

The cumulative construction impact is rated the same as the baseline impact and remains a **High** impact.

Due to the existing impact levels and the proposed new development adding to that impact the operational impact will is rated as a HIGH negative impact, acting on the *local area* in the long term. As this impact *will occur* the impact is rated as a **High** negative impact.

Mitigation Measures

There are several methods of screening the visual impact of a development like waste disposal site and any of these can be utilised by the power station to reduce the visual impact:

- Ensure that the waste is covered with soil on a daily basis;
- Design the site to match local topographical features and avoid sharp edges;

- Re-vegetate the waste body once capacity has been reached in order to match the local surroundings;
- Screening vegetation can be planted to screen sensitive receptors (in this case trees have already been planted along the Thuthukani – Tutuka road see **Figure 10-7**); and
- Do not exceed the maximum licensed height of the facility.

Figure 10-7: Picture from the Tutuka – Thuthukani road, showing existing screening by trees

Residual Impact

During construction the residual impact will remain as assessed during the cumulative impact assessment. This remains a **High** impact.

If the waste disposal site is screened from all sides by vegetation the impact can be reduced as the development will only be visible intermittently and only to people very close to the site. This reduces the impact rating to a MODERATE negative impact only acting on the *study site* in the long term. This impact *will occur* and is therefore rated as a **Moderate** impact.

After closure and rehabilitation has been completed the site will be covered with vegetation and profiled to appear naturally. However the waste body will remain on site and the visual impact will persist. If the mitigation measures remain in place (screening vegetation) then the impact will remain as assessed for the operational phase, a **Moderate** impact.

Table 10-8: Impact Rating Matrix for the Visual Impact

Construction phase					
Impact Type	**Significance**	**Spatial**	**Temporal**	**Probability**	**Rating**
Baseline	Moderate	Local Area	Long Term	Is occurring	**3.3 – High**
Additional	Low	Local Area	Short Term	Will Occur	**2.3 – Moderate**
Cumulative	Moderate	Local Area	Long Term	Will Occur	**3.3 – High**
Residual	Moderate	Local Area	Long Term	Will Occur	**3.3 – High**
Operational Phase					
Impact Type	**Significance**	**Spatial**	**Temporal**	**Probability**	**Rating**
Additional	High	Local Area	Long Term	Will Occur	**3.67 - High**
Cumulative	High	Local Area	Long Term	Will Occur	**3.67 - High**
Residual	Moderate	Study Site	Long Term	Will Occur	**3.0 - Moderate**
Closure and Rehabilitation Phase					
Impact Type	**Significance**	**Spatial**	**Temporal**	**Probability**	**Rating**
Residual	Moderate	Study Site	Long Term	Will Occur	**3.0 - Moderate**

10.7 Heritage Impact

The Heritage impact assessment did not find any features of cultural or historical importance on site. Therefore the baseline impact is rated as **no impact.** The same is relevant for the additional impact for all the alternatives and all the phases.

Mitigation Measures

Although no sites of heritage significance were identified within and on-surface of the proposed study area, the following recommendations are given should any sub-surface remains of heritage sites be identified;

- All operators of excavation equipment should be made aware of the possibility of the occurrence of sub-surface heritage features and the following procedures should they be encountered.
- All construction in the immediate vicinity (50m radius) of the site should cease.
- The heritage practitioner should be informed as soon as possible, and work must stop in that area.
- In the event of obvious human remains the SAPS should be notified.
- Mitigative measures (such as refilling etc.) should not be attempted.
- The area in a 50m radius of the find should be cordoned off with hazard tape.
- Public access should be limited.
- The area should be placed under guard.

10.8 Air Quality Impact

Baseline Impact

The contribution of various sources of emission to ambient particulate concentrations within the proposed Tutuka General Waste Disposal Site (GWDS) is of interest given the potential for elevated concentrations in the area. The most significant sources located in close proximity to the proposed Tutuka GWDS include:

- Stack, vent and fugitive emissions from industrial operations;
- Fugitive emissions from mining operations;
- Vehicle tailpipe emissions;
- Household fuel combustion (coal, wood); and
- Biomass burning.

Various miscellaneous fugitive dust sources are present, including: agricultural activities, wind erosion of open areas, vehicle-entrainment of dust along paved and unpaved roads. Unfortunately the information from the closest air quality monitoring station (Standerton) was requested from the relevant government department, but the data was not provided and hence the baseline impact could not be quantified.

Additional Impact

Atmospheric emissions represent the environmental aspects of concern in the current study. For the construction phase such aspects were identified as the clearing of the proposed Tutuka GWDS area, construction of buildings and vehicle entrainment. Various components of the bio-physical and socio-economic environment may be impacted by the atmospheric emissions associated with the construction phase of the proposed Tutuka GWDS. Such components include:

- Ambient air quality;
- Local residents and neighbouring communities;
- Employees;
- The aesthetic environment; and
- Possibly fauna and flora.

Unmitigated construction activities provide the potential for impacts on local communities, primarily due to nuisance and aesthetic impacts associated with fugitive dust emissions. On-site dustfall may also represent a nuisance to employees at work.

This impact is identical on all the potential alternatives and is rated as a LOW negative construction impact that *could occur* on the *study site* during the short-term. This impact is rated as a **Low impact.**

During the operational phase the proposed Tutuka GWDS is expected to be characterised by the following sources of atmospheric emissions:

- Gaseous emissions from the working surface and covered portions of the landfill; and,
- Fugitive particulate emissions as a result of vehicles travelling on unpaved road surfaces.

These impacts have been rated as a LOW negative impact acting on the *study site* for the long term. This impact *could occur* and is therefore rated as a **Low** impact.

Only landfill gas emissions are associated with the decommissioning (post-closure) phase. Landfill gas generation is expected to decrease exponentially from year 40 of operation. No particulate emissions are expected since no materials handling or vehicle activities will be present and all exposed areas are expected to be closed and rehabilitated.

These impacts have been rated as a LOW negative impact acting on the *study site* for the long term. This impact *could occur* and is therefore rated as a **Low** impact.

Cumulative Impact

The cumulative impact cannot be calculated as the baseline impact could not be quantified.

Mitigation Measures

- It is recommended that the proposed Tutuka GWDS be operated according to the Minimum Requirements for Waste Disposal by Landfill (Second Edition 1998).
- As the Minimum Requirements currently do not provide recommended buffer zone distances for landfill sites it is recommended that a buffer zone (delineation exclusively on the basis of health impact zones) be a minimum distance of 500 m from the proposed Tutuka GWDS as stipulated by the Australia EPA. Based on odour impacts from previous quantitative studies undertaken for General Waste Disposal Sites, it is recommended that the management zone (delineation based on nuisance issues, i.e. odour impacts and dust fallout) be a distance of ~1 500m from the proposed Tutuka GWDS. It should be noted, however, that these recommended buffer and management zone delineations are based on previous studies undertaken.
- The current air quality monitoring network should be expanded to include ambient PM10 concentrations and dust fallout measurements in the vicinity of the proposed Tutuka GWDS prior to its operation in order to establish background ambient air quality. Once the proposed Tutuka GWDS is in operation, the ambient measurements will provide an indication of impacts due to the General Waste Disposal Site.
- The proposed Tutuka GWDS operator should control on-site fugitive dust emissions by effective management and mitigation due to the potential cumulative impacts of this pollutant in the study area.

Residual Impact

The residual impact cannot be calculated as the baseline impact could not be quantified. However the additional impact is rated as a **Low impact** and it is the professional opinion of the specialist that this development will not have a major impact on the air quality.

Table 10-9: Impact Rating Matrix for Air Quality

Construction phase					
Impact Type	**Significance**	**Spatial**	**Temporal**	**Probability**	**Rating**
Baseline					**Unknown**
Additional	Low	Study Site	Short Term	Could occur	**1.2 - Low Impact**
Operational Phase					
Impact Type	**Significance**	**Spatial**	**Temporal**	**Probability**	**Rating**
Additional	Low	Study Site	Long Term	Could occur	**1.6 – Low Impact**
Closure and Rehabilitation Phase					
Impact Type	**Significance**	**Spatial**	**Temporal**	**Probability**	**Rating**
Additional	Low	Study Site	Short Term	Could occur	**1.2 - Low Impact**

10.9 Noise Impact

The following description was extracted from the noise impact report in order to provide clarity on the potential noise impact of the development.

Construction and operation of the waste disposal site

The following noise related aspects were identified:

- The alternatives for the proposed new waste disposal site are all in close proximity to the present site.
- During construction a bulldozer will clear the area and prepare the waste disposal site. It is further assumed that the soil on the site will be compacted by a vibrating roller and topsoil will be stacked using a front end loader (FEL) and truck.
- Construction of the new waste disposal site will only require a short period of time.
- During operation the waste is collected in skips which are then transported to the waste disposal site by tractors. There the waste is dumped, spread and covered with topsoil by a FEL.
- The waste collection method, i.e. the deposit of waste into skips which are then transported by tractors to the waste disposal site, already forms part of the present ambient noise climate in the area. Therefore, the operation of the new site will not be a new source of noise.
- Construction and operation of the new waste disposal site will only take place during the day and not during the night and weekend.

Noise sensitive receptors

The identified noise sensitive receptors are:

- Tutuka and Thuthukani villages at distances of approximately 2 km or more from the site; and
- The farmsteads on the farms Meyersvallei, Slagkraal and Pretoriusvlei, all at distances of approximately 2 000 m or more from the site.

Major existing sources of noise

Major existing sources of noise are:

- The Tutuka power station;
- Road traffic on the R38 and the road that leads to New Denmark;
- Localised road traffic; and
- Community generated noise in Thuthukani villages.

Baseline Impact

Despite the presence of the Tutuka power station, the New Denmark colliery and the R38 the general character of the area is rural. The typical ambient noise level during the day (06:00 to 22:00) in a rural area is 45 dBA. This was assumed to be the current ambient noise level in the general area during the day. It must be noted that this is a conservative estimate, i.e. one that will tend to overestimate rather than underestimate the noise impact. In addition to the rural activities the current operations at the existing waste disposal site also cause a noise impact. The noise assessment calculated the noise impact from the machinery used on site and it showed that the typical noise level rages between 14 and 19 dBA. These existing impacts are rated as VERY LOW negative impact acting in the incidental on the *study area*. This impact *is occurring* and is therefore rates as a **Low** negative impact.

Additional Impact

The additional impact from the development will be very hard to quantify as the exact same machinery will be utilised that is currently used on site. According to the noise regulations that are applicable in Mpumalanga an intruding noise is defined as 'disturbing' if it exceeds the ambient noise level at a receptor by 7 dB or more. The results of the noise study have shown that any possible increase in ambient noise level will be entirely negligible. Therefore the additional impact to noise during the operations, closure and construction phases are rated as **no impact.**

Cumulative Impact

Since the additional impact is negligible the cumulative impact is identical to the baseline impact and rated as a **Low** negative impact.

Mitigation Measures

- Ensure that the construction and operating hours of the waste disposal site is kept to normal working hours (7h00 – 17h00) to avoid noise disturbance at night;
- Ensure that all machinery is in good working order; and
- Unnecessary noise must be kept to a minimum, precautions can be put in place to minimise vibration and noise during construction.

Residual Impact

The residual impact of the construction phase if the mitigation measures are implemented will ensure that the impact remains as assessed in the cumulative impact stage. The same applied during the operational phase. However during the closure and rehabilitation phase the impact from the vehicles will be removed as the site is closed and the minimal impact that there was will reduce to **no impact.**

Table 10-10: Impact Rating Matrix for Noise

Construction phase					
Impact Type	**Significance**	**Spatial**	**Temporal**	**Probability**	**Rating**
Baseline	Very Low	Study Site	Incidental	Is occurring	**1.3 – Low Impact**
Additional					**No Impact**
Cumulative	Very Low	Study Site	Incidental	Is occurring	**1.3 – Low Impact**
Residual	Very Low	Study Site	Incidental	Is occurring	**1.3 – Low Impact**
Operational Phase					
Impact Type	**Significance**	**Spatial**	**Temporal**	**Probability**	**Rating**
Additional					**No impact**
Cumulative	Very Low	Study Site	Incidental	Is occurring	**2.0 – Low Impact**
Residual	Very Low	Study Site	Incidental	Is occurring	**2.0 – Low Impact**
Closure and Rehabilitation Phase					
Impact Type	**Significance**	**Spatial**	**Temporal**	**Probability**	**Rating**
Additional	Very Low	Study Site	Incidental	Is occurring	**2.0 – Low Impact**
Residual					**No Impact**

10.10 Traffic Impact

The discussion on the traffic impact is extracted from the traffic impact opinion by WSP.

Trip Generation

The existing waste disposal site operates from 07:00 to 15:45 Monday to Thursday, 07:00 to 15:00 on Friday and 07:00 to 12:00 on payweek Friday. The waste that requires disposal on the site originates from four main sources:

- Tutuka Power Station general, domestic and garden waste;
- Tutuka Power Station contractor general, domestic and building rubble waste;

- Thuthukani Township general and domestic waste; and
- New Denmark Colliery general, domestic and garden waste.

It is anticipated that the site will have to take similar volumes of the same type of waste for another 40 years. It is not possible to project trends in passing traffic over such an extended period but given the location of the site it is anticipated that annual growth would be extremely low.

The waste received by the site from the above sources is transported to the site in the following vehicles:

- 3 tonne tractor with skip;
- 6 tonne tipper; and
- 7 tonne truck.

The total number of vehicle trips of the above vehicles is anticipated to be of the order of 5-6 vehicles per week with an annual growth rate of less than 3% per annum. The site inspection mentioned above also indicated a very low volume of other vehicles accessing the site. These volumes of traffic are below the level of significance for further analysis.

Baseline Impact

Direct observations undertaken in the study area revealed volumes of traffic that are too low to analyse in terms of Levels of Service. The direct observations indicate that on all critical elements of the roads in the study area the peak levels of service are LOS A. Even if peak hour traffic volumes are doubled, levels of service will remain at LOS A.

As the traffic impact is too low to measure using standard traffic techniques it is therefore rated as a VERY LOW impact incidentally acting on *isolated sites*. This impact *is unlikely* to occur and is therefore rated as a **Very Low** impact.

Additional Impact

During the construction period the site would initially need to be cleared by a grader after which other construction activities will make use of one grader, two front-end loaders and one compactor. It is understood that these vehicles will be sourced from the Tutuka Power Station and once on site will remain there for the duration of the construction period with no need to use external roads.

The conclusion of the above is that peak period road capacity will not be an issue at any stage and activities associated with the proposal will have no discernable impacts on traffic operating conditions in the vicinity of the site. In this regard therefore there will be no need for any capacity related road improvements in the vicinity.

On the basis of the professional opinion provided above and the fact that the existing operations already form part of the baseline assessment the additional impact to traffic from the construction and

operational phases of the development are rated as **no impact**. This is the case for all three alternative sites.

Cumulative Impact

The cumulative impact is identical to the baseline impact and therefore rated as a **Very Low** impact. This is the case for all the development phases.

Mitigation Measures

- It is recommended that W107 and W108 intersection warning signs with IN 11.569 supplementary warning plates be erected on the approaches to the site indicating the presence of heavy and potentially slow moving vehicles, at the intersections.

Residual Impact

The residual impact remains as assessed for the cumulative impact. This is the case for all the development phases.

Table 10-11: Impact Rating Matrix for Traffic

Construction phase					
Impact Type	**Significance**	**Spatial**	**Temporal**	**Probability**	**Rating**
Baseline	Very Low	Isolates Sites	Incidental	Unlikely	**0.4 – Low Impact**
Additional					**No impact**
Cumulative	Very Low	Isolates Sites	Incidental	Unlikely	**0.4 – Low Impact**
Residual	Very Low	Isolates Sites	Incidental	Unlikely	**0.4 – Low Impact**
Operational Phase					
Impact Type	**Significance**	**Spatial**	**Temporal**	**Probability**	**Rating**
Additional					**No impact**
Cumulative	Very Low	Isolates Sites	Incidental	Unlikely	**0.4 – Low Impact**
Residual	Very Low	Isolates Sites	Incidental	Unlikely	**0.4 – Low Impact**
Closure and Rehabilitation Phase					
Impact Type	**Significance**	**Spatial**	**Temporal**	**Probability**	**Rating**
Additional					**No impact**
Residual	Very Low	Isolates Sites	Incidental	Unlikely	**0.4 – Low Impact**

10.11 Infrastructure

As the proposed development is located entirely on Eskom property in an area with no existing infrastructure other that the existing waste disposal site, there will be **no impact** to infrastructure. However the Alternative preference in terms of the existing infrastructure is noteworthy.

Alternative A is located in such a way that all the existing infrastructure can be utilised with minimal amendment required. In addition this option can utilise the existing monitoring program a minimal additional boreholes will have to be drilled, all resulting in a cost saving to the project.

Alternatives B and C are located along the current access road and should be able to link into the existing services without any major problems. Therefore Alternative A is the preferred alternative in terms of infrastructure.

10.12 Social

The impact of this development to the social environment is seen as a positive impact. This is due to the fact that the development will allow increased provision of general waste disposal faculties not only to the power station, but also to the community of Thuthukani, at no increased costs.

Unfortunately the construction and operation of the site will not generate any job opportunities, as the existing waste disposal site staff will be utilised. The impact to the social environment is therefore rated as a LOW positive impact occurring in the *local area* over the long term. This impact *will occur* and is therefore rated as a **Moderate** positive impact.

11 SUMMARY

11.1 Impact Summary

This impact summary provides a tabular summary of the descriptions in the impact assessment. In addition it provides an opportunity to finalise the preferred site alternative. The table below highlights the results from the impact assessment. In some cases in this project, the impact would be rated similar for all three alternatives but there would be a difference in the baseline impact level. For example the soils section, all three alternatives scored a high impact for the additional impact but Alternative A had a high baseline impact, Alternative C a moderate and Alternative B a low. In such a scenario it would be preferable to localise the high impacts and Alternative A would be the most preferred as a high additional impact on an area that is already disturbed is a lot better than a high impact on an area that has not been disturbed.

Table 11-1: Impact Summary

Element	Alt	Baseline	Additional Construction	Cumulative	Residual	Additional Operation	Cumulative	Residual	Preference
Geology	Alt A	Moderate	Very Low	No Impact	Moderate	No impact	No Impact	Moderate	1
	Alt B								1
	Alt C								1
Soils and Agriculture	Alt A	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate	1
	Alt B	Very Low							3
	Alt C	Moderate							2
Ecology	Alt A	Moderate	Low	Moderate	Low	Low	Low	Low	1
	Alt B	Low	Moderate						3
	Alt C	Low	Low						2
Surface Water	Alt A	Very Low	Low	Low	Low	Moderate	Moderate	Low	1
	Alt B								1
	Alt C								1
Ground Water	Alt A	Moderate	No impact	Moderate	Moderate	Moderate	Moderate	Low	1
	Alt B								1
	Alt C								1
Heritage	All	No impact							1
Visual	Alt A	High	Moderate	High	High	High	High	Moderate	1
	Alt B								2
	Alt C								2
Air Quality	Alt A	Unknown	Low	Unknown		Low	Unknown		1
	Alt B								1
	Alt C								1
Traffic	Alt A	Low	No impact	Low		No impact	Low		1
	Alt B								1
	Alt C								1
Noise	Alt A	Low	No impact	Low	No impact	Low	Low	No impact	1
	Alt B								1
	Alt C								1
Social	All	Moderate positive							1
Final Rating	**Alt A**								**11**
	Alt B								**16**
	Alt C								**14**

For this analysis the most preferred alternative is given 1 point and the least preferred 3. The site with the least points is the preferred alternative.

From the impact summary it is clear that Alternative A is the preferred alternative. This can be attributed to the close proximity to the current site which also makes it a more feasible alternative in terms of establishment costs and minimising the footprint of environmental impacts. Furthermore, environmentally the area is already impacted by the existing waste disposal site and by upgrading this facility the impacts can be managed better.

11.2 Waste Management License Application

On the basis of the impact summary it is clear that the preferred alternative is to extend the current waste disposal site (Alternative A) rather that to establish a new site (Alternatives B and C). This being the case a permit amendment application is being submitted to DEA as the current site does have a legal ECA 20 waste permit. However with the change in legislation this permit will be amended into a Waste Management License as per the NEM: WA requirements.

11.3 Management of the Site

The management of the site will be done according to two documents. The first is the Environmental Management Plan (EMP) as attached in Appendix S. This document prescribes the management of all the potential environmental impacts arising from the proposed development during construction.

Secondly the operating plan that is included in the design report in Appendix L prescribes how the waste disposal site will be managed in terms of its day-to-day operations.

The closure and rehabilitation of the facility has been briefly addressed in these reports, however a detailed closure and rehabilitation plan will be developed within the last two years of site operations.

12 CONCLUSION AND WAY FORWARD

Eskom appointed Zitholele Consulting to undertake the EIA and waste licence application for the proposed Tutuka general waste disposal site and associated infrastructure. This EIR and WMLA study is being undertaken with the aim of identifying the potential impacts that the development will have on the environment.

This report details the various specialist studies undertaken as well as the proposed site design. It is the opinion of the Environmental Assessment Practitioner that the residual impacts from the proposed development are acceptable when considering the advantages that the development will bring.

The way forward recommended by this study is as follows:

- This Final EIR, EMP and WMLA is being submitted to the Department of Environmental Affairs (DEA) for approval;
- Once the DEA has reached a decision, an Environmental Authorisation (EA) / Waste Management License (WML) will be issued; and
- Upon receipt of the EA / WML, Zitholele will notify all I&APs on the stakeholder database of the DEA's decision by means of individualised letters

ZITHOLELE CONSULTING (PTY) LTD

Konrad Kruger Anelle Lötter

Appendix A: EAP CV

Appendix B: EIA Application Form and DEA acceptance letter

Appendix C: Newspaper Advertisements and Site Notices

Appendix D: I&AP Database

Appendix E: Issues and Response Report

Appendix F: Background Information Document

Appendix G: Waste Classification Report

Appendix H: Geotechnical Report

Appendix I: Surface Water Report

Appendix J: Air Quality Report

Appendix K: Noise Impact Opinion

Appendix L: Design Report

Appendix M: Ground Water Assessment

Appendix N: Ecological Assessment

Appendix O: Heritage Assessment

Appendix P: Traffic Opinion

Appendix Q: Soil and Agricultural Potential Report

Appendix R: Visual Impact Report

Appendix S: Environmental Management Plan

Appendix T: License Application Report

Appendix U: The Future of the Tutuka Landfill Site